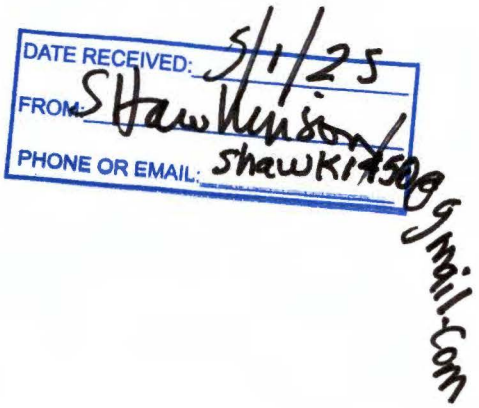


May 1, 2025

From: Stephanie Hawkinson
1450 NW Grant Ave.
Corvallis, OR 97330
Shawk1450@gmail.com

To: Benton County Planning Commission

Re: Oppose/Deny Application LU-24-027

53.215 Criteria: ...(1.) ..."character of the area"

The proposed landfill expansion would seriously/definitely impact the character of the area. Because it has already impacted the "character of the area" does NOT mean that further expansion would just go unnoticed. Taking something that is quite unsightly and enlarging makes it even worse. It is NOT hidden, it is in full view. The "character of the area" was once completely bucolic and now has a massive dome of trash that is covered, but still in full view....the" elephant in the room" so to speak. How could enlarging it not make it worse?

I have lived in Corvallis for 47 years and seen the changes that have been made at Coffin Butte over the years. We have taken things to the landfill many, many times over the years. While teaching in Lebanon I took my fifth grade classes there on field trips so they would better understand the landfill, and where their trash was going. Those field trips included walking up on top of the site to look down into the deep pit where the trash was dumped, understanding what was happening with the leachate, and hearing about the electricity that was generated there and used. Interestingly, the "odor" was not strong and 5th graders enjoyed that field trip. It has grown from a user-friendly place to discard unwanted things to a behemoth....a giant mountain of trash that is fed by many large garbage trucks coming and going all day. While it is "our" landfill many people I know do not take things there anymore.

I attended the Tuesday evening Planning Commission meeting and I came away with some concerns. When Odor of the proposed landfill was addressed one board member and Winterbrook Consulting both responded by stating there is already a landfill there so Odor is already there. That is hopefully not how one would plan for any type of upcoming change/growth. We are looking at the possible impact of an uncapped amount of trash. And Winterbrook could not address traffic more thoroughly? If Benton County was looking at making the Corvallis Airport into a regional airport I would hope future planning/predictions would be addressed. I also have concerns about the groundwater/leachate and why it is not being addressed. Having the applicant provide that information seems not in the county's best interests. Addressing these potential problems prior to granting the permit does seem necessary.

I appreciate the time the Benton County Planning Commission is putting into this matter. It is important and will have a big impact on Benton County.

Stephanie Hawkinson



Dear Benton County Planning Commissioners,

My name is Maggie Underwood and I live at 625 NW 13th Street, Corvallis, Oregon.

I am writing in opposition to Republic Services' Conditional Use Permit application LU-24-027 to expand the Coffin Butte landfill & I strongly urge the Planning Commission to deny this application.

The proposed expansion would seriously interfere with the character of the surrounding area and impose an undue burden on public resources, in violation of Benton County Code 53.215 (1) and (2). Specifically, this expansion raises major concerns about:

Air and water pollution threaten our local ecosystems and community health
Traffic increases that pose safety risks on nearby roads and pathways
Odor and noise issues that degrade quality of life for residents and visitors
Negative impacts on wildlife, recreation, and property values
Long-term climate and environmental consequences for future generations
The proposed expansion does nothing to align with Benton County's 2040 Thriving Communities Initiative. This expansion undermines our shared goals for responsible environmental stewardship, prioritizing public health, and sustainable waste management.

I believe Benton County should invest in waste reduction, recycling, and circular economy solutions, not expanding landfills that perpetuate pollution and place a long-term burden on local communities!

Please reject LU-24-027. Thank you for your consideration and for protecting the health and future of Benton County.

Sincerely,

Maggie Underwood
Corvallis, OR 97330

From:	Misty Bearden
To:	Benton Public Comment
Subject:	Coffin Butte CUP testimony
Date:	Tuesday, May 6, 2025 12:56:45 PM
Attachments:	image001.png

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello,

Please see the attached letter for submittal of testimony for Coffin Butte.

Misty Bearden

Office Supervisor

Thompson's Sanitary Service, Inc.

7450 NE Avery | PO Box 643 | Newport, OR 97365

Phone: 541.265.7249 | Fax 541-265-3034

THOMPSON'S SANITARY SERVICE
Guiding Sustainable Choices

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Download on the App Store GET IT ON Google Play

Misty Bearden
1431 NE Yaquina Heights Dr, Newport OR 97365
5/6/2025

Commissioners,

My name is Misty Bearden, and I am an employee of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact my customers. I encourage you to grant Republic's application for expansion. Below are some of the reasons I support the expansion:

Choose some of these, or expand on them if you wish…

- The landfill is an essential resource in our ability to be responsible for our own waste
- Hauling the waste to a landfill further away doesn't fix the problem, it just makes people in another part of Oregon deal with our trash
- The trash we are talking about is our trash. It's yours, it's mine, it's all of ours together, and we should be the ones to deal with it responsibly
- Republic has done an excellent job managing the landfill
- DEQ has environmental oversight regarding the operations at Coffin Butte, so the landfill is already very highly regulated, which greatly limits any environmental impacts
- Closing the landfill is not a way to responsibly manage our waste stream. We should deal with our own trash the right way, and Republic is doing that
- Collection customers will bear the burden of increased prices to cover increased hauling costs
- Increased collection rates will have a significant impact to small businesses in my community
- Hauling trash to another part of Oregon increases greenhouse gas output from the trucks that haul it, which pollutes the environment we are trying to protect
- "Not in my backyard" is not an acceptable solution to managing the waste stream

Thank you for your attention. I strongly encourage you to vote to expand.

Misty Bearden

From: Erin Bradley
To: Benton Public Comment
Subject: Deny LU-24-027
Date: Tuesday, May 6, 2025 9:59:49 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good Morning County Planning Commissioners,

My name is Erin Bradley. I live at 38578 OR-99W, Corvallis OR 97330.

I would like to mention a possible error in the map at the presentation last week and in the conditional land use application. The property north of us is listed as a 10 acres parcel and is shaded purple. The property is Republics Forrest Land owned by Valley Landfills and should be shaded green. I believe the map paints an inaccurate picture. It appears there is a 10 acre buffer between my property and the forest land.

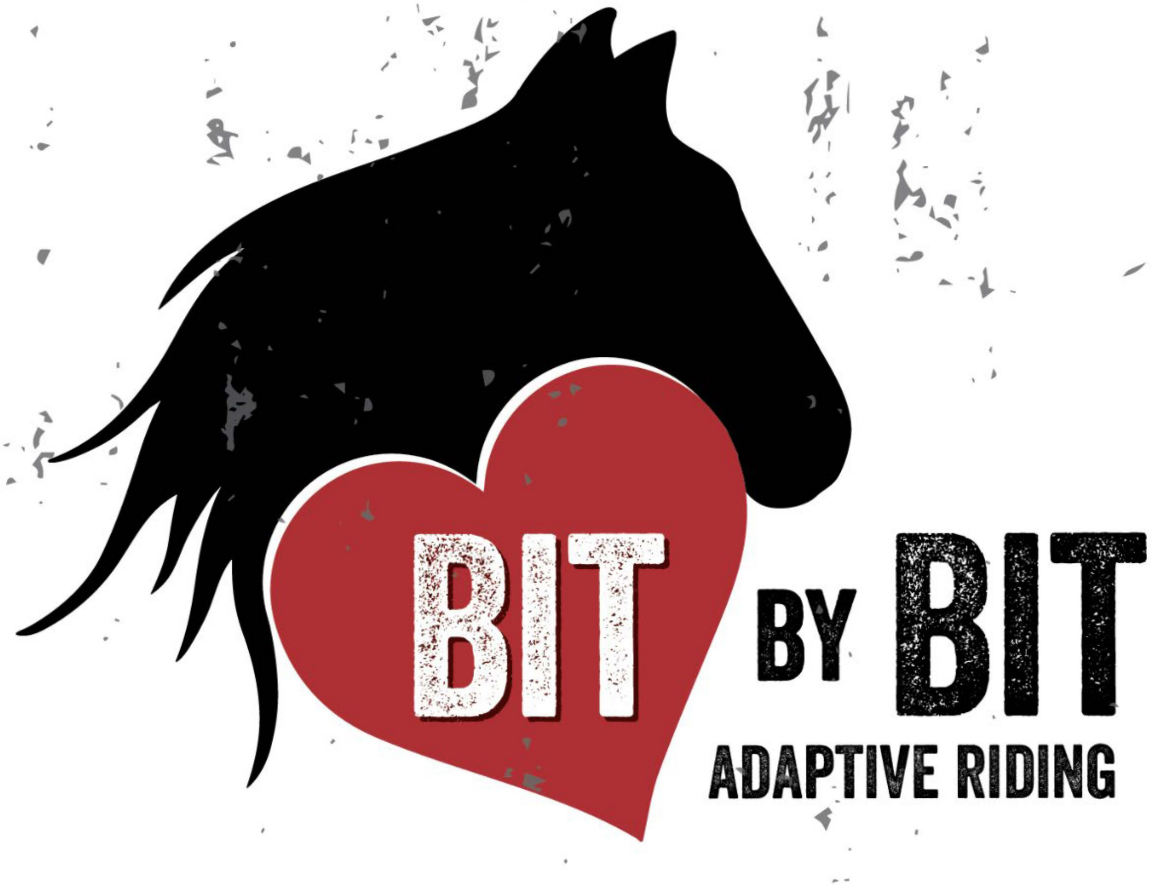
Please see the attached photos of the maps presented, a current photo of the forrest looking north in my property, and Benton County's information.

I would also like to add photos to the record of the July 24th 2024 fire next to this forrest.This demonstrates the almost need to evacuate on our part. This fire could have spread to the forrest, or to the landfill.

Please deny LU-24-027 as it is affecting the enjoyment and use of our land.

Erin Bradley

Erin Bradley
Bit By Bit
541-908-3293
bitbybitadaptiveriding.org


BIT
BY BIT
ADAPTIVE RIDING

9:17 5G

English

005888 - Property Detail

FOR ASSESSMENT AND TAX PURPOSES ONLY

Account Information

Account Information

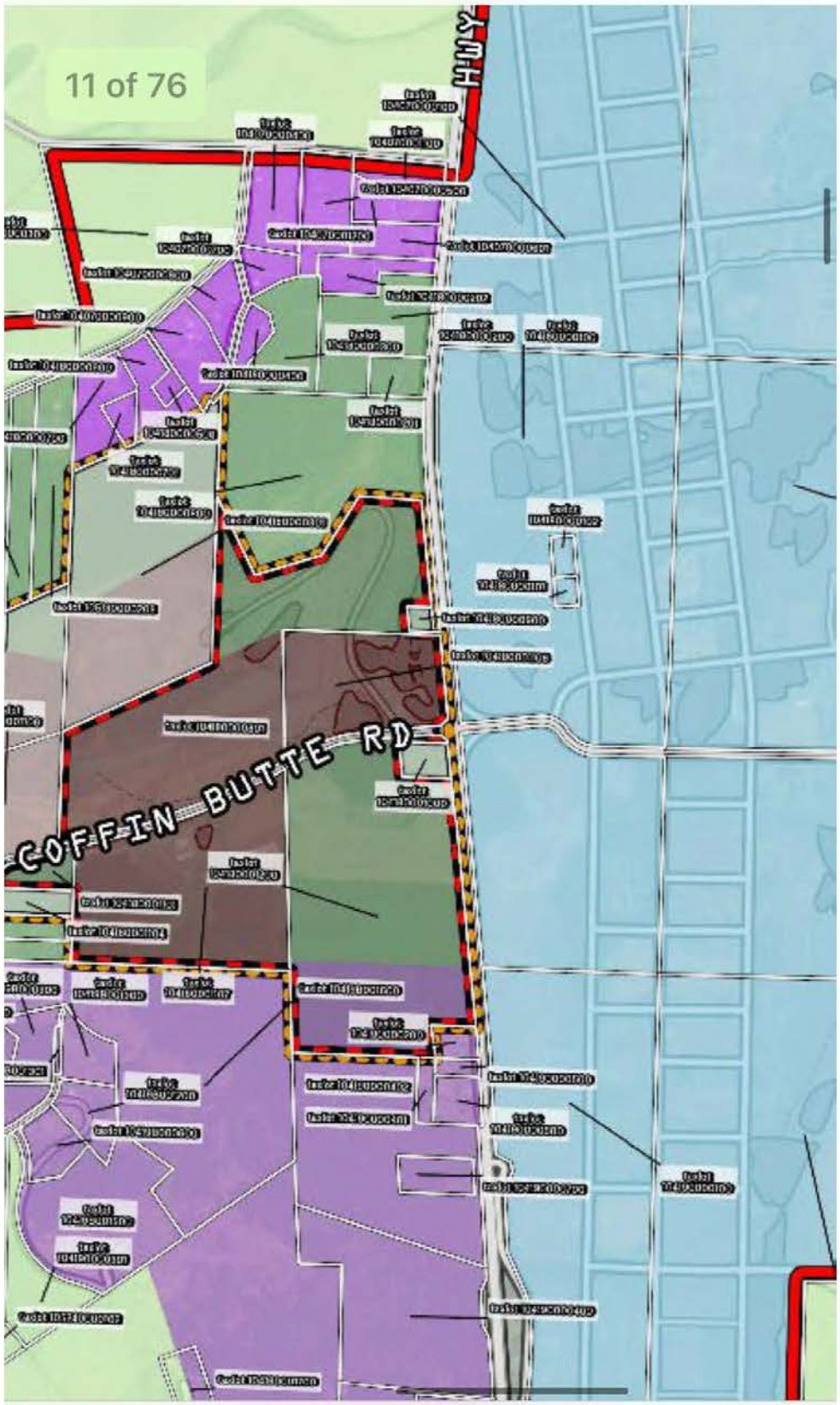
Account #:	005888
Map Taxlot:	104180001200
Acreage:	82.7
Property Class:	400
Tax Code Area:	0916
Situs Address:	
	29160 COFFIN BUTTE RD
	CORVALLIS, OR 97330

Last Certified Values

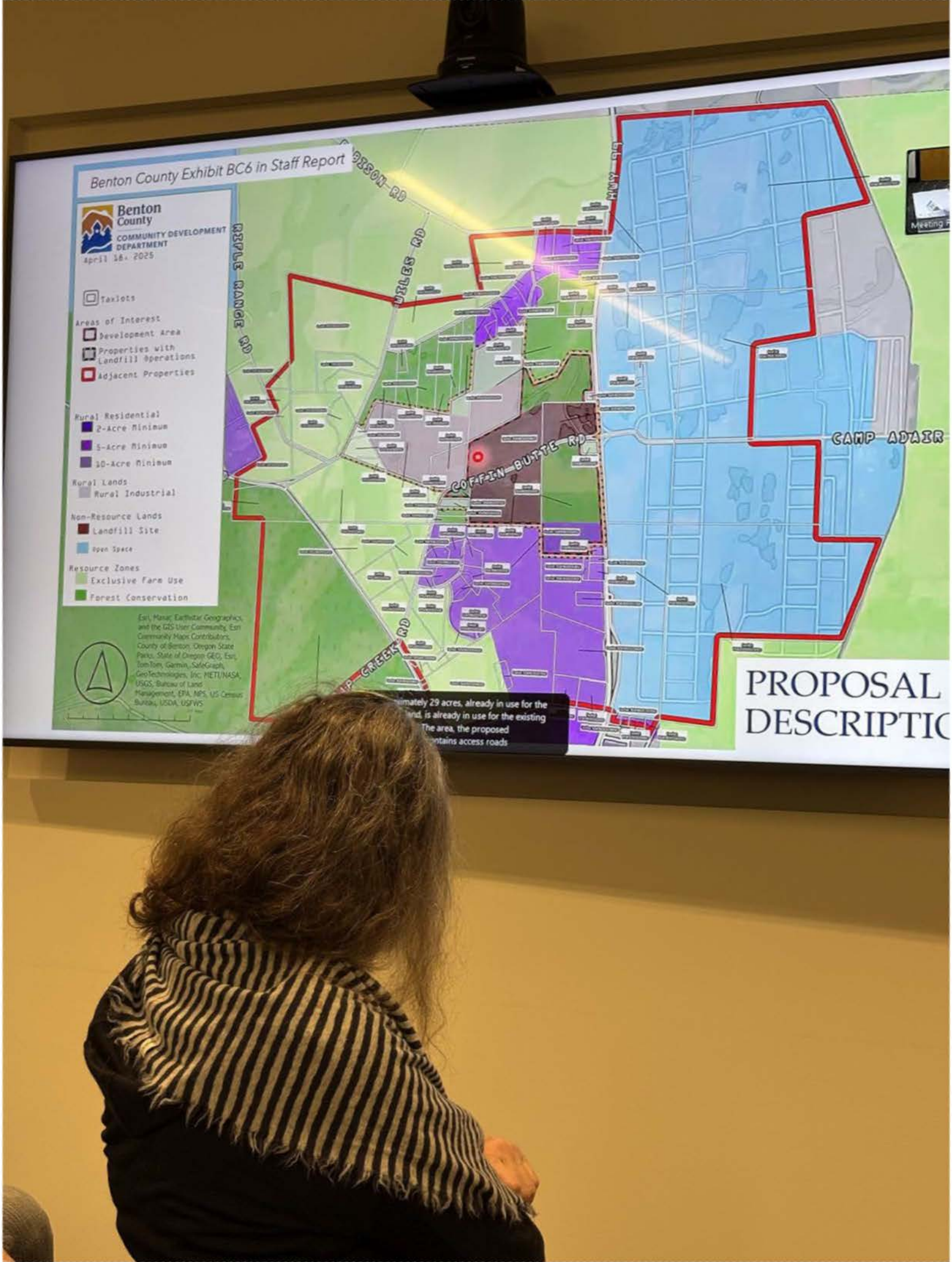
Market Land:	$526,080.0
	0

Print Close

essment.bentoncountyor.gov



libraryfunctions.azurewebsites.us


Benton County Exhibit BC6 in Staff Report
Benton County
COMMUNITY DEVELOPMENT DEPARTMENT
April 16, 2025
Taxlots
Areas of Interest
Development Area
Properties with Landfill Operations
Adjacent Properties
Rural Residential
2-Acre Minimum
5-Acre Minimum
10-Acre Minimum
Rural Lands
Rural Industrial
Non-Resource Lands
Landfill Site
Open Space
Resource Zones
Exclusive Farm Use
Forest Conservation
MAPLE RANGE RD
BUELL RD
COFFIN BUTTE RD
CAMP ADAIR
PROPOSAL
DESCRIPTIO











DATE RECEIVED: 05-06-25
FROM: Julia Bradshaw
PHONE OR EMAIL: faye@forestfractal.com



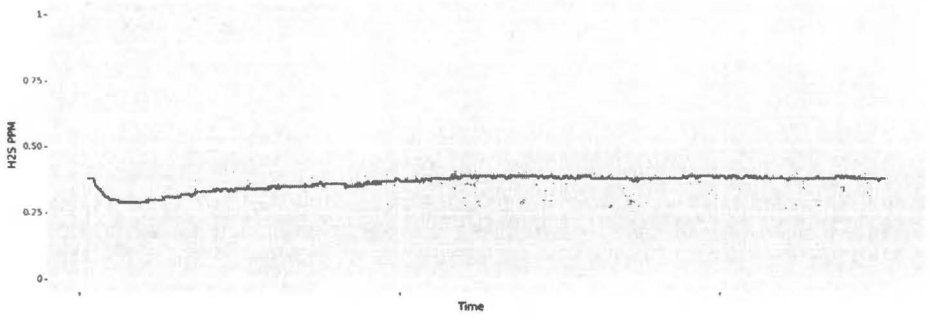




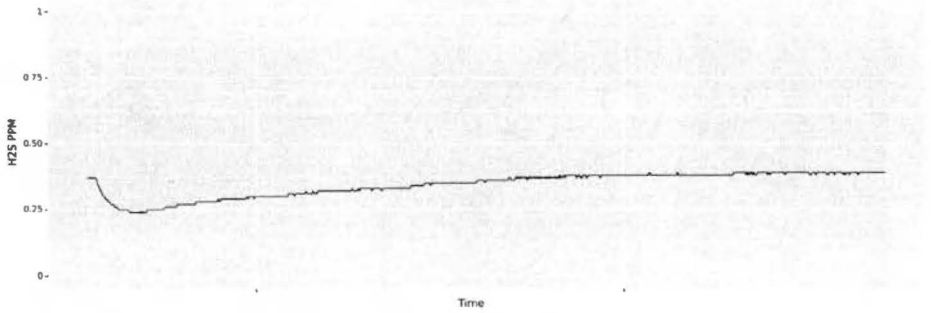


CORRECTION: Dates should be 01/31/2023

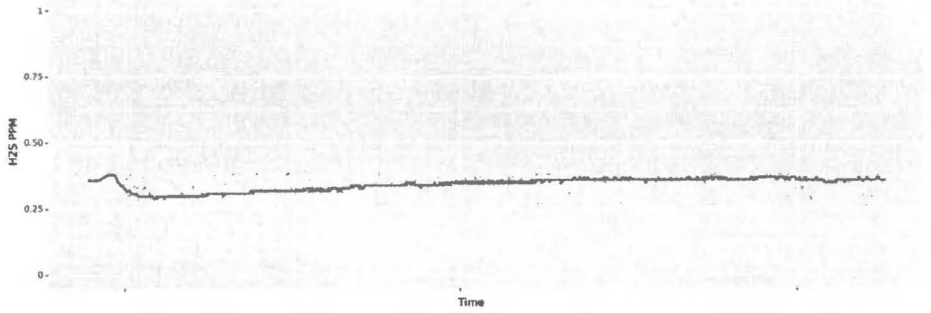
Feb 8 10:15am to 10:30am



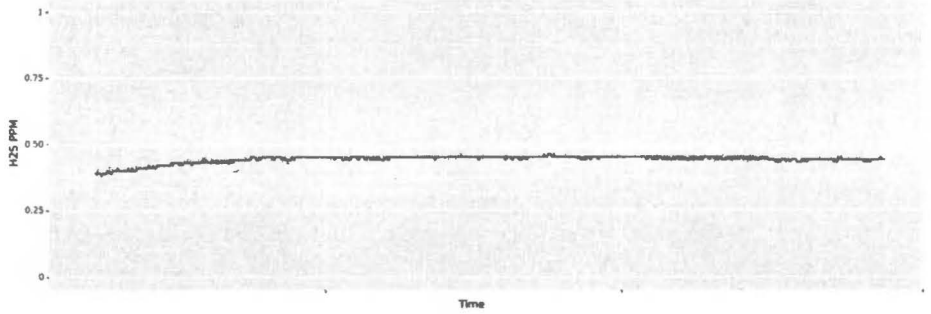
Feb 8 11:00am to 11:10am



Feb 9 11:20am to 11:30am



Feb 15 10:10am to 10:25am



From: FRANK BRETL
To: Benton Public Comment
Subject: Opposition to Landfill Expansion
Date: Tuesday, May 6, 2025 1:55:29 PM

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Dear Benton County Planning Commissioners,

My name is Frank Bretl and I live at 4820 NW Crescent Valley Drive, Corvallis, OR 97330.

I am writing because I strongly oppose Republic Services' Conditional Use Permit application LU-24-027 to expand the Coffin Butte landfill. I urge the Planning Commission to deny this application.

The proposed expansion would seriously interfere with the character of the surrounding area and impose an undue burden on public resources, in violation of Benton County Code 53.215 (1) and (2). Specifically, this expansion raises major concerns about:

- Air and water pollution threaten our local ecosystems and community health
- Traffic increases that pose safety risks on nearby roads and pathways
- Odor and noise issues that degrade quality of life for residents and visitors
- Negative impacts on wildlife, recreation, and property values
- Long-term climate and environmental consequences for future generations

The proposed expansion does nothing to align with *Benton County's 2040 Thriving Communities Initiative*. This expansion undermines our shared goals for responsible environmental stewardship, prioritizing public health, and sustainable waste management.

I believe Benton County should invest in waste reduction, recycling, and circular economy solutions, not expanding landfills that perpetuate pollution and place a long-term burden on local communities!

Please reject LU-24-027. Thank you for your consideration and for protecting the health and future of Benton County.

Sincerely,
Frank Bretl
Corvallis, OR 97330

From: Pamela Castle
To: Benton Public Comment
Subject: Testimony for LU-24-027
Date: Tuesday, May 6, 2025 4:40:57 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

See attached PDF of testimony in opposition to the expansion.

Thank you,

Pam Castle

Planning Commission members, my name is Pam Castle at 993 NW Cypress Avenue in Corvallis, some eight miles from the landfill. I have a Master's in pharmacology/toxicology and am testifying in opposition to the expansion of the landfill.

Landfill odor

It is not unusual for us to smell landfill odor at our home in the morning. The landfill is the only reasonable potential source since we smell the characteristic landfill gas (LFG) odor imparted by sulfides and ammonia. In addition, during the May 1st hearing, the applicant stated that the odors were most often reported from morning to 11 a.m. which are the hours following the removal of the cover from the working face of the landfill each day.

Historically, concern surrounding environmental effects of PFAS from landfills has focused on leachate as a pathway for them to enter the environment, either directly by leaks or via wastewater treatment plant effluent since it is common, as is the case for Coffin Butte Landfill, to mix leachate with wastewater treatment plant influent. Until recently, the PFAS in LFG was largely uncharacterized. The potential for long-range distribution of PFAS from landfills via atmospheric transport of landfill gas components has spurred examination of LFG.

PFAS in LFG

A 2024 paper characterizing PFAS in LFG and leachate at three municipal solid waste landfills in Florida found that the fluorine mass escaping in LFG (32-76%) was at least as great as the mass escaping in leachate (24- 68%). They concluded that it is likely that LFG is a major route of PFAS entering the environment (*Reference A).*

Further, as seen in Figure 1 below, a 2023 review paper reported that of the yearly total mass of PFAS entering a landfill, 6% escaped via LFG while 10% escaped via leachate (*Reference B).*

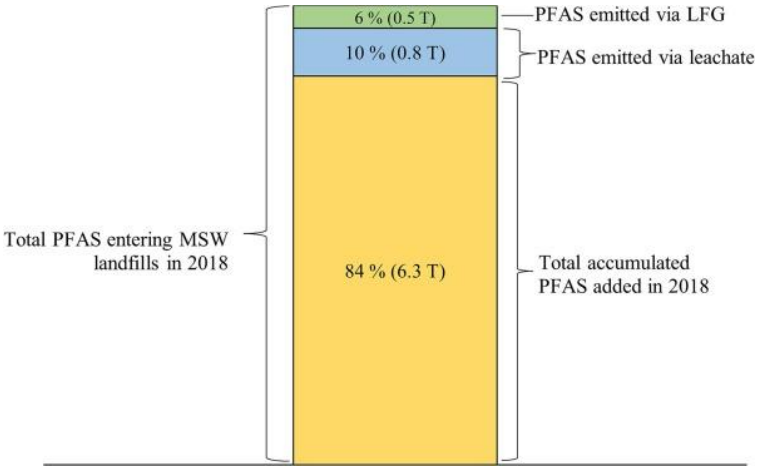


Figure 1. The fate of PFAS entering landfills

This may be an underestimate of LFG PFAS as precursor PFAS, some of which are semi-volatile, that are later converted to PFAS in the environment have not generally been measured (*Reference C).*

In the same review, the authors traced the fate of PFAS in landfills (**see Figure 2 below)** and it is important to note that even though part of LFG is captured and burned at flares, flares do not burn at high enough temperatures to mineralize PFAS into an inert salt. Flares do not mitigate PFAS. In addition, some products of incomplete combustion are potent greenhouse gases (*Reference B).*

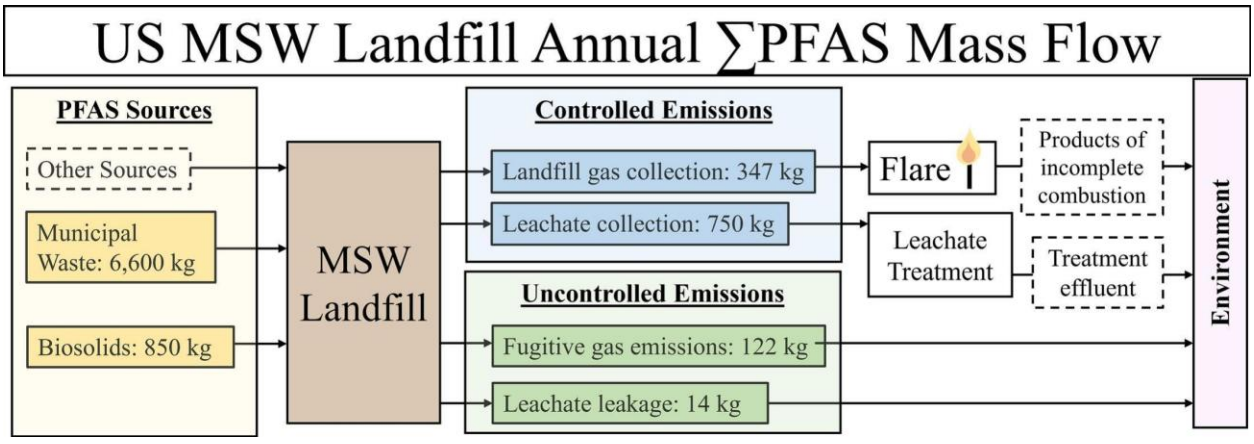


Figure 2. Flowchart depiction of annual sum PFAS loading and release at MSW and C&D debris landfills based on current understanding in the literature. Dashed lines represent PFAS streams which have not been quantified to any extent in the literature.

In agreement with this review, PFAS in ambient air, in dry deposition and in plant leaves close to landfills have been found to be elevated (*Reference D).*

PFAS health issues

It is well-documented that PFAS have a number of effects on human and biotic health. Among these are altered immune and thyroid function, liver disease, lipid and insulin dysregulation, kidney disease, adverse reproductive and developmental outcomes, and cancer *(Reference E).*

PFAS distribution in the atmosphere – is the city testimony providing a serious warning?

Given what is in the literature, I would suggest that the landfill odor testimony by those of us in the city of Corvallis is an important indicator of the widespread nature of the LFG problem. I don't think it a stretch to hypothesize that PFAS are spread over a large region when landfill gas is carried by air currents. What I want to make clear is that while the odor is unpleasant, it is not simply a nuisance issue, it is a public health issue.

The 2024 review refers to landfills as "unabating PFAS repositories" and states that their findings that LFG possibly accounts for more environmental deposition of PFAS mean that managing LFG is requisite for preventing long-term, atmospheric transport of PFAS over long distances (*Reference A).* We know that Coffin Butte Landfill has a long history of uncontrolled and insufficiently mitigated LFG emissions as evidenced by EPA monitoring and Carbon Mapper measurements, some of which show methane plumes extending for approximately a mile from their source.

At the April 29th hearing, the removal of the cap on the amount of trash that can be deposited in the landfill each year was brought up. Someone stated that the amount of trash trucked in was not expected to increase with the removal of that cap. That begs the question as to why the cap would be removed. Even if the amount of waste deposited does not increase, the total amount of waste at the landfill will increase resulting in greater total amounts of PFAS at the site.

To allow the spread of more PFAS in LFG would mean the county is not meeting Benton County's Comprehensive Plan policies 6.1.2, 6.1.4 and 6.3.1. In addition, since studies show plants (*Reference D)* and animals (*Reference F)* bioaccumulate PFAS, the landfill **does seriously affect** the ability of farmers on adjacent land to use their properties. The expansion of the landfill is antithetical to purported goal of Benton County, as expressed in policies and plans, to provide a healthy environment for future generations.

Trading our health for a relatively small amount of money for the county is not a good deal – the wet environment makes our landfill primed to spread PFAS via leachate and LFG. For the above reasons, I urge the commission to deny the application for expansion of Coffin Butte Landfill. We must develop plans to keep organics and recyclables out of landfills and to decrease the use of disposable items to rectify this problem.

Thank you,
Pam Castle

Reference A (from 2024)

Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release
https://pubs.acs.org/doi/epdf/10.1021/acs.estlett.4c00364?ref=article_openPDF

Reference B (from 2023)

A critical review of perfluoroalkyl and polyfluoroalkyl substances (PFAS) landfill disposal in the United States

https://www.sciencedirect.com/science/article/pii/S0048969723058126

Reference C

Review of the fate and transformation of per- and polyfluoroalkyl substances (PFASs) in landfills

https://www.sciencedirect.com/science/article/pii/S0269749117311612

Reference D

Occurrence and Phase Distribution of Neutral and Ionizable Per- and Polyfluoroalkyl Substances (PFASs) in the Atmosphere and Plant Leaves around Landfills: A Case Study in Tianjin, China.

https://pubs.acs.org/doi/epdf/10.1021/acs.est.7b05385?ref=article_openPDF

Reference E

Per- and Polyfluoroalkyl Substance Toxicity and Human Health Review: Current State of Knowledge and Strategies for Informing Future Research

https://academic.oup.com/etc/article-abstract/40/3/606/7734619?redirectedFrom=fulltext&login=false

Reference F

Per- and polyfluoroalkyl substances (PFAS) in livestock and game species: A review

https://www.sciencedirect.com/science/article/pii/S0048969720383285

Fig. 1

DATE RECEIVED: 05-06-25
FROM: Pam Castle
PHONE OR EMAIL: ← pcastle@gettysburg.edu

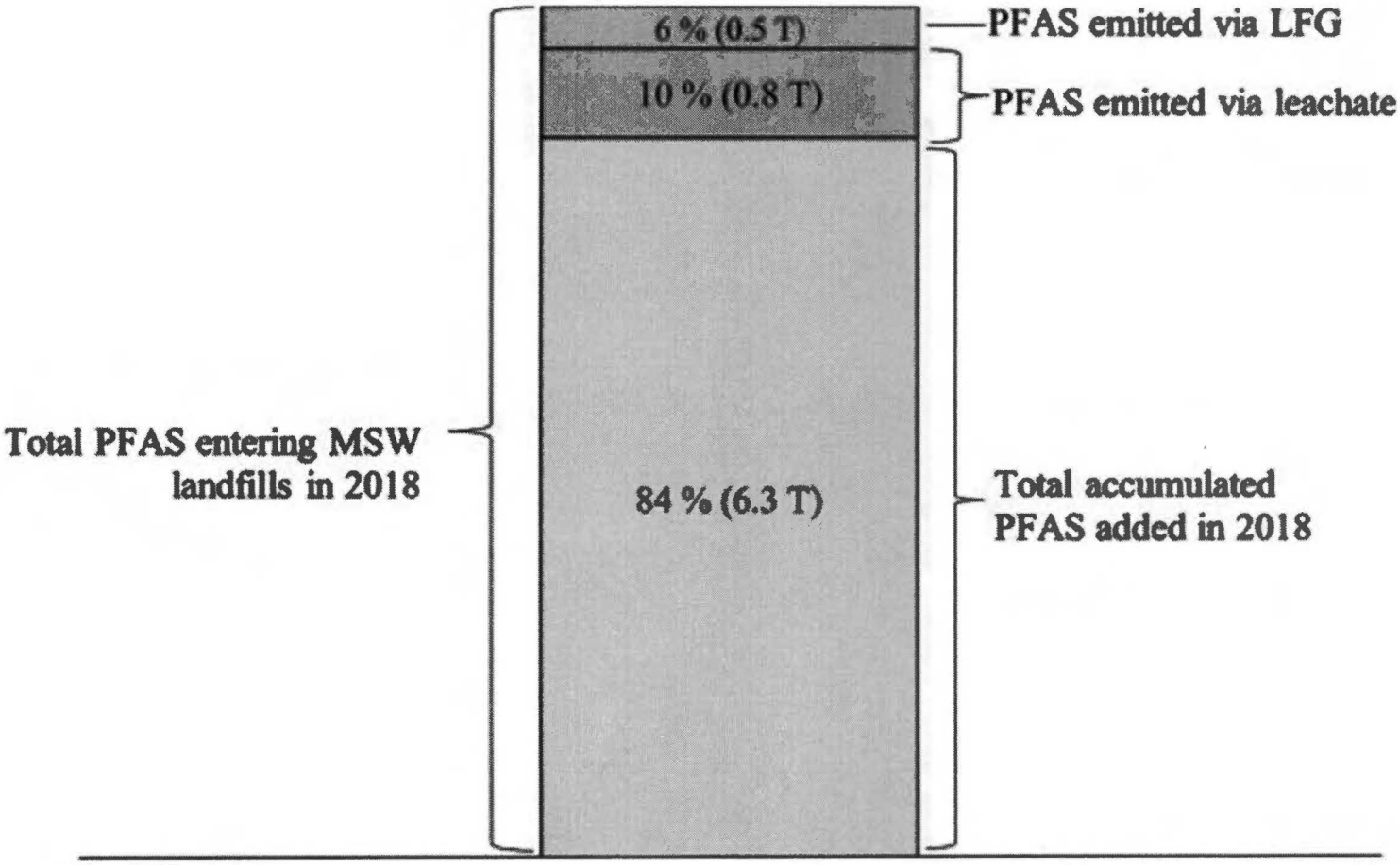
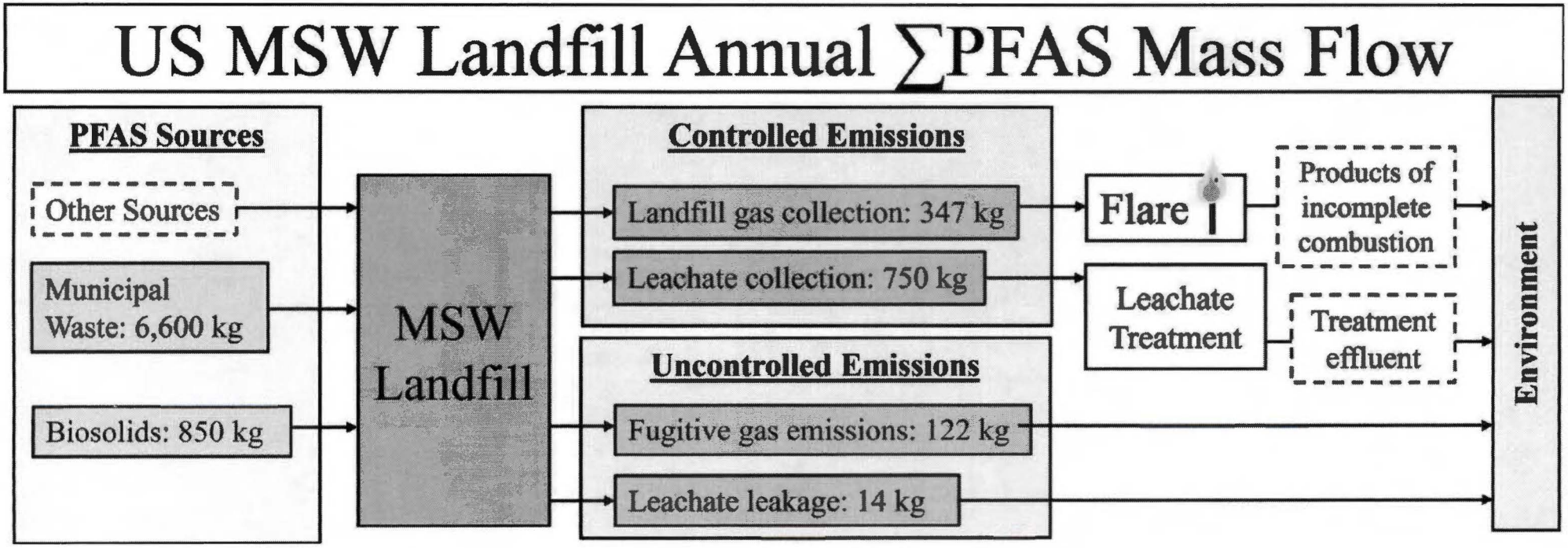


Fig. 2


US MSW Landfill Annual ∑PFAS Mass Flow
PFAS Sources
Other Sources
Municipal Waste: 6,600 kg
Biosolids: 850 kg
MSW Landfill
Controlled Emissions
Landfill gas collection: 347 kg
Leachate collection: 750 kg
Uncontrolled Emissions
Fugitive gas emissions: 122 kg
Leachate leakage: 14 kg
Flare
Leachate Treatment
Products of incomplete combustion
Treatment effluent
Environment

Planning Commission members, my name is Pam Castle and I live at 993 NW Cypress Avenue in Corvallis some eight miles from the landfill - I have a Master's in pharmacology/toxicology and am testifying in opposition to the expansion of the landfill.

Landfill odor

The landfill is the only likely source of the signature sulfide and ammonia landfill gas (LFG) odor we smell at our home some mornings. We smell the odor when most odor complaints are reported - during the hours following the morning removal of the landfill cover.

As reflected in discussions during the hearing, until recently, leachate presented the largest concern surrounding PFAS escaping landfills. Recently, the potential for long-range distribution of PFAS from landfills via LFG has spurred its examination.

PFAS in LFG

A 2024 study comparing PFAS escape at three landfills in Florida found that fluorine escaping in LFG at 32 -76% of the total was at least as great as that escaping in leachate at 24 - 68%. They concluded it is likely that LFG is a major route of PFAS entering the environment. (*Reference A)*

As seen in **Figure 1,** a 2023 review paper reported that of the yearly total mass of PFAS entering landfills, 6% escaped via LFG while 10% escaped via leachate. *Reference B*

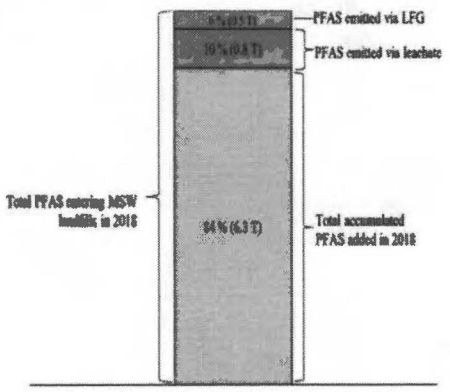


Figure 1. The fate of PFAS entering landfills

Looking at **Figure 2**, it is important to note that even though part of LFG is captured and burned at flares, flares do not burn at high enough temperatures to mineralize PFAS into an inert salt. Flares do not mitigate PFAS. *Reference B*

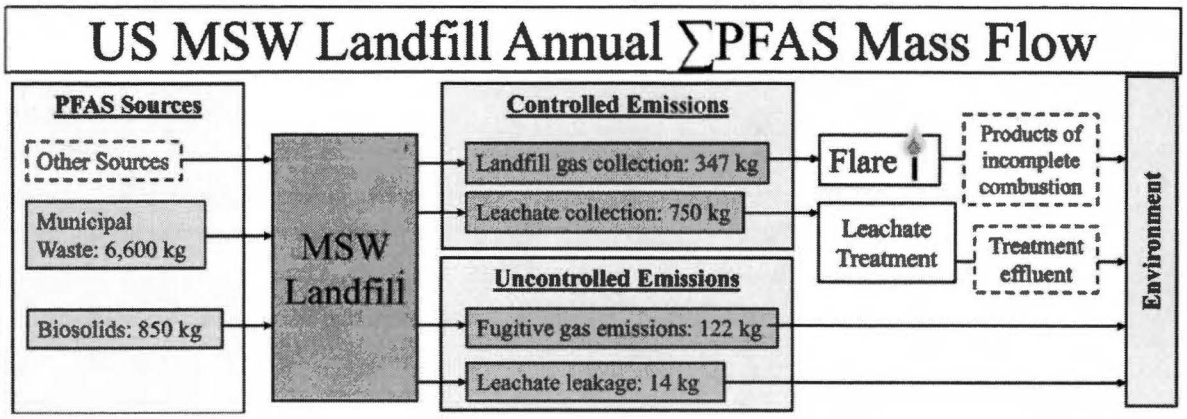


Figure 2. Flowchart of annual PFAS entering and leaving landfills.

PFAS health issues

It is well-documented that PFAS have a number of effects on human and biotic health. Among these are altered immune and thyroid function, liver and kidney disease, lipid and insulin dysregulation, adverse reproductive and developmental outcomes, and cancer. *Reference C.*

PFAS for generations to come

The 2023 review refers to landfills as "unabating PFAS repositories" and states that LFG may account for more environmental deposition of PFAS than leachate indicating that managing LFG is requisite for preventing long-term, atmospheric transport of PFAS. *Reference A*

A landfill expansion would expand our "PFAS repository" increasing the human health, environmental and economic burdens we pass to future generations.

PFAS distribution in the atmosphere – is the city testimony providing a warning?

Given recent findings about PFAS in LFG, I contend that the landfill odor testimony by those in Corvallis is an important indicator of the widespread nature of the LFG problem and that PFAS are being spread over a large area when landfill gas is carried by air currents. This means LFG odor is not simply a nuisance issue, but a public health issue. Expansion of the landfill would **seriously interfere with my ability to use my property** by increasing the likelihood that it is receiving PFAS deposition from LFG.

To allow the spread of more PFAS in LFG would mean the county is not meeting Benton County's Comprehensive Plan policies 6.1.2, 6.1.4 and 6.3.1. In addition, since studies show plants (*Reference D)*, and animals accumulate PFAS, the landfill **does seriously interfere with** the ability of farmers on adjacent land to use their properties for their designated purposes.

For these reasons, I urge the commission to deny the application for expansion of Coffin Butte Landfill.

Reference A (from 2024)

Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release https://pubs.acs.org/doi/epdf/10.1021/acs.estlett.4c00364?ref=article_openPDF

Reference B (from 2023)

A critical review of perfluoroalkyl and polyfluoroalkyl substances (PFAS) landfill disposal in the United States

https://www.sciencedirect.com/science/article/pii/S0048969723058126

Reference C

Per- and Polyfluoroalkyl Substance Toxicity and Human Health Review: Current State of Knowledge and Strategies for Informing Future Research

https://academic.oup.com/etc/article-abstract/40/3/606/7734619?redirectedFrom=fulltext&login=false

Reference D

Occurrence and Phase Distribution of Neutral and Ionizable Per- and PolyfluoroalkylSutbastances (PFASs) in the Atmosphere and Plant Leaves around Landfillls: A Case Study in Tianjin, China.

https://pubs.acs.org/doi/epdf/10.1021/acs.est.7b05385?ref=article_openPDF

Ref. A

ENVIRONMENTAL Science & Technology LETTERS

pubs.acs.org/journal/estlcu

Letter

Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release

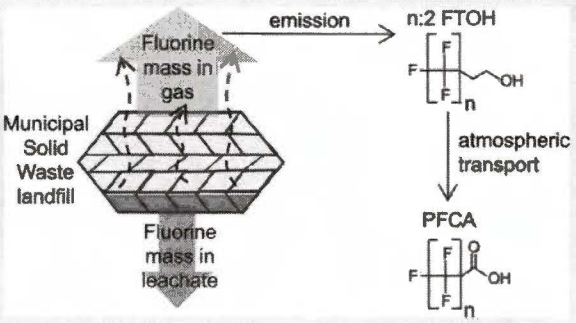
Ashley M. Lin, Jake T. Thompson, Jeremy P. Koelmel, Yalan Liu, John A. Bowden, and Timothy G. Townsend*

Cite This: *Environ. Sci. Technol. Lett.* 2024, 11, 730−737

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ABSTRACT: The undisclosed and ubiquitous use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in consumer products has led to a growing issue of environmental pollution, particularly within the solid waste community, where the fate of volatile (neutral) PFAS in landfilled refuse is not well understood. Here, three municipal solid waste landfills in Florida were assessed for neutral PFAS in landfill gas and ionic PFAS in landfill leachate to compare the relative mobility between the two pathways. Landfill gas was directly sampled using a high volume, XAD-2 resin based sampling approach developed for adsorption and analysis of 27 neutral PFAS. Across sites, 13 neutral PFAS were identified from fluorotelomer alcohol (FTOH), fluorotelomer olefin (FTO), secondary FTOH, fluorotelomer acetate (FTOAc), and fluorotelomer methyl acrylate (FTMAc) classes; however, FTOHs dominated concentrations (87−97% total neutral PFAS), with most detections surpassing utilized calibration levels. Even under conservative assumptions, the mass of fluorine leaving in landfill gas (32−76%) was comparable to or greater than the mass leaving in landfill leachate (24−68%). These findings suggest that landfill gas, a less scrutinized byproduct, serves as a major pathway for the mobility of PFAS from landfills.



KEYWORDS: *volatile, emissions, GC, fluorotelomer alcohol*

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1. INTRODUCTION

Widespread per- and polyfluoroalkyl substance (PFAS) contamination has been a mounting environmental concern due to their chemical persistence and toxicity to human and biotic health.[1−4] While numerous industries are being confronted with PFAS-related management challenges, the burden of remediation and PFAS removal has often fallen on downstream industries—namely, the solid waste sector.[5−9] Discarded, PFAS-laden consumer products including textiles, wood products, and packaging and commonly landfilled industrial byproducts like MSW incineration ash and wastewater biosolids are known contributors to PFAS loading in landfills.[10−16] Existing research suggests most discarded PFAS mass is retained within landfills[9,17] with liquid-phase byproducts of waste decomposition, leachate and gas condensate, currently considered prevalent pathways for PFAS mobilization.[2,7,9] However, the extent of PFAS release to another major byproduct, landfill gas (LFG), has remained largely unscrutinized.

The bulk of PFAS characterization studies focus on nonvolatile/semivolatile (ionic) perfluoroalkyl acids (PFAAs) measured in liquid and solid matrices, in part because of a high presence and awareness of these species within the PFAS community but largely because analytical capabilities for ionic PFAS measurement are better established.[18−21] Volatile (neutral) PFAS are also utilized in consumer products[13,22−27] and have been determined in a few studies on ambient air surrounding landfills and near wastewater treatment plants,[28−32] but a lack of volatile analytical standards and latency in methodological development has hindered the progression of gas phase research in environmental matrices. Whereas PFAS characterization in leachate is established, concentrations ranging from thousands to tens of thousands of nanograms per liter are commonly encountered;[33−38] only two studies characterize volatile PFAS directly in LFG.[39,40] Titaley et al. identified fluorotelomer alcohol (FTOH), fluorotelomer acrylate (FTAc) and fluorotelomer olefin (FTO) homologues in LFG with combined concentrations ranging from 4,600 to 14,000 ng m^{-3} across three landfills. Goukeh et al., only assessing FTOHs, identified higher combined concentrations than Titaley et al., finding ~18,000 ng m^{-3} (sum of 6:2 and 8:2

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Review

A critical review of perfluoroalkyl and polyfluoroalkyl substances (PFAS) landfill disposal in the United States

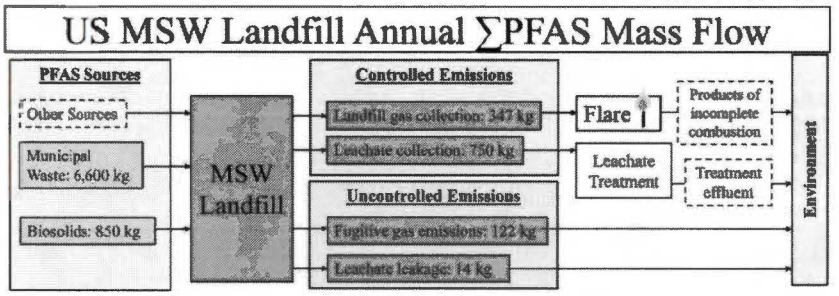
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HIGHLIGHTS

- Solid waste management strategies impact PFAS emissions.
- PFOA has the highest ratio to its respective RSL in C&D and MSW landfill leachates.
- Unlined C&D landfills present a significant source of PFAS to the environment.
- An estimated 7.5 metric tons of PFAS enter MSW landfills annually.
- Annually, 460 kg of PFAS emitted via landfill gas, 750 kg via landfill leachate.

GRAPHICAL ABSTRACT



ARTICLE INFO

Editor: Damia Barcelo

ABSTRACT

Landfills manage materials containing per- and polyfluoroalkyl substances (PFAS) from municipal solid waste (MSW) and other waste streams. This manuscript summarizes state and federal initiatives and critically reviews peer-reviewed literature to define best practices for managing these wastes and identify data gaps to guide future

Abbreviations: µg, Microgram; AFFF, Aqueous film-forming foams; C&D, Construction and demolition; diPAP, Polyfluoroalkyl phosphoric acid diesters; FASA, Perfluoroalkane sulfonamide; FASE, Perfluoroalkane sulfonamido ethanol; FTAc, Fluorotelomer acrylate; FTCA, Fluorotelomer carboxylic acid; FTO, Fluorotelomer olefin; FTOH, Fluorotelomer alcohol; H_2S, Hydrogen sulfide gas; HAL, Health Advisory Limit; kg, Kilogram; L, Liter; LFG, Landfill gas; MCL, Maximum Contaminent Level; MeFBSAA, Methyl-n-perfluorobutanesulfonamidoacetic acid; MeFOSAA, Methyl-n-perfluorooctanesulfonamidoacetic acid; mg, Milligram; Mg, Megagram (metric ton); MPCA, Minnesota Pollution Control Agency; MSW, Municipal solid waste; MSWI, Municipal solid waste incineration; NEBRA, North East Biosolids & Residuals Association; NWRA, National Waste & Recycling Association; PFAA, Perfluoroalkyl acids; PFAS, Per- and polyfluoroalkyl substance(s); PFBS, Perfluorobutane sulfonate; PFCA, Perfluoroalkyl carboxylic acids; PFHxA, Perfluorohexanoic acid; PFHxS, perfluorohexane sulfonate; PFOA, Perfluorooctanoic acid; PFOS, Perfluorooctane sulfonic acid; PFPeA, Perfluoropentanoic acid; PFSA, Perfluoroalkyl sulfonic acids; PIC, Product of incomplete combustion; RCRA, Resource Conservation and Recovery Act; RNG, Renewable natural gas; RO, Reverse osmosis; RSL, Regional Screening Limit; SI, Supplementary information; US EPA, United States Environmental Protection Agency; WWTP, Wastewater treatment plant.

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JOURNAL ARTICLE

Per- and Polyfluoroalkyl Substance Toxicity and Human Health Review: Current State of Knowledge and Strategies for Informing Future Research

Get access

Suzanne E. Fenton , Alan Ducatman , Alan Boobis , Jamie C. DeWitt , Christopher Lau , Carla Ng , James S. Smith , Stephen M. Roberts ✉

Environmental Toxicology and Chemistry, Volume 40, Issue 3, 1 March 2021, Pages 606–630, https://doi.org/10.1002/etc.4890

Published: 05 October 2020 **Article history** ▾

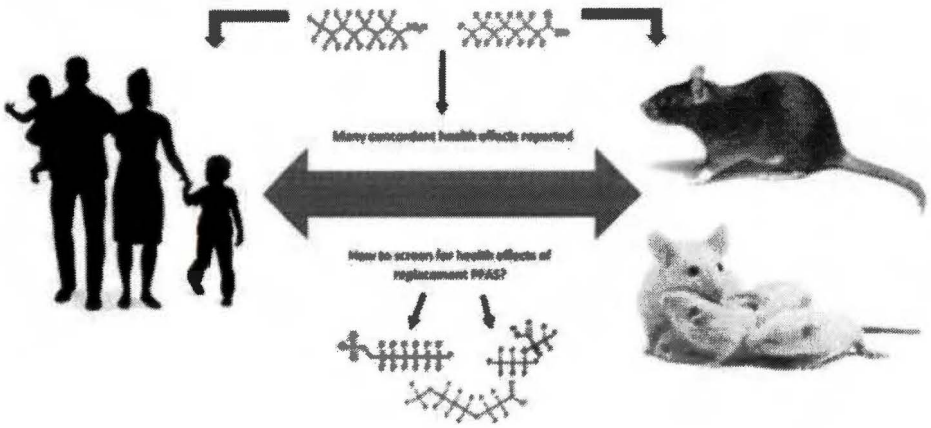
Abstract

Reports of environmental and human health impacts of per- and polyfluoroalkyl substances (PFAS) have greatly increased in the peer-reviewed literature. The goals of the present review are to assess the state of the science regarding toxicological effects of PFAS and to develop strategies for advancing knowledge on the health effects of this large family of chemicals. Currently, much of the toxicity data available for PFAS are for a handful of chemicals, primarily legacy PFAS such as perfluorooctanoic acid and perfluorooctane sulfonate. Epidemiological studies have revealed associations between exposure to specific PFAS and a variety of health effects, including altered immune and thyroid function, liver disease, lipid and insulin dysregulation, kidney disease, adverse reproductive and developmental outcomes, and cancer. Concordance with experimental animal data exists for many of these effects. However, information on modes of action and adverse outcome pathways must be expanded, and profound differences in PFAS toxicokinetic properties must be considered in understanding differences in responses between the sexes and among species and life stages. With many health effects noted for a relatively few example compounds and hundreds of other PFAS in commerce lacking toxicity data, more contemporary and high-throughput approaches such as read-across, molecular dynamics, and protein modeling are proposed to accelerate the development

of toxicity information on emerging and legacy PFAS, individually and as mixtures. In addition, an appropriate degree of precaution, given what is already known from the PFAS examples noted, may be needed to protect human health. *Environ Toxicol Chem* 2021;40:606–630. © 2020 SETAC

Abstract

Many health effects have been reported in association with or due to per- and polyfluoroalkyl substance (PFAS) exposures in humans and toxicologic models. Species concordance of effects is evident for a handful of legacy PFAS. With hundreds of PFAS in commerce that lack exposure and health effects data, contemporary and novel methods must be implemented to inform exposed communities, risk assessors, and concerned citizens and prioritize those most likely to affect human health.



Keywords: Per- and polyfluoroalkyl substances, Perfluorooctane sulfonate, Perfluorooctanoic acid, Persistent compounds, Contaminants of emerging concern

Issue Section: CRITICAL REVIEWS

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Environmental Science & Technology

Article

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Occurrence and Phase Distribution of Neutral and Ionizable Per- and Polyfluoroalkyl Substances (PFASs) in the Atmosphere and Plant Leaves around Landfills: A Case Study in Tianjin, China

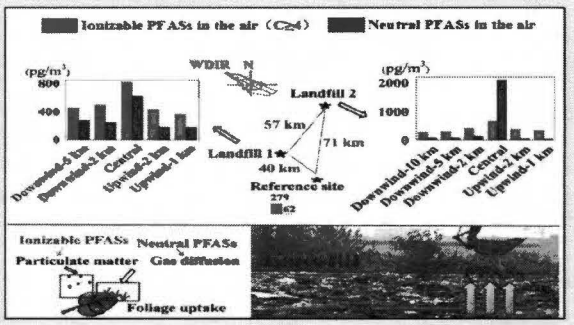
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Supporting Information

ABSTRACT: A total of 23 per- and polyfluoroalkyl substances (PFASs) were investigated in the air, dry deposition, and plant leaves at two different landfills and one suburban reference site in Tianjin, China. The potential of landfills as sources of PFASs to the atmosphere and the phase distribution therein were evaluated. The maximum concentrations of ∑PFASs in the two landfills were up to 9.5 ng/m^3 in the air, 4.1 μg/g in dry deposition, and 48 μg/g lipid in leaves with trifluoroacetic acid and perfluoropropionic acid being dominant (71%−94%). Spatially, the distribution trend of ionizable and neutral PFASs in all three kinds of media consistently showed the central landfill > the downwind > the upwind > the reference sites, indicating that landfills are important sources to PFASs in the environment. Plant leaves were found effective in uptake of a variety of airborne PFASs including polyfluoroalkyl phosphoric acid diesters, thus capable of acting as a passive air sampling approach for air monitoring.



INTRODUCTION

Per- and polyfluoroalkyl substances (PFASs) have been widely used in industry and consumer products[1,2] due to their chemical and thermal stability together with their amphiphilic nature.[3] Perfluoroalkyl acids (PFAAs), are stable forms of PFASs being most frequently detected in the surface environment, especially for medium- and long-chain analogues (C7−C12), such as perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS).[4−7] Owing to their persistence, bioaccumulation, toxicity, and the high detection frequencies in the environmental and biota samples in remote regions,[8,9] PFOS and its salts were listed as persistent organic pollutants (POPs) under the Stockholm Convention in 2009, and the phase-out of PFOA has been implemented in many regions.[10] Meanwhile, short-chain analogues (C4−C6), which are recognized as less toxic and bioaccumulative to aquatic organisms and human beings, have been used as substitutes for long-chain PFASs.[11,12]

PFAAs can be directly released from products as well as derived from incomplete degradation of their precursors, which have greater production and wider applications. Fluorotelomer alcohols (FTOHs),[13,14] perfluorooctane sulfonamides (FOSAs),[15] and perfluorooctane sulfonamidoethanols (FOSEs)[16] are precursors of most concern, and their degradation in various media has been well investigated in laboratory studies, where PFAAs and other saturated and unsaturated polyfluorinated acids were proposed as stable metabolites.[17] Hence, the long-range atmospheric transport (LRAT) of precursors and their subsequent degradation are proposed as a dominant source of PFAAs detected in the remote environment.[13] For the past ten years, polyfluoroalkyl phosphoric acid diesters (diPAPs) that are ionizable and biodegradable to perfluoroalkyl carboxylic acids (PFCAs) have been detected in human specimens,[18,19] indoor dust[20,21] as well as seawater.[22] The high levels of up to 1.9 × 10^2 μg/g in indoor dust[20] have raised emerging concerns for their human exposure risk. More recently, diPAPs were found occurring in the particle phase of the oceanic atmosphere indicating a direct transport from nearby source regions.[23] Meanwhile, C2−C3 PFCA analogues (referred as ultrashort-chain PFCAs), especially trifluoroacetic acid (TFA), have been detected at high levels of 1.0 × 10^3 pg/m^3 to 2.1 × 10^3 pg/m^3 in the atmosphere of Beijing and up to 2.4 μg/L in Northern American

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Environ. Sci. Technol. 2018, 52, 1301−1310

From: Michelle Collins, Thompson Sanitary Service
To: Benton Public Comment
Subject: Public testimony
Date: Tuesday, May 6, 2025 1:14:45 PM

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Michelle Collins
510 SE First ST
Toledo, OR 97391
5/6/2025

Commissioners,

My name is Michelle, and I am an employee of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact my customers. I encourage you to grant Republic's application for expansion. Below are some of the reasons I support the expansion:

The landfill is an essential resource in our ability to be responsible for our own waste. I am both an employee and a customer who relies on hauling waste to this facility. Hauling the waste to a landfill further away doesn't fix the problem, it just makes people in another part of Oregon deal with our trash. Republic has done an excellent job managing the landfill. Unfortunately, collection customers will bear the burden of increased prices to cover increased hauling cost and Increased collection rates will have a significant impact to our small businesses and my community. Hauling trash to another part of Oregon increases greenhouse gas output from the trucks that haul it, which pollutes the environment we are trying to protect.

Thank you for your attention. I strongly encourage you to vote to expand.

From:	Community Development, Benton County, Oregon
To:	Benton Public Comment
Subject:	LU-24-027 Coffin Butte Proposed Expansion Written Feedback
Date:	Tuesday, May 6, 2025 5:02:14 PM

Subject of Testimony: Stop the landfill expansion

Full Name: Arianne Custer

Email: arianne.custer731@gmail.com

Street Address: 4955 SW Philomath Blvd

Written Testimony:

I strongly oppose this expansion due to the serious negative impacts it will have on our environment, public health, and quality of life.

First and foremost, expanding the landfill poses a significant risk to groundwater quality. Even with modern liners and containment systems, no landfill is completely fail-safe. Over time, toxic leachate can and often does seep into the groundwater, contaminating the very resource we rely on for drinking water, irrigation, and natural ecosystems. Once our groundwater is polluted, the damage is extremely difficult—and costly—to reverse.

Secondly, this expansion will lead to increased air pollution. Decomposing waste emits harmful gases such as methane, a potent greenhouse gas, as well as volatile organic compounds and foul odors that affect the health of nearby residents. These emissions contribute to climate change and can cause respiratory issues, especially in children and seniors.

Another serious concern is the increase in traffic and noise. Expanding the landfill would mean more trucks hauling garbage from outside our community. This will place a greater burden on our local roads, increase the risk of accidents, and contribute to noise pollution and wear and tear on infrastructure—all while importing waste that we did not generate.

If this landfill were used only for waste generated within our area, it would last significantly longer and serve its intended purpose more responsibly. Importing trash from other regions only accelerates the filling of the site and forces our community to bear the burden of others' waste problems.

In conclusion, this expansion prioritizes short-term convenience and profit over long-term public and environmental health. I urge you to listen to the concerns of the residents you serve and deny the proposed landfill expansion. Thank you for your time and consideration

--
This is a notification that a contact form was submitted on your website (Community Development, Benton County, Oregon https://cd.bentoncountyor.gov).
Submitter's IP Address: 76.144.18.254

From: Ken Eklund
To: Benton Public Comment
Subject: I Oppose LU-24-027: Republic"s fire report doesn"t address subsurface fires, ETLF risk
Date: Tuesday, May 6, 2025 2:03:07 PM

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Benton County Planning Commissioners
c/o Planning Division 4500 SW Research Way, Corvallis, OR 97333
May 6, 2025

RE: Please Deny LU-24-027, the Conditional Use Permit Application Regarding Landfill Expansion

Dear Chair Fowler and Members of the Benton County Planning Commission:

I call your attention to an omission in the applicant's Burden of Proof regarding fire hazards: there's no discussion of a type of fire that's unique to landfills, the subsurface fire.

As you'll see in the attached Explainer, subsurface fires ("exothermic chemical reactions") disrupt the landfill's ability to serve the community and can turn into major health risks for the area.

You'll also see that Coffin Butte Landfill is a candidate for the onset of such an event, as it has several high-risk factors present such as incinerator ash, a history of landfill gas leaks, and a history of surface fires (documented elsewhere).

I ask that you deny this land use application – thank you,

Ken Eklund, writerguy

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Corvallis OR 97330
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Creator of
World Without Oil
Ed Zed Omega
FutureCoast
and other storymaking games

ELEVATED TEMPERATURE LANDFILLS, SUBSURFACE LANDFILL FIRES

an explainer

EXOTHERMIC REACTIONS

Landfills can host unique kinds of “fires” (heat-generating chemical reactions) that begin or travel deep within the landfill and can be functionally impossible to extinguish. These fires fundamentally change the normal landfilling operations and usually lead to increased levels of toxins released in landfill gas and in leachate, both of which have been known to erupt out of the landfill itself. Elevated temperatures can also drastically degrade the durability of the membranes used as liners, causing them to prematurely fail.

AT-RISK LANDFILLS

The onset of these fires are not well understood; there is currently no reliable way to predict the onset of this kind of fire. There are known risk factors, though, including:

- Wet conditions in the landfill
- incinerator ash mixed with municipal solid waste
- partially extinguished surface fires
- landfill gas leaks
- exothermic chemical reactions

All of these risk factors are present at Coffin Butte Landfill:

- The dump has very wet conditions. It exported 40 million gallons of leachate in 2024.
- The dump has been disposing of incinerator bottom and fly ash from the Covanta Incinerator for many years. The dump uses this ash as daily cover, i.e. it is spread over the municipal solid waste at the end of each working day.
- The dump operators acknowledge there are surface fires on a regular basis, but keep no records of them. Most notably, a surface fire at the working face in 2024 was only partially extinguished by dump operators and re-erupted after workers had gone home, requiring local fire response.
- The dump is under legal action by the EPA to investigate excessive leaks of landfill gas. A 2024 EPA inspection revealed an uncapped gas well, which was venting landfill gas out and allowing air to oxygenate the dump interior.
- The dump is the repository for at-risk substances for exothermic chemical reactions, as it received an unknown amount of industrial waste from the Teledyne Wah Chang metals plant in Albany before it was closed and became a Superfund site. Articles from the time disclose that this industrial waste included radium chloride (radioactive) and various forms of magnesium (reactive). Low-level waste from the Wah Chang Superfund cleanup went to an unnamed local landfill.

EFFECT OF A FIRE ON LANDFILL OPERATIONS: CHIQUITA CANYON LANDFILL
The Chiquita Canyon Landfill outside Castaic, California, is a case study of the real-life effects of such a fire.

From Newsweek, Feb 1, 2024:

Deep within the Chiquita Canyon Landfill site near Santa Clarita, to the north of Los Angeles, a fire has been burning, releasing noxious gases and vapors that have left local residents smelling foul odors and led to a multiagency task force to be formed to address the issue.

Hazardous chemicals such as benzene—a carcinogen—and dimethyl sulfide, which is considered acutely toxic, have been detected being emitted at the landfill site, along with a host of other compounds, as discarded substances in the landfill mix and react with one another, raising concerns about the impact to locals' health that the emissions could have if not addressed soon.

...

Benzene can cause skin and eye irritations, but can also cause genetic defects and cancer. Prolonged or repeated exposure to the chemical can cause damage to the organs. Glass described it as "a nasty and very common industrial chemical" that gave the sweet smell to gasoline, but became problematic the more someone is exposed to it.

Dimethyl sulfide can cause skin, eye and lung irritation as a vapor, as well as dizziness and asphyxiation.

The EPA, which is leading the multiagency effort, has said that, as well as those two chemicals, chloromethane, carbon disulfide, toluene, hexane, tetrachloroethane, styrene and acrylonitrile have been detected at the landfill site. All are considered hazardous, if not toxic.

A South Coast Air Quality Management District (SCAQMD) spokesperson told *Newsweek* that "elevated levels" of hydrogen sulfide and benzene have been detected through sampling in the nearby community, as well as at the landfill site.

Glass said that the emissions would be a concern for workers on the landfill site, and that air monitoring would keep track of the levels around nearby housing, but suggested that residents should watch out for their sense of smell getting used to the odors, which was a person's "first warning sign."

"You can become desensitized to them and fail to smell them or detect them by odor—even when they're there, if you're having a lot of exposure to them—so residents in the area should also be concerned about that," he said.

(link)

From The LA Times, Feb 23, 2024:

Federal officials have ordered operators of Chiquita Canyon landfill to take immediate steps to protect human health and the environment, saying the smoldering Castaic facility poses an imminent danger to nearby communities due to noxious odors and hazardous liquid waste.

The action taken Thursday by the U.S. Environmental Protection Agency comes amid growing calls to shut down the facility.

“This order reflects EPA’s commitment to ensuring landfill operators mitigate noxious odors and comply with federal law to prevent public exposure to hazardous wastes,” said EPA Pacific Southwest Regional Administrator Martha Guzman. “Today’s order is the result of local, state, and federal collaboration to better protect the health of nearby residents as well as the surrounding environment.”

The source of the growing crisis is a heat-generating chemical reaction that probably began deep within the landfill in May of 2022. Extreme heat and growing pressure within the dump have caused piping-hot, contaminated water to spill onto the surface, or occasionally erupt like a geyser.



Sarah Olaguez joins residents of Val Verde and Castaic in Hasley Canyon Park calling for the Chiquita Canyon Landfill to be closed. (Allen J. Schaben/Los Angeles Times)

This polluted water has contained cancer-causing benzene above federal standards, making it liquid hazardous waste, according to environmental regulators. Officials have also raised concerns that toxic fumes are drifting into neighboring communities and polluted water has been discharged into nearby waterways due to heavy rains.

(link)

From Cal Matters, March 14, 2025:

For more than two years, Assemblymember Pilar Schiavo's constituents have been complaining to her about the stench and fumes they've been breathing since trash buried at the Chiquita Canyon Landfill in Southern California ignited and never stopped burning.

Schiavo, a Democrat representing the Santa Clarita Valley north of Los Angeles, decided to spend the night as a guest of one of the 639-acre landfill's closest neighbors. She wanted to experience for herself what life is like for the hundreds of people who've complained about the noxious fumes since the underground chemical reaction started below the Castaic landfill in May 2022.

It's not known what caused the chemical reaction, but a state official said this week the burn zone had grown underground to an estimated 90 acres. As the landfill belches a stench like rotten milk, residents allege chemical emissions are making them sick. And it could keep burning for years.

When she arrived in Val Verde, it didn't take long before Schiavo got a pounding headache. Her skin felt itchy. When she woke up the following day, she was disturbed to get her first bloody nose in years, she said.

"People are getting sick," Schiavo said in a video diary taken on her phone during her stay last fall. "People are being barricaded in their homes, and not opening windows and doors and not letting kids come out and play on trampolines because they're afraid of breathing the air. … We have to get people out of here and keep them safe."

…

In June, the U.S. EPA also cited the landfill company for violating various regulations intended to safeguard human health. The company is facing potential civil penalties of up to $59,114 for each day of violation.

"EPA cannot comment on ongoing investigations, including assessment of penalties," EPA spokesperson Joshua Alexander said in an email.

(link)

RISKS OF ELEVATED TEMPERATURES OMITTED FROM APPLICANT'S FIRE REPORT
Republic's Fire Report does not mention the risk of a subsurface fire. It does have a section on gas well fires, which are one of the ways in which subsurface fires get started:

7. MFA/LFCI Comment: For Gas Well Fires, LFCI recommends preventive monitoring, including monitoring for CO levels, targeted maximum oxygen concentrations, and balancing gas levels to prevent aerobic decomposition. In addition, the Applicant should provide standard operating procedures for handling high-temperature wells and specify operating temperature thresholds.
   SCS Response: Current procedures or preventive monitoring to detect developing gas well fires in place now, are extraordinarily robust and more than sufficient to detect and prevent gas well fires. First, the site abides by the U.S. EPA's NSPS regulations. These rules prescribe routine monthly monitoring of all gas wells for pressure, temperature, and oxygen. NSPS sets limits for each of those three parameters as a way to detect early on the potential to develop a gas well fire. Second, the landfill's parent Republic Services has a 205-page SOP document specifically for landfill gas management. Several sections in that SOP address the prevention, detection, and mitigation of gas well fires. Coffin Butte Landfill follows that SOP. Third, all Republic Services landfills including Coffin Butte enter all landfill gas monitoring results into an advanced database system for monitoring and managing landfill gas systems. That software is SCSeTools, and it automatically detects any exceedances of the NSPS Standards on gas well fires, and in fact also spots early trends toward a possible gas well fire before actual exceedances occur, so that mitigation measures can be employed early on.

Highlighting mine. The EPA is currently auditing the dump operator to determine whether or not the dump operator is indeed abiding by EPA regulations. Also, as documented elsewhere, the EPA's Air Enforcement Officer for this Region, during an inspection of the landfill, discovered a gas well that was completely uncapped. This would have been introducing a large amount of oxygen into the interior of the landfill. The operator at the time stated that the gas collection system showed normal conditions. It's not known how long the well had been uncapped, but it is clear that the system that is being cited here failed to detect it in any timely way. One thing that's conspicuous by its absence: Republic has not brought forth any monitoring logs showing that the uncapping was a recent event. So it's reasonable to assume that either (a) it was not a recent event, or (b) the software doesn't actually detect events like this, or (c) both.

I'll also note that I have been looking at the dump's monthly monitoring reports for years now, and pressure/temperature are not regularly reported in them.

SUMMARY

Subsurface fires ("exothermic chemical reactions") are a significant fire risk at Coffin Butte Landfill, which has many of the currently known major risk factors. The applicant does not address subsurface fires but rather seems resistant to any question of its current protocols. The onset of a subsurface fire would likely be of severe impact to the surrounding area. A landfill expansion would increase the surface area of the landfill (fire entry points) by about 35%, the intake volume (fire entry point) by 68%, and waste-in-place (ignition source, fuel) by 20%, increasing this undocumented risk. The applicant has not met its Burden of Proof regarding the subsurface fire risks at Coffin Butte Landfill.

Ken Eklund
37340 Moss Rock Drive
Corvallis OR 97330

May 6, 2025

Good evening Chair Fowler and Planning Commissioners. I'm Ken Eklund, I live at Three Seven Three Four Zero Moss Rock Drive in Benton County.

Thank you, Carol, Catherine, Betsy, and David, for gifting me more time to speak.

First, I'll read you testimony about fire hazards on Carol's behalf:

DATE RECEIVED: 05-06-25
FROM: Ken Eklund
PHONE OR EMAIL: futureeverything@writerguy.com

My name is Carol McClelland Fields, and I live at 37326 Soap Creek Rd. About four miles from Coffin Butte Landfill.

I strongly oppose Republic Services' application to expand the landfill. I urge the Planning Commission to deny this application.

Benton County has a number of official initiatives dedicated to **assessing the wildfire risks associated with wildland-urban interface areas and identifying strategies to reduce those risks – most notably,** the Benton County Vision for Wildfire Management and the Community Wildfire Protection Plan. Oregon State Law places a significant focus on Wildland-Urban Interface areas that have "**sufficient fuels (including combustible fuels and infrastructure) to generate a conflagration."**

Unfortunately, there is a Garbage-Truck-Sized Hole in Benton County's vision for managing wildfires. The Community Wildfire Protection Plan inventories the high voltage powerlines in this region, but somehow misses the fact that there's a **methane-belching landfill** in the Northern Forest Area **that has a documented pattern of landfill equipment and working face fires.**

In my written testimony, I have an email transcript that shows that Coffin Butte Landfill was INTENTIONALLY LEFT OUT of the Community Wildfire Protection Plan – because staff didn't understand what the fire risks were.

Benton County cannot afford to make a decision to expand the landfill without a full understanding of the fire risks associated with landfills.

The current landfill is an immense Flammable Target for airborne embers from nearby fires and a Source of airborne embers that will only get bigger if the expansion is approved. The risk and threat of fire cannot be minimized or dismissed. In my written testimony, I provide more details about landfill fires and local fires in the last two years.

Any operations plan for Coffin Butte Landfill put forth by the applicant can't erase the enhanced fire risk in our region.

The flammable, explosive nature of the landfill's gas plumes and the toxic consequences of any fire there creates a dangerous scenario for a devastating, irrevocable change to the character of our area.

A sizable fire at the landfill would put undue burden on fire and emergency management services, and on local and regional residents forced to flee the flames or the plumes of toxic smoke from a landfill fire.

I strongly oppose Republic Services' application to expand the landfill. I urge the Planning Commission to deny this application. Thank you.

That's testimony from Carol McClelland Fields.

Commissioners,

I want to take you back in time, to less than a year ago, when the EPA Air Enforcement Officer for this Region arrived with her team at the dump, to continue the EPA's investigation of Coffin Butte Landfill. She reports: *There's a strong landfill odor. The landfill operators assure me that all systems show normal.*

So now the inspectors walk out onto the landfill at random and find – leak after leak. They are finding a reportable leak once every three minutes on average. For an hour. And then they come across a landfill gas well that's just completely uncapped. It's beyond leaking, it's just venting landfill gas straight into the atmosphere.

How long has that well been uncapped? Unknown, All systems are normal. How many other wells are like this? Unknown. All systems are normal. How much gas is coming out? The Air Enforcement Officer measures it at 12% methane – which is 240 times the limit.

I think our main takeaway here is that the dump operators were correct. Their gas collection system was operating normally. It's normal for Coffin Butte Landfill to have dozens of leaks and at least one that's super-emitting. Every independent survey of the dump shows this. No reason to expect the expansion will be any different.

The volume of these landfill gas emissions drive many serious problems at the dump – most notably: odor, climate damage, toxics pollution and fire. I'm going to talk about the first three of these, but remember, these are like the ~~three~~ heads on the same multi-headed dragon, that dragon being, landfill gas.

Odor. The applicant's odor report uses an "industry standard" to estimate how much landfill gas is leaking out for people to smell. It doesn't use a figure specific to Coffin Butte Landfill. So, needless to say I hope, this odor report is invalid. They're not grounding this study on the volume of gas actually leaking out of the dump, they're using some industry average instead.

For obvious reasons, I would say. In response to community complaints, the EPA inspected the dump in 2022, and found over 60 leaks, four at explosive levels. And then an EPA Air Enforcement team returned in 2024, as I told you; they found 41 leaks, three at explosive levels, plus that uncapped well. EPA Air Enforcement then served an EPA Clean Air Act Section 114 process on the dump in early 2025. These aren't things that happen to your "average" landfill.

The applicant's odor model doesn't account for any of this. It also doesn't account for the landfill expansion's increase in the dump's total surface area, 35% more, which would lead to a proportional increase in gas emissions from leaks, nor the expansion's increase in intake volumes, 68% more, which would likewise lead to a proportional increase in landfill gas generation.

For all these reasons, I suggest the applicant has failed their Burden of Proof for odor.

Likewise for methane pollution. Climate damage. As you know, methane is a pernicious greenhouse gas and as we've seen, Coffin Butte Landfill leaks a lot of it and is going to leak more. Climate damage meets your review criteria in many ways, but I'll focus on one: by reducing the disaster assistance service available to the area.

As you know, climate damage is accelerating the number and severity of disasters nationally, draining disaster response resources. And the people who are losing out are the people in rural areas.

We're seeing this happen already with the LA fires. People in major metro areas get disaster assistance, people outside metro areas don't.

So, the climate damage from landfill gas is increasing the risk of disaster in our area, and by also increasing the incidence of disaster nationally, it's also decreasing our likelihood of getting help when we need it. This disparity will only accelerate as climate shifts get more extreme and disaster funds get exhausted.

Let's move on to toxics damage. When I smell the landfill, what is it that I'm smelling? What's in landfill gas? Too many things even to list, it turns out, some pretty evil stuff, so again I'll focus on just one, one we all know by now: PFAS.

study in Florida – I will get the Commission that reference

Studies show that these "forever chemicals" get airborne and escape the dump in landfill gas. They're not destroyed by burning – they're called "forever" for a reason – so they're coming out of the stack at the power plant, at the flare, and of course out of leaks or gas wells that are left uncapped.

This PFAS is steadily accumulating in the surrounding environment. Which really drags down the character of our area. And torpedoes the idea that the dump will someday export landfill gas into the natural gas system – I mean, no one wants PFAS delivered straight into their home.

Odor, methane, toxics – Republic's burden of proof fails in all of these, and all of them go against the character of the area.

Speaking of "character" – Commissioners, I think the word "character" is being tortured in the application. The application would have you believe there's a "visual character" which is a small area around the landfill. And the "odor character" is 90 square miles. The "methane character" is *we haven't been fined.* And so on. These are all snapshots: they have no past, and no future.

Commissioners, that's no one's idea of "character." Character is one thing, not separate things, and it's built over time, it's not a snapshot. The character of an area is the understanding that people acquire about that area, through all their experiences of it. And it's more than its physical forms. Character is first and foremost a social value. I'm a writer professionally, so I've thought about character A LOT.

By "social value," I mean there are things that are "in character," and things that are not. You bike down Soap Creek Road and you see farms and trees and people's rural houses. There are horses in a pasture. Here's a vineyard. Somebody waves at you, you wave back. You can ride like that for forty miles. That's character.

And when you continue on and see trash piled along the road, you think, *that doesn't belong here*. And when you see a mountain of garbage draped in tattered plastic, you say, *that doesn't belong here either*. And when you're biking through EE Wilson and you smell that chemically smell, you say, *that's wrong. That's out of character.*

Or, rather, you say *I hope that's out of character. We need to do something about these wrong things. We need to have less of them. Or else they will become the new character of this area.* And what Republic is proposing in this expansion application, is not to have less of those wrong things, but more. Roughly 50% percent more, in fact, year by year. And for longer.

Commissioners, you live here. You know the character of this area. Which is why the law has chosen you to make the decisions you do about land, and given you the word "character" to base your decisions on, and the word "discretion" to support what you decide. These are your words, don't let them be tortured. Set them free.

A word about Conditions of Approval. Commissioner Biscoe has expressed that Conditions of Approval on the dump have never been enforced, and you all heard for yourselves that there's no enforcement mechanism in place and none contemplated. I can assure you this is true. I'm speaking now from my experience as past Chair of the county Disposal Site Advisory Committee.

The reality is, Commissioners, you have only a clean decision before you: Approve, or Deny. Nothing in the middle. Anything in the middle continues the status quo, which poses an undue burden upon the community. Anything in the middle is saying that we are the sheriff of this lawless town but with no badge and no gun.

Your criteria enjoin you from Approving an application that imposes an undue burden, so if you feel the application must have Conditions, you should properly and promptly vote Deny.

You know, I ballparked how much it's cost the community to resist Republic's attempts to expand the landfill so far. Volunteers have put in about **one point two** million dollars' worth of time. In case you were wondering how undue that burden has been so far.

Getting close to the end. I have just one more thing. I want to speak up for the land. That 59 acres.

Right now it's a few industrial buildings but mostly wild woods on shady slopes. There's nothing wrong with it. The herons love it. Take away the open trash heaps which bring too many eagles, and our "species of concern" will be back in their rookeries raising chicks.

It just seems incredible to me that because a company would like to despoil this bit of land for their profit, that such a thing could happen. I kinda thought we were past the days of robber barons and strip-mining.

It just seems incredible to me that someone can look at this piece of land and say, "you know what your community needs? For us to dig a 150-foot deep hole here and fill it with other people's garbage until it's higher than the hills." Which is what it will be, and how it will be, permanently. Forever and ever, amen.

Of course, we are past the days of robber barons and strip-mining. We have two things now that weren't present then. One, we have the knowledge of how these things turn out. We can remember. There is no Peabody Coal Company anymore, once it was huge. The only thing left of it now are the folk songs about how it "tortured the timber and ruined the land."

The other thing we have now is, we have a Planning Commission. People from here who can look at the evidence and decide what's truly best for our community. Who can do what's best for the land. Who can listen to what the land says about character.

Thank you for your attention. Deny this application. I'm happy to answer any questions.

From: Zac Fierro - Thompson Sanitary Service
To: Benton Public Comment
Subject: Testimony for landfill
Date: Tuesday, May 6, 2025 1:59:48 PM
Attachments: image001.png

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Commissioners,

> My name is Zac Fierro and I am an employee of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact my customers. I encourage you to grant Republic's application for expansion due to DEQ having environmental oversight regarding the operations at Coffin Butte, so the landfill is already very highly regulated, which greatly limits any environmental impacts. Also, Republic has done an excellent job managing the landfill and increased collection rates will have a significant impact to small businesses/ residential in my community. Please consider keeping Republic and Coffin Butte landfill our number one priority for landfilling.

Thank you for your attention and I strongly encourage you to vote to expand,
Zac

Zac Fierro
Transfer Station & Shop Manager
Thompson's Sanitary Service, Inc.
7450 NE Avery | PO Box 643 | Newport, OR 97365
Phone: 541.265.7249 | Fax 541-265-3034

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From:	Emily Finnan
To:	Benton Public Comment
Subject:	Opposition to Republic Services expansion of Coffin Butte
Date:	Tuesday, May 6, 2025 6:23:26 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hello,
I am writing in opposition to Republic Services application to expand Coffin Butte.

The landfill is more than adequate for the waste of Benton County residents. It doesn't seem right that 90% of the trash (including more than half of Marion County's municipal waste!) hauled to Coffin Butte comes from counties other than Benton County. 50 years ago the landfill was created for 5 counties. My understanding is it now takes garbage from SW Washington and 2 dozen counties. Perhaps Republic Services should build dumps in those counties - why would Benton County bear the brunt of others garbage? The fact that more waste equals more revenue for Republic Services is troubling for those of us in the area bearing the environmental and ecological impacts of that waste.

With the known harm of PFAs and methane I don't want any more garbage coming into Benton County's dump than is absolutely necessary. The 2022 EPA inspection reported 21 readings of methane concentrations exceeding 10,000 (!) parts per million. The federal limit for this is 500 parts per million. Republic Services has not shown adequate concern or action in addressing the methane and leachates at the landfill.

Lastly, Republic Services has not been a partner in good faith, as evidenced by the EPA report, them leaving things out of their annual report, and not being upfront about charges when people bring items to the landfill. Coupled with low enforcement and monitoring of land use and environmental factors by Benton County, DEQ and EPA, any new permits given to Republic Services have a high chance of not following the law or being a good neighbor. When someone tells you who they are, believe them! Republic Services continues to stonewall and obfuscate information and doesn't take enough (any) responsibility for environmental shortcomings at Coffin Butte under their watch. It's also concerning that the franchise agreement gives the county $1 million more per year if the landfill expansion is approved by 2024. Of course the county would want that money and the promise of these funds may sway the county's decision.

The Coffin Butte expansion is NOT necessary at this time and I urge you to vote no.

Emily Finnan
Benton County resident



DATE RECEIVED: 050625
FROM: Joel Geier
PHONE OR EMAIL: clearwater@peak.org

Topics

Impacts of the construction period

Risks to wells and springs

Risk for the new landfill as an additional source of arsenic

Risk to the Willamette basin aquifer

Ongoing disturbance to Great Blue Heron nesting colony

(to accompany testimony by Joel Geier, May 6, 2025)

Planned excavations: Impacts not evaluated



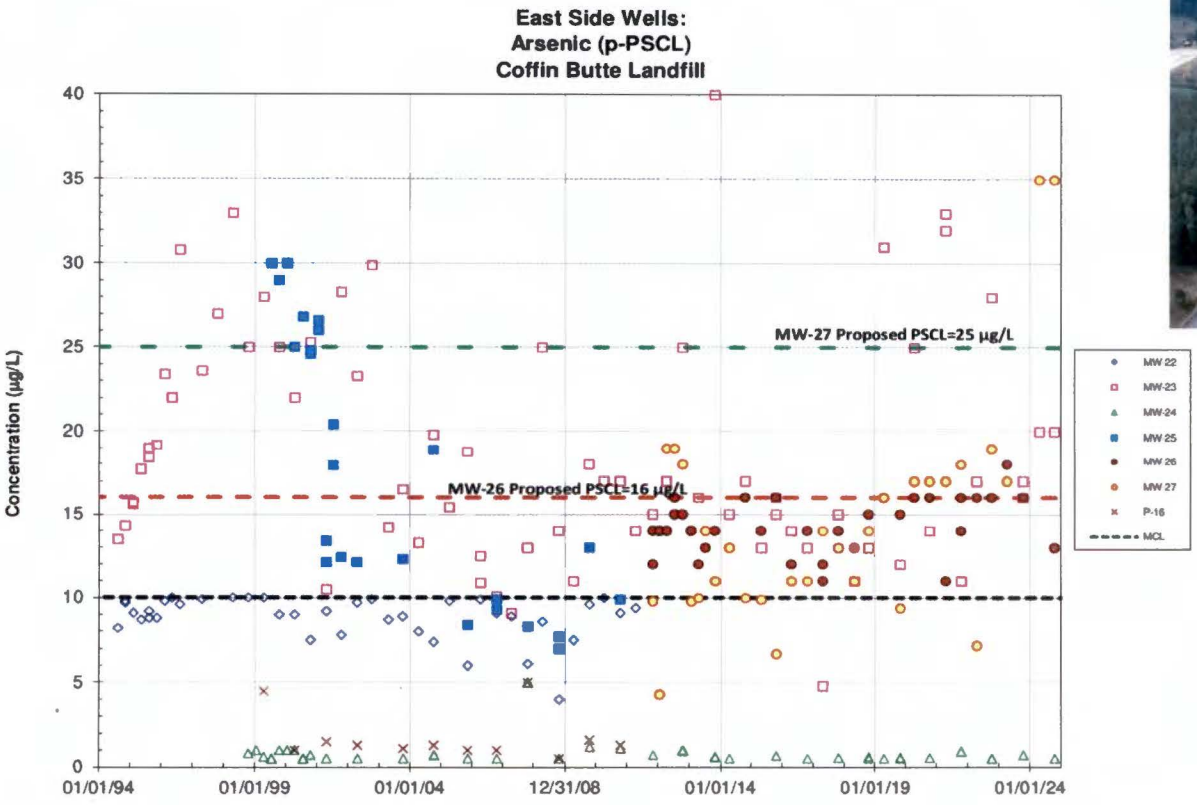


3.5 million cubic yards:
1.4 times more rubble than from the Seattle Kingdome implosion.

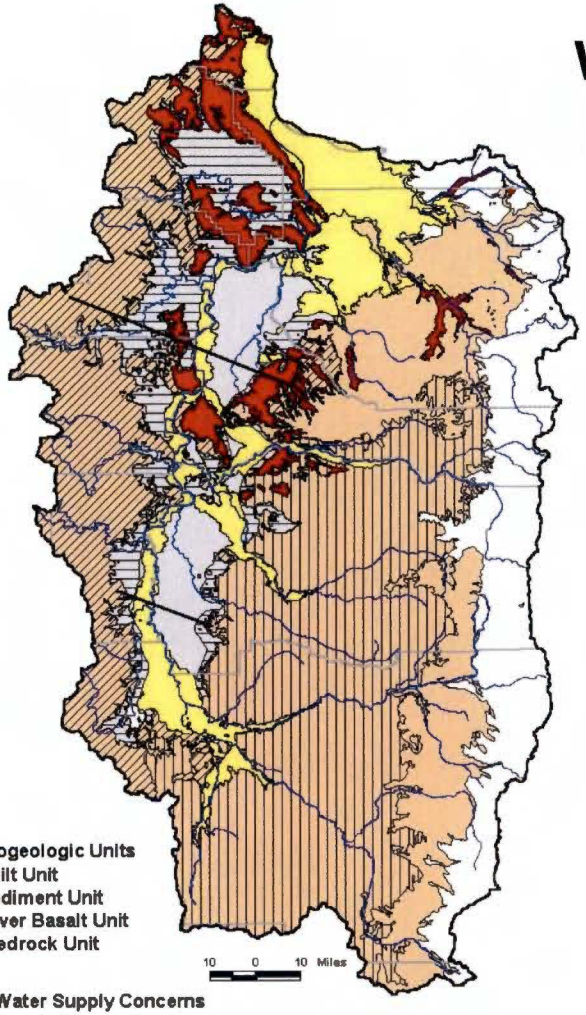
Arsenic Concentrations
East-side wells 1994-**2024**

Data from 2024 Annual Environmental Monitoring Report

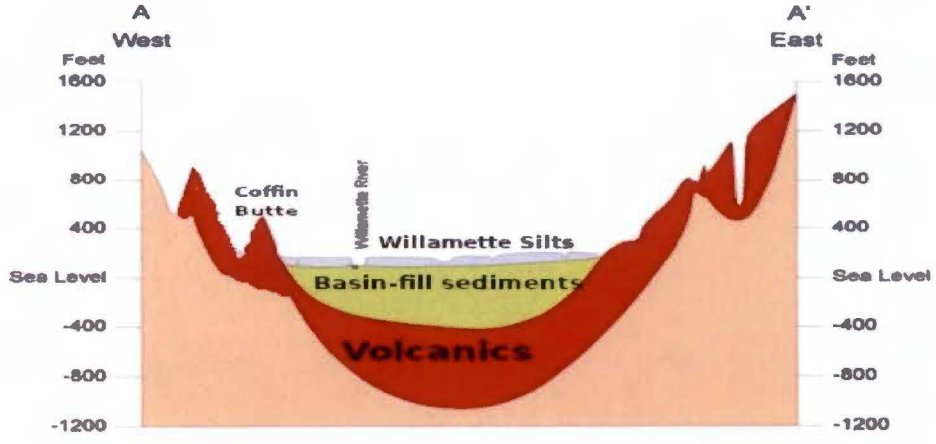




Willamette Valley basin-fill aquifer







Adapted from: *Ground Water Supplies in the Willamette Basin,* Oregon Dept. of Water Resources

Heron colony: Not abandoned yet!



Excavation activity on March 14, 2025 within 200 yards of the nesting area in the poplars (“east rookery”).



April 2025: Herons nesting approx. 200 yards east of the “east rookery” after disturbances on adjacent lot in 2022, 2023, 2024, and ongoing in 2025.



Herons still on nests May 4, 2025

#36

Testimony for Coffin Butte Landfill CUP Meetings 4/29/2025, 5/2/2025 and 5/6/2025.

Good evening, I'm Bill Gellatly, a ten-year resident of Corvallis, a retired engineering manager with over 45 years in high tech.

I am focused on the impact of microplastics in the landfill. and will shed technical light on PFAS. They are a class of fluorinated carbon molecules now better known as "forever chemicals." That name is a direct reference to the fact that Fluorine and Carbon create the strongest bond in the world of chemistry.

The best known of these chemicals are Teflon and Gore-Tex. Since 1938, more than 4,000 compounds have been created that contain PFAS. We recognize their properties for non-stick pans, for stain resistance in carpets and upholstery, and for great rain gear.

They are also important in the manufacture of integrated circuits and microprocessors. They play a crucial role in the photolithography process, in which intricate patterns are etched onto silicon wafers.

Those benefits to not come without drawbacks

The reason we should ALL be aware of PFAS is that they are very difficult to remove from wastewater AND that they do not break down to any inert form in the landfills, to say nothing of adding greatly to the need for process water in virtually all applications. PFAS are three to four orders of magnitude smaller than most microplastics and as a result, they are now being identified in the circulatory systems of human and animal populations.

Much has already been published about the use of PFAS for lotions and makeup. The CDC's Agency for Toxic Substances and Disease Registry states "PFAS contamination has the potential to affect growth, learning, and behavior of infants and older children" and goes on to say "PFAS Contamination could lower a woman's chance of getting pregnant, and could increase the risk of cancer." These two statements are very softly worded as has been a notable trend for the last 20 or more years of EPA guidelines that science suggests should be regulations.

Thanks to a FOIA request from March of 2023, we now know that 2022 test data from the City of Corvallis waste-water treatment plant shows that Coffin Butte leachate being received contains five or more variants of PFAS that far exceed the amounts in water received by Hillsboro or McMinnville treatment plants. This begs the question of why and when the City of Corvallis decided to stop accepting landfill leachate. Return of treatment water with residual PFAS is a risk to fish and all subsequent downstream users.

For these reasons and more, I am adamantly OPPOSED to Expansion of the Coffin Butte Landfill.

Respectfully submitted,

Bill Gellatly BILL GELLATLY

2923 NW 13th Place
Corvallis OR 97330

DATE RECEIVED: 5-6-25
FROM: Bill Gellatly
PHONE OR EMAIL: 503-867-6514 bjg

DATE RECEIVED: 5/6/25
FROM: Mark Henkels
PHONE OR EMAIL:

Deborah Wolf, who was registered for this time slot, could not make it tonight. Deborah ceded me her time. I am Mark Henkels, Benton County resident and former professor of Public Policy and Administration at Western Oregon University. I am combining Deborah's time with my later reserved time. Recognizing the volume of public comments, I will keep mine to four minutes.

Testimony in Opposition to Coffin Butte Landfill Expansion: Application file number: LU-24-027

Mark Henkels

Revised May 6, 2025

First, let me say that I appreciate your diligence to this review task. You clearly recognize that this decision will affect Benton County residents for many, many decades.

I helped research and write the context and history section of the Benton County Talks Trash document. I originally planned to emphasize how the BCTT makes clear that residents and experts have recognized for over fifty years that Coffin Butte is not suitable as a permanent landfill site. Even the "Chemeketa Agreement" making Coffin Butte a "regional landfill" envisioned it would close by the year 2000 and that only wastes from specific areas of Polk, Benton, and Linn County would go there. Coffin Butte was never considered ideal, and the idea of unlimited wastes being deposited defies all historical perspectives.

But these hearings have made me focus on three other specific points. First, as members of the Planning Commission have suggested, we need to think broadly when considering the area affected by the dump, especially regarding how the proposed use affects the character of the area. I live seven miles away and on the other side of Logsden Ridge, but still sometimes can smell the facility. I also drive up the Independence Road and Highway 99 very frequently and am appalled by the

litter from landfill traffic. I have seen papers float out of Republic Trucks driving on 99W.

The "character" of the area also requires more attention. On April 29th, the Planning Department said that they did not consider the expansion's visual impact a problem since there is a landfill there already. The landfill's visibility and noise have changed greatly since the cap rose over 1 million tons and as the mountain grew larger, truly harming the experience of visitors to E.E. Wilson and anyone driving by or living in the area. Still, the area has many lovely characteristics that a second mountain of trash and the extension and increase of industrial activities will destroy. This area provides highly valuable agricultural, recreational, and wildlife resources. Expansion, and the lifting of annual waste limits, guarantee that the quality of this area will be harmed and more deeply threatened for decades more.

Finally, Benton County should not rely on any added "conditions of approval" to mitigate problems and risks. Conditions of Approval are unlikely to be consistently enforced and probably would not address the deeper problems and risks anyway.

Consider how the methane leaks found by the EPA and state environmental inspectors just recently far exceeded Republic Services's self-reported leaks. No government bodies consistently monitor and enforce landfill regulations, and we should not rely on Republic Services or its contractors for this reporting. The expansion will open large surfaces above and below the wastes for all time. Leaks in the linings will create health, fire, hydrological, and climate change risks.

As noted in my written submission, a USGS publication notes that the EPA has concluded that all landfills eventually will leak into the environment.(https://pubs.usgs.gov/fs/fs-040-03/pdf/fs-040-03.pdf).

Even the existing operation violates the character of the area and the environmental values stated in our County codes. It's time to set limits.

Thank you for your attention.

From: Rick Hernandez
To: Benton Public Comment
Subject: Republic"s Application
Date: Tuesday, May 6, 2025 1:40:03 PM
Attachments: image001.png

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Enrique Hernandez
633 NE Fogarty St Newport Or
5/6/2025

Commissioners,

My name is Enrique Hernandez, and I am an employee of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact my customers. I encourage you to grant Republic's application for expansion. Below are some of the reasons I support the expansion:

Choose some of these, or expand on them if you wish…

- The landfill is an essential resource in our ability to be responsible for our own waste
- Hauling the waste to a landfill further away doesn't fix the problem, it just makes people in another part of Oregon deal with our trash
- The trash we are talking about is our trash. It's yours, its mine, it's all of ours together, and we should be the ones to deal with it responsibly
- Republic has done an excellent job managing the landfill
- DEQ has environmental oversight regarding the operations at Coffin Butte, so the landfill is already very highly regulated, which greatly limits any environmental impacts
- Closing the landfill is not a way to responsibly manage our waste stream. We should deal with our own trash in the right way, and Republic is doing that
- Collection customers will bear the burden of increased prices to cover increased hauling costs
- Increased collection rates will have a significant impact on small businesses in my community
- Hauling trash to another part of Oregon increases greenhouse gas output from the trucks that haul it, which pollutes the environment we are trying to protect
- "Not in my backyard" is not an acceptable solution to managing the waste stream

Thank you for your attention. I strongly encourage you to vote to expand.

Enrique Hernandez

Rick Hernandez
Collections Supervisor
Safety Coordinator
Thompson's Sanitary Service, Inc.
7450 NE Avery | PO Box 643 | Newport, OR 97365

Phone: 541.265.7249 | Fax 541-265-3034

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From:	Community Development, Benton County, Oregon
To:	Benton Public Comment
Subject:	LU-24-027 Coffin Butte Proposed Expansion Written Feedback
Date:	Tuesday, May 6, 2025 4:02:05 PM

Subject of Testimony: Please Deny Coffin Butte Landfill Expansion

Full Name: Holly Higgins

Email: hollyagneshiggins@gmail.com

Street Address: 4702 SW Birdsong Drive, Corvallis, 97333

Written Testimony:

Dear Planning Commission,

Thank you for all you do to serve the citizens of Benton County. Thank you as well for taking the time to read my comments. Please deny Republic Services' request to expand the Coffin Butte landfill. I am very concerned about leachate, methane emissions, noise and odor. I'm also very concerned about Republic Services' character and trustworthiness. The fact that Brian Rupe, Republic Services VP for the Northwest area, implied that since only a small percentage of people have spoken out against the expansion means that the rest of Benton County is okay with it is uninformed at best and deceptive at worst. If Republic Services had conducted a survey asking Benton County residents for their opinion on the expansion, then Mr. Rupe's comments might have some merit. I've never received such a survey. In fact, every person I've spoken with about the expansion either didn't know about it or if they did, was strongly against it.

Most people never submit public comments, even about issues that really concern them. If Republic Services is this uninformed or deceptive, how can we trust them to be stewards for our county?

Thank you again for reading my comments.
Sincerely,
Holly Higgins
4702 SW Birdsong Drive
Corvallis, OR 97333

--
This is a notification that a contact form was submitted on your website (Community Development, Benton County, Oregon https://cd.bentoncountyor.gov).
Submitter's IP Address: 71.236.246.240

From: Community Development, Benton County, Oregon
To: Benton Public Comment
Subject: LU-24-027 Coffin Butte Proposed Expansion Written Feedback
Date: Tuesday, May 6, 2025 3:31:41 PM

Subject of Testimony: Coffin Butte Landfill

Full Name: Joseph Jaracz

Email: jpj49919@gmail.com

Street Address: 305 Northeast 36th Street

Written Testimony:

Joseph Jaracz
305 NE 36th St.
Newport, Or.
5/6/2025

Commissioners,

My name is Joseph Jaracz and I am an employee of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact customers. I encourage you to grant Republic's application for expansion. Below are some of the reasons I support the expansion:

The landfill is an essential resource in our ability to be responsible for our own waste.
DEQ has environmental oversight regarding the operations at Coffin Butte, so the landfill is already very highly regulated, which greatly limits any environmental impacts.
Republic has done an excellent job managing the landfill.
Collection customers will bear the burden of increased prices to cover increased hauling costs.
Increased collection rates will have a significant impact on small businesses in my community.

Thank You for your attention. I strongly encourage you to vote to expand.

Joseph Jaracz

--
This is a notification that a contact form was submitted on your website (Community Development, Benton County, Oregon https://cd.bentoncountyor.gov).
Submitter's IP Address: 35.149.178.147

From: Kevin Kenaga
To: Benton Public Comment
Subject: OPPOSE LU-24-027
Date: Tuesday, May 6, 2025 4:10:07 PM

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Testimony

>
>

LU-24-027 Testimony

For the record
Kevin Kenaga
37461 Soap Creek Rd.
North Benton County
Corvallis, Oregon 97330

Good evening Chair Fowler and members of the planning commission.
Thank you for your volunteer service on this Planning Commission

I oppose LU-24-027 and any expansion of the Coffin Butte Landfill due to the increasing changes to the character of the area and the increasing undue burden placed on Benton County and Planet Earth largely because of Republic Services mismanagement.

Deck 1 images show the 7 days that satellite data are available for the last five years, Republic Services was out of compliance on 6 of the 7 days for an 86% noncompliance rate.
By exceeding the agreed upon exposed area Republic Services can take in more trash because they have a larger working area for the tippers and trucks to dump trash. Basically a corporation putting profits over people and Planet Earth. The larger exposed area releases more methane into our environment along with odors and toxins.

Please move to deck two
Deck 2 photo 1) shows birds scavenging on landfill, photo 2) shows tarps as an alternative daily cover on only 1/2 the working face, photo 3) shows alternative daily cover completely lacking on the working face 4) shows newly installed enclosed flare. Methane oxidation in landfills is a natural process where methane gas, a byproduct of decomposition, is converted into carbon dioxide and water by bacteria within the landfill cover soil. That is if soil is used as a daily cover. Federal rules require 6” of soil as daily cover but Oregon DEQ has issued Republic Services an alternative daily cover permit which is why we see tarps in the photos. Tarps do not have the same effect as 6” of daily soil yet DEQ issued this permit. Alternative daily cover doesn’t trigger methane oxidation therefore Republic Services operating under this permit is putting an additional undue burden on Benton County and Planet Earth.

Our concerns also extend to the use of Covanta/Reworld incinerator ash that had previously been used as Alternative Daily cover. The 2024 publication in the journal, Environmental Monitoring and Assessment, was submitted in written testimony. It documents signature heavy metal contaminants found in the moss around the

Covanta/Reworld incinerator. The researchers are working towards publication of the companion study focused on Coffin Butte Landfill sometime this year.

You have heard that there has never ever been any enforcement of prior conditions of approval at Coffin Butte Landfill, you also heard Petra Schuetz state that Benton County has no staff to enforce conditions of approval . So any conditions of approval just as in the past would mean nothing. The situation with Oregon DEQ is very similar. DEQ does one annual inspection at Coffin Butte Landfill. DEQ makes an appointment to visit the Landfill. Republic Services gets the dump all cleaned up for the inspection. These visits are like realtor open houses.

Having called DEQ several times over the years I have never been able to get them to make an unannounced site visit. On one occasion I sent numerous photos covering a period of several months showing that daily cover and/or alternative daily cover was minimal or nonexistent. DEQ then received one photo from Republic Services showing that daily cover had been applied on one yes just one day. DEQ then considered the case closed without any penalty imposed. So much for any DEQ enforcement.
Republic Services could quickly double the life expectancy of the existing landfill space by simply returning to pre 2017 annual tonnage. But no this corporation is putting money over people and our planet earth. If Republic Services did reduce the annual tonnage they would lessen the change to the character of the area and also would be reducing the existing undue burden on Benton County. Having one blighted slope has already changed the character of the area. And now with this expansion request Republic Services is asking to blight yet another slope which would further degrade the character of the Soap Creek Valley area while continuing to place an undue burden on Benton County. This is an unacceptable request.

Prior to Republic Services ownership of the Coffin Butte Landfill an expansion application was proposed in the 1980s and was shot down by Benton County residents. An expansion application submitted in the 1990s was denied. Then under the ownership of Republic Services an application was submitted in 2021 and in 2022 that application was unanimously denied by the Benton County planning commission. These landfill expansion applications have become a generational issue and we need to make sure future generations don't have to go through this undue burden.
This application and the 2021 application have put an undue burden on Benton County, Benton County staff, (there appears to be a complete turnover in the Planning Department largely due to the 2021 application) and the residents of Benton County. County Council Vance Croney being absent or possibly removed from participation in this application process raises questions and concerns about his involvement in the past expansion application processes.

Lastly with all the health concerns associated with landfills. it is very disturbing that our Benton County health department has been allowed to decline from making any testimony. How can this be, when landfills are known to create an undue burden on our environment and our health.

I ask you our planning commission to deny this application and also do whatever is possible to ensure that this is the last expansion application Benton County ever has to consider.

I thank you for the time to give oral testimony.

RECEIVED
MAY 08 2025
By

VLI DAILY WORK AREA OF EXPOSED REFUSE

These 7 images show the situation for all of the dates in the past 5 years for which Google Earth has satellite images available.

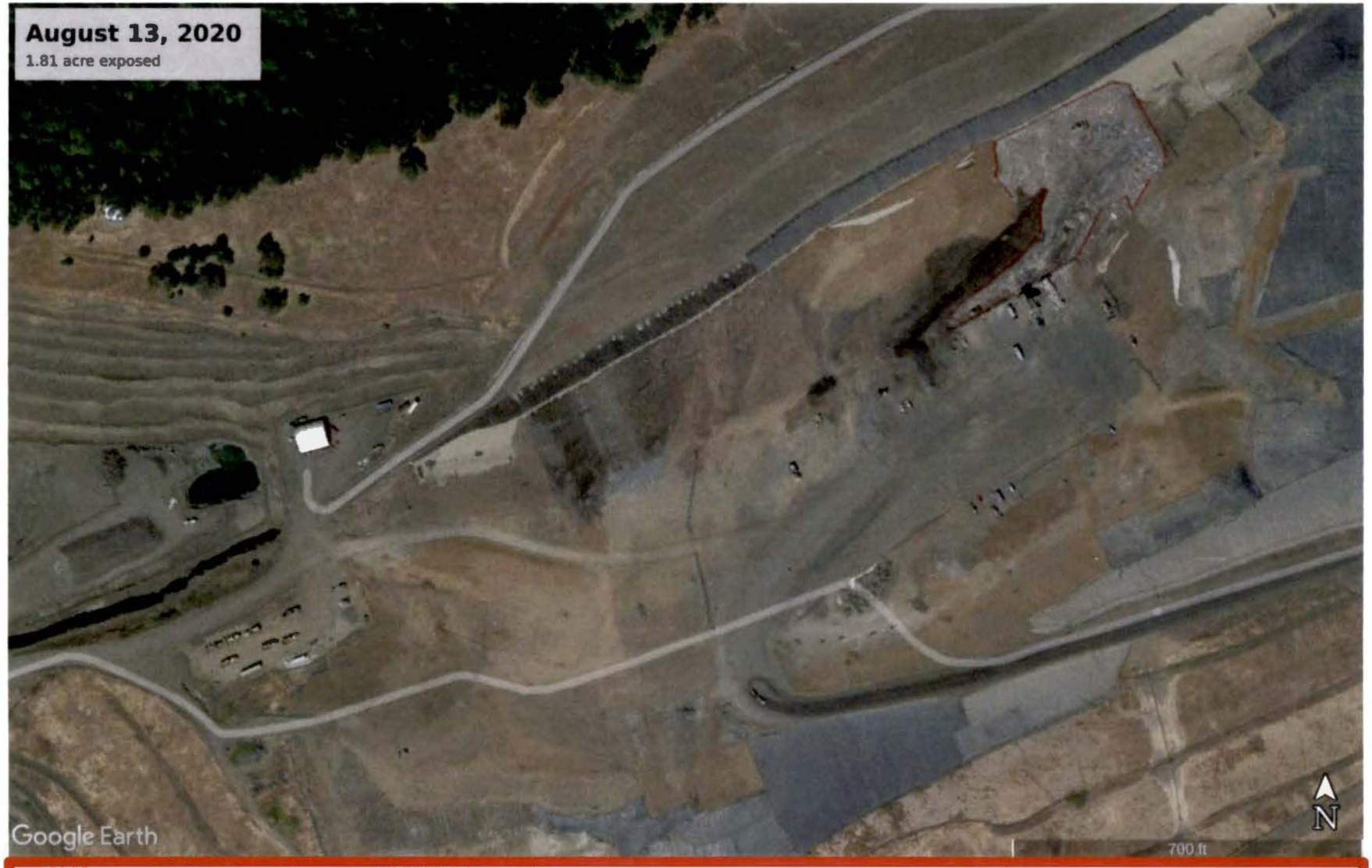
2020-08-13 1.81 acres exposed (out of compliance)
2022-06-22 1.23 acres exposed (out of compliance)
2022-07-14 2.1 acres exposed (out of compliance)
2023-04-29 1.00 acre exposed (in compliance)
2024-04-19 2.59 acres exposed (out of compliance)
2024-07-02 1.04 acres exposed (out of compliance)
2025-03-26 2.26 acres exposed (out of compliance)

DATE RECEIVED: 5/6/25
FROM: Kevin Kenaga
PHONE OR EMAIL: kjkenaga@gmail.com
testimony
#63

Compliance area based on from BCTT p. 792:

"The current (and future) permit addresses requiring daily compaction of refuse and require exposed refuse areas to not exceed 2 acres during the periods of October 15 to June 1 and to not exceed ¾ of an acre during all other periods. This shall be adhere to."

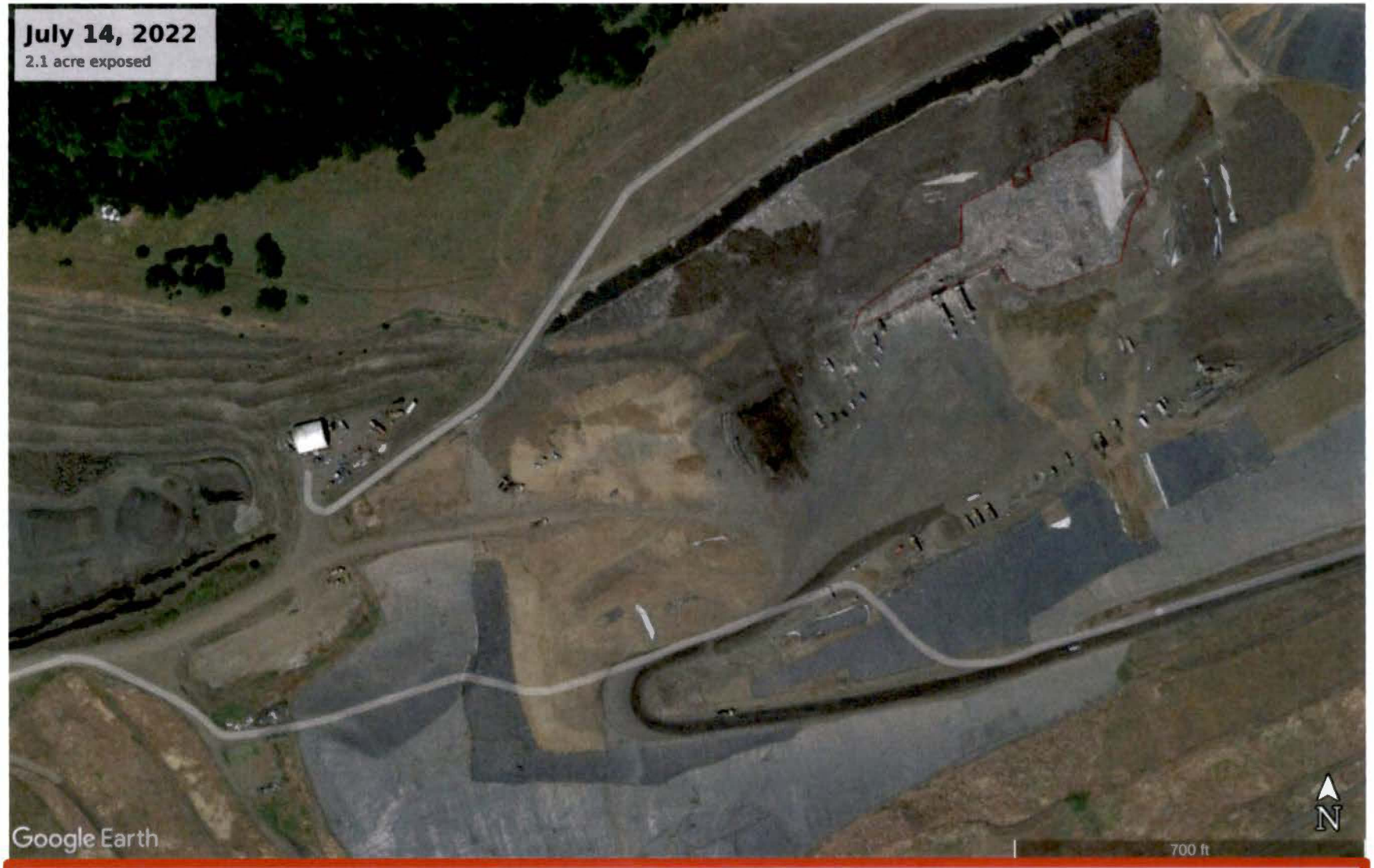
Out of 7 days for which satellite data are available from the past 5 years, VLI was out of compliance on 6 out of 7 for an 86% noncompliance rate.



Out of Compliance: 1.81 acres exposed. Maximum ¾ acre allowed during this period.



Out of Compliance: 1.23 acres exposed. Maximum ¾ acre allowed during this period.



Out of Compliance: 2.1 acres exposed. Maximum ¾ acre allowed during this period.



In Compliance: 1.0 acre exposed. Maximum 2 acres allowed during this period.



Out of Compliance: 2.59 acres exposed. Maximum 2 acres allowed during this period



Out of Compliance: 1.04 acres exposed. Maximum ¾ acre allowed during this period



Out of Compliance: 2.26 acre exposed. Maximum 2 acres allowed during this period.



When viewing this photo consider the Mid-Valley Bird Alliance testimony regarding the undue burden the landfill creates on wildlife. Also consider the testimony of Republic Services wildlife consultant on how the concentration of eagles preyed on the Great Blue Heron rookery. CORRECTION: Date should be 01/22/2023.



Alternative Daily Cover lacking on over half of the working face.

CORRECTION: Date should be 01/15/2023



Alternative Daily Cover completely lacking on the working face.

CORRECTION: Date should be 12/25/2022.



The newly installed enclosed flare at Coffin Butte Landfill power generation facility

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DATE RECEIVED: 05-06-25
FROM: Jeff Kleinman
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May 5, 2025

MEMORANDUM OF VALLEY NEIGHBORS FOR ENVIRONMENTAL QUALITY AND SAFETY

TO: Benton County Planning Commission

FROM: Jeffrey L. Kleinman

RE: File No. LU-24-027 (Republic Services/Valley Landfills Inc.)

I. INTRODUCTION

I represent Valley Neighbors for Environmental Quality and Safety ("Valley Neighbors") in this proceeding. Valley Neighbors comprises a large group of property owners and residents in the area surrounding the proposed landfill expansion site, including but not limited to the Soap Creek Valley and Tampico community. The members of Valley Neighbors will be directly and adversely affected by the proposed expansion.

The comments presented here summarize some of the legal obstacles to approval of this application which the applicant has failed to overcome. A number of the members of the affected community who will testify orally, in writing, or both, have the professional and personal expertise to flesh out the issues in detail. Some will be filing (or attempting to file)

media which we strongly encourage you to view, as county rules apparently do not allow them to be played or displayed during hearings.[1]

For all the reasons set out below and those to be adduced on the record of this proceeding, the applicant has not come close to meeting its burden of proof under the county's approval criteria. Simply stated, this application must be denied.

II. GENERAL COMMENTS REGARDING STAFF REPORT; ADDITIONAL CONSIDERATIONS

Valley Neighbors offer the following comments:

1. What is the applicant's rush? It has just converted the Knife River quarry site on its property to the west of its existing operation to landfill use. The applicant has 12-14 years of capacity at that location.

2. The staff report reflects a diligent effort, with excellent graphics, and a clear understanding of the issues facing the county. Valley Neighbors agree with its ultimate conclusion that this application must be denied.

3. At the same time, staff did not have the benefit of the written and oral testimony of Valley Neighbors and others, which reinforces the grounds for denial and adds others with a similar degree of importance.

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[1]Media containing video and audio are essential to forming an understanding of the impacts of this proposal. Staff has indicated then any media submissions such as thumb drives will be discarded. For the record, Valley Neighbors object to this "rule" and procedure, as they interfere with the substantial rights of parties to present their case. Such materials are necessary to understand the impacts of the proposal before you.

4. It is not just the southward movement of Republic's operation that will cause the increased, adverse impacts in question. Rather, that movement will serve to sustain a dump operation which would otherwise be greatly constrained in scope. Thus, this proposal cannot be characterized as one for a preexisting use, inherently accepted as part of the character of the area. The character of the area entails a large operating landfill north of Coffin Butte Road that is close to shutting down. Its past role in establishing the character of the area cannot be "grandfathered" into the present time, much less the future. To the extent that you may be advised to the contrary, we strongly (but respectfully) disagree. The application must be treated as one for a brand new landfill, because that is precisely what it is.

5. The county can impose as many conditions of approval as it wishes. Unfortunately, the applicant's existing operation has a solid track record of noncompliance with conditions, and the county has a solid track record of failing to enforce conditions.

6. Valley Neighbors have two initial comments concerning the work product of Benton County Talks Trash (BCTT):

(a) Just to be clear, BCTT's report was "accepted"–deemed received–by the county's board of commissioners. It was not *adopted*, much less in a manner which would make BCTT's proposed interpretations of the Benton County Development Code binding upon you, or upon the board itself in any appeal hearing.

(b) The legal subcommittee of BCTT, which recommended certain of those interpretations, included four attorneys. Three of those attorneys were not neutral participants, but have consistently favored landfill expansion. Two work for Republic, its in-house attorney, Holly Doyle, and its local counsel, Mr. Condit. The other is the county counsel, Mr. Croney.

7. If you are inclined to be persuaded that approval of this application would not result in "serious interference," please picture yourselves as homeowners or farmers at or near the expansion site. We can nearly guarantee that you would find that the proposed operation seriously interferes with your use and enjoyment of your property, as well as with the character of the area. Under no circumstances would you move to or wish to live anywhere near it, regardless of depressed property prices. You will hear testimony that the prospect of an expansion causes potential buyers to back out of home and farm purchases in the area. Being unable to sell your property comprises "serious interference."

III. CONDITIONAL USE APPROVAL STANDARDS-BCC 53.215

The general Conditional Use approval criteria provide:

> **53.215 Criteria.** The decision to approve a conditional use permit shall be based on findings that:
>
> (1) The proposed use does not seriously interfere with uses on adjacent property, with the character of the area, or with the purpose of the zone;
>
> (2) The proposed use does not impose an undue burden on any public improvements, facilities, utilities, or services available to the area; and

(3) The proposed use complies with any additional criteria which may be required for the specific use by this code.

A. WHAT IS THE MEANING OF "SERIOUSLY INTERFERE" UNDER BCC 53.215(1)?

This is discussed at pages 18-19 of the staff report. Valley Neighbors agree at least in part with the interpretation propounded there, especially that the proposed use causes "more than an inconvenience or irritation but is a lesser threshold than rendering the uses on adjacent property impossible." *Id.* at 19. Of course, little short of an armed attack would render such uses impossible, so it is important to find a way to draw the line.

The following discussion is a bit lengthy, but reflects our best effort to get there.

For words not otherwise defined in the Code, LUBA and the Oregon courts look to their plain meaning, quite specifically as set out in *Webster's Third New International Dictionary* (unabridged ed 2002). Webster's defines "seriously" as "in a serious manner or vein : to a serious extent * *." *Webster's Third New Int'l Dictionary*, 2073. In turn, "serious" has several definitions depending upon the context in which it is used. The applicable ones are these:

> 4a : IMPORTANT, SIGNIFICANT * * *
>
> **c. : such as to cause considerable distress, anxiety, or inconvenience**
> * * *

Id. (Emphasis added.)

LUBA has discussed the meaning of "significant" in the related context of statutory conditional uses in farm and forest zones. Those uses are subject to the requirements of the "significant impacts" test set out in ORS 215.296(1):

> (1) A use allowed under ORS 215.213 (2) or (11) or 215.283 (2) or (4) may be approved only where the local governing body or its designee finds that the use will not:
>
> (a) Force a **significant** change in accepted farm or forest practices on surrounding lands devoted to farm or forest use; or
>
> (b) **Significantly** increase the cost of accepted farm or forest practices on surrounding lands devoted to farm or forest use.

(Emphasis added.)

In *Stop the Dump Coalition v. Yamhill County* ("*SDC*"), 72 Or LUBA 341, 359 (2015), another case dealing with the proposed expansion of a landfill, LUBA examined the meaning of "significant":

> Because the term "significant" is undefined, and of common usage, it is permissible to consult dictionary definitions. The most pertinent definition of "significant" in Webster's Third New International Dictionary (2002), 2116, appears to be "3 a : **having or likely to have influence or effect : deserving to be considered**[.]" Because ORS 215.296(1) is framed in the negative (the applicant must demonstrate that the proposed use "will not" force a significant change, etc.), it seems appropriate to consider related antonyms such as the term **"insignificant," which Webster's defines in relevant part as "e : of little size or importance**[.]" *Id.* at 1169.

(Emphasis added.)

The above discussion sets out the most accurate and appropriate definition for the Planning Commission to apply. In summary, "SERIOUSLY"=TO A SERIOUS EXTENT. "SERIOUS"=SIGNIFICANT=LIKELY TO HAVE INFLUENCE OR EFFECT : DESERVING TO BE CONSIDERED=NOT OF LITTLE SIZE OR IMPORTANCE.

Regardless of the definition or interpretation of "seriously interfere with," the evidence will be replete with sufficient evidence to show that the applicant has not met its burden of proving the absence of serious interference with "uses on adjacent property, with the character of the area, or with the purpose of the zone." At the same time, it would be a disservice to both the community and the Development Code to artificially constrain the effect of this approval standard.

B. INTERFERENCE WITH USES ON ADJACENT PROPERTY

One can assume for the sake of argument that, as staff states, "adjacent property" includes the adjacent and nearby properties mapped on page 20 of the staff report. It would be nothing short of bizarre for conditional use criteria to be concerned only with directly abutting properties, especially in light of the size, scale, and diverse intense impacts of the use proposed here. At the same time, properties as to which serious interference can be demonstrated should be included within the definition of adjacent property, in order to give effect to the purpose and intent of the conditional use criteria.

The staff report discusses adjacent properties in the Exclusive Farm Use zoning district. Blowing waste, especially plastics, and the attraction of gulls to the landfill who then

root around in and uproot newly planted crops, were found to be a significant impact in SDC. As just one example of such impact, if every speck of plastic is not assiduously removed by a hay farmer, and any amount of it is picked up by their harvesting equipment and thus mixed into the harvested hay, it will render the crop unsaleable. It also takes very little plastic to knock the farmer's equipment out of commission.[2]

Further, owners and residents of adjacent properties will provide evidence of the impacts they would endure under this proposal, especially as the landfill comes ever closer to them and gets much larger–and the more methane is emitted and the more leachate is generated. The impacts include truly intrusive and disruptive noise and odor impacts, and wind-blown garbage which will require constant clean up by property owners. These are impacts which neither the members of the Planning Commission nor attorneys, consultants,

---

[2]Note that BCC 60.220, discussed later in the staff report, addresses this issue directly:

> **"60.220 Conditional Use Criteria.**
>
> (1) A use allowed under BCC 60.205 or 60.215 may be approved only upon findings that the use:
>
> > (a) Will not force a significant change in, or significantly increase the cost of, accepted farming or forest practices on agriculture or forest lands * * *."

LUBA's holding in SDC is directly applicable to the Planning Commission's analysis under this provision.

county staffers, or BCTT participants would abide for even a single day. When you get right down to it, this is the reality of "talking trash."

Noise

Dump operations are proposed to be conducted from 5:00 AM to 5:00 PM, Monday through Saturday and noon to 5:00 PM on Sunday. (However, movement of heavy equipment regularly starts by 4:00 A.M., to prepare the fill for the arrival of trash.) It would be difficult to overstate the extent to which landfill-related noises will "seriously interfere with uses on adjacent property." Hundreds of heavy diesel trucks hauling waste to the site, climbing the working face of the fill, traveling over the fill itself, and braking down the slope and departing from the site will produce a nearly constant heavy roar and squeal, most intrusive during the warmer months when residents are trying to enjoy being outdoors on their property. The dumping operation itself will produce the regular sounds of vehicle hydraulics and clanging tailgates as loads are dumped. Perhaps worst of all will be the high-intensity chirping of back up beepers (whether or not outfitted to be triggered only by proximity to obstacles[3]), on both the haul trucks and landfill equipment such as bulldozers. Noise impacts alone will render adjacent properties nearly unlivable.

With respect to noise, staff found as follows:

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[3]The applicant proposes to require proximity-generated buzzers for their own equipment. These devices produce an alarm-clock-like buzzing which is louder than the traditional beeping.

The applicant identified the closest noise-sensitive properties (residential uses) and evaluated potential noise impacts on these uses. The applicant did not evaluate noise impacts on other adjacent properties at greater distances. Staff concurs with the applicant's reasoning that if noise does not seriously interfere with close noise-sensitive uses, it will not seriously interfere with noise-sensitive uses farther away, as noise diminishes over distance.

As noted by the applicant, the cited DEQ Noise Rule does not appear to be directly and entirely applicable to the proposed application. However, staff concurs with the applicant's use of that DEQ regulation to set a threshold for noise increase to "seriously interfere" with noise-sensitive uses.

However, as noted in MFA findings above, the proposal appears to exceed the DEQ regulatory noise threshold proposed for use by the applicant to evaluate consistency with this standard.

In the absence of a proposed solution to meet identified noise impacts, staff recommends denial of the application due to noise impacts on adjacent noise-sensitive uses.

Valley Neighbors generally agree with staff's findings. However, we would reinforce them with the following modifications:

(1) Even hypothetical compliance with DEQ noise standards, which are effectively unenforceable in any event[4], may seriously interfere with uses on adjacent property. The proposed conditional use and the disturbing sounds it will generate are simply incompatible with adjacent residential uses, and even with the outdoor activities of small farm operators who have placed comments into the record.

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[4]Sadly, this is putting it very mildly. The applicant's representative testified on May 1 that DEQ no longer conducts enforcement. DEQ in fact stopped updating noise regulations in 1991, which is when it ceased noise enforcement. The applicant is not constrained by DEQ regulations.

(2) The science of acoustics does not lend itself to straight-line calculations. For example, based upon the height of the fill at any given time, varying atmospheric conditions, and the occasionally sheltering effect of the fill itself, properties further away may suffer greater impacts than "the closest noise-sensitive properties." Thus, the applicant did not meet its burden of proof when it only evaluated potential noise impacts on those properties and their uses, and not on other properties within the as-defined adjacent area.

(3) The applicant is only able to exercise some semblance of control over its own vehicles. The vehicles of other haulers and private customers will be entirely out of their control. Assurance of compliance with any relevant or agreed noise standards will be impossible.

Odor

With specific regard to odor impacts, staff found as follows:

* * * Staff has two general concerns with the applicant's analysis:

1. Odor-sensitive uses. The analysis does not appear to identify adjacent uses that are likely to be more sensitive to odor impacts. For example, a residential use is likely to be more sensitive to odor impacts than a farmed field. Locations of odor-sensitive uses are not clearly defined in the odor analysis or mapping, and the potential impact on these uses is not specifically evaluated. Of special note, there may be odor-sensitive uses within the boundary area identified in the applicant's odor analysis.

2. As identified in the MFA engineering response, several technical elements of the analysis appear to be inadequately supported.

Due to these concerns, and the lack of options for conditions to mitigate these concerns, staff recommends denial of the application.

Staff Report at 33. The evidence placed in the record will strongly support your staff's determination.

In addition, commissioners should not assume that some community members would be unaffected by or benefit from this proposal because the landfill and its working face would be further away than before. If the current fill (and the expansion into the quarry to its west) reach full capacity and this application is not approved, then the impacts other than residual fumes and odors (which are supposed to be controlled in the first place) would for the most part disappear. That is the baseline condition you must measure against, not the supposed baseline of an operating dump.

You have been presented with testimony that the applicant and county promised and planned that the landfill use would be temporary ever since the first CUP for a landfill in the Forest Conservation zone was granted in 1973. Afterward, it was to have been capped, and revegetated, so as to return the parcels on which it was located to the original pastoral character of the area. There has never been a provision for the landfill to be an ever-growing, permanent operation. The commitment to fully and permanently cap and close the landfill and restore the site to its original condition reflecting the pastoral character of the area, is part of the county's only duly adopted Solid Waste Management Plan (the 1977 Plan, a copy of which is attached as Exhibit A). This commitment has been made repeatedly but never fulfilled. It was contained in the 1983 zone adoption and change, and revalidated in every single land use decision since that time that addressed landfill operations, in 1994, in

2001, in 2003, and most recently in the 2021 CUP proposals.

One characteristic that can be drawn from the preexisting operation, though, is the applicant's manner of operating a landfill. In this regard, please be aware that the voluminous application materials on file do not disclose that Republic's Pollyannaish description of its methane emissions overlooks an ongoing action by the US Environmental Protection Agency. (Please see the recap attached as Exhibit B.) Simply stated, the EPA does not believe Republic's numbers and has the dump under investigation.

This reflects the way this operator operates. Leaking malodorous, unhealthy methane (that also contains airborne PFAS and many other air pollutants as described by the applicant during its May 1 testimony) onto adjacent properties will interfere with all uses on those properties, and with the character of the area (however "area" is defined).

Visual Impacts

While perhaps not as impactful on its adjacent properties as would have been the applicant's 2021 proposal on its affected properties to the north, the new mountain of garbage will nonetheless have a dramatic visual impact on the nearby properties to the south. . The applicant proposes to plant trees to screen the visual impacts. The main problem with this is that screening the landfill is already a Condition of Development for the zone (as well as a requirement of the 1967 Highway Beautification Act). But the current landfill operator has never been able to adequately screen a 500-foot tall artificial landform with "proposed trees" that might reach 15 feet in height by the time the expansion is full. There is no indication

that this will change. The operator has not capped and revegetated a closed cell since the mid-1990's. Instead, it covers cells with unsightly, deteriorating tarps which can be seen for miles. This conduct too will never change. The applicant acknowledges that even if the proposed vegetative screening is installed and maintained, the new landform made of trash "may be visible." The applicant also states that expanding the landfill will "reduce * * *visual impacts * * * caused by the current operation" which, under prior Conditions of Development, are already required. What are we to make of the applicant's suggestion that it will now belatedly, voluntarily comply, after the passage of 50 years?

Note also that the "artist's rendering" of "visual impacts" depicts the landfill mass in a green color. The landfill mass is in fact the colors of a patchwork of decaying tarps. Thus, the new topology of trash should be depicted in its current unnatural colors.

C. INTERFERENCE WITH THE "CHARACTER OF THE AREA"

The "area" in question covers considerably more territory than "adjacent properties." In spite of alternative characterizations offered by the applicant, the character of the area surrounding the proposed fill site is pastoral and considerably more quiet and free of industrial noises and landfill debris and odors than it would be if this application were approved. There is even a nearby wildlife refuge. the E. E. Wilson Wildlife Area, to the east, and a public hiking trail to the north which will have direct views of the 59-acre parcel. The use and enjoyment of both will suffer interference due to landfill noise and odors. The applicant's tree-planting proposal, even if implemented and duly maintained over time, will not mitigate

these impacts. By definition, moving the fill operation south of Coffin Butte Road will seriously interfere with the character of the area to the south.

You will receive direct first-person testimony and evidence with respect to the proposal's serious interference with the character of the area. The discussion of noise and odor impacts above applies to the surrounding area as well, as those witnesses will explain. Valley Neighbors propose that you rely upon the actual testimony placed in the record to determine the boundaries of the relevant "area" under the Development Code.

Visual Impacts

The applicant first proposes to strip the 59-acre parcel of all its vegetation and topsoil, then dig a 155-foot hole in the side of the geographic feature that is the ridge, fill the hole (below the water table) with garbage, and then pile more garbage atop what previously were the natural contours of the hillside. It is possible that preparing the site to accept trash will actually have more of a visual impact than filling it with trash will (the applicant has not provided Benton County with a timeline for site preparation), so it is appropriate to consider the visual impacts of site preparation in addition to the impacts of the operating fill as well as its impacts after final closure.

The area south of Coffin Butte Road currently lacks the view of the giant trash pile the applicant proposes to erect. Even if the height of that pile is lower than would have been the height of the one proposed for the area north of Coffin Butte Road in 2021, its visual impacts

will nonetheless seriously interfere with the character of the newly affected area. Under your code, this impact cannot be glossed over.

D. FINDINGS OF THE PLANNING COMMISSION IN DENYING THE 2021 APPLICATION (LU-21-047)

The applicant's 2021 conditional use application was different in scope from this one, especially in seeking to close and fill over Coffin Butte Road.[5] However, many of the other impacts would be quite similar and are directly applicable to this application. There are other ways to say the same thing and reach the same result, but the Planning Commission took a great deal of time and care in crafting its findings of denial. We do not feel a need to reinvent the wheel, and thus set out the most relevant ones here:

Uses on adjacent property:

> Many residents of the area testified that the odor and noise has continually gotten worse over the years. Some testified that they have to seek shelter inside to avoid the noise and smell. They warn that the levels expected in the future will affect their rural residential uses. Some farmers have testified that getting workers to work in the stench has been an issue.
>
> Odor: Methane emission rules do not capture the impacts to the character and use of the area because many people testified that the smell inhibits them from going outside and enjoying the use of their property. Property owners within miles of the site stated they could smell the landfill. The current mitigation of an earthen cap over cells does not mitigate smell and smell reflects emissions of other gases such as Volatile Organic Compounds (VOCs) and hydrogen sulfide. The same mitigation is proposed for the

[5]Valley Neighbors believe that may still be the plan. If the proposed expansion is approved, it is not at all inconceivable that the county would apply (to itself) to vacate the road so that Republic would own and could fill over the right-of-way. It is not impossible that this could be carried out without significant public scrutiny or review. Thus, this application could well be a Trojan horse.

expansion and if it currently does not mitigate the odor then it cannot be used as a mitigation for the future and be expected to minimize the concern.

Bad air quality: People living in areas with poor air quality does pose serious interference with livability. Risk of health concerns is likely with the landfill expansion; enough so nearby residents speak out about it. Some residents point to increasing cancer clusters in their neighborhood and suggest that poor air quality may be responsible. One nearby resident pointed to studies in Europe that tied poor air quality in the proximity of landfills to bad health issues. The applicant noted they cannot control all of the releases of VOCs or hydrogen sulfide and these gases are understood to be potent carcinogens. The applicant did not address the long-term effects of those gases in varying concentrations in different weather situations but the Planning Commission certainly heard from people that they can smell these.

Noise: The noise study contracted by the applicant has been criticized as faulty and inadequate. Proposed mitigations do not seem feasible and such conditions couched as "whenever feasible" or "if permitted by safety conditions" are not stringent enough. Further concern of noise from banging truck gates, loud noises from unloading, was not addressed. Point noises are often the most debilitating and background noise is easier to live with. * * *

Much of the applicant's response to these issues is to rely on subsequent review and approval by Oregon Dept. of Environmental Quality (DEQ); however, there is no ability for the Planning Commission to review the situation after DEQ's approval to ensure that DEQ's standards were adequate to prevent the proposed use from seriously interfering with uses on adjacent property.

Conclusion: The proposed use does seriously interfere with uses on adjacent property.

The character of the area:

[We cite only the relevant portion of the findings here, which would be directly related to the southward march of the fill. The evidence presented to you will demonstrate those impacts upon such properties.]

* * * Residents of the area point to the change in the character of the area. * * *

* * * The livability of the area because of noise, odors, and the visibility of the garbage pile will continue to degrade.

Benton County File No. LU-21-047, Planning Commission Findings at 2-3.

D. SERIOUS INTERFERENCE WITH THE PURPOSE OF THE FC ZONE

The purpose of the Forest Conservation zone is set out in BCC 60.005. The relevant subsection is set out below, with the most directly relevant language italicized:

Forest Conservation Zone.

60.005 Forest Conservation Zone.

(1) The Forest Conservation Zone shall conserve forest lands, promote the management and growing of trees, support the harvesting of trees and primary processing of wood products, and *protect the air, water, and wildlife resources in the zone. Resources important to Benton County and protected by this chapter include watersheds, wildlife and fisheries habitat, maintenance of clean air and water*, support activities related to forest management, opportunities for outdoor recreational activities, and grazing land for livestock. Except for activities permitted or allowed as a conditional use, non-forest uses shall be prohibited in order to minimize conflicts with forest uses, reduce the potential for wildfire, and protect this area as the primary timber producing area of the County.

As staff points out:

The FC zone conditional use criterion BCC 60.220(1)(c) requires consistency with BCC 53.215. As discussed above, staff does not consider BCC 53.215 criteria to be met with respect to noise and odor impacts; therefore, the proposal also is not consistent with the purpose of the FC zone.

Staff Report at 46.

We concur with that portion of staff's findings. We would also point out that the LS classification was created so that landfills would not be located in FC zones. Hence, the

proposed siting on FC parcels of accessory uses which would be part of the landfill operation would subvert the intent of the county's zoning scheme. Note also that landfill "buffers" are not a by-right use in the FC zone, and are not allowed at all in the RR zoning district.

The only parcel in the applicant's ownership that is currently permitted for landfill "buffer" is the 59-acre parcel that the applicant proposes to put a new landfill on. This is the buffer between existing landfill operations, which are slated to continue for the next 12 years, and the RR-10 and FC parcels with residences on them to the east, west, and south. A landfill cannot "buffer" itself. The 59-acre parcel was zoned LS in 1983 to provide visual/noise/odor screening from adjacent parcels, and that is its current function. Without rezoning existing rural residential parcels to LS, or obtaining Conditional Use Permits on FC parcels for landfill "buffering," this use is not compatible with surrounding existing uses.

IV. BCC 53.215(2) AND OTHER CRITERIA RELATING TO TRAFFIC AND THE APPLICANT'S TRAFFIC IMPACT ANALYSIS; DRAINAGE AND LEACHATE MANAGEMENT

Returning to the Conditional Use criteria of BCC 53.215, subsection (2) requires the applicant to prove:

> (2) The proposed use does not impose an undue burden on any public improvements, facilities, utilities, or services available to the area.

In this regard, the staff report discusses both traffic impacts and drainage and leachate management issues.

The applicant's TIA seems to have withstood staff and consultant scrutiny thus far. However, it is not clear that the TIA and its reviewers understood that the Knife River quarry operation on land leased from Republic had ceased. Republic has now prepared that portion of its property for landfill use, and commenced to fill it. That use will have traffic impacts which are substantially different from and more intense than those generated by Knife River. The defects in the applicant's TIA are separately addressed in a submittal from Mark Yeager.

Considerable testimony will be placed in the record with respect to drainage and leachate management. The record will show that the applicant has not demonstrated that it can or will construct and operate a compliant landfill. Additionally, none of the applicant's studies–not traffic, nor noise, nor odor–takes into account the impact of removal of 3,500,000 tons of material from a topographic feature, the relocation of that material to the stockpile across the road, and the eventual removal of the material from the stockpile to some remote location to be determined in the future. (The applicant has not shared the details of this operation with county staff.) The impacts of site preparation and operation must be weighed and considered when the process will be as extensive as is the case here.

V. CONDITIONAL USE CRITERIA UNDER BCC 60.220

BCC 60.220 applies in this case and provides in material part:

60.220 Conditional Use Criteria.

(1) A use allowed under BCC 60.205 or 60.215 may be approved only upon findings that the use:

(a) Will not force a significant change in, or significantly increase the cost of, accepted farming or forest practices on agriculture or forest lands; * * *

This is essentially the language of ORS 215.296(1), which sets out the "significant impacts" test and was interpreted by the Oregon Supreme Court in SDC. Again, the Supreme Court interpreted "significant" in this context as follows:

> Because the term "significant" is undefined, and of common usage, it is permissible to consult dictionary definitions. The most pertinent definition of "significant" in *Webster's Third New International Dictionary* (2002), 2116, appears to be "3 a : **having or likely to have influence or effect : deserving to be considered[.]**" Because ORS 215.296(1) is framed in the negative (the applicant must demonstrate that the proposed use "will not" force a significant change, etc.), it seems appropriate to consider related antonyms such as the term **"insignificant," which *Webster's* defines in relevant part as "e : of little size or importance[.]"** *Id.* at 1169.

(Emphasis added.) This provides the definition and interpretation which are binding upon the county here.

The staff report concurs with the applicant's characterization:

> The new or relocated elements that are proposed on the FC-zoned lands are an 1,800-square-foot employee building and parking, access road modifications, the relocation of leachate ponds, leachate loadout, leachate sump, an outbound scale, portions of the perimeter landfill road, cut activities for landfill, and a shop/maintenance area to support the landfill. These elements will slightly reduce the amount of land that is available for farm and forest uses * * *.

Staff Report, 52-53.

Staff then concludes:

> Staff concurs with the applicant that farm and forest uses have operated on and adjacent to an active landfill use on this site for decades. In the absence of contradictory information, as of the writing of this staff report staff sees no evidence the proposal will force a significant change in, or significantly increase the cost of, accepted farm and forest practices.

Id. at 53.

This conclusion fails to take into account the movement of the applicant's operation toward the south, and the farm impacts which will occur there. In fairness, staff did not have "contradictory information" at the time the staff report was prepared. However, farmers will submit contradictory evidence into this record. That evidence is also likely to be highly relevant to your consideration under the general Conditional Use criteria of BCC 53.215. As we have discussed, this would be a new landfill. While it will be closer to some farms than is the fill north of Coffin Butte Road, the Commission must also take into account impacts on other affected farms in light of the fact that the existing northerly site will shrink and then close, which would otherwise eliminate its impacts but for the opening of this new, proposed fill.

VI. BCC 99.225-DEVELOPMENT ACTIVITIES IN WETLANDS

With respect to these criteria, staff states:

> On-site are a Freshwater Emergent Wetland, a Freshwater Pond, and Freshwater Forested/Shrub Wetland. Benton County notified DSL of the complete application on March 20, 2025, following the 58-day extension requested by the applicant (Exhibit BC4). The County did not receive a response from DSL.

Staff Report at 66.

DSL's failure to respond is not the fault of the applicant or staff. Nonetheless, receipt of a response should be required before this application can be approved. Then, if there is somehow an otherwise approvable application, it may (or may not) be possible to craft appropriate conditions based upon DSL's comments.

VI. CONCLUSION

For all the reasons set out above and in the staff report, and adduced in the written and oral testimony before you, the applicant has not met its burden of proof to show compliance with Benton County's approval standards. Accordingly, this application must be denied.

Respectfully submitted,

Jeffrey L. Kleinman

Jeffrey L. Kleinman
Attorney for Valley Neighbors for
Environmental Quality and Safety

From: Skeeter Lancaster
To: Benton Public Comment
Subject: Coffin Butte Landfill's permit
Date: Tuesday, May 6, 2025 4:40:12 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dennis Lancaster
P.O. Box 605
Siletz,Oregon 97380
5/6/2025

Commissioners,

My name is Dennis Lancaster and I am an employee of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact my customers. I encourage you to grant Republic's application for expansion. Below are some of the reasons I support the expansion:

Choose some of these, or expand on them if you wish…

- The landfill is an essential resource in our ability to be responsible for our own waste
- Hauling the waste to a landfill further away doesn't fix the problem, it just makes people in another part of Oregon deal with our trash
- The trash we are talking about is our trash. It's yours, it's mine, it's all of ours together, and we should be the ones to deal with it responsibly
- Republic has done an excellent job managing the landfill
- DEQ has environmental oversight regarding the operations at Coffin Butte, so the landfill is already very highly regulated, which greatly limits any environmental impacts
- Closing the landfill is not a way to responsibly manage our waste stream. We should deal with our own trash the right way, and Republic is doing that
- Collection customers will bear the burden of increased prices to cover increased hauling costs
- Increased collection rates will have a significant impact to small businesses in my community
- Hauling trash to another part of Oregon increases greenhouse gas output from the trucks that haul it, which pollutes the environment we are trying to protect
- "Not in my backyard" is not an acceptable solution to managing the waste stream

Thank you for your attention. I strongly encourage you to vote to expand.

Dennis Lancaster

From: Mason Leavitt
To: Benton Public Comment
Subject: Public Comment Opposing LU-24-027
Date: Tuesday, May 6, 2025 2:59:02 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Please find the attached testimony and supporting documents for the record.

--

Mason Leavitt
GIS Analyst and Programs Coordinator
Beyond Toxics
mleavitt@beyondtoxics.org
(541) 645-5972

BEYOND TOXICS

DATE RECEIVED: 05-06-25
FROM: Mason Leavitt
PHONE OR EMAIL: M

MLeavitt@BeyondToxics.org

LU-24-027
Mason Leavitt GIS Analyst
120 Shelton McMurphy Blvd
Suite 280, Eugene OR, 97401

Becky Merja, speaker 67 and Todd Rowland, Speaker 69 have ceded their time to me. I am speaking for 9 minutes today.

My name is Mason Leavitt, and I am testifying on behalf of Beyond Toxics, a decades old Oregon Based environmental organization that fights for all Oregonians to have access to clean, safe air, water, and land. Our organization has worked with Soap Creek Valley and Adair Village Residents for three years to find solutions to many of the challenges posed by this facility, and I have been there through that journey.

My background is based in Geographic Information Systems or GIS, and I have been trained to map and analyze spatial data.

Today I want to draw attention to the odor study, which the county has determined as grounds for denial. This is due to the fact the applicant used an outdated software version and did not adequately take elevational differences into account. I wish to elaborate on why this odor study is neither **comprehensive nor objective**. But, first, I want to add some related details to the record.

One, the applicant highlighted the newly installed enclosed flare as an important piece of infrastructure to manage landfill gas. I want to note for the record that DEQ announced the requirement of enclosing all landfill gas flares in 2022. The applicant received multiple notices and extensions to comply with this requirement, and failed to do so resulting in an enforcement notice from DEQ. It's installed now, but this process is illustrative of how laborious it is to get the applicant to respond to required operating conditions.

Two, the applicant has waited until last week's hearing to announce their intentions to install fenceline monitoring for odorous pollutants. Beyond Toxics and residents have been pressing for this for years now, and that technology has been available the entire time. I want to note that the applicant's odor study chase not to incorporate any real time air monitoring despite the availability of that technology

Third, I want to problematize the applicants claim they found 99% of odor complaints to be "impossible" despite acknowledging they were working with an incomplete data set that does not have the time or location of odor detection. It's worth elaborating on this. How can we know someone didn't smell the landfill because the wind was blowing the opposite direction of their location, if we do now know their location or the wind direction at the time of their complaint? Additionally, when we find a model invalidates 99% of human experiences, we typically conclude the model is wrong. I teach GIS part time at the UO, and I would fail any student who would make a similar claim to the applicant without additional explanation.

Next, I want to turn to some additional assumptions of the applicant's odor study that need more explanation. The applicant has chosen to go with an atmospheric modeling system

using weather data from Coffin Butte, Salem Airport, and Corvallis airport. Using this data, they have made an educated guess on how air has moved around in the nearby area of the landfill.

As the famous saying goes: "All models are wrong, but some are useful." Models have fundamental limitations and they cannot and do not reflect all the complexities of the real world. Modeling is a great tool but it is not the entire picture and there are many other tools in the toolbox the applicant has chosen not to deploy including the air monitoring I mentioned above.

Models are a series of mathematical equations- if you change the numerical inputs or the parameters, you get different results. Choosing those inputs is not an objective decision- it is subjective to the applicants preferences.

One of the most important assumptions made by the applicant is that the facility has a 25% fugitive emissions rate - mind you, I want to note that they used to claim it was 10%- the best in Oregon before quietly revising those numbers last year. Recall, fugitive emissions are landfill gas emissions that are not captured by gas extraction wells and other gas controls. I want to complicate that 25% assumption made by the applicant. Planning Commissioners brought up two important questions last session I would like to answer:

1. What about all the photos of holes in Coffin Butte's covers and tarps meticulously documented by residents? Recall, the applicant stated they do regular surface emissions monitoring to repair these holes. This prompted the second question.

2. Do we have results of the surface emissions monitoring done by the applicant?

First, let's look at the EPA: Coffin Butte has been inspected twice by the US EPA inspections which uncovered over 100 violations, some of them 200 times the regulatory limit. The first time EPA inspected the landfill in 2022, Coffin Butte had done their own SEM monitoring 10 days prior where they found 6 leaks between 500ppm and 1,500 Ppm. The EPA found 71 leaks between 500 ppm and over 70,000 ppm and they only monitored a small portion of the landfill. They also found that the applicant had been not complying with several standard testing procedures required by Oregon Law. A similar story occurred in 2024 with 41 leaks between 500 and 118,000 ppm. the applicant is currently under investigation for failing to meet Clean Air Act standards.

Second, I have analyzed surface emissions monitoring reports submitted to DEQ by all Oregon Landfills legally required to do so. I found records that show that Coffin Butte is choosing not to monitor 56% percent of their landfill surface area in SEM using a legal loophole (**Exhibit A**). This is above average for privately operated landfills in Oregon which omit 50% on average. Publicly operated landfills omit about 10%. Coffin Butte claims that some of their slopes are too steep or too covered in vegetation meaning they can't monitor them. These are slopes operators designed and vegetation they chose not to maintain, and the legality of these exemptions are ambiguous at best or illegal at worst.

Additionally, Third party satellite flyovers have found massive plumes of landfill gas that can be observed from space. They have flown over Coffin Butte 6 times over the last two years, and found leaks 100% of the time.

The working face, where garbage is currently being deposited, is a site of significant fugitive emissions. Coffin Butte claims they limit their working face to a half acre at any time. I have submitted nearly a dozen random satellite images showing otherwise (**Exhibit B**). They also claim they cover it with daily cover at the end of each working day. Photographs show otherwise.

Additionally, I have used air monitoring equipment to document hydrogen sulfide levels at residential households. This is the classic rotten-eggy smell we have all smelled in our garbage. Through monitoring, we have found Hydrogen sulfide levels between 250 and 500 ppb. This is well over the human detection threshold of 30 ppb (**Exhibit C**)

I also worked with Linfield University students to conduct a door to door survey of all 500 homes in Adair Village. Of 126 households that spoke to us, we found 60% of residents reported regularly smelling the landfill, and many were specific that the smell is distinct from the compost facility. 20% of residents reported having modified their daily activities to avoid going outside due to the smell being unbearable or concerns over exposure to toxics.

Remember, all models are wrong, but some are useful. The applicant's model is serving a purpose to cast doubt on hundreds of people's lived experiences. The applicant has offered no explanation for the discrepancy between their odor study results and the experience of residents. They have offered no explanation of why their gas collection system is failing and how they plan to fix it. I urge the planning committee to believe the residents' experiences, and to acknowledge the applicants reliable record of bad behaviour.

Exhibit A

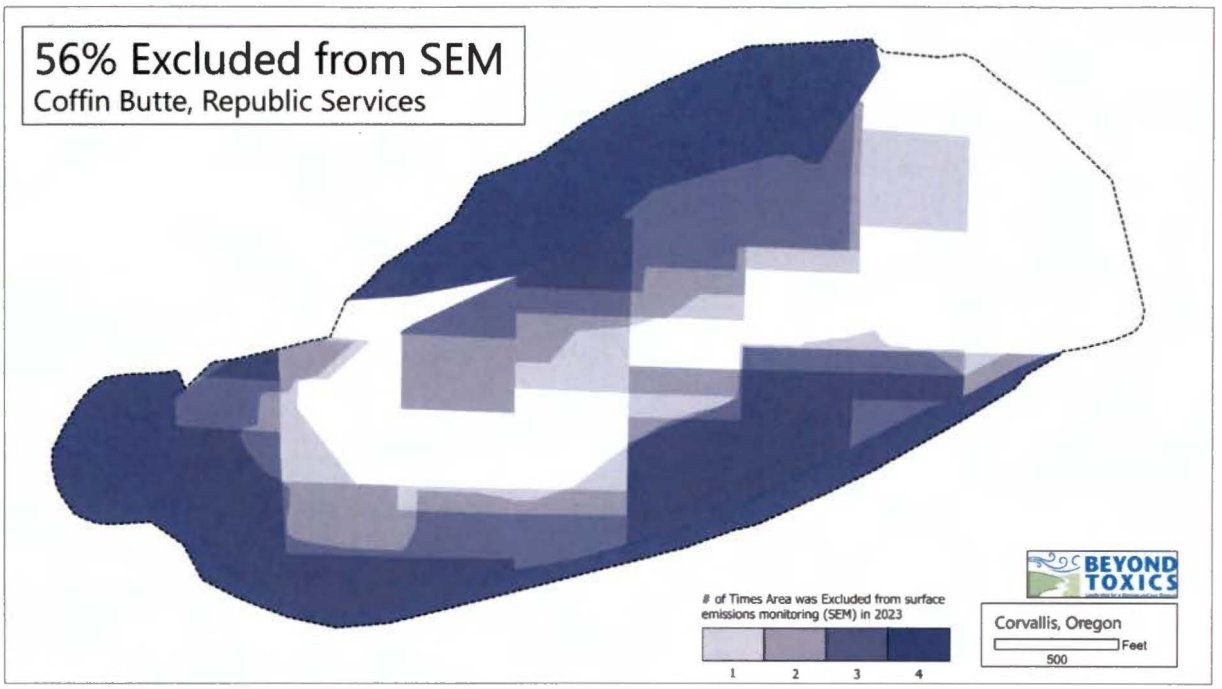


Exhibit B




June 22, 2022
1.23 acre exposed
Google Earth
700 ft
N


July 14, 2022
2.1 acre exposed
Google Earth
700 ft
N

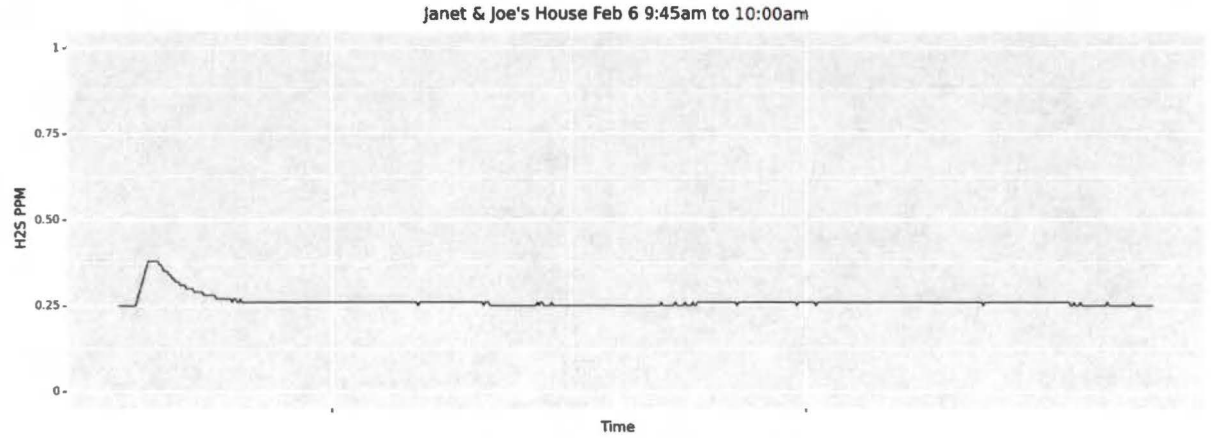

April 29, 2023
1.00 acre exposed
Google Earth
700 ft
N

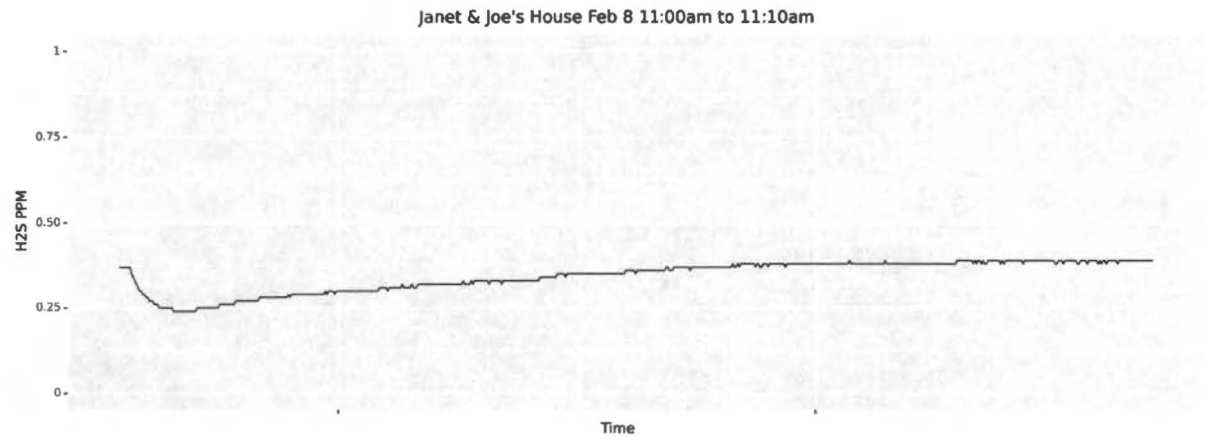

April 19, 2024
2.59 acres exposed
Google Earth
700 ft
N

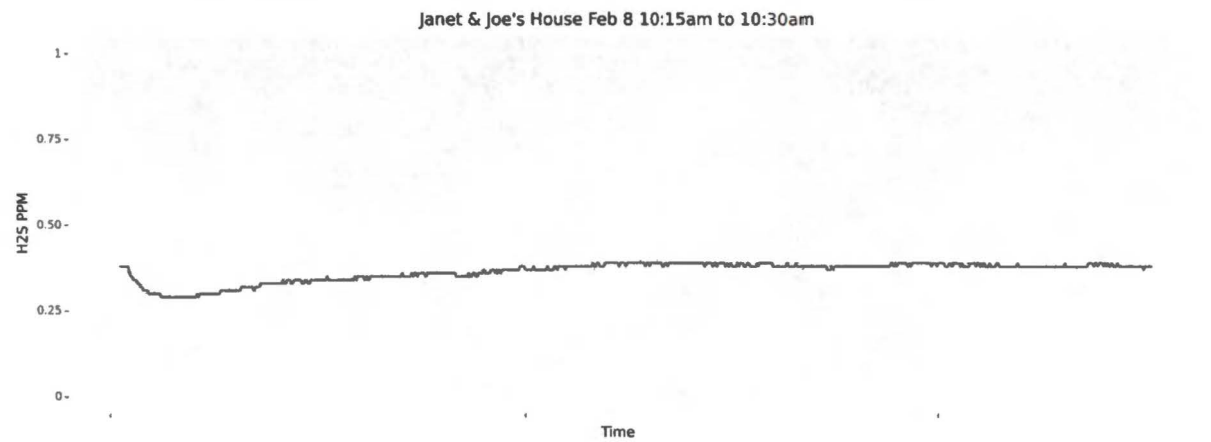

July 2, 2024
1.04 acres exposed
Google Earth
700 ft
N

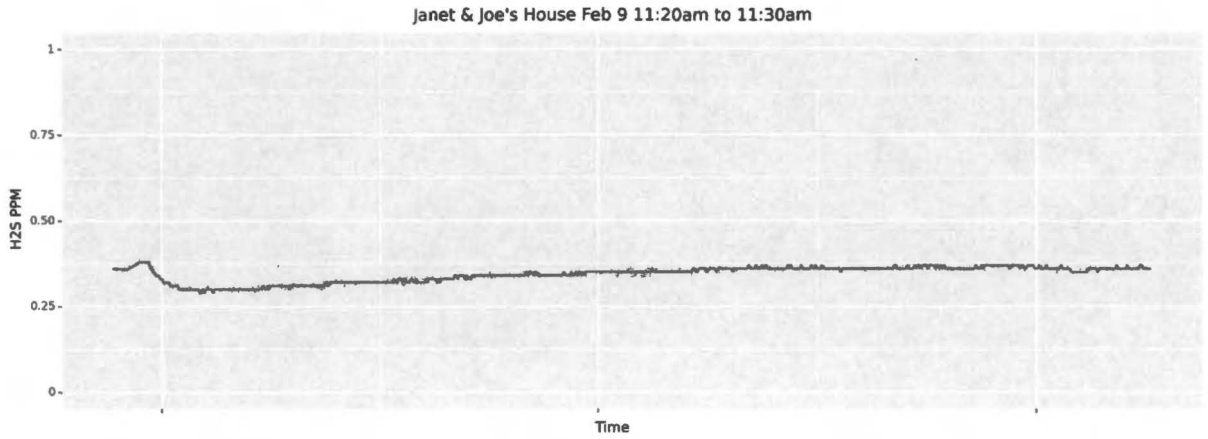

March 26, 2025
2.26 acres exposed
Google Earth
700 ft
N

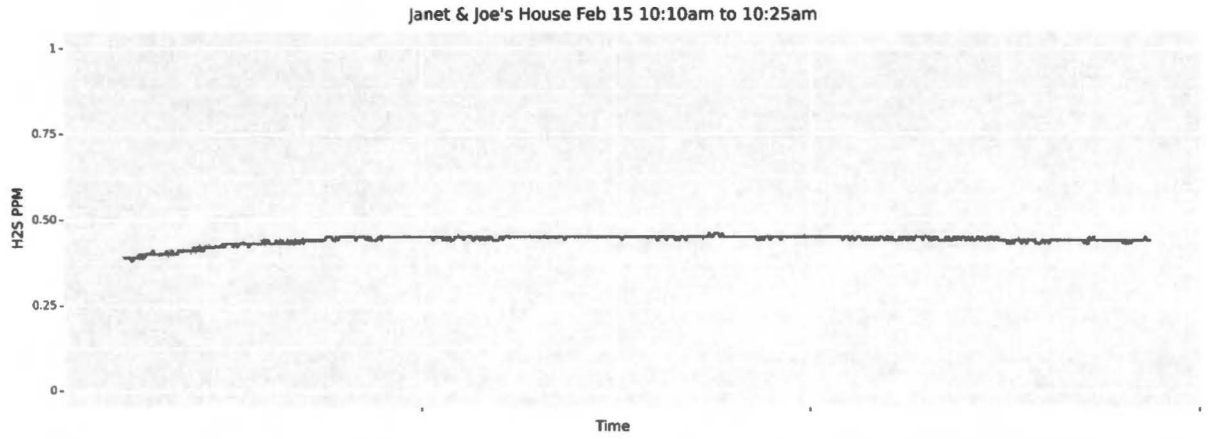
Exhibit C (Note graphics are in PPM. Convert to PPB= PPM x 1,000)

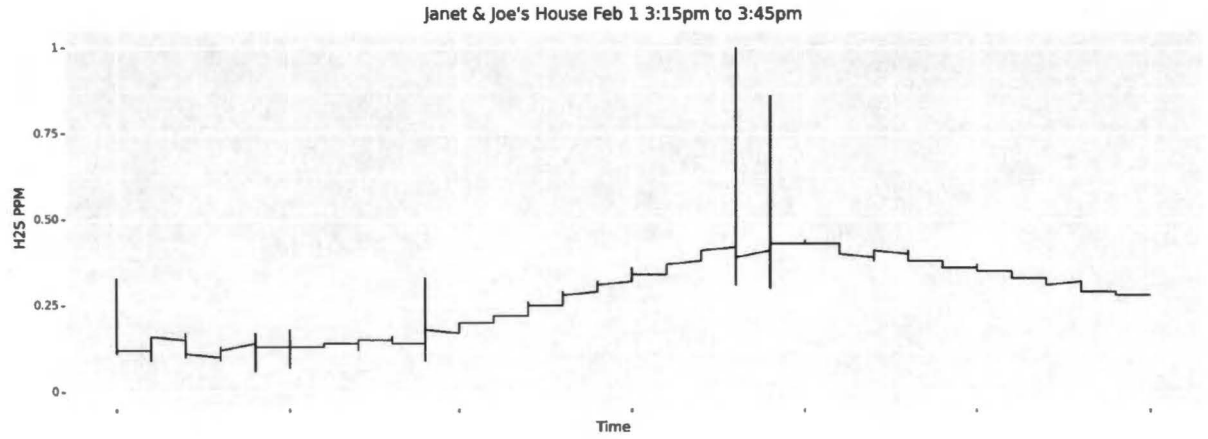







Janet & Joe's House Feb 9 11:20am to 11:30am
H2S PPM
1
0.75
0.50
0.25
0
Time


Janet & Joe's House Feb 15 10:10am to 10:25am
H2S PPM
1
0.75
0.50
0.25
0
Time


Janet & Joe's House Feb 1 3:15pm to 3:45pm
H2S PPM
1
0.75
0.50
0.25
0
Time





BEYOND TOXICS

OREGON'S SECRET CLIMATE KILLERS

PULLING BACK THE CURTAIN ON HIDDEN LANDFILL METHANE EMISSIONS

March 2025

MASON LEAVITT
LISA ARKIN

BRIEF PURPOSE STATEMENT

In 2022, the Oregon Department of Environmental Quality implemented new rules which regulate landfill gas emissions. The rules require Oregon landfills with greater than 200,000 tons of waste-in-place to obtain an Air Contaminant Discharge Permit to submit data on the landfill characteristics and potentially monitor, collect and/or control landfill gas emissions. The DEQ's purpose was to reduce methane emissions to meet former Governor Kate Brown's directive provided in Executive Order No. 20-04 to give state agencies the authority to establish science-based greenhouse gas emissions reduction goals. Typically, landfill gas is made up of around 50% methane. Methane is a very strong greenhouse gas, more than 80 times as potent as carbon dioxide in the short-term.

In 2024, Beyond Toxics conducted an analysis of landfill operator compliance with Oregon's new landfill methane regulations which went into effect in October 2022. We examined 32 Surface Emissions Monitoring (SEM) reports submitted by eight Municipal Solid Waste (MSW) landfills out of a total of 11 MSW landfills that are required to follow the new rules. Our report is limited to eight landfills because three of the 11 large landfills received exemptions from the Department of Environmental Quality or did not comply with the new rules. Our investigation resulted in the following findings.

KEY FINDINGS

Three out of 11 of Oregon's large, currently operating landfills did not follow the state's surface emissions monitoring rules in 2023, one year after the rules went into effect in 2022. As a result, three of Oregon's largest landfills are completely unmonitored for potent methane emissions. This is important because 90% of the methane emissions produced by industries in Oregon come from its largest landfills.[1]

[1] Industrious Labs (2025). Don't Waste Our Future. Based on U.S. EPA Greenhouse Gas Reporting Program (GHGRP) 2022, U.S. EPA Landfill Methane Outreach Program (LMOP) (July 2023), and U.S. EPA GHG Equivalency calculator.

Our examination of maps submitted by the remaining eight largest MSW landfills reporting to regulators found that privately owned landfills (five out of eight)– all owned by large corporations– on average, excluded 48.6% of the landfill surface area from monitoring for methane emissions. While minor portions of these exemptions are legally justified, for example the open area of the landfill's working face where trash is being dumped, most of these exemptions are ambiguous. The high rate of exemptions calls into question how compliant landfill owner-operators are with Oregon's laws. Notably, it coincides with the U.S. EPA's recent nationwide enforcement alert noting "widespread" noncompliance with surface emissions monitoring rules including exempting substantial portions of landfills from SEM without sufficient justification.[2]

Compared to privately owned landfills, publicly owned landfills managed by local governments excluded, on average, just 10% of the surface area. The difference demonstrates significant disparities in methane emission data between privately owned landfills that are managed for profit, and publicly owned landfill operations that are managed for the benefit of local taxpayers and businesses.

There are key gaps regarding what surface emissions monitoring data is required to be reported to state regulators, which leaves the Oregon Department of Environmental Quality unable to review results. Most Oregon landfills required to conduct monitoring are not reporting their surface emissions monitoring locations using verifiable GPS tracking, making it impossible to verify that owner-operators are monitoring every 25 feet as required by law. As a result, there could be significant gaps in methane detection. There is also no way for state regulators to verify integrated monitoring results because landfills are not required to report basic information such as their 50,000 square foot grids and the average surface emission reading in each of those grids.[3]

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[2] Environmental Protection Agency. (2024, September 25). Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements. EPA Investigations Find Municipal Solid Waste Landfill Operators Are Failing to Properly Conduct Compliant Monitoring and Maintenance of Gas Collection and Control System. https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

[3] Integrated monitoring results are derived from the averaging of all surface emissions monitoring measurements in a given 50,000 square foot grid.

RECOMMENDATIONS

The state of Oregon Department of Environmental Quality (DEQ) should immediately move to integrate the mandatory use of remote sensing technologies into Surface Emission Monitoring (SEM) rules to detect and pinpoint methane leaks at landfills.[4] One available technology is deploying methane detection equipment mounted on drones. The State can also require third party satellite methane detection systems, which provide comprehensive and more accurate measurements of the concentration of methane plumes, the direction of methane plumes moving off the landfill property, and the exact location of emission exceedances from landfills. DEQ can also require fixed monitors for real-time methane tracking. Gathering this comprehensive data set will lead to rapid mitigation of super-emitter leaks, improved methane capture for use in local energy generation or methane destruction through enclosed flaring.

DEQ should update their regulations to require SEM on all areas of landfills including steep slopes, closed cells, locations with covering vegetation and unspecified exemptions. Combining actionable emissions data from these areas along with mitigation strategies such as horizontal gas collection is critical for reducing greenhouse gas impacts and associated air toxics such as volatile organic compounds (VOCs), hydrogen sulfide, forever chemicals and fine particulate matter thereby improving air quality for local communities and climate mitigation to follow state climate action mandates.

Close reporting loopholes to ensure landfill owner-operators are adequately monitoring for methane. DEQ should immediately update its regulations to require that any owner or operator who conducts surface emissions monitoring must:

1. Report the areas exempted from monitoring and report the reasons for requesting those exemptions. This would address the current issue of exemptions being granted on a de facto basis.

[4] Throughout this report we emphasize Oregon because these are the arenas at which Beyond Toxics focuses its advocacy. Our findings could be replicable in other states or at the federal level.

2. Report measured concentration of methane in ppm for each SEM reading.

3. Report the SEM path walked by owner-operators.

4. All the above data should be in a spatial data format such as a shapefile, which makes for more efficient analysis of data gathered through surface emissions monitoring.

To prevent future potent methane emissions, governments at all scales can introduce mandatory organics diversion policies requiring consumers and haulers to separate and sort organic waste so that food and yard waste can be sent to facilities other than landfills to make compost and other products thereby preventing future generation of methane in landfills.

EXECUTIVE SUMMARY

Beyond Toxics conducted an analysis of 32 Surface Emissions Monitoring (SEM) reports submitted by eight MSW landfill operators to the Oregon Department of Environmental Quality for the year of 2023.[5] Per state rules, SEM is currently performed at landfills with over 200,000 tons of total lifetime waste and modeled methane emissions greater than 664 tons. We analyzed open landfills currently accepting municipal solid waste (variations of these rules apply to other landfills that are closed and/or accept only industrial waste). According to records from the DEQ, a total of 11 currently operating municipal solid waste landfills in Oregon meet the waste-in-place and methane emissions thresholds for the state's surface emissions monitoring rules. Three of those landfills were not following the new rules; two due to exemptions granted by the DEQ and one did not comply. SEM is performed quarterly by walking portions of the landfill surface with a handheld gas analyzer in a grid pattern to detect methane leaks. Individual leaks detected measuring over 500 parts per million (ppm) require remediation within 10 days. Operators are also required to divide their landfill into 50,000 square foot grids and average their SEM results within each grid, referred to as integrated monitoring. If a grid has an average of 25 ppm or higher, then the operator is required to conduct mitigation efforts to bring it below 25 ppm.

[5] (See OAR 340-239-0100).

These reports were qualitatively and spatially assessed to determine transparency, compliance, completeness and quality of submitted reports and gaps with landfill emissions regulations.

Across eight landfills, five are privately owned and three are publicly owned and managed by a local government. We found that an average of 33.1% of landfill surface area was excluded from surface emissions monitoring. These exemptions include permitted exemptions, such as the working face where garbage is actively being deposited, and exemptions that are more questionable such as final grading (the slopes of landfill sections that are closed and no longer having waste deposited into them).

Although on average 33.1% of landfill surface area was excluded from emissions monitoring, the data revealed that private landfill operators are excluding an average of 48.6% of landfill surface area from SEM. Methane leaks in those areas are going undetected. The result of data omission is accelerated climate damage, dangerous conditions for workers, and air pollution and odors burdening nearby residential neighbors who are exposed to hazardous byproducts escaping along with methane. While some of these areas are too dangerous to be monitored by workers, substantial portions of landfills could have been safely monitored, such as areas with some vegetation or moderately sloped sides. Instead, they were excluded and listed as exempted on the report to the DEQ. Additionally, all of these areas could have been safely monitored with unmanned aerial equipment or fixed sensor systems. For example, owner-operator Waste Connections in Medford argued 69% of Dry Creek Landfill was too steep to monitor despite there being readily available methane detection technology that could fly over these areas.

We observed that, in comparison, public operators excluded only an average of 10% of landfill surface areas from monitoring. The stark difference in the comprehensiveness of surface emissions monitoring calls for further investigation of how landfill operators request exemptions, how transparent they are about their operating procedures, and the frequency and duration of exemption approvals on the part of the DEQ.

Our findings come in tandem with the U.S. Environmental Protection Agency's recent public release of draft white papers that delineate how advanced methane detection technology such as fixed methane sensors and satellites could address serious deficiencies in finding and fixing methane leaks.[6] In fall of 2024, the EPA issued a nationwide enforcement alert, stating, in part, "While the regulations allow MSW landfills to exclude certain areas from the SEM (e.g., areas with steep slopes or other dangerous areas), the EPA observed during recent inspections that areas that are not dangerous are improperly excluded from monitoring. If a MSW landfill excludes areas from the SEM, the facility should document and explain the basis for excluding each area from monitoring in the surface emission design plan and SEM reports. The regular side slopes of the landfill may not be excluded from monitoring per the regulations."[7] Excluding the working face and a few other time-limited activities,[8] state and federal rules require that all areas of landfills should be monitored during SEM. In Oregon, DEQ air pollution permit writers approve or deny exemptions from SEM proposed by operators (referred to as "alternative monitoring plans").[9]

State regulatory agencies need to use their authority to ensure the exceptions they permit are ultimately demonstrated to be necessary. Additionally, requiring operators to use advanced monitoring systems for SEM in difficult to monitor areas could fill this regulatory gap.

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[6] USEPA, Office of Air and Radiation. (2024). White Paper Series: Municipal Solid Waste Landfills – Advancements in Technology and Operating Practices. USEPA, Office of Air and Radiation. https://www.epa.gov/stationary-sources-air-pollution/non-regulatory-public-docket-municipal-solid-waste-landfills

[7] Environmental Protection Agency. (2024, September 25). Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements. EPA Investigations Find Municipal Solid Waste Landfill Operators Are Failing to Properly Conduct Compliant Monitoring and Maintenance of Gas Collection and Control System. https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

[8] Or. Admin. R. 340-239-0330, "The requirements of OAR 340-239-0200 do not apply to the working face of the landfill or to areas of the landfill surface where the landfill cover material has been removed and solid waste has been exposed for the purpose of installing, expanding, replacing, or repairing components of the landfill gas, leachate, or gas condensate collection and removal system, for conducting a remedial action, or for law enforcement activities requiring excavation; as long as these areas are kept to the minimum size and time duration as possible." [4] Throughout this report we emphasize Oregon because these are the arenas at which Beyond Toxics focuses its advocacy. Our findings could be replicable in other states or at the federal level.

[9] Or. Admin. R. 340-239-500(1)(c) "Alternative walking patterns to address potential safety and other issues, such as: steep or slippery slopes, monitoring instrument obstructions, and physical obstructions;"

We also found that landfill operators are omitting key pieces of data gathered from SEM, which, while legal, is an outcome of weak regulatory requirements and enforcement. For example, Oregon rules require that operators monitor every 25 feet of a landfill's surface area every year. This can be accomplished by monitoring every 25 feet every quarter or by monitoring every 100 feet each quarter but offsetting that path by 25 feet each quarter.[10] However, Oregon rules do not require operators to share their SEM path, so regulators are not able to verify the rule is being followed. Additionally, SEM data that is reported comes in print format, which requires regulatory staff hundreds of hours to translate to a spatial file storage format that provides comprehensive and more accurate data for analysis. This labor to convert the data, despite the existence of accessible Geographic Information Systems (GIS) technology for data analysis, is inefficient and a burden on regulatory agency resources.

Furthermore, landfill operators are only required to report methane leaks over 200 ppm or integrated monitoring exceedances 25 ppm and greater; they do not report all measured SEM values. This is particularly problematic for integrated monitoring results because those results are based on averaging all SEM measurements within a 50,000 square foot section, not just the values over 200 ppm. For example, there could be a series of SEM measurements between 100 ppm and 199 ppm in a concentrated area that would suggest a problem. However, if it were grouped in a 50,000 square foot cell where there were a substantial amount of measurements near 0 ppm, the problem area could be masked through the averaging process. Enhancing the specificity of data reporting and transparency would provide regulatory agencies with a stronger ability to identify problematic areas of methane escaping from landfills and require targeted remediation. Critical to this would be requiring landfill operators to report data in spatial data formats that are usable by widely available GIS software.

Policymakers can act to address data gaps and upgrade methane reporting standards to ensure a healthy climate, protect worker safety and public health and to reduce greenhouse gas emissions and related air pollutants.

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[10] Or. Admin. R. 340-239-0400(2)(a) "The walking grid in OAR 340-239-0800(3)(a)(B) may be reduced to 100-foot spacing so long as the walking grid is offset by 25-feet each quarter so that by the end of one year of monitoring, the entire surface area has been monitored every 25 feet"

BACKGROUND

Mitigating short-term methane emissions, a climate pollutant about 80 times more powerful than CO2,[11] is critical to preventing the world from reaching climate tipping points. Climate tipping points are thresholds at which the climate systems would irrevocably change and upend local weather systems, supply chains, and global food productions. Currently landfills are the third leading cause of methane emissions in Oregon and the United States, and the second leading globally.[12]

Methane emissions are a byproduct of disposing of organic waste into landfills. As organic waste (food scraps, wood, paper, textiles) decomposes in an oxygen deprived environment, methane gas is generated over the course of decades. Most landfills can be thought of as giant plastic bags containing waste (although some landfills have waste in direct contact with the ground). These cells are lined next to and on top of each other in a pyramid-like structure. Pipes line the bottom of cells in horizontal rows to extract liquid byproducts, referred to as leachate. Gas extraction wells are drilled vertically and sometimes horizontally into landfill cells to capture continually generated methane gas before it escapes to the atmosphere.

Currently, federal rules require certain landfills in the United States to implement gas collection and control systems (GCCS), which use gas wells to extract methane from about 600 U.S. landfills, excluding the working face (where waste is deposited on a daily basis).[13] While GCCS are intended to extract and capture methane, several challenges exist regarding their successful and efficient operation.

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[11] United Nations Environmental Programme. (2022, October 18). What's the deal with methane? Climate Action: Chemicals & Pollution Action. https://www.unep.org/news-and-stories/video/whats-deal-methane
[12] Saunois, M., Martinez, A., Poulter, B., Zhang, Z., Raymond, P., Regnier, P., Canadell, J. G., Jackson, R. B., Patra, P. K., Bousquet, P., Ciais, P., Dlugokencky, E. J., Lan, X., Allen, G. H., Bastviken, D., Beerling, D. J., Belikov, D. A., Blake, D. R., Castaldi, S., … Zhuang, Q. (2024). Global Methane Budget 2000–2020. Earth System Science Data Discussions, 2024, 1–147. https://doi.org/10.5194/essd-2024-115
[13] Rocky Mountain Institute, Ebun Ayandele, Tom Frankiewicz, & Ellie Garland. (2024). Deploying Advanced Monitoring Technologies at US Landfills.
https://rmi.org/wp-content/uploads/dlm_uploads/2024/03/wasteMAP_united_states_playbook.pdf

Primary failures include insufficient gas collection coverage, holes in the plastic-lined cells, poorly or non-operating pipe systems, badly calibrated extraction wells, and leachate liquids clogging gas extraction pipelines.[14] Notably, when methane is escaping landfills, other hazardous air pollutants are being released to the air as well. These include hydrogen sulfide, other volatile organic compounds, and airborne PFOAs (aka “forever chemicals”).[15] These chemicals harm quality of life and pose public health risks for nearby residents and landfill workers. It is critical to consider landfill air emissions as a public health threat and a significant environmental justice challenge.

SURFACE EMISSIONS MONITORING (SEM)

Certain landfill operators are required to implement and comply with Surface Emissions Monitoring (SEM) requirements. SEM requirements were first introduced by the federal government and administered by the EPA. Federal regulations require that these landfills perform SEM quarterly and follow the EPA’s Method 21 guidance,[16] to detect and mitigate emissions greater than 500 parts per million.[17] SEM involves technicians walking the surface of the landfill at regular intervals of 30 meters looking for distressed vegetation, holes in tarps, protruding equipment, and other signs of potential methane leaks. Technicians use hand-held methane gas monitoring equipment to measure methane concentrations in the air just above the surface of the landfill. If a leak above 500 ppm is detected, the operator is required to remediate the cause of the leak.[18]

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[14] Preet Brains, Haley Lewis, Keene Kelderman, & Leah Kelly. (2023). Trashing the Climate: Methane from Municipal Landfills. Environmental Integrity Project. https://environmentalintegrity.org/wp-content/uploads/2023/05/Trashing-the-Climate-report-5.18.23-updated.pdf
[15] Ashley M. Lin, Jake T. Thompson, Jeremy P. Koelmel, Yalan Liu, John A.. Bowden, & Timothy G. Townsend. (2024). Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release. Environmental Science & Technology, 11(7), 730–737. https://doi.org/10.1021/acs.estlett.4c00364
[16]40 C.F.R. §§ 63.1958(d) and 63.1960(c)-(d)
[17] U.S. Environmental Protection Agency, https://www.govinfo.gov/content/pkg/FR-2021-05-21/html/2021-10109.htm
[18] U.S. Environmental Protection Agency, https://www.govinfo.gov/content/pkg/FR-2021-05-21/html/2021-10109.htm

States including California, Oregon, Maryland, and Washington have promulgated state regulations strengthening various aspects of SEM to detect and reduce methane emissions. However, they are still reliant on a quarterly walking survey grid pattern monitoring, which still allows areas of the landfill to be skipped altogether leading to insufficient detection of leaks (see more in our discussion).

Oregon updated its landfill emissions rules, finalized October 2021, as a result of Executive Order 20-04 initiated by Governor Kate Brown in 2020 to direct state agencies to reduce greenhouse gases to at least 80% below 1990 emissions levels by 2050. The state's 2022 rules differ from federal rules in significant ways. The new regulations require landfill operators to conduct SEM following a walking pattern with no more than 25-foot intervals annually across the landfill's surface area, as opposed to the federally mandated 100 foot intervals. It also requires integrated monitoring for landfills, which averages SEM measurements across 50,000 square foot gridded sections. If a section has an average of 25 ppm or higher, then the landfill operator is required to take action to bring methane levels down.[19] The working face of the landfill is excluded from surface emissions monitoring along with areas under construction for gas collection.[20] Regulations also reduced the size and emissions threshold at which landfills are required to install a GCCS and conduct SEM.[21] The DEQ also added additional requirements to boost methane capture, including stronger GCCS leak component monitoring and data reporting requirements for GCCS equipment indicators and down time, which we did not evaluate in this report.

Our research questions were as follows, for those MSW landfill operators that fall subject to Oregon's regulatory parameters:

1. Which currently operating Oregon landfills accepting municipal solid waste are subject to implementing the updated rules?

2. How much landfill surface area is being included and excluded from SEM?

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[19] Oregon Department of Environmental Quality, Heather Kuoppamaki. (2021, October 1). Landfill Gas Emissions Rulemaking DEQ Presentation. Landfill Gas Emissions Rules Advisory Committee. https://www.oregon.gov/deq/EQCdocs/100121_I_Slides.pdf
[20] https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=6533
[21] Ibid.

3. Are the MSW landfill operators monitoring in a walking 25-foot grid pattern over the course of a year, per state regulatory requirements?

4. Are the MSW landfill operators conducting and reporting integrated monitoring results per a 50,000 sq. ft. grid, per state regulatory requirements?

5. Are reports complete, accurate, easy to analyze and useful to ODEQ to help regulators determine compliance and effective methane mitigation?

METHODS

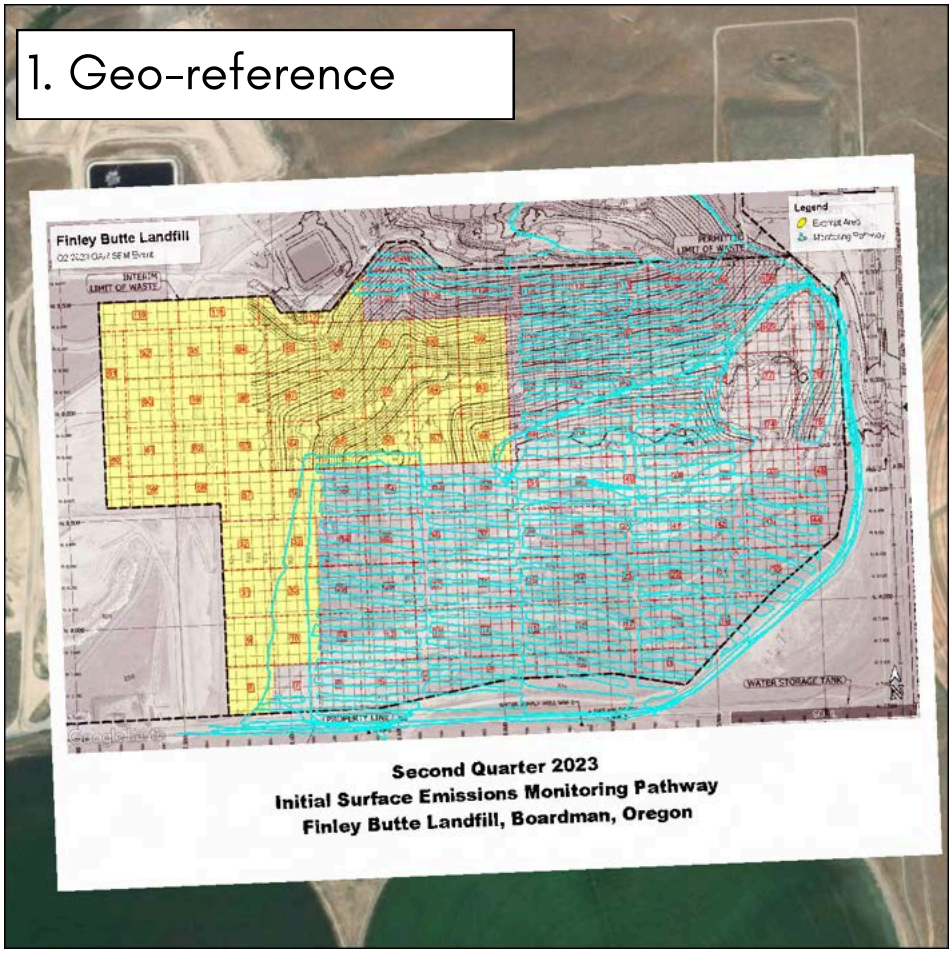
Beyond Toxics procured annual and semiannual reports, which certain landfills are required to file,[22] through a public records request to the Oregon DEQ filed in January 2024. We asked for reports filed by currently operating landfills accepting municipal solid waste that are known to exceed 200,000 tons of waste-in-place and 664 tons of methane a year since those are the thresholds at which Oregon's stricter SEM procedures go into effect.

Records were released in June 2024, and included SEM reports from eight of 11 qualifying Oregon landfills in 2022 and 2023. The other three landfills did not conduct SEM, which we inquired further about and will be discussed later. We analyzed solid waste landfills and we excluded landfills exclusively accepting construction and demolition waste, landfills that take only waste from industrial facilities, and all closed landfills. We performed a records analysis of SEM reports included in semiannual and annual reports to DEQ from 2023 for the eight of 11 currently operating municipal solid landfills required to adhere to stricter SEM requirements. In these reports, we analyzed the reporting of integrated monitoring results, 50,000 square foot grids, SEM exclusions, and SEM walking paths. We did not differentiate between SEM exclusions for the working face, asbestos pits, storage piles, steep slopes, overgrown vegetation, etc. because this information is not consistently available in reports compiled by operators. Operators often listed where they did not monitor without a specific justification.

[22] OAR 340-239-700(3)(c).

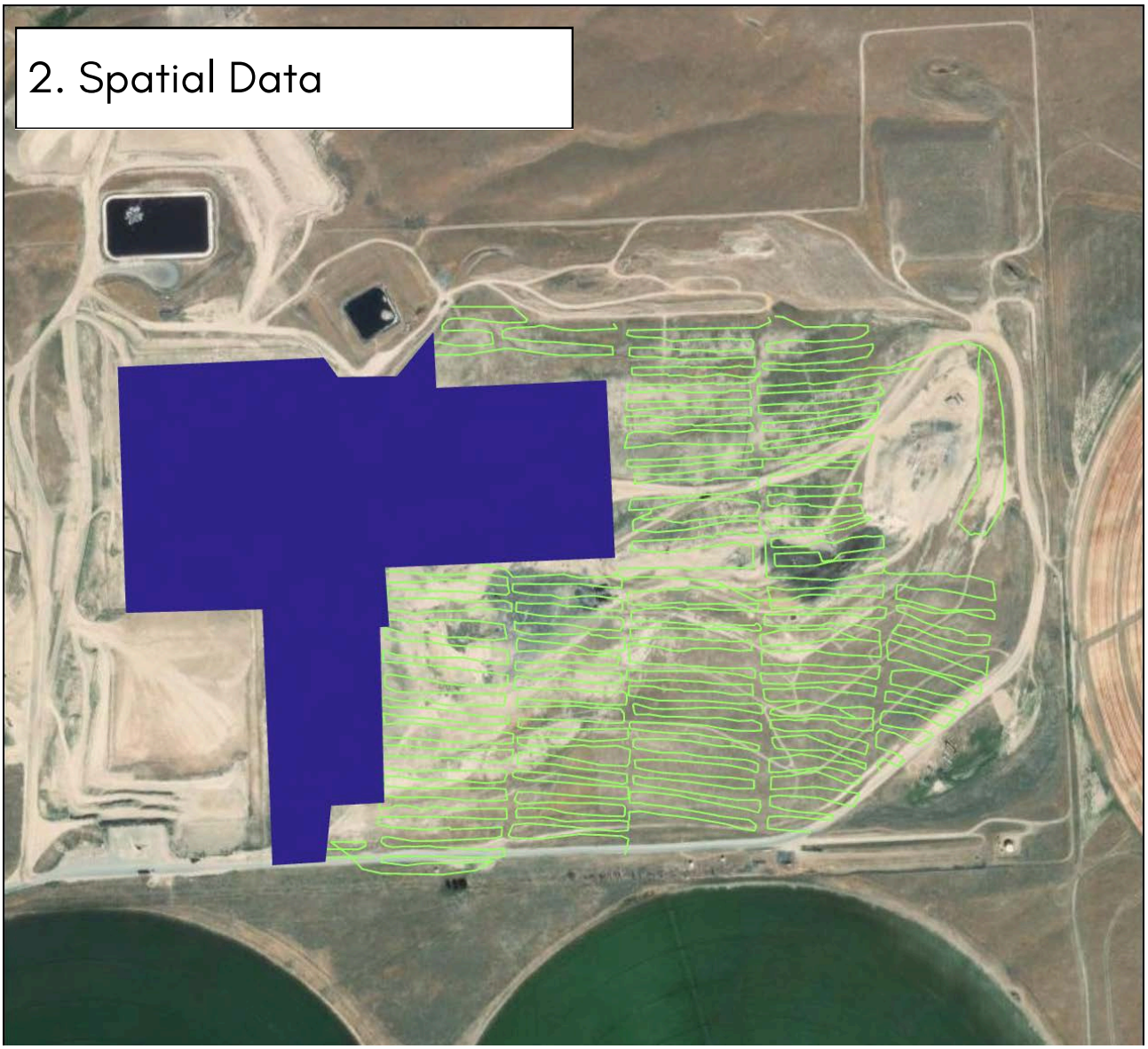
For research questions that required a spatial analysis, we georeferenced SEM report maps using ArcGIS Pro software. We then traced mapped features into vector data, which are GPS synchronized shapes that can be spatially analyzed. This allows us to do a few additional modes of analysis. For example, we can calculate the total area of a landfill and the SEM exempted areas. We can also create buffers around SEM paths to see if operators monitored every 25 feet. For the total area of landfill and areas of landfills excluded from SEM, we calculated their surface area in acres. For SEM paths, we created a 12.5 foot buffer around the walking path so we could visualize where gaps larger than 25 feet occurred between walking paths.

Figure 1: Frame 1, Frame 2, Frame 3, Frame 4

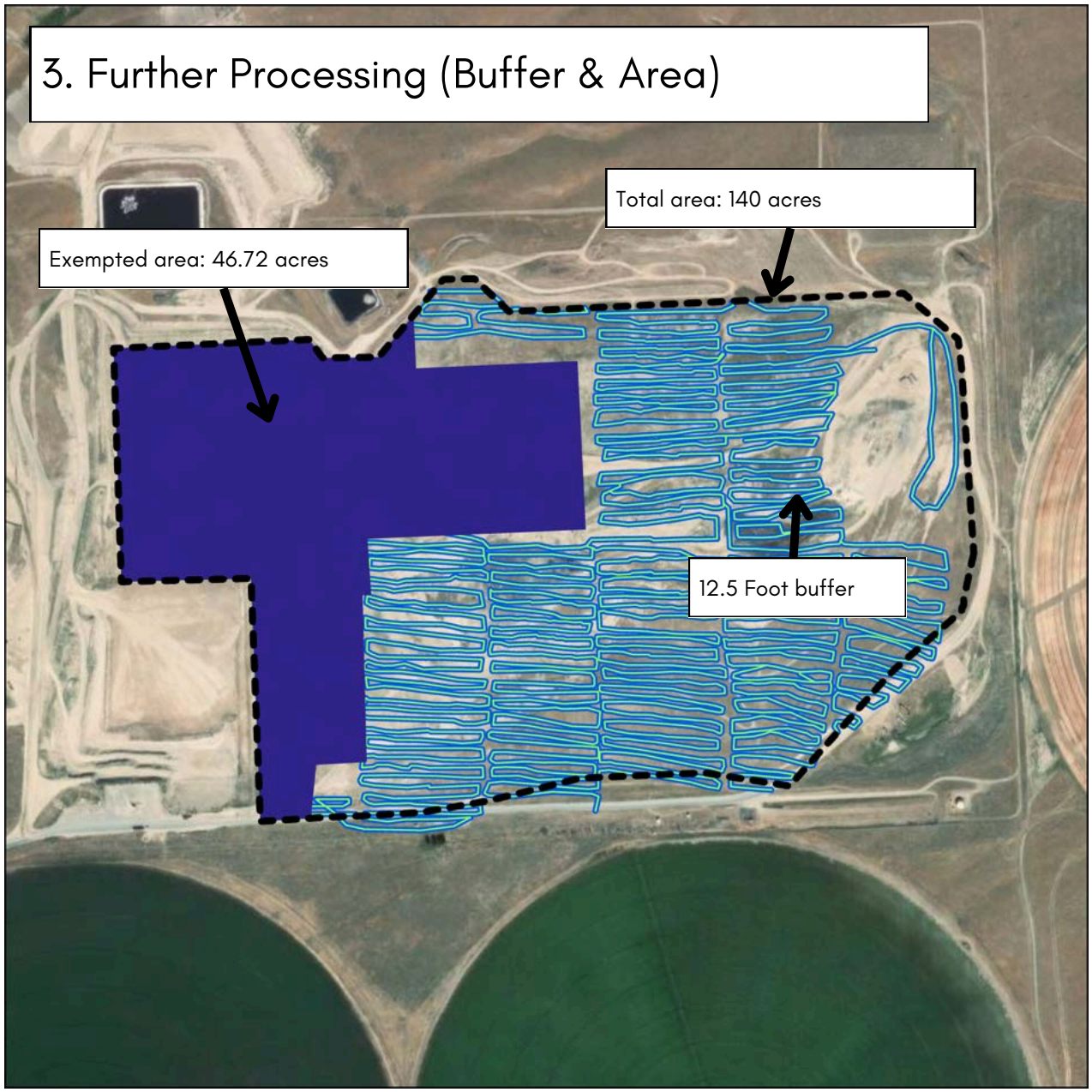


Frame 1: Overall, figure 1 shows our process of spatial data analysis for SEM reports using Finley Butte Landfill managed by Waste Connections in Boardman, Oregon as an example.

First we take the report graphic provided to the DEQ by the operator, which features a yellow polygon showing the area exempt from monitoring and a blue line showing where operators monitored. The first step is attaching the "paper" graphic to its GPS location. This is referred to as georeferencing. Now the graphic is overlaying its current satellite location.

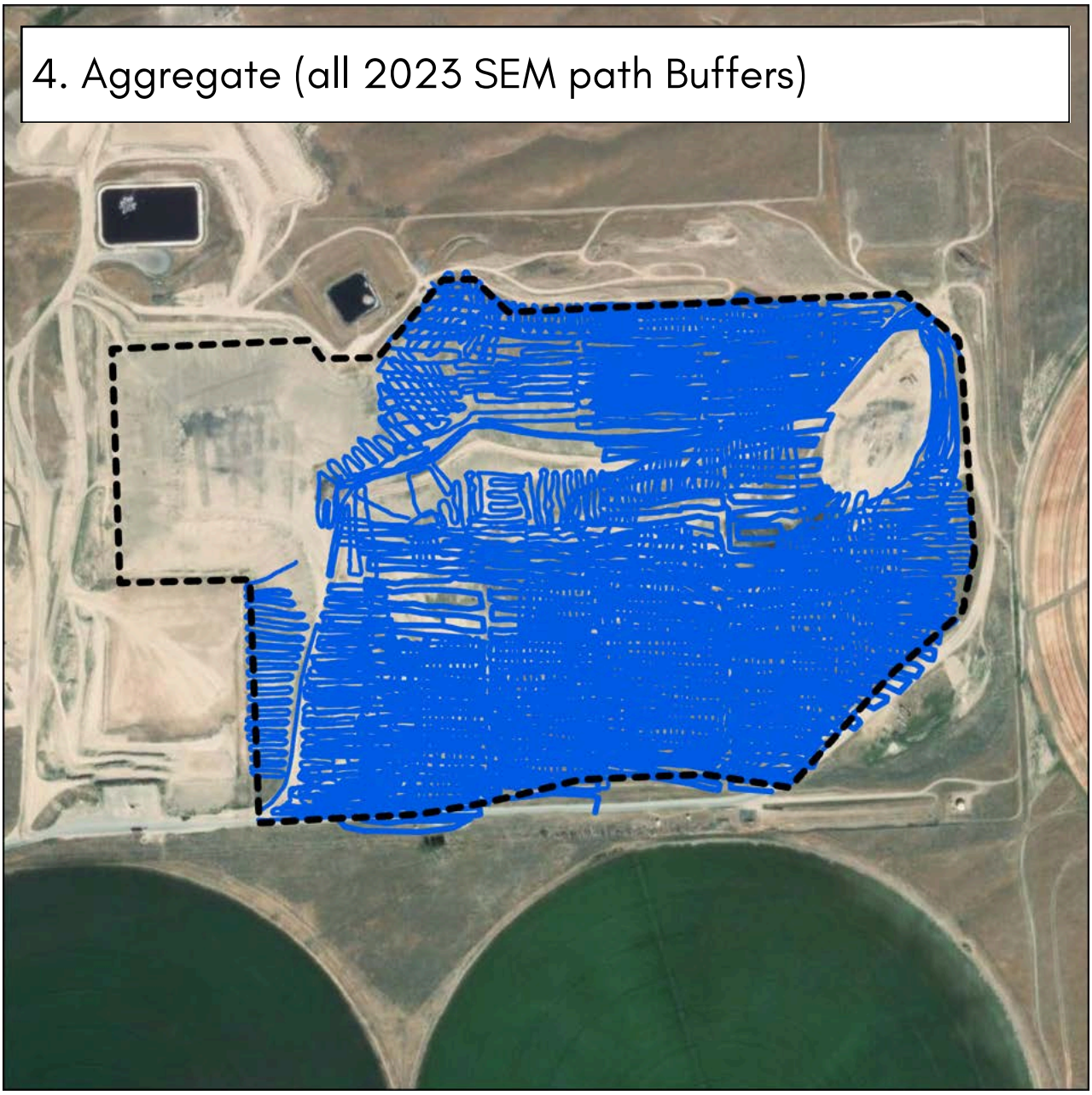


Frame 2: Next we build a shapefile, which is a file storage format used by GIS software. This is accomplished by tracing the exempt area into a polygon and the path into lines. Now, the area the operator exempted from SEM, formerly in yellow, is now in dark blue and the SEM monitoring path, formerly in blue and now depicted in green.



Frame 3: Now that we have a shapefile, we can do further forms of analysis. In this case, we want to know the area of the landfill, which we also traced into a shapefile, and the area of the exempt section. Since the data has been tied to GPS locations, we can calculate those features. The total area of the landfill is 140 acres and 46.72 acres were exempt. We can now calculate that for this quarter, Finley Butte excluded 33.4% of its surface area from monitoring.

We also need to know how well they followed the 25 foot rule. By calculating a 12.5 foot buffer on either side of the path, we can see where the buffers from all paths meet. 12.5 x 2 is 25 feet. We need to put all the paths from the year together to evaluate how well Finley Butte complied with this rule, which we will see in the next graphic.



Frame 4: In this graphic, we have compiled all of the SEM path buffers from each of the four quarters into one graphic. Areas that are in blue are where operators complied with Oregon's 25 foot rule. Areas where we can see the satellite imagery are where paths aren't offset by 25 feet, which means the operator failed to comply with the law. The only way we can evaluate this is through the ability to view all four paths/buffers around paths from each of the quarterly reports. This underscores how GIS analysis makes compliance monitoring more efficient.

WHY THIS METHODOLOGY?

By translating all of this data into a format that is usable in GIS software, we have the ability to look at data from across quarterly reports, or even years, in one environment. This allows us to see if areas have been repeatedly excluded from SEM each quarter, if the landfill operator has indeed monitored every 25 feet of the landfill over the course of a year, or if there are areas that repeatedly have high emissions for integrated monitoring.

Furthermore, we can plug in more spatial data for further exploration. Possibilities we didn't examine in this report, but are possible include: adding data on gas extraction wells, data on landfill cover infrastructure, or pulling in third party methane detection data such as Carbon Mapper, which detects methane plumes from space. The ability to see where landfills are experiencing methane exceedances from different sources of detection alongside their gas collection system infrastructure could generate effective insights on weaknesses in landfill gas systems, areas that need better or more frequent monitoring, or areas that DEQ needs to prioritize inspecting.

RESULTS AND DISCUSSION

Which Oregon landfills accepting municipal solid waste are complying with the DEQ rules adopted in 2021?

Oregon landfills are required to adhere to stricter DEQ requirements for methane management if they exceed 200,000 tons or more of lifetime waste-in-place and if their projected methane generation reaches 664 or more tons a year. Currently 11 Oregon landfills that are open and accepting municipal solid waste meet these metrics based on DEQ provided data (Table 1). Once a landfill reaches these thresholds, they are required to conduct surface emissions monitoring for four consecutive quarterly monitoring periods, with differing requirements thereafter if there is no measured concentration of methane of 200 ppm or greater are discovered during SEM.

Seven of the 11 MSW landfills are privately owned and operated while the other four are owned and operated by a county government. In total, all 11 landfills have a combined modeled methane generation of 169,943 tons in 2023, equivalent to the emissions of 1.6 billion gallons of gasoline burned.[23] The DEQ stated, "In 2017, six of the twenty-five largest stationary sources of GHG emissions in Oregon were landfills."[24] The seven private landfills were typically larger, occupying the top five ranked positions by total waste. On the other hand, the four public landfills held three of the bottom four slots by total waste. All 11 landfills are currently in operation and accepting municipal waste as of 2024.

Based on the numbers in Table 1 from Oregon DEQ, we would expect that all 11 Oregon MSW landfills would be subject to the stricter requirements of the state's current landfill emissions rules pertaining to conducting quarterly surface emissions monitoring. Through analyzing records and conversations with DEQ, we found that three landfills are not held to those higher standards. Each of these three landfills claimed unique circumstances specified below.

Examples of limited or non compliance:

1. Hillsboro Landfill, managed by Waste Management, Inc., was granted an exception to conducting surface emissions monitoring in its Title V operating permit by the DEQ, and does not have to comply with SEM requirements until April 2025. DEQ did not specify why.

2. Roseburg Landfill, managed by Douglas County, has not complied, and, as of May 2024, DEQ has stated they are looking into enforcement. We have not heard any developments since.

3. Baker Sanitary Landfill, managed by a local private company, claimed that its facility is two separate landfills, enabling it to divide its methane emissions between the two facilities and fall below the 664 tons threshold. DEQ has accepted this explanation although its own records present the landfill as one facility.

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[23] [22] OAR 340-239-700(3)(c). We first converted methane to a co2 equivalent of 84.
[24] [22] OAR 340-239-700(3)(c). , page 3

Table 1: Open Oregon MSW Landfills waste-in-place and Annual Methane Generation

Landfill, Owner-Operator	Owner-Operator Type	Total Lifetime Waste In Place (Tons)	Annual Methane Generation (Tons)
Columbia Ridge Landfill, WM	Private	64,358,280	43,497
Coffin Butte Landfill, Republic Services	Private	18,269,157	34,777
Hillsboro Landfill, Waste Management	Private	13,158,408	13,933
Finley Butte Landfill, Waste Connections	Private	13,158,408	13,933
Short Mountain Landfill, Lane County	County Government	11,750,975	13,042
Dry Creek Landfill, Waste Connections	Private	9,075,149	14,090
Wasco County Landfill, Waste Connections	Private	6,006,973	6,138
Knott Landfill, Deschutes County	County Government	4,642,663	3,826
Roseburg Landfill, Douglas County	County Government	3,696,825	35,058
Crook County Landfill, Crook County	County Government	1,116,102	739
Baker Landfill, Baker Sanitary Service	Private	766,113	778

Caption: The table features waste-in-place and methane generation rates for Oregon landfills accepting municipal solid waste while DEQ finalized rulemaking in 2021. Landfills highlighted in green were held to the updated SEM standards in 2023 and included in our analysis.

How much landfill surface area is being excluded from SEM?

We found that Oregon private landfill operators have excluded landfill areas from basic monitoring much more frequently than their publicly operated counterparts. During 2023 private landfills in Oregon exclude an average of 48.6% of landfill surface area from SEM each quarterly monitoring. On the other hand, county government operated landfills exclude an average of 10% surface area from SEM. We documented all exclusions, whether those exclusions have been shown to comply with Oregon rules or are more ambiguous.

Some landfills chose to give a reason for an exemption, and in other cases we were able to speculate a reason based on the design of the landfill. For example, we noticed Short Mountain, operated by Lane County, continuously did not monitor their asbestos pit, but did not specify that reason. In other cases, the landfill simply stated areas were exempt without providing a description and how a claimed exemption complies with the requirements, and we were unable to determine the criteria used to comply with exemption requests. Given this pattern, it was difficult to ascertain which exceptions were for working faces or other reasons consistently across all landfills. For this reason, we combined all exemptions to get a higher level view.

Table 2

Landfill, Operator	Private/Public	Quarter	Total Area (acres)	Exempted areas	% Excluded
Finley Butte, Waste Connections	Private	2023 - 1	140.08	37.52	26.78%
Finley Butte, Waste Connections	Private	2023 - 2	140.08	46.72	33.36%
Finley Butte, Waste Connections	Private	2023 - 3	140.08	80.92	57.77%

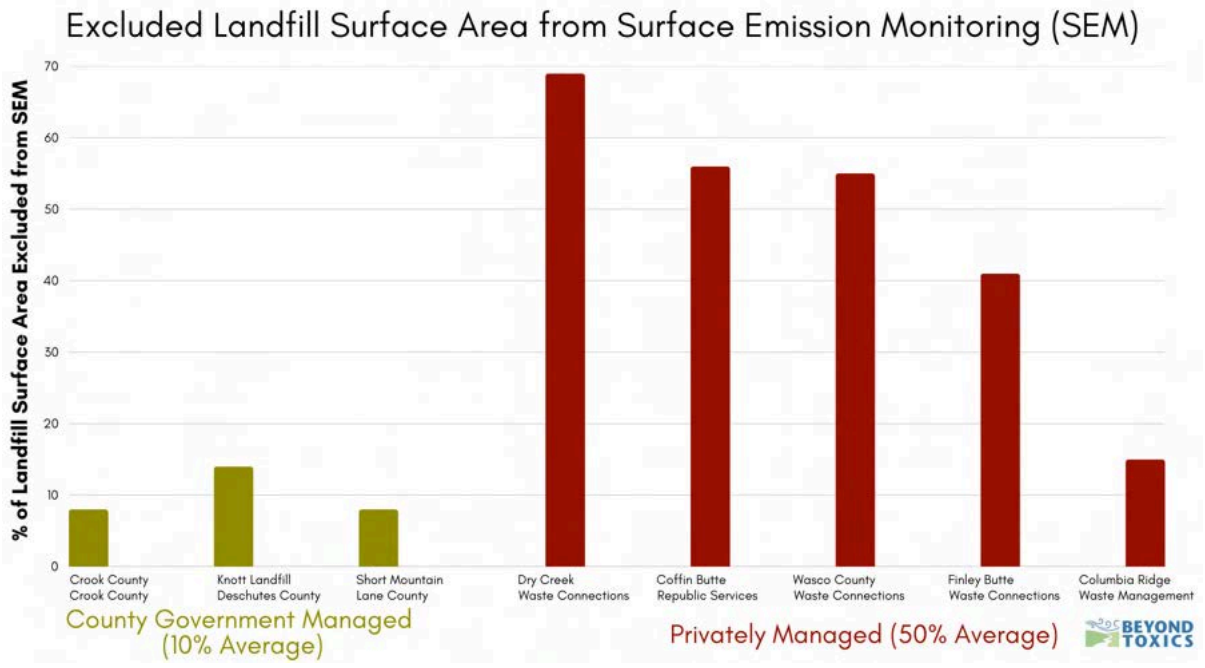
Finley Butte, Waste Connections	Private	2023 - 4	140.08	63.23	45.14%
Dry Creek, Waste Connections	Private	2023 - 1	85.86	59.62	69.45%
Dry Creek, Waste Connections	Private	2023 - 2	85.86	59.62	69.45%
Dry Creek, Waste Connections	Private	2023 - 3	85.86	59.62	69.45%
Dry Creek, Waste Connections	Private	2023 - 4	85.86	59.62	69.45%
Wasco County, Waste Connections	Private	2023 - 1	176.27	109.50	62.12%
Wasco County, Waste Connections	Private	2023 - 2	176.27	81.89	46.45%
Wasco County, Waste Connections	Private	2023 - 3	176.27	89.41	50.72%
Wasco County, Waste Connections	Private	2023 - 4	176.27	100.22	56.86%
Coffin Butte, Republic Services	Private	2023 - 1	136.34	84.21	61.77%
Coffin Butte, Republic Services	Private	2023 - 2	136.34	74.04	54.31%

Coffin Butte, Republic Services	Private	2023 - 3	136.34	74.04	54.31%
Coffin Butte, Republic Services	Private	2023 - 4	136.34	71.87	52.71%
Columbia Ridge, Waste Management	Private	2023 - 1	335.53	41.13	12.26%
Columbia Ridge, Waste Management	Private	2023 - 2	85.86	46.96	14.00%
Columbia Ridge, Waste Management	Private	2023 - 3	85.86	45.83	13.66%
Columbia Ridge, Waste Management	Private	2023 - 4	176.27	64.26	19.15%
Knott Landfill, Deschutes County	Public	2023 - 1	107.48	14.91	13.88%
Knott Landfill, Deschutes County	Public	2023 - 2	107.48	12.92	12.02%
Knott Landfill, Deschutes County	Public	2023 - 3	107.48	16.05	14.93%
Knott Landfill, Deschutes County	Public	2023 - 4	107.48	17.14	15.95%
Short Mountain, Lane County	Public	2023 - 1	111.34	9.30	8.35%
Short Mountain, Lane County	Public	2023 - 2	111.34	9.30	8.35%
Short Mountain, Lane County	Public	2023 - 3	111.34	9.30	8.35%

Short Mountain, Lane County	Public	2023 - 4	111.34	9.30	8.35%
Crook County. Crook County	Public	2023 - 1	84.52	5.82	6.88%
Crook County, Crook County	Public	2023 - 2	84.52	6.29	7.44%
Crook County, Crook County	Public	2023 - 3	84.52	6.96	8.23%
Crook County, Crook County	Public	2023 - 4	84.52	6.50	7.69%

The table above features the eight landfills following stricter SEM protocols and the data we were able to derive from their reports. Note that the working face is included in exemptions for SEM because most landfills did not specify the location and why an area of land was exempt. Total acres for landfills did not change over the course of a year because operators did not add any landfill surface area.

Figure 2.



Caption: The bar graph shows the average percentage of landfill surface area omitted from SEM by landfill site. Privately operated landfills for the most part excluded far more surface area than their government operated counterparts.

Our study found that the five private MSW landfills we analyzed on average omit nearly half (48.6%) of surface area from SEM every quarter (as opposed to the whole year together), leaving operators and regulatory agencies blind to vast portions of the landfill and the emissions emanating from them. While some of these exemptions might be intended to keep workers safe or are legally permissible, the large amount of surface area excluded raises questions as to whether private landfill operators are improperly excluding land from SEM. We found that 75% ofpublic landfills specified their exemptions for the working face, asbestos pits, or gravel and soil stockpiles, which totaled to an average of 10% of landfill surface areas. We were able to cross reference the fourth landfill based on other information they included in their report. On the other hand no private landfills specified the reason for exemptions in 2023 reports. The wide gap between private and public facilities may be an indication of non or limited compliance on the part of private waste corporations.

Examples of reasons given for not conducting surface emissions monitoring on certain areas

1. Waste Connections in Medford exempted 69% of its landfill, Dry Creek, from SEM monitoring without explanation. These areas all had final grade slopes, which could possibly be argued are too steep for monitoring. However, the EPA has stated that regular final grade side slopes of a landfill are not to be exempted.[25]

2. Owner-operator Waste Connections in Boardman, Oregon, chose not to monitor portions of the Finley Butte landfill that the U.S. EPA had monitored in June 2022. Waste Connections repeatedly denied the need to monitor anywhere they had placed waste in the last five years, even if that section of the landfill had waste older than five years. (Five years after waste is placed is the federal regulatory requirement to start SEM monitoring). Owner-operators then argued that the EPA should have never inspected that area due to safety concerns, even though they had never warned EPA of any safety concerns while accompanying them during their inspection. In 2023, Finley Butte Landfill continued to exclude those areas from monitoring.[26]

[25] Environmental Protection Agency. (2024, September 25). Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements. EPA Investigations Find Municipal Solid Waste Landfill Operators Are Failing to Properly Conduct Compliant Monitoring and Maintenance of Gas Collection and Control System. https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

[26] Environmental Protection Agency & Daniel Heins. (2022). Clean Air Act Inspection Report Republic Services Waste Connections Finley Buttes Landfill, Boardman Oregon. EPA Region 10.

3 Republic Services, the owner-operator of Coffin Butte landfill near Corvallis, Oregon, argued 30-40 acres[27] of its landfill had too much vegetation to monitor. We would emphasize the owner-operators chose not to maintain the vegetation, which means this is a problem they created. Vegetation breaks through the upper cover material which would be highly prone to methane leakage (figure 3).

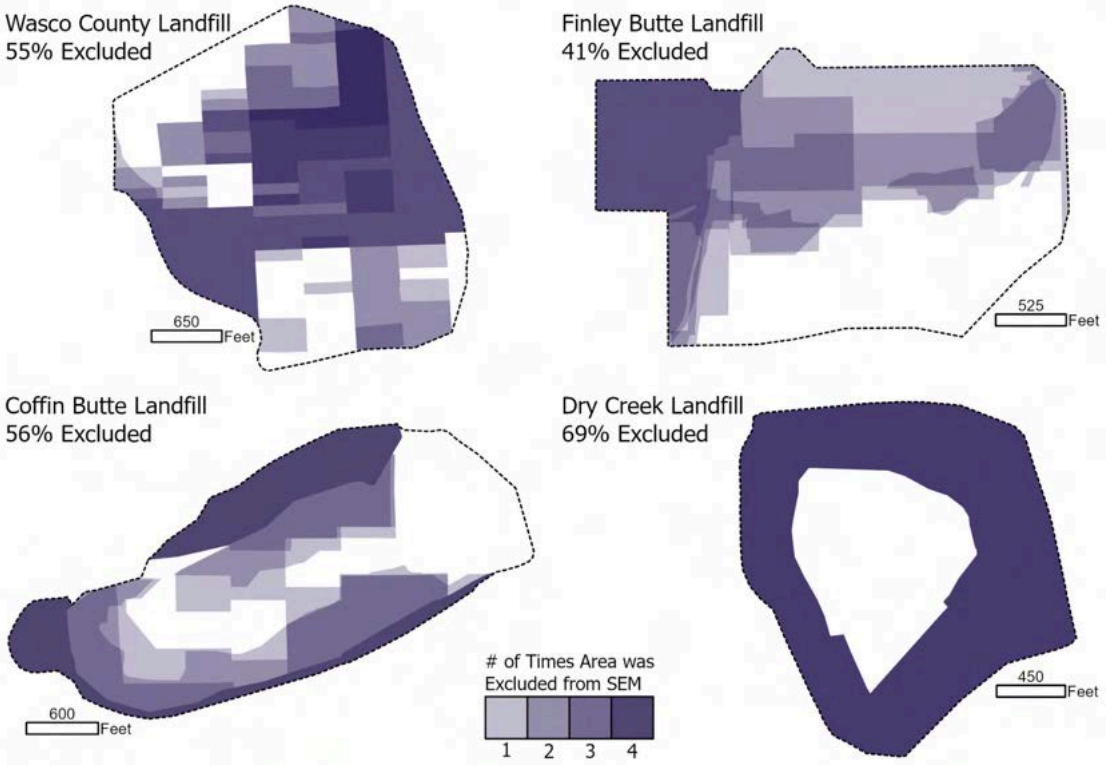


Caption: The EPA found multiple instances of vegetation growing through the tarp of the Coffin Butte landfill in both 2022 and 2024. The picture is one such example. The EPA measured methane at 1,000 ppm, twice the regulatory limit, near the base of the plant. Operators are supposed to constantly monitor the tarp integrity to ensure that there are no areas where methane could be leaking.

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[27] Coffin Butte specifically exempted 40 acres in quarter 3 2022 and 30 acres in quarter 4 for high vegetation (both outside of our study). However, they continued to exempt the same areas in 2023, which spans the duration of our study, but they decline to specify the reason. We assume they are exempting those areas for the same reason based on satellite imagery from the times of inspection in 2023.

Figure 2



Caption: The maps feature four privately operated Oregon landfills with waste deposits outlined in black dotted lines. Each exempted area for the four quarterly reports in 2024 is layered and features where operators did not conduct SEM. The darker the shade of violet, the more frequently the area of the landfill went unmonitored. Oregon's private landfills excluded an average of 48.6% of landfill surface area from each quarterly monitoring.

Oregon rules exempt "the working face of the landfill to areas of the landfill surface where the landfill cover material has been removed and solid waste has been exposed for the purpose of installing, expanding, replacing, or repairing components of the landfill gas, leachate, or gas condensate collection and removal system, for conducting a remedial action, or for law enforcement activities requiring excavation. Rules specify this exclusion should be kept to the minimum size and time duration as possible."[28]

However, Oregon rules also allow for an alternative monitoring plan for "Alternative walking patterns to address potential safety and other issues, such as: steep or slippery slopes, monitoring instrument obstructions, and physical obstructions" approved by DEQ.

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[28] https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=6533

The reports we analyzed did not include information or details on alternative monitoring plans approved by DEQ, so it's difficult to evaluate exactly what agreements are made between private owner-operators and DEQ. Regardless, the large disparity between private and public owner-operators calls for further scrutiny by the DEQ for how and when they allow exceptions to SEM. As of now, the agency and public are completely blind to what is happening on 48.6% of private landfill surface areas. Large swaths of preventable methane leaks may be and likely are going undetected and unrepaired.

Further Limitations of SEM

Excluding large portions of landfills from any SEM is one demonstrated method of reducing the efficacy of methane monitoring. Not only can operators avoid conducting SEM over vast swaths of landfills, the EPA has repeatedly observed poor practices of operating SEM equipment. The EPA recently stated there is a massive gap in the monitoring methodology used by private operators and regulatory agency staff.[29] When conducting limited SEM, as part of inspections of several Oregon MSW landfills in 2022 and 2024, U.S. EPA inspectors found glaring issues with private operators including failing to use SEM equipment at a proper height leading to underrepresented emissions, ignoring protruding waste piercing through landfill cover, not monitoring leachate clean outs and gas wells, and more.[30] These led to landfills filing reports appearing to have fewer methane leaks of lesser severity. For example, at the Coffin Butte landfill owned and operated by Republic Services, a 2022 EPA inspection report stated that "despite Republic having seen no more than six exceedances in the recent SEM reports supplied ahead of the inspection that included penetration monitoring, including reports with zero exceedances, the EPA identified 61 points in exceedance of legal limit of 500 ppm, including 21 points above 10,000 ppm."[31]

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[29] Environmental Protection Agency. (2024, September 25). Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements. EPA Investigations Find Municipal Solid Waste Landfill Operators Are Failing to Properly Conduct Compliant Monitoring and Maintenance of Gas Collection and Control System. https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

[30] Environmental Protection Agency & Daniel Heins. (2022). Clean Air Act Inspection Report Waste Connections Finley Butte Landfill, Boardman Oregon. EPA Region 10.

[31] Environmental Protection Agency & Daniel Heins. (2022). Clean Air Act Inspection Report Republic Services Coffin Butte Landfill, Corvallis Oregon. EPA Region 10.

Coffin Butte was not alone. The EPA also found glaring issues at Finley Butte landfill and Wasco County landfill both operated by Waste Connections. EPA inspectors found multiple large pieces of waste protruding through the cover, including wind turbine blade parts and tires, compromising the integrity of Finley Butte's landfill tarp cover.[32] At Wasco County, inspectors noted that the landfill operator had failed to keep adequate records of organic waste, which artificially reduced the projected methane emissions from LandGEM modeling.[33] These are three of the 100 landfills the EPA inspected across the nation before the agency put out an alert of widespread noncompliance with SEM rules.[34]

Recommendation: There are a variety of ready-to-go solutions that Oregon's regulatory agency can leverage to improve SEM and methane emissions prevention. For the immediate future, state regulators should immediately follow-up with MSW landfill operators, require explanations for areas excluded from monitoring and ensure that operators are following state regulations. Further, there are available advanced sensing technologies such as fixed methane sensors and drones that can comprehensively monitor large areas with greater frequency, including steep slopes and areas with vegetation, to provide Oregon operators and regulators with the missing information they need to find and mitigate methane leaks.

Are landfill operators monitoring in a walking 25-foot grid pattern, per state regulatory requirements?

Oregon requires that operators conduct SEM every 25 feet of a landfill over the course of a year. An operator can accomplish this by monitoring every 25 feet every quarter. Or, they can monitor every 100 feet every quarter, then offset that path by 25 feet for each consecutive quarter, so that by the end of the year every 25 feet has been covered. Notably, this rule was not followed in areas that were marked as exempt one or more times in a year.

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[32] Environmental Protection Agency & Daniel Heins. (2022). Clean Air Act Inspection Report Republic Services Waste Connections Finley Buttes Landfill, Boardman Oregon. EPA Region 10.
[32] Environmental Protection Agency & Daniel Heins. (2022). Clean Air Act Inspection Report Republic Services Waste Connections Wasco County Landfill, The Dalles Oregon. EPA Region 10.
[33]Environmental Protection Agency. (2024, September 25). Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements. EPA Investigations Find Municipal Solid Waste Landfill Operators Are Failing to Properly Conduct Compliant Monitoring and Maintenance of Gas Collection and Control System. https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance
[34] Environmental Protection Agency. (2024, September 25). Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements. EPA Investigations Find Municipal Solid Waste Landfill Operators Are Failing to Properly Conduct Compliant Monitoring and Maintenance of Gas Collection and Control System. https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

Five of the eight landfill operators did not report the GPS route they took to conduct SEM. Unfortunately, they are not required to report this information by Oregon rule. In our analysis of walking 25-foot grid patterns, we focused on landfill reports that provided actual monitoring paths because actual monitoring each quarter differs substantially from planned monitoring paths (see Figure 4).

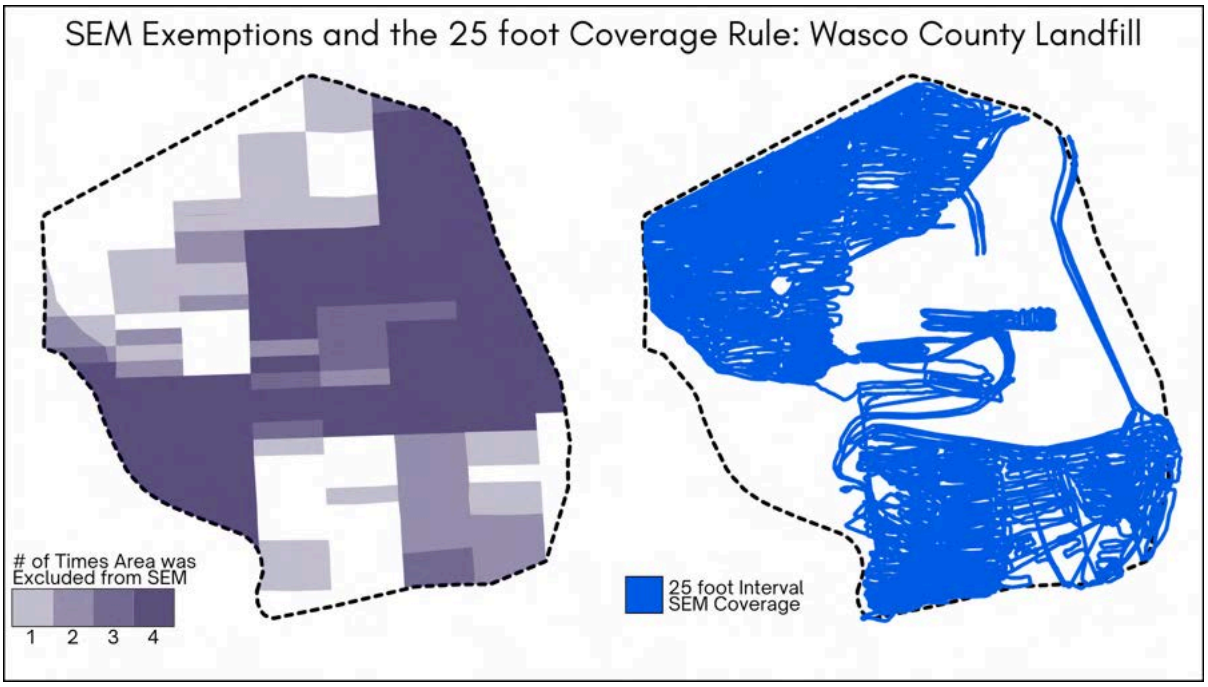
Figure 4 - Planned SEM route Differs Greatly from Actual SEM route



Caption: The first frame of the figure features a planned SEM path that the Coffin Butte Landfill operator submitted to the DEQ. The second frame is a map of the actual GPS tracked SEM route. We can see far less of the landfill was actually monitored with the GPS path than the estimated route. These GPS referenced paths are much more accurate than planned routes when evaluating the comprehensiveness of SEM.

Only three out of eight MSW landfills (Coffin Butte, Finley Butte, and Wasco County) that conducted SEM voluntarily reported the GPS tracked SEM monitoring path. Our analysis found that, for the most part, those landfill operators that shared their SEM traversed path in reports appeared to have followed this rule with some room for improvement and one substantial failure. Given many of these operators excluded substantial surface area of their landfill from any SEM (see above section), the 25 foot rule was often not followed in areas that were excluded one or more times (Figure 5).

Figure 5



Caption: On the left is Waste Connections' exempted areas for Wasco County Landfill in 2023. The darker shade of violet, the more often that area was excluded from SEM over the course of the year. On the right, the graphic shows how the 25 foot rule was followed. If an area is completely blue, the 25 foot rule was followed. Gaps of white show where operators failed to monitor every 25 feet. By comparing the two graphics, we can see that operators most consistently met the 25 foot rule in areas that were monitored all four quarters. We can also observe the inverse relationship. The more often operators excluded an area from SEM, the more that area failed to follow the 25 foot rule.

Recommendation: This can easily be remedied by adding GPS tracked SEM paths to the recordkeeping and reporting requirements in OAR 340-239-0700, and a similar mechanism at the federal level. It would be beneficial to require that this data is not only reported in print form, but also in some spatial data format (shapefile, GeoJSON, etc.). The reason for this is Oregon does not require monitoring every 25 feet every quarter. Rather, they require that over the course of a calendar year, every 25 feet of a landfill is monitored. Having access to the spatial data will allow regulatory agencies to view all quarterly monitoring paths and results at once, and quickly verify the results.

Are landfill operators conducting integrated monitoring and reporting results?

Integrated monitoring is a key early identification monitoring strategy to identify where there are problematic methane emissions. It involves dividing the landfill into an integrated monitoring grid of 50,000 square foot cells, an area slightly smaller than a football field. After conducting SEM looking for individual, instantaneous exceedances of 500 ppm, the operators create an aggravate reading for each 50,000 square foot cell by averaging all individual SEM readings within each grid. If a grid has an aggregate SEM average above 25 ppm, then the landfill needs to perform remediation and do follow up SEM to ensure the average falls below 25 ppm.[35] State regulations require the landfill to report integrated monitoring exceedances over 25 ppm. State regulations do not specifically require the reporting of operators' integrated monitoring grids or non-exceedance integrated monitoring results. The requirements only stipulate that operators must tell DEQ if they have a 50,000 square foot cell exceeding 25 ppm.

Given that, we found that seven out of eight landfills reported at least some integrated monitoring result. Two of those landfills only reported their grid cells that exceeded 25 ppm as legally required. Five out of eight voluntarily shared all of their integrated monitoring results – the average SEM reading for each grid cell including their exceedances of 25 ppm.[36] The last landfill either did not have a 25 ppm integrated exceedance, or it simply did not report any data

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[35] https://www.oregon.gov/deq/EQCdocs/100121_I_Slides.pdf

[36] https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=6533 340-239-0700, 3(c) Semi-Annual Report. A landfill owner or operator subject to this rule, must prepare semi-annual reports for the periods of January 1 through June 30 of each year, unless otherwise approved in writing by DEQ. The Semi-Annual Report will be due on July 30, unless otherwise approved in writing by DEQ. The Semi-Annual Report must contain the following information:

Figure 6



Caption: The above graphic was submitted to DEQ by Waste Management at Columbia Ridge landfill showing how they divided the landfill into 50,000 square foot grids for their integrated monitoring results. In the full report, the operator submitted a table with each grid numbered and the associated average SEM reading result. Ideally, operators should be required to report this information to DEQ. Columbia Ridge is an example of data reporting that should be required by law.

Oregon Administrative Rules do not require operators to report the grid or integrated monitoring results unless a grid exceeds 25 ppm. We strongly recommend regulatory agencies require this basic information and they add a requirement for it to be in a spatial data format. We also recommend agencies require all SEM measurements and the coordinate it was recorded at (also in spatial data). Some landfills already report this information, but it's in a print table, which is too time intensive for a state agency to turn into spatial data.

Recommendation: Given the U.S. EPA's findings of widespread noncompliance, and as the climate crisis intensifies, Oregon DEQ needs to take a stronger stance in monitoring operators. DEQ should require operators to transfer the data they generate for annual and semiannual reports directly into spatial data formats.

We also recommend that regulators require spatial data on the location of gas extraction wells. Oregon DEQ could then visualize all of this data (integrated monitoring, instantaneous monitoring, SEM paths, Gas Collection and Control infrastructure, leaks detected by satellites, etc.) simultaneously using GIS software. This is important because it allows them to efficiently identify gaps in methane gas collection infrastructure and SEM results including exceedances and integrated monitoring measurements. Regulatory agencies need a complete picture of the puzzle, and allowing operators to spread those puzzle pieces across different reports and in unusable formats wastes public agencies' resources and hinders their ability to conduct oversight.

The Limits of SEM: Additional Solutions to Mitigating and Preventing Landfill Methane

SEM is a critical tool for identifying and mitigating methane leaks from landfills. However, there are more solutions already in use that operators and regulators can leverage to more effectively prevent harmful air emissions. Remote sensing, both passive (solar spectrometer) and active (Lidar), are promising avenues to enhance methane monitoring. Sensors are mounted on planes, satellites, and even drones, which then fly over landfills and detect methane plumes and concentrations at various scales depending on the air/spacecraft and instrument.

The White House National Strategy to Advance an Integrated U.S. Greenhouse Gas Measurement, Monitoring, and Information System notes that remote sensing has found many preventable methane leaks that are currently going undetected by traditional SEM.[37] Recent findings from remote sensing technology have demonstrated that methane emissions are much higher than formula estimates by the EPA.[38] Remote sensing technology has been used to reduce methane emissions and associated environmental justice burdens posed by other air pollutants associated with methane leaks.[39]

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[37] Greenhouse Gas Monitoring and Measurement Interagency Working group. (2023). National Strategy To Advance an Integrated U.S. Greenhouse Gas Measurement, Monitoring, and Information System. The White House. https://www.whitehouse.gov/wp-content/uploads/2023/11/NationalGHGMMISStrategy-2023.pdf
[38] Daniel H. Cusworth et al., Quantifying methane emissions from United States landfills.Science383,1499-1504(2024).DOI:10.1126/science.adi7735
[39] Daniel H Cusworth et al 2020 Environ. Res. Lett. 15 054012

There are readily available advanced methane detection technologies that can detect and pinpoint methane leaks at landfills, as illustrated in EPA's draft White Papers issued in Fall 2024, EPA's Landfill Methane Emissions Workshop in April 2021, EPA's Methane Detection Workshop in August 2021, CARB's Public Workshop on Landfill Methane Emissions in California in December 2022, and EPA's LMOP Webinar on Detecting Landfill Methane Emissions with Drones in September 2023.[40] Technology providers with drone surveying capabilities at landfills include ABB, Aerometrex, Bridger Photonics, Project Canary, Scientific Aviation, SeekOps, and SnifferDrone, among others. Airborne and satellite remote sensing are currently offered by Carbon Mapper and GHG Sat. Drones can survey a full landfill footprint with precision using point sensing or active imaging, measuring methane concentration in parts per million (ppm) or parts per million per meter (ppm-m). One drone provider has its technology deployed at over 150 landfills nationwide.[41] Stationary and land-based methane sensors can be placed strategically to support rapid and ongoing leak detection and repair on the active working face. These methods are the next wave in "smart" landfill design and can identify methane hot spots via always-on sensors on low towers or tripods on the landfill surface – meaning a methane spike can be found and dealt with quickly.

Recommendation: Oregon policymakers should ensure landfills move into the 21st century by requiring advanced methane sensing technology deployment that makes methane emissions visible, accurate and actionable. Both California and Colorado are building out programs that require owner-operators to respond to methane leaks detected by satellites orbiting the earth operated by third party institutions such as Carbon Mapper and GHG Sat.[42]

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[40]Greenhouse Gas Monitoring and Measurement Interagency Working group. (2023). National Strategy To Advance an Integrated U.S. Greenhouse Gas Measurement, Monitoring, and Information System. The White House. https://www.whitehouse.gov/wp-content/uploads/2023/11/NationalGHGMMISStrategy-2023.pdf
[41]Greenhouse Gas Monitoring and Measurement Interagency Working group. (2023). National Strategy To Advance an Integrated U.S. Greenhouse Gas Measurement, Monitoring, and Information System. The White House. https://www.whitehouse.gov/wp-content/uploads/2023/11/NationalGHGMMISStrategy-2023.pdf
[42] https://carbonmapper.org/ and https://www.ghgsat.com/en/

Diverting Organic Waste

Given that methane generation is the byproduct of placing organic waste in landfills, an obvious solution is to stop placing organic waste into landfills. Food rescue, food waste as an animal feedstock, composting food waste, placing synthetic organics (inorganic/organic hybrids for example carpet) in anaerobic digesters, and other forms of waste sorting are desirable alternatives to landfilling or incineration. These strategies preserve space in landfills for other uses, preventing or significantly delaying the need for landfill expansions and, depending on the policy, make progress towards zero-waste circular economies.

It's critical to note that methane is generated over the course of decades. Therefore, while organic diversion is an important solution to implement, we will need to monitor and mitigate methane from active and closed landfills decades into the future regardless.

CONCLUSION

In this report, we analyzed 36 Surface Emissions Monitoring (SEM) reports from eight currently operating municipal solid waste landfills in Oregon. We found that landfills in Oregon have varying levels of compliance with state regulations. Additionally, although legal, owner-operators under-report key pieces of information, which make it hard for regulators to ensure full compliance with the law. The Oregon DEQ needs to act quickly to remedy this situation by requiring owner-operators to monitor larger sections of their landfills and use other forms of monitoring when walking SEM is not possible or to support walking SEM with early identification of leaking emissions. Landfills are responsible for 90% of Oregon's industriously produced methane emissions ahead of both enteric fermentation (cattle) and the oil and gas sector. Curbing the pollutant is key to mitigating climate damage in the immediate future. The technology is available, and taking advantage of it is low hanging fruit for fighting the climate crisis.

Recommendations Review:

1. Use Advanced Methane Sensing Technology. Gathering this comprehensive data set will lead to rapid mitigation of super-emitter leaks, improved methane capture for use in local energy generation or methane destruction through enclosed flaring.

- The Oregon Department of Environmental Quality (DEQ)[43] should immediately move to require the use of advanced methane detection technology such as drones.

- Require landfill operators to respond to third party satellite methane detection systems, which provide comprehensive and more accurate measurements of the concentration of methane plumes, the direction of methane plumes off the landfill property, and the exact location of emission exceedances from landfills.

2. Update regulations to require Surface Emissions Monitoring (SEM) on all areas of landfills

    - Require fixed monitors for real time methane tracking in unsafe or other areas to ensure full coverage and to protect workers from hazards of conducting walking SEM. This requirement should also be instituted for landfills with high volumes of odor complaints from nearby communities.

    - Include steep slopes, closed cells, locations with covering vegetation and unspecified exemptions.

    - Actionable emissions data combined with mitigation strategies such as vertical and horizontal gas collection is critical for reducing greenhouse gas impacts and associated air toxics such as VOCs, hydrogen sulfide, forever chemicals and fine particulate matter thereby improving air quality and climate mitigation.

3. Oregon DEQ should immediately address reporting gaps by updating their regulations to require landfill owners and operators who are required to conduct surface emissions monitoring to:

    - Report all data in a spatial data format such as a shapefile, which makes for more efficient analysis of data gathered through surface emissions monitoring.

    - Report and identify the areas exempted from monitoring and report the reasons for those exemptions.

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[43] Throughout this report we emphasize Oregon because these are the arenas at which Beyond Toxics focuses their advocacy. Our findings could be replicable in other states. Thus regulatory recommendations are likely also applicable to other U.S. states.

- Report measured concentration of methane in ppm for each instantaneous SEM reading and integrated monitoring results.
- The SEM path walked by operators.
- Gas Control and Collection System Infrastructure– Gas extraction wells, piping, landfill cover.

4. To prevent future potent methane emissions, advance mandatory organic diversion policies requiring consumers and haulers to sort organic waste so that food waste can be used as a resource that is sent to facilities other than landfills to make compost and other products thereby preventing future generation of methane in landfills.

Acknowledgements

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REPUBLIC SERVICES

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July 21, 2023

Ms. Suzy Luttrell
Oregon Department of Environmental Quality
Air Quality Division
4026 Fairview Industrial Drive
Salem, OR 97302

Re: Semi-Annual Report
Coffin Butte Landfill
Operating Permit No. 02-9502-TV-01
Project No. 0120-174-50-38-08

Dear Ms. Luttrell:

Pursuant to the State of Oregon Department of Environmental Quality (ODEQ) Oregon Administrative Rule (OAR) 340-239-0700(3)(c), Valley Landfills, Inc. submits the original and two copies of the enclosed Semi-Annual Report for Coffin Butte Landfill. This report is being submitted to cover the period of January 1, 2023 through June 30, 2023.

If you have any questions or comments, please do not hesitate to contact us at 720.529.0132.

Sincerely,
Valley Landfills, Inc.

Bret Davis
General Manager

Attachment

cc: United States EPA, Region X, Air Operating Permits, OAQ1-08
Melissa Green, Weaver Consultants Group *(via email)*

RECEIVED
JUL 26 2023
DEQ-SALEM OFFICE

COFFIN BUTTE LANDFILL

SEMI-ANNUAL REPORT

PREPARED FOR

VALLEY LANDFILLS, INC.

July 21, 2023

PREPARED BY

Weaver Consultants Group

TABLE OF CONTENTS

1 INTRODUCTION 1

2 SEMI-ANNUAL REPORTING REQUIREMENTS 2

§340-239-0700(3)(c)(A) – Monitoring and Exceedances 2
§340-239-0700(3)(c)(B) – Corrective Action Analysis 4
§340-239-0700(3)(c)(C) – Subsurface Landfill Fire(s) 4
§340-239-0700(3)(c)(D) – Deviations 4
§340-239-0700(3)(c)(E) – Bypass line 5
§340-239-0700(3)(c)(F) – Control Device or Treatment System Downtime 5
§340-239-0700(3)(c)(G) – Collection System Downtime 5
§340-239-0700(3)(c)(H) – Collection System Expansion 5
§340-239-0700(3)(c)(I) – Enhanced Monitoring 6
§340-239-0700(3)(c)(J) – Enclosed Combustors 6
§340-239-0700(3)(c)(K) – Boilers or Process Heaters 6

3 ADDITIONAL REPORTING/RECORDKEEPING 7

§340-239-0600(3)(b)(E)(5) – Monitoring System Malfunctions 7

4 LIMITATIONS 8

APPENDICES

Appendix A Surface Emission Monitoring
Appendix B Wellfield Pressure Exceedance Report
Appendix C Control Device Downtime Log/Treatment System Downtime Log
Appendix D Collection System Downtime Log
Appendix E GCCS Expansion/Current Site GCCS Layout

1 INTRODUCTION

The Coffin Butte Landfill is a municipal solid waste (MSW) landfill located in Benton County, Oregon and is owned by Valley Landfills, Inc (VLI). The facility is subject to the Semi-Annual Report requirements of Oregon Department of Environmental Quality (ODEQ) Oregon Administrative Rule (OAR) 340-239-0700(3)(c). This Semi-Annual Report covers the period of January 1, 2023 through June 30, 2023.

2 SEMI-ANNUAL REPORTING REQUIREMENTS

Records are prepared and maintained in accordance with OAR 340-239-0700(3)(c). The primary location for records storage is the Coffin Butte Landfill. Coffin Butte Landfill is submitting this Semi-Annual Report in accordance with OAR 340-239-0700(3)(c).

§340-239-0700(3)(c)(A) – Monitoring and Exceedances

> All instantaneous surface readings of 100 ppmv or greater. All exceedances of the limits in OAR 340-239-0100(6)(b), 340-239-0200 and 340-239-0600(2)(c) including the location of the leak (or affected grid), leak concentration in ppmv, date and time of measurement, the action taken to repair the leak, date of repair, any required remonitoring and the remonitored concentration in ppmv, wind speed during surface sampling, the concentration recorded at each location for which an exceedance was recorded in the previous month, and the installation date and location of each well installed as part of a gas collection system expansion.

§340-239-0100(6)(b) – Methane Generation Rate Exceedances

> Demonstrate that after four consecutive quarterly monitoring periods there is no measured concentration of methane of 200 parts per million by volume (ppmv) or greater using the instantaneous surface monitoring procedures specified in OAR 340-239-0800(3). The owner or operator of the landfill must begin quarterly monitoring within 90 days after the Methane Generation Rate Report is required to be submitted under section (1) or (2) of this rule or OAR 340-239-0100(6) and submit Instantaneous Surface Monitoring Reports according to OAR 340-239-0700(3)(l).

Quarterly instantaneous surface emissions monitoring (SEM) was performed at the landfill by SCS Field Services (SCS) personnel.

The first quarter instantaneous SEM monitoring results are included in the SEM Report provided in Appendix A. The second quarter instantaneous SEM monitoring results will be provided in the next semi-annual report.

§340-239-0200 – Compliance Standards

> When required as provided in OAR 340-239-0100 through 340-239-0800, the owner or operator of a landfill must comply with this rule.
>
> (1) Surface Emission Methane Concentration Limits. Except as provided in OAR 340-239-0110(4), 340-239-0110(5), 340-239-0300, and 340-239-0600(1), beginning August 1, 2022, or upon commencing operation of a newly installed gas collection and control system or modification of an existing gas collection and control system pursuant to OAR 340-239-0110(1), whichever is later, no location on the landfill surface may exceed either of the following methane concentration limits:
>
> (a) 500 ppmv, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring conducted in accordance with OAR 340-239-0800(3)(b);

(b) An average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring conducted in accordance with OAR 340-239-800(3)(c).

Quarterly integrated SEM was performed at the landfill by SCS personnel.

The first quarter integrated SEM monitoring results are included in the SEM Report provided in Appendix A. The second quarter integrated SEM monitoring results will be provided in the next semi-annual report.

§340-239-0200(2) – Wellhead Gauge Pressure Requirement

Operate the collection system with negative pressure at each wellhead

On a monthly basis, operations and maintenance personnel measure the gauge pressure at each wellhead. The gauge pressure taken at the wellhead is used in determining the presence of vacuum at the collector. The wellfield pressure exceedance report is provided in Appendix B.

§340-239-0200(3) – Wellhead Temperature Requirement

Each landfill gas collection and control system interior wellhead in the collection system must be operated with a landfill gas temperature less than 62.8 degrees Celsius (145 degrees Fahrenheit).

Each LFG collector is equipped with an access port for measuring temperature at each wellhead. On a monthly basis, operations and maintenance personnel measure the temperature at each wellhead. All wells operated below 145 °F during the reporting period. Therefore, a temperature wellfield exceedance report is not applicable during this reporting report.

§340-239-0600(2)(c) – Gas Control System Equipment Monitoring

Components containing landfill gas and under positive pressure must be monitored quarterly for leaks. Any component leak over 500 ppmv methane must be tagged and repaired within 10 days. Any component leak over 250 ppmv must be recorded pursuant to OAR 340-239-0700(2)(a)(S). Quarterly component leak testing at landfills having landfill gas-to-energy facilities may be conducted prior to scheduled maintenance or planned outage periods.

SCS performed the first quarter gas control system equipment monitoring on March 8, 2023. No locations exceeding the 500 ppmv threshold were observed during the monitoring event. The gas control system equipment monitoring results are included in the first quarter SEM Report, included as Appendix A.

SCS performed the second quarter gas control system equipment monitoring throughout the second quarter of 2023. The gas control system equipment monitoring results for the second quarter will be provided in the next semi-annual report.

§340-239-0700(3)(c)(B) – Corrective Action Analysis

> For any corrective action analysis for which corrective actions are required in OAR 340-239-0600(3)(a) and 340-239-0600(3)(b) and that take more than 60 days to correct the exceedance, the root cause analysis conducted, including a description of the recommended corrective action(s), the date for corrective action(s) already completed following the positive pressure or elevated temperature reading, and, for action(s) not already completed, a schedule for implementation, including proposed commencement and completion dates.

During the reporting period all exceedances were within 0 to 60 days, except for the wells operating under the site's approved Alternative Monitoring Plan. The corrective action and root cause analysis are not applicable to wells operating under an approved plan.

§340-239-0700(3)(c)(C) – Subsurface Landfill Fire(s)

> All known, prevented, or suspected subsurface landfill fire(s) along with potential causes and any efforts conducted to avoid or put out the fire(s). Any positive pressure readings that may have contributed to the known, prevented, or suspected fire.

During the reporting period, no subsurface landfill fire(s) occurred.

§340-239-0700(3)(c)(D) – Deviations

> The number of times that applicable parameters monitored under OAR 340-239-0110(2) or 340-239-0200, were exceeded and when the gas collection and control system was not operating in compliance with OAR 340-0110(2)(a) including periods of startup, shutdown, and malfunction. For each instance, report the date, time, and duration of each exceedance. Where an owner or operator subject to the requirements of this division is demonstrating compliance with the operational standard for temperature OAR 340-239-0600(3)(b), the owner or operator must provide a statement of the wellhead operational standard for temperature and oxygen the landfill is complying with for the period covered by the report.

During this reporting period, there were no times that applicable parameters monitored under OAR 340-239-0110(2) or 340-239-0200 were exceeded. There were also no times when the gas collection and control system (GCCS) was not operating in compliance with OAR 340-0110(2).

> (i) The number of times each of those parameters monitored under OAR 340-239-0600(3)(b), were exceeded. For each instance, report the date, time, and duration of each exceedance.

During the reporting period, no temperature exceedances occurred.

> (ii) The number of times the parameters for the site-specific treatment system in OAR 340-239-0110(2)(d)(C) were exceeded.
>
> **§340-239-0110(2)(d)(C)** – Route the collected gas to a treatment system that processes the collected gas for subsequent sale or use. Venting of treated landfill gas to the ambient air is not allowed. If the treated landfill gas cannot be routed for subsequent sale or beneficial use, then the treated landfill gas must be controlled according to either subsection (2)(b), (2)(c) or

(2)(d) of this rule. All emissions vented to the atmosphere from the gas treatment system are subject to the requirements of subsection (2)(b) or (2)(c) of this rule.

In accordance with §340-239-0110(2)(d)(C), PNGC Power owns and operates a landfill treatment system at the landfill that processes the collected gas for subsequent sale or beneficial use. There are no vents within the treatment system that allow venting of gas to the atmosphere. The treatment system is not designed nor equipped to bypass the control devices. A calibrated flow meter was installed to measure flow to the treatment system. PNGC Power maintains and operates all monitoring systems associated with the treatment system in accordance with the PNGC Power site-specific treatment system monitoring plan required by §340-239-0700(2)(b)(H)(ii). During this reporting period there were no parameter exceedances of the Treatment Monitoring Plan.

§340-239-0700(3)(c)(E) – Bypass line

Description and duration of all periods when the gas stream was diverted from the control device or treatment system through a bypass line or the indication of bypass flow as specified OAR 340-239-0110(2)(c).

The gas collection system is not designed nor equipped to bypass the control devices; therefore, §340-239-0700(2)(c)(E) is not applicable.

§340-239-0700(3)(c)(F) – Control Device or Treatment System Downtime

Description and duration of all periods when the control device or treatment system was not operating and length of time the control device or treatment system was not operating.

The tables provided in Appendix C summarize all the periods when the control device was not operating.

§340-239-0700(3)(c)(G) – Collection System Downtime

All periods when the collection system was not operating.

The table provided in Appendix D summarizes all the periods when the collection system was not operating.

§340-239-0700(3)(c)(H) – Collection System Expansion

The date of installation and the location of each well or collection system expansion.

During this reporting period, the GCCS was expanded by adding ten new extraction wells. The new wells are adding to the performance of the GCCS. During this reporting period, seven extraction wells were decommissioned. Appendix E contains an updated site layout

showing the approximate locations of the new wells and a table with their installation dates.

§340-239-0700(3)(c)(I) – Enhanced Monitoring

> Each owner or operator required to conduct enhanced monitoring in accordance with OAR 340-239-0800(8) for temperatures exceeding 62.8 degrees Celsius (145 degrees Fahrenheit) must include the results of all monitoring activities conducted during the period.

During the reporting period, no temperature exceedances occurred.

§340-239-0700(3)(c)(J) – Enclosed Combustors

> For enclosed combustors except for boilers and process heaters with design heat input capacity of 44 megawatts per hour (150 million British thermal units per hour) or greater, all three-hour periods of operation during which the average temperature was more than 28 degrees Celsius (82 degrees Fahrenheit) below the average combustion temperature during the most recent performance test.

Coffin Butte Landfill does not own and/or operate an enclosed combustor; therefore, §340-239-0700(3)(c)(J) is not applicable.

§340-239-0700(3)(c)(K) – Boilers or Process Heaters

> For boilers or process heaters, whenever there is a change in the location at which the vent stream is introduced into the flame zone.

Coffin Butte Landfill does not own and/or operate boilers or process heaters; therefore, §340-239-0700(3)(c)(K) is not applicable.

3 ADDITIONAL REPORTING/RECORDKEEPING

The information in this section includes additional recording/reporting within the semi-annual report.

§340-239-0600(3)(b)(E)(5) – Monitoring System Malfunctions

> The monitoring requirements of this division apply at all times, except for periods of monitoring system malfunctions, repairs associated with monitoring system malfunctions, and required monitoring system quality assurance or quality control activities. A monitoring system malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring system failures that are caused in part by poor maintenance or careless operation are not malfunctions. Monitoring system repairs completed in response to monitoring system malfunctions to return the monitoring system to operation must be completed as expeditiously as practicable.

There were no monitoring system malfunctions during this reporting period.

4 LIMITATIONS

This Semi-Annual Report for the Coffin Butte Landfill GCCS has been prepared by WCG, as authorized by VLI. The report was prepared based on WCG's review of information provided by Coffin Butte Landfill. The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. These services were performed consistent with our agreement with our client. Any reliance on this report by a third party is at such party's sole risk. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

APPENDIX A

SURFACE EMISSION MONITORING

FIRST QUARTER 2023

SURFACE EMISSIONS MONITORING

SCS FIELD SERVICES

Environmental
Consultants & Contractors

May 19, 2023
File No. 07222178.00

Mr. Ian MacNab
Republic Services – Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, Oregon 97330

Subject: Coffin Butte Landfill - Corvallis, Oregon

Surface Emissions Monitoring for First Quarter 2023.

Dear Mr. MacNab:

SCS Field Services (SCS-FS) is pleased to provide the Republic Services, with the enclosed report summarizing the surface emissions monitoring services provided at the Coffin Butte Landfill (Site) during the first quarter 2023. This report includes the results of surface scan, component emissions and blower/flare station emissions monitoring for the Site for this monitoring period.

SCS-FS appreciates the opportunity to be of assistance to Republic Services on this project. As you review the enclosed information, please contact Stephan Harquail (503) 867-2369 or Whitney Stackhouse at (209) 338-7990 if you have any questions or comments.

Sincerely,

Max Polkabla

Max Polkabla
Senior Technician/Data Analyst
SCS Field Services

Stephen Harquail
PNW Region Manager
SCS Field Services

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring

First Quarter 2023

Presented to:

REPUBLIC SERVICES

Mr. Ian MacNab
28972 Coffin Butte Road
Corvallis, Oregon 97330

SCS FIELD SERVICES

File No. 0722178.00 | May 19, 2023

SCS FIELD SERVICES
15949 SW 72nd Ave
Portland, Or 97224

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring First Quarter 2023

INTRODUCTION

This letter provides results of the March 8, 14, 17, 24, 26, 30 and April 6, 2023, OAR landfill surface emissions monitoring (SEM) performed by SCS Field Services (SCS) at the Coffin Butte Landfill. All work was performed in accordance with our approved Work Scope dated August 29, 2022, and the OAR requirements.

2022 State Regulatory Applicability

CBL is subject to the Oregon-specific landfill gas emission regulations in OAR Chapter 340 Division 239. These SEM regulations are detailed below. The following requirements are stricter than the NESHAP regulations in previous Sections and require additional compliance:

SURFACE EMISSION METHANE CONCENTRATION LIMITS

> *340-239-0200 (1) Surface Emission Methane Concentration Limits. Except as provided in OAR 340-239-0110(4), 340-239-0110(5), 340-239-0300, and 340-239-0600(1), beginning August 1, 2022, or upon commencing operation of a newly installed gas collection and control system or modification of an existing gas collection and control system pursuant to OAR 340-239-0110(1), whichever is later, no location on the landfill surface may exceed either of the following methane concentration limits:*
>
> *(a) 500 ppmv, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring conducted in accordance with OAR 340-239-0800(3)(b);*
>
> *(b) An average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring conducted in accordance with OAR 340-239-800(3)(c).*

The 500 ppmv limit is already a requirement in the Federal regulations above, but an average methane concentration limit of 25 ppmv will be adhered to as required.

SURFACE EMISSION RECORDKEEPING

> *340-239-0700(2)(a)(C) All instantaneous surface readings of 100 ppmv methane or greater. All exceedances of the limits in OAR 340-239-0100(6)(b) and 340-239-0200, including the location of the leak (or affected grid), leak concentration in ppmv methane, date and time of measurement, the action taken to repair the leak, date of repair, any required remonitoring and the remonitored concentration in ppmv methane, wind speed during surface sampling, and the installation date and location of each well installed as part of a gas collection system expansion;*

The Federal regulations only require monitored surface emissions over 500 ppmv to be documented, so all of the above recordkeeping will be performed on emission points 100 ppmv or over. All repeatable instantaneous records of 100 ppm or higher (taken during SEM) must be kept for 5 years AND recorded in the semi-annual reports.

SUMMARY AND CONCLUSIONS

As stipulated in OAR, if uncorrectable exceedances within the 10-day limitation are detected or emissions are discovered during an inspection by Regulatory Agencies, the landfill must perform monitoring on a 25-foot pathway on a quarterly basis for active disposal sites. Upon completion of four consecutive SEM events without an uncorrectable exceedance of the 25 ppmv or 500 ppmv standards, other than non-repeatable momentary readings, the landfill may perform the monitoring on a 100-foot spacing on an annual basis for closed landfills or quarterly for active disposal sites. In accordance with the provisions of the OAR, the monitoring of the landfill was done on 25 foot pathway based on a prior inspection, in which exceedances were observed.

On March 8, 14, 17, 24, 26, 30 and April 6, 2023, SCS performed first quarter 2023 surface emissions monitoring testing as required by the Oregon Landfill Gas emission Rule. Instantaneous surface emissions monitoring results indicated that six (6) locations exceeded the 500 ppmv maximum concentration on the above-mentioned dates (Table 1 in Attachment 3). The required first/second 10-day (OAR) and 1-month (OAR) follow-up monitoring indicated that all areas had returned to compliance following system adjustments and remediation by SCS and site personnel. Based on these monitoring results no additional follow up testing was required.

Also, during the instantaneous monitoring event, SCS performed integrated monitoring of the landfill surface. As required by the OAR, the landfill was divided into 50,000 square foot areas. The Coffin Butte Landfill surface area was therefore divided into 105 grids, as shown on Figure 1 in Attachment 1. During this monitoring event, several grids were not monitored, in accordance with the regulations, due to ongoing active landfilling activities, unsafe conditions, or there was no waste in place prior to the monitoring event.

During the monitoring event, there were fifteen (15) areas observed to exceed the 25 ppmv OAR integrated average threshold (Table 2 in Attachment 4). The required first and second 10-day OAR follow-up monitoring were unable to be performed due to weather. The required first and second 10-day (OAR) follow-up monitoring indicated that not all areas had returned to compliance. These results are discussed in a subsequent section of this report.

In addition, quarterly monitoring of the pressurized piping or components of the Gas Collection and Control System (GCCS) that are under positive pressure must be performed quarterly. Results of the testing of the landfill gas (LFG) Blower Flare Station (BFS) pressurized pipe and components indicated that all test locations were in compliance with the 500 ppmv requirements.

Further, as required under the OAR, any location on the landfill that has an observed instantaneous methane concentration above 100 ppmv, must be included within the surface emission monitoring report and if any instantaneous location records above 250 ppmv, it must be monitored in a 5 foot grid around the location to determine extents of the methane leak. During this reporting period, thirty-three 33) locations were observed showing elevated concentrations between 100-499 ppmv, of the reporting threshold. When these readings are observed to be repeatable, they are reported to site personnel for tracking and/or remediation and will be reported in the next submittal of the annual OAR report. Finally, to help prevent potential future exceedances, SCS recommends that the landfill surface be routinely inspected and any observed surface erosion be routinely repaired.

BACKGROUND

The Coffin Butte Landfill is an active organic refuse disposal site. By way of background, organic materials buried in a landfill decompose anaerobically (in the absence of oxygen) producing a combustible gas which contains approximately 50 to 60 percent methane gas, 40 to 50 percent carbon dioxide, and trace amount of various other gases, some of which are odorous. The Coffin-Butte/Corvallis property contains a system to control the combustible gases generated in the landfill.

SURFACE EMISSIONS MONITORING

On March 8, 14, 17, 24, 26, 30 and April 6, 2023, the instantaneous and integrated SEM was performed over the surface of the subject site. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring in the 50,000 square foot grids as required under the OAR. During this event, SCS performed the monitoring on a 25 and 100-foot pathway in accordance with the rules as required.

EMISSIONS TESTING INSTRUMENTATION/CALIBRATION

Instruments used to perform the landfill surface emission testing consisted of the following:

- Thermo Scientific TVA 2020 portable Flame Ionization Detector (FID). This instrument measures methane in air over a range of 1 to 50,000 ppmv. The TVA 2020 meets the State of California Air Resources Board (CARB) requirements for combined instantaneous and integrated monitoring and was calibrated in accordance with United States Environmental Protection Agency (US EPA) Method 21.

- Weather Anemometer with continuous recorder for meteorological conditions in accordance with the OAR.

Instrument calibration logs and weather information are shown in Attachments 5 and 6.

SURFACE EMISSIONS MONITORING PROCEDURES

Surface emissions monitoring was conducted in accordance with the OAR and SEM requirements. Monitoring was performed with the FID inlet held within 2-inches of the landfill surface while a technician walked a grid in parallel paths not more than 25 or 100-feet apart over the surface of the landfill. Cracks, holes and other cover penetrations in the surface were also tested. Surface emissions readings were monitored continuously and recorded every 5 seconds. Any areas in exceedance of the 100 or 500 ppmv standards (reporting and compliance levels, respectively) would be GPS tagged and stake-marked for on-site personnel to perform remediation or repairs.

The integrated average is based on the readings stored on the instrument, which are recorded every 5 seconds. The readings are then downloaded and the averages are calculated for each grid using SCS eTools®. All readings are maintained in this secure SCS Database. The readings are not provided in the report due to the volume of readings, but can be furnished upon request.

Recorded wind speed results are shown in Attachment 6. Wind speed averages were observed to remain below the alternative threshold of 10 miles per hour, and no instantaneous speeds exceeded 20 miles per hour. No rainfall had occurred within 72 hours of the monitoring events. Therefore, site

meteorological conditions were within the alternatives of the OAR requirements on the above mentioned dates.

TESTING RESULTS

During this event, SCS performed the monitoring on a 25-foot pathway in accordance with the rule as required under the OAR. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR or NSPS threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring (OAR).

On March 8, 14, 17, 24, 26, 30 and April 6, 2023, SCS performed first quarter 2023 instantaneous emissions monitoring testing as required by the Oregon DEQ/OAR. During this monitoring, surface emissions results indicated that six (6) locations exceeded the 500 ppmv maximum concentration. The required first 10-day (OAR) follow-up monitoring performed on March 17 & 24 and the 1-month (OAR) follow-up monitoring event performed on April 6, 2023, indicated that all areas had returned to compliance following system adjustments and remediation by SCS and site personnel. Based on these monitoring results no additional follow up testing was required. Results of the monitoring are shown in Attachments 2 and 3 (Table 1).

Additionally, calculated integrated monitoring indicated Fifteen (15) integrated exceedances of the 25-ppmv requirement on March 16, 17 and 21, 2023. The required first and second 10-day OAR follow-up monitoring performed on March 21, 26, and 30, 2023 indicated that four (4) of the fifteen (15) areas had returned to compliance. Calibration logs for monitoring equipment are provided in Attachment 5.

During this monitoring event, several girds were not monitored, in accordance with the OAR, due to active landfilling activities, unsafe conditions, overgrown vegetation or no waste in place. SCS will continue to monitor all accessible locations during the second quarter 2023.

PRESSURIZED PIPE AND COMPONENT LEAK MONITORING

On March 8, 2023, quarterly leak monitoring was performed in accordance with the OAR. SCS performed LFG pressurized pipe and component leak monitoring at the BFS. Monitoring was performed with the detector inlet held one-half of an inch from pressurized pipe and associated components. No locations exceeding the 500 ppmv threshold were observed during our monitoring event. The maximum reading, which was 6.20 ppmv, was well below the maximum threshold (see Table 1 for component results). Therefore, all pressurized pipe and components located at the LFG BFS were in compliance at the time of our testing.

PROJECT SCHEDULE

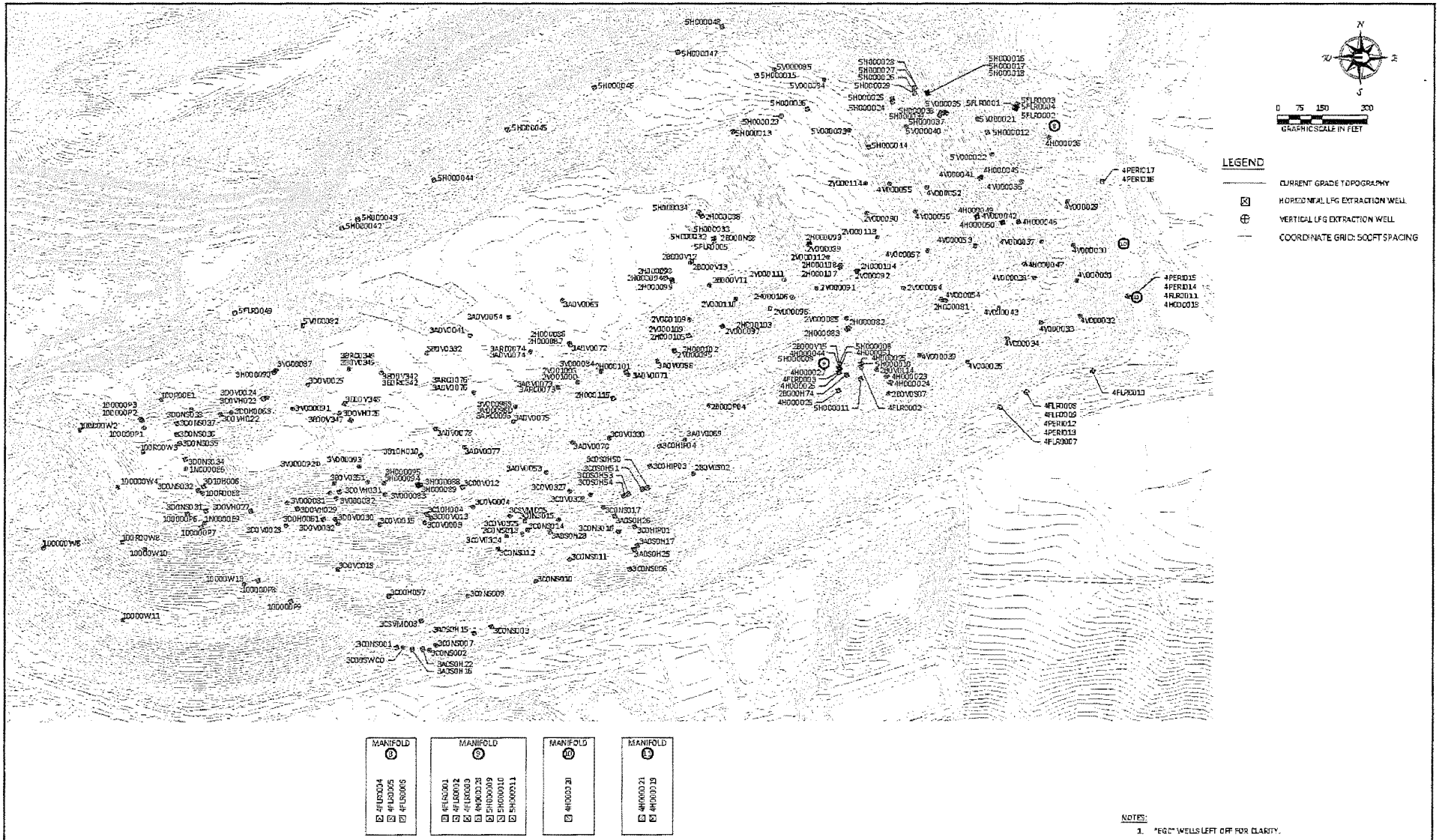
According to the OAR, surface emissions monitoring at active landfills is required to be performed on a quarterly basis. Therefore, in accordance with our approved Work Scope, the second quarter 2023 (April through June) surface emissions testing event is scheduled to be performed by the end of June 2023.

STANDARD PROVISIONS

This report addresses conditions of the subject site during the testing dates only. Accordingly, we assume no responsibility for any changes that may occur subsequent to our testing which could affect the surface emissions at the subject site or adjacent properties.

Attachment 1

Landfill Grid



NOTES:

1. "EGC" WELLS LEFT OFF FOR CLARITY.

REV	DATE	DESCRIPTION	DRN BY	DSN BY	CHK BY
0	07/14/22	AS-BUILT	PD	AH	AH

REPUBLIC SERVICES
22972 COFFIN BUTTE ROAD CORVALLIS OR 97330 PHONE: (541) 745-5792 FAX: (541) 745-3835

ENERGYNEERING SOLUTIONS
15820 BARCLAY DRIVESISTERS, OR 97759 PHONE: (541) 549-8766 FAX: (541) 549-1901

WELLHEAD LAYOUT

2022 WELLFIELD GCCS AS-BUILT
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
W1.01
PROJECT NO.
XXX.XXX

Attachment 2

Surface Pathway



First Quarter 2023
Initial Surface Emissions Monitoring Pathway
Coffin Butte Landfill, Corvallis, Oregon

Attachment 3

Instantaneous and Component Emissions Monitoring Results

First Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Instantaneous Data Report for March 8, 14, 17, 24 and April 6, 2023

Location (Surface)	Initial Monitoring Results (ppmv) 3/8/2023	Initial Monitoring Results (ppmv) 3/14/2023	Follow Up Monitoring Results (ppmv) 3/17/2023	Follow Up Monitoring Results (ppmv) 3/24/2023	1-Month Follow Up Monitoring Results (ppmv) 4/6/2023	Latitude	Longitude
3D0VH031	1619	--	375	--	361	44.69793	-123.23417
2V000089	1600	--	296	--	304	44.70056	-123.22847
2V00109	--	5000	--	189	197	44.69979317	-123.2300255
3V0096	--	1600	--	371	382	44.69994371	-123.228961
3V0096D	--	1600	--	434	421	44.69896051	-123.2321997
3V0081	--	2708	--	418	439	44.69799332	-123.235095

Instantaneous Data Report for March 8, 14, 17, 24 and April 6, 2023
Readings between 100-499 ppmv

Location (Surface)	Initial Monitoring Results (ppmv) 3/8/2023	Latitude	Longitude
2H000099	491	44.700149	-123.2302418
2B000V12	481	44.70034	-123.23002
2H000094	476	44.70019	-123.23034
2H000088	462	44.70039	-123.22993
5H000032	437	44.70079	-123.22993

First Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Location (Surface)	Initial Monitoring Results (ppmv) 3/8/2023	Latitude	Longitude
3V000093	381	44.6983595	-123.234183
2H000086	327	44.69953	-123.23151
3A0V0065	318	44.70002	-123.23163
3A0V0076	285	44.69911	-123.23275
2H000087	268	44.69954	-123.23152
4V000029	240	44.70101	-123.22521
3D0V0025	237	44.69909	-123.23487
3ARC0D26	235	44.6988542	-123.2346213
3D0NS035	230	44.69814	-123.23629
3B0V0351	212	44.69821	-123.23407
3D0VH022	210	44.69886	-123.23597
3A0V0074	207	44.69945	-123.23204
3D0H0061	204	44.69788	-123.23453
3V000087	203	44.6992	-123.23531
3H000095	194	44.6982145	-123.233391
2H000102	171	44.6995335	-123.2302335
3A0V0072	159	44.69954	-123.23152
3V000091	156	44.6988698	-123.2350643
3B10H010	150	44.69819	-123.23331
3H000089	147	44.6982093	-123.233385
3V000082	139	44.69808	-123.23449

First Quarter 2023

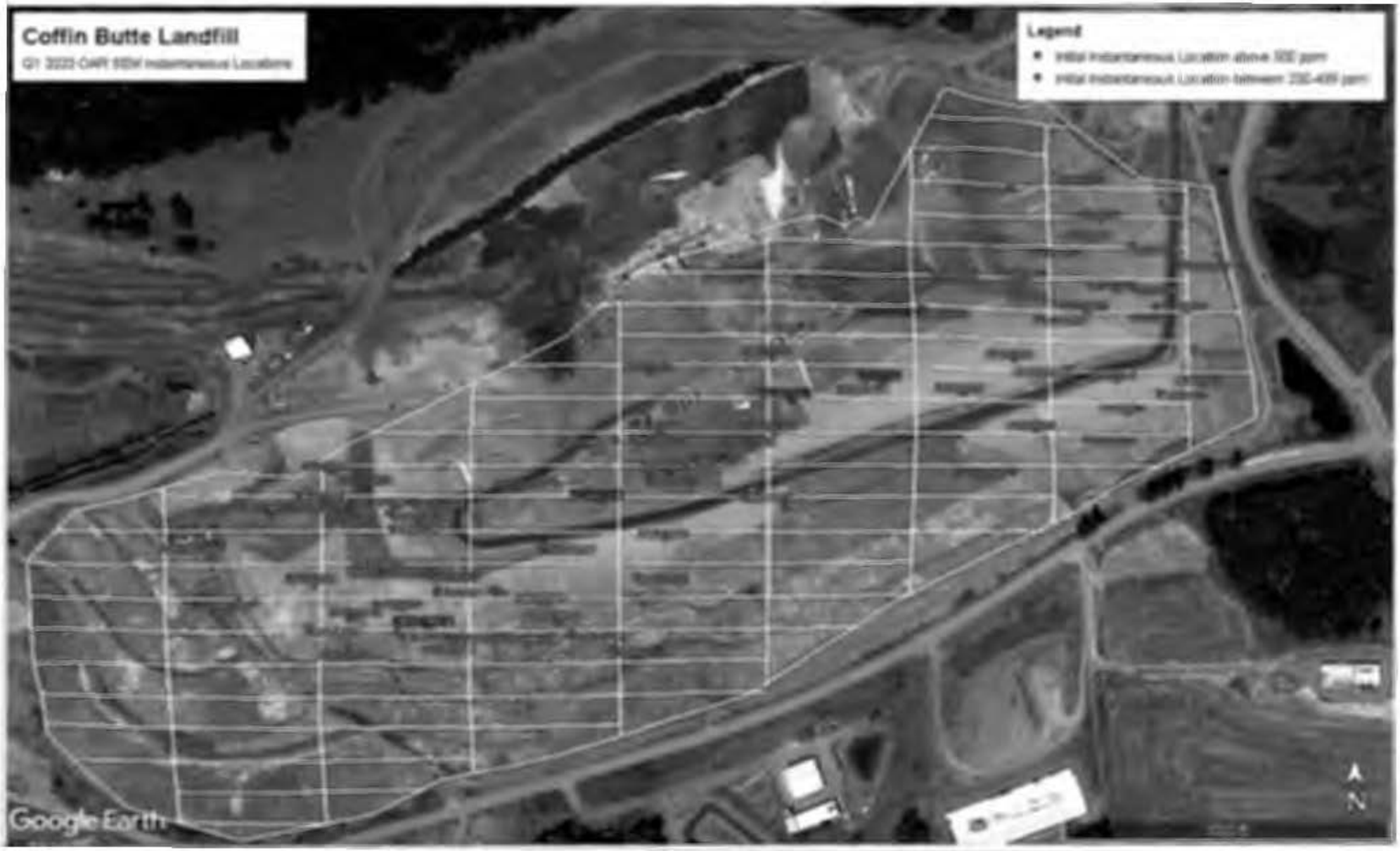
Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Location (Surface)	Initial Monitoring Results (ppmv) 3/8/2023	Latitude	Longitude
2V00100D	138	44.699207	-123.2314233
4V000055	137	44.70118	-123.2276
2V00100S	136	44.6992075	-123.2314313
3D0VH023	129	44.69897	-123.23541
3D0V0024	114	44.69895	-123.2354
2V000090	108	44.70084	-123.22802
2B0V0S07	100	44.6992	-123.22738

Pressurized Pipe and Component Results

Route	Date	Concentration (ppmv)
FLARE STATION	3/8/2023	6.20

No other exceedances of the 500 ppmv threshold were observed during the first quarter 2023 monitoring.



First Quarter 2023
Initial Emissions Monitoring Results Greater Than 200 ppmv and 500 ppmv
Coffin Butte Landfill, Corvallis, Oregon

Attachment 4

Integrated Monitoring Results

First Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-001	--	--	Exempt Area
CBLF-002	--	--	
CBLF-003	3/21/2023	2.05	
CBLF-004	--	--	Exempt Area
CBLF-005	--	--	Exempt Area
CBLF-006	--	--	Exempt Area
CBLF-007	--	--	Exempt Area
CBLF-008	--	--	Exempt Area
CBLF-009	--	--	Exempt Area
CBLF-010	--	--	Exempt Area
CBLF-011	--	--	Exempt Area
CBLF-012	--	--	Exempt Area
CBLF-013	--	--	Exempt Area
CBLF-014	--	--	Exempt Area
CBLF-015	--	--	Exempt Area
CBLF-016	3/16/2023	9.53	
CBLF-017	3/16/2023	4.14	
CBLF-018	3/16/2023	10.05	
CBLF-019	3/16/2023	8.22	
CBLF-020	3/16/2023	3.76	
CBLF-021	3/16/2023	2.04	
CBLF-022	--	--	Exempt Area
CBLF-023	--	--	Exempt Area
CBLF-024	--	--	Exempt Area
CBLF-025	--	--	Exempt Area
CBLF-026	--	--	Exempt Area
CBLF-027	3/16/2023	26.63	Initial Monitoring
CBLF-027	3/26/2023	27.85	First 10-Day Recheck
CBLF-027	3/30/2023	5.94	Second 10-Day Recheck
CBLF-028	3/16/2023	14.89	
CBLF-029	3/16/2023	5.45	
CBLF-030	3/16/2023	4.59	
CBLF-031	--	--	Exempt Area
CBLF-032	--	--	Exempt Area
CBLF-033	--	--	Exempt Area
CBLF-034	--	--	Exempt Area
CBLF-035	--	--	Exempt Area
CBLF-036	--	--	Exempt Area
CBLF-037	--	--	Exempt Area
CBLF-038	3/21/2023	3.56	
CBLF-039	3/8/2023	4.20	
CBLF-040	3/16/2023	7.24	
CBLF-041	3/21/2023	34.82	Initial Monitoring

First Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-041	3/26/2023	27.17	First 10-Day Recheck
CBLF-041	3/30/2023	1.06	Second 10-Day Recheck
CBLF-042	3/8/2023	6.60	
CBLF-043	3/8/2023	5.43	
CBLF-044	3/8/2023	7.23	
CBLF-045	--	--	Exempt Area
CBLF-046	--	--	Exempt Area
CBLF-047	--	--	Exempt Area
CBLF-048	3/17/2023	113.22	Initial Monitoring
CBLF-048	3/26/2023	95.34	First 10-Day Recheck
CBLF-048	3/30/2023	58.84	Second 10-Day Recheck
CBLF-049	3/17/2023	41.44	Initial Monitoring
CBLF-049	3/26/2023	28.42	First 10-Day Recheck
CBLF-049	3/30/2023	21.70	Second 10-Day Recheck
CBLF-050	3/17/2023	53.56	Initial Monitoring
CBLF-050	3/26/2023	63.84	First 10-Day Recheck
CBLF-050	3/30/2023	71.53	Second 10-Day Recheck
CBLF-051	3/17/2023	61.18	Initial Monitoring
CBLF-051	3/26/2023	57.28	First 10-Day Recheck
CBLF-051	3/30/2023	59.73	Second 10-Day Recheck
CBLF-052	--	--	Exempt Area
CBLF-053	--	--	Exempt Area
CBLF-054	3/21/2023	63.70	Initial Monitoring
CBLF-054	3/26/2023	66.61	First 10-Day Recheck
CBLF-054	3/30/2023	42.37	Second 10-Day Recheck
CBLF-055	3/21/2023	21.99	
CBLF-056	--	--	Exempt Area
CBLF-057	3/21/2023	3.10	
CBLF-058	--	--	Exempt Area
CBLF-059	--	--	Exempt Area
CBLF-060	--	--	Exempt Area
CBLF-061	--	--	Exempt Area
CBLF-062	--	--	Exempt Area
CBLF-063	--	--	Exempt Area
CBLF-064	--	--	Exempt Area
CBLF-065	--	--	Exempt Area
CBLF-066	--	--	Exempt Area
CBLF-067	--	--	Exempt Area
CBLF-068	3/21/2023	28.32	Initial Monitoring
CBLF-068	3/26/2023	26.82	First 10-Day Recheck
CBLF-068	3/30/2023	5.70	Second 10-Day Recheck
CBLF-069	3/21/2023	9.07	
CBLF-070	3/21/2023	16.57	

First Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-071	3/21/2023	52.29	Initial Monitoring
CBLF-071	3/26/2023	48.78	First 10-Day Recheck
CBLF-071	3/30/2023	40.93	Second 10-Day Recheck
CBLF-072	3/17/2023	55.50	Initial Monitoring
CBLF-072	3/21/2023	97.78	First 10-Day Recheck
CBLF-072	3/30/2023	94.60	Second 10-Day Recheck
CBLF-073	3/17/2023	43.80	Initial Monitoring
CBLF-073	3/26/2023	27.99	First 10-Day Recheck
CBLF-073	3/30/2023	61.15	Second 10-Day Recheck
CBLF-074	3/17/2023	79.82	Initial Monitoring
CBLF-074	3/26/2023	69.65	First 10-Day Recheck
CBLF-074	3/30/2023	68.45	Second 10-Day Recheck
CBLF-075	3/17/2023	46.57	Initial Monitoring
CBLF-075	3/26/2023	36.76	First 10-Day Recheck
CBLF-075	3/30/2023	73.00	Second 10-Day Recheck
CBLF-076	3/17/2023	102.34	Initial Monitoring
CBLF-076	3/26/2023	89.12	First 10-Day Recheck
CBLF-076	3/30/2023	117.08	Second 10-Day Recheck
CBLF-077	3/21/2023	14.80	
CBLF-078	3/21/2023	11.03	
CBLF-079	3/21/2023	2.77	
CBLF-080	--	--	Exempt Area
CBLF-081	--	--	Exempt Area
CBLF-082	--	--	Exempt Area
CBLF-083	--	--	Exempt Area
CBLF-084	3/21/2023	39.70	Initial Monitoring
CBLF-084	3/26/2023	37.73	First 10-Day Recheck
CBLF-084	3/30/2023	47.99	Second 10-Day Recheck
CBLF-085	3/17/2023	11.07	
CBLF-086	3/17/2023	2.08	
CBLF-087	3/17/2023	3.20	
CBLF-088	3/17/2023	1.90	
CBLF-089	3/17/2023	2.30	
CBLF-090	--	--	Exempt Area
CBLF-091	3/14/2023	5.20	
CBLF-092	--	--	Exempt Area
CBLF-093	3/17/2023	4.34	
CBLF-094	3/17/2023	4.78	
CBLF-095	3/17/2023	5.10	
CBLF-096	3/17/2023	5.37	
CBLF-097	3/13/2023	21.27	
CBLF-098	3/14/2023	21.90	
CBLF-099	3/14/2023	10.57	

First Quarter 2023

Table 2. Integrated Surface Emissions Monitoring Results

Coffin-Butte Landfill Corvallis, Oregon

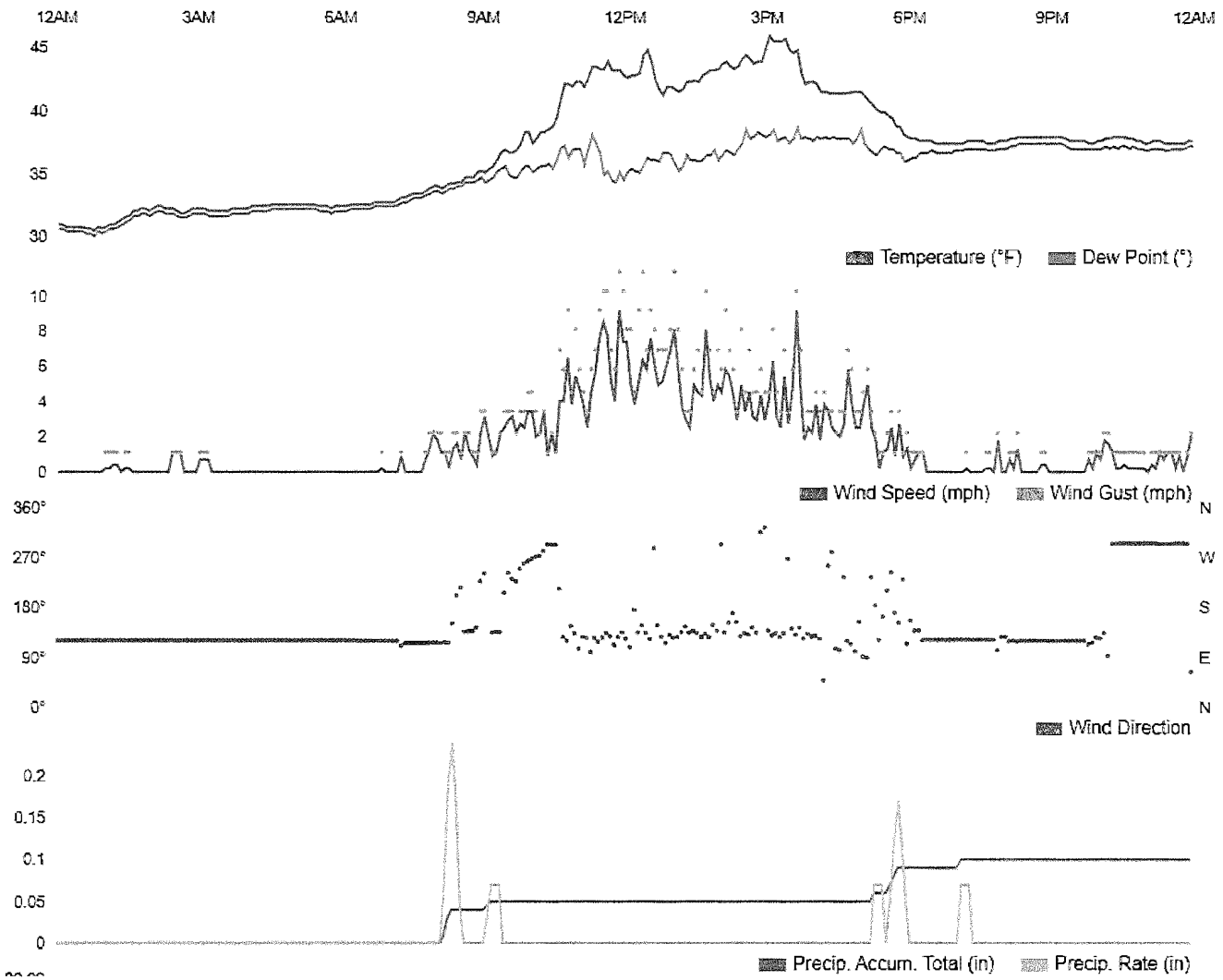
Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-100	3/14/2023	11.12	
CBLF-101	3/12/2023	15.53	
CBLF-102	3/14/2023	10.23	
CBLF-103	3/16/2023	15.10	
CBLF-104	3/16/2023	2.10	
CBLF-105	3/14/2023	2.34	

Attachment 5

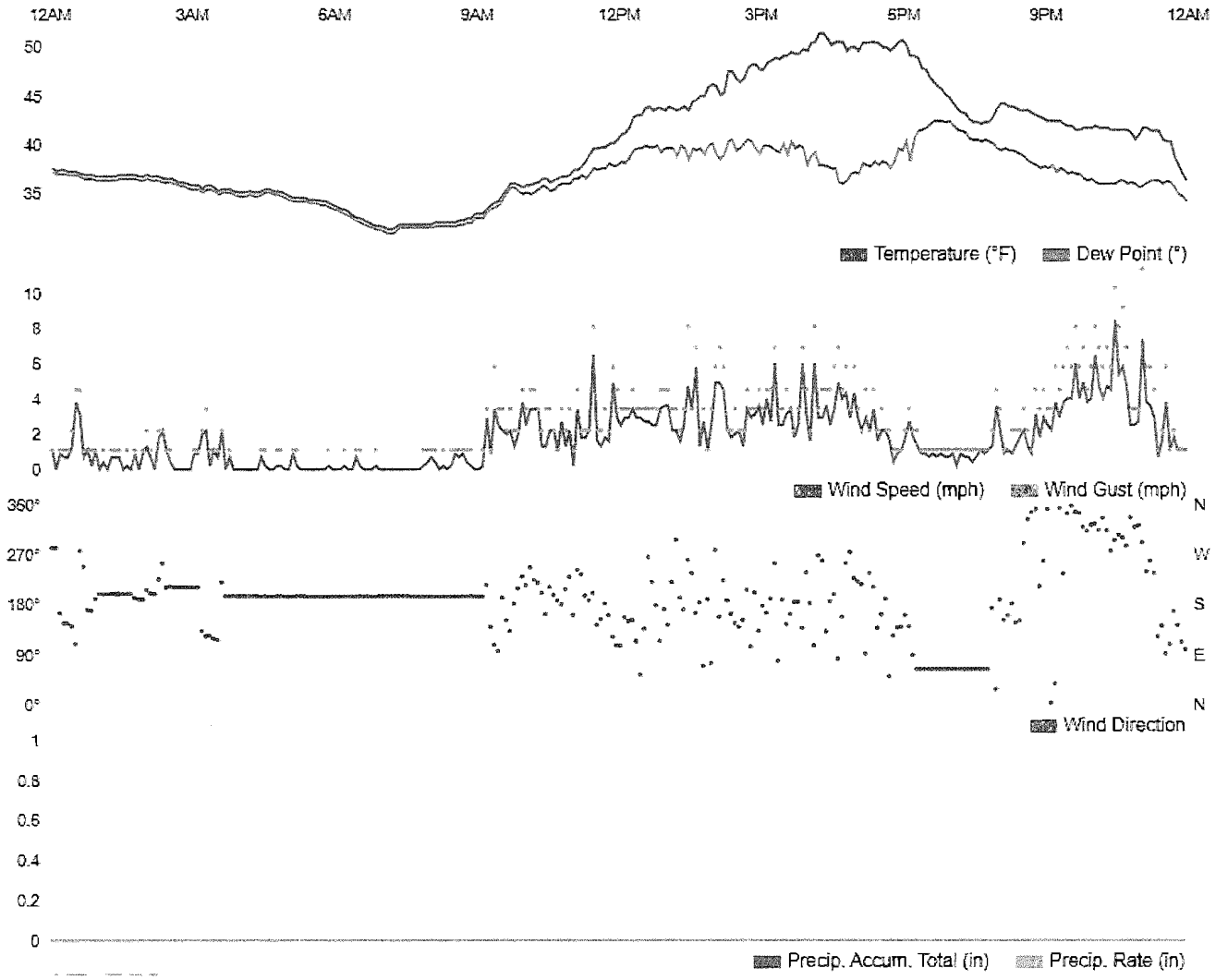
Calibration Logs

Attachment 6

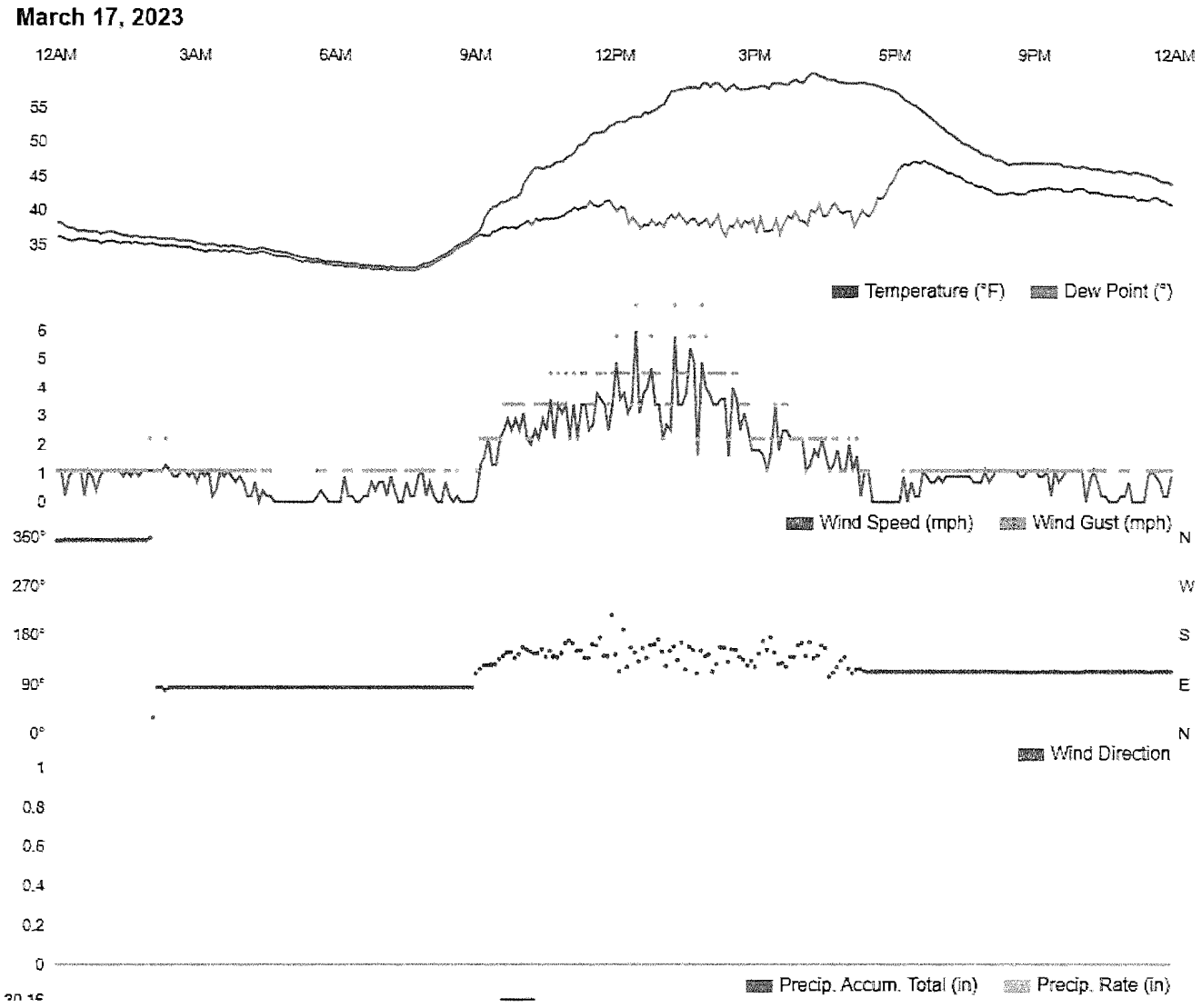
Weather Data



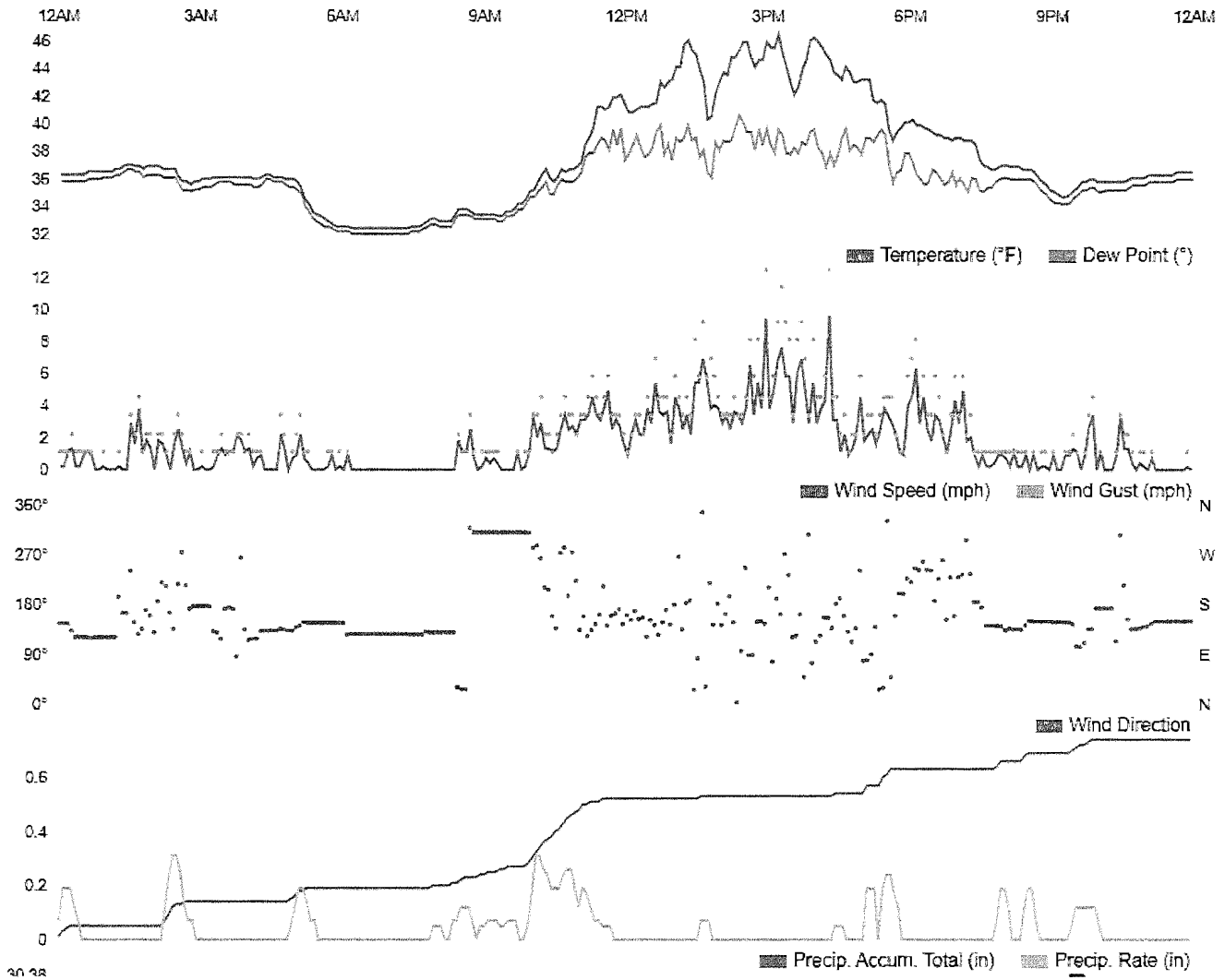
March 8, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



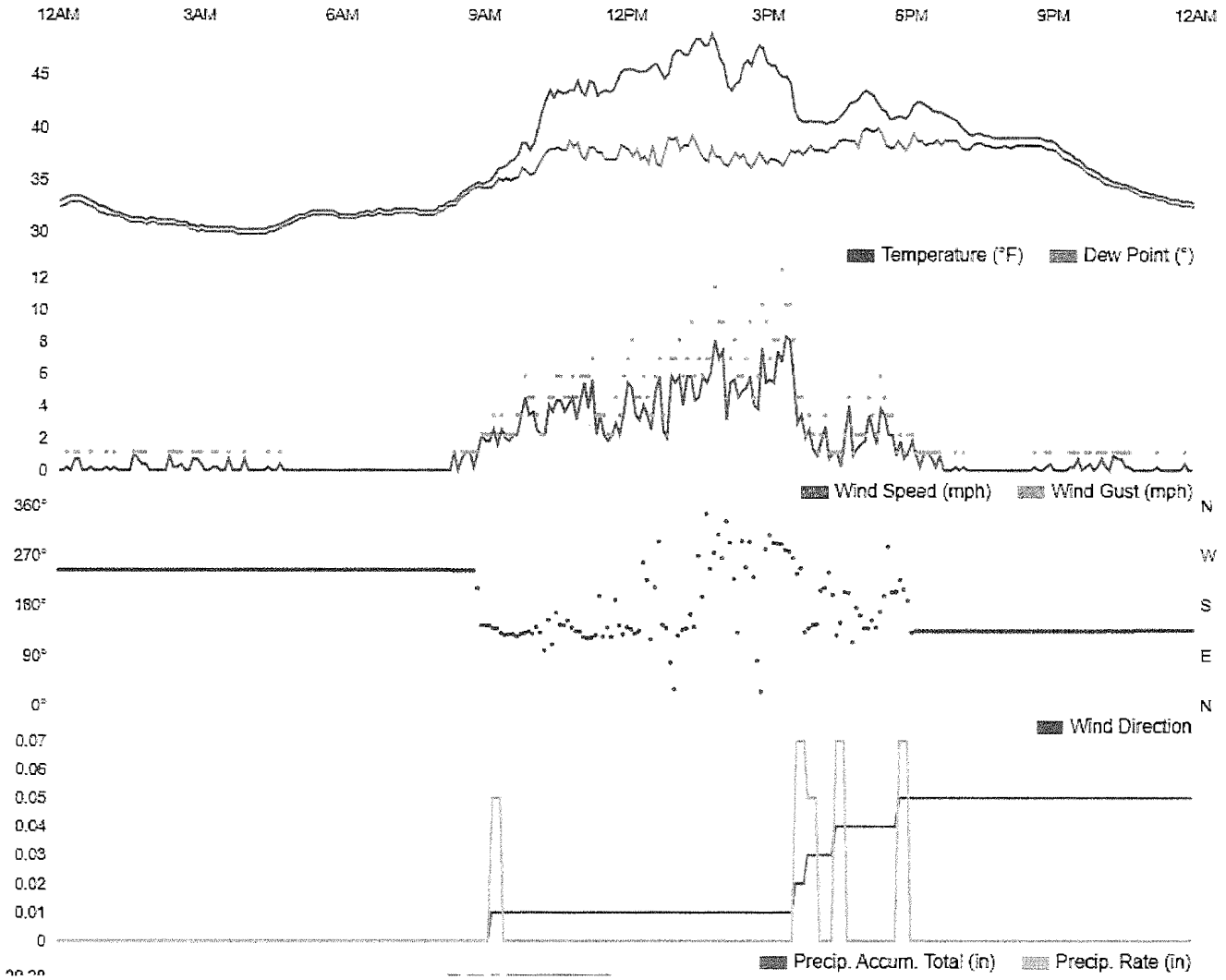
March 14, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



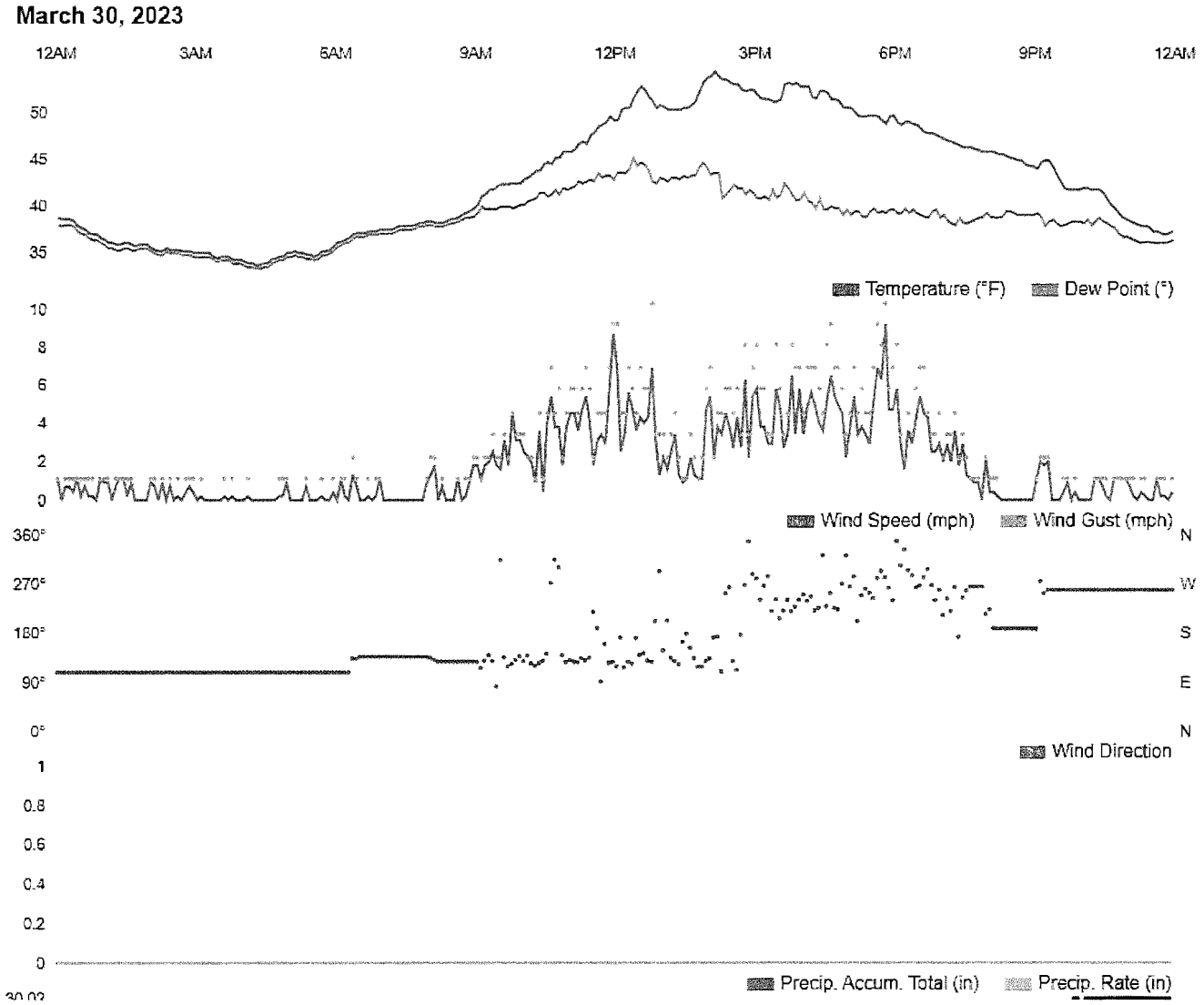
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Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



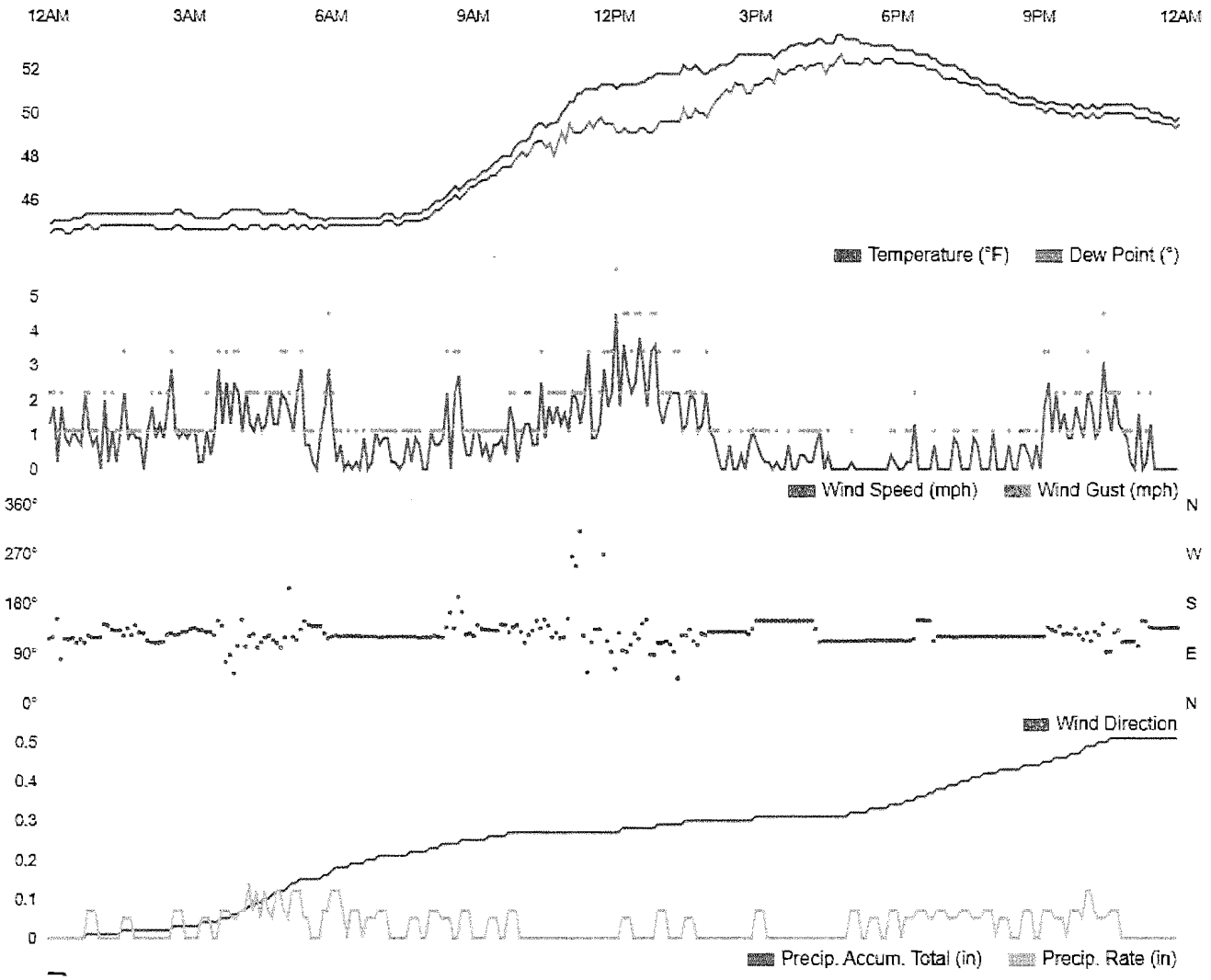
March 24, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



March 26, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



March 30, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



April 6, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon

SECOND QUARTER 2023

SURFACE EMISSIONS MONITORING REPORT TO BE PROVIDED IN FEBRUARY 2024 SEMI-ANNUAL REPORT

APPENDIX B

WELLFIELD PRESSURE EXCEEDANCE REPORT

Coffin Butte Landfill
Wellfield Pressure Exceedance Report
Reporting Period: January 1, 2023 to June 30, 2023

WellName	Date/Time Monitored	Pressure (in. H20)	Temperature (°F)	Date/Time Remediated	Duration Days
2H000088	4/15/2023 14:14	0.02	55.0	4/18/2023 13:54	3
3A0V0076	4/29/2023 13:42	0.00	78.0	5/9/2023 13:52	10
3ARC0076	4/29/2023 13:40	0.00	95.0	5/9/2023 13:50	10
3V000092	5/24/2023 13:47	0.04	80.0	5/24/2023 14:07	0

* All wells listed are operating under the approved alternative monitoring plan. Therefore, the corrective action and root cause analysis is not applicable.

APPENDIX C

CONTROL DEVICE DOWNTIME LOG/TREATMENT SYSTEM DOWNTIME LOG

CONTROL DEVICE DOWNTIME LOG – FLARE #1

Coffin Butte Landfill
Control Device Downtime for Flare #1
Reporting Period: January 1, 2023 to June 30, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Description
2/9/2023 13:04	2/9/2023 13:34	0:30:00	Power outage to flare
2/21/2023 1:30	2/21/2023 1:42	0:12:00	LFG diverted to PNGC
2/21/2023 3:06	2/21/2023 3:38	0:32:00	LFG diverted to PNGC
2/21/2023 13:58	2/21/2023 15:00	1:02:00	LFG diverted to PNGC
2/21/2023 15:14	2/21/2023 15:22	0:08:00	LFG diverted to PNGC
2/27/2023 16:14	2/27/2023 16:34	0:20:00	LFG diverted to PNGC
2/28/2023 13:30	2/28/2023 13:38	0:08:00	LFG diverted to PNGC
3/2/2023 8:18	3/2/2023 8:36	0:18:00	LFG diverted to PNGC
3/2/2023 9:30	3/2/2023 9:44	0:14:00	LFG diverted to PNGC
3/8/2023 9:22	3/8/2023 9:28	0:06:00	Sump cleaning
3/8/2023 9:30	3/8/2023 9:32	0:02:00	Sump cleaning
3/8/2023 9:34	3/8/2023 9:40	0:06:00	Sump cleaning
3/8/2023 9:42	3/8/2023 10:50	1:08:00	Sump cleaning
3/8/2023 11:20	3/8/2023 11:28	0:08:00	LFG diverted to PNGC
3/8/2023 15:32	3/10/2023 8:28	40:56:00	LFG diverted to PNGC
3/19/2023 12:04	3/19/2023 12:14	0:10:00	LFG diverted to PNGC
3/24/2023 9:26	3/24/2023 9:48	0:22:00	LFG diverted to PNGC
4/19/2023 10:30	4/19/2023 13:00	2:30:00	LFG diverted to PNGC
4/19/2023 13:02	4/19/2023 13:06	0:04:00	LFG diverted to PNGC
5/4/2023 9:26	5/4/2023 9:34	0:08:00	LFG diverted to PNGC
5/19/2023 18:50	5/19/2023 19:00	0:10:00	LFG diverted to PNGC
5/20/2023 23:12	5/20/2023 23:20	0:08:00	LFG diverted to PNGC
5/21/2023 21:36	5/21/2023 21:48	0:12:00	LFG diverted to PNGC
5/23/2023 10:34	5/23/2023 10:40	0:06:00	LFG diverted to PNGC
5/23/2023 10:44	5/23/2023 10:58	0:14:00	LFG diverted to PNGC
5/25/2023 10:30	5/25/2023 10:40	0:10:00	LFG diverted to PNGC
5/31/2023 21:46	5/31/2023 21:54	0:08:00	LFG diverted to PNGC
6/1/2023 20:26	6/1/2023 20:38	0:12:00	LFG diverted to PNGC
6/7/2023 7:46	6/7/2023 7:54	0:08:00	LFG diverted to PNGC
6/7/2023 8:12	6/7/2023 10:10	1:58:00	LFG diverted to PNGC
6/7/2023 11:08	6/7/2023 11:16	0:08:00	Sump and plant outage
6/7/2023 13:14	6/7/2023 13:38	0:24:00	LFG diverted to PNGC
6/7/2023 18:40	6/7/2023 18:50	0:10:00	LFG diverted to PNGC
6/7/2023 20:16	6/7/2023 20:26	0:10:00	LFG diverted to PNGC
6/7/2023 21:38	6/7/2023 21:48	0:10:00	LFG diverted to PNGC
6/7/2023 21:50	6/7/2023 22:04	0:14:00	LFG diverted to PNGC
6/7/2023 22:10	6/7/2023 22:22	0:12:00	LFG diverted to PNGC
6/7/2023 22:48	6/7/2023 23:02	0:14:00	LFG diverted to PNGC
6/8/2023 8:30	6/8/2023 8:38	0:08:00	LFG diverted to PNGC
6/8/2023 8:42	6/8/2023 8:50	0:08:00	LFG diverted to PNGC
6/12/2023 12:06	6/12/2023 12:14	0:08:00	LFG diverted to PNGC
6/13/2023 7:46	6/13/2023 7:52	0:06:00	LFG diverted to PNGC
6/21/2023 8:34	6/21/2023 8:42	0:08:00	LFG diverted to PNGC

CONTROL DEVICE DOWNTIME LOG – FLARE #2

Coffin Butte Landfill
Control Device Downtime for Flare #2
Reporting Period: January 1, 2023 to June 30, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Description
2/9/2023 13:04	2/9/2023 13:34	0:30:00	Power outage to flare
2/21/2023 1:28	2/21/2023 1:38	0:10:00	LFG diverted to PNGC
2/21/2023 13:58	2/21/2023 14:26	0:28:00	LFG diverted to PNGC
2/21/2023 14:28	3/8/2023 15:36	361:08:00	LFG diverted to PNGC Sump cleaning
4/19/2023 10:32	4/19/2023 10:48	0:16:00	LFG diverted to PNGC
5/4/2023 9:26	5/4/2023 9:32	0:06:00	LFG diverted to PNGC
5/21/2023 21:36	5/21/2023 21:38	0:02:00	LFG diverted to PNGC
5/23/2023 10:34	5/23/2023 10:36	0:02:00	LFG diverted to PNGC
5/31/2023 21:46	5/31/2023 21:48	0:02:00	LFG diverted to PNGC
6/7/2023 7:46	6/7/2023 7:50	0:04:00	LFG diverted to PNGC
6/7/2023 8:12	6/7/2023 10:08	1:56:00	Power outage to flare
6/7/2023 20:16	6/7/2023 20:18	0:02:00	LFG diverted to PNGC
6/7/2023 21:38	6/7/2023 21:40	0:02:00	LFG diverted to PNGC
6/7/2023 21:50	6/7/2023 21:52	0:02:00	LFG diverted to PNGC
6/7/2023 21:54	6/7/2023 21:58	0:04:00	LFG diverted to PNGC
6/7/2023 22:10	6/7/2023 22:16	0:06:00	LFG diverted to PNGC
6/7/2023 22:48	6/13/2023 7:50	129:02:00	LFG diverted to PNGC

TREATMENT SYSTEM DOWNTIME LOG – PNGC

Coffin Butte Landfill
Treatment System Downtime Log
Reporting Period: January 1, 2023 to June 30, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Comments
2/21/2023 1:15	2/21/2023 2:45	1:30:00	Utility outage
3/8/2023 9:00	3/8/2023 11:00	2:00:00	Plant outage for sump cleaning
6/7/2023 8:00	6/7/2023 13:00	5:00:00	Plant outage and sump cleaning

APPENDIX D

COLLECTION SYSTEM DOWNTIME LOG

Coffin Butte Landfill
Collection System Downtime
Reporting Period: January 1, 2023 to June 30, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm)	Description
2/21/2023 1:30	2/21/2023 1:42	0:12:00	Utility outage
6/7/2023 8:12	6/7/2023 10:08	1:56:00	Sump and plant outage

APPENDIX E

GCCS EXPANSION/CURRENT SITE GCCS LAYOUT

Coffin Butte Landfill - GCCS Expansion

Reporting Period: January 1, 2023 to June 30, 2023

New Extraction Wells

New Well ID	Date Installed
5H000091	3/31/2023
5H000092	3/31/2023
5H000093	3/31/2023
5H000094	3/31/2023
5H000095	3/31/2023
5H000096	3/31/2023
5H000097	3/31/2023
5H000098	3/31/2023
5H000099	3/31/2023
2HRC0099	6/16/2023

Decommissioned Wells

Well ID	Date Decomissioned
3A0V0041	2/14/2023
3A0V0064	2/14/2023
2H000088	3/28/2023
2H000094	3/28/2023
2B000012	3/28/2023
5H000032	3/28/2023
5H000033	3/28/2023

N

W E

S

0 75 150 300

GRAPHIC SCALE IN FEET

LEGEND

- CURRENT GRADE TOPOGRAPHY
- HORIZONTAL LFG EXTRACTION WELL
- VERTICAL LFG EXTRACTION WELL
- COORDINATE GRID: 500FT SPACING
- NEW VERTICAL EXTRACTION WELL

MANIFOLD 8	MANIFOLD 9	MANIFOLD 10	MANIFOLD 11
4FLR0004	4FLR0001	4H000020	4H000021
4FLR0005	4FLR0002		4H000019
4FLR0006	4FLR0003		
	4HCC0028		
	5H000009		
	5H000010		
	5H000011		

NOTES:

1. "EGC" WELLS LEFT OFF FOR CLARITY.

REV	DATE	DESCRIPTION	DRN BY	DSN BY	CHK BY
0	07/18/23	AS-BUILT	PD	AH	AH

REPUBLIC SERVICES
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330 PHONE: (541) 745-5792 FAX: (541) 745-3826

ENERGYNEERING SOLUTIONS
15820 BARCLAY DRIVE SISTERS, OR 97759 PHONE: (541) 549-8766 FAX: (541) 549-1901

WELLHEAD LAYOUT

2022 WELLFIELD GCCS AS-BUILT
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
W1.01
PROJECT NO.
XXX.XXX

REPUBLIC SERVICES

28972 Coffin Butte Rd Corvallis, OR 97330
o 541.745.5792 f 541.230.5534 republicservices.com

February 7, 2024

Ms. Suzy Luttrell
Oregon Department of Environmental Quality
Air Quality Division
4026 Fairview Industrial Drive
Salem, OR 97302

Re: Semi-Annual Report and Annual Report
Coffin Butte Landfill
Operating Permit No. 02-9502-TV-01
Project No. 0120-174-76-09-14

Dear Ms. Luttrell:

Pursuant to the State of Oregon Department of Environmental Quality (ODEQ) Oregon Administrative Rule (OAR) 340-239-0700(3)(c) and 340-239-0700(3)(d), Valley Landfills, Inc. submits the original and two copies of the enclosed Semi-Annual Report and Annual Report for Coffin Butte Landfill. The semi-annual report is being submitted to cover the period of July 1, 2023 through December 31, 2023. The annual report is being submitted to cover the period of January 1, 2023 through December 31, 2023.

If you have any questions, please do not hesitate to contact Ian Macnab or myself at 541.745.5792.

Sincerely,
Valley Landfills, Inc.

Bret Davis
General Manager

Attachments

cc: U.S. Environmental Protection Agency, Air Operating Permits, Region X
ODEQ AQ Document Upload Website (electronic upload)
Melissa Green, Weaver Consultants Group *(via email)*

ANNUAL REPORT

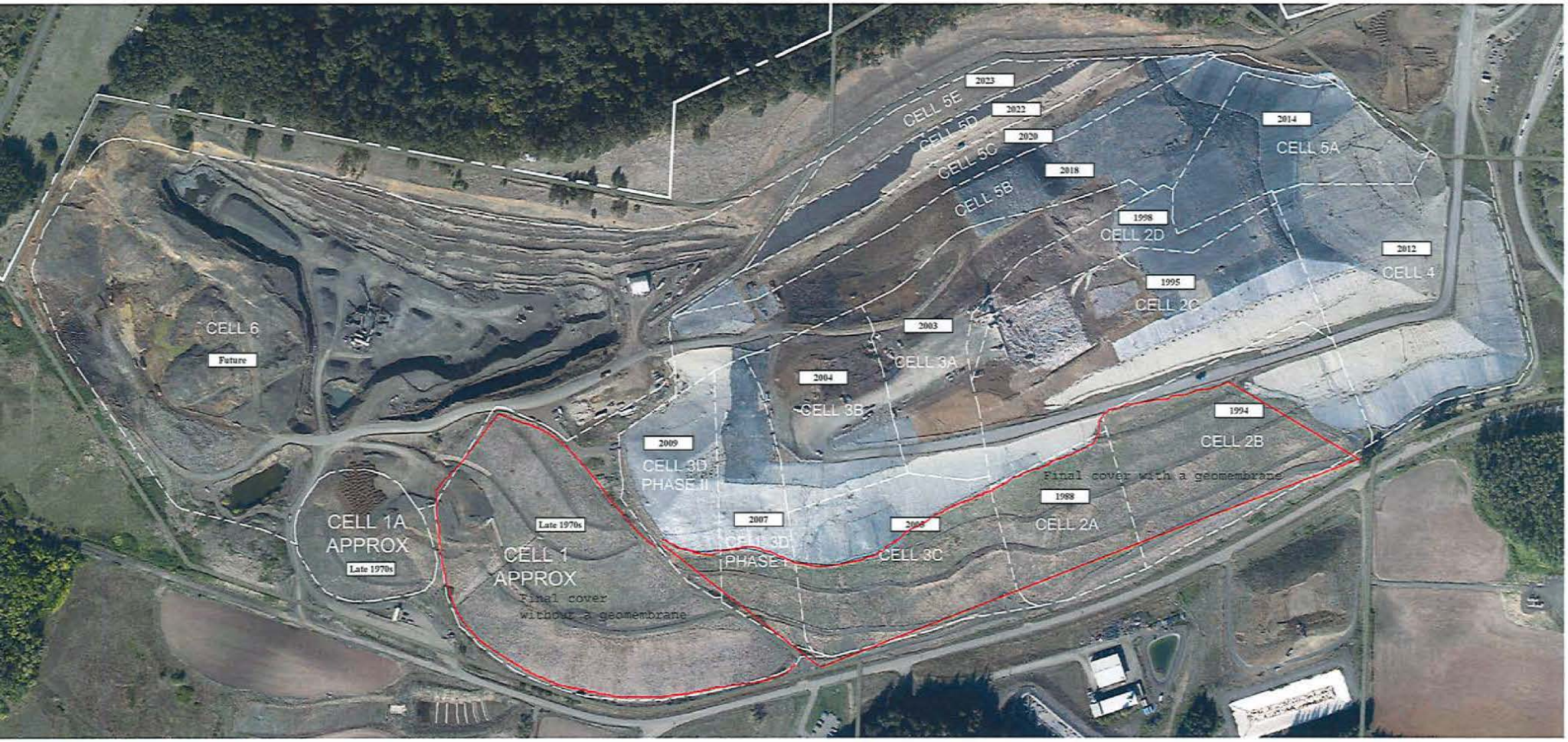
340-239-0700(3)(d)

Coffin Butte Landfill
Oregon Department of Environmental Quality
§340-239-0700(3)(d) Annual Report
Reporting Period: January 1, 2023 to December 31, 2023

Regulation	Citation	Description
Landfill name, owner and operator, address, and permit number	§340-239-0700(3)(d)(A)	Landfill Name: Coffin Butte Landfill Owner/Operator: Valley Landfills, Inc. Address: Highway 99 & Coffin Butte Road, Corvallis, OR 97330 Permit Number: 02-9502-TV-01
Total volume of landfill gas collected (standard cubic feet)	§340-239-0700(3)(d)(B)	Total volume of landfill gas collected: 1,497,523,240 scf (on-site and off-site devices)
Average composition of the landfill gas collected over the reporting period (% methane and % carbon dioxide by volume)	§340-239-0700(3)(d)(C)	Average Methane Composition = 52.7% Average Carbon Dioxide Composition = 37.9%
Gas control device type, year of installation, rating, fuel type, and total amount of landfill gas combusted in each control device	§340-239-0700(3)(d)(D)	Coffin Butte Landfill has 3 gas control devices. Control device 1 is a utility flare with a capacity of 2,000 scfm of landfill gas. Control device 1 was installed in 2002. In 2023, this control device combusted 266,118,599 scf. Control device 2 is a utility flare with a capacity of 1,000 scfm of landfill gas. Control device 2 was installed in 2015. In 2023, this control device combusted 311,507,784 scf. Control device 3 is a landfill gas to energy facility with a capacity of 2,000 scfm of landfill gas. Control device 3 was installed in 1995. In 2023, this control device combusted 919,896,857 scf.
The date that the gas collection and control system was installed and in full operation	§340-239-0700(3)(d)(E)	1994
The percent methane destruction efficiency of each gas control device(s)	§340-239-0700(3)(d)(F)	The utility flares have a 98% destructive efficiency. The landfill gas to energy facility has a 99% destruction efficiency.
Type and amount of supplemental fuels burned with the landfill gas in each device, if applicable	§340-239-0700(3)(d)(G)	No supplemental fuels are burned with the landfill gas. Minimal quantities of propane are utilized during flare startup event.
Total volume of landfill gas shipped off-site (MMscf), the composition of the landfill gas collected (reported in % methane and % carbon dioxide by volume), and the recipient of the gas	§340-239-0700(3)(d)(H)	PNGC Power owns and operates the landfill gas to energy facility at Coffin Butte Landfill. The is referred to as control device 3 above. The average methane composition is 52.6% and the average carbon dioxide composition is 38.0% In 2023, PNGC combusted 919.90 MMscf. The beneficial use and recipient of the gas is the power grid (electricity).
Most recent topographic map of the site showing the areas with final cover and a geomembrane and the areas with final cover without a geomembrane with corresponding percentages over the landfill surface	§340-239-0700(3)(d)(I)	CBLF has installed final cover on 45.3 acres out of the constructed 118.7 acres (45.3/118.7 = 38%), therefore, 38% of the landfill surface has final cover. Landfills are not required to install final certified closure until the landfill is no longer accepting waste. However, CBLF is installing final clover well before it is required regulatorily. The attachment includes the drawing showing the final cover areas.
The information required in paragraphs (2)(a)(A) through (2)(a)(E), (2)(a)(G), (2)(a)(J) through (2)(a)(L) of this rule	§340-239-0700(3)(d)(J)	This information is included in the OAR Semi-Annual Reports for reporting periods January 1 through June 31 (submitted in July 2023) and July 1 through December 31 (submitted as Attachment 2 of this Annual Report) and the Annual Waste-in-Place Report (submitted in January 2024).
Instrument specifications for all instruments used for monitoring compliance with this division	§340-239-0700(3)(d)(K)	The flares and landfill gas to energy facility each have individual flow meters. The two flares share a data recorder and the plant has a data recorder. All flowmeters are Rosemount and are field calibrated therefore no calibrated pressure and temperature. The flare data recorder is a Yokogawa.

FINAL COVER AREAS DRAWING

340-239-0700(3)(d)(I)


CELL 6
Future
CELL 1A
APPROX
Late 1970s
CELL 1
APPROX
Late 1970s
Final cover
without a geomembrane
2009
CELL 3D
PHASE II
2007
CELL 3D
PHASE I
2004
CELL 3B
2003
CELL 3A
2000
CELL 3C
1988
CELL 2A
1994
CELL 2B
Final cover with a geomembrane
1995
CELL 2C
1998
CELL 2D
2012
CELL 4
2014
CELL 5A
2018
2020
2022
2023
CELL 5E
CELL 5D
CELL 5C
CELL 5B

SEMI-ANNUAL REPORT

340-239-0700(3)(c)

COFFIN BUTTE LANDFILL

SEMI-ANNUAL REPORT

PREPARED FOR

VALLEY LANDFILLS, INC.

February 7, 2024

PREPARED BY

Weaver Consultants Group

TABLE OF CONTENTS

1 INTRODUCTION 1

2 SEMI-ANNUAL REPORTING REQUIREMENTS 2

§340-239-0700(3)(c)(A) – Monitoring and Exceedances 2
§340-239-0700(3)(c)(B) – Corrective Action Analysis 4
§340-239-0700(3)(c)(C) – Subsurface Landfill Fire(s) 4
§340-239-0700(3)(c)(D) – Deviations 4
§340-239-0700(3)(c)(E) – Bypass line 5
§340-239-0700(3)(c)(F) – Control Device or Treatment System Downtime 5
§340-239-0700(3)(c)(G) – Collection System Downtime 5
§340-239-0700(3)(c)(H) – Collection System Expansion 5
§340-239-0700(3)(c)(I) – Enhanced Monitoring 6
§340-239-0700(3)(c)(J) – Enclosed Combustors 6
§340-239-0700(3)(c)(K) – Boilers or Process Heaters 6

3 ADDITIONAL REPORTING/RECORDKEEPING 7

§340-239-0600(3)(b)(E)(5) – Monitoring System Malfunctions 7

4 LIMITATIONS 8

APPENDICES

Appendix A Surface Emission Monitoring
Appendix B Wellfield Pressure Exceedance Report
Appendix C Control Device Downtime Log/Treatment System Downtime Log
Appendix D Collection System Downtime Log
Appendix E GCCS Expansion/Current Site GCCS Layout
Appendix F Root Cause Analyses

1 INTRODUCTION

The Coffin Butte Landfill is a municipal solid waste (MSW) landfill located in Benton County, Oregon and is owned by Valley Landfills, Inc (VLI). The facility is subject to the Semi-Annual Report requirements of Oregon Department of Environmental Quality (ODEQ) Oregon Administrative Rule (OAR) 340-239-0700(3)(c). This Semi-Annual Report covers the period of July 1, 2023 through December 31, 2023.

2 SEMI-ANNUAL REPORTING REQUIREMENTS

Records are prepared and maintained in accordance with OAR 340-239-0700(3)(c). The primary location for records storage is the Coffin Butte Landfill. Coffin Butte Landfill is submitting this Semi-Annual Report in accordance with OAR 340-239-0700(3)(c).

§340-239-0700(3)(c)(A) – Monitoring and Exceedances

> All instantaneous surface readings of 100 ppmv or greater. All exceedances of the limits in OAR 340-239-0100(6)(b), 340-239-0200 and 340-239-0600(2)(c) including the location of the leak (or affected grid), leak concentration in ppmv, date and time of measurement, the action taken to repair the leak, date of repair, any required remonitoring and the remonitored concentration in ppmv, wind speed during surface sampling, the concentration recorded at each location for which an exceedance was recorded in the previous month, and the installation date and location of each well installed as part of a gas collection system expansion.

§340-239-0100(6)(b) – Methane Generation Rate Exceedances

> Demonstrate that after four consecutive quarterly monitoring periods there is no measured concentration of methane of 200 parts per million by volume (ppmv) or greater using the instantaneous surface monitoring procedures specified in OAR 340-239-0800(3). The owner or operator of the landfill must begin quarterly monitoring within 90 days after the Methane Generation Rate Report is required to be submitted under section (1) or (2) of this rule or OAR 340-239-0100(6) and submit Instantaneous Surface Monitoring Reports according to OAR 340-239-0700(3)(l).

Quarterly instantaneous surface emissions monitoring (SEM) was performed at the landfill by SCS Field Services (SCS) personnel.

The second, third, and fourth quarter 2023 instantaneous SEM monitoring results are included in the SEM Reports provided in Appendix A.

§340-239-0200 – Compliance Standards

> When required as provided in OAR 340-239-0100 through 340-239-0800, the owner or operator of a landfill must comply with this rule.
>
> (1) Surface Emission Methane Concentration Limits. Except as provided in OAR 340-239-0110(4), 340-239-0110(5), 340-239-0300, and 340-239-0600(1), beginning August 1, 2022, or upon commencing operation of a newly installed gas collection and control system or modification of an existing gas collection and control system pursuant to OAR 340-239-0110(1), whichever is later, no location on the landfill surface may exceed either of the following methane concentration limits:
>
> (a) 500 ppmv, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring conducted in accordance with OAR 340-239-0800(3)(b);
> (b) An average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring conducted in accordance with OAR 340-239-800(3)(c).

Quarterly integrated SEM was performed at the landfill by SCS personnel.

The second, third, and fourth quarter 2023 integrated SEM monitoring results are included in the SEM Report provided in Appendix A.

§340-239-0200(2) – Wellhead Gauge Pressure Requirement

Operate the collection system with negative pressure at each wellhead

On a monthly basis, operations and maintenance personnel measure the gauge pressure at each wellhead. The gauge pressure taken at the wellhead is used in determining the presence of vacuum at the collector. The wellfield pressure exceedance report is provided in Appendix B.

§340-239-0200(3) – Wellhead Temperature Requirement

Each landfill gas collection and control system interior wellhead in the collection system must be operated with a landfill gas temperature less than 62.8 degrees Celsius (145 degrees Fahrenheit).

Each LFG collector is equipped with an access port for measuring temperature at each wellhead. On a monthly basis, operations and maintenance personnel measure the temperature at each wellhead. All wells operated below 145 °F during the reporting period. Therefore, a temperature wellfield exceedance report is not applicable during this reporting report.

§340-239-0600(2)(c) – Gas Control System Equipment Monitoring

Components containing landfill gas and under positive pressure must be monitored quarterly for leaks. Any component leak over 500 ppmv methane must be tagged and repaired within 10 days. Any component leak over 250 ppmv must be recorded pursuant to OAR 340-239-0700(2)(a)(S). Quarterly component leak testing at landfills having landfill gas-to-energy facilities may be conducted prior to scheduled maintenance or planned outage periods.

SCS performed the second quarter gas control system equipment monitoring on May 22, 2023. No locations exceeding the 500 ppmv threshold were observed during the monitoring event. The gas control system equipment monitoring results are included in the second quarter SEM Report, included as Appendix A.

SCS performed the third quarter gas control system equipment monitoring on September 12, 2023. No locations exceeding the 500 ppmv threshold were observed during the monitoring event. The gas control system equipment monitoring results are included in the third quarter SEM Report, included as Appendix A.

SCS performed the fourth quarter gas control system equipment monitoring on November 21, 2023. No locations exceeding the 500 ppmv threshold were observed during the monitoring event. The gas control system equipment monitoring results are included in the fourth quarter SEM Report, included as Appendix A.

§340-239-0700(3)(c)(B) – Corrective Action Analysis

> For any corrective action analysis for which corrective actions are required in OAR 340-239-0600(3)(a) and 340-239-0600(3)(b) and that take more than 60 days to correct the exceedance, the root cause analysis conducted, including a description of the recommended corrective action(s), the date for corrective action(s) already completed following the positive pressure or elevated temperature reading, and, for action(s) not already completed, a schedule for implementation, including proposed commencement and completion dates.

During the reporting period, all exceedances were corrected within 60 days. The site conducted a pressure exceedance root cause analysis for exceedances that were remediated between 15 and 60 days and were not operating under the site's approved Alternative Monitoring Plan. The Root Cause Analyses are not required to be submitted; however, they are provided in Appendix F for informational purposes.

§340-239-0700(3)(c)(C) – Subsurface Landfill Fire(s)

> All known, prevented, or suspected subsurface landfill fire(s) along with potential causes and any efforts conducted to avoid or put out the fire(s). Any positive pressure readings that may have contributed to the known, prevented, or suspected fire.

During the reporting period, no subsurface landfill fire(s) occurred.

§340-239-0700(3)(c)(D) – Deviations

> The number of times that applicable parameters monitored under OAR 340-239-0110(2) or 340-239-0200, were exceeded and when the gas collection and control system was not operating in compliance with OAR 340-0110(2)(a) including periods of startup, shutdown, and malfunction. For each instance, report the date, time, and duration of each exceedance. Where an owner or operator subject to the requirements of this division is demonstrating compliance with the operational standard for temperature OAR 340-239-0600(3)(b), the owner or operator must provide a statement of the wellhead operational standard for temperature and oxygen the landfill is complying with for the period covered by the report.

During this reporting period, there were no times that applicable parameters monitored under OAR 340-239-0110(2) or 340-239-0200 were exceeded. There were also no times when the gas collection and control system (GCCS) was not operating in compliance with OAR 340-0110(2).

> (i) The number of times each of those parameters monitored under OAR 340-239-0600(3)(b), were exceeded. For each instance, report the date, time, and duration of each exceedance.

During the reporting period, no temperature exceedances occurred.

> (ii) The number of times the parameters for the site-specific treatment system in OAR 340-239-0110(2)(d)(C) were exceeded.

> **§340-239-0110(2)(d)(C) –** Route the collected gas to a treatment system that processes the collected gas for subsequent sale or use. Venting of treated landfill gas to the ambient air is not allowed. If the treated landfill gas cannot be routed for subsequent sale or beneficial use, then the treated landfill gas must be controlled according to either subsection (2)(b), (2)(c) or (2)(d) of this rule. All emissions vented to the atmosphere from the gas treatment system are subject to the requirements of subsection (2)(b) or (2)(c) of this rule.

In accordance with §340-239-0110(2)(d)(C), PNGC Power owns and operates a landfill treatment system at the landfill that processes the collected gas for subsequent sale or beneficial use. There are no vents within the treatment system that allow venting of gas to the atmosphere. The treatment system is not designed nor equipped to bypass the control devices. A calibrated flow meter was installed to measure flow to the treatment system. PNGC Power maintains and operates all monitoring systems associated with the treatment system in accordance with the PNGC Power site-specific treatment system monitoring plan required by §340-239-0700(2)(b)(H)(ii). During this reporting period there were no parameter exceedances of the Treatment Monitoring Plan.

§340-239-0700(3)(c)(E) – Bypass line

> Description and duration of all periods when the gas stream was diverted from the control device or treatment system through a bypass line or the indication of bypass flow as specified OAR 340-239-0110(2)(c).

The gas collection system is not designed nor equipped to bypass the control devices; therefore, §340-239-0700(2)(c)(E) is not applicable.

§340-239-0700(3)(c)(F) – Control Device or Treatment System Downtime

> Description and duration of all periods when the control device or treatment system was not operating and length of time the control device or treatment system was not operating.

The tables provided in Appendix C summarize all the periods when the control device was not operating.

§340-239-0700(3)(c)(G) – Collection System Downtime

> All periods when the collection system was not operating.

The table provided in Appendix D summarizes all the periods when the collection system was not operating.

§340-239-0700(3)(c)(H) – Collection System Expansion

> The date of installation and the location of each well or collection system expansion.

During this reporting period, the gas collection and control system (GCCS) was expanded by adding 15 new extraction wells. The new wells are adding to the performance of the GCCS. During this reporting period, no wells were decommissioned. Appendix E contains an updated site layout showing the approximate locations of the new wells and a table with their installation dates.

§340-239-0700(3)(c)(I) – Enhanced Monitoring

> Each owner or operator required to conduct enhanced monitoring in accordance with OAR 340-239-0800(8) for temperatures exceeding 62.8 degrees Celsius (145 degrees Fahrenheit) must include the results of all monitoring activities conducted during the period.

During the reporting period, no temperature exceedances occurred.

§340-239-0700(3)(c)(J) – Enclosed Combustors

> For enclosed combustors except for boilers and process heaters with design heat input capacity of 44 megawatts per hour (150 million British thermal units per hour) or greater, all three-hour periods of operation during which the average temperature was more than 28 degrees Celsius (82 degrees Fahrenheit) below the average combustion temperature during the most recent performance test.

Coffin Butte Landfill does not own and/or operate an enclosed combustor; therefore, §340-239-0700(3)(c)(J) is not applicable.

§340-239-0700(3)(c)(K) – Boilers or Process Heaters

> For boilers or process heaters, whenever there is a change in the location at which the vent stream is introduced into the flame zone.

Coffin Butte Landfill does not own and/or operate boilers or process heaters; therefore, §340-239-0700(3)(c)(K) is not applicable.

3 ADDITIONAL REPORTING/RECORDKEEPING

The information in this section includes additional recording/reporting within the semi-annual report.

§340-239-0600(3)(b)(E)(5) – Monitoring System Malfunctions

> The monitoring requirements of this division apply at all times, except for periods of monitoring system malfunctions, repairs associated with monitoring system malfunctions, and required monitoring system quality assurance or quality control activities. A monitoring system malfunction is any sudden, infrequent, not reasonably preventable failure of the monitoring system to provide valid data. Monitoring system failures that are caused in part by poor maintenance or careless operation are not malfunctions. Monitoring system repairs completed in response to monitoring system malfunctions to return the monitoring system to operation must be completed as expeditiously as practicable.

There were no monitoring system malfunctions during this reporting period.

4 LIMITATIONS

This Semi-Annual Report for the Coffin Butte Landfill GCCS has been prepared by WCG, as authorized by VLI. The report was prepared based on WCG's review of information provided by Coffin Butte Landfill. The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. These services were performed consistent with our agreement with our client. Any reliance on this report by a third party is at such party's sole risk. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

APPENDIX A

SURFACE EMISSION MONITORING

SECOND QUARTER 2023

SURFACE EMISSIONS MONITORING

August 17, 2023
File No. 07222178.00

Mr. Ian MacNab
Republic Services – Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, Oregon 97330

Subject: Coffin Butte Landfill - Corvallis, Oregon

Surface Emissions Monitoring for Second Quarter 2023.

Dear Mr. MacNab:

SCS Field Services (SCS-FS) is pleased to provide Republic Services, with the enclosed report summarizing the surface emissions monitoring services provided at the Coffin Butte Landfill (Site) during the second quarter of 2023. This report includes the results of the surface scan, component emissions, and blower/flare station emissions monitoring for the Site for this monitoring period.

SCS-FS appreciates the opportunity to be of assistance to Republic Services on this project. As you review the enclosed information, please contact Stephan Harquail at (503) 867-2369 or Max Polkabla at (510) 277-5122 if you have any questions or comments.

Sincerely,

Max Polkabla

Max Polkabla
Senior Technician/Data Analyst
SCS Field Services

Stephen Harquail
PNW Region Manager
SCS Field Services

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring

Second Quarter 2023

Presented to:



Mr. Ian MacNab
28972 Coffin Butte Road
Corvallis, Oregon 97330

SCS FIELD SERVICES

File No. 0722178.00 | August 17, 2023

SCS FIELD SERVICES
15949 SW 72nd Ave
Portland, Or 97224

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring Second Quarter 2023

INTRODUCTION

This letter provides results of the May 16, 17, 22, 23, 26, 30, and June 5 and 16, 2023, OAR landfill surface emissions monitoring (SEM) performed by SCS Field Services (SCS) at the Coffin Butte Landfill. All work was performed in accordance with our approved Work Scope dated August 29, 2022, and the OAR requirements.

2022 State Regulatory Applicability

CBL is subject to the Oregon-specific landfill gas emission regulations in OAR Chapter 340 Division 239. These SEM regulations are detailed below. The following requirements are stricter than the NESHAP regulations in previous Sections and require additional compliance:

SURFACE EMISSION METHANE CONCENTRATION LIMITS

> *340-239-0200 (1) Surface Emission Methane Concentration Limits. Except as provided in OAR 340-239-0110(4), 340-239-0110(5), 340-239-0300, and 340-239-0600(1), beginning August 1, 2022, or upon commencing operation of a newly installed gas collection and control system or modification of an existing gas collection and control system pursuant to OAR 340-239-0110(1), whichever is later, no location on the landfill surface may exceed either of the following methane concentration limits:*
>
> *(a) 500 ppmv, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring conducted in accordance with OAR 340-239-0800(3)(b);*
>
> *(b) An average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring conducted in accordance with OAR 340-239-800(3)(c).*

The 500 ppmv limit is already a requirement in the Federal regulations above, but an average methane concentration limit of 25 ppmv will be adhered to as required.

SURFACE EMISSION RECORDKEEPING

> *340-239-0700(2)(a)(C) All instantaneous surface readings of 100 ppmv methane or greater. All exceedances of the limits in OAR 340-239-0100(6)(b) and 340-239-0200, including the location of the leak (or affected grid), leak concentration in ppmv methane, date and time of measurement, the action taken to repair the leak, date of repair, any required remonitoring and the remonitored concentration in ppmv methane, wind speed during surface sampling, and the installation date and location of each well installed as part of a gas collection system expansion;*

The Federal regulations only require monitored surface emissions over 500 ppmv to be documented, so all of the above recordkeeping will be performed on emission points 100 ppmv or over. All repeatable instantaneous records of 100 ppm or higher (taken during SEM) must be kept for 5 years AND recorded in the semi-annual reports.

SUMMARY AND CONCLUSIONS

As stipulated in OAR, if uncorrectable exceedances within the 10-day limitation are detected or emissions are discovered during an inspection by Regulatory Agencies, the landfill must perform monitoring on a 25-foot pathway on a quarterly basis for active disposal sites. Upon completion of four consecutive SEM events without an uncorrectable exceedance of the 25 ppmv or 500 ppmv standards, other than non-repeatable momentary readings, the landfill may perform the monitoring on a 100-foot spacing on an annual basis for closed landfills or quarterly for active disposal sites. In accordance with the provisions of the OAR, the monitoring of the landfill was done on 25-foot pathway based on a prior inspection, in which exceedances were observed.

On May 16, 17, 22, 23, 26, 30, and June 5 and 16, 2023, SCS performed second quarter 2023 surface emissions monitoring testing as required by the Oregon Landfill Gas emission Rule. Instantaneous surface emissions monitoring results indicated that eighteen (18) locations exceeded the 500 ppmv maximum concentration on the above-mentioned dates (Table 1 in Attachment 3). The required first/second 10-day (OAR) and 1-month (OAR) follow-up monitoring indicated that fourteen (14) areas had returned to compliance following system adjustments and remediation by SCS and site personnel. However, the remaining 4 areas remained above compliance. Based on these monitoring results, and in accordance with the OAR, the site is required to perform a system expansion within 120 days of the third detected exceedance or October 3, 2023. These results are discussed in a subsequent section of this report.

Also, during the instantaneous monitoring event, SCS performed integrated monitoring of the landfill surface. As required by the OAR, the landfill was divided into 50,000 square foot areas. The Coffin Butte Landfill surface is divided into 105 grids, as shown in Figure 1 in Attachment 1. During this monitoring event, several grids were not monitored, in accordance with the regulations, due to ongoing active landfilling activities, unsafe conditions, or there was no waste in place prior to the monitoring event.

During the monitoring event, there were nineteen (19) areas observed to exceed the 25 ppmv OAR integrated average threshold (Table 2 in Attachment 4). The required first and second 10-day OAR follow-up monitoring indicated that two (2) areas had returned to compliance following system adjustments and remediation by SCS and site personnel. However, the remaining seventeen (17) areas remained above compliance. Based on these monitoring results, and in accordance with the OAR, the site is required to perform a system expansion within 120 days of the third detected exceedance or October 3, 2023. These results are discussed in a subsequent section of this report.

In addition, quarterly monitoring of the pressurized piping or components of the Gas Collection and Control System (GCCS) under positive pressure must be performed quarterly. Results of the testing of the landfill gas (LFG) Blower Flare Station (BFS) pressurized pipe and components indicated that all test locations were in compliance with the 500 ppmv requirements.

Further, as required under the OAR, any location on the landfill that has an observed instantaneous methane concentration above 100 ppmv, must be included within the surface emission monitoring report and if any instantaneous location records above 250 ppmv, it must be monitored in a 5-foot grid around the location to determine extents of the methane leak. During this reporting period, two (2)

locations were observed showing elevated concentrations between 100-499 ppmv, of the reporting threshold. When these readings are observed to be repeatable, they are reported to site personnel for tracking and/or remediation and will be reported in the next submittal of the annual OAR report. Finally, to help prevent potential future exceedances, SCS recommends that the landfill surface be routinely inspected and any observed surface erosion be routinely repaired.

BACKGROUND

The Coffin Butte Landfill is an active organic refuse disposal site. By way of background, organic materials buried in a landfill decompose anaerobically (in the absence of oxygen) producing a combustible gas that contains approximately 50 to 60 percent methane gas, 40 to 50 percent carbon dioxide, and a trace amount of various other gases, some of which are odorous. The Coffin-Butte/Corvallis property contains a system to control the combustible gases generated in the landfill.

SURFACE EMISSIONS MONITORING

On May 16, 17, 22, 23, 26, 30, and June 5 and 16, 2023, the instantaneous and integrated SEM was performed over the surface of the subject site. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring in the 50,000 square foot grids as required under the OAR. During this event, SCS performed the monitoring on a 25 and 100-foot pathway in accordance with the rules as required.

EMISSIONS TESTING INSTRUMENTATION/CALIBRATION

The instruments used to perform the landfill surface emission testing consisted of the following:

- Thermo Scientific TVA 2020 portable Flame Ionization Detector (FID). This instrument measures methane in the air over a range of 1 to 50,000 ppmv. The TVA 2020 meets the State of California Air Resources Board (CARB) requirements for combined instantaneous and integrated monitoring and was calibrated in accordance with the United States Environmental Protection Agency (US EPA) Method 21.

- Weather Anemometer with continuous recorder for meteorological conditions in accordance with the OAR.

Instrument calibration logs and weather information are shown in Attachments 5 and 6.

SURFACE EMISSIONS MONITORING PROCEDURES

Surface emissions monitoring was conducted in accordance with the OAR and SEM requirements. Monitoring was performed with the FID inlet held within 2 inches of the landfill surface while a technician walked a grid in parallel paths not more than 25 or 100 feet apart over the landfill's surface. Cracks, holes, and other cover penetrations in the surface were also tested. Surface emissions readings were monitored continuously and recorded every 5 seconds. Any areas exceeding the 100 or 500 ppmv standards (reporting and compliance levels, respectively) would be GPS tagged and stake-marked for on-site personnel to perform remediation or repairs.

The integrated average is based on the readings stored on the instrument, which are recorded every 5 seconds. The readings are then downloaded and the averages are calculated for each grid using SCS

eTools®. All readings are maintained in this secure SCS Database. The readings are not provided in the report due to the volume of readings but can be furnished upon request.

Recorded wind speed results are shown in Attachment 6. Wind speed averages were observed to remain below the alternative threshold of 10 miles per hour, and no instantaneous speeds exceeded 20 miles per hour. No rainfall occurred within 72 hours of the monitoring events. Therefore, site meteorological conditions were within the alternatives of the OAR requirements on the above-mentioned dates.

TESTING RESULTS

During this event, SCS performed the monitoring on a 25-foot pathway in accordance with the rule as required under the OAR. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR or NSPS threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring (OAR).

On May 16, 17, 22, 23, 26, 30, and June 5 and 16, 2023, SCS performed second quarter 2023 instantaneous emissions monitoring testing as required by the Oregon DEQ/OAR. During this monitoring, surface emissions results indicated that eighteen (18) locations exceeded the 500 ppmv maximum concentration. The required first and second 10-day (OAR) follow-up monitoring performed on May 30 & June 5 and the 1-month (OAR) follow-up monitoring event performed on June 16, 2023, indicated that fourteen (14) areas had returned to compliance following system adjustments and remediation by SCS and site personnel. In accordance with requirements for expansion and remediation, the instantaneous locations needs to be remediated and returned to compliance in accordance with the rule (expansion of the collection system or an alternative compliance option if approved by the OAR) within 120 days after the third integrated exceedance, which will be due by October 3, 2023. Results of the monitoring are shown in Attachments 2 and 3 (Table 1).

Additionally, calculated integrated monitoring indicated nineteen (19) integrated exceedances of the 25-ppmv requirement on May 16, 17 and 22, 2023. The required first and second 10-day OAR follow-up monitoring performed on May 26 and June 5, 2023, indicated that two (2) of the nineteen (19) areas had returned to compliance. In accordance with requirements for expansion and remediation, the instantaneous locations need to be remediated and returned to compliance in accordance with the rule (expansion of the collection system or an alternative compliance option if approved by the OAR) within 120 days after the third integrated exceedance, which will be due by October 3, 2023. Calibration logs for monitoring equipment are provided in Attachment 5.

During this monitoring event, several girds were not monitored, in accordance with the OAR, due to active landfilling activities, unsafe conditions, overgrown vegetation, or no waste in place. SCS will continue to monitor all accessible locations during the third quarter of 2023.

PRESSURIZED PIPE AND COMPONENT LEAK MONITORING

On May 22, 2023, quarterly leak monitoring was performed in accordance with the OAR. SCS performed LFG pressurized pipe and component leak monitoring at the BFS. Monitoring was performed with the detector inlet held one-half of an inch from the pressurized pipe and associated components. No locations exceeding the 500 ppmv threshold were observed during our monitoring event. The maximum reading, which was 3.50 ppmv, was well below the maximum threshold (see Table 1 for component results). Therefore, all pressurized pipes and components located at the LFG BFS were in compliance at the time of our testing.

PROJECT SCHEDULE

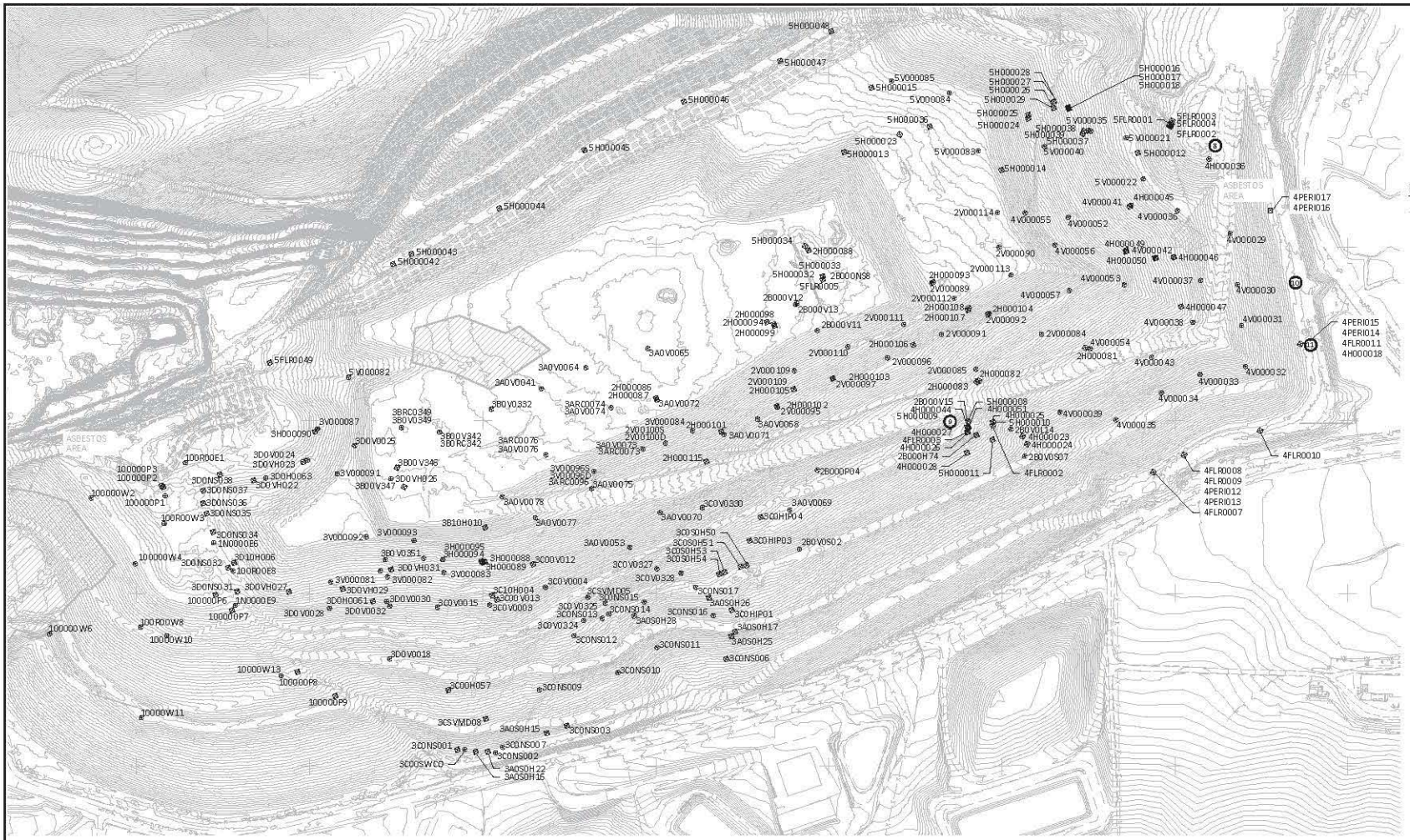
According to the OAR, surface emissions monitoring at active landfills is required to be performed on a quarterly basis. Therefore, in accordance with our approved Work Scope, the third quarter 2023 (July through September) surface emissions testing event is scheduled to be performed by the end of September 2023.

STANDARD PROVISIONS

This report addresses the conditions of the subject site during the testing dates only. Accordingly, we assume no responsibility for any changes that may occur subsequent to our testing which could affect the surface emissions at the subject site or adjacent properties.

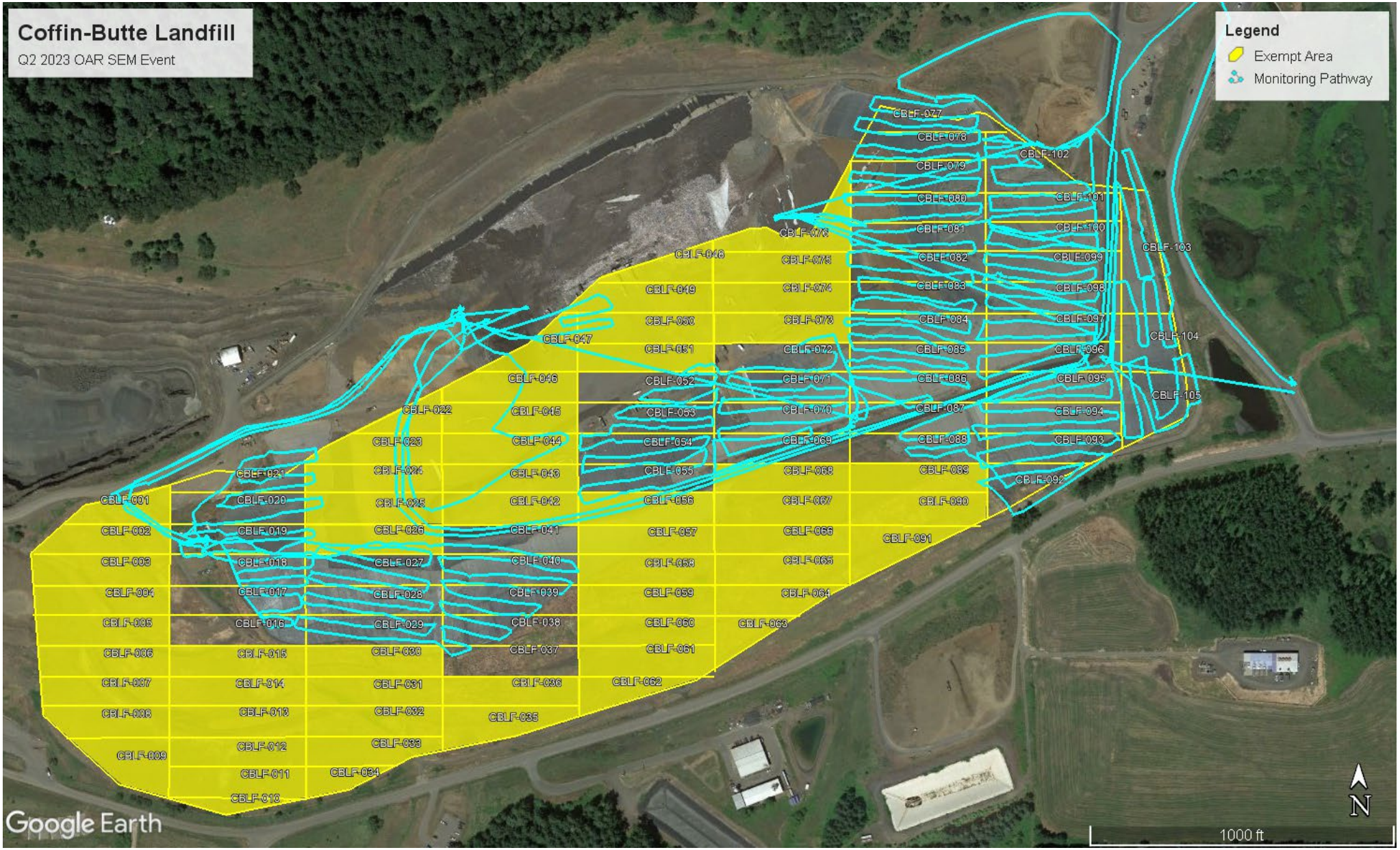
Attachment 1

Landfill Grid


N
W
E
S
0 75 150 300
GRAPHIC SCALE IN FEET
LEGEND
CURRENT GRADE TOPOGRAPHY
HORIZONTAL LFG EXTRACTION WELL
VERTICAL LFG EXTRACTION WELL
COORDINATE GRID: 500FT SPACING
ASBESTOS AREA
5H000048
5H000047
5H000046
5H000045
5H000044
5H000043
5H000042
5FLR0049
5V000082
3V000087
3H000090
3D0V0025
3D0V0024
3D0VH023
3D0H0063
3D0VH022
3D0NS038
3D0NS037
3D0NS036
3D0NS035
3D0NS034
3D0NS032
3D0NS031
3D0VH027
3D0H0061
3D0VH029
3D0V0030
3D0VH032
3D0V0026
3D0H006
3D0VH031
3D0V0018
3V000081
3V000082
3V000083
3V000092
3V000093
3V000091
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3B0V347
3B0V351
3B0V342
3B0RC342
3B0V0349
3BRC0349
3B10H010
3H000095
3H000094
3H000088
3H000089
3C00V012
3C0V0004
3C0V0015
3C00V013
3C0V0003
3C0V0327
3C0V0328
3C0V0325
3C0V0324
3C0NS014
3CSVMD05
3C0NS015
3C10H004
3C0NS013
3C0NS012
3C0NS011
3C0NS010
3C0NS009
3C00H057
3CSVMD08
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3C0NS016
3C0HIP01
3C0HIP03
3C0HIP04
3C0V0330
3C0V0069
3C0V0070
3C0S0H50
3C0S0H51
3C0S0H53
3C0S0H54
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2B000P04
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2H000102
2H000115
2V000100
2V001000
2V000095
2H000098
2H000094
2H000099
2H000088
2H000033
2H000032
2B000N58
5FLR0005
2B000V12
2B000V13
2B000V11
2V000111
2V000110
2H000106
2V000096
2V000109
2H000105
2V000097
2H000103
2V000112
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4V000029
4V000031
4V000032
4V000033
4V000034
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4V000039
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4H000050
4H000046
4H000047
4H000045
4H000036
4PERI017
4PERI016
4PERI015
4PERI014
4FLR0011
4H000018
4FLR0010
4FLR0008
4FLR0009
4PERI012
4PERI013
4FLR0007
4FLR0002
4H000027
4FLR0005
4H000026
4H000028
4H000025
4H000024
4H000023
2B000H74
2B000V07
2B000V14
2B000V15
4H000044
4H000051
5H000008
5H000010
5H000009
5H000011
5V000022
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5H000012
5H000014
5H000013
5V000083
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5H000027
5H000028
5H000029
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5H000018
5V000035
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1N0000E9
100000P7
100R00W8
100000W6
100000W10
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100000P9
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100000W8
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100000P30
100000W33

Attachment 2

Surface Pathway



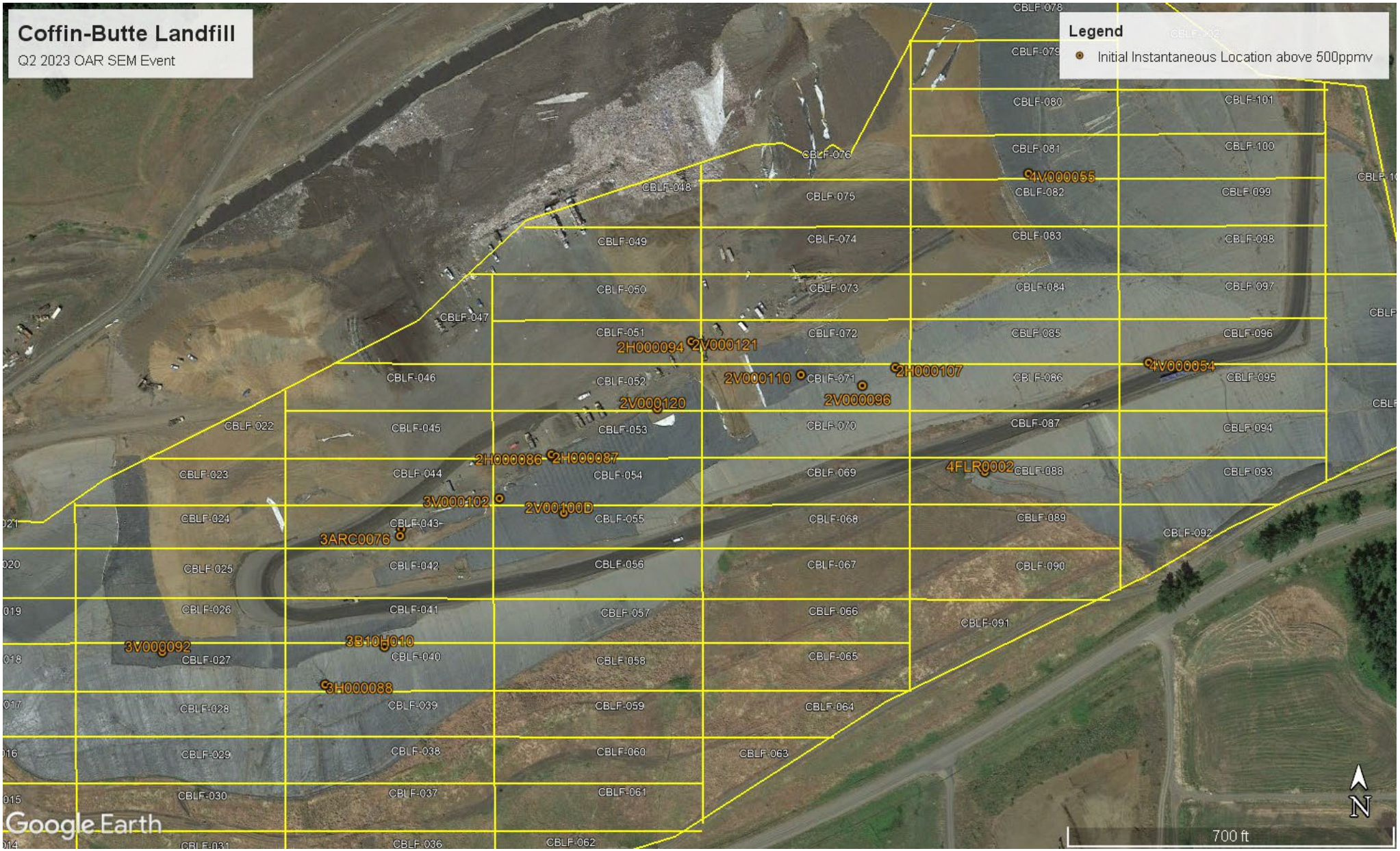
Second Quarter 2023

Initial Surface Emissions Monitoring Pathway

Coffin Butte Landfill, Corvallis, Oregon

Attachment 3

Instantaneous and Component Emissions Monitoring Results



Second Quarter 2023

Initial Emissions Monitoring Results Greater Than 500 ppmv

Coffin Butte Landfill, Corvallis, Oregon

Second Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Instantaneous Data Report for May 16, 17, 22, 23, 26, 30, and June 5 and 16, 2023

Location (Surface)	Initial Monitoring Results (ppmv) 5/23/2023	Follow Up Monitoring Results (ppmv) 5/30/2023	Follow Up Monitoring Results (ppmv) 6/5/2023	1-Month Follow Up Monitoring Results (ppmv) 6/16/2023	Latitude	Longitude
2V000121	10322	Active	Active	Active	44.70020221	-123.230366
2H000107	9960	9923	450	193	44.70004924	-123.2286903
4V000055	9907	8364	7000	3658	44.70118172	-123.2275967
2V000096	9800	8790	220	138	44.69994371	-123.228961
2H000094	9790	Active	Active	Active	44.7001867	-123.2303417
2V00100D	4100	3817	341	115	44.69919973	-123.2314128
2V000120	3397	3159	92	54.8	44.69981018	-123.2306442
2V000110	3368	3298	87	63.5	44.70000699	-123.2294653
3V000102	3349	3012	111	443	44.69928531	-123.2319418
2H000086	2471	2263	780	663	44.69953174	-123.2315083
4FLR0002	2296	2149	54	43	44.69944004	-123.227955
4V000054	2213	2426	23	4	44.70007832	-123.22661
2H000087	2158	2303	677	685	44.69954171	-123.231515
3ARC0076	1639	1654	2045	4850	44.69906671	-123.232757
3B10H010	1287	1155	50	63	44.69841996	-123.232885
3A0V0076	1215	940	35	482	44.69910828	-123.2327483
3H000088	788	473	--	250	44.69819801	-123.2333723

Second Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Location (Surface)	Initial Monitoring Results (ppmv) 5/23/2023	Follow Up Monitoring Results (ppmv) 5/30/2023	Follow Up Monitoring Results (ppmv) 6/5/2023	1-Month Follow Up Monitoring Results (ppmv) 6/16/2023	Latitude	Longitude
3V000092	572		--	321	44.69838803	-123.2347092

Instantaneous Data Report for May 16, 17, 22, 23, 26, 30, and June 5 and 16, 2023
Readings between 100-499 ppmv

Location (Surface)	Initial Monitoring Results (ppmv) 5/22/2023	Latitude	Longitude
FD5	456	44.702429	-123.228200
H15	315	44.701791	-123.227407

Pressurized Pipe and Component Results

Route	Date	Concentration (ppmv)
FLARE STATION	5/22/2023	3.50

No other exceedances of the 500 ppmv threshold were observed during the second quarter of 2023 monitoring.

Attachment 4

Integrated Monitoring Results

Second Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-001	--	--	Overgrown Vegetation
CBLF-002	--	--	Overgrown Vegetation
CBLF-003	--	--	Overgrown Vegetation
CBLF-004	--	--	Overgrown Vegetation
CBLF-005	--	--	Overgrown Vegetation
CBLF-006	--	--	Overgrown Vegetation
CBLF-007	--	--	Overgrown Vegetation
CBLF-008	--	--	Overgrown Vegetation
CBLF-009	--	--	Overgrown Vegetation
CBLF-010	--	--	Overgrown Vegetation
CBLF-011	--	--	Overgrown Vegetation
CBLF-012	--	--	Overgrown Vegetation
CBLF-013	--	--	Overgrown Vegetation
CBLF-014	--	--	Overgrown Vegetation
CBLF-015	--	--	Overgrown Vegetation
CBLF-016	5/22/2023	9.38	
CBLF-017	5/22/2023	5.83	
CBLF-018	5/22/2023	15.32	
CBLF-019	5/22/2023	5.11	
CBLF-020	5/22/2023	6.78	
CBLF-021	5/22/2023	5.01	
CBLF-022	--	--	Active Area
CBLF-023	--	--	Active Area
CBLF-024	--	--	Active Area
CBLF-025	--	--	Active Area
CBLF-026	--	--	Active Area
CBLF-027	5/17/2023	82.74	Initial Monitoring
CBLF-027	5/26/2023	33.29	First 10-Day Recheck
CBLF-027	6/5/2023	40.47	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-028	5/17/2023	24.66	
CBLF-029	5/17/2023	6.30	
CBLF-030	--	--	Overgrown Vegetation
CBLF-031	--	--	Overgrown Vegetation
CBLF-032	--	--	Overgrown Vegetation
CBLF-033	--	--	Overgrown Vegetation
CBLF-034	--	--	Overgrown Vegetation
CBLF-035	--	--	Overgrown Vegetation
CBLF-036	--	--	Overgrown Vegetation
CBLF-037	5/17/2023	0.00	
CBLF-038	5/17/2023	0.39	
CBLF-039	5/17/2023	7.39	
CBLF-040	5/17/2023	38.51	Initial Monitoring

Second Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-040	5/26/2023	42.60	First 10-Day Recheck
CBLF-040	6/5/2023	47.34	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-041	5/17/2023	6.68	
CBLF-042	--	--	Active Area
CBLF-043	--	--	Active Area
CBLF-044	--	--	Active Area
CBLF-045	--	--	Active Area
CBLF-046	--	--	Active Area
CBLF-047	--	--	Active Area
CBLF-048	--	--	Active Area
CBLF-049	--	--	Active Area
CBLF-050	--	--	Active Area
CBLF-051	--	--	Active Area
CBLF-052	5/17/2023	127.07	Initial Monitoring
CBLF-052	5/26/2023	88.23	First 10-Day Recheck
CBLF-052	6/5/2023	181.32	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-053	5/17/2023	119.33	Initial Monitoring
CBLF-053	5/26/2023	96.40	First 10-Day Recheck
CBLF-053	6/5/2023	84.67	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-054	5/17/2023	62.21	Initial Monitoring
CBLF-054	5/26/2023	40.56	First 10-Day Recheck
CBLF-054	6/5/2023	87.42	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-055	5/17/2023	40.26	Initial Monitoring
CBLF-055	5/26/2023	22.45	First 10-Day Recheck
CBLF-056	--	--	Overgrown Vegetation
CBLF-057	--	--	Overgrown Vegetation
CBLF-058	--	--	Overgrown Vegetation
CBLF-059	--	--	Overgrown Vegetation
CBLF-060	--	--	Overgrown Vegetation
CBLF-061	--	--	Overgrown Vegetation
CBLF-062	--	--	Overgrown Vegetation
CBLF-063	--	--	Overgrown Vegetation
CBLF-064	--	--	Overgrown Vegetation
CBLF-065	--	--	Overgrown Vegetation
CBLF-066	--	--	Overgrown Vegetation
CBLF-067	--	--	Overgrown Vegetation
CBLF-068	--	--	Overgrown Vegetation
CBLF-069	5/17/2023	31.46	Initial Monitoring
CBLF-069	5/26/2023	7.67	First 10-Day Recheck
CBLF-070	5/17/2023	89.36	Initial Monitoring
CBLF-070	5/26/2023	33.41	First 10-Day Recheck



Second Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-070	6/5/2023	58.79	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-071	5/17/2023	207.08	Initial Monitoring
CBLF-071	5/26/2023	90.20	First 10-Day Recheck
CBLF-071	6/5/2023	119.10	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-072	5/17/2023	196.26	Initial Monitoring
CBLF-072	5/26/2023	74.76	First 10-Day Recheck
CBLF-072	6/5/2023	217.64	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-073	--	--	Active Area
CBLF-074	--	--	Active Area
CBLF-075	--	--	Active Area
CBLF-076	--	--	Active Area
CBLF-077	5/16/2023	2.05	
CBLF-078	5/16/2023	3.55	
CBLF-079	5/16/2023	18.01	
CBLF-080	5/16/2023	80.16	Initial Monitoring
CBLF-080	5/26/2023	48.09	First 10-Day Recheck
CBLF-080	6/5/2023	27.42	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-081	5/17/2023	122.36	Initial Monitoring
CBLF-081	5/26/2023	107.23	First 10-Day Recheck
CBLF-081	6/5/2023	16.19	Second 10-Day Recheck
CBLF-082	5/17/2023	87.44	Initial Monitoring
CBLF-082	5/26/2023	24.16	First 10-Day Recheck
CBLF-083	5/17/2023	72.94	Initial Monitoring
CBLF-083	5/26/2023	107.73	First 10-Day Recheck
CBLF-083	6/5/2023	46.58	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-084	5/17/2023	191.69	Initial Monitoring
CBLF-084	5/26/2023	93.43	First 10-Day Recheck
CBLF-084	6/5/2023	59.25	Second 10-Day Recheck 120-Day Expansion due by Oct 3, 2023
CBLF-085	5/17/2023	60.79	Initial Monitoring
CBLF-085	5/26/2023	24.80	First 10-Day Recheck
CBLF-086	5/17/2023	23.19	
CBLF-087	5/17/2023	26.55	Initial Monitoring
CBLF-087	5/26/2023	14.11	First 10-Day Recheck
CBLF-088	5/16/2023	26.06	Initial Monitoring
CBLF-088	5/26/2023	63.08	First 10-Day Recheck
CBLF-088	6/5/2023	2.23	Second 10-Day Recheck
CBLF-089	--	--	Overgrown Vegetation
CBLF-090	--	--	Overgrown Vegetation
CBLF-091	--	--	Overgrown Vegetation
CBLF-092	5/16/2023	4.84	

Second Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-093	5/16/2023	4.55	
CBLF-094	5/16/2023	22.12	
CBLF-095	5/16/2023	42.65	Initial Monitoring
CBLF-095	5/26/2023	22.48	First 10-Day Recheck
CBLF-096	5/16/2023	6.54	
CBLF-097	5/16/2023	5.07	
CBLF-098	5/16/2023	4.72	
CBLF-099	5/16/2023	0.58	
CBLF-100	5/16/2023	0.00	
CBLF-101	5/16/2023	0.00	
CBLF-102	5/16/2023	0.00	
CBLF-103	5/16/2023	6.17	
CBLF-104	5/16/2023	7.27	
CBLF-105	5/16/2023	5.62	

Attachment 5

Calibration Logs

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 5/16/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 4 MPH Wind Direction: SW Barometric Pressure: 29.93

Air Temperature: 72 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	502	2
2	0	501	1
3	0	499	1

Average Difference: 1.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 1.33 / 500 X 100%
= 0.3% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.5 ppm

Downwind West side of site Reading: 1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 5/17/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SW Barometric Pressure: 30.04

Air Temperature: 76 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *4 seconds*

Response Time trial #2 *6 seconds*

Response Time Trial #3 5 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	1
2	0	497	3
3	0	498	2

Average Difference: 2

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 2 / 500 X 100%
= 0.4% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.5 ppm

Downwind West side of site Reading: 1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 5/22/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 5 MPH Wind Direction: SW Barometric Pressure: 29, 29.97

Air Temperature: 72 deg F General Weather Conditions: overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *6 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 5 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	1
2	0	498	2
3	0	502	2

Average Difference: 1.666

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 1.666 / 500 X 100%
= 0.3% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.2 ppm

Downwind West side of site Reading: 1.1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 5/23/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SW Barometric Pressure: 29.92

Air Temperature: 71 deg F General Weather Conditions: overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *6 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 5 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	498	2
2	0	499	1
3	0	501	1

Average Difference: 1.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 1.33 / 500 X 100%
= 0.3% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0 ppm

Downwind West side of site Reading: 1.1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 5/30/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: W Barometric Pressure: 29.73

Air Temperature: 69 deg F General Weather Conditions: overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	1
2	0	498	2
3	0	499	1

Average Difference: 1.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 1.33 / 500 X 100%
= 0.3% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area near entrance Reading: 0 ppm

Downwind South West side of site Reading: 1.1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 6/5/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 7 MPH Wind Direction: W Barometric Pressure: 29.89

Air Temperature: 68 deg F General Weather Conditions: overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *4 seconds*

Response Time Trial #3 5 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	502	2
2	0	501	1
3	0	499	1

Average Difference: 1.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 1.33 / 500 X 100%
= 0.3% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0 ppm

Downwind West side of site Reading: 0 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 6/16/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 6 MPH Wind Direction: SW Barometric Pressure: 29.97

Air Temperature: 74 deg F General Weather Conditions: overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *4 seconds*

Response Time trial #2 *6 seconds*

Response Time Trial #3 4 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	499	1
2	0	498	2
3	0	501	1

Average Difference: 1.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 1.33 / 500 X 100%
= 0.3% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

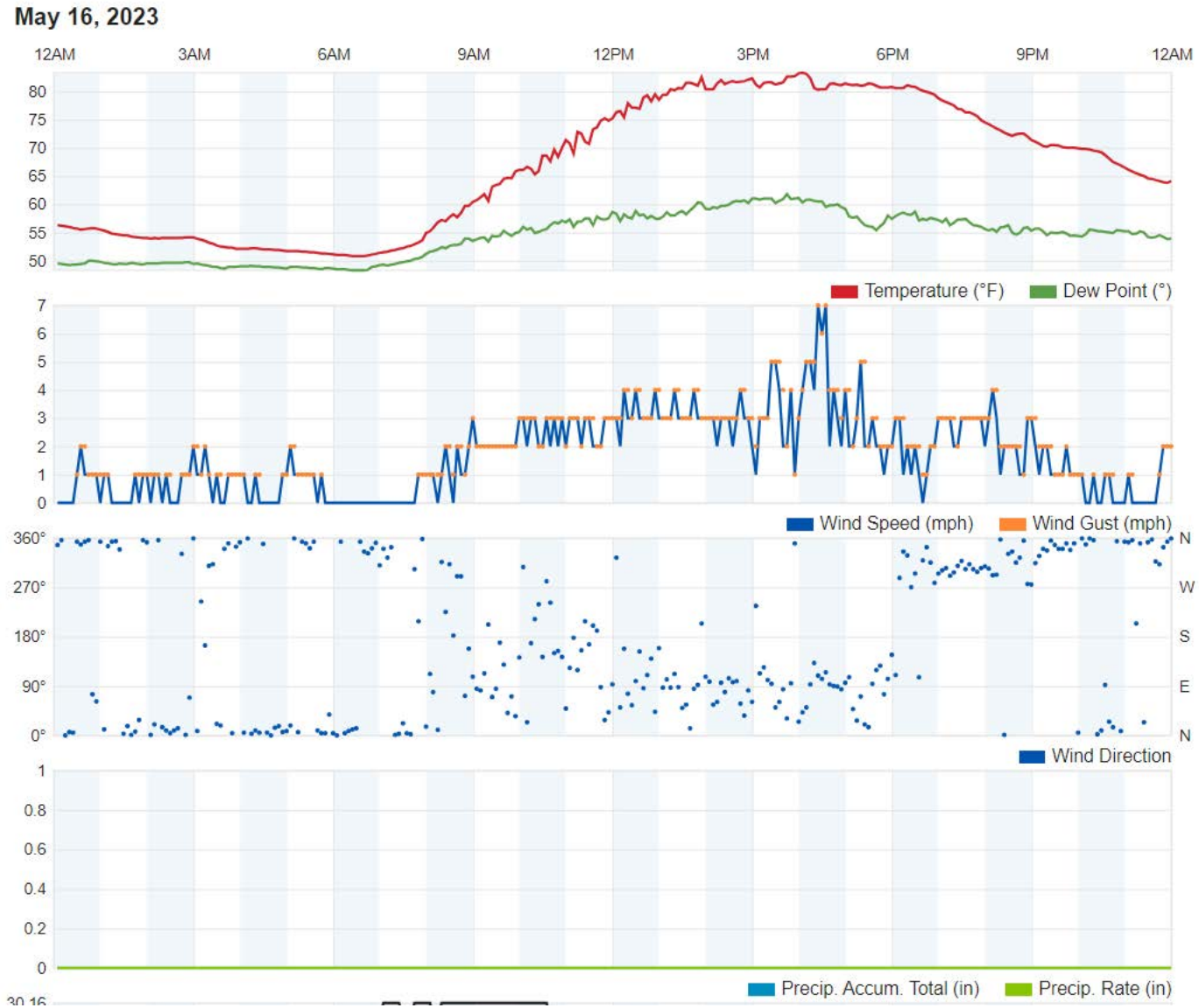
Up Wind of landfill area on SE side. Reading: 0 ppm

Downwind West side of site Reading: 1 ppm

NOTES:

Attachment 6

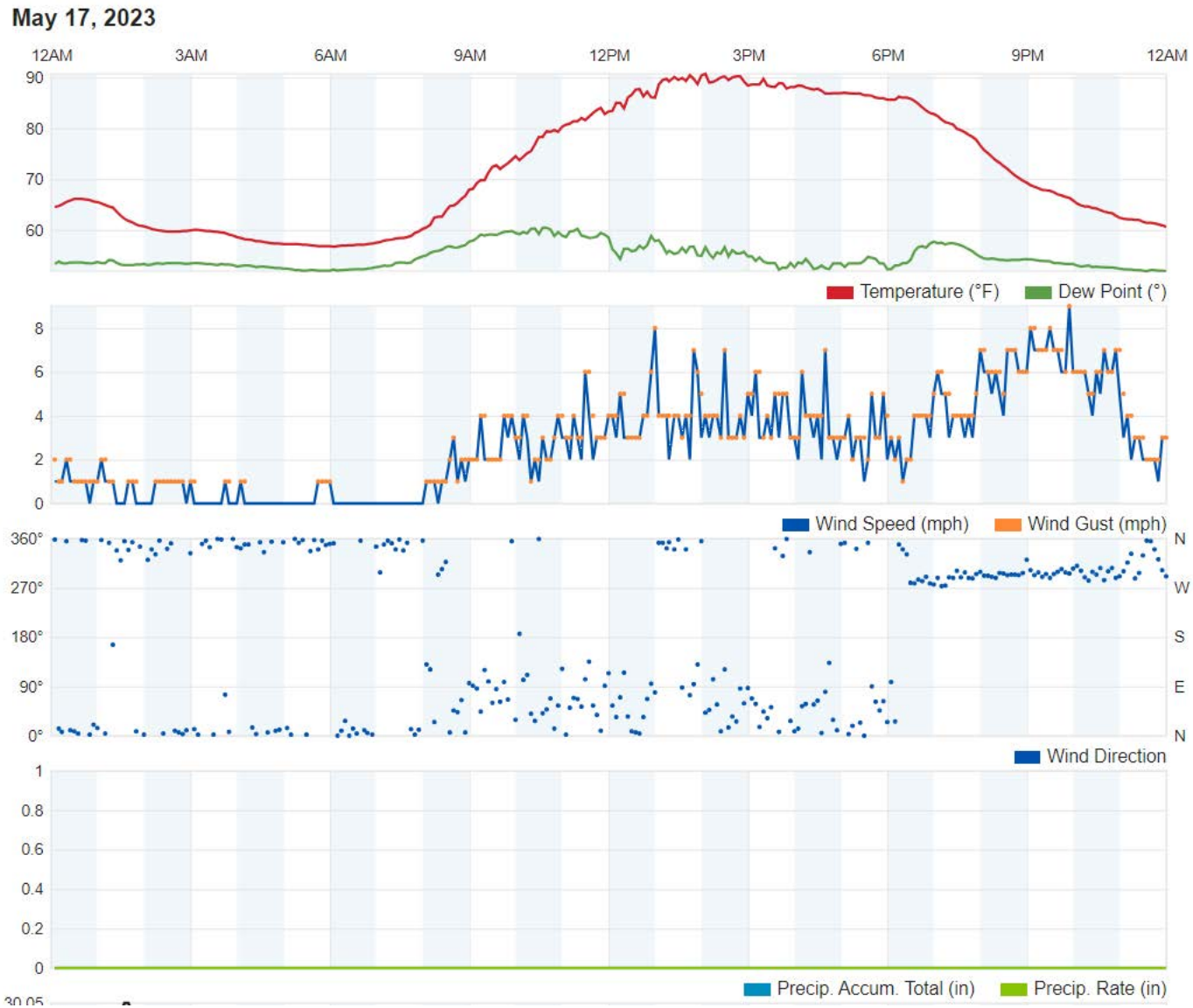
Weather Data



May 16, 2023

Emissions Monitoring Weather Data

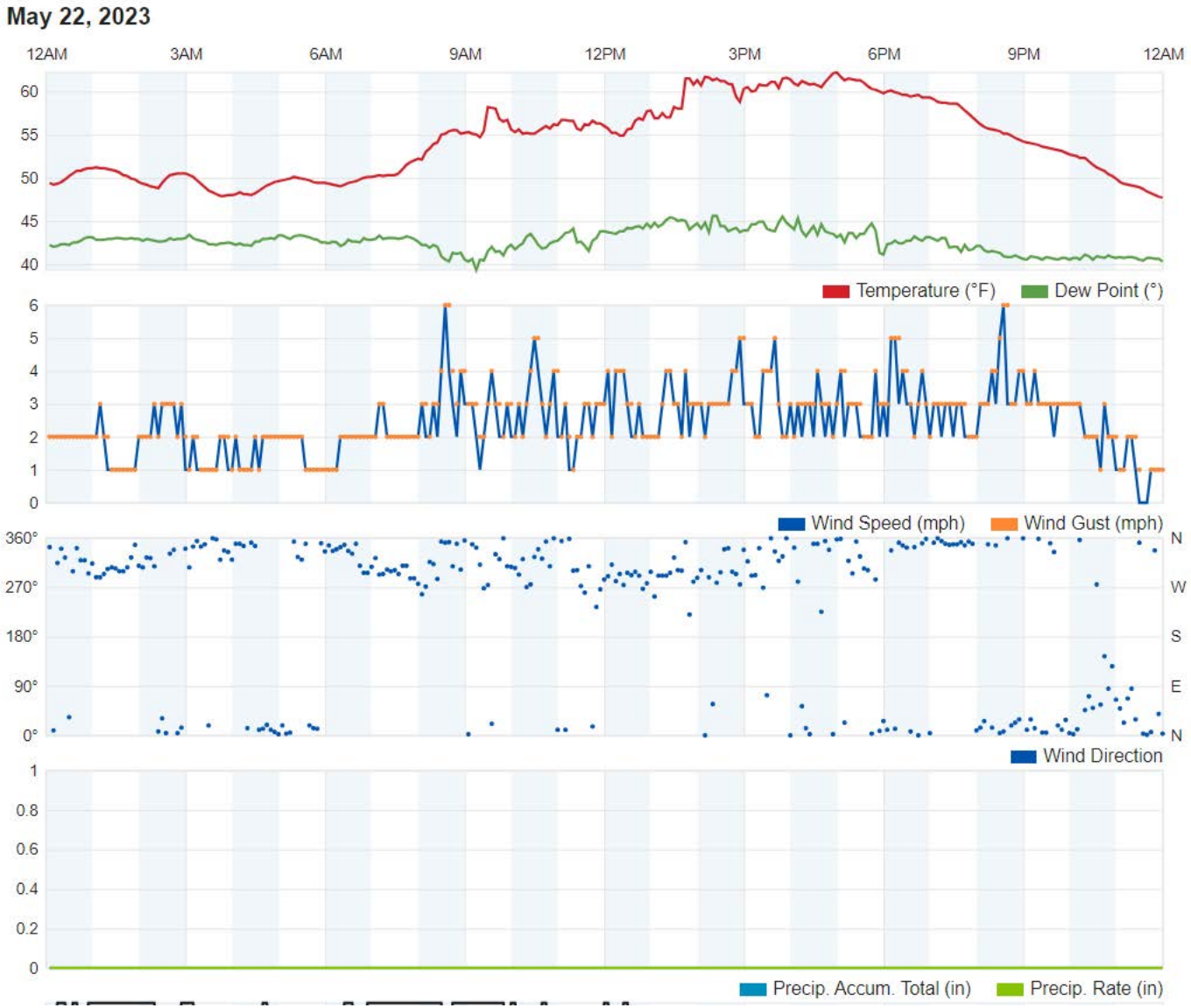
Coffin-Butte Landfill, Corvallis, Oregon



May 17, 2023

Emissions Monitoring Weather Data

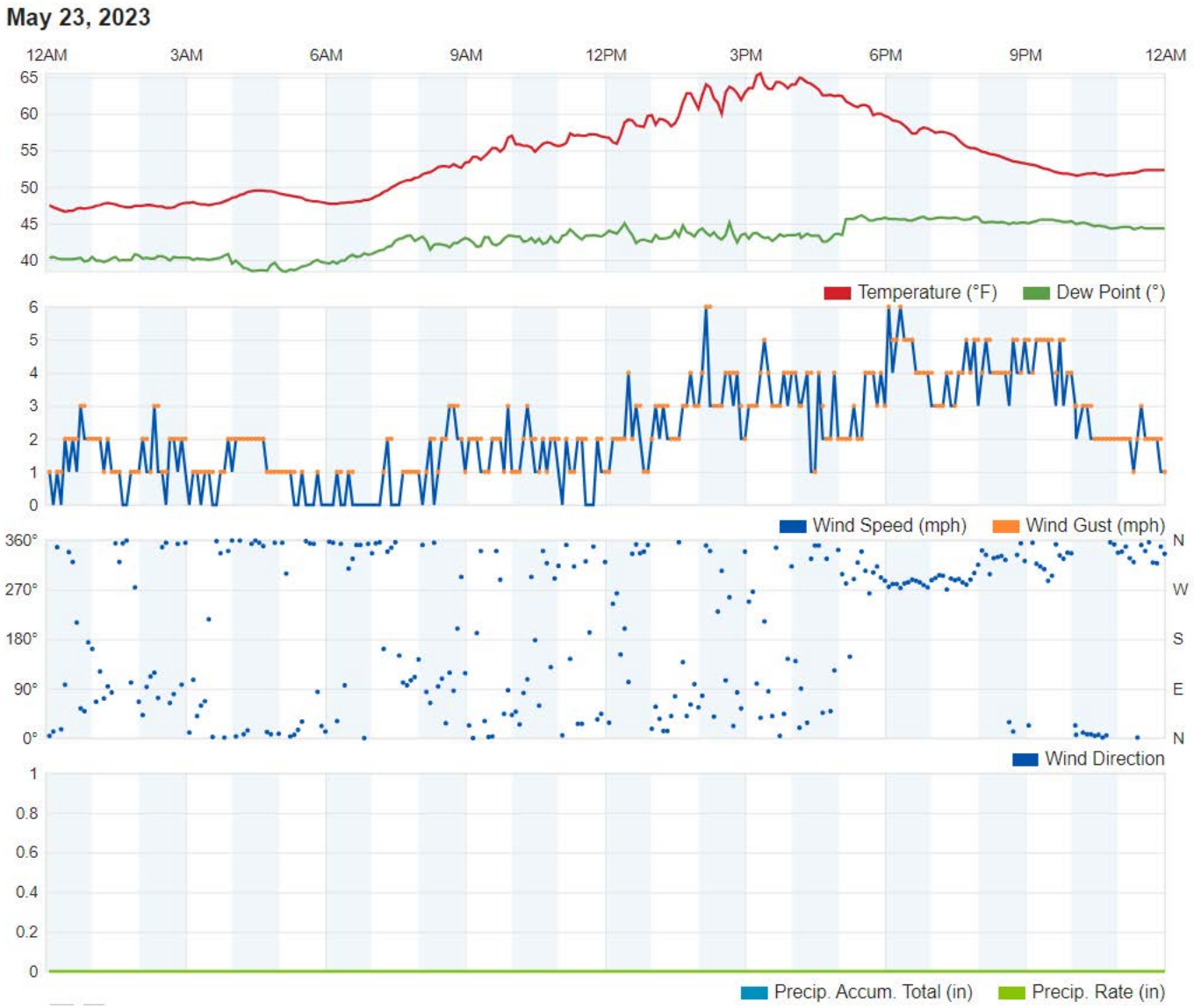
Coffin-Butte Landfill, Corvallis, Oregon



May 22, 2023

Emissions Monitoring Weather Data

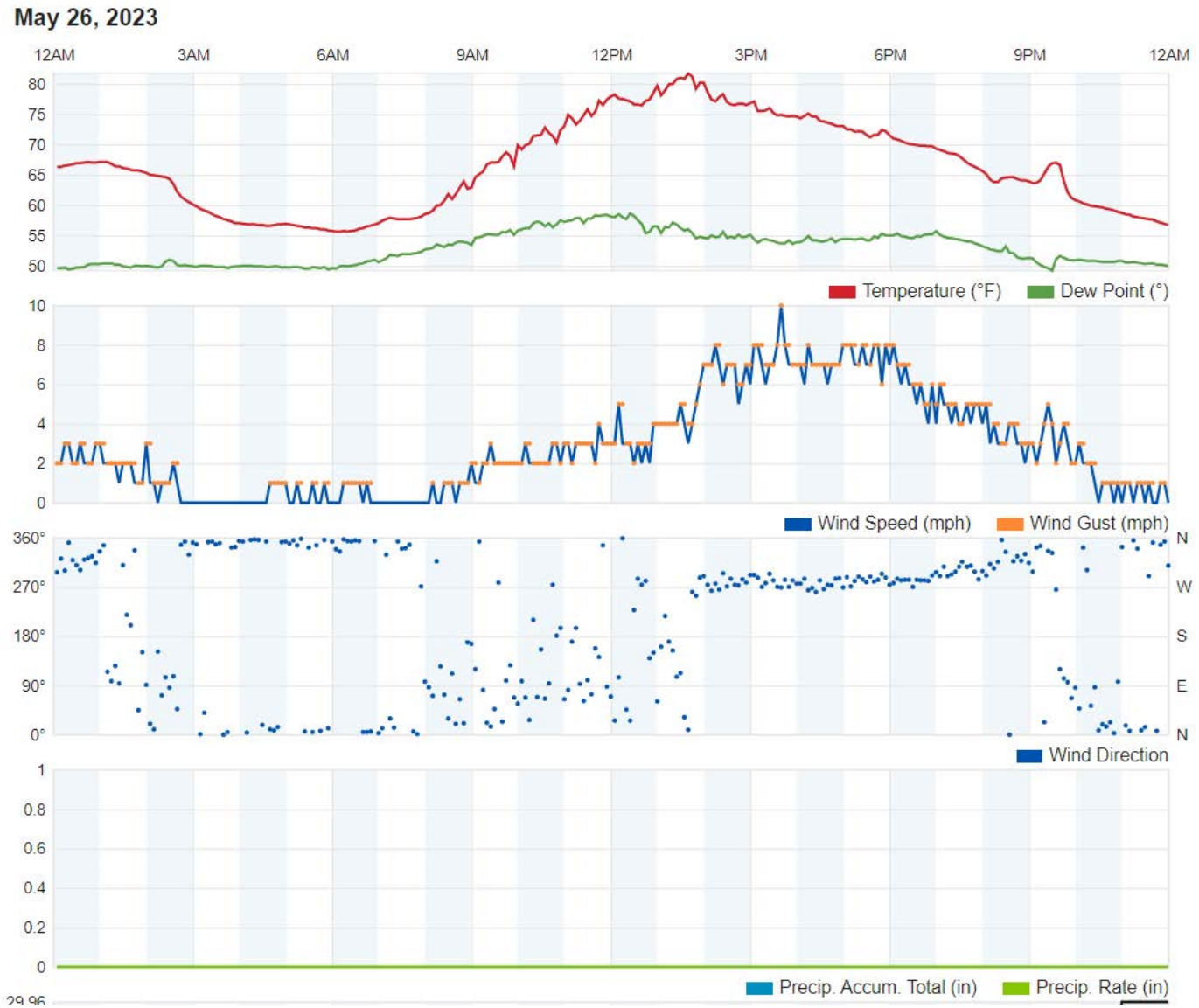
Coffin-Butte Landfill, Corvallis, Oregon



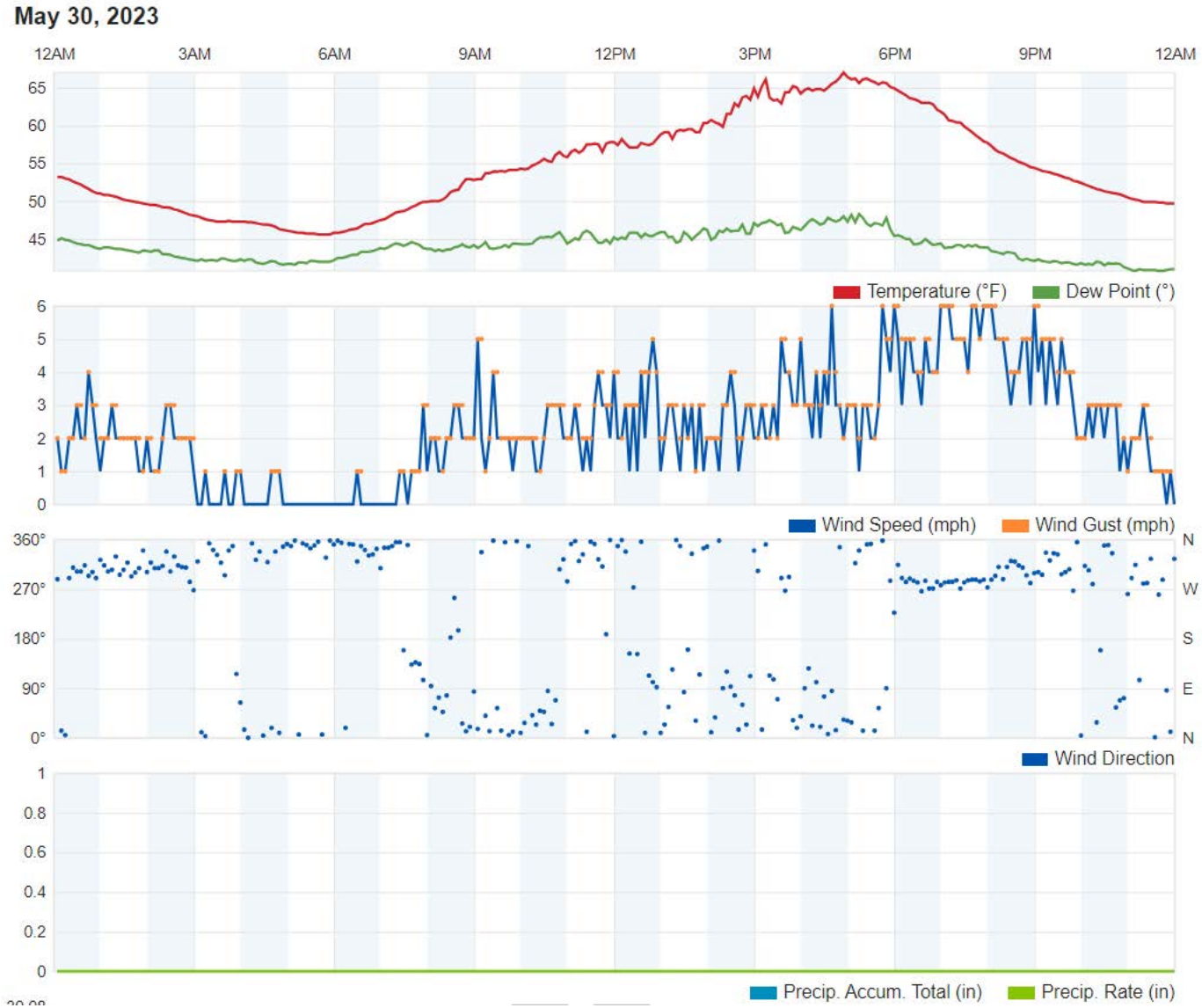
May 23, 2023

Emissions Monitoring Weather Data

Coffin-Butte Landfill, Corvallis, Oregon



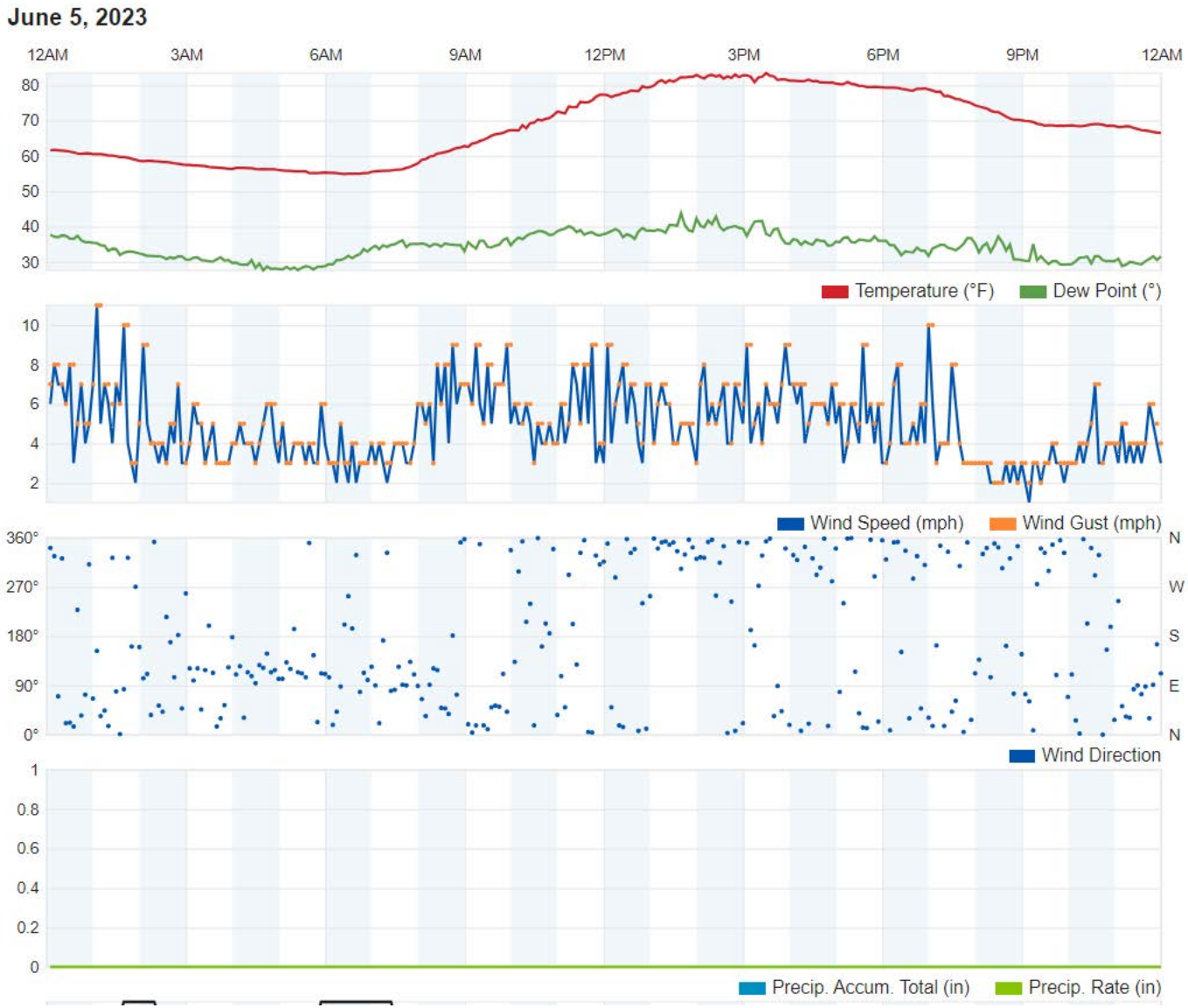
May 26, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



May 30, 2023

Emissions Monitoring Weather Data

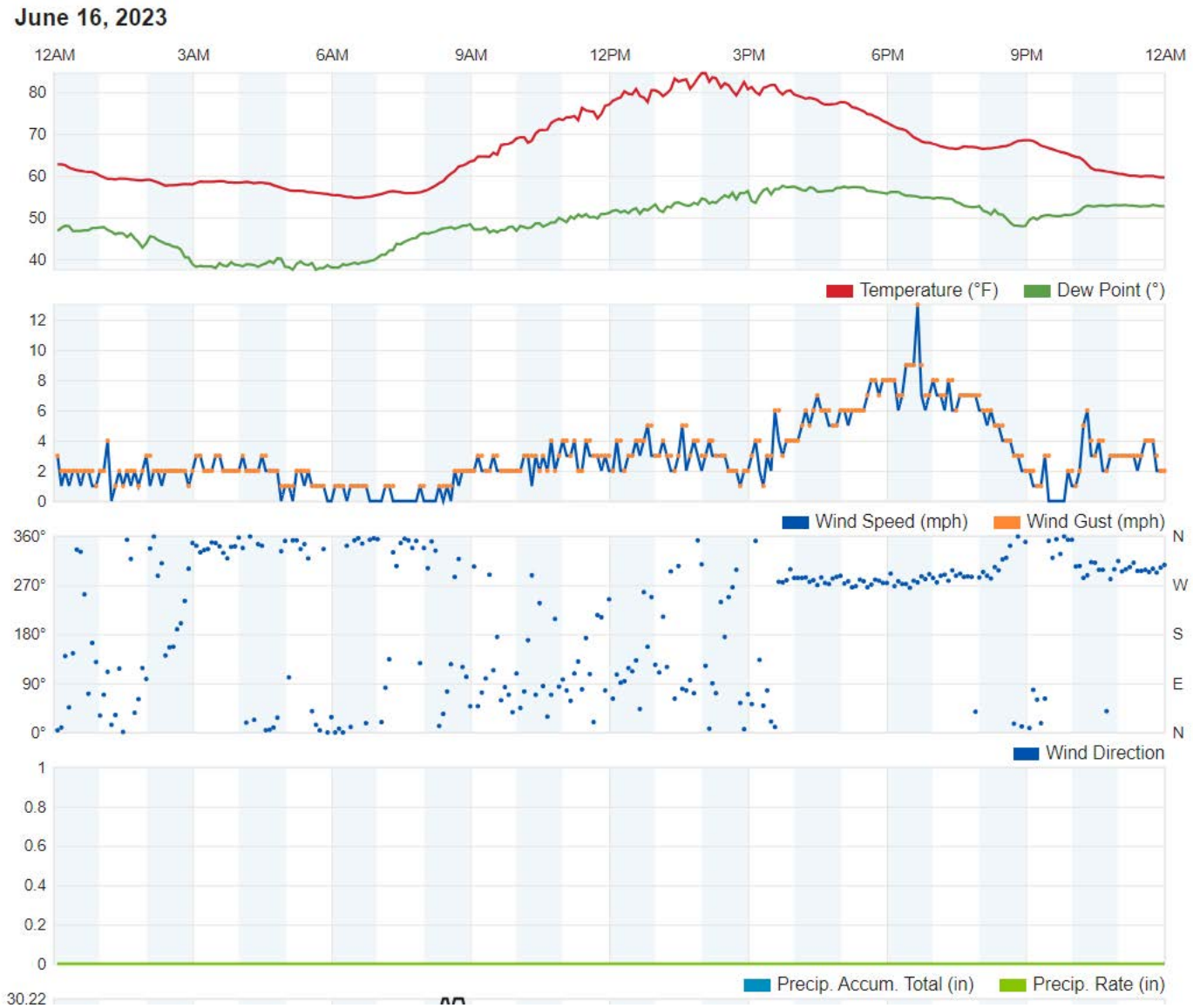
Coffin-Butte Landfill, Corvallis, Oregon



June 5, 2023

Emissions Monitoring Weather Data

Coffin-Butte Landfill, Corvallis, Oregon



June 16, 2023

Emissions Monitoring Weather Data

Coffin-Butte Landfill, Corvallis, Oregon

THIRD QUARTER 2023

SURFACE EMISSIONS MONITORING

November 15, 2023
File No. 07222178.00

Mr. Ian MacNab
Republic Services – Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, Oregon 97330

Subject: Coffin Butte Landfill - Corvallis, Oregon

Surface Emissions Monitoring for Third Quarter 2023.

Dear Mr. MacNab:

SCS Field Services (SCS-FS) is pleased to provide Republic Services, with the enclosed report summarizing the surface emissions monitoring services provided at the Coffin Butte Landfill (Site) during the third quarter of 2023. This report includes the results of the surface scan, component emissions, and blower/flare station emissions monitoring for the Site for this monitoring period.

SCS-FS appreciates the opportunity to be of assistance to Republic Services on this project. As you review the enclosed information, please contact Stephan Harquail at (503) 867-2369 or Max Polkabla at (510) 277-5122 if you have any questions or comments.

Sincerely,

Max Polkabla

Max Polkabla
Senior Technician/Data Analyst
SCS Field Services

Stephen Harquail
PNW Region Manager
SCS Field Services

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring

Third Quarter 2023

Presented to:

Mr. Ian MacNab
28972 Coffin Butte Road
Corvallis, Oregon 97330

SCS FIELD SERVICES

File No. 0722178.00 | November 15, 2023

SCS FIELD SERVICES
15949 SW 72nd Ave
Portland, Or 97224

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring
Third Quarter 2023

INTRODUCTION

This letter provides results of the August 29, September 1, 6, 7, 8, 11, 12, 20, and 29, 2023, OAR landfill surface emissions monitoring (SEM) performed by SCS Field Services (SCS) at the Coffin Butte Landfill. All work was performed in accordance with our approved Work Scope dated August 29, 2022, and the OAR requirements.

2022 State Regulatory Applicability

CBL is subject to the Oregon-specific landfill gas emission regulations in OAR Chapter 340 Division 239. These SEM regulations are detailed below. The following requirements are stricter than the NESHAP regulations in previous Sections and require additional compliance:

SURFACE EMISSION METHANE CONCENTRATION LIMITS

> *340-239-0200 (1) Surface Emission Methane Concentration Limits. Except as provided in OAR 340-239-0110(4), 340-239-0110(5), 340-239-0300, and 340-239-0600(1), beginning August 1, 2022, or upon commencing operation of a newly installed gas collection and control system or modification of an existing gas collection and control system pursuant to OAR 340-239-0110(1), whichever is later, no location on the landfill surface may exceed either of the following methane concentration limits:*
>
> *(a) 500 ppmv, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring conducted in accordance with OAR 340-239-0800(3)(b);*
>
> *(b) An average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring conducted in accordance with OAR 340-239-800(3)(c).*

The 500 ppmv limit is already a requirement in the Federal regulations above, but an average methane concentration limit of 25 ppmv will be adhered to as required.

SURFACE EMISSION RECORDKEEPING

> *340-239-0700(2)(a)(C) All instantaneous surface readings of 100 ppmv methane or greater. All exceedances of the limits in OAR 340-239-0100(6)(b) and 340-239-0200, including the location of the leak (or affected grid), leak concentration in ppmv methane, date and time of measurement, the action taken to repair the leak, date of repair, any required remonitoring and the remonitored concentration in ppmv methane, wind speed during surface sampling, and the installation date and location of each well installed as part of a gas collection system expansion;*

The Federal regulations only require monitored surface emissions over 500 ppmv to be documented, so all of the above recordkeeping will be performed on emission points 100 ppmv or over. All repeatable

instantaneous records of 100 ppm or higher (taken during SEM) must be kept for 5 years AND recorded in the semi-annual reports.

SUMMARY AND CONCLUSIONS

As stipulated in OAR, if uncorrectable exceedances within the 10-day limitation are detected or emissions are discovered during an inspection by Regulatory Agencies, the landfill must perform monitoring on a 25-foot pathway on a quarterly basis for active disposal sites. Upon completion of four consecutive SEM events without an uncorrectable exceedance of the 25 ppmv or 500 ppmv standards, other than non-repeatable momentary readings, the landfill may perform the monitoring on a 100-foot spacing on an annual basis for closed landfills or quarterly for active disposal sites. In accordance with the provisions of the OAR, the monitoring of the landfill was done on a 25-foot pathway based on a prior inspection, in which exceedances were observed.

On August 29, September 1, 6, 7, 8, 11, 12, 20, and 29, 2023, SCS performed third quarter 2023 surface emissions monitoring testing as required by the Oregon Landfill Gas emission Rule. Instantaneous surface emissions monitoring results indicated that one (1) location exceeded the 500 ppmv maximum concentration on the above-mentioned dates (Table 1 in Attachment 3). The required first 10-day (OAR) and 1-month (OAR) follow-up monitoring indicated that the area had returned to compliance following system adjustments and remediation by SCS and site personnel. Based on these monitoring results no additional follow-up testing was required.

Also, during the instantaneous monitoring event, SCS performed integrated monitoring of the landfill surface. As required by the OAR, the landfill was divided into 50,000 square foot areas. The Coffin Butte Landfill surface is divided into 105 grids, as shown in Figure 1 in Attachment 1. During this monitoring event, several grids were not monitored, in accordance with the regulations, due to ongoing active landfilling activities, unsafe conditions, or there was no waste in place prior to the monitoring event.

During the monitoring event, there were five (5) areas observed to exceed the 25 ppmv OAR integrated average threshold (Table 2 in Attachment 4). The required first and second 10-day OAR follow-up monitoring indicated that two (2) areas had returned to compliance following system adjustments and remediation by SCS and site personnel. However, the remaining three (3) areas remained above compliance. Based on these monitoring results, and in accordance with the OAR, the site is required to perform a system expansion within 120 days of the third detected exceedance or January 27, 2024. These results are discussed in a subsequent section of this report.

In addition, quarterly monitoring of the pressurized piping or components of the Gas Collection and Control System (GCCS) under positive pressure must be performed quarterly. Results of the testing of the landfill gas (LFG) Blower Flare Station (BFS) pressurized pipe and components indicated that all test locations were in compliance with the 500 ppmv requirements.

Further, as required under the OAR, any location on the landfill that has an observed instantaneous methane concentration above 100 ppmv, must be included within the surface emission monitoring report and if any instantaneous location records above 250 ppmv, it must be monitored in a 5-foot grid around the location to determine extents of the methane leak. During this reporting period, nine (9) locations were observed showing elevated concentrations between 100-499 ppmv, of the reporting threshold. When these readings are observed to be repeatable, they are reported to site personnel for tracking and/or remediation and will be reported in the next submittal of the annual OAR report. Finally, to help prevent potential future exceedances, SCS recommends that the landfill surface be routinely inspected and any observed surface erosion be routinely repaired.

BACKGROUND

The Coffin Butte Landfill is an active organic refuse disposal site. By way of background, organic materials buried in a landfill decompose anaerobically (in the absence of oxygen) producing a combustible gas that contains approximately 50 to 60 percent methane gas, 40 to 50 percent carbon dioxide, and a trace amount of various other gases, some of which are odorous. The Coffin-Butte/Corvallis property contains a system to control the combustible gases generated in the landfill.

SURFACE EMISSIONS MONITORING

On August 29, September 1, 6, 7, 8, 11, 12, 20, and 29, 2023, the instantaneous and integrated SEM was performed over the surface of the subject site. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring in the 50,000 square foot grids as required under the OAR. During this event, SCS performed the monitoring on a 25 and 100-foot pathway in accordance with the rules as required.

EMISSIONS TESTING INSTRUMENTATION/CALIBRATION

The instruments used to perform the landfill surface emission testing consisted of the following:

- Thermo Scientific TVA 2020 portable Flame Ionization Detector (FID). This instrument measures methane in the air over a range of 1 to 50,000 ppmv. The TVA 2020 meets the State of California Air Resources Board (CARB) requirements for combined instantaneous and integrated monitoring and was calibrated in accordance with the United States Environmental Protection Agency (US EPA) Method 21.

- Weather Anemometer with continuous recorder for meteorological conditions in accordance with the OAR.

Instrument calibration logs and weather information are shown in Attachments 5 and 6.

SURFACE EMISSIONS MONITORING PROCEDURES

Surface emissions monitoring was conducted in accordance with the OAR and SEM requirements. Monitoring was performed with the FID inlet held within 2 inches of the landfill surface while a technician walked a grid in parallel paths not more than 25 or 100 feet apart over the landfill's surface. Cracks, holes, and other cover penetrations in the surface were also tested. Surface emissions readings were monitored continuously and recorded every 5 seconds. Any areas exceeding the 100 or 500 ppmv standards (reporting and compliance levels, respectively) would be GPS tagged and stake-marked for on-site personnel to perform remediation or repairs.

The integrated average is based on the readings stored on the instrument, which are recorded every 5 seconds. The readings are then downloaded and the averages are calculated for each grid using SCS eTools®. All readings are maintained in this secure SCS Database. The readings are not provided in the report due to the volume of readings but can be furnished upon request.

Recorded wind speed results are shown in Attachment 6. Wind speed averages were observed to remain below the alternative threshold of 10 miles per hour, and no instantaneous speeds exceeded 20 miles

per hour. No rainfall occurred within 72 hours of the monitoring events. Therefore, site meteorological conditions were within the alternatives of the OAR requirements on the above-mentioned dates.

TESTING RESULTS

During this event, SCS performed the monitoring on a 25-foot pathway in accordance with the rule as required under the OAR. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR or NSPS threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring (OAR).

On August 29, September 1, 6, 7, 8, 11, and 12, 2023, SCS performed third quarter 2023 instantaneous emissions monitoring testing as required by the Oregon DEQ/OAR. During this monitoring, surface emissions results indicated that one (1) location exceeded the 500 ppmv maximum concentration. The required first 10-day (OAR) follow-up monitoring performed on September 20, 2023, and the 1-month (OAR) follow-up monitoring event performed on September 29, 2023, indicated that the area had returned to compliance following system adjustments and remediation by SCS and site personnel. Based on these monitoring results no additional follow-up testing was required. Results of the monitoring are shown in Attachments 2 and 3 (Table 1).

Additionally, calculated integrated monitoring indicated five (5) integrated exceedances of the 25-ppmv requirement on August 29, September 1, 6, 7, 8, 11, and 12, 2023. The required first and second 10-day OAR follow-up monitoring performed on September 20 and September 29, 2023, indicated that two (2) of the five (5) areas had returned to compliance. In accordance with requirements for expansion and remediation, the exceedance locations need to be remediated and returned to compliance in accordance with the rule (expansion of the collection system or an alternative compliance option if approved by the OAR) within 120 days after the third integrated exceedance, which will be due by January 27, 2024. Calibration logs for monitoring equipment are provided in Attachment 5.

During this monitoring event, several girds were not monitored, in accordance with the OAR, due to active landfilling activities, unsafe conditions, overgrown vegetation, or no waste in place. SCS will continue to monitor all accessible locations during the fourth quarter of 2023.

PRESSURIZED PIPE AND COMPONENT LEAK MONITORING

On September 12, 2023, quarterly leak monitoring was performed in accordance with the OAR. SCS performed LFG pressurized pipe and component leak monitoring at the BFS. Monitoring was performed with the detector inlet held one-half of an inch from the pressurized pipe and associated components. No locations exceeding the 500 ppmv threshold were observed during our monitoring event. The maximum reading, which was 3.00 ppmv, was well below the maximum threshold (see Table 1 for component results). Therefore, all pressurized pipes and components located at the LFG BFS were in compliance at the time of our testing.

PROJECT SCHEDULE

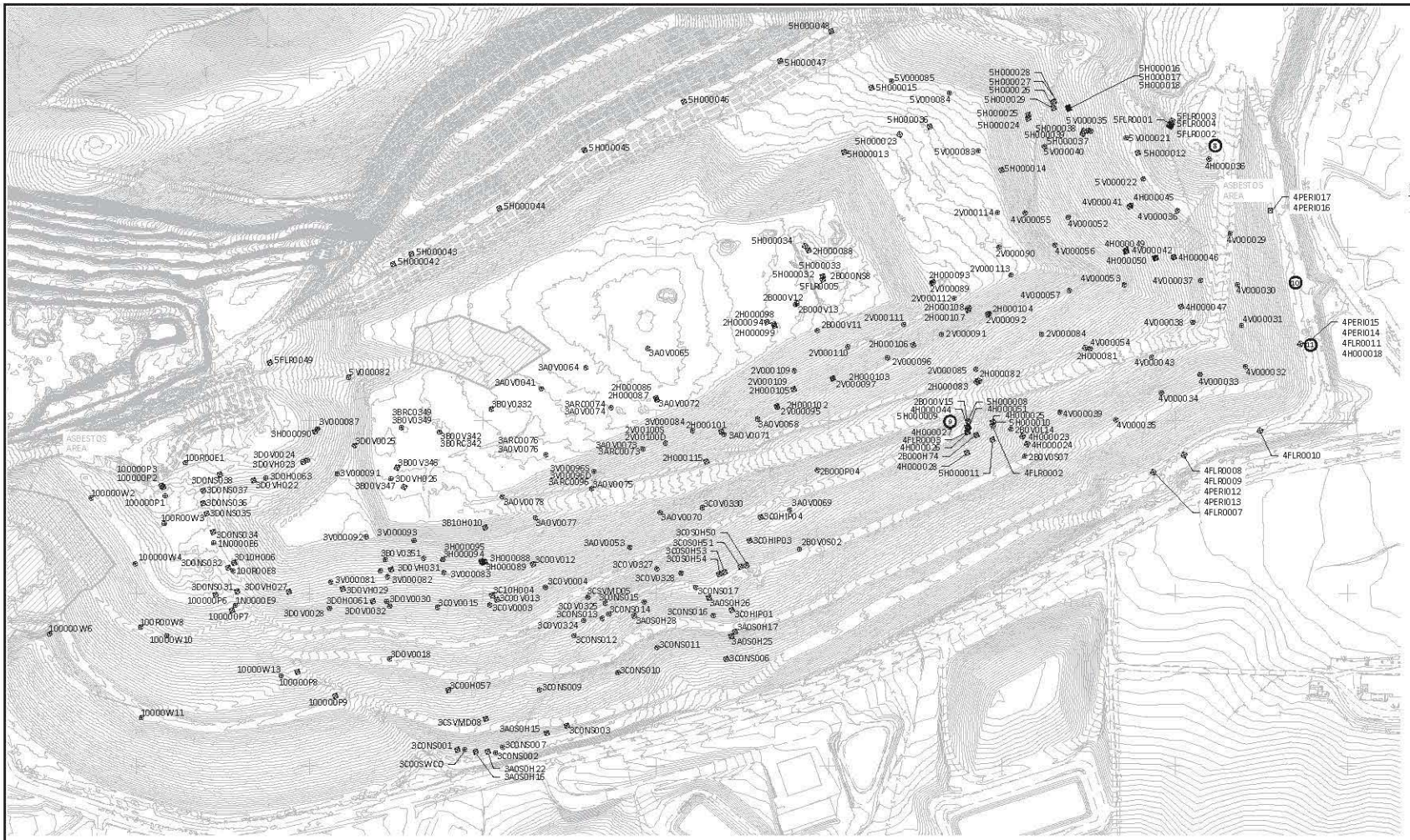
According to the OAR, surface emissions monitoring at active landfills is required to be performed on a quarterly basis. Therefore, in accordance with our approved Work Scope, the fourth quarter 2023 (October through December) surface emissions testing event is scheduled to be performed by the end of December 2023.

STANDARD PROVISIONS

This report addresses the conditions of the subject site during the testing dates only. Accordingly, we assume no responsibility for any changes that may occur subsequent to our testing which could affect the surface emissions at the subject site or adjacent properties.

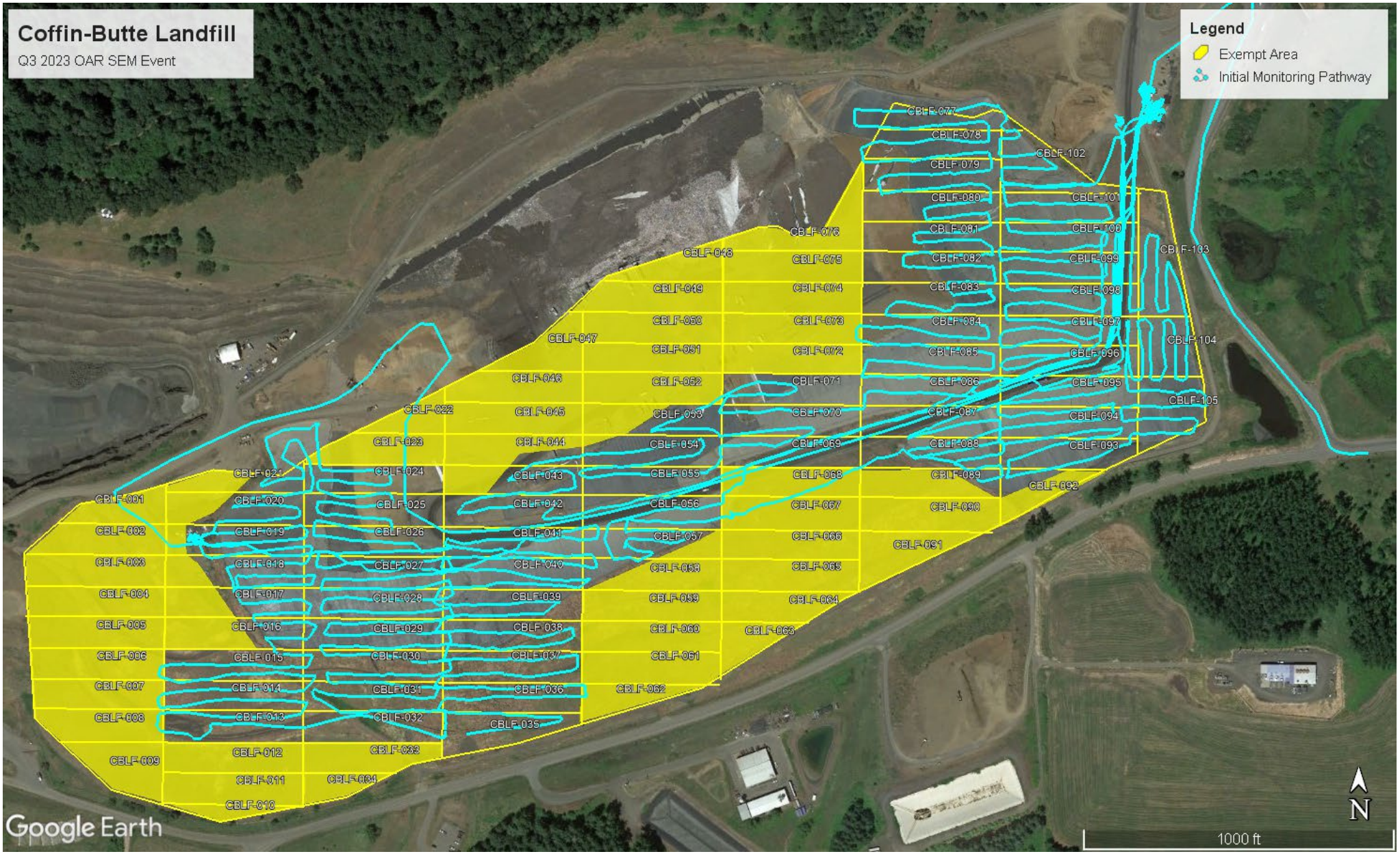
Attachment 1

Landfill Grid


N
W
E
S
0 75 150 300
GRAPHIC SCALE IN FEET
LEGEND
CURRENT GRADE TOPOGRAPHY
HORIZONTAL LFG EXTRACTION WELL
VERTICAL LFG EXTRACTION WELL
COORDINATE GRID: 500FT SPACING
ASBESTOS AREA
5H000048
5H000047
5H000046
5H000045
5H000044
5H000043
5H000042
5FLR0049
5V000082
3V000087
3H000090
3D0V0025
3D0V0024
3D0VH023
3D0H0063
3D0VH022
3D0NS038
3D0NS037
3D0NS036
3D0NS035
3D0NS034
3D0NS032
3D0NS031
3D0VH027
3D0H0061
3D0VH029
3D0V0030
3D0VH032
3D0V0026
3D0H006
3D0VH031
3D0V0018
3V000081
3V000082
3V000083
3V000092
3V000093
3V000091
3B0V346
3B0V347
3B0V351
3B0V342
3B0RC342
3B0V0349
3BRC0349
3B10H010
3H000095
3H000094
3H000088
3H000089
3C00V012
3C0V0004
3C0V0015
3C00V013
3C0V0003
3C0V0327
3C0V0328
3C0V0325
3C0V0324
3C0NS014
3CSVMD05
3C0NS015
3C10H004
3C0NS013
3C0NS012
3C0NS011
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3C00H057
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3C0HIP04
3C0V0330
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3C0S0H50
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3C0S0H54
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3A0V0041
3A0V0332
3A0V0076
3A0V0078
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3A0V0071
3A0V0068
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3A0V0074
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3ARC0076
3ARC0073
3ARC0096
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3V000960
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3A0S0H22
3A0S0H16
3A0S0H28
3A0S0H26
3A0S0H17
3A0S0H25
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2H000087
2H000084
2H000101
2H000102
2H000115
2V000100
2V001000
2V000095
2H000098
2H000094
2H000099
2H000088
2H000033
2H000032
2B000N58
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2B000V12
2B000V13
2B000V11
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100000W4
100R00E8
1N0000E6
1000000P6
1N0000E9
100000P7
100R00W8
100000W6
100000W10
10000W13
100000P8
100000P9
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Attachment 2

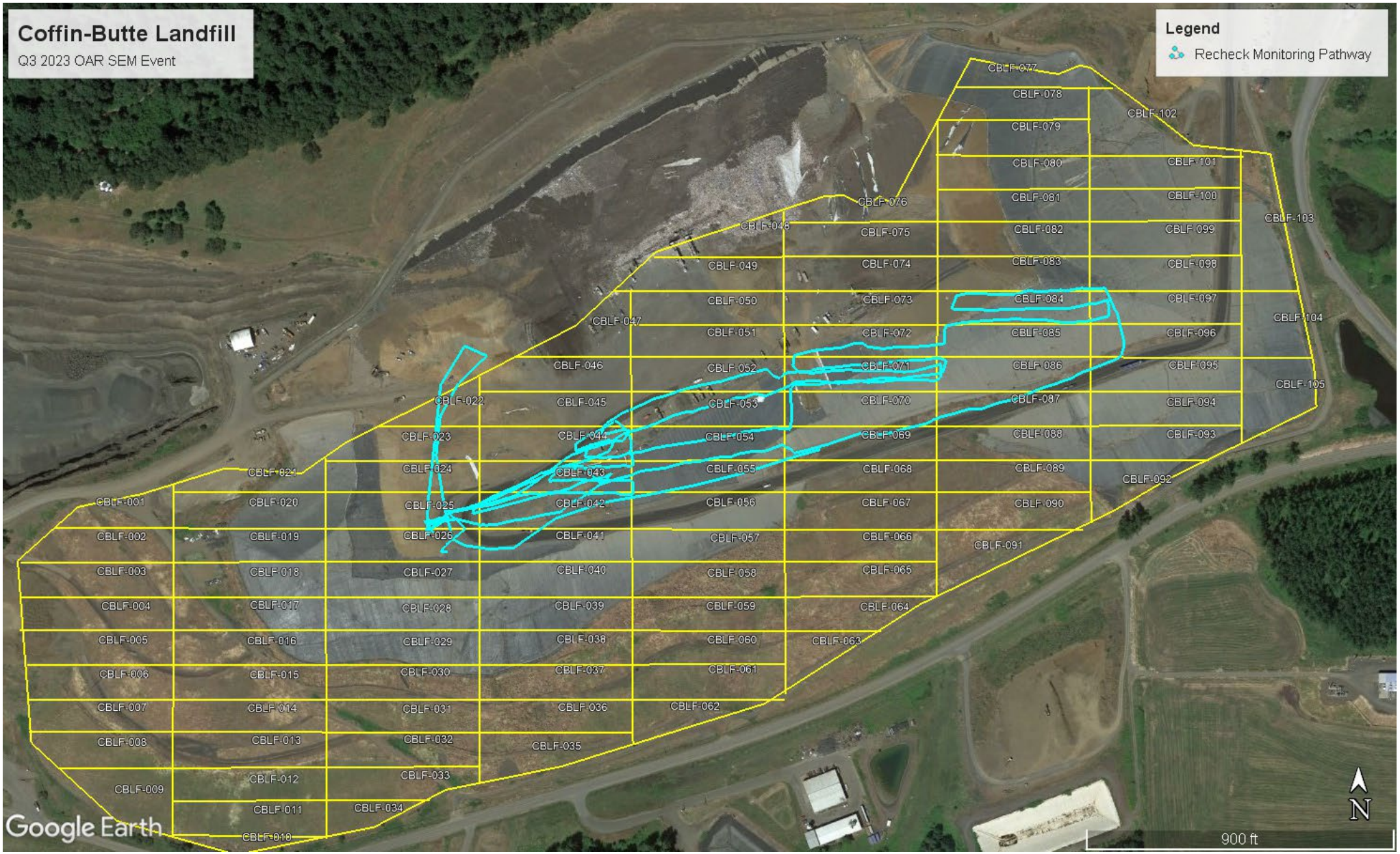
Surface Pathway



Third Quarter 2023

Initial Surface Emissions Monitoring Pathway

Coffin Butte Landfill, Corvallis, Oregon



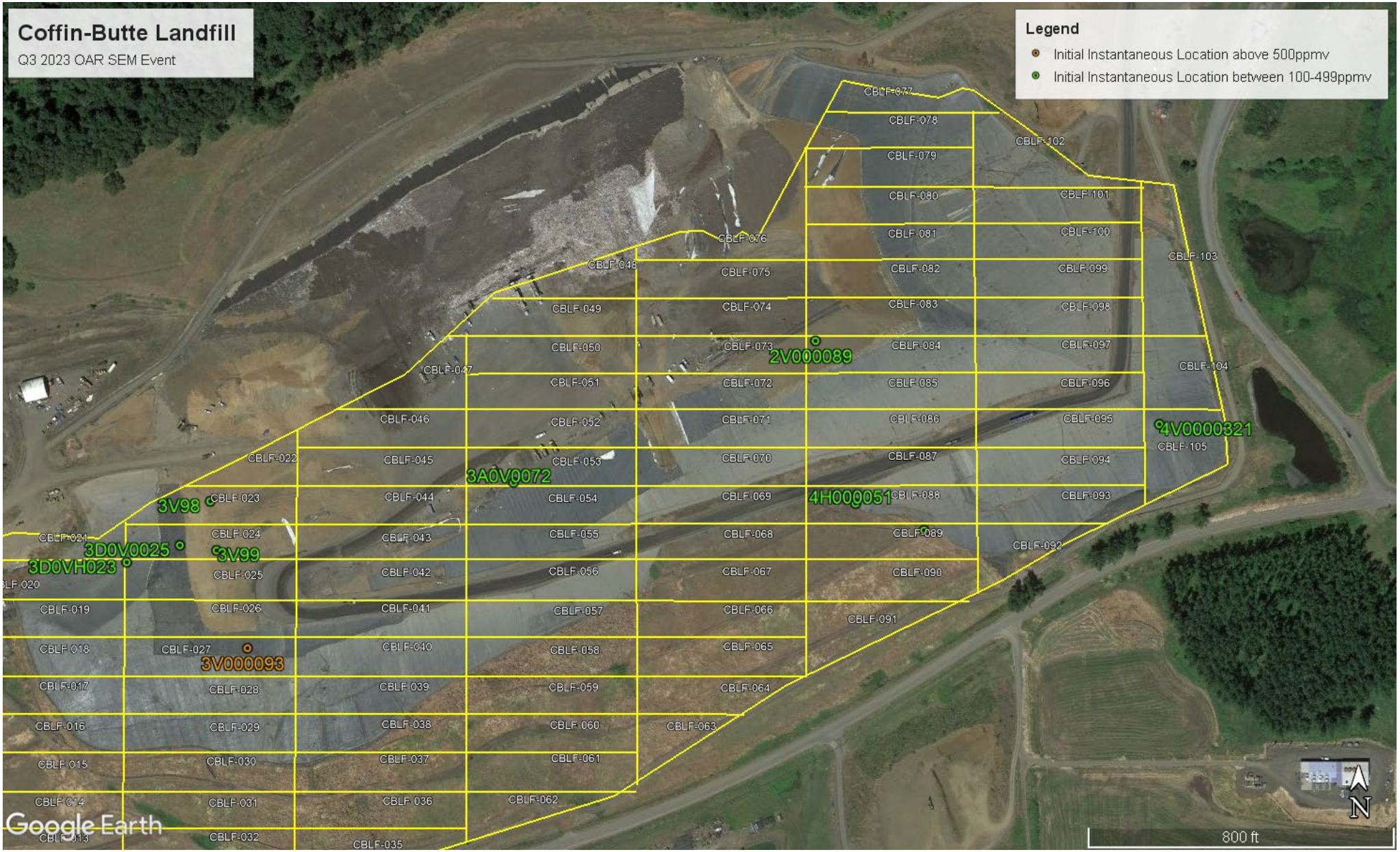
Third Quarter 2023

Initial Surface Emissions Recheck Monitoring Pathway

Coffin Butte Landfill, Corvallis, Oregon

Attachment 3

Instantaneous and Component Emissions Monitoring Results



Third Quarter 2023

Initial Emissions Monitoring Results Greater Than 100 ppmv

Coffin Butte Landfill, Corvallis, Oregon

Third Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Instantaneous Data Report for August 29, September 1, 6, 7, 8, 11, 12, 20, and 29, 2023

Location (Surface)	Initial Monitoring Results (ppmv) 9/12/2023	Follow Up Monitoring Results (ppmv) 9/20/2023	1-Month Follow-Up Monitoring Results (ppmv) 9/29/2023	Latitude	Longitude
3V000093	543	455	400	44.69835953	-123.23418296

Instantaneous Data Report for August 29, September 1, 6, 7, 8, 11, 12, 20, and 29, 2023
Readings between 100-499 ppmv

Location (Surface)	Initial Monitoring Results (ppmv) 9/11/2023	Initial Monitoring Results (ppmv) 9/12/2023	Latitude	Longitude
4H000051	N/A	497	44.69939168	-123.22806828
4V000032	N/A	442	44.69995997	-123.22500000
2B0V0S07	N/A	239	44.69919998	-123.22738004
2V000089	N/A	212	44.70056003	-123.22846826
3D0VH023	N/A	195	44.69897166	-123.23540672
3D0V0025	N/A	182	44.69909328	-123.23487329
3V99	139	N/A	44.69905699	-123.23450399
3A0V0072	N/A	122	44.69954330	-123.23151668
3V98	107	N/A	44.69940802	-123.23457196

Third Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Pressurized Pipe and Component Results

Route	Date	Concentration (ppmv)
FLARE STATION	9/12/2023	3.00

No other exceedances of the 500 ppmv threshold were observed during the third quarter of 2023 monitoring.

Attachment 4

Integrated Monitoring Results

Third Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-001	--	--	Exempt Area
CBLF-002	--	--	Exempt Area
CBLF-003	--	--	Exempt Area
CBLF-004	--	--	Exempt Area
CBLF-005	--	--	Exempt Area
CBLF-006	--	--	Exempt Area
CBLF-007	--	--	Exempt Area
CBLF-008	--	--	Exempt Area
CBLF-009	--	--	Exempt Area
CBLF-010	--	--	Exempt Area
CBLF-011	--	--	Exempt Area
CBLF-012	--	--	Exempt Area
CBLF-013	8/29/2023	0.00	
CBLF-014	8/29/2023	0.00	
CBLF-015	8/29/2023	0.00	
CBLF-016	8/29/2023	0.05	
CBLF-017	8/29/2023	1.42	
CBLF-018	8/29/2023	9.36	
CBLF-019	8/29/2023	4.84	
CBLF-020	8/29/2023	2.70	
CBLF-021	8/29/2023	3.88	
CBLF-022	--	--	Exempt Area
CBLF-023	--	--	Exempt Area
CBLF-024	8/29/2023	21.04	
CBLF-025	8/29/2023	13.75	
CBLF-026	8/29/2023	4.94	
CBLF-027	8/29/2023	4.41	
CBLF-028	8/29/2023	1.21	
CBLF-029	8/29/2023	0.37	
CBLF-030	8/29/2023	0.00	
CBLF-031	8/29/2023	0.00	
CBLF-032	8/29/2023	0.11	
CBLF-033	--	--	Exempt Area
CBLF-034	--	--	Exempt Area
CBLF-035	9/1/2023	0.50	
CBLF-036	9/1/2023	0.34	
CBLF-037	9/1/2023	0.36	
CBLF-038	9/1/2023	0.20	
CBLF-039	9/1/2023	0.76	
CBLF-040	9/1/2023	1.19	
CBLF-041	9/1/2023	1.31	
CBLF-042	9/8/2023	11.54	
CBLF-043	9/8/2023	51.87	Initial Monitoring



Third Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-043	9/20/2023	46.89	First 10-Day Recheck (Delayed due to weather)
CBLF-043	9/29/2023	92.78	Second 10-Day 120-Day Expansion due 1/27/2024
CBLF-044	9/8/2023	30.31	Initial Monitoring
CBLF-044	9/20/2023	46.09	First 10-Day Recheck (Delayed due to weather)
CBLF-044	9/29/2023	86.14	Second 10-Day 120-Day Expansion due 1/27/2024
CBLF-045	--	--	Exempt Area
CBLF-046	--	--	Exempt Area
CBLF-047	--	--	Exempt Area
CBLF-048	--	--	Exempt Area
CBLF-049	--	--	Exempt Area
CBLF-050	--	--	Exempt Area
CBLF-051	--	--	Exempt Area
CBLF-052	--	--	Exempt Area
CBLF-053	9/8/2023	24.14	
CBLF-054	9/8/2023	57.74	Initial Monitoring
CBLF-054	9/20/2023	19.85	First 10-Day Recheck (Delayed due to weather)
CBLF-055	9/8/2023	18.70	
CBLF-056	9/7/2023	5.60	
CBLF-057	9/7/2023	3.58	
CBLF-058	9/7/2023	1.20	
CBLF-059	--	--	Exempt Area
CBLF-060	--	--	Exempt Area
CBLF-061	--	--	Exempt Area
CBLF-062	--	--	Exempt Area
CBLF-063	--	--	Exempt Area
CBLF-064	--	--	Exempt Area
CBLF-065	--	--	Exempt Area
CBLF-066	--	--	Exempt Area
CBLF-067	--	--	Exempt Area
CBLF-068	--	--	Exempt Area
CBLF-069	9/8/2023	5.95	
CBLF-070	9/8/2023	12.73	
CBLF-071	9/8/2023	72.77	Initial Monitoring
CBLF-071	9/20/2023	31.26	First 10-Day Recheck (Delayed due to weather)
CBLF-071	9/29/2023	38.84	Second 10-Day 120-Day Expansion due 1/27/2024
CBLF-072	--	--	Exempt Area
CBLF-073	--	--	Exempt Area
CBLF-074	--	--	Exempt Area
CBLF-075	--	--	Exempt Area

Third Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-076	--	--	Exempt Area
CBLF-077	9/8/2023	3.75	
CBLF-078	9/8/2023	3.12	
CBLF-079	9/8/2023	4.05	
CBLF-080	9/8/2023	3.10	
CBLF-081	9/8/2023	5.87	
CBLF-082	9/8/2023	8.38	
CBLF-083	9/8/2023	21.79	
CBLF-084	9/8/2023	35.70	Initial Monitoring
CBLF-084	9/20/2023	10.77	First 10-Day Recheck (Delayed due to weather)
CBLF-085	9/8/2023	7.18	
CBLF-086	9/8/2023	11.95	
CBLF-087	9/8/2023	10.95	
CBLF-088	9/7/2023	3.30	
CBLF-089	9/7/2023	2.36	
CBLF-090	--	--	Exempt Area
CBLF-091	--	--	Exempt Area
CBLF-092	9/7/2023	22.63	
CBLF-093	9/6/2023	2.01	
CBLF-094	9/6/2023	1.76	
CBLF-095	9/6/2023	4.82	
CBLF-096	9/7/2023	0.35	
CBLF-097	9/7/2023	5.38	
CBLF-098	9/7/2023	4.73	
CBLF-099	9/7/2023	-0.05	
CBLF-100	9/7/2023	0.15	
CBLF-101	9/7/2023	0.28	
CBLF-102	9/8/2023	2.36	
CBLF-103	9/6/2023	5.53	
CBLF-104	9/6/2023	3.48	
CBLF-105	9/6/2023	2.42	



Attachment 5

Calibration Logs

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 8/29/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 7 MPH Wind Direction: SE Barometric Pressure: 29.91

Air Temperature: 69 deg F General Weather Conditions: Partly Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	500	2
2	0	501	1
3	0	500	1

Average Difference: 0.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0.333333333 / 500 X 100%
= 0.1% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.9 ppm

Downwind NW side of site Reading: 3.5 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/1/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SE Barometric Pressure: 29.96

Air Temperature: 67 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	2
2	0	499	1
3	0	500	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 1.2 ppm

Downwind NW side of site Reading: 3.7 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/6/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 3 MPH Wind Direction: SE Barometric Pressure: 29.91

Air Temperature: 65 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	500	2
2	0	501	1
3	0	499	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.7 ppm

Downwind NW side of site Reading: 3.2 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/7/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 9 MPH Wind Direction: S Barometric Pressure: 29.96

Air Temperature: 58 deg F General Weather Conditions: Partly Cloudy

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	2
2	0	499	1
3	0	499	1

Average Difference: -0.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= -0.333333333 / 500 X 100%
= -0.1% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on S side. Reading: 0.3 ppm

Downwind N side of site Reading: 3.1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/8/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 10 MPH Wind Direction: SE Barometric Pressure: 30.02

Air Temperature: 66 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	499	2
2	0	500	1
3	0	501	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 1.4 ppm

Downwind NW side of site Reading: 3.4 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/11/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 6 MPH Wind Direction: SE Barometric Pressure: 29.94

Air Temperature: 58 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	499	2
2	0	499	1
3	0	501	1

Average Difference: -0.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= -0.333333333 / 500 X 100%
= -0.1% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 1.1 ppm

Downwind NW side of site Reading: 3.3 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/12/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SE Barometric Pressure: 30.01

Air Temperature: 53 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	500	2
2	0	499	1
3	0	500	1

Average Difference: -0.33

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= -0.333333333 / 500 X 100%
= -0.1% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 1.7 ppm

Downwind NW side of site Reading: 4.1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/20/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 9 MPH Wind Direction: SE Barometric Pressure: 29.95

Air Temperature: 61 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	2
2	0	499	1
3	0	500	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 1.4 ppm

Downwind NW side of site Reading: 3.5 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/29/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SE Barometric Pressure: 29.91

Air Temperature: 68 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	2
2	0	499	1
3	0	500	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

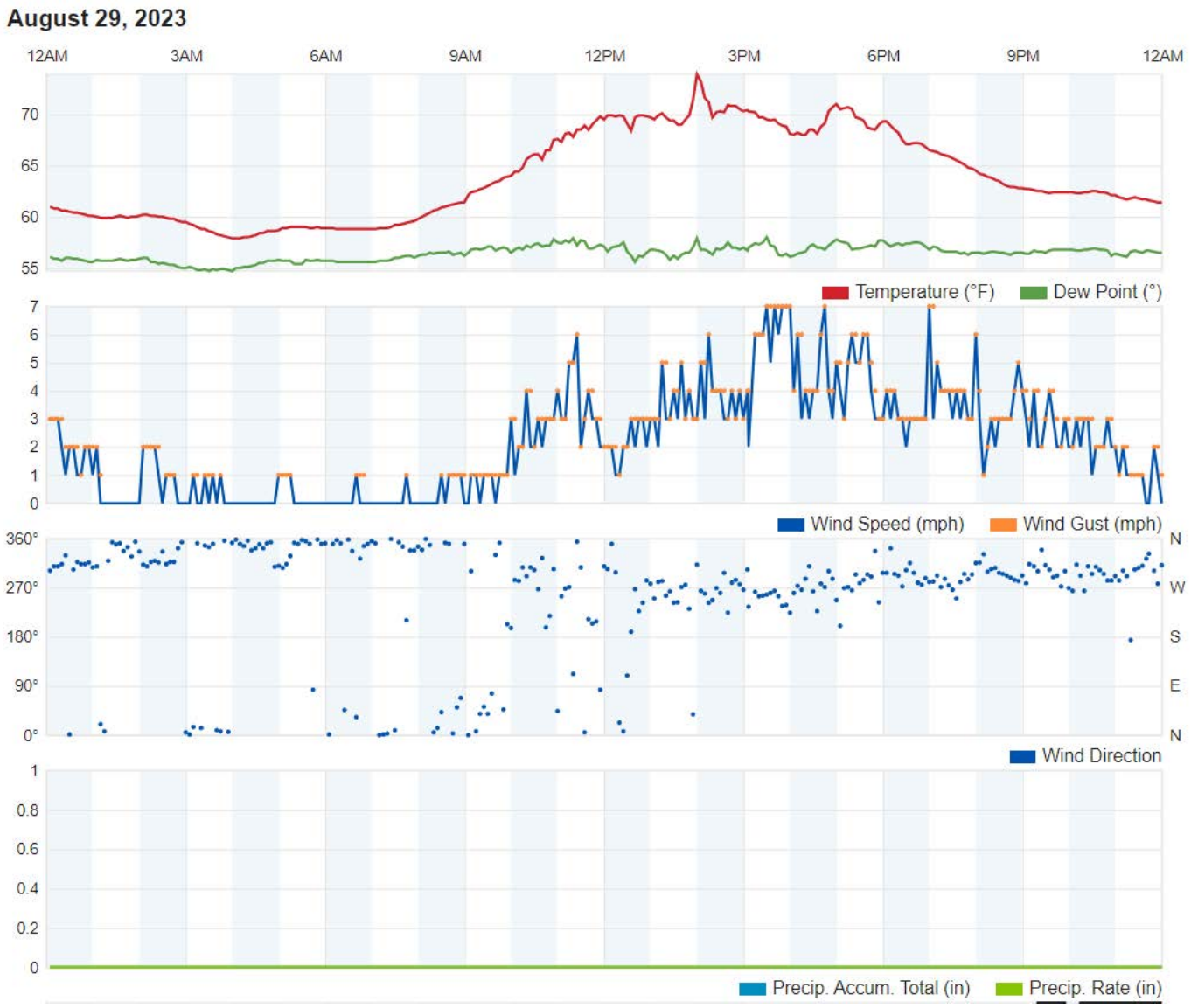
Up Wind of landfill area on SE side. Reading: 1.2 ppm

Downwind NW side of site Reading: 3.4 ppm

NOTES:

Attachment 6

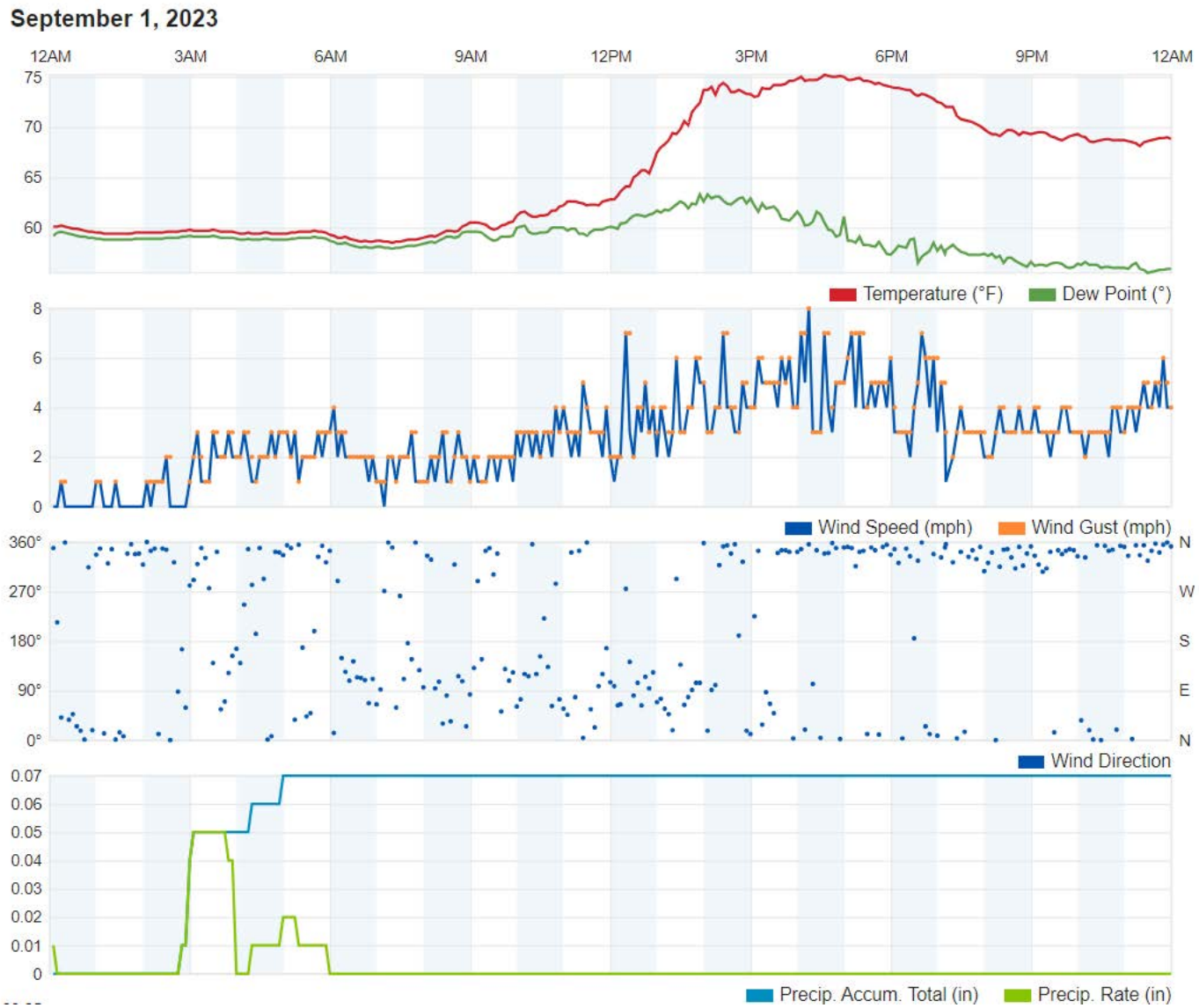
Weather Data



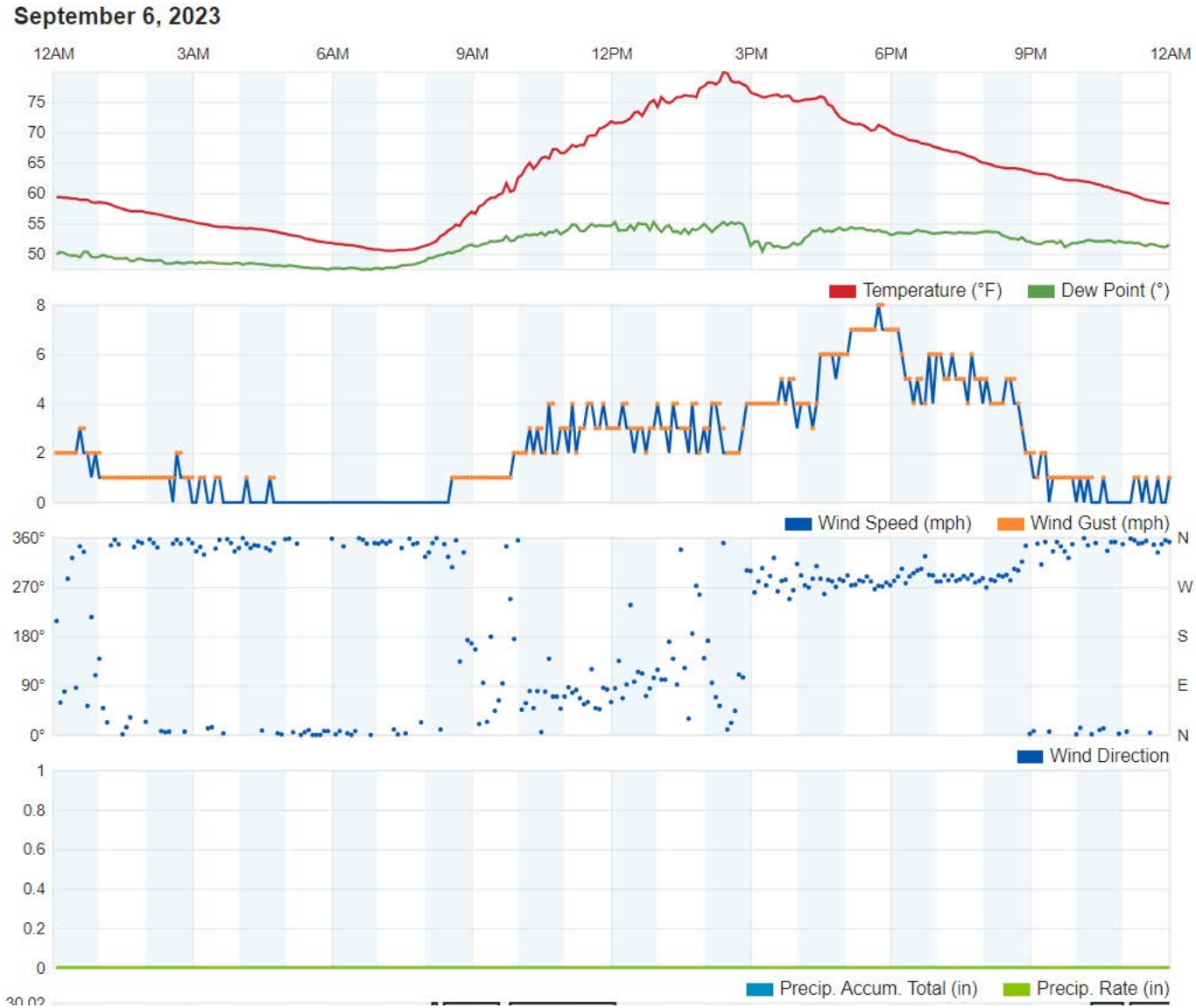
August 29, 2023

Emissions Monitoring Weather Data

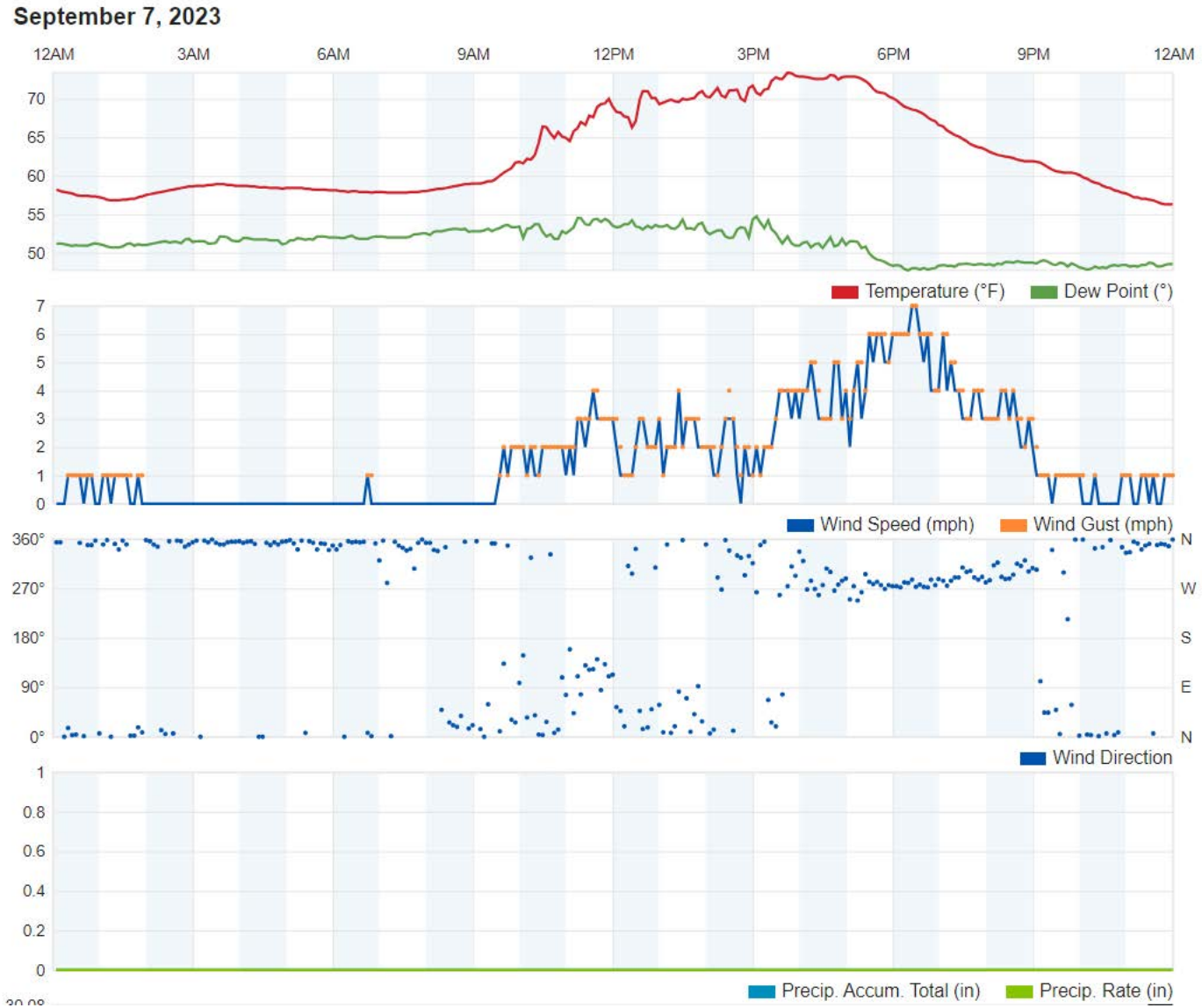
Coffin-Butte Landfill, Corvallis, Oregon



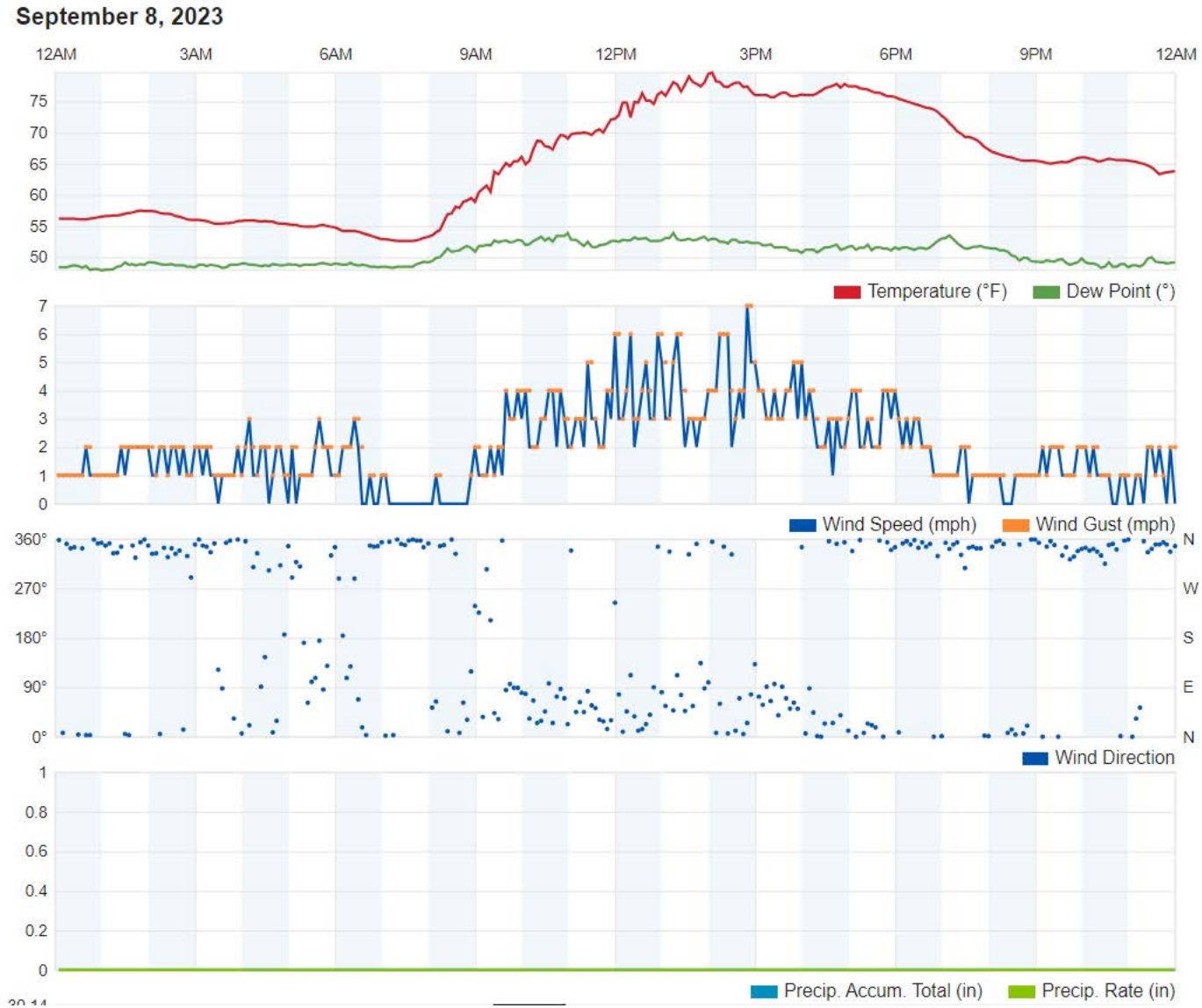
September 1, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



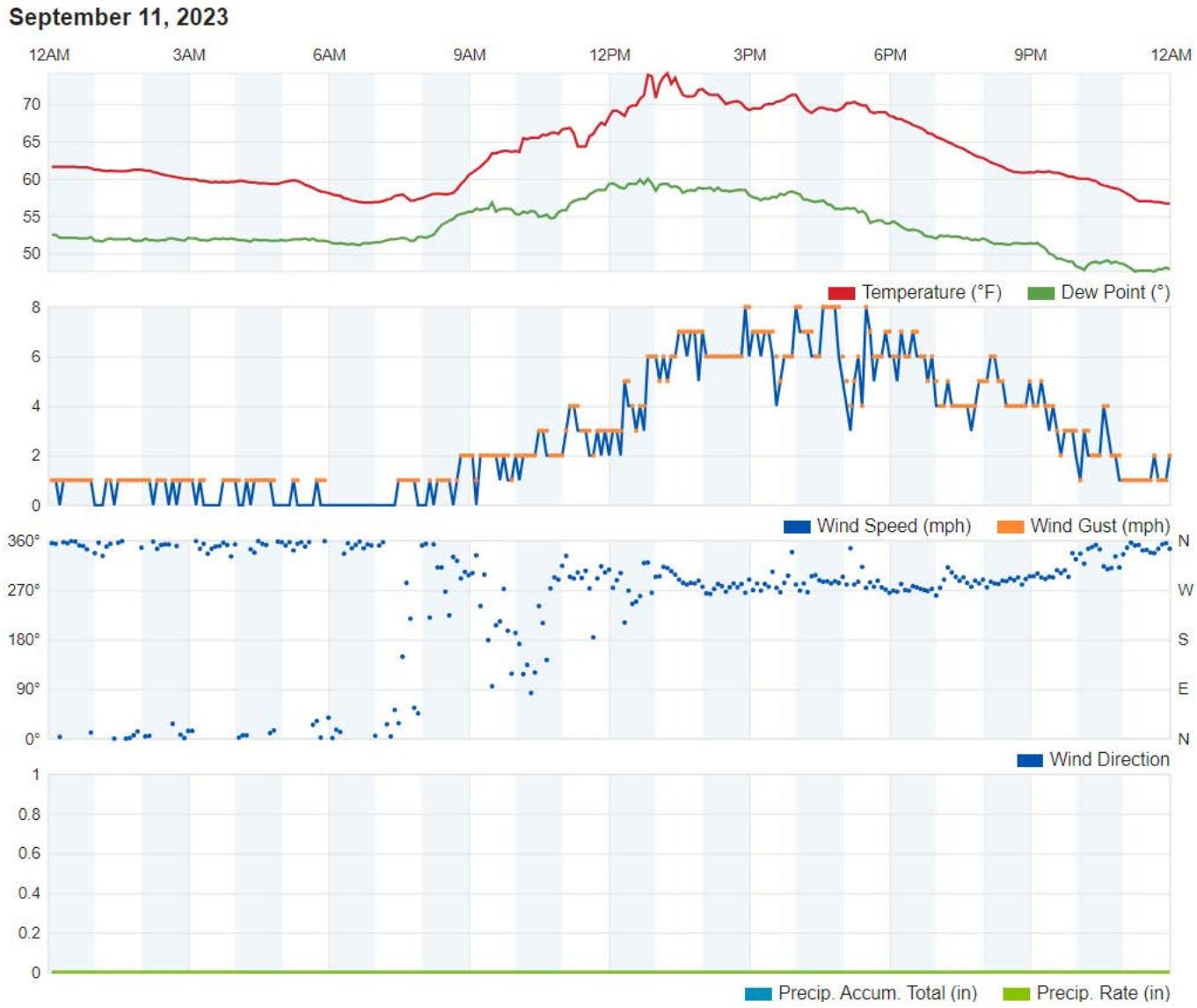
September 6, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



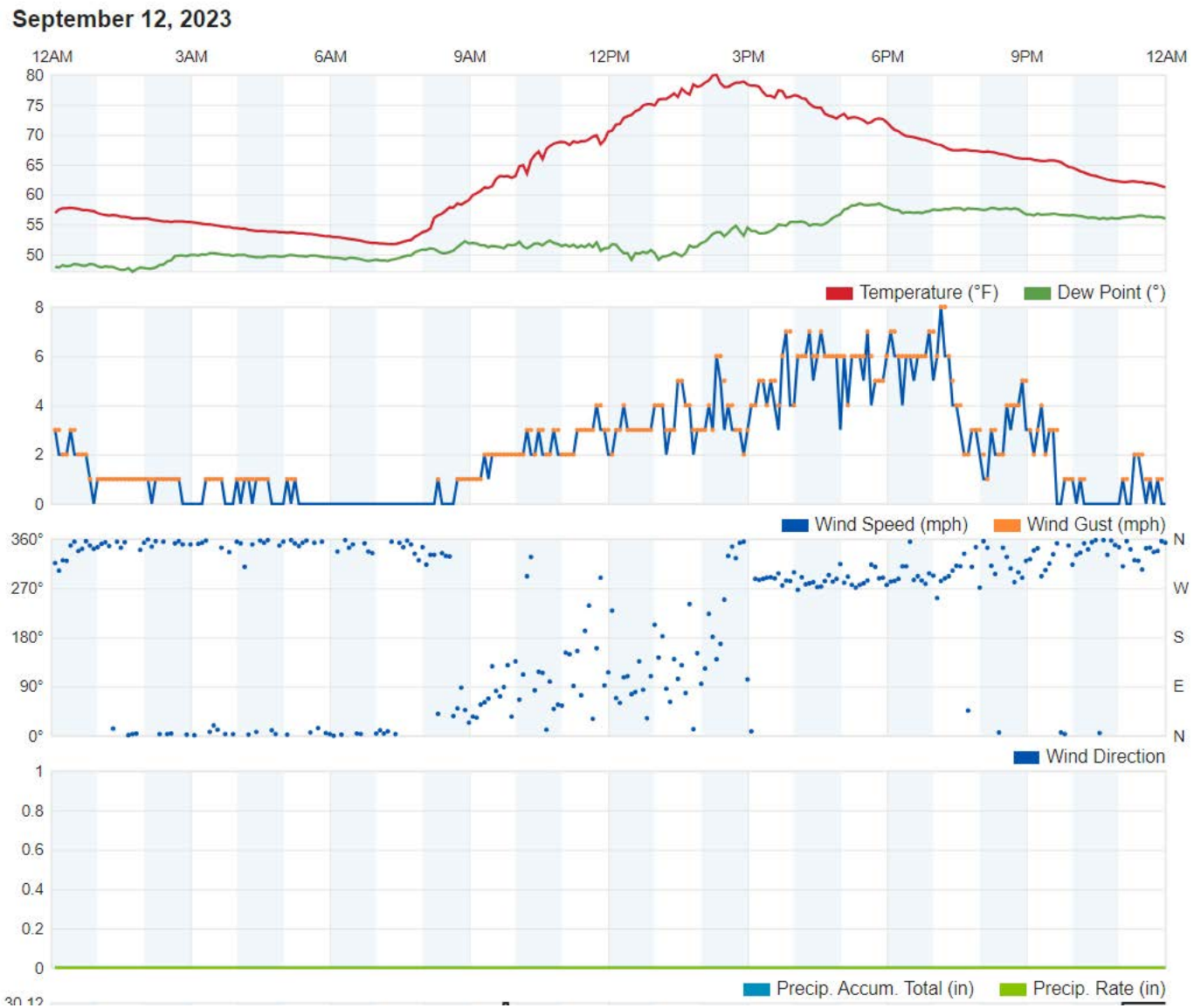
September 7, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



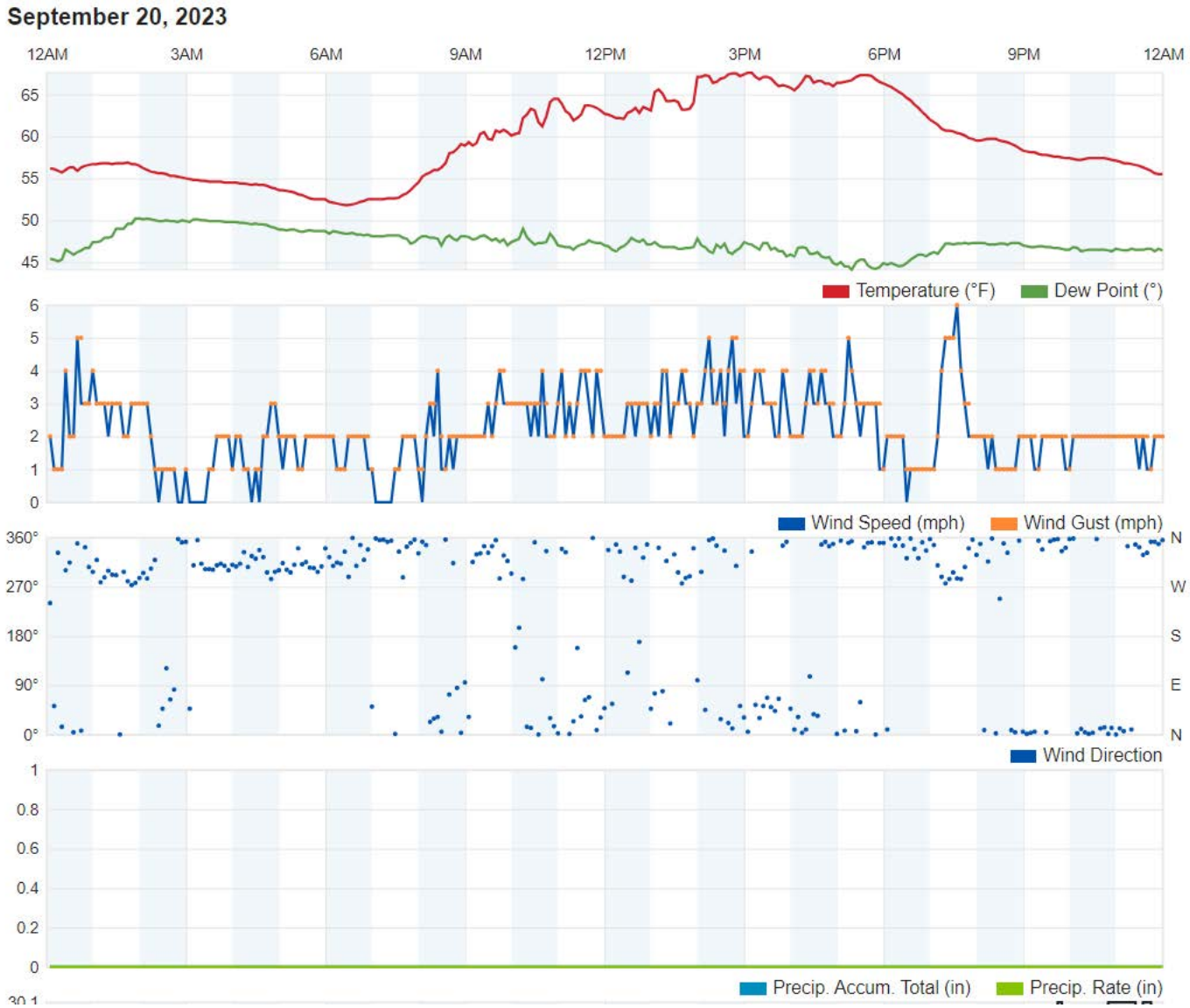
September 8, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



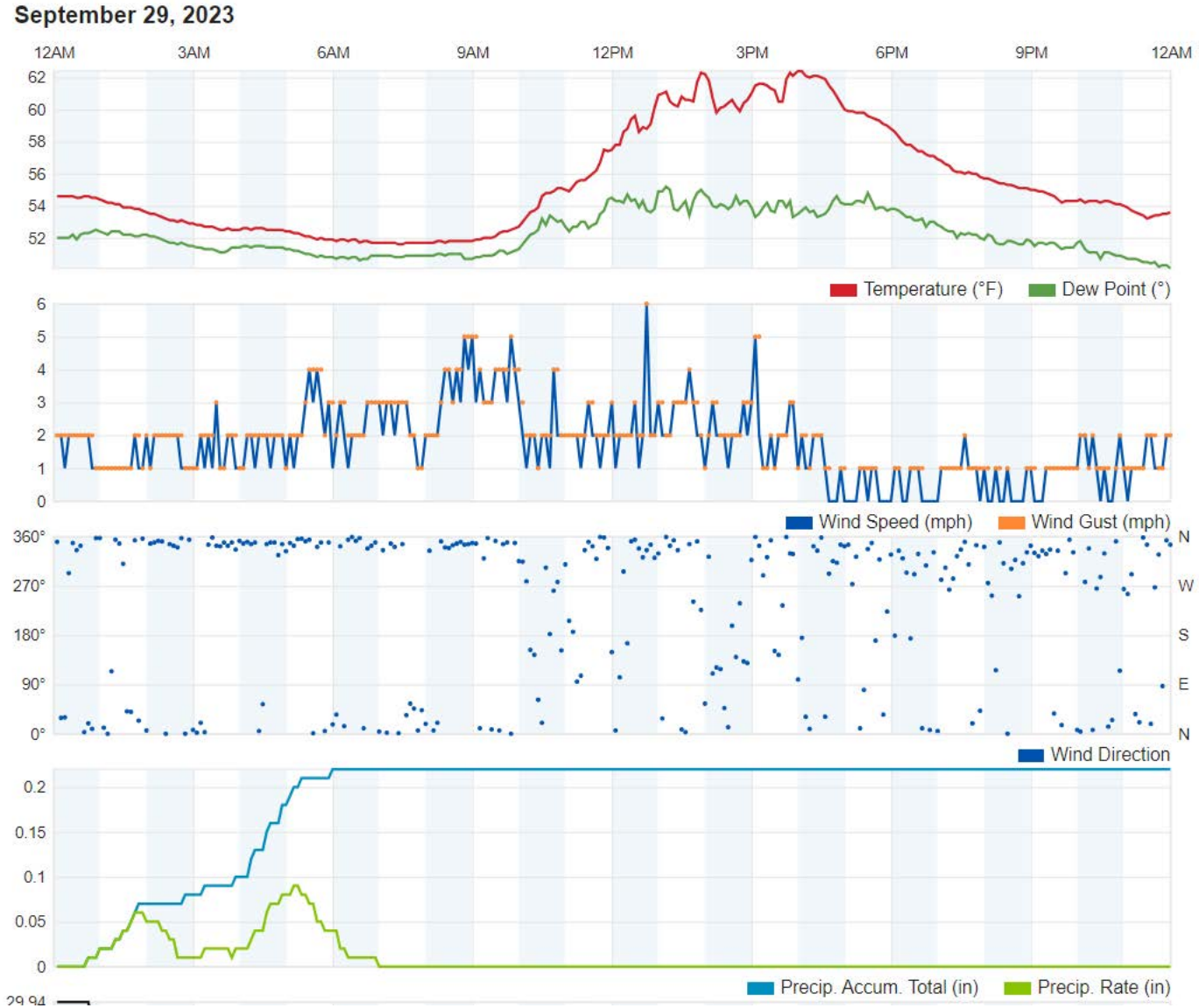
September 11, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



September 12, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



September 20, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



September 29, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon

FOURTH QUARTER 2023

SURFACE EMISSIONS MONITORING

January 16, 2024
File No. 07222178.00

Mr. Ian MacNab
Republic Services – Coffin Butte Landfill
28972 Coffin Butte Road
Corvallis, Oregon 97330

Subject: Coffin Butte Landfill - Corvallis, Oregon

Surface Emissions Monitoring for Fourth Quarter 2023.

Dear Mr. MacNab:

SCS Field Services (SCS-FS) is pleased to provide Republic Services, with the enclosed report summarizing the surface emissions monitoring services provided at the Coffin Butte Landfill (Site) during the fourth quarter of 2023. This report includes the results of the surface scan, component emissions, and blower/flare station emissions monitoring for the Site for this monitoring period.

SCS-FS appreciates the opportunity to be of assistance to Republic Services on this project. As you review the enclosed information, please contact Stephan Harquail at (503) 867-2369 or Max Polkabla at (510) 277-5122 if you have any questions or comments.

Sincerely,

Max Polkabla

Max Polkabla
Senior Technician/Data Analyst
SCS Field Services

Stephen Harquail
PNW Region Manager
SCS Field Services

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring

Fourth Quarter 2023

Presented to:



Mr. Ian MacNab
28972 Coffin Butte Road
Corvallis, Oregon 97330

SCS FIELD SERVICES

File No. 0722178.00 | January 16, 2024

SCS FIELD SERVICES
15949 SW 72nd Ave
Portland, Or 97224

Coffin Butte Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring
Fourth Quarter 2023

INTRODUCTION

This letter provides results of the November 14, 16, 20, 21, and December 8, 15, and 18, 2023, OAR landfill surface emissions monitoring (SEM) performed by SCS Field Services (SCS) at the Coffin Butte Landfill. All work was performed in accordance with our approved Work Scope dated August 29, 2022, and the OAR requirements.

2022 State Regulatory Applicability

CBL is subject to the Oregon-specific landfill gas emission regulations in OAR Chapter 340 Division 239. These SEM regulations are detailed below. The following requirements are stricter than the NESHAP regulations in previous Sections and require additional compliance:

SURFACE EMISSION METHANE CONCENTRATION LIMITS

> *340-239-0200 (1) Surface Emission Methane Concentration Limits. Except as provided in OAR 340-239-0110(4), 340-239-0110(5), 340-239-0300, and 340-239-0600(1), beginning August 1, 2022, or upon commencing operation of a newly installed gas collection and control system or modification of an existing gas collection and control system pursuant to OAR 340-239-0110(1), whichever is later, no location on the landfill surface may exceed either of the following methane concentration limits:*
>
> *(a) 500 ppmv, other than nonrepeatable, momentary readings, as determined by instantaneous surface emissions monitoring conducted in accordance with OAR 340-239-0800(3)(b);*
>
> *(b) An average methane concentration limit of 25 ppmv as determined by integrated surface emissions monitoring conducted in accordance with OAR 340-239-800(3)(c).*

The 500 ppmv limit is already a requirement in the Federal regulations above, but an average methane concentration limit of 25 ppmv will be adhered to as required.

SURFACE EMISSION RECORDKEEPING

> *340-239-0700(2)(a)(C) All instantaneous surface readings of 100 ppmv methane or greater. All exceedances of the limits in OAR 340-239-0100(6)(b) and 340-239-0200, including the location of the leak (or affected grid), leak concentration in ppmv methane, date and time of measurement, the action taken to repair the leak, date of repair, any required remonitoring and the remonitored concentration in ppmv methane, wind speed during surface sampling, and the installation date and location of each well installed as part of a gas collection system expansion;*

The Federal regulations only require monitored surface emissions over 500 ppmv to be documented, so all of the above recordkeeping will be performed on emission points 100 ppmv or over. All repeatable

instantaneous records of 100 ppm or higher (taken during SEM) must be kept for 5 years AND recorded in the semi-annual reports.

SUMMARY AND CONCLUSIONS

As stipulated in OAR, if uncorrectable exceedances within the 10-day limitation are detected or emissions are discovered during an inspection by Regulatory Agencies, the landfill must perform monitoring on a 25-foot pathway on a quarterly basis for active disposal sites. Upon completion of four consecutive SEM events without an uncorrectable exceedance of the 25 ppmv or 500 ppmv standards, other than non-repeatable momentary readings, the landfill may perform the monitoring on a 100-foot spacing on an annual basis for closed landfills or quarterly for active disposal sites. In accordance with the provisions of the OAR, the monitoring of the landfill was done on a 25-foot pathway based on a prior inspection, in which exceedances were observed.

On November 14, 16, 20, 21, and December 8, 15, and 18, 2023, SCS performed fourth quarter 2023 surface emissions monitoring testing as required by the Oregon Landfill Gas emission Rule. Instantaneous surface emissions monitoring results indicated that five (5) locations exceeded the 500 ppmv maximum concentration on the above-mentioned dates (Table 1 in Attachment 3). The required first and second 10-day (OAR) and 30-day (OAR) follow-up monitoring indicated that not all areas returned to below regulatory compliance limits following system adjustments and remediation by site personnel. Based on these monitoring results, and in accordance with OAR, the site is required to perform a system expansion within 120 days of the initial detected exceedance or March 20, 2024. These results are discussed in a subsequent section of this report.

Also, during the instantaneous monitoring event, SCS performed integrated monitoring of the landfill surface. As required by the OAR, the landfill was divided into 50,000 square foot areas. The Coffin Butte Landfill surface is divided into 105 grids, as shown in Figure 1 in Attachment 1. During this monitoring event, several grids were not monitored, in accordance with the regulations, due to ongoing active landfilling activities, unsafe conditions, or there was no waste in place prior to the monitoring event.

During the monitoring event, there were eight (8) areas observed to exceed the 25 ppmv OAR integrated average threshold (Table 2 in Attachment 4). The required first and second 10-day OAR follow-up monitoring indicated that seven (7) areas had returned to compliance following system adjustments and remediation by SCS and site personnel. However, the remaining one (1) area remained above compliance. Based on these monitoring results, and in accordance with the OAR, the site is required to perform a system expansion within 120 days of the third detected exceedance or April 6, 2024. These results are discussed in a subsequent section of this report. However since the instantaneous exceedance regulation is from the initial exceedance, we will be using the March 20, 2024, due date for expansion. These results are discussed in a subsequent section of this report.

In addition, quarterly monitoring of the pressurized piping or components of the Gas Collection and Control System (GCCS) under positive pressure must be performed quarterly. Results of the testing of the landfill gas (LFG) Blower Flare Station (BFS) pressurized pipe and components indicated that all test locations were in compliance with the 500 ppmv requirements.

Further, as required under the OAR, any location on the landfill that has an observed instantaneous methane concentration above 100 ppmv, must be included within the surface emission monitoring report and if any instantaneous location records above 250 ppmv, it must be monitored in a 5-foot grid around the location to determine extents of the methane leak. During this reporting period, no locations were observed showing elevated concentrations between 100-499 ppmv, of the reporting threshold.

When these readings are observed to be repeatable, they are reported to site personnel for tracking and/or remediation and will be reported in the next submittal of the annual OAR report. Finally, to help prevent potential future exceedances, SCS recommends that the landfill surface be routinely inspected and any observed surface erosion be routinely repaired.

BACKGROUND

The Coffin Butte Landfill is an active organic refuse disposal site. By way of background, organic materials buried in a landfill decompose anaerobically (in the absence of oxygen) producing a combustible gas that contains approximately 50 to 60 percent methane gas, 40 to 50 percent carbon dioxide, and a trace amount of various other gases, some of which are odorous. The Coffin-Butte/Corvallis property contains a system to control the combustible gases generated in the landfill.

SURFACE EMISSIONS MONITORING

On November 14, 16, 20, 21, and December 8, 15, and 18, 2023, the instantaneous and integrated SEM was performed over the surface of the subject site. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring in the 50,000 square foot grids as required under the OAR. During this event, SCS performed the monitoring on a 25 and 100-foot pathway in accordance with the rules as required.

EMISSIONS TESTING INSTRUMENTATION/CALIBRATION

The instruments used to perform the landfill surface emission testing consisted of the following:

- Thermo Scientific TVA 2020 portable Flame Ionization Detector (FID). This instrument measures methane in the air over a range of 1 to 50,000 ppmv. The TVA 2020 meets the State of California Air Resources Board (CARB) requirements for combined instantaneous and integrated monitoring and was calibrated in accordance with the United States Environmental Protection Agency (US EPA) Method 21.

- Weather Anemometer with continuous recorder for meteorological conditions in accordance with the OAR.

Instrument calibration logs and weather information are shown in Attachments 5 and 6.

SURFACE EMISSIONS MONITORING PROCEDURES

Surface emissions monitoring was conducted in accordance with the OAR and SEM requirements. Monitoring was performed with the FID inlet held within 2 inches of the landfill surface while a technician walked a grid in parallel paths not more than 25 or 100 feet apart over the landfill's surface. Cracks, holes, and other cover penetrations in the surface were also tested. Surface emissions readings were monitored continuously and recorded every 5 seconds. Any areas exceeding the 100 or 500 ppmv standards (reporting and compliance levels, respectively) would be GPS-tagged and stake-marked for on-site personnel to perform remediation or repairs.

The integrated average is based on the readings stored on the instrument, which are recorded every 5 seconds. The readings are then downloaded and the averages are calculated for each grid using SCS

eTools®. All readings are maintained in this secure SCS Database. The readings are not provided in the report due to the volume of readings but can be furnished upon request.

Recorded wind speed results are shown in Attachment 6. Wind speed averages were observed to remain below the alternative threshold of 10 miles per hour, and no instantaneous speeds exceeded 20 miles per hour. No rainfall occurred within 72 hours of the monitoring events. Therefore, site meteorological conditions were within the alternatives of the OAR requirements on the above-mentioned dates.

TESTING RESULTS

During this event, SCS performed the monitoring on a 25-foot pathway in accordance with the rule as required under the OAR. The intent of the monitoring was to identify any specific locations or areas of the landfill surface with organic compound concentrations exceeding the OAR or NSPS threshold limit values of 500 ppmv measured as methane for instantaneous monitoring, or an average methane concentration of 25 ppmv for the integrated monitoring (OAR).

On November 14, 16, 20, and 21, 2023, SCS performed fourth quarter 2023 instantaneous emissions monitoring testing as required by the Oregon DEQ/OAR. During this monitoring, surface emissions results indicated that five (5) location exceeded the 500 ppmv maximum concentration. The required first and second 10-day (OAR) follow-up monitoring performed on December 8, and 15, 2023, and the 1-month (OAR) follow-up monitoring event performed on December 18, 2023, indicated that not all locations returned below compliance limits as required, following system adjustments and remediation by site personnel. Based on these monitoring results, and in accordance with NSPS, the site is required to perform a system expansion within 120 days of the initial detected exceedance or March 20, 2024. Results of the initial and follow-up monitoring are shown in Attachment 3 (Table 1). Calibration logs for the monitoring equipment are provided in Attachment 5. Results of the monitoring are shown in Attachments 2 and 3 (Table 1).

Additionally, calculated integrated monitoring indicated eight (8) integrated exceedances of the 25-ppmv requirement on November 14, 16, 20, and 21, 2023. The required first and second 10-day OAR follow-up monitoring performed on December 8, and 15, 2023, indicated that seven (7) of the eight (8) areas had returned to compliance. In accordance with requirements for expansion and remediation, the exceedance locations need to be remediated and returned to compliance in accordance with the rule (expansion of the collection system or an alternative compliance option if approved by the OAR) within 120 days after the third integrated exceedance, which will be due by April 6, 2024. However since the instantaneous exceedance regulation is from the initial exceedance, we will be using the March 20, 2024, due date for expansion. Calibration logs for monitoring equipment are provided in Attachment 5.

During this monitoring event, several girds were not monitored, in accordance with the OAR, due to active landfilling activities, unsafe conditions, overgrown vegetation, or no waste in place. SCS will continue to monitor all accessible locations during the first quarter of 2024.

PRESSURIZED PIPE AND COMPONENT LEAK MONITORING

On November 21, 2023, quarterly leak monitoring was performed in accordance with the OAR. SCS performed LFG pressurized pipe and component leak monitoring at the BFS. Monitoring was performed with the detector inlet held one-half of an inch from the pressurized pipe and associated components. No locations exceeding the 500 ppmv threshold were observed during our monitoring event. The maximum reading, which was 5.00 ppmv, was well below the maximum threshold (see Table 1 for component results). Therefore, all pressurized pipes and components located at the LFG BFS were in compliance at the time of our testing.

PROJECT SCHEDULE

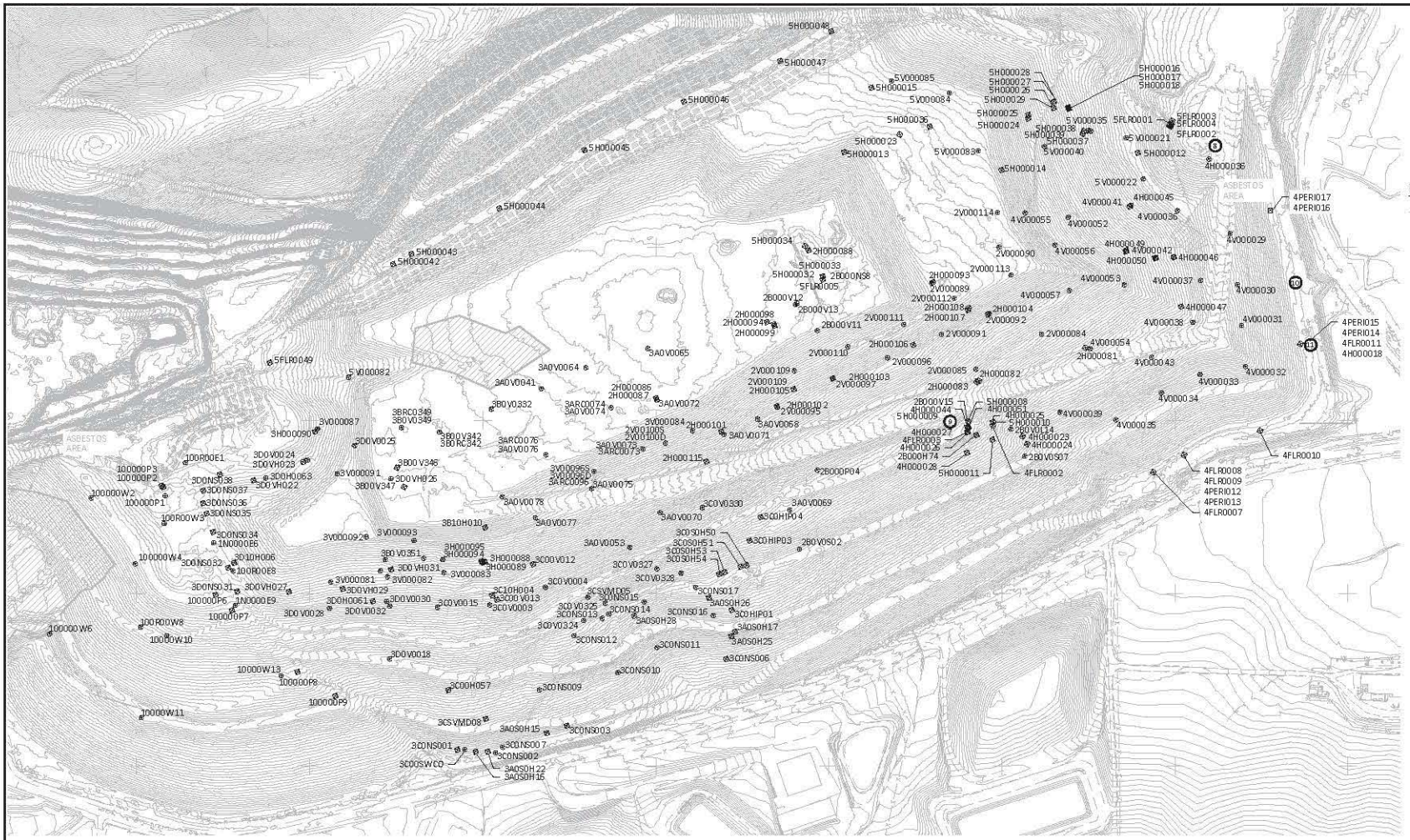
According to the OAR, surface emissions monitoring at active landfills is required to be performed on a quarterly basis. Therefore, in accordance with our approved Work Scope, the first quarter 2024 (January through March) surface emissions testing event is scheduled to be performed by the end of March 2024.

STANDARD PROVISIONS

This report addresses the conditions of the subject site during the testing dates only. Accordingly, we assume no responsibility for any changes that may occur subsequent to our testing which could affect the surface emissions at the subject site or adjacent properties.

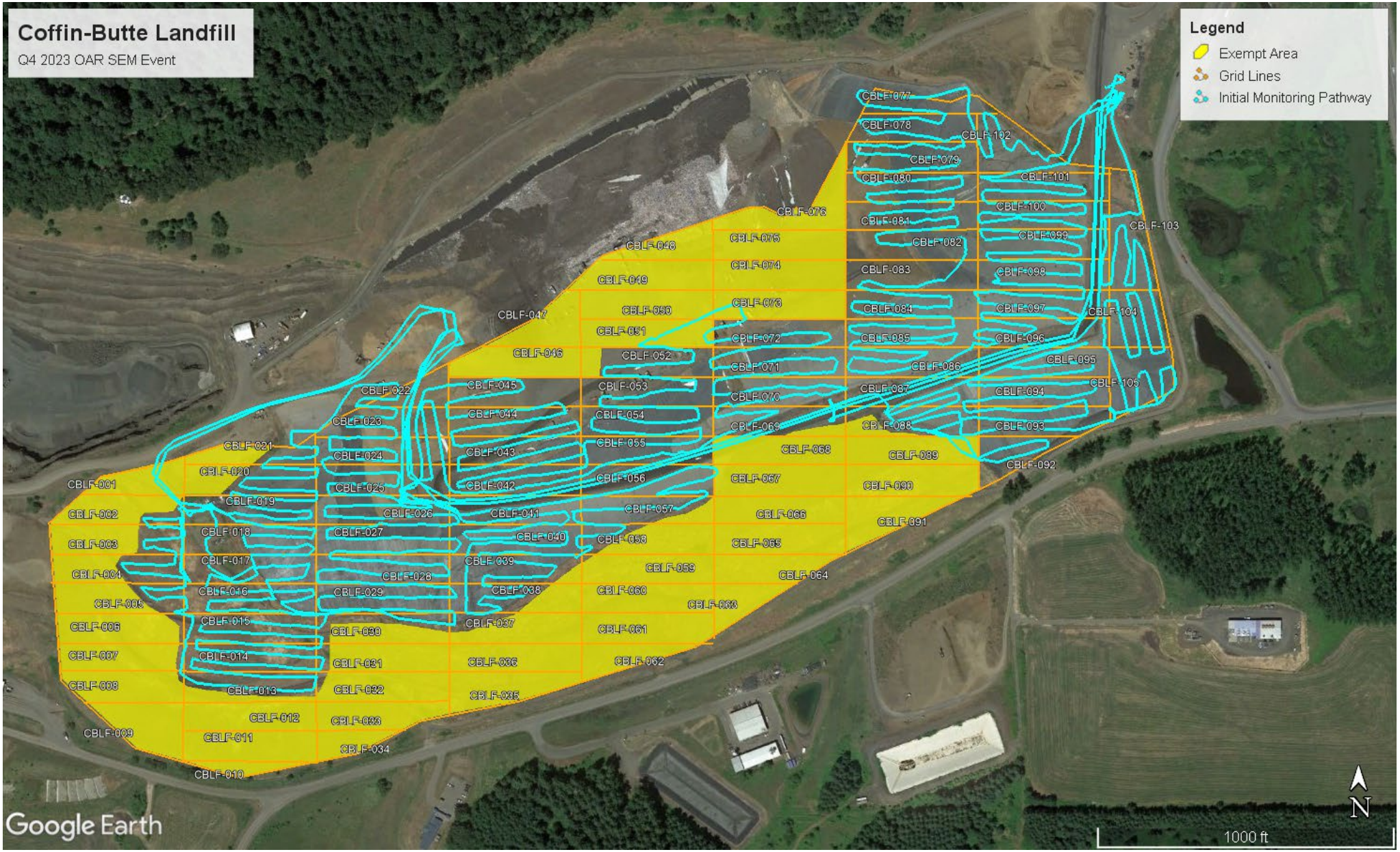
Attachment 1

Landfill Grid


N
W
E
S
0 75 150 300
GRAPHIC SCALE IN FEET
LEGEND
CURRENT GRADE TOPOGRAPHY
HORIZONTAL LFG EXTRACTION WELL
VERTICAL LFG EXTRACTION WELL
COORDINATE GRID: 500FT SPACING
ASBESTOS AREA
5H000048
5H000047
5H000046
5H000045
5H000044
5H000043
5H000042
5FLR0049
5V000082
3V000087
3H000090
3D0V0025
3D0V0024
3D0VH023
3D0H0063
3D0VH022
3D0NS038
3D0NS037
3D0NS036
3D0NS035
3D0NS034
3D0NS032
3D0NS031
3D0VH027
3D0H0061
3D0VH029
3D0V0030
3D0VH032
3D0V0026
3D0H006
3D0VH031
3D0V0018
3V000081
3V000082
3V000083
3V000092
3V000093
3V000091
3B0V346
3B0V347
3B0V351
3B0V342
3B0RC342
3B0V0349
3BRC0349
3B10H010
3H000095
3H000094
3H000088
3H000089
3C00V012
3C0V0004
3C0V0015
3C00V013
3C0V0003
3C0V0327
3C0V0328
3C0V0325
3C0V0324
3C0NS014
3CSVMD05
3C0NS015
3C10H004
3C0NS013
3C0NS012
3C0NS011
3C0NS010
3C0NS009
3C00H057
3CSVMD08
3C0NS003
3C0NS001
3C0NS007
3C0NS002
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3C0NS017
3C0NS016
3C0HIP01
3C0HIP03
3C0HIP04
3C0V0330
3C0V0069
3C0V0070
3C0S0H50
3C0S0H51
3C0S0H53
3C0S0H54
2B0V0S02
2B000P04
3A0V0065
3A0V0064
3A0V0041
3A0V0332
3A0V0076
3A0V0078
3A0V0077
3A0V0053
3A0V0075
3A0V0071
3A0V0068
3A0V0072
3A0V0074
3ARC0074
3ARC0076
3ARC0073
3ARC0096
3V000965
3V000960
3A0S0H15
3A0S0H22
3A0S0H16
3A0S0H28
3A0S0H26
3A0S0H17
3A0S0H25
2H000085
2H000087
2H000084
2H000101
2H000102
2H000115
2V000100
2V001000
2V000095
2H000098
2H000094
2H000099
2H000088
2H000033
2H000032
2B000N58
5FLR0005
2B000V12
2B000V13
2B000V11
2V000111
2V000110
2H000106
2V000096
2V000109
2H000105
2V000097
2H000103
2V000112
2H000108
2H000107
2V000089
2H000093
2V000113
2V000114
2V000090
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2V000091
2V000084
2H000104
2H000082
2V000085
2H000083
2H000081
4V000041
4V000055
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4PERI012
4PERI013
4FLR0007
4FLR0002
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4FLR0005
4H000026
4H000028
4H000025
4H000024
4H000023
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2B000V07
2B000V14
2B000V15
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5H000018
5V000035
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5FLR0003
5FLR0004
5FLR0002
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5H000037
5H000039
5H000057
5V000040
5H000036
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100000P3
100000P2
100000W2
100000P1
100R00W3
100000W4
100R00E8
1N0000E6
1000000P6
1N0000E9
100000P7
100R00W8
100000W6
100000W10
10000W13
100000P8
100000P9
10000W11
100000W5
100000W7
100000P5
100000W9
100000P4
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100000W32
100000P30
100000W33

Attachment 2

Surface Pathway



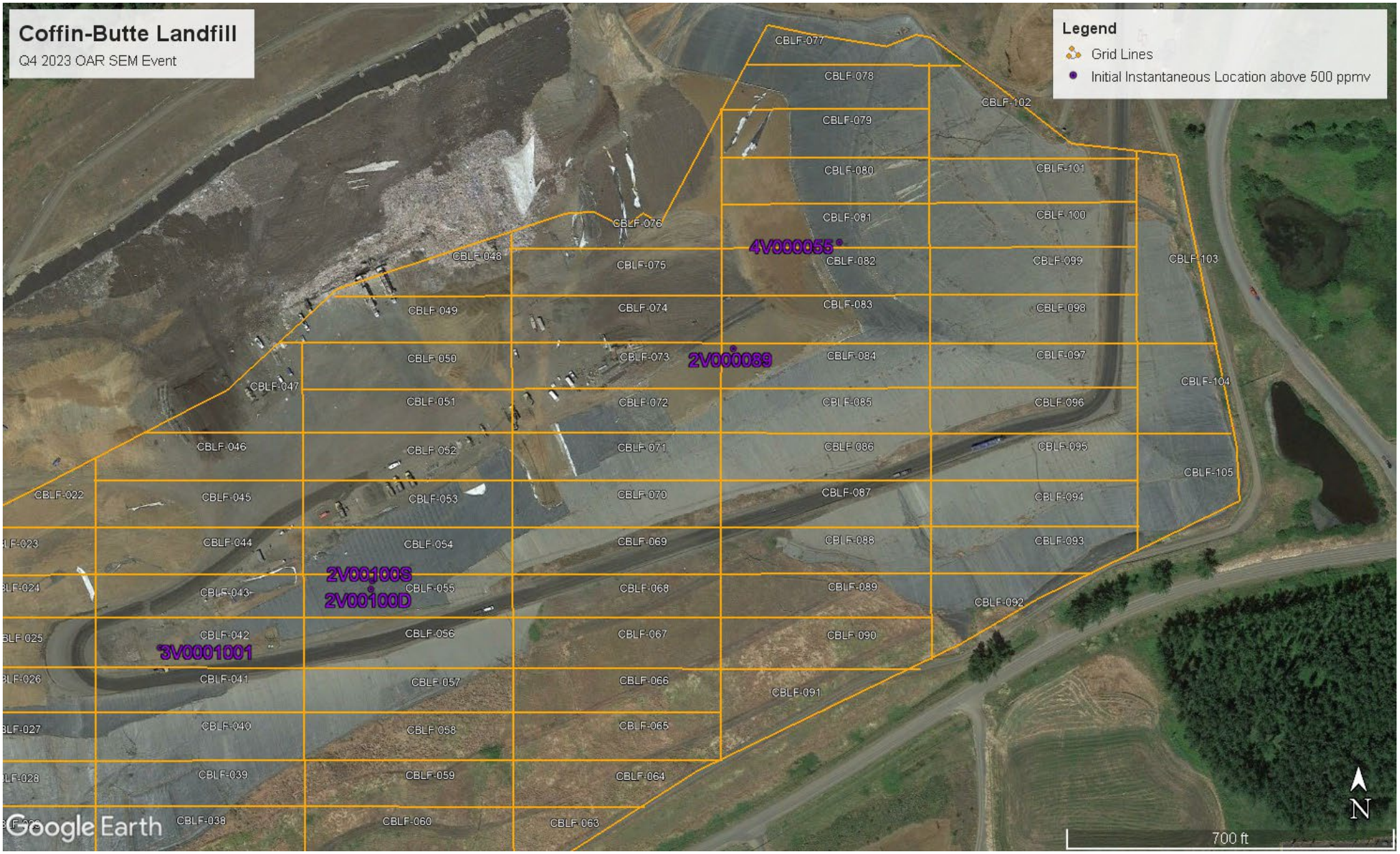
Fourth Quarter 2023

Initial Surface Emissions Monitoring Pathway

Coffin Butte Landfill, Corvallis, Oregon

Attachment 3

Instantaneous and Component Emissions Monitoring Results



Fourth Quarter 2023
Initial Emissions Monitoring Results Greater Than 500 ppmv
Coffin Butte Landfill, Corvallis, Oregon

Fourth Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results
Coffin-Butte Landfill, Corvallis, Oregon

Instantaneous Data Report for November 14, 16, 20, 21, and December 8, 15 and 18, 2023

Location (Surface)	Initial Monitoring Results (ppmv) 11/21/2023	First 10-Day Monitoring Results (ppmv) 12/8/2023	Second 10-Day Monitoring Results (ppmv) 12/15/2023	1-Month Follow-Up Monitoring Results (ppmv) 12/18/2023	120-Day Expansion Due Date:	Latitude	Longitude
2V000089	3300	800	752	1360	**March 20,2024**	44.70056003	-123.22847002
2V00100D	1600	189	N/A	269	N/A	44.69920702	-123.23142330
2V00100S	2191	1000	336	449	N/A	44.69920753	-123.23143126
3V0001001	5194	250	N/A	105	N/A	44.69881701	-123.23317202
4V000055	3700	3000	1853	5807	**March 20,2024**	44.70118004	-123.22759998

Instantaneous Data Report for November 14, 16, 20, 21, and December 8, 15 and 18, 2023
Readings between 100-499 ppmv

N/A

Fourth Quarter 2023

Table 1. Instantaneous Surface and Component Emissions Monitoring Results Coffin-Butte Landfill, Corvallis, Oregon

Pressurized Pipe and Component Results

Route	Date	Concentration (ppmv)
FLARE STATION	11/21/2023	5.00

No other exceedances of the 500 ppmv threshold were observed during the fourth quarter of 2023 monitoring.

Attachment 4

Integrated Monitoring Results

Fourth Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-001	--	--	Exempt Area
CBLF-002	--	--	Exempt Area
CBLF-003	11/16/2023	2.58	
CBLF-004	11/16/2023	2.21	
CBLF-005	11/16/2023	2.07	
CBLF-006	--	--	Exempt Area
CBLF-007	--	--	Exempt Area
CBLF-008	--	--	Exempt Area
CBLF-009	--	--	Exempt Area
CBLF-010	--	--	Exempt Area
CBLF-011	--	--	Exempt Area
CBLF-012	--	--	Exempt Area
CBLF-013	11/16/2023	1.95	
CBLF-014	11/16/2023	1.89	
CBLF-015	11/16/2023	1.91	
CBLF-016	11/20/2023	4.59	
CBLF-017	11/16/2023	1.78	
CBLF-018	11/20/2023	5.70	
CBLF-019	11/20/2023	2.95	
CBLF-020	11/20/2023	2.66	
CBLF-021	11/20/2023	9.18	
CBLF-022	11/14/2023	62.94	Initial Monitoring
CBLF-022	11/21/2023	94.31	First 10-Day Recheck
CBLF-022	12/8/2023	34.78	Second 10-Day Recheck Expansion due by March 20, 2024
CBLF-023	11/20/2023	35.35	Initial Monitoring
CBLF-023	11/21/2023	68.53	First 10-Day Recheck
CBLF-023	12/8/2023	17.61	Second 10-Day Recheck
CBLF-024	11/20/2023	14.26	
CBLF-025	11/20/2023	10.02	
CBLF-026	11/20/2023	25.53	Initial Monitoring
CBLF-026	11/21/2023	29.47	First 10-Day Recheck
CBLF-026	12/8/2023	9.45	Second 10-Day Recheck
CBLF-027	11/20/2023	20.35	
CBLF-028	11/20/2023	11.49	
CBLF-029	11/20/2023	2.35	
CBLF-030	11/20/2023	5.22	
CBLF-031	--	--	Exempt Area
CBLF-032	--	--	Exempt Area
CBLF-033	--	--	Exempt Area
CBLF-034	--	--	Exempt Area
CBLF-035	--	--	Exempt Area
CBLF-036	--	--	Exempt Area

Fourth Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-037	--	--	Exempt Area
CBLF-038	11/20/2023	6.86	
CBLF-039	11/20/2023	10.19	
CBLF-040	11/20/2023	25.91	Initial Monitoring
CBLF-040	11/21/2023	7.64	First 10-Day Recheck
CBLF-041	--	--	Exempt Area
CBLF-042	11/14/2023	24.68	
CBLF-043	11/14/2023	22.67	
CBLF-044	11/14/2023	35.15	Initial Monitoring
CBLF-044	11/21/2023	11.21	First 10-Day Recheck
CBLF-045	11/14/2023	35.63	Initial Monitoring
CBLF-045	11/21/2023	28.55	First 10-Day Recheck
CBLF-045	12/8/2023	10.84	Second 10-Day Recheck
CBLF-046	--	--	Exempt Area
CBLF-047	--	--	Exempt Area
CBLF-048	--	--	Exempt Area
CBLF-049	--	--	Exempt Area
CBLF-050	--	--	Exempt Area
CBLF-051	--	--	Exempt Area
CBLF-052	11/14/2023	141.79	Initial Monitoring
CBLF-052	11/21/2023	14.85	First 10-Day Recheck
CBLF-053	11/14/2023	60.42	Initial Monitoring
CBLF-053	11/21/2023	9.83	First 10-Day Recheck
CBLF-054	11/14/2023	19.13	
CBLF-055	11/14/2023	7.70	
CBLF-056	11/20/2023	18.60	
CBLF-057	11/20/2023	14.07	
CBLF-058	11/20/2023	11.60	
CBLF-059	--	--	Exempt Area
CBLF-060	--	--	Exempt Area
CBLF-061	--	--	Exempt Area
CBLF-062	--	--	Exempt Area
CBLF-063	--	--	Exempt Area
CBLF-064	--	--	Exempt Area
CBLF-065	--	--	Exempt Area
CBLF-066	--	--	Exempt Area
CBLF-067	--	--	Exempt Area
CBLF-068	--	--	Exempt Area
CBLF-069	11/14/2023	10.35	
CBLF-070	11/14/2023	2.43	
CBLF-071	11/14/2023	15.24	
CBLF-072	11/14/2023	21.91	
CBLF-073	--	--	Exempt Area

Fourth Quarter 2023
Table 2. Integrated Surface Emissions Monitoring Results
Coffin-Butte Landfill Corvallis, Oregon

Point Name	Record Date	FID Concentration (ppm)	Comments
CBLF-074	--	--	Exempt Area
CBLF-075	--	--	Exempt Area
CBLF-076	--	--	Exempt Area
CBLF-077	--	--	Exempt Area
CBLF-078	11/14/2023	1.00	
CBLF-079	11/14/2023	7.07	
CBLF-080	11/14/2023	11.64	
CBLF-081	11/14/2023	11.30	
CBLF-082	11/14/2023	21.34	
CBLF-083	--	--	Exempt Area
CBLF-084	11/14/2023	24.57	
CBLF-085	11/14/2023	9.35	
CBLF-086	11/14/2023	6.22	
CBLF-087	11/14/2023	13.13	
CBLF-088	11/14/2023	1.64	
CBLF-089	--	--	Exempt Area
CBLF-090	--	--	Exempt Area
CBLF-091	--	--	Exempt Area
CBLF-092	11/14/2023	3.36	
CBLF-093	11/14/2023	2.34	
CBLF-094	11/14/2023	18.46	
CBLF-095	11/14/2023	3.90	
CBLF-096	11/14/2023	3.26	
CBLF-097	11/14/2023	5.56	
CBLF-098	11/14/2023	6.21	
CBLF-099	11/14/2023	2.99	
CBLF-100	11/14/2023	3.43	
CBLF-101	11/14/2023	5.76	
CBLF-102	11/14/2023	1.16	
CBLF-103	11/14/2023	0.63	
CBLF-104	11/14/2023	2.78	
CBLF-105	11/14/2023	8.12	

Attachment 5

Calibration Logs

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 11/14/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 3 MPH Wind Direction: SE Barometric Pressure: 29.89

Air Temperature: 39 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	1
2	0	499	1
3	0	500	0

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.7 ppm

Downwind NW side of site Reading: 4.1 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 11/16/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SE Barometric Pressure: 29.84

Air Temperature: 39 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	2
2	0	499	1
3	0	500	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.9 ppm

Downwind NW side of site Reading: 3.8 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 9/20/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SE Barometric Pressure: 29.95

Air Temperature: 39 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	501	1
2	0	499	1
3	0	500	0

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 1.4 ppm

Downwind NW side of site Reading: 3.2 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 11/21/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 9 MPH Wind Direction: SE Barometric Pressure: 29.78

Air Temperature: 36 deg F General Weather Conditions: Overcast

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	500	0
2	0	501	1
3	0	499	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

Up Wind of landfill area on SE side. Reading: 0.7 ppm

Downwind NW side of site Reading: 3.3 ppm

NOTES:

CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA

Date: 12/8/2023 Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: SE Barometric Pressure: 29.82

Air Temperature: 42 deg F General Weather Conditions: Sunny

CALIBRATION INFORMATION

Pre-monitoring Calibration Precision Check

Response Time trial #1 *5 seconds*

Response Time trial #2 *5 seconds*

Response Time Trial #3 6 seconds

Instrument ID: TVA-202016031210 Cal Gas Concentration: 500 ppm

Trial	Zero Air Reading	Cal Gas Reading	|(Cal Gas Conc. - Cal Gas Reading)|
1	0	500	0
2	0	499	1
3	0	501	1

Average Difference: 0.00

Calibration Precision = Average Difference / Cal Gas Concentration X 100%
= 0 / 500 X 100%
= 0.0% %

Post-monitoring Calibration Check

Zero Air Reading: 0 ppm Cal Gas Reading: 500 ppm

BACKGROUND CONCENTRATION CHECKS

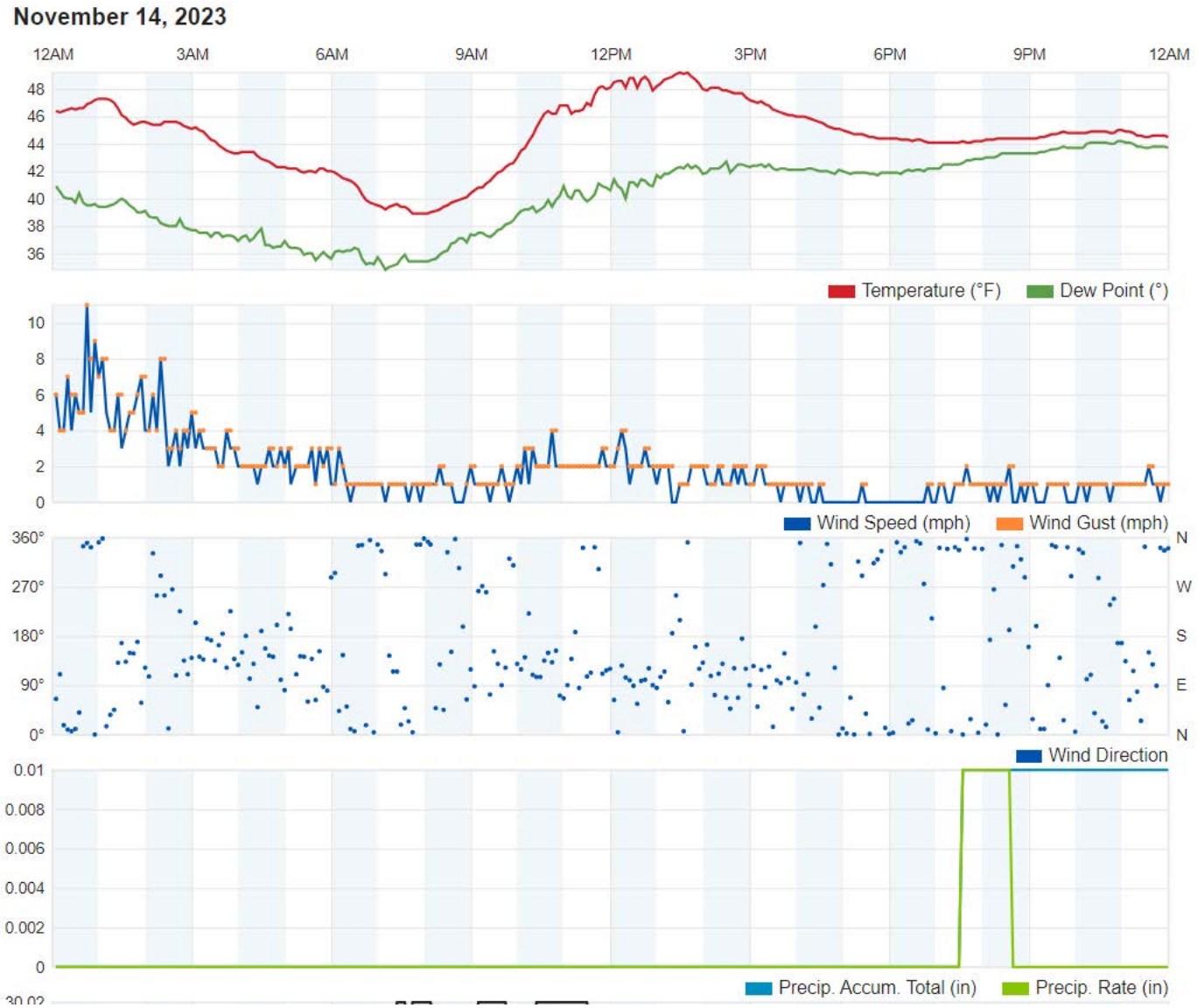
Up Wind of landfill area on SE side. Reading: 1.9 ppm

Downwind NW side of site Reading: 4.4 ppm

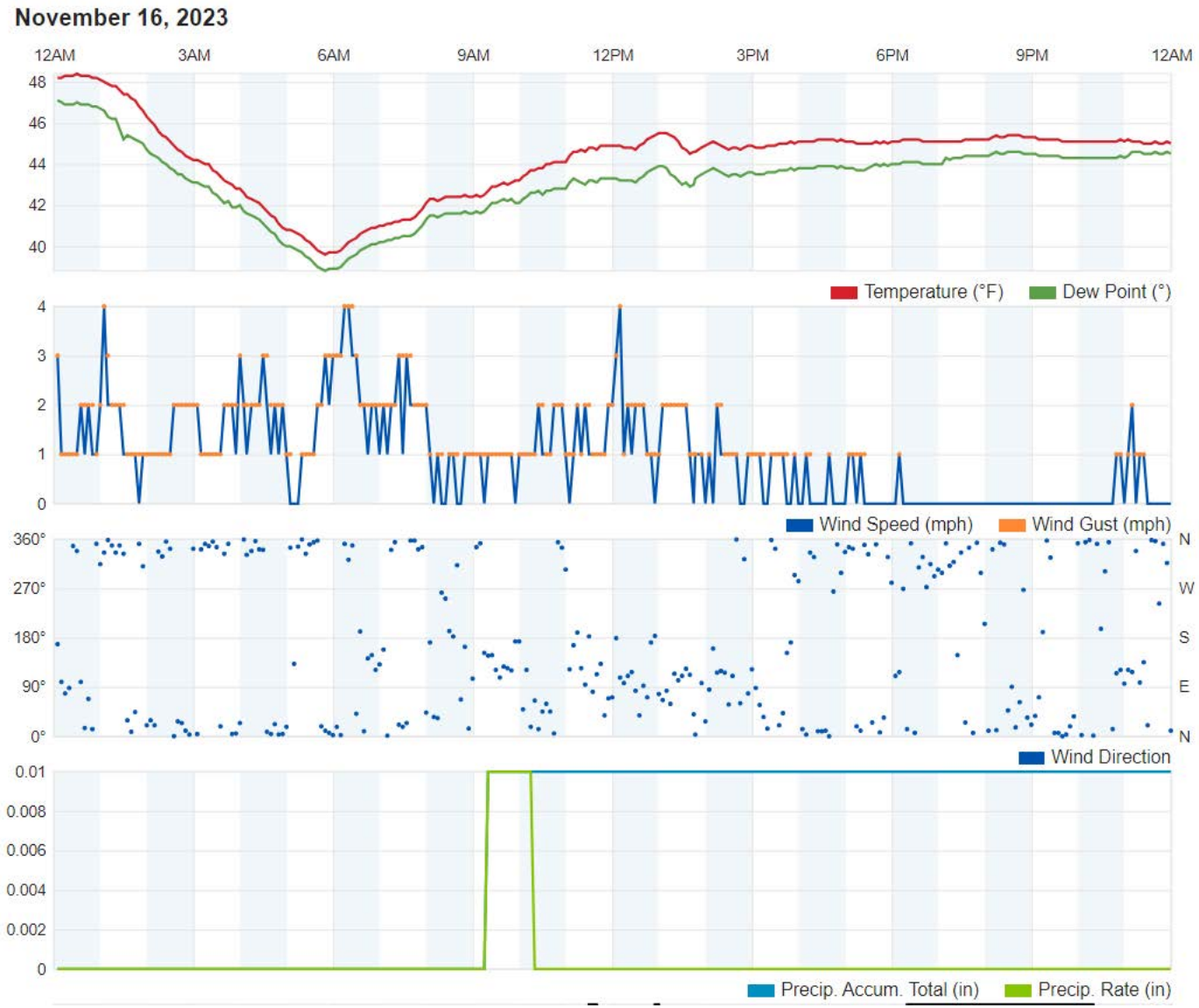
NOTES:

Attachment 6

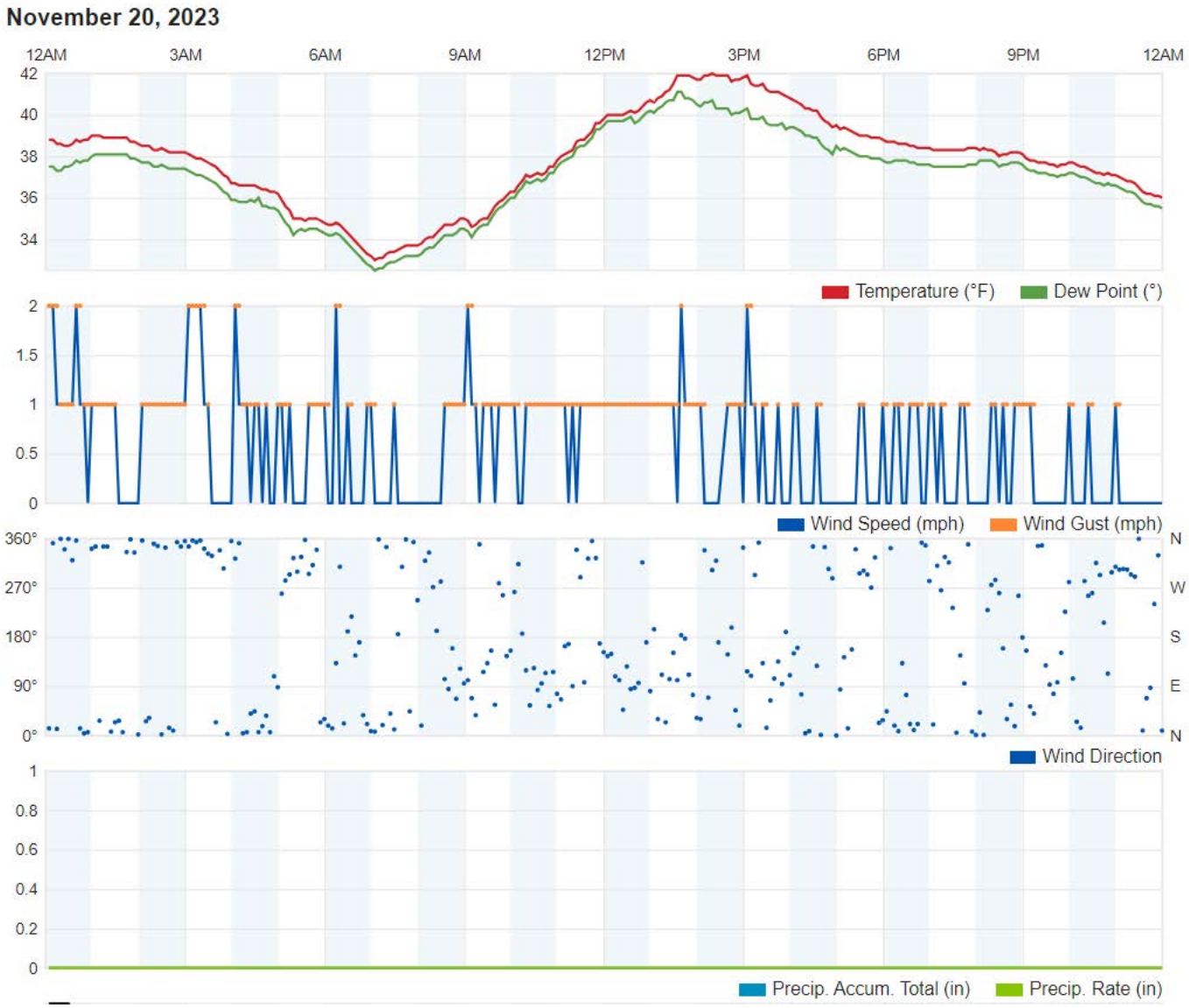
Weather Data



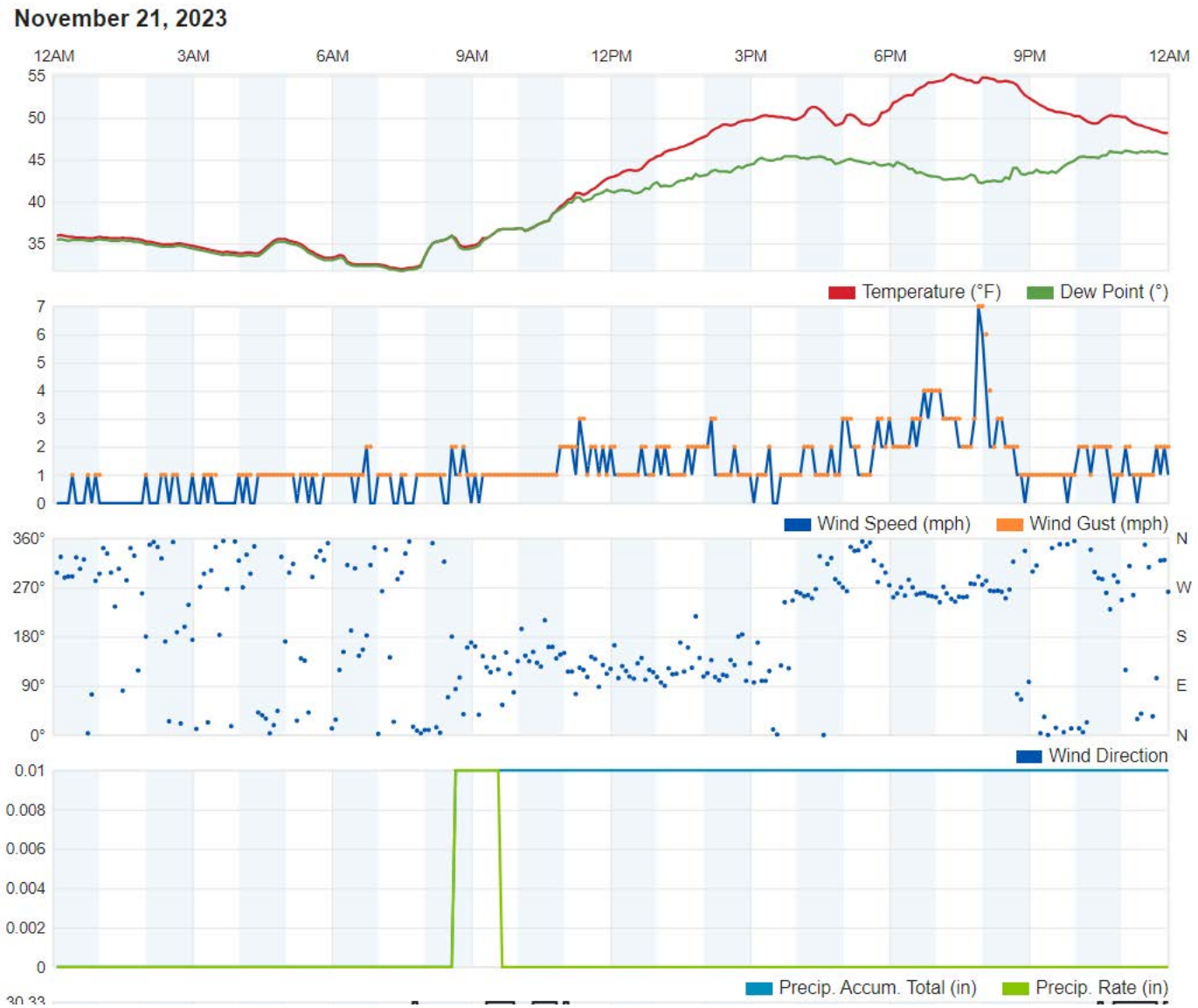
November 14, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



November 16, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



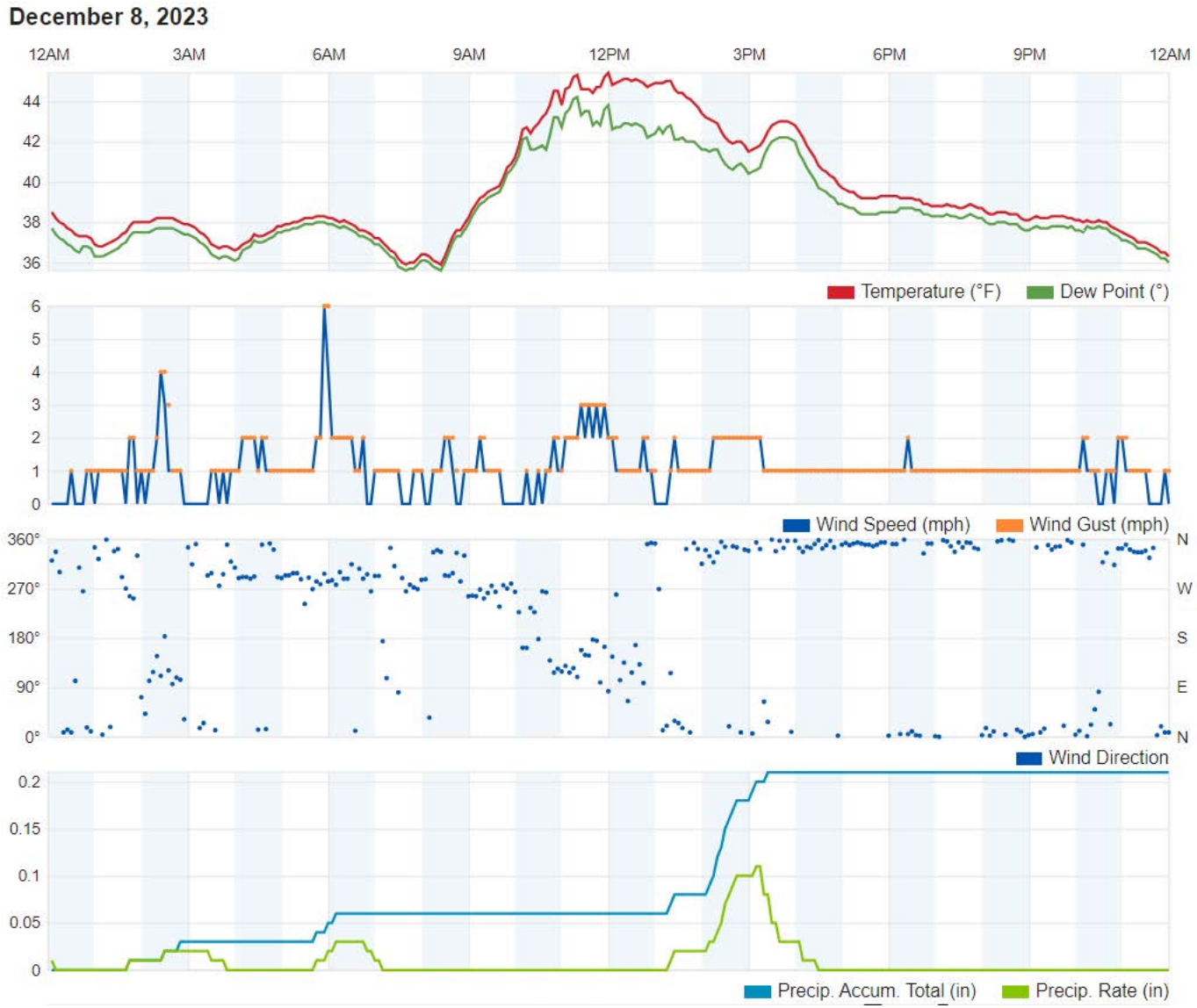
November 20, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



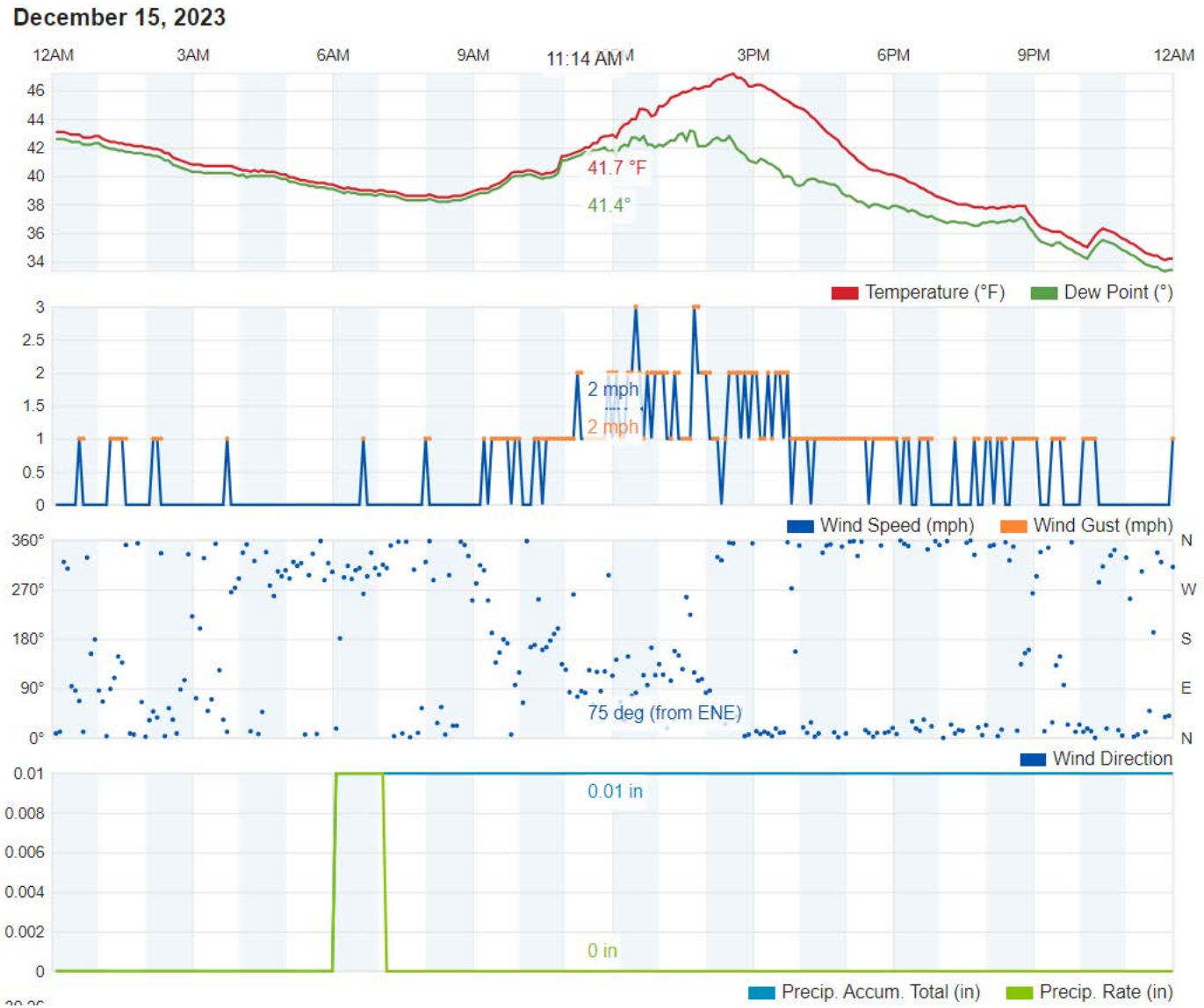
November 21, 2023

Emissions Monitoring Weather Data

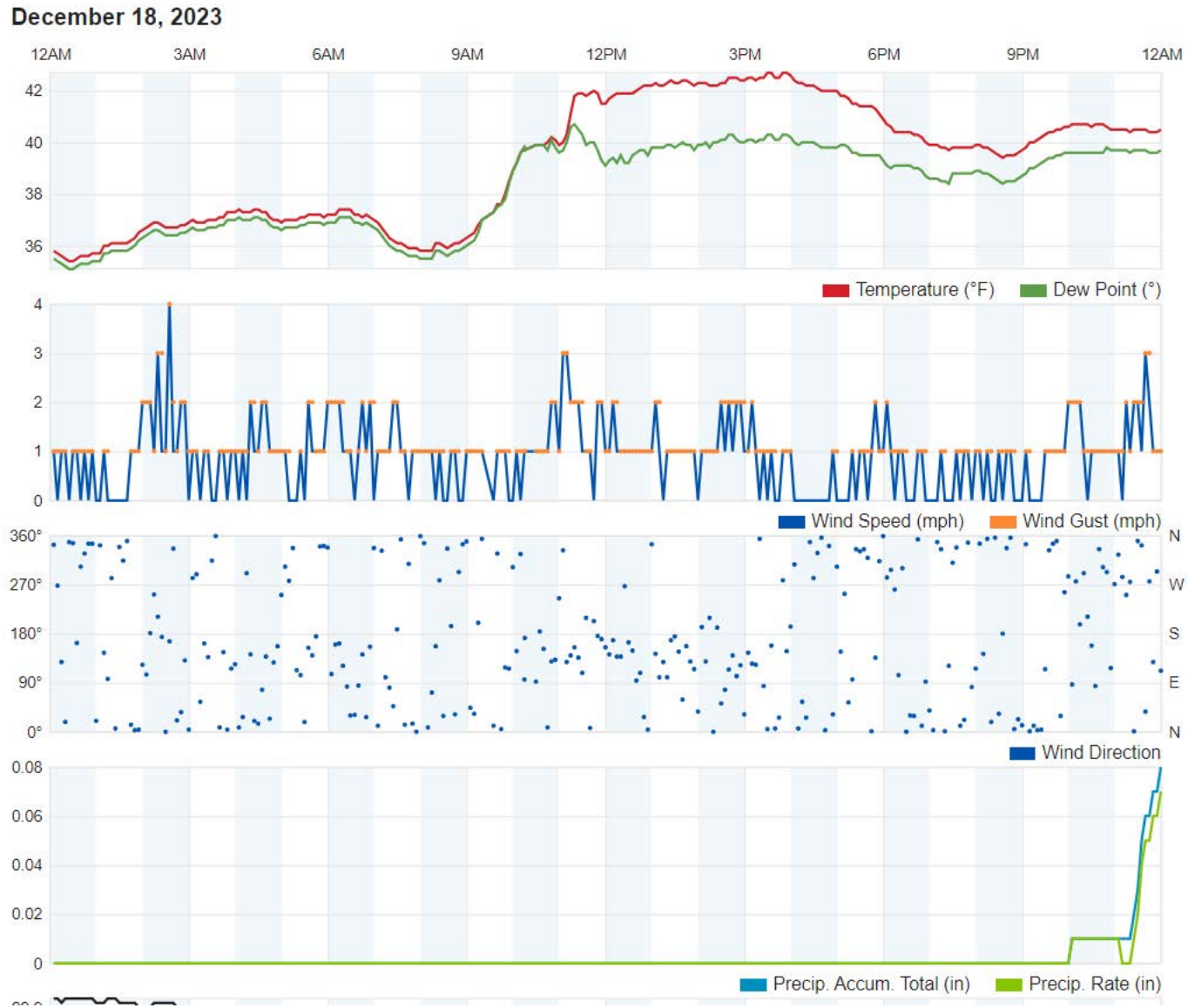
Coffin-Butte Landfill, Corvallis, Oregon



December 8, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



December 15, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon



December 18, 2023
Emissions Monitoring Weather Data
Coffin-Butte Landfill, Corvallis, Oregon

APPENDIX B

WELLFIELD PRESSURE EXCEEDANCE REPORT

Coffin Butte Landfill
Wellfield Pressure Exceedance Report
Reporting Period: July 1, 2023 to December 31, 2023

WellName	Date/Time Monitored	Pressure (in. H20)	Temperature (°F)	Date/Time Remediated	Duration Days
2H000082	9/26/2023 14:05	1.60	73.0	9/28/2023 14:26	2
2V000085	10/21/2023 15:38	2.22	73.0	11/10/2023 14:35	20
3D0NS034	8/11/2023 15:30	0.02	86.0	8/30/2023 8:52	19
3D0VH031	9/13/2023 14:19	27.20	78.0	9/27/2023 16:32	14
5V000084	8/25/2023 10:50	0.10	85.0	9/22/2023 13:58	28
5V000085	8/25/2023 10:41	6.51	100.0	9/22/2023 13:53	28

* Well 3D0NS034 is operating under the approved alternative monitoring plan. Therefore, the root cause analysis is not applicable.

APPENDIX C

CONTROL DEVICE DOWNTIME LOG/TREATMENT SYSTEM DOWNTIME LOG

CONTROL DEVICE DOWNTIME LOG – FLARE #1

Coffin Butte Landfill
Control Device Downtime for Flare #1
Reporting Period: July 1, 2023 to December 31, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Description
7/3/2023 21:56	7/3/2023 22:18	0:22:00	LFG diverted to PNGC
7/6/2023 14:12	7/6/2023 14:22	0:10:00	LFG diverted to PNGC
7/13/2023 10:16	7/13/2023 10:28	0:12:00	LFG diverted to PNGC
7/25/2023 15:08	7/25/2023 15:18	0:10:00	LFG diverted to PNGC
7/27/2023 14:48	7/27/2023 14:56	0:08:00	LFG diverted to PNGC
7/28/2023 12:22	7/28/2023 12:34	0:12:00	LFG diverted to PNGC
8/11/2023 2:04	8/11/2023 2:14	0:10:00	LFG diverted to PNGC
8/11/2023 19:22	8/11/2023 21:40	2:18:00	LFG diverted to PNGC
8/16/2023 1:20	8/16/2023 1:34	0:14:00	LFG diverted to PNGC
8/16/2023 7:44	8/16/2023 8:10	0:26:00	LFG diverted to PNGC
8/17/2023 7:40	8/17/2023 8:24	0:44:00	LFG diverted to PNGC
8/17/2023 11:58	8/17/2023 15:22	3:24:00	LFG diverted to PNGC
8/17/2023 16:12	8/17/2023 17:20	1:08:00	LFG diverted to PNGC
8/18/2023 9:16	8/18/2023 13:40	4:24:00	LFG diverted to PNGC
8/25/2023 4:42	8/25/2023 4:48	0:06:00	LFG diverted to PNGC
8/25/2023 5:00	8/25/2023 5:04	0:04:00	LFG diverted to PNGC
8/28/2023 12:56	8/29/2023 11:22	22:26:00	LFG diverted to PNGC
8/30/2023 9:46	8/30/2023 16:08	6:22:00	LFG diverted to PNGC
8/30/2023 19:16	8/31/2023 8:38	13:22:00	LFG diverted to PNGC
8/31/2023 11:50	8/31/2023 11:54	0:04:00	LFG diverted to PNGC
9/1/2023 6:00	9/1/2023 12:54	6:54:00	LFG diverted to PNGC
9/2/2023 21:54	9/2/2023 22:02	0:08:00	LFG diverted to PNGC
9/12/2023 13:16	9/13/2023 8:08	18:52:00	LFG diverted to PNGC
9/16/2023 0:56	9/16/2023 1:00	0:04:00	LFG diverted to PNGC
9/16/2023 1:12	9/16/2023 1:14	0:02:00	LFG diverted to PNGC
9/16/2023 4:30	9/16/2023 19:20	14:50:00	LFG diverted to PNGC
9/23/2023 11:22	9/23/2023 11:30	0:08:00	LFG diverted to PNGC
9/23/2023 13:42	9/23/2023 13:50	0:08:00	LFG diverted to PNGC
9/25/2023 17:36	9/25/2023 17:44	0:08:00	LFG diverted to PNGC
9/26/2023 12:34	9/26/2023 12:42	0:08:00	LFG diverted to PNGC
9/27/2023 2:02	9/27/2023 2:44	0:42:00	LFG diverted to PNGC
9/27/2023 3:10	9/27/2023 3:20	0:10:00	LFG diverted to PNGC
9/27/2023 3:36	9/27/2023 3:46	0:10:00	LFG diverted to PNGC
9/27/2023 5:04	9/27/2023 5:26	0:22:00	LFG diverted to PNGC
9/27/2023 9:36	9/27/2023 11:32	1:56:00	Power loss due to sump cleaning
9/27/2023 11:52	9/27/2023 12:30	0:38:00	LFG diverted to PNGC
9/27/2023 12:36	9/27/2023 12:42	0:06:00	LFG diverted to PNGC
9/27/2023 13:06	9/27/2023 13:30	0:24:00	LFG diverted to PNGC
9/27/2023 14:10	9/27/2023 14:30	0:20:00	LFG diverted to PNGC
9/27/2023 15:04	9/27/2023 15:14	0:10:00	LFG diverted to PNGC
9/27/2023 15:56	9/27/2023 16:10	0:14:00	LFG diverted to PNGC
9/27/2023 18:30	9/27/2023 18:40	0:10:00	LFG diverted to PNGC

Coffin Butte Landfill
Control Device Downtime for Flare #1
Reporting Period: July 1, 2023 to December 31, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Description
10/11/2023 8:12	10/11/2023 8:26	0:14:00	LFG diverted to PNGC
10/20/2023 2:10	10/20/2023 2:22	0:12:00	LFG diverted to PNGC
10/24/2023 4:22	10/24/2023 4:30	0:08:00	LFG diverted to PNGC
10/24/2023 23:04	10/25/2023 7:30	8:26:00	LFG diverted to PNGC
10/25/2023 7:36	10/25/2023 8:52	1:16:00	LFG diverted to PNGC
11/2/2023 5:16	11/2/2023 5:58	0:42:00	LFG diverted to PNGC
11/2/2023 10:14	11/2/2023 10:28	0:14:00	LFG diverted to PNGC
11/30/2023 10:26	11/30/2023 13:58	3:32:00	LFG diverted to PNGC
12/6/2023 9:24	12/6/2023 11:52	2:28:00	LFG diverted to PNGC
12/7/2023 13:24	12/7/2023 13:26	0:02:00	LFG diverted to PNGC
12/11/2023 11:06	12/11/2023 11:14	0:08:00	LFG diverted to PNGC
12/11/2023 12:38	12/11/2023 13:02	0:24:00	LFG diverted to PNGC
12/21/2023 15:44	12/21/2023 15:54	0:10:00	LFG diverted to PNGC
12/21/2023 16:28	12/21/2023 16:40	0:12:00	LFG diverted to PNGC
12/22/2023 11:04	12/22/2023 11:22	0:18:00	LFG diverted to PNGC
12/22/2023 11:42	12/22/2023 11:58	0:16:00	LFG diverted to PNGC

CONTROL DEVICE DOWNTIME LOG – FLARE #2

Coffin Butte Landfill
Control Device Downtime for Flare #2
Reporting Period: July 1, 2023 to December 31, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Description
8/16/2023 7:44	8/16/2023 7:56	0:12:00	LFG diverted to PNGC
9/27/2023 9:36	9/27/2023 14:18	4:42:00	Power loss due to sump cleaning
10/25/2023 7:28	10/25/2023 7:38	0:10:00	LFG diverted to PNGC
11/2/2023 5:16	11/2/2023 5:58	0:42:00	LFG diverted to PNGC
11/2/2023 10:14	11/2/2023 10:28	0:14:00	LFG diverted to PNGC
11/30/2023 10:26	11/30/2023 13:58	3:32:00	LFG diverted to PNGC
12/6/2023 9:34	12/6/2023 11:02	1:28:00	LFG diverted to PNGC
12/11/2023 11:06	12/11/2023 12:58	1:52:00	LFG diverted to PNGC
12/20/2023 13:32	12/22/2023 11:18	45:46:00	LFG diverted to PNGC
12/22/2023 11:46	12/22/2023 11:54	0:08:00	LFG diverted to PNGC
12/22/2023 11:58	12/31/2023 23:59	228:01:00	LFG diverted to PNGC

TREATMENT SYSTEM DOWNTIME LOG – PNGC

Coffin Butte Landfill
Treatment System Downtime Log
Reporting Period: July 1, 2023 to December 31, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm:ss)	Comments
7/3/2023 19:30	7/3/2023 20:45	1:15:00	Gas skid failure
7/6/2023 13:30	7/6/2023 13:45	0:15:00	Gas skid failure
7/25/2023 13:45	7/25/2023 14:30	0:45:00	Electrician working on gas skid
7/27/2023 13:15	7/27/2023 13:45	0:30:00	Electrician working on gas skid
9/27/2023 9:30	9/27/2023 10:45	1:15:00	Power loss due to sump cleaning

APPENDIX D

COLLECTION SYSTEM DOWNTIME LOG

Coffin Butte Landfill
Collection System Downtime
Reporting Period: July 1, 2023 to December 31, 2023

Shutdown Date/Time	Startup Date/Time	Duration (h:mm)	Description
9/27/2023 9:36	9/27/2023 10:45	1:09:00	Power loss due to sump cleaning

APPENDIX E

GCCS EXPANSION/CURRENT SITE GCCS LAYOUT

Coffin Butte Landfill - GCCS Expansion

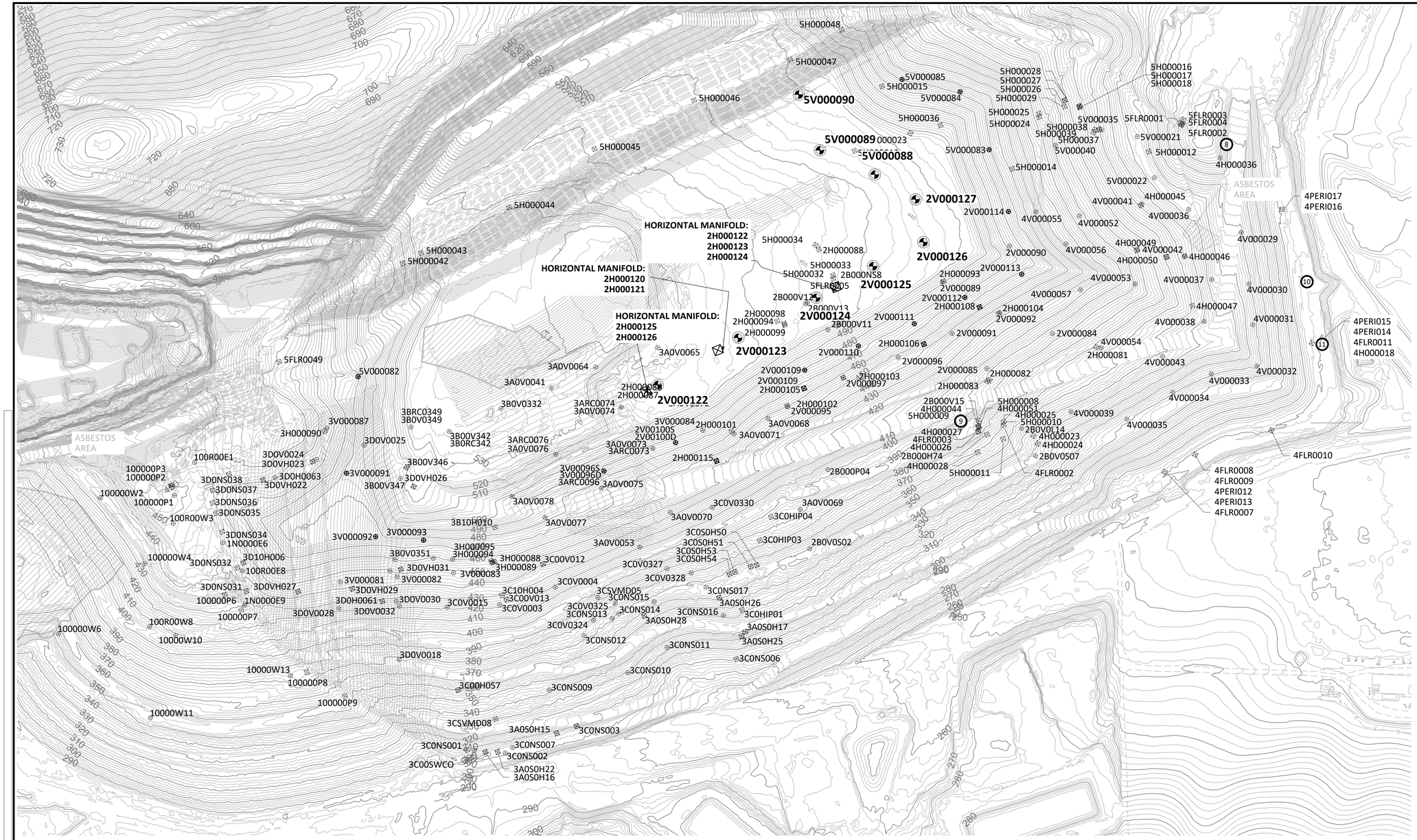
Reporting Period: July 1, 2023 to December 31, 2023

New Extraction Wells

New Well ID	Date Installed
2H000120	9/19/2023
2H000121	9/19/2023
2H000122	9/19/2023
2H000123	9/19/2023
2H000124	9/19/2023
2H000125	9/19/2023
2V000122	9/19/2023
2V000123	9/19/2023
2V000124	9/19/2023
2V000125	9/20/2023
2V000126	9/20/2023
2V000127	9/20/2023
5V000088	9/20/2023
5V000089	9/20/2023
5V000090	9/20/2023

Decommissioned Wells

Well ID	Date Decomissioned
No wells decommissioned	


HORIZONTAL MANIFOLD:
2H000122
2H000123
2H000124
HORIZONTAL MANIFOLD:
2H000120
2H000121
HORIZONTAL MANIFOLD:
2H000125
2H000126
ASBESTOS AREA
ASBESTOS AREA
5V000090
5V000089
5V000088
2V000127
2V000126
2V000125
2V000124
2V000123
2V000122
5H000048
5H000047
5H000046
5H000045
5H000044
5H000043
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5H000009
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5V000083
5V000082
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5V000022
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5FLR0003
5FLR0004
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3ARC0076
3ARC0073
3ARC0096
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3B0V0349
3BRC0349
3B0RC342
3B00V342
3B00V346
3B00V347
3B10H010
3B0V0351
3C0V0330
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3C0V0325
3C0V0324
3C0V0003
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3V000091
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100R00W4
100R00W8
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1N0000E9
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100000P2
100000P3
100000W4
100000P6
100000P7
100000W6
10000W10
10000W13
100000P8
100000P9
10000W11
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2B000V12
2B000V13
2B000V11
2B000P04
2B000V15
2B000H74
2B0V0S07
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5H000039
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5H000040
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5H000093
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5H000127
5H000128
5H000129

APPENDIX F

ROOT CAUSE ANALYSES

PRESSURE EXCEEDANCE

Root Cause Analysis

Date of Initial Exceedance:	8/25/2023
Collection Device ID:	5V000084
Pressure Reading:	0.08

Root Cause Analysis		
Was the reason for the positive pressure due to one of the following:		
A fire or increased well temperature.	☐ Yes	☒ No
Use of a geomembrane or synthetic cover.	☐ Yes	☒ No
A decommissioned well.	☐ Yes	☒ No
• If YES to **ANY** of the above, exempt as per 40 CFR 62.16720(a)(3)(iii)/ 40 CFR §63.1958(b). • If NO to **ALL** of the above, continue the form.		
Describe what was inspected.		
Lateral inspected		
Describe what was determined to be the root cause of the exceedance.		
Lateral had settled		
Determine the required next steps.		
Was the positive pressure remediated within 60 days since the initial exceedance?	☒ Yes	☐ No
• If YES, keep records of Root Cause Analysis. No reporting required. • If NO, continue with Corrective Action Analysis and Implementation Plan and submit Notification to state agency within 75 days of initial exceedance.		

PRESSURE EXCEEDANCE

Root Cause Analysis

Date of Initial Exceedance:	8/25/2023
Collection Device ID:	5V000085
Pressure Reading:	6.51

Root Cause Analysis		
Was the reason for the positive pressure due to one of the following:		
A fire or increased well temperature.	☐ Yes	☒ No
Use of a geomembrane or synthetic cover.	☐ Yes	☒ No
A decommissioned well.	☐ Yes	☒ No
• If YES to **ANY** of the above, exempt as per 40 CFR 62.16720(a)(3)(iii)/ 40 CFR §63.1958(b). • If NO to **ALL** of the above, continue the form.		
Describe what was inspected.		
Lateral inspected		
Describe what was determined to be the root cause of the exceedance.		
Lateral had settled		
Determine the required next steps.		
Was the positive pressure remediated within 60 days since the initial exceedance?	☒ Yes	☐ No
• If YES, keep records of Root Cause Analysis. No reporting required. • If NO, continue with Corrective Action Analysis and Implementation Plan and submit Notification to state agency within 75 days of initial exceedance.		

PRESSURE EXCEEDANCE

Root Cause Analysis

Date of Initial Exceedance:	10/21/2023
Collection Device ID:	2V000085
Pressure Reading:	2.22

Root Cause Analysis		
Was the reason for the positive pressure due to one of the following:		
A fire or increased well temperature.	☐ Yes	☒ No
Use of a geomembrane or synthetic cover.	☐ Yes	☒ No
A decommissioned well.	☐ Yes	☒ No
• If YES to **ANY** of the above, exempt as per 40 CFR 62.16720(a)(3)(iii)/ 40 CFR §63.1958(b). • If NO to **ALL** of the above, continue the form.		
Describe what was inspected.		
Lateral inspected		
Describe what was determined to be the root cause of the exceedance.		
Lateral had settled		
Determine the required next steps.		
Was the positive pressure remediated within 60 days since the initial exceedance?	☒ Yes	☐ No
• If YES, keep records of Root Cause Analysis. No reporting required. • If NO, continue with Corrective Action Analysis and Implementation Plan and submit Notification to state agency within 75 days of initial exceedance.		

LU-24-027
Mason Leavitt GIS Analyst
120 Shelton McMurphy Blvd
Suite 280, Eugene OR, 97401

Becky Merja, speaker 67 and Todd Rowland, Speaker 69 have ceded their time to me. I am speaking for 9 minutes today.

My name is Mason Leavitt, and I am testifying on behalf of Beyond Toxics, a decades old Oregon Based environmental organization that fights for all Oregonians to have access to clean, safe air, water, and land. Our organization has worked with Soap Creek Valley and Adair Village Residents for three years to find solutions to many of the challenges posed by this facility, and I have been there through that journey.

My background is based in Geographic Information Systems or GIS, and I have been trained to map and analyze spatial data.

Today I want to draw attention to the odor study, which the county has determined as grounds for denial. This is due to the fact the applicant used an outdated software version and did not adequately take elevational differences into account. I wish to elaborate on why this odor study is neither **comprehensive nor objective**. But, first, I want to add some related details to the record.

One, the applicant highlighted the newly installed enclosed flare as an important piece of infrastructure to manage landfill gas. I want to note for the record that DEQ announced the requirement of enclosing all landfill gas flares in 2022. The applicant received multiple notices and extensions to comply with this requirement, and failed to do so resulting in an enforcement notice from DEQ. It's installed now, but this process is illustrative of how laborious it is to get the applicant to respond to required operating conditions.

Two, the applicant has waited until last week's hearing to announce their intentions to install fenceline monitoring for odorous pollutants. Beyond Toxics and residents have been pressing for this for years now, and that technology has been available the entire time. I want to note that the applicant's odor study chase not to incorporate any real time air monitoring despite the availability of that technology

Third, I want to problematize the applicants claim they found 99% of odor complaints to be "impossible" despite acknowledging they were working with an incomplete data set that does not have the time or location of odor detection. It's worth elaborating on this. How can we know someone didn't smell the landfill because the wind was blowing the opposite direction of their location, if we do now know their location or the wind direction at the time of their complaint? Additionally, when we find a model invalidates 99% of human experiences, we typically conclude the model is wrong. I teach GIS part time at the UO, and I would fail any student who would make a similar claim to the applicant without additional explanation.

Next, I want to turn to some additional assumptions of the applicant's odor study that need more explanation**.** The applicant has chosen to go with an atmospheric modeling system

using weather data from Coffin Butte, Salem Airport, and Corvallis airport. Using this data, they have made an educated guess on how air has moved around in the nearby area of the landfill.

As the famous saying goes: “All models are wrong, but some are useful.” Models have fundamental limitations and they cannot and do not reflect all the complexities of the real world. Modeling is a great tool but it is not the entire picture and there are many other tools in the toolbox the applicant has chosen not to deploy including the air monitoring I mentioned above.

Models are a series of mathematical equations- if you change the numerical inputs or the parameters, you get different results. Choosing those inputs is not an objective decision- it is subjective to the applicants preferences.

One of the most important assumptions made by the applicant is that the facility has a 25% fugitive emissions rate - mind you, I want to note that they used to claim it was 10%- the best in Oregon before quietly revising those numbers last year. Recall, fugitive emissions are landfill gas emissions that are not captured by gas extraction wells and other gas controls. I want to complicate that 25% assumption made by the applicant. Planning Commissioners brought up two important questions last session I would like to answer:

1. What about all the photos of holes in Coffin Butte’s covers and tarps meticulously documented by residents? Recall, the applicant stated they do regular surface emissions monitoring to repair these holes. This prompted the second question.

2. Do we have results of the surface emissions monitoring done by the applicant?

First, let's look at the EPA: Coffin Butte has been inspected twice by the US EPA inspections which uncovered over 100 violations, some of them 200 times the regulatory limit. The first time EPA inspected the landfill in 2022, Coffin Butte had done their own SEM monitoring 10 days prior where they found 6 leaks between 500ppm and 1,500 Ppm. The EPA found 71 leaks between 500 ppm and over 70,000 ppm and they only monitored a small portion of the landfill. They also found that the applicant had been not complying with several standard testing procedures required by Oregon Law. A similar story occurred in 2024 with 41 leaks between 500 and 118,000 ppm. the applicant is currently under investigation for failing to meet Clean Air Act standards.

Second, I have analyzed surface emissions monitoring reports submitted to DEQ by all Oregon Landfills legally required to do so. I found records that show that Coffin Butte is choosing not to monitor 56% percent of their landfill surface area in SEM using a legal loophole (**Exhibit A**). This is above average for privately operated landfills in Oregon which omit 50% on average. Publicly operated landfills omit about 10%. Coffin Butte claims that some of their slopes are too steep or too covered in vegetation meaning they can’t monitor them. These are slopes operators designed and vegetation they chose not to maintain, and the legality of these exemptions are ambiguous at best or illegal at worst.

Additionally, Third party satellite flyovers have found massive plumes of landfill gas that can be observed from space. They have flown over Coffin Butte 6 times over the last two years, and found leaks 100% of the time.

The working face, where garbage is currently being deposited, is a site of significant fugitive emissions. Coffin Butte claims they limit their working face to a half acre at any time. I have submitted nearly a dozen random satellite images showing otherwise (**Exhibit B**). They also claim they cover it with daily cover at the end of each working day. Photographs show otherwise.

Additionally, I have used air monitoring equipment to document hydrogen sulfide levels at residential households. This is the classic rotten-eggy smell we have all smelled in our garbage. Through monitoring, we have found Hydrogen sulfide levels between 250 and 500 ppb. This is well over the human detection threshold of 30 ppb (**Exhibit C**)

I also worked with Linfield University students to conduct a door to door survey of all 500 homes in Adair Village. Of 126 households that spoke to us, we found 60% of residents reported regularly smelling the landfill, and many were specific that the smell is distinct from the compost facility. 20% of residents reported having modified their daily activities to avoid going outside due to the smell being unbearable or concerns over exposure to toxics.

Remember, all models are wrong, but some are useful. The applicant's model is serving a purpose to cast doubt on hundreds of people’s lived experiences. The applicant has offered no explanation for the discrepancy between their odor study results and the experience of residents. They have offered no explanation of why their gas collection system is failing and how they plan to fix it. I urge the planning committee to believe the residents' experiences, and to acknowledge the applicants reliable record of bad behaviour.

Exhibit A

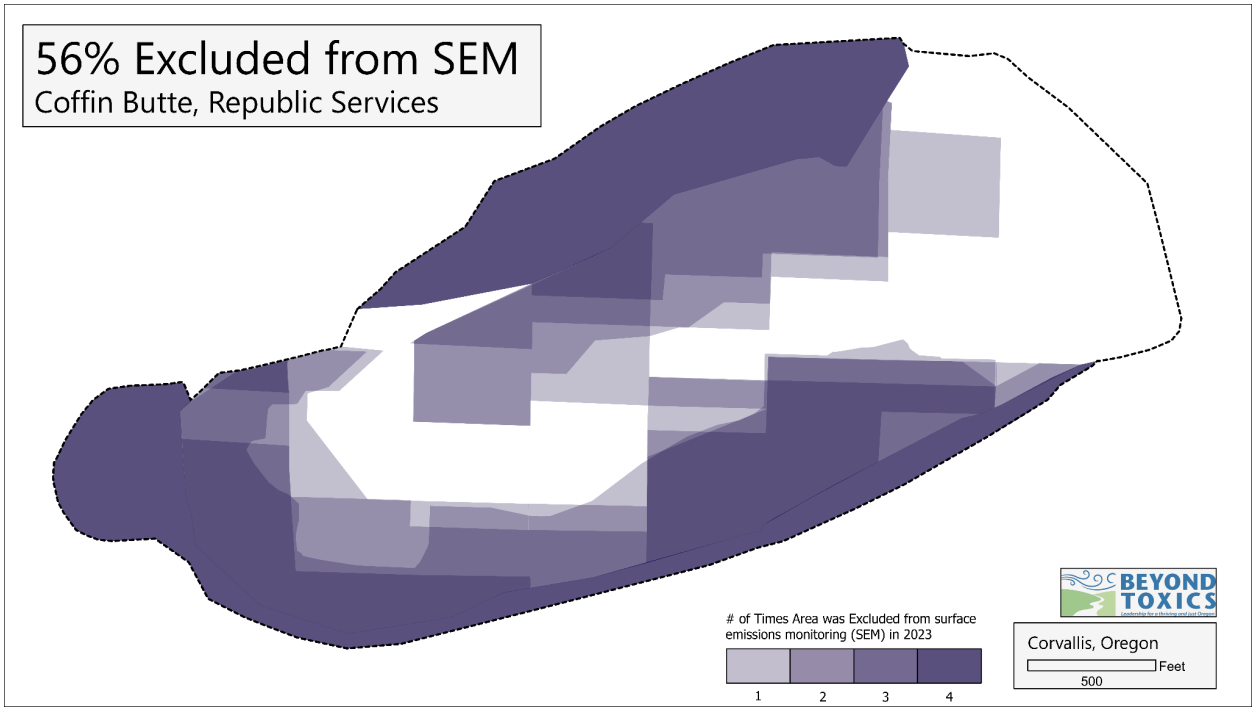


Exhibit B




June 22, 2022
1.23 acre exposed
Google Earth
Image © 2025 Maxar Technologies
700 ft
N


July 14, 2022
2.1 acre exposed
Google Earth
700 ft
N

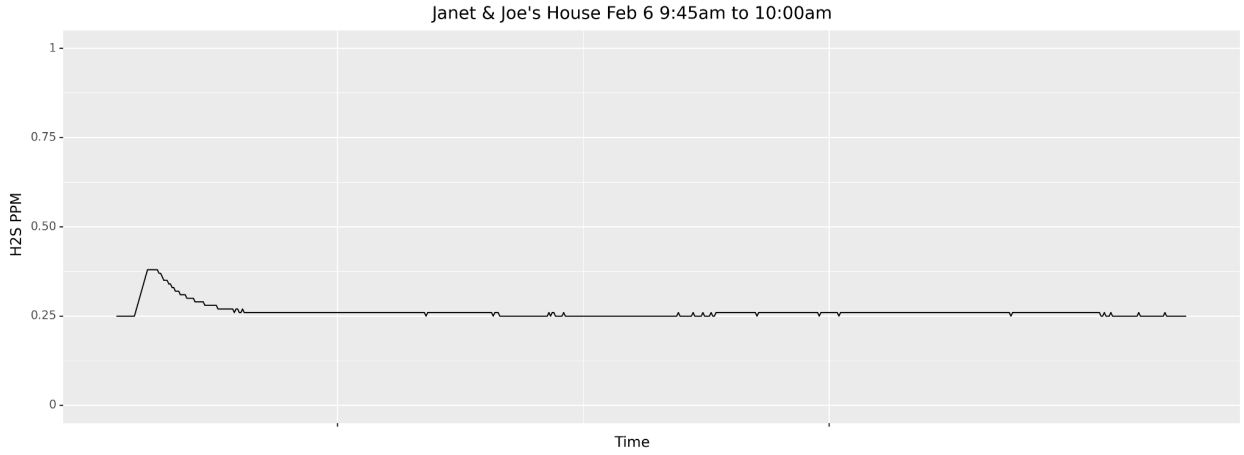

April 29, 2023
1.00 acre exposed
Google Earth
Image © 2025 Airbus
700 ft
N

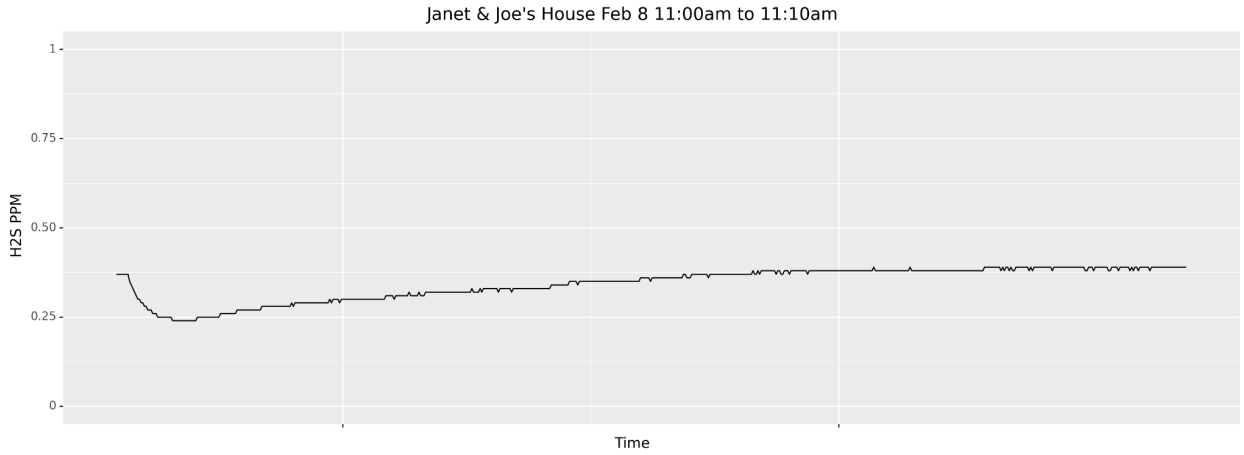

April 19, 2024
2.59 acres exposed
Google Earth
Image © 2025 Airbus
700 ft
N

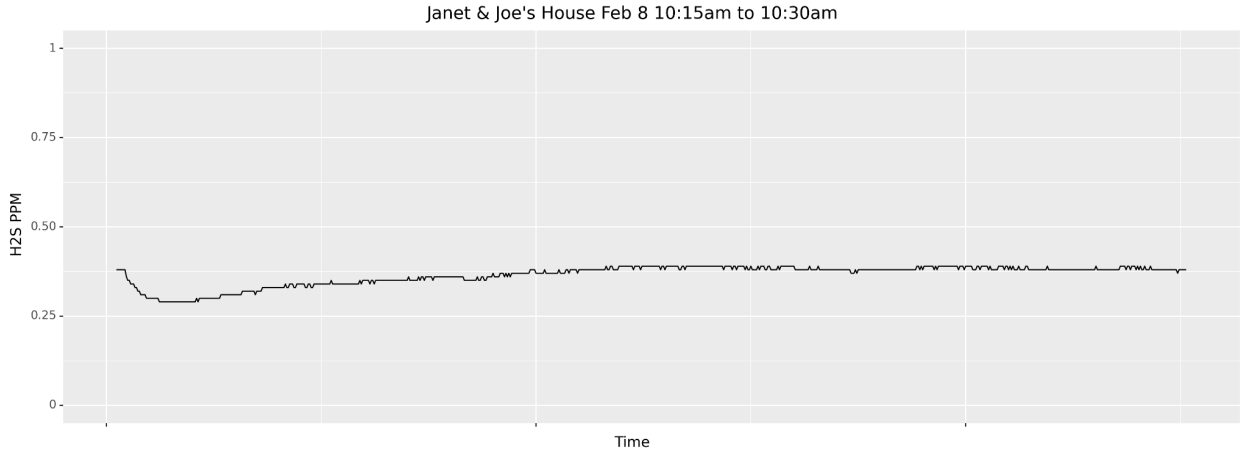

July 2, 2024
1.04 acres exposed
Google Earth
700 ft
N

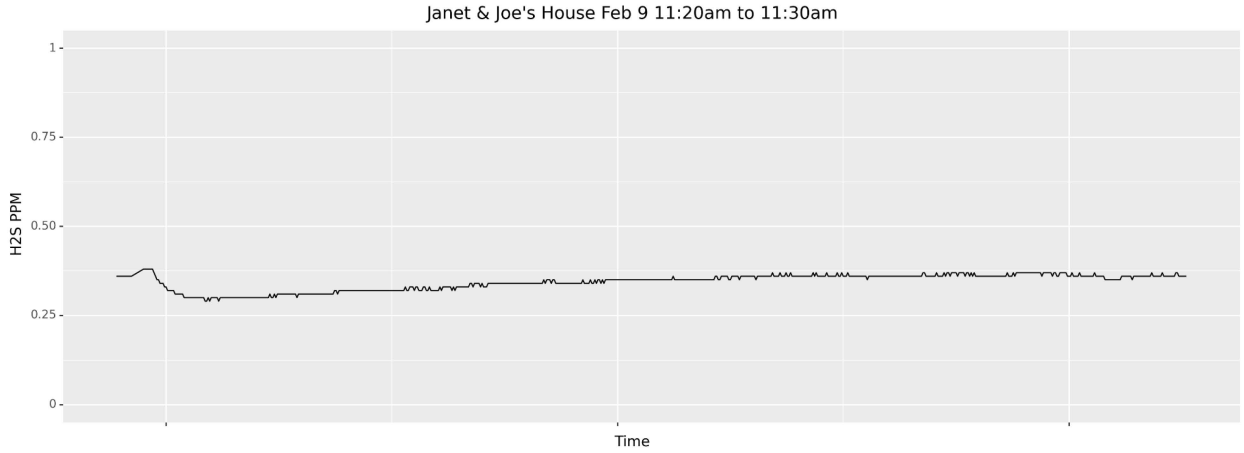

March 26, 2025
2.26 acres exposed
Google Earth
Image © 2025 Airbus
700 ft
N

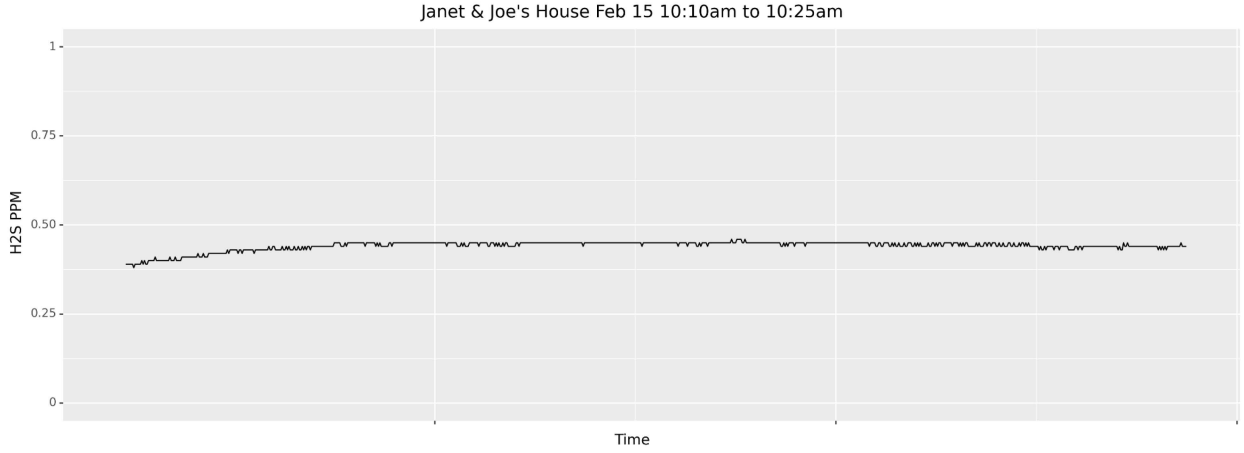
Exhibit C (Note graphics are in PPM. Convert to PPB= PPM x 1,000)

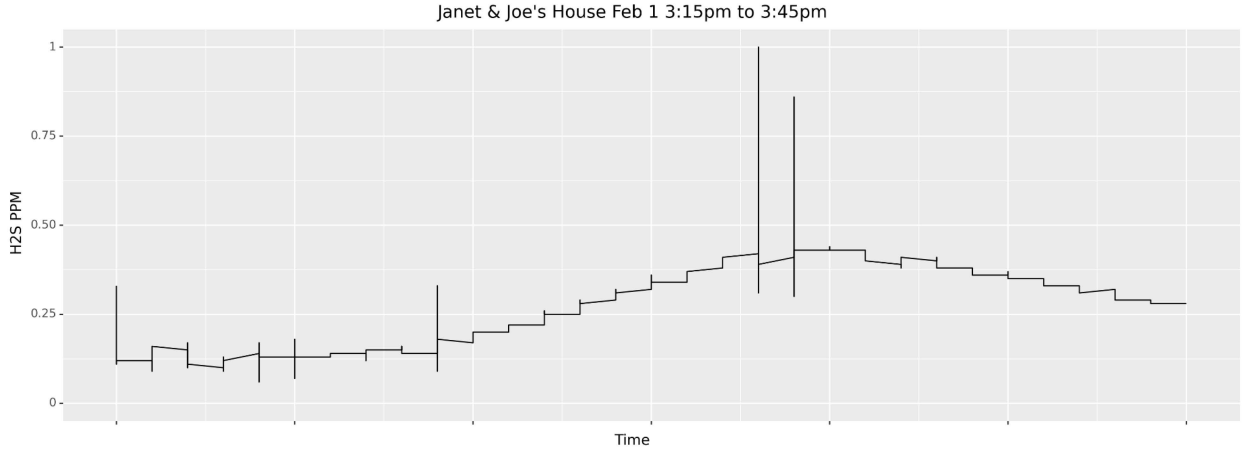







Janet & Joe's House Feb 9 11:20am to 11:30am
H2S PPM
1
0.75
0.50
0.25
0
Time


Janet & Joe's House Feb 15 10:10am to 10:25am
H2S PPM
1
0.75
0.50
0.25
0
Time


Janet & Joe's House Feb 1 3:15pm to 3:45pm
H2S PPM
1
0.75
0.50
0.25
0
Time

7

Hinton

I'm Keith Lembke - I've resided at 3944 Trillium Lane a mile West of Coffin Butte since 2003, ~~I am the Chairman of the Benton County Republicans and speak for them~~, I have a Doctorate in Public Administration and over forty years of experience in public service. ~~We are~~ I am against the ~~proposal~~ EXPANSION and I urge you to consider three additional criteria in your analysis - public mandate, safety assurance, and the cumulative effects on the pattern of life.

My research reveals a long-standing belief among the county population since at least 1974 that the Coffin Butte landfill would be temporary, with a long-term vision of an advanced waste management system. The beginnig of the evolution from county dump to Regional Landfill started with The Chemeketa Region Solid Waste Plan of 1974. It was a collaborative effort between Benton, Linn,

Klenman

Statesman Journal
Capital Journal

nepis.epa.gov
National Service Center for Environmental
Pub EPA

Marion, Yamhill, and Polk Counties and the DEQ to solve a burgeoning waste problem. It had five goals ~~leading to~~ culminating in the end of landfill operations and the creation of advanced waste disposal management systems. The plan consisted of the five counties' waste going to Coffin Butte while the separate components of the advanced waste management systems were to be developed in all the counties. While waste delivery to Benton County proceeded the rest of the plan did not materialize. Since its franchising in 1985, Coffin Butte has incrementally evolved to receive waste from 27 counties.

The fact is I could not find a record of any public referendum on the plan or any of the expansions thereafter. It seems like the County considered the lack of "significant" opposition to the expansions as unanimous

consent to the landfill's expansion. ~~That was not true~~ - there ~~has~~ always ~~been an~~ expectation ~~of~~ an evolution to advanced waste disposal systems. ~~It's~~ Every lawyer in this room knows that assumption is nonsense.

Guardianship. The Oregon Revised Statute 459 bestows upon the Department of Environmental Quality and the local County Government the responsibility to oversee and uphold the contractual and statutory obligations of the franchise and landfill. ORS 459.992 grants them the power to conduct inspections, stipulate permit conditions, and impose penalties. They are entrusted as our vigilant custodians. Regrettably, it has come to our attention that they can't do those things.

They apparently either lack the technical capability or resources to protect us. This is not fair to us.

DATE RECEIVED: 05-06-25
FROM: Keith Lembke
PHONE OR EMAIL: 541-740-8315

Finally, there has been no evaluation conducted on the combined impact of the various categorized "minor" disturbances involving air quality, traffic congestion, noise pollution, visual blight, ~~and~~ potential hydrological ~~disruptions~~ problems and decrease in property value - which won't coincide at all. While individually these factors may appear insignificant in the grand scheme of our daily lives, it is imperative to emphasize that their cumulative effect is indeed substantial. Each day brings forth its own challenges - whether it be the noxious odors (which, incidentally, caused me physical distress two weeks prior), the perpetual traffic congestion and litter along Independence Highway, or the disheartening sight of a

~~mortgage or business loan~~, The obvious loss of property value

growing mountain of waste that starkly contradicts the professed cultural values of our community. I assure you that all those added together have a significant ~~effe~~interference on our pattern of life, and thus, the character of the area. Thank you for affording me the opportunity to address these matters.

From: Carol McClelland Fields
To: Benton Public Comment
Subject: Oppose/Deny LU-24-027
Date: Tuesday, May 6, 2025 4:01:57 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Written testimony.

Carol McClelland Fields
37326 Soap Creek Rd
Corvallis, OR 97330

Thank you.
--
~~~~~~~~~~~~~~~~~~~~~~~~~~~

Carol McClelland Fields, PhD, BCC
541 243 3675
~~~~~~~~~~~~~~~~~~~~~~~~~~~

To: publiccomment@bentoncountyor.gov

Subject: Oppose/Deny LU-24-027 -

Dear Benton County Planning Commissioners,

My name is Carol McClelland Fields, and I live at 37326 Soap Creek Rd, Corvallis.

I am writing because I **strongly oppose** Republic Services' Conditional Use Permit application LU-24-027 to expand the Coffin Butte landfill. I urge the Planning Commission to deny this application.

- The proposed use ***does* seriously interfere with** uses on adjacent property, with the character of the area, or with the purpose of the zone [Benton County Code 53.215 (1)]
- The proposed use ***does* impose an undue burden on** any public improvements, facilities, utilities or services available to the area [Benton County Code 53.215 (2)]

I want to draw your attention to a recent segment that was broadcast on 60 Minutes (CBS) on March 31, 2025: **California wildfires left behind *9 billion pounds* of toxic ash and debris.** https://www.youtube.com/watch?v=iYFksPCL-I8

You are likely aware of the devastating wildfires that ravaged neighborhoods and cities in Los Angeles, California in January 2025. Watching this short 15-minute segment raised my awareness of what happens after wildfires:

> **Debris Removal Phase 1 – Removing hazardous waste, electric car batteries, power wall chargers, or any other battery.** Even after a fire, lithium batteries can explode or reignite because they are unstable. It takes six people up to two hours to remove six drums of cells from each battery, then the cells go into a saltwater bath for three days, and finally they are steamrolled to make sure they can no longer function. This material can't be recycled, it **must go to *hazardous material* landfills.**
>
> **Debris Removal Phase 2** – Removing the rest of the debris – in this case, **9 Billion (yes, that's a B) pounds of toxic ash and debris from the 2025 LA Fires** – and depositing the debris in 17 landfills and recycling center in various ***dry-climate landfills*** throughout the southwest. In addition, they **scraped 6 inches of contaminated soil throughout the region.** (The current "rule" is that anything deeper than 6 inches is said to be due to prior contamination.)

Devastating Limbo for Homes that Didn't Burn – 10,000 homes didn't burn to the ground during the LA Wildfires, which might sound like cause for celebration until you learn that these **homes are filled with soot, ash, and toxins, asbestos, exploded batteries, insulation, lead levels, arsenic, and debris. The indoor air quality within these homes is incredibly toxic.** There is a film of toxic dust throughout every home and smell the toxicity. Can these homes be cleaned to the point of being livable? Or are they total losses. Unfortunately, this is new territory and because they haven't suffered a "physical loss," the clean-up and their losses may not be covered by insurance.

This information concerns me for two reasons.

1. **If a large fire originates on Coffin Butte Landfill + Expansion or is sparked by flying embers from a nearby fire, the toxic nature of a burning landfill** (smoke, ash, soot, particulate matter, gases, and chemicals), **would negatively impact the entire region – where the fire burned and downwind of the fire.**

   In the aftermath of a large wildfire, *even if your home survives the fire,* the ash, chemicals, and soot penetrate the buildings through cracks around windows and doors, **making your home unlivable**. *Furthermore, **it is toxic and dangerous to continue to live in the region***. Ensuing health challenges range from: headaches, dizziness, and cognitive trouble to reproductive, kidney, respiratory problems, cardiovascular problems, and cancer.

   A 2023 study by researchers at the **Environmental Protection Agency (EPA)** found that emission factors for some toxic compounds were more than 1,000 times **higher in urban wildfires than in fires that burned in woodland areas.**
   (https://academic.oup.com/pnasnexus/article/2/6/pgad186/7202258)

   > ***Excerpt from Abstract***
   > *Fires that occur in the wildland urban interface (WUI) often burn structures, vehicles, and their contents in addition to biomass in the natural landscape. Because these fires burn near population centers, **their emissions may have a sizeable impact on public health**, necessitating a better understanding of criteria and hazardous air pollutants emitted from these fires and how they differ from wildland fires.*
   >
   > ***Excerpt from Significance Statement***
   > ***Wildfires in the wildland urban interface (WUI) burn homes and vehicles leading to potentially greater emissions of hazardous air pollutants than from wildfires***

burning only natural vegetation. *The greater proximity of these wildfires to population centers and the potentially more toxic emissions* ***make fires in the WUI a unique threat to public health****...Our results demonstrate that WUI fires are a potential major source of hazardous air pollutants and a better understanding of what and how much is emitted from them is needed.*

Now imagine how toxins generated from a Coffin Butte Landfill-based fire would contribute to the impact of a local WUI fire.

> *Burning trash can cause long-term health problems. The* ***toxic chemicals*** *released during burning include nitrogen oxides, sulfur dioxide, volatile organic chemicals (VOCs) and polycyclic organic matter (POMs). Burning plastic and treated wood also releases* ***heavy metals*** *and toxic chemicals, such as dioxin.*
>
> *Other chemicals released while* ***burning plastic*** *include benzo(a)pyrene (BAP) and polyaromatic hydrocarbons (PAHs), which have both been shown to cause cancer. If agricultural bags or containers are contaminated with pesticides or other harmful substances, those will also be released into the air.* *(https://dnr.wisconsin.gov/topic/OpenBurning/Impacts.html)*

Increasing the size of the landfill with an expansion would contribute additional toxins to any local WUI fire.

- The proposed use **<u>does seriously interfere with</u>** uses on adjacent property, with the character of the area, or with the purpose of the zone [Benton County Code 53.215 (1)] – *A Toxic fire definitely interferes with use of adjacent property and beyond – nearby homes, Benton County, surrounding counties; the entire character of the area would be irrevocably changed; and Rural Residential properties and Urban would no longer be livable.*

- The proposed use **<u>does impose an undue burden on</u>** any public improvements, facilities, utilities or services available to the area [Benton County Code 53.215 (2)] – *Undue burden would especially impact fire & emergency services, health services, mental health services, Republic Service employees, utility employees, and residents who pay county taxes.*

The Bottom Line: Expanding the landfill in such close proximity with residential neighborhoods, agricultural lands, and forested areas, creates greater fire risk and more likelihood that WUI fires would be catastrophic in nature.

2. **Given wildfire debris from structures is so hazardous** – asbestos, insulation, plastics, exploded batteries, appliances, coolant fluid, polyester curtains, cleaning products, lead, arsenic, mercury, cadmium, chromium and a variety of other dangerous PFAS chemicals – ***Why on Earth is hazardous/disaster debris coming to Coffin Butte Landfill?***

Corporate Republic Services Site lists several services under **Disaster Response**:
(https://www.republicservices.com/environmental-solutions/emergency-response-services/disaster-response)

Disaster Debris Removal and Waste Disposal

- *Flood water management and mobile treatment*
- *Construction and demolition (C&D) waste*
- *Asbestos containing material and PCBs*
- *Compressed gas cylinders and other volatile hazards*
- *Biological material and biohazardous waste*
- *Hazardous waste disaster cleanup*
- *Hazardous and non-hazardous waste transportation and disposal*
- *Hazmat disaster cleanup*

Wildfire Hazardous Waste Response

Significant quantities of hazardous material and debris create unique challenges for cleanup and recovery from the widespread destruction caused by a wildfire. Our dedicated crews have supported hazardous waste disaster cleanup efforts for dozens of wildfires, including countless major disasters over recent years. During each event, our crews worked closely with regulators to provide management, assessment and removal of Household Hazardous Waste (HHW), asbestos containing material, and other hazardous debris from ***thousands of sites across the Pacific Northwest and other areas of the country.***

Republic Services' Environmental Services Map **does NOT list Coffin Butte Landfill as an Environmental Services Facility.** https://www.republicservices.com/facilities/environmental-solutions

In addition, **I don't see any mention of these disaster services on the Coffin Butte Landfill's site.**

DEQ Fact Sheet: Protect Surface Waters While Cleaning Up Your Property
(https://www.oregon.gov/deq/wildfires/Documents/wfSWHomeownersFS.pdf)

After a Wildfire: ***Ash and debris generated from wildfires can be harmful to our rivers and streams.*** *When rainwater carries sediment and debris from burned areas it also transports pollutants to our surface waters.* ***Many of these pollutants can be toxic to humans and aquatic life.*** **Water seeping through hazardous disaster debris would amplify these effects.**

Under their Corporate PFAS Solutions Services, Republic Services describes their Long-Term Secure Disposal Options are RS' landfills in Grand View, Idaho, and Beatty, Nevada, that have special design and construction ***"with the added natural protection of being in arid locations with very little rain and low humidity."***
https://www.republicservices.com/environmental-solutions/treatment-disposal/pfas-solutions

The pollutants from disaster debris are toxic to humans and water species.
The best place to put disaster debris is in an arid location. We all know this area is not an arid location with very little rain and low humidity. **Coffin Butte Landfill + Expansion has the exact opposite description – high levels of rain and humidity.**

Why on Earth is the Coffin Butte location / expansion taking in hazardous waste?

Given our wet climate, adding more dangerous disaster debris into the Coffin Butte Landfill + Expansion will generate even MORE toxic leachate than the current landfill already does. This toxic commodity needs to be disposed of even though no local water treatment plant has the ability to remove PFAS from the leachate to create non-harmful water.

Instead, the diluted leachate gets released into the Willamette River upstream from cities that receive their drinking water from the Willamette River.

Given that the detrimental impacts of PFAS chemicals are cumulative, this means human bodies, wildlife, and the environment will have **increasing levels of PFAS in their systems.**

Republic Services may be "getting rid" of a noxious problem, but **at what cost to the people, wildlife, and ecosystems downstream?**

- The proposed use **does seriously interfere with** uses on adjacent property, with the character of the area, or with the purpose of the zone [Benton County Code 53.215 (1)] – *Additional leachate that is even more toxic than the "regular landfill leachate" impact adjacent properties and beyond – local wells, water intakes along the Willamette River; if our waterways become polluted due to the extra toxic leachate and the regular toxic leachate, the character of our area and the state of Oregon would be compromised. Imagine the public relations nightmare*

if people along the Willamette River have health impacts from leachate chemicals in their drinking water. ***What kind of reputation will Corvallis and Benton County have then?***

- The proposed use **does impose an undue burden on** any public improvements, facilities, utilities or services available to the area [Benton County Code 53.215 (2)] – *Extra toxic leachate from disaster debris + additional leachate from the expansion would impose an undue burden on health services, agriculture, and residents throughout the Willamette Valley.*

The Bottom Line: Disaster Debris does not belong in a landfill in a wet climate. Republic Services built state of the art landfills in dry climates for this very reason!

Please reject LU-24-027. Thank you for your consideration and for protecting the health and future of Benton County.

Sincerely,
Carol McClelland Fields
Corvallis, OR 97330

From:	Community Development, Benton County, Oregon
To:	Benton Public Comment
Subject:	LU-24-027 Coffin Butte Proposed Expansion Written Feedback
Date:	Tuesday, May 6, 2025 5:04:41 PM

Subject of Testimony: 5 Reasons to Deny Expansion of Coffin Butte Landfill

Full Name: Lois Stacy Mellem

Email: stacymellem@gmail.com

Street Address: 433 NW Survista Ave., Corvallis, OR 97330

Written Testimony:

I would like to urge Benton County decision makers to deny the proposed expansion of the Coffin Butte Landfill for the following reasons: 1). It is an environmental hazard. High volumes of methane and other harmful gasses leak out of the dump and toxic leachate is dumped into the Willamette River. 2). Republic Services has not managed the environmental hazards. The EPA has twice cited Republic Services yet to no avail. How can we expect them to run a safe facility with that kind of a track record? 3). It is a fire hazard. Several fires have occurred at the landfill and we have just been lucky that quick response from Adair Fire has kept them from creating an LA-style fire in our county. 4). It's not even our trash. We are the recipient of other people's garbage. 5). It stinks. There are better options. Please keep our beautiful county beautiful and deny this expansion.

--
This is a notification that a contact form was submitted on your website (Community Development, Benton County, Oregon https://cd.bentoncountyor.gov).
Submitter's IP Address: 73.37.91.148

From:	Community Development, Benton County, Oregon
To:	Benton Public Comment
Subject:	LU-24-027 Coffin Butte Proposed Expansion Written Feedback
Date:	Tuesday, May 6, 2025 10:00:47 AM

Subject of Testimony: LU-24-027 Coffin Butte landfill expansion – OPPOSED

Full Name: Mark Miller

Email: mzmiller@mac.com

Street Address: 6655 NW Grandview Dr, Corvallis 97330

Written Testimony:

I strongly oppose the proposed expansion of Coffin Butte Landfill. It fails to align with Benton County's 2040 Thriving Communities Initiative, and undermines our community's stated goals for responsible environmental stewardship, enhanced public health, and sustainable waste management. The proposed expansion would incentivize increased amounts of trash to be received, and more traffic and environmental impacts.

Benton County should invest in waste reduction, recycling, and circular economy solutions, not expanding landfills that perpetuate pollution and place long-term burdens on local communities!

--
This is a notification that a contact form was submitted on your website (Community Development, Benton County, Oregon https://cd.bentoncountyor.gov).
Submitter's IP Address: 76.115.213.199

DATE RECEIVED: 5.6.25
FROM: Debbie Palmer
PHONE OR EMAIL:

5-6-25

Dear Chair Fowler and members of the Planning Commission -

My name is Debbie Palmer, and I live at 37340 Moss Rock Dr, in Corvallis.
I am a member of the group VNEQS (pronounced "vee-necks") - it's what we go by, as our full name is a mouthful: Valley Neighbors for Environmental Quality and Safety.

Below please find the full content of the petition VNEQS has had on our CoffinButteFacts.org website since 2023; it is the one I touched on in my oral testimony. I wanted you to have the full text. Please note that at the time this was written, we used the phrase "In its latest annual report..." to refer to years of landfill life left. That was Republic Services' 2021 annual report, as their 2022 report had not yet come out.

If you wish to view all the signatures and comments left by signers, you may do so at https://www.coffinbuttefacts.org/petition/

Petition Title: **WE NEED A PLAN, NOT A BIGGER LANDFILL**

By signing this petition, we are telling Commissioners **Nancy Wyse, Xan Augerot** [replaced by **Gabe Shepherd** 1/1/25] and **Pat Malone** to OPPOSE ANY expansion of the Coffin Butte Landfill before Benton County completes a thorough, detailed waste management plan that *focuses on future resilience* and *includes alternatives for decreasing and redistributing materials from the waste stream.*

Background:
If it seems like the dump has been getting bigger faster, if it seems like there is always more garbage truck traffic and more litter, that's because there is! For the past twenty years, other counties in Western Oregon have been closing down their landfills. Now their household and industrial waste is trucked in to Benton County. What do they know that we don't know?

History:
March 29, 1977 is the last time a waste management plan was completed for Benton County. In it, the landfill was projected to close in the year 2000.

December 7, 2021 – Benton County Planning Commission **unanimously denied** LU-21-047, the application by Republic Services to expand Coffin Butte Landfill, finding that it would cause significant harm to Benton County.

(over)

Current Activity:
Republic Services says they intend to submit a new application to expand Coffin Butte Landfill north of Corvallis "soon."

According to Oregon Department of Environmental Quality estimates, household waste from Benton County *is less than 7% of what comes into the dump each year.* If expansion is approved, Republic Services will be free to haul *even more waste* — household, commercial and industrial — into Benton County.

People say, "Trash has to go somewhere. If we don't let them expand the dump, what alternatives are there?"

The answer is, *we don't know,* ***because Benton County has no waste management plan.*** Other counties have plans that guide them through their options. *It's absurd to expand this landfill before completing a thorough plan, including alternatives for decreasing and redistributing the waste stream.*

Republic Services is in a big hurry to get its expansion plan approved because of "contractual obligations to dozens of parties" **outside** Benton County. This is Republic's own problem — not Benton County's. *We should not be threatened and rushed to make an irreversible decision to solve the poor planning and over-commitment issues of a huge national corporation.*

Expansion would be a climate change disaster. Coffin Butte Landfill *already* produces lots of methane, a potent greenhouse gas, and less than 60% of it is captured, according to Oregon DEQ.

Let's take the time this important issue demands. In its latest annual report, Republic Services estimated that the existing landfill has capacity for at least 18 more years. That gives us plenty of time for a thorough study of what's best for our county over the long run. ***It's our future, not Republic's, that's important here.***

%%your signature%%

(over)

From: Rob Thompson
To: Benton Public Comment
Subject: Coffin Butte Landfill CUP testimony is favor
Date: Tuesday, May 6, 2025 11:41:18 AM
Attachments: image001.png

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Dear Benton County Planning Commissioners,

My name is Rob Thompson and I am the owner of Thompson's Sanitary Service in Newport, Oregon. As a member of the waste industry, I am in a unique position to have a good understanding of how the closure of Coffin Butte landfill will impact my customers. I encourage you to grant Republic's application for expansion. Below are some of the reasons I support the expansion:

- The landfill is an essential resource in our ability to be responsible for our own waste
- Hauling the waste to a landfill further away doesn't fix the problem, it just makes people in another part of Oregon deal with our trash
- The trash we are talking about is our trash. It's yours, it's mine, it's all of ours together, and we should be the ones to deal with it responsibly
- Republic has done an excellent job managing the landfill
- DEQ has environmental oversight regarding the operations at Coffin Butte, so the landfill is already very highly regulated, which greatly limits any environmental impacts
- Closing the landfill is not a way to responsibly manage our waste stream. We should deal with our own trash the right way, and Republic is doing that
- Collection customers will bear the burden of increased prices to cover increased hauling costs, which we believe contributes to illegal dumping in the forests
- Increased collection rates will have a significant impact to small businesses in my community
- Hauling trash to another part of Oregon increases greenhouse gas output from the trucks that haul it, which pollutes the environment we are trying to protect
- "Not in my backyard" is not an acceptable solution to managing the waste stream

Thank you for your attention. I strongly encourage you to vote to expand.

Rob
For the record name and address below.
Rob Thompson

President
7450 NE Avery, PO Box 643, Newport, OR 97365
Phone: 541.265.7249|Cell: 541.270.1066

THOMPSON'S
SANITARY SERVICE
Guiding Sustainable Choices

Download our mobile app *to access your service days, service alerts, Waste Wizard, schedule a bulky item pickup, or pay your bill online:*

Download on the App Store GET IT ON Google Play

From: Sam i
To: Benton Public Comment
Subject: Coffin Butte Expansion testimony written May 6, 2025
Date: Tuesday, May 6, 2025 6:34:52 PM

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Dear Commissioners,

Clean air and water are precious vital resources for all of us. A feeling of safety and comfort on our roads is also a precious resource. The landfill expansion if approved weighs on our common resources to a greater extent and for longer.

This post war landfill is in a very wet part of a wet Valley.
Adair Village gets 51 inches of rain, on average, per year.
In Arlington, Oregon, the average annual rainfall is about 8.85 inches.

There is a strong link between wet conditions and methane production in landfills.
Every droplet of water that splashes down on an open landfill cell will slowly trickle through the trash, transforming into a concentrated liquid waste known as leachate, according to *The Problem of Leachate and Storm Water at the Modern Landfill*- BTL Liners

Moisture encourages bacterial decomposition, which is the primary process for methane generation in landfills.

And billowing tarps, tears and odors indicate the release of landfill gasses. Which contain also PFAS.

Landfill Gas

https://www.eenews.net/articles/forever-chemicals-in-landfill-gas-higher-than-expected-study/
“Researchers have detected “unexpectedly” high levels of PFAS in landfill gas, adding to a growing body of evidence on how “forever chemicals” leave waste sites.

“According to an EPA-funded study recently published in the peer-reviewed Environmental Science and Technology Letters, per- and polyfluoroalkyl substances could be escaping landfills via gas at concentrations similar to — if not higher than — liquid leachate.

“Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release”

“Their study reports unexpectedly high levels of airborne PFAS at three landfills and demonstrates that vented gases and liquid by-products called leachates could transport similar amounts of these contaminants to the environment.”

I live 8 miles from the landfill and about 1/4 mile north of OSU. I have walked out my front door smelling landfill odor - infrequently- but still it is jarring, concerning and awful. I have mentioned it to fellow walkers in the morning.

The owners and managers of Coffin Butte have not been good stewards, and they have not made good partners.

Witness these headlines:

Oregon warns Coffin Butte Landfill over methane emissions
Statesman Journal
https://www.statesmanjournal.com › oregon › 2024/08/14

Aug 14, 2024 — **Oregon environmental regulators have issued a formal warning to Coffin Butte Landfill** for not complying with new requirements to reduce methane emissions.

Oregon landfills use loophole to avoid methane monitoring

Statesman Journal
https://www.statesmanjournal.com › science › 2025/03/06

Mar 6, 2025 — **Coffin Butte Landfill was among those the EPA inspected**. In 2022, the EPA found Coffin Butte was leaking methane at levels that exceed state ...

Coffin Butte Landfill given citations after worker complaints
Statesman Journal
https://www.statesmanjournal.com › oregon › 2024/04/16

Apr 16, 2024 — **Oregon OSHA has cited and fined Coffin Butte Landfill** following investigations into worker complaints. The company denies the allegations

Oregon pauses Coffin Butte Landfill air quality permit process
Statesman Journal
https://www.statesmanjournal.com › local › 2025/01/10

Jan 10, 2025 — In October 2023, the **Statesman Journal** reported an EPA inspection found the landfill was leaking **methane** at levels that exceed state and

NPR for Oregonians
https://www.klcc.org › environment › epa-inspection-u...

Jan 17, 2025 — An EPA inspection last summer found **dozens of methane leaks at the Coffin Butte landfill** in Benton County. The site accepts more than 1 million tons of garbage

YachatsNews.com
https://lincolnchronicle.org › benton-county-says-propo...

In October 2023, the Statesman Journal reported on an EPA investigation that found massive **methane** leaks at the **landfill**.

Coffin Butte Landfill north of Corvallis under scrutiny
Statesman Journal
https://www.statesmanjournal.com · Aug 8, 2024

Coffin Butte Landfill under scrutiny. Members of Oregon's Congressional delegation are asking the U.S. EPA to investigate Coffin Butte Landfill.

Benton County is now the receiver of PFAS in a very wet climate environment that promotes a great amount of leachate production - a part of which will be released in water and another part in air. Why here? In the future as more is known, to what extent will it lead to greater long term harm, liability and further diminishment of our precious vital natural resources upon which we all depend.

Thank you,

Susan Walenza
1415 NW Greenwood Place
Corvallis Oregon 97330

From:	Joel Geier
To:	Benton Public Comment
Cc:	SCHUETZ Petra
Subject:	LU-24-027 annotated version of verbal testimony given May 6th 2025
Date:	Wednesday, May 7, 2025 6:19:29 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dear CDD staff,

Attached please find a PDF version of the script which was the basis for my verbal testimony as given last evening.

I've annotated this to include information on ODF rules regarding heron rookeries as requested by Commissioner Biscoe, and also notes on where to find supporting details in my previous written testimony and documents submitted for the record.

Also attached is a digital version of my "slides" which I printed out beforehand, in the hope that the Commissioners would be able to have these to follow along. You have my printed copies already, but perhaps it's useful to have the digital version for the files.

Yours sincerely,
Joel Geier
--
38566 Hwy 99W
Corvallis OR 97330
clearwater@peak.org

My name is Joel Geier, resident at 38566 Hwy 99W Corvallis, on the east side of Tampico Ridge. Two neighbors are kindly ceding their time: Dick Woodcock (# 65) and Vicki Druliner (# 68).

My neighbors and I appreciate that you've been asking keen questions on issues that **do** affect the character of the area and **will** pose a public burden. I'll focusing on the following topics which are relevant to these criteria:

- Impacts of the construction period
- Risks to water wells and natural springs
- Risk for the new landfill to become an additional source of an arsenic plume
- Risk to the Willamette basin aquifer below E.E. Wilson Wildlife Area
- Ongoing disturbance to the Great Blue Heron colony

My background includes a bachelor of science and master's studies in mining engineering, plus a Ph.D. in geology, specializing in groundwater flow through fractured bedrock. I've worked internationally on that topic for 38 years. I also like birds, and do bird conservation research as a side gig. That includes recent peer-reviewed work published in the journal, *Avian Conservation and Ecology*. I served 8 years as Audubon Christmas Bird Count regional editor for Oregon, and continue in that role for Nevada.

My first topic is impacts of construction

The applicant is proposing to build what amounts to a brand-new landfill. And they're not just working with the lay of the land *(See slides p. 2).*

In technical terms, they plan to dig a great big hole on the north end of Tampico Ridge, and a not-quite-so-big hole for brand-new leachate ponds. For the bigger hole, they'll need to move 3-1/2 million yards of rock. That's bigger than the pile of rubble from the Seattle Kingdome.

They're going to do a lot of blasting, maybe even daily and for how long? One year? Two years? We don't know. And they haven't assessed the impacts.

You don't have to be a trained mining engineer to know that blasting is loud. Their noise study should have included that, but it didn't.

Noise isn't the only issue, there's also seismic disturbance. Does having your windows rattle at irregular intervals count as "seriously interfere"? I'd think so, especially in an earthquake zone where all of us know that the next "big one" is getting overdue.

That's a lot of disturbance up front, for what could end up as just a few years of landfill capacity, if the annual tonnage cap is lifted.

But there's also a **risk to our water wells and springs on adjacent properties.**

When you dig a big hole in the ground, water tends to flow in. That lowers the water table around your hole, and that effect tends to spread.

How far does the effect spread? It depends on the geology. In my written testimony I've given more technical details. But to put it simply: If this big hole cuts into a fractured zone in the basalt that serves as an aquifer for nearby residences, our wells could go dry.

Again, the applicant hasn't assessed the effects of construction. They haven't investigated groundwater below Tampico Ridge any more than 100 yards south of the new landfill's footprint. They haven't even compiled a list of neighboring wells and springs. They haven't presented any groundwater models to evaluate the risks.

We and our neighbors rely on our wells for drinking water, livestock, vegetable gardens and even small farms. Loss of a reliable well would **seriously interfere** with our use of our property, no doubt about it.

Then there's arsenic. Again, I've provided written testimony with more technical details. This could be big topic all on its own, maybe even a good topic for a Ph.D. dissertation, for some aspiring grad student.

What we know is that, contrary to the applicant's claims, the high levels of arsenic in wells on the east side of the landfill site are highly unusual for this part of the valley. No one has found such high levels, anywhere else in the Willamette Valley portions of Polk or Benton County. But somehow the applicant has not just one well, but a cluster of five wells with high arsenic.[1]

They acknowledge that they had a leak in the early 1990s, which was responsible for the high arsenic levels discovered in 1994. They claim to have baseline data, but their historic database included with the 2023 annual environmental monitoring report doesn't show any arsenic data prior to 1995 from the well that they're now claiming as "baseline."

And the levels keep bouncing around, despite statements about them being "stable." After I pointed out to Oregon DEQ that the existing permits don't have any site-specific limit to allow for this, lately VLI seems to have proposed Permit-Specific Concentration Limits (PSCLs) for arsenic.

Page 3 shows a plot of arsenic data from their 2024 annual monitoring report which shows their proposed new criteria. Notice the most recent measurements, at far right, have blown right through even these new proposed new limits. In 2023 and 2024 they literally went off the chart, compared to how these data were plotted up until 2022.

Despite that now they want you to believe that the recent observations are "natural," and not a sign of more leaks. Last Thursday their consultant read a memo that gave a complicated explanation about volcanic soils, anoxic conditions and so on.

---

1 Compare Plate 1 of *Arsenic in Ground Water of the Willamette Basin, Oregon* by Stephen R. Hinkle and Danial J. Polette, USGS Water-Resources Investigations Report 98–4205, which I have separately entered into the record, as well as data aggregated by the Oregon Health Authority for census tracts in Polk and Benton counties which I summarized in previous written testimony.

In simpler terms, they're claiming that the existing dump, by cutting off air to soils below the liner, has changed the chemistry so that arsenic is now leaching out of the soils. That's an interesting hypothesis, but without more evidence, it's just speculation.

For the sake of argument, let's suppose they're right. What would that mean for your decision?
It means that the new landfill, even if it doesn't leak, could have the same effect by leaching arsenic out of any chemically similar rock and soils beneath it. The new landfill could generate its own arsenic plume which would spread east into the valley, merging with plumes from the existing landfill. The effects would be additive.

As Commissioner Lee noted last Thursday, there are adjacent properties to the east, downhill, most immediately **E.E. Wilson Wildlife Area**. There's also a third dimension to think about: Vertical. **See page 4** which shows a schematic cross-section. As a plume moves out to the east, the sediments get deeper. Below the silts left by the late-Pleistocene Missoula floods, there are older gravels that are part of the **Willamette basin-fill aquifer.** That's a big one. Here's what the Oregon Water Resources Department has to say[2]:

> *Collectively the basin-fill sediment unit contains the largest volume of ground water in storage and has the highest production capacity of all of the hydrogeologic units in the basin.*

(end quote). In other words, this is the aquifer used for high-capacity irrigation wells and even municipal water supplies. You don't want to mess that up. That would be a real **burden on public resources.**

The applicant hasn't evaluated that risk, which arises from this new landfill. They don't even have a good handle on what's happening with the old one.

---

2 *Ground Water Supplies in the Willamette Basin*, report by Oregon Water Resources Department and the Oregon Department of Land Conservation and Development, September 2002.

Lastly, I'd like to speak up for the **Great Blue Herons. (**See page 5).

Rumors of their disappearance are greatly exaggerated. Despite repeated disturbance by excavation equipment operating in the proposed development area, in all four nesting seasons since VLI was advised of the need to keep a quarter-mile buffer, the herons haven't abandoned this location. They're nesting right across the highway, within 200 yards of where they nested in 2022. The second photo was from just last Sunday.

They're still under stress, becoming agitated when roadside trash crews, cleaning up the mess from the landfill, walk past their nests. Construction of the proposed new leachate ponds on the Forest Conservation parcel (Lot 1200) would once again impinge on the buffer zone mandated by Oregon Department Forestry. That gives you one more reason to deny this application.

Thank you for your diligence and your attention to these issues. I'll be happy to answer any questions.[3]

---

3 Testimony by Debbie and Norm Johnson dated 8/23/2020 submitted for the applicant's previous expansion application, LU-21-047, included the following information (emphasis added on final sentence which may also pertain to the poplar nesting area):

The project location hosts a great-blue heron rookery which was documented by the Oregon Department of Forestry in a Notification of Operations (NOAP) under NOAP ID: 2019-551-05885. Great-blue herons are colonial nesters, and as many as 20 heron nests have been observed in the rookery.

Under the Oregon Forest Practices Act heron rookeries are protected. Between February 15 th and July 31 st no forest operations (including truck traffic) are allowed within one-quarter mile of active nest trees *and trees cannot be harvested within 300 feet of heron nests.*

Heron rookeries are also protected under the Benton County Development Code as a "Goal 5"resource. According to 87.210 (Sensitive fish and Wildlife Habitat Overlay) a 600-foot area around the great-blue heron rookery must be protected and a site-specific management plan is needed to ensure that "proposed uses and activities will not destroy or result in the abandonment of these areas. [Ord 91-0080, Ord 93-0098]"

Although anecdotal information suggests that the rookery, or portions of the rookery have moved since the 2019 ODF NOAP was filed, a site-specific management plan is needed before the Coffin Butte conditional use permit can be considered. The management plan should evaluate the quality of heron nesting habitat at the location documented in the ODF NOAP as well as any other locations that are currently in use or have been used in the past. If a previous heron rookery location offers better nest tree structure, then that location should be preserved so that the rookery has an opportunity to move back.



Topics

Impacts of the construction period

Risks to wells and springs

Risk for the new landfill as an additional source of arsenic

Risk to the Willamette basin aquifer

Ongoing disturbance to Great Blue Heron nesting colony

(to accompany testimony by Joel Geier, May 6, 2025)

Planned excavations: Impacts not evaluated

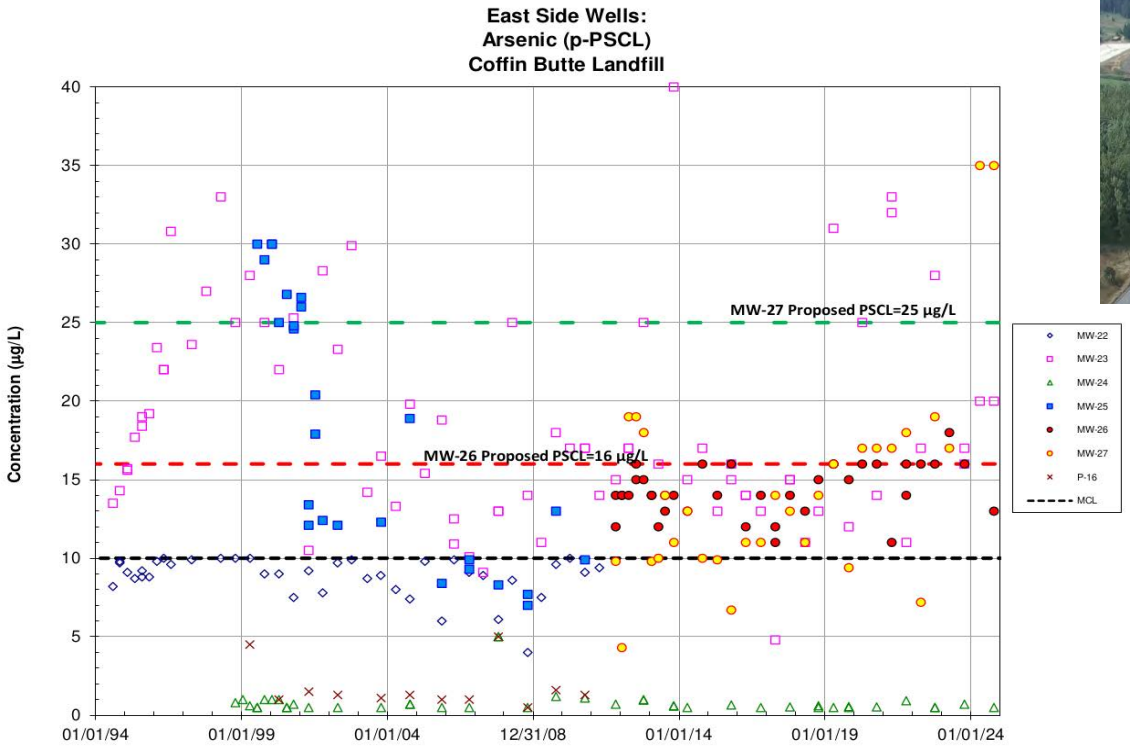


3.5 million cubic yards:
1.4 times more rubble than from the Seattle Kingdome implosion.



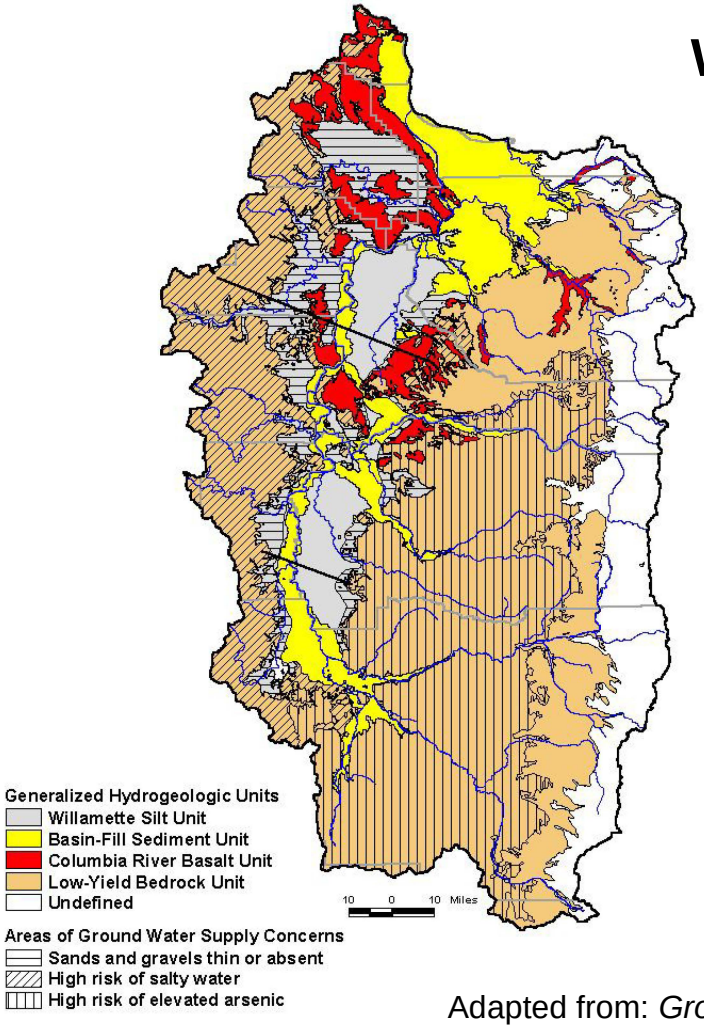
Arsenic Concentrations
East-side wells 1994-**2024**

Data from 2024 Annual Environmental Monitoring Report

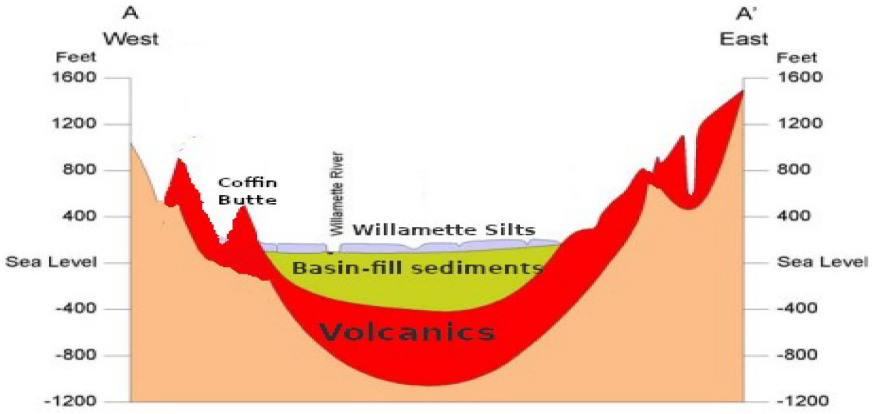




Willamette Valley basin-fill aquifer







Adapted from: *Ground Water Supplies in the Willamette Basin,* Oregon Dept. of Water Resources

Heron colony: Not abandoned yet!



April 2025: Herons nesting approx. 200 yards east of the “east rookery” after disturbances on adjacent lot in 2022, 2023, 2024, and ongoing in 2025.



Excavation activity on March 14, 2025 within 200 yards of the nesting area in the poplars (“east rookery”).

Herons still on nests May 4, 2025



From: Paul Nietfeld
To: Benton Public Comment
Subject: LU-24-027: Conditional Use Permit Application Regarding Landfill Expansion
Date: Wednesday, May 7, 2025 11:01:04 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

From: Paul Nietfeld, 37049 Moss Rock Dr., Corvallis, OR, 97330

Dear Chair Fowler and Members of the Benton County Planning Commission:

Thank you for the opportunity to comment on this Conditional Use Permit (CUP) application, and in particular the extension of the public meeting schedule to accommodate all who wish to speak. The opportunity to present public testimony on the landfill issue is very much appreciated by many of the county residents, myself included.

Attached is the brief presentation I had prepared to deliver verbally, with the expectation that members of the public would either be allowed to present graphics electronically or at a minimum by handing out printed copies for Commissioners to view during my presentation. Understanding now that neither of these options is supported in the current meeting structure, I am providing this document in advance of my live testimony so that you will have access to the document for reference during my presentation and/or preview in advance.

Even this short presentation is now repetitive on some points already covered in public testimony of May 6. As requested, I will not repeat these in my live presentation, but I do wish to reiterate my support for the following:

Conditions of approval have proven to be wholly ineffective with regard to the Coffin Butte Landfill. I or other members of the public will provide separate additional written testimony documenting the specific conditions that have been ignored and/or unenforced. Based on the historical record the Planning Commission should consider the effectiveness of such conditions as highly dubious in the case of this CUP. I believe this applies in particular to the speculation noted by Outside Counsel Ryan in the April 29 meeting that the intake cap currently in force as a contractual obligation under the 2020 Landfill Franchise Agreement ("2020 LFA") could be effectively continued via a Condition of Approval if the Committee were to vote to approve this CUP application. I will elaborate on the importance of this point during my verbal testimony in reference to the Coffin Butte Landfill Intake plot (Page 2 of attached document).

The observed impacts and burdens of the landfill have grown significantly worse in recent years. Mr. Henkels and others noted this point, and as a resident living in the vicinity of the landfill I absolutely agree. In my verbal testimony I will address the intake volume increase in 2017 that I believe explains much of the observed increased impact.

Approval of a new landfill cell via LU-24-027 would increase the negative impacts of this landfill and extend the duration of these impacts. Both of these factors are important.

The character of the area is pastoral, not landfill. The landfill was long considered to be a temporary blight on this otherwise beautiful, productive area. As recently as 2008 (the year

Republic Services took over operation) the landfill had been developed and managed in a manner that largely controlled its impact on surrounding property (see the aerial photo on the front page of the 2008 Coffin Butte Annual Report, attached). The landfill is now the largest, busiest industrial operation in Benton County, with corresponding burdens, harms and visual blight. The sooner expansion is foreclosed the sooner we collectively can proceed with returning the landfill area to a semblance of its former pastoral nature.

Given the landfill burdens and harms I have observed and the high probability of increased burdens and harms if the LU-24-027 application were to be approved, I ask you to please vote to deny this application.

Thank you again for all the personal time, effort and attention you are applying as Planning Commissioners to this complex and challenging decision.

Regards,
Paul Nietfeld

LU-24-027

Two Facts: Background/Context for the CUP Decision

Paul Nietfeld 37049 Moss Rock Dr. Corvallis, Oregon 97330

Member of the A.1 Subcommittee of BCTT: Landfill Size / Capacity / Longevity

Fact 1: Expansion of the Coffin Butte Landfill is already underway

Source: 2023 Coffin Butte Annual Report, Google Earth imagery of 3/30/2025, Applicant Testimony of 5/1/2025

- Filling of Cell 6 (Quarry cavity) began this year
- Approx. 14M cubic yards
- 50+% increase over current landfill size (1942 – 2025)
- No permit
- No Planning Commission review
- No conditions of approval



Credit: E J Harris Photography

Franchisee presentation of 5/1/2025 to Planning Commission

- Cell 6 not identified ("Quarry")
- Cell 6 similar in footprint area to proposed expansion
- Cell 6 similar in structure to proposed expansion: steep, sharp excavated cavity



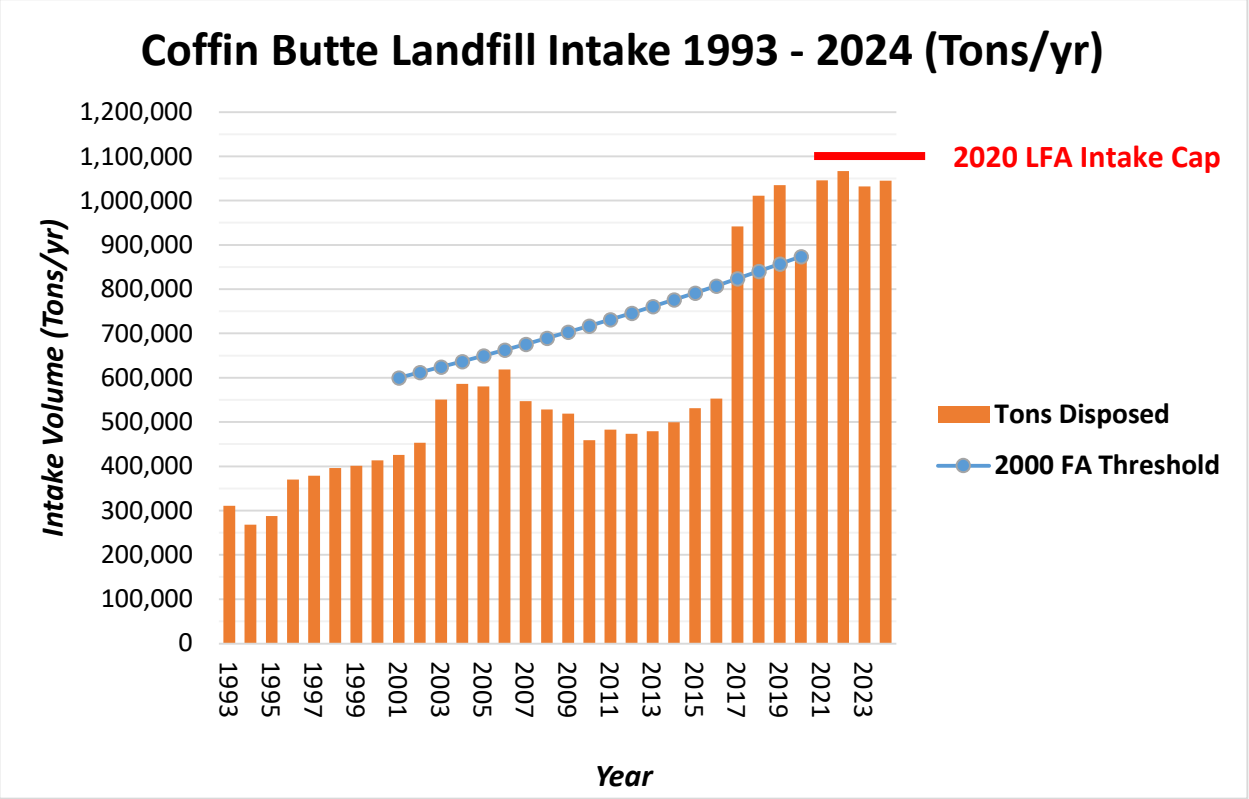
Cell 6 burdens, harms, and damage are yet to be determined

- Will add more than a 50% increase to waste in place volume over the next 11-12 years
- Unique characteristics: liner placement on steep face, excavation below ground level
- Groundwater contamination over time is a particular concern with this cell

It would be imprudent to approve a second expansion in parallel with Cell 6 before the Cell 6 burdens are known

Fact 2: A vote to approve LU-24-027 is a vote to remove the intake cap

Source: 2020 Landfill Franchise Agreement, Section 5(b)



Data/plot from BCTT Final Report, P. 620, with 2023 and 2024 intake figures added

Approval of LU-24-027 will remove the contractual legally binding intake tonnage cap

Outside counsel: Are conditions of approval or applicant statements similarly legally binding?

Franchisee could have asked to renegotiate the 2020 LFA prior to this CUP **but did not**

Intake for the past 8 years indicates high demand for landfill volume, but cap appears to be honored

Closure of the Reworld incinerator in Marion County will likely add to the demand

The 70% year-over-year increase 2016-2017 demonstrates volume increase capability

Intake volume growth rate 2000-2024 = approximately 3x the area population growth rate[1]

Franchisee's application drawings state an expected 1.5 – 1.86M CY/year fill rate[2]

No intake limit → No limit on the harms and burdens resulting from the intake rate

- Traffic / Accidents / Road Damage & Repair Cost / Trash: Roadside & Farm Fields / Noise / Odor

Therefore the application should be denied

[1] Area (Benton, Lincoln, Linn, Marion, Polk, Tillamook) growth = 30.3% 2000-2024 (Portland State Univ. Population Research Center), or approximately 1.9%/year; CBL intake growth = 152.5% 2000-2024, or approximately 6.8%/year.

[2] *322142 - Coffin Butte CUP Plans - Final Drawings_compressed_Part1.pdf*, Pages 15-18. Assuming this includes a 15% ADC burden, at 0.98 Tons/CY this corresponds to "Solid Waste" intake volumes of 1.28 M Tons/year and 1.59 M Tons/year respectively.

Coffin Butte Landfill
2008 Benton County Annual Report



COFFIN BUTTE LANDFILL

2008 Summary of Operations and Environmental Monitoring

This report provides a summary of the following aspects of Coffin Butte Landfill operational and environmental status for calendar year 2008:

- Landfill Capacity
- Future Landfill Cell and Infrastructure Development
- Summary of Annual Groundwater Monitoring Report
- Summary of Annual Leachate Management Report
- Summary of Title V Air Monitoring Report
- Summary of Landfill Users by County of Origin, Tonnage and Total Vehicles
- Status of Environmental Trust Fund and Insurance
- Summary of Environmental and Regulatory Permits
- Summary of Customer Complaints at Coffin Butte Landfill
- Summary of Processing and Recovery Center Activity

LANDFILL CAPACITY

Coffin Butte Landfill has permitted airspace of 39,594,002 cubic yards (including consumed). During 2008 the landfill accepted 528,395 tons of solid waste. Based on historical aerial fly-over data, the average effective density of the in-place waste at the Coffin Butte Landfill is 0.80 tons/cy.[1] Therefore, an estimated 660,494 cubic yards of airspace was used for the year. A total of 11,808,920 cubic yards has been consumed as of December 31, 2008.

The remaining capacity for the entire permitted landfill footprint as of the end of 2008 was approximately 27,785,082 cubic yards. This information is updated annually with aerial flyovers. Using 0.80 tons/cy, the remaining available landfill space expressed in tons is about 22,228,066 tons. Using the current disposal rate of approximately 600,000 tons per year, there are about 37.1 years of landfill space available.

FUTURE INFRASTRUCTURE DEVELOPMENT

The following projects and estimated timing for construction are anticipated for the upcoming year:

- A real-time flow monitor will replace the existing "smart box" used to control leachate discharge volumes to the City of Corvallis Waste Water Reclamation Plant (WWRP). Installation and testing will be completed in spring of 2009.

- Approximately 25 vertical and horizontal landfill gas extraction wells are scheduled for decommission/abandonment and/or replacement on Cells 2B, 2C, and 3C during the summer of 2009. In addition, approximately 10 new pumps will be installed during spring/summer of 2009

[1] Effective density incorporates the effects of daily and intermediate soil cover usage. It is calculated by measuring the amount of airspace occupied between successive aerial flyovers using photogrammetric maps, and dividing that volume into the number of tons of waste received at the gate.

SUMMARY OF ANNUAL GROUNDWATER MONITORING REPORT

This annual report provides a summary of the water quality monitoring activities at Coffin Butte Landfill during 2008. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI). Environmental monitoring and associated reporting is required by the landfill's solid waste disposal permit number 306, issued and administered by the Oregon Department of Environmental Quality (DEQ).

During 2008, no significant changes in water quality were measured. Volatile organic compound (VOC) concentrations in wells along the compliance boundary were below primary drinking water standards with the exception of MW-12S, where tetrachloroethene (PCE) was detected above the drinking water standard. Beginning in 2007, the trend in MW-12S declined and is currently below 10 micrograms per liter (µg/L). Vinyl chloride was not detected in any of the site monitoring wells and represents continued depletion of VOCs in the aquifer. Other than PCE, five VOCs were detected at low concentrations (below 3 µg/L) and several inorganic parameters were present above background concentrations. Since the landfill cover was installed on Cells 1/1A in 1996 and landfill gas removal wells were installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. Groundwater conditions at the detection wells (MW-17, MW-18, MW-19, and P-8), 300 to 400 feet downgradient of the compliance boundary, reflect background water quality.

At the compliance boundary for Cell 2, no primary drinking water standards were exceeded and concentrations of monitored parameters are at or below the permit-specific concentration limits.

Downgradient of the closed landfill, groundwater quality trends are stable as well. Based on the age of the landfill, it is expected that the existing low level impacts will diminish with time.

Leachate production for the water year 2007-2008 was estimated at 27.2 million gallons of leachate. This was generated by Cells 1, 2, and 3 during the water year ending September 30, 2008. VLI continues to monitor the secondary leachate collection system (SLCS) beneath Cell 2. The rate of liquid infiltrating to the system declined in 2008 to below that of the previous year.

The text portion of the groundwater report is presented in Appendix A.

SUMMARY OF ANNUAL LEACHATE MANAGEMENT REPORT

Leachate production and management for the water-year October 2007 to October 2008 is discussed in a report by Thiel Engineering (2008). The text portion of the leachate report is presented in Appendix B.

SUMMARY OF ANNUAL TITLE V AIR MONITORING REPORT

Air emissions generated at the Coffin Butte Landfill in 2008 were summarized in a report on DEQ forms prepared by Valley Landfills. The air emissions generated in 2008 were less than the plant site emission limits (PSELs) allowed under the Title V Operating Permit and there were not any deviations from the Title V Operating Permit conditions.

The landfill received, responded to, documented and reported 38 odor complaints to DEQ. Semi-annual meetings with the public are conducted as part of Title V permit. The meetings give the public and Coffin Butte Landfill an opportunity to discuss improvements being made to address the odor issues.

SUMMARY OF LANDFILL USERS BY COUNTY OF ORGIN, TONNAGE AND TOTAL VEHICLES

Tables showing the 2007 and 2008 landfill users by vehicle class, tonnage and county of origin are presented in Appendix C.

STATUS OF ENVIRONMENTAL TRUST FUND AND INSURANCE

The value of the Environmental Trust on 12/31/2008 was $4,496,176.

The value of the Environmental Trust on 12/31/2007 was $6,841,458.

The value of the Environmental Trust on 12/31/2006 was $6,472,396.

A copy of the Certificate of Liability Insurance, showing Benton County as an additional insured is presented in Appendix D.

SUMMARY OF ENVIRONMENTAL AND REGULATORY PERMITS

Permit Number	Permit Type	Permit Terms	Renewal Date	Enforcement Actions - 2008	Comments
SWDP # 306	Solid Waste	10 Year	March 1, 2009	None	Application Accepted – Automatic Permit Extension
# 1200Z	NPDES Stormwater	5 Year	June 30, 2007	None	Application to Permit Reviewer
#101545	NPDES Leachate Treatment	5 Year	September 30, 2008	None	Application Complete
#02-9502	Title V Air Quality	5 Year	February 1, 2010	None	Application Renewal Submitted Alternative Operating and Monitoring Plan Approved

SUMMARY OF CUSTOMER COMPLAINTS – COFFIN BUTTE

Customer Complaints at Coffin Butte Landfill and the Process & Recovery Center - 2008

Price	Public Tipping Area	Process and Recovery Center
6	6	0

The table was compiled from the verbal complaints logged at the Coffin Butte and the Process and Recovery Center scale houses. The landfill also received positive compliments related to the public tipping area and assistance at the public tipping.

SUMMARY OF PROCESSING AND RECOVERY CENTER ACTIVITY 2008

Green waste and urban wood waste recycling activity at the Processing and Recovery Center (PRC), including and compost and hog fuel sales are presented in Appendix E.

REFERENCES

2008 Annual Monitoring Report for the Coffin Butte Landfill. Prepared by Tuppan Consultants LLC and submitted to the DEQ on March 2009.

2007-08 Annual Leachate Management Report for Coffin Butte. Prepared by Thiel Engineering, and submitted to DEQ on December 2008.

Annual Report for Year 2008, Oregon Title V Operating Permit Number 02-9502, Coffin Butte Landfill. Prepared by Valley Landfills, Inc. and submitted to the DEQ February 2009. This annual report provides a summary of the air quality monitoring activities at Coffin Butte Landfill during 2008. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI) a subsidiary of Allied Waste. Environmental monitoring and associated reporting is required by the landfill's Title V permit, issued and administered by the Oregon Department of Environmental Quality (DEQ).

Appendix A

Text Portion of Annual Groundwater Monitoring Report

2008 ANNUAL MONITORING REPORT

COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

Prepared for

Valley Landfills, Inc.

March 19, 2009

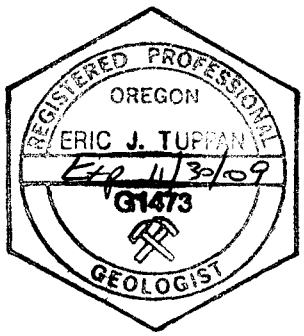
Prepared by

TUPPAN CONSULTANTS LLC
460 SECOND STREET, SUITE 103
LAKE OSWEGO, OREGON 97034

Project VLI-001-002

2008 Annual Monitoring Report
Coffin Butte Landfill
Benton County, Oregon

The material and data in this report were prepared under the supervision and direction of the undersigned.



TUPPAN CONSULTANTS LLC

Eric J. Tuppan, R.G.

CONTENTS

SIGNATURE PAGE ii

LIST OF TABLES AND ILLUSTRATIONS vi

EXECUTIVE SUMMARY vii

1 INTRODUCTION 1-1

2 WATER QUALITY MONITORING 2-1
2.1 Monitoring Network 2-1
2.2 Sampling and Analysis Program 2-1

3 FINDINGS 3-1
3.1 Hydrogeology 3-1
3.1.1 Groundwater Occurrence and Flow 3-1
3.1.2 Groundwater Velocity 3-2
3.2 Water Quality 3-3
3.2.1 Data Quality 3-3
3.2.2 Groundwater 3-3
3.2.2.1 West Side 3-4
3.2.2.2 East Side 3-5
3.2.2.3 Former Leachate Irrigation Fields 3-6
3.2.3 Surface Water 3-7
3.2.4 Underdrains 3-7
3.3 Secondary Leachate Collection System 3-8
3.3.1 Cell 2 3-8
3.3.2 Leachate Ponds 3-9
3.4 Leachate Production 3-9
3.5 Landfill Gas Monitoring 3-9

4 DISCUSSION 4-1
4.1 West Side 4-1
4.1.1 Aquifer Restoration-Contaminant Removal 4-1
4.1.1.1 Cells 1/1A 4-1
4.1.1.2 Closed Landfill 4-2
4.1.2 Source Control Effectiveness 4-2

CONTENTS (Continued)

4.1.3	Plume Stabilization	4-3
4.1.4	Protectiveness Monitoring	4-3
4.2	East Side	4-4
4.2.1	Comparison to Concentration Limits	4-4
4.2.2	Indications of Significant Change	4-4
4.2.3	Trends	4-4
4.3	Comparison to Water Quality Standards	4-5
5	**MONITORING PLAN MODIFICATIONS AND RECOMMENDATIONS**	**5-1**
REFERENCES		
LIMITATIONS		

CONTENTS (Continued)

APPENDIX A DATA REVIEW MEMORANDA

APPENDIX B 2008 WATER QUALITY SUMMARY TABLES

APPENDIX C TIME-SERIES CONCENTRATION PLOTS

APPENDIX D SLCS AND LCRS DATA

TABLES AND ILLUSTRATIONS

Following Report:

Tables

2-1 Description of Monitoring Network
2-2 Well Construction Summary
2-3 Monitoring Program
3-1 Groundwater and Surface Water Elevations
3-2 Trends of Inorganic Indicator Parameters—Cells 1 and 1A
3-3 VOC Detections
3-4 Trends of Volatile Organic Compounds—Cells 1 and 1A
3-5 Constituent Trends—Closed Landfill
3-6 Trends of Inorganic Parameters—Cell 2
3-7 Inorganic Constituents in Underdrains
3-8 Dissolved Metals in Underdrains
3-9 Water Year Summary for SLCS Volume Data
3-10 Landfill Gas Monitoring
4-1 Comparison of Sampling Results with RACLs-West Side
4-2 Historical Number of VOCs at Compliance Wells
4-3 Comparison of Sampling Results with PSCLs, East Side - MW-22
4-4 Sample Results Above Drinking Water Standards

Figures

1-1 Site Location
3-1 Hydrographs for Cell 2 Area Wells
3-2 Hydrographs for Upgradient Bedrock Wells
3-3 Hydrographs for Cell 1A Area Wells
3-4 Hydrographs for Cell 1 Area Wells
3-5 Groundwater Contours, April 2008
3-6 Groundwater Contours, October 2008
4-1 Sodium and Rainfall at MW-22

EXECUTIVE SUMMARY

This annual report provides a summary of the water quality monitoring activities at Coffin Butte Landfill during 2008. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI). Environmental monitoring and associated reporting is required by the landfill's solid waste disposal permit number 306, issued and administered by the Oregon Department of Environmental Quality (DEQ).

During 2008, no significant changes in water quality were measured. Volatile organic compound (VOC) concentrations in wells along the compliance boundary were below primary drinking water standards with the exception of MW-12S, where tetrachloroethene (PCE) was detected above the drinking water standard. Beginning in 2007, the trend in MW-12S declined and is currently below 10 micrograms per liter (µg/L). Vinyl chloride was not detected in any of the site monitoring wells and represents continued depletion of VOCs in the aquifer. Other than PCE, five VOCs were detected at low concentrations (below 3 µg/L) and several inorganic parameters were present above background concentrations. Since the landfill cover was installed on Cells 1/1A in 1996 and landfill gas removal wells were installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. Groundwater conditions at the detection wells (MW-17, MW-18, MW-19, and P-8), 300 to 400 feet downgradient of the compliance boundary, reflect background water quality.

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Downgradient of the closed landfill, groundwater quality trends are stable as well. Based on the age of the landfill, it is expected that the existing low level impacts will diminish with time.

Leachate production for the water year 2007-2008 was estimated at 27.2 million gallons of leachate. This was generated by Cells 1, 2, and 3 during the water year ending September 30, 2008. VLI continues to monitor the secondary leachate collection system (SLCS) beneath Cell 2. The rate of liquid infiltrating to the system declined in 2008 to below that of the previous year.

1 INTRODUCTION

This report presents results of water quality and landfill gas probe monitoring during the 2008 calendar year at the Coffin Butte Landfill in Benton County, Oregon (Figure 1-1), operated by Valley Landfills, Inc. (VLI). For the April event, water quality sampling was performed by Kennec, Inc. Subsequently, TUPPAN CONSULTANTS LLC oversaw sampling (the October event), managed the water quality data, and prepared this annual report. Annual reporting is required by Section 17.2 of the landfill's solid waste disposal permit number 306, issued by Oregon Department of Environmental Quality (DEQ) on March 9, 1999.

In late 2004 and 2005, the process for selecting and approving a remedy for the west side of the site and for setting concentration limits for the east side of the site was completed. The solid waste permit was amended November 4, 2004, to incorporate concentration limits for the east side and cleanup levels for the west side. The DEQ signed the Record of Decision (ROD) on November 2, 2005 (DEQ, 2005). Subsequent to issuing the ROD, VLI updated and revised the Environmental Monitoring Plan (TC, 2005b), which describes methods of evaluating water quality data and updates the practical aspects of monitoring at the site. The Environmental Monitoring Plan (EMP) also outlines the manner in which water quality data is used to evaluate the remedy performance and describes types of response actions that would be implemented if concentrations at east-side compliance well MW-22 were exceeded.

As defined in the EMP, the annual report serves as the mechanism to (1) collate and report analytical data for the past year, (2) assess achievement of remedial goals for the west side, and (3) evaluate detection monitoring data for east-side cells which bears on the performance of the engineered liner systems for the active waste management units. The last two items will be discussed in Section 4 of the annual report.

For the west side, the purpose of the report is to assess (1) the effect of remedial actions on groundwater quality (i.e., assess progress of cleanup) and (2) protection of potential human health receptors. Consequently, the intent of the report focuses data evaluation on the following objectives:

- Assess aquifer restoration and contaminant removal rates based on concentration trends.
- Evaluate the effectiveness of source control.

- Evaluate stabilization of the plume based on the extent and concentration of volatile organic compounds (VOCs).
- Discuss results of protectiveness monitoring at domestic wells and at early warning detection wells.

For the east side, the report compares analytical results to permit specific concentration limits (PSCLs) and examines the data for indications of a significant change as described in Section 4.2.2. Results are also compared to relevant water quality standards.

Consistent with solid waste permit requirements, municipal solid waste guidance (DEQ, 1996), and the updated EMP, the annual report contains the following:

- A cover letter that
  - Compares the analytical results with relevant monitoring standards.
  - States whether or not federal or state standards were exceeded for the relevant media.
  - States whether or not a significant change in water quality occurred.
- An executive summary.
- Assessment of the current status of the environmental monitoring network and recommendations for improvements.
- Data analysis and evaluation, based on the following:
  - Updated groundwater elevation information for each sampling event and monitored unit, depicting groundwater flow velocities and direction, and piezometric water contours.
  - Data evaluation tools (e.g., time-series plots, box plots, trilinear diagrams) as appropriate, for selected constituents of concern; to be used in assessing data.
  - Summary of results of monitoring for the year, including a table that compares results with water quality standards.
- Description of activities resulting from exceeding a relevant standard or significant change in water quality, such as resampling or additional investigation.
- Results of landfill gas (LFG) probe monitoring (monitoring related to operations of the gas-to-electric plant are not reported as part of the environmental monitoring program).
- Summary of sampling and analysis, field quality assurance and quality control (QA/QC), and laboratory QA/QC techniques implemented during the year.
- Copies of applicable information, including field data, laboratory analytical reports, and chain-of-custody reports; data are cross-referenced and labeled with the designated field sampling location.

2 WATER QUALITY MONITORING

2.1 Monitoring Network

The water quality monitoring network has five components: (1) groundwater monitoring wells, which include compliance and detection wells, (2) water level observation wells and piezometers, (3) the secondary leachate collection system (SLCS), (4) leachate sumps, and (5) surface water monitoring points. In addition to water quality, landfill gas is monitored at probes surrounding the landfill, and in buildings or structures near the landfill. The rationale for the network design and the media monitored was presented in the updated EMP (TC, 2005b). The water quality monitoring locations are summarized on Table 2-1. A summary of the well construction, survey information, and lithologic completion intervals is provided in Table 2-2.

With construction of the supplemental leachate holding pond in summer 2004, nomenclature for sampling points was revised. The older 4-million gallon leachate surge pond was renamed the West Leachate Pond and the new pond is referred to as the East Leachate Pond. Sampling points for the secondary leachate collection system for each pond will be referred to as LDS-WLP and LDS-ELP, respectively.

In addition to these points, 6 shallow piezometers were installed during January 2008, in the fields south of the west-side landfill, in the area previously referred to as Field C. These piezometers are monitored intermittently to evaluate water levels near the wetland mitigation area along Soap Creek.

2.2 Sampling and Analysis Program

Monitoring in 2008 was conducted consistent with the updated EMP for Coffin Butte Landfill (TC, 2005b). The EMP presents monitoring rationale, sampling and analysis parameters, locations, and a schedule. The DEQ approved the plan by letter (DEQ, 2006). The frequency of monitoring, the sampling points, and the analytical parameters for 2008 are summarized in Table 2-3.

Water was sampled consistent with procedures described in the site sampling and analysis plan in Appendix C of the EMP. Samples were submitted to TestAmerica's laboratory in Denver, Colorado.

In 2008, samples could not be collected from several locations as follows:

- Second Quarter: S-U2 was dry and no sample was collected.

- Fourth Quarter: S-3, S-U2, S-U3, and SU-4 were not sampled because sample discharge pipes were dry. At MW-12S and MW-17, a minimal level of water in the wells prohibited collecting enough water to test for inorganic and metal constituents, however, a sample from each well was collected for VOCs. Both wells are outfitted with dedicated bladder pumps with the pump inlet located near the bottom of the screened interval.

Memoranda that document field sampling procedures, copies of field sampling data sheets that record measurements for the sampling events, and laboratory reports are included in Portable Document Format (PDF) on a compact disc (CD) attached to the inside back of the report cover. Memoranda that review laboratory quality assurance and quality control data can be found in Appendix A.

3 FINDINGS

The discussion of hydrogeology is summarized from sections on site characterization in past reports and the EMP (EMCON, 1994, 1996, 2000; TC, 2003a,b, 2005b).

3.1 Hydrogeology

The landfill is situated along the south flank of Coffin Butte. The upper third (approximately) of the butte consists of steep grass-covered slopes, the middle third of exposed bedrock with little vegetation, and the lower third of gentle, soil-covered slopes. Generally, the steeper slopes are underlain by basalt bedrock and the lower, flatter slopes on the flanks of Coffin Butte are underlain by alluvium that consists of silty clay to clayey silt with variable amounts of thin, interbedded sands and silty to sandy gravels (commonly referred to as Willamette Silt).

There are two principal water-bearing units: unconsolidated alluvium, and bedrock volcanics. Groundwater occurs in both units, although the alluvial deposits are absent or unsaturated over much of the site where landfill occurs. Where both units are present, they are hydraulically connected. The two units are monitored separately by groundwater monitoring wells.

3.1.1 Groundwater Occurrence and Flow

Depth to groundwater depends on season and topography. In site wells, the groundwater depths range from over 80 feet below the ground surface midway up the slopes of Coffin Butte (in bedrock) to less than 1 foot in the flat lowland area southeast of the butte (in alluvium). East of Cell 2, potentiometric elevations measured during the wet winter and spring months are near or higher than the ground surface elevation, indicating the potential for groundwater to discharge in this area.

Table 3-1 summarizes the groundwater elevations for 2008. Seasonal fluctuations vary, depending on the hydrogeologic position of the monitoring point. The seasonal changes in 2008 ranged from less than 2 feet in MW-22, MW-23, MW-25, and P-16 to approximately 20 feet in well MW-13. Figures 3-1 to 3-4 illustrate the range of seasonal fluctuations for typical site wells in similar hydrogeologic positions. The average site-wide fluctuation in monitoring wells and piezometers was approximately 4 feet, with the lowest groundwater elevations in late summer to fall and the highest in winter and spring.

The direction of groundwater flow is controlled by the topographic setting of Coffin Butte and Poison Oak Hill and the intervening low areas. Groundwater in the bedrock generally flows downslope from the hills until it reaches a groundwater divide near the southeast corner of Cell 1. At the divide, groundwater flows toward the east and west, generally following the long axes of the valleys. Groundwater flow direction in the saturated portion of the alluvium mimics the underlying bedrock.

Groundwater contours for the site are illustrated on Figures 3-5 and 3-6. The groundwater elevations are from wells screened either in the alluvium or the bedrock. With the relatively large topographic relief between wells, any vertical gradients (generally small) between hydrogeologic units at monitoring locations are insignificant, and therefore do not substantially affect the site's groundwater flow pattern or horizontal gradients.

Factors affecting the groundwater gradients include the topographic slope, hydrogeologic material, and the season. The steepest horizontal gradients measured at the site are on the flanks of Coffin Butte. These range from approximately 0.049 to 0.068 foot per foot (ft/ft) downslope of well MW-13, to 0.14 ft/ft downslope of piezometer P-17. Smaller gradients are an order of magnitude lower, approximately 0.014 ft/ft, downgradient of Cell 2 (in alluvium between MW-23 and MW-9S), and average between 0.006 and 0.009 ft/ft downgradient of Cells 1 and 1A. Downgradient of the Closed Landfill, the gradient is relatively consistent between seasons at approximately 0.06 to 0.079 ft/ft.

3.1.2 Groundwater Velocity

Groundwater velocity depends on hydraulic conductivity, horizontal hydraulic gradient, and effective porosity of the water-bearing medium. The horizontal velocity (V_h) of groundwater is calculated by the following equation:

$$V_h = \frac{Ki}{n_e}$$

where

V_h = horizontal groundwater velocity.
K = hydraulic conductivity.
i = horizontal hydraulic gradient.
n_e = effective porosity.

Estimates of V_h were calculated at the Coffin Butte Landfill for three areas: on the east side, downgradient of Cell 2, and on the west side, downgradient of Cell 1 and the Closed Landfill. Near Cell 2, estimates of V_h are fairly consistent between seasons because the gradient does not change significantly (low slopes and an area of groundwater discharge to the marsh). V_h is calculated at approximately 1.3 feet per year (ft/yr), given a hydraulic conductivity of 6.3×10^{-2} feet per day (ft/day) for the alluvium (EMCON,

1994), an estimated effective porosity of 25 percent (Morris and Johnson, 1967), and a hydraulic gradient of 0.014 ft/ft.

Downgradient of Cells 1/1A, estimates for V_h are 50 to 250 ft/yr in the spring and somewhat lower in the drier months at 30 to 160 ft/yr in the fall. Assumptions include an average hydraulic conductivity of 4 ft/day for the bedrock (EMCON, 1994), an estimated effective porosity of between 5 and 25 percent (Morris and Johnson, 1967), and an average hydraulic gradient of 0.0086 ft/ft in the spring and 0.0056 ft/ft in the fall.

Downgradient of the Closed Landfill, estimates for V_h are approximately 6 to 7 ft/yr for the alluvium, and 360 to 460 ft/yr in the bedrock. Assumptions include the hydraulic conductivities for alluvium and bedrock noted above, an estimated effective porosity of 25 percent both for alluvium and weathered bedrock (Morris and Johnson, 1967), and an average hydraulic gradient of 0.06 ft/ft.

3.2 Water Quality

Water quality summary tables for 2008 can be found in Appendix B. The tables organize the monitoring points by wells, surface water stations, leachate (Cell 1, Cell 2, or Cell 3), and the SLCS (LDS monitoring points).

3.2.1 Data Quality

Results of laboratory quality assurance and quality control data indicate acceptable results (see data review memoranda in Appendix A). TestAmerica's standard laboratory reporting limits (RLs) for several of the trace metals are higher than reporting limit goals devised by the DEQ at 10 percent of the primary drinking water standard. The laboratory can report at lower values to meet these goals, although the laboratory must qualify the data as estimated since the resultant values are below the standard laboratory RL, but above the method detection limit. Qualified data are discussed in the memoranda in Appendix A (along with a table comparing the various reporting limits) and listed in the summary tables in Appendix B.

3.2.2 Groundwater

This section evaluates groundwater quality at Coffin Butte Landfill by examining trends that can be used to predict or assess subtle changes in water quality or which track parameter concentrations used to assess areas with existing impacts. This qualitative examination is complemented with quantitative comparisons in Section 4 to assess remedy performance for the west side, or whether water quality meets concentration limits for the east side.

The following discussion is divided into geographic areas on the basis of trend evaluation. At the compliance boundary for Cell 2, baseline data for background water

quality were characterized in the compliance well (no upgradient background well can be feasibly located) as part of an intrawell evaluation approach.

Parameters evaluated for Cell 2 include site-specific indicator parameters that are tested semiannually and a group of site-specific trace metals that are tested annually. For Cells 1 and 1A, parameter evaluation focuses on the same suite of indicators and selected VOCs that have been consistently detected over the years. Water quality evaluation downgradient of the Closed Landfill focuses on site indicator compounds and three historically detected VOCs. A list of wells and time-series concentration plots by parameter can be found in Appendix C.

Time-series concentration plots for groundwater wells that monitor the former leachate irrigation Fields B and C document recovery of groundwater quality since leachate irrigation was discontinued in 1998. Plots for these wells can also be found in Appendix C.

TUPPAN CONSULTANTS visually examined groundwater quality trends and summarized those findings in Tables 3-2, 3-4, 3-5, and 3-6. These tables show the most recent trend (approximately the last five years) and indicate the general range of parameter concentrations for that period. Trend information from decommissioned wells (e.g., MW-6, MW-7S/7D, and MW-16) can be found in annual reports from 2004 and earlier (e.g., TC, 2005a). Descriptive evaluation terms include the following:

- Upward: generally upward trend during the last five years; this is indicated by shading in the tables.
- Downward: generally downward trend during the last five years; there may have been earlier periods of water quality variability.
- Stable: indicates that the water quality varies within a range (degree of variability depends on well or parameter) and that no long-term consistently upward or downward trend is apparent.
- Peaked: concentrations have peaked and are now either declining or appear to have stabilized, suggesting that water quality is beginning to improve.

3.2.2.1 West Side

Cells 1 and 1A. Groundwater in this area is characterized by elevated, but declining, concentrations of inorganic compounds downgradient of Cell 1A and low concentrations of inorganic compounds downgradient of Cell 1. Except for MW-12S at Cell 1, VOC concentrations in this area have declined to below 3 micrograms per liter (µg/L) and continue to trend downward (Table 3-3). Trace metals concentrations are low to nondetect and generally follow stable trends.

Downgradient of Cell 1A, inorganic trends are mixed (Table 3-2), but there are fewer parameters with upward trends than last year (nine in 2008 compared to fifteen in 2007). This is most apparent for well MW-12S, in which bicarbonate, calcium, magnesium and sodium all appear to have peaked and stabilized since 2005. Wells downgradient of Cell 1 have much lower inorganic concentrations than those downgradient of Cell 1A and the magnitude of any increases is slight. Overall, the inorganic concentrations downgradient of Cell 1 are considerably lower than in well pairs MW-10 or MW-11 (downgradient of Cell 1A), and chloride concentrations are more than an order of magnitude below the secondary drinking water standard of 250 milligrams per liter (mg/L).

Of the four VOCs historically detected in well pair MW-10S/10D downgradient of Cell 1A (see Tables 3-3 and 3-4), concentrations of 1,1-dichloroethane (1,1-DCA) continue to decline in both wells. Cis-1,2-dichloroethene (cis 1,2, DCE) and chloroethane were only detected in MW-10S, and vinyl chloride was not detected in either well in 2008. No VOCs were detected in either MW-11S or MW-11D in 2008. Downgradient of Cell 1, PCE had been routinely detected in well MW-12S, and since 1994 had shown an upward trend. In October 2000, the concentration peaked at 25 µg/L. Beginning last year, the trends appears to be headed downward and is currently below 10 µg/L. Trichloroethene (TCE), while still being detected in MW-12S, also appears to be declining in concentration. In deep well MW-12D, PCE was detected both sampling events at less than 1 µg/L.

Closed Landfill. The closed landfill is monitored by two monitoring wells designated as compliance wells in the solid waste permit addendum: one completed in the alluvium (MW-20) and one completed in bedrock (MW-21). The alluvial well has shown stable to downward trends for the site indicator parameters. Trends are summarized in Table 3-5.

In the bedrock well, bicarbonate alkalinity, which had increased in concentration before 2001, appears to have peaked; the other indicator compounds appear stable the past 5 years. Of the three historically detected VOCs in MW-21, cis-1,2-DCE has not been detected since May 1995, 1,2 dichlorobenzene has been nondetect since 1999, and chlorobenzene was last detected at 0.62 µg/L in 2006. No VOCs were detected in either well in 2008.

3.2.2.2 East Side

Cell 2 - Compliance Well MW-22 and Detection Wells MW-24, MW-25. Wells near Cell 2 include compliance well MW-22 downgradient of Cell 2, detection well MW-24 at the upgradient edge of Cell 2A, and MW-25 which is downgradient of the southeast corner of Cell 2B, but upgradient of MW-22. Both MW-22 and MW-25 are completed in shallow alluvium and MW-24 is completed in shallow weathered bedrock (the alluvium is not saturated in this area). Piezometer P-16, which is sampled once a year, was added to the trend plots to supplement information on natural water quality variability in the alluvium.

Trends for indicator parameters (Table 3-6) at the compliance well MW-22 were stable through 2008, although for the last 3 to 4 years (since approximately 2005), concentrations for sodium and chloride appear to be marginally higher more frequently. This relationship is explored more fully in Section 4.2. Parameters tested in MW-24 and MW-25 are stable, and reflect natural water quality in the area. Of those two wells, MW-25 (completed in alluvium) is more similar in water quality to MW-22. Subtle differences, though, are present, for instance lower concentrations for bicarbonate, calcium, and sodium, and higher natural chloride and arsenic in MW-25 than in MW-22.

Cell 2 – Detection Well MW-23. Early in its history, detection well MW-23 had shown increases for bicarbonate alkalinity, chloride, hardness, total dissolved solids (TDS), for five of the major dissolved metals, and for arsenic (As). This had been attributed to localized seepage of leachate from the south side of the landfill. Since 2000 to 2001, the upward trends for bicarbonate, chloride, hardness, TDS, Ca, Fe, Mg, Mn, Na, and As peaked, and within the last year have declined to the range of background concentrations. Of those, the cations, bicarbonate, and chloride continue to demonstrate seasonality with higher concentrations in the fall and lower concentrations in the spring.

3.2.2.3 Former Leachate Irrigation Fields

Field B (East Side). In Field B wells MW-8S and MW-15, concentrations of inorganic indicators continue longer-term trends of past years (see time-series concentration plots in Appendix C). At MW-8S, an earlier increasing trend for chloride peaked in 2001 and is declining gradually, while Na has remained relatively consistent in concentration.

In well MW-15 chloride shows an upward trend, but is still below the concentration in MW-8S. Over the same period, bicarbonate and calcium have declined slightly. Inorganic concentrations in wells MW-8S and MW-15 contrast with those at MW-16, which was screened in fresh bedrock, and had naturally lower concentrations for indicators than the alluvium.

Trace metals in Field B wells were detected at low to trace concentrations, or were not detected in 2008. Historically, trend plots show distinctly lower concentrations beginning with the fall 1996 sampling event (e.g., barium, lead and nickel). That was the first sampling event in which dedicated bladder pumps were used, and the results for trace metals reflect lower suspended solids in the water samples. Since then, concentrations have remained low with more limited variability. None of the wells shows a trend indicating effects of past leachate irrigation. No VOCs were detected.

Field C (West Side). Past leachate irrigation in Field C appears to have mildly affected the concentrations of some inorganic parameters over the last few years. Since irrigation stopped in 1998, levels appear to be recovering to pre-irrigation conditions, although some variability persists (see time-series concentration plots in Appendix C). It is possible that this minor variability could be related to amending the field with lime to improve agricultural production or more recently, to disruption of the surface soils in

creating wetlands in the area, especially near well MW-19 which has seen increased concentrations for chloride, Ca, and Mg.

As with Field B, trace metals were either not detected in Field C wells, or were detected at low to trace concentrations. Where detected, none of the wells showed a trend indicative of past leachate irrigation. No VOCs were detected in former irrigation field wells except for dichlorodifluoromethane[1] (Freon 12) in MW-19 (at 1.5 µg/L). Beginning in 1999, Freon 12 was first detected at low levels (<1 µg/L) in that well. In 2005, the trend increased slightly to its current level at 1.5 µg/L. Upgradient, near the edge of the landfill in MW-11S/11D, concentrations in the early 1990s had been between 3.5 and 4 µg/L for Freon 12. However, since 2000, it has not been detected in that well pair. We expect that Freon 12 concentrations at MW-19 will follow the upgradient pattern and dissipate with time.

3.2.3 Surface Water

Surface water is monitored upstream (S-1) and downstream (S-2 and S-4) in Soap Creek to test for potential impacts from the west side of the facility, and for residual impacts from spray irrigation on Field C. Surface water is also monitored on the east side, where an intermittent creek crosses the landfill access road (S-3). In 2008, water flowed at this point during the April sampling event, but no sample could be collected in October because it was dry.

At the Soap Creek monitoring points, year 2008 results for biological oxygen demand (BOD), total Kjeldahl nitrogen, total phosphorus, and orthophosphate were either nondetect or were virtually identical in concentration between the upstream and downstream monitoring points. This is similar to past years.

The other inorganic parameters (chloride, Ca, Fe, Mg, Mn, and Na) showed seasonal changes in concentration, with low concentrations in April (high stream flow) and higher concentrations in October (low stream flow). There were no significant differences between upstream and downstream points for those parameters, with most concentration differences less than 1 mg/L. Differences in concentration between seasons are typically greater, from 8 to 11 mg/L (e.g., for chloride).

3.2.4 Underdrains

Results of sampling the underdrains for Cell 3 (S-U3) and from below the East Leachate Pond (S-U4) are shown in Tables 3-7 and 3-8. The Cell 2C/D subdrain was not sampled because no water flowed at the sampling point. Elevated concentrations for some of the inorganic parameters for Cell 3 in the October 2003 and subsequent sampling events are likely related to construction activities in the area during the summers of 2003 to 2005.

[1] Freon 12 was not identified as a chemical of concern in the remedial investigation and has a preliminary remediation goal (PRG) of 390 µg/L.

Current water quality from this underdrain is comparable to a sample collected from upgradient bedrock well MW-13, suggesting that water from this underdrain is not being affected by landfill operations.

Water quality from the East Leachate Pond underdrain (S-U4) represents baseline concentrations. Concentrations for inorganic compounds and dissolved metals from the underdrain are comparable to or lower than concentrations at MW-16, which was a background well that monitored bedrock in the pond location before it was decommissioned in 2004.

3.3 Secondary Leachate Collection System

The SLCS was monitored by riser pipes at four locations: beneath the Cell 2 sump in the southeast corner of that cell (LDS-2B), beneath the Cell 3 sump (LDS-3), and beneath the west and east leachate ponds (LDS-WLP and LDS-ELP, respectively). Results for liquid quantity and quality are shown graphically in Appendix D.

3.3.1 Cell 2

Historical variations in the concentrations of indicator parameters measured for LDS-2B reflect changes to the volume and liquid chemistry from different sources. These had varied (1) seasonally as the amount of leachate generated changed, surface water runoff changed, and groundwater levels fluctuated, and (2) from year to year as sources had been eliminated through reconstruction. Increased concentrations were generally attributed to a greater volume of leachate-dominated sources, while decreases reflected a greater ratio of surface water or groundwater to leachate. Trend plots of indicator parameters for both the SLCS and Cell 2 leachate can be found in Appendix D.

The volume of liquid that infiltrated into the SLCS for the water years since 1995 is shown in Table 3-9. Cumulative water purged from the system is shown in Figure D-1. For the 2007-2008 water year, an infiltration performance value of 10.2 gallons per acre per day (gpad) was calculated. This is below the 20 gpad action level generally suggested in the literature, and used by the USEPA and several states (Thiel, 2001).

Liquid levels in the primary and secondary leachate collections systems are not illustrated for the past year because the telemetry system malfunctioned and did not produce reliable data. The transducers and telemetry system continued to have significant technical problems this year. The situation is being corrected and data should be available for the next reporting period. Based on the settings for the on/off switch for the pumps in the primary and secondary sumps, it can be inferred that on average, the head levels in the sumps met permit requirements.

3.3.2 Leachate Ponds

Both leachate ponds were used to store leachate this past year. The detection system underlying the West Leachate Pond (previously referred to as the leachate surge pond) was outfitted with a pump in first quarter 1999. Except for purging during sampling events, no liquid was pumped from the LDS-WLP in 2008. The 5-million-gallon East Leachate Pond was constructed in 2004. No liquid was pumped from the secondary system except to collect samples. Sample quality results are listed on the water quality summaries in Appendix B. For the leachate pond SLCSs, the liquid is generally high in inorganic indicators such as chloride, bicarbonate, dissolved calcium, magnesium, and sodium with detections of several VOCs, such as benzene, toluene, ethylbenzene, xylenes, and acetone.

3.4 Leachate Production

Leachate production for the water year 2007-2008 was discussed in a report by Thiel Engineering (Thiel, 2008). An estimated 27.2 million gallons of leachate as calculated by volumetrics and by flowmeters were generated by Cells 1, 2, and 3 during the water year. This is slightly lower than last year at 29.9 million gallons. Tabular and graphical weekly leachate production data from totalizing flowmeters are used to illustrate overall seasonal trends in the data (Appendix D).

3.5 Landfill Gas Monitoring

VLI routinely monitors a total of six landfill gas monitoring probes around the perimeter of the landfill (GP-2 through GP-6), in addition to the interior of twelve site structures. Monitored parameters include lower explosive limit (LEL), methane, and oxygen. Levels of percent LEL and methane were zero for all monitoring events. Results of 2008 gas monitoring are shown in Table 3-10.

4 DISCUSSION

Monitoring wells at Coffin Butte Landfill are sited to assess a number of different areas around the landfill. For older areas that have undergone a focused risk assessment and feasibility study (TC, 2003a), the purpose of monitoring is to evaluate the performance of the remedy in protecting potential receptors and in restoring groundwater quality. The purpose of evaluating groundwater data at the east-side landfill cells is to determine if engineering controls (e.g., the landfill liner, cover, leachate or landfill gas [LFG] collection and removal systems) and operations are effective in preventing the release of landfill-derived compounds to the environment. Early identification of a release can mitigate those impacts relatively quickly, as documented for historical impacts in MW-23.

Consequently, the approach to evaluating monitoring data is slightly different for each area. For older areas, the monitoring objective is to assess the performance of the remedy in restoring groundwater quality to RACLs and in protecting potential receptors. For the active landfill on the east side, monitoring is classified as detection monitoring—in essence, to identify whether the landfill is leaking. Instrumental to this purpose is comparing monitoring results of indicator parameters with PSCLs and assessing the data for significant change.

4.1 West Side

For the west side, the purpose of the report is to assess (1) the effect of remedial actions on groundwater quality (i.e., assess progress of cleanup) and (2) protection of potential human health receptors. These are discussed in the following sections.

4.1.1 Aquifer Restoration-Contaminant Removal

Areas downgradient of the landfills on the west side rely on containment and control of the source with natural attenuation in groundwater downgradient. Contaminant removal occurs through natural processes and is measured with respect to trends of constituent concentrations with time. Cleanup levels referred to as RACLs, are the long term goals of aquifer restoration.

4.1.1.1 Cells 1/1A

Groundwater quality along the compliance boundary of Cells 1 and 1A has been relatively stable the past few years. Fewer inorganic indicator parameters exhibit upward

trends (e.g., bicarbonate, likely as a result of dissolution of carbonate minerals lining fractures or in pores driven by carbon dioxide produced through the metabolism of microorganisms in breaking down VOCs), and most have peaked or show downward trends.

Of the inorganic compounds, only chloride and manganese exceed their RACLs, and their trends continue to decline. Trends of VOC have peaked and are declining in each of the compliance wells (many are now nondetect), and except for PCE at MW-12S, none exceeded its RACL (Table 4-1). For the ninth year, vinyl chloride was not detected at concentrations above its MCL, nor was it detected at any monitoring well in 2008. From 300 to 400 feet downgradient of the compliance boundary, groundwater quality approximates background conditions in detection wells MW-17 through MW-19, indicating that contaminants attenuate significantly between the compliance boundary and the downgradient detection wells.

4.1.1.2 Closed Landfill

Trends of monitored parameters downgradient of the closed landfill are stable and reflect a steady improvement in groundwater quality. None of the parameters measured in 2008 indicated increases in concentration or levels of concern with respect to water quality standards; each was below its respective RACL except for manganese. On the basis of the landfill's age (20 to 50 years) and its low potential for significant leachate generation, it is expected that existing low level impacts to the aquifer will diminish with time.

4.1.2 Source Control Effectiveness

Source control includes the final cover at the landfill, leachate removal, and active landfill gas recovery to control the migration of landfill gas that contains methane and VOCs. Effectiveness can be measured qualitatively by examining (1) the trends and number of VOCs at downgradient monitoring wells and (2) whether landfill gas is migrating to perimeter gas probes.

Groundwater Quality. Since the landfill cover was installed on Cells 1/1A in 1996 and LFG removal wells installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. This is illustrated by Table 4-2 in which the number of VOCs are tallied for five periods beginning in 1990 (last column on table) and ending with total number of VOC for 2008. At each well along the compliance boundary, the total number of VOCs has decreased since 1990. In 2005 for the first time, no VOCs were detected in one of the wells, MW-11S. Concentrations continue to decline in each of the other wells, even in MW-12S, where PCE and TCE concentrations appear to be declining from last year. The reduction in the number and decrease in concentration of VOCs can be partly attributed to removal of landfill gas, which contains VOCs, and covering the landfill to prevent infiltration of rainwater to the waste pile.

Another source control measure for Cell 1 is leachate removal. Cell 1A does not have leachate removal but it has been shown that the base elevation of that cell is above the groundwater table and therefore, it is unlikely to generate a significant amount of leachate, if any.

LFG Probe Results. Probe monitoring shows that LFG does not migrate laterally away from the landfill, but is being contained by the gas recovery wells. Gas recovery rates for Cell 1 are monitored routinely by Pacific Northwest Generating Cooperative as part of optimizing flow and maximizing methane recovery for the gas-to-energy plant.

4.1.3 Plume Stabilization

The stability of the VOC plume can be evaluated qualitatively by examining whether concentrations at impacted wells are increasing and whether monitoring wells downgradient of the VOC plume detect VOCs. Both criteria suggest a stable to shrinking plume as concentrations are declining within the plume and wells outside the plume have not detected VOCs. (One exception was MW-19 in which residual concentrations of Freon 12 were detected.) Continued retraction of the extent of VOCs is further indicated by recent declines to nondetect within the last few years for:

- 1,1-DCA in MW-11S and MW-11D
- Chloroethane in MW-10D and MW-11S/11D
- Cis-1,2-DCE in MW-10D and MW-11S/11D
- Vinyl chloride in MW-10S/10D and MW-11S/11D

4.1.4 Protectiveness Monitoring

Protectiveness is assessed at two locations: at the Phillips domestic well and at P-8, which is spatially between the domestic well and the landfill. Trend plots for indicator parameters for these wells can be found in Appendix C. Analytical results for the Phillips well were either nondetect or significantly below safe drinking water standards for inorganics and metals (see tables in Appendix B). No VOCs were detected. Trends of indicator parameters do not show significant upward movement suggestive of impacts from the landfill.

Early warning detection monitoring well P-8 is located between the landfill and the Phillips well, near the hydrogeologic divide that protects the domestic well from landfill-contaminant migration. None of the indicator parameter trends for that well suggest changes in groundwater quality, and no VOCs were detected in 2008.

4.2 East Side

For the east side, the report compares analytical results for MW-22 to PSCLs established in the solid waste permit addendum, and examines the data for indications of a significant increase. Results are compared to water quality standards in Section 4.3.

4.2.1 Comparison to Concentration Limits

Permit-specific concentration limits were formalized for eight indicator parameters in the solid waste permit addendum. PSCLs apply to compliance well MW-22 for the east-side multiunit landfill, and are based on intrawell statistics (TC, 2003b). Table 4-3 compares analytical results since October 2000 with the PSCLs. None of the values in 2008 was above a concentration limit, although the sodium concentration was comparable to its PSCL of 27 mg/L in October. This duplicates last year's October sodium concentration for that well (the results are further examined below). Concentrations for each of the indicator parameters was within the historical range of variability as illustrated on the trend plots in Appendix C (the PSCLs are shown on the plots as a dashed line).

4.2.2 Indications of Significant Change

Sample results that could indicate an increase above what are considered to be natural background concentrations are evaluated to determine their significance with regard to operations or potential receptors. Potential actions taken in response to significant change are discussed in the Section 5.1.2 of the EMP. Examples of significant change include:

- Exceedance of a Safe Drinking Water Standard (primary MCL), unless historical water quality also exceeds that value (i.e., background is elevated). An example of elevated background concentration is arsenic which exceeds its MCL of 10 µg/L, but whose statistical background concentration is 12.1 µg/L.

- Detection at a concentration an order of magnitude higher than the historical trend.

- Detection of a previously undetected VOC.

None of these criteria were met in 2008 for analytical results from MW-22.

4.2.3 Trends

Downgradient of the active landfill cell on the east side, indicator parameter concentrations are stable in detection monitoring well MW-22. However, as mentioned above, sodium has been measured at its PSCL twice, in October of 2007 and 2008. In examining the longer-term trend for sodium in this well, it appears that there has been a slow creep upward in concentrations of a few mg/L over thirteen years. Chloride also

shows a modest increase, but none of the other indicators follow this pattern and, for some the trend is downward. Clearly, the degree of the relative increase is still within the calculated PSCL, but given the low statistical variability for sodium concentrations in this well and the short time frame for accumulating the baseline data (from August 1994 to April 2003, a total of 16 analyses), it could be that the long term natural variability of the statistical population was not fully defined when originally deriving the PSCLs.

For instance, climatic conditions over decades can alter groundwater quality in subtle ways. As an example, we plotted the annual precipitation for the Corvallis area over the period of monitoring. We then applied simple trend lines to the rainfall data and sodium data and found that from 1994 to 2008, the annual rainfall has declined while the sodium concentration for MW-22 has increased slightly (shown in Figure 4-1). This inverse correlation suggests that factors unrelated to a possible release (e.g., climate) could affect long-term trends in groundwater quality. In this situation, it could be from a lack of rainfall which affects the natural dilution of sodium in groundwater. Other site specific information that supports a cause other than the landfill is the sodium concentration in intervening detection monitoring well MW-25, which is upgradient and closer to the southeast perimeter of the landfill than MW-22. That well has lower sodium concentrations than at MW-22, effectively precluding a landfill-related release as the explanation for the inflection of the MW-22 sodium data.

In the mean time, VLI will continue to closely watch concentrations at MW-22, and if the sodium concentration exceeds a PSCL, will consult with the DEQ on developing an explanation as to the cause of the excursion. Part of the resolution may be to re-examine the statistical assumptions for the PSCLs in light of other causes of marginally increasing concentrations.

Table 5-4 of the EMP recommends potential actions that could be implemented should a non-hazardous compound increase in concentration or exceed a PSCL. In the situation that currently exists, possible responses include:

- Re-evaluate the statistical distribution of the baseline water quality data
- Continue monitoring
- Examine other compounds and other wells for any associated increases

Any findings from further data exploration could be presented to the DEQ, with a possible result being to re-set the PSCLs at statistically higher values for sodium and chloride based on additional baseline data.

4.3 Comparison to Water Quality Standards

Water quality standards are discussed with respect to detection and compliance wells on the east side and west side. Table 4-4 lists monitoring results that exceeded a water

quality standard. Additionally, the water quality summary tables in Appendix B list relevant water quality standards at the head of each column.

Primary Maximum Contaminant Levels (MCLs). No federal or state primary MCLs (health-based) were exceeded at eastside compliance well MW-22. The arsenic concentration in detection monitoring well MW-23 exceeded the primary MCL of 10 µg/L both sampling events (in this part of the landfill, the primary MCL is below the background concentration, which was estimated at 12.1 mg/L). Arsenic has declined in this well since approximately 2000 to background levels, but still shows some variability. The primary MCL for PCE was exceeded downgradient of Cell 1 along the west-side compliance boundary in MW-12S. VOCs were not detected in a detection monitoring well (P-8) approximately 250 feet downgradient of MW-12S. No other primary MCLs were exceeded at west-side wells for VOCs, trace metals or inorganic parameters.

Secondary MCLs. Federal and state secondary MCLs (non-health-based) were exceeded at eastside compliance well MW-22 for Fe and Mn, downgradient of Cell 2. Concentrations for those compounds are stable and reflect natural background conditions for this part of the site. Secondary MCLs for Fe and Mn were also exceeded at detection wells MW-23 and MW-25. Concentrations at MW-25 represent natural conditions for this part of the site.

At the west-side compliance boundary, the secondary MCL for chloride was exceeded at MW-10S where the trend is declining. The secondary MCL for Mn was exceeded at well pair MW-10S/10D both sampling events. These values are consistent with historical concentrations for those wells. Groundwater samples from compliance wells MW-20 and MW-21 (downgradient of the closed landfill) exceeded the secondary MCL for manganese in October.

5 MONITORING PLAN MODIFICATIONS AND RECOMMENDATIONS

There are minor changes planned for the landfill monitoring network or the monitoring program in 2009. One is to decommission piezometer QP-1S, which is located at the head of the Closed Landfill, very near to current quarry operations. The reason for decommissioning is that quarry will be operating next to the well and it was deemed prudent to remove the well rather than risk damaging it. Other changes to the monitoring network in the eastern part of the landfill could possibly occur in 2010 to accommodate construction of Cell 4. This would include decommissioning wells within and near the footprint of the planned cell, and establishing new compliance wells along the eastern, downgradient perimeter of the new cell. The other task is to repair the telemetry system that relays depth of liquid information for the primary and secondary sumps in Cells 2 and 3.

The October 2009 sampling event is scheduled as a split sampling event with the DEQ as specified in the solid waste permit.

Based on the information and discussion presented in Section 4.2, VLI proposes to not resample at MW-22, should the sodium concentration in that well be detected above the PSCL of 27 mg/L. Should sodium be detected above the PSCL, VLI will review the data and contact the DEQ in a timely manner to discuss possible actions to explain the excursion.

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Appendix B

Text Portion of Annual Leachate Management Report for Coffin Butte

Thiel
Engineering

Brian May
Valley Landfills, Inc.
28972 Coffin Butte Rd.
Corvallis, OR 97330

December 24, 2008

Re: 2007-08 Annual Leachate Management Report for Coffin Butte

Dear Brian:

This letter-report is being sent to you to fulfill the condition in Solid Waste Disposal Permit No. 306, Section 17.5, that an annual leachate management report for the Coffin Butte landfill be submitted for the previous water year. Information contained in this report is a summary of information provided by your staff to Thiel Engineering. This report covers the 2007-08 water year, from approximately October 1, 2007 to October 1, 2008.

1. OVERVIEW OF LEACHATE MANAGEMENT FOR THE 2007-08 WATER YEAR

During the 2007-08 rain year, leachate was generated from Cells 1, 2, and 3. Leachate from all sources was pumped into one of two leachate surge ponds on the south side of Coffin Butte Road. Leachate was treated by the following methods:

- All of the leachate was trucked to the waste-water treatment plant in the City of Corvallis. No leachate was irrigated onto the waste, and none was delivered to other treatment plants.

2. PRIMARY LEACHATE MANAGEMENT

Section 17.5 of the site's solid waste permit No. 306 lists the information that is to be included in the annual leachate management report. The six items to be reported are described in the following paragraphs.

2.1 Yearly Totals by Month

The permit requests that monthly totals be reported for (a) leachate volume generated from the landfill sumps and (b) leachate volume treated. These two values would be expected to be similar taking into account the difference in pond volume at the beginning and end of the water year, and any rain that falls into an active leachate pond.

There are two ways to estimate the volume of leachate generated. One is to use flow meters on the discharge lines from the leachate sumps. The other is use the volume

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treated (volumetrics). Both methods were used and are presented in the data provided by the Coffin Butte landfill in Table 1.

Both the flow meters and the volumetrics indicated that 27.2 million gallons (MG) of leachate were generated during the reporting period (compared to 29.9 MG last year).

Attachment 1 provides raw data on volumes of leachate treated, flow-meter data, and rainfall records.

The volume of leachate from the secondary leachate collection systems (SLCS) in Cells 2 and 3 is not itemized separately on Table 1 because this liquid was pumped directly into the primary sumps (the volumes are tracked for internal use). From the point of view of leachate management, the total volume of leachate managed from the primary Cells 2 and 3 sumps are inclusive of the SLCS volume. The volume that was extracted from the SLCS is discussed separately later in the report.

Table 1 - Summary of Coffin Butte Landfill 2007-2008 Leachate Volumes

2007-2008 Leachate Management Summary

Coffin Butte Landfill

Month	Corvallis WWTP	Leachate Irrigation onto Landfill	Treatment Plant	Pond Vol at Start of Month	Rainfall (inches)	Cell 1 Flowmeter	Cell 2 Flowmeter	Diaphragm Pumps	Downwell Pumps	Condensate Sump	Cell 3 Flowmeter	No. of days irrig. occurred	Avg irrig. per day
Oct-07	2,159,117	0	0	3,750,000	3.05	206,331	669,110	155,975	90,215		530,550	0	0
Nov-07	1,855,458	0	0	3,260,000	3.53	302,681	650,965	191,868	178,817		584,355	0	0
Dec-07	2,625,002	0	0	3,600,000	9.55	308,893	1,332,340	392,357	430,503		1,419,475	0	0
Jan-08	4,746,465	0	0	4,590,000	8.92	330,020	1,330,865	464,794	572,591		1,451,300	0	0
Feb-08	3,701,442	0	0	3,900,000	3.15	386,363	948,787	511,509	456,738		991,460	0	0
Mar-08	3,349,984	0	0	3,370,000	4.89	340,379	549,871	489,950	258,565	62,980	759,050	0	0
Apr-08	2,844,547	0	0	2,890,000	2.48	327,915	375,235	484,968	230,922	101,625	576,740	0	0
May-08	2,422,499	0	0	2,100,000	0.18	266,437	283,150	437,026	229,419	122,087	502,780	0	0
Jun-08	1,836,176	0	0	1,430,000	0.72	249,868	175,052	378,440	140,548	104,678	446,370	0	0
Jul-08	1,363,195	0	0	1,170,000	0.04	326,930	172,201	354,476	149,143	97,400	404,040	0	0
Aug-08	1,402,962	0	0	1,120,000	1.57	240,406	445,221	77,386	168,378	112,090	404,411	0	0
Sep-08	1,109,419	0	0	1,230,000	0.37	229,534	510,864	40,242	185,105	132,670	333,299	0	0
Oct-08				1,540,000									
Totals	29,416,266	0	0		38.45	3,515,757	7,443,662	3,978,992	3,090,944	733,530	8,403,830	0	0

2007-2008 TOTAL LEACHATE VOLUME TREATED:	29,416,266
LEACHATE GENERATED FROM VOLUMETRICS:	27,206,266
LEACHATE GENERATED FROM FLOWMETERS:	27,166,714
Ratio of flowmeters to volumetrics:	1.00

Notes:
1.) All values in gallons unless noted
2.) Leachate season Oct 1 to Oct 1

2.2 Review of Significant Leachate Management Events That Occurred During the Last Water Year

Significant events for the 2007-08 water year are noted in the points below.

- Rainfall of 38.45 inches which is slightly below normal average precipitation (normal at Hyslop is approx 41 inches).
- Leachate volumes generated were slightly lower than the previous year.
- Cell 3D-Phase 2 construction was performed in 2008, adding approximately 4.2 acres of new lined area. No cell closure construction was performed in 2008.
- No leachate irrigation was performed on the landfill in the last water year.

2.3 Review of Leachate Monitoring Network and Recommendations for Improvements

The leachate monitoring network includes the following components:

- Volume estimates for each of the treatment methods are made using a range of techniques such as flow meters, or truck counts.
- Monitoring effluent quality of the on-site treatment plant is performed in accordance with the site's NPDES permit (none performed in 2008).
- Leachate quality monitoring is performed for the POTWs and for the solid waste permit in the annual groundwater monitoring report.
- Monitoring of head levels in the landfill primary and secondary sumps (for Cells 2 and 3) is intended to be performed using transducers and automatic recording. The transducers and telemetry system continued to have significant technical problems this past year, and no head-data is available. This situation is actively being corrected, and data should be available for the next report. Based on settings for the on/off switch for the pumps in the primary and secondary sumps, and the fact that the pumps operated normally, without any pump failures, it can be inferred that, on average, the head levels in the sumps met permit requirements.
- Monitoring of pond levels (volumes) is recorded regularly using manual dip-sticks in the leachate holding ponds. West Pond is manual dipped. The East pond volume is estimated from the flow meters. The inventory of both ponds combined is included in Table 1.
- The regular maintenance for the leachate sumps (pumping sediment well, pump, check valves, and flowmeters) was performed on a quarterly basis.

2.4 Summary of Site Conditions and Compilation of Monitoring and Analysis Data

Table 2 provides a summary of the monitoring and analysis data references. Site conditions relative to leachate management in the 2007-08 water year were efficient and well-managed, with the exception of the telemetry system not working.

Table 2 - Monitoring and Analysis Summary Data References

Monitoring or Analysis Item	Reference
Flow meters from landfill sumps	Significant amounts of useful data over the reporting period, summarized in Att. 1.
Volumes handled by various methods	Table 1.
Gas production changes, waste saturation, and side-slope seeps in waste irrigation areas	Since leachate irrigation was not performed, these issues are not monitored relative to leachate, and they are managed separately.
Effluent quality from treatment plant	Monthly monitoring reports sent to DEQ (Water Quality Dept) for NPDES compliance (reported "No Discharge" each month this year).
Leachate quality	Annual Water Quality Monitoring Report to be issued by March 31 of each year.
Head level in Cell 2 primary and secondary leachate sumps. Head Level in Cell 3 primary and secondary.	Technical problems with the data-logging equipment this year. Repairs are actively underway with consultant.
Rainfall	Recorded automatically by site weather station.
Pond levels (volumes)	Table 1 for beginning and ending volumes; monitored weekly.

2.5 Summary of Reports for Monitoring Irrigation on Waste

The leachate irrigation program was phased out and put on indefinite hold at the beginning of the 2006-07 water-year, and none occurred in the 2007-08 water-year.

2.6 Proposed Plans/Changes for Upcoming Leachate Management

The strategy for future leachate management is as follows:

- Continue with aggressive landfill operations and cover procedures to reduce leachate generation from precipitation to the extent possible.
- Continue to maintain all management options for treating leachate.

LEACHATE COLLECTED FROM THE SECONDARY LEACHATE COLLECTION SYSTEM (SLCS)

The amount pumped from the Cell 2 SLCS for the 2007-08 water year was approximately 108,457 gallons, compared to 126,030 gallons in the previous year. This is less than half the amount that was collected the 2005-06 water year (227,760 gallons). Production from Cell 3 SLCS was not recorded for the water year because it was minimal.

If there are any questions concerning the contents of this report, please call me at 530/692-9114.

Sincerely,
Thiel Engineering



Richard Thiel, P.E.
Oregon RCE # 14894

Attachments:
1. Site data for leachate volumes handled, flow meters, and rainfall.

Appendix C

Summary of Landfill Users by County of Origin, Tonnage and Total Vehicles

Coffin Butte Landfill Vehicles by Class and Tons Disposed - Total for Year 2008

	Commecial Vehicles Intercompany Franchised &		Private Vehicles	Total Vehicles	Total Tons
	MSW	C&D	(Includes Special Waste, Asbestos, & Public)		
County	Tons	Tons	Tons		
Benton	46,649.43	5,058.06	8,023.75	23,116	59,731.24
Linn	91,502.39	3,057.04	29,268.12	22,304	123,827.55
Polk	25,470.92	1,318.16	4,392.37	11,250	31,181.45
Marion	49,100.10	1,417.02	9,834.67	4,838	60,351.79
Lane	1,496.49	418.23	40,403.18	1,819	42,317.90
Tillamook	23,734.27	-	1,992.49	1,260	25,726.76
Yamhill	0.00	7.42	17.62	9	25.04
Lincoln	27,501.97	8.85	538.47	1,295	28,049.29
Coos	19,368.39	-	2,186.33	775	21,554.72
Curry	0.00	-	14.88	1	14.88
Washington	44,116.76	0.00	3,229.87	1,724	47,346.63
Josephine	-	-	8.81	1	8.81
Multnomah	0.00	0.00	31.55	122	31.55
Douglas	0.00	0.00	358.75	19	358.75
Clackamas	10,193.24	20.77	2,745.29	582	12,959.30
Columbia	-	-	4,607.45	154	4,607.45
Harney	-	0.00	0.37	1	0.37
Gilliam	-	-	0.00	0	0.00
Baker	3.46	1.82	1.78	10	7.06
Malheur	-	-	0.00	0	0.00
Lake	-	-	0.59	2	0.59
Misc. County	0.00	0.00	11.40	2	11.40
King, WA	0.00	0.00	0.00	0	0.00
Cowlitz, WA	-	0.00	372.05	16	372.05
Pierce, WA	1.79	-	0.00	5	1.79
Snohomish, WA	-	-	0.00	0	0.00
M-Clackamas	-	-	29,061.03	1,686	29,061.03
M-Multnomah	-	-	24,036.07	999	24,036.07
M-Washington	15,286.87	-	1,525.25	703	16,812.12
Totals	**339,139.21**	**11,307.37**	**161,136.89**	**72,693**	**528,395.59**

Coffin Butte Landfill Vehicles by Class and Tons Disposed - Total for Year 2007

	Commecial Vehicles Intercompany Franchised &		Private Vehicles	Total Vehicles	Total Tons
	MSW	C&D	(Includes Special Waste, Asbestos, & Public)		
County	Tons	Tons	Tons		
Benton	45,888.36	7,905.09	7,246.46	26,268	61,039.91
Linn	105,373.22	5,649.96	17,794.66	25,393	128,817.84
Polk	29,004.33	2,430.29	4,024.95	13,507	35,459.57
Marion	63,054.04	3,764.88	4,385.40	6,874	71,204.32
Lane	1,453.22	200.38	2,345.90	389	3,999.50
Tillamook	24,448.75	-	923.99	1,176	25,372.74
Yamhill	21.57	0.54	44.48	16	66.59
Lincoln	28,897.99	32.74	569.59	1,399	29,500.32
Coos	23,385.64	-	1,163.40	1,011	24,549.04
Washington	76,600.68	3.86	16,443.70	3,783	93,048.24
Jackson	-	-	0.13	1	0.13
Multnomah	58.21	8.82	22,457.36	922	22,524.39
Douglas	0.00	54.62	914.87	67	969.49
Clackamas	7,496.30	0.33	29,475.62	1,946	36,972.25
Columbia	-	-	13,152.56	459	13,152.56
Harney	0.60	0.00	0.49	3	1.09
Gilliam	0.21	-	0.00	1	0.21
Sherman	-	-	0.20	1	0.20
Deschutes	-	8.36	0.00	3	8.36
Baker		3.89	3.70	12	7.59
Malheur	0.64	-	0.00	1	0.64
Lake	-	2.70	4.04	3	6.74
King, WA	1.02	0.00	0.00	1	1.02
Cowlitz, WA	120.98	0.00	123.12	10	244.10
Pierce, WA	2.70	2.80	0.00	8	5.50
Snohomish, WA	-	-	44.07	8	44.07
Totals	**405,808.46**	**20,069.26**	**121,118.69**	**83,262**	**546,996.41**

Appendix D

Certificate of Liability Insurance Showing Benton County as Additional Insured

MARSH

CERTIFICATE OF INSURANCE

CERTIFICATE NUMBER
HOU-000690885-06

PRODUCER

Marsh USA Inc.
1000 Main Street, Suite 3000
Houston, TX 77002
Attn: Houston.Certs@marsh.com Fax# 212.948.0509

016022-AWNA-Poll-08-10 F32

INSURED

Allied Waste North America, Inc.
(Named Insured Continued Below)
18500 North Allied Way
Phoenix, AZ 85054

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES DESCRIBED HEREIN.

COMPANIES AFFORDING COVERAGE

COMPANY A American International Specialty Lines Ins Co

COMPANY B

COMPANY C

COMPANY D

COVERAGES This certificate supersedes and replaces any previously issued certificate for the policy period noted below. 5

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE DESCRIBED HEREIN HAVE BEEN ISSUED TO THE INSURED NAMED HEREIN FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THE CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, CONDITIONS AND EXCLUSIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$
	☐ COMMERCIAL GENERAL LIABILITY				PRODUCTS - COMP/OP AGG	$
	☐ CLAIMS MADE ☐ OCCUR				PERSONAL & ADV INJURY	$
	☐ OWNER'S & CONTRACTOR'S PROT				EACH OCCURRENCE	$
	_____				FIRE DAMAGE (Any one fire)	$
					MED EXP (Any one person)	$
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT	$
	☐ ANY AUTO					
	☐ ALL OWNED AUTOS				BODILY INJURY (Per person)	$
	☐ SCHEDULED AUTOS					
	☐ HIRED AUTOS				BODILY INJURY (Per accident)	$
	☐ NON-OWNED AUTOS					
	_____				PROPERTY DAMAGE	$
	GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
	☐ ANY AUTO				OTHER THAN AUTO ONLY:	
	_____				EACH ACCIDENT	$
					AGGREGATE	$
	EXCESS LIABILITY				EACH OCCURRENCE	$
	☐ UMBRELLA FORM				AGGREGATE	$
	☐ OTHER THAN UMBRELLA FORM					$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE: ☐ INCL ☐ EXCL				EL EACH ACCIDENT	$
					EL DISEASE-POLICY LIMIT	$
					EL DISEASE-EACH EMPLOYEE	$
A	OTHER Pollution Legal Liability	PLS 1897971	06/01/08	06/01/10	Each Incident Limit	6,000,000
					Aggregate	6,000,000
					Self-Insured Retention	5,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

Named Insured Includes Valley Landfills, Inc, DIV# F32

CERTIFICATE HOLDER

Benton County, Oregon
Chairman of the Board of Commissioners
408 SW Monroe Avenue, Suite 111
PO Box 3020
Corvallis, OR 97339-3020

CANCELLATION

SHOULD ANY OF THE POLICIES DESCRIBED HEREIN BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE INSURER AFFORDING COVERAGE WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED HEREIN, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER AFFORDING COVERAGE, ITS AGENTS OR REPRESENTATIVES, OR THE ISSUER OF THIS CERTIFICATE.

AUTHORIZED REPRESENTATIVE
of Marsh USA Inc.
BY: Stephanie S. Story



MM1(3/02) VALID AS OF:01/20/09

Appendix E

Summary of Processing and Recovery Center Activity 2007 - 2008

Summary of Processing and Recovery Center Activity 2008							
Recycling					Sales		
	Green Waste		Urban Wood Waste		Wood Chips	Hog Fuel	Compost
	Cubic Yards	Tons	Cubic Yards	Tons	Cubic Yards	Tons	Cubic Yards
Inbound	12,274.00	18,360.83	5,430.43	5,474.10			
Outbound					0.00	12,717.87	15,458.55
Totals	**12,274.00**	**18,360.83**	**5,430.43**	**5,474.10**	**0.00**	**12,717.87**	**15,458.55**

Summary of Processing and Recovery Center Activity 2007							
Recycling					Sales		
	Green Waste		Urban Wood Waste		Wood Chips	Hog Fuel	Compost
	Cubic Yards	Tons	Cubic Yards	Tons	Cubic Yards	Tons	Tons
Inbound	17,335.50	18,780.32	8,550.00	7,040.00			
Outbound					0.00	10,381.67	17,178.55
Totals	**17,335.50**	**18,780.32**	**8,550.00**	**7,040.00**	**0.00**	**10,381.67**	**17,178.55**

From: Paul Nietfeld
To: Benton Public Comment
Subject: LU-24-027: Conditional Use Permit Application Regarding Landfill Expansion
Date: Wednesday, May 7, 2025 11:01:04 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

From: Paul Nietfeld, 37049 Moss Rock Dr., Corvallis, OR, 97330

Dear Chair Fowler and Members of the Benton County Planning Commission:

Thank you for the opportunity to comment on this Conditional Use Permit (CUP) application, and in particular the extension of the public meeting schedule to accommodate all who wish to speak. The opportunity to present public testimony on the landfill issue is very much appreciated by many of the county residents, myself included.

Attached is the brief presentation I had prepared to deliver verbally, with the expectation that members of the public would either be allowed to present graphics electronically or at a minimum by handing out printed copies for Commissioners to view during my presentation. Understanding now that neither of these options is supported in the current meeting structure, I am providing this document in advance of my live testimony so that you will have access to the document for reference during my presentation and/or preview in advance.

Even this short presentation is now repetitive on some points already covered in public testimony of May 6. As requested, I will not repeat these in my live presentation, but I do wish to reiterate my support for the following:

Conditions of approval have proven to be wholly ineffective with regard to the Coffin Butte Landfill. I or other members of the public will provide separate additional written testimony documenting the specific conditions that have been ignored and/or unenforced. Based on the historical record the Planning Commission should consider the effectiveness of such conditions as highly dubious in the case of this CUP. I believe this applies in particular to the speculation noted by Outside Counsel Ryan in the April 29 meeting that the intake cap currently in force as a contractual obligation under the 2020 Landfill Franchise Agreement ("2020 LFA") could be effectively continued via a Condition of Approval if the Committee were to vote to approve this CUP application. I will elaborate on the importance of this point during my verbal testimony in reference to the Coffin Butte Landfill Intake plot (Page 2 of attached document).

The observed impacts and burdens of the landfill have grown significantly worse in recent years. Mr. Henkels and others noted this point, and as a resident living in the vicinity of the landfill I absolutely agree. In my verbal testimony I will address the intake volume increase in 2017 that I believe explains much of the observed increased impact.

Approval of a new landfill cell via LU-24-027 would increase the negative impacts of this landfill and extend the duration of these impacts. Both of these factors are important.

The character of the area is pastoral, not landfill. The landfill was long considered to be a temporary blight on this otherwise beautiful, productive area. As recently as 2008 (the year

Republic Services took over operation) the landfill had been developed and managed in a manner that largely controlled its impact on surrounding property (see the aerial photo on the front page of the 2008 Coffin Butte Annual Report, attached). The landfill is now the largest, busiest industrial operation in Benton County, with corresponding burdens, harms and visual blight. The sooner expansion is foreclosed the sooner we collectively can proceed with returning the landfill area to a semblance of its former pastoral nature.

Given the landfill burdens and harms I have observed and the high probability of increased burdens and harms if the LU-24-027 application were to be approved, I ask you to please vote to deny this application.

Thank you again for all the personal time, effort and attention you are applying as Planning Commissioners to this complex and challenging decision.

Regards,
Paul Nietfeld

LU-24-027

Two Facts: Background/Context for the CUP Decision

Paul Nietfeld 37049 Moss Rock Dr. Corvallis, Oregon 97330

Member of the A.1 Subcommittee of BCTT: Landfill Size / Capacity / Longevity

Fact 1: Expansion of the Coffin Butte Landfill is already underway

Source: 2023 Coffin Butte Annual Report, Google Earth imagery of 3/30/2025, Applicant Testimony of 5/1/2025

- Filling of Cell 6 (Quarry cavity) began this year
- Approx. 14M cubic yards
- 50+% increase over current landfill size (1942 – 2025)
- No permit
- No Planning Commission review
- No conditions of approval



Credit: E J Harris Photography

Franchisee presentation of 5/1/2025 to Planning Commission

- Cell 6 not identified ("Quarry")
- Cell 6 similar in footprint area to proposed expansion
- Cell 6 similar in structure to proposed expansion: steep, sharp excavated cavity



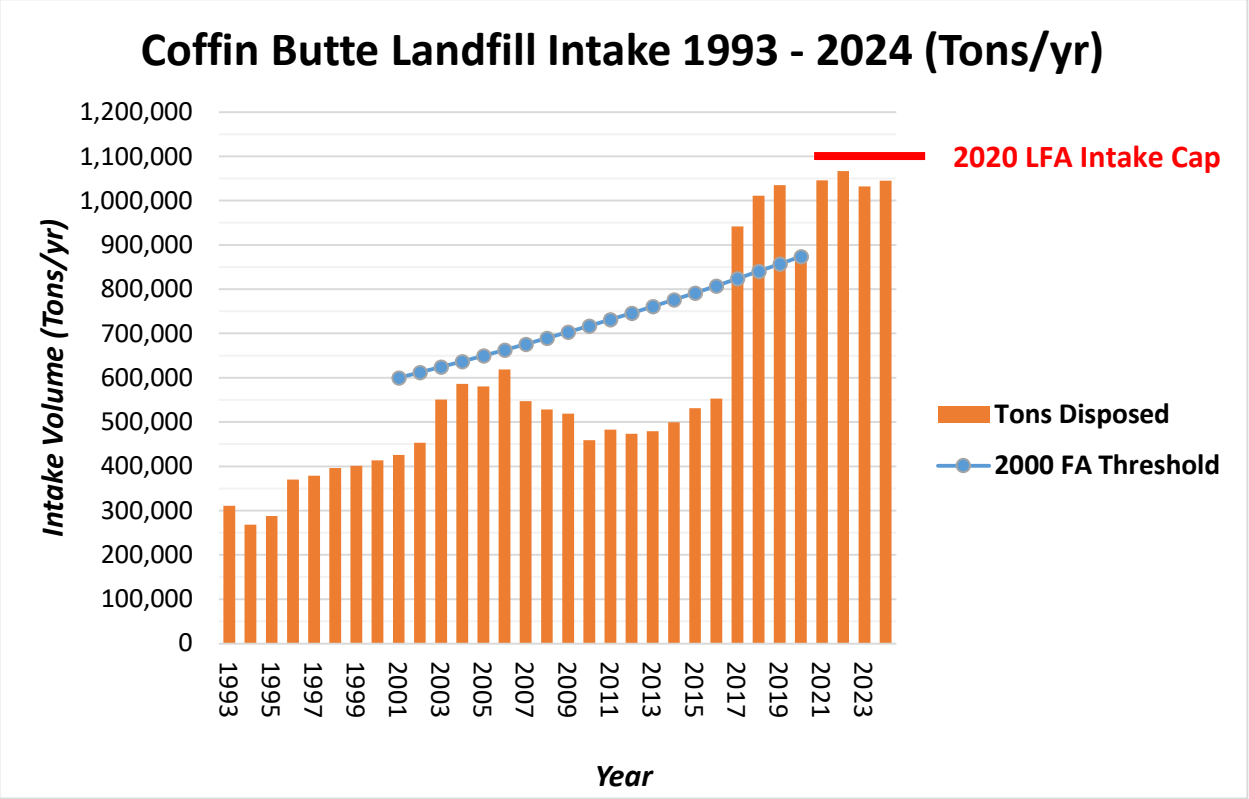
Cell 6 burdens, harms, and damage are yet to be determined

- Will add more than a 50% increase to waste in place volume over the next 11-12 years
- Unique characteristics: liner placement on steep face, excavation below ground level
- Groundwater contamination over time is a particular concern with this cell

It would be imprudent to approve a second expansion in parallel with Cell 6 before the Cell 6 burdens are known

Fact 2: A vote to approve LU-24-027 is a vote to remove the intake cap

Source: 2020 Landfill Franchise Agreement, Section 5(b)



Data/plot from BCTT Final Report, P. 620, with 2023 and 2024 intake figures added

Approval of LU-24-027 will remove the contractual legally binding intake tonnage cap

Outside counsel: Are conditions of approval or applicant statements similarly legally binding?

Franchisee could have asked to renegotiate the 2020 LFA prior to this CUP **but did not**

Intake for the past 8 years indicates high demand for landfill volume, but cap appears to be honored

Closure of the Reworld incinerator in Marion County will likely add to the demand

The 70% year-over-year increase 2016-2017 demonstrates volume increase capability

Intake volume growth rate 2000-2024 = approximately 3x the area population growth rate[1]

Franchisee's application drawings state an expected 1.5 – 1.86M CY/year fill rate[2]

No intake limit → No limit on the harms and burdens resulting from the intake rate

- Traffic / Accidents / Road Damage & Repair Cost / Trash: Roadside & Farm Fields / Noise / Odor

Therefore the application should be denied

[1] Area (Benton, Lincoln, Linn, Marion, Polk, Tillamook) growth = 30.3% 2000-2024 (Portland State Univ. Population Research Center), or approximately 1.9%/year; CBL intake growth = 152.5% 2000-2024, or approximately 6.8%/year.

[2] *322142 - Coffin Butte CUP Plans - Final Drawings_compressed_Part1.pdf*, Pages 15-18. Assuming this includes a 15% ADC burden, at 0.98 Tons/CY this corresponds to "Solid Waste" intake volumes of 1.28 M Tons/year and 1.59 M Tons/year respectively.

Coffin Butte Landfill
2008 Benton County Annual Report



COFFIN BUTTE LANDFILL

2008 Summary of Operations and Environmental Monitoring

This report provides a summary of the following aspects of Coffin Butte Landfill operational and environmental status for calendar year 2008:

- Landfill Capacity
- Future Landfill Cell and Infrastructure Development
- Summary of Annual Groundwater Monitoring Report
- Summary of Annual Leachate Management Report
- Summary of Title V Air Monitoring Report
- Summary of Landfill Users by County of Origin, Tonnage and Total Vehicles
- Status of Environmental Trust Fund and Insurance
- Summary of Environmental and Regulatory Permits
- Summary of Customer Complaints at Coffin Butte Landfill
- Summary of Processing and Recovery Center Activity

LANDFILL CAPACITY

Coffin Butte Landfill has permitted airspace of 39,594,002 cubic yards (including consumed). During 2008 the landfill accepted 528,395 tons of solid waste. Based on historical aerial fly-over data, the average effective density of the in-place waste at the Coffin Butte Landfill is 0.80 tons/cy.[1] Therefore, an estimated 660,494 cubic yards of airspace was used for the year. A total of 11,808,920 cubic yards has been consumed as of December 31, 2008.

The remaining capacity for the entire permitted landfill footprint as of the end of 2008 was approximately 27,785,082 cubic yards. This information is updated annually with aerial flyovers. Using 0.80 tons/cy, the remaining available landfill space expressed in tons is about 22,228,066 tons. Using the current disposal rate of approximately 600,000 tons per year, there are about 37.1 years of landfill space available.

FUTURE INFRASTRUCTURE DEVELOPMENT

The following projects and estimated timing for construction are anticipated for the upcoming year:

- A real-time flow monitor will replace the existing "smart box" used to control leachate discharge volumes to the City of Corvallis Waste Water Reclamation Plant (WWRP). Installation and testing will be completed in spring of 2009.

- Approximately 25 vertical and horizontal landfill gas extraction wells are scheduled for decommission/abandonment and/or replacement on Cells 2B, 2C, and 3C during the summer of 2009. In addition, approximately 10 new pumps will be installed during spring/summer of 2009

[1] Effective density incorporates the effects of daily and intermediate soil cover usage. It is calculated by measuring the amount of airspace occupied between successive aerial flyovers using photogrammetric maps, and dividing that volume into the number of tons of waste received at the gate.

SUMMARY OF ANNUAL GROUNDWATER MONITORING REPORT

This annual report provides a summary of the water quality monitoring activities at Coffin Butte Landfill during 2008. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI). Environmental monitoring and associated reporting is required by the landfill's solid waste disposal permit number 306, issued and administered by the Oregon Department of Environmental Quality (DEQ).

During 2008, no significant changes in water quality were measured. Volatile organic compound (VOC) concentrations in wells along the compliance boundary were below primary drinking water standards with the exception of MW-12S, where tetrachloroethene (PCE) was detected above the drinking water standard. Beginning in 2007, the trend in MW-12S declined and is currently below 10 micrograms per liter (µg/L). Vinyl chloride was not detected in any of the site monitoring wells and represents continued depletion of VOCs in the aquifer. Other than PCE, five VOCs were detected at low concentrations (below 3 µg/L) and several inorganic parameters were present above background concentrations. Since the landfill cover was installed on Cells 1/1A in 1996 and landfill gas removal wells were installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. Groundwater conditions at the detection wells (MW-17, MW-18, MW-19, and P-8), 300 to 400 feet downgradient of the compliance boundary, reflect background water quality.

At the compliance boundary for Cell 2, no primary drinking water standards were exceeded and concentrations of monitored parameters are at or below the permit-specific concentration limits.

Downgradient of the closed landfill, groundwater quality trends are stable as well. Based on the age of the landfill, it is expected that the existing low level impacts will diminish with time.

Leachate production for the water year 2007-2008 was estimated at 27.2 million gallons of leachate. This was generated by Cells 1, 2, and 3 during the water year ending September 30, 2008. VLI continues to monitor the secondary leachate collection system (SLCS) beneath Cell 2. The rate of liquid infiltrating to the system declined in 2008 to below that of the previous year.

The text portion of the groundwater report is presented in Appendix A.

SUMMARY OF ANNUAL LEACHATE MANAGEMENT REPORT

Leachate production and management for the water-year October 2007 to October 2008 is discussed in a report by Thiel Engineering (2008). The text portion of the leachate report is presented in Appendix B.

SUMMARY OF ANNUAL TITLE V AIR MONITORING REPORT

Air emissions generated at the Coffin Butte Landfill in 2008 were summarized in a report on DEQ forms prepared by Valley Landfills. The air emissions generated in 2008 were less than the plant site emission limits (PSELs) allowed under the Title V Operating Permit and there were not any deviations from the Title V Operating Permit conditions.

The landfill received, responded to, documented and reported 38 odor complaints to DEQ. Semi-annual meetings with the public are conducted as part of Title V permit. The meetings give the public and Coffin Butte Landfill an opportunity to discuss improvements being made to address the odor issues.

SUMMARY OF LANDFILL USERS BY COUNTY OF ORGIN, TONNAGE AND TOTAL VEHICLES

Tables showing the 2007 and 2008 landfill users by vehicle class, tonnage and county of origin are presented in Appendix C.

STATUS OF ENVIRONMENTAL TRUST FUND AND INSURANCE

The value of the Environmental Trust on 12/31/2008 was $4,496,176.

The value of the Environmental Trust on 12/31/2007 was $6,841,458.

The value of the Environmental Trust on 12/31/2006 was $6,472,396.

A copy of the Certificate of Liability Insurance, showing Benton County as an additional insured is presented in Appendix D.

SUMMARY OF ENVIRONMENTAL AND REGULATORY PERMITS

Permit Number	Permit Type	Permit Terms	Renewal Date	Enforcement Actions - 2008	Comments
SWDP # 306	Solid Waste	10 Year	March 1, 2009	None	Application Accepted – Automatic Permit Extension
# 1200Z	NPDES Stormwater	5 Year	June 30, 2007	None	Application to Permit Reviewer
#101545	NPDES Leachate Treatment	5 Year	September 30, 2008	None	Application Complete
#02-9502	Title V Air Quality	5 Year	February 1, 2010	None	Application Renewal Submitted Alternative Operating and Monitoring Plan Approved

SUMMARY OF CUSTOMER COMPLAINTS – COFFIN BUTTE

Customer Complaints at Coffin Butte Landfill and the Process & Recovery Center - 2008

Price	Public Tipping Area	Process and Recovery Center
6	6	0

The table was compiled from the verbal complaints logged at the Coffin Butte and the Process and Recovery Center scale houses. The landfill also received positive compliments related to the public tipping area and assistance at the public tipping.

SUMMARY OF PROCESSING AND RECOVERY CENTER ACTIVITY 2008

Green waste and urban wood waste recycling activity at the Processing and Recovery Center (PRC), including and compost and hog fuel sales are presented in Appendix E.

REFERENCES

2008 Annual Monitoring Report for the Coffin Butte Landfill. Prepared by Tuppan Consultants LLC and submitted to the DEQ on March 2009.

2007-08 Annual Leachate Management Report for Coffin Butte. Prepared by Thiel Engineering, and submitted to DEQ on December 2008.

Annual Report for Year 2008, Oregon Title V Operating Permit Number 02-9502, Coffin Butte Landfill. Prepared by Valley Landfills, Inc. and submitted to the DEQ February 2009. This annual report provides a summary of the air quality monitoring activities at Coffin Butte Landfill during 2008. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI) a subsidiary of Allied Waste. Environmental monitoring and associated reporting is required by the landfill's Title V permit, issued and administered by the Oregon Department of Environmental Quality (DEQ).

Appendix A

Text Portion of Annual Groundwater Monitoring Report

2008 ANNUAL MONITORING REPORT

COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

Prepared for

Valley Landfills, Inc.

March 19, 2009

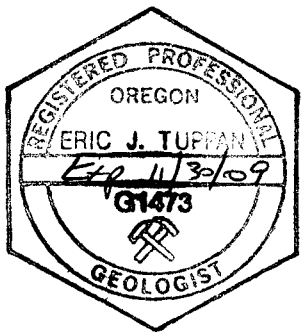
Prepared by

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LAKE OSWEGO, OREGON 97034

Project VLI-001-002

2008 Annual Monitoring Report
Coffin Butte Landfill
Benton County, Oregon

The material and data in this report were prepared under the supervision and direction of the undersigned.



TUPPAN CONSULTANTS LLC

Eric J. Tuppan, R.G.

CONTENTS

SIGNATURE PAGE ii

LIST OF TABLES AND ILLUSTRATIONS vi

EXECUTIVE SUMMARY vii

1 INTRODUCTION 1-1

2 WATER QUALITY MONITORING 2-1
2.1 Monitoring Network 2-1
2.2 Sampling and Analysis Program 2-1

3 FINDINGS 3-1
3.1 Hydrogeology 3-1
3.1.1 Groundwater Occurrence and Flow 3-1
3.1.2 Groundwater Velocity 3-2
3.2 Water Quality 3-3
3.2.1 Data Quality 3-3
3.2.2 Groundwater 3-3
3.2.2.1 West Side 3-4
3.2.2.2 East Side 3-5
3.2.2.3 Former Leachate Irrigation Fields 3-6
3.2.3 Surface Water 3-7
3.2.4 Underdrains 3-7
3.3 Secondary Leachate Collection System 3-8
3.3.1 Cell 2 3-8
3.3.2 Leachate Ponds 3-9
3.4 Leachate Production 3-9
3.5 Landfill Gas Monitoring 3-9

4 DISCUSSION 4-1
4.1 West Side 4-1
4.1.1 Aquifer Restoration-Contaminant Removal 4-1
4.1.1.1 Cells 1/1A 4-1
4.1.1.2 Closed Landfill 4-2
4.1.2 Source Control Effectiveness 4-2

CONTENTS (Continued)

4.1.3	Plume Stabilization	4-3
4.1.4	Protectiveness Monitoring	4-3
4.2	East Side	4-4
4.2.1	Comparison to Concentration Limits	4-4
4.2.2	Indications of Significant Change	4-4
4.2.3	Trends	4-4
4.3	Comparison to Water Quality Standards	4-5
5	**MONITORING PLAN MODIFICATIONS AND RECOMMENDATIONS**	**5-1**
REFERENCES		
LIMITATIONS		

CONTENTS (Continued)

APPENDIX A DATA REVIEW MEMORANDA

APPENDIX B 2008 WATER QUALITY SUMMARY TABLES

APPENDIX C TIME-SERIES CONCENTRATION PLOTS

APPENDIX D SLCS AND LCRS DATA

TABLES AND ILLUSTRATIONS

Following Report:

Tables

2-1 Description of Monitoring Network
2-2 Well Construction Summary
2-3 Monitoring Program
3-1 Groundwater and Surface Water Elevations
3-2 Trends of Inorganic Indicator Parameters—Cells 1 and 1A
3-3 VOC Detections
3-4 Trends of Volatile Organic Compounds—Cells 1 and 1A
3-5 Constituent Trends—Closed Landfill
3-6 Trends of Inorganic Parameters—Cell 2
3-7 Inorganic Constituents in Underdrains
3-8 Dissolved Metals in Underdrains
3-9 Water Year Summary for SLCS Volume Data
3-10 Landfill Gas Monitoring
4-1 Comparison of Sampling Results with RACLs-West Side
4-2 Historical Number of VOCs at Compliance Wells
4-3 Comparison of Sampling Results with PSCLs, East Side - MW-22
4-4 Sample Results Above Drinking Water Standards

Figures

1-1 Site Location
3-1 Hydrographs for Cell 2 Area Wells
3-2 Hydrographs for Upgradient Bedrock Wells
3-3 Hydrographs for Cell 1A Area Wells
3-4 Hydrographs for Cell 1 Area Wells
3-5 Groundwater Contours, April 2008
3-6 Groundwater Contours, October 2008
4-1 Sodium and Rainfall at MW-22

EXECUTIVE SUMMARY

This annual report provides a summary of the water quality monitoring activities at Coffin Butte Landfill during 2008. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI). Environmental monitoring and associated reporting is required by the landfill's solid waste disposal permit number 306, issued and administered by the Oregon Department of Environmental Quality (DEQ).

During 2008, no significant changes in water quality were measured. Volatile organic compound (VOC) concentrations in wells along the compliance boundary were below primary drinking water standards with the exception of MW-12S, where tetrachloroethene (PCE) was detected above the drinking water standard. Beginning in 2007, the trend in MW-12S declined and is currently below 10 micrograms per liter (µg/L). Vinyl chloride was not detected in any of the site monitoring wells and represents continued depletion of VOCs in the aquifer. Other than PCE, five VOCs were detected at low concentrations (below 3 µg/L) and several inorganic parameters were present above background concentrations. Since the landfill cover was installed on Cells 1/1A in 1996 and landfill gas removal wells were installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. Groundwater conditions at the detection wells (MW-17, MW-18, MW-19, and P-8), 300 to 400 feet downgradient of the compliance boundary, reflect background water quality.

At the compliance boundary for Cell 2, no primary drinking water standards were exceeded and concentrations of monitored parameters are at or below the permit-specific concentration limits.

Downgradient of the closed landfill, groundwater quality trends are stable as well. Based on the age of the landfill, it is expected that the existing low level impacts will diminish with time.

Leachate production for the water year 2007-2008 was estimated at 27.2 million gallons of leachate. This was generated by Cells 1, 2, and 3 during the water year ending September 30, 2008. VLI continues to monitor the secondary leachate collection system (SLCS) beneath Cell 2. The rate of liquid infiltrating to the system declined in 2008 to below that of the previous year.

1 INTRODUCTION

This report presents results of water quality and landfill gas probe monitoring during the 2008 calendar year at the Coffin Butte Landfill in Benton County, Oregon (Figure 1-1), operated by Valley Landfills, Inc. (VLI). For the April event, water quality sampling was performed by Kennec, Inc. Subsequently, TUPPAN CONSULTANTS LLC oversaw sampling (the October event), managed the water quality data, and prepared this annual report. Annual reporting is required by Section 17.2 of the landfill's solid waste disposal permit number 306, issued by Oregon Department of Environmental Quality (DEQ) on March 9, 1999.

In late 2004 and 2005, the process for selecting and approving a remedy for the west side of the site and for setting concentration limits for the east side of the site was completed. The solid waste permit was amended November 4, 2004, to incorporate concentration limits for the east side and cleanup levels for the west side. The DEQ signed the Record of Decision (ROD) on November 2, 2005 (DEQ, 2005). Subsequent to issuing the ROD, VLI updated and revised the Environmental Monitoring Plan (TC, 2005b), which describes methods of evaluating water quality data and updates the practical aspects of monitoring at the site. The Environmental Monitoring Plan (EMP) also outlines the manner in which water quality data is used to evaluate the remedy performance and describes types of response actions that would be implemented if concentrations at east-side compliance well MW-22 were exceeded.

As defined in the EMP, the annual report serves as the mechanism to (1) collate and report analytical data for the past year, (2) assess achievement of remedial goals for the west side, and (3) evaluate detection monitoring data for east-side cells which bears on the performance of the engineered liner systems for the active waste management units. The last two items will be discussed in Section 4 of the annual report.

For the west side, the purpose of the report is to assess (1) the effect of remedial actions on groundwater quality (i.e., assess progress of cleanup) and (2) protection of potential human health receptors. Consequently, the intent of the report focuses data evaluation on the following objectives:

- Assess aquifer restoration and contaminant removal rates based on concentration trends.
- Evaluate the effectiveness of source control.

- Evaluate stabilization of the plume based on the extent and concentration of volatile organic compounds (VOCs).
- Discuss results of protectiveness monitoring at domestic wells and at early warning detection wells.

For the east side, the report compares analytical results to permit specific concentration limits (PSCLs) and examines the data for indications of a significant change as described in Section 4.2.2. Results are also compared to relevant water quality standards.

Consistent with solid waste permit requirements, municipal solid waste guidance (DEQ, 1996), and the updated EMP, the annual report contains the following:

- A cover letter that
  - Compares the analytical results with relevant monitoring standards.
  - States whether or not federal or state standards were exceeded for the relevant media.
  - States whether or not a significant change in water quality occurred.
- An executive summary.
- Assessment of the current status of the environmental monitoring network and recommendations for improvements.
- Data analysis and evaluation, based on the following:
  - Updated groundwater elevation information for each sampling event and monitored unit, depicting groundwater flow velocities and direction, and piezometric water contours.
  - Data evaluation tools (e.g., time-series plots, box plots, trilinear diagrams) as appropriate, for selected constituents of concern; to be used in assessing data.
  - Summary of results of monitoring for the year, including a table that compares results with water quality standards.
- Description of activities resulting from exceeding a relevant standard or significant change in water quality, such as resampling or additional investigation.
- Results of landfill gas (LFG) probe monitoring (monitoring related to operations of the gas-to-electric plant are not reported as part of the environmental monitoring program).
- Summary of sampling and analysis, field quality assurance and quality control (QA/QC), and laboratory QA/QC techniques implemented during the year.
- Copies of applicable information, including field data, laboratory analytical reports, and chain-of-custody reports; data are cross-referenced and labeled with the designated field sampling location.

2 WATER QUALITY MONITORING

2.1 Monitoring Network

The water quality monitoring network has five components: (1) groundwater monitoring wells, which include compliance and detection wells, (2) water level observation wells and piezometers, (3) the secondary leachate collection system (SLCS), (4) leachate sumps, and (5) surface water monitoring points. In addition to water quality, landfill gas is monitored at probes surrounding the landfill, and in buildings or structures near the landfill. The rationale for the network design and the media monitored was presented in the updated EMP (TC, 2005b). The water quality monitoring locations are summarized on Table 2-1. A summary of the well construction, survey information, and lithologic completion intervals is provided in Table 2-2.

With construction of the supplemental leachate holding pond in summer 2004, nomenclature for sampling points was revised. The older 4-million gallon leachate surge pond was renamed the West Leachate Pond and the new pond is referred to as the East Leachate Pond. Sampling points for the secondary leachate collection system for each pond will be referred to as LDS-WLP and LDS-ELP, respectively.

In addition to these points, 6 shallow piezometers were installed during January 2008, in the fields south of the west-side landfill, in the area previously referred to as Field C. These piezometers are monitored intermittently to evaluate water levels near the wetland mitigation area along Soap Creek.

2.2 Sampling and Analysis Program

Monitoring in 2008 was conducted consistent with the updated EMP for Coffin Butte Landfill (TC, 2005b). The EMP presents monitoring rationale, sampling and analysis parameters, locations, and a schedule. The DEQ approved the plan by letter (DEQ, 2006). The frequency of monitoring, the sampling points, and the analytical parameters for 2008 are summarized in Table 2-3.

Water was sampled consistent with procedures described in the site sampling and analysis plan in Appendix C of the EMP. Samples were submitted to TestAmerica's laboratory in Denver, Colorado.

In 2008, samples could not be collected from several locations as follows:

- Second Quarter: S-U2 was dry and no sample was collected.

- Fourth Quarter: S-3, S-U2, S-U3, and SU-4 were not sampled because sample discharge pipes were dry. At MW-12S and MW-17, a minimal level of water in the wells prohibited collecting enough water to test for inorganic and metal constituents, however, a sample from each well was collected for VOCs. Both wells are outfitted with dedicated bladder pumps with the pump inlet located near the bottom of the screened interval.

Memoranda that document field sampling procedures, copies of field sampling data sheets that record measurements for the sampling events, and laboratory reports are included in Portable Document Format (PDF) on a compact disc (CD) attached to the inside back of the report cover. Memoranda that review laboratory quality assurance and quality control data can be found in Appendix A.

3 FINDINGS

The discussion of hydrogeology is summarized from sections on site characterization in past reports and the EMP (EMCON, 1994, 1996, 2000; TC, 2003a,b, 2005b).

3.1 Hydrogeology

The landfill is situated along the south flank of Coffin Butte. The upper third (approximately) of the butte consists of steep grass-covered slopes, the middle third of exposed bedrock with little vegetation, and the lower third of gentle, soil-covered slopes. Generally, the steeper slopes are underlain by basalt bedrock and the lower, flatter slopes on the flanks of Coffin Butte are underlain by alluvium that consists of silty clay to clayey silt with variable amounts of thin, interbedded sands and silty to sandy gravels (commonly referred to as Willamette Silt).

There are two principal water-bearing units: unconsolidated alluvium, and bedrock volcanics. Groundwater occurs in both units, although the alluvial deposits are absent or unsaturated over much of the site where landfill occurs. Where both units are present, they are hydraulically connected. The two units are monitored separately by groundwater monitoring wells.

3.1.1 Groundwater Occurrence and Flow

Depth to groundwater depends on season and topography. In site wells, the groundwater depths range from over 80 feet below the ground surface midway up the slopes of Coffin Butte (in bedrock) to less than 1 foot in the flat lowland area southeast of the butte (in alluvium). East of Cell 2, potentiometric elevations measured during the wet winter and spring months are near or higher than the ground surface elevation, indicating the potential for groundwater to discharge in this area.

Table 3-1 summarizes the groundwater elevations for 2008. Seasonal fluctuations vary, depending on the hydrogeologic position of the monitoring point. The seasonal changes in 2008 ranged from less than 2 feet in MW-22, MW-23, MW-25, and P-16 to approximately 20 feet in well MW-13. Figures 3-1 to 3-4 illustrate the range of seasonal fluctuations for typical site wells in similar hydrogeologic positions. The average site-wide fluctuation in monitoring wells and piezometers was approximately 4 feet, with the lowest groundwater elevations in late summer to fall and the highest in winter and spring.

The direction of groundwater flow is controlled by the topographic setting of Coffin Butte and Poison Oak Hill and the intervening low areas. Groundwater in the bedrock generally flows downslope from the hills until it reaches a groundwater divide near the southeast corner of Cell 1. At the divide, groundwater flows toward the east and west, generally following the long axes of the valleys. Groundwater flow direction in the saturated portion of the alluvium mimics the underlying bedrock.

Groundwater contours for the site are illustrated on Figures 3-5 and 3-6. The groundwater elevations are from wells screened either in the alluvium or the bedrock. With the relatively large topographic relief between wells, any vertical gradients (generally small) between hydrogeologic units at monitoring locations are insignificant, and therefore do not substantially affect the site's groundwater flow pattern or horizontal gradients.

Factors affecting the groundwater gradients include the topographic slope, hydrogeologic material, and the season. The steepest horizontal gradients measured at the site are on the flanks of Coffin Butte. These range from approximately 0.049 to 0.068 foot per foot (ft/ft) downslope of well MW-13, to 0.14 ft/ft downslope of piezometer P-17. Smaller gradients are an order of magnitude lower, approximately 0.014 ft/ft, downgradient of Cell 2 (in alluvium between MW-23 and MW-9S), and average between 0.006 and 0.009 ft/ft downgradient of Cells 1 and 1A. Downgradient of the Closed Landfill, the gradient is relatively consistent between seasons at approximately 0.06 to 0.079 ft/ft.

3.1.2 Groundwater Velocity

Groundwater velocity depends on hydraulic conductivity, horizontal hydraulic gradient, and effective porosity of the water-bearing medium. The horizontal velocity (V_h) of groundwater is calculated by the following equation:

$$V_h = \frac{Ki}{n_e}$$

where

V_h = horizontal groundwater velocity.
K = hydraulic conductivity.
i = horizontal hydraulic gradient.
n_e = effective porosity.

Estimates of V_h were calculated at the Coffin Butte Landfill for three areas: on the east side, downgradient of Cell 2, and on the west side, downgradient of Cell 1 and the Closed Landfill. Near Cell 2, estimates of V_h are fairly consistent between seasons because the gradient does not change significantly (low slopes and an area of groundwater discharge to the marsh). V_h is calculated at approximately 1.3 feet per year (ft/yr), given a hydraulic conductivity of 6.3×10^{-2} feet per day (ft/day) for the alluvium (EMCON,

1994), an estimated effective porosity of 25 percent (Morris and Johnson, 1967), and a hydraulic gradient of 0.014 ft/ft.

Downgradient of Cells 1/1A, estimates for V_h are 50 to 250 ft/yr in the spring and somewhat lower in the drier months at 30 to 160 ft/yr in the fall. Assumptions include an average hydraulic conductivity of 4 ft/day for the bedrock (EMCON, 1994), an estimated effective porosity of between 5 and 25 percent (Morris and Johnson, 1967), and an average hydraulic gradient of 0.0086 ft/ft in the spring and 0.0056 ft/ft in the fall.

Downgradient of the Closed Landfill, estimates for V_h are approximately 6 to 7 ft/yr for the alluvium, and 360 to 460 ft/yr in the bedrock. Assumptions include the hydraulic conductivities for alluvium and bedrock noted above, an estimated effective porosity of 25 percent both for alluvium and weathered bedrock (Morris and Johnson, 1967), and an average hydraulic gradient of 0.06 ft/ft.

3.2 Water Quality

Water quality summary tables for 2008 can be found in Appendix B. The tables organize the monitoring points by wells, surface water stations, leachate (Cell 1, Cell 2, or Cell 3), and the SLCS (LDS monitoring points).

3.2.1 Data Quality

Results of laboratory quality assurance and quality control data indicate acceptable results (see data review memoranda in Appendix A). TestAmerica's standard laboratory reporting limits (RLs) for several of the trace metals are higher than reporting limit goals devised by the DEQ at 10 percent of the primary drinking water standard. The laboratory can report at lower values to meet these goals, although the laboratory must qualify the data as estimated since the resultant values are below the standard laboratory RL, but above the method detection limit. Qualified data are discussed in the memoranda in Appendix A (along with a table comparing the various reporting limits) and listed in the summary tables in Appendix B.

3.2.2 Groundwater

This section evaluates groundwater quality at Coffin Butte Landfill by examining trends that can be used to predict or assess subtle changes in water quality or which track parameter concentrations used to assess areas with existing impacts. This qualitative examination is complemented with quantitative comparisons in Section 4 to assess remedy performance for the west side, or whether water quality meets concentration limits for the east side.

The following discussion is divided into geographic areas on the basis of trend evaluation. At the compliance boundary for Cell 2, baseline data for background water

quality were characterized in the compliance well (no upgradient background well can be feasibly located) as part of an intrawell evaluation approach.

Parameters evaluated for Cell 2 include site-specific indicator parameters that are tested semiannually and a group of site-specific trace metals that are tested annually. For Cells 1 and 1A, parameter evaluation focuses on the same suite of indicators and selected VOCs that have been consistently detected over the years. Water quality evaluation downgradient of the Closed Landfill focuses on site indicator compounds and three historically detected VOCs. A list of wells and time-series concentration plots by parameter can be found in Appendix C.

Time-series concentration plots for groundwater wells that monitor the former leachate irrigation Fields B and C document recovery of groundwater quality since leachate irrigation was discontinued in 1998. Plots for these wells can also be found in Appendix C.

TUPPAN CONSULTANTS visually examined groundwater quality trends and summarized those findings in Tables 3-2, 3-4, 3-5, and 3-6. These tables show the most recent trend (approximately the last five years) and indicate the general range of parameter concentrations for that period. Trend information from decommissioned wells (e.g., MW-6, MW-7S/7D, and MW-16) can be found in annual reports from 2004 and earlier (e.g., TC, 2005a). Descriptive evaluation terms include the following:

- Upward: generally upward trend during the last five years; this is indicated by shading in the tables.
- Downward: generally downward trend during the last five years; there may have been earlier periods of water quality variability.
- Stable: indicates that the water quality varies within a range (degree of variability depends on well or parameter) and that no long-term consistently upward or downward trend is apparent.
- Peaked: concentrations have peaked and are now either declining or appear to have stabilized, suggesting that water quality is beginning to improve.

3.2.2.1 West Side

Cells 1 and 1A. Groundwater in this area is characterized by elevated, but declining, concentrations of inorganic compounds downgradient of Cell 1A and low concentrations of inorganic compounds downgradient of Cell 1. Except for MW-12S at Cell 1, VOC concentrations in this area have declined to below 3 micrograms per liter (µg/L) and continue to trend downward (Table 3-3). Trace metals concentrations are low to nondetect and generally follow stable trends.

Downgradient of Cell 1A, inorganic trends are mixed (Table 3-2), but there are fewer parameters with upward trends than last year (nine in 2008 compared to fifteen in 2007). This is most apparent for well MW-12S, in which bicarbonate, calcium, magnesium and sodium all appear to have peaked and stabilized since 2005. Wells downgradient of Cell 1 have much lower inorganic concentrations than those downgradient of Cell 1A and the magnitude of any increases is slight. Overall, the inorganic concentrations downgradient of Cell 1 are considerably lower than in well pairs MW-10 or MW-11 (downgradient of Cell 1A), and chloride concentrations are more than an order of magnitude below the secondary drinking water standard of 250 milligrams per liter (mg/L).

Of the four VOCs historically detected in well pair MW-10S/10D downgradient of Cell 1A (see Tables 3-3 and 3-4), concentrations of 1,1-dichloroethane (1,1-DCA) continue to decline in both wells. Cis-1,2-dichloroethene (cis 1,2, DCE) and chloroethane were only detected in MW-10S, and vinyl chloride was not detected in either well in 2008. No VOCs were detected in either MW-11S or MW-11D in 2008. Downgradient of Cell 1, PCE had been routinely detected in well MW-12S, and since 1994 had shown an upward trend. In October 2000, the concentration peaked at 25 µg/L. Beginning last year, the trends appears to be headed downward and is currently below 10 µg/L. Trichloroethene (TCE), while still being detected in MW-12S, also appears to be declining in concentration. In deep well MW-12D, PCE was detected both sampling events at less than 1 µg/L.

Closed Landfill. The closed landfill is monitored by two monitoring wells designated as compliance wells in the solid waste permit addendum: one completed in the alluvium (MW-20) and one completed in bedrock (MW-21). The alluvial well has shown stable to downward trends for the site indicator parameters. Trends are summarized in Table 3-5.

In the bedrock well, bicarbonate alkalinity, which had increased in concentration before 2001, appears to have peaked; the other indicator compounds appear stable the past 5 years. Of the three historically detected VOCs in MW-21, cis-1,2-DCE has not been detected since May 1995, 1,2 dichlorobenzene has been nondetect since 1999, and chlorobenzene was last detected at 0.62 µg/L in 2006. No VOCs were detected in either well in 2008.

3.2.2.2 East Side

Cell 2 - Compliance Well MW-22 and Detection Wells MW-24, MW-25. Wells near Cell 2 include compliance well MW-22 downgradient of Cell 2, detection well MW-24 at the upgradient edge of Cell 2A, and MW-25 which is downgradient of the southeast corner of Cell 2B, but upgradient of MW-22. Both MW-22 and MW-25 are completed in shallow alluvium and MW-24 is completed in shallow weathered bedrock (the alluvium is not saturated in this area). Piezometer P-16, which is sampled once a year, was added to the trend plots to supplement information on natural water quality variability in the alluvium.

Trends for indicator parameters (Table 3-6) at the compliance well MW-22 were stable through 2008, although for the last 3 to 4 years (since approximately 2005), concentrations for sodium and chloride appear to be marginally higher more frequently. This relationship is explored more fully in Section 4.2. Parameters tested in MW-24 and MW-25 are stable, and reflect natural water quality in the area. Of those two wells, MW-25 (completed in alluvium) is more similar in water quality to MW-22. Subtle differences, though, are present, for instance lower concentrations for bicarbonate, calcium, and sodium, and higher natural chloride and arsenic in MW-25 than in MW-22.

Cell 2 – Detection Well MW-23. Early in its history, detection well MW-23 had shown increases for bicarbonate alkalinity, chloride, hardness, total dissolved solids (TDS), for five of the major dissolved metals, and for arsenic (As). This had been attributed to localized seepage of leachate from the south side of the landfill. Since 2000 to 2001, the upward trends for bicarbonate, chloride, hardness, TDS, Ca, Fe, Mg, Mn, Na, and As peaked, and within the last year have declined to the range of background concentrations. Of those, the cations, bicarbonate, and chloride continue to demonstrate seasonality with higher concentrations in the fall and lower concentrations in the spring.

3.2.2.3 Former Leachate Irrigation Fields

Field B (East Side). In Field B wells MW-8S and MW-15, concentrations of inorganic indicators continue longer-term trends of past years (see time-series concentration plots in Appendix C). At MW-8S, an earlier increasing trend for chloride peaked in 2001 and is declining gradually, while Na has remained relatively consistent in concentration.

In well MW-15 chloride shows an upward trend, but is still below the concentration in MW-8S. Over the same period, bicarbonate and calcium have declined slightly. Inorganic concentrations in wells MW-8S and MW-15 contrast with those at MW-16, which was screened in fresh bedrock, and had naturally lower concentrations for indicators than the alluvium.

Trace metals in Field B wells were detected at low to trace concentrations, or were not detected in 2008. Historically, trend plots show distinctly lower concentrations beginning with the fall 1996 sampling event (e.g., barium, lead and nickel). That was the first sampling event in which dedicated bladder pumps were used, and the results for trace metals reflect lower suspended solids in the water samples. Since then, concentrations have remained low with more limited variability. None of the wells shows a trend indicating effects of past leachate irrigation. No VOCs were detected.

Field C (West Side). Past leachate irrigation in Field C appears to have mildly affected the concentrations of some inorganic parameters over the last few years. Since irrigation stopped in 1998, levels appear to be recovering to pre-irrigation conditions, although some variability persists (see time-series concentration plots in Appendix C). It is possible that this minor variability could be related to amending the field with lime to improve agricultural production or more recently, to disruption of the surface soils in

creating wetlands in the area, especially near well MW-19 which has seen increased concentrations for chloride, Ca, and Mg.

As with Field B, trace metals were either not detected in Field C wells, or were detected at low to trace concentrations. Where detected, none of the wells showed a trend indicative of past leachate irrigation. No VOCs were detected in former irrigation field wells except for dichlorodifluoromethane[1] (Freon 12) in MW-19 (at 1.5 µg/L). Beginning in 1999, Freon 12 was first detected at low levels (<1 µg/L) in that well. In 2005, the trend increased slightly to its current level at 1.5 µg/L. Upgradient, near the edge of the landfill in MW-11S/11D, concentrations in the early 1990s had been between 3.5 and 4 µg/L for Freon 12. However, since 2000, it has not been detected in that well pair. We expect that Freon 12 concentrations at MW-19 will follow the upgradient pattern and dissipate with time.

3.2.3 Surface Water

Surface water is monitored upstream (S-1) and downstream (S-2 and S-4) in Soap Creek to test for potential impacts from the west side of the facility, and for residual impacts from spray irrigation on Field C. Surface water is also monitored on the east side, where an intermittent creek crosses the landfill access road (S-3). In 2008, water flowed at this point during the April sampling event, but no sample could be collected in October because it was dry.

At the Soap Creek monitoring points, year 2008 results for biological oxygen demand (BOD), total Kjeldahl nitrogen, total phosphorus, and orthophosphate were either nondetect or were virtually identical in concentration between the upstream and downstream monitoring points. This is similar to past years.

The other inorganic parameters (chloride, Ca, Fe, Mg, Mn, and Na) showed seasonal changes in concentration, with low concentrations in April (high stream flow) and higher concentrations in October (low stream flow). There were no significant differences between upstream and downstream points for those parameters, with most concentration differences less than 1 mg/L. Differences in concentration between seasons are typically greater, from 8 to 11 mg/L (e.g., for chloride).

3.2.4 Underdrains

Results of sampling the underdrains for Cell 3 (S-U3) and from below the East Leachate Pond (S-U4) are shown in Tables 3-7 and 3-8. The Cell 2C/D subdrain was not sampled because no water flowed at the sampling point. Elevated concentrations for some of the inorganic parameters for Cell 3 in the October 2003 and subsequent sampling events are likely related to construction activities in the area during the summers of 2003 to 2005.

[1] Freon 12 was not identified as a chemical of concern in the remedial investigation and has a preliminary remediation goal (PRG) of 390 µg/L.

Current water quality from this underdrain is comparable to a sample collected from upgradient bedrock well MW-13, suggesting that water from this underdrain is not being affected by landfill operations.

Water quality from the East Leachate Pond underdrain (S-U4) represents baseline concentrations. Concentrations for inorganic compounds and dissolved metals from the underdrain are comparable to or lower than concentrations at MW-16, which was a background well that monitored bedrock in the pond location before it was decommissioned in 2004.

3.3 Secondary Leachate Collection System

The SLCS was monitored by riser pipes at four locations: beneath the Cell 2 sump in the southeast corner of that cell (LDS-2B), beneath the Cell 3 sump (LDS-3), and beneath the west and east leachate ponds (LDS-WLP and LDS-ELP, respectively). Results for liquid quantity and quality are shown graphically in Appendix D.

3.3.1 Cell 2

Historical variations in the concentrations of indicator parameters measured for LDS-2B reflect changes to the volume and liquid chemistry from different sources. These had varied (1) seasonally as the amount of leachate generated changed, surface water runoff changed, and groundwater levels fluctuated, and (2) from year to year as sources had been eliminated through reconstruction. Increased concentrations were generally attributed to a greater volume of leachate-dominated sources, while decreases reflected a greater ratio of surface water or groundwater to leachate. Trend plots of indicator parameters for both the SLCS and Cell 2 leachate can be found in Appendix D.

The volume of liquid that infiltrated into the SLCS for the water years since 1995 is shown in Table 3-9. Cumulative water purged from the system is shown in Figure D-1. For the 2007-2008 water year, an infiltration performance value of 10.2 gallons per acre per day (gpad) was calculated. This is below the 20 gpad action level generally suggested in the literature, and used by the USEPA and several states (Thiel, 2001).

Liquid levels in the primary and secondary leachate collections systems are not illustrated for the past year because the telemetry system malfunctioned and did not produce reliable data. The transducers and telemetry system continued to have significant technical problems this year. The situation is being corrected and data should be available for the next reporting period. Based on the settings for the on/off switch for the pumps in the primary and secondary sumps, it can be inferred that on average, the head levels in the sumps met permit requirements.

3.3.2 Leachate Ponds

Both leachate ponds were used to store leachate this past year. The detection system underlying the West Leachate Pond (previously referred to as the leachate surge pond) was outfitted with a pump in first quarter 1999. Except for purging during sampling events, no liquid was pumped from the LDS-WLP in 2008. The 5-million-gallon East Leachate Pond was constructed in 2004. No liquid was pumped from the secondary system except to collect samples. Sample quality results are listed on the water quality summaries in Appendix B. For the leachate pond SLCSs, the liquid is generally high in inorganic indicators such as chloride, bicarbonate, dissolved calcium, magnesium, and sodium with detections of several VOCs, such as benzene, toluene, ethylbenzene, xylenes, and acetone.

3.4 Leachate Production

Leachate production for the water year 2007-2008 was discussed in a report by Thiel Engineering (Thiel, 2008). An estimated 27.2 million gallons of leachate as calculated by volumetrics and by flowmeters were generated by Cells 1, 2, and 3 during the water year. This is slightly lower than last year at 29.9 million gallons. Tabular and graphical weekly leachate production data from totalizing flowmeters are used to illustrate overall seasonal trends in the data (Appendix D).

3.5 Landfill Gas Monitoring

VLI routinely monitors a total of six landfill gas monitoring probes around the perimeter of the landfill (GP-2 through GP-6), in addition to the interior of twelve site structures. Monitored parameters include lower explosive limit (LEL), methane, and oxygen. Levels of percent LEL and methane were zero for all monitoring events. Results of 2008 gas monitoring are shown in Table 3-10.

4 DISCUSSION

Monitoring wells at Coffin Butte Landfill are sited to assess a number of different areas around the landfill. For older areas that have undergone a focused risk assessment and feasibility study (TC, 2003a), the purpose of monitoring is to evaluate the performance of the remedy in protecting potential receptors and in restoring groundwater quality. The purpose of evaluating groundwater data at the east-side landfill cells is to determine if engineering controls (e.g., the landfill liner, cover, leachate or landfill gas [LFG] collection and removal systems) and operations are effective in preventing the release of landfill-derived compounds to the environment. Early identification of a release can mitigate those impacts relatively quickly, as documented for historical impacts in MW-23.

Consequently, the approach to evaluating monitoring data is slightly different for each area. For older areas, the monitoring objective is to assess the performance of the remedy in restoring groundwater quality to RACLs and in protecting potential receptors. For the active landfill on the east side, monitoring is classified as detection monitoring—in essence, to identify whether the landfill is leaking. Instrumental to this purpose is comparing monitoring results of indicator parameters with PSCLs and assessing the data for significant change.

4.1 West Side

For the west side, the purpose of the report is to assess (1) the effect of remedial actions on groundwater quality (i.e., assess progress of cleanup) and (2) protection of potential human health receptors. These are discussed in the following sections.

4.1.1 Aquifer Restoration-Contaminant Removal

Areas downgradient of the landfills on the west side rely on containment and control of the source with natural attenuation in groundwater downgradient. Contaminant removal occurs through natural processes and is measured with respect to trends of constituent concentrations with time. Cleanup levels referred to as RACLs, are the long term goals of aquifer restoration.

4.1.1.1 Cells 1/1A

Groundwater quality along the compliance boundary of Cells 1 and 1A has been relatively stable the past few years. Fewer inorganic indicator parameters exhibit upward

trends (e.g., bicarbonate, likely as a result of dissolution of carbonate minerals lining fractures or in pores driven by carbon dioxide produced through the metabolism of microorganisms in breaking down VOCs), and most have peaked or show downward trends.

Of the inorganic compounds, only chloride and manganese exceed their RACLs, and their trends continue to decline. Trends of VOC have peaked and are declining in each of the compliance wells (many are now nondetect), and except for PCE at MW-12S, none exceeded its RACL (Table 4-1). For the ninth year, vinyl chloride was not detected at concentrations above its MCL, nor was it detected at any monitoring well in 2008. From 300 to 400 feet downgradient of the compliance boundary, groundwater quality approximates background conditions in detection wells MW-17 through MW-19, indicating that contaminants attenuate significantly between the compliance boundary and the downgradient detection wells.

4.1.1.2 Closed Landfill

Trends of monitored parameters downgradient of the closed landfill are stable and reflect a steady improvement in groundwater quality. None of the parameters measured in 2008 indicated increases in concentration or levels of concern with respect to water quality standards; each was below its respective RACL except for manganese. On the basis of the landfill's age (20 to 50 years) and its low potential for significant leachate generation, it is expected that existing low level impacts to the aquifer will diminish with time.

4.1.2 Source Control Effectiveness

Source control includes the final cover at the landfill, leachate removal, and active landfill gas recovery to control the migration of landfill gas that contains methane and VOCs. Effectiveness can be measured qualitatively by examining (1) the trends and number of VOCs at downgradient monitoring wells and (2) whether landfill gas is migrating to perimeter gas probes.

Groundwater Quality. Since the landfill cover was installed on Cells 1/1A in 1996 and LFG removal wells installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. This is illustrated by Table 4-2 in which the number of VOCs are tallied for five periods beginning in 1990 (last column on table) and ending with total number of VOC for 2008. At each well along the compliance boundary, the total number of VOCs has decreased since 1990. In 2005 for the first time, no VOCs were detected in one of the wells, MW-11S. Concentrations continue to decline in each of the other wells, even in MW-12S, where PCE and TCE concentrations appear to be declining from last year. The reduction in the number and decrease in concentration of VOCs can be partly attributed to removal of landfill gas, which contains VOCs, and covering the landfill to prevent infiltration of rainwater to the waste pile.

Another source control measure for Cell 1 is leachate removal. Cell 1A does not have leachate removal but it has been shown that the base elevation of that cell is above the groundwater table and therefore, it is unlikely to generate a significant amount of leachate, if any.

LFG Probe Results. Probe monitoring shows that LFG does not migrate laterally away from the landfill, but is being contained by the gas recovery wells. Gas recovery rates for Cell 1 are monitored routinely by Pacific Northwest Generating Cooperative as part of optimizing flow and maximizing methane recovery for the gas-to-energy plant.

4.1.3 Plume Stabilization

The stability of the VOC plume can be evaluated qualitatively by examining whether concentrations at impacted wells are increasing and whether monitoring wells downgradient of the VOC plume detect VOCs. Both criteria suggest a stable to shrinking plume as concentrations are declining within the plume and wells outside the plume have not detected VOCs. (One exception was MW-19 in which residual concentrations of Freon 12 were detected.) Continued retraction of the extent of VOCs is further indicated by recent declines to nondetect within the last few years for:

- 1,1-DCA in MW-11S and MW-11D
- Chloroethane in MW-10D and MW-11S/11D
- Cis-1,2-DCE in MW-10D and MW-11S/11D
- Vinyl chloride in MW-10S/10D and MW-11S/11D

4.1.4 Protectiveness Monitoring

Protectiveness is assessed at two locations: at the Phillips domestic well and at P-8, which is spatially between the domestic well and the landfill. Trend plots for indicator parameters for these wells can be found in Appendix C. Analytical results for the Phillips well were either nondetect or significantly below safe drinking water standards for inorganics and metals (see tables in Appendix B). No VOCs were detected. Trends of indicator parameters do not show significant upward movement suggestive of impacts from the landfill.

Early warning detection monitoring well P-8 is located between the landfill and the Phillips well, near the hydrogeologic divide that protects the domestic well from landfill-contaminant migration. None of the indicator parameter trends for that well suggest changes in groundwater quality, and no VOCs were detected in 2008.

4.2 East Side

For the east side, the report compares analytical results for MW-22 to PSCLs established in the solid waste permit addendum, and examines the data for indications of a significant increase. Results are compared to water quality standards in Section 4.3.

4.2.1 Comparison to Concentration Limits

Permit-specific concentration limits were formalized for eight indicator parameters in the solid waste permit addendum. PSCLs apply to compliance well MW-22 for the east-side multiunit landfill, and are based on intrawell statistics (TC, 2003b). Table 4-3 compares analytical results since October 2000 with the PSCLs. None of the values in 2008 was above a concentration limit, although the sodium concentration was comparable to its PSCL of 27 mg/L in October. This duplicates last year's October sodium concentration for that well (the results are further examined below). Concentrations for each of the indicator parameters was within the historical range of variability as illustrated on the trend plots in Appendix C (the PSCLs are shown on the plots as a dashed line).

4.2.2 Indications of Significant Change

Sample results that could indicate an increase above what are considered to be natural background concentrations are evaluated to determine their significance with regard to operations or potential receptors. Potential actions taken in response to significant change are discussed in the Section 5.1.2 of the EMP. Examples of significant change include:

- Exceedance of a Safe Drinking Water Standard (primary MCL), unless historical water quality also exceeds that value (i.e., background is elevated). An example of elevated background concentration is arsenic which exceeds its MCL of 10 µg/L, but whose statistical background concentration is 12.1 µg/L.

- Detection at a concentration an order of magnitude higher than the historical trend.

- Detection of a previously undetected VOC.

None of these criteria were met in 2008 for analytical results from MW-22.

4.2.3 Trends

Downgradient of the active landfill cell on the east side, indicator parameter concentrations are stable in detection monitoring well MW-22. However, as mentioned above, sodium has been measured at its PSCL twice, in October of 2007 and 2008. In examining the longer-term trend for sodium in this well, it appears that there has been a slow creep upward in concentrations of a few mg/L over thirteen years. Chloride also

shows a modest increase, but none of the other indicators follow this pattern and, for some the trend is downward. Clearly, the degree of the relative increase is still within the calculated PSCL, but given the low statistical variability for sodium concentrations in this well and the short time frame for accumulating the baseline data (from August 1994 to April 2003, a total of 16 analyses), it could be that the long term natural variability of the statistical population was not fully defined when originally deriving the PSCLs.

For instance, climatic conditions over decades can alter groundwater quality in subtle ways. As an example, we plotted the annual precipitation for the Corvallis area over the period of monitoring. We then applied simple trend lines to the rainfall data and sodium data and found that from 1994 to 2008, the annual rainfall has declined while the sodium concentration for MW-22 has increased slightly (shown in Figure 4-1). This inverse correlation suggests that factors unrelated to a possible release (e.g., climate) could affect long-term trends in groundwater quality. In this situation, it could be from a lack of rainfall which affects the natural dilution of sodium in groundwater. Other site specific information that supports a cause other than the landfill is the sodium concentration in intervening detection monitoring well MW-25, which is upgradient and closer to the southeast perimeter of the landfill than MW-22. That well has lower sodium concentrations than at MW-22, effectively precluding a landfill-related release as the explanation for the inflection of the MW-22 sodium data.

In the mean time, VLI will continue to closely watch concentrations at MW-22, and if the sodium concentration exceeds a PSCL, will consult with the DEQ on developing an explanation as to the cause of the excursion. Part of the resolution may be to re-examine the statistical assumptions for the PSCLs in light of other causes of marginally increasing concentrations.

Table 5-4 of the EMP recommends potential actions that could be implemented should a non-hazardous compound increase in concentration or exceed a PSCL. In the situation that currently exists, possible responses include:

- Re-evaluate the statistical distribution of the baseline water quality data
- Continue monitoring
- Examine other compounds and other wells for any associated increases

Any findings from further data exploration could be presented to the DEQ, with a possible result being to re-set the PSCLs at statistically higher values for sodium and chloride based on additional baseline data.

4.3 Comparison to Water Quality Standards

Water quality standards are discussed with respect to detection and compliance wells on the east side and west side. Table 4-4 lists monitoring results that exceeded a water

quality standard. Additionally, the water quality summary tables in Appendix B list relevant water quality standards at the head of each column.

Primary Maximum Contaminant Levels (MCLs). No federal or state primary MCLs (health-based) were exceeded at eastside compliance well MW-22. The arsenic concentration in detection monitoring well MW-23 exceeded the primary MCL of 10 µg/L both sampling events (in this part of the landfill, the primary MCL is below the background concentration, which was estimated at 12.1 mg/L). Arsenic has declined in this well since approximately 2000 to background levels, but still shows some variability. The primary MCL for PCE was exceeded downgradient of Cell 1 along the west-side compliance boundary in MW-12S. VOCs were not detected in a detection monitoring well (P-8) approximately 250 feet downgradient of MW-12S. No other primary MCLs were exceeded at west-side wells for VOCs, trace metals or inorganic parameters.

Secondary MCLs. Federal and state secondary MCLs (non-health-based) were exceeded at eastside compliance well MW-22 for Fe and Mn, downgradient of Cell 2. Concentrations for those compounds are stable and reflect natural background conditions for this part of the site. Secondary MCLs for Fe and Mn were also exceeded at detection wells MW-23 and MW-25. Concentrations at MW-25 represent natural conditions for this part of the site.

At the west-side compliance boundary, the secondary MCL for chloride was exceeded at MW-10S where the trend is declining. The secondary MCL for Mn was exceeded at well pair MW-10S/10D both sampling events. These values are consistent with historical concentrations for those wells. Groundwater samples from compliance wells MW-20 and MW-21 (downgradient of the closed landfill) exceeded the secondary MCL for manganese in October.

5 MONITORING PLAN MODIFICATIONS AND RECOMMENDATIONS

There are minor changes planned for the landfill monitoring network or the monitoring program in 2009. One is to decommission piezometer QP-1S, which is located at the head of the Closed Landfill, very near to current quarry operations. The reason for decommissioning is that quarry will be operating next to the well and it was deemed prudent to remove the well rather than risk damaging it. Other changes to the monitoring network in the eastern part of the landfill could possibly occur in 2010 to accommodate construction of Cell 4. This would include decommissioning wells within and near the footprint of the planned cell, and establishing new compliance wells along the eastern, downgradient perimeter of the new cell. The other task is to repair the telemetry system that relays depth of liquid information for the primary and secondary sumps in Cells 2 and 3.

The October 2009 sampling event is scheduled as a split sampling event with the DEQ as specified in the solid waste permit.

Based on the information and discussion presented in Section 4.2, VLI proposes to not resample at MW-22, should the sodium concentration in that well be detected above the PSCL of 27 mg/L. Should sodium be detected above the PSCL, VLI will review the data and contact the DEQ in a timely manner to discuss possible actions to explain the excursion.

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Thiel. 2001. Annual Leachate Management Report, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California. January 15.

Thiel. 2008. Letter (re: 2007-08 Annual Leachate Management Report for Coffin Butte) to B. May, Valley Landfills, Inc., Corvallis, Oregon from R. Thiel, Thiel Engineering, Oregon House, California. December 24.

Appendix B

Text Portion of Annual Leachate Management Report for Coffin Butte

Thiel
Engineering

Brian May
Valley Landfills, Inc.
28972 Coffin Butte Rd.
Corvallis, OR 97330

December 24, 2008

Re: 2007-08 Annual Leachate Management Report for Coffin Butte

Dear Brian:

This letter-report is being sent to you to fulfill the condition in Solid Waste Disposal Permit No. 306, Section 17.5, that an annual leachate management report for the Coffin Butte landfill be submitted for the previous water year. Information contained in this report is a summary of information provided by your staff to Thiel Engineering. This report covers the 2007-08 water year, from approximately October 1, 2007 to October 1, 2008.

1. OVERVIEW OF LEACHATE MANAGEMENT FOR THE 2007-08 WATER YEAR

During the 2007-08 rain year, leachate was generated from Cells 1, 2, and 3. Leachate from all sources was pumped into one of two leachate surge ponds on the south side of Coffin Butte Road. Leachate was treated by the following methods:

- All of the leachate was trucked to the waste-water treatment plant in the City of Corvallis. No leachate was irrigated onto the waste, and none was delivered to other treatment plants.

2. PRIMARY LEACHATE MANAGEMENT

Section 17.5 of the site's solid waste permit No. 306 lists the information that is to be included in the annual leachate management report. The six items to be reported are described in the following paragraphs.

2.1 Yearly Totals by Month

The permit requests that monthly totals be reported for (a) leachate volume generated from the landfill sumps and (b) leachate volume treated. These two values would be expected to be similar taking into account the difference in pond volume at the beginning and end of the water year, and any rain that falls into an active leachate pond.

There are two ways to estimate the volume of leachate generated. One is to use flow meters on the discharge lines from the leachate sumps. The other is use the volume

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treated (volumetrics). Both methods were used and are presented in the data provided by the Coffin Butte landfill in Table 1.

Both the flow meters and the volumetrics indicated that 27.2 million gallons (MG) of leachate were generated during the reporting period (compared to 29.9 MG last year).

Attachment 1 provides raw data on volumes of leachate treated, flow-meter data, and rainfall records.

The volume of leachate from the secondary leachate collection systems (SLCS) in Cells 2 and 3 is not itemized separately on Table 1 because this liquid was pumped directly into the primary sumps (the volumes are tracked for internal use). From the point of view of leachate management, the total volume of leachate managed from the primary Cells 2 and 3 sumps are inclusive of the SLCS volume. The volume that was extracted from the SLCS is discussed separately later in the report.

Table 1 - Summary of Coffin Butte Landfill 2007-2008 Leachate Volumes

2007-2008 Leachate Management Summary

Coffin Butte Landfill

Month	Corvallis WWTP	Leachate Irrigation onto Landfill	Treatment Plant	Pond Vol at Start of Month	Rainfall (inches)	Cell 1 Flowmeter	Cell 2 Flowmeter	Diaphragm Pumps	Downwell Pumps	Condensate Sump	Cell 3 Flowmeter	No. of days irrig. occurred	Avg irrig. per day
Oct-07	2,159,117	0	0	3,750,000	3.05	206,331	669,110	155,975	90,215		530,550	0	0
Nov-07	1,855,458	0	0	3,260,000	3.53	302,681	650,965	191,868	178,817		584,355	0	0
Dec-07	2,625,002	0	0	3,600,000	9.55	308,893	1,332,340	392,357	430,503		1,419,475	0	0
Jan-08	4,746,465	0	0	4,590,000	8.92	330,020	1,330,865	464,794	572,591		1,451,300	0	0
Feb-08	3,701,442	0	0	3,900,000	3.15	386,363	948,787	511,509	456,738		991,460	0	0
Mar-08	3,349,984	0	0	3,370,000	4.89	340,379	549,871	489,950	258,565	62,980	759,050	0	0
Apr-08	2,844,547	0	0	2,890,000	2.48	327,915	375,235	484,968	230,922	101,625	576,740	0	0
May-08	2,422,499	0	0	2,100,000	0.18	266,437	283,150	437,026	229,419	122,087	502,780	0	0
Jun-08	1,836,176	0	0	1,430,000	0.72	249,868	175,052	378,440	140,548	104,678	446,370	0	0
Jul-08	1,363,195	0	0	1,170,000	0.04	326,930	172,201	354,476	149,143	97,400	404,040	0	0
Aug-08	1,402,962	0	0	1,120,000	1.57	240,406	445,221	77,386	168,378	112,090	404,411	0	0
Sep-08	1,109,419	0	0	1,230,000	0.37	229,534	510,864	40,242	185,105	132,670	333,299	0	0
Oct-08				1,540,000									
Totals	29,416,266	0	0		38.45	3,515,757	7,443,662	3,978,992	3,090,944	733,530	8,403,830	0	0

2007-2008 TOTAL LEACHATE VOLUME TREATED:	29,416,266
LEACHATE GENERATED FROM VOLUMETRICS:	27,206,266
LEACHATE GENERATED FROM FLOWMETERS:	27,166,714
Ratio of flowmeters to volumetrics:	1.00

Notes:
1.) All values in gallons unless noted
2.) Leachate season Oct 1 to Oct 1

2.2 Review of Significant Leachate Management Events That Occurred During the Last Water Year

Significant events for the 2007-08 water year are noted in the points below.

- Rainfall of 38.45 inches which is slightly below normal average precipitation (normal at Hyslop is approx 41 inches).
- Leachate volumes generated were slightly lower than the previous year.
- Cell 3D-Phase 2 construction was performed in 2008, adding approximately 4.2 acres of new lined area. No cell closure construction was performed in 2008.
- No leachate irrigation was performed on the landfill in the last water year.

2.3 Review of Leachate Monitoring Network and Recommendations for Improvements

The leachate monitoring network includes the following components:

- Volume estimates for each of the treatment methods are made using a range of techniques such as flow meters, or truck counts.
- Monitoring effluent quality of the on-site treatment plant is performed in accordance with the site's NPDES permit (none performed in 2008).
- Leachate quality monitoring is performed for the POTWs and for the solid waste permit in the annual groundwater monitoring report.
- Monitoring of head levels in the landfill primary and secondary sumps (for Cells 2 and 3) is intended to be performed using transducers and automatic recording. The transducers and telemetry system continued to have significant technical problems this past year, and no head-data is available. This situation is actively being corrected, and data should be available for the next report. Based on settings for the on/off switch for the pumps in the primary and secondary sumps, and the fact that the pumps operated normally, without any pump failures, it can be inferred that, on average, the head levels in the sumps met permit requirements.
- Monitoring of pond levels (volumes) is recorded regularly using manual dip-sticks in the leachate holding ponds. West Pond is manual dipped. The East pond volume is estimated from the flow meters. The inventory of both ponds combined is included in Table 1.
- The regular maintenance for the leachate sumps (pumping sediment well, pump, check valves, and flowmeters) was performed on a quarterly basis.

2.4 Summary of Site Conditions and Compilation of Monitoring and Analysis Data

Table 2 provides a summary of the monitoring and analysis data references. Site conditions relative to leachate management in the 2007-08 water year were efficient and well-managed, with the exception of the telemetry system not working.

Table 2 - Monitoring and Analysis Summary Data References

Monitoring or Analysis Item	Reference
Flow meters from landfill sumps	Significant amounts of useful data over the reporting period, summarized in Att. 1.
Volumes handled by various methods	Table 1.
Gas production changes, waste saturation, and side-slope seeps in waste irrigation areas	Since leachate irrigation was not performed, these issues are not monitored relative to leachate, and they are managed separately.
Effluent quality from treatment plant	Monthly monitoring reports sent to DEQ (Water Quality Dept) for NPDES compliance (reported "No Discharge" each month this year).
Leachate quality	Annual Water Quality Monitoring Report to be issued by March 31 of each year.
Head level in Cell 2 primary and secondary leachate sumps. Head Level in Cell 3 primary and secondary.	Technical problems with the data-logging equipment this year. Repairs are actively underway with consultant.
Rainfall	Recorded automatically by site weather station.
Pond levels (volumes)	Table 1 for beginning and ending volumes; monitored weekly.

2.5 Summary of Reports for Monitoring Irrigation on Waste

The leachate irrigation program was phased out and put on indefinite hold at the beginning of the 2006-07 water-year, and none occurred in the 2007-08 water-year.

2.6 Proposed Plans/Changes for Upcoming Leachate Management

The strategy for future leachate management is as follows:

- Continue with aggressive landfill operations and cover procedures to reduce leachate generation from precipitation to the extent possible.
- Continue to maintain all management options for treating leachate.

LEACHATE COLLECTED FROM THE SECONDARY LEACHATE COLLECTION SYSTEM (SLCS)

The amount pumped from the Cell 2 SLCS for the 2007-08 water year was approximately 108,457 gallons, compared to 126,030 gallons in the previous year. This is less than half the amount that was collected the 2005-06 water year (227,760 gallons). Production from Cell 3 SLCS was not recorded for the water year because it was minimal.

If there are any questions concerning the contents of this report, please call me at 530/692-9114.

Sincerely,
Thiel Engineering



Richard Thiel, P.E.
Oregon RCE # 14894

Attachments:
1. Site data for leachate volumes handled, flow meters, and rainfall.

Appendix C

Summary of Landfill Users by County of Origin, Tonnage and Total Vehicles

Coffin Butte Landfill Vehicles by Class and Tons Disposed - Total for Year 2008

	Commecial Vehicles Intercompany Franchised &		Private Vehicles	Total Vehicles	Total Tons
	MSW	C&D	(Includes Special Waste, Asbestos, & Public)		
County	Tons	Tons	Tons		
Benton	46,649.43	5,058.06	8,023.75	23,116	59,731.24
Linn	91,502.39	3,057.04	29,268.12	22,304	123,827.55
Polk	25,470.92	1,318.16	4,392.37	11,250	31,181.45
Marion	49,100.10	1,417.02	9,834.67	4,838	60,351.79
Lane	1,496.49	418.23	40,403.18	1,819	42,317.90
Tillamook	23,734.27	-	1,992.49	1,260	25,726.76
Yamhill	0.00	7.42	17.62	9	25.04
Lincoln	27,501.97	8.85	538.47	1,295	28,049.29
Coos	19,368.39	-	2,186.33	775	21,554.72
Curry	0.00	-	14.88	1	14.88
Washington	44,116.76	0.00	3,229.87	1,724	47,346.63
Josephine	-	-	8.81	1	8.81
Multnomah	0.00	0.00	31.55	122	31.55
Douglas	0.00	0.00	358.75	19	358.75
Clackamas	10,193.24	20.77	2,745.29	582	12,959.30
Columbia	-	-	4,607.45	154	4,607.45
Harney	-	0.00	0.37	1	0.37
Gilliam	-	-	0.00	0	0.00
Baker	3.46	1.82	1.78	10	7.06
Malheur	-	-	0.00	0	0.00
Lake	-	-	0.59	2	0.59
Misc. County	0.00	0.00	11.40	2	11.40
King, WA	0.00	0.00	0.00	0	0.00
Cowlitz, WA	-	0.00	372.05	16	372.05
Pierce, WA	1.79	-	0.00	5	1.79
Snohomish, WA	-	-	0.00	0	0.00
M-Clackamas	-	-	29,061.03	1,686	29,061.03
M-Multnomah	-	-	24,036.07	999	24,036.07
M-Washington	15,286.87	-	1,525.25	703	16,812.12
Totals	**339,139.21**	**11,307.37**	**161,136.89**	**72,693**	**528,395.59**

Coffin Butte Landfill Vehicles by Class and Tons Disposed - Total for Year 2007

	Commecial Vehicles Intercompany Franchised &		Private Vehicles	Total Vehicles	Total Tons
	MSW	C&D	(Includes Special Waste, Asbestos, & Public)		
County	Tons	Tons	Tons		
Benton	45,888.36	7,905.09	7,246.46	26,268	61,039.91
Linn	105,373.22	5,649.96	17,794.66	25,393	128,817.84
Polk	29,004.33	2,430.29	4,024.95	13,507	35,459.57
Marion	63,054.04	3,764.88	4,385.40	6,874	71,204.32
Lane	1,453.22	200.38	2,345.90	389	3,999.50
Tillamook	24,448.75	-	923.99	1,176	25,372.74
Yamhill	21.57	0.54	44.48	16	66.59
Lincoln	28,897.99	32.74	569.59	1,399	29,500.32
Coos	23,385.64	-	1,163.40	1,011	24,549.04
Washington	76,600.68	3.86	16,443.70	3,783	93,048.24
Jackson	-	-	0.13	1	0.13
Multnomah	58.21	8.82	22,457.36	922	22,524.39
Douglas	0.00	54.62	914.87	67	969.49
Clackamas	7,496.30	0.33	29,475.62	1,946	36,972.25
Columbia	-	-	13,152.56	459	13,152.56
Harney	0.60	0.00	0.49	3	1.09
Gilliam	0.21	-	0.00	1	0.21
Sherman	-	-	0.20	1	0.20
Deschutes	-	8.36	0.00	3	8.36
Baker		3.89	3.70	12	7.59
Malheur	0.64	-	0.00	1	0.64
Lake	-	2.70	4.04	3	6.74
King, WA	1.02	0.00	0.00	1	1.02
Cowlitz, WA	120.98	0.00	123.12	10	244.10
Pierce, WA	2.70	2.80	0.00	8	5.50
Snohomish, WA	-	-	44.07	8	44.07
Totals	**405,808.46**	**20,069.26**	**121,118.69**	**83,262**	**546,996.41**

Appendix D

Certificate of Liability Insurance Showing Benton County as Additional Insured

MARSH

CERTIFICATE OF INSURANCE

CERTIFICATE NUMBER
HOU-000690885-06

PRODUCER

Marsh USA Inc.
1000 Main Street, Suite 3000
Houston, TX 77002
Attn: Houston.Certs@marsh.com Fax# 212.948.0509

016022-AWNA-Poll-08-10 F32

INSURED

Allied Waste North America, Inc.
(Named Insured Continued Below)
18500 North Allied Way
Phoenix, AZ 85054

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES DESCRIBED HEREIN.

COMPANIES AFFORDING COVERAGE

COMPANY A American International Specialty Lines Ins Co

COMPANY B

COMPANY C

COMPANY D

COVERAGES This certificate supersedes and replaces any previously issued certificate for the policy period noted below. 5

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE DESCRIBED HEREIN HAVE BEEN ISSUED TO THE INSURED NAMED HEREIN FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THE CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, CONDITIONS AND EXCLUSIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$
	☐ COMMERCIAL GENERAL LIABILITY				PRODUCTS - COMP/OP AGG	$
	☐ CLAIMS MADE ☐ OCCUR				PERSONAL & ADV INJURY	$
	☐ OWNER'S & CONTRACTOR'S PROT				EACH OCCURRENCE	$
	_____				FIRE DAMAGE (Any one fire)	$
					MED EXP (Any one person)	$
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT	$
	☐ ANY AUTO					
	☐ ALL OWNED AUTOS				BODILY INJURY (Per person)	$
	☐ SCHEDULED AUTOS					
	☐ HIRED AUTOS				BODILY INJURY (Per accident)	$
	☐ NON-OWNED AUTOS					
	_____				PROPERTY DAMAGE	$
	GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
	☐ ANY AUTO				OTHER THAN AUTO ONLY:	
	_____				EACH ACCIDENT	$
					AGGREGATE	$
	EXCESS LIABILITY				EACH OCCURRENCE	$
	☐ UMBRELLA FORM				AGGREGATE	$
	☐ OTHER THAN UMBRELLA FORM					$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE: ☐ INCL ☐ EXCL				EL EACH ACCIDENT	$
					EL DISEASE-POLICY LIMIT	$
					EL DISEASE-EACH EMPLOYEE	$
A	OTHER Pollution Legal Liability	PLS 1897971	06/01/08	06/01/10	Each Incident Limit	6,000,000
					Aggregate	6,000,000
					Self-Insured Retention	5,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

Named Insured Includes Valley Landfills, Inc, DIV# F32

CERTIFICATE HOLDER

Benton County, Oregon
Chairman of the Board of Commissioners
408 SW Monroe Avenue, Suite 111
PO Box 3020
Corvallis, OR 97339-3020

CANCELLATION

SHOULD ANY OF THE POLICIES DESCRIBED HEREIN BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE INSURER AFFORDING COVERAGE WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED HEREIN, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER AFFORDING COVERAGE, ITS AGENTS OR REPRESENTATIVES, OR THE ISSUER OF THIS CERTIFICATE.

AUTHORIZED REPRESENTATIVE
of Marsh USA Inc.
BY: Stephanie S. Story



MM1(3/02) VALID AS OF:01/20/09

Appendix E

Summary of Processing and Recovery Center Activity 2007 - 2008

Summary of Processing and Recovery Center Activity 2008							
Recycling					Sales		
	Green Waste		Urban Wood Waste		Wood Chips	Hog Fuel	Compost
	Cubic Yards	Tons	Cubic Yards	Tons	Cubic Yards	Tons	Cubic Yards
Inbound	12,274.00	18,360.83	5,430.43	5,474.10			
Outbound					0.00	12,717.87	15,458.55
Totals	**12,274.00**	**18,360.83**	**5,430.43**	**5,474.10**	**0.00**	**12,717.87**	**15,458.55**

Summary of Processing and Recovery Center Activity 2007							
Recycling					Sales		
	Green Waste		Urban Wood Waste		Wood Chips	Hog Fuel	Compost
	Cubic Yards	Tons	Cubic Yards	Tons	Cubic Yards	Tons	Tons
Inbound	17,335.50	18,780.32	8,550.00	7,040.00			
Outbound					0.00	10,381.67	17,178.55
Totals	**17,335.50**	**18,780.32**	**8,550.00**	**7,040.00**	**0.00**	**10,381.67**	**17,178.55**

From: Joel Geier
To: Benton Public Comment
Subject: Oppose/Deny LU-24-027: Resubmittal of 2021 testimony on heron impact
Date: Thursday, May 8, 2025 12:43:14 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dear Chair Fowler and Members of the Planning Commission:

As additional testimony on the issue of sensitive Great Blue Heron rookeries (Development Code Sections 87.200 through 87.230), I'm herewith resubmitting my testimony from a very similar application by the same applicant in 2021 (LU-21-047). I am also attaching related testimony by Debbie and Norm Johnson for that same proposal, which includes facts that are still relevant regarding heron rookeries and the applicable state forestry rules and county development code.

My 2021 testimony applies in its entirely to the current application, except regarding the details of the changes in topography.

The main difference is that LU-21-047 proposed a 270 ft tall ridge constructed of waste that would completely block the existing flyway through existing, broad topographic saddle between Coffin Butte and Tampico Ridge. In 2021 I noted that this would cut off access to one or more foraging areas that are used by the herons during nesting season.

The current proposal, if taken at face value, would not entirely block this flyway, but it would severely constrict it by building another huge hill of garbage out from the north end of Tampico Ridge. Only a narrow "valley" would be left along the road running between the new and old landfills. Herons using that valley to fly to foraging areas to the west and then to carry food back to their nests would be vulnerable to harassment by Bald Eagles which (as the applicant has documented) congregate around the dump site.

Again, **that's only if the current proposal is taken at face value.**

As noted by the VNEQS attorney, Jeffrey Kleinman, during his oral testimony on May 6th, if you approve LU-24-027, there is no real impediment to the applicant reverting to the original plan set forth in LU-21-047. All that would be needed is a vacation of the section of Coffin Butte Road between the new and old landfills, which would not require approval of the Planning Commission. Indeed, the Applicant's submissions to Oregon Department of Environmental Quality (DEQ) for the current application are essentially unchanged from their submissions for LU-21-047. In particular these two exhibits in the Applicant's Burden of Proof are the same as were submitted to Oregon DEQ for LU-21-047:

Exhibit 24. Oregon DEQ Permit Work Plan.
Exhibit 25. Oregon DEQ Approval of Work Plan

The field investigations described in Exhibit 5 (geotechnical engineering explorations

of the Development Site) were all carried out under the same 2021 work plan. Thus the Applicant would not need to change any of its filings with DEQ, to go ahead with the original plan.

If the Applicant reverts to their original 2021 design after securing your assent to LU-24-027, then the impacts on the herons in their current nesting location, just east of Lot 1200, will be the same as for the original design put forward in LU-21-047.

Please note this applies to all aspects of LU-24-027. Denial of LU-24-027 is your only way to assure that the Applicant doesn't implement by stealth what you rejected unanimously in 2021.

Yours sincerely,
Joel Geier, Ph.D.
38566 Hwy 99W
Corvallis OR 97330

Joel Geier
38566 Hwy 99W
Corvallis, Oregon 97330-9320
(541) 745-5821
joel.geier@peak.org

Benton County Planning Commissioners
c/o Planning Division
360 SW Avery Avenue
Corvallis, Oregon 97333-1139
Phone: 541-766-6819
FAX: 541-766-6891

November 1, 2021

RE: LU-21-047 Coffin Butte Conditional Use Permit

Dear Ken Kenaston, Chair, and Members of the Benton County Planning Commission:

Thank you for this opportunity to comment on this Conditional Use Permit (CUP) application. I am submitting additional comments based on documents from county staff and others that were not made available to the public until after my previous comments on October 22nd. My supplemental comments here are to note the insufficiency of county staff recommendations regarding a specific topic:

Great Blue Heron rookeries in the path of this development will be disturbed (BCDC Sections 87.200 through 87.230)

Summary: The conditions of approval recommended by staff are insufficient to prevent disturbance and likely permanent loss of at least one significant rookery known to be active in 2021:

- The recommended conditions of approval only address disruptions by preliminary construction activities at ground level.
- They do not address impacts of constructing a high ridge that will obstruct flyways between the rookery and important feeding areas.
- They do not address impacts of future garbage tipping activity including heavy equipment, noise, and bright lights on an adjacent slope above the trees that host the rookery.
- There is no provision for independent monitoring and assessment of disturbance.
- There is no provision for mitigation in the likely event that this landfill expansion causes the rookery to be abandoned.

In the absence of a plan to ensure that disturbance can be avoided and in the absence of a mitigation plan to compensate if and when the rookeries are abandoned, **Section 87.230 requires you to reject this application.**

Background: Two Great Blue Heron rookeries active within the past decade are known to exist in the immediate vicinity, one just east and one on the west edge of the proposed new landfill disposal area (Figure 1). The **eastern rookery**, in hybrid poplars south of Coffin Butte Road, was still active during the 2021 nesting season, with counts of up to 24 occupied nests. The **western rookery**, in dense

conifers west of the existing leachate pond, may still be active but is difficult to observe from the public right-of-way along Coffin Butte Road. Applicant acknowledges that their staff have seen herons using both areas.

The western rookery site will mostly be *buried under* the proposed new disposal area. Portions on an adjacent lot to the west are directly in the path of the proposed new haul road for quarry and landfill traffic. Applicant has already bulldozed a route through this area (observable from Soap Creek Road), apparently without waiting for biologist surveys to check for evidence of recent use.

The eastern rookery is on a lot zoned as FC (Forest Conservation, Lot 1200). The proposed new haul road will run close the the west edge of the poplars that host the eastern rookery. Applicant also proposes to excavate the hillside to the south, to build two large new leachate ponds.

Thus future landfill operations will be on three sides of the rookery, rather than mainly just the northern side. With a state highway and truck merging lanes to the east, there will be disturbance to this rookery from all four sides.

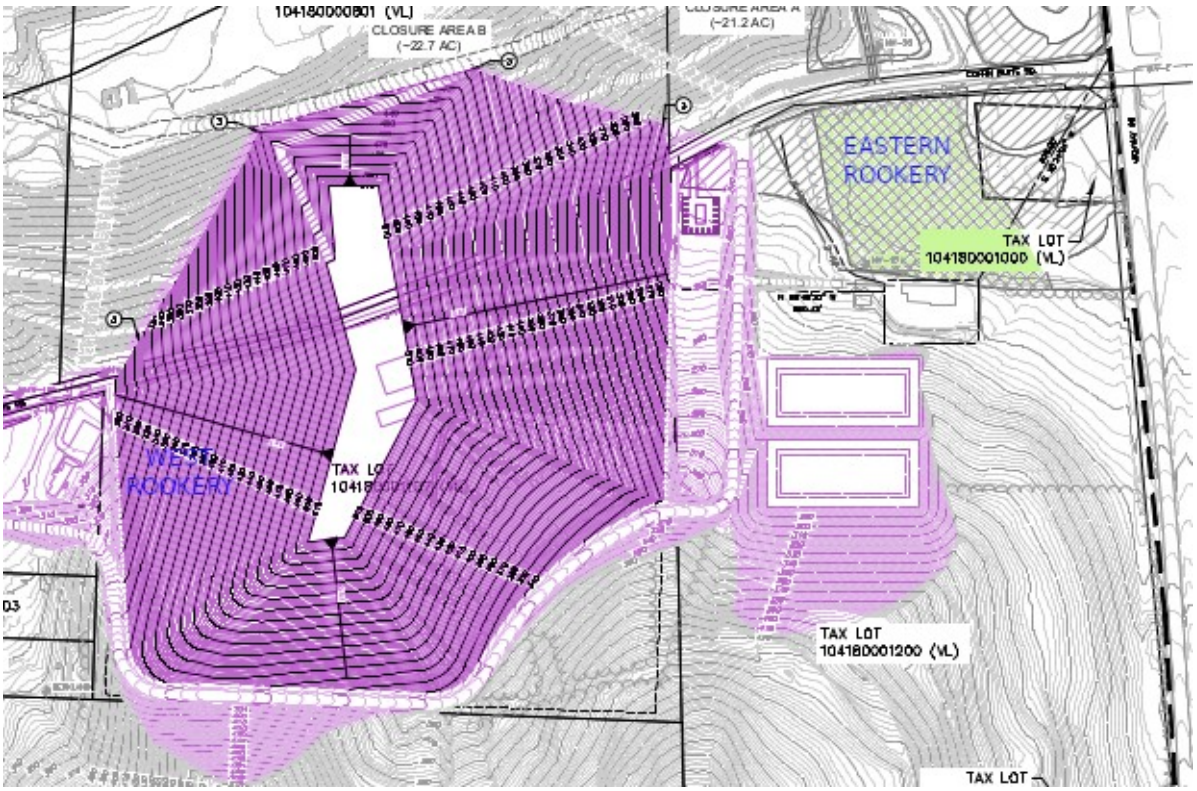


Figure 1. Location of eastern and western Great Blue Heron rookeries in relation to proposed new landfill disposal area and related roads and leachate ponds. Purple shading shows the extent of areas that are directly impacted by construction plans, including a new haul road, new employee building, new ponds, and areas to be regraded. The new ridge line to be created by garbage disposal is shaded in darker purple. Numbered contours are at 10-ft intervals.

Applicant proposes to build the new disposal cell to a height 270 ft above the east end of Coffin Butte Rd. This means that active tipping areas will be on a slope high above the tops of the nesting trees, increasing exposure of the colony to predators such as ravens and eagles.

Persistence and reproductive success of Great Blue Heron rookeries depend on multiple factors. From personal communication with wildlife biologist and noted heron expert Ann Eissinger, key factors include:

- Proximity to multiple nearby foraging areas as food sources;
- Undisturbed flyways between the rookery and foraging areas;
- Buffers around nesting trees to protect from disturbance by human activity including pedestrian access, equipment noise and bright lights.

While some heron rookeries may tolerate some degree of disturbance by acclimation to regular human activity nearby, increases in the level of disturbance, the proximity, or types of disturbance could lead to colony abandonment.

The conservation status and population trends for the Willamette Valley nesting population are not understood, due in part to a chronic dearth of resources for non-game species monitoring by the responsible state wildlife agency, ODFW. Thus the consequences of disrupting a rookery of this size (20+ pairs) for the regional population are unknown.

Site-specific conditions and impacts:

Observations of this particular nesting site by skilled local observers, over the past two decades, indicate that herons nesting here utilize foraging areas both to the east (prairie restorations and wetlands on E.E. Wilson Wildlife Area) and west (pastures in the Soap Creek Valley), as well as fields to the north near Wiles Rd. and Robison Rd. Thus there are multiple nearby foraging areas, all of which may be necessary for reproductive success of this rookery.

The natural, gentle topographical saddle between Coffin Butte to the north and Tampico Ridge to the south currently provides flyways for herons to travel easily to all of these foraging areas, either by flying west through the saddle and then north or south along Soap Creek, or flying east toward E.E. Wilson Wildlife Area.

If the development proceeds as proposed, a 270 ft tall ridge constructed of waste will completely block the existing flyway through this saddle, cutting off access to one or more foraging areas.

Heavy equipment operating on this rising mountain of garbage will, within just a few years (based on the disposal rates implied by Applicant's projected capacity of just 12 years) be operating at tree-top level or higher, relative to the adjacent rookeries. This will be a *new type and new direction* of disturbance, different from what has not existed for these rookeries in the past.

Code requirements: Benton County, in Development Code Sections 87.200 through 87.230, has recognized the sensitivity of heron rookeries. ODFW biologists have submitted comments noting that this development has a significant chance of impact. Section 87.230 specifically states:

> *(i) The County shall impose conditions on the proposed use in order to* ***ensure that it will not destroy the sensitive habitat or result in abandonment of the area.***

*(ii) The County **shall deny the application if such impacts of the proposed use can not be mitigated** and that the development **may** lead to destruction or abandonment of the sensitive habitat.*

The conditions of approval suggested in the Benton County staff report **do not ensure** that the proposed use will not result in abandonment of the area. They only provide for guidelines to reduce disruptions during preliminary construction activities at ground level, and then subsequent monitoring to see if the herons stay or abandon the site.

These conditions **do not address** impacts of constructing a 270 ft high ridge that will obstruct flyways between the rookery and important feeding areas.

They **do not address** impacts of future garbage tipping, trash compaction, daily cover application, and other activities that will result in heavy equipment activity, noise, and bright lights on an adjacent slope above the trees that host the rookery.

The conditions call only for monitoring by a biologist under contract to the Applicant. Applicant has very strong financial motivation for this multi-million dollar expansion to proceed without impediment, and no financial incentive to ensure that the heron rookeries persist. **Independent monitoring is needed to avoid this clear conflict of interest**.

The mitigation measures suggested by county staff are very weak, suggesting only that "*the applicant's biologist shall consult with ODFW on improvements that can be made to the site, and the applicant shall incorporate those improvements, that will enhance nesting productivity, mitigate disturbance, and enhance nearby foraging habitat.*"

Note that these proposed conditions contain **no provision nor requirement** for off-site mitigation or enhancements. The applicant's land does not contain enough open foraging habitat to sustain this rookery. Open foraging habitat on Applicant's land could only be expanded by logging of trees on adjoining parcels, which are required to buffer neighboring residences, and furthermore restricted by FC zoning.

The proposed conditions make no requirement for Applicant to fund or post bond for habitat mitigation on nearby lands not owned by Applicant, in the very likely event that this landfill expansion causes the rookery to be abandoned.

Thus the proposed conditions are not adequate, as required by Section 87.230, to ensure that the proposed use will not result in abandonment of the area. The development may – and very likely *will* – lead to abandonment of the sensitive habitat.

In these circumstances, Section 87.230 of the Benton County Development Code clearly states that the County **shall deny the application**.

Thank you for considering these comments. I reserve the right to give further written and oral testimony on this and other issues according to the time frame allowed by statute.

Yours sincerely,

Joel E. Geier, Ph.D.

cc: Ann Eissinger
cc: Audubon Society of Corvallis, Portland Audubon Society, Salem Audubon Society, and Lane County Audubon, Defenders of Wildlife – Northwest Region

From: m h
To: Benton Public Comment
Subject: Melissa Hartley Testimony in Opposition to Landfill Expansion, May 8, 2025
Date: Thursday, May 8, 2025 6:56:37 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Melissa Hartley
Testimony in opposition to expansion of Benton County, Oregon landfill
Public Hearing, May 8, 2025

This is a revision of testimony that I sent via email on May 6. However, it was not confirmed that testimony was actually accepted, so I have revised that testimony with some additional information, and I am submitting this testimony document for the May 8 hearing.

I grew up in the south Salem area, and settled in Corvallis in 1982. My opinion based on experience of the area, that the Coffin Butte Landfill in Benton County landfill should not be granted approval to expand. Here are some of my reasons:

* Proximity of toxic pollutants in the landfill to the Luckiamute State Natural Area (4 miles) and the Willamette Greenway. Sensitive threatened wildlife in the area such as the Western Pond Turtle, and downstream life are at risk from airborne toxicants, ground contaminants, and toxic leachate that is eventually released into the Willamette River after partial treatment at the Corvallis water treatment facility.

* Leachate treatment needs improvement.

* Transport of toxic leachate in tanker trucks on busy highway 99 is a potential hazard.

* Many adverse health impacts to life in the area come from the landfill pollutants. For myself for example, I have genetic variants that reduce my ability to detoxify toxicants. Avoidance of toxic chemicals is very important to my health. An exposure to fumes such as natural gas, cleaning agents, fragrances, diesel and gas fumes, paint, pesticides, and chemicals such as bleach and ammonia, can cause my throat to close, ears ring loudly, migraine headaches, exhaustion, vertigo and disturbed vision, and can take a week to recuperate.

* Regulations pertaining to monitoring pollution from the landfill are not enforced.

* Landfill extension site is of great value for recreation, tourism, housing, and conservation. Property values within smelling distance of the landfill are negatively impacted– a larger landfill would be worse.

* Site is close to population centers (Adair and Corvallis) and residences, which are at risk for disease and as well as property value loss from air and ground pollutants.

* Better waste management practices and a waste management plan are needed before investing in a new landfill.

* Stench from the landfill is general to the area and is unacceptable.

Coffin Butte Landfill accepts garbage from nearly two dozen Oregon counties. Eighty-eight percent of materials for the landfill are transported from distant communities, a large expenditure of fuels which also contributes to pollution. There are likely better sites for a landfill. The present site was selected when the population of the area had many fewer residents. It is time for other areas to do their share and take responsibility for their own waste.

We often travel near the landfill, the quickest way from our house in Corvallis to the Willamette River Greenway four miles east of the landfill. You can't miss it the landfill. It is a huge mountain next to Highway 99. The dump is usually busy with large garbage trucks coming and going during the day from the steaming mountain of garbage on Coffin Butte Road pulling onto or across Highway 99. Smaller trucks also go back and forth to the dump, such as contractors and community members.

As we turn east off 99 toward the Willamette River on Camp Adair Road, I stop holding my breath to avoid the airborne toxic particles. The dump stinks.

Garbage is strewn on both sides of Camp Adair road as we travel east toward the Luckiamute Landing State Natural Area on Buena Vista Road. Somewhat less garbage is on the sides of Springhill Road on our route. The garbage doesn't look like normal fast food littler, it looks like things that were destined for the dump. I have seen garbage fly off trucks.

It is a beautiful area of rolling hills and flat farms if you don't look in the direction of the dump. The dump's plastic covered mountain is incongruous with the natural beauty of the area, and it is inappropriate use of this area to have this blight on the landscape. Whenever I see the landfill, I wonder why anyone ever thought that burying toxics and garbage in such a beautiful valley so near human habitations and wells was an acceptable idea. It was expedient during WWII to dump toxic materials in that area. We can do better now.

When we reach the Luckiamute Landing State Natural Area, the dump is still in view across the valley's fields and forests to the west. The landfill's mountain of garbage is visible for miles and sends up plumes of vapor. Sometimes The state natural area includes the confluence of the Luckiamute, Willamette, and Santiam Rivers. There are hiking trails, and

the north section of the area has been restored to native flora. The south section has lakes and is protected habitat for the Western Pond Turtle, which is listed as sensitive/critical in Oregon, and endangered in Washington.

This area should be kept free of toxic pollution, but the Willamette River here is downstream from where toxic effluent, inadequately treated by the City of Corvallis, is released into the river. Besides Corvallis, Wilsonville and Sherwood also get their drinking water from the Willamette after the toxic dump liquid is released into it, and other downstream Willamette Valley counties plan to use the Willamette's water to provide drinking water for the Willamette Valley Water Supply System.

Driving back from hiking in the Luckiamute State Natural Area, where I often photograph, usually requires waiting at the intersection of Coffin Butte Road and Highway 99. While we wait, we observe the landfill and highway traffic, looking for a break in traffic to get onto 99 to Corvallis. The vast steaming mountain is partially covered with black plastic tarps, with roads and trucks crossing the surface. This dystopian view to the west is out of character in the otherwise beautiful landscape. It is obvious that this is not the best use of this land.

Still waiting at the intersection with highway 99, large tanker trucks full of toxic liquid leachate from the dump also pull out of the Coffin Butte Road onto the highway. The tankers are loaded with liquid toxic effluent bound for the Corvallis water treatment plant, which is not equipped to treat it properly, but they make an attempt before it is released into the Willamette. This toxic liquid travels downstream, eventually to the Pacific Ocean, poisoning everything it comes into contact with to some extent: the fish we eat, the crops grown, the myriad life forms living downstream: the herons, red winged blackbirds, pheasant, beaver, bright yellow backed garter snakes, deer, bears, red racers, blue skinks, newts, hawks, otters, whales, and others.

We need state of the art methods to prevent and deal with waste, regulations not to produce toxic products in the first place, and to render any remaining toxic substances harmless before we are done with them.

We do not want other people's waste in Benton County. We don't want our own waste to persist in the environment in Benton County. Oregon is a special place that should not be wasted. Benton County's has done more than its share to take garbage into its landfill. It's time that other localities take care of their waste.

I agree with Ken Ecklund's testimony.

Thank you.

Melissa Hartley
2535 NW Pendleton Place

Corvallis, OR 97330
hartley_me@yahoo.com
541 740-6203

File Number LU-21-047

Comments on the application for a Conditional Use Permit for the Coffin Butte Landfill to place a new disposal cell south of Coffin Butte Road, relocate the leachate ponds south of Coffin Butte Road, vacate Coffin Butte [presumably this means Coffin Butte Road] and relocate the roadway around the area of the new disposal cell.

Debbie and Norm Johnson
28831 Tampico Road
Corvallis, OR 97330

We oppose this conditional use permit for the following reasons:

1. **Habitat for the Great-blue Heron Rookery Must be Protected and Enhanced**
   The project location hosts a great-blue heron rookery which was documented by the Oregon Department of Forestry in a Notification of Operations (NOAP) under NOAP ID: 2019-551-05885. Great-blue herons are colonial nesters, and as many as 20 heron nests have been observed in the rookery. Under the Oregon Forest Practices Act heron rookeries are protected. Between February 15th and July 31st no forest operations (including truck traffic) are allowed within one-quarter mile of active nest trees and trees cannot be harvested within 300 feet of heron nests.

   Heron rookeries are also protected under the Benton County Development Code as a "Goal 5" resource. According to 87.210 (Sensitive fish and Wildlife Habitat Overlay) a 600-foot area around the great-blue heron rookery must be protected and a site-specific management plan is needed to ensure that "proposed uses and activities will not destroy or result in the abandonment of these areas. [Ord 91-0080, Ord 93-0098]"

   Although anecdotal information suggests that the rookery, or portions of the rookery have moved since the 2019 ODF NOAP was filed, a site-specific management plan is needed before the Coffin Butte conditional use permit can be considered. The management plan should evaluate the quality of heron nesting habitat at the location documented in the ODF NOAP as well as any other locations that are currently in use or have been used in the past. If a previous heron rookery location offers better nest tree structure, then that location should be preserved so that the rookery has an opportunity to move back (Figure 1).

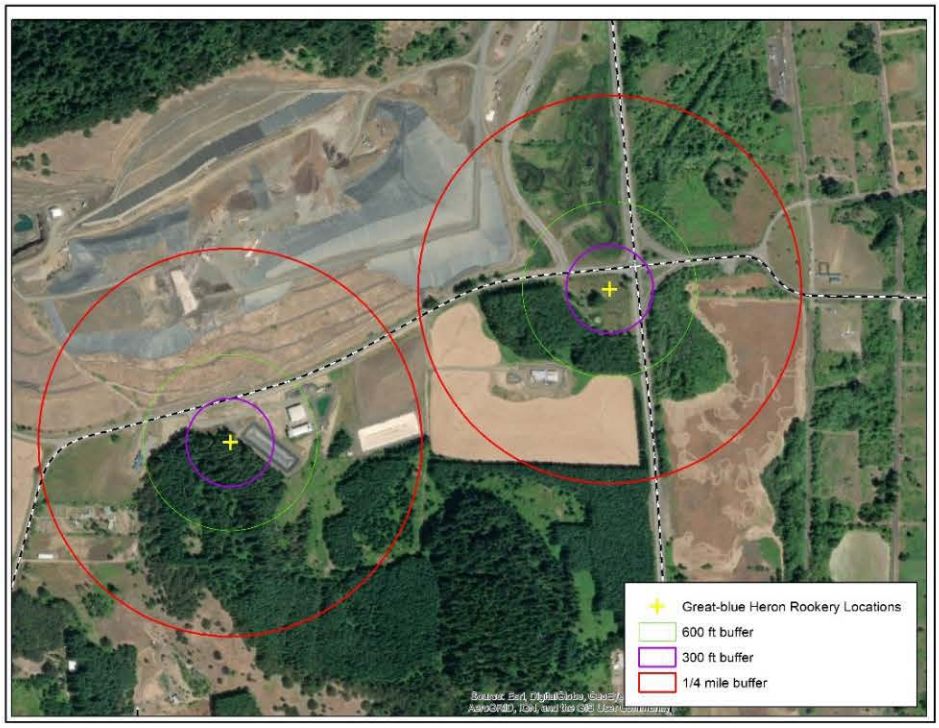


Figure1. Location of known great-blue heron rookeries and buffers associated with the Oregon Forest Practices Act and the Benton County Development Code.

File Number LU-21-047

Comments on the application for a Conditional Use Permit for the Coffin Butte Landfill to place a new disposal cell south of Coffin Butte Road, relocate the leachate ponds south of Coffin Butte Road, vacate Coffin Butte [presumably this means Coffin Butte Road] and relocate the roadway around the area of the new disposal cell.

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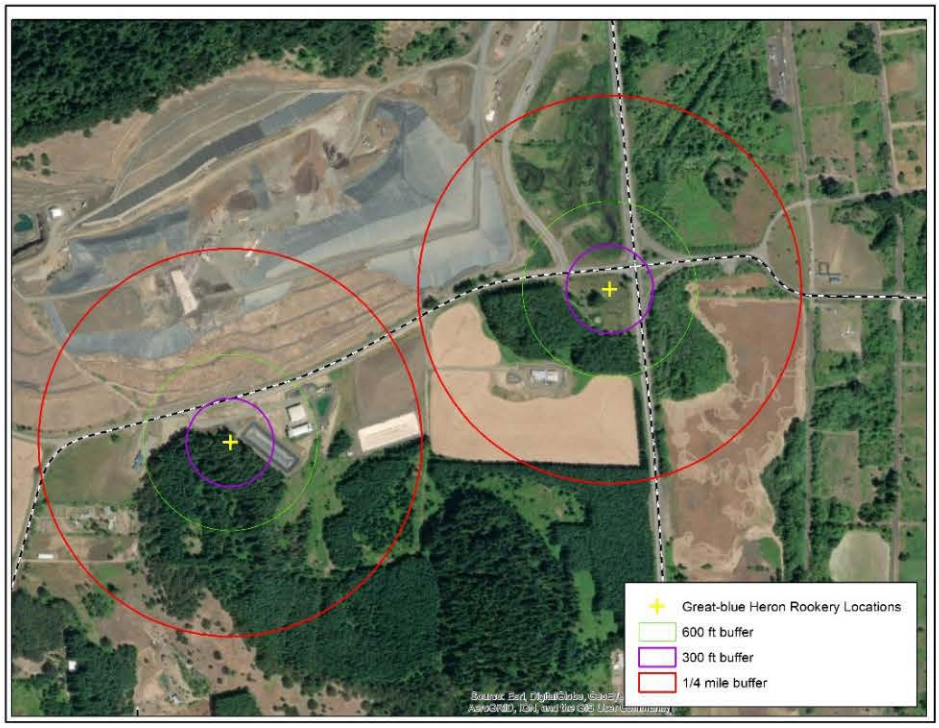


Figure1. Location of known great-blue heron rookeries and buffers associated with the Oregon Forest Practices Act and the Benton County Development Code.

From: Kevin Kenaga
To: Benton Public Comment
Subject: OPPOSE LU-24-027
Date: Thursday, May 8, 2025 3:59:13 PM

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Public Comments May 8th, 2025

LU-24-027 Testimony - May 8th

Kevin Kenaga
37461 Soap Creek Rd.
North Benton County
Corvallis, Oregon 97330

Good evening Chair Fowler and members of the planning commission.
Thank you for your volunteer service.

I oppose LU-24-027 under BCC 53.205 and 53.215 due to the increasing changes to the character of the area and the increasing undue burden placed on Benton County and Planet Earth largely due to Republic Services mismanagement.

I planned to give you handouts but I was told that I could not.

Deck 1 images show the landfills exposed area for the 7 days that satellite data are available for the last five years, so of 7 images, Republic Services was out of compliance on 6 of the 7 days available for an 86% noncompliance rate.

By exceeding the agreed upon exposed area Republic Services can take in more trash because they have a larger working area for the tippers and trucks to dump trash. This larger exposed area releases more methane, odors and toxins into our environment.

Methane Oxidation in landfills is a natural process where methane gas, a byproduct of decomposition, is converted into carbon dioxide and water by bacteria within landfill cover soil.
That is if soil is used as a daily cover. Federal rules require 6" of soil as daily cover but Oregon DEQ has issued Republic Services an alternative daily cover permit which is why we see tarps in the photos. Tarps do not trigger methane oxidation yet DEQ issued this permit. By operating under this permit Republic Services is putting an additional undue burden on Benton County and Planet Earth.

Deck 2
photo 1) shows birds scavenging on the landfills exposed area, birds that later go off and do crop damage which is documented in others testimony. Please consider this photo when reading the Mid Valley Bird Alliance testimony and in considering Republic Services Wildlife consultant's report.
photo 2) shows tarps as an alternative daily cover on only 1/2 the exposed area
photo 3) shows alternative daily cover completely lacking on the exposed area
photo 4) shows the newly installed enclosed flare billowing smoke.

Concerns also extend to the use of Covanta/Reworld incinerator ash that had previously been used as Alternative Daily cover. The 2024 publication in the journal, Environmental Monitoring and Assessment, was submitted in written testimony. It documents signature heavy metal contaminants found in the moss around the Covanta/Reworld incinerator. The researchers are working towards the publication of the companion study focused on Coffin Butte Landfill expected out sometime this year.

Benton County Talks Trash found that there has never ever been any enforcement of prior conditions of approval at Coffin Butte Landfill, you also heard Petra Schuetz state that Benton County does not have the staff to enforce conditions of approval . So any conditions of approval, just as in the past, would mean nothing. The situation with Oregon DEQ is very similar. DEQ does one annual inspection at Coffin Butte Landfill. DEQ makes an appointment to visit the Landfill. Republic Services gets the dump all cleaned up for the inspection. These inspections are like realtor open houses.

Having called DEQ several times over the years I have never been able to get them to make an unannounced site visit. On one occasion I sent numerous photos covering a period of several months showing that daily cover and/or alternative daily cover was minimal or nonexistent. DEQ then received one photo from Republic Services showing that daily cover had been applied on one, yes, just one day. DEQ then considered the case closed without any penalty imposed. So much for any DEQ enforcement.

Deck 3
photo 1) Rohner family on their farm on the south slope of Coffin Butte pre 1945.
photo 2) Coffin Butte distant view circa 1900
photo 3) Coffin Butte annual tonnage in millions of tons

Republic Services could quickly double the life expectancy of the existing landfill, yes double, by simply returning to pre 2017 annual tonnage. But no this corporation is putting profits over people and Planet Earth. If Republic Services did reduce the annual tonnage they would lessen the change to the character of the area and would also be reducing the existing undue burden on Benton County. Having one blighted slope has already changed the character of the area. And now with this expansion application Republic Services is asking to blight yet another slope which would further degrade the character of the Soap Creek Valley area while continuing to place an undue burden on Benton County and Planet Earth. This is an unacceptable request.

Prior to Republic Services ownership of the Coffin Butte Landfill an expansion application was proposed in the 1980s and was shot down by Benton County residents. An expansion application submitted in the 1990s was denied. Then under the ownership of Republic Services an application was submitted in 2021 and in 2022 that application was unanimously denied by the Benton County planning commission. These landfill expansion applications have become a generational issue and we need to make sure that future generations don't have to go through this undue burden. This application and the 2021 application have put an undue burden on Benton County, Benton County staff, (where there appears to be a complete turnover in the Planning Department largely due to the 2021 application) and also on the residents of Benton County.

Comparing Republic Services expansion application to a landlord tenant agreement or maybe more likely for all of us ,to the experience of an overnight houseguest, one that you wouldn't invite back.

How did we get here?

I find it more than troubling that our County Council has never taken any action to enforce any, not even one, of the past conditions of approval. Non enforcement of all previous conditions of approval is documented in Benton County Talks Trash in which County Council participated and acknowledged. County Counsel has the legal right to enforce Conditions of Approval and has chosen not to act.

Lastly with all the health concerns associated with landfills. it is very disturbing that our Benton County health department has been allowed to decline from making any testimony. How can this be when landfills are known to create an undue burden on our health and our environment?

Republic Services has not been a good tenant nor have they been a good neighbor, yet here they are asking "to stay for 6 more years".

I ask you our planning commission to deny this expansion application.

I thank you for the time to give oral testimony.

From:	Lang, Jackie
To:	Benton Public Comment
Subject:	From WM (formerly Waste Management): LU-24-027 - proposed expansion of Coffin Butte Landfill
Date:	Thursday, May 8, 2025 4:59:30 PM
Importance:	High

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Please accept the two attachments from WM regarding LU-24-027 – the proposed expansion of Coffin Butte Landfill.

Jackie J. Lang
Senior Area Manager – Strategic Engagement and Public Affairs
Pacific Northwest/British Columbia
jjlang@wm.com
503-705-0007

Learn about WM's innovative research and pilot programs to reduce waste and improve recycling at innovation.wmnorthwest.com

WM Portland
7227 NE 55th Avenue
Portland, OR 97218

May 8, 2025

Benton County Commissioners Nancy Wyse, Pat Malone and Gabe Shepard
Benton County Planning Commission
Benton County Solid Waste Division

Dear Benton County Commissioners, Planning Commission Members and Solid Waste Staff:

Thank you for the opportunity to share this information as you contemplate Benton County's long-term needs related to solid waste.

By way of introduction, WM is North America's leading provider of comprehensive environmental solutions and the largest recycler in North America. We operate the largest landfill network and lead the industry in transporting waste by rail. WM also manages the most extensive network of landfill gas-to-energy plants in North America and currently owns or hosts more than 20 renewable natural gas (RNG) facilities that convert landfill gas into pipeline-quality RNG. We have served Oregon communities, from Portland to Klamath Falls, for four decades with a track record of safety leadership, operational excellence, environmental compliance and world-class logistics expertise.

We are reaching out now to encourage you to consider a new solid waste solution that is environmentally sound, logistically smart and economically feasible for Benton County.

As we have discussed with Benton County staff, WM is prepared to offer a long-term, regional solution that uses rail to transport waste from the Mid-Willamette Valley to WM's state-of-the-art landfill in Gilliam County.

Three elements make this a workable solution for Benton County -- the availability of the intermodal site at Millersburg, WM's rail expertise and WM's state-of-the-art landfill in Gilliam County:

1. **MID-WILLAMETTE VALLEY INTERMODAL CENTER:** This infrastructure is readily available and ideally suited for waste transport by WM and Union Pacific Railroad. In fact, Union Pacific is already our rail partner for transporting waste to WM's landfill in Gilliam County. Because WM and Union Pacific have worked together for three decades, we could be operational at this site in six to nine months after agreements are in place.

2. **WM'S RAIL EXPERTISE:** No company transports more waste by rail than WM. Rail service is part of WM's logistics expertise.

    - Consider a unit train going directly from Millersburg to Gilliam County. No trucks traveling hundreds of miles on I-5 or I-84. No stops, detours or complicated rail switches along the way. Safety, reliability and a far smaller carbon footprint than trucking!

- WM has transported Seattle's waste by rail for more than three decades -- from Seattle to Columbia Ridge Landfill. It's an arrangement that has made sense because it is cost effective for the city and it delivers a smaller carbon footprint compared to trucking.

3. WM'S COLUMBIA RIDGE LANDFILL: Columbia Ridge is a leader in environmental compliance and renewable energy. It is permitted and operating in good standing as a Subtitle D landfill. The facility has capacity for more than 120 years and has earned strong community support from neighbors and community leaders.

- For Benton County, Columbia Ridge offers peace of mind through environmental performance. Columbia Ridge's dry climate, unique geology and superior environmental protection systems set it apart from other landfills. With leachate, as an example, other landfills can struggle with the cost and logistics of transporting leachate for processing. In Gilliam County, where rainfall averages nine inches a year, Columbia Ridge generates far less leachate than landfills in other parts of the state. This allows WM to manage the leachate onsite – with no discharge to a public waterway or a treatment facility.

- Columbia Ridge uses landfill gas to generate renewable energy to power homes and businesses.

For your consideration, we have included an attachment that overviews this solution. We are grateful for the opportunity to share this information and look forward to discussing how WM may be of service to the citizens and businesses in Benton County.

Most sincerely,

Rob Jones
Area Director - Pacific Northwest
WM Transportation and Recycling Operations

David M. Rettell

Dave Rettell
Area Director – Pacific Northwest
WM Disposal Operations and Environmental Protection



Peace of Mind for Benton County

Questions about Coffin Butte's future create uncertainties for Benton County.

How will the county manage its waste in the decades ahead?

The county needs a plan that is economical, safe for the environment and reliable — a long-term plan that comes with peace of mind.

WM is equipped to provide this long-term solution and peace of mind for Benton County.

WM's solution for Benton County is economical, environmentally sound and logistically smart. In fact, the logistics in the WM plan are a game-changer because of WM's rail expertise.

Logistics Expertise

No company transports more waste by rail than WM. Rail service is part of our logistics expertise at WM.

For Benton County, WM would rail waste from the Mid-Willamette Valley Intermodal Center to Columbia Ridge, WM's state-of-the-art landfill in Gilliam County.

WM's solution would use existing infrastructure at Millersburg and WM's rail expertise to provide an entirely new and logistically smart solution. No trucks traveling hundreds of miles on I-5!

Benton County would also benefit in terms of safety and reliability of a unit train going directly to Columbia Ridge. No stops, detours or complicated switches along the way.



Mid-Willamette Valley Intermodal Center

The new intermodal facility at Millersburg is ideally located for reloading Benton County's waste. The new 65-acre development includes a 140,000 square foot container yard and 16,500 linear feet of rail track. It's everything WM and Benton County need!

mvic-intermodal.com ▸

Columbia Ridge Rail Yard

Columbia Ridge is the only regional landfill with rail capability on the landfill property. This keeps trucks off public roads, offering maximum safety, versatility and efficiency. The newly enlarged rail yard at Columbia Ridge stretches 40,000 linear feet and includes six switch lanes.

wmnorthwest.com/landfill/columbiaridge ▸

Environmental Leadership, Community Support and Capacity

Columbia Ridge Landfill is a top performer for environmental protection and innovation — and it has capacity for another 120 years. For Benton County, disposal at Columbia Ridge would come with peace of mind.

No more concerns about environmental compliance.

- Columbia Ridge's dry climate and unique geology set it apart from other landfills. This translates to superior environmental performance for leachate management. With an average rainfall of only nine inches/year, the site generates far less leachate than landfills in other parts of the state. This allows WM to manage the leachate onsite simply and safely with no discharge to a public waterway or a public treatment facility.
- Columbia Ridge is a modern landfill engineered with overlapping environmental protection systems that meet or exceed rigorous state and federal regulations and are subject to highly regulated monitoring and reporting requirements. WM's commitment is 100% environmental compliance, and we use sophisticated monitoring protocols to verify that environmental systems are operating properly.

No more concerns about impacts to landfill neighbors.

- Columbia Ridge is surrounded by a 10,000-acre buffer that WM owns and manages for farming and ranching. The spacious buffer provides "elbow room," distancing truck traffic and operations from neighbors.
- WM has a 30-year track record as an engaged and valued community member in Gilliam County.

Economics

For Benton County, long-term economic benefits are possible by signing in 2025 as a priority rail customer.

Imagine the peace of mind that would come with a reliable, long-term solution that works economically — for Benton County and the entire Mid-Willamette Valley! Leaders from across the region have championed the Mid-Willamette Valley Intermodal Center for years. A long-term agreement with WM would resonate throughout the region, providing a stable revenue stream and stimulating visibility for additional economic development.

Innovation: renewable energy and drones at Columbia Ridge

Columbia Ridge is also an innovation leader — a platform for renewable energy and next-generation drone technology. We use landfill gas to power homes and businesses, and we use drones to capture real-time data to ensure safe and complaint operations.



Seattle's Success Story

WM has transported Seattle's waste by rail for more than 30 years — from Seattle to WM's Columbia Ridge Landfill. It's an arrangement that has made sense because it is cost effective and it delivers a smaller carbon footprint compared to trucking.

WM transports Seattle's waste on the Union Pacific Railroad, which can move a ton of freight 454 miles on a single gallon of fuel. That's four times more fuel efficient than trucks. Other benefits: lower GHG emissions and no trucks adding to highway congestion!

Where does Seattle's garbage go?

Watch the first two minutes of this video to see how WM transports and manages Seattle's waste.

tinyurl.com/seattlewastebyrail ▶

Learn more!

sustainability.wm.com ▶

WasteByRail.com ▶

Contact
Dean Boening
WM Project Manager
dboenin1@wm.com
503 201-0778

From: Gregg Olson
To: Benton Public Comment
Subject: Waste Train Coffin Butte Alternative
Date: Friday, May 9, 2025 10:56:11 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

This document backs up what I presented as Public Testimony last night, May 8th, at the Planning Commission hearing on the Coffin Butte Expansion.

Dear Planning Commission,

My name is Gregg Olson, and I now live at 5394 Davidson St, SE, Albany, 97322. Until this year I lived in Corvallis since 2007.

I am writing now because I believe there is a very good alternative to the expansions of Coffin Butte landfill.

Currently there are about 10,000 municipal waste dumps in the United States. In 10 years, 90 percent will be closed. Seattle saw this coming 30 years ago and started shipping their waste by rail to Columbia Ridge Landfill, near Arlington, Oregon, over 300 miles away from Seattle. It is owned and operated by Waste Management, and is 2500 acres, with a life span of 143 years.

Seattle now ships over 63% of its waste by rail. In the U.S. the use of trains for waste has increased at 35% per year- doubling in less than 3 years. Los Angeles is now shipping waste to the Mojave Desert.

Close to us the Mid-Willamette Valley Intermodal Center for moving truck substances to rail cars was recently built, with 3 extra tracks. On its website it states that waste transfer would be a quite large use of the center. ODOT's Rail Advisory Committee in this March's meeting received a suggestion to create a "garbage train" from Millersburg to Columbia Ridge, 150 miles away. Using intermodal containers or gondola cars, 4 waste trains a week could annually carry over 1 million tons of waste to Arlington, Oregon, 100% of Coffin Butte's current deposits.

Effects of using waste trains from Millersburg include the use of Interstate 5 in place of Highway 99 for 88% of deposits (those from out of Benton County). Trains are over 4 times more efficient than trucks, reducing emissions. Columbia Ridge receives less than 10 inches of rain per year. This greatly reduces the production of methane and other toxic gases, compared with over 50 inches of rain at Coffin Butte. Columbia Ridge also has a deep clay base to reduce ground contamination, compared to Coffin Butte's fractured basalt.

I believe Millersburg waste trains are a good shorter-term alternative to Coffin Butte's usage and expansion. Longer term, countries like Sweden deposit only about 1% of their waste in landfill, but that is another story.

Sincerely,

Gregg Olson

541-207-7136

From: Virginia Scott
To: Benton Public Comment
Subject: LU-24-027: Information to add to the record regarding Opposition to the Landfill Expansion - Traffic and Roadside Garbage
Date: Thursday, May 8, 2025 2:29:52 PM

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Please enter the the information below into the record for LU-24-027:

May 8, 2024

Reference: LU-24-027, Coffin Butte Landfill Conditional Use Permit Application

To: Benton County Planning Commission
Benton County Community Development
4500 SW Research Way
Corvallis, OR 97333-1139

Dear Chair Fowler and Members of the Planning Commission;

I appreciate the opportunity to comment on the future of the Coffin Butte Landfill, a county planning decision of great concern to our community, the citizens, farms, wildlife, environment, and properties along the truck routes used throughout the state and affected by this Conditional Use Permit application.

I am concerned about the truck traffic to and from the Coffin Butte Landfill for several reasons and concerned about the increase in these issues if the landfill expansion is approved.

BCC 53.215(2) As self-reported by Republic Services, there are 256,000 trash truck trips to and from the Coffin Butte Landfill per year. This does not include the 20+ trips per day, 5-6 days a week, which haul the leachate from the landfill to inadequately "process" it prior to dumping this leachate in the Willamette River where it travels up to the Columbia River and out to the Pacific Ocean distributing toxic forever chemicals along the way.

A landfill expansion with the tonnage cap removed means more truck traffic with more of the associated issues outlined below.

These truck trips produce diesel exhaust, contributing to greenhouse gases and global warming. What is Republic Services' plan to convert these trucks to an all-electric fleet in keeping with Oregon's Climate Protection Program (CPP) adopted by the Environmental Quality Commission on November 21, 2024 to reduce fossil fuel use by moving commercial trucking from diesel to electric?

BCC 53.215(2) What is Republic Services' plan to mitigate the wear and tear on our Oregon roads from this excessive truck traffic? Currently this upkeep is an undue burden on the county and state and on our taxpayers.

These 256,000 trash truck trips per year are producing an enormous amount of roadside garbage. BCC 53.215 (1) Roadside garbage pollutes the waterways, creeks, streams, rivers,

farm fields and properties along our Oregon roads. If you traveled highway 99, between the landfill and Monmouth, in the November 2024, for example, you may have observed the giant yellow, contractor sized bags of trash the were distributed every 30 to 50 feet on both sides of the highway for 14 miles, which is roughly 4,928 commercial sized bags of garbage. This is garbage that flew off the trucks on this one stretch of road, and from one cleanup event (provided not by Republic Services, but rather by incarcerated work crews). BCC 53.215 (1) This cleanup event, cleaned the ditches, not the farmers' fields, or citizens properties. Now consider how much more garbage is lining the other miles of Oregon roads and highways that these trucks travel as they collect the bulk of Oregon's garbage for delivery to the Coffin Butte Landfill.

What is Republic Services' plan to prevent future, and clean up past roadside garbage pollution that their current 256,000 trash truck trips per year deposit?

I would like us to also consider the risk posed to other traffic, pedestrians, and bicyclists by the 256,000 trash truck trips per year and the approximate 6,240 leachate truck trips per year crisscrossing our state. BCC 53.215(2) Adair Rural Fire & Rescue, alone, has responded to 195 to Motor Vehicle Accidents (MVA) near the landfill. How many of these Motor Vehicle Accidents were connected to landfill traffic? How many more will occur with an expanded landfill? The analysis of this issue has not been undertaken by the county or ODOT.

What is Republic Services' plan to mitigate these risks to our citizenry?

I oppose any further expansion of the Coffin Butte Landfill and urge the Planning Commission to reject this application. I believe the Planning Commission will find that the Applicant, Republic Services, does not provide evidence to conclude that conditional use permit issuance would not violate County Development Code criteria and Comprehensive Plan policies. Further, based on its current performance, Republic Services cannot be expected to demonstrate that it can assure the County of its future compliance with any conditions that the county might issue.

Development Code Chapter 53: Conditional Uses; Administrative Procedures, General Review:

> BCC 53.215 (1): The proposed use does not seriously interfere with uses on adjacent property, with the character of the area, or with the purpose of the zone;
>
> BCC 53.215(2): The proposed use does not impose an undue burden on any public improvements, facilities, utilities, or services available to the area;

Based on these findings, the proposed use seriously interferes with uses on adjacent public and private property, significantly alters and disrupts the ecological, visual, and rural character of both the zoned area and all other surrounding zoned uses, and thereby greatly exceeds the purpose of the zone.

It has been clearly established that the current landfill use already imposes an undue burden on public rights-of-way, transportation routes, esthetic and scenic values, as well as conservation and restoration efforts and recreational opportunities at state facilities, along with greatly increased traffic, incidental refuse, incompatible noise, noxious odor, combustible vapor, and contaminated air, soil and water. Such grievous current offense cannot justify its furtherance or any proposed increase in its size or use.

I appreciate the opportunity to provide comment to inform your Planning Commission consideration.

Sincerely,

Virginia Scott
37016 Soap Creek Road
Corvallis, OR 97330

Virginia Scott • 37016 Soap Creek Rd • Corvallis, Oregon 97330

DATE RECEIVED: 5-8-25
FROM: Virginia Scott
PHONE OR EMAIL: 541-588-0020

Benton County Planning Commissioners c/o Planning Division

4500 SW Research Way, Corvallis, OR 97333

April 29, 2025

RE: LU-24-027 Conditional Use Permit Application Regarding Landfill Expansion: Fire

Dear Chair Fowler and Members of the Benton County Planning Commission:

Thank you for the opportunity to comment on the Conditional Use Permit (CUP) application submitted by Valley Landfills Inc., which proposes to start what amounts to a new landfill on the north end of Tampico Ridge, south of Coffin Butte Road.

My comments, focuses on the risk of fire to our local communities, homes, recreation, wildlife, industry, business, property, and wellbeing of our Adair Rural Fire & Rescue posed by the Coffin Butte Landfill.

In Exhibit 20_Fire Risk Assessment for Coffin Butte Landfill the applicant has outlined five fires since 1999 and identified three possible sources of landfill fires that have a material chance of ever developing at the Landfill. These include (1) working face fires, (2) grass fires, and (3) gas well fires. They have declared that there have been no fires in the surrounding area. And have outlined their plan to address and handle fires that do occur.

In the supporting document, I show that there is a distinct mismatch between the E20 report and the data provided by Adair Rural Fire and Rescue (ARFR), which records 28 fires between 2013 and 2025. Adair Rural Fire & Rescue has responded to 28 calls to the Landfill, 17 to the Republic Services Pacific Region Composting (PRC), 111 to fires near the Coffin Butte Landfill, and 195 to Motor Vehicle Accidents (MVA) near the landfill. I question whether any of the fires that involved ARFR or the ones that were handled internally were reported to the DEQ as their Operations Plan states.

I also show additional fire risks that are not accounted for in the E20, and show that Republic Services does not have a thorough plan to monitor and address fires, especially after hours, where they rely on the public for monitoring and volunteers for fire suppression.

The applicant drastically under represents the severity, number and types of fire risks to individuals and property in the area and yet asks you to approve their CUP. Exhibit 20 does serve as a useful example of how

the applicant handles legitimate fire risk concerns that have been raised by local residents.

As I detail in my attachment to this statement, the applicant's arguments are dismissive at best. The fact that they have included this Exhibit as part of their application casts doubt on the entire application, and gives you further grounds to deny.

Sincerely,

Virginia Scott

In 2024, Oregon's Governor invoked the Emergency Conflagration Act and Oregon was in a state of emergency due to the 2024 wildfires. These wildfires were exacerbated by the dry environment that is a result of global warming. Oregon called on its mutual assistance teams around the country to help us with fighting these wildfires. When the 2024 season finished, we had lost a record number of acres to fire. As we know the cost of firefighting and recovery from wildfires is massive and it costs lives, like the 2024 death of single-engine air tanker pilot James Bailey Maxwell. We also know that many of our Wildland firefighters have lost their jobs.

In addition, Oregon Health Authority is reporting record numbers of heat related deaths due to climate change, including 14 since July 5, 2025. The Climate and Health in Oregon report for 2023 reminds us that extreme climate effects continue and that we must build resilience against wildfire, drought and extreme heat. It seems that reducing methane release from Coffin Butte would be more effective than building resilience to the effects of methane releases. An expansion of the landfill will only result in more methane, not less.

This methane release is causing losses in human life, environmental losses, fire losses and expenses, and these are not limited to our county. These effects are cumulative across our state, our neighbor states, and have worldwide implications that often fall on those least able to adapt to them.

An expanded landfill is an additional fire risk to our community and to Benton County. BCC 53.215 (1) A landfill fire sweeping through the area will seriously interfere with uses on adjacent property, (e.g. the destruction of the homes that we live in, the research forestry in McDonald Forest, the commercial forestry in Starker Forest, agriculture like Anderson Blues, the recreational hiking and horse trails at the Lewisburg Saddle, the Old Growth Trail, the Sulphur Springs Trails, E.E. Wilson Wildlife Area, Peavy Arboretum, etc.) If fire sweeps through the area it will seriously interfere with the character of the area, (e.g. the loss of the historic oldest standing one room schoolhouse in Oregon, and much like the destruction along the scenic McKenzie River highway (below):



Before



After

An expanded landfill is an additional fire risk to our community and to Benton County. BCC 53.215 (2) will impose an undue burden on public improvements, facilities, utilities, or services (e.g. the Adair Rural Fire And Rescue Substation in the Soap Creek Valley, utilities (e.g.in that the toxic smoke from a landfill fire will contaminate water lines and wells that residents depend on, (as happened in the recent LA fires)), or services in the area (e.g. Adair Village Schools).

Per BCC 50.015: 5.9.4 the Soap Creek Valley is home to the endangered Calypso orchid, 5.1.2 The ecological health would be irreparably damaged by the toxic smoke from a landfill fire particularly if it burns for years. 5.2.1 Soap Creek is an important part of the Luckiamute Watershed and would become inhospitable to fish and other aquatic creatures if the cooling tree-cover were destroyed by fire.

Wildfire Hazard Map:





To create the wildfire hazard map, OSU researchers combined two primary datasets – burn probability and fire intensity. Both were modeled across Oregon using the best available data and with the help of state and local fire professionals. Burn probability and fire intensity are based on four criteria:

- **climate**
- **topography**
- **weather**
- **vegetation**

Data regarding these criteria were combined with data from historical fires and simulations of 10,000+ plausible fire seasons, accounting for fire likelihood and intensity under everything from mild to severe fire weather.

Question: Why aren't any of the frequent Coffin Butte landfill fires included in the Benton County Wildfire Protection Plan (CWPP)?

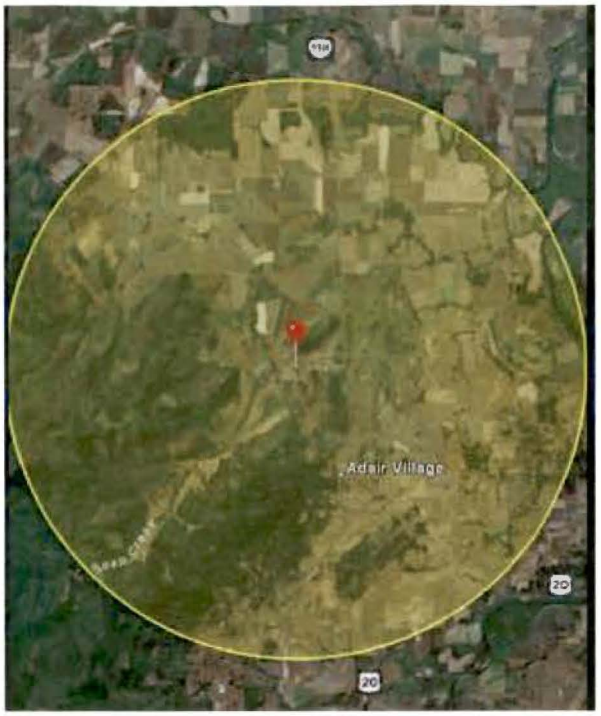
I am concerned that a landfill with documented explosive levels of methane would be considered for location in a parcel rated as Moderate risk land adjacent to residential homes.

The Wildfire Hazard Map takes into account climate and weather, both of which are changing dramatically (perhaps accelerated by the massive unmitigated methane release from the landfill). It also factors in vegetation. It does not factor in explosive levels of methane, equipment fires, composting material, or battery fires, for example, which I believe make the current map misleading.

August 6, 2025 – At the Benton County Board of Commissioners (BoC) meeting, Republic Services reported to the BoC that they used the Covanta ash as daily cover because they do not have soil available for the daily cover, yet in the E20 Fire Risk Report the operating procedures state that 12"of soil is used for intermediate cover, 6" of soil is used for daily cover and that "Soil stockpiles arranged in a U-shape are always available near the Landfill working face in accordance with Standard Operating Procedures (SOPs) developed by Republic Services corporate staff for all their landfills nationwide." This seems to be conflicting information.

Question: Is there soil available at Coffin Butte or not?

Five Mile Radius Around Coffin Butte Landfill:



Reports by the Institute for Home and Business Safety (IBHS Research Center) are finding that embers from wildfires can travel on the wind up to five miles in front of a fire. They ignite structures, trees, or landfill trash that then produces their own embers that can travel another five miles. These embers jump fire breaks in high wind situations.

I attended a webinar called Cascadia Wildfire and Urban Smoke. One of the hosts shared some film snippets and insights that are from the "Inside the LA Firestorm" documentary that recently aired on PBS. In that training, the film teams showed footage of the high LA winds blowing open trash can lids, the contents of which ignited from the wind born embers, and produced their own ember storm that ignited homes. I can only imagine the ember storm produced by a mountain of trash vs. the contents of an individual trash can.

During this same webinar the fire experts were explaining that in a wind event with fire, extinguishing the fire is not a matter of "putting the wet stuff on the red stuff" because when spraying water in high wind, the water dissipates before it ever reaches the fire. The E20 reports that "The site can readily use water to extinguish grass fires on the landfill or to supplement soil application at the landfill working face. The site has a 4,000-gallon water truck with spray bar and hose attachment that is used routinely in dry weather for dust control. The water truck is loaded with fresh water from a truck-loading station connected to the public water supply." Even if there is a 4,000 gallon truck (this should be verified independently), it will not be sufficient or effective in a wind event with fire to extinguish a blaze.

The E20 goes on to say "Other control measures could be employed, such as firebreaks and soil barriers, to keep such fires off the Landfill property." Another important point made during the webinar by fire experts was that firebreaks are not effective at stopping wind events with fire as the embers can travel up to five miles on the wind ahead of a fire.

We need to consider the risks of fires started outside the Coffin Butte Landfill, whose wind driven embers ignite the trash and/or explosive methane plumes at the landfill, that then blow into MacDonald and Starker forests, Adair Village, Soap Creek Valley, the Vineyard Mountain community, Lewisburg, North Albany, Airlie Road, Suver crossroads, Peavy Arboretum, Springhill Drive, Tampico Road community, etc. From there the ember storms can jump another five miles reaching Monmouth or Corvallis, Albany and Millersburg. A larger landfill is a larger target for airborne embers.

And we need to consider fires originating at the landfill from: pyrophoric materials (e.g. lithium ion batteries), automobile batteries crushed by landfill equipment, hot loads that ignite landfill contents, heavy equipment fires, underground fires from composting, lighting strikes, methane explosions, etc. Ember storms from these fires could be blown out as far as five miles and reach the same areas listed above.

Landfill Fires:

Coffin Butte catches fire regularly. In order to approve the expansion you must judge that the expanded landfill will **not** significantly increase the fire hazard, increase the suppression costs, or significantly increase risks to people engaged in fire suppression. The landfill runs counter to all of these concerns and values, by consuming firefighting resources that could be used to protect our residents, increasing costs to the community that supports our Adair Rural Fire and Rescue and the other stations that provide them mutual aid, and seriously risks the lives and health of our largely volunteer department and the lives of the Republic Services employees. Now combine this proclivity to catch on fire with the explosive levels of methane detected in leaks across the landfill property and we have some very concerning situations.

The E20 – Fire Risk Assessment Report Prepared by James J. Walsh, P.E., BCEE, lists only five fires since 1999 as reported by Republic Services. There is a distinct mismatch between the report and the data provided by Adair Rural Fire and Rescue, which records 28 fires between 2013 and 2025. The five fires identified in the report are included below with the preface of "E20 – Fire Risk Assessment Report".

The table below is a summary of the Adair Rural Fire & Rescue calls responding to the Landfill (28), to the Republic Services Pacific Region Composting (PRC) (17), to fires near the Coffin Butte Landfill (111), and to Motor Vehicle Accidents (MVA) near the landfill (195)

Question: Does the County know how many of these MVAs involve Republic Service's vehicles?

Year	Landfill Fire	PRC Fire	Nearby Fire	MVA
2013	4	5	3	18
2014	2	1	7	22
2015	2	0	6	23
2016	3	0	7	17
2017	0	1	5	17
2018	4	2	5	21
2019	2	2	6	11
2020	1	0	12	9
2021	3	0	17	8
2022	0	2	8	17
2023	2	0	13	8
2024	5	2	11	12
2025	0	2	11	12
Total	**28**	**17**	**111**	**195**

It would be truly unfortunate if after all the work on the CWPP, if the fire that starts and burns peoples' homes down ends up starting at the landfill, which is the single place in Benton County where more fires have started over the past 50 years than any other single place in Benton County.

Reported by a former Republic Services Engineer:

Equipment fires which smoldered for days were a common occurrence. They were often caused when trash gets inside the engine compartments on the D9 dozers and packs around the turbos, causing the trash to start to smolder. This is so frequent an occurrence, that no reports were kept except on equipment repair orders, which only noted the nature of the damage being repaired. [This means no calls to the Adair Rural Fire and Rescue and no reports to DEQ.] The procedure was to pull equipment out of the trash and hose out the engine compartment where the trash had packed and caught on fire. Stir up the embers, hose them down, and if the equipment was still operational (note I did not say safe), put it right back into the trash.

E20 – Fire Risk Assessment Report: The first notable fire at the Landfill occurred in 1999 and was its [the] largest fire to date, as reported in local media at the time. The site was owned and operated by Valley Landfills Inc., before site ownership and operation was assumed by large national waste companies—Allied Waste and Republic Services. The fire broke out in the exposed waste area of the daily working face and reportedly came from an undetected hot load from a large waste-transfer trailer known as a "waste tipper." Apparently, the fire was not spotted and/or responded to quickly enough and spread over the full extent of exposed waste surfaces. It reportedly expanded beyond exposed waste and burned some grass atop the Landfill and also burned and melted some of the above-ground plastic pipe serving as landfill gas headers.

On August 24, 1999, at around 6:30 pm, the landfill caught fire. This fire, large enough to be covered by the Associated Press as national news, burned for more than 24 hours, prompting fire crews from Adair Village, Corvallis, Albany, and Polk County to respond. The Landfill's owner said the blaze was caused by a 'hot load' delivered to the site. Corvallis Gazette-Times. August 25, 1999

Figure 6 - Karl Maasdam/Gazette-Times August 25, 1999. Permission to use granted by OWH News Archives and Licensing Manager.



E20 – Fire Risk Assessment Report: [Approx. 2018] - A second fire broke out at the Landfill's working face about six years ago. The source of the fire is unknown, but was likely from a smoldering portion of a waste load delivered to the site during working hours. The fire went undetected during staffed daytime operations and broke through to the surface during the night and spread through some of the working face before it was observed by neighbors. Adair Fire quickly extinguished the fire with water.

E20 – Fire Risk Assessment Report: A third fire occurred on grassed areas adjacent to the Landfill flare. The cause of the fire is unknown, but site operators believe there may have been an ember from charcoal buildup in the flare that ignited grass. The incident occurred during the workday and was quickly extinguished by Landfill personnel. Since then, the areas around the flare at the site have been covered with gravel. With this improvement, it is believed that a repeat of a fire starting in this manner cannot occur. (The author of this report, having significant experience with landfill fires, has never heard of a surface fire starting from landfill gas flare. I am skeptical that the fire occurred from this source and believe this grass fire likely came from some other source.)

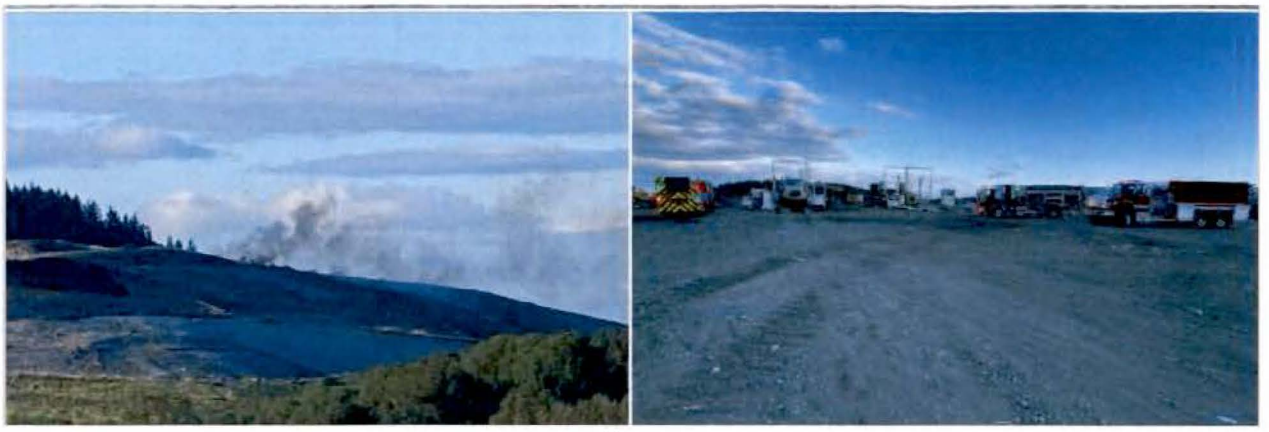
E20 – Fire Risk Assessment Report: A fourth fire was reported to have occurred on May 18, 2024. It is believed that a hot load was delivered to the working face from the public convenience center at the site. Although the subject waste was delivered during the operational day, it apparently was not an obvious hot load and on fire until after the site was closed that day. At about 6:00 pm that day, a trail of smoke was seen rising from the working face of the landfill. The fire was reported to Adair Fire who mobilized to the site after first contacting site operating personnel. The site's Operations Manager and Operations Superintendent responded to the site within 15 minutes of contact from Adair Fire. Site personnel immediately used heavy equipment to extract the affected waste from the working face, moving it nearby to an area isolated from the waste at the working face. Site personnel then used the equipment to apply soil over the waste. The fire was soon extinguished. After that, the waste was observed for another hour, to ensure it did not re-ignite.

Adair Rural Fire & Rescue's Post

Adair Rural Fire & Rescue
May 19, 2024 ·

At 7:04pm, Saturday 5/18, Adair Fire was dispatched to a smoke investigation at the top of the Coffin Butte Landfill. Firefighters arrived to find burning trash damaging both hydraulic transfer truck lifts. The lift fires were quickly knocked down. We greatly appreciate the assistance from Corvallis Fire to send an additional fire engine and tender to help extinguish the trash. Landfill employees operating a dozer and backhoe were instrumental in the effort to completely put the fire out. Adair Fire was on scene for 1 hour and 25 minutes.





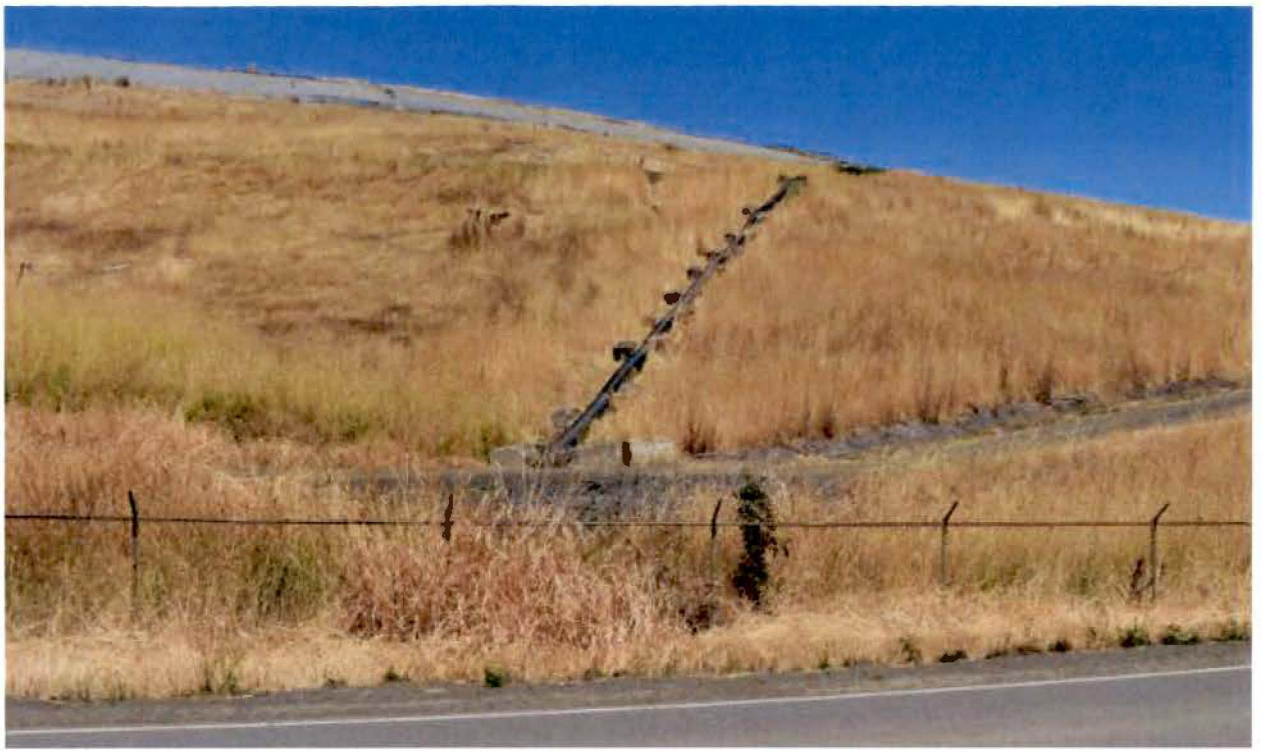
E20 – Fire Risk Assessment Report: A fifth fire occurred on July 24, 2024. A small fire ignited in a grassy area near the landfill's flaring station. Again, the fire was observed from off-site and reported to Adair Fire. Adair Fire notified site operating personnel, who live nearby and mobilized to the site in 12 minutes. By then, Adair Fire had already extinguished the grass fire with water. The source of the fire is unknown. But since this event, the ground in a large area around the enclosed flare has had its grass removed and replaced by a gravel surface.

It is notable that Republic Services reported to the Fire Assessment team that they placed gravel around the flare after the earlier reported event and that "a repeat of a fire starting in this manner cannot occur", but it clearly did.

Also of note is the fact that "The author of this report, having significant experience with landfill fires, has never heard of a surface fire starting from landfill gas flare." And yet we have two such events in a matter of a year. This calls into question both Republic Services operations and preventative measures and the expertise of the author hired to write this report for the applicant.

OPB reported that on July 24, 2024 firefighters responded to a grass fire near a flare stack that burns off methane gas from the landfill.

Adair Rural Fire and Rescue was onsite prior to Republic Services response to this fire.



Above: Fence high dry grass surrounds and partially covers the Coffin Butte Landfill. An arsonist, a spark from a dragging chain, an ember from a nearby fire, a lightning strike, or a carelessly tossed cigarette could ignite the grass and the explosive levels of methane leaking from multiple sites across the landfill surface.

Possible Landfill Fire April 9, 2025 7:05 PM - A neighbor was out on E.E. Wilson Wildlife Area this afternoon. From the archery range she saw smoke or steam coming up, and a bunch of people working on the area with heavy equipment.

This possible fire was not called in to Adair Rural Fire and Rescue.

E20 Addendum - #12 states that bird deterrent flairs are not used at the landfill. There are recent witness accounts of bird deterrent flairs in use at the Coffin Butte landfill and they are being used in the presence of explosive levels of methane gas. This is alarming.

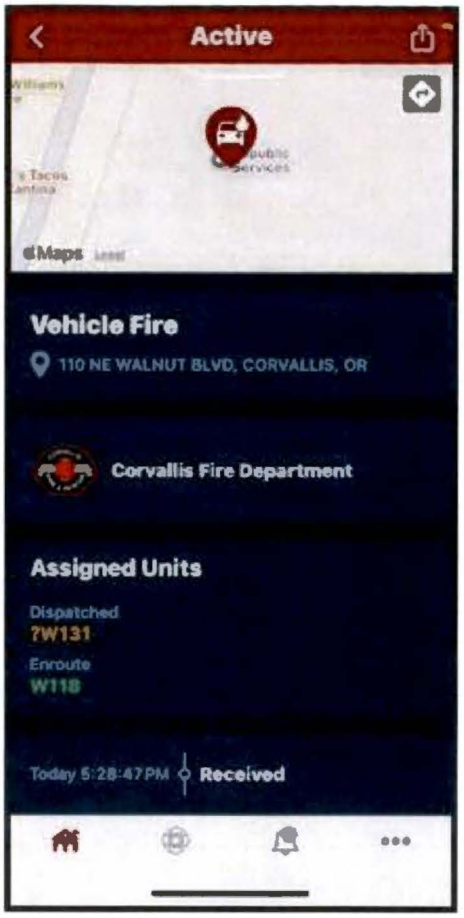
I have not seen any indication that proper PPE is available for the Republic Services staff, or an indication that they have been trained to use it properly to protect their health. This seems to be an undue burden on the employees.

I think that it is significant to note that many of these fires occurred after hours and the reporting mechanism was citizens driving by who call Adair Rural Fire and Rescue. This is a significant burden on the citizens in order to protect the area from fire. August 6, 2025 – At the Benton County Board of Commissioners meeting, Republic Services reported to the BoC Republic Services reported that they "do not have a way to monitor for fires after hours and that they rely on citizens and Adair Rural Fire and Rescue for monitoring and subsequent response. Republic Services was also asked if they have a mechanism to alert residents in the area in the event of a fire. Again, they said, "No, that they relied on Adair Rural Fire and Rescue to do the alerting. This is a serious burden on our local services.

Garbage Truck and Hot Load Fires:







April 6, 2025 6:12 PM – This fire occurred on Walnut in Corvallis.


EXIT ONLY





Batteries and Other Items Cause Oregon Landfill Fires:

https://kpic.com/news/local/car-battery-thrown-in-trash-sparks-wildfire-at-landfill-in-douglas-county

OPB reported in October of 2023 on the growing risk of lithium battery fires in Oregon landfills. Lithium battery fires are particularly dangerous. If damaged, or if their contacts touch metal, they are particularly susceptible to thermal runaway. Lithium batteries can burn without oxygen because they create their own oxygen. The fire that they produce is considered a chemical fire and produces highly toxic fumes. They burn at temperatures in excess of 932 degrees F which can easily ignite surrounding material. They are exceptionally difficult to extinguish. Republic does not inspect the loads that come to the landfill. Lithium batteries in are everything now, including: electronic devices, like laptops and phones, tooth brushes, hand tools, yard implements, handheld radios, battery backup power sources, etc. They are everywhere and they pose unique fire challenges and danger to firefighter, landfill personal, and area residents. E20 indicates that there is signage posted at the landfill, but they do not inspect their loads.

Question: What is Republic's plan to address this ever growing issue?

Car battery thrown in trash sparks wildfire at landfill in Douglas County

by News Staff

Thu, August 20th 2020 at 1:43 PM
Updated Fri, August 21st 2020 at 12:10 PM

The most recent fire was caused by an "an improperly discarded automobile battery that exploded and caught fire when it was run over by a trash compactor working in the landfill," the county said. Other items to watch out for include cell phones, home electronics, charcoal briquettes, wood stove ashes, cigarettes, propane fuel tanks and cylinders, fireworks, explosives, radioactive materials, lighters, oil, oil soaked rags, chemicals and cigarettes. (Douglas County)

ROSEBURG, Ore. - When you throw something away in Douglas County, it goes to the landfill. And when what you throw away is flammable, it can set the landfill on fire. That's been the case in the past - and this week - at the county landfill.

"We have experienced landfill fires in the past and after identifying the causes, we know that most of the fires could have been prevented with a little help from our residents," Douglas County Commissioner Tom Kress said. "So, we are asking residents to take a little extra time to separate and properly dispose of flammable and combustible materials, and make sure that hot waste items are cooled and contained before they place them in a garbage can or dispose of them at a transfer station."

According to the county:

Landfill fires are especially dangerous, not only with the potential to start a wildfire on neighboring lands, but also because they can cause injury to employees and fire crews, and they can emit dangerous fumes from the combustion of the wide range of materials contained within the landfill.

Luckily, the recent fires were quickly contained by staff at the landfill, which prevented the spread to the nearby hill sides.

"It is extremely dangerous for our solid waste staff, as well as fire crews to fight fires at a landfill," said Gabe Forrester, manager of the Douglas County Solid Waste Division. "Between navigating the steep terrain with fire equipment,

preventing the spread of fires to neighboring lands, enduring the extreme heat caused by combustible materials and avoiding potentially toxic fumes, there is an incredible safety and health risk."

The most recent fire was caused by an "an improperly discarded automobile battery that exploded and caught fire when it was run over by a trash compactor working in the landfill," the county said.

Other items to watch out for include cell phones, home electronics, charcoal briquettes, wood stove ashes, cigarettes, propane fuel tanks and cylinders, fireworks, explosives, radioactive materials, lighters, oil, oil soaked rags, chemicals and cigarettes.

The county offered these tips for handling potentially flammable waste:

Lithium-ion and Lithium-polymer Batteries: These kinds of batteries are commonly found in cell phones, tablets, notebooks, computers, RC cars and other electronic children's toys. Locally you can recycle these at Lowes and Batteries Plus Bulbs. Additionally, Batteries Plus Bulbs and Call2Recycle will accept alkaline, rechargeable, dry/wet cell and miscellaneous batteries. For all other electronics that contain batteries, the closest location for disposal is at the Lane County Hazardous Waste Collection Center - Glenwood Transfer Station, 3100 E. 17th Ave. in Eugene. Please remove the batteries and do not place these items with your regular refuse or in garbage bags.

Cell phones, Tablets, Notebooks and Computers: Most cell phones or tablets can be recycled or traded-in with your phone service provider, or at an ECO-ATM kiosk located inside your local Wal*Mart, Safeway and Fred Meyer stores buy or recycle them for you. You can also contact the local Lions Club or Call2Recycle for local locations that recycle these items. For all other communication devices that contain batteries, the closest location for disposal is at the Lane County Hazardous Waste Collection Center - Glenwood Transfer Station, 3100 E. 17th Ave. in Eugene. Please remember to remove batteries and do not place these items with your regular refuse or in garbage bags.

Electronics and Televisions: Sunrise Enterprise locations will accept most home electronics, including computers and TV's for recycling. For all other electronics, the closest location for disposal is at the Lane County Hazardous Waste Collection Center - Glenwood Transfer Station, 3100 E. 17th Ave. in Eugene. Disposal is by appointment only, so please call for more information and to make an appointment, (541) 682-4120. Please do not place these items with your regular refuse or in garbage bags.

Auto and Boat Batteries: The Douglas County Landfill and All Transfer Stations will accept auto and boat batteries for recycling. Or you can typically trade in these kinds of batteries and receive a core credit or discount on your next battery purchase at a local store. Call local stores and inquire about "take back" or other recycling options. Please do not place these items with your regular refuse or in garbage bags.

Charcoal Briquettes, Coals and Hot Ashes: Close the lid and vents to your charcoal grill for 48 hours until ash has completely cooled. Soak ash with water to reduce potential for combustion. Place the completely cooled ash in a plastic bag or in a plastic container before placing it in a non-combustible garbage bin for disposal. The same method applies for the proper disposal of cigarettes, fireplace ashes or fire pit coals. Make sure the coals, briquettes and ashes are completely cooled and dead out for disposal. Please do not place hot waste items with your regular refuse or in garbage bags.

Propane Tanks: The Douglas County Landfill and All Transfer Stations will accept propane tanks for recycling with the valves removed. Or you can call the retailer where you purchased your propane tank, and inquire about "take back" or other recycling options. Please do not place these items with your regular refuse or in garbage bags.

Used Fireworks: Submerge used fireworks in a bucket of water and soak overnight. Wrap soaked fireworks in plastic so they do not dry out and place in a non-combustible garbage bin before disposal. Unused fireworks cannot be thrown

away in your regular garbage. Please contact a hazardous waste collection center for disposal information.

Explosives and Radioactive Materials: Explosives and radioactive materials cannot be thrown away in your regular garbage. Please do not place these items with your regular refuse or in garbage bags. Please contact a hazardous waste collection center for disposal information.

Lighters, Oil, Oil Soaked Rags and Chemicals: Lighters, oil, oil soaked rags and chemicals cannot be thrown away in your regular garbage. Please do not place these items with your regular refuse or in garbage bags. Please contact a hazardous waste collection center for disposal information.

Smoking or Vaping: A safety reminder that Smoking or Vaping is not permitted inside the gates of the county landfill or at any of the County Transfer Station locations. Please do not place lit cigarettes or flick hot cigarette butts into our disposal bins or throw them away with your regular refuse or garbage bags.

Lightning:

What happens if one of the 2000 lightning strikes that Oregon experienced between Wednesday July 17 and Sunday July 21 randomly hit a particularly explosive methane release? These fires endanger the life and safety of our firefighters, and are likely to blow embers and toxic plumes into residential neighborhoods. Embers are the leading fire ignition source in a fire. As stated above the embers can travel on the wind up to five miles in front of a fire.

Lightning is capable of igniting methane above ground and it is also capable of igniting pockets of methane deep in the ground

Lightning strike causes methane fireball

A food waste plant erupted in a ball of flames after it was struck by lightning near Wallingford, Oxfordshire, at 17:20 BST on Thursday.

It ignited the methane gas stored inside.

Eyewitness Emma Shepperd said: "I was trying to film the lightning, and looking out the window, and it struck the top end - that's when it caught fire."

Subsection Oxford

Published 17 June 2016

Lightning strike causes huge explosion at Oxford recycling plant

Witnesses report large 'fireball' in sky at Severn Trent Green Power facility but no one is thought to have been injured in the blast

Donna Ferguson
Mon 2 Oct 2023 17.33 EDT
A lightning strike at a recycling plant in Oxford caused a huge gas explosion and local power outages.

Eyewitnesses reported hearing a loud bang and seeing a "fireball" lighting up the sky.

Emergency services are attending the scene, but a representative from Severn Trent Green Power told the PA news

agency that no one was injured in the incident.

Video and images shared on social media show a pyramid of flames on the horizon, inside a yellow and orange mushroom-like shape.

Severn Trent Green Power confirmed that biogas from a container had ignited at its Cassington AD Facility, near Oxford airport, at about 7.20pm and it was working with emergency services to secure the site.

The facility processes more than 50,000 tons of solid and liquid waste each year.

Ana Cavey, who lives in Somerton, about 15 miles north of Oxford, told Sky News: "We've had the most unbelievable thunder and lightning storm ever ... it came out of nowhere and the noise was incredible."

She said her power had been cut off for most of the evening and has only just come back on.

Another witness told the Oxford Mail they saw a "strange pulsing sky out of our windows".

Power outages have been reported in Witney, Burford, Chipping Norton and Milton-under-Wychwood, according to the BBC.

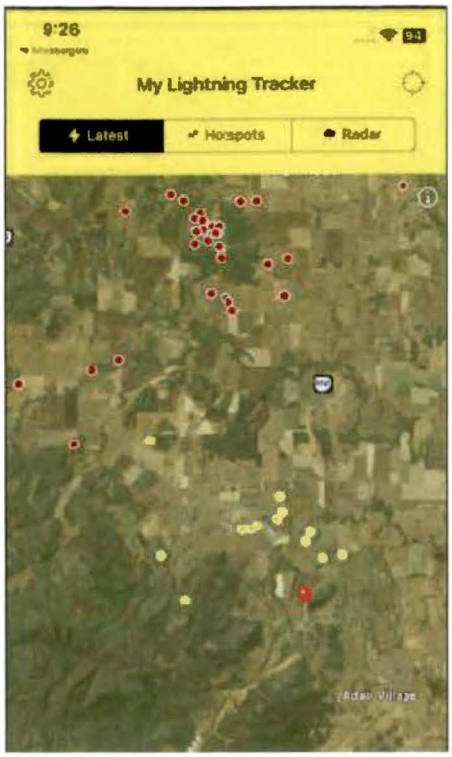
Other witnesses reported seeing "orange lightning" and hearing what sounded like a car crash outside their home. "The sky was glowing for about two minutes and then it just disappeared," one person wrote on social media.

A statement from Thames Valley police said: "Our officers are currently at the scene of a fire at a waste plant near Yarnton, Oxfordshire.

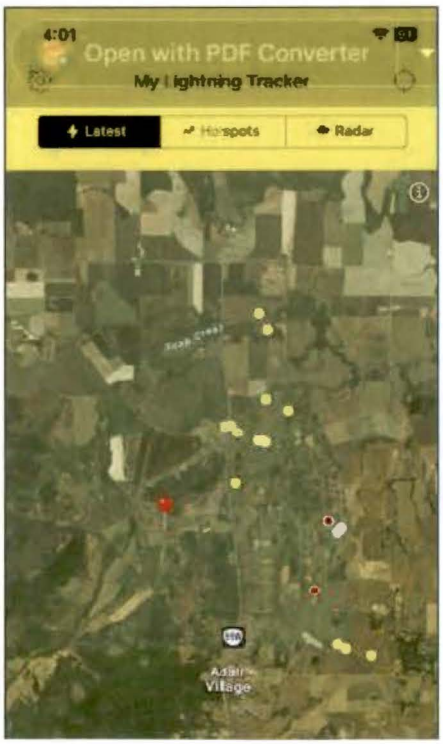
"It is believed that lightning struck gas containers at the site during bad weather this evening, causing a large fire."

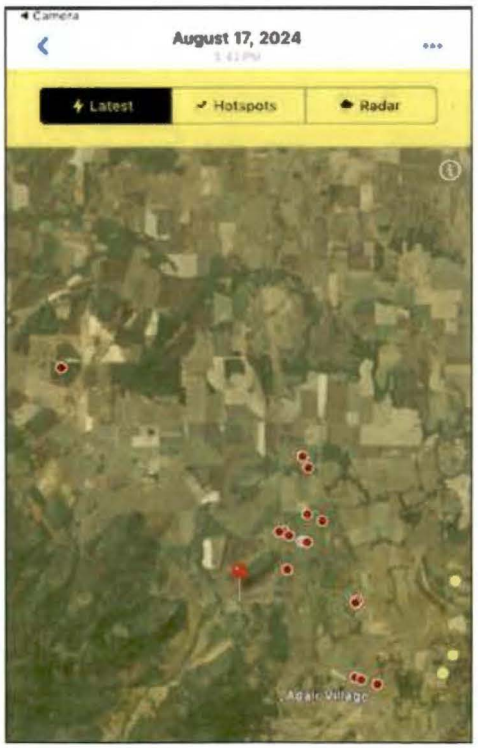
The Met Office had issued a yellow weather warning for thunderstorms in Oxford on Monday evening.

The following are records of lightning strikes in and around the Coffin Butte Landfill:



Above: August 17, 2024 9:26 AM Red Pin is Coffin Butte
Red dots lightning strikes less than 30 minutes ago
Yellow dots are lightning strikes over 30 minutes ago





August 17, 2024 4:01 PM Red Pin is Coffin Butte
Red dots lightning strikes less than 30 minutes ago
Yellow dots are lightning strikes over 30 minutes ago



September 6, 2024 8:24 PM Red Pin is Coffin Butte
Red dots lightning strikes less than 30 minutes ago
Yellow dots are lightning strikes over 30 minutes ago

Vegetation Fire:

E20- Fire Risk Assessment states: The risk is low for wildfires starting off site to come on site, and there is no history of wildfires in the area of the Landfill. And yet there were 111 nearby fires recorded by Adair Rural Fire and Rescue between 2013 and 2025.

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Story updated at 8:20 p.m. on Friday, Sept. 9, 2022

A significant grass fire in South Salem that brought evacuations to the Vitae Springs Road South area has been surrounded by firefighters but has not been fully contained, officials said Friday night.

The fire was reported at 4:02 p.m. and spread in the area south of Vitae Springs Road.

Salem emergency manager Greg Walsh said fire crews would remain on the fire and nearby through the night and until any danger has passed.

"It's in a very difficult-to-access area," Walsh said, adding that the dry weather, high heat and expected winds of 25 mph tonight are reason for concern. "The fire is still ongoing. We cannot get to all of it. We have crews out there essentially surrounding it, but not containing it."

This fire was 18 miles away from Coffin Butte Landfill with 25mph winds and could have reached the landfill in less than 1 hour in a high wind event situation.

Rural firefighters urge caution during hot weather after grass fire near Adair Village

By: Robert Desaulniers Jul 4, 2023 Updated Jul 4, 2023



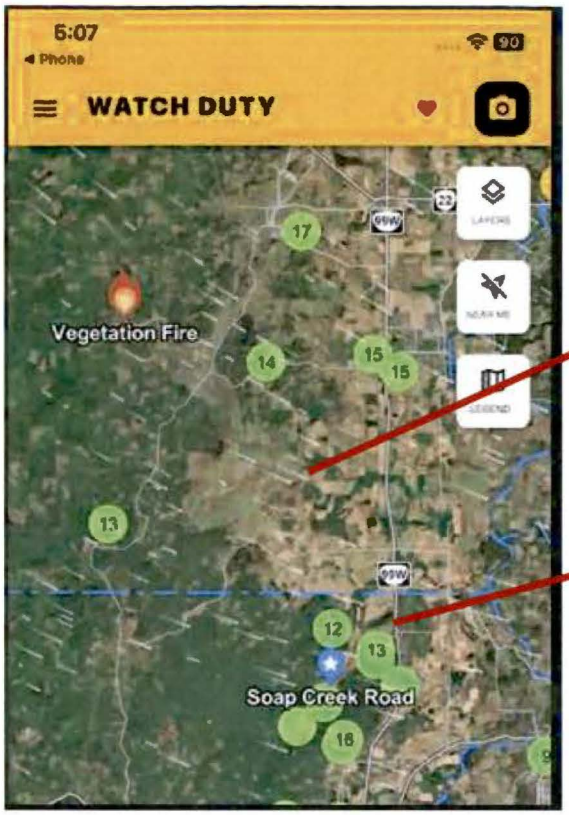
July 2, 2023

ADAIR VILLAGE, Ore. – A small pump house was lost but nobody was injured in a grass fire near Coffin Butte Landfill early Sunday morning, according to Adair Rural Fire and Rescue.

According to firefighters, crews responded to a reported grass fire on Wiles Road near the Knife River Quarry and Coffin Butte landfill at about 12:45 a.m. on July 2. Adair Rural Fire said crews arrived to find a grass fire that was rapidly spreading, and covered a total of about 1.5 acres. Firefighters said they were able to contain the fire before it did any damage to a nearby home, trailer and barn, but a pump house was unable to be saved. Firefighters said there were no injuries, but the cause of the fire is not yet known.



Firefighters said the fire didn't spread far because it happened at night when temperatures were relatively low, humidity was relatively high, and wind was calm. Adair Rural Fire and Rescue said that if the fire had started during the day, when it was hot and windy, it could have been much worse. Adair Village firefighters joined fire officials all over the state in urging extreme caution during Fourth of July celebrations and on the hot days still to come.



Vegetation Fire October 16, 2024 5:07 PM

Wind coming from NW towards the landfill

Coffin Butte Landfill

Wood Chip Fire at Pacific Region Composting (PRC):

Friday, November 11, 17, 2023 8:35 AM

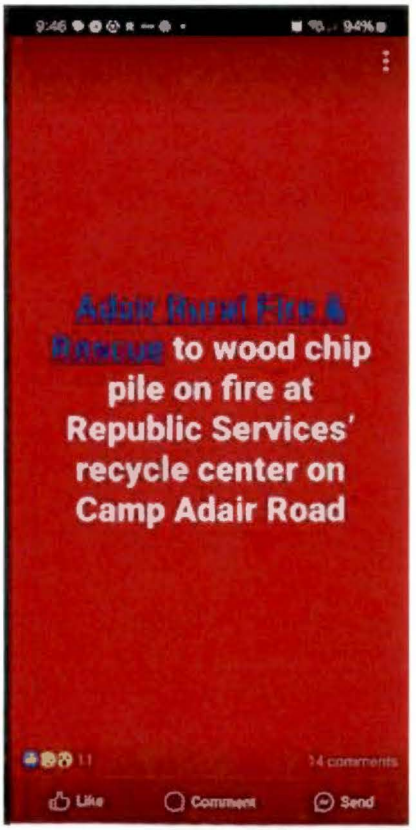


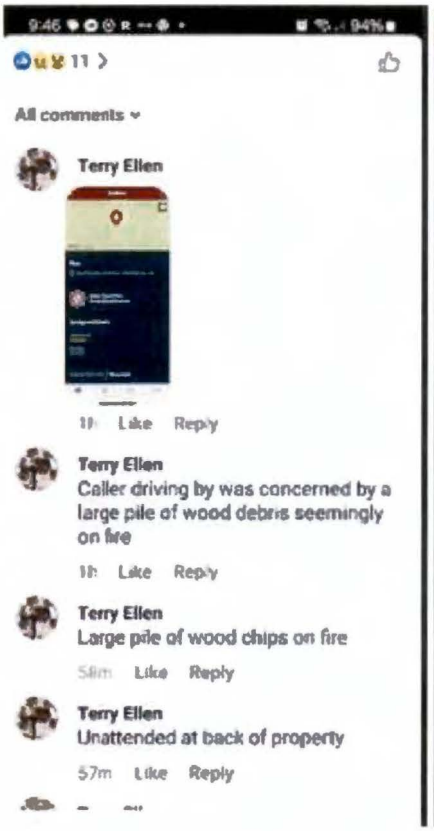


Question: Was this fire reported to the DEQ?



Smoke investigation 9/24/24 7:44pm
Pacific Region Composting (PRC)









Sunday, January 5, 2025, 9:50 AM

Reported by a citizen passing by the Pacific Region Composting (PRC)

The pile was unattended and the Fire Department was having difficulty reaching anyone from Republic Services.

Economic Impact of Wildfire to Benton County:

A red flag day with low humidity, high temperatures and strong winds coming from the north could take one of the many landfill fires quickly through the Soap Creek Valley, Adair Village, McDonald and Starker forests, Vineyard Mountain, and down into Corvallis and North Albany. This is a significant financial burden on our communities, a significant burden on our services, a significant burden on our citizens, their homes, families, livestock, pets, a significant burden on our industry, including farms and forestry, and business, an overwhelming burden on our firefighters and will absolutely interfere with the uses on adjacent property and with the character of the area.

Question: Does Republic Services and Valley Landfills application include a bond that would cover the catastrophic loses of an event like this now, or after they close shop and leave the landfill to the County and its residents to manage? The $16 million insurance, certainly will not address this magnitude of event.

Economic Impact

$7,224
Expected Annual Loss Caused by Wildfire
Benton County, OR

$107,037,018,461
Total Exposure to Wildfire
Benton County, OR

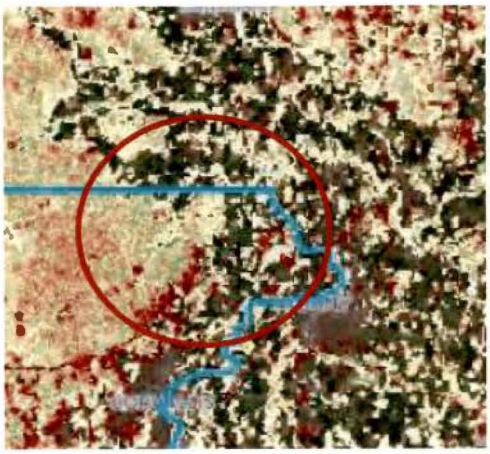
Sources: FEMA NRI 2023

From the Fire Risk Reduction Profile for Benton County:

https://reports.mysidewalk.com/b4dd6dbfce

Overall Potential Impact of Wildfire:

From the Wildfire Risk Explorer Report:



Overall potential impact (if a wildfire were to occur)	
Very High	Overall potential impact is very highly negative (top 5% of values).
High	Overall potential impact is highly negative (80-95th percentile).
Moderate	Overall potential impact is moderately negative (50-80th percentile).
Low	Overall potential impact is slightly negative (30-50th percentile).
Low Benefit	Overall potential impact is slightly beneficial at low flame lengths (15-30th percentile).
Benefit	Overall potential impact is slightly beneficial, with a cumulative positive impact of fire (0-15th percentile).
No Data (blank)	There are no highly valued resources or assets mapped in the area or it is non-burnable (urban, agriculture, barren,etc).

Red circle above ○ is an approximate 5 mile radius of wildfire impact around Coffin Butte Landfill. Note the number of Very High potential risks is this area.

Per the Wildfire Risk Explorer Report: Overall potential impact represents the exposure or consequence of wildfire on all mapped highly valued assets and resources combined, including critical infrastructure, developed recreation, housing density, seed orchards, sawmills, historic structures, timber, municipal watersheds, vegetation condition, and selected terrestrial and aquatic wildlife habitat.

This area includes the Historic Soap Creek Valley Schoolhouse and the Old Growth Forest Trail, Anderson Blues, etc.

Accessed from the Oregon Wildfire Risk Explorer on July 21, 2021
URL:https://tools.oregonexplorer.info/OE_HtmlViewer/index.html?viewer=wildfireplanning
Primary data Source: USDA Forest Service Pacific Northwest Quantitative Wildfire Risk Assessment (2018)

In addition to all of the risks above, is the risk of fire along what should be the safest emergency fire exit route for the nearly 200 households of the Soap Creek Valley. What happens if a Coffin Butte fire ignites the Soap Creek Valley and then, what should be the safest exit route for its residents is blocked by flames and toxic fumes from a landfill fire?

Conditional Use Criteria for the Forest Conservation Zone - Chapter 60

60.220 Conditional Use Criteria. (1) A use allowed under BCC 60.205 or 60.215 may be approved only upon findings that the use: (a) Will not force a significant change in, or significantly increase the cost of, accepted farming or forest practices on agriculture or forest lands; (b) Will not significantly increase fire hazard or significantly increase fire suppression costs or significantly increase risks to fire suppression personnel; and (c) Complies with criteria set forth in BCC 53.215 and 53.220.

Excerpt from the City of Adair Comprehensive Plan:

SECTION 9.612 FIRE PROTECTION & EMERGENCY SERVICES

There are few serious fire hazards within the City or the District. The area has a very light commercial fire hazard with the most significant life hazard being the schools. The District's greatest hazard is the wild land interface properties and the landfill. The District has enjoyed Mutual Aid agreements with the neighboring fire departments since the early 1980's and has established a first alarm mutual response policy with the Corvallis Fire Department, Albany Fire Department, and SouthEast Polk Fire District.

Excerpt from newspaper article on the Landfill risks:

So far, fires have remained isolated to the landfill, but residents of Soap Creek Valley fear that the increasing severity of wildfire conditions in Oregon could cause one of these blazes to spread to the surrounding hills. "We're in a valley with limited ways out," Eklund said. He worries that if the landfill caught fire, Coffin Butte Road would be impassable due to flames and toxic smoke from burning waste. "It's a nightmare scenario."

Question: If there was a fire at Coffin Butte Landfill that completely shut down the ability to dispose of trash, where would Republic Services send all of the incoming trash? Basically, what are the details of Republic Services back up disposal site plan?

I strongly oppose LU-24-027 and urge you to deny its approval. Conditions have never been enforced, so approval with conditions is the same as approval without conditions. Please do not approve this CUP.

The **SUBCOMMITTEE'S REPORT can be found linked HERE** in Appendix C.

The **SUBCOMMITTEE'S "MEETING NOTES" can be found linked HERE.**

DATE RECEIVED: 5-8-25
FROM: Mark Yeager
PHONE OR EMAIL: mayeager@gmail.com

KEY FINDINGS AND KEY RECOMMENDATIONS

This section lists Key Findings and Key Recommendations from the full subcommittee report below. These Key findings and Key recommendations do not capture the comprehensive discussions of the subcommittee, nor are they intended to do so. Instead, these provide a summary overview of key observations. The link adjacent to each Key Finding and Key Recommendation provides access to the full report. These summaries encourage readers to follow the links to find detailed content in the full subcommittee report.

			Unanimous Agreement		Consensus Agreement		Majority-Minority Approval	
Sub. Comm.	Findings and Recs	Total	# with all 1s	% with only 1s	# with no 3 votes	% with no 3 votes	# with at least one 3	% with at least one 3
CUP	Findings	33	22	66.7%	33	100.0%	0	0.0%
CUP	Recs	25	13	52.0%	23	92.0%	2	8.0%

Key Findings:

A review of the extensive number of land use decisions and associated conditions of approval reveals some overarching key findings regarding how land use decisions for the landfill, the quarry, power generation, and associated uses are implemented in Benton County.

#	Finding	Formal Workgroup Polling		
		1's	2's	3's
CUP F-1	The Subcommittee's Full Report is an in-depth review of selected historical land use documents. County Staff, Republic, Workgroup and public members participating on the Subcommittee provided comments, opinions and evaluations of the historical record. Each condition was vetted in depth. Consensus was reached by public members of the Subcommittee on most topics. Consensus was not reached with County Staff and Republic. Information from DEQ is needed to potentially reach consensus on many Conditions of Approval. All inputs have been retained to assist the public in understanding the historical documents and how they were viewed by the Subcommittee. Where needed, information obtained by firsthand experiences on BCTT's Landfill and Neighborhood	11	0	0

	Tours was used to verify the compliance status of visible Conditions of Approval.			
CUP F-2	Benton County has not and does not actively monitor compliance with many Conditions of Approval, nor does it proactively act to enforce compliance. See Table 5 in Appendix C4 of the CUP subcommittee report.	11	0	0
CUP F-3	Benton County relies on complaints to initiate action to enforce Conditions of Approval.	11	0	0
CUP F-4	All County materials reviewed reflect historical information and/or decisions from public processes (e.g., meetings, hearings, advertisement notices, etc.) based on public input and approval by appropriately authorized public planning boards.	11	0	0
CUP F-5	For over 50 years, Conditional Use Approvals have been the basis for the public's understanding of many aspects of the landfill, including but not limited to: hours of operation, management of noise, screening of the site from view, how the site should look, and how the site can be used after the landfill is closed.	11	0	0
CUP F-6	No record was found of an official Benton County decision to increase the number of counties sending wastes to Coffin Butte Landfill prior to the Supreme Court's 1998 ruling. However, the 1983 land use decision expressly repealed the comprehensive plan provisions that were adopted after the 1974 decision that limit the number of counties that could waste to landfill. According to the staff report, the effect of this change was to remove such limitation.	10	1	0
CUP F-7	Conditions of Approval 4 and 6 in CP-74-01 require reclamation of the landfill to meet criteria relating to visual appearance, screening from abutting county road, and use for grazing or another farm-type operation or other permitted use as approved by the Planning Commission and Board of County Commissioners. Reclamation was also addressed in PC-83-07.	11	0	0
CUP F-8	The required DEQ reports are submitted by the Applicant and maintained by the County for the public record. A full review of these County required submittals (e.g. monitoring records) was not conducted due to time constraints.	11	0	0
CUP F-9 [Link]	Compliance with Conditions of Approval often involves a direction from the County that the Applicant should obtain permits from other entities such as, but not limited to, state agencies.	11	0	0

CUP F-10	Benton County did not and does not have a readily accessible, transparent complaint tracking system known to the public in place to receive and record land use complaints for documentation, investigation, and resolution.	11	0	0
CUP F-11	In assessing the status of compliance with past land use documents, there are numerous instances where supporting evidence may not be or is not available in County records.	11	0	0
CUP F-12	Benton County does not review reports and other submitted materials as required per conditions of approval. Examples include: copies of water quality and air quality permits, emergency plans, permit submittals, financial assurance statements, etc., and data produced from associated monitoring programs required of the applicant by the Oregon Department of Environmental Quality or other governmental agencies. See Table 5 in Appendix C4 of the CUP subcommittee report.	11	0	0
CUP F-13	Benton County has issued land use Conditions of Approval before the Applicant was granted necessary operating permits from multiple State agencies. The County advised the Applicant that those permits were required but did not check that those required permits were procured by the Applicant, except for DEQ permits.	11	0	0
CUP F-14	As of 1974 the Coffin Butte landfill was identified as a regional landfill site for wastes from ten areas in three counties. Expanding beyond this limited geographic area was to require re-review by the Planning Commission. Starting in 1998, legal precedents are believed to have superseded the 1974 requirements allowing for the expansion of the service area beyond the original three counties. Since 2013, the Coffin Butte Landfill has served 39 counties. Also, since 2013, Coffin Butte Landfill has accepted waste from seven out-of-state counties (2 from CA, 5 from WA). Only one out-of-state county (in WA) was served in 2021, which represented 1.88 Tons (0.00018% of total). For supporting information see Comments for CP-74-01 Condition 1 in Table 2 Assessments of Land Use Conditions and Legal Land Use Subcommittee analysis.	11	0	0
CUP F-15	County land use decisions have been written in a way that makes it difficult to understand the County's commitment to public expectations and enforceability of Conditions of Approval. Building on information presented by the Legal	11	0	0

	issues and Landfill Capacity Subcommittees, examples of these are:· • A 1983 County decision where all but one of the publicly agreed to requirements for the visual appearance and ultimate use of the landfill may be unenforceable. • A 1983 Benton County Amendment to the Comprehensive Plan. • A 1992 United States Supreme Court ruling (Fort Gratiot Sanitary Landfill, Inc. v. Michigan Dept. of Natural Resources, 504 U.S. 353, 112 S.Ct. 2019 (1992) limiting the County's power to regulate where wastes come from, wastes from as many as 39 counties in three states (OR, WA, ID) are allowed to be brought to Coffin Butte. These wastes have made up over 90 percent of the material coming to Coffin Butte in the last 5 years. The Workgroup's CUP Subcommittee and Legal Subcommittee have analyzed past land use documents and have reached different conclusions as to their effect. This has resulted in changes to what was authorized to occur at the landfill without notification or a public review process that would ensure public trust.			
CUP F-16	County approval documents and Applicant submittals for PC 83-07/L-83-07 describe reclamation of the site once it stops receiving waste. Requirements include what the appearance of the site is to be, terracing, allowable steepness of slopes, screening, use for grazing, consistency with agricultural and forest land use, etc. The Subcommittee did not reach a consensus on whether the County decisions and Applicant submittals associated with PC 83-07/L-83-07 are enforceable and require compliance. The public members believe they are enforceable. The County and Republic members believe they are not enforceable. Information on the County documents and Applicant submittals are in Comments for PC 83-07/L-83-07 Conditions 1 and 3 in Table 2 Assessments of Land Use Conditions. The viewpoints of the Public Members can be found here. The position of the Legal Subcommittee is found at here.	11	0	0
CUP F-17	DEQ's requirements for a Worst–Case Closure and Post-Closure Care Plan and financial assurances do not require Valley Landfills to comply with County's reclamation conditions of approval or public expectations.	11	0	0



Figure 1

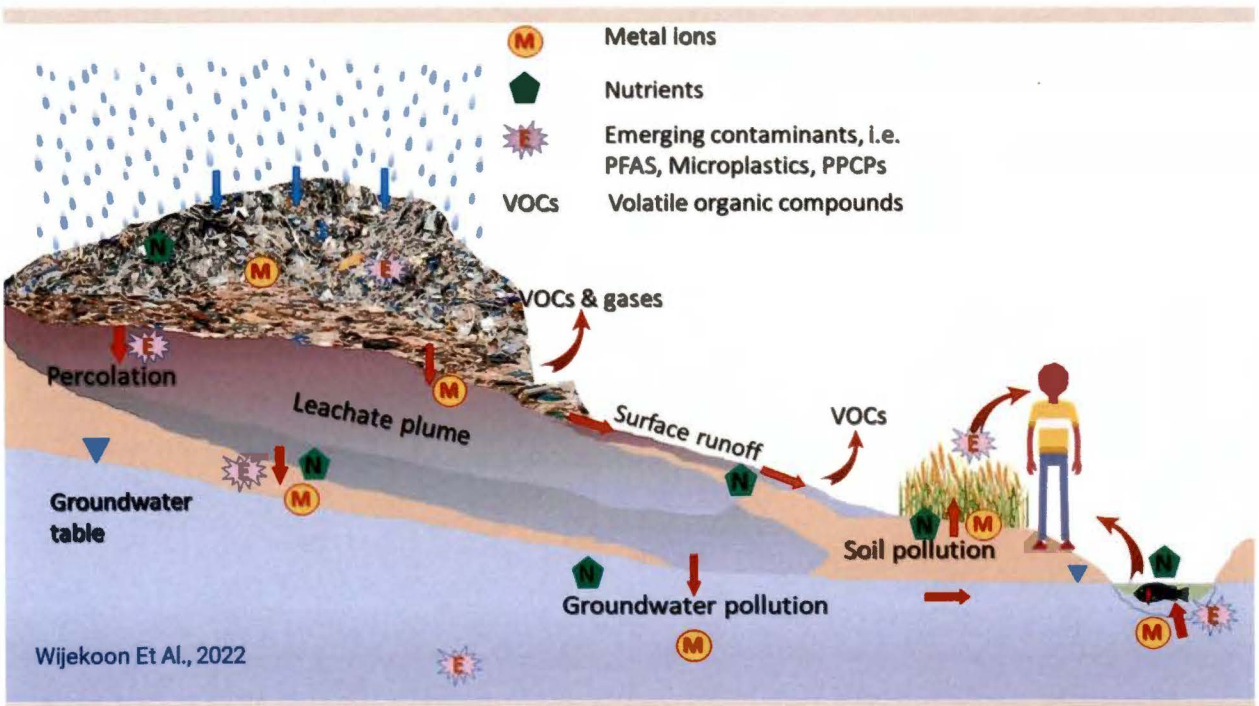


Figure 2

DATE RECEIVED: 5-8-25
FROM: Mark Yeager
PHONE OR EMAIL: mayeager@gmail.com

Landfill leachate is especially high in PFAS

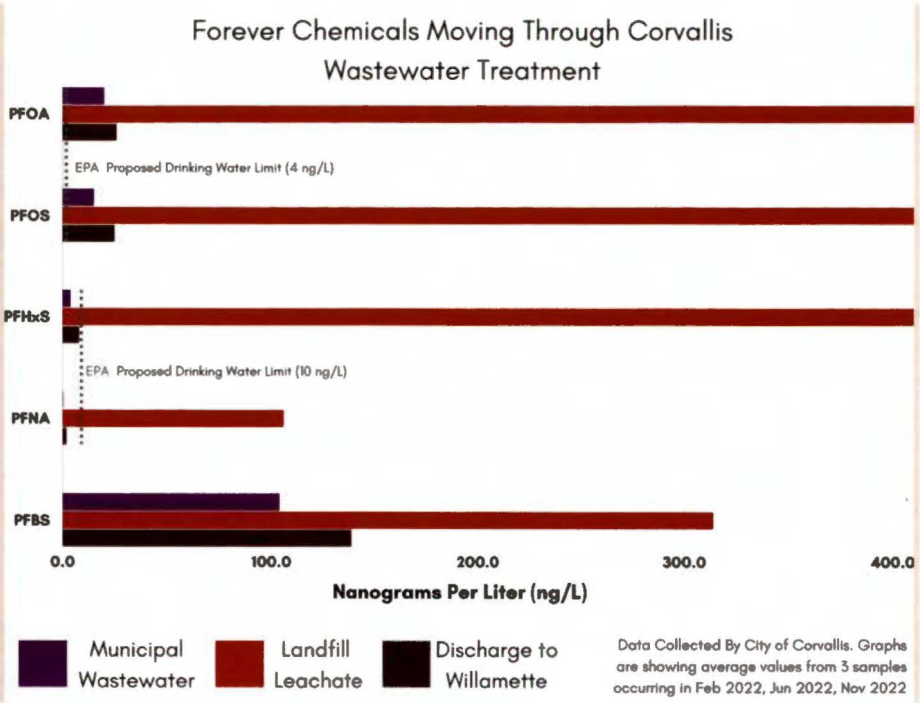


Figure 3

From:	Joel Geier
To:	Benton Public Comment
Cc:	REED; Dave Mellinger; AnneMary Myers; Shawn Woods
Subject:	Fwd: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2025
Date:	Friday, May 9, 2025 5:48:33 AM

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Dear Chair Fowler and Members of the Planning Commission,

I noted in last night's hearing that Commissioner Biscoe in particular seemed interested in establishing the record regarding the nesting area currently in use by the herons adjacent to the proposed development site.

Here's an acknowledgement that I received from the Oregon Department of Forestry (ODF) when I shared my report with them as well as Oregon Department of Fish & Wildlife (ODFW) on March 14, 2025.

I did not receive any acknowledgement from ODFW at that time, but I'm cc:ing ODFW's District Biologist Greg Reed here, in the hope that he can confirm receipt of that report.

I have not yet sent the nest tree GPS coordinates referenced in the e-mails below. Those coordinates are sensitive information due to the risk of yet further disturbance to these herons during nesting season, so I won't place them in the public record, but I will be making them available to Mr. Reed and refuge manager Shawn Woods via a separate communication.

Yours sincerely,
Joel Geier

From: "Jennifer Weikel" <jennifer.weikel@odf.oregon.gov>
To: "Joel Geier" <clearwater@peak.org>
Sent: Friday, March 14, 2025 4:08:15 PM
Subject: RE: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2015

Thank you Joel. I received your email. I am not working as the wildlife biologist right now, but I passed on your information to the person who is in that roll right now.

Appreciate the detailed report.

Jennifer Weikel
Oregon Department of Forestry
(503) 931-9521

From: Joel Geier <clearwater@peak.org>
Sent: Friday, March 14, 2025 3:55 PM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Cc: AnneMary Myers <AnneMary.Myers@state.or.us>; WEIKEL Jennifer * ODF <jennifer.weikel@odf.oregon.gov>; WOODS Shawn K * ODFW <Shawn.K.WOODS@odfw.oregon.gov>; Jim Fairchild <jim@alderspring.net>; Jayshaun Talbert <talberja@oregonstate.edu>
Subject: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2015

You don't often get email from clearwater@peak.org. Learn why this is important

Hi Greg,

Hope all's well as you look forward to field season, despite what I suppose could be complications for any programs relying on federal funds this year.

As I mentioned to you last year, I've been keeping track of community observations of the Great Blue Heron nesting colony at the Coffin Butte site, including my own observations as well as those of volunteers affiliated with the Mid-Willamette Bird Alliance (formerly known as Audubon Society of Corvallis).

Here's a report that summarizes nesting-season observations both of heron nesting activity and potential causes of disturbance, from 2000 through the current year (right up to today, in fact). I hope this will help to inform you in your own assessment of the status of this heron nesting colony, and how it might best be protected for future seasons. Please feel free to give me a call if you have any questions!

A bit of data still missing from this report: Back in mid-January, I went into the ash grove area and mapped the trees with nests remaining from the 2024 nesting season. I have GPS coordinates for those trees as well as notes and sketches of the nest configurations. There are five nest trees (most of them with multiple trunks) holding a total of 13 "full-sized" stick nests, plus three smaller/partial nests that don't appear to have been completed.

I can get those nest-tree data to you at a later date, and will also share those with Shawn Woods (cc:d here) in case it's helpful for his management decisions in that area.

As a side note, I found a couple more elk/deer carcasses in there (pretty far decomposed) which I'll add into ODFW's roadkill project on iNaturalist (I'm up to about 8 now).

I'm also cc:ing Anne Mary Meyers and Jen Weikel here to keep them in the loop, as well as Jim Fairchild and Jayshaun Talbert on behalf of MVBA.

All the best,
Joel

--
Joel Geier
38566 Hwy 99W
Corvallis Oregon 97330-9320
tel +1 541 745-5821
clearwater@peak.org

From: BECKY MERJA
To: Benton Public Comment
Cc: Marcy
Subject: LU-24-027 Testimony - Marcy Follett
Date: Sunday, May 11, 2025 8:53:34 AM

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Please enter this PDF into the record for LU-24-027.
Thank you.

May 9, 2025
Marcy Follett
14605 Corvallis Rd.
Monmouth, OR 97361

I oppose LU-24-027 application to expand Coffin Butte Landfill.
This testimony is from a social media comment I made when this land use process first started:

When my grandparents bought this farm from the pioneers who settled here. I believe it was in 1934 about 10 years before WWII. The dump was not here. My grandma was part of the citizen group that showed up to say they did not want the dump here. It was in 1970 I believe. But this is the site that lost. At that time there was a promise to a time limit.

Back then garbage was dealt with differently. Paper was burnt in fires that warmed the homes. Oils were reused in many ways. Table scraps went to feed the animals that fed the people. Or to compost for improving the soil which grew more to feed the people. Clothes not made of synthetic materials were passed on to others when they no longer served the owner. Glass was only disposed of when it could not be reused to preserve food. The glass that could not be reused, the cans, the occasional bakelite (like an early plastic), and a few pieces of metal that could serve no other purpose were taken to the side of the creek and dumped. Just like children's textbooks had taught children was the way to deal with it.

After the war started a government man came walking from the direction of the dump. He offered my grandfather a silver dollar. My grandpa did not "want anything from some government man". And it's a good thing. Because had he accepted that coin it would have been considered as a down payment for our land. He would not have been allowed to negotiate the sale price or the time of departure. But the sale was mandatory for the good of the nation. He was paid $11,000.

After the war he paid $14,000 to get it back. What he got back was a land littered with ammunition (some of it live), bomb holes in his fields, and no house to call home. But the dump was not here then.

At that time there were large incinerators at Camp Adair. And here on the farm there was a new pile next to the cans and glass. We call it the ammunition dump. It is where we put the waste left behind from the military training.

After the war, there was a plywood mill where the recycle/compost center is. If you look on Google you can still tell where the waste glue chemicals from that operation entered the GP Reservoir. (I have noticed a lot of sores on the fish there. All in the same general location.). But the dump was not here then.

In the 70s there was a big movement to fight pollution. Even the cartoons pictured the evils of pollution as nasty foamy bubbling streams of filth. Needless to say schoolbooks had been revised and dumping in creeks was no longer an acceptable solution. But the dump was not here then. In 1978 there was a need for a dump to serve the Willamette Valley as more people were living in urban areas. And America had figured out that dumping anything that had no other possible use into a nearby creek, actually had a negative impact to our environment. As well as to the people and animals who lived and played nearby. Also to those who were downstream. Clear to the creatures in the ocean. But the dump was not here then.

At least 3 sites were being considered. There were local public meetings held for each site. Many people showed up to voice their opposition to it. But this site was selected. Partly because prior it had been Camp Adair. And so it was not as easily turned into productive farmland or housing. And although I don't think it was classified as one of the DUMP sites yet, the land was not healthy and could already stand to be cleaned up.

THIS IS THE IMPORTANT PART.
With the dump came a promise. That the dump would only be here for a limited amount of time. Then there would be another one located somewhere else to take its place. That time limit was not given as a bargaining chip. It was not a condition set by our community. It was set by science in consideration of the environment. Experts evaluated the site. Determined how much the land could handle without jeopardizing the health of the land around it. The original proposal included a managed way to return the land to nature. So that it could recover and have a minimal impact on us and our environment.

What was that length of time, that had been determined to meet the needs of the Willamette Valley and cause minimal impact to this local community? My husband and I thought we read 50 or 60 years. someone who attended a public meeting in the 80s remembers being told the year 2000. Anyone moving their family to this area since 1978 had to ask themselves if they really wanted to live this close to a dump. But the dump has not always stunk. So it would have been reasonable to think that it would be ok. And if anyone would have been concerned enough to research it, they should of had any concerns put to ease, if they saw the original proposal.

If the dump had been closed in 2000. Then we would not be discussing this. If it was 50 years. Then we may still be smelling an operation that shut down 6 yrs ago. But here we are today and the dump is still here.

Beyond the stench. The pollution of our land. The need to allow the land to recover. Even beyond the lengthy discussion of how expanding the size of the dump is not an addition of pollution in the area. But it is a compounding of the pollution and health hazard. Or how the long term impact of over a century of mishandling waste compares to today's regulations and resulting waste.

One very big thing to consider is the implications of not holding government officials, corporations, and even each other accountable to promises made and contracts signed. As an average person if I sign a contract and later find that it doesn't meet my needs.... Say I buy a little sports car with no back seat. Then my family grows to include 2 kids and a spouse.

Sure, I can get a new car. But the guy that sold me the sports car is under no obligation to simply give me a bigger car. What I have to do is fulfill the original contract. There are no options that allow the original contract not to be fulfilled. A lot of what happens in our government is based on promises for the future. Make sure that it is known that promises still mean something even if the original people have passed and it is a new generation. Part of our responsibility is to not just our noses but the lives of the future generations.

Sure, with today's laws the dumps have to go somewhere. And of course everyone will say NOT IN MY BACKYARD. That is not what we are saying. We are saying. IT HAS BEEN IN OUR BACK YARD LONG ENOUGH!!!

From: Richard Llewellyn
To: Benton Public Comment
Subject: Re: Deny Coffin Butte CUP, LU-24-027 with respect to PFAS in Landfill Gas Emissions
Date: Friday, May 9, 2025 1:36:09 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Re: Deny Coffin Butte CUP, LU-24-027 with respect to PFAS in Landfill Gas Emissions, inclusion of cited references in written testimony of Richard Llewellyn

Dear Benton County Commission,

Listening to the oral comments of the Commission and participants, I have found that the Commission may not have access to cited references. In my written testimony I had numerous footnotes to the primary scientific literature, reviews, and supporting documents. I am attaching some of these here for completeness, and would appreciate if you can add these to the public record -- hopefully in a manner that can reference my original submission. I will add that again here for completeness.

I've attached page 74 from footnote 2:

"Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and
Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances— Version 2" EPA.gov. 2024. From
https://www.epa.gov/system/files/documents/2024-04/2024-interim-guidance-on-pfas-destruction-and-dis
posal.pdf

This EPA research states that the typical landfill flare does not operate in conditions (eg hot enough) to destroy PFAS. There are other more detailed evaluations of knowledge about the conditions needed to destroy PFAS in other parts of the document.

I've attached the paper from footnote 3:

Tolaymat T, et al. A critical review of perfluoroalkyl and polyfluoroalkyl substances (PFAS) landfill disposal in the United States. Sci Total Environ. 2023 Dec 20;905:167185.

This establishes that before the University of Florida Townsend study (2024), that the working hypothesis was that, of the PFAS escaping landfills, on average about 1/3 of PFAS left through landfill gas (LFG), and 2/3 through leachate.

I've attached the paper from footnote 4:

Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release Ashley M. Lin, Jake T. Thompson, Jeremy P. Koelmel, Yalan Liu, John A. Bowden,

and Timothy G. Townsend. Environmental Science & Technology Letters 2024 11 (7), 730-737

This is the revelatory research finding much higher levels of PFAS in LFG. I have spoken with Dr. Timothy Townsend and Dr. Ashley Lin regarding this research. To their knowledge, nothing about the three MSW landfills they sampled suggest that these emissions would be substantially different than other MSW landfills in the US -- they further explain this question in the Supplemental Data. The major novelty in their study was that they intentionally sampled for volatile PFAS they expected to be present in LFG (fluorotelomers, such as the 8:2 fluorotelomer that degrades or metabolizes to PFOA).

I've attached the paper from footnote 11:

Nilsson H, Kärrman A, Rotander A, van Bavel B, Lindström G, Westberg H. Biotransformation of fluorotelomer compound to perfluorocarboxylates in humans. Environ Int. 2013 Jan;51:8-12.

This paper examines the association between inhalation exposure of 8:2 FTOH to blood serum levels of PFOA in humans.
--

Other research has described the biochemical pathway in rats -- attached paper from footnote 9:
Huang MC, et al. Toxicokinetics of 8:2 fluorotelomer alcohol (8:2-FTOH) in male and female Hsd:Sprague Dawley SD rats after intravenous and gavage administration. Toxicol Rep. 2019 Aug
20;6:924-932

Thank you for your considerable efforts to uphold the public process.

Richard Llewellyn

On Fri, Apr 11, 2025 at 8:21 AM Richard Llewellyn <llewelr@gmail.com> wrote:

> Dear Benton County Commission,
>
> Please submit the attached pdf document as my testimony regarding Coffin Butte CUP, LU-24-027 with respect to PFAS in Landfill Gas Emissions.
>
> Thank you,
>
> Richard Llewellyn

Environmental Science & Technology Letters

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Letter

Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release

Ashley M. Lin, Jake T. Thompson, Jeremy P. Koelmel, Yalan Liu, John A. Bowden, and Timothy G. Townsend*

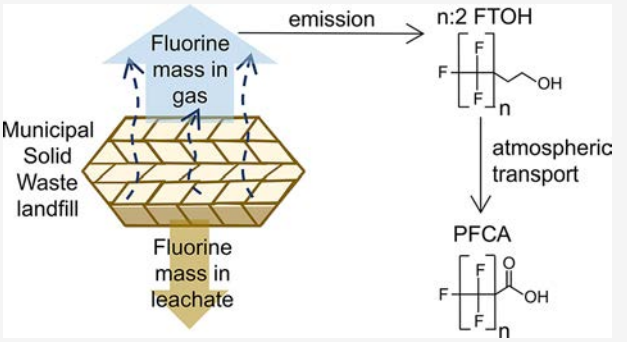
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ABSTRACT: The undisclosed and ubiquitous use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in consumer products has led to a growing issue of environmental pollution, particularly within the solid waste community, where the fate of volatile (neutral) PFAS in landfilled refuse is not well understood. Here, three municipal solid waste landfills in Florida were assessed for neutral PFAS in landfill gas and ionic PFAS in landfill leachate to compare the relative mobility between the two pathways. Landfill gas was directly sampled using a high volume, XAD-2 resin based sampling approach developed for adsorption and analysis of 27 neutral PFAS. Across sites, 13 neutral PFAS were identified from fluorotelomer alcohol (FTOH), fluorotelomer olefin (FTO), secondary FTOH, fluorotelomer acetate (FTOAc), and fluorotelomer methyl acrylate (FTMAc) classes; however, FTOHs dominated concentrations (87−97% total neutral PFAS), with most detections surpassing utilized calibration levels. Even under conservative assumptions, the mass of fluorine leaving in landfill gas (32−76%) was comparable to or greater than the mass leaving in landfill leachate (24−68%). These findings suggest that landfill gas, a less scrutinized byproduct, serves as a major pathway for the mobility of PFAS from landfills.



KEYWORDS: *volatile, emissions, GC, fluorotelomer alcohol*

1. INTRODUCTION

Widespread per- and polyfluoroalkyl substance (PFAS) contamination has been a mounting environmental concern due to their chemical persistence and toxicity to human and biotic health.[1−4] While numerous industries are being confronted with PFAS-related management challenges, the burden of remediation and PFAS removal has often fallen on downstream industries—namely, the solid waste sector.[5−9] Discarded, PFAS-laden consumer products including textiles, wood products, and packaging and commonly landfilled industrial byproducts like MSW incineration ash and wastewater biosolids are known contributors to PFAS loading in landfills.[10−16] Existing research suggests most discarded PFAS mass is retained within landfills[9,17] with liquid-phase byproducts of waste decomposition, leachate and gas condensate, currently considered prevalent pathways for PFAS mobilization.[2,7,9] However, the extent of PFAS release to another major byproduct, landfill gas (LFG), has remained largely unscrutinized.

The bulk of PFAS characterization studies focus on nonvolatile/semivolatile (ionic) perfluoroalkyl acids (PFAAs) measured in liquid and solid matrices, in part because of a high presence and awareness of these species within the PFAS community but largely because analytical capabilities for ionic PFAS measurement are better established.[18−21] Volatile (neutral) PFAS are also utilized in consumer products[13,22−27,27] and have been determined in a few studies on ambient air surrounding landfills and near wastewater treatment plants,[28−32] but a lack of volatile analytical standards and latency in methodological development has hindered the progression of gas phase research in environmental matrices. Whereas PFAS characterization in leachate is established, concentrations ranging from thousands to tens of thousands of nanograms per liter are commonly encountered;[33−38] only two studies characterize volatile PFAS directly in LFG.[39,40] Titaley et al. identified fluorotelomer alcohol (FTOH), fluorotelomer acrylate (FTAc) and fluorotelomer olefin (FTO) homologues in LFG with combined concentrations ranging from 4,600 to 14,000 ng m^{-3} across three landfills. Goukeh et al., only assessing FTOHs, identified higher combined concentrations than Titaley et al., finding ∼18,000 ng m^{-3} (sum of 6:2 and 8:2

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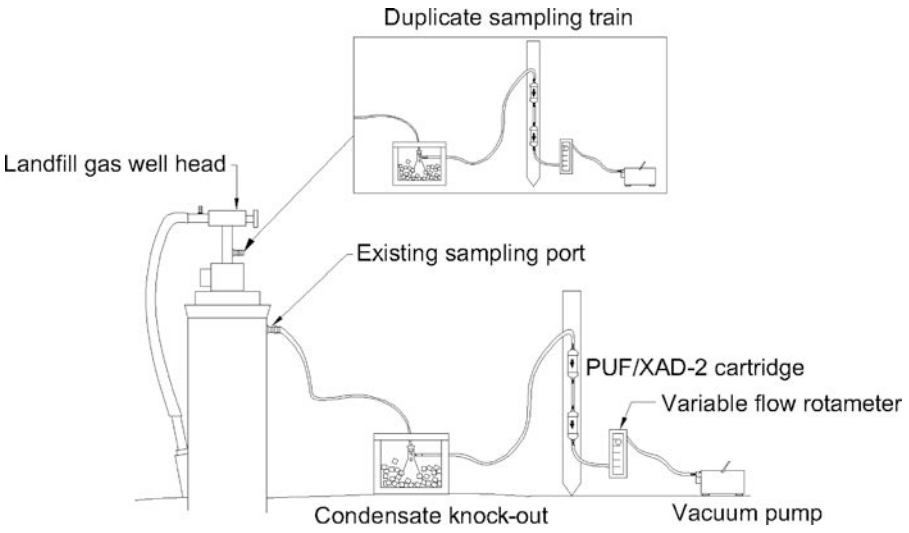


Figure 1. Developed system for sampling neutral PFAS directly from landfill gas well heads.

FTOH) in the one LFG sample examined. These studies suggest PFAS variability in LFG, which motivates further investigation, deploying higher sampling volumes[39] and larger analyte lists[40] to understand the potential presence of other neutral PFAS and distribution among landfills of different regions, compositions, and sizes.

With the ongoing development of PFAS regulation,[19] understanding the partitioning behavior of PFAS in major repositories like MSW landfills grows increasingly critical to minimize environmental and human risk. Unlike leachate, LFG is not always captured by collection systems, and management varies broadly across landfills, ranging from no treatment (i.e., passive venting) to some treatment (i.e., flaring, LFG to energy projects), but current treatment, if any, is not intended for PFAS.[41,42] Emerging research suggests the toxicity of volatile species (specifically 6:2 FTOH) to be significantly higher than their ionic counterparts via the inhalation pathway (a main route of exposure for volatile compounds).[43−47] Further, degradation of neutral species to ionic PFAAs once emitted to the atmosphere is well established.[48−58] The potential for long-range atmospheric transport of PFAS from landfills underscores the importance of considering neutral species and their fate during management to prevent further environmental contamination of highly scrutinized PFAAs such as perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). As the only studies on LFG primarily identified FTOHs in LFG, the magnitude and significance of other neutral species remains unclear.

Here, LFG was sampled directly from gas well heads at three MSW landfill locations in Florida using a higher volume sampling protocol. XAD-2 resin sandwiched between polyurethane foam (PUF) was utilized for PFAS capture, then samples were analyzed for 27 volatile/semivolatile (neutral) PFAS via targeted gas chromatography high resolution mass spectrometry (GC-HRMS). To contextualize release in the gas phase, leachate was also collected at each landfill and analyzed for ionic PFAS (n = 93) using ultrahigh pressure liquid chromatography tandem mass spectrometry (UHPLC-MS/MS). The observed LFG and leachate concentrations were normalized on a mass of fluorine basis to compare the potential mobility in gas versus leachate matrices. This study provides foundational data critical for understanding the role of landfills in anthropogenic PFAS release and for informing LFG management.

2. METHODS AND MATERIALS

For brevity, materials and methods associated with ionic PFAS analysis in landfill leachate are provided in section 1 of the Supporting Information (Tables S-1 through S-4).

2.1. Standards and Reagents. Targeted neutral PFAS (≥97% purity, n = 27) were purchased from Wellington Laboratories Inc. (Guelph, ON, Canada), SynQuest Laboratories (Alachua, FL), and Chiron (Stiklestadveien, Trondheim, Norway). Nine classes of neutral PFAS (perfluoroalkane sulfonamides (FASAs), perfluoroalkane sulfonamidoethanols (FASEs), fluorotelomer acetates (FTOAcs), fluorotelomer methyl acrylates (FTMAcs), fluorotelomer iodides (FTIs), fluorotelomer secondary alcohols (sFTOHs), FTOHs, FTAcs, and FTOs) were measured using eight isotopically labeled internal standards (IS) from FASA, FASE, FTOH, and FTMAc classes for quantitation (Table S-5).

2.2. Sample Preparation and Collection. Polyvinyl chloride (PVC) cartridges filled with 4−5 g of Amberlite XAD-2 resin retained between two polyurethane foam (PUF) discs were utilized for PFAS capture.[29,59,60] Before use, XAD-2 sorbent was made PFAS-free through sequential Soxhlet extractions.[61] All cartridge components, sampling vessels, and tubing were sonicated in a mixture of Liquinox and PFAS-free water, rinsed, and then sonicated in methanol and methanol rinsed before use. Once dried and assembled, cartridges were stored in individually sealed polyethylene bags at 4 °C until sampling.

As neutral compounds were the focus of this investigation, aerosolized/particulate-bound PFAS were not specifically targeted for capture; however, a condensate collection system was included to prevent moisture interference. The developed sampling system (Figure 1) consisted of a condensate knockout (borosilicate, barbed Erlenmeyer flask contained in a cold box), two PUF/XAD-2 cartridges (installed in-series), a rotameter for flow control, a portable vacuum pump, and PFAS-free Tygon tubing. Before each sampling event, gas well head connection to the larger landfill gas collection system was disabled to create a neutral to positive pressure, workable for flow through the sampling system, then gas composition/

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Environ. Sci. Technol. Lett. XXXX, XXX, XXX−XXX

Table 1. Average Concentrations (n = 2) of 13 Neutral PFAS (ng m^{-3}) from Three Municipal Solid Waste Landfills in Florida (Site Characteristics Are Provided in Table S-9)[a]

	concentration (ng m^{-3})					
analyte	landfill 1	E	landfill 2	E	landfill 3	E
4:2 FTOH	220		ND		57	
6:2 FTOH	*>9,900*	**170,000**	*>6,000*	**22,000**	*>6,500*	**62,000**
8:2 FTOH	*>6,800*	**200,000**	*>6,000*	**140,000**	*>6,500*	**740,000**
10:2 FTOH	*>5,100*	**14,000**	*>3,000*	**23,000**	*>5,000*	**120,000**
12:2 FTOH	860		1,400		5,000	
5:2 sFTOH	*>2,900*	**8,800**	*>1,700*	**9,000**	*>1,900*	**5,900**
7:2 sFTOH	320		*>1,300*	**13,000**	*>1,400*	**11,000**
8:2 FTO	2,500		1,300		550	
10:2 FTO	650		840		540	
12:2 FTO	97		580		160	
8:2 FTOAc	610		90		490	
10:2 FTOAc	99		19		140	
6:2 FTMAc	3,800		56		150	

[a]Concentrations of 6:2, 8:2, and 12:2 FTOH and 5:2 and 7:2 sFTOH consistently exceeded the upper limit of developed calibration ranges; therefore, both a minimum concentration (assuming the highest calibration concentration) and a maximum extrapolated concentration are provided. Italicized values denote a minimum concentration. Column "E" presents average maximum concentrations. "ND" denotes non-detect measurements. FTAcs, FASAs, FASEs, FTIs, and 8:2 FTMAc were not detected in any samples. Analyte acronyms and details are provided in Table S-5.

temperature was recorded using an Optimax Biogas analyzer (MRU Instruments, Humble, TX). Duplicate sampling trains were connected to existing gas well sampling ports. Approximately 1,200 L was sampled through each train at a flow rate of 5 L min^{-1}. After sampling, PUF/XAD-2 cartridges were sealed and individually stored at ≤4 °C for transport/storage. Quality control (QC) procedures are provided in the SI, section 2.

2.3. Extraction and Analysis. Spent XAD-2 from each cartridge was weighed and transferred to a 50 mL polypropylene centrifuge tube and vortexed, and approximately 2 g aliquoted for extraction. Samples were spiked with a mixture of mass labeled IS (Table S-5), rotated end-over-end for 18 h in 4 mL of 75/25% (v/v) ethyl acetate and methanol, and centrifuged for 10 min at 4,000 rpm. Supernatants were transferred to 15 mL centrifuge tubes, and the extraction process was repeated, combining supernatants from the two-fold extraction. Extracts were concentrated to 3 mL via gentle nitrogen evaporation, aliquoted, and stored no more than 30 days at −20 °C until analysis. QC details are provided in the SI, section 2 (Table S-6 and Figure S-1).

Targeted analysis of 27 neutral PFAS by positive chemical ionization (PCI) with selected ion monitoring (SIM) was conducted using a Thermo Scientific TRACE 1310 gas chromatograph coupled to a Thermo Scientific Orbitrap Exploris GC 240 mass spectrometer (GC-HRMS; see SI, section 2 for details regarding GC separations and instrumentation). A 12-point external calibration curve (from 1 to 2,000 pg μL^{-1}) was developed for quantitation, prepared through serial gravimetrically derived dilutions of primary stock solutions. A mixture of mass labeled IS at concentrations of 150 pg μL^{-1} was added to each calibration level. When a labeled standard was not available for a compound, a labeled standard with a similar retention time or structure was utilized for quantitation (Table S-5).

3. RESULTS AND DISCUSSION

Unexpectedly, several neutral PFAS concentrations in LFG exceeded the implemented calibration levels. Because of considerable exceedance for some compounds, dilution would reduce IS below instrument detection; therefore, in instances where sample concentrations exceeded calibration limits, two concentrations are presented (Equation S-1): a minimum value which assumes the highest calibration concentration and a maximum extrapolated concentration. Fluorine mass release calculations utilize minimum values, preventing overextrapolation while providing a conservative estimate for leachate comparison. Even under these assumptions, substantial concentrations of neutral PFAS, higher than those previously observed, were identified. Future assessments should deploy shorter sampling durations to refine findings.

3.1. Neutral PFAS in Landfill Gas. Except for 4:2 FTOH in one landfill, 13 PFAS were detected in duplicate samples across the three sites (site characteristics are provided in Table S-9). Observed concentrations are displayed in Table 1. At minimum, combined concentrations of neutral PFAS in LFG ranged from 22,000 to 33,000 ng m^{-3}. Considering extrapolated values, total concentrations ranged from 210,000 to 940,000 ng m^{-3}, an order of magnitude higher than those previously reported in LFG.[39]

3.1.1. FTOHs and sFTOHs in Landfill Gas. Like previous studies on LFG and air surrounding landfills, FTOHs dominated neutral PFAS concentrations;[28,31,32,39,40] however, extrapolated concentrations in this study surpassed previous reports in LFG, in some cases by 2 orders of magnitude, and were more comparable (although much lower) to concentrations recently identified in soil vapor near a PFAS manufacturing facility.[55] While there are uncertainties given the degree of extrapolation, the magnitude of FTOHs found in this study compared to existing research suggests fundamental differences potentially related to sampling methodology (e.g., much larger sampling volumes) and/or sampled landfill characteristics (e.g., waste type, age, air intrusion), although these data were not available for comparison. Across the three sites, 6:2, 8:2, and 10:2 FTOH, combined, made up 87 to 97% of total concentrations, but 8:2 FTOH alone constituted 50 to 79%. The shortest and longest analyzed homologues, 4:2 and

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Environ. Sci. Technol. Lett. XXXX, XXX, XXX−XXX

12:2 FTOH, were significantly lower in concentration (Table S-10). This is supported by previous FTOH distributions determined from source fluoro-telomer polymers[62] and observations in LFG, urban air, and air surrounding wastewater treatment/landfill sites.[28−31,39,40,63] Concentrations of 12:2 FTOH were of similar magnitude to those in Titaley et al., but 4:2 FTOH has not been detected in LFG, suggesting MSW landfills to be a previously unidentified potential source of atmospheric 4:2 FTOH.[39]

Secondary FTOHs have not been targeted in gas-phase landfill research but have been identified in condensate associated with LFG collection systems.[37] As intermediary byproducts of 6:2 and 8:2 FTOH biodegradation to PFAAs, 5:2 and 7:2 sFTOH, were unsurprisingly elevated, they were at least an order of magnitude lower than respective parent FTOH homologues.[64−66] All detections of 5:2 sFTOH and two out of three detections of 7:2 sFTOH were above calibration, combined sums attributed to 2 to 10% of total concentrations.

3.1.2. Other Neutral PFAS in Landfill Gas. Other neutral PFAS fell within acceptable calibration ranges and together accounted for 0.22 to 1.9% of total concentrations. FTO homologues have been encountered in other LFG and ambient air studies, but in past assessments 8:2 and 10:2 FTO were below limits of quantitation and 12:2 FTO concentrations were consistently an order of magnitude higher than those reported here.[39,59] To the authors' knowledge, 8:2 and 10:2 FTOAc and 6:2 FTMAc have not been determined in LFG. FTOAcs are not commonly assessed analytes but are associated with fluoropolymer textile treatments and have been identified in one indoor air study from Japan.[67,68] Similarly, 6:2 FTMAc has only been analyzed in a few studies on cosmetics and wastewaters but at lower concentrations.[69−71]

3.2. Comparative Fluorine Mass Release between Landfill Byproducts. Normalizing PFAS concentrations on a fluorine basis allows comparisons to be drawn between different matrices and PFAS types (e.g., gas−liquid, neutral−ionic, precursor−terminal). This methodology is widely used to assess the "mass balance" of PFAS within systems, given that the long-term environmental fate of measurable PFAS is transient, whereas the mass of fluorine is conserved.[17,72,73]

Here, the same approach is utilized to compare the PFAS mobility in leachate versus LFG pathways. Neutral (Table 1, minimum values) and ionic (Table S-4) PFAS concentrations in LFG and leachate from this study were individually normalized to a mass of fluorine (Equation S-2) using compound specific fluorine mass fractions (Table S-8). Summed fluorine masses in leachate and LFG were then scaled according to site-specific annual generation volumes reported for each landfill (Table S-9).[41] A caveat of this comparison is the absence of measurements for neutral species in leachate and ionic species in LFG; however, the literature suggests FTOHs (the dominant neutral class identified) predominantly exist in the gaseous phase, while PFAAs exist in liquid or particulate phases.[28,74] Subsequent research should assess neutral and ionic compounds in both matrices to validate findings and further elucidate the PFAS behavior in landfills.

Even utilizing minimum concentrations observed in LFG, equal magnitudes of fluorine release are observed between LFG and leachate at each site (Figure 2)—contrasting from existing estimates of PFAS mass flow from landfills.[9] Existing

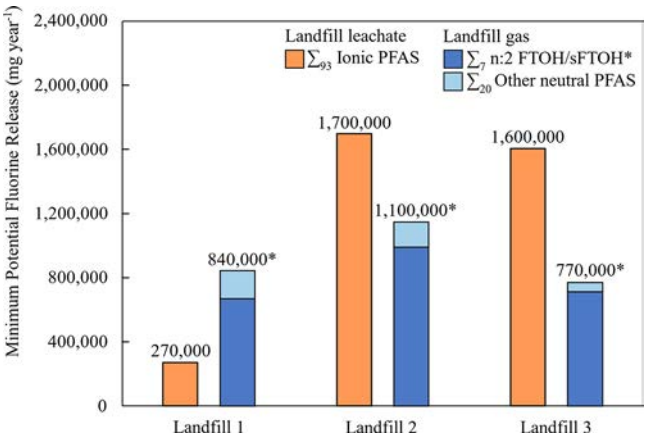


Figure 2. Annual fluorine mass release in landfill leachate versus landfill gas (LFG) from three municipal solid waste landfills in Florida. Fluorine masses in leachate are derived from ionic PFAS ($\sum_{93}$ PFAS) concentrations measured in leachate from each site (Table S-4) multiplied by the annual leachate generation volume and scaled using each detected compound's fluorine mass fraction (Tables S-8, S-9). The same methodology was applied for neutral PFAS ($\sum_{27}$ PFAS) in LFG by using the average of minimum concentrations (Table 1). Asterisked (*) values denote input FTOH/sFTOH concentrations which were above calibration levels developed for this study and therefore assumed to be at the highest calibration concentration. Consequently, these findings should be viewed as minimum values which conservatively estimate the magnitude of PFAS mobility in leachate versus LFG.

estimates, based on limited data, suggest that most PFAS mass mobilized from landfills releases through leachate (~62%).[9] However, our data from Landfill 1, showing over 76% fluorine release in LFG, along with substantial masses released by LFG in Landfills 2 and 3 (at minimum 40% and 32%, respectively), indicate that LFG may serve as an equal, likely greater, conduit of PFAS mobility from landfills than leachate, concurring with previous reactor studies on FTOH volatilization and neutral/ionic PFAS assessments of select waste materials.[17,75,76]

At least 79 to 92% of the fluorine mass in LFGs were derived from FTOH/sFTOH classes, with minimal contribution from FTOs, FTOAcs, and FTMAcs. In this conservative assessment, fluorine from LFG surpassed leachate in only Landfill 1. Although actual fluorine emission from LFG is higher than reported here, the elevated ratio of gas-to-leachate generation at Landfill 1 likely caused this difference (Table S-9). Landfill 2, the largest site, demonstrated the highest combined fluorine release from leachate and LFG, followed by Landfill 3, and then Landfill 1, corresponding to descending waste mass in place at each location.

4. IMPLICATIONS

This study provides fundamental data about neutral PFAS in LFG from MSW landfills. Unexpectedly, FTOH/sFTOH detections in LFG from this study exceeded implemented calibration levels; subsequent research should deploy shorter sampling durations. Regardless, even under more conservative assumptions these findings suggest that LFG, largely unscrutinized for PFAS, contains similar or greater magnitudes of PFAS compared to leachate, mostly attributed to midlength FTOH homologues. As landfills can be viewed as unabating PFAS repositories, the significance of LFG management in mitigating the long-term, long-range atmospheric transport of

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neutral PFAS, and subsequently derived PFAAs, cannot be understated. Unlike landfill leachate, LFG collection systems (when in place) are not fully efficient, collecting an estimated ~50−70% of generated biogases.[77] Though this is a considerable collection efficiency of biogas and presumably neutral PFAS, management of captured LFG fractions varies globally, from no treatment to degrees of carbon filtration and thermal treatment (i.e., flaring, advanced renewable natural gas technologies). Because the feasibility of PFAS destruction through thermal treatment remains unclear, research is needed to determine the treatment/removal efficiency of existing LFG management technologies. Considering the range of LFG capture efficiency, the retention and emission of neutral PFAS via fugitive emissions (i.e., migration through the waste layer) should also be examined, along with the role of landfill waste type, age, and temperature in neutral PFAS variability.

■ ASSOCIATED CONTENT

Supporting Information

The Supporting Information is available free of charge at https://pubs.acs.org/doi/10.1021/acs.estlett.4c00364.

Acronyms, structures, and instrumental parameters for neutral PFAS via GC-HRMS and ionic PFAS via LC-MS/MS; detailed QC information and results; and fluorine mass balance/extrapolation details and assumptions (PDF)

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Notes

The authors declare no competing financial interest.

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Environ. Sci. Technol. Lett. XXXX, XXX, XXX−XXX

landfills could include PFAS-containing wastes that are easily emitted into the environment. Depending on their mobility, PFAS compounds could impact groundwater if disposed of in an unlined landfill.

A liner is built of layers of clay and/or polymers (i.e., FMLs) designed to withstand the weight of waste and soil. Leachate will collect on top of the liner, so its design must include a leachate collection system contoured to collect leachate through a network of pipes leading to a low point called a sump. The collected leachate is pumped from the landfill and managed as liquid wastes (see Section 2.f and Section 3.b.iii.5). Uncontrolled leachate could result in the release of PFAS into the environment.

PFAS interactions with landfill liner materials have been the subject of limited studies. The most common types of FML are made with polyethylene geomembranes. PFAS diffusion through linear low-density polyethylene is reported below detection diffusion rates (Di Battista et al., 2020), and diffusion through high-density polyethylene may be even slower due to differences in material structure. PFAS likely pass through clay liners, which are required to have low hydraulic conductivity on the order of 10^{-6} centimeters per second, at the same rate as leachate and other constituents such as chloride (Li et al., 2015).

The most significant pathway for leachate (and PFAS) transmission through geomembrane or composite liners is via imperfections (e.g., flaws or holes) (Di Battista et al., 2020). A review of landfill liner performance reported median leakage rates of 44 and 33 liters per hectare per day for geomembrane and composite liners, respectively, and overall liner collection efficiency of 98 percent (Jain et al., 2023). Even if liners successfully prevent leachate from reaching groundwater, very few data exist on whether concentrated PFAS waste interacts with the different types of geotextiles used for landfill liners, thus affecting the performance of the liner. While the performance of clay liners may not be affected drastically, there is currently no research on the long-term stability of FML in the presence of PFAS.

3.b.iii.2 Landfill gas collection system

Landfills use GCCSs to manage gas generated from decomposing organic waste. A GCCS consists of a network of perforated pipes sunken into the waste mass. These “gas wells” are connected to a central blower that pulls gas from the wells. Despite the presence of a GCCS, gas can still migrate both through the surface of the landfill and underground through the bottom of the landfill. The gas produced by MSW landfills contains about 50 percent methane that is usually collected and burned off at the site via flares or for energy recovery; however, those systems for LFG destruction (e.g., flares, engines, boilers) typically operate up to 85°C—below the minimum temperature required to destroy PFAS.

Not all landfills are required to collect LFG (see Table 3-2). As noted in Section 3.b.iii.6.1, research has found that soluble PFAS with relatively high vapor pressures can be emitted into the atmosphere via the gas generated at landfills (Ahrens et al., 2011; Hamid et al., 2018; Wang et al., 2020; Weinberg et al., 2011). Direct sampling methodologies are currently under development, and published concentrations of PFAS measured *in situ* are limited to a single study (Titaley et al., 2023). LFG flares generally operate at approximately 650°C to 850°C, lower than the 1,100°C necessary to achieve the mineralization of PFAS. Nonetheless, LFG collection and management systems (e.g., flares) must be present at MSW landfill sites that accept PFAS waste, especially biodegradable PFAS waste such as biosolids. The use of GAC prior to the flaring of LFG can be effective in removing PFAS from LFG. Data on the fate of PFAS in LFG that is managed through on-site GCCS, including on-site flares, are still limited. See Section 5 for potential research needs.

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Biotransformation of fluorotelomer compound to perfluorocarboxylates in humans ☆

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ABSTRACT

Levels of perfluorocarboxylates (PFCAs) in biological compartments have been known for some time but their transport routes and distribution patterns are not properly elucidated. The opinions diverge whether the exposure of the general population occurs indirect through precursors or direct via PFCAs. Previous results showed that ski wax technicians are exposed to levels up to 92 000 ng/m^3 of 8:2 fluorotelomer alcohol (FTOH) via air and have elevated blood levels of PFCAs. Blood samples were collected in 2007–2011 and analyzed for C_4–C_{18} PFCAs, 6:2, 8:2 and 10:2 unsaturated fluorotelomer acids (FTUCAs) and 3:3, 5:3 and 7:3 fluorotelomer acids (FTCAs) using UPLC–MS/MS. Perfluorooctanoic acid (PFOA) was detected in levels ranging from 1.90 to 628 ng/mL whole blood (wb). Metabolic intermediates 5:3 and 7:3 FTCA were detected in all samples at levels up to 6.1 and 3.9 ng/mL wb. 6:2, 8:2 and 10:2 FTUCAs showed maximum levels of 0.07, 0.64 and 0.11 ng/mL wb. Also, for the first time levels of PFHxDA and PFOcDA were detected in the human blood at mean concentrations up to 4.22 ng/mL wb and 4.25 ng/mL wb respectively.
The aim of this study was to determine concentrations of PFCAs and FTOH metabolites in blood from ski wax technicians.

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1. Introduction

Per- and polyfluorinated compounds (PFASs) were used in commercial products already in the 50s because of their chemical and thermal resistance and ability to repel both oil and water (Speel and Schwarz, 1957). Today this diverse group of chemicals are extensively used in textile treatment, food packaging paper, stain repellant, hydraulic oil, non-stick cooking pans, ski wax and several other consumer products (Plassman, 2010; Prevedouros et al., 2006). Paradoxically, the thermal and chemical persistence which makes PFASs ideal in many industrial applications is also what makes them problematic in the environment due to their long half-lives. As a result, many PFASs have been found in humans, oceans, air and wildlife from all over the world (Butt et al., 2010a; Jahnke et al., 2007; Kärrman et al., 2005; Martin et al., 2004; Rotander et al., 2012). Around the millennium scientists became aware of the adverse effects in animals exposed to perfluorooctane sulfonate (PFOS), a notorious member of the PFAS family, including cancer, reduced fertility, suppression of immune system, hormonal alteration and changes in fatty acid metabolism (Review by Lau et al.) (Lau et al., 2007). PFOS was detected in wildlife worldwide and evidence grew that it has a strong tendency to accumulate in human and animal tissues and could potentially pose a risk to human health and the environment over the long term (3M, 2000a; Giesy and Kannan, 2001; Olsen et al., 1999; Sohlenius et al., 1993). This made 3M, a major North American manufacturer phase out PFOS and PFOS related products in May 2000 (3M, 2000b). In 2009 PFOS was added to the United Nations list of persistent organic pollutants, the Stockholm Convention of persistent organic pollutants (POPs) meaning that it is regulated in many countries.

Another member of the PFAS family, perfluorooctanoic acid (PFOA), is not yet on the Stockholm Convention List but in 2006 the U.S. Environmental Protection Agency (EPA) and the eight major PFOA manufacturers launched the 2010/15 PFOA Stewardship Program in which the companies committed to eliminate emissions and product content of PFOA by 2015 (EPA, 2010). PFOA is associated with liver toxicity, immunotoxicity, fatty acid metabolism, and developmental toxicity in rodents and humans (Elcombe et al., 2010; Fei et al., 2007; Klaunig et al., 2011; Lau et al., 2006; Yang et al., 2000). Also, U.S. EPA considers in its risk assessment of PFOA exposure that it is likely carcinogenic to humans (EPA, 2006). Therefore it is important to elucidate the metabolic pathways of all PFASs that potentially degrade to PFOA including the fluorotelomer alcohols (FTOHs). Already in 1981 Hagen et al. reported biotransformation of FTOH to PFOA in rats. More recent research shows that 8:2 FTOH rapidly metabolizes to biopersistent PFCAs in rats, mice and fish. However, the international literature lacks data on whether this metabolization can also occur in humans (Brandsma et al., 2011; Butt et al., 2010b; Fasano et al., 2006; Hagen et al., 1981).

☆ Brief: The study suggests that fluorotelomer alcohols (FTOHs) biotransform to perfluorocarboxylates in humans implying that evaluation of perfluorooctanoic acid (PFOA) exposure to humans should include FTOH exposure.

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Fluorochemicals are used in ski wax gliders since they reduce the friction between the ski and the snow consequently generating a higher speed (Swixsport, 2012). In our earlier studies on ski wax technicians' PFAS exposure we confirmed high levels of PFOA in the blood in addition to very high levels of FTOHs in the air during ski waxing (Nilsson et al., 2010a, 2010b). In this paper we aim to report the PFAS blood levels of the same technicians included in previous studies during 4 consecutive years, '07–11'. We also investigate the presence of metabolites FTCAs and FTUCAs in the blood previously identified as degradation products from FTOH exposure.

2. Materials and methods

2.1. Study design

We collected blood samples ($n=94$) from 11 male professional ski wax technicians at 11 World Cup events in Cross Country skiing 2007–2011 at the end of the working day and monthly from April–August 2008 when the technicians were not working with ski wax. However, the technicians use fluorinated ski wax for approximately 30 h a week during the skiing season from December through March. The technicians' length and weight are presented in Table A.5 in the Appendix.

Before the study we received written informed consent from all participants and the ethical vetting board of Uppsala, Sweden (Reference No. Dnr 2010/ 056) approved of the study protocol.

2.2. Chemicals

Details of chemicals, abbreviations of PFASs and standard compounds used for the sample preparation are given in the Appendix on page A3 and A4. The molecular structures are shown in Fig. 1.

2.3. Extraction and analysis

Detailed information of the sample extraction has been described elsewhere (Kärrman et al., 2007). In brief, mass labeled internal standards (IS) and 2 mL of formic acid/water (1:1 v/v) were added to 0.5 mL of whole blood. After sonication and centrifugation, the supernatant was extracted using solid-phase extraction with weak anion exchange (Waters Oasis WAX), and the per- and polyfluorinated compounds were eluted with 4 mL methanol and 1 mL of 2% ammonium hydroxide in methanol. The volume of the blood extract was adjusted to 200 μL using nitrogen. Recovery standard (RS) and 300 μL of 2 mM ammonium acetate in water were added prior to UPLC–MS/MS analysis.

Levels of C_4–C_{14}, C_{16} and C_{18} PFCAs and 3:3, 5:3 and 7:3 FTCAs and 6:2, 8:2 and 10:2 FTUCAs were monitored. C_4, C_6, C_8 and C_{10} PFSAs were also measured in the same method and were included in the study. However, PFSAs are not further discussed in the paper since earlier results showed that the ski wax technicians do not have elevated PFSA blood levels (Nilsson et al., 2010b). Concentrations of PFHxDA and PFOcDA were measured semi quantitative since no mass labeled standard are available for those compounds and therefore these results are not compensated for possible matrix effects. The metabolites were chosen based on previous works on mammalian biotransformation of FTOH (Fasano et al., 2009; Nabb et al., 2007). An Acquity UPLC system coupled to a Quattro Premier XE (Waters Corporation, Milford) with an atmospheric electrospray interface operating in negative ion mode (ES–MS/MS) was used for analysis. Separation was performed on an Acquity BEH C18 2.1×100 mm, 1.7 μm kept at 50 °C with a PFCs isolator column (Waters Corporation, Milford) inserted between the pump and injector to retain any fluorochemicals originating from the UPLC system. Injection volume was 10 μL and the flow was set to 300 μL/min.

MRM-transitions, mass labeled internal and recovery standards used for quantification of analytes are presented in Tables A.1 and A.2 in the Appendix.

2.4. QA/QC

A calibration curve at concentrations 0.04, 0.08, 0.2, 0.4, 0.8, 2.0, 4.0, 8.0, 20 and 40 ng/mL was used for C_4–C_{14}, C_{16} and C_{18} PFCAs, 6:2 FTUCA, 8:2 FTUCA, 10:2 FTUCA, 3:3 FTCA 5:3 FTCA and 7:3 FTCA. The relative response factors of all analytes over the whole range showed relative standard deviations (RSD) of less than 15% except for perfluorooctadecanoic acid (PFOcDA, C_{18}) from 0.08 to 4 ng/mL. Quantification was performed using the internal standard method. The limit of detection (LOD) was defined as mean concentration in blanks + 3 standard deviations (σ), and the limit of quantitation (LOQ) was defined as mean blank level + 10σ. All LODs and LOQs are shown in Table A.3 in the Appendix. Mean recoveries ($n=94$) for labeled PFOA, 6:2 FTUCA and 10:2 FTUCA were 86%, 72% and 52% respectively. The reported levels were recovery corrected. Mass labeled FTCAs to be used as internal standards were not available therefore the 3:3, 5:3 and 7:3 FTCAs were quantified using the FTUCAs according to Table A.2 in the Appendix. Spiking experiments showed mean ($n=6$) matrix recoveries for 3:3, 5:3 and 7:3 FTCAs of 56%, 88% and 89% which corresponds well with the FTUCAs. No FTUCAs or FTCAs were present in in-house reference blood samples (human whole blood) or blanks. Samples were stored in freezer prior to analysis. No contamination was detected from utensils and chemicals which were evaluated by analyzing multiple blanks and reference blood samples stored more than 2 years.

3. Results

PFOA, PFNA, PFDA, PFDoDA, PFTDA, 5:3 FTCA and 7:3 FTCA were detected in all samples. Their individual levels are presented in the Appendix, Table A.4. Also, levels of the long chained PFCAs, PFHxDA and PFOcDA were detected in the human blood at mean concentration of 1.09 ng/mL wb and up to 4.22 ng/mL wb for PFHxDA and 0.69 ng/mL wb and up to 4.25 ng/mL wb for PFOcDA.

Fig. 2 shows UPLC–MS/MS multiple reaction monitoring (MRM) chromatograms of polyfluorinated metabolites FTCAs and FTUCAs. 5:3 FTCA concentrations range between 0.09 and 6.1 ng/mL wb and 7:3 FTCA between 0.05 and 3.5 ng/mL wb. 3:3 FTCA was not detected in levels exceeding LOQ in any of the samples but 8:2 FTUCA and 10:2 FTUCA were detected in 84% and 39% of the samples in ranges of as presented in Tables 1and A.4 in the Appendix.

The technicians can be divided in two groups with regard to the trend in blood concentrations of PFOA. For the group with PFOA levels exceeding 100 ng/mL wb at the beginning of the sampling campaign in September 2007, the concentration of PFOA has decreased until the last sampling in March. The other group with PFOA levels less than 100 ng/mL wb has, generally, increased the blood concentrations from 2007 to 2011. PFNA levels range from 0.33 to 163 ng/mL wb with a mean of 23 ng/mL wb which is up to 300 times higher levels than those found in the general population (Haug et al., 2009; Kato et al., 2011; Toms et al., 2009).

4. Discussion

Our findings of FTOH metabolites FTCAs and FTUCAs in the blood from ski wax technicians exposed to high levels of 8:2 FTOH via air suggest metabolism of FTOHs to PFOA and PFNA also in humans (Fasano et al., 2009; Nabb et al., 2007). This data is important to explain biological levels of PFCAs because the parent compound itself may not accumulate but biotransformation forms persistent metabolites PFOA and PFNA. In fact, it is reported that the FTCA metabolites were responsible for toxic effects in rats and microorganisms rather than the parent compound FTOH (Martin et al., 2009; Phillips et al., 2007). In addition, we are able to report the blood level of PFHxDA and PFOcDA in wax technicians of concentrations up to 4.22 ng/mL blood for PFHxDA and up to 4.25 ng/mL PFOcDA.

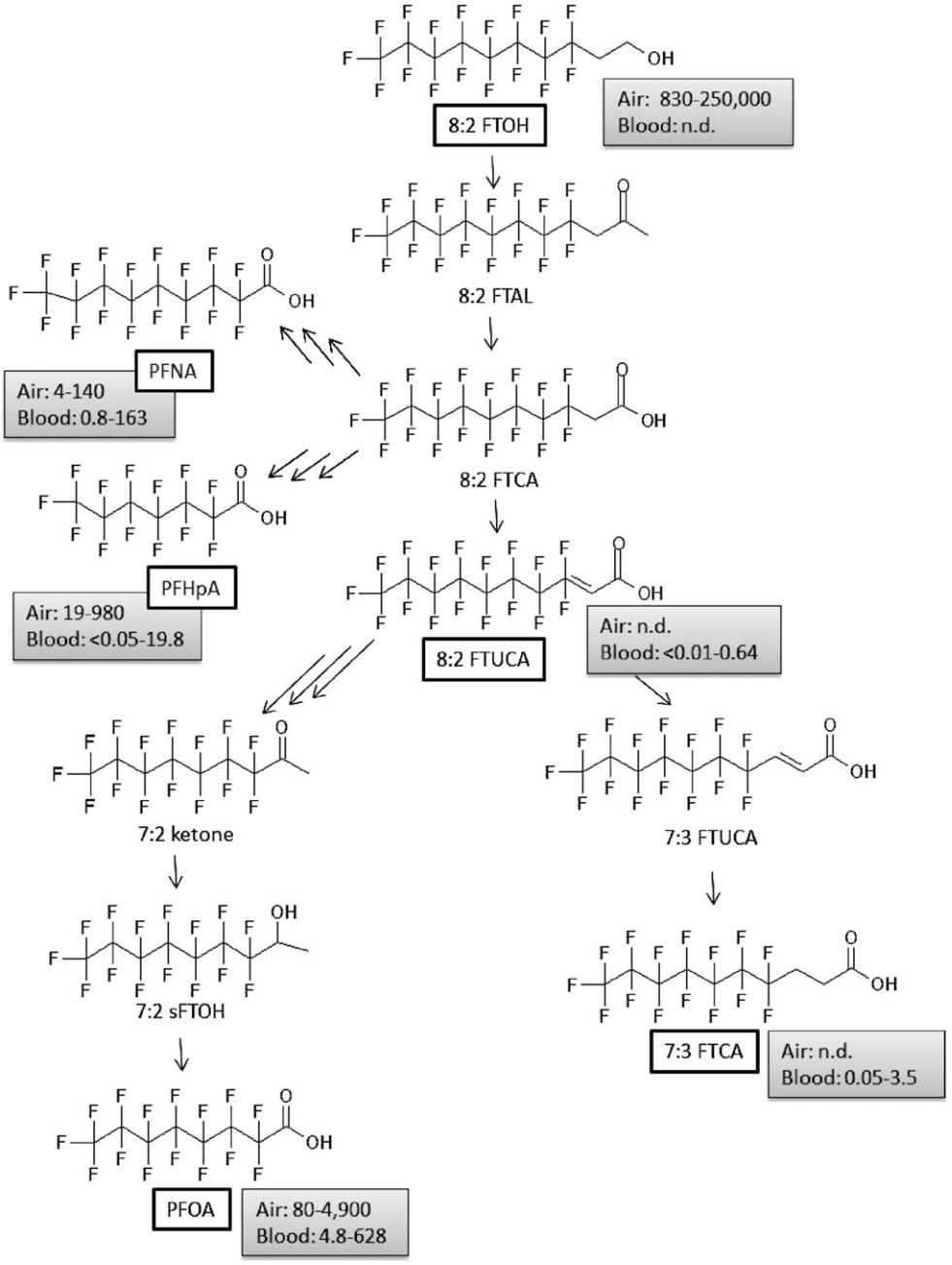


Fig. 1. Simplified metabolic pathway for 8:2 FTOH showing combined suggestions by Martin et al. (2005), Fasano et al. (2009), Martin et al. (2009) and Himmelstein et al. (2011). The ranges of blood and air levels of the compounds included in the pathway are presented in ng/mL for blood and ng/m^3 for air (Nilsson et al., 2010a, 2010b).

In Fig. 1 a simplified metabolic pathway for 8:2 FTOH metabolism in rat is presented by combining the findings from Fasano et al. (2006), Martin et al. (2005) and Nabb et al. (2007) including our results of PFHpA, PFOA, PFNA, 7:3 FTCA and 8:2 FTUCA levels in blood and air. The metabolic routes of FTOHs in in vivo rainbow trout and rat and in vitro human hepatic cells are very complex including phase I (oxidation)

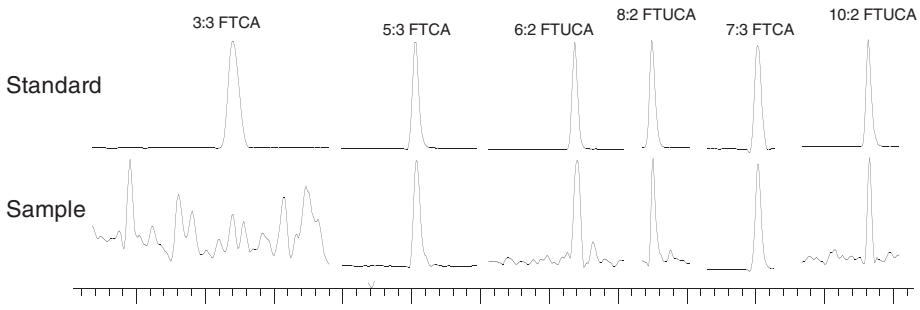


Fig. 2. UPLC–MS/MS multiple reaction monitoring chromatograms of polyfluorinated metabolites identified in the blood of humans exposed to extremely high levels of 8:2 FTOH via air.

Table 1
Minimum, maximum, median and average concentration (ng/mL whole blood) of PFASs in the blood from ski wax technicians ($n = 11$) collected 2007–2011.

		Min	Max	Median	Average
PFCAs	PFBA	<0.13	11	0.51	1.8
	PFPeA	<0.05	0.18	0.14	0.14
	PFHxA	<0.05	15	0.68	1.9
	PFHpA	<0.05	20	2.4	4.0
	PFOA	1.9	630	110	130
	PFNA	0.33	160	12	23
	PFDA	0.87	24	7.2	7.8
	PFUnDA	<0.16	2.8	1.0	1.0
	PFDoDA	0.21	2.8	1.3	1.4
	PFTrDA	<0.10	1.1	0.39	0.44
	PFTDA	0.07	5.2	1.2	1.5
	PFHxDA	<0.15	4.2	1.2	1.4
	PFOcDA	0.20	4.3	0.85	1.0
PFSAs	PFBS	<0.02	0.04	0.04	0.03
	PFHxS	<0.04	4.3	1.4	1.5
	PFOS	0.28	27	11	11
	PFDS	<0.02	<0.02	<0.02	<0.02
Metabolites	6:2 FTUCA	<0.01	0.07	0.03	0.03
	8:2 FTUCA	<0.01	0.64	0.07	0.10
	10:2 FTUCA	<0.02	0.11	0.05	0.06
	3:3 FTCA	<0.03	<0.03	<0.03	<0.03
	5:3 FTCA	0.09	6.1	1.7	1.9
	7:3 FTCA	0.05	3.9	0.92	1.0

and phase II pathways (conjugation of parent compounds and metabolites) (Fasano et al., 2009; Himmelstein et al., 2011; Nabb et al., 2007). A similar metabolization complexity is also expected in in vivo humans.

In our study the average concentrations of 6:2 FTOH, 8:2 FTOH, and 10:2 FTOH are extremely high (280 ng/m^3, 92,800 ng/m^3, and 370 ng/m^3) in the air of wax technicians' breathing zone during work applying ski wax. PFOA is also detected in the air but at almost 100 times lower in level (mean = of 1 200 ng/m^3) than in 8:2 FTOH. Average levels of PFNA are 30 ng/m^3 compared to 4 900 ng/m^3 for PFHxA which is detected at the highest level of all the PFCAs in air (Nilsson et al., 2010a). Typical indoor air concentrations of 8:2 FTOH are approximately 5 ng/m^3 (Haug et al., 2011). The general population have on average 1.5 ng/mL PFOA and 0.3 ng/mL PFNA in their blood compared to the technicians who show levels of up to 635 ng/mL PFOA and 163 ng/mL PFNA (Haug et al., 2009; Kato et al., 2011; Shoeib et al., 2011).

The results found in our study confirming high levels of PFOA in the blood can result from either direct air exposure of PFOA and/or from the metabolism of 8:2 FTOH. In the literature, experiments where rats inhaled 3 or 30 mg/m^3 it was shown that 1.6–2.1% of the dosed 8:2 FTOH was metabolized to PFOA (Himmelstein et al., 2011). The technicians' occupational exposure to PFCAs is much higher than the exposure from the diet and ambient indoor air and therefore those are assumed to be a minor contributor to their blood levels (Haug et al., 2011). Low levels of FTUCAs (<0.002–0.080 ng/g) were recently detected in indoor environment however FTCAs were not detected in the dust samples from the same households (Jogsten et al., 2012).

It is difficult to draw any conclusions about how much of the FTOH is metabolized to PFOA. PFOA has a half-life of 2.3–3.8 years and therefore the blood levels reflect the exposure from several years back in time (Bartell et al., 2010; Olsen et al., 2007). The air data in our study are single-point measurements providing information of that particular working day only and we have seen that the air exposure can differ by several orders of magnitude from one occasion to the next (Nilsson et al., 2010a). Another factor is that the exposure consists of a cocktail of PFASs as most animal studies where the aim is to elucidate the metabolic pathways and yields only one chemical is dosed at a time. However, this is a unique group of workers providing an exceptional opportunity to study people highly exposed to FTOHs. The extreme exposure makes it possible to detect metabolic products that in a less exposed group would remain undiscovered.

Out of the metabolic products included in our study the most biopersistent compounds in humans are the 5:3 and 7:3 FTCAs since they are detected in the samples collected throughout the summer even though the technicians are not working with ski wax during the summer. The levels of 5:3 and 7:3 FTCAs are shown in Table A.4 and Figs. A.1 and A.2 in the Appendix.

Butt et al. showed that biotransformation of a different fluorochemical, 8:2 fluorotelomer acrylate (FTAc), metabolizes via 8:2 FTOH in rainbow trout and yields 8:2 FTCA, 8:2 FTUCA and 7:3 FTCA as the most biopersistent metabolites (Butt et al., 2010b). Both 8:2 FTUCA and 7:3 FTCA were present at very low levels in our samples. However, 7:3 FTCA was detected in all of the blood samples although levels declined in summer samples. A biotransformation pathway of 8:2 FTOH in rat was reported by Fasano et al. and also there the 7:3 FTCA was identified as a major metabolite (Fasano et al., 2009). Generally, we observed slightly higher levels of 5:3 FTCA as compared to 7:3 FTCA but in 22% of the blood samples 7:3 FTCA levels were higher than 5:3 FTCA. Experiments with rats and rainbow trout have demonstrated that the 7:3 FTCA does not form PFOA but PFHxA (Butt et al., 2010b; Himmelstein et al., 2011).

Similar to this study, lower PFNA levels compared to PFOA were reported after 8:2 FTOH exposure in mammalian systems by several researchers (Butt et al., 2010b; Himmelstein et al., 2011; Kudo et al., 2005; Nabb et al., 2007). In our survey both PFOA and PFNA are present at high concentrations in the blood over a long period of time and show similar fluctuation indicating that they are persistent end products originating from a common source as exemplified in Figs. A.1 and A.2 in the Appendix. This is an unexpected finding since PFNA has a longer half-life than PFOA in rats and therefore is expected to eliminate more slowly also in humans (Ohmori et al., 2003; Tatum-Gibbs et al., 2011). Scientific reports after the 3M phase-out show decreasing PFOA serum concentrations in the general population, whereas levels of PFNA still increase (Calafat et al., 2007). However, increased background exposure is not likely the explanation for the high PFNA levels seen in wax technicians which are on average 50 times higher than for the general population (Haug et al., 2009; Kato et al., 2011).

Since the study began in 2007 three more technicians have accepted to participate in the study. One of these show the highest levels of PFOA with 628 ng/mL wb which corresponds to approximately 1256 ng/mL serum (Ehresman et al., 2007). What is also noteworthy is that most technicians have PFOA concentrations 7–10 times higher than PFNA but one of the new technicians show 37 times higher level of PFOA than PFNA. PFHxA has a half-life in the blood of less than one month since it is not present in the samples collected in April one month after the end of the World Cup ski season (Table A.4 in the Appendix). This is in agreement with PFHxA half-lives of 2.4–5.3 h in monkeys which has been reported previously (Chengelis et al., 2009).

5. Conclusion

The novel findings of FTOH metabolites FTCAs and FTUCAs in the blood from ski wax technicians exposed to high levels of 8:2 FTOH via air is indicating metabolism of FTOHs to PFOA and PFNA also in humans (Fasano et al., 2009; Nabb et al., 2007). Our data may be important in the discussion of PFOA phase-out since it has been reported that the general population is exposed to FTOHs in air and dust (Dreyer et al., 2009; Shoeib et al., 2011).

In addition, for the first time we present the levels of PFHxDA and PFOcDA in the human blood.

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Appendix A. Supplementary data

Available in Appendix are the following: List of abbreviations, chemicals, UPLC gradient program, common name, acronym, LC/MS–MS MRM transitions of analytes, limit of detection (LOD) and limit of quantification (LOQ) for the analytes, individual concentration (ng/mL whole blood) of per-/polyfluorinated compounds in the blood from ski wax technicians ($n = 11$) collected in 2007–2011.

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.envint.2012.09.001.

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Toxicokinetics of 8:2 fluorotelomer alcohol (8:2-FTOH) in male and female Hsd:Sprague Dawley SD rats after intravenous and gavage administration

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ABSTRACT

Fluorotelomer alcohols (FTOHs) are used in the production of persistent per- and polyfluorinated alkyl substances (PFAS). Rodents and humans metabolize FTOHs to perfluoralkyl carboxylic acids which have several associated toxicities. Thus, understanding the toxicokinetics of these FTOHs and their metabolites will be useful for interpreting their toxicity for humans. Here, male and female Hsd:Sprague-Dawley SD rats were administered a single dose of 8:2-FTOH via gavage (males: 12, 24, 48 mg/kg; females: 40, 80, 160 mg/kg) or IV (males: 12 mg/kg; females: 40 mg/kg). Toxicokinetics of 8:2-FTOH and two primary metabolites, perfluorooctanoic acid (PFOA) and 7:3-fluorotelomer acid (7:3-FTA) were determined in plasma. Concentrations (total) of these chemicals were determined in the liver, kidney, and brain. There was rapid absorption and distribution of 8:2-FTOH after gavage administration in male rats. The plasma elimination half-life ranged from 1.1 to 1.7 hours. Kinetic parameters of 8:2-FTOH in females were similar to that in males. Bioavailability of 8:2-FTOH ranged from 22 to 41% for both sexes with no dose-dependent trends. 8:2-FTOH metabolites, PFOA and 7:3-FTA were detected in plasma following administration of the parent FTOH. Consistent with existing literature, the plasma half-life of PFOA was longer in males than in females (198–353 hours and 4.47–6.9 hours, respectively). The plasma half-life of 7:3-FTA was around 2–3 days in both sexes. 8:2-FTOH and 7:3-FTA were detected in all tissues; PFOA was found in the liver and kidney but not the brain. Detectable concentrations of metabolites persisted longer than the parent FTOH. These data demonstrate that in rats given a single gavage dose, 8:2-FTOH is rapidly absorbed, metabolized to form PFOA and 7:3-FTA, distributed to tissues, and eliminated faster than its metabolites. Sex differences were observed in the tissue distribution and elimination of PFOA, but not 8:2-FTOH and 7:3-FTA.

1. Introduction

Per- and polyfluorinated alkyl substances (PFAS) are used to repel water and oils for use on paper, food packaging products, furniture, and outdoor equipment. Due to their chemical properties, PFAS are resistant to degradation, bioaccumulate, and persist in the environment [1]. PFAS such as perfluorooctanoic sulfonate (PFOS) and perfluorooctanoic acid (PFOA) have been detected in human sera worldwide for many years [2–6]. In humans and laboratory animals, exposure to PFOS and PFOA has been associated with cancer, impairments in reproduction and development, hormonal changes, and liver toxicity [7–10], which led to regulatory actions and voluntary reductions of PFOA and PFOS production by major manufacturers in the US between 2000 and 2015. During this time, concentrations of PFAS in sera of the US population decreased but, interestingly, there was a larger decrease in PFOS than PFOA concentrations [3,4]. Given that PFOS has a longer half-life than PFOA, the continued persistence of PFOA in sera suggests continued exposure to PFOA [11].

One explanation for the continued presence of PFOA is the continued use of fluorotelomer alcohols (FTOHs) in the manufacture of PFAS. Since the electrochemical fluorination process for PFAS synthesis was discontinued in 2003, telomerization, which synthesizes FTOHs that can be converted to other products, has become the primary industrial synthesis process [12]. FTOHs are a potential source of perfluorinated carboxylates (PFCAs) such as PFOA in the environment as they are converted into PFCAs by microbes [13] and abiotically [14].

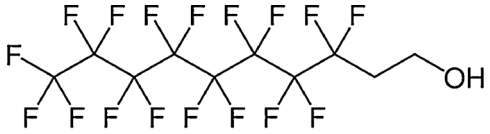
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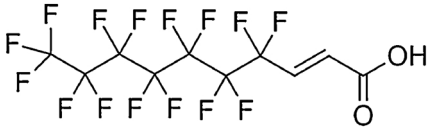
Furthermore, FTOH-derived PFCAs have been detected in rats [15] and are suspected to form in humans [16–18]. In 2006, worldwide production of FTOHs was estimated to be 20 million pounds per year [19].

Human exposure to environmental FTOHs comes from residual FTOHs in PFAS-containing products. Inhalation is a potential route of exposure due to the volatility of FTOHs. While manufacturing workers and ski wax technicians have high levels of exposure due to occupational use of PFAS-containing products [17], airborne FTOHs have also been detected in office environments, private homes, and furniture and outdoor equipment stores [20–23]. Ingestion may be another route of human exposure given the use of PFAS in food-contact coatings [24] and its presence in dust [25]. Exposure to FTOHs specifically has been associated with hepatotoxicity [26–28], increased breast cancer cell proliferation [29,30], and estrogenic activity [31,32]. Some effects on reproduction and development were observed, but these may be due to maternal toxicities [33,34]. It is possible that some of the toxicities of FTOHs are related to effects of their metabolites, either one specific metabolite or a combination of multiple metabolites [15]. Thus, increased understanding of the toxicokinetics of FTOHs and their metabolites may help delineate which toxicities are attributable to the parent compound versus the metabolites. Assessing the toxicokinetics of FTOHs will also be essential for contextualizing toxicological data and interpreting the relevance of animal data to humans.

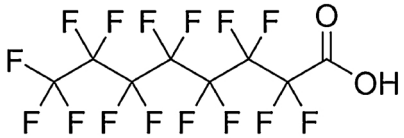
8:2-FTOH is a fluorotelomer manufactured extensively around the world [35]. It is excreted primarily through the feces and bile [27] and has been shown to be metabolized to PFCAs, such as PFOA and fluorotelomer carboxylic acids, in rodents [15,36]. Although there is a shift towards the use of more short-chain PFAS (six carbons and less), long-chain PFAS and FTOHs are still in use and are present in the environment. Toxicokinetics of 8:2-FTOH have been reported following intraperitoneal injection [37], oral administration either once [27] or daily for multiple days [15], or inhalation [36] of the chemical. Many of these studies identify metabolites produced but not all evaluate their kinetics. This paper reports the toxicokinetic parameters of 8:2-FTOH and two primary 8:2-FTOH metabolites, PFOA and 7:3-fluorotelomer carboxylic acid (7:3-FTA), in adult male and female Harlan Sprague-Dawley rats following oral gavage exposure to 8:2-FTOH (Fig. 1).



8:2 fluorotelomer



7:3 fluorotelomer acid



Perfluorooctanoic acid

Fig. 1. Chemical structures of 8:2-fluorotelomer and its metabolites, perfluorooctanoic acid and 7:3 fluorotelomer acid.

2. Materials and methods

2.1. Chemicals and reagents

8:2-FTOH (CAS# 678-39-7; Lot# 09115HE; Sigma-Aldrich, St. Louis, MO) was purchased commercially (Fig. 1). Chemical identity was confirmed by infrared spectroscopy, ^{13}C and ^{19}F nuclear magnetic resonance spectroscopy and mass spectrometry. Purity (98.4%) was determined using gas chromatography (GC) with flame ionization. There were three reportable impurities: 1.3% was a perfluoroalkyl compound similar in structure to 8:2-FTOH, 0.19% was allylic 8:2-FTOH, and 0.11% was a perfluoroalkyl compound dissimilar to 8:2-FTOH. 2-perfluorooctyl-(1,1-$^{2}H_2$)-(1,2-$^{13}C_2$)-ethanol (MTHPFD) and perfluoro-n-(1,2,3,4- $^{13}C_4$)octanoic acid (MPFOA) to be used as internal standards were obtained from Wellington Laboratories (Guelph, Ontario). All other reagents were obtained from commercial sources.

2.2. Animals

These studies were conducted in Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC)-accredited facilities and approved by Battelle's (Columbus, OH) Animal Care and Use Committee. Animal care was performed according to the *Guide for the Care and Use of Laboratory Animals* [38]. Studies were conducted in compliance with the Food and Drug Administration Good Laboratory Practice Regulation [39].

Male and female Hsd:Sprague Dawley SD rats, approximately 7 weeks old, were purchased from Harlan Laboratories, Inc. (now Envigo, Inc., Indianapolis, IN). Prior to shipment, jugular catheters were implanted in rats for IV administration. Irradiated NTP-2000 feed (Zeigler Brothers, Inc., Gardners, PA) and municipal tap water was provided *ad libitum*. Animals were maintained on a 12:12 light cycle in a room at 64–79 °F with 30–70% relative humidity. Prior to dosing, rats were randomized using a partitioning algorithm program (Xybion PATH/TOX SYSTEM, Xybion Medical Systems Corporation, Version 4.2.2) to ensure mean body weights of rats in each group were similar. Additional animals were included as replacements for when dosing was believed to be incomplete or an insufficient volume of blood was collected. Animals were approximately 8 weeks old at the time of dosing.

2.3. Dose administration and sample collection

Dose formulations were prepared in 1:1:8 Cremophor:ethanol:water for gavage (2.4, 4.8, 8, 9.6, 16 and 32 mg/mL) and IV (3 or 10 mg/mL) and analyzed using a validated GC with electron capture detection method (range, 1.5–80 mg/mL; $r \geq 0.99$; precision $\leq$ 5% relative standard deviation; accuracy, $\leq \pm$ 10% relative error). All formulations were within 10% of target concentrations. Prior to study initiation, stability ($\leq \pm$ 10% of day 0) of both oral and IV formulations was confirmed for up to 42 days when stored in sealed amber bottles with Teflon-lined lids at ambient or refrigerated conditions.

The study design is given in Table 1. A single bolus IV in 4 mL/kg (males: 12 mg/kg; females: 40 mg/kg) or a gavage dose in 5 mL/kg (males: 12, 24, 48 mg/kg; females: 40, 80, 160 mg/kg) was administered to non-fasted rats based on individual body weight on the day of dosing. Due to the anticipated differences in PFOA toxicokinetics from previous literature, females received higher doses than males. Following dose administration, retro-orbital blood (~ 0.7 mL) was collected from each rat after anesthesia with 70% CO_2/O_2 at 11–12 timepoints (Table 1). Time points were selected based on preliminary studies (data not shown) and literature. Each animal was bled for a maximum of two time points and three animals were bled at each time point. Samples were collected into a tube containing ethylenediaminetetraacetic acid, gently inverted, and placed on wet ice until separated into plasma. Plasma was separated by centrifugation at 1750 x g for 10 min at 4 °C and stored in at -20° C until analysis. In specific gavage dose groups

Table 1
The route of administration, dose, and time points for a single dose of 8:2-FTOH administered to Hsd:Sprague Dawley SD rats.

Route of Administration	Sex	Dose (mg/kg)	Dose (mmol/kg)	Time Points (hours)
IV	Male	12	0.026	0.083, 0.25, 0.5, 0.75,
	Female	40	0.086	1, 3, 6, 9, 12, 24, 192
Gavage	Male	12	0.026	0.083, 0.25, 0.5, 0.75, 1, 3, 6, 9, 12, 24, 48, 192
		24	0.052	
		48	0.103	
	Female	40	0.086	0.083, 0.25, 0.5, 0.75,
		80	0.172	1, 3, 6, 9, 12, 24, 48,
		160	0.345	192

(24 mg/kg for males and 80 mg/kg for females), following blood collection, the liver, kidney, and brain were collected at 0.5, 1, 3, 6, and 12 -h time points to measure 8:2-FTOH, PFOA, and 7:3-FTA tissue concentrations.

2.4. Sample preparation and analysis

An analytical method using protein precipitation followed by high performance liquid chromatography (HPLC) tandem mass spectrometry (MS/MS) was used to quantitate 8:2-FTOH, PFOA (CAS# 335-67-1), and 7:3-FTA (CAS# 812-70-4) (Fig. 1) in HSD rat plasma, liver, kidney, and brain. The validation included an assessment of linearity (r), inter- and intraday accuracy (estimated as standard error, RE), and inter- and intraday precision (estimated as relative standard deviation, RSD), absolute recovery, and limit of detection (LOD). Analytical method validation parameters are given in Supplemental Table S1-S4.

Stock solutions of chemical analyte were prepared in methanol and further diluted in the same solvent to generate concentrations of standards in the working range. Stock solutions of the internal standard (IS) was prepared in methanol and diluted in 4:1 ASTM Type 1 water:-methanol to generate working IS solutions. Matrix calibration curves were prepared in duplicate by adding the standard solutions to blank HSD rat plasma/tissue. Quality control (QC) samples were prepared in blank HSD rat plasma/tissue using a procedure similar to that for the matrix standards, using an independent stock solution. Matrix blanks were prepared the same as matrix standards except the addition of the analyte.

Sample tissues (100–300 mg) were homogenized in a volume of ASTM Type 1 water that was 10x the weight of wet tissue prior to analysis. For analysis of 8:2-FTOH, 30 µL of plasma was combined with 30 µL of IS solution (10 ng/mL MTHPFD in methanol). In tissues, 100 µL of homogenized tissue was combined with 50 µL of 200 ng/mL MTHPFD in methanol and 200 µL of 0.05 N potassium hydroxide in 1:1 water:methanol. For analysis of PFOA and 7:3-FTA, 100 µL of plasma was combined with 100 µL of the IS solution 20 ng/mL MPFOA. In tissues, 100 µL of homogenized tissue was combined with 200 µL of 50 ng/mL MPFOA. Samples (i.e. tissue samples) were neutralized with hydrochloric acid and vortexed, centrifuged, and an aliquot of 10–15 µL of the supernatant was removed for analysis. Matrix calibration standards, QC samples and matrix blanks were prepared in the same manner as study samples and run with each batch of samples.

The HPLC-MS/MS system used was a Shimadzu (Kyoto, Japan) or Agilent 1200 (Santa Clara, CA) HPLC coupled to a Sciex API 5000 or Sciex Q Trap 4000 mass spectrometer (Toronto, Canada). Chromatography was performed using a Gemini-NX column (C18, 50 x 2.0 mm, 5 µm for 8:2 FTOH or 3 µm for metabolites; Phenomenex, Torrance, CA). For the analysis of 8:2-FTOH, mobile phases A (water) and B (methanol) were run with a linear gradient from 5% B (1.6 min) to 100% B over 0.9 min at a flow rate of 0.25 mL/min. For the analysis of PFOA and 7:3-FTA, mobile phases A (aqueous 10 mM ammonium formate/0.1% formic acid in water) and B (0.1% formic acid in acetonitrile) were run with a linear gradient from 10% B to 90% B in 0.6 min and held there for 2.4 min at a flow rate of 0.5 mL/min. The Turbo Ionspray™ (Sciex) ionization source was operated in negative ion mode with a source temperature of 350 °C (Sciex API 5000) or 500 °C for the (Sciex Q Trap 4000) and an ion spray voltage of −4500 V. Transitions monitored were m/z 463→403, 413→169, 441→337, 467→406 and 417→169 for 8:2 FTOH, PFOA, 7:3-FTA, ($^{2}H^{13}C$)POE, and (^{13}C) PFOA, respectively.

A quadratic regression with 1/x weighting was used to relate LC–MS/MS analyte to IS peak area response ratio to the concentration of 8:2 FTOH. The concentration of 8:2 FTOH in samples was calculated using the response ratio, the regression equation, initial sample volume, and dilution when applicable. The concentration in plasma was expressed as ng/mL and in tissues as ng/g. All concentrations above the limit of quantitation (LOQ) were reported. Data from study samples were considered valid if: the matrix calibration curve was linear ($r \geq 0.99$), at least 75% of matrix standards were within 15% of nominal (20% at the LOQ), and at least 67% of the QC samples were within 15% of nominal values.

2.5. TK analysis

WinNonlin (Version 5.0.1, Pharsight Corporation, Mountain View, CA) was used for TK modeling of data. Concentrations below the LOQ were not used in the analysis. For 8:2-FTOH plasma data, individual animal concentration time data were used to find a best-fit model. One- and/or two-compartment models were tested based on the appearance of the plasma concentration time curve. The model and weighting factor that resulted in the best goodness-of-fit were used to calculate primary and secondary TK parameters based on conventional mathematical equations [40]. A two-compartmental model was used to calculate TK parameters following IV and gavage administration using the equation:

$$C_{(t)} = Ae^{-\alpha t} + Be^{-\beta t}$$

For 8:2-FTOH metabolites PFOA and 7:3-FTA, the plasma concentration-time profiles were assessed using noncompartmental analysis. Bioavailability was calculated using the area under the curve (AUC) with the equation:

$$F\% = [AUC_{\infty(gavage)})/(Dose_{(gavage)}]/\ [AUC_{\infty(IV))}/(Dose_{(IV)}] \ *100$$

To facilitate comparisons, plasma and tissue concentrations and systemic exposure parameters were converted to a molar basis using the molecular weight of 8:2-FTOH (464 g/mol), PFOA (414 g/mol), and 7:3-FTA (442 g/mol).

3. Results

Data from this study are available at https://doi.org/10.22427/NTP-DATA-002-02182-0003-0000-8. There were no animals found dead or moribund due to toxicity and no treatment-related clinical signs observed following IV or gavage administration at any dosage level for 8:2-FTOH.

3.1. Plasma 8:2-FTOH Toxicokinetics

Plasma concentrations of 8:2-FTOH were below the LOQ by day 8. The plasma concentration-time profiles for IV administration were best described by a two-compartment model with first order elimination. For gavage administration, a two-compartment model with first order input and first order elimination was used. Plasma concentrations over time are shown in Fig. 2. Since males and females were given different doses of 8:2-FTOH, dose-adjusted plasma concentrations over time are shown in Figure S1.

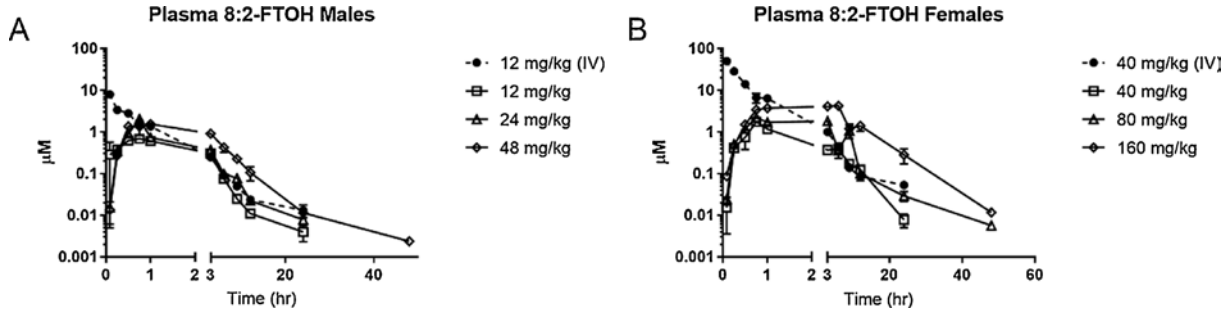


Fig. 2. Plasma concentrations (μM; mean and SEM) of 8:2-FTOH in male (A) and female (B) Sprague Dawley rats (N = 3) after a single administration of 8:2-FTOH (one IV dose, three gavage doses).

Table 2
Summary of toxicokinetic parameters (mean ± SEM, N = 3) of 8:2 fluorotelomer in plasma after a single IV (italicized) or gavage dose (three dose levels) in male and female Hsd:Sprague Dawley SD Rats.

	Male				Female			
Dose (mg/kg)	*12 (IV)*	12	24	48	*40 (IV)*	40	80	160
C_{max} [a] (μM)	*6.51 ± 0.84*	0.754 ± 0.127	1.01 ± 0.20	1.49 ± 0.29	*37.9 ± 5.8*	1.25 ± 0.33	2.039 ± 0.438	4.40 ± 0.91
C_{max}/Dose (μM/mg/kg)	*0.542 ± 0.070*	0.063 ± 0.011	0.042 ± 0.009	0.031 ± 0.006	*0.950 ± 0.145*	0.031 ± 0.008	0.025 ± 0.005	0.027 ± 0.006
T_{max} [a] (hr)	–	0.545 ± 0.167	0.853 ± 0.226	1.37 ± 0.300	–	0.921 ± 0.303	2.40 ± 0.510	2.76 ± 0.410
α $T_{1/2}$ (hr)	*0.508 ± 0.060*	1.32 ± 0.38	0.702 ± 1.190	1.00 ± 2.58	*0.475 ± 0.055*	0.617 ± 4.150	2.08 ± 2.62	1.59 ± 16.90
β $T_{1/2}$ (hr)	*6.62 ± 0.95*	13.0 ± 11.3	5.16 ± 1.16	6.65 ± 1.20	*7.33 ± 1.38*	7.52 ± 2.50	9.48 ± 5.05	5.40 ± 0.76
Elimination $T_{1/2}$ (hrs)	*0.651 ± 0.069*	1.76 ± 0.46	1.17 ± 1.80	1.67 ± 3.99	*0.563 ± 0.062*	1.68 ± 10.60	2.33 ± 2.70	3.37 ± 28.70
AUC [a] (μM*hr)	*6.12 ± 0.45*	2.52 ± 0.39	3.58 ± 0.52	8.06 ± 1.14	*30.8 ± 2.8*	6.85 ± 0.99	14.8 ± 2.6	44.0 ± 5.2
AUC/ Dose (μM·hr/mg/kg)	*0.510 ± 0.037*	0.210 ± 0.032	0.149 ± 0.022	0.168 ± 0.024	*0.770 ± 0.070*	0.171 ± 0.025	0.185 ± 0.033	0.275 ± 0.032
CL (mL/hr/kg)	*4230 ± 310*	10,300 ± 1600	14,500 ± 2,100	12,800 ± 1,800	*2,800 ± 250*	12,600 ± 1,800	11,600 ± 2,000	7,860 ± 900
V_1 [b] (mL/kg)	*3970 ± 520*	26,000 ± 6800	24,500 ± 38,400	30,900 ± 75,800	*2,270 ± 340*	30,500 ± 193,000	39,200 ± 49,000	38,200 ± 327,000
V_2 [c] (mL/kg)	*7990 ± 1570*	41,500 ± 38,000	33,400 ± 21,200	37,000 ± 35,500	*4,270 ± 1110*	67,200 ± 126,000	12,800 ± 10,100	12,100 ± 190,000
F [b](%)	–	41	29	33	–	22	24	36

C_{max}/Dose = dose-adjusted C_{max}.
CL = clearance.
F = bioavailability.
AUC/Dose = dose-adjusted area under the curve.
[a] Predicted from two-compartment model with first order elimination for IV, two-compartment model with first order elimination and first order input for gavage.
[b] Volume of distribution to central compartments.
[c] Volume of distribution to peripheral compartments.

Kinetic and systemic exposure parameters are reported in Table 2. Male rats administered an IV dose (12 mg/kg) had a C_{max} of 6.5 μM (Table 2). The α and β half-lives were 0.5 and 6.6 h, respectively. The plasma elimination half-life was around a half hour (0.65 h). AUC was 6.12 μM*hr and clearance was 4230 mL/hr/kg. Female rats administered 40 mg/kg had similar alpha, beta, and elimination half-lives compared to males (0.48, 7.33, and 0.56 h respectively). Dose-adjusted C_{max}, dose-adjusted AUC, and clearance were also similar to that in males.

With gavage administration, the T_{max} in males ranged from 0.55 to 1.37 h and increased with increasing doses. The elimination half-life was 1.17 to 1.76 h (Table 2). The volume of distribution greatly exceeded the estimated aqueous volume of total body water for rats (668 mL/kg) at all doses suggesting distribution of 8:2-FTOH into tissues. There were no major differences in the dose-adjusted C_{max}, dose-adjusted AUC, and clearance with increasing dose. In females, the T_{max}, elimination half-life, dose-adjusted C_{max}, and clearance were similar to that in males. Unlike males, the dose-adjusted AUC increased with dose and clearance dropped by almost half in females with the highest dose, 160 mg/kg. The bioavailability of 8:2-FTOH ranged from 29 to 41% in males and 22 to 36% in females. There was a slight increase in bioavailability with increasing dose only in female rats.

3.2. Plasma 8:2-FTOH metabolite toxicokinetics

The plasma concentration-time profiles of PFOA and 7:3-FTA for male and female rats administered IV and gavage doses of 8:2-FTOH (Fig. 3, dose-adjusted in Figure S1) were assessed using noncompartmental analysis. When 8:2-FTOH was administered by gavage, PFOA was not detectable in plasma at the first timepoint (0.083 h) in either sex or at the last time point (192 h) in females. 7:3-FTA was not detectable in plasma at the first timepoint (0.083 h) in any males or females in the 12 mg/kg dose group.

Toxicokinetic and systemic exposure parameters for PFOA and 7:3-FTA in plasma are reported in Table 3. Because there were few differences in metabolite parameters due to route of administration, only data for gavage administration will be discussed. In males, the T_{max} of PFOA after gavage administration of 8:2-FTOH was observed at 24 h for most dose groups. The elimination half-life of PFOA ranged from 198 to 353 h. The AUC increased in a dose-dependent manner. In females, the T_{max} was earlier than in males, occurring between 3 to 6 h. After adjustment for dose, there was no apparent difference in PFOA C_{max} between sexes. However, the dose-adjusted AUC_{∞} was 36- to 48-fold lower in females compared to males, which corresponded to a faster elimination half-life (6.4–12.0 h) in females. For 7:3-FTA, the T_{max} in males occured between 3–6 h and the elimination half-life ranged from 52.5 to 105 h. The AUC increased in a dose-proportional manner. There

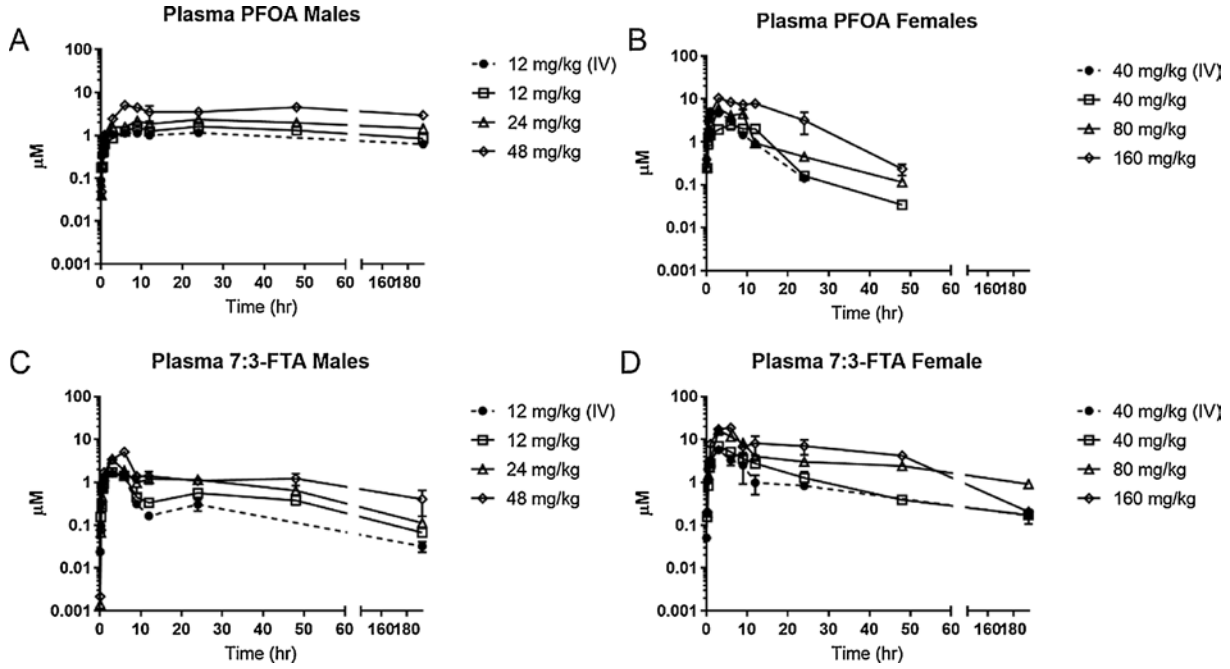


Fig. 3. Plasma concentrations (µM; mean and SEM) of 8:2-FTOH metabolites, PFOA (A, B) and 7:3-FTA (C, D), in male and female Sprague Dawley rats (N = 3) after a single administration (one IV dose, three gavage doses) of 8:2-FTOH.

were no sex differences in toxicokinetic parameters for 7:3-FTA.

3.3. Tissue concentrations of 8:2-FTOH, PFOA, and 7:3-FTA

Concentrations of 8:2-FTOH, PFOA, and 7:3-FTA were measured over a period of 12 h in tissues from male and female rats following gavage administration of 24 mg/kg and 80 mg/kg, respectively. In both sexes, concentrations of 8:2-FTOH were highest in the liver, followed by brain and kidney (Fig. 4A, B). PFOA was detected in the liver and kidney but not in the brain (except one female brain measurement at the 6 -h timepoint). At 12 h, concentrations of PFOA were similar in both sexes but appeared to plateau in males yet decrease in females starting at 3 h (Fig. 4C, D). 7:3-FTA concentrations in both sexes were highest in the liver, followed by kidney then brain. By the 12 -h timepoint, tissue concentrations of 7:3-FTA plateaued or were decreasing slightly in both males and females (Fig. 4E, F). Females had slightly higher concentrations of 7:3-FTA in all tissues.

To evaluate the amount of accumulation of these chemicals into tissues, tissue:plasma ratios were calculated, since concentrations in whole blood were not measured in this study. In male rats, tissue:-plasma ratios of 8:2-FTOH exceeded one at all timepoints, showing distribution of the fluorotelomer into all measured tissues (Fig. 5A, B). Liver:plasma ratios were the highest compared to the kidney:plasma and brain:plasma ratios for all three analytes. In males, the tissue:-plasma ratios in liver, kidney, and brain increased by 3- to 4-fold over the time period measured. Brain:plasma ratios of 8:2 FTOH were generally higher than kidney:plasma ratios. In females, the liver:plasma ratios of 8:2-FTOH were slightly lower than ratios in males, but still exceeded 1. Female kidney:plasma and brain:plasma ratios of 8:2 FTOH were similar to ratios in corresponding male tissues. However,

Table 3
Summary of toxicokinetic properties of 8:2 fluorotelomer (8:2-FTOH) metabolites, perfluorinated octanoic acid (PFOA) and 7:3 fluorotelomer acid (7:3-FTA), in plasma after a single IV or gavage dose (three dose levels) of 8:2-FTOH in male and female Hsd:Sprague Dawley SD Rats[a,b].

	Dose of 8:2-FTOH (mg/kg)	C_{max}[c] (µM)	C_{max}/Dose (µM/mg/kg)	T_{max}[c] (hr)	Elimination $T_{1/2}$ (hr)	AUC (µM·hr)	AUC / Dose (µM·hr/mg/kg)
PFOA (M)	12 (IV)	1.29	0.108	24	225	425	35.4
	12 (Gavage)	1.79	0.149	24	198	515	42.9
	24 (Gavage)	2.61	0.109	24	269	1010	42.1
	48 (Gavage)	5.65	0.118	6	353	2490	51.8
PFOA (F)	40 (IV)	5.77	0.144	1	4.47	47.6	1.18
	40 (Gavage)	2.85	0.071	6	6.35	44.2	1.11
	80 (Gavage)	6.69	0.084	3	12.0	69.8	0.872
	160 (Gavage)	11.8	0.074	3	6.97	226	1.41
7:3-FTA (M)	12 (IV)	1.69	0.141	3	60.6	46.8	3.90
	12 (Gavage)	1.80	0.150	3	56.1	69.0	5.75
	24 (Gavage)	3.64	0.152	3	52.5	124	5.18
	48 (Gavage)	5.36	0.112	6	105	267	5.56
7:3-FTA (F)	40 (IV)	5.95	0.149	3	71.2	158	3.93
	40 (Gavage)	7.35	0.184	3	40.0	150	3.74
	80 (Gavage)	17.6	0.220	3	99.0	615	7.69
	160 (Gavage)	19.4	0.121	6	33.0	722	4.51

[a] Predicted from non-compartmental analysis (NCA).
[b] NCA does not calculate error.

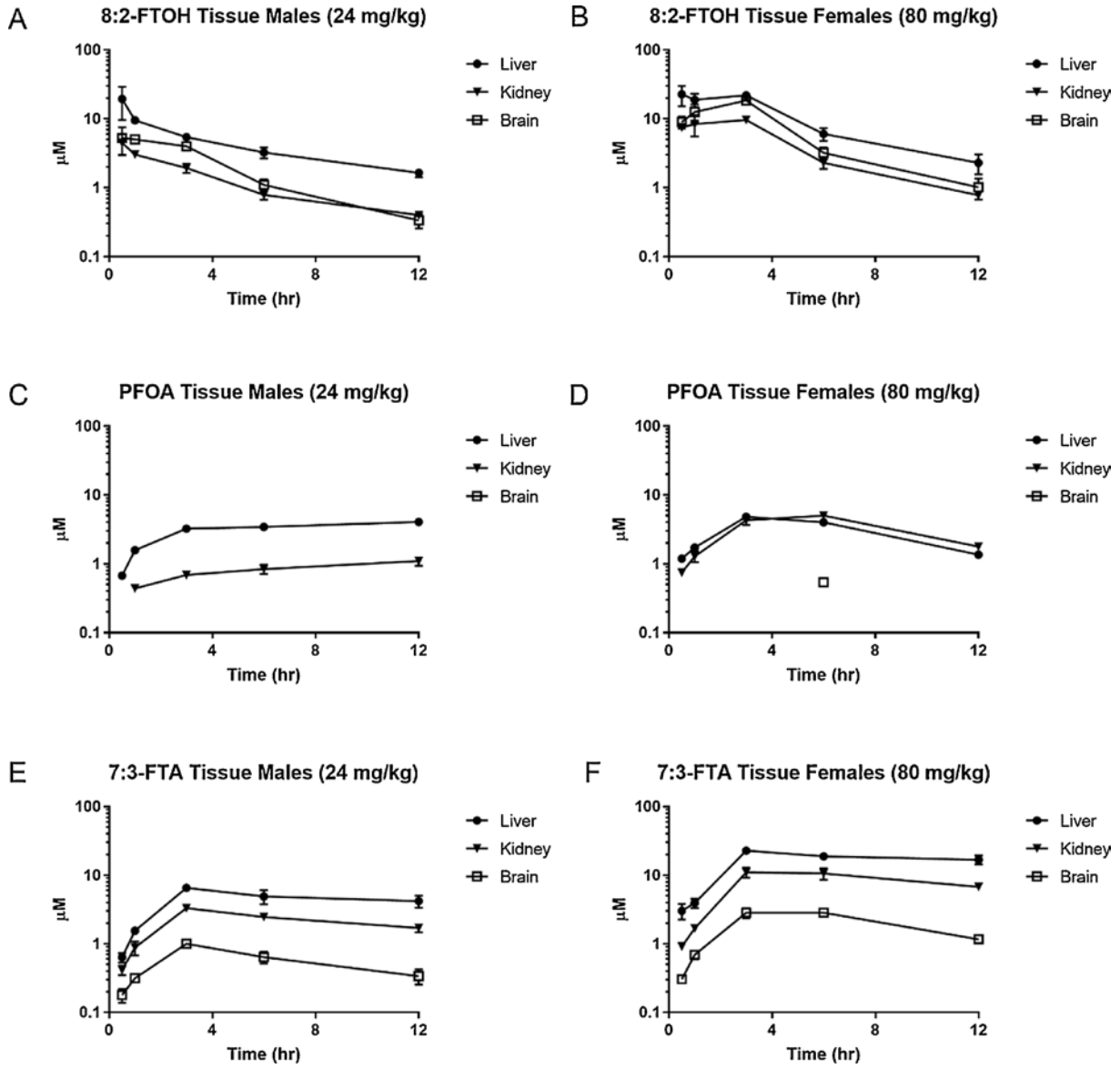


Fig. 4. Tissue concentrations (µM; mean and SEM) of 8:2-FTOH (A,B) and its metabolites PFOA (C,D) and 7:3-FTA (E, F) in liver, kidney, and brain of male and female Sprague Dawley rats (N = 3) administered via gavage 24 mg/kg and 80 mg/kg 8:2-FTOH, respectively.

tissue:plasma ratios in females had a smaller increase over time than those in males.

For PFOA, the tissue:plasma ratios in males were > 1.0 in the liver but < 1.0 in the kidney (Fig. 5C, D) and stayed consistent over time. Liver:plasma ratios of PFOA in females were lower than ratios in males. Unlike males, the kidney:plasma and liver:plasma ratios tended to increase over time in females, suggesting elimination from the plasma. For 7:3-FTA, the liver:plasma ratio in male rats increased 2.5-fold over time while the 7:3 FTA kidney:plasma ratios increased by 1.6-fold (Fig. 5E, F). Brain:plasma ratios of 7:3-FTA were consistent over time and were lower than kidney:plasma 7:3-FTA ratios. Tissue:plasma ratios of 7:3-FTA in females followed similar trends to those observed in males.

4. Discussion

A shift towards telomerization in the production method of PFAS has increased the production of FTOHs. Since metabolism of FTOHs produces PFCAs [13], understanding the toxicokinetics of FTOHs and their metabolites is essential for understanding animal toxicity data and its relevance to humans. In the current investigation, we report the toxicokinetic parameters of 8:2-FTOH and its metabolites, PFOA and 7:3-FTA, after a single administration (IV or gavage) of 8:2-FTOH in male and female Sprague-Dawley rats. Due to the anticipated differences in PFOA toxicokinetics, females received higher doses of 8:2-FTOH than males.

After gavage administration, 8:2-FTOH was rapidly distributed to tissues, evidenced by a T_{max} of 0.5–3 h and high tissue:plasma ratios even at the earliest time point (0.5 h post-administration). The tissue:-plasma ratios increased over time. The high volume of distribution that greatly exceeded the total body water volume in rats also indicates distribution into the peripheral compartment. Determined concentrations of 8:2-FTOH in the kidney and brain were both about a quarter of the liver concentration, which was similar to the ratio seen by Fasano et al. [27]. Fasano and collaborators found that in Crl:CD SD rats 168 h post-administration of 125 mg/kg [3-^{14}C] 8:2-FTOH, the liver had one of the highest amounts of radioactivity (9–17 µg/g), the kidney contained ˜5 µg/g, and the brain ˜0.3 µg/g [27]. Out of these tissues, only the liver had significant sex differences in tissue concentration [27]. We found higher concentrations of 8:2-FTOH in the brain, but this

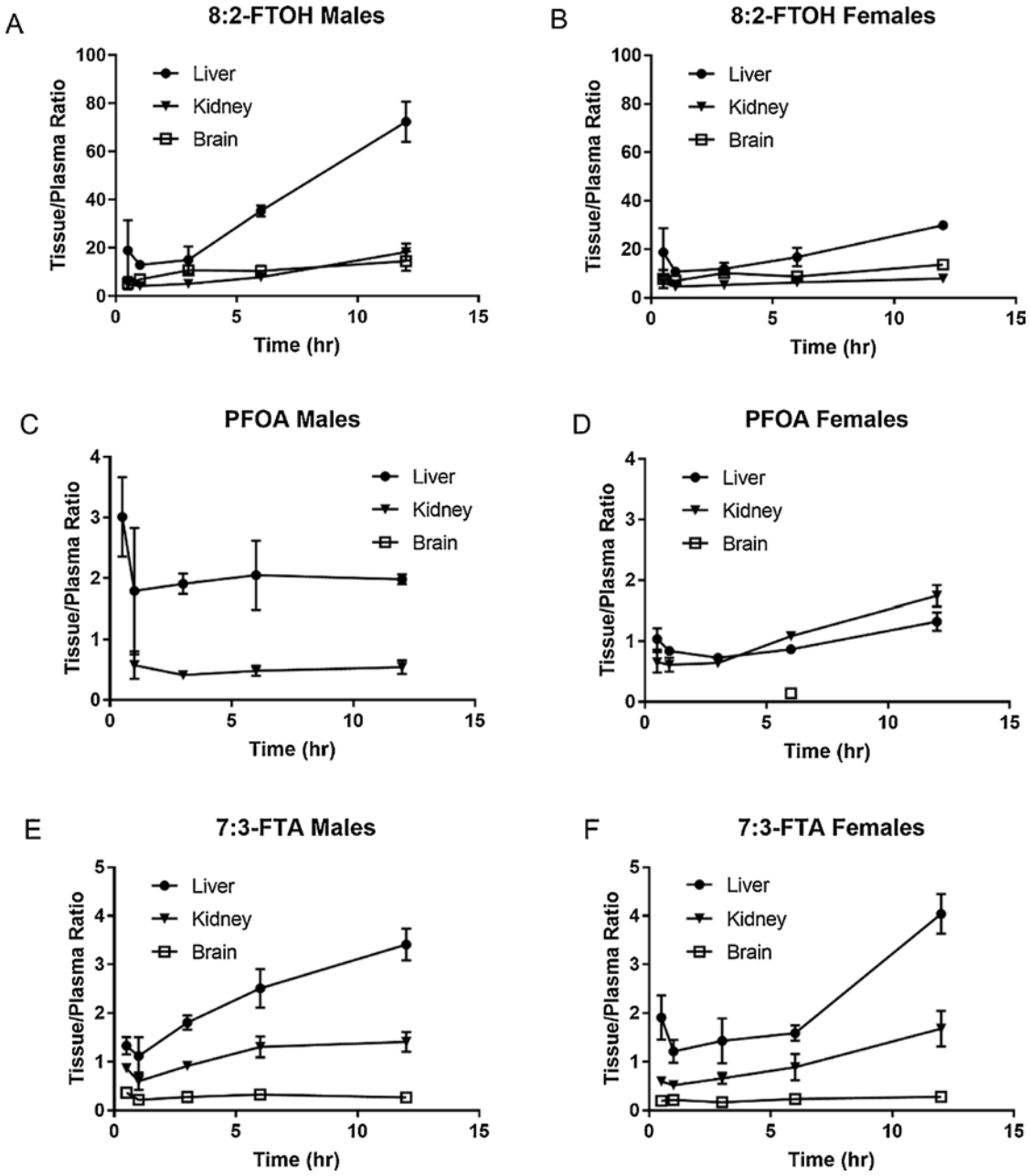


Fig. 5. Tissue:plasma ratios over time of 8:2-FTOH, PFOA, and 7:3-FTA in liver, kidney, and brain of male and female Sprague Dawley rats (N = 3) administered via gavage 24 mg/kg and 80 mg/kg 8:2-FTOH, respectively.

discrepancy may be due to time of tissue collection and the fact that Fasano et al. measured total radioactivity and not FTOH specifically.

In our study, females and males had similar tissue concentrations and tissue:plasma ratios of 8:2-FTOH. Since whole blood concentrations of the chemicals were not measured, tissue:plasma ratios were used to compare tissue accumulation. The plasma:blood partitioning for FTOH has not been determined, though it has been shown that FTOHs bind to serum proteins during its metabolism [41]. In humans, PFOA and other anionic PFAS show preferential binding in plasma with plasma:blood ratios of around 2 [42,43]. Thus, using the assumption that FTOH, PFOA, and 7:3-FTA have plasma:blood ratios of ˜2:1 in both male and female rats, tissue:plasma ratios reported in this study would underestimate tissue:blood ratios. However, comparisons across chemicals and sexes can still be made. Concentrations of 8:2-FTOH in tissues slowly decreased over time (Fig. 4), suggesting that there was minimal accumulation of the compound in tissues and that the rise in tissue:plasma ratios observed was likely due to elimination from plasma.

The plasma elimination half-life of 8:2-FTOH ranged from 1 to 4 h in both sexes which is similar to what was found in Fasano et al. [27]. In Fasano et al. [27], plasma elimination half-life ranged from 1 to 5 h, depending on the dose, and was not significantly different between males and females. Although there were few differences between sexes in our single administration study, prolonged exposure may elicit sex differences, as was observed in a 45-day exposure study in Crl:CD SD rats which showed there were greater sex differences in plasma and tissue 8:2-FTOH concentrations on Day 45 than on Day 1 of dosing [15].

Metabolism of 8:2-FTOH has been shown to occur in humans, rodents, and trout [15,17,44]. In rats, 8:2-FTOH is metabolized in the liver to produce glucuronidated and sulfonated 8:2-FTOH compounds as well as oxidized fluorotelomer acids that are metabolized to terminal

perfluorinated acids (summarized in [15]). PFOA and 7:3-FTA are stable metabolites found in rats and humans after exposure to 8:2-FTOH [15,17,44]. Here, we substantiate these reports, showing increases in tissue and plasma concentrations of PFOA and 7:3-FTA after administration of 8:2-FTOH in rats. At the doses administered in this study, we did not observe evidence of metabolic saturation in males because dose-adjusted AUC and C_{max} of 8:2-FTOH and its metabolites were similar across the gavage doses. However, in females, which were administered a higher dose, there may have been metabolic saturation at the highest dose of 160 mg/kg as the dose-adjusted AUC of 8:2-FTOH was higher compared to the lower dose females and all male groups. The 22–41% bioavailability across the doses in males and females is likely due, in part, to metabolism of 8:2-FTOH.

PFOA was detected in the liver and kidney but not in the brain, consistent with previous studies [45,46]. Tissue:plasma ratios of 7:3-FTA in the liver and kidney were similar to those of PFOA in the same organs except in the brain where it was present in both males and females. Concentrations of 7:3-FTA in the brain remained constant during the measured time. Females had slightly higher concentrations of 7:3-FTA in tissues than males, which was also observed in Fasano et al. [15].

The plasma C_{max} of PFOA and 7:3-FTA were 2- to 8-fold higher than the parent chemical 8:2 FTOH and reached T_{max} much later than 8:2-FTOH. Females had a substantially shorter elimination half-life of PFOA than males, which has also been previously reported [27,46–48], resulting in lower C_{max} and AUC after normalizing for dose (Table 3). The sex difference in PFOA half-life has been attributed to differences in renal resorption due to differences in expression of organic ion transporters [48,49]. The half-life of 7:3-FTA has not been reported in gavage studies of 8:2-FTOH [15,27] but in an inhalation exposure study, the half-life was 4–7 hours for both males and females [36]. This half-life is much shorter than our findings of ˜2–3 days, implying differences in kinetics depending on the route of FTOH exposure. In our study, there were no major differences in internal exposure (dose-adjusted C_{max} or AUC) or kinetic parameters of 7:3-FTA between males and females.

In females, the AUCs of 7:3-FTA are ˜3-fold higher than that of PFOA but this trend is reversed in males whereas the AUCs of 7:3-FTA are 7 to 9-fold lower than AUCs of PFOA (Table 3). Furthermore, in females, dose-adjusted AUC of 7:3-FTA were higher than that of PFOA while the opposite was true in males (Table 3), indicating that following exposure to 8:2-FTOH, the persistent metabolite in females is 7:3-FTA while in males it is PFOA. Findings from other studies also show this trend, where females generally had higher concentrations of upstream metabolites (8:2-FTOH, 8:2-fluorotelomer acid, 7:3-FTA, and unsaturated 7:3-FTA) while males had more downstream metabolites (PFOA, perfluorononanoic acid, perfluoroheptanoic acid) [15,36]. Since some studies have found precursor FTAs to be more toxic than PFCAs [50–52], higher concentrations of FTAs in female rodents may be of concern. These different metabolite profiles in males and females are likely primarily due to the major sex difference in the half-life of PFOA. Additionally, in our study, females were administered higher doses of 8:2-FTOH than males, potentially altering metabolism kinetics which could explain these sex differences in metabolite concentrations.

There are few data on the concentrations or kinetics of FTOHs and their metabolites in humans. At the time of writing, there are no kinetic studies in humans that can be compared to the parameters presented in this study. However, it is possible to compare concentrations of FTOH metabolites. In a study of 11 male ski wax technicians with high inhalation exposure to 8:2-FTOH, 1.9 to 630 ng/mL of PFOA and 0.05 to 3.9 ng/mL 7:3-FTA were found in their blood; concentrations of 8:2-FTOH were not measured [17]. In the present study, the lowest oral dose of 8:2-FTOH in males (12 mg/kg) produced a plasma PFOA C_{max} of 1.98 μM (743 ng/mL) and plasma 7:3-FTA C_{max} of 1.79 μM (795 ng/mL). Though it is difficult to determine if concentrations of these metabolites in humans is from direct exposure or due to metabolism of 8:2-FTOH, it is conceivable that occupationally-exposed individuals may experience internal doses of the metabolites, particularly PFOA, similar to the animals in this study. For the general population, the contribution of 8:2-FTOH exposure to PFOA levels is estimated to be minimal [16,18,44]. However, the combined effects of low concentrations of 8:2-FTOH metabolites and other PFAS remain to be elucidated.

Overall, our study corroborates previously published kinetic studies of 8:2-FTOH and its metabolite profile. This study confirmed that 8:2-FTOH has a rapid plasma elimination half-life and is readily absorbed into tissues. Sex differences in kinetics and tissue distribution of 8:2-FTOH were not observed. PFOA and 7:3-FTA were stable metabolites detected in plasma and tissues of both male and female rats after exposure to 8:2-FTOH. At these doses, there was little evidence of 8:2 FTOH metabolic saturation. Consistent with previous studies, there were sex differences in elimination and distribution of PFOA but not of 7:3-FTA.

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April 10, 2025

Re: **Coffin Butte CUP, LU-24-027 with respect to PFAS in Landfill Gas Emissions**

Dear Benton County Planning Commission,

I have family residing in Benton County, and have lived and worked in the Corvallis area. However, the experiences I wish to relate to you are those of having a landfill sited next to our family home near Boise, Idaho in 1972, and after it expanded in the 1990s into a major regional landfill.

The original cell did not use an impermeable liner, because, although it was widely understood at that time that unlined landfills were likely to contaminate groundwater, it was not until several years later that the federal Resource Conservation and Recovery Act (RCRA) of 1976 required the practice.

After that original cell received waste for twenty years, at least one neighbor's drinking water well was contaminated. Around that time the county decided it needed to either prepare to close the landfill, as it was approaching its expected life, or expand it. The latter was chosen, with plans to operate the landfill for another century.

However, the original cell still accepted most of the county's waste for another two decades, growing so large that the 'Hidden Hollow Cell' became the largest ridge in the area, blotting out our view of the Boise Mountains. By the time the cell closed several years ago, it had accepted more than a half century of waste perched, unlined, above our neighborhood aquifer – compounding a long term liability that would have been mitigated had common sense prevailed in 1972 rather than obeisance to outdated regulations.

I call attention to my neighborhood's experience because a similar situation has developed with respect to chemicals collectively known as per-and-polyfluoroalkyl substances (PFAS), or informally as 'forever chemicals,' due to the highly stable nature of the many carbon fluorine bonds that characterize this large group of chemicals – chemicals that we are increasingly finding toxic at minute exposure levels.[1]

Industrial, medical, and consumer wastes that generally end up either in sewage treatment plants or landfills, often contain 'forever chemicals,' so that in many communities, these represent the major local repository of PFAS. Until recently, the primary risk of PFAS release from municipal solid waste landfills has been thought to be in the liquid leachate or 'garbage tea' that accumulates as water percolates through the landfill layers. Leachate now requires careful handling in part due to the PFAS risk – it is not uncommon for this to be shipped at considerable cost to hazardous waste facilities when onsite collection ponds fill.

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[1] Human Health Toxicity Assessment for Perfluorooctanoic Acid (PFOA) and Related Salts. EPA.gov 2024. From https://www.epa.gov/sdwa/human-health-toxicity-assessment-perfluorooctanoic-acid-pfoa

Less attention has been given to the PFAS released in air emissions, either as uncontrolled 'fugitive' gases or upon being burned in flares or even upon combustion to drive electricity generation, as it is unlikely that the conditions in flares and engines are adequate to fully mineralize PFAS and prevent its escape into the local airshed.[2] Neighbors of landfills could tell the Commission much about the occurrence of odors from the fugitive gases, and although officials generally downplay the smell as a mere nuisance, these odors likely contain volatile PFAS as well.

Until a year ago, the general consensus was that the landfill gas emissions contained about a third as much PFAS as was found in the leachate.[3] However, recent research that specifically measured the neutral, more volatile PFAS known as fluorotelomers found 'stunning' concentrations in three municipal solid waste landfills.[4] The findings made headlines in the American Chemical Society,[5] and science[6] and industry newsletters.[7,8]

The most prevalent type of fluorotelomer found in landfill gas is especially troubling due to its relationship to one of the two types of PFAS that are now federally classified as hazardous substances in drinking water. The 8:2 fluorotelomer has eight fully fluorinated carbons, and two that are not – so that these latter two are not protected by the shell of fluorine, and are readily lost either by metabolism upon inhalation of the fluorotelomer, or through environmental degradation. The result is often the highly stable and highly toxic eight carbon type of PFAS

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[2] "Interim Guidance on the Destruction and Disposal of Perfluoroalkyl and Polyfluoroalkyl Substances and Materials Containing Perfluoroalkyl and Polyfluoroalkyl Substances— Version 2" EPA.gov. 2024. From https://www.epa.gov/system/files/documents/2024-04/2024-interim-guidance-on-pfas-destruction-and-disposal.pdf

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[8] Four Landfill Studies to Follow this Summer. Waste Dive 2924. From https://www.wastedive.com/news/landfill-roundup-july-pfas-coffin-butte-oregon-brookhaven-new-york-landfill-scs-volusia-florida/723786/

known as PFOA[9] which accumulates in human blood upon repeated exposure due to its half life of longer than one year.[10,11]

PFOA, is one of the two PFAS mentioned above now classified as hazardous. It was voluntarily phased out of production by industry more than a decade ago due to its known toxicity – the current federal standards in drinking water are 4 parts per trillion (4 ng/L). The precursor chemical, 8:2 FTOH, in one of the three landfills in this recent study, had a calculated concentration of 740,000 parts per trillion escaping in landfill gas (740,000 ng/cubic meter).

Common sense would suggest that landfills should also treat the gaseous component of PFAS, and prevent the contamination of local air, soils, and eventually, waterways. However, no such regulations enforce this common sense protection on the federal level, and Oregon's recent proposed expansion of its hazardous substance list to include PFAS will not extend to airborne emissions.[12]

Like the unlined cell near my family home, a landfill that expands today in Benton County may contribute another half century of toxic contamination and liability, even though today we too should know better. No major landfill, especially one near residential homes, organic farming, critical waterways, and a wildlife refuge should be allowed to expand without fully addressing this major pathway of PFAS contamination. If this common sense action is not taken before expansion, the problem may never be addressed.

Please deny the requested Conditional Use Permit.

Sincerely,

Richard Llewellyn
PhD Biochemistry

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Boise, Idaho 83714
(208) 419-7527

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[9] Huang MC, et al. Toxicokinetics of 8:2 fluorotelomer alcohol (8:2-FTOH) in male and female Hsd:Sprague Dawley SD rats after intravenous and gavage administration. Toxicol Rep. 2019 Aug 20;6:924-932

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[12] State updates hazardous substances list to include harmful forever chemicals, begins rulemaking. Alex Baumhardt, Oregon Capital Chronicle. April 2, 2025. https://oregoncapitalchronicle.com/2025/04/02/state-updates-hazardous-substances-list-to-include-harmful-forever-chemicals-begins-rulemaking/

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A critical review of perfluoroalkyl and polyfluoroalkyl substances (PFAS) landfill disposal in the United States

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Abstract

Landfills manage materials containing per- and polyfluoroalkyl substances (PFAS) from municipal solid waste (MSW) and other waste streams. This manuscript summarizes state and federal initiatives and critically reviews peer-reviewed literature to define best practices for managing these wastes and identify data gaps to guide future research. The objective is to inform stakeholders about waste-derived PFAS disposed of in landfills, PFAS emissions, and the potential for related environmental impacts. Furthermore, this document highlights data gaps and uncertainties concerning the fate of PFAS during landfill disposal. Most studies on this topic measured PFAS in liquid landfill effluent (leachate); comparatively fewer have attempted to estimate PFAS loading in landfills or other effluent streams such as landfill gas (LFG). In all media, the reported total PFAS heavily depends on waste types and the number of PFAS included in the analytical method. Early studies which only measured a small number of PFAS, predominantly perfluoroalkyl acids (PFAAs), likely report a significant underestimation of total PFAS. Major findings include relationships between PFAS effluent and landfill conditions – biodegradable waste increases PFAS transformation and leaching. Based on the results of multiple

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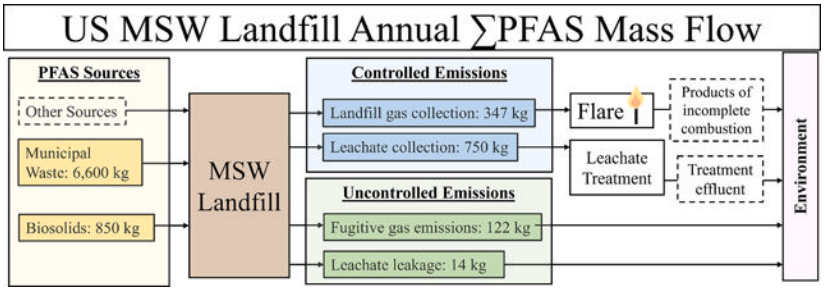
Declaration of competing interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement
Thabet Tolaymat: conceptualization, approach, methodology, writing-reviewing, editing, funding, **Nicole Robey**: data curation, methodology, calculations, writing-original draft, writing and editing. **Max Krause**: writing and editing, **Judd Larson, Keith Weitz, Sameer Parvathikar**: data curation, original draft preparation, editing, **Lara Phelps, William Linak, Susan Burden, Tom Speth, Jonathan Krug:** writing and editing

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.scitotenv.2023.167185.

studies, it is estimated that 84% of PFAS loading to MSW landfills (7.2 T total) remains in the waste mass, while 5% leaves via LFG and 11% via leachate on an annual basis. The environmental impact of landfill-derived PFAS has been well-documented. Additional research is needed on PFAS in landfilled construction and demolition debris, hazardous, and industrial waste in the US.

Graphical Abstract



Keywords

PFAS; Solid waste; Biogas; Leachate; Treatment; Transformation

1. Introduction

Per- and polyfluoroalkyl substances (PFAS) include thousands of unique manufactured chemical compounds with a hydrophobic carbon-fluorine chain and a functional group that may be hydrophilic or hydrophobic. PFAS provides beneficial properties for many consumer products and industrial applications, mostly stick- and stain-resistance and surfactant qualities. PFAS's usefulness has led to a nearly ubiquitous presence in our lives, and PFAS's stability, due to the strength of carbon-fluorine bonds, result in long half-lives and the nickname "forever chemicals."

Human exposure to PFAS has been linked to detrimental health effects which impact all systems, including reproductive effects such as decreased fertility or increased high blood pressure in pregnant women, developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, behavioral changes, increased risk of some cancers, including prostate, kidney, and testicular cancers, reduced ability of the body's immune system to fight infections, including reduced vaccine response; interference with the body's natural hormones and increased cholesterol levels and risk of obesity (reviewed by Fenton et al., 2021). In response to the growing body of evidence identifying PFAS as a significant threat to human health and the environment, the United States Environmental Protection Agency (US EPA) is undertaking research to determine the impact of PFAS via a risk paradigm approach: (1) determine toxicity, (2) understand exposure, (3) assess risk, and (4) find and innovate effective treatment and remediation techniques and strategies. Because PFAS-containing products are disposed of at the end of their useful lives, significant PFAS quantities are managed with solid waste in the US and elsewhere. Properly managing solid waste via containment, treatment, and destruction is essential to protecting our environment and reducing the risk of harmful exposures.

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Recognizing the impact of PFAS on human health and the environment, the US EPA released its first provisional Health Advisory Levels (HALs) for PFAS in drinking water in 2009. As analytical capabilities and scientific understanding of PFAS health impacts have improved, the Agency has promulgated additional guidance and risk-based thresholds. For the first time, in 2023, the US EPA proposed enforceable drinking water regulatory limits to reduce human exposure to PFAS (US EPA, 2022d). In April of 2021, the US EPA released the PFAS Strategic Roadmap, which outlines the EPA's commitments to action for 2021 through 2024. Information about US EPA PFAS initiatives is summarized in Table S1 of the Supplementary information (SI), and applicable limits are included in Table 1. The US EPA has also proposed designating PFOA and PFOS as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and is considering adding certain PFAS to the Resource Conservation and Recovery Act (RCRA) list of hazardous constituents (US EPA, 2022b).

At the State level, all the US states except Arkansas, Louisiana, Mississippi, Nebraska, Texas, and Wyoming have dedicated websites providing PFAS-specific information. Some states have banned PFAS-containing products, as summarized in Table S2 (SI). In contrast, others have initiated their own regulatory limits and advisory guidelines, as presented in Table S3 (SI). Eight states have undertaken specific actions and introduced or passed bills targeting PFAS in solid waste (see Table S4, SI). Notably, PFAS regulations are rapidly evolving, and any documentation of state-level PFAS initiatives will likely be outdated quickly.

Confronted with significant quantities of PFAS managed in landfills, the solid waste community struggles to understand the best means to manage PFAS-containing waste streams. Many studies have evaluated PFAS in landfills. However, there is a need for a critical review of the literature that would define the best methodologies for managing these wastes and identify data gaps to guide future research. This manuscript aims to inform the public and stakeholders from the solid waste industry about PFAS entering the waste stream and being disposed of in landfills, potential landfill PFAS emissions, and the related environmental impacts. Furthermore, this document highlights data gaps and uncertainties concerning the fate of PFAS during landfill disposal. Data were compiled and summarized, as described in the Methods section of the SI (Section S2 and Table S5), to provide a concise critical review of this evolving research topic.

2. Solid waste management in the United States

A detailed discussion of solid waste management in the US is included in the SI (Section S3). Residents, businesses, and industries in the United States (US) generate significant amounts of solid waste; overall municipal solid waste (MSW) generation in 2018 was 265 million metric tons (US EPA, 2020b). In addition to MSW, significant amounts of construction and demolition (C&D) waste (545 million metric tons), wastewater treatment plant (WWTP) biosolids (2.5 million metric tons), and varied amounts of industrial waste and disaster debris enter the US solid waste management system every year (US EPA, 2020b). Over time, MSW generation in the US has increased. While the fraction of MSW which is landfilled has decreased from over 90% in 1960 to 50% in recent years, the mass

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of MSW disposed of in landfills reached its highest recorded level at 133 million metric tons in 2018 (see Fig. S1 in the SI). The US's landfill design, monitoring, and classification are identified and regulated according to the RCRA described in the SI's RCRA section. RCRA and its regulations provide requirements for landfill engineering controls based on the type of waste the landfill receives (MSW (Subtitle D), Hazardous (Subtitle C), industrial, construction, and demolition (C&D) debris) as outlined in the SI.

2.1. Sources of PFAS in solid waste

While extensive research has been undertaken to measure PFAS in effluent from waste management activities (particularly landfill leachate), fewer studies have attempted to estimate the PFAS load entering the waste management sector. Coffin et al. (2022) estimated an extractable ∑PFAS concentration in MSW of 50 μg kg^{-1} based on concentrations in MSW screenings reported by Liu et al. (2022a). Estimating PFAS loading to landfills is not only complicated by analytical challenges and the diversity of measurable PFAS, but also by the heterogeneity of MSW and other waste streams (e.g., household products, building materials, industrial waste, and "other wastes"). The following subsections focus on waste representing suspected high PFAS load or a significant fraction of the waste stream. Fig. 1 presents PFAS concentrations measured in various products and the environment compared to those measured in landfill leachate, compost, and biosolids from WWTPs.

2.1.1. Municipal solid waste—In the US, household waste is among the most significant fractions of MSW. Few studies measured the PFAS concentration of suspected PFAS-containing consumer products in the context of direct exposure during product use (Buck et al., 2011; Favreau et al., 2017; Glüge et al., 2020; Guo et al., 2009; Herzke et al., 2012; ITRC, 2022; Kotthoff et al., 2015; OECD, 2022; US FDA, 2022; Ye et al., 2015). These findings indicate a significant load of PFAS remaining in products at the end of their useful life. Household waste consists of two main categories: the biodegradable fraction and the non-biodegradable fraction. Both types of waste streams contain PFAS, but the fate of their PFAS may differ.

2.1.1.1. Biodegradable fraction.: Paper and paperboard are the most abundant components of MSW, representing 23% of the US MSW generation in 2018 (US EPA, 2021a). PFAS are often added to paper products to improve stick and stain resistance, which results in paper products (including food packaging) consistently reported as a significant source of PFAS for human exposure and in the waste stream (Curtzwiler et al., 2021; D'eon et al., 2009; Ramírez Carnero et al., 2021; Robel et al., 2017; Seltenrich, 2020; Yuan et al., 2016; Zabaleta et al., 2016). In a review of studies that measured PFAS in food-contact materials, Siao et al. (2022) reported concentrations of $\sum_{13}$PFAS in food packaging as high as 8500 μg kg^{-1}; at these concentrations, paper and paper products likely contribute significantly to the overall PFAS loading in MSW, as well as contamination of food and food waste. Sapozhnikova et al. (2023) used targeted and total oxidizable precursor (TOP) assays to measure PFAS migration from food packaging into food products among 88 packaged food samples. TOP analysis identified a significant portion of total PFAS in packaging came from unknown precursor PFAS; average $\sum_{8}$PFAA was 28 μg kg^{-1} before oxidation and 380 μg kg^{-1} after oxidation. Migration from the packaging into food was found to

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increase over the course of the ten-day study. Unfortunately, many new products marketed as environmentally-friendly alternatives to plastic products have been found to contain PFAS (Timshina et al., 2021), and advocacy groups in the US and beyond have moved to revise compostable labeling to preclude PFAS-containing products (BioCycle, 2020). Disubstituted polyfluoroalkyl phosphates (diPAPs) have been found to represent a significant fraction of the PFAS used in paper products. However, most studies do not include diPAP as an analyte (D'eon et al., 2009; Thompson et al., 2023a). These findings suggest the concentration of ∑PFAS in paper products may be significantly higher than current estimates.

Another large fraction of biodegradable household waste is food waste, accounting for 22% of the MSW generated in the US in 2018 (US EPA, 2021a, 2021b, 2021c). Unlike paper products, PFAS are not intentionally added to food; contact with PFAS-containing equipment, packaging, water, feed, or soil amendments may result in residual PFAS. Several studies have been published describing the potential migration of PFAS from PFAS-impregnated food packaging (Ramírez Carnero et al., 2021). Up to 33% of extractable PFAS on the surface of food contact materials have been reported to migrate to simulated foods – the migration efficiency depends on the food type and PFAS class (Yuan et al., 2016). Additionally, some PFAS are known to bioaccumulate in the food chain. A European Food Safety Authority (2012) report lists seafood and meat as the food categories most frequently reported containing measurable concentrations of PFAS, with PFOS and PFOA quantified most commonly in 29% and 9% of samples, respectively. The same study estimated mean overall dietary exposure for PFOS and PFOA ranging from 0.07 to 32 ng kg^{-1} body weight per day, with lower exposure rates for 14 additional PFAS. Exposure was highest among toddlers and children due to higher food consumption for body size. Among 25 samples of food waste analyzed for PFAS by Thakali et al. (2022), 17 contained PFAS (mean $\sum_{17}$PFAS = 0.38 μg kg^{-1}); PFOS and PFOA were not detected in any of the samples.

Wood and yard trimmings represent approximately 18% of the US MSW generation (US EPA, 2020b). While natural wood and plant matter are unlikely to contain significant concentrations of PFAS (Thompson et al., 2023b), engineered wood building materials may be coated with PFAS to enhance performance. In a study of PFAS content in consumer and building materials, 100% of oriented strand board and wood products analyzed contained measurable PFAS concentrations, with median and maximum Σ_{15}PFAA of 5 and 18 μg kg^{-1}, respectively (Bečanová et al., 2016).

2.1.1.2. Non-biodegradable fraction.: In the non-biodegradable category of household waste, carpets, and textiles have been consistently found to contain intentionally added PFAS that provide stick and stain resistance and waterproof properties (Kallee and Santen, 2012; Kim et al., 2015; Lang et al., 2016; Peaslee et al., 2020; van der Veen et al., 2022). A review of Σ_{15}PFAA in various household and consumer products found textiles, floor covering, and car interior materials represented the three highest maximum concentrations (78, 38, and 36 μg kg^{-1}, respectively); the highest non-biodegradable median PFAS concentration was from insulation (3.6 μg kg^{-1}) (Bečanová et al., 2016). PFAS and fluoropolymers are also used in non-stick cookware (Sajid and Ilyas, 2017) and electronics to provide smudge resistance, insulation, and other properties. An estimated 114 separate PFAS have been identified in electronic production (Garg et al., 2020). PFAS contamination

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and exposure through e-waste management have been the subject of several studies (Garg et al., 2020; Tansel, 2022; B. Zhang et al., 2020). Notably, the measurement of PFAS in e-waste itself (as opposed to through leachate, environmental contamination, or dust) is limited. A range of 0.07–0.43 μg kg^{-1} PFOS among all electronic products is provided by Garg et al. (2020). Σ_{15}PFAA reported by Bečanová et al. (2016) ranged as high as 11.7 μg kg^{-1} (median: 0.4 μg kg^{-1}) in electronic and electrical equipment (EEE) and as high as 2.2 μg kg^{-1} (median: 1.4 μg kg^{-1}) in waste EEE.

2.1.2. Industrial waste—Industrial processes generate waste and effluent in large volumes; processes that use PFAS, such as the leather tannery, chrome plating, and textile industries, represent a significant contribution of PFAS to the solid waste stream (ITRC, 2022) which are often disposed of in landfills. Other types of industrial processes which generate PFAS-containing waste involve the management of PFAS-contaminated materials, including the separation of wastewater biosolids as part of municipal wastewater treatment, the management of MSW incineration residuals (MSWI ash), and the disposal of PFAS-contaminated soils and other residuals generated as part of environmental cleanup processes.

2.1.2.1. Biosolids.: WWTPs manage residential, commercial, and industrial wastewater, including landfill leachate, and have been the subject of many PFAS studies (Lenka et al., 2022). Biosolids account for a significant fraction of WWTP effluent (Fredriksson et al., 2022) and impact PFAS loading to the environment and landfills (Johnson, 2022; Thompson et al., 2023b). Reported PFAS concentrations in biosolids vary with the number of PFAS included in the analytical method. et al. (2018) reported mean $\sum_9$PFAS of 45 μg kg^{-1} of biosolids; Thompson et al. (2023a, 2023b) reported mean $\sum_{92}$PFAS of 500 μg kg $(dry)^{-1}$ in untreated biosludge and 330 μg $kg(dry)^{-1}$ in biosolids (biosludge treated for pathogen removal), indicating that early studies of PFAS in biosolids which measured fewer PFAS, and predominantly PFAAs, did not capture a significant portion of the total PFAS. Over 5.8 million dry metric tons of biosolids were managed in the US in 2018, of which 30% was managed in landfills, 15% was incinerated, and over 50% was used as a soil amendment (NEBRA, 2022).

2.1.2.2. MSW incineration ash.: The incineration of MSW for energy recovery (MSWI) produces two solid waste streams – bottom ash, the material that does not burn, and fly ash, fine particulate matter collected in the air pollution control system. Approximately 13% of MSW in the US is managed through incineration (US EPA, 2021a, 2021b, 2021c), resulting in an estimated 7.5 million tons of MSWI ash (Liu et al., 2019). Few studies have measured PFAS in MSWI ash. Liu et al. (2021b) reported $\sum_{21}$PFAS in fly and bottom ash from three facilities in China, with concentrations ranging from 1.5 to 88 μg kg^{-1} in fly ash and from 3.1 to 77 μg kg^{-1} in bottom ash. Based on the concentrations of PFAS in a laboratory leaching study, the average minimum $\sum_{26}$PFAS in MSWI ash from a US facility was 1.5 μg kg^{-1} (Liu et al., 2022b); this represents a conservative estimate of total PFAS. These concentrations are in the same range as MSW. Incineration temperatures may not be sufficiently high to mineralize or destroy PFAS, and operational strategies likely play a significant role in the fate of PFAS during incineration. The impact of temperatures on PFAS

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leaching from MSWI is discussed in greater detail in the context of MSWI ash monofill leachates.

2.1.2.3. Manufacturing wastes.: There is extensive use of PFAS in some industries, as PFAS is added intentionally to products (i.e., to produce stain-resistant properties in textiles and paper products) and as part of the manufacturing process (i.e., to facilitate demolding). This results in unintentionally contaminated materials through contact. The Interstate Technology Review Committee (ITRC) thoroughly lists PFAS uses in the industrial and manufacturing sectors (ITRC, 2022). PFAS-laden manufacturing waste is often sent to landfills for disposal across industries.

Among specific industries and industrial wastes which have been the subject of PFAS analysis, high-concentration effluents from electronic industries have been described in the literature; photolithographic effluent in Taiwan contained 130,000 ng L^{-1} each of PFHxS and PFOS (Lin et al., 2009); liquid effluent from television and circuit board manufacturing contained 1600 ng L^{-1} of $\sum_{11}$PFAS (Kim et al., 2016); sludge effluent collected from an electronics industry location in South Korea contained 91 μg kg^{-1} of $\sum_{11}$PFAAs (Kim et al., 2016). PFAS are used commonly in paper processing and treatment; a case study in Norway identified PFAS impacts downstream of a landfill used for paper factory waste disposal (Langberg et al., 2021). Chrome plating industry waste sludges are designated hazardous wastes (F006), which contain high concentrations of PFAS (ITRC, 2022) and are therefore managed in Subtitle C hazardous waste landfills. A study of chrome sludge in China identified PFOS as the most predominant PFAS at concentrations as high as 2435 μg kg^{-1} (Qu et al., 2020). The chrome plating industry consumes an estimated 6500 kg of PFOS annually (Garg et al., 2020).

2.1.2.4. PFAS remediation residuals.: Sites with high levels of PFAS contamination from the historical use of PFAS-containing aqueous film-forming foams (AFFF) or other releases are frequently remediated, and the contaminated media is commonly disposed of in landfills (either with the waste or used as daily cover). Remediation approaches include mobilization of PFAS and collection of the leachate, sorption of PFAS using activated carbon or other sorbents, or soil excavation for landfill disposal (Bolan et al., 2021; Ross et al., 2018). Brusseau et al. (2020) reviewed PFAS concentrations measured in soils from contaminated sites, reporting median PFOA and PFOS concentrations of 83 and 8700 μg kg^{-1}, respectively, with concentrations as high as 50,000 μg kg^{-1} for PFOA and 460,000 μg kg^{-1} for PFOS.

3. Fate of PFAS in landfills

The fate of solid waste-derived PFAS within landfills is dominated by transformation and partitioning. Many PFAS species are persistent in the environment and PFAS that are degradable can transform into more recalcitrant, typically more environmentally mobile PFAS (Bolan et al., 2021). The partitioning behavior of PFAS are related to the chemical structure of individual species, both according to PFAS class, functional groups, and chain length among homologous species. In turn, the ongoing transformation will impact partitioning behavior (Robey et al., 2020; Zhang et al., 2020a, 2020b; Smallwood et al.,

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2023). In landfills, PFAS may partition to the liquid phase (leachate) and gaseous phase (landfill gas; LFG), remain sorbed to the waste, and/or interact with the engineering controls of the landfills (e.g., leachate collection systems, gas collection, and control systems). PFAS that are resistant to degradation and minimally soluble or volatile, such as certain polymeric PFAS, have historically been presumed to remain immobile and sequestered in landfills, although more recent studies have called this assumption into question (Lohmann et al., 2020).

3.1. PFAS transformation

Many studies observed the transformation of PFAS precursors into terminal species under abiotic and microbially active aerobic and anaerobic conditions. While this section briefly reviews these processes to provide context to PFAS in landfills, the aim is not to conduct an exhaustive review of the topic, which is available in other reviews (Lu et al., 2023).

3.1.1. Abiotic transformation—PFAS transformation pathways under abiotic conditions include oxidation, photolysis, and thermal degradation (ITRC, 2020; Washington and Jenkins, 2015). While the bulk of PFAS transformations in organic-rich landfills are likely a result of biodegradation, these abiotic processes play an essential role in solid waste management systems. PFAS such as fluorotelomer alcohols (FTOHs) can volatilize under temperatures typical in landfills (35–55 °C). Once in the atmosphere, FTOH can transform via photolysis or other chemical reactions into perfluorocarboxylic acids (PFCAs) which are then deposited on land and waterbodies (Esfahani et al., 2022; Martin et al., 2006). Other abiotic processes include thermal degradation. An increase in the temperature of waste may facilitate PFAS transformation. Wastes within landfills may be exposed to temperatures insufficient to mineralize or defluorinate PFAS but which may cause precursor transformations. Thompson et al. (2023a, 2023b) measured higher concentrations of diPAPs in biosolids that had undergone any form of heat treatment, including heat drying as well as higher temperature vector reduction treatment, indicating the presence and transformation of unidentified precursors.

3.1.2. Aerobic transformation—Aerobic environments exist at the early stages of landfill decomposition. The waste still contains atmospheric oxygen in its void space and likely contributes to the transformation of PFAS in waste. Thompson et al. (2023a, 2023b) observed a proportional increase in PFCAs after aerobic biosolids composting, especially short-chain (perfluoropentanoic acid, PFPeA, and perfluorohexanoic acid, PFHxA). Similarly, Li et al. (2022) found significant increases among short-chain PFAAs (including PFBS and PFOS) in aerobically treated anaerobic digestor sludge. These findings are significant because short-chain PFAS are more mobile in the environment, more likely to be uptaken by plants (Ghisi et al., 2019), and more challenging to treat (Ross et al., 2018). Multiple studies have shown that aerobic decomposition facilitates the transformation of precursor PFAS to shorter-chain terminal PFAS, such as PFOA and PFOS (Hamid et al., 2020; Lee et al., 2010a; Liu et al., 2010; Lott et al., 2023; Rhoads et al., 2008; Schultz et al., 2006; Wang et al., 2009, 2011; Zhao et al., 2013).

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3.1.3. Anaerobic transformations—Comparatively, fewer studies have documented PFAS transformation under anaerobic or methanogenic conditions similar to landfills. Liu et al. (2021a) compared 52 PFAS in leachate from waste collection vehicles to anaerobic MSW landfill leachate and concluded the vehicle leachate contained proportionally more precursor PFAS and short-chain PFAAs compared to the landfill leachate as a result of the transformation in the anaerobic landfill environments. Studies of anaerobic precursor transformation identified FTCAs as the predominant by-product of FTOH degradation. Allred et al. (2015) reported increased MeFBSAA and FTCA leaching over abiotic reactors in biologically active landfill microcosm reactors, indicating that methanogenic biological transformation was responsible for the increase. Zhang et al. (2013) observed the accumulation of FTCAs in landfills over time, concluding that FTCAs are indicators of FTOH transformation, while Lang et al. (2016) and Weber et al. (2022) reported PFOA accumulation in leachate as a result of precursor transformation under anaerobic experimental conditions. Lang et al. (2016) attributed this to the longer experimental duration, with PFOA appearing as a significant degradation by-product only 200+ days into the 550-day experiment.

3.2. PFAS partitioning in landfills

3.2.1. PFAS partitioning to the liquid phase—PFAS concentrations in landfill leachate are a function of multiple factors, including the PFAS profile of the incoming waste stream and conditions within the landfill, which, in turn, correspond with waste composition, stage of decomposition, and environmental factors, especially rainfall precipitation. These factors also affect the physical-chemical aspects of the leachate quality, and any discussion of PFAS in leachate should also include matrix contextualization. The number of PFAS that can be detected and quantified in landfill leachate has grown. Early methods were able to quantify 24 PFAS compounds in three classes (Huset et al., 2011), but improvements have been made; more recent studies attempted to measure 92 PFAS and detected 53, as presented in Table 2.

3.2.1.1. PFAS in landfill leachate by type

3.2.1.1.1. MSW landfills.: The vast majority of PFAS landfill leachate data are measured from MSW landfills (Allred et al., 2014; California Water Boards, 2023; Chen et al., 2022, 2023; Huset et al., 2011; Lang et al., 2017; Liu et al., 2022a; Masoner et al., 2020; NWRA, 2020; Solo-Gabriele et al., 2020). The ∑PFAS content of MSW landfill leachate in published US studies ranges from BDL - 125,000 ng L^{-1} with an average of 10,500 ng L^{-1} and a weighted average of 12,600 ng L^{-1}. The weighted average is notably similar to the estimated average ∑PFAS concentration reported by Lang et al. (2017) using Monte Carlo simulation. Often, the ∑PFAS content heavily depends on the number of unique PFAS measured in the study, which ranged from two to 70 for MSW landfill leachate (see SI Fig. S2). For comparison among studies, we will focus on PFAS with corresponding US EPA tapwater Regional Screening Levels (RSL) (i.e., PFOA, PFNA, PFBS, PFHxS, PFOS, and Gen-X), as presented in Table 1. Except for Gen-X, which has only been quantified in a single sample of landfill leachate from a North Carolina MSW landfill with a history of accepting PFAS manufacturing wastes (NWRA, 2020), the remaining five PFAS are reliably quantified in

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all published landfill leachate studies. Other PFAS which reliably contribute significantly to ∑PFAS in landfill leachates, PFHxA and 5:3 FTCA, are also included in Table 1.

PFAS concentrations have also been reported for leachates from MSW landfills in other countries, including Australia (Gallen et al., 2016, 2017), Europe (Ahrens et al., 2011; Busch et al., 2010; Eggen et al., 2010; Fuertes et al., 2017; Kallenborn et al., 2004; Knutsen et al., 2019; Perkola and Sainio, 2013; Woldegiorgis et al., 2005), and Asia (Huang et al., 2022; Liu et al., 2022b; Yan et al., 2015; Yin et al., 2017; Zhang et al., 2014). International differences in waste composition, sample collection, and analytical processes can impact reported PFAS concentrations, making a direct comparison of the overall PFAS content challenging. Concentrations of PFOS and PFOA, which have been reliably measured in most or all studies, are included for eight countries in Table S6 and described by Travar et al. (2020).

3.2.1.1.2. C&D landfills.: PFAS were detected in all C&D landfill leachate samples analyzed across three studies with ∑PFAS ranging from 270 to 30,500 ng L^{-1} (weighted average 10,300 ng L^{-1}). Solo-Gabriele et al. (2020) and Chen et al. (2023) found no significant difference in the total measured PFAS between leachate from MSW and C&D landfills. The analytical method used by Chen et al. (2023) included 18 terminal PFAS (PFAAs) and eight precursors (FASAs, FTCAs, and FTSs). The study, however, reported a significant difference in the fraction of ∑Terminal and ∑Precursor species between MSW and C&D landfill leachates. C&D leachate contained, on average, 86% terminal PFAS, while MSW leachate contained 64% terminal PFAS (Chen et al., 2023). This could be attributed to the different types of PFAS present in each waste stream and the type of biological activity prevalent in each landfill type. Because C&D landfills contain proportionally less food waste and more concrete and gypsum drywall, the prevailing landfill conditions result in higher pH leachate and proportionally more sulfate chemical species in the leachate as opposed to ammonia, which is typically at higher concentrations in MSW landfill leachate (Townsend et al., 1999). Further, due to those differences in leachate conditions, microbial differences result from presence of different carbon sources as well as electron donors and acceptors. Generally, sulfur-reducing bacteria are found in higher concentrations at C&D landfills due to higher amounts of sulfate, while methanogens are more prevalent at conventional landfills (Meyer-Dombard et al., 2020).

Fig. 2 includes the range of concentrations for PFAS with RSLs for MSW and C&D landfill leachate; average PFHxS concentrations were higher in C&D landfill leachate than in MSW landfill leachate, and PFBS concentrations were lower in C&D landfill leachate. Waste composition is highly variable between landfills as well as over time at an individual landfill, so, while limited studies may suggest potential sources of select PFAS in C&D debris (e.g., higher concentrations of PFHxS may be attributed to their use in carpeting and other building materials (Beesoon et al., 2012; Jin et al., 2011), generalizations about specific sources may not be appropriate. Gallen et al. (2017) measured nine terminal PFAS in Australian C&D landfill leachates (n = 5), reporting average $\sum_9$PFAS concentrations of 6000 ng L^{-1} (compared to 6100 ng L^{-1} in 94 MSW leachates from the same study).

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Unlike MSW landfills, at the US federal level, C&D landfills do not require a bottom liner and leachate collection systems. This contributes to the lower number of studies describing PFAS in C&D relative to MSW landfill leachate and an increase in the probability of groundwater contamination from C&D compared to MSW landfills. Average concentrations of PFOA, PFOS, PFNA, PFBS, and PFHxS, along with corresponding US EPA risk-based thresholds (HALs, MCLs, and RSLs), are included in Table 1. PFOA poses the most significant challenge as its concentration in C&D landfill leachate would have to be diluted by 19 to meet the tapwater RSL or by 287 to meet the US EPA proposed MCL.

3.2.1.1.3. MSWI Ash monofills.: Solo-Gabriele et al. (2020) and Chen et al. (2023) found leachate from MSWI ash monofills to have lower ∑PFAS concentrations than leachate from MSW landfills. Solo-Gabriele et al. (2020) reported $\sum_{11}$PFAS in MSWI ash monofill leachates ranging from 2800 to 3400 ng L^{-1} and inversely correlated with incineration temperature. $\sum_{11}$PFAS in leachate from MSWI ash that underwent incineration at 800 °C was almost three times higher than after incineration at 950 °C. The decrease indicates loss of measurable PFAS via mineralization (i.e., destruction), volatilization (i.e., air emission), or transformation to PFAS species which are not measured in standard analytical methods (e.g., products of incomplete combustion or PICs). Leachates from MSWI ash which had undergone incineration at 950 °C, still contained >2000 ng L^{-1} of PFAS, indicating PFAS are not fully mineralized at these operating conditions. Liu et al. (2021b) reported substantially higher $\sum_{21}$PFAS in MSWI ash leachate from three facilities in China, with concentrations ranging from 127,000–450,000 ng L^{-1}. The study did not report incineration temperatures or other operating conditions.

However, when MSWI ash was co-disposed with other wastes, such as MSW or biosolids, ∑PFAS concentration in the leachate was on par with that in MSW landfill leachate (Solo-Gabriele et al., 2020; Liu et al., 2022a). Liu et al. (2022a) found the co-disposal of a small fraction (e.g., 4%) of MSW, including biosolids, with MSWI ash resulted in leachate concentrations that were comparable to MSW landfill leachate, suggesting liquids are preferentially flowing through and leaching PFAS from the non-incinerated waste as opposed to the ash. While MSWI ash-derived leachates have lower concentrations of PFAS, these studies suggest care should be taken to dispose of MSW and MSWI ash separately, and more research is needed to understand the fate of PFAS during MSW incineration.

3.2.1.1.4. Industrial landfills.: Unlined industrial landfills that received residuals from manufacturing PFAS and PFAS-containing products have been linked to contamination of local groundwater sources. Notable examples include the House Street landfill in Belmont, Michigan which received tannery waste (US EPA, 2022e); Crown Vantage landfills in Parchment, Michigan (MPART, 2020), that were used to dispose of paper mill waste from the production of laminated paper products; and the 3M Woodbury disposal site in Washington County, Minnesota, that was used to dispose of PFAS production waste. As part of this literature search, no leachate PFAS concentration data from industrial landfills in the US were located. However, Kameoka et al. (2022) measured PFAS in leachate from three industrial landfills in Japan; $\sum_{17}$PFAA concentrations averaged 45,000 ng L^{-1}.

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3.2.1.1.5. Hazardous waste landfills.: Although PFAS are not federally regulated as listed hazardous wastes, some solid wastes managed in Subtitle C hazardous waste landfills contain PFAS (as discussed in Section 2.1.2, e.g., chrome-plating sludge), while other PFAS-containing wastes may meet hazardous waste characteristic criteria (e.g., flammable, corrosive, etc.). Some hazardous waste landfills have also reported receipt of AFFF waste at their sites. No peer-reviewed studies have evaluated PFAS concentrations in leachate collected from hazardous waste landfills; however, California Water Boards have released PFAS concentrations for landfill leachate, including two hazardous waste landfills in California (California Water Boards, 2023). The data for these sites are included in the SI Table S7. Among 29 samples from the two sites, $\sum_{24}$PFAS and $\sum_{28}$PFAS concentration was as high as 377,000 ng L^{-1} (average 68,000 ng L^{-1}), substantially higher than MSW, C&D debris, or MSWI ash landfill leachates (see Table 2). In the US, hazardous waste landfill disposal requires waste pre-treatment to minimize contaminant mobility – land disposal restrictions for hazardous waste are described in the Code of Federal Regulations (CFR; 40 CFR § 268). Leaching studies have shown minimal PFAS immobilization using traditional solidification techniques (Barth et al., 2021), which may explain elevated PFAS concentrations in the leachate.

US hazardous waste landfills must also use secondary leachate collection systems; California's database includes five samples of sec ondary hazardous waste landfill leachate from one site, with $\sum_{24}$PFAS averaging 1800 ng L^{-1} (see Table 2). Without exception, for all sampling locations with both primary and secondary leachate PFAS data, concentrations for individual and $\sum_{24}$PFAS were higher in the primary compared to the secondary leachate. While the absence of biological decomposition in hazardous waste landfills may minimize the microbially-mediated precursor transformation to PFAAs, waste treatment methods (e.g., lime treatment) may also impact transformation and partitioning, possibly oxidizing precursor PFAS. Hazardous waste pretreatment standards are designed to minimize traditional hazardous waste constituent leaching (e.g., lime treatment stabilizes metals and neutralizes acidic waste) and have not been optimized for PFAS stabilization; PFAS fate, transport, and transformations under hazardous waste pretreatment processes are not well understood. Because of the strict Subtitle C landfill operation requirements and the pre-treatment of wastes, leachate generation in these landfills is typically minimal, and any leachate which is produced is often managed as hazardous waste (i.e., not discharged to WWTP, as other landfill leachates often are).

3.2.1.2. Other factors impacting PFAS concentrations in leachate

3.2.1.2.1. Waste age.: As waste degrades under the anaerobic conditions of biologically active landfills, the overall PFAS concentrations in the leachate and the ratio of the terminal to precursor species have been found to increase. Lang et al. (2017) reported leachate from waste older than ten years had significantly lower concentrations of PFNA, 8:2 FTCA, 5:3 FTCA, PFBS, MeFBSAA, and MeFOSAA than leachate from younger waste. These differences could be attributed to changes in the PFAS formulations in commercial products and/or the conversion of PFAA precursors. Liu et al. (2021a) measured PFAS in leachate from waste collection vehicles alongside leachate from the receiving MSW landfill. The study found significantly higher $\sum_{51}$PFAS concentrations in landfill leachate which had

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undergone further biological decomposition. Furthermore, Liu et al. (2021a) also reported a difference in PFAS profiles likely caused by the transformation of precursor PFAS in landfill environments.

3.2.1.2.2. Leachate quality.: Although most PFAS behavior and solution chemistry studies focus on remediation technologies, generalizations regarding PFAS phase partitioning also apply to landfill leaching (Z. Du et al., 2014). Comparatively, fewer studies have explored PFAS partitioning in the context of leachate chemistry. In a landfill simulator study, Allred et al. (2015) observed increases in longer-chain PFCA and perfluoroalkyl sulfonic acids (PFSA) concentrations when biodegradation reached the methanogenic stage. At this stage, increased methanogenic and secondary fermentation and decreased volatile fatty acid concentrations from the acidogenic stage result In increased pH, more neutral pH, which is theorized to deprotonate waste surfaces, resulting in less sorption of PFAS to the degrading organic matter. This theory is supported by the results described by Solo-Gabriele et al. (2020), where a significant positive correlation was reported between PFAS concentrations and increasing leachate pH. This effect has also been observed in several previous landfill leachate sampling studies (Benskin et al., 2012; Gallen et al., 2017; Hamid et al., 2018; Yan et al., 2015).

In addition to partitioning behavior, the PFAS profile of landfill leachate is a function of PFAA precursor transformation resulting from biodegradation. Biological activity is catalyzed by landfill moisture, resulting in higher landfilled waste temperatures and more PFAS transformation. In a study of WWTP biosolids pathogen removal, precursor transformation and apparent increases in $\sum_{92}$PFAS, driven by increased PFAA content, resulted after aerobic composting and increased diPAP concentrations from heat treatment (Thompson et al., 2023b). Based on a nationwide study of 95 leachate samples collected from 18 landfills, leachate from MSW landfills in US regions with high annual precipitation showed significantly greater $\sum_{19}$PFAS than comparable landfills in arid locations (Lang et al., 2017); see Table 2 for all US-based studies included in this review. Further, leachate generation volume is significantly higher in regions that experience more precipitation. As a result, landfills in arid regions are estimated to contribute <1% of the nationwide landfill leachate PFAS mass load (Lang et al., 2017). When studies have evaluated the short-term impacts of precipitation on PFAS in landfill leachate, however, leachate PFAS concentration decreased within a day of a precipitation event due to dilution (Benskin et al., 2012; Gallen et al., 2017). Normalization of PFAS concentrations to bulk parameters such as chloride or total dissolved solids may be able to account for such dilution.

3.2.2. PFAS partitioning to the gas phase—MSW contains a proportionally more biodegradable organic matter which undergoes anaerobic decomposition in landfill environments compared to other waste streams (e.g., C&D). The decomposition of organic matter produces MSW LFG, which is, on average, about 50% methane (CH_4), and 50% carbon dioxide (CO_2), with a small fraction consisting of other gaseous and volatile constituents (Wang et al., 2021). LFG at MSW landfills is collected and managed according to the requirements of the US EPA New Source Performance Standards (US Clean Air Act, 40 CFR § 60). According to the US EPA's Landfill Methane Outreach Program (LMOP)

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August 2022 database, 1230 of the 2635 MSW landfills in the US have gas collection systems in place, and 1157 have flares in place (US EPA, 2022a). C&D LFG is rarely collected in the US, as C&D landfills contain less biodegradable organic matter and produce less LFG than MSW landfills. Additionally, C&D LFG contains proportionally more $H_2S_{(g)}$ produced by sulfur-reducing bacteria and the decomposition of gypsum disposed of as drywall.

Gas generation and composition at other landfill types has yet to be the subject of significant research. MSWI ash monofills are not expected to generate LFG because there is minimal biodegradable matter in the ash; however, the co-disposal of WWTP biosolids, MSW, or any degradable organic matter with MSWI ash will produce biogas as a result of decomposition. Gas generation at industrial landfill sites is primarily a function of the type of waste deposited. Organic waste like pulp and paper mill sludges will likely generate gas requiring management. In general, Subtitle C hazardous waste landfills in the US do not contain putrescible organic waste and do not generate biogas.

3.2.2.1.1. PFAS in MSW landfill gas.: PFAS volatilization and release from MSW landfills within the gaseous phase is receiving an increased focus driven by advances in volatile PFAS measurement (Riedel et al., 2019) and an improved understanding of PFAS chemistry. The partitioning coefficients (e.g., Henry's constant) for ionizable PFAS are significantly lower than neutral PFAS (Abusallout et al., 2022), making ionizable PFAS less likely to volatilize under typical MSW landfill conditions. Experimental measurement of PFAS vapor pressures similarly suggests FTOHs (i.e., neutral PFAS) are more readily volatilized than PFCAs (i.e., ionizable PFAS) and that vapor pressure decreases logarithmically with carbon chain length in homologous species (M. Zhang et al., 2020). Measurement and data of PFAS in actual MSW LFG are still minimal.

In a 2007 analysis of landfills that accepted PFAS-containing industrial wastes, the MPCA detected several PFAS (12 PFAAs and per fluorooctane sulfonamide, PFOSA) in MSW LFG with $\sum_{13}$PFAS ranging from 4.1 to 18.7 ng m^{-3} (MPCA, 2010). Titaley et al. (2023) measured neutral PFAS in LFG of three active MSW landfills (n = 12 samples) and reported concentrations of four n:2 FTOHs (n = 6, 8, 10, and 12), one fluorotelomer acrylate (6:2 FTAc), and one fluorotelomer olefins (12:2 FTO). Concentrations for individual PFAS range from 270 to 4900 ng m^{-3}, and the total measured neutral PFAS for each landfill was, on average, between 4600 and 14,000 ng m^{-3} (weighted average across all samples: 10,200 ng m^{-3}). Smallwood et al. (2023) reported FTOH in LFG condensate, which, when normalized to gas volume, was three orders of magnitude lower than the gaseous phase concentrations reported by Titaley et al. (see SI Table S8 for calculations), indicating FTOHs preferentially partition to the gas phase; FTOHs may transform in the atmosphere into PFCAs, such as PFOA, which have known and suspected toxic effects.

3.2.2.1.2. PFAS in C&D landfill gas.: While no data exist on the concentration of PFAS in C&D LFG, it can be conservatively assumed, based on data from MSW LFG measurements, that PFAS also leave C&D landfills via gas effluent. As previously described, PFAS-containing wastes are disposed of at C&D landfills, and it is highly likely C&D debris contains volatile PFAS, such as FTOHs, which readily transform into FTCAs and PFCAs

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as a result of biodegradation and environmental oxidation, respectively. Lower rates of biological activity in C&D landfills may result in slower biodegradation of PFAS like FTOH (and other volatile precursors) may persist longer in C&D compared to MSW landfills and therefore have more opportunity to volatilize and leave the landfill via LFG. This is likely offset by the lower volume of LFG generated overall at C&D landfills compared to MSW. Nonetheless, this read-across should be validated by experimental data.

3.3. Fate of PFAS in traditional landfill leachate and gas management systems

Most landfills compliant with New Source Performance Standards (Clean Air Act) and RCRA must capture gas effluent and leachate to minimize environmental impacts. Leachate is often intercepted using a low-permeability bottom liner made of high-density polyethylene, collected, and may be transported off-site to a WWTP, disposed of using deep well injection, or otherwise managed and treated on-site.

PFAS interactions with low-permeability landfill liners have been the subject of limited studies. Most landfill liners are constructed from polyethylene geomembranes. Laboratory studies of PFAS diffusion through linear low-density polyethylene report below detection diffusion rates (Di Battista et al., 2020). Diffusion through high-density polyethylene has yet to be reported but maybe even lower due to differences in material structure. Landfill liner integrity – the absence of flaws or holes – is the most critical factor in preventing PFAS transmission through geomembrane and composite liners (Di Battista et al., 2020). An analysis of landfill liner performance reported median leakage rates of 44 and 33 L ha^{-1} day^{-1} for geomembrane and composite liners, respectively, with an overall liner collection efficiency of 98% (Jain et al., 2023). Compacted clay liners, which are more common in older landfills and C&D landfills, do not adsorb PFAS, which are reported to pass through bentonite clay at the same rate as other mobile leachate constituents like chloride (Li et al., 2015). PFAS profile, leachate quality, and soil characteristics all play a role in soil interaction, and decisions should be made on a site-specific basis (Li et al., 2019; Gates et al., 2020; Mukhopadhyay et al., 2021).

Management of leachate in the US is dependent on climate – in dry regions, leachate generation is minimal, and many facilities use atmospheric evaporation. In contrast, in wet regions, leachate management presents a significant challenge (US EPA, 2021c). A nationwide survey found approximately 60% of US Subtitle D landfills conveyed their leachate to WWTPs for off-site treatment, 28% recirculated leachate or use other techniques resulting in no necessary leachate treatment, and 12% used on-site treatment (US EPA, 2021c). A breakdown of on-site leachate treatment strategies is included in SI Fig. S3. Traditional leachate treatment typically targets non-PFAS leachate constituents of concern, such as ammonia and chemical oxygen demand (COD). The fate of PFAS in existing leachate treatment systems and wastewater treatment systems that manage leachate have been the subject of several studies and have been reviewed previously (Appleman et al., 2014; Lu et al., 2023; Meegoda et al., 2020; Travar et al., 2020; Zhang et al., 2022). To generalize, the treatment of ammonia and COD relies on chemical or biological oxidation, which do not effectively treat PFAS but often have the unintended effect of transforming precursor PFAS to terminal PFAS (US EPA, 2021b). Furthermore, during treatment, PFAS

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may partition into solids (e.g., biosolids) to a limited extent, which results in additional management challenges (Thompson et al., 2023b). Studies have recommended PFAS removal prior to such treatment (Lott et al., 2023). The targeted treatment of PFAS via removal or destruction in landfill leachate has been the subject of multiple reviews (Bandala et al., 2021; Berg et al., 2022; Lu et al., 2023; Ross et al., 2018; Travar et al., 2020) which have thoroughly discussed the effectiveness of different technologies and which are, here, summarized in Table 3.

PFAS separation technologies typically rely on adsorption over materials, such as activated carbons and ion exchange resins (US EPA, 2022c; Chow et al., 2022; Crone et al., 2019; Appleman et al., 2013), the use of high-pressure membrane separation (US EPA, 2022c; Lipp et al., 2010; Steinle-Darling and Reinhard, 2008), and newer technologies such as ozo- and foam-fractionation with the aim of concentrating the PFAS into a smaller volume of either a solid phase or concentrated liquid residual to either be disposed or destroyed via a subsequent high-energy destructive treatment method (Du et al., 2021; Labiadh et al., 2016). Several novel technologies are being investigated for the destructive treatment of landfill leachate – most require large amounts of energy in the form of chemical reactions or localized high temperatures to break the C–F bond. MSWI for energy recovery is not currently optimized to target PFAS destruction. Additional research is ongoing to define the conditions needed for PFAS destruction in MSWI and other incineration approaches, such as sewage sludge incineration.

Flaring and combustion are common LFG management techniques. Flaring is typically carried out in an open (candle) or enclosed flare. Combustion processes can generate energy on-site (e.g., a combustion engine) or off-site in a gas-fired power generation system. MSW LFG regulations target the destruction of nonmethane organic compounds (NMOCs), not PFAS. Flares generally operate at ~650 °C to 850 °C and temperatures in combustion engines or boiler systems could be lower (Wade, 2022). PFAS separation treatment has not been applied to LFG, however, laboratory-scale thermal PFAS destruction experiments indicate that temperatures higher than 1000 °C are necessary to achieve the mineralization of PFAS (Winchell et al., 2021). MSW LFG flare temperatures and the time that gaseous PFAS are in the presence of high temperatures are too low to completely mineralize PFAS, but may result in the transformation of volatile PFAS into products of incomplete combustion (PICs). Notably, several PICs have been identified as significant greenhouse gases (Ahmed et al., 2020; Hong et al., 2013; Longendyke et al., 2022).

4. Environmental impact of PFAS emissions from landfills

Waste-derived PFAS may be emitted from landfills through multiple pathways, primarily in leachate or LFG effluent. While most RCRA-compliant landfills are operated to minimize environmental impacts, controls have yet to be designed to manage PFAS, and there is a subclass of small landfills in the US that are not required to install bottom liners as they are exempt from RCRA requirements (40 CFR § 258.1(f)(1)).

PFAS may be released into the atmosphere via fugitive gas emissions or gas flares. No data were found on PFAS concentrations in the ambient air surrounding C&D landfills,

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hazardous waste landfills, or industrial landfills; however, PFAS concentrations in the ambient air close to MSW landfills have been the subject of studies in the US, Germany, and China. Ahrens et al. (2011) reported average total FTOH concentrations of 2.6 and 26 ng m^{-3} at two US MSW landfills, representing 93% and 98% of total gas phase PFAS, with the remaining fraction consisting of perfluoroalkane sulfonamide (FASAs), perfluoroalkane sulfonamido ethanols (FASEs), and PFAAs. Weinberg et al. (2011) reported average total FTOH concentrations at two German landfill sites of 0.086 and 0.271 ng m^{-3}, representing 80% and 92% of total gas phase PFAS. Tian et al. (2018) measured PFAS in air sampled on-site at two landfills as well as downwind. The PFAS profile of the on-site air samples was more evenly split among classes. Total FTOHs were 0.61 and 2.1 ng m^{-3} at the two sites, representing 42% and 76% of $\sum_6$PFAS, with PFAAs representing the bulk of the remaining fraction. PFAS concentrations downwind of the two landfill sites were lower than on-site but elevated relative to control sites, indicating atmospheric transport of PFAS. Lower concentrations downwind may indicate dilution or deposition of volatile PFAS. Neutral PFAS readily transform in the environment – studies have shown the degradation of FTOHs into PFCAs via photooxidation (Esfahani et al., 2022; Martin et al., 2006). Tian et al. (2018) reported elevated neutral and ionizable PFAS in dry deposition samples on-site and downwind of landfills, driven primarily by PFBA and PFOA. Ahmadireskety et al. (2020) reported PFAS concentrations in landfill cover soils of approximately 8 μg kg^{-1}, similarly driven by PFCAs.

Deposition of PFAS from landfill-impacted air may also contribute to PFAS measured in surface water on landfill sites. Chen et al. (2023) reported $\sum_{26}$PFAS concentrations in stormwater at MSW landfill sites averaging 470 ng L^{-1}, significantly lower than leachate concentrations from the same study but significantly higher than groundwater samples, which averaged 140 ng L^{-1} of $\sum_{26}$PFAS. PFAS may be present in both surface and groundwater due to leachate contamination. At the same time, particulate transport from the working face or atmospheric transport and deposition of PFAS are more likely to impact surface water. The MPCA (2010) reported PFAS contamination in groundwater impacted by landfills accepting PFAS-laden industrial waste. Hepburn et al. (2019) measured PFAS and other landfill leachate indicators in groundwater impacted by legacy landfills in Australia, where PFOA represented >10% of total PFAAs, likely associated with legacy landfills.

Using the landfill liner collection efficiency reported by Jain et al. (2023) and overall leachate leakage rate of 1.9% with the leachate generation rate reported in Lang et al. (2017) (61 billion L $year^{-1}$), approximately 1.2 billion L of MSW landfill leachate enter the groundwater directly as a result of liner imperfections every year (14.3 kg of total PFAS using the average $\sum_{19}$PFAS from Lang et al. (2017)). This represents a conservative estimate, as Lang et al. (2017) note that most but not all landfills contributing to the total estimated leachate generation are lined. Although C&D leachate generation rates are not readily available, using leachate generation rates calculated for 17 MSW landfills in six US states, Jain et al. (2023) reported an average collection rate of 6900 L ha^{-1} day^{-1}. Assuming similar leachate generation rates for C&D landfills, this corresponds to approximately 2.5 million L of C&D leachate entering the groundwater per hectare of C&D landfill annually, representing a ∑PFAS mass of 26 g of PFAS per hectare of C&D landfill (see Table S9 in

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the SI for more calculation information). In 2012, the US EPA inventoried 1504 active C&D landfills (US EPA, 2012).

In the US, most landfill leachate generated from RCRA-permitted landfills is managed off-site (again, many C&D landfills are not required to collect leachate and thus operate without a bottom liner). This represents a significant flux of PFAS leaving the landfill. Multiple studies in the US and Australia have estimated the contribution of PFAS to municipal WWTP from landfill leachate and the environmental impact of PFAS in WWTP effluent. Masoner et al. (2020) estimated the PFAS load in landfill leachates and receiving WWTPs. They reported that landfill leachate while representing, on average, <2% of WWTP influent by volume across three sites, contributed 18% of influent PFAS. Gallen et al. (2017) reported similar contributions of PFAS to WWTPs from landfill leachates. PFAS are not effectively treated with traditional WWTP processes and are released to the environment via WWTP liquid effluent, land-applied biosolids, landfills, and possibly incineration of biosludge (Barisci and Suri, 2021; Coggan et al., 2019; Gallen et al., 2018; Helmer et al., 2022; Tavasoli et al., 2021).

5. Estimate of US MSW landfill PFAS mass balance

Estabrooks and Zemba (2019) evaluated landfill PFAS mass balance at an MSW landfill in Vermont, identifying the PFAS load from targeted waste types suspected to contain PFAS, not including residential MSW, and found that approximately 7% of the PFAS load entering landfills is emitted via leachate annually, and hypothesize the majority of ∑PFAS remain in the waste mass within the landfill. Coffin et al. (2022) propose an estimated extractable ∑PFAS load in MSW entering landfills of 50 ng g^{-1} based on the findings in Liu et al. (2022a). This, combined with US EPA estimation of landfilled MSW in 2018 (the most recent year for which MSW generation data is available for the US), corresponds to 6600 kg of extractable PFAS entering MSW landfills in 2018 with MSW (US EPA, 2020b). Biosludge and biosolids also contribute a significant fraction of PFAS loading in MSW landfills. Using $\sum_{92}$PFAS in treated biosolids reported by Thompson et al. (2023b) and biosolids management statistics reported by NEBRA (2022), the 1.74 million dry metric tons of biosolids landfilled each year contribute an additional estimated 850 kg of PFAS to MSW landfills. Based on our calculations, a conservative estimate of 7480 kg of extractable PFAS entered US MSW landfills in 2018. This estimate does not include PFAS polymers.

As described earlier, PFAS can be emitted from landfills via the gaseous and liquid phase. MSW landfills in the US collect approximately 93.5 million m^3 of gas daily according to the US EPA LMOP database. This translates to nearly 1 kg of neutral PFAS emitted via MSW LFG per day (347 kg annually) based on the concentrations reported by Titaley et al. (2023). The US EPA estimates MSW LFG collection efficiency of approximately 75% (US EPA, 2020a), indicating an additional 31.2 million m^3 of LFG are released via fugitive emissions from MSW landfills annually. Leachate generation in the US, estimated by Lang et al. (2017), is 61.1 billion L $year^{-1}$ which corresponds to 750 kg of PFAS emitted from MSW landfills via leachate annually (using the weighted average ∑PFAS concentration of 12,300 ng L^{-1} calculated in this study). See Fig. 3 for a flowchart representing PFAS sources, controlled emissions, and uncontrolled emissions to the environment corresponding

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to MSW landfills, and Fig. 4 for a graphical presentation of the fraction of PFAS entering landfills from MSW and biosolids and corresponding emissions; the majority of PFAS entering landfills remain in the waste (84% annually) and significant a mass of PFAS have likely accumulated since PFAS use in consumer products began. Detailed calculations for Fig. 3 are included in the SI Table S10.

One can estimate the total PFAS released via the gaseous phase per ton of MSW based on the potential methane generation capacity (L_o) of MSW. Jain et al. (2021) estimated MSW methane emissions of 68 m^3 of methane per metric ton (Mg) of waste, or approximately 136 m^3 of LFG per Mg of waste; using these values and the Titaley et al. (2023) LFG PFAS concentrations suggest 1.38 mg of PFAS are released, cumulatively, via LFG for every Mg of MSW.

5.1. Limitations

The estimated PFAS mass loading and emissions presented here are based on multiple assumptions and, in some cases, limited data, resulting in significant uncertainty. We have not provided additional data quality assurance in this review process. A small number of studies have explored changes in landfill leachate PFAS profile over time, and no studies have looked for similar relationships in LFG; for this critical review, it was assumed that ∑PFAS reported in leachate and gas are representative of a range of waste ages and stages of decomposition and, overall, are expected to remain consistent over time. Even fewer studies have looked at C&D debris landfills in the US, and those studies are limited to Florida landfills. This critical review of previous analyses provides perspective, not precise values, which should be derived through additional empirical studies.

6. Conclusions and data gaps

The bulk of studies of PFAS in solid waste and landfills focus on MSW landfill leachate, with comparatively fewer studies estimating overall PFAS loading in other types of landfill leachate, in the solid waste itself, or gaseous effluent. Regardless of the type of landfill, in all studies across all locations, PFAS were quantified in all leachate samples. PFAS concentrations in leachates vary across studies, which may be a function of waste type, leachate qualities, climate, and the analytical method.

US MSW and C&D landfill leachates have similar ∑PFAS concentrations. However, C&D leachate contains proportionally more terminal PFAS. This is likely due to the PFAS present and the conditions within each landfill type. Concentrations of the five PFAS which have been the subject of proposed US EPA regulations (i.e., PFBS, PFHxS, PFOS, PFOA, and PFNA) consistently exceed US EPA tapwater RSLs in both MSW and C&D landfill leachates by a factor as high as 20 (PFOA) and in HW landfill leachates by a factor as high as 104 (PFOS); as presented in Table 1 and Fig. 2.

MSWI ash leachates have lower PFAS concentrations than other leachates, however, co-disposal of ash with other wastes results in disproportionately high PFAS concentrations in leachate. To minimize PFAS leaching from MSWI ash landfills, care should be taken to dispose of unburned waste which contains higher concentrations of PFAS separately

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from MSWI ash. No peer-reiviewed studies have reported PFAS concentrations in effluent from hazardous waste (Subtitle C) landfills, although hazardous waste management methods are likely to reduce PFAS leaching. Since some hazardous waste landfills likely accept PFAS-laden industrial waste at relatively high levels, it would be helpful to have more information on effluent generated from these facilities.

Traditional leachate treatment methods that use oxidation (e.g., a treatment that targets ammonia, COD) are likely to increase the transformation rate of precursor PFAS to terminal PFAS, such as regulated PFAAs. Treatment that relies on volatilization, such as evaporation, likely contributes significant quantities of PFAS to the atmosphere and surrounding environment, increasing off-site transport. Separating PFAS from leachate prior to additional treatment would avoid these issues. Though there are many aqueous treatment technologies for the targeted removal or destruction of PFAS, few have been tested for effectiveness on landfill leachate. Those tested on leachate and have shown promise include supercritical water oxidation, electrochemical oxidation, reverse osmosis, and foam separation. Assuming treatment efficacy is comparable across PFAAs, reducing PFOA concentration to its limit (e.g., MCL) will reduce all other PFAS to below their respective limits. PFAS treatment of liquid wastes often produces a secondary residual waste requiring additional management.

PFAS are expected to be present in LFG as a product of volatilization and the anaerobic decomposition of biodegradable waste but have been quantified only in MSW LFG. PFAS have not been measured in C&D LFG. However, based on PFAS profiles in C&D landfill leachate, similar PFAS concentrations are likely present in C&D LFG, although LFG generation rates from C&D debris is lower. To reduce gaseous emissions of PFAS, biodegradable waste should be disposed of separately from other PFAS-containing waste. Data do not exist on the effectiveness of PFAS destruction from LFG combustion within flares and internal combustion engines or PFAS removal from LFG to RNG conversion processes. However, the temperatures reached in LFG flares are expected to transform volatile PFAS into terminal PFAS and possible PICs, with minimal mineralization.

Based on our estimate of the PFAS entering and leaving landfills, significant quantities of PFAS are emitted in both LFG and leachate; however, the bulk of PFAS remains within the waste mass on a per-year basis (see Fig. 3). This suggests landfills will be a source of PFAS emissions for the foreseeable future. Studies have demonstrated down-gradient impacts on groundwater from landfills. C&D landfills pose the highest risk of environmental contamination since they are not required (at the federal level) to install liners to collect leachate. Even among lined landfills, the average liner collection efficiency is approximately 98%, corresponding to an annual flux of 14.3 kg PFAS entering groundwater via liner imperfections.

Elevated PFAS concentrations were measured in ambient air at landfills across several studies. The highest concentrations were found among FTOHs, which transform into PFAAs in the environment. Atmospheric PFAS may deposit and contribute to soil and surface water concentrations. Even if LFG collection systems were equipped to operate at temperatures and residence times sufficient to destroy PFAS, current MSW LFG collection efficiency is

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only 75%, and landfills not required to collect LFG will continue to emit PFAS into the atmosphere. The fate of PFAS in LFG that passes through landfill cover soil should be analyzed in future studies.

This review has identified several data gaps for PFAS emissions from US landfills. Data are needed from hazardous waste landfill sites and relevant industrial waste landfills. Furthermore, US C&D landfill leachate data are limited to Florida landfills, and additional efforts should be made to collect information from other states. C&D waste streams may vary due to regional construction requirements. The measurement of PFAS in LFG and other gaseous emissions is an area of emerging study. More research is needed on both controlled and uncontrolled landfill gaseous emissions. A closer evaluation of the fate of PFAS during leachate treatment and LFG management is needed to help decision-makers guide the solid waste community. Geomembrane liners are the most effective tools for the protection from and collection of PFAS-containing liquids, such as landfill leachate. More research is needed to understand long-term interactions between PFAS and liner systems, especially in complex matrices such as landfill leachate. More research is needed to evaluate the long-term implications of PFAS in the landfill environment since the bulk of PFAS remains within the solid waste mass. This review focused on landfilling as a management option for solid waste; evaluation of PFAS fate during other solid waste management processes (e.g., anaerobic digestion, thermal treatment, composting, and recycling) is needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability

Data will be made available on request.

Abbreviations:

μg	Microgram
AFFF	Aqueous film-forming foams
C&D	Construction and demolition
diPAP	Polyfluoroalkyl phosphoric acid diesters
FASA	Perfluoroalkane sulfonamide
FASE	Perfluoroalkane sulfonamido ethanol

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FTAc	Fluorotelomer acrylate
FTCA	Fluorotelomer carboxylic acid
FTO	Fluorotelomer olefin
FTOH	Fluorotelomer alcohol
H_2S	Hydrogen sulfide gas
HAL	Health Advisory Limit
kg	Kilogram
L	Liter
LFG	Landfill gas
MCL	Maximum Contaminent Level
MeFBSAA	Methyl-n-perfluorobutanesulfonamidoacetic acid
MeFOSAA	Methyl-n-perfluorooctanesulfonamidoacetic acid
mg	Milligram
Mg	Megagram (metric ton)
MPCA	Minnesota Pollution Control Agency
MSW	Municipal solid waste
MSWI	Municipal solid waste incineration
NEBRA	North East Biosolids & Residuals Association
NWRA	National Waste & Recycling Association
PFAA	Perfluoroalkyl acids
PFAS	Per- and polyfluoroalkyl substance(s)
PFBS	Perfluorobutane sulfonate
PFCA	Perfluoroalkyl carboxylic acids
PFHxA	Perfluorohexanoic acid
PFHxS	perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PFPeA	Perfluoropentanoic acid
PFSA	Perfluoroalkyl sulfonic acids

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PIC	Product of incomplete combustion
RCRA	Resource Conservation and Recovery Act
RNG	Renewable natural gas
RO	Reverse osmosis
RSL	Regional Screening Limit
SI	Supplementary information
US EPA	United States Environmental Protection Agency
WWTP	Wastewater treatment plant

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HIGHLIGHTS

- Solid waste management strategies impact PFAS emissions.
- PFOA has the highest ratio to its respective RSL in C&D and MSW landfill leachates.
- Unlined C&D landfills present a significant source of PFAS to the environment.
- An estimated 7.5 metric tons of PFAS enter MSW landfills annually.
- Annually, 460 kg of PFAS emitted via landfill gas, 750 kg via landfill leachate.

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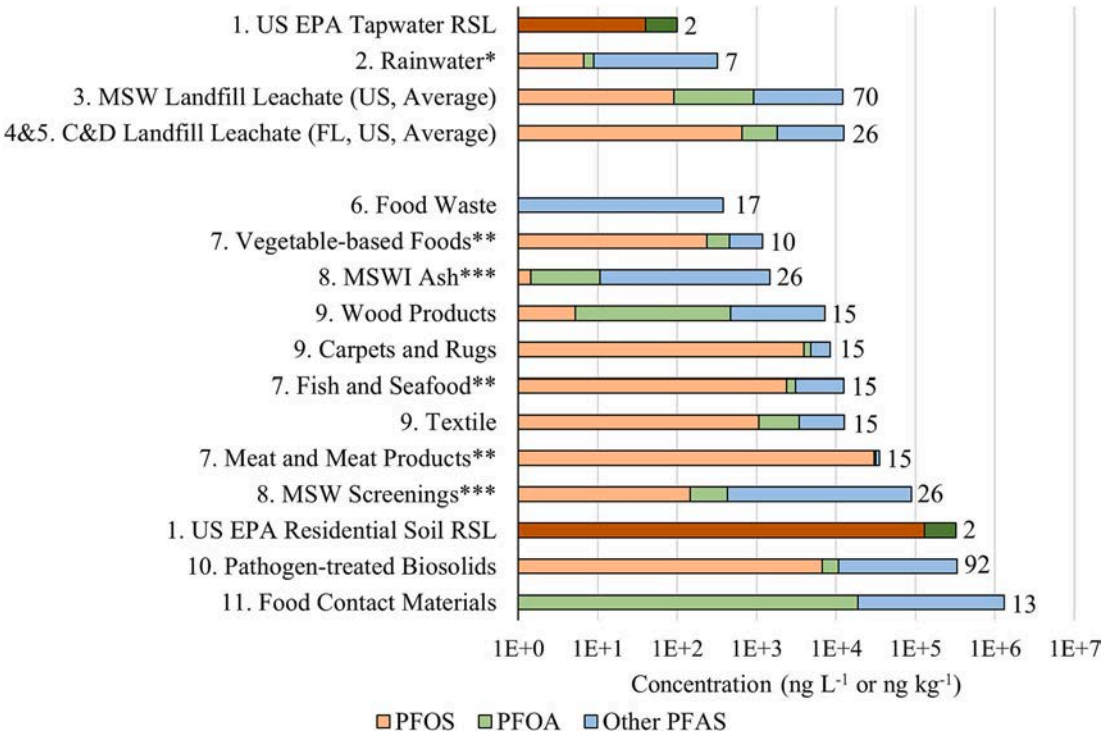


Fig. 1.

PFAS concentrations and compositions measured in various products, wastes, and the environment compared to MSW landfill leachate.

* includes ultra-short chain PFAS, TFA.

** upper bound of the mean.

*** minimum total PFAS based on leachable fraction.

Note: numbers prior to matrix type refer to sources. Numbers to the right of the bars are the number of PFAS analytes. RSLs refer to risk-based screening levels, not enforceable regulatory limits. Sources: 1. US EPA (2022d) 2. Pike et al. (2021) 3. Lang et al. (2017) 4. Solo-Gabriele et al. (2020) 5. Chen et al. (2023) 6. Thakali et al. (2022) 7. European Food Safety Authority (2012) 8. Liu et al. (2022b) 9. Bečanová et al. (2016) 10. Thompson et al. (2023a, 2023b) 11. Siao et al. (2022).

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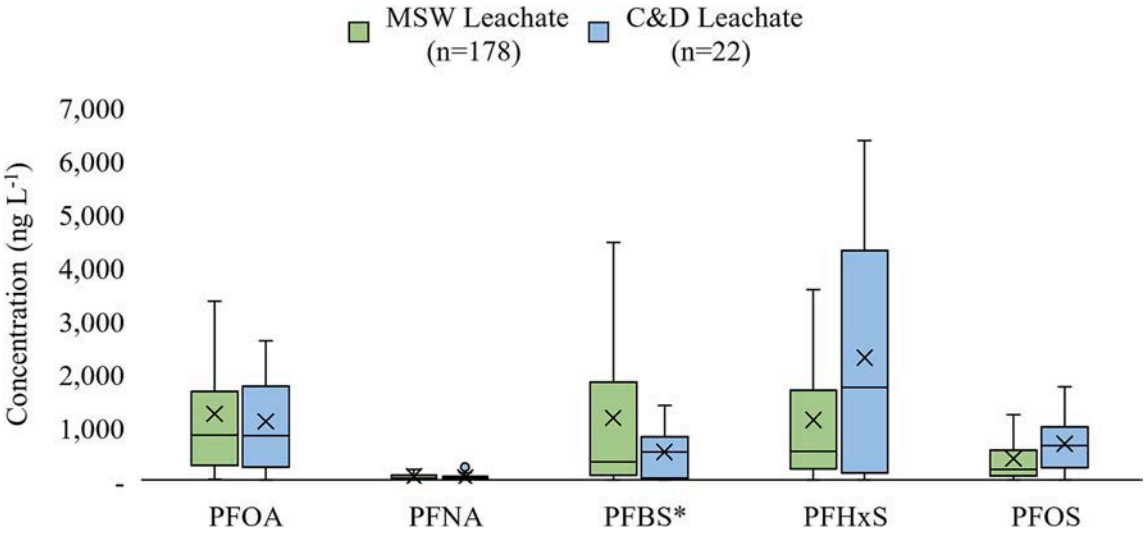


Fig. 2.

Average concentrations of five PFAS with US EPA tapwater RSLs.

Data from Gallen et al. (2017), Solo-Gabriele et al. (2020), and Chen et al. (2023).

* Gallen et al. (2017) did not include PFBS analysis.

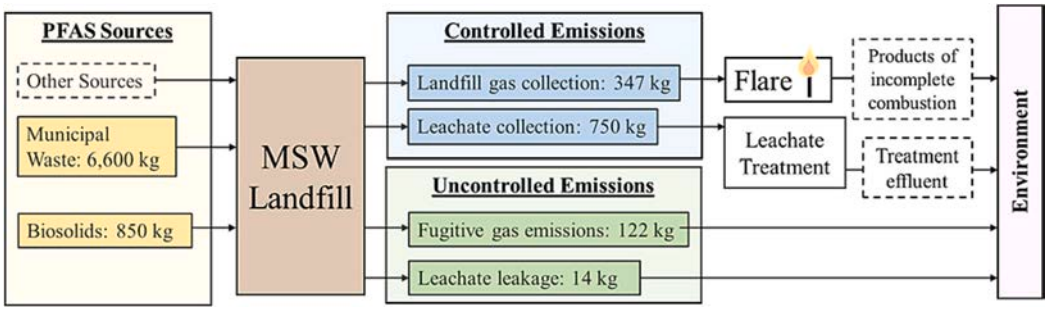


Fig. 3.

Flowchart depiction of annual ∑PFAS loading and release at MSW and C&D debris landfills based on current understanding in the literature. Dashed lines represent PFAS streams which have not been quantified to any extent in the literature.

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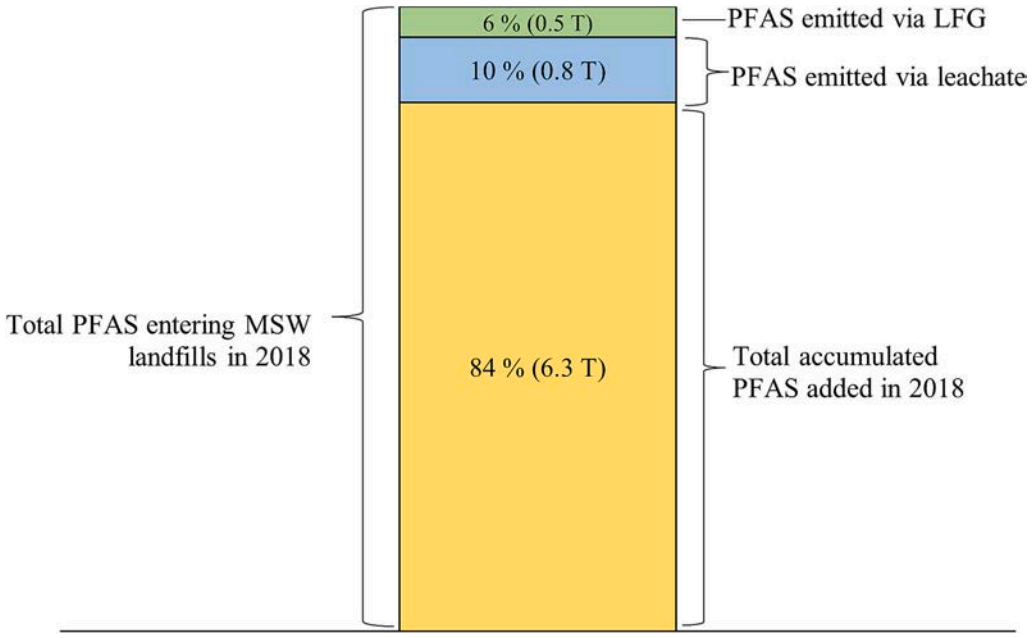


Fig. 4.
Estimated PFAS mass balance for US MSW landfills.

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Table 1.

Average concentrations (ng L^{-1}) of select PFAS in landfill leachate and US EPA risk-based thresholds.

Leachate matrix		PFOA		PFOS		PFNA		PFBS		PFHxS		PFHxA	5:3 FTCA
		Mean (n)	DF	Mean (n)	DF	Mean (n)	DF	Mean (n)	DF	Mean (n)	DF	Mean (n)	Mean (n)
MSW		*1400 (284)*	*23*	260 (284)	6.6	69 (234)	1.2	910 (234)	0.1	540 (234)	1.4	2800 (225)	3500 (86)
CDD		*1100 (17)*	*19*	660 (17)	17	50 (17)	0.8	530 (17)	0.1	2200 (17)	5.7	1600 (17)	1400 (17)
MSWI Ash		*800 (40)*	*13*	400 (40)	10	59 (40)	1.1	1400 (40)	0.2	510 (40)	1.3	1300 (40)	700 (40)
HW (Primary)		4900 (24)	81	4100 (24)	102	530 (24)	8.7	6500 (24)	1.1	12,000 (24)	32	12,000 (24)	NM
HW (Secondary)		*100 (5)*	*1.7*	14 (5)	0.4	40 (5)	0.7	57 (5)	0.01	86 (5)	0.2	440 (5)	NM
EPA limit (ng L^{-1})	Tapwater RSL (HQ = 1.0)	60		40		59		6000		390		n/a	n/a
	Lifetime HAL	0.004		0.020		n/a		2000		n/a		n/a	n/a
	Proposed MCL	4		4		n/a		n/a		n/a		n/a	n/a

(HAL = health advisory level; MCL = maximum contaminant level; RSL = regional screening level; HQ = hazard quotient; DF = average dilution factor required to meet RSL; NM = not measured).

Italicized values represent the controlling dilution factor.

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Table 2.

Number of PFAS measured and ΣPFAS among published landfill leachate studies.

Matrix	Number of samples	Number of PFAS detected (in Method)	Average ΣPFAS (ng L^{-1})	PFAS range (ng L^{-1})	Country	Reference
MSW LL	1	38 (51)	9700	9700	USA	Liu et al. (2021a)
	1	32 (51)	9400	9400	USA	Robey et al. (2020)
	78	25 (26)	12,700	300–58,000	USA	Chen et al. (2023)
	4	10 (11)	17,200	15,000–18,000	USA	Solo-Gabriele et al. (2020)
	6	24 (24)	4700	2700–7400	USA	Huset et al. (2011)
	40	30 (70)	12,200	2000–29,000	USA	Lang et al. (2017)
	11	2 (2)	840	330–2600	USA	Clarke et al. (2015)
	19	28 (28)	5400	230–29,000	USA	Helmer et al. (2022)
	39	2 (2)	1500	47–3400	USA	EGLE (2019)
	9	22 (25)	24,300	1400–125,000	USA	NWRA (2020)
	131	31 (40)	17,500	BDL - 104,000	USA	California Water Boards (2023)
	17	14 (14)	3000	33–15,000	Australia	Gallen et al. (2016)
	94	9 (9)	6100	210–46,000	Australia	Gallen et al. (2017)
	22	15 (15)	7000	Not reported	Australia	Simmons (2019)
	6	25 (43)	6100	31–13,000	Germany	Busch et al. (2010)
	11	24 (24)	9800	2500–36,000	Canada	Benskin et al. (2012)
	31	16 (18)	2700	700–6400	Canada	Li (2009)
	10	2 (2)	*	50–2300	Canada	Gewurtz et al. (2013)
	2	16 (27)	4200	2200–6100	Norway	Eggen et al. (2010)
	5	7 (8)	770	200–1500	Norway	Kallenborn et al. (2004)
	2	4 (4)	400	210–610	Finland	Perkola and Sainio (2013)
	48	7 (10)	2400	14–17,500	Ireland	Harrad et al. (2019)
	4	8 (16)	1100	640–1400	Spain	Fuertes et al. (2017)
	12	28 (30)	1700	320–11,000	Norway	Knutsen et al. (2019)
	10	17 (26)	490	0.3–1300	Sweden	Gobelius et al. (2018)
	5	11 (14)	82,100	7300–290,000	China	Yan et al. (2015)
	9	33 (57)	42,900	3040–109,000	China	Liu et al. (2022b)
	6	17 (17)	14,200	1800–43,300	China	Huang et al. (2022)
	12	18 (18)	4060	1270–7660	Singapore	Yin et al. (2017)
	5	8 (9)	6000	4200–11,000	Australia	Gallen et al. (2017)
CDD LL	13	24 (26)	9500	270–30,500	USA	Chen et al. (2023)
	2	11 (11)	15,500	14,000–16,000	USA	Solo-Gabriele et al. (2020)
MSWIA LL	2	9 (11)	3100	2800–3400	USA	Solo-Gabriele et al. (2020)
	31	26 (26)	7300	39–54,500	USA	Chen et al. (2023)
MSW GC	21	26 (26)	12,200	199–80,900	USA	Chen et al. (2023)
	12	53 (92)	19,000	3000–50,000	USA	Smallwood et al. (2023)

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Matrix	Number of samples	Number of PFAS detected (in Method)	Average ΣPFAS (ng L^{-1})	PFAS range (ng L^{-1})	Country	Reference
HW LL (Primary)	24	17 (28)	68,000	570–377,000	USA	California Water Boards (2023)
HW LL (Secondary)	5	13 (24)	1800	25–3700	USA	California Water Boards (2023)

(LL = landfill leachate; MSW = municipal solid waste; CDD = construction and demolition debris; MSWIA = MSW incineration ash; GC = gas condensate).

* Gewurtz et al. (2013) do not provide detailed data to calculate average ΣPFAS.

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Table 3.

Summary of treatment methods for PFAS in landfill leachate (Bandala et al., 2021; Berg et al., 2022; Lu et al., 2023; Ross et al., 2018; Travar et al., 2020; Wei et al., 2019).

	Technology	Pros	Cons	Matrix	References
Separation technologies	Activated carbon (GAC, PAC)	• High maturity level • Highly effective for long-chain PFAS	•Generates large quantities of spent sorbent that need additional treatment and disposal	GW	Busch et al. (2010); McCleaf et al. (2017), Pan et al. (2016), Ross et al. (2018); Bao et al. (2014), Pan et al. (2016); Malovanyy et al. (2023)
	Ion exchange resins	• High maturity level • Can remove compounds such as GenX	•Needs secondary treatment and disposal	GW, LL	Gao et al. (2015); Dixit et al. (2021); McCleaf et al. (2017); Ross et al. (2018); Boyer et al. (2021); Park et al. (2020); Ellis et al. (2022); Malovanyy et al. (2023)
	Membranes (RO, UF, NF)	• High maturity level and commonly practiced • 2-stage RO most effective on raw leachate	• Membrane fouling • Secondary stream with high PFAS concentrations and volume requires treatment • UF might not be effective	GW, LL	Das and Ronen (2022); Enzminger et al. (1987); Wei et al. (2019); Ross et al. (2018); Boo et al. (2018); Malovanyy et al. (2023)
	Foam/ ozofractionation	• High maturity level and commercially available pilot-scale technology • Potentially low cost	• Pretreatment of leachate might be required • Secondary treatment of concentrated PFAS required	GW, AFFF, LL	Smith et al. (2022); Robey et al. (2020); Malovanyy et al. (2023)
	Incineration	• Highly effective method • Can be used for regeneration of spent materials	•As a standalone method, not practical for large volumes of leachate		
	Chemical Oxidation	•Controllable by varying pH and temperatures	• Uses additional chemicals for treatment • Low effectiveness of removal • Needs to be paired with other methods such as UV for higher effectiveness	LL	Abu Amr et al. (2013); Lin et al. (2012)
	Electrochemical	• 98–99.7% effectiveness demonstrated • Operates at ambient temperatures • No chemicals required • Lower energy consumption compared to incineration	• Expensive electrode materials • Perchlorates could be formed	LL	Labiadh et al. (2016); Du et al. (2021); Gomez-Ruiz et al. (2017); Witt et al. (2020); Krause et al. (2021)
Destruction technologies	Photocatalysis	• 94–99% degradation reported • Can also potentially mineralize PFAS	• Slow kinetics • Lab-scale testing only • Difficult to scale for larger volumes		Esfahani et al. (2022)
	Sonolysis	• Can destroy short-chain and long- chain molecules • Effective for high concentration samples Can be combined with chemical oxidation to lower costs	•High capital costs		Moriwaki et al. (2005); Vecitis et al. (2008); Babu et al. (2016)
	Microwaves	• Can be used to regenerate GACs • Catalytic microwave treatment could result in ~65–67% effectiveness	•Expensive for large-scale use		Gagliano et al. (2021); Lee et al. (2010b); Liu et al. (2020)
	Subcritical water oxidation	•Effective for short-chain PFAS	• Additional chemicals (e.g., zerovalent iron) needed for		Hori et al. (2006)

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	Technology	Pros	Cons	Matrix	References
			higher effectiveness • Slower kinetics		
	Supercritical water oxidation	• High maturity and close to commercialization • Low residence times required	• Full fluorine balance needed • High-pressure and temperature processes can be energy intensive	GW, AFF, LL	Pinkard et al. (2021); Hori et al. (2006); Krause et al. (2022)
	Wet Air Oxidation	•No demonstrated benefits for PFAS treatment	Converts FTOH precursors to PFCAs	LL	Travar et al. (2020)
	Biological processes	•Limited aerobic and anaerobic degradation of PFOS by bacteria and fungi reported	• Laboratory demonstrations only and thus low technology readiness level • Slow kinetics • Longer-chain PFAS converted to shorter-chain; no mineralization • Unlikely to be effective		Berhanu et al. (2023); Huang and Jaffé (2019)
	Constructed wetlands	•No demonstrated benefits for PFAS treatment	• Does not result in a concentrated PFAS stream that can be adequately managed • Environmental release of PFAS	LL	Yin et al. (2017, 2019); Awad et al. (2022); Lott et al. (2023)

(GAC = granular activated carbon; PAC = powder activated carbon; RO = reverse osmosis; UF = ultrafiltrations; NF = nanofiltration; GW = groundwater; LL = landfill leachate; AFFF = aqueous film-forming foam).

From: REED Gregory C * ODFW
To: Joel Geier; Benton Public Comment
Cc: Dave Mellinger; AnneMary Myers; WOODS Shawn K * ODFW
Subject: RE: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2025
Date: Friday, May 9, 2025 11:53:26 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Hi Joel,

I did receive your email in March about the nesting herons. Sorry I did not respond at that time. I have also consistently observed the herons at the new nesting area on the EE Wilson Wildlife Area adjacent to the landfill this past winter and spring.

Best,

Greg Reed | District Wildlife Biologist
Oregon Department of Fish and Wildlife
7118 NE Vandenberg Ave. Corvallis, OR 97330
541-757-5226 | gregory.c.reed@odfw.oregon.gov

From: Joel Geier <clearwater@peak.org>
Sent: Friday, May 9, 2025 5:48 AM
To: publiccomment <publiccomment@bentoncountyor.gov>
Cc: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>; Dave Mellinger <David.Mellinger@oregonstate.edu>; AnneMary Myers <annemary.myers@state.or.us>; WOODS Shawn K * ODFW <Shawn.K.WOODS@odfw.oregon.gov>
Subject: Fwd: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2025

Dear Chair Fowler and Members of the Planning Commission,

I noted in last night's hearing that Commissioner Biscoe in particular seemed interested in establishing the record regarding the nesting area currently in use by the herons adjacent to the proposed development site.

Here's an acknowledgement that I received from the Oregon Department of Forestry (ODF) when I shared my report with them as well as Oregon Department of Fish & Wildlife (ODFW) on March 14, 2025.

I did not receive any acknowledgement from ODFW at that time, but I'm cc:ing ODFW's District Biologist Greg Reed here, in the hope that he can confirm receipt of that report.

I have not yet sent the nest tree GPS coordinates referenced in the e-mails below. Those coordinates are sensitive information due to the risk of yet further disturbance to these herons during nesting season, so I won't place them in the public record, but I will be making them available to Mr. Reed and refuge manager Shawn Woods via a separate communication.

Yours sincerely,
Joel Geier

From: "Jennifer Weikel" <jennifer.weikel@odf.oregon.gov>
To: "Joel Geier" <clearwater@peak.org>
Sent: Friday, March 14, 2025 4:08:15 PM
Subject: RE: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2015

Thank you Joel. I received your email. I am not working as the wildlife biologist right now, but I passed on your information to the person who is in that roll right now.

Appreciate the detailed report.

Jennifer Weikel
Oregon Department of Forestry
(503) 931-9521

From: Joel Geier <clearwater@peak.org>
Sent: Friday, March 14, 2025 3:55 PM
To: REED Gregory C * ODFW <Gregory.C.REED@odfw.oregon.gov>
Cc: AnneMary Myers <AnneMary.Myers@state.or.us>; WEIKEL Jennifer * ODF <jennifer.weikel@odf.oregon.gov>; WOODS Shawn K * ODFW <Shawn.K.WOODS@odfw.oregon.gov>; Jim Fairchild <jim@alderspring.net>; Jayshaun Talbert <talberja@oregonstate.edu>
Subject: Great Blue Heron monitoring at the Coffin Butte landfill site and adjacent areas of E.E. Wilson, 2000-2015

You don't often get email from clearwater@peak.org. Learn why this is important

Hi Greg,

Hope all's well as you look forward to field season, despite what I suppose could be complications for any programs relying on federal funds this year.

As I mentioned to you last year, I've been keeping track of community observations of the Great Blue Heron nesting colony at the Coffin Butte site, including my own observations as well as those of volunteers affiliated with the Mid-Willamette Bird

Alliance (formerly known as Audubon Society of Corvallis).

Here's a report that summarizes nesting-season observations both of heron nesting activity and potential causes of disturbance, from 2000 through the current year (right up to today, in fact). I hope this will help to inform you in your own assessment of the status of this heron nesting colony, and how it might best be protected for future seasons. Please feel free to give me a call if you have any questions!

A bit of data still missing from this report: Back in mid-January, I went into the ash grove area and mapped the trees with nests remaining from the 2024 nesting season. I have GPS coordinates for those trees as well as notes and sketches of the nest configurations. There are five nest trees (most of them with multiple trunks) holding a total of 13 "full-sized" stick nests, plus three smaller/partial nests that don't appear to have been completed.

I can get those nest-tree data to you at a later date, and will also share those with Shawn Woods (cc:d here) in case it's helpful for his management decisions in that area.

As a side note, I found a couple more elk/deer carcasses in there (pretty far decomposed) which I'll add into ODFW's roadkill project on iNaturalist (I'm up to about 8 now).

I'm also cc:ing Anne Mary Meyers and Jen Weikel here to keep them in the loop, as well as Jim Fairchild and Jayshaun Talbert on behalf of MVBA.

All the best,
Joel

--
Joel Geier
38566 Hwy 99W
Corvallis Oregon 97330-9320
tel +1 541 745-5821
clearwater@peak.org

From: D Mellinger
To: Benton Public Comment
Subject: Please deny LU-24-027
Date: Sunday, May 11, 2025 9:48:53 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

My name is David Mellinger, 3798 NW Jameson Dr., Corvallis, OR 97330. Attached please find my testimony about the Coffin Butte Landfill expansion request. Please deny this request. Thank you.

David Mellinger, 3798 NW Jameson Dr, Corvallis; Co-president of Mid-Willamette Bird Alliance (MWBA; formerly Audubon Society of Corvallis)

I would like to address the character of the area, which includes its wildlife. Not long after I moved to this area in 1999, I went out to Coffin Butte to see the Great Blue Heron rookery there. (A rookery is a collection of nests, and during nesting season it's typically a busy sight, with birds flying in and out, guarding the nests, tending to chicks, etc.) The rookery was well-known in the birding community, and sure enough it was an impressive sight to see all those huge, gangly birds nesting up in the trees there. The herons aren't there anymore; apparently they left in 2022. The Republic Services wildlife person pointed out in testimony that Bald Eagles were seen by the nests, giving the impression that the herons were pushed out by the eagles. But Bald Eagles have always been present in the area; I saw them by the landfill when I went there way back in the early 2000's, and the herons co-existed with them for decades. Furthermore, Great Blue Herons are known to nest in association with Bald Eagles.[1] The thing that did change in 2022, per MWBA members, was that Republic Services started some activities on the south side of Coffin Butte Road near the rookery. It is my understanding they weren't supposed to do this under their existing permit, but I'm no expert on the legalities here. Herons *are* responsive to human disturbance[2], and they soon left, possibly because of this disturbance. The eagles seen at their now-former nests may have been just trying to find things left by the departed herons. The herons are still in the area, nesting on the east side of Hwy. 99W, and would probably re-occupy their former rookery if the disturbance stopped, but that's exactly the opposite of what the proposed expansion would do.

Also I would like to talk about what "nearby" means in the context of a large dump like Coffin Butte. Republic Services drew a rectangle on a map and said that that was the "nearby" area for the dump. That rectangle was less than 10 miles in width, so the dump in the center is less than 5 miles from the edge of this rectangle.

We've heard about the toxins present in both the airborne plume and the leachate, including PFAS, the so-called forever chemicals that, in the words of the EPA, "have been linked to immune, cardiovascular, liver, and developmental health effects such as decreased fertility or low birth weight, as well as an increased risk of certain cancers." [3] The dump expansion will also have lead, cadmium, arsenic, and other toxic elements because while some people are diligent about recycling things correctly, plenty of other people are not, and just toss electronics, batteries, and so on into their trash. These substances are harmful in really, really minute amounts, so we should pay attention to where they're going.

The airborne plume with its PFAS and other toxins will extend for many miles in whatever direction the wind is blowing, far beyond the less-than-5 mile distance of the rectangle Republic Services considered "nearby".

In addition, the leachate from the dump will get into groundwater once the dump liner starts to leak, which it will eventually do, and will also get into the Willamette River because there is no effective way to get the toxins out of it. Trucking it to Corvallis's treatment plant isn't going to solve this problem, since that plant has no special means to clean leachate. So "nearby" should include the Willamette River from the Corvallis treatment plant all the way downstream to the Columbia and thence to the ocean, because that's where the toxins from this dump will go.

Approving the landfill expansion will change the character of the area, by changing the wildlife that can live both at Coffin Butte and in nearby places over a very large area downwind and downstream. Please deny this request for expansion.

Footnotes

1 "[P]hotographs taken by [Bryan] Watts during the Center for Conservation Biology survey reveal an anomaly: great blues and bald eagles nesting in the same trees.... Sometimes a great blue heron colony forms around an eagle nest, and sometimes an eagle moves into a great blue colony." William and Mary News Archive (2014) "Blue herons are nesting among the bald eagles, but why?" Avail. at https://www.wm.edu/news/stories/2014/blue-herons-are-nesting-among-the-bald-eagles,-but-why123.php .

2 "Heron species tend to desert nests and entire rookeries if repeatedly disturbed during the periods of pair formation, nest construction, or egg laying." Vermont Fish & Wildlife Department (2002) "Guidelines for protection & mitigation of impacts to Great Blue Heron rookeries in Vermont." Avail. at http://vtfishandwildlife.com/sites/fishandwildlife/files/documents/Conserve/RegulatoryReview/Guidelines/Guidelines_for_Protection_and_Mitigation_of_Impacts_to_Great_Blue_Heron_Rookeries_in_VT.pdf .

3 Environmental Protection Agency (2024) "*National Rivers and Streams Assessment: The Third Collaborative Survey* [2018-19]". (The survey was done in 2018-19 but results from it weren't published until 2023, then updated in 2024.) Avail. at https://riverstreamassessment.epa.gov/webreport/ .

From: Faye Yoshihara
To: Benton Public Comment
Subject: Copy of Oral Testimony LU-24-027 Speaker #26
Date: Sunday, May 11, 2025 2:51:25 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dear Benton County Public Comment, I am attached a written copy of my verbal testimony for the record. I was speaker #26.

Thank you,
Faye Yoshihara

Thank you, Commissioners, for the volunteer service and care you are putting into reviewing this CUP. My name is Faye Yoshihara, I live at 37461 Soap Creek Rd. I oppose LU-24-027, due to its impacts on the character of the area.

Chair Fowler, you asked how to square Mr. Ledford's odor analysis with our lived experience of "dump days". Beyond wind direction, we have cloud cover, elevation, topography, temperature, humidity, all interacting with wind and human caused air currents. In a former life, I was a sensory scientist working with human panels to discriminate odor profiles for the purposes of claim substantiation. I am submitting examples of data confirming obnoxious levels of landfill stench, including hydrogen sulfide (H2S), smelled near the Schoolhouse, 4 miles southwest. This data was generated by Oregon PAQMS, the award-winning science fair invention of three high school students. The applicant uses an assumed value of **36 ppm** for their Title V permit. This is a burden on our community. The EPA and even SCS Engineering's webinar "Staying Ahead of Odor Management at Solid Waste Facilities" state that the public recognizes H2S at **2 – 3 ppb** (billion). Our data shows 250 - 500 ppb, or 0.25 - 0.50 ppm, mixed with other foul-smelling molecules.

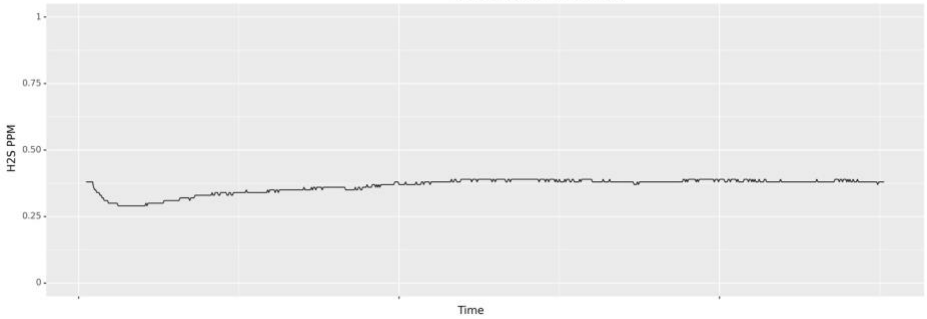
I experience the vagaries of how landfill stench moves on my daily jogs. At mid-valley and tucked behind a knoll at 500 feet, we get both PRC and dump. At the bottom of our ¼ mile driveway, at 400 feet, dump odors are more frequent. I look outside for inversion or cloud banks, which direction they are moving and the color to decide which way to go. Sometimes I get a visual cue, other times not.

I have a good nose, so I only report to DEQ when the odors are nauseating and only at my house. One DEQ report had Republic Services investigation that said nothing was smelled by their staff, however a dead skunk was seen on the road. Soon after, I reported on a blast from PRC, so they know, we know the difference between compost, landfill stench and skunk. In sensory science, there is a condition, called **anosmia or smell blindness**, that can be caused by over exposure to a particular molecule. One known cause is exposure to hydrogen sulfide which causes paralysis of the olfactory nerve.

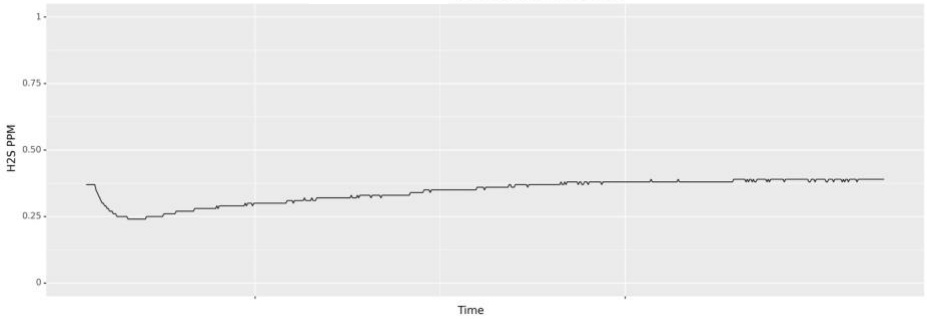
I've heard "acrid, chemical, vomit, feces, bad fart, rotten cabbage, sulfur, ammonia and nail polish remover" amongst other descriptors. While each person may perceive differently, our noses are far more accurate than Mr. Ledford's analysis. Odors are also disbursed by human caused air currents. I am submitting still images, but we also have video of garbage trucks tipping their loads, creating swirling clouds drifting in multiple, shifting directions over time. Near neighbors know when a leachate truck is being filled. Far neighbors smell the smallest molecules, including hydrogen sulfide, that stay airborne for much, much longer. True, one mercaptan in landfill stench is also that of skunk, but we know the difference.

The next generation of Benton County residents, possibly including the students who helped us, will live with the decision you take now. Please use your authority to deny the CUP and break the cycle by ensuring no future attempt can be made to grow this industrial sized facility. Thank you for giving me the opportunity to express my concerns.

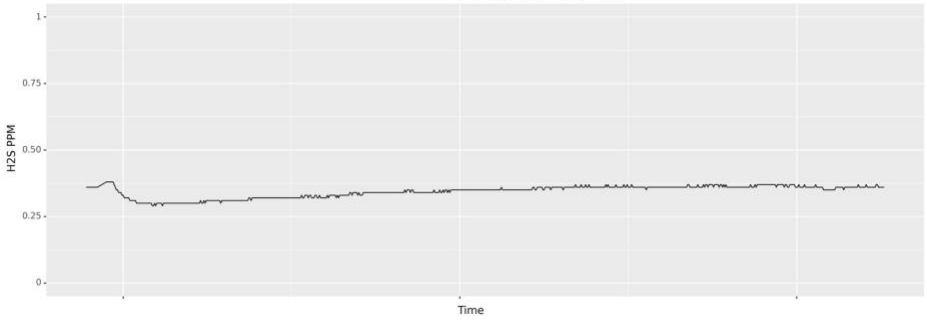
Feb 8 10:15am to 10:30am



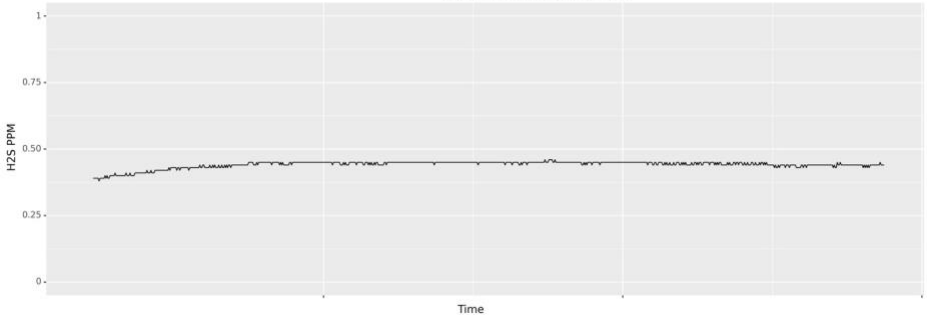
Feb 8 11:00am to 11:10am



Feb 9 11:20am to 11:30am



Feb 15 10:10am to 10:25am




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5 °C / 41 °F
01/31/2022 10:24:58 AM
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Meidase
5 °C / 41 °F
01/31/2022 10:26:58 AM
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CORRECTION: Dates should be 01/31/2023

From:	BILL GELLATLY
To:	Benton Public Comment
Subject:	From Bill Gellatly (speaker $36) - Supporting information for my testimony re: LU-24-027
Date:	Monday, May 12, 2025 11:25:36 AM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dear Members of the Planning Commission,

At the request of Commissioner Biscoe, here are the data files I received to prepare my testimony.

Attached are:

1. A spreadsheet with data from the City of Corvallis water treatment facility via FOIA. Pay particular attention to the highlighted cells on the tab "SITES."
2. A spreadsheet containing data from Riverbend (McMinnville) and Clean Water Services (Hillsboro).
3. A spreadsheet with the NRSA Fish Tissue Study with EPA districts, including the data for OREGON. That data drives the indicators in the map.
4. A map of the United States showing concentrations of PFAS in Fish

The graph section noted abo in the spreadsheets in attachment 3 underscore just one case.

Attachments 1 and 2 were sent to me by Joel Geier.

As I understand it, Mark Yeager used the FOIA process to get the data found in attachments 3 and 4. I received them from Joel Geier.

My comments regarding PFAS in Meibo eye drops came from an internet ad for Meibo, and I verified that the compound is a PFAS compound from Wikipedia.

In all fairness, information about PFAS is a far larger issue than just in landfills. It all flows from invention, manufacture, marketing, sales and use. The concern here is the disposal of waste and its safety thereafter.

Respectfully submitted,

Bill Gellatly
2923 NW 13th Place
Corvallis OR 97330
(503) 867-6514

AllData

Analyte	Lab Sample ID	Client Sample ID	Collection Time	Day Number	Dilution F	Result (ng/L)	Flag	High Limit	Low Limit
13C2 PFDA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	44			
13C2 PFDA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	45			
13C2 PFDA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	46			
13C2 PFDA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	29			
13C2 PFDA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	40			
13C2 PFDA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	310			
13C2 PFDA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	25			
13C2 PFDA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	270			
13C2 PFDA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3100			
13C2 PFDoA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	36			
13C2 PFDoA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	21			
13C2 PFDoA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	20			
13C2 PFDoA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	20			
13C2 PFDoA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	26			
13C2 PFDoA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	210			
13C2 PFDoA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	20			
13C2 PFDoA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	240			
13C2 PFDoA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3100			
13C2 PFHxA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	37			
13C2 PFHxA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	28			
13C2 PFHxA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	38			
13C2 PFHxA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	32			
13C2 PFHxA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	27			
13C2 PFHxA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	200			
13C2 PFHxA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	27			
13C2 PFHxA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	280			
13C2 PFHxA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3700			
13C2 PFTeDA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	17			
13C2 PFTeDA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	11			
13C2 PFTeDA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	3.7	*5-		
13C2 PFTeDA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	7	*5-		
13C2 PFTeDA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	19			
13C2 PFTeDA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	73			
13C2 PFTeDA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	12			
13C2 PFTeDA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	150			
13C2 PFTeDA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	1800			
13C2 PFUnA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	43			
13C2 PFUnA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	33			
13C2 PFUnA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	23			
13C2 PFUnA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	30			
13C2 PFUnA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	32			
13C2 PFUnA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	340			
13C2 PFUnA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	23			
13C2 PFUnA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	270			
13C2 PFUnA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3000			

13C3 HFPO-DA	**320-84547-6**	**Final Effluent**	**2/2/2022 6:50**	**33**	**1**	**33**	
13C3 HFPO-DA	**320-84547-4**	**Raw Influent**	**2/2/2022 13:10**	**33**	**1**	**33**	
13C3 HFPO-DA	**320-84547-2**	**Valley Landfills**	**2/2/2022 12:13**	**33**	**100**	**35**	
13C3 HFPO-DA	**320-89934-6**	**Final Effluent**	**6/30/2022 10:35**	**181**	**1**	**26**	
13C3 HFPO-DA	**320-89934-4**	**Raw Influent**	**6/30/2022 10:55**	**181**	**1**	**27**	
13C3 HFPO-DA	**320-89934-2**	**Valley Landfills**	**6/30/2022 9:05**	**181**	**1**	**200**	
13C3 HFPO-DA	**320-94028-6**	**Final Effluent**	**11/2/2022 16:10**	**306**	**1**	**19**	
13C3 HFPO-DA	**320-94028-4**	**Raw Influent**	**11/2/2022 11:10**	**306**	**1**	**230**	
13C3 HFPO-DA	**320-94028-2**	**Valley Landfills**	**11/2/2022 10:50**	**306**	**1**	**2200**	
13C3 PFBS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	37	
13C3 PFBS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	39	
13C3 PFBS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	42	
13C3 PFBS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	26	
13C3 PFBS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	28	
13C3 PFBS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	180	
13C3 PFBS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	25	
13C3 PFBS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	250	
13C3 PFBS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2600	
13C4 PFBA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	23	
13C4 PFBA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	23	
13C4 PFBA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	1	4500	
13C4 PFBA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	0.48	*5-
13C4 PFBA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	18	
13C4 PFBA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	18	
13C4 PFBA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	3400	
13C4 PFBA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	1.1	*5-
13C4 PFBA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	20	
13C4 PFBA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	230	
13C4 PFBA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	1900	
13C4 PFHpA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	36	
13C4 PFHpA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	27	
13C4 PFHpA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	47	
13C4 PFHpA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	32	
13C4 PFHpA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	34	
13C4 PFHpA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	270	
13C4 PFHpA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	26	
13C4 PFHpA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	270	
13C4 PFHpA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3300	
13C4 PFOA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	39	
13C4 PFOA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	40	
13C4 PFOA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	41	
13C4 PFOA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	30	
13C4 PFOA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	34	
13C4 PFOA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	180	
13C4 PFOA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	24	

13C4 PFOA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	250
13C4 PFOA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2500
13C4 PFOS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	37
13C4 PFOS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	40
13C4 PFOS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	30
13C4 PFOS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	26
13C4 PFOS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	33
13C4 PFOS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	270
13C4 PFOS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	23
13C4 PFOS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	230
13C4 PFOS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2700
13C5 PFNA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	42
13C5 PFNA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	42
13C5 PFNA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	45
13C5 PFNA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	31
13C5 PFNA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	36
13C5 PFNA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	230
13C5 PFNA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	24
13C5 PFNA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	260
13C5 PFNA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2900
13C5 PFPeA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	34
13C5 PFPeA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	35
13C5 PFPeA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	13
13C5 PFPeA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	26
13C5 PFPeA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	26
13C5 PFPeA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	85
13C5 PFPeA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	24
13C5 PFPeA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	260
13C5 PFPeA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2500
13C8 FOSA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	36
13C8 FOSA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	30
13C8 FOSA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	41
13C8 FOSA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	26
13C8 FOSA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	28
13C8 FOSA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	290
13C8 FOSA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	25
13C8 FOSA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	260
13C8 FOSA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3000
18O2 PFHxS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	36
18O2 PFHxS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	35
18O2 PFHxS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	48
18O2 PFHxS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	28
18O2 PFHxS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	30
18O2 PFHxS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	290
18O2 PFHxS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	24
18O2 PFHxS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	250

18O2 PFHxS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2700			
3:3 FTCA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	2.9		1.6	0.35
3:3 FTCA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	4.2		1.6	0.34
3:3 FTCA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	39
3:3 FTCA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	7.5		1.7	0.37
3:3 FTCA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	6.6		1.6	0.35
3:3 FTCA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	120		10	2.2
3:3 FTCA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	6		1.7	0.37
3:3 FTCA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	2.2
3:3 FTCA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	810		100	22
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.32
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.32
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	36
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.35
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.33
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	2
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.35
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	2
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100	20
4:2 FTS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.19
4:2 FTS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.19
4:2 FTS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	22
4:2 FTS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.21
4:2 FTS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.2
4:2 FTS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	1.2
4:2 FTS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.21
4:2 FTS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	1.2
4:2 FTS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100	12
5:3 FTCA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	90		1.6	0.27
5:3 FTCA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	120		1.6	0.26
5:3 FTCA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	9600		180	30
5:3 FTCA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	110		1.7	0.29
5:3 FTCA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	160		1.6	0.27
5:3 FTCA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	27000	E	10	1.7
5:3 FTCA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	85		1.7	0.29
5:3 FTCA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	190		10	1.7
5:3 FTCA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	35000	E	100	17
6:2 FTS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			4	2
6:2 FTS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			4	2
6:2 FTS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			450	220
6:2 FTS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			4.3	2.2
6:2 FTS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			4.1	2.1
6:2 FTS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	470		25	13
6:2 FTS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	4.7		4.4	2.2
6:2 FTS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			25	13
6:2 FTS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	680		250	130

7:3 FTCA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	2.3		1.6	0.44
7:3 FTCA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	13		1.6	0.44
7:3 FTCA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	5600		180	49
7:3 FTCA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	2.1		1.7	0.48
7:3 FTCA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	13		1.6	0.45
7:3 FTCA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	2700	E	10	2.8
7:3 FTCA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.48
7:3 FTCA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	12		10	2.8
7:3 FTCA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2600		100	28
8:2 FTS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.37
8:2 FTS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.37
8:2 FTS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	41
8:2 FTS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.4
8:2 FTS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.38
8:2 FTS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	120		10	2.3
8:2 FTS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.4
8:2 FTS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	2.3
8:2 FTS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	120		100	23
9Cl-PF3ONS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.19
9Cl-PF3ONS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.19
9Cl-PF3ONS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	22
9Cl-PF3ONS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.21
9Cl-PF3ONS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.2
9Cl-PF3ONS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	1.2
9Cl-PF3ONS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.21
9Cl-PF3ONS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	1.2
9Cl-PF3ONS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100	12
d-N-EtFOSA-M	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	28			
d-N-EtFOSA-M	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	23			
d-N-EtFOSA-M	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	16			
d-N-EtFOSA-M	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	21			
d-N-EtFOSA-M	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	22			
d-N-EtFOSA-M	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	200			
d-N-EtFOSA-M	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	16			
d-N-EtFOSA-M	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	180			
d-N-EtFOSA-M	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2500			
d-N-MeFOSA-M	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	29			
d-N-MeFOSA-M	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	18			
d-N-MeFOSA-M	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	27			
d-N-MeFOSA-M	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	20			
d-N-MeFOSA-M	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	15			
d-N-MeFOSA-M	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	250			
d-N-MeFOSA-M	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	18			
d-N-MeFOSA-M	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	200			
d-N-MeFOSA-M	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2500			
d3-NMeFOSAA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	39			

d3-NMeFOSAA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	24		
d3-NMeFOSAA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	39		
d3-NMeFOSAA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	35		
d3-NMeFOSAA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	25		
d3-NMeFOSAA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	250		
d3-NMeFOSAA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	25		
d3-NMeFOSAA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	280		
d3-NMeFOSAA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3200		
d5-NEtFOSAA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	46		
d5-NEtFOSAA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	28		
d5-NEtFOSAA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	46		
d5-NEtFOSAA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	31		
d5-NEtFOSAA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	21		
d5-NEtFOSAA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	300		
d5-NEtFOSAA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	27		
d5-NEtFOSAA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	280		
d5-NEtFOSAA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3200		
d7-N-MeFOSE-M	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	30		
d7-N-MeFOSE-M	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	18		
d7-N-MeFOSE-M	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	19		
d7-N-MeFOSE-M	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	20		
d7-N-MeFOSE-M	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	16		
d7-N-MeFOSE-M	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	190		
d7-N-MeFOSE-M	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	18		
d7-N-MeFOSE-M	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	210		
d7-N-MeFOSE-M	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2300		
d9-N-EtFOSE-M	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	30		
d9-N-EtFOSE-M	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	17		
d9-N-EtFOSE-M	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	17		
d9-N-EtFOSE-M	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	20		
d9-N-EtFOSE-M	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	29		
d9-N-EtFOSE-M	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	140		
d9-N-EtFOSE-M	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	19		
d9-N-EtFOSE-M	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	240		
d9-N-EtFOSE-M	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2900		
HFPO-DA (GenX)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			3.2 1.2
HFPO-DA (GenX)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			3.2 1.2
HFPO-DA (GenX)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			360 130
HFPO-DA (GenX)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			3.5 1.3
HFPO-DA (GenX)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			3.3 1.2
HFPO-DA (GenX)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			20 7.5
HFPO-DA (GenX)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			3.5 1.3
HFPO-DA (GenX)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			20 7.5
HFPO-DA (GenX)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			200 75
M2-4:2 FTS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	58	*5+	
M2-4:2 FTS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	65	*5+	

M2-4:2 FTS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	37		
M2-4:2 FTS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	33		
M2-4:2 FTS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	50		
M2-4:2 FTS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	220		
M2-4:2 FTS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	27		
M2-4:2 FTS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	290		
M2-4:2 FTS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	4300	*5+	
M2-6:2 FTS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	62	*5+	
M2-6:2 FTS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	97	*5+	
M2-6:2 FTS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	91	*5+	
M2-6:2 FTS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	39		
M2-6:2 FTS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	64	*5+	
M2-6:2 FTS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	350		
M2-6:2 FTS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	29		
M2-6:2 FTS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	320		
M2-6:2 FTS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	4000	*5+	
M2-8:2 FTS	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	53		
M2-8:2 FTS	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	91	*5+	
M2-8:2 FTS	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	40		
M2-8:2 FTS	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	34		
M2-8:2 FTS	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	66	*5+	
M2-8:2 FTS	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	480	*5+	
M2-8:2 FTS	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	27		
M2-8:2 FTS	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	340		
M2-8:2 FTS	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	4200	*5+	
NEtFOSA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6 0.7
NEtFOSA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6 0.69
NEtFOSA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180 78
NEtFOSA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7 0.75
NEtFOSA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6 0.72
NEtFOSA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10 4.4
NEtFOSA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7 0.76
NEtFOSA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10 4.4
NEtFOSA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100 44
NEtFOSAA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			4 1
NEtFOSAA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			4 1
NEtFOSAA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			450 120
NEtFOSAA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			4.3 1.1
NEtFOSAA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			4.1 1.1
NEtFOSAA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	260		25 6.5
NEtFOSAA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			4.4 1.1
NEtFOSAA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			25 6.5
NEtFOSAA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	300		250 65
NEtFOSE	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6 0.68
NEtFOSE	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6 0.68
NEtFOSE	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	220		180 76

NEtFOSE	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	4.3		1.7	0.74
NEtFOSE	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.7
NEtFOSE	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	140		10	4.3
NEtFOSE	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.74
NEtFOSE	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	4.3
NEtFOSE	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	120		100	43
NFDHA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.5
NFDHA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.49
NFDHA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	56
NFDHA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.54
NFDHA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.51
NFDHA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	3.1
NFDHA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		*+	1.7	0.54
NFDHA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		*+	10	3.1
NFDHA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		*+	100	31
NMeFOSA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.35
NMeFOSA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.34
NMeFOSA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	39
NMeFOSA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.37
NMeFOSA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.35
NMeFOSA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	2.2
NMeFOSA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.37
NMeFOSA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	2.2
NMeFOSA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100	22
NMeFOSAA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			4	0.96
NMeFOSAA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			4	0.95
NMeFOSAA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	500		450	110
NMeFOSAA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			4.3	1
NMeFOSAA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			4.1	0.99
NMeFOSAA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	590		25	6
NMeFOSAA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			4.4	1
NMeFOSAA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			25	6
NMeFOSAA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	590		250	60
NMeFOSE	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			3.2	1.1
NMeFOSE	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			3.2	1.1
NMeFOSE	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	390		360	130
NMeFOSE	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			3.5	1.2
NMeFOSE	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			3.3	1.2
NMeFOSE	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	320		20	7
NMeFOSE	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			3.5	1.2
NMeFOSE	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			20	7
NMeFOSE	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	350		200	70
Perfluorobutanesulfonic acid (PFBS)	**320-84547-6**	**Final Effluent**	**2/2/2022 6:50**	**33**	**1**	**67**		**1.6**	**0.16**
Perfluorobutanesulfonic acid (PFBS)	**320-84547-4**	**Raw Influent**	**2/2/2022 13:10**	**33**	**1**	**52**		**1.6**	**0.16**
Perfluorobutanesulfonic acid (PFBS)	**320-84547-2**	**Valley Landfills**	**2/2/2022 12:13**	**33**	**100**	**9700**		**180**	**18**
Perfluorobutanesulfonic acid (PFBS)	**320-89934-6**	**Final Effluent**	**6/30/2022 10:35**	**181**	**1**	**110**		**1.7**	**0.17**

Perfluorobutanesulfonic acid (PFBS)	**320-89934-4**	**Raw Influent**	**6/30/2022 10:55**	**181**	**1**	**72**		**1.6**	**0.16**
Perfluorobutanesulfonic acid (PFBS)	**320-89934-2**	**Valley Landfills**	**6/30/2022 9:05**	**181**	**1**	**15000**	**E**	**10**	**1**
Perfluorobutanesulfonic acid (PFBS)	**320-94028-6**	**Final Effluent**	**11/2/2022 16:10**	**306**	**1**	**240**		**1.7**	**0.17**
Perfluorobutanesulfonic acid (PFBS)	**320-94028-4**	**Raw Influent**	**11/2/2022 11:10**	**306**	**1**	**190**		**10**	**1**
Perfluorobutanesulfonic acid (PFBS)	**320-94028-2**	**Valley Landfills**	**11/2/2022 10:50**	**306**	**1**	**40000**	**E I**	**100**	**10**
Perfluorobutanoic acid (PFBA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	26		4	1.9
Perfluorobutanoic acid (PFBA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	19		4	1.9
Perfluorobutanoic acid (PFBA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	1	3300	H	500	240
Perfluorobutanoic acid (PFBA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	1100		450	220
Perfluorobutanoic acid (PFBA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	33		4.3	2.1
Perfluorobutanoic acid (PFBA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	22		4.1	2
Perfluorobutanoic acid (PFBA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	6100	E	25	12
Perfluorobutanoic acid (PFBA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	4300	H	500	240
Perfluorobutanoic acid (PFBA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	41		4.4	2.1
Perfluorobutanoic acid (PFBA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	37		25	12
Perfluorobutanoic acid (PFBA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	4900		250	120
Perfluorodecanesulfonic acid (PFDS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.26
Perfluorodecanesulfonic acid (PFDS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.25
Perfluorodecanesulfonic acid (PFDS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	29
Perfluorodecanesulfonic acid (PFDS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.28
Perfluorodecanesulfonic acid (PFDS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.26
Perfluorodecanesulfonic acid (PFDS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	1.6
Perfluorodecanesulfonic acid (PFDS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.28
Perfluorodecanesulfonic acid (PFDS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	1.6
Perfluorodecanesulfonic acid (PFDS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100	16
Perfluorodecanoic acid (PFDA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	2.4		1.6	0.25
Perfluorodecanoic acid (PFDA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.25
Perfluorodecanoic acid (PFDA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	28
Perfluorodecanoic acid (PFDA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	2.2		1.7	0.27
Perfluorodecanoic acid (PFDA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	2	I	1.6	0.25
Perfluorodecanoic acid (PFDA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	190		10	1.6
Perfluorodecanoic acid (PFDA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	2.7		1.7	0.27
Perfluorodecanoic acid (PFDA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	1.6
Perfluorodecanoic acid (PFDA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	180		100	16
Perfluorododecanesulfonic acid (PFDoS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.78
Perfluorododecanesulfonic acid (PFDoS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.77
Perfluorododecanesulfonic acid (PFDoS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	87
Perfluorododecanesulfonic acid (PFDoS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1			1.7	0.84
Perfluorododecanesulfonic acid (PFDoS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		*1	1.6	0.8
Perfluorododecanesulfonic acid (PFDoS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1			10	4.9
Perfluorododecanesulfonic acid (PFDoS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1			1.7	0.84
Perfluorododecanesulfonic acid (PFDoS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	4.9
Perfluorododecanesulfonic acid (PFDoS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1			100	49
Perfluorododecanoic acid (PFDoA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1			1.6	0.44
Perfluorododecanoic acid (PFDoA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.44

Perfluorododecanoic acid (PFDoA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	49
Perfluorododecanoic acid (PFDoA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.48
Perfluorododecanoic acid (PFDoA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.45
Perfluorododecanoic acid (PFDoA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	2.8
Perfluorododecanoic acid (PFDoA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.48
Perfluorododecanoic acid (PFDoA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	2.8
Perfluorododecanoic acid (PFDoA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	28
Perfluoroheptanesulfonic Acid (PFHpS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.15
Perfluoroheptanesulfonic Acid (PFHpS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.15
Perfluoroheptanesulfonic Acid (PFHpS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	17
Perfluoroheptanesulfonic Acid (PFHpS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.16
Perfluoroheptanesulfonic Acid (PFHpS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.16
Perfluoroheptanesulfonic Acid (PFHpS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	0.95
Perfluoroheptanesulfonic Acid (PFHpS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.17
Perfluoroheptanesulfonic Acid (PFHpS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	0.95
Perfluoroheptanesulfonic Acid (PFHpS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	9.5
Perfluoroheptanoic acid (PFHpA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	8.8	1.6	0.2
Perfluoroheptanoic acid (PFHpA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	6.1	1.6	0.2
Perfluoroheptanoic acid (PFHpA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	950	180	22
Perfluoroheptanoic acid (PFHpA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	7.8	1.7	0.22
Perfluoroheptanoic acid (PFHpA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	6.5	1.6	0.21
Perfluoroheptanoic acid (PFHpA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	910	10	1.3
Perfluoroheptanoic acid (PFHpA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	11	1.7	0.22
Perfluoroheptanoic acid (PFHpA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	11	10	1.3
Perfluoroheptanoic acid (PFHpA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	1100	100	13
Perfluorohexanesulfonic acid (PFHxS)	**320-84547-6**	**Final Effluent**	**2/2/2022 6:50**	**33**	**1**	**6.8**	**1.6**	**0.46**
Perfluorohexanesulfonic acid (PFHxS)	**320-84547-4**	**Raw Influent**	**2/2/2022 13:10**	**33**	**1**	**4.9**	**1.6**	**0.45**
Perfluorohexanesulfonic acid (PFHxS)	**320-84547-2**	**Valley Landfills**	**2/2/2022 12:13**	**33**	**100**	**460**	**180**	**51**
Perfluorohexanesulfonic acid (PFHxS)	**320-89934-6**	**Final Effluent**	**6/30/2022 10:35**	**181**	**1**	**8.2**	**1.7**	**0.49**
Perfluorohexanesulfonic acid (PFHxS)	**320-89934-4**	**Raw Influent**	**6/30/2022 10:55**	**181**	**1**	**6.5**	**1.6**	**0.47**
Perfluorohexanesulfonic acid (PFHxS)	**320-89934-2**	**Valley Landfills**	**6/30/2022 9:05**	**181**	**1**	**690**	**10**	**2.9**
Perfluorohexanesulfonic acid (PFHxS)	**320-94028-6**	**Final Effluent**	**11/2/2022 16:10**	**306**	**1**	**8.8**	**1.7**	**0.5**
Perfluorohexanesulfonic acid (PFHxS)	**320-94028-4**	**Raw Influent**	**11/2/2022 11:10**	**306**	**1**		**10**	**2.9**
Perfluorohexanesulfonic acid (PFHxS)	**320-94028-2**	**Valley Landfills**	**11/2/2022 10:50**	**306**	**1**	**840**	**100**	**29**
Perfluorohexanoic acid (PFHxA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	46	1.6	0.47
Perfluorohexanoic acid (PFHxA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	30	1.6	0.46
Perfluorohexanoic acid (PFHxA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	4900	180	52
Perfluorohexanoic acid (PFHxA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	46	1.7	0.5
Perfluorohexanoic acid (PFHxA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	33	1.6	0.48
Perfluorohexanoic acid (PFHxA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	4400	E 10	2.9
Perfluorohexanoic acid (PFHxA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	62	1.7	0.51
Perfluorohexanoic acid (PFHxA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	42	10	2.9
Perfluorohexanoic acid (PFHxA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	5600	100	29
Perfluorononanesulfonic acid (PFNS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.3
Perfluorononanesulfonic acid (PFNS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.29

Perfluorononanesulfonic acid (PFNS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	33
Perfluorononanesulfonic acid (PFNS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.32
Perfluorononanesulfonic acid (PFNS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.3
Perfluorononanesulfonic acid (PFNS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	1.9
Perfluorononanesulfonic acid (PFNS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.32
Perfluorononanesulfonic acid (PFNS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	1.9
Perfluorononanesulfonic acid (PFNS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	19
Perfluorononanoic acid (PFNA)	**320-84547-6**	**Final Effluent**	**2/2/2022 6:50**	**33**	**1**	**1.7**	**1.6**	**0.22**
Perfluorononanoic acid (PFNA)	**320-84547-4**	**Raw Influent**	**2/2/2022 13:10**	**33**	**1**		**1.6**	**0.21**
Perfluorononanoic acid (PFNA)	**320-84547-2**	**Valley Landfills**	**2/2/2022 12:13**	**33**	**100**		**180**	**24**
Perfluorononanoic acid (PFNA)	**320-89934-6**	**Final Effluent**	**6/30/2022 10:35**	**181**	**1**	**1.8**	**1.7**	**0.23**
Perfluorononanoic acid (PFNA)	**320-89934-4**	**Raw Influent**	**6/30/2022 10:55**	**181**	**1**		**1.6**	**0.22**
Perfluorononanoic acid (PFNA)	**320-89934-2**	**Valley Landfills**	**6/30/2022 9:05**	**181**	**1**	**140**	**10**	**1.4**
Perfluorononanoic acid (PFNA)	**320-94028-6**	**Final Effluent**	**11/2/2022 16:10**	**306**	**1**	**2.4**	**1.7**	**0.24**
Perfluorononanoic acid (PFNA)	**320-94028-4**	**Raw Influent**	**11/2/2022 11:10**	**306**	**1**		**10**	**1.4**
Perfluorononanoic acid (PFNA)	**320-94028-2**	**Valley Landfills**	**11/2/2022 10:50**	**306**	**1**	**180**	**100**	**14**
Perfluorooctanesulfonamide (FOSA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.79
Perfluorooctanesulfonamide (FOSA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.78
Perfluorooctanesulfonamide (FOSA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	88
Perfluorooctanesulfonamide (FOSA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.85
Perfluorooctanesulfonamide (FOSA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.81
Perfluorooctanesulfonamide (FOSA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	12	10	4.9
Perfluorooctanesulfonamide (FOSA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.85
Perfluorooctanesulfonamide (FOSA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	4.9
Perfluorooctanesulfonamide (FOSA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	49
Perfluorooctanesulfonic acid (PFOS)	**320-84547-6**	**Final Effluent**	**2/2/2022 6:50**	**33**	**1**	**8.6**	**1.6**	**0.43**
Perfluorooctanesulfonic acid (PFOS)	**320-84547-4**	**Raw Influent**	**2/2/2022 13:10**	**33**	**1**	**8**	**1.6**	**0.43**
Perfluorooctanesulfonic acid (PFOS)	**320-84547-2**	**Valley Landfills**	**2/2/2022 12:13**	**33**	**100**	**470**	**180**	**49**
Perfluorooctanesulfonic acid (PFOS)	**320-89934-6**	**Final Effluent**	**6/30/2022 10:35**	**181**	**1**	**20**	**1.7**	**0.47**
Perfluorooctanesulfonic acid (PFOS)	**320-89934-4**	**Raw Influent**	**6/30/2022 10:55**	**181**	**1**	**9**	**1.6**	**0.44**
Perfluorooctanesulfonic acid (PFOS)	**320-89934-2**	**Valley Landfills**	**6/30/2022 9:05**	**181**	**1**	**400**	**10**	**2.7**
Perfluorooctanesulfonic acid (PFOS)	**320-94028-6**	**Final Effluent**	**11/2/2022 16:10**	**306**	**1**	**46**	**1.7**	**0.47**
Perfluorooctanesulfonic acid (PFOS)	**320-94028-4**	**Raw Influent**	**11/2/2022 11:10**	**306**	**1**	**29**	**10**	**2.7**
Perfluorooctanesulfonic acid (PFOS)	**320-94028-2**	**Valley Landfills**	**11/2/2022 10:50**	**306**	**1**	**540**	**100**	**27**
Perfluorooctanoic acid (PFOA)	**320-84547-6**	**Final Effluent**	**2/2/2022 6:50**	**33**	**1**	**26**	**1.6**	**0.68**
Perfluorooctanoic acid (PFOA)	**320-84547-4**	**Raw Influent**	**2/2/2022 13:10**	**33**	**1**	**18**	**1.6**	**0.68**
Perfluorooctanoic acid (PFOA)	**320-84547-2**	**Valley Landfills**	**2/2/2022 12:13**	**33**	**100**	**3100**	**180**	**76**
Perfluorooctanoic acid (PFOA)	**320-89934-6**	**Final Effluent**	**6/30/2022 10:35**	**181**	**1**	**24**	**1.7**	**0.74**
Perfluorooctanoic acid (PFOA)	**320-89934-4**	**Raw Influent**	**6/30/2022 10:55**	**181**	**1**	**17**	**1.6**	**0.7**
Perfluorooctanoic acid (PFOA)	**320-89934-2**	**Valley Landfills**	**6/30/2022 9:05**	**181**	**1**	**2600**	**E** **10**	**4.3**
Perfluorooctanoic acid (PFOA)	**320-94028-6**	**Final Effluent**	**11/2/2022 16:10**	**306**	**1**	**28**	**1.7**	**0.74**
Perfluorooctanoic acid (PFOA)	**320-94028-4**	**Raw Influent**	**11/2/2022 11:10**	**306**	**1**	**24**	**10**	**4.3**
Perfluorooctanoic acid (PFOA)	**320-94028-2**	**Valley Landfills**	**11/2/2022 10:50**	**306**	**1**	**3000**	**100**	**43**
Perfluoropentanesulfonic acid (PFPeS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.24

Perfluoropentanesulfonic acid (PFPeS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.24
Perfluoropentanesulfonic acid (PFPeS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	27
Perfluoropentanesulfonic acid (PFPeS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.26
Perfluoropentanesulfonic acid (PFPeS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.25
Perfluoropentanesulfonic acid (PFPeS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	1.5
Perfluoropentanesulfonic acid (PFPeS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.26
Perfluoropentanesulfonic acid (PFPeS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	1.5
Perfluoropentanesulfonic acid (PFPeS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	15
Perfluoropentanoic acid (PFPeA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	16	1.6	0.39
Perfluoropentanoic acid (PFPeA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	12	1.6	0.39
Perfluoropentanoic acid (PFPeA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	930	180	44
Perfluoropentanoic acid (PFPeA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	18	1.7	0.43
Perfluoropentanoic acid (PFPeA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	7.9	1.6	0.4
Perfluoropentanoic acid (PFPeA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	1500	10	2.5
Perfluoropentanoic acid (PFPeA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	23	1.7	0.43
Perfluoropentanoic acid (PFPeA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	23	10	2.5
Perfluoropentanoic acid (PFPeA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	1800	100	25
Perfluorotetradecanoic acid (PFTeA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.59
Perfluorotetradecanoic acid (PFTeA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.58
Perfluorotetradecanoic acid (PFTeA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	66
Perfluorotetradecanoic acid (PFTeA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.63
Perfluorotetradecanoic acid (PFTeA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.6
Perfluorotetradecanoic acid (PFTeA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	3.7
Perfluorotetradecanoic acid (PFTeA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.64
Perfluorotetradecanoic acid (PFTeA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	3.7
Perfluorotetradecanoic acid (PFTeA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	37
Perfluorotridecanoic acid (PFTrDA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	1
Perfluorotridecanoic acid (PFTrDA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	1
Perfluorotridecanoic acid (PFTrDA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	120
Perfluorotridecanoic acid (PFTrDA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	1.1
Perfluorotridecanoic acid (PFTrDA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	1.1
Perfluorotridecanoic acid (PFTrDA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	6.5
Perfluorotridecanoic acid (PFTrDA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	1.1
Perfluorotridecanoic acid (PFTrDA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	6.5
Perfluorotridecanoic acid (PFTrDA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	65
Perfluoroundecanoic acid (PFUnA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.88
Perfluoroundecanoic acid (PFUnA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.87
Perfluoroundecanoic acid (PFUnA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	99
Perfluoroundecanoic acid (PFUnA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.95
Perfluoroundecanoic acid (PFUnA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.9
Perfluoroundecanoic acid (PFUnA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	5.5
Perfluoroundecanoic acid (PFUnA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.96
Perfluoroundecanoic acid (PFUnA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	5.5
Perfluoroundecanoic acid (PFUnA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	55
PFEESA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.23
PFEESA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.23

PFEESA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	26
PFEESA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.25
PFEESA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.24
PFEESA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	1.5
PFEESA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.25
PFEESA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	1.5
PFEESA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	15
PFMBA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.21
PFMBA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.21
PFMBA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	23
PFMBA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.23
PFMBA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.21
PFMBA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	1.3
PFMBA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.23
PFMBA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	1.3
PFMBA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	13
PFMPA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1		1.6	0.23
PFMPA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1		1.6	0.22
PFMPA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100		180	25
PFMPA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1		1.7	0.24
PFMPA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1		1.6	0.23
PFMPA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1		10	1.4
PFMPA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1		1.7	0.24
PFMPA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1		10	1.4
PFMPA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1		100	14

									Sample Type
Perfluorobutanoic acid (PFBA)	320-84547-2	Valley Landfills	2/2/2022 12:13		1	6800	500	240	**Matrix Spike Duplicate**
Perfluorobutanoic acid (PFBA)	320-84547-2	Valley Landfills	2/2/2022 12:13		1	6780	500	240	**Matrix Spike**
13C4 PFBA	320-84547-2	Valley Landfills	2/2/2022 12:13		1	4600			**Matrix Spike**
13C4 PFBA	320-84547-2	Valley Landfills	2/2/2022 12:13		1	3930			**Matrix Spike Duplicate**

Analyte	Lab Sample ID	Client Sample ID	Collection Time	Day Number	Dilution Factor	Result (ng/L)	Flag	High Limit	Low Limit	Regulated Average	Std Dev	MCL (proposed)	HQ_i	MCLG (proposed)	HBWC	MCL (proposed)
Perfluorooctanesulfonic acid (PFOS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	8.6		1.6	0.43	**24.9**	19.2	**4**			**0**	
Perfluorooctanesulfonic acid (PFOS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	8		1.6	0.43	**15.3**	11.8					
Perfluorooctanesulfonic acid (PFOS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	470		180	49	**470**	70					
Perfluorooctanesulfonic acid (PFOS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	20		1.7	0.47							
Perfluorooctanesulfonic acid (PFOS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	9		1.6	0.44							
Perfluorooctanesulfonic acid (PFOS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	400		10	2.7							
Perfluorooctanesulfonic acid (PFOS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	46		1.7	0.47							
Perfluorooctanesulfonic acid (PFOS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	29		10	2.7							
Perfluorooctanesulfonic acid (PFOS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	540		100	27							
Perfluorooctanoic acid (PFOA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	26		1.6	0.68	**26**	2	**4**			**0**	
Perfluorooctanoic acid (PFOA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	18		1.6	0.68	**19.7**	3.8					
Perfluorooctanoic acid (PFOA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	3100		180	76	**2900**	264.6					
Perfluorooctanoic acid (PFOA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	24		1.7	0.74							
Perfluorooctanoic acid (PFOA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	17		1.6	0.7							
Perfluorooctanoic acid (PFOA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	2600	E	10	4.3							
Perfluorooctanoic acid (PFOA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	28		1.7	0.74							
Perfluorooctanoic acid (PFOA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	24		10	4.3							
Perfluorooctanoic acid (PFOA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	3000		100	43							
Risk Index		**Final Effluent**											**3.75**			
Risk Index		**Raw Influent**											**10.42**			
Risk Index		**Valley Landfills**											**181.65**			
Perfluorohexanesulfonic acid (PFHxS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	6.8		1.6	0.46	**7.9**	1		**0.878**			**9**
Perfluorohexanesulfonic acid (PFHxS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	4.9		1.6	0.45	**5.7**	1.1		**0.633**			**9**
Perfluorohexanesulfonic acid (PFHxS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	460		180	51	**663.3**	191.4		**73.700**			**9**
Perfluorohexanesulfonic acid (PFHxS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	8.2		1.7	0.49							
Perfluorohexanesulfonic acid (PFHxS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	6.5		1.6	0.47							
Perfluorohexanesulfonic acid (PFHxS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	690		10	2.9							
Perfluorohexanesulfonic acid (PFHxS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	8.8		1.7	0.5							
Perfluorohexanesulfonic acid (PFHxS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	2.9							
Perfluorohexanesulfonic acid (PFHxS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	840		100	29							
Perfluorononanoic acid (PFNA)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	1.7		1.6	0.22	**2**	0.4	**0.200**				**10**
Perfluorononanoic acid (PFNA)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1			1.6	0.21	***0.6***	*0.7*	**0.060**				**10**
Perfluorononanoic acid (PFNA)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100			180	24	**160**	28.3	**16.000**				**10**
Perfluorononanoic acid (PFNA)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	1.8		1.7	0.23							
Perfluorononanoic acid (PFNA)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1			1.6	0.22							
Perfluorononanoic acid (PFNA)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	140		10	1.4							
Perfluorononanoic acid (PFNA)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	2.4		1.7	0.24							
Perfluorononanoic acid (PFNA)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1			10	1.4							
Perfluorononanoic acid (PFNA)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	180		100	14							
13C3 HFPO-DA	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	33				**26**	7	**2.600**				**10**
13C3 HFPO-DA	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	33				**96.7**	115.5	**9.670**				**10**
13C3 HFPO-DA	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	35				**811.7**	1205.2	**81.170**				**10**
13C3 HFPO-DA	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	26										
13C3 HFPO-DA	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	27										
13C3 HFPO-DA	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	200										
13C3 HFPO-DA	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	19										
13C3 HFPO-DA	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	230										
13C3 HFPO-DA	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	2200										
Perfluorobutanesulfonic acid (PFBS)	320-84547-6	Final Effluent	2/2/2022 6:50	33	1	67		1.6	0.16	**139**		**0.070**				**2000**
Perfluorobutanesulfonic acid (PFBS)	320-84547-4	Raw Influent	2/2/2022 13:10	33	1	52		1.6	0.16	**104.7**		**0.052**				**2000**
Perfluorobutanesulfonic acid (PFBS)	320-84547-2	Valley Landfills	2/2/2022 12:13	33	100	9700		180	18	**21566.7**		**10.783**				**2000**
Perfluorobutanesulfonic acid (PFBS)	320-89934-6	Final Effluent	6/30/2022 10:35	181	1	110		1.7	0.17							
Perfluorobutanesulfonic acid (PFBS)	320-89934-4	Raw Influent	6/30/2022 10:55	181	1	72		1.6	0.16							
Perfluorobutanesulfonic acid (PFBS)	320-89934-2	Valley Landfills	6/30/2022 9:05	181	1	15000	E	10	1							
Perfluorobutanesulfonic acid (PFBS)	320-94028-6	Final Effluent	11/2/2022 16:10	306	1	240		1.7	0.17							
Perfluorobutanesulfonic acid (PFBS)	320-94028-4	Raw Influent	11/2/2022 11:10	306	1	190		10	1							

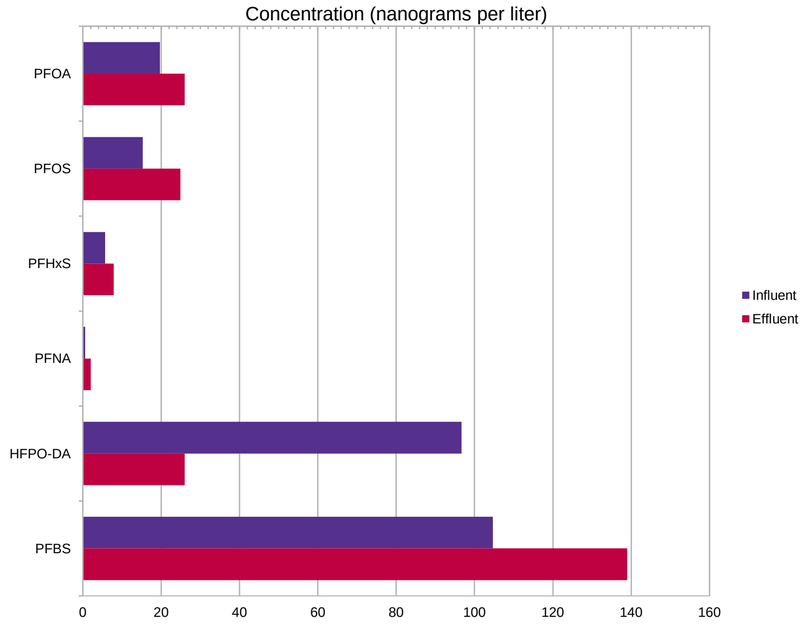
								Regulated		
Perfluorobutanesulfonic acid (PFBS)	320-94028-2	Valley Landfills	11/2/2022 10:50	306	1	40000	E I	100	10	

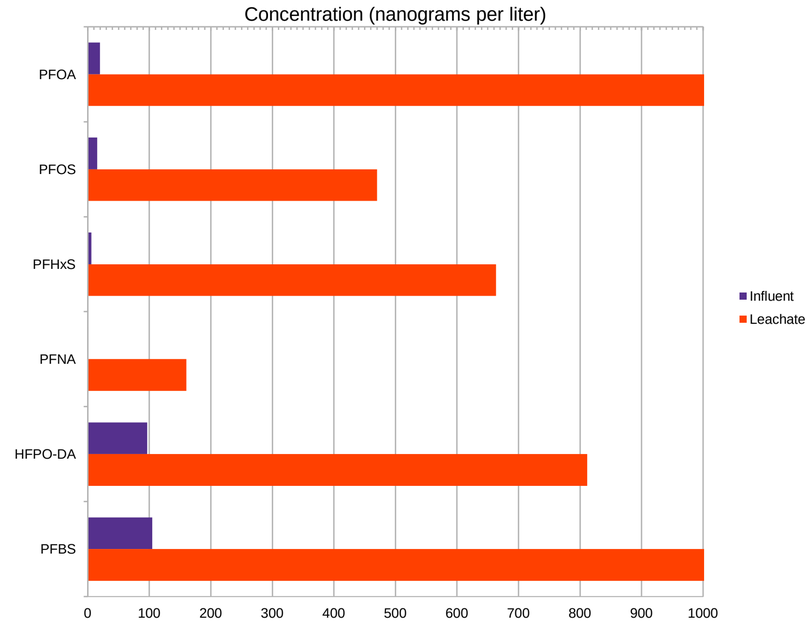
Summary

Contaminant	Leachate	Influent	Effluent	MCL	MCLG	HBWC	Notes	
PFOA	2900	20	26	4	0		Increased concentration in effluent, exceeds MCL by more than factor of 6	Perfluorooctanoic acid (PFOA)
PFOS	470	15	25	4	0		Increased concentration in effluent, exceeds MCL by more than factor of 6	Perfluorooctanesulfonic acid (PFOS)
PFHxS	663.3	5.7	7.9			9		Perfluorohexanesulfonic acid (PFHxS)
PFNA	160	0.6	2			10		Perfluorononanoic acid (PFNA)
HFPO-DA	811.7	96.7	26			10		HFPO-DA
PFBS	21566.7	104.7	139			2000		Perfluorobutanesulfonic acid (PFBS)
Hazard Quotients (HQ_i)								
PFHxS	73.70	0.63	0.88				Increased risk in effluent, close to HQ = 1	
PFNA	16.00	0.06	0.20				Increased risk in effluent though relatively low risk	
HFPO-DA	81.17	9.67	2.60				Decreased risk in effluent (treatment must remove this but may go to biosolids)	
PFBS	10.78	0.05	0.07				Increased risk in effluent though relatively low risk	
Hazard Index (Sum of HQ_i)	**181.7**	**10.4**	**3.7**					

All concentrations in ng/L
HBWC = Health Based Water Concentration

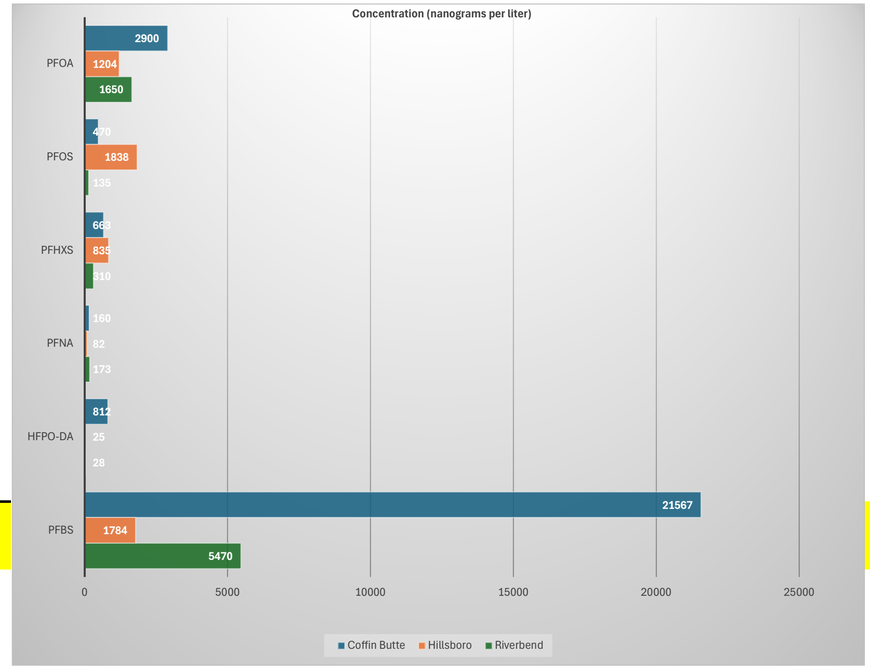
Proposed to be regulated by MCL
Proposed to be regulatedin aggregate by hazard index (HI)

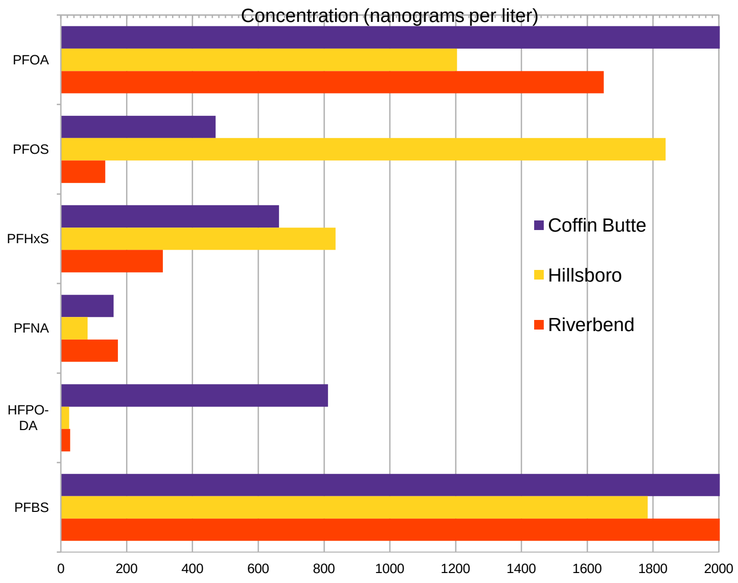




Sites

Contaminant	Coffin Butte	Hillsboro	Riverbend	MCL	MCLG	HBWC
PFOA	2900	1204	1650	4	0	
PFOS	470	1838	135	4	0	
PFHxS	663	835	310			9
PFNA	160	82	173			10
HFPO-DA	812	25	28			10
PFBS	**21567**	**1784**	**5470**			2000
		12.1	3.9	Ratio of CB amount to alternate site.		
Hazard Quotients (HQ_i)						
PFHxS	73.70	92.73	34.44			
PFNA	16.00	8.15	17.34			
HFPO-DA	81.17	2.53	2.80			
PFBS	10.78	0.89	2.74			
Hazard Index (Sı	**181.7**	**104.3**	**57.3**			





Orig Seq	Sample Location	Type	Sample Date	PFAS Compound	MDL
22	Hillsboro Landfill	Outfall of Industry	8/15/2019	10:2Fluorotelomersulfonic acid	10
62	WM Landfill-Comb	Outfall of Industry	10/29/2019	10:2Fluorotelomersulfonic acid	9.1
88	WM Landfill-Comb	Outfall of Industry	12/28/2020	10:2Fluorotelomersulfonic acid	65
118	WM Landfill-Comb	Outfall of Industry	2/16/2021	10:2Fluorotelomersulfonic acid	30
152	WM Landfill-Comb	Outfall of Industry	5/19/2021	10:2Fluorotelomersulfonic acid	62
184	WM Landfill-Comb	Outfall of Industry	8/18/2021	10:2Fluorotelomersulfonic acid	60
217	WM Landfill-Comb	Outfall of Industry	10/21/2021	10:2Fluorotelomersulfonic acid	6.1
254	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	10:2Fluorotelomersulfonic acid	8.8
279	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	10:2Fluorotelomersulfonic acid	64
312	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	10:2Fluorotelomersulfonic acid	5.8
345	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	10:2Fluorotelomersulfonic acid	34
376	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	10:2Fluorotelomersulfonic acid	62
409	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	10:2Fluorotelomersulfonic acid	6.5
445	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	10:2Fluorotelomersulfonic acid	8.8
471	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	10:2Fluorotelomersulfonic acid	72
504	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	10:2Fluorotelomersulfonic acid	30
514	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	10:2Fluorotelomersulfonic acid	NA
566	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	10:2Fluorotelomersulfonic acid	59
601	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	10:2Fluorotelomersulfonic acid	7.2
620	Hillsboro Landfill	Outfall of Industry	4/13/2022	10:2Fluorotelomersulfonic acid	100
659	Hillsboro Landfill	Outfall of Industry	8/4/2022	10:2Fluorotelomersulfonic acid	100
681	WM Landfill-Comb	Outfall of Industry	3/10/2022	10:2Fluorotelomersulfonic acid	6.4
713	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	10:2Fluorotelomersulfonic acid	6.3
745	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	10:2Fluorotelomersulfonic acid	6.6
777	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	10:2Fluorotelomersulfonic acid	34
816	WM Landfill-Comb	Outfall of Industry	4/13/2022	10:2Fluorotelomersulfonic acid	6.7
841	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	10:2Fluorotelomersulfonic acid	5.9
873	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	10:2Fluorotelomersulfonic acid	3.4
905	WM Landfill-Comb	Outfall of Industry	9/7/2022	10:2Fluorotelomersulfonic acid	3.4
937	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	10:2Fluorotelomersulfonic acid	3.4

969	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	10:2Fluorotelomersulfonic acid	6.7
1001	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	10:2Fluorotelomersulfonic acid	6.7
1033	WM Landfill-Comb	Outfall of Industry	12/15/2022	10:2Fluorotelomersulfonic acid	6.7
26	Hillsboro Landfill	Outfall of Industry	8/15/2019	11Cl-PF3OUdS	5
58	WM Landfill-Comb	Outfall of Industry	10/29/2019	11Cl-PF3OUdS	15
93	WM Landfill-Comb	Outfall of Industry	12/28/2020	11Cl-PF3OUdS	31
123	WM Landfill-Comb	Outfall of Industry	2/16/2021	11Cl-PF3OUdS	14
156	WM Landfill-Comb	Outfall of Industry	5/19/2021	11Cl-PF3OUdS	29
188	WM Landfill-Comb	Outfall of Industry	8/18/2021	11Cl-PF3OUdS	29
220	WM Landfill-Comb	Outfall of Industry	10/21/2021	11Cl-PF3OUdS	2.9
250	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	11Cl-PF3OUdS	15
284	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	11Cl-PF3OUdS	31
316	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	11Cl-PF3OUdS	2.8
349	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	11Cl-PF3OUdS	16
380	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	11Cl-PF3OUdS	30
413	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	11Cl-PF3OUdS	3.1
441	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	11Cl-PF3OUdS	15
476	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	11Cl-PF3OUdS	34
507	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	11Cl-PF3OUdS	14
537	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	11Cl-PF3OUdS	2
571	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	11Cl-PF3OUdS	28
604	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	11Cl-PF3OUdS	3.4
628	Hillsboro Landfill	Outfall of Industry	4/13/2022	11Cl-PF3OUdS	50
667	Hillsboro Landfill	Outfall of Industry	8/4/2022	11Cl-PF3OUdS	50
707	WM Landfill-Comb	Outfall of Industry	3/10/2022	11Cl-PF3OUdS	3
741	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	11Cl-PF3OUdS	3
774	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	11Cl-PF3OUdS	3.2
806	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	11Cl-PF3OUdS	16
838	WM Landfill-Comb	Outfall of Industry	4/13/2022	11Cl-PF3OUdS	3.2
870	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	11Cl-PF3OUdS	2.8
902	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	11Cl-PF3OUdS	2
934	WM Landfill-Comb	Outfall of Industry	9/7/2022	11Cl-PF3OUdS	2
966	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	11Cl-PF3OUdS	2
998	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	11Cl-PF3OUdS	3.2

1030	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	11Cl-PF3OUdS	3.2
1062	WM Landfill-Comb	Outfall of Industry	12/15/2022	11Cl-PF3OUdS	3.2
4	Hillsboro Landfill	Outfall of Industry	8/15/2019	4:2 Fluorotelomersulfonic acid	NA
49	WM Landfill-Comb	Outfall of Industry	10/29/2019	4:2 Fluorotelomersulfonic acid	250
67	WM Landfill-Comb	Outfall of Industry	12/28/2020	4:2 Fluorotelomersulfonic acid	NA
125	WM Landfill-Comb	Outfall of Industry	2/16/2021	4:2 Fluorotelomersulfonic acid	11
159	WM Landfill-Comb	Outfall of Industry	5/19/2021	4:2 Fluorotelomersulfonic acid	12
190	WM Landfill-Comb	Outfall of Industry	8/18/2021	4:2 Fluorotelomersulfonic acid	21
194	WM Landfill-Comb	Outfall of Industry	10/21/2021	4:2 Fluorotelomersulfonic acid	NA
241	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	4:2 Fluorotelomersulfonic acid	240
286	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	4:2 Fluorotelomersulfonic acid	23
318	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	4:2 Fluorotelomersulfonic acid	2.1
322	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	4:2 Fluorotelomersulfonic acid	NA
382	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	4:2 Fluorotelomersulfonic acid	22
386	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	4:2 Fluorotelomersulfonic acid	NA
430	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	4:2 Fluorotelomersulfonic acid	240
478	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	4:2 Fluorotelomersulfonic acid	26
509	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	4:2 Fluorotelomersulfonic acid	11
535	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	4:2 Fluorotelomersulfonic acid	12
573	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	4:2 Fluorotelomersulfonic acid	21
578	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	4:2 Fluorotelomersulfonic acid	NA
629	Hillsboro Landfill	Outfall of Industry	4/13/2022	4:2 Fluorotelomersulfonic acid	50
668	Hillsboro Landfill	Outfall of Industry	8/4/2022	4:2 Fluorotelomersulfonic acid	50
706	WM Landfill-Comb	Outfall of Industry	3/10/2022	4:2 Fluorotelomersulfonic acid	NA
740	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	4:2 Fluorotelomersulfonic acid	NA
773	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	4:2 Fluorotelomersulfonic acid	NA
805	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	4:2 Fluorotelomersulfonic acid	12
837	WM Landfill-Comb	Outfall of Industry	4/13/2022	4:2 Fluorotelomersulfonic acid	NA
869	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	4:2 Fluorotelomersulfonic acid	NA
901	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	4:2 Fluorotelomersulfonic acid	NA
933	WM Landfill-Comb	Outfall of Industry	9/7/2022	4:2 Fluorotelomersulfonic acid	2
965	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	4:2 Fluorotelomersulfonic acid	2
997	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	4:2 Fluorotelomersulfonic acid	NA
1029	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	4:2 Fluorotelomersulfonic acid	2.4

1061	WM Landfill-Comb	Outfall of Industry	12/15/2022	4:2 Fluorotelomersulfonic acid	2.4
5	Hillsboro Landfill	Outfall of Industry	8/15/2019	6:2 Fluorotelomersulfonic acid	NA
34	WM Landfill-Comb	Outfall of Industry	10/29/2019	6:2 Fluorotelomersulfonic acid	NA
68	WM Landfill-Comb	Outfall of Industry	12/28/2020	6:2 Fluorotelomersulfonic acid	NA
98	WM Landfill-Comb	Outfall of Industry	2/16/2021	6:2 Fluorotelomersulfonic acid	NA
130	WM Landfill-Comb	Outfall of Industry	5/19/2021	6:2 Fluorotelomersulfonic acid	NA
176	WM Landfill-Comb	Outfall of Industry	8/18/2021	6:2 Fluorotelomersulfonic acid	2500
195	WM Landfill-Comb	Outfall of Industry	10/21/2021	6:2 Fluorotelomersulfonic acid	NA
226	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	6:2 Fluorotelomersulfonic acid	NA
259	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	6:2 Fluorotelomersulfonic acid	NA
290	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	6:2 Fluorotelomersulfonic acid	NA
323	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	6:2 Fluorotelomersulfonic acid	NA
368	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	6:2 Fluorotelomersulfonic acid	2500
387	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	6:2 Fluorotelomersulfonic acid	NA
420	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	6:2 Fluorotelomersulfonic acid	NA
461	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	6:2 Fluorotelomersulfonic acid	270
482	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	6:2 Fluorotelomersulfonic acid	NA
515	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	6:2 Fluorotelomersulfonic acid	NA
556	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	6:2 Fluorotelomersulfonic acid	220
579	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	6:2 Fluorotelomersulfonic acid	NA
619	Hillsboro Landfill	Outfall of Industry	4/13/2022	6:2 Fluorotelomersulfonic acid	200
645	Hillsboro Landfill	Outfall of Industry	8/4/2022	6:2 Fluorotelomersulfonic acid	NA
688	WM Landfill-Comb	Outfall of Industry	3/10/2022	6:2 Fluorotelomersulfonic acid	NA
721	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	6:2 Fluorotelomersulfonic acid	NA
753	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	6:2 Fluorotelomersulfonic acid	NA
785	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	6:2 Fluorotelomersulfonic acid	NA
823	WM Landfill-Comb	Outfall of Industry	4/13/2022	6:2 Fluorotelomersulfonic acid	NA
849	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	6:2 Fluorotelomersulfonic acid	NA
881	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	6:2 Fluorotelomersulfonic acid	NA
913	WM Landfill-Comb	Outfall of Industry	9/7/2022	6:2 Fluorotelomersulfonic acid	NA
945	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	6:2 Fluorotelomersulfonic acid	NA
977	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	6:2 Fluorotelomersulfonic acid	NA
1009	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	6:2 Fluorotelomersulfonic acid	NA
1041	WM Landfill-Comb	Outfall of Industry	12/15/2022	6:2 Fluorotelomersulfonic acid	NA

6	Hillsboro Landfill	Outfall of Industry	8/15/2019	8:2 Fluorotelomersulfonic acid	NA
50	WM Landfill-Comb	Outfall of Industry	10/29/2019	8:2 Fluorotelomersulfonic acid	95
90	WM Landfill-Comb	Outfall of Industry	12/28/2020	8:2 Fluorotelomersulfonic acid	45
120	WM Landfill-Comb	Outfall of Industry	2/16/2021	8:2 Fluorotelomersulfonic acid	21
131	WM Landfill-Comb	Outfall of Industry	5/19/2021	8:2 Fluorotelomersulfonic acid	NA
162	WM Landfill-Comb	Outfall of Industry	8/18/2021	8:2 Fluorotelomersulfonic acid	NA
196	WM Landfill-Comb	Outfall of Industry	10/21/2021	8:2 Fluorotelomersulfonic acid	NA
242	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	8:2 Fluorotelomersulfonic acid	92
281	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	8:2 Fluorotelomersulfonic acid	44
291	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	8:2 Fluorotelomersulfonic acid	NA
324	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	8:2 Fluorotelomersulfonic acid	NA
354	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	8:2 Fluorotelomersulfonic acid	NA
388	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	8:2 Fluorotelomersulfonic acid	NA
432	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	8:2 Fluorotelomersulfonic acid	93
473	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	8:2 Fluorotelomersulfonic acid	49
483	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	8:2 Fluorotelomersulfonic acid	NA
516	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	8:2 Fluorotelomersulfonic acid	NA
568	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	8:2 Fluorotelomersulfonic acid	40
580	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	8:2 Fluorotelomersulfonic acid	NA
621	Hillsboro Landfill	Outfall of Industry	4/13/2022	8:2 Fluorotelomersulfonic acid	100
660	Hillsboro Landfill	Outfall of Industry	8/4/2022	8:2 Fluorotelomersulfonic acid	100
701	WM Landfill-Comb	Outfall of Industry	3/10/2022	8:2 Fluorotelomersulfonic acid	NA
734	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	8:2 Fluorotelomersulfonic acid	NA
767	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	8:2 Fluorotelomersulfonic acid	NA
799	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	8:2 Fluorotelomersulfonic acid	23
815	WM Landfill-Comb	Outfall of Industry	4/13/2022	8:2 Fluorotelomersulfonic acid	NA
863	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	8:2 Fluorotelomersulfonic acid	NA
895	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	8:2 Fluorotelomersulfonic acid	NA
927	WM Landfill-Comb	Outfall of Industry	9/7/2022	8:2 Fluorotelomersulfonic acid	NA
959	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	8:2 Fluorotelomersulfonic acid	NA
991	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	8:2 Fluorotelomersulfonic acid	NA
1023	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	8:2 Fluorotelomersulfonic acid	NA
1055	WM Landfill-Comb	Outfall of Industry	12/15/2022	8:2 Fluorotelomersulfonic acid	NA
27	Hillsboro Landfill	Outfall of Industry	8/15/2019	9Cl-PF3ONS	5

61	WM Landfill-Comb	Outfall of Industry	10/29/2019	9Cl-PF3ONS	11
95	WM Landfill-Comb	Outfall of Industry	12/28/2020	9Cl-PF3ONS	23
126	WM Landfill-Comb	Outfall of Industry	2/16/2021	9Cl-PF3ONS	11
158	WM Landfill-Comb	Outfall of Industry	5/19/2021	9Cl-PF3ONS	22
191	WM Landfill-Comb	Outfall of Industry	8/18/2021	9Cl-PF3ONS	21
222	WM Landfill-Comb	Outfall of Industry	10/21/2021	9Cl-PF3ONS	2.2
253	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	9Cl-PF3ONS	11
287	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	9Cl-PF3ONS	23
319	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	9Cl-PF3ONS	2.1
351	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	9Cl-PF3ONS	12
383	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	9Cl-PF3ONS	22
415	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	9Cl-PF3ONS	2.3
444	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	9Cl-PF3ONS	11
479	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	9Cl-PF3ONS	26
510	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	9Cl-PF3ONS	11
536	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	9Cl-PF3ONS	2
574	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	9Cl-PF3ONS	21
606	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	9Cl-PF3ONS	2.6
630	Hillsboro Landfill	Outfall of Industry	4/13/2022	9Cl-PF3ONS	50
669	Hillsboro Landfill	Outfall of Industry	8/4/2022	9Cl-PF3ONS	50
705	WM Landfill-Comb	Outfall of Industry	3/10/2022	9Cl-PF3ONS	2.3
739	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	9Cl-PF3ONS	2.3
772	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	9Cl-PF3ONS	2.4
804	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	9Cl-PF3ONS	12
836	WM Landfill-Comb	Outfall of Industry	4/13/2022	9Cl-PF3ONS	2.4
868	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	9Cl-PF3ONS	2.1
900	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	9Cl-PF3ONS	2
932	WM Landfill-Comb	Outfall of Industry	9/7/2022	9Cl-PF3ONS	2
964	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	9Cl-PF3ONS	2
996	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	9Cl-PF3ONS	2.4
1028	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	9Cl-PF3ONS	2.4
1060	WM Landfill-Comb	Outfall of Industry	12/15/2022	9Cl-PF3ONS	2.4
25	Hillsboro Landfill	Outfall of Industry	8/15/2019	ADONA	5
63	WM Landfill-Comb	Outfall of Industry	10/29/2019	ADONA	8.6

91	WM Landfill-Comb	Outfall of Industry	12/28/2020	ADONA	39
121	WM Landfill-Comb	Outfall of Industry	2/16/2021	ADONA	18
154	WM Landfill-Comb	Outfall of Industry	5/19/2021	ADONA	37
186	WM Landfill-Comb	Outfall of Industry	8/18/2021	ADONA	36
218	WM Landfill-Comb	Outfall of Industry	10/21/2021	ADONA	3.7
255	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	ADONA	8.3
282	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	ADONA	38
314	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	ADONA	3.5
347	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	ADONA	20
378	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	ADONA	37
411	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	ADONA	3.9
447	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	ADONA	8.3
474	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	ADONA	43
505	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	ADONA	18
543	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	ADONA	2
569	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	ADONA	35
602	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	ADONA	4.3
643	Hillsboro Landfill	Outfall of Industry	4/13/2022	ADONA	50
670	Hillsboro Landfill	Outfall of Industry	8/4/2022	ADONA	50
709	WM Landfill-Comb	Outfall of Industry	3/10/2022	ADONA	3.8
743	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	ADONA	3.8
776	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	ADONA	4
808	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	ADONA	20
840	WM Landfill-Comb	Outfall of Industry	4/13/2022	ADONA	4
872	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	ADONA	3.5
904	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	ADONA	2
936	WM Landfill-Comb	Outfall of Industry	9/7/2022	ADONA	2
968	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	ADONA	2
1000	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	ADONA	4
1032	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	ADONA	4
1064	WM Landfill-Comb	Outfall of Industry	12/15/2022	ADONA	4
1	Hillsboro Landfill	Outfall of Industry	8/15/2019	HFPO-DA	5
33	WM Landfill-Comb	Outfall of Industry	10/29/2019	HFPO-DA	71
65	WM Landfill-Comb	Outfall of Industry	12/28/2020	HFPO-DA	150

128	WM Landfill-Comb	Outfall of Industry	2/16/2021	HFPO-DA	67
160	WM Landfill-Comb	Outfall of Industry	5/19/2021	HFPO-DA	140
192	WM Landfill-Comb	Outfall of Industry	8/18/2021	HFPO-DA	130
224	WM Landfill-Comb	Outfall of Industry	10/21/2021	HFPO-DA	14
225	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	HFPO-DA	69
257	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	HFPO-DA	140
320	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	HFPO-DA	13
352	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	HFPO-DA	75
384	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	HFPO-DA	140
416	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	HFPO-DA	14
417	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	HFPO-DA	70
449	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	HFPO-DA	160
512	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	HFPO-DA	68
544	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	HFPO-DA	4
576	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	HFPO-DA	130
608	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	HFPO-DA	16
644	Hillsboro Landfill	Outfall of Industry	4/13/2022	HFPO-DA	NA
680	Hillsboro Landfill	Outfall of Industry	8/4/2022	HFPO-DA	100
682	WM Landfill-Comb	Outfall of Industry	3/10/2022	HFPO-DA	14
714	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	HFPO-DA	14
746	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	HFPO-DA	15
778	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	HFPO-DA	75
817	WM Landfill-Comb	Outfall of Industry	4/13/2022	HFPO-DA	15
842	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	HFPO-DA	13
874	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	HFPO-DA	7.5
906	WM Landfill-Comb	Outfall of Industry	9/7/2022	HFPO-DA	7.5
938	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	HFPO-DA	7.5
970	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	HFPO-DA	15
1002	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	HFPO-DA	15
1034	WM Landfill-Comb	Outfall of Industry	12/15/2022	HFPO-DA	15
627	Hillsboro Landfill	Outfall of Industry	4/13/2022	NEtFOSA	100
661	Hillsboro Landfill	Outfall of Industry	8/4/2022	NEtFOSA	100
7	Hillsboro Landfill	Outfall of Industry	8/15/2019	NEtFOSAA	NA
35	WM Landfill-Comb	Outfall of Industry	10/29/2019	NEtFOSAA	NA

69	WM Landfill-Comb	Outfall of Industry	12/28/2020	NEtFOSAA	NA
99	WM Landfill-Comb	Outfall of Industry	2/16/2021	NEtFOSAA	NA
132	WM Landfill-Comb	Outfall of Industry	5/19/2021	NEtFOSAA	NA
163	WM Landfill-Comb	Outfall of Industry	8/18/2021	NEtFOSAA	NA
197	WM Landfill-Comb	Outfall of Industry	10/21/2021	NEtFOSAA	NA
229	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	NEtFOSAA	NA
271	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	NEtFOSAA	120
292	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	NEtFOSAA	NA
325	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	NEtFOSAA	NA
355	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	NEtFOSAA	NA
389	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	NEtFOSAA	NA
433	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	NEtFOSAA	88
462	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	NEtFOSAA	140
496	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	NEtFOSAA	59
517	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	NEtFOSAA	NA
557	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	NEtFOSAA	110
581	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	NEtFOSAA	NA
631	Hillsboro Landfill	Outfall of Industry	4/13/2022	NEtFOSAA	50
646	Hillsboro Landfill	Outfall of Industry	8/4/2022	NEtFOSAA	NA
689	WM Landfill-Comb	Outfall of Industry	3/10/2022	NEtFOSAA	NA
722	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	NEtFOSAA	NA
754	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	NEtFOSAA	NA
786	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	NEtFOSAA	65
824	WM Landfill-Comb	Outfall of Industry	4/13/2022	NEtFOSAA	NA
850	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	NEtFOSAA	NA
882	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	NEtFOSAA	NA
914	WM Landfill-Comb	Outfall of Industry	9/7/2022	NEtFOSAA	NA
946	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	NEtFOSAA	NA
978	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	NEtFOSAA	NA
1010	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	NEtFOSAA	NA
1042	WM Landfill-Comb	Outfall of Industry	12/15/2022	NEtFOSAA	NA
622	Hillsboro Landfill	Outfall of Industry	4/13/2022	NEtFOSE	100
662	Hillsboro Landfill	Outfall of Industry	8/4/2022	NEtFOSE	100
623	Hillsboro Landfill	Outfall of Industry	4/13/2022	NMeFOSA	100

663	Hillsboro Landfill	Outfall of Industry	8/4/2022	NMeFOSA	100
8	Hillsboro Landfill	Outfall of Industry	8/15/2019	NMeFOSAA	NA
36	WM Landfill-Comb	Outfall of Industry	10/29/2019	NMeFOSAA	NA
70	WM Landfill-Comb	Outfall of Industry	12/28/2020	NMeFOSAA	NA
100	WM Landfill-Comb	Outfall of Industry	2/16/2021	NMeFOSAA	NA
133	WM Landfill-Comb	Outfall of Industry	5/19/2021	NMeFOSAA	NA
164	WM Landfill-Comb	Outfall of Industry	8/18/2021	NMeFOSAA	NA
198	WM Landfill-Comb	Outfall of Industry	10/21/2021	NMeFOSAA	NA
230	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	NMeFOSAA	NA
260	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	NMeFOSAA	NA
293	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	NMeFOSAA	NA
326	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	NMeFOSAA	NA
356	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	NMeFOSAA	NA
390	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	NMeFOSAA	NA
431	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	NMeFOSAA	140
464	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	NMeFOSAA	130
484	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	NMeFOSAA	NA
518	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	NMeFOSAA	NA
558	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	NMeFOSAA	110
582	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	NMeFOSAA	NA
610	Hillsboro Landfill	Outfall of Industry	4/13/2022	NMeFOSAA	NA
647	Hillsboro Landfill	Outfall of Industry	8/4/2022	NMeFOSAA	NA
685	WM Landfill-Comb	Outfall of Industry	3/10/2022	NMeFOSAA	NA
718	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	NMeFOSAA	NA
750	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	NMeFOSAA	NA
782	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	NMeFOSAA	NA
821	WM Landfill-Comb	Outfall of Industry	4/13/2022	NMeFOSAA	NA
846	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	NMeFOSAA	NA
878	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	NMeFOSAA	NA
910	WM Landfill-Comb	Outfall of Industry	9/7/2022	NMeFOSAA	NA
942	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	NMeFOSAA	NA
974	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	NMeFOSAA	NA
1006	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	NMeFOSAA	NA
1038	WM Landfill-Comb	Outfall of Industry	12/15/2022	NMeFOSAA	NA

624	Hillsboro Landfill	Outfall of Industry	4/13/2022	NMeFOSE	100
664	Hillsboro Landfill	Outfall of Industry	8/4/2022	NMeFOSE	100
9	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorobutanesulfonic acid	NA
38	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorobutanesulfonic acid	NA
71	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorobutanesulfonic acid	NA
101	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorobutanesulfonic acid	NA
134	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorobutanesulfonic acid	NA
165	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorobutanesulfonic acid	NA
199	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorobutanesulfonic acid	NA
231	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorobutanesulfonic acid	NA
261	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorobutanesulfonic acid	NA
294	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorobutanesulfonic acid	NA
327	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorobutanesulfonic acid	NA
357	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorobutanesulfonic acid	NA
391	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorobutanesulfonic acid	NA
421	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorobutanesulfonic acid	NA
451	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorobutanesulfonic acid	NA
485	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorobutanesulfonic acid	NA
519	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorobutanesulfonic acid	NA
546	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorobutanesulfonic acid	NA
583	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorobutanesulfonic acid	NA
611	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorobutanesulfonic acid	NA
648	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorobutanesulfonic acid	NA
696	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorobutanesulfonic acid	NA
729	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorobutanesulfonic acid	NA
762	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorobutanesulfonic acid	NA
794	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorobutanesulfonic acid	NA
813	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorobutanesulfonic acid	NA
858	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorobutanesulfonic acid	NA
890	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorobutanesulfonic acid	NA
922	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorobutanesulfonic acid	NA
954	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorobutanesulfonic acid	NA
986	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorobutanesulfonic acid	NA
1018	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorobutanesulfonic acid	NA

1050	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorobutanesulfonic acid	NA
10	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorobutanoic acid	NA
39	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorobutanoic acid	NA
72	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorobutanoic acid	NA
102	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorobutanoic acid	NA
135	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorobutanoic acid	NA
166	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorobutanoic acid	NA
200	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorobutanoic acid	NA
232	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorobutanoic acid	NA
262	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorobutanoic acid	NA
295	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorobutanoic acid	NA
328	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorobutanoic acid	NA
358	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorobutanoic acid	NA
392	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorobutanoic acid	NA
422	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorobutanoic acid	NA
452	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorobutanoic acid	NA
486	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorobutanoic acid	NA
520	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorobutanoic acid	NA
547	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorobutanoic acid	NA
584	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorobutanoic acid	NA
612	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorobutanoic acid	NA
649	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorobutanoic acid	NA
711	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorobutanoic acid	NA
744	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorobutanoic acid	NA
761	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorobutanoic acid	NA
793	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorobutanoic acid	NA
812	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorobutanoic acid	NA
857	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorobutanoic acid	NA
889	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorobutanoic acid	NA
921	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorobutanoic acid	NA
953	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorobutanoic acid	NA
985	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorobutanoic acid	NA
1017	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorobutanoic acid	NA
1049	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorobutanoic acid	NA

28	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorodecanesulfonic acid	5
59	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorodecanesulfonic acid	15
94	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorodecanesulfonic acid	31
124	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorodecanesulfonic acid	14
157	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorodecanesulfonic acid	29
189	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorodecanesulfonic acid	29
221	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorodecanesulfonic acid	2.9
251	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorodecanesulfonic acid	15
285	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorodecanesulfonic acid	31
317	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorodecanesulfonic acid	2.8
350	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorodecanesulfonic acid	16
381	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorodecanesulfonic acid	30
414	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorodecanesulfonic acid	3.1
442	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorodecanesulfonic acid	15
477	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorodecanesulfonic acid	34
508	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorodecanesulfonic acid	14
521	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorodecanesulfonic acid	NA
572	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorodecanesulfonic acid	28
605	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorodecanesulfonic acid	3.4
632	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorodecanesulfonic acid	50
671	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorodecanesulfonic acid	50
694	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorodecanesulfonic acid	3
727	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorodecanesulfonic acid	3
759	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorodecanesulfonic acid	3.2
791	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorodecanesulfonic acid	16
827	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorodecanesulfonic acid	3.2
855	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorodecanesulfonic acid	2.8
887	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorodecanesulfonic acid	2
919	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorodecanesulfonic acid	2
951	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorodecanesulfonic acid	2
983	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorodecanesulfonic acid	3.2
1015	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorodecanesulfonic acid	3.2
1047	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorodecanesulfonic acid	3.2
11	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorodecanoic acid	NA

40	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorodecanoic acid	NA
73	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorodecanoic acid	NA
103	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorodecanoic acid	NA
136	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorodecanoic acid	NA
167	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorodecanoic acid	NA
201	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorodecanoic acid	NA
233	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorodecanoic acid	NA
263	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorodecanoic acid	NA
296	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorodecanoic acid	NA
329	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorodecanoic acid	NA
359	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorodecanoic acid	NA
393	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorodecanoic acid	NA
423	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorodecanoic acid	NA
453	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorodecanoic acid	NA
487	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorodecanoic acid	NA
522	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorodecanoic acid	NA
548	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorodecanoic acid	NA
585	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorodecanoic acid	NA
613	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorodecanoic acid	NA
650	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorodecanoic acid	NA
693	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorodecanoic acid	NA
726	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorodecanoic acid	NA
758	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorodecanoic acid	NA
790	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorodecanoic acid	NA
826	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorodecanoic acid	NA
854	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorodecanoic acid	NA
886	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorodecanoic acid	NA
918	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorodecanoic acid	NA
950	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorodecanoic acid	NA
982	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorodecanoic acid	NA
1014	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorodecanoic acid	NA
1046	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorodecanoic acid	NA
29	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorododecanesulfonic acid	5
56	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorododecanesulfonic acid	21

84	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorododecanesulfonic acid	94
114	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorododecanesulfonic acid	43
148	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorododecanesulfonic acid	89
180	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorododecanesulfonic acid	87
213	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorododecanesulfonic acid	8.9
247	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorododecanesulfonic acid	21
275	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorododecanesulfonic acid	93
307	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorododecanesulfonic acid	8.5
340	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorododecanesulfonic acid	49
372	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorododecanesulfonic acid	90
404	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorododecanesulfonic acid	9.4
438	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorododecanesulfonic acid	21
467	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorododecanesulfonic acid	100
499	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorododecanesulfonic acid	44
538	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorododecanesulfonic acid	2
562	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorododecanesulfonic acid	85
597	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorododecanesulfonic acid	10
633	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorododecanesulfonic acid	50
672	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorododecanesulfonic acid	50
708	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorododecanesulfonic acid	9.2
742	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorododecanesulfonic acid	9.1
775	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorododecanesulfonic acid	9.6
807	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorododecanesulfonic acid	49
839	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorododecanesulfonic acid	9.7
871	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorododecanesulfonic acid	8.5
903	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorododecanesulfonic acid	4.9
935	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorododecanesulfonic acid	4.9
967	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorododecanesulfonic acid	4.9
999	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorododecanesulfonic acid	9.7
1031	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorododecanesulfonic acid	9.7
1063	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorododecanesulfonic acid	9.7
12	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorododecanoic acid	NA
54	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorododecanoic acid	26
89	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorododecanoic acid	53

119	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorododecanoic acid	25
153	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorododecanoic acid	51
185	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorododecanoic acid	49
202	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorododecanoic acid	NA
246	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorododecanoic acid	25
280	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorododecanoic acid	53
313	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorododecanoic acid	4.8
346	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorododecanoic acid	28
377	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorododecanoic acid	51
410	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorododecanoic acid	5.3
437	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorododecanoic acid	25
472	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorododecanoic acid	59
488	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorododecanoic acid	NA
523	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorododecanoic acid	NA
567	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorododecanoic acid	48
586	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorododecanoic acid	NA
634	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorododecanoic acid	50
673	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorododecanoic acid	50
691	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorododecanoic acid	NA
724	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorododecanoic acid	5.2
756	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorododecanoic acid	NA
788	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorododecanoic acid	28
825	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorododecanoic acid	NA
852	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorododecanoic acid	NA
884	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorododecanoic acid	NA
916	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorododecanoic acid	NA
948	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorododecanoic acid	NA
980	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorododecanoic acid	NA
1012	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorododecanoic acid	5.5
1044	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorododecanoic acid	NA
13	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluoroheptanesulfonic acid	NA
41	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluoroheptanesulfonic acid	NA
96	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluoroheptanesulfonic acid	18
127	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluoroheptanesulfonic acid	8.5

137	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluoroheptanesulfonic acid	NA
168	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluoroheptanesulfonic acid	NA
223	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluoroheptanesulfonic acid	2
234	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluoroheptanesulfonic acid	NA
288	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluoroheptanesulfonic acid	18
297	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluoroheptanesulfonic acid	NA
330	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluoroheptanesulfonic acid	NA
360	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluoroheptanesulfonic acid	NA
394	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluoroheptanesulfonic acid	NA
446	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluoroheptanesulfonic acid	8.8
480	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluoroheptanesulfonic acid	20
511	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluoroheptanesulfonic acid	8.6
524	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluoroheptanesulfonic acid	NA
575	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluoroheptanesulfonic acid	17
607	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluoroheptanesulfonic acid	2
635	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluoroheptanesulfonic acid	50
674	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluoroheptanesulfonic acid	50
698	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluoroheptanesulfonic acid	NA
731	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluoroheptanesulfonic acid	NA
764	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluoroheptanesulfonic acid	2
796	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluoroheptanesulfonic acid	9.5
829	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluoroheptanesulfonic acid	NA
860	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluoroheptanesulfonic acid	NA
892	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluoroheptanesulfonic acid	2
924	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluoroheptanesulfonic acid	NA
956	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluoroheptanesulfonic acid	NA
988	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluoroheptanesulfonic acid	2
1020	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluoroheptanesulfonic acid	NA
1052	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluoroheptanesulfonic acid	NA
14	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluoroheptanoic acid	NA
42	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluoroheptanoic acid	NA
74	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluoroheptanoic acid	NA
104	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluoroheptanoic acid	NA
138	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluoroheptanoic acid	NA

169	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluoroheptanoic acid	NA
203	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluoroheptanoic acid	NA
235	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluoroheptanoic acid	NA
264	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluoroheptanoic acid	NA
298	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluoroheptanoic acid	NA
331	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluoroheptanoic acid	NA
361	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluoroheptanoic acid	NA
395	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluoroheptanoic acid	NA
424	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluoroheptanoic acid	NA
454	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluoroheptanoic acid	NA
489	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluoroheptanoic acid	NA
525	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluoroheptanoic acid	NA
549	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluoroheptanoic acid	NA
587	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluoroheptanoic acid	NA
614	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluoroheptanoic acid	NA
651	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluoroheptanoic acid	NA
697	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluoroheptanoic acid	NA
730	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluoroheptanoic acid	NA
763	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluoroheptanoic acid	NA
795	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluoroheptanoic acid	NA
814	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluoroheptanoic acid	NA
859	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluoroheptanoic acid	NA
891	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluoroheptanoic acid	NA
923	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluoroheptanoic acid	NA
955	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluoroheptanoic acid	NA
987	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluoroheptanoic acid	NA
1019	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluoroheptanoic acid	NA
1051	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluoroheptanoic acid	NA
23	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorohexadecanoic acid	10
53	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorohexadecanoic acid	42
86	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorohexadecanoic acid	86
116	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorohexadecanoic acid	40
150	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorohexadecanoic acid	82
182	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorohexadecanoic acid	80

215	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorohexadecanoic acid	8.2
245	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorohexadecanoic acid	41
277	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorohexadecanoic acid	85
310	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorohexadecanoic acid	7.8
343	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorohexadecanoic acid	45
374	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorohexadecanoic acid	83
407	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorohexadecanoic acid	8.6
436	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorohexadecanoic acid	41
469	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorohexadecanoic acid	96
502	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorohexadecanoic acid	40
539	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorohexadecanoic acid	2
564	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorohexadecanoic acid	78
599	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorohexadecanoic acid	9.5
625	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorohexadecanoic acid	100
665	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorohexadecanoic acid	100
712	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorohexadecanoic acid	45
735	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorohexadecanoic acid	8.4
768	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorohexadecanoic acid	8.8
800	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorohexadecanoic acid	45
832	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorohexadecanoic acid	8.9
864	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorohexadecanoic acid	7.8
896	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorohexadecanoic acid	4.5
928	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorohexadecanoic acid	4.5
960	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorohexadecanoic acid	4.5
992	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorohexadecanoic acid	8.9
1024	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorohexadecanoic acid	8.9
1056	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorohexadecanoic acid	8.9
15	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorohexanesulfonic acid	NA
43	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorohexanesulfonic acid	NA
75	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorohexanesulfonic acid	NA
105	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorohexanesulfonic acid	NA
139	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorohexanesulfonic acid	NA
170	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorohexanesulfonic acid	NA
204	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorohexanesulfonic acid	NA

236	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorohexanesulfonic acid	NA
265	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorohexanesulfonic acid	NA
299	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorohexanesulfonic acid	NA
332	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorohexanesulfonic acid	NA
362	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorohexanesulfonic acid	NA
396	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorohexanesulfonic acid	NA
425	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorohexanesulfonic acid	NA
455	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorohexanesulfonic acid	NA
490	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorohexanesulfonic acid	NA
526	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorohexanesulfonic acid	NA
550	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorohexanesulfonic acid	NA
588	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorohexanesulfonic acid	NA
615	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorohexanesulfonic acid	NA
652	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorohexanesulfonic acid	NA
695	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorohexanesulfonic acid	NA
728	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorohexanesulfonic acid	NA
760	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorohexanesulfonic acid	NA
792	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorohexanesulfonic acid	NA
828	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorohexanesulfonic acid	NA
856	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorohexanesulfonic acid	NA
888	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorohexanesulfonic acid	NA
920	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorohexanesulfonic acid	NA
952	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorohexanesulfonic acid	NA
984	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorohexanesulfonic acid	NA
1016	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorohexanesulfonic acid	NA
1048	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorohexanesulfonic acid	NA
16	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorohexanoic acid	NA
44	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorohexanoic acid	NA
76	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorohexanoic acid	NA
106	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorohexanoic acid	NA
140	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorohexanoic acid	NA
171	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorohexanoic acid	NA
205	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorohexanoic acid	NA
237	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorohexanoic acid	NA

266	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorohexanoic acid	NA
300	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorohexanoic acid	NA
333	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorohexanoic acid	NA
363	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorohexanoic acid	NA
397	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorohexanoic acid	NA
426	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorohexanoic acid	NA
456	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorohexanoic acid	NA
491	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorohexanoic acid	NA
527	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorohexanoic acid	NA
551	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorohexanoic acid	NA
589	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorohexanoic acid	NA
616	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorohexanoic acid	NA
653	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorohexanoic acid	NA
690	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorohexanoic acid	NA
723	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorohexanoic acid	NA
755	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorohexanoic acid	NA
787	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorohexanoic acid	NA
810	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorohexanoic acid	NA
851	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorohexanoic acid	NA
883	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorohexanoic acid	NA
915	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorohexanoic acid	NA
947	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorohexanoic acid	NA
979	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorohexanoic acid	NA
1011	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorohexanoic acid	NA
1043	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorohexanoic acid	NA
30	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorononanesulfonic acid	5
64	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorononanesulfonic acid	7.6
92	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorononanesulfonic acid	36
122	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorononanesulfonic acid	17
155	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorononanesulfonic acid	34
187	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorononanesulfonic acid	33
219	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorononanesulfonic acid	3.4
256	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorononanesulfonic acid	7.4
283	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorononanesulfonic acid	35

315	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorononanesulfonic acid	3.2
348	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorononanesulfonic acid	19
379	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorononanesulfonic acid	34
412	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorononanesulfonic acid	3.6
448	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorononanesulfonic acid	7.4
475	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorononanesulfonic acid	40
506	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorononanesulfonic acid	17
541	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorononanesulfonic acid	2
570	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorononanesulfonic acid	32
603	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorononanesulfonic acid	4
636	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorononanesulfonic acid	50
675	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorononanesulfonic acid	50
702	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorononanesulfonic acid	3.5
736	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorononanesulfonic acid	3.5
769	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorononanesulfonic acid	3.7
801	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorononanesulfonic acid	19
833	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorononanesulfonic acid	3.7
865	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorononanesulfonic acid	3.3
897	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorononanesulfonic acid	2
929	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorononanesulfonic acid	2
961	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorononanesulfonic acid	2
993	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorononanesulfonic acid	3.7
1025	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorononanesulfonic acid	3.7
1057	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorononanesulfonic acid	3.7
17	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorononanoic acid	NA
45	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorononanoic acid	NA
77	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorononanoic acid	NA
107	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorononanoic acid	NA
141	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorononanoic acid	NA
172	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorononanoic acid	NA
206	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorononanoic acid	NA
238	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorononanoic acid	NA
267	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorononanoic acid	NA
301	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorononanoic acid	NA

334	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorononanoic acid	NA
364	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorononanoic acid	NA
398	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorononanoic acid	NA
427	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorononanoic acid	NA
457	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorononanoic acid	NA
492	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorononanoic acid	NA
528	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorononanoic acid	NA
552	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorononanoic acid	NA
590	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorononanoic acid	NA
637	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorononanoic acid	50
654	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorononanoic acid	NA
699	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorononanoic acid	NA
732	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorononanoic acid	NA
765	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorononanoic acid	NA
797	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorononanoic acid	NA
830	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorononanoic acid	NA
861	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorononanoic acid	NA
893	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorononanoic acid	NA
925	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorononanoic acid	NA
957	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorononanoic acid	NA
989	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorononanoic acid	NA
1021	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorononanoic acid	NA
1053	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorononanoic acid	NA
24	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorooctadecanoic acid	10
55	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorooctadecanoic acid	22
85	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorooctadecanoic acid	91
115	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorooctadecanoic acid	42
149	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorooctadecanoic acid	87
181	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorooctadecanoic acid	84
214	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorooctadecanoic acid	8.6
248	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorooctadecanoic acid	21
276	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorooctadecanoic acid	90
309	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorooctadecanoic acid	8.2
342	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorooctadecanoic acid	47

373	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorooctadecanoic acid	87
406	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorooctadecanoic acid	9.1
439	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorooctadecanoic acid	21
468	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorooctadecanoic acid	100
501	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorooctadecanoic acid	42
540	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorooctadecanoic acid	2
563	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorooctadecanoic acid	83
598	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorooctadecanoic acid	10
626	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorooctadecanoic acid	100
666	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorooctadecanoic acid	100
710	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorooctadecanoic acid	47
715	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorooctadecanoic acid	8.8
747	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorooctadecanoic acid	9.3
779	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorooctadecanoic acid	47
818	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorooctadecanoic acid	9.4
843	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorooctadecanoic acid	8.3
875	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorooctadecanoic acid	4.7
907	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorooctadecanoic acid	4.7
939	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorooctadecanoic acid	4.7
971	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorooctadecanoic acid	9.4
1003	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorooctadecanoic acid	9.4
1035	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorooctadecanoic acid	9.4
18	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorooctanesulfonamide	NA
57	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorooctanesulfonamide	17
83	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorooctanesulfonamide	95
113	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorooctanesulfonamide	44
147	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorooctanesulfonamide	90
179	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorooctanesulfonamide	88
212	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorooctanesulfonamide	9
249	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorooctanesulfonamide	16
274	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorooctanesulfonamide	94
308	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorooctanesulfonamide	8.5
341	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorooctanesulfonamide	49
371	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorooctanesulfonamide	91

405	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorooctanesulfonamide	9.4
440	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorooctanesulfonamide	16
466	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorooctanesulfonamide	110
500	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorooctanesulfonamide	44
529	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorooctanesulfonamide	NA
561	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorooctanesulfonamide	86
596	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorooctanesulfonamide	11
638	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorooctanesulfonamide	50
676	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorooctanesulfonamide	50
704	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorooctanesulfonamide	9.3
738	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorooctanesulfonamide	9.2
771	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorooctanesulfonamide	9.7
803	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorooctanesulfonamide	49
835	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorooctanesulfonamide	9.8
867	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorooctanesulfonamide	8.6
899	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorooctanesulfonamide	4.9
931	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorooctanesulfonamide	NA
963	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorooctanesulfonamide	NA
995	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorooctanesulfonamide	9.8
1027	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorooctanesulfonamide	9.8
1059	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorooctanesulfonamide	9.8
3	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorooctanesulfonic acid (PFOS)	NA
48	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorooctanesulfonic acid (PFOS)	NA
66	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorooctanesulfonic acid (PFOS)	NA
97	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorooctanesulfonic acid (PFOS)	NA
129	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorooctanesulfonic acid (PFOS)	NA
161	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorooctanesulfonic acid (PFOS)	NA
193	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorooctanesulfonic acid (PFOS)	NA
228	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorooctanesulfonic acid (PFOS)	NA
258	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorooctanesulfonic acid (PFOS)	NA
289	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorooctanesulfonic acid (PFOS)	NA
321	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorooctanesulfonic acid (PFOS)	NA
353	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorooctanesulfonic acid (PFOS)	NA
385	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorooctanesulfonic acid (PFOS)	NA

419	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorooctanesulfonic acid (PFOS)	NA
450	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorooctanesulfonic acid (PFOS)	NA
481	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorooctanesulfonic acid (PFOS)	NA
513	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorooctanesulfonic acid (PFOS)	NA
545	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorooctanesulfonic acid (PFOS)	NA
577	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorooctanesulfonic acid (PFOS)	NA
609	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorooctanesulfonic acid (PFOS)	NA
655	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorooctanesulfonic acid (PFOS)	NA
683	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorooctanesulfonic acid (PFOS)	NA
716	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorooctanesulfonic acid (PFOS)	NA
748	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorooctanesulfonic acid (PFOS)	NA
780	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorooctanesulfonic acid (PFOS)	NA
819	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorooctanesulfonic acid (PFOS)	NA
844	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorooctanesulfonic acid (PFOS)	NA
876	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorooctanesulfonic acid (PFOS)	NA
908	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorooctanesulfonic acid (PFOS)	NA
940	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorooctanesulfonic acid (PFOS)	NA
972	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorooctanesulfonic acid (PFOS)	NA
1004	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorooctanesulfonic acid (PFOS)	NA
1036	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorooctanesulfonic acid (PFOS)	NA
2	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorooctanoic acid (PFOA)	NA
37	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorooctanoic acid (PFOA)	NA
80	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorooctanoic acid (PFOA)	NA
110	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorooctanoic acid (PFOA)	NA
144	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorooctanoic acid (PFOA)	NA
175	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorooctanoic acid (PFOA)	NA
210	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorooctanoic acid (PFOA)	NA
227	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorooctanoic acid (PFOA)	NA
270	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorooctanoic acid (PFOA)	NA
304	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorooctanoic acid (PFOA)	NA
337	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorooctanoic acid (PFOA)	NA
367	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorooctanoic acid (PFOA)	NA
401	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorooctanoic acid (PFOA)	NA
418	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorooctanoic acid (PFOA)	NA

460	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorooctanoic acid (PFOA)	NA
495	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorooctanoic acid (PFOA)	NA
534	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorooctanoic acid (PFOA)	NA
555	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorooctanoic acid (PFOA)	NA
594	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorooctanoic acid (PFOA)	NA
618	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorooctanoic acid (PFOA)	NA
656	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorooctanoic acid (PFOA)	NA
692	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorooctanoic acid (PFOA)	NA
725	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorooctanoic acid (PFOA)	NA
757	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorooctanoic acid (PFOA)	NA
789	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorooctanoic acid (PFOA)	NA
811	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorooctanoic acid (PFOA)	NA
853	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorooctanoic acid (PFOA)	NA
885	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorooctanoic acid (PFOA)	NA
917	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorooctanoic acid (PFOA)	NA
949	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorooctanoic acid (PFOA)	NA
981	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorooctanoic acid (PFOA)	NA
1013	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorooctanoic acid (PFOA)	NA
1045	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorooctanoic acid (PFOA)	NA
19	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluoropentanesulfonic acid	NA
46	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluoropentanesulfonic acid	NA
78	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluoropentanesulfonic acid	NA
108	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluoropentanesulfonic acid	NA
142	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluoropentanesulfonic acid	NA
173	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluoropentanesulfonic acid	NA
207	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluoropentanesulfonic acid	NA
239	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluoropentanesulfonic acid	NA
268	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluoropentanesulfonic acid	NA
302	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluoropentanesulfonic acid	NA
335	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluoropentanesulfonic acid	NA
365	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluoropentanesulfonic acid	NA
399	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluoropentanesulfonic acid	NA
428	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluoropentanesulfonic acid	NA
458	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluoropentanesulfonic acid	NA

493	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluoropentanesulfonic acid	NA
530	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluoropentanesulfonic acid	NA
553	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluoropentanesulfonic acid	NA
591	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluoropentanesulfonic acid	NA
639	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluoropentanesulfonic acid	50
657	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluoropentanesulfonic acid	NA
687	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluoropentanesulfonic acid	NA
720	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluoropentanesulfonic acid	NA
752	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluoropentanesulfonic acid	NA
784	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluoropentanesulfonic acid	NA
822	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluoropentanesulfonic acid	NA
848	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluoropentanesulfonic acid	NA
880	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluoropentanesulfonic acid	NA
912	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluoropentanesulfonic acid	NA
944	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluoropentanesulfonic acid	NA
976	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluoropentanesulfonic acid	NA
1008	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluoropentanesulfonic acid	NA
1040	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluoropentanesulfonic acid	NA
20	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluoropentanoic acid	NA
47	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluoropentanoic acid	NA
79	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluoropentanoic acid	NA
109	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluoropentanoic acid	NA
143	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluoropentanoic acid	NA
174	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluoropentanoic acid	NA
208	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluoropentanoic acid	NA
240	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluoropentanoic acid	NA
269	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluoropentanoic acid	NA
303	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluoropentanoic acid	NA
336	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluoropentanoic acid	NA
366	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluoropentanoic acid	NA
400	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluoropentanoic acid	NA
429	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluoropentanoic acid	NA
459	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluoropentanoic acid	NA
494	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluoropentanoic acid	NA

531	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluoropentanoic acid	NA
554	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluoropentanoic acid	NA
592	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluoropentanoic acid	NA
617	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluoropentanoic acid	NA
658	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluoropentanoic acid	NA
686	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluoropentanoic acid	NA
719	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluoropentanoic acid	NA
751	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluoropentanoic acid	NA
783	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluoropentanoic acid	NA
809	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluoropentanoic acid	NA
847	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluoropentanoic acid	NA
879	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluoropentanoic acid	NA
911	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluoropentanoic acid	NA
943	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluoropentanoic acid	NA
975	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluoropentanoic acid	NA
1007	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluoropentanoic acid	NA
1039	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluoropentanoic acid	NA
31	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorotetradecanoic acid	5
60	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorotetradecanoic acid	14
87	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorotetradecanoic acid	71
117	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorotetradecanoic acid	33
151	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorotetradecanoic acid	67
183	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorotetradecanoic acid	65
216	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorotetradecanoic acid	6.7
252	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorotetradecanoic acid	13
278	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorotetradecanoic acid	70
311	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorotetradecanoic acid	6.4
344	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorotetradecanoic acid	37
375	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorotetradecanoic acid	68
408	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorotetradecanoic acid	7
443	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorotetradecanoic acid	13
470	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorotetradecanoic acid	78
503	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorotetradecanoic acid	33
532	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorotetradecanoic acid	NA

565	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorotetradecanoic acid	64
600	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorotetradecanoic acid	7.8
640	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorotetradecanoic acid	50
677	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorotetradecanoic acid	50
700	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorotetradecanoic acid	6.9
733	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorotetradecanoic acid	6.9
766	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorotetradecanoic acid	7.2
798	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorotetradecanoic acid	37
831	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorotetradecanoic acid	7.3
862	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorotetradecanoic acid	NA
894	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorotetradecanoic acid	3.7
926	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorotetradecanoic acid	3.7
958	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorotetradecanoic acid	3.7
990	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorotetradecanoic acid	7.3
1022	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorotetradecanoic acid	7.3
1054	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorotetradecanoic acid	7.3
32	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluorotridecanoic acid	5
51	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluorotridecanoic acid	62
81	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluorotridecanoic acid	130
111	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluorotridecanoic acid	58
145	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluorotridecanoic acid	120
177	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluorotridecanoic acid	120
211	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluorotridecanoic acid	12
243	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluorotridecanoic acid	60
272	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluorotridecanoic acid	120
305	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluorotridecanoic acid	11
338	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluorotridecanoic acid	65
369	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluorotridecanoic acid	120
402	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluorotridecanoic acid	13
434	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluorotridecanoic acid	60
463	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluorotridecanoic acid	140
497	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluorotridecanoic acid	59
542	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluorotridecanoic acid	2
559	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluorotridecanoic acid	110

595	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluorotridecanoic acid	14
641	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluorotridecanoic acid	50
678	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluorotridecanoic acid	50
703	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluorotridecanoic acid	12
737	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluorotridecanoic acid	12
770	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluorotridecanoic acid	13
802	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluorotridecanoic acid	65
834	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluorotridecanoic acid	13
866	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluorotridecanoic acid	11
898	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluorotridecanoic acid	6.5
930	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluorotridecanoic acid	6.5
962	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluorotridecanoic acid	6.5
994	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluorotridecanoic acid	13
1026	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluorotridecanoic acid	13
1058	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluorotridecanoic acid	13
21	Hillsboro Landfill	Outfall of Industry	8/15/2019	Perfluoroundecanoic acid	NA
52	WM Landfill-Comb	Outfall of Industry	10/29/2019	Perfluoroundecanoic acid	52
82	WM Landfill-Comb	Outfall of Industry	12/28/2020	Perfluoroundecanoic acid	110
112	WM Landfill-Comb	Outfall of Industry	2/16/2021	Perfluoroundecanoic acid	49
146	WM Landfill-Comb	Outfall of Industry	5/19/2021	Perfluoroundecanoic acid	100
178	WM Landfill-Comb	Outfall of Industry	8/18/2021	Perfluoroundecanoic acid	99
209	WM Landfill-Comb	Outfall of Industry	10/21/2021	Perfluoroundecanoic acid	NA
244	WM Landfill-Hillsboro	Outfall of Industry	10/29/2019	Perfluoroundecanoic acid	51
273	WM Landfill-Hillsboro	Outfall of Industry	12/28/2020	Perfluoroundecanoic acid	110
306	WM Landfill-Hillsboro	Outfall of Industry	2/16/2021	Perfluoroundecanoic acid	9.6
339	WM Landfill-Hillsboro	Outfall of Industry	5/19/2021	Perfluoroundecanoic acid	55
370	WM Landfill-Hillsboro	Outfall of Industry	8/18/2021	Perfluoroundecanoic acid	100
403	WM Landfill-Hillsboro	Outfall of Industry	10/21/2021	Perfluoroundecanoic acid	11
435	WM Landfill-Riverbend	Outfall of Industry	10/29/2019	Perfluoroundecanoic acid	51
465	WM Landfill-Riverbend	Outfall of Industry	12/28/2020	Perfluoroundecanoic acid	120
498	WM Landfill-Riverbend	Outfall of Industry	2/16/2021	Perfluoroundecanoic acid	50
533	WM Landfill-Riverbend	Outfall of Industry	5/19/2021	Perfluoroundecanoic acid	NA
560	WM Landfill-Riverbend	Outfall of Industry	8/18/2021	Perfluoroundecanoic acid	97
593	WM Landfill-Riverbend	Outfall of Industry	10/21/2021	Perfluoroundecanoic acid	NA

642	Hillsboro Landfill	Outfall of Industry	4/13/2022	Perfluoroundecanoic acid	50
679	Hillsboro Landfill	Outfall of Industry	8/4/2022	Perfluoroundecanoic acid	50
684	WM Landfill-Comb	Outfall of Industry	3/10/2022	Perfluoroundecanoic acid	10
717	WM Landfill-Hillsboro	Outfall of Industry	3/10/2022	Perfluoroundecanoic acid	10
749	WM Landfill-Riverbend	Outfall of Industry	3/10/2022	Perfluoroundecanoic acid	NA
781	WM Landfill-Riverbend	Outfall of Industry	4/13/2022	Perfluoroundecanoic acid	55
820	WM Landfill-Comb	Outfall of Industry	4/13/2022	Perfluoroundecanoic acid	11
845	WM Landfill-Hillsboro	Outfall of Industry	4/13/2022	Perfluoroundecanoic acid	NA
877	WM Landfill-Riverbend	Outfall of Industry	9/7/2022	Perfluoroundecanoic acid	NA
909	WM Landfill-Comb	Outfall of Industry	9/7/2022	Perfluoroundecanoic acid	NA
941	WM Landfill-Hillsboro	Outfall of Industry	9/7/2022	Perfluoroundecanoic acid	NA
973	WM Landfill-Riverbend	Outfall of Industry	12/15/2022	Perfluoroundecanoic acid	NA
1005	WM Landfill-Hillsboro	Outfall of Industry	12/15/2022	Perfluoroundecanoic acid	11
1037	WM Landfill-Comb	Outfall of Industry	12/15/2022	Perfluoroundecanoic acid	NA
			22 collection d	33 compounds	

Results - Quantitations Only	Results - Quantiations plus BQLs	Results - All (w BDL= MDL/2)	Units	Sewershed	Collected By
BDL	BDL	5	ng/L	Rock Creek	CWS
BDL	BDL	4.55	ng/L	Rock Creek	WM
BDL	BDL	32.5	ng/L	Rock Creek	WM
BDL	BDL	15	ng/L	Rock Creek	WM
BDL	BDL	31	ng/L	Rock Creek	WM
BDL	BDL	30	ng/L	Rock Creek	WM
BDL	BDL	3.05	ng/L	Rock Creek	WM
BDL	BDL	4.4	ng/L	Rock Creek	WM
BDL	BDL	32	ng/L	Rock Creek	WM
BDL	BDL	2.9	ng/L	Rock Creek	WM
BDL	BDL	17	ng/L	Rock Creek	WM
BDL	BDL	31	ng/L	Rock Creek	WM
BDL	BDL	3.25	ng/L	Rock Creek	WM
BDL	BDL	4.4	ng/L	Rock Creek	WM
BDL	BDL	36	ng/L	Rock Creek	WM
BDL	BDL	15	ng/L	Rock Creek	WM
2.8	2.8	2.8	ng/L	Rock Creek	WM
BDL	BDL	29.5	ng/L	Rock Creek	WM
BDL	BDL	3.6	ng/L	Rock Creek	WM
BDL	BDL	50	ng/L	Rock Creek	CWS
BDL	BDL	50	ng/L	Rock Creek	CWS
BDL	BDL	3.2	ng/L	Rock Creek	WM
BDL	BDL	3.15	ng/L	Rock Creek	WM
BDL	BDL	3.3	ng/L	Rock Creek	WM
BDL	BDL	17	ng/L	Rock Creek	WM
BDL	BDL	3.35	ng/L	Rock Creek	WM
BDL	BDL	2.95	ng/L	Rock Creek	WM
BDL	BDL	1.7	ng/L	Rock Creek	WM
BDL	BDL	1.7	ng/L	Rock Creek	WM
BDL	BDL	1.7	ng/L	Rock Creek	WM

BDL	BDL	3.35	ng/L	Rock Creek	WM
BDL	BDL	3.35	ng/L	Rock Creek	WM
BDL	BDL	3.35	ng/L	Rock Creek	WM
BDL	BDL	2.5	ng/L	Rock Creek	CWS
BDL	BDL	7.5	ng/L	Rock Creek	WM
BDL	BDL	15.5	ng/L	Rock Creek	WM
BDL	BDL	7	ng/L	Rock Creek	WM
BDL	BDL	14.5	ng/L	Rock Creek	WM
BDL	BDL	14.5	ng/L	Rock Creek	WM
BDL	BDL	1.45	ng/L	Rock Creek	WM
BDL	BDL	7.5	ng/L	Rock Creek	WM
BDL	BDL	15.5	ng/L	Rock Creek	WM
BDL	BDL	1.4	ng/L	Rock Creek	WM
BDL	BDL	8	ng/L	Rock Creek	WM
BDL	BDL	15	ng/L	Rock Creek	WM
BDL	BDL	1.55	ng/L	Rock Creek	WM
BDL	BDL	7.5	ng/L	Rock Creek	WM
BDL	BDL	17	ng/L	Rock Creek	WM
BDL	BDL	7	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	14	ng/L	Rock Creek	WM
BDL	BDL	1.7	ng/L	Rock Creek	WM
BDL	BDL	25	ng/L	Rock Creek	CWS
BDL	BDL	25	ng/L	Rock Creek	CWS
BDL	BDL	1.5	ng/L	Rock Creek	WM
BDL	BDL	1.5	ng/L	Rock Creek	WM
BDL	BDL	1.6	ng/L	Rock Creek	WM
BDL	BDL	8	ng/L	Rock Creek	WM
BDL	BDL	1.6	ng/L	Rock Creek	WM
BDL	BDL	1.4	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1.6	ng/L	Rock Creek	WM

BDL	BDL		1.6	ng/L	Rock Creek	WM
BDL	BDL		1.6	ng/L	Rock Creek	WM
Est		8.9	8.9	ng/L	Rock Creek	CWS
BDL	BDL		125	ng/L	Rock Creek	WM
26		26	26	ng/L	Rock Creek	WM
BDL	BDL		5.5	ng/L	Rock Creek	WM
BDL	BDL		6	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
3.7		3.7	3.7	ng/L	Rock Creek	WM
BDL	BDL		120	ng/L	Rock Creek	WM
BDL	BDL		11.5	ng/L	Rock Creek	WM
BDL	BDL		1.05	ng/L	Rock Creek	WM
16		16	16	ng/L	Rock Creek	WM
BDL	BDL		11	ng/L	Rock Creek	WM
16		16	16	ng/L	Rock Creek	WM
BDL	BDL		120	ng/L	Rock Creek	WM
BDL	BDL		13	ng/L	Rock Creek	WM
BDL	BDL		5.5	ng/L	Rock Creek	WM
BDL	BDL		6	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
7.7		7.7	7.7	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
8.3		8.3	8.3	ng/L	Rock Creek	WM
13		13	13	ng/L	Rock Creek	WM
6.1		6.1	6.1	ng/L	Rock Creek	WM
BDL	BDL		6	ng/L	Rock Creek	WM
5.7		5.7	5.7	ng/L	Rock Creek	WM
4.8		4.8	4.8	ng/L	Rock Creek	WM
6		6	6	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
8.1		8.1	8.1	ng/L	Rock Creek	WM
BDL	BDL		1.2	ng/L	Rock Creek	WM

BDL	BDL		1.2	ng/L	Rock Creek	WM
360		360	360	ng/L	Rock Creek	CWS
630		630	630	ng/L	Rock Creek	WM
1000		1000	1000	ng/L	Rock Creek	WM
240		240	240	ng/L	Rock Creek	WM
400		400	400	ng/L	Rock Creek	WM
BDL	BDL		1250	ng/L	Rock Creek	WM
200		200	200	ng/L	Rock Creek	WM
1200		1200	1200	ng/L	Rock Creek	WM
290		290	290	ng/L	Rock Creek	WM
77		77	77	ng/L	Rock Creek	WM
1500		1500	1500	ng/L	Rock Creek	WM
BDL	BDL		1250	ng/L	Rock Creek	WM
590		590	590	ng/L	Rock Creek	WM
250		250	250	ng/L	Rock Creek	WM
BDL	BDL		135	ng/L	Rock Creek	WM
160		160	160	ng/L	Rock Creek	WM
210		210	210	ng/L	Rock Creek	WM
BDL	BDL		110	ng/L	Rock Creek	WM
220		220	220	ng/L	Rock Creek	WM
BDL	BDL		100	ng/L	Rock Creek	CWS
610		610	610	ng/L	Rock Creek	CWS
470		470	470	ng/L	Rock Creek	WM
640		640	640	ng/L	Rock Creek	WM
190		190	190	ng/L	Rock Creek	WM
140		140	140	ng/L	Rock Creek	WM
150		150	150	ng/L	Rock Creek	WM
300		300	300	ng/L	Rock Creek	WM
160		160	160	ng/L	Rock Creek	WM
690		690	690	ng/L	Rock Creek	WM
1100		1100	1100	ng/L	Rock Creek	WM
220		220	220	ng/L	Rock Creek	WM
1700		1700	1700	ng/L	Rock Creek	WM
1000		1000	1000	ng/L	Rock Creek	WM

Est		25	25	ng/L	Rock Creek	CWS
BDL	BDL		47.5	ng/L	Rock Creek	WM
BDL	BDL		22.5	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
31		31	31	ng/L	Rock Creek	WM
42		42	42	ng/L	Rock Creek	WM
19		19	19	ng/L	Rock Creek	WM
BDL	BDL		46	ng/L	Rock Creek	WM
BDL	BDL		22	ng/L	Rock Creek	WM
5.4		5.4	5.4	ng/L	Rock Creek	WM
77		77	77	ng/L	Rock Creek	WM
62		62	62	ng/L	Rock Creek	WM
35		35	35	ng/L	Rock Creek	WM
BDL	BDL		46.5	ng/L	Rock Creek	WM
BDL	BDL		24.5	ng/L	Rock Creek	WM
23		23	23	ng/L	Rock Creek	WM
28		28	28	ng/L	Rock Creek	WM
BDL	BDL		20	ng/L	Rock Creek	WM
18		18	18	ng/L	Rock Creek	WM
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		50	ng/L	Rock Creek	CWS
28		28	28	ng/L	Rock Creek	WM
28		28	28	ng/L	Rock Creek	WM
17		17	17	ng/L	Rock Creek	WM
BDL	BDL		11.5	ng/L	Rock Creek	WM
20		20	20	ng/L	Rock Creek	WM
27		27	27	ng/L	Rock Creek	WM
26		26	26	ng/L	Rock Creek	WM
32		32	32	ng/L	Rock Creek	WM
35		35	35	ng/L	Rock Creek	WM
35		35	35	ng/L	Rock Creek	WM
36		36	36	ng/L	Rock Creek	WM
34		34	34	ng/L	Rock Creek	WM
BDL	BDL		2.5	ng/L	Rock Creek	CWS

BDL	BDL	5.5	ng/L	Rock Creek	WM
BDL	BDL	11.5	ng/L	Rock Creek	WM
BDL	BDL	5.5	ng/L	Rock Creek	WM
BDL	BDL	11	ng/L	Rock Creek	WM
BDL	BDL	10.5	ng/L	Rock Creek	WM
BDL	BDL	1.1	ng/L	Rock Creek	WM
BDL	BDL	5.5	ng/L	Rock Creek	WM
BDL	BDL	11.5	ng/L	Rock Creek	WM
BDL	BDL	1.05	ng/L	Rock Creek	WM
BDL	BDL	6	ng/L	Rock Creek	WM
BDL	BDL	11	ng/L	Rock Creek	WM
BDL	BDL	1.15	ng/L	Rock Creek	WM
BDL	BDL	5.5	ng/L	Rock Creek	WM
BDL	BDL	13	ng/L	Rock Creek	WM
BDL	BDL	5.5	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	10.5	ng/L	Rock Creek	WM
BDL	BDL	1.3	ng/L	Rock Creek	WM
BDL	BDL	25	ng/L	Rock Creek	CWS
BDL	BDL	25	ng/L	Rock Creek	CWS
BDL	BDL	1.15	ng/L	Rock Creek	WM
BDL	BDL	1.15	ng/L	Rock Creek	WM
BDL	BDL	1.2	ng/L	Rock Creek	WM
BDL	BDL	6	ng/L	Rock Creek	WM
BDL	BDL	1.2	ng/L	Rock Creek	WM
BDL	BDL	1.05	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1.2	ng/L	Rock Creek	WM
BDL	BDL	1.2	ng/L	Rock Creek	WM
BDL	BDL	1.2	ng/L	Rock Creek	WM
BDL	BDL	2.5	ng/L	Rock Creek	CWS
BDL	BDL	4.3	ng/L	Rock Creek	WM

BDL	BDL	19.5	ng/L	Rock Creek	WM
BDL	BDL	9	ng/L	Rock Creek	WM
BDL	BDL	18.5	ng/L	Rock Creek	WM
BDL	BDL	18	ng/L	Rock Creek	WM
BDL	BDL	1.85	ng/L	Rock Creek	WM
BDL	BDL	4.15	ng/L	Rock Creek	WM
BDL	BDL	19	ng/L	Rock Creek	WM
BDL	BDL	1.75	ng/L	Rock Creek	WM
BDL	BDL	10	ng/L	Rock Creek	WM
BDL	BDL	18.5	ng/L	Rock Creek	WM
BDL	BDL	1.95	ng/L	Rock Creek	WM
BDL	BDL	4.15	ng/L	Rock Creek	WM
BDL	BDL	21.5	ng/L	Rock Creek	WM
BDL	BDL	9	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	17.5	ng/L	Rock Creek	WM
BDL	BDL	2.15	ng/L	Rock Creek	WM
BDL	BDL	25	ng/L	Rock Creek	CWS
BDL	BDL	25	ng/L	Rock Creek	CWS
BDL	BDL	1.9	ng/L	Rock Creek	WM
BDL	BDL	1.9	ng/L	Rock Creek	WM
BDL	BDL	2	ng/L	Rock Creek	WM
BDL	BDL	10	ng/L	Rock Creek	WM
BDL	BDL	2	ng/L	Rock Creek	WM
BDL	BDL	1.75	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	1	ng/L	Rock Creek	WM
BDL	BDL	2	ng/L	Rock Creek	WM
BDL	BDL	2	ng/L	Rock Creek	WM
BDL	BDL	2	ng/L	Rock Creek	WM
BDL	BDL	2.5	ng/L	Rock Creek	CWS
BDL	BDL	35.5	ng/L	Rock Creek	WM
BDL	BDL	75	ng/L	Rock Creek	WM

BDL	BDL		33.5	ng/L	Rock Creek	WM
BDL	BDL		70	ng/L	Rock Creek	WM
BDL	BDL		65	ng/L	Rock Creek	WM
BDL	BDL		7	ng/L	Rock Creek	WM
BDL	BDL		34.5	ng/L	Rock Creek	WM
BDL	BDL		70	ng/L	Rock Creek	WM
BDL	BDL		6.5	ng/L	Rock Creek	WM
BDL	BDL		37.5	ng/L	Rock Creek	WM
BDL	BDL		70	ng/L	Rock Creek	WM
BDL	BDL		7	ng/L	Rock Creek	WM
BDL	BDL		35	ng/L	Rock Creek	WM
BDL	BDL		80	ng/L	Rock Creek	WM
BDL	BDL		34	ng/L	Rock Creek	WM
BDL	BDL		2	ng/L	Rock Creek	WM
BDL	BDL		65	ng/L	Rock Creek	WM
BDL	BDL		8	ng/L	Rock Creek	WM
				ng/L	Rock Creek	CWS
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		7	ng/L	Rock Creek	WM
BDL	BDL		7	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		37.5	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		6.5	ng/L	Rock Creek	WM
BDL	BDL		3.75	ng/L	Rock Creek	WM
BDL	BDL		3.75	ng/L	Rock Creek	WM
BDL	BDL		3.75	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		50	ng/L	Rock Creek	CWS
42	42		42	ng/L	Rock Creek	CWS
110	110		110	ng/L	Rock Creek	WM

	170		170	170	ng/L	Rock Creek	WM
	62		62	62	ng/L	Rock Creek	WM
	130		130	130	ng/L	Rock Creek	WM
	140		140	140	ng/L	Rock Creek	WM
	70		70	70	ng/L	Rock Creek	WM
	130		130	130	ng/L	Rock Creek	WM
BDL		BDL		60	ng/L	Rock Creek	WM
	71		71	71	ng/L	Rock Creek	WM
	260		260	260	ng/L	Rock Creek	WM
	240		240	240	ng/L	Rock Creek	WM
	100		100	100	ng/L	Rock Creek	WM
BDL		BDL		44	ng/L	Rock Creek	WM
BDL		BDL		70	ng/L	Rock Creek	WM
BDL		BDL		29.5	ng/L	Rock Creek	WM
	56		56	56	ng/L	Rock Creek	WM
BDL		BDL		55	ng/L	Rock Creek	WM
	65		65	65	ng/L	Rock Creek	WM
BDL		BDL		25	ng/L	Rock Creek	CWS
Est			74	74	ng/L	Rock Creek	CWS
	55		55	55	ng/L	Rock Creek	WM
	63		63	63	ng/L	Rock Creek	WM
	34		34	34	ng/L	Rock Creek	WM
BDL		BDL		32.5	ng/L	Rock Creek	WM
	37		37	37	ng/L	Rock Creek	WM
	240		240	240	ng/L	Rock Creek	WM
	34		34	34	ng/L	Rock Creek	WM
	150		150	150	ng/L	Rock Creek	WM
	440		440	440	ng/L	Rock Creek	WM
	92		92	92	ng/L	Rock Creek	WM
	490		490	490	ng/L	Rock Creek	WM
	290		290	290	ng/L	Rock Creek	WM
BDL		BDL		50	ng/L	Rock Creek	CWS
BDL		BDL		50	ng/L	Rock Creek	CWS
BDL		BDL		50	ng/L	Rock Creek	CWS

BDL	BDL		50	ng/L	Rock Creek	CWS
190		190	190	ng/L	Rock Creek	CWS
260		260	260	ng/L	Rock Creek	WM
170		170	170	ng/L	Rock Creek	WM
260		260	260	ng/L	Rock Creek	WM
450		450	450	ng/L	Rock Creek	WM
570		570	570	ng/L	Rock Creek	WM
530		530	530	ng/L	Rock Creek	WM
510		510	510	ng/L	Rock Creek	WM
530		530	530	ng/L	Rock Creek	WM
120		120	120	ng/L	Rock Creek	WM
930		930	930	ng/L	Rock Creek	WM
790		790	790	ng/L	Rock Creek	WM
1100		1100	1100	ng/L	Rock Creek	WM
BDL	BDL		70	ng/L	Rock Creek	WM
BDL	BDL		65	ng/L	Rock Creek	WM
110		110	110	ng/L	Rock Creek	WM
110		110	110	ng/L	Rock Creek	WM
BDL	BDL		55	ng/L	Rock Creek	WM
130		130	130	ng/L	Rock Creek	WM
Est		120	120	ng/L	Rock Creek	CWS
210		210	210	ng/L	Rock Creek	CWS
580		580	580	ng/L	Rock Creek	WM
790		790	790	ng/L	Rock Creek	WM
59		59	59	ng/L	Rock Creek	WM
61		61	61	ng/L	Rock Creek	WM
110		110	110	ng/L	Rock Creek	WM
530		530	530	ng/L	Rock Creek	WM
65		65	65	ng/L	Rock Creek	WM
330		330	330	ng/L	Rock Creek	WM
590		590	590	ng/L	Rock Creek	WM
160		160	160	ng/L	Rock Creek	WM
580		580	580	ng/L	Rock Creek	WM
340		340	340	ng/L	Rock Creek	WM

BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		50	ng/L	Rock Creek	CWS
5200		5200	5200	ng/L	Rock Creek	CWS
3500		3500	3500	ng/L	Rock Creek	WM
5000		5000	5000	ng/L	Rock Creek	WM
3800		3800	3800	ng/L	Rock Creek	WM
3000		3000	3000	ng/L	Rock Creek	WM
3200		3200	3200	ng/L	Rock Creek	WM
2000		2000	2000	ng/L	Rock Creek	WM
1500		1500	1500	ng/L	Rock Creek	WM
640		640	640	ng/L	Rock Creek	WM
180		180	180	ng/L	Rock Creek	WM
1700		1700	1700	ng/L	Rock Creek	WM
1400		1400	1400	ng/L	Rock Creek	WM
940		940	940	ng/L	Rock Creek	WM
5200		5200	5200	ng/L	Rock Creek	WM
5300		5300	5300	ng/L	Rock Creek	WM
4900		4900	4900	ng/L	Rock Creek	WM
5200		5200	5200	ng/L	Rock Creek	WM
5100		5100	5100	ng/L	Rock Creek	WM
7100		7100	7100	ng/L	Rock Creek	WM
4000		4000	4000	ng/L	Rock Creek	CWS
3400		3400	3400	ng/L	Rock Creek	CWS
3500		3500	3500	ng/L	Rock Creek	WM
1300		1300	1300	ng/L	Rock Creek	WM
6300		6300	6300	ng/L	Rock Creek	WM
3900		3900	3900	ng/L	Rock Creek	WM
4400		4400	4400	ng/L	Rock Creek	WM
680		680	680	ng/L	Rock Creek	WM
5900		5900	5900	ng/L	Rock Creek	WM
4300		4300	4300	ng/L	Rock Creek	WM
1300		1300	1300	ng/L	Rock Creek	WM
5800		5800	5800	ng/L	Rock Creek	WM
950		950	950	ng/L	Rock Creek	WM

3700	3700	3700	ng/L	Rock Creek	WM
2600	2600	2600	ng/L	Rock Creek	CWS
3800	3800	3800	ng/L	Rock Creek	WM
2600	2600	2600	ng/L	Rock Creek	WM
2800	2800	2800	ng/L	Rock Creek	WM
3100	3100	3100	ng/L	Rock Creek	WM
7300	7300	7300	ng/L	Rock Creek	WM
2500	2500	2500	ng/L	Rock Creek	WM
3700	3700	3700	ng/L	Rock Creek	WM
6800	6800	6800	ng/L	Rock Creek	WM
300	300	300	ng/L	Rock Creek	WM
4400	4400	4400	ng/L	Rock Creek	WM
7200	7200	7200	ng/L	Rock Creek	WM
13000	13000	13000	ng/L	Rock Creek	WM
2300	2300	2300	ng/L	Rock Creek	WM
2700	2700	2700	ng/L	Rock Creek	WM
2600	2600	2600	ng/L	Rock Creek	WM
2900	2900	2900	ng/L	Rock Creek	WM
3600	3600	3600	ng/L	Rock Creek	WM
4500	4500	4500	ng/L	Rock Creek	WM
2800	2800	2800	ng/L	Rock Creek	CWS
3100	3100	3100	ng/L	Rock Creek	CWS
4500	4500	4500	ng/L	Rock Creek	WM
5800	5800	5800	ng/L	Rock Creek	WM
2400	2400	2400	ng/L	Rock Creek	WM
2500	2500	2500	ng/L	Rock Creek	WM
5100	5100	5100	ng/L	Rock Creek	WM
3600	3600	3600	ng/L	Rock Creek	WM
3100	3100	3100	ng/L	Rock Creek	WM
4800	4800	4800	ng/L	Rock Creek	WM
5000	5000	5000	ng/L	Rock Creek	WM
3200	3200	3200	ng/L	Rock Creek	WM
3200	3200	3200	ng/L	Rock Creek	WM
3200	3200	3200	ng/L	Rock Creek	WM

BDL	BDL		2.5	ng/L	Rock Creek	CWS
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		15.5	ng/L	Rock Creek	WM
BDL	BDL		7	ng/L	Rock Creek	WM
BDL	BDL		14.5	ng/L	Rock Creek	WM
BDL	BDL		14.5	ng/L	Rock Creek	WM
BDL	BDL		1.45	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		15.5	ng/L	Rock Creek	WM
BDL	BDL		1.4	ng/L	Rock Creek	WM
BDL	BDL		8	ng/L	Rock Creek	WM
BDL	BDL		15	ng/L	Rock Creek	WM
BDL	BDL		1.55	ng/L	Rock Creek	WM
BDL	BDL		7.5	ng/L	Rock Creek	WM
BDL	BDL		17	ng/L	Rock Creek	WM
BDL	BDL		7	ng/L	Rock Creek	WM
2.4		2.4	2.4	ng/L	Rock Creek	WM
BDL	BDL		14	ng/L	Rock Creek	WM
BDL	BDL		1.7	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		1.5	ng/L	Rock Creek	WM
BDL	BDL		1.5	ng/L	Rock Creek	WM
BDL	BDL		1.6	ng/L	Rock Creek	WM
BDL	BDL		8	ng/L	Rock Creek	WM
BDL	BDL		1.6	ng/L	Rock Creek	WM
BDL	BDL		1.4	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1.6	ng/L	Rock Creek	WM
BDL	BDL		1.6	ng/L	Rock Creek	WM
BDL	BDL		1.6	ng/L	Rock Creek	WM
62		62	62	ng/L	Rock Creek	CWS

	61	61	61	ng/L	Rock Creek	WM
	320	320	320	ng/L	Rock Creek	WM
	180	180	180	ng/L	Rock Creek	WM
	190	190	190	ng/L	Rock Creek	WM
	130	130	130	ng/L	Rock Creek	WM
	150	150	150	ng/L	Rock Creek	WM
	43	43	43	ng/L	Rock Creek	WM
	46	46	46	ng/L	Rock Creek	WM
	9.9	9.9	9.9	ng/L	Rock Creek	WM
	47	47	47	ng/L	Rock Creek	WM
	33	33	33	ng/L	Rock Creek	WM
	45	45	45	ng/L	Rock Creek	WM
	70	70	70	ng/L	Rock Creek	WM
	300	300	300	ng/L	Rock Creek	WM
	280	280	280	ng/L	Rock Creek	WM
	360	360	360	ng/L	Rock Creek	WM
	290	290	290	ng/L	Rock Creek	WM
	540	540	540	ng/L	Rock Creek	WM
Est		110	110	ng/L	Rock Creek	CWS
Est		140	140	ng/L	Rock Creek	CWS
	79	79	79	ng/L	Rock Creek	WM
	26	26	26	ng/L	Rock Creek	WM
	130	130	130	ng/L	Rock Creek	WM
	130	130	130	ng/L	Rock Creek	WM
	98	98	98	ng/L	Rock Creek	WM
	44	44	44	ng/L	Rock Creek	WM
	290	290	290	ng/L	Rock Creek	WM
	170	170	170	ng/L	Rock Creek	WM
	75	75	75	ng/L	Rock Creek	WM
	360	360	360	ng/L	Rock Creek	WM
	48	48	48	ng/L	Rock Creek	WM
	220	220	220	ng/L	Rock Creek	WM
BDL	BDL		2.5	ng/L	Rock Creek	CWS
BDL	BDL		10.5	ng/L	Rock Creek	WM

BDL	BDL		47	ng/L	Rock Creek	WM
BDL	BDL		21.5	ng/L	Rock Creek	WM
BDL	BDL		44.5	ng/L	Rock Creek	WM
BDL	BDL		43.5	ng/L	Rock Creek	WM
BDL	BDL		4.45	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
BDL	BDL		46.5	ng/L	Rock Creek	WM
BDL	BDL		4.25	ng/L	Rock Creek	WM
BDL	BDL		24.5	ng/L	Rock Creek	WM
BDL	BDL		45	ng/L	Rock Creek	WM
BDL	BDL		4.7	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
BDL	BDL		50	ng/L	Rock Creek	WM
BDL	BDL		22	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		42.5	ng/L	Rock Creek	WM
BDL	BDL		5	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		4.6	ng/L	Rock Creek	WM
BDL	BDL		4.55	ng/L	Rock Creek	WM
BDL	BDL		4.8	ng/L	Rock Creek	WM
BDL	BDL		24.5	ng/L	Rock Creek	WM
BDL	BDL		4.85	ng/L	Rock Creek	WM
BDL	BDL		4.25	ng/L	Rock Creek	WM
BDL	BDL		2.45	ng/L	Rock Creek	WM
BDL	BDL		2.45	ng/L	Rock Creek	WM
BDL	BDL		2.45	ng/L	Rock Creek	WM
BDL	BDL		4.85	ng/L	Rock Creek	WM
BDL	BDL		4.85	ng/L	Rock Creek	WM
BDL	BDL		4.85	ng/L	Rock Creek	WM
Est		9.1	9.1	ng/L	Rock Creek	CWS
BDL	BDL		13	ng/L	Rock Creek	WM
BDL	BDL		26.5	ng/L	Rock Creek	WM

BDL	BDL		12.5	ng/L	Rock Creek	WM
BDL	BDL		25.5	ng/L	Rock Creek	WM
BDL	BDL		24.5	ng/L	Rock Creek	WM
13		13	13	ng/L	Rock Creek	WM
BDL	BDL		12.5	ng/L	Rock Creek	WM
BDL	BDL		26.5	ng/L	Rock Creek	WM
BDL	BDL		2.4	ng/L	Rock Creek	WM
BDL	BDL		14	ng/L	Rock Creek	WM
BDL	BDL		25.5	ng/L	Rock Creek	WM
BDL	BDL		2.65	ng/L	Rock Creek	WM
BDL	BDL		12.5	ng/L	Rock Creek	WM
BDL	BDL		29.5	ng/L	Rock Creek	WM
26		26	26	ng/L	Rock Creek	WM
57		57	57	ng/L	Rock Creek	WM
BDL	BDL		24	ng/L	Rock Creek	WM
32		32	32	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
12		12	12	ng/L	Rock Creek	WM
BDL	BDL		2.6	ng/L	Rock Creek	WM
24		24	24	ng/L	Rock Creek	WM
BDL	BDL		14	ng/L	Rock Creek	WM
15		15	15	ng/L	Rock Creek	WM
14		14	14	ng/L	Rock Creek	WM
35		35	35	ng/L	Rock Creek	WM
22		22	22	ng/L	Rock Creek	WM
9		9	9	ng/L	Rock Creek	WM
30		30	30	ng/L	Rock Creek	WM
BDL	BDL		2.75	ng/L	Rock Creek	WM
18		18	18	ng/L	Rock Creek	WM
Est		5.5	5.5	ng/L	Rock Creek	CWS
31		31	31	ng/L	Rock Creek	WM
BDL	BDL		9	ng/L	Rock Creek	WM
BDL	BDL		4.25	ng/L	Rock Creek	WM

	32	32	32	ng/L	Rock Creek	WM
	75	75	75	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
	29	29	29	ng/L	Rock Creek	WM
BDL	BDL		9	ng/L	Rock Creek	WM
	6	6	6	ng/L	Rock Creek	WM
	200	200	200	ng/L	Rock Creek	WM
	160	160	160	ng/L	Rock Creek	WM
	19	19	19	ng/L	Rock Creek	WM
BDL	BDL		4.4	ng/L	Rock Creek	WM
BDL	BDL		10	ng/L	Rock Creek	WM
BDL	BDL		4.3	ng/L	Rock Creek	WM
	2.3	2.3	2.3	ng/L	Rock Creek	WM
BDL	BDL		8.5	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
	6.1	6.1	6.1	ng/L	Rock Creek	WM
	11	11	11	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		4.75	ng/L	Rock Creek	WM
	4.7	4.7	4.7	ng/L	Rock Creek	WM
	31	31	31	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
	24	24	24	ng/L	Rock Creek	WM
	16	16	16	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
	70	70	70	ng/L	Rock Creek	WM
	39	39	39	ng/L	Rock Creek	WM
	750	750	750	ng/L	Rock Creek	CWS
	670	670	670	ng/L	Rock Creek	WM
	770	770	770	ng/L	Rock Creek	WM
	610	610	610	ng/L	Rock Creek	WM
	720	720	720	ng/L	Rock Creek	WM

	1100	1100	1100	ng/L	Rock Creek	WM
	410	410	410	ng/L	Rock Creek	WM
	820	820	820	ng/L	Rock Creek	WM
	640	640	640	ng/L	Rock Creek	WM
	130	130	130	ng/L	Rock Creek	WM
	970	970	970	ng/L	Rock Creek	WM
	930	930	930	ng/L	Rock Creek	WM
	900	900	900	ng/L	Rock Creek	WM
	720	720	720	ng/L	Rock Creek	WM
	720	720	720	ng/L	Rock Creek	WM
	670	670	670	ng/L	Rock Creek	WM
	800	800	800	ng/L	Rock Creek	WM
	990	990	990	ng/L	Rock Creek	WM
	1000	1000	1000	ng/L	Rock Creek	WM
	590	590	590	ng/L	Rock Creek	CWS
	750	750	750	ng/L	Rock Creek	CWS
	960	960	960	ng/L	Rock Creek	WM
	1100	1100	1100	ng/L	Rock Creek	WM
	850	850	850	ng/L	Rock Creek	WM
	650	650	650	ng/L	Rock Creek	WM
	800	800	800	ng/L	Rock Creek	WM
	570	570	570	ng/L	Rock Creek	WM
	920	920	920	ng/L	Rock Creek	WM
	900	900	900	ng/L	Rock Creek	WM
	820	820	820	ng/L	Rock Creek	WM
	950	950	950	ng/L	Rock Creek	WM
	820	820	820	ng/L	Rock Creek	WM
	940	940	940	ng/L	Rock Creek	WM
BDL	BDL		5	ng/L	Rock Creek	CWS
BDL	BDL		21	ng/L	Rock Creek	WM
BDL	BDL		43	ng/L	Rock Creek	WM
BDL	BDL		20	ng/L	Rock Creek	WM
BDL	BDL		41	ng/L	Rock Creek	WM
BDL	BDL		40	ng/L	Rock Creek	WM

BDL	BDL		4.1	ng/L	Rock Creek	WM
BDL	BDL		20.5	ng/L	Rock Creek	WM
BDL	BDL		42.5	ng/L	Rock Creek	WM
BDL	BDL		3.9	ng/L	Rock Creek	WM
BDL	BDL		22.5	ng/L	Rock Creek	WM
BDL	BDL		41.5	ng/L	Rock Creek	WM
BDL	BDL		4.3	ng/L	Rock Creek	WM
BDL	BDL		20.5	ng/L	Rock Creek	WM
BDL	BDL		48	ng/L	Rock Creek	WM
BDL	BDL		20	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		39	ng/L	Rock Creek	WM
BDL	BDL		4.75	ng/L	Rock Creek	WM
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		22.5	ng/L	Rock Creek	WM
BDL	BDL		4.2	ng/L	Rock Creek	WM
BDL	BDL		4.4	ng/L	Rock Creek	WM
BDL	BDL		22.5	ng/L	Rock Creek	WM
BDL	BDL		4.45	ng/L	Rock Creek	WM
BDL	BDL		3.9	ng/L	Rock Creek	WM
BDL	BDL		2.25	ng/L	Rock Creek	WM
BDL	BDL		2.25	ng/L	Rock Creek	WM
BDL	BDL		2.25	ng/L	Rock Creek	WM
BDL	BDL		4.45	ng/L	Rock Creek	WM
BDL	BDL		4.45	ng/L	Rock Creek	WM
BDL	BDL		4.45	ng/L	Rock Creek	WM
	460	460	460	ng/L	Rock Creek	CWS
	580	580	580	ng/L	Rock Creek	WM
	580	580	580	ng/L	Rock Creek	WM
	320	320	320	ng/L	Rock Creek	WM
	540	540	540	ng/L	Rock Creek	WM
	1300	1300	1300	ng/L	Rock Creek	WM
	250	250	250	ng/L	Rock Creek	WM

1000	1000	1000	ng/L	Rock Creek	WM
540	540	540	ng/L	Rock Creek	WM
180	180	180	ng/L	Rock Creek	WM
2100	2100	2100	ng/L	Rock Creek	WM
1700	1700	1700	ng/L	Rock Creek	WM
850	850	850	ng/L	Rock Creek	WM
370	370	370	ng/L	Rock Creek	WM
290	290	290	ng/L	Rock Creek	WM
300	300	300	ng/L	Rock Creek	WM
320	320	320	ng/L	Rock Creek	WM
360	360	360	ng/L	Rock Creek	WM
380	380	380	ng/L	Rock Creek	WM
250	250	250	ng/L	Rock Creek	CWS
840	840	840	ng/L	Rock Creek	CWS
570	570	570	ng/L	Rock Creek	WM
700	700	700	ng/L	Rock Creek	WM
240	240	240	ng/L	Rock Creek	WM
210	210	210	ng/L	Rock Creek	WM
280	280	280	ng/L	Rock Creek	WM
450	450	450	ng/L	Rock Creek	WM
300	300	300	ng/L	Rock Creek	WM
580	580	580	ng/L	Rock Creek	WM
890	890	890	ng/L	Rock Creek	WM
330	330	330	ng/L	Rock Creek	WM
890	890	890	ng/L	Rock Creek	WM
600	600	600	ng/L	Rock Creek	WM
5100	5100	5100	ng/L	Rock Creek	CWS
3500	3500	3500	ng/L	Rock Creek	WM
4500	4500	4500	ng/L	Rock Creek	WM
2900	2900	2900	ng/L	Rock Creek	WM
3000	3000	3000	ng/L	Rock Creek	WM
3800	3800	3800	ng/L	Rock Creek	WM
2000	2000	2000	ng/L	Rock Creek	WM
2500	2500	2500	ng/L	Rock Creek	WM

	1700	1700	1700	ng/L	Rock Creek	WM
	290	290	290	ng/L	Rock Creek	WM
	2300	2300	2300	ng/L	Rock Creek	WM
	2700	2700	2700	ng/L	Rock Creek	WM
	2200	2200	2200	ng/L	Rock Creek	WM
	5000	5000	5000	ng/L	Rock Creek	WM
	4400	4400	4400	ng/L	Rock Creek	WM
	3900	3900	3900	ng/L	Rock Creek	WM
	5100	5100	5100	ng/L	Rock Creek	WM
	6000	6000	6000	ng/L	Rock Creek	WM
	6200	6200	6200	ng/L	Rock Creek	WM
	4700	4700	4700	ng/L	Rock Creek	CWS
	4500	4500	4500	ng/L	Rock Creek	CWS
	3700	3700	3700	ng/L	Rock Creek	WM
	2400	2400	2400	ng/L	Rock Creek	WM
	4200	4200	4200	ng/L	Rock Creek	WM
	3900	3900	3900	ng/L	Rock Creek	WM
	4300	4300	4300	ng/L	Rock Creek	WM
	1600	1600	1600	ng/L	Rock Creek	WM
	5500	5500	5500	ng/L	Rock Creek	WM
	4300	4300	4300	ng/L	Rock Creek	WM
	2600	2600	2600	ng/L	Rock Creek	WM
	5900	5900	5900	ng/L	Rock Creek	WM
	2200	2200	2200	ng/L	Rock Creek	WM
	4000	4000	4000	ng/L	Rock Creek	WM
BDL	BDL		2.5	ng/L	Rock Creek	CWS
BDL	BDL		3.8	ng/L	Rock Creek	WM
BDL	BDL		18	ng/L	Rock Creek	WM
BDL	BDL		8.5	ng/L	Rock Creek	WM
BDL	BDL		17	ng/L	Rock Creek	WM
BDL	BDL		16.5	ng/L	Rock Creek	WM
BDL	BDL		1.7	ng/L	Rock Creek	WM
BDL	BDL		3.7	ng/L	Rock Creek	WM
BDL	BDL		17.5	ng/L	Rock Creek	WM

BDL	BDL		1.6	ng/L	Rock Creek	WM
BDL	BDL		9.5	ng/L	Rock Creek	WM
BDL	BDL		17	ng/L	Rock Creek	WM
BDL	BDL		1.8	ng/L	Rock Creek	WM
BDL	BDL		3.7	ng/L	Rock Creek	WM
BDL	BDL		20	ng/L	Rock Creek	WM
BDL	BDL		8.5	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		16	ng/L	Rock Creek	WM
BDL	BDL		2	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		1.75	ng/L	Rock Creek	WM
BDL	BDL		1.75	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		9.5	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		1.65	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
50	50		50	ng/L	Rock Creek	CWS
88	88		88	ng/L	Rock Creek	WM
130	130		130	ng/L	Rock Creek	WM
100	100		100	ng/L	Rock Creek	WM
150	150		150	ng/L	Rock Creek	WM
200	200		200	ng/L	Rock Creek	WM
110	110		110	ng/L	Rock Creek	WM
95	95		95	ng/L	Rock Creek	WM
76	76		76	ng/L	Rock Creek	WM
16	16		16	ng/L	Rock Creek	WM

	88	88	88	ng/L	Rock Creek	WM
	130	130	130	ng/L	Rock Creek	WM
	130	130	130	ng/L	Rock Creek	WM
	86	86	86	ng/L	Rock Creek	WM
	160	160	160	ng/L	Rock Creek	WM
	140	140	140	ng/L	Rock Creek	WM
	200	200	200	ng/L	Rock Creek	WM
	320	320	320	ng/L	Rock Creek	WM
	310	310	310	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
Est		100	100	ng/L	Rock Creek	CWS
	96	96	96	ng/L	Rock Creek	WM
	100	100	100	ng/L	Rock Creek	WM
	77	77	77	ng/L	Rock Creek	WM
	71	71	71	ng/L	Rock Creek	WM
	63	63	63	ng/L	Rock Creek	WM
	91	91	91	ng/L	Rock Creek	WM
	160	160	160	ng/L	Rock Creek	WM
	120	120	120	ng/L	Rock Creek	WM
	78	78	78	ng/L	Rock Creek	WM
	210	210	210	ng/L	Rock Creek	WM
	80	80	80	ng/L	Rock Creek	WM
	140	140	140	ng/L	Rock Creek	WM
BDL	BDL		5	ng/L	Rock Creek	CWS
BDL	BDL		11	ng/L	Rock Creek	WM
BDL	BDL		45.5	ng/L	Rock Creek	WM
BDL	BDL		21	ng/L	Rock Creek	WM
BDL	BDL		43.5	ng/L	Rock Creek	WM
BDL	BDL		42	ng/L	Rock Creek	WM
BDL	BDL		4.3	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
BDL	BDL		45	ng/L	Rock Creek	WM
BDL	BDL		4.1	ng/L	Rock Creek	WM
BDL	BDL		23.5	ng/L	Rock Creek	WM

BDL	BDL		43.5	ng/L	Rock Creek	WM
BDL	BDL		4.55	ng/L	Rock Creek	WM
BDL	BDL		10.5	ng/L	Rock Creek	WM
BDL	BDL		50	ng/L	Rock Creek	WM
BDL	BDL		21	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		41.5	ng/L	Rock Creek	WM
BDL	BDL		5	ng/L	Rock Creek	WM
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		50	ng/L	Rock Creek	CWS
BDL	BDL		23.5	ng/L	Rock Creek	WM
BDL	BDL		4.4	ng/L	Rock Creek	WM
BDL	BDL		4.65	ng/L	Rock Creek	WM
BDL	BDL		23.5	ng/L	Rock Creek	WM
BDL	BDL		4.7	ng/L	Rock Creek	WM
BDL	BDL		4.15	ng/L	Rock Creek	WM
BDL	BDL		2.35	ng/L	Rock Creek	WM
BDL	BDL		2.35	ng/L	Rock Creek	WM
BDL	BDL		2.35	ng/L	Rock Creek	WM
BDL	BDL		4.7	ng/L	Rock Creek	WM
BDL	BDL		4.7	ng/L	Rock Creek	WM
BDL	BDL		4.7	ng/L	Rock Creek	WM
Est		6.1	6.1	ng/L	Rock Creek	CWS
BDL	BDL		8.5	ng/L	Rock Creek	WM
BDL	BDL		47.5	ng/L	Rock Creek	WM
BDL	BDL		22	ng/L	Rock Creek	WM
BDL	BDL		45	ng/L	Rock Creek	WM
BDL	BDL		44	ng/L	Rock Creek	WM
BDL	BDL		4.5	ng/L	Rock Creek	WM
BDL	BDL		8	ng/L	Rock Creek	WM
BDL	BDL		47	ng/L	Rock Creek	WM
BDL	BDL		4.25	ng/L	Rock Creek	WM
BDL	BDL		24.5	ng/L	Rock Creek	WM
BDL	BDL		45.5	ng/L	Rock Creek	WM

BDL	BDL		4.7	ng/L	Rock Creek	WM
BDL	BDL		8	ng/L	Rock Creek	WM
BDL	BDL		55	ng/L	Rock Creek	WM
BDL	BDL		22	ng/L	Rock Creek	WM
4.6		4.6	4.6	ng/L	Rock Creek	WM
BDL	BDL		43	ng/L	Rock Creek	WM
BDL	BDL		5.5	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		4.65	ng/L	Rock Creek	WM
BDL	BDL		4.6	ng/L	Rock Creek	WM
BDL	BDL		4.85	ng/L	Rock Creek	WM
BDL	BDL		24.5	ng/L	Rock Creek	WM
BDL	BDL		4.9	ng/L	Rock Creek	WM
BDL	BDL		4.3	ng/L	Rock Creek	WM
BDL	BDL		2.45	ng/L	Rock Creek	WM
5.4		5.4	5.4	ng/L	Rock Creek	WM
8.1		8.1	8.1	ng/L	Rock Creek	WM
BDL	BDL		4.9	ng/L	Rock Creek	WM
BDL	BDL		4.9	ng/L	Rock Creek	WM
BDL	BDL		4.9	ng/L	Rock Creek	WM
240		240	240	ng/L	Rock Creek	CWS
770		770	770	ng/L	Rock Creek	WM
890		890	890	ng/L	Rock Creek	WM
270		270	270	ng/L	Rock Creek	WM
1500		1500	1500	ng/L	Rock Creek	WM
2400		2400	2400	ng/L	Rock Creek	WM
340		340	340	ng/L	Rock Creek	WM
1500		1500	1500	ng/L	Rock Creek	WM
660		660	660	ng/L	Rock Creek	WM
390		390	390	ng/L	Rock Creek	WM
6400		6400	6400	ng/L	Rock Creek	WM
5000		5000	5000	ng/L	Rock Creek	WM
680		680	680	ng/L	Rock Creek	WM

	110	110	110	ng/L	Rock Creek	WM
	110	110	110	ng/L	Rock Creek	WM
	110	110	110	ng/L	Rock Creek	WM
	150	150	150	ng/L	Rock Creek	WM
	260	260	260	ng/L	Rock Creek	WM
	200	200	200	ng/L	Rock Creek	WM
Est		150	150	ng/L	Rock Creek	CWS
	1900	1900	1900	ng/L	Rock Creek	CWS
	260	260	260	ng/L	Rock Creek	WM
	370	370	370	ng/L	Rock Creek	WM
	64	64	64	ng/L	Rock Creek	WM
	54	54	54	ng/L	Rock Creek	WM
	140	140	140	ng/L	Rock Creek	WM
	2900	2900	2900	ng/L	Rock Creek	WM
	100	100	100	ng/L	Rock Creek	WM
	680	680	680	ng/L	Rock Creek	WM
	1600	1600	1600	ng/L	Rock Creek	WM
	190	190	190	ng/L	Rock Creek	WM
	2100	2100	2100	ng/L	Rock Creek	WM
	980	980	980	ng/L	Rock Creek	WM
	1300	1300	1300	ng/L	Rock Creek	CWS
	1300	1300	1300	ng/L	Rock Creek	WM
	1600	1600	1600	ng/L	Rock Creek	WM
	1000	1000	1000	ng/L	Rock Creek	WM
	1300	1300	1300	ng/L	Rock Creek	WM
	1700	1700	1700	ng/L	Rock Creek	WM
	850	850	850	ng/L	Rock Creek	WM
	1300	1300	1300	ng/L	Rock Creek	WM
	900	900	900	ng/L	Rock Creek	WM
	230	230	230	ng/L	Rock Creek	WM
	1500	1500	1500	ng/L	Rock Creek	WM
	1700	1700	1700	ng/L	Rock Creek	WM
	1600	1600	1600	ng/L	Rock Creek	WM
	1500	1500	1500	ng/L	Rock Creek	WM

1600	1600	1600	ng/L	Rock Creek	WM
1400	1400	1400	ng/L	Rock Creek	WM
1900	1900	1900	ng/L	Rock Creek	WM
1900	1900	1900	ng/L	Rock Creek	WM
2200	2200	2200	ng/L	Rock Creek	WM
1200	1200	1200	ng/L	Rock Creek	CWS
1400	1400	1400	ng/L	Rock Creek	CWS
1400	1400	1400	ng/L	Rock Creek	WM
1300	1300	1300	ng/L	Rock Creek	WM
1300	1300	1300	ng/L	Rock Creek	WM
1100	1100	1100	ng/L	Rock Creek	WM
1200	1200	1200	ng/L	Rock Creek	WM
820	820	820	ng/L	Rock Creek	WM
1500	1500	1500	ng/L	Rock Creek	WM
1500	1500	1500	ng/L	Rock Creek	WM
1300	1300	1300	ng/L	Rock Creek	WM
2100	2100	2100	ng/L	Rock Creek	WM
1100	1100	1100	ng/L	Rock Creek	WM
1600	1600	1600	ng/L	Rock Creek	WM
64	64	64	ng/L	Rock Creek	CWS
77	77	77	ng/L	Rock Creek	WM
75	75	75	ng/L	Rock Creek	WM
38	38	38	ng/L	Rock Creek	WM
38	38	38	ng/L	Rock Creek	WM
170	170	170	ng/L	Rock Creek	WM
21	21	21	ng/L	Rock Creek	WM
79	79	79	ng/L	Rock Creek	WM
44	44	44	ng/L	Rock Creek	WM
28	28	28	ng/L	Rock Creek	WM
350	350	350	ng/L	Rock Creek	WM
300	300	300	ng/L	Rock Creek	WM
67	67	67	ng/L	Rock Creek	WM
26	26	26	ng/L	Rock Creek	WM
35	35	35	ng/L	Rock Creek	WM

	21	21	21	ng/L	Rock Creek	WM
	37	37	37	ng/L	Rock Creek	WM
	30	30	30	ng/L	Rock Creek	WM
	31	31	31	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
Est		190	190	ng/L	Rock Creek	CWS
	47	47	47	ng/L	Rock Creek	WM
	58	58	58	ng/L	Rock Creek	WM
	27	27	27	ng/L	Rock Creek	WM
	18	18	18	ng/L	Rock Creek	WM
	22	22	22	ng/L	Rock Creek	WM
	45	45	45	ng/L	Rock Creek	WM
	82	82	82	ng/L	Rock Creek	WM
	86	86	86	ng/L	Rock Creek	WM
	170	170	170	ng/L	Rock Creek	WM
	26	26	26	ng/L	Rock Creek	WM
	170	170	170	ng/L	Rock Creek	WM
	93	93	93	ng/L	Rock Creek	WM
	1700	1700	1700	ng/L	Rock Creek	CWS
	1700	1700	1700	ng/L	Rock Creek	WM
	2200	2200	2200	ng/L	Rock Creek	WM
	1500	1500	1500	ng/L	Rock Creek	WM
	2200	2200	2200	ng/L	Rock Creek	WM
	2600	2600	2600	ng/L	Rock Creek	WM
	1600	1600	1600	ng/L	Rock Creek	WM
	1200	1200	1200	ng/L	Rock Creek	WM
	1200	1200	1200	ng/L	Rock Creek	WM
	270	270	270	ng/L	Rock Creek	WM
	1300	1300	1300	ng/L	Rock Creek	WM
	1300	1300	1300	ng/L	Rock Creek	WM
	1400	1400	1400	ng/L	Rock Creek	WM
	1900	1900	1900	ng/L	Rock Creek	WM
	2200	2200	2200	ng/L	Rock Creek	WM
	2100	2100	2100	ng/L	Rock Creek	WM

	3300		3300	3300	ng/L	Rock Creek	WM
	4200		4200	4200	ng/L	Rock Creek	WM
	4600		4600	4600	ng/L	Rock Creek	WM
	3800		3800	3800	ng/L	Rock Creek	CWS
	2700		2700	2700	ng/L	Rock Creek	CWS
	3400		3400	3400	ng/L	Rock Creek	WM
	2600		2600	2600	ng/L	Rock Creek	WM
	3800		3800	3800	ng/L	Rock Creek	WM
	3400		3400	3400	ng/L	Rock Creek	WM
	4000		4000	4000	ng/L	Rock Creek	WM
	1600		1600	1600	ng/L	Rock Creek	WM
	4400		4400	4400	ng/L	Rock Creek	WM
	3600		3600	3600	ng/L	Rock Creek	WM
	1700		1700	1700	ng/L	Rock Creek	WM
	3800		3800	3800	ng/L	Rock Creek	WM
	1500		1500	1500	ng/L	Rock Creek	WM
	2800		2800	2800	ng/L	Rock Creek	WM
BDL		BDL		2.5	ng/L	Rock Creek	CWS
BDL		BDL		7	ng/L	Rock Creek	WM
BDL		BDL		35.5	ng/L	Rock Creek	WM
BDL		BDL		16.5	ng/L	Rock Creek	WM
BDL		BDL		33.5	ng/L	Rock Creek	WM
BDL		BDL		32.5	ng/L	Rock Creek	WM
BDL		BDL		3.35	ng/L	Rock Creek	WM
BDL		BDL		6.5	ng/L	Rock Creek	WM
BDL		BDL		35	ng/L	Rock Creek	WM
BDL		BDL		3.2	ng/L	Rock Creek	WM
BDL		BDL		18.5	ng/L	Rock Creek	WM
BDL		BDL		34	ng/L	Rock Creek	WM
BDL		BDL		3.5	ng/L	Rock Creek	WM
BDL		BDL		6.5	ng/L	Rock Creek	WM
BDL		BDL		39	ng/L	Rock Creek	WM
BDL		BDL		16.5	ng/L	Rock Creek	WM
	4.9		4.9	4.9	ng/L	Rock Creek	WM

BDL	BDL		32	ng/L	Rock Creek	WM
BDL	BDL		3.9	ng/L	Rock Creek	WM
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		3.45	ng/L	Rock Creek	WM
BDL	BDL		3.45	ng/L	Rock Creek	WM
BDL	BDL		3.6	ng/L	Rock Creek	WM
BDL	BDL		18.5	ng/L	Rock Creek	WM
BDL	BDL		3.65	ng/L	Rock Creek	WM
	6.8	6.8	6.8	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		1.85	ng/L	Rock Creek	WM
BDL	BDL		3.65	ng/L	Rock Creek	WM
BDL	BDL		3.65	ng/L	Rock Creek	WM
BDL	BDL		3.65	ng/L	Rock Creek	WM
BDL	BDL		2.5	ng/L	Rock Creek	CWS
BDL	BDL		31	ng/L	Rock Creek	WM
BDL	BDL		65	ng/L	Rock Creek	WM
BDL	BDL		29	ng/L	Rock Creek	WM
BDL	BDL		60	ng/L	Rock Creek	WM
BDL	BDL		60	ng/L	Rock Creek	WM
BDL	BDL		6	ng/L	Rock Creek	WM
BDL	BDL		30	ng/L	Rock Creek	WM
BDL	BDL		60	ng/L	Rock Creek	WM
BDL	BDL		5.5	ng/L	Rock Creek	WM
BDL	BDL		32.5	ng/L	Rock Creek	WM
BDL	BDL		60	ng/L	Rock Creek	WM
BDL	BDL		6.5	ng/L	Rock Creek	WM
BDL	BDL		30	ng/L	Rock Creek	WM
BDL	BDL		70	ng/L	Rock Creek	WM
BDL	BDL		29.5	ng/L	Rock Creek	WM
BDL	BDL		1	ng/L	Rock Creek	WM
BDL	BDL		55	ng/L	Rock Creek	WM

BDL		BDL			7	ng/L	Rock Creek	WM
BDL		BDL			25	ng/L	Rock Creek	CWS
BDL		BDL			25	ng/L	Rock Creek	CWS
BDL		BDL			6	ng/L	Rock Creek	WM
BDL		BDL			6	ng/L	Rock Creek	WM
BDL		BDL			6.5	ng/L	Rock Creek	WM
BDL		BDL			32.5	ng/L	Rock Creek	WM
BDL		BDL			6.5	ng/L	Rock Creek	WM
BDL		BDL			5.5	ng/L	Rock Creek	WM
BDL		BDL			3.25	ng/L	Rock Creek	WM
BDL		BDL			3.25	ng/L	Rock Creek	WM
BDL		BDL			3.25	ng/L	Rock Creek	WM
BDL		BDL			6.5	ng/L	Rock Creek	WM
BDL		BDL			6.5	ng/L	Rock Creek	WM
BDL		BDL			6.5	ng/L	Rock Creek	WM
Est				5.4	5.4	ng/L	Rock Creek	CWS
BDL		BDL			26	ng/L	Rock Creek	WM
BDL		BDL			55	ng/L	Rock Creek	WM
BDL		BDL			24.5	ng/L	Rock Creek	WM
BDL		BDL			50	ng/L	Rock Creek	WM
BDL		BDL			49.5	ng/L	Rock Creek	WM
	19			19	19	ng/L	Rock Creek	WM
BDL		BDL			25.5	ng/L	Rock Creek	WM
BDL		BDL			55	ng/L	Rock Creek	WM
BDL		BDL			4.8	ng/L	Rock Creek	WM
BDL		BDL			27.5	ng/L	Rock Creek	WM
BDL		BDL			50	ng/L	Rock Creek	WM
BDL		BDL			5.5	ng/L	Rock Creek	WM
BDL		BDL			25.5	ng/L	Rock Creek	WM
BDL		BDL			60	ng/L	Rock Creek	WM
BDL		BDL			25	ng/L	Rock Creek	WM
	29			29	29	ng/L	Rock Creek	WM
BDL		BDL			48.5	ng/L	Rock Creek	WM
	56			56	56	ng/L	Rock Creek	WM

BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		25	ng/L	Rock Creek	CWS
BDL	BDL		5	ng/L	Rock Creek	WM
BDL	BDL		5	ng/L	Rock Creek	WM
13		13	13	ng/L	Rock Creek	WM
BDL	BDL		27.5	ng/L	Rock Creek	WM
BDL	BDL		5.5	ng/L	Rock Creek	WM
15		15	15	ng/L	Rock Creek	WM
31		31	31	ng/L	Rock Creek	WM
19		19	19	ng/L	Rock Creek	WM
17		17	17	ng/L	Rock Creek	WM
34		34	34	ng/L	Rock Creek	WM
BDL	BDL		5.5	ng/L	Rock Creek	WM
21		21	21	ng/L	Rock Creek	WM

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	81.0	40	Exceeds SV	5.35	12.26	ng/g	ppb			
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	15.5			2.63	6.13	ng/g	ppb			
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	14.5			2.76	6.13	ng/g	ppb			
4	AL	FW08AL025	550149	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	8.3			1.38	6.13	ng/g	ppb			
4	AL	FW08AL025	550149	HPLC/MS/MS	Summed PFCs (13)	NA	119.3					ng/g	ppb			
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	70.6	40	Exceeds SV	5.35	12.26	ng/g	ppb			
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.2			2.63	6.13	ng/g	ppb	J	J	Estimated
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	AL	FW08AL035	550539	HPLC/MS/MS	Summed PFCs (13)	NA	73.8					ng/g	ppb			
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	AR	FW08AR060	550319	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
9	CA	FW08CA031	532729	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	25.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT005	549629	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	2.6			1.38	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT005	549629	HPLC/MS/MS	Summed PFCs (13)	NA	31.4					ng/g	ppb			
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	22.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	8.6			2.63	6.13	ng/g	ppb			
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	13.1			2.76	6.13	ng/g	ppb			
1	CT	FW08CT006	555219	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.7			1.38	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT006	555219	HPLC/MS/MS	Summed PFCs (13)	NA	48.2					ng/g	ppb			
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	40.1	40	Exceeds SV	5.35	12.26	ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	4.0			2.63	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.3			2.76	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT012	556789	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	4.1			1.38	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT012	556789	HPLC/MS/MS	Summed PFCs (13)	NA	51.5					ng/g	ppb			
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	12.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT015	549649	HPLC/MS/MS	Summed PFCs (13)	NA	12.0					ng/g	ppb			
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	32.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.8			2.76	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT016	556799	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT016	556799	HPLC/MS/MS	Summed PFCs (13)	NA	35.2					ng/g	ppb			
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	26.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.3			2.76	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT017	555199	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT017	555199	HPLC/MS/MS	Summed PFCs (13)	NA	29.7					ng/g	ppb			
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT018	555069	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	9.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT020	527649	HPLC/MS/MS	Summed PFCs (13)	NA	9.2					ng/g	ppb			
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	8.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT021	556919	HPLC/MS/MS	Summed PFCs (13)	NA	8.8					ng/g	ppb			
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	30.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT022	555309	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT022	555309	HPLC/MS/MS	Summed PFCs (13)	NA	33.2					ng/g	ppb			
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	37.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	4.3			2.63	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.9			2.76	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT025	556779	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	4.2			1.38	6.13	ng/g	ppb	J	J	Estimated
1	CT	FW08CT025	556779	HPLC/MS/MS	Summed PFCs (13)	NA	49.9					ng/g	ppb			
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	21.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	CT	FW08CT032	545769	HPLC/MS/MS	Summed PFCs (13)	NA	21.2					ng/g	ppb			
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	2.7			2.63	6.13	ng/g	ppb	J	J	Estimated
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	15.1			2.76	6.13	ng/g	ppb			
3	DE	FW08DE005	521009	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	18.4			1.38	6.13	ng/g	ppb			
3	DE	FW08DE005	521009	HPLC/MS/MS	Summed PFCs (13)	NA	36.2					ng/g	ppb			
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.3			2.63	6.13	ng/g	ppb	J	J	Estimated
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	8.7			2.76	6.13	ng/g	ppb			
3	DE	FW08DE009	541879	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.6			1.38	6.13	ng/g	ppb	J	J	Estimated
3	DE	FW08DE009	541879	HPLC/MS/MS	Summed PFCs (13)	NA	30.3					ng/g	ppb			
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.1	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.5			2.76	6.13	ng/g	ppb	J	J	Estimated
3	DE	FW08DE010	525119	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	5.8			1.38	6.13	ng/g	ppb	J	J	Estimated
3	DE	FW08DE010	525119	HPLC/MS/MS	Summed PFCs (13)	NA	14.4					ng/g	ppb			
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	9.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.8			2.76	6.13	ng/g	ppb	J	J	Estimated
3	DE	FW08DE014	525179	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	DE	FW08DE014	525179	HPLC/MS/MS	Summed PFCs (13)	NA	12.1					ng/g	ppb			
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	5.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	FL	FW08FL015	547959	HPLC/MS/MS	Summed PFCs (13)	NA	5.3					ng/g	ppb			
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	FL	FW08FL032	550629	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	34.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.7			2.76	6.13	ng/g	ppb	J	J	Estimated
4	GA	FW08GA024	550559	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	GA	FW08GA024	550559	HPLC/MS/MS	Summed PFCs (13)	NA	37.3					ng/g	ppb			
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
10	ID	FW08ID019	546079	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	8.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IL	FW08IL018	527179	HPLC/MS/MS	Summed PFCs (13)	NA	8.2					ng/g	ppb			
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	17.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IL	FW08IL022	526779	HPLC/MS/MS	Summed PFCs (13)	NA	17.5					ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	16.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IL	FW08IL027	526789	HPLC/MS/MS	Summed PFCs (13)	NA	16.2					ng/g	ppb			
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	39.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IL	FW08IL035	543999	HPLC/MS/MS	Summed PFCs (13)	NA	39.7					ng/g	ppb			
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	10.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IL	FW08IL036	527439	HPLC/MS/MS	Summed PFCs (13)	NA	10.8					ng/g	ppb			
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	28.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IN	FW08IN008	529969	HPLC/MS/MS	Summed PFCs (13)	NA	28.6					ng/g	ppb			
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	15.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IN	FW08IN009	521509	HPLC/MS/MS	Summed PFCs (13)	NA	15.2					ng/g	ppb			
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	11.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IN	FW08IN013	528329	HPLC/MS/MS	Summed PFCs (13)	NA	11.5					ng/g	ppb			
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	12.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	IN	FW08IN025	521419	HPLC/MS/MS	Summed PFCs (13)	NA	12.4					ng/g	ppb			
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	19.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
7	KS	FW08KS011	541489	HPLC/MS/MS	Summed PFCs (13)	NA	19.5					ng/g	ppb			
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	16.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
7	KS	FW08KS023	554759	HPLC/MS/MS	Summed PFCs (13)	NA	16.9					ng/g	ppb			
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	34.1	40	Does not exceed SV	5.35	12.26	ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.6			2.76	6.13	ng/g	ppb	J	J	Estimated
4	KY	FW08KY032	521839	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	KY	FW08KY032	521839	HPLC/MS/MS	Summed PFCs (13)	NA	36.7					ng/g	ppb			
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA029	529079	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	35.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1	2.5			2.07	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.7			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA044	528949	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA044	528949	HPLC/MS/MS	Summed PFCs (13)	NA	43.4					ng/g	ppb			
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	18.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.5			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA067	535439	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA067	535439	HPLC/MS/MS	Summed PFCs (13)	NA	21.8					ng/g	ppb			
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U	HSSR, RNAF	High Surrogate Spike Recovery, Result Is Not Affected
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	30.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	8.2			2.76	6.13	ng/g	ppb			
6	LA	FW08LA070	534479	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA070	534479	HPLC/MS/MS	Summed PFCs (13)	NA	38.8					ng/g	ppb			
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	18.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.4			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA088	532159	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA088	532159	HPLC/MS/MS	Summed PFCs (13)	NA	23.2					ng/g	ppb			
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	12.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.0			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA131	535429	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA131	535429	HPLC/MS/MS	Summed PFCs (13)	NA	16.7					ng/g	ppb			
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	12.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.2			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA134	535489	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA134	535489	HPLC/MS/MS	Summed PFCs (13)	NA	15.4					ng/g	ppb			
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	12.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.3			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA182	535509	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA182	535509	HPLC/MS/MS	Summed PFCs (13)	NA	16.9					ng/g	ppb			
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	17.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.8			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA195	535419	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
6	LA	FW08LA195	535419	HPLC/MS/MS	Summed PFCs (13)	NA	20.4					ng/g	ppb			
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	17.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.6			2.76	6.13	ng/g	ppb	J	J	Estimated
6	LA	FW08LA198	533849	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA198	533849	HPLC/MS/MS	Summed PFCs (13)	NA	21.0					ng/g	ppb			
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U	HSSR, RNAF	High Surrogate Spike Recovery, Result Is Not Affected
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	LA	FW08LA227	530489	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	26.1	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	2.9			2.70	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA003	554989	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.8			1.38	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA003	554989	HPLC/MS/MS	Summed PFCs (13)	NA	37.8					ng/g	ppb			
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	MA	FW08MA005	555119	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	19.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	MA	FW08MA006	526309	HPLC/MS/MS	Summed PFCs (13)	NA	19.3					ng/g	ppb			
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.3			2.63	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	11.4			2.76	6.13	ng/g	ppb			
1	MA	FW08MA007	528139	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.4			1.38	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA007	528139	HPLC/MS/MS	Summed PFCs (13)	NA	32.4					ng/g	ppb			
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	MA	FW08MA013	528009	HPLC/MS/MS	Summed PFCs (13)	NA	14.0					ng/g	ppb			
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	10.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	MA	FW08MA017	526569	HPLC/MS/MS	Summed PFCs (13)	NA	10.7					ng/g	ppb			
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	8.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA019	554959	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	MA	FW08MA019	554959	HPLC/MS/MS	Summed PFCs (13)	NA	11.3					ng/g	ppb			
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	MA	FW08MA021	555249	HPLC/MS/MS	Summed PFCs (13)	NA	6.4					ng/g	ppb			
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	21.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	4.2			2.70	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.0			2.63	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	11.1			2.76	6.13	ng/g	ppb			
1	MA	FW08MA023	554889	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.2			1.38	6.13	ng/g	ppb	J	J	Estimated
1	MA	FW08MA023	554889	HPLC/MS/MS	Summed PFCs (13)	NA	43.4					ng/g	ppb			
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	MD	FW08MD008	521489	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	MD	FW08MD009	526059	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	104.6	40	Exceeds SV	5.35	12.26	ng/g	ppb			
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	14.5			2.63	6.13	ng/g	ppb			
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	14.1			2.76	6.13	ng/g	ppb			
3	MD	FW08MD014	526039	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	5.8			1.38	6.13	ng/g	ppb	J	J	Estimated
3	MD	FW08MD014	526039	HPLC/MS/MS	Summed PFCs (13)	NA	139.0					ng/g	ppb			
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	61.1	40	Exceeds SV	5.35	12.26	ng/g	ppb			
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	6.4			2.63	6.13	ng/g	ppb			
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	8.8			2.76	6.13	ng/g	ppb			
3	MD	FW08MD018	526009	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.6			1.38	6.13	ng/g	ppb	J	J	Estimated
3	MD	FW08MD018	526009	HPLC/MS/MS	Summed PFCs (13)	NA	79.9					ng/g	ppb			
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	15.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	MD	FW08MD020	526089	HPLC/MS/MS	Summed PFCs (13)	NA	15.5					ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	MD	FW08MD027	541959	HPLC/MS/MS	Summed PFCs (13)	NA	6.7					ng/g	ppb			
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	ME	FW08ME019	531499	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	28.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	9.3			2.63	6.13	ng/g	ppb			
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	6.9			2.76	6.13	ng/g	ppb			
1	ME	FW08ME026	526959	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.7			1.38	6.13	ng/g	ppb	J	J	Estimated
1	ME	FW08ME026	526959	HPLC/MS/MS	Summed PFCs (13)	NA	48.2					ng/g	ppb			
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	15.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	7.7			2.70	6.13	ng/g	ppb			
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	5.8			2.63	6.13	ng/g	ppb	J	J	Estimated
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	ME	FW08ME027	530679	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	5.5			1.38	6.13	ng/g	ppb	J	J	Estimated
1	ME	FW08ME027	530679	HPLC/MS/MS	Summed PFCs (13)	NA	37.8					ng/g	ppb			
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	110.0	40	Exceeds SV	5.35	12.26	ng/g	ppb			
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI019	528079	HPLC/MS/MS	Summed PFCs (13)	NA	110.0					ng/g	ppb			
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI023	527129	HPLC/MS/MS	Summed PFCs (13)	NA	14.5					ng/g	ppb			
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	26.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI036	526579	HPLC/MS/MS	Summed PFCs (13)	NA	26.6					ng/g	ppb			
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	59.4	40	Exceeds SV	5.35	12.26	ng/g	ppb			
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	4.8			2.63	6.13	ng/g	ppb	J	J	Estimated
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI037	527489	HPLC/MS/MS	Summed PFCs (13)	NA	64.2					ng/g	ppb			
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	5.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI046	532059	HPLC/MS/MS	Summed PFCs (13)	NA	5.6					ng/g	ppb			
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI050	525149	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MI	FW08MI057	532879	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	5.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MN	FW08MN019	529119	HPLC/MS/MS	Summed PFCs (13)	NA	5.2					ng/g	ppb			
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	50.5	40	Exceeds SV	5.35	12.26	ng/g	ppb			
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	2.6			2.63	6.13	ng/g	ppb	J	J	Estimated

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MN	FW08MN024	529089	HPLC/MS/MS	Summed PFCs (13)	NA	53.1					ng/g	ppb			
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	13.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MN	FW08MN035	529799	HPLC/MS/MS	Summed PFCs (13)	NA	13.9					ng/g	ppb			
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	54.8	40	Exceeds SV	5.35	12.26	ng/g	ppb			
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MN	FW08MN036	527099	HPLC/MS/MS	Summed PFCs (13)	NA	54.8					ng/g	ppb			
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MN	FW08MN049	532789	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	MN	FW08MN057	554449	HPLC/MS/MS	Summed PFCs (13)	NA	6.6					ng/g	ppb			
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	10.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
7	MO	FW08MO025	526289	HPLC/MS/MS	Summed PFCs (13)	NA	10.2					ng/g	ppb			
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
8	MT	FW08MT043	532489	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	23.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	3.0			2.70	6.13	ng/g	ppb	J	J	Estimated
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	5.1			2.63	6.13	ng/g	ppb	J	J	Estimated
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	29.2			2.76	6.13	ng/g	ppb			
4	NC	FW08NC032	544189	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	10.5			1.38	6.13	ng/g	ppb			
4	NC	FW08NC032	544189	HPLC/MS/MS	Summed PFCs (13)	NA	71.7					ng/g	ppb			
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	25.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.3			2.76	6.13	ng/g	ppb	J	J	Estimated
4	NC	FW08NC041	544649	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	NC	FW08NC041	544649	HPLC/MS/MS	Summed PFCs (13)	NA	30.2					ng/g	ppb			
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	15.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb		RPDX	RPD Between Lab Duplicates Exceeds Criteria
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	NH	FW08NH010	527239	HPLC/MS/MS	Summed PFCs (13)	NA	15.9					ng/g	ppb			
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	4.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	NH	FW08NH011	527229	HPLC/MS/MS	Summed PFCs (13)	NA	4.8					ng/g	ppb			
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	NH	FW08NH016	521569	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.5			2.76	6.13	ng/g	ppb	J	J	Estimated
1	NH	FW08NH017	521719	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	NH	FW08NH017	521719	HPLC/MS/MS	Summed PFCs (13)	NA	2.5					ng/g	ppb			
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	NH	FW08NH018	521789	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.5			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NJ	FW08NJ005	550359	HPLC/MS/MS	Summed PFCs (13)	NA	2.5					ng/g	ppb			
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	33.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	3.6			2.70	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	4.4			2.63	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.0			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.2			1.38	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ007	551879	HPLC/MS/MS	Summed PFCs (13)	NA	49.6					ng/g	ppb			
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NJ	FW08NJ009	529639	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	62.2	40	Exceeds SV	5.35	12.26	ng/g	ppb			
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	3.4			2.70	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.0			2.63	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.4			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.5			1.38	6.13	ng/g	ppb	J	J	Estimated
2	NJ	FW08NJ011	548529	HPLC/MS/MS	Summed PFCs (13)	NA	76.5					ng/g	ppb			
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NJ	FW08NJ013	550679	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY019	526339	HPLC/MS/MS	Summed PFCs (13)	NA	6.4					ng/g	ppb			
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	7.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.9			2.63	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY021	530399	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	2.9			1.38	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY021	530399	HPLC/MS/MS	Summed PFCs (13)	NA	14.1					ng/g	ppb			
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY023	532589	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY028	527989	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	7.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY030	529939	HPLC/MS/MS	Summed PFCs (13)	NA	7.8					ng/g	ppb			
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY032	527199	HPLC/MS/MS	Summed PFCs (13)	NA	14.0					ng/g	ppb			
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	38.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.5			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY034	527209	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY034	527209	HPLC/MS/MS	Summed PFCs (13)	NA	41.5					ng/g	ppb			
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	19.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	6.5			2.63	6.13	ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.8			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY037	531139	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	2.9			1.38	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY037	531139	HPLC/MS/MS	Summed PFCs (13)	NA	31.2					ng/g	ppb			
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY040	530419	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	41.3	40	Exceeds SV	5.35	12.26	ng/g	ppb			
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	8.7			2.63	6.13	ng/g	ppb			
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.4			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY044	528439	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY044	528439	HPLC/MS/MS	Summed PFCs (13)	NA	55.4					ng/g	ppb			
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	65.6	40	Exceeds SV	5.35	12.26	ng/g	ppb			
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY049	555129	HPLC/MS/MS	Summed PFCs (13)	NA	65.6					ng/g	ppb			
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	127.4	40	Exceeds SV	5.35	12.26	ng/g	ppb			
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	4.8			2.63	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.3			2.76	6.13	ng/g	ppb	J	J	Estimated
2	NY	FW08NY050	531439	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
2	NY	FW08NY050	531439	HPLC/MS/MS	Summed PFCs (13)	NA	137.5					ng/g	ppb			
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	4.7			2.63	6.13	ng/g	ppb	J	J	Estimated
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	9.8			2.76	6.13	ng/g	ppb			
5	OH	FW08OH012	526929	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	2.8			1.38	6.13	ng/g	ppb	J	J	Estimated
5	OH	FW08OH012	526929	HPLC/MS/MS	Summed PFCs (13)	NA	17.3					ng/g	ppb			
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	35.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	OH	FW08OH017	521869	HPLC/MS/MS	Summed PFCs (13)	NA	35.8					ng/g	ppb			
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	OH	FW08OH019	529209	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	40.1	40	Exceeds SV	5.35	12.26	ng/g	ppb			
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	OH	FW08OH031	521609	HPLC/MS/MS	Summed PFCs (13)	NA	40.1					ng/g	ppb			
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	OH	FW08OH033	524309	HPLC/MS/MS	Summed PFCs (13)	NA	6.2					ng/g	ppb			
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	28.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	OH	FW08OH035	521729	HPLC/MS/MS	Summed PFCs (13)	NA	28.2					ng/g	ppb			
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	41.5	40	Exceeds SV	5.35	12.26	ng/g	ppb			
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	7.2			2.63	6.13	ng/g	ppb			
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.0			2.76	6.13	ng/g	ppb	J	J	Estimated
5	OH	FW08OH038	528799	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.7			1.38	6.13	ng/g	ppb	J	J	Estimated
5	OH	FW08OH038	528799	HPLC/MS/MS	Summed PFCs (13)	NA	57.4					ng/g	ppb			
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	OK	FW08OK032	548659	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
10	OR	FW08OR015	532799	HPLC/MS/MS	Summed PFCs (13)	NA	6.4					ng/g	ppb			
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	5.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
10	OR	FW08OR027	529659	HPLC/MS/MS	Summed PFCs (13)	NA	5.3					ng/g	ppb			
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	10.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
10	OR	FW08OR028	528409	HPLC/MS/MS	Summed PFCs (13)	NA	10.4					ng/g	ppb			
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	OR	FW08OR060	521459	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
10	OR	FW08OR060	521459	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	10.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
10	OR	FW08OR071	529459	HPLC/MS/MS	Summed PFCs (13)	NA	10.0					ng/g	ppb			
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	8.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	PA	FW08PA019	554259	HPLC/MS/MS	Summed PFCs (13)	NA	8.0					ng/g	ppb			
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U	HLCS, RNAF	High LCS, Result Is Not Affected
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	PA	FW08PA020	556659	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	8.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	PA	FW08PA021	547899	HPLC/MS/MS	Summed PFCs (13)	NA	8.6					ng/g	ppb			
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	15.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.5			2.76	6.13	ng/g	ppb	J	J	Estimated
3	PA	FW08PA030	541409	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.0			1.38	6.13	ng/g	ppb	J	J	Estimated
3	PA	FW08PA030	541409	HPLC/MS/MS	Summed PFCs (13)	NA	21.9					ng/g	ppb			
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	PA	FW08PA035	530509	HPLC/MS/MS	Summed PFCs (13)	NA	6.9					ng/g	ppb			
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	PA	FW08PA036	550189	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	30.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	2.7			2.63	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI003	555279	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	4.1			1.38	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI003	555279	HPLC/MS/MS	Summed PFCs (13)	NA	40.8					ng/g	ppb			
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	9.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	11.1			2.63	6.13	ng/g	ppb			
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	43.3			2.76	6.13	ng/g	ppb			
1	RI	FW08RI004	555099	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	23.8			1.38	6.13	ng/g	ppb			
1	RI	FW08RI004	555099	HPLC/MS/MS	Summed PFCs (13)	NA	87.4					ng/g	ppb			
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	11.4	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.5			2.76	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI005	545359	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	RI	FW08RI005	545359	HPLC/MS/MS	Summed PFCs (13)	NA	14.9					ng/g	ppb			
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	11.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	2.6			2.63	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.6			2.76	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI006	544499	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	3.0			1.38	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI006	544499	HPLC/MS/MS	Summed PFCs (13)	NA	20.1					ng/g	ppb			
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	RI	FW08RI009	554779	HPLC/MS/MS	Summed PFCs (13)	NA	6.2					ng/g	ppb			
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	RI	FW08RI010	545729	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	RI	FW08RI010	545729	HPLC/MS/MS	Summed PFCs (13)	NA	6.0					ng/g	ppb			
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	11.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.4			2.63	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.0			2.76	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI013	554799	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	5.4			1.38	6.13	ng/g	ppb	J	J	Estimated
1	RI	FW08RI013	554799	HPLC/MS/MS	Summed PFCs (13)	NA	25.1					ng/g	ppb			
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.8			2.76	6.13	ng/g	ppb	J	J	Estimated
4	SC	FW08SC008	544139	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	SC	FW08SC008	544139	HPLC/MS/MS	Summed PFCs (13)	NA	2.8					ng/g	ppb			
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	39.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	18.6			2.63	6.13	ng/g	ppb			
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	45.6			2.76	6.13	ng/g	ppb			
4	SC	FW08SC013	541769	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	15.3			1.38	6.13	ng/g	ppb			
4	SC	FW08SC013	541769	HPLC/MS/MS	Summed PFCs (13)	NA	118.7					ng/g	ppb			
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	65.2	40	Exceeds SV	5.35	12.26	ng/g	ppb			
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	14.4			2.63	6.13	ng/g	ppb			
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	18.9			2.76	6.13	ng/g	ppb			
4	SC	FW08SC014	545039	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	9.2			1.38	6.13	ng/g	ppb			
4	SC	FW08SC014	545039	HPLC/MS/MS	Summed PFCs (13)	NA	107.7					ng/g	ppb			
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	59.8	40	Exceeds SV	5.35	12.26	ng/g	ppb			
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	28.5			2.63	6.13	ng/g	ppb			
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	43.4			2.76	6.13	ng/g	ppb			
4	SC	FW08SC015	553299	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	7.5			1.38	6.13	ng/g	ppb			
4	SC	FW08SC015	553299	HPLC/MS/MS	Summed PFCs (13)	NA	139.1					ng/g	ppb			
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	5.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	SC	FW08SC019	551829	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	2.6			1.38	6.13	ng/g	ppb	J	J	Estimated
4	SC	FW08SC019	551829	HPLC/MS/MS	Summed PFCs (13)	NA	7.8					ng/g	ppb			
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	16.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.9			2.63	6.13	ng/g	ppb	J	J	Estimated
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	4.0			2.76	6.13	ng/g	ppb	J	J	Estimated
4	SC	FW08SC026	545079	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	SC	FW08SC026	545079	HPLC/MS/MS	Summed PFCs (13)	NA	24.6					ng/g	ppb			
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
8	SD	FW08SD075	550809	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	63.6	40	Exceeds SV	5.35	12.26	ng/g	ppb			
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.0			2.63	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.7			2.76	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN012	547939	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	TN	FW08TN012	547939	HPLC/MS/MS	Summed PFCs (13)	NA	70.3					ng/g	ppb			
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	25.1	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2	3.7			2.63	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.2			2.76	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN018	527569	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	TN	FW08TN018	527569	HPLC/MS/MS	Summed PFCs (13)	NA	32.0					ng/g	ppb			
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	5.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	TN	FW08TN037	556719	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	2.5			1.38	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN037	556719	HPLC/MS/MS	Summed PFCs (13)	NA	8.0					ng/g	ppb			
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	50.5	40	Exceeds SV	5.35	12.26	ng/g	ppb			
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	TN	FW08TN039	523839	HPLC/MS/MS	Summed PFCs (13)	NA	50.5					ng/g	ppb			
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	TN	FW08TN085	529909	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.4			2.76	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN097	526679	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	TN	FW08TN097	526679	HPLC/MS/MS	Summed PFCs (13)	NA	8.4					ng/g	ppb			
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	18.5	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.2			2.76	6.13	ng/g	ppb	J	J	Estimated
4	TN	FW08TN261	533649	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
4	TN	FW08TN261	533649	HPLC/MS/MS	Summed PFCs (13)	NA	23.7					ng/g	ppb			
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	6.3	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	TX	FW08TX030	523799	HPLC/MS/MS	Summed PFCs (13)	NA	6.3					ng/g	ppb			
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	TX	FW08TX038	530389	HPLC/MS/MS	Summed PFCs (13)	NA	14.0					ng/g	ppb			
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	33.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
6	TX	FW08TX059	526169	HPLC/MS/MS	Summed PFCs (13)	NA	33.2					ng/g	ppb			
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	14.0	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	VT	FW08VT011	532079	HPLC/MS/MS	Summed PFCs (13)	NA	14.0					ng/g	ppb			
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	2.7			2.70	6.13	ng/g	ppb	J	J	Estimated
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	VT	FW08VT016	529879	HPLC/MS/MS	Summed PFCs (13)	NA	2.7					ng/g	ppb			
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
1	VT	FW08VT018	527479	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
10	WA	FW08WA040	535119	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	29.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	WI	FW08WI029	531159	HPLC/MS/MS	Summed PFCs (13)	NA	29.9					ng/g	ppb			
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	35.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6	63.1			2.70	6.13	ng/g	ppb			
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	5.8			2.76	6.13	ng/g	ppb	J	J	Estimated
5	WI	FW08WI034	531209	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1	7.7			1.38	6.13	ng/g	ppb			
5	WI	FW08WI034	531209	HPLC/MS/MS	Summed PFCs (13)	NA	112.4					ng/g	ppb			
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	17.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	2.5			2.76	6.13	ng/g	ppb	J	J	Estimated
5	WI	FW08WI048	530449	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
5	WI	FW08WI048	530449	HPLC/MS/MS	Summed PFCs (13)	NA	20.4					ng/g	ppb			
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U	HSSR, RNAF	High Surrogate Spike Recovery, Result Is Not Affected
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	25.2	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.2			2.76	6.13	ng/g	ppb	J	J	Estimated
3	WV	FW08WV010	521849	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	WV	FW08WV010	521849	HPLC/MS/MS	Summed PFCs (13)	NA	28.4					ng/g	ppb			
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	7.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	WV	FW08WV013	525969	HPLC/MS/MS	Summed PFCs (13)	NA	7.9					ng/g	ppb			
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	11.7	40	Does not exceed SV	5.35	12.26	ng/g	ppb	J	J	Estimated
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	WV	FW08WV014	528349	HPLC/MS/MS	Summed PFCs (13)	NA	11.7					ng/g	ppb			
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	32.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	WV	FW08WV027	525189	HPLC/MS/MS	Summed PFCs (13)	NA	32.6					ng/g	ppb			
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U	HSSR, RNAF	High Surrogate Spike Recovery, Result Is Not Affected

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	18.8	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	WV	FW08WV029	521829	HPLC/MS/MS	Summed PFCs (13)	NA	18.8					ng/g	ppb			
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	33.6	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8	3.3			2.76	6.13	ng/g	ppb	J	J	Estimated
3	WV	FW08WV030	521859	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	WV	FW08WV030	521859	HPLC/MS/MS	Summed PFCs (13)	NA	36.9					ng/g	ppb			
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1	16.9	40	Does not exceed SV	5.35	12.26	ng/g	ppb			
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
3	WV	FW08WV034	526849	HPLC/MS/MS	Summed PFCs (13)	NA	16.9					ng/g	ppb			
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorobutanoate (PFBA)	375-22-4				2.70	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorobutane sulfonate (PFBS)	375-73-5				5.69	12.26	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluoropentanoate (PFPeA)	2706-90-3				1.42	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorohexanoate (PFHxA)	307-24-4				2.34	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorohexane sulfonate (PFHxS)	355-46-4				10.45	12.26	ng/g	ppb	U		

EPA Region	State	Site ID	EPA Sample ID	Method	Analyte	CAS Number	Amount	HH Screening Value	Over HH SV?	MDL	QL	Unit 1	Unit 2	Lab Qualifier Flag	SCC Code	Comments
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluoroheptanoate (PFHpA)	375-85-9				1.25	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorooctanoate (PFOA)	335-67-1				2.37	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorooctanesulfonate (PFOS)	1763-23-1		40	Does not exceed SV	5.35	12.26	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorooctane sulfonamide (PFOSA)	754-91-6				2.70	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorononanoate (PFNA)	375-95-1				2.07	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorodecanoate (PFDA)	335-76-2				2.63	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluoroundecanoate (PFUnA)	2058-94-8				2.76	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Perfluorododecanoate (PFDoA)	307-55-1				1.38	6.13	ng/g	ppb	U		
8	WY	FW08WY039	550129	HPLC/MS/MS	Summed PFCs (13)	NA						ng/g	ppb			

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
4	AL	FW08AL025	Chattahoochee River	32.43329	-84.96699	550149	Urban	6	07/23/2009	550149.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	285	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	AL	FW08AL025	Chattahoochee River	32.43329	-84.96699	550149	Urban	6	07/23/2009	550149.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	AL	FW08AL025	Chattahoochee River	32.43329	-84.96699	550149	Urban	6	07/23/2009	550149.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	344	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	AL	FW08AL025	Chattahoochee River	32.43329	-84.96699	550149	Urban	6	07/23/2009	550149.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	360	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	AL	FW08AL025	Chattahoochee River	32.43329	-84.96699	550149	Urban	6	07/23/2009	550149.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	AL	FW08AL035	Black Warrior River	33.24312	-87.50378	550539	Urban	6	07/14/2009	550539.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	403	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	AL	FW08AL035	Black Warrior River	33.24312	-87.50378	550539	Urban	6	07/14/2009	550539.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	379	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	AL	FW08AL035	Black Warrior River	33.24312	-87.50378	550539	Urban	6	07/14/2009	550539.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	305	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	AR	FW08AR060	Arkansas River	35.40392	-94.33819	550319	Urban	8+	08/18/2009	550319.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	401	Yes	BD	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (351 mm).	
6	AR	FW08AR060	Arkansas River	35.40392	-94.33819	550319	Urban	8+	08/18/2009	550319.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	495	Yes	BD	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (351 mm).	
6	AR	FW08AR060	Arkansas River	35.40392	-94.33819	550319	Urban	8+	08/18/2009	550319.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	351	No	BD	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (351 mm).	
6	AR	FW08AR060	Arkansas River	35.40392	-94.33819	550319	Urban	8+	08/18/2009	550319.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	402	Yes	BD	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (351 mm).	
9	CA	FW08CA031	Russian River	38.81627	-123.01119	532729	Urban	5	09/15/2008	532729.1	1	*Ptychocheilus grandis*	Sacramento pikeminnow	Cyprinidae	Fillet	540	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
9	CA	FW08CA031	Russian River	38.81627	-123.01119	532729	Urban	5	09/15/2008	532729.2	2	*Ptychocheilus grandis*	Sacramento pikeminnow	Cyprinidae	Fillet	420	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
1	CT	FW08CT005	Farmington River	41.89123	-72.66210	549629	Urban	5	08/15/2009	549629.1	1	*Perca flavescens*	Yellow perch	Percidae	Fillet	250	Yes	P	Non-routine	Number	Form a new 5-fish composite using specimens 1, 2, and 3 (250, 196, and 191 mm) PLUS specimens 2 (201 mm) and 3 (194 mm) from the CT005 duplicate composite below.	
1	CT	FW08CT005	Farmington River	41.89123	-72.66210	549629	Urban	5	08/15/2009	549629.2	2	*Perca flavescens*	Yellow perch	Percidae	Fillet	196	Yes	P	Non-routine	Number	Form a new 5-fish composite using specimens 1, 2, and 3 (250, 196, and 191 mm) PLUS specimens 2 (201 mm) and 3 (194 mm) from the CT005 duplicate composite below.	
1	CT	FW08CT005	Farmington River	41.89123	-72.66210	549629	Urban	5	08/15/2009	549629.3	3	*Perca flavescens*	Yellow perch	Percidae	Fillet	191	Yes	P	Non-routine	Number	Form a new 5-fish composite using specimens 1, 2, and 3 (250, 196, and 191 mm) PLUS specimens 2 (201 mm) and 3 (194 mm) from the CT005 duplicate composite below.	
1	CT	FW08CT005	Farmington River	41.89123	-72.66210	549629	Urban	5	08/15/2009	549629.4	4	*Perca flavescens*	Yellow perch	Percidae	Fillet	201	Yes	P	Non-routine	Number	This specimen was from Sample 543939. Form a new 5-fish composite using specimens 1, 2, and 3 (250, 196, and 191 mm) PLUS specimens 2 (201 mm) and 3 (194 mm) from the CT005 duplicate composite below.	
1	CT	FW08CT005	Farmington River	41.89123	-72.66210	549629	Urban	5	08/15/2009	549629.5	5	*Perca flavescens*	Yellow perch	Percidae	Fillet	194	Yes	P	Non-routine	Number	This specimen was from Sample 543939. Form a new 5-fish composite using specimens 1, 2, and 3 (250, 196, and 191 mm) PLUS specimens 2 (201 mm) and 3 (194 mm) from the CT005 duplicate composite below.	
1	CT	FW08CT006	Quinebaug River	41.78270	-71.89588	555219	Urban	5	08/25/2009	555219.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	271	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT006	Quinebaug River	41.78270	-71.89588	555219	Urban	5	08/25/2009	555219.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	262	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT006	Quinebaug River	41.78270	-71.89588	555219	Urban	5	08/25/2009	555219.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	300	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT006	Quinebaug River	41.78270	-71.89588	555219	Urban	5	08/25/2009	555219.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	279	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT012	Connecticut River	41.71023	-72.61803	556789	Urban	6	10/06/2009	556789.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	274	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT012	Connecticut River	41.71023	-72.61803	556789	Urban	6	10/06/2009	556789.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	308	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT012	Connecticut River	41.71023	-72.61803	556789	Urban	6	10/06/2009	556789.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	257	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT015	Housatonic River	41.64140	-73.47779	549649	Urban	6	08/12/2009	549649.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	295	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT015	Housatonic River	41.64140	-73.47779	549649	Urban	6	08/12/2009	549649.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	304	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT015	Housatonic River	41.64140	-73.47779	549649	Urban	6	08/12/2009	549649.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	238	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT015	Housatonic River	41.64140	-73.47779	549649	Urban	6	08/12/2009	549649.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	257	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT016	Farmington River	41.84448	-72.63200	556799	Urban	5	09/30/2009	556799.1	1	*Perca flavescens*	Yellow perch	Percidae	Fillet	240	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	CT	FW08CT016	Farmington River	41.84448	-72.63200	556799	Urban	5	09/30/2009	556799.2	2	*Perca flavescens*	Yellow perch	Percidae	Fillet	203	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	CT	FW08CT016	Farmington River	41.84448	-72.63200	556799	Urban	5	09/30/2009	556799.3	3	*Perca flavescens*	Yellow perch	Percidae	Fillet	216	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	CT	FW08CT016	Farmington River	41.84448	-72.63200	556799	Urban	5	09/30/2009	556799.4	4	*Perca flavescens*	Yellow perch	Percidae	Fillet	212	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	CT	FW08CT016	Farmington River	41.84448	-72.63200	556799	Urban	5	09/30/2009	556799.5	5	*Perca flavescens*	Yellow perch	Percidae	Fillet	200	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	CT	FW08CT017	Shetucket River	41.62374	-72.08866	555199	Urban	5	08/18/2009	555199.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	229	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT017	Shetucket River	41.62374	-72.08866	555199	Urban	5	08/18/2009	555199.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	257	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT017	Shetucket River	41.62374	-72.08866	555199	Urban	5	08/18/2009	555199.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	249	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT017	Shetucket River	41.62374	-72.08866	555199	Urban	5	08/18/2009	555199.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	253	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	CT	FW08CT018	West Branch Farmington River	41.87092	-72.96373	555069	Urban	5	08/21/2009	555069.1	1	*Salmo trutta*	Brown trout	Salmonidae	Fillet	334	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT018	West Branch Farmington River	41.87092	-72.96373	555069	Urban	5	08/21/2009	555069.2	2	*Salmo trutta*	Brown trout	Salmonidae	Fillet	336	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT018	West Branch Farmington River	41.87092	-72.96373	555069	Urban	5	08/21/2009	555069.3	3	*Salmo trutta*	Brown trout	Salmonidae	Fillet	332	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT020	Housatonic River	41.57493	-73.41535	527649	Urban	6	08/15/2008	527649.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	292	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT020	Housatonic River	41.57493	-73.41535	527649	Urban	6	08/15/2008	527649.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	300	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT020	Housatonic River	41.57493	-73.41535	527649	Urban	6	08/15/2008	527649.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	265	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT021	Connecticut River	41.95210	-72.60858	556919	Urban	6	10/08/2009	556919.1	1	*Perca flavescens*	Yellow perch	Percidae	Fillet	197	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT021	Connecticut River	41.95210	-72.60858	556919	Urban	6	10/08/2009	556919.2	2	*Perca flavescens*	Yellow perch	Percidae	Fillet	236	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT021	Connecticut River	41.95210	-72.60858	556919	Urban	6	10/08/2009	556919.3	3	*Perca flavescens*	Yellow perch	Percidae	Fillet	194	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT022	Quinebaug River	41.67572	-71.95360	555309	Urban	5	08/27/2009	555309.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	269	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT022	Quinebaug River	41.67572	-71.95360	555309	Urban	5	08/27/2009	555309.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	295	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT022	Quinebaug River	41.67572	-71.95360	555309	Urban	5	08/27/2009	555309.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	352	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT025	Connecticut River	41.72616	-72.64876	556779	Urban	6	10/06/2009	556779.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	327	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT025	Connecticut River	41.72616	-72.64876	556779	Urban	6	10/06/2009	556779.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	328	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT025	Connecticut River	41.72616	-72.64876	556779	Urban	6	10/06/2009	556779.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	339	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	CT	FW08CT032	Farmington River	41.86233	-72.64702	545769	Urban	5	09/23/2009	545769.1	1	*Perca flavescens*	Yellow perch	Percidae	Fillet	192	Yes	P	Non-routine	Number	Process all specimens in the 6-fish composite.	
1	CT	FW08CT032	Farmington River	41.86233	-72.64702	545769	Urban	5	09/23/2009	545769.2	2	*Perca flavescens*	Yellow perch	Percidae	Fillet	208	Yes	P	Non-routine	Number	Process all specimens in the 6-fish composite.	
1	CT	FW08CT032	Farmington River	41.86233	-72.64702	545769	Urban	5	09/23/2009	545769.3	3	*Perca flavescens*	Yellow perch	Percidae	Fillet	209	Yes	P	Non-routine	Number	Process all specimens in the 6-fish composite.	
1	CT	FW08CT032	Farmington River	41.86233	-72.64702	545769	Urban	5	09/23/2009	545769.4	4	*Perca flavescens*	Yellow perch	Percidae	Fillet	195	Yes	P	Non-routine	Number	Process all specimens in the 6-fish composite.	
1	CT	FW08CT032	Farmington River	41.86233	-72.64702	545769	Urban	5	09/23/2009	545769.5	5	*Perca flavescens*	Yellow perch	Percidae	Fillet	212	Yes	P	Non-routine	Number	Process all specimens in the 6-fish composite.	
1	CT	FW08CT032	Farmington River	41.86233	-72.64702	545769	Urban	5	09/23/2009	545769.6	6	*Perca flavescens*	Yellow perch	Percidae	Fillet	178	Yes	P	Non-routine	Number	Process all specimens in the 6-fish composite.	
4	DE	FW08DE005	White Clay Creek	39.70013	-75.63339	521009	Urban	5	08/04/2008	521009.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	365	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE005	White Clay Creek	39.70013	-75.63339	521009	Urban	5	08/04/2008	521009.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	375	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE005	White Clay Creek	39.70013	-75.63339	521009	Urban	5	08/04/2008	521009.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	420	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE005	White Clay Creek	39.70013	-75.63339	521009	Urban	5	08/04/2008	521009.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	385	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE005	White Clay Creek	39.70013	-75.63339	521009	Urban	5	08/04/2008	521009.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	450	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.1	1	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	217	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.2	2	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	216	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.3	3	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	203	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.4	4	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	202	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.5	5	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	197	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.6	6	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	196	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.7	7	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	195	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.8	8	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	190	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.9	9	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	187	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE009	Brandywine Creek	39.83430	-75.57709	541879	Urban	5	06/03/2009	541879.10	10	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	186	Yes	P	Non-routine	Number	Process all specimens in the 10-fish composite.	
4	DE	FW08DE010	Nanticoke River	38.61817	-75.63092	525119	Urban	5	08/05/2008	525119.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	365	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE010	Nanticoke River	38.61817	-75.63092	525119	Urban	5	08/05/2008	525119.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE010	Nanticoke River	38.61817	-75.63092	525119	Urban	5	08/05/2008	525119.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	345	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE010	Nanticoke River	38.61817	-75.63092	525119	Urban	5	08/05/2008	525119.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	340	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE010	Nanticoke River	38.61817	-75.63092	525119	Urban	5	08/05/2008	525119.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	370	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE014	Nanticoke River	38.66814	-75.56031	525179	Urban	5	08/25/2008	525179.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	415	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE014	Nanticoke River	38.66814	-75.56031	525179	Urban	5	08/25/2008	525179.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	370	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE014	Nanticoke River	38.66814	-75.56031	525179	Urban	5	08/25/2008	525179.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	320	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE014	Nanticoke River	38.66814	-75.56031	525179	Urban	5	08/25/2008	525179.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	330	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	DE	FW08DE014	Nanticoke River	38.66814	-75.56031	525179	Urban	5	08/25/2008	525179.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	390	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL015	Withlacoochee River	28.88817	-82.26073	547959	Urban	5	06/15/2009	547959.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	331	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL015	Withlacoochee River	28.88817	-82.26073	547959	Urban	5	06/15/2009	547959.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	306	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL015	Withlacoochee River	28.88817	-82.26073	547959	Urban	5	06/15/2009	547959.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	308	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL015	Withlacoochee River	28.88817	-82.26073	547959	Urban	5	06/15/2009	547959.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	338	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
4	FL	FW08FL015	Withlacoochee River	28.88817	-82.26073	547959	Urban	5	06/15/2009	547959.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	298	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL032	Escambia River	30.92899	-87.27582	550629	Urban	6	08/08/2009	550629.1	1	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL032	Escambia River	30.92899	-87.27582	550629	Urban	6	08/08/2009	550629.2	2	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	450	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL032	Escambia River	30.92899	-87.27582	550629	Urban	6	08/08/2009	550629.3	3	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	443	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL032	Escambia River	30.92899	-87.27582	550629	Urban	6	08/08/2009	550629.4	4	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	440	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	FL	FW08FL032	Escambia River	30.92899	-87.27582	550629	Urban	6	08/08/2009	550629.5	5	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	431	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	GA	FW08GA024	Ocmulgee River	32.69376	-83.61136	550559	Urban	6	08/02/2009	550559.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	197	Yes	P	Non-routine	Length & Number	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimen 2 (284 mm).	Not enough mass for metals analysis. PFC only
4	GA	FW08GA024	Ocmulgee River	32.69376	-83.61136	550559	Urban	6	08/02/2009	550559.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	284	No	P	Non-routine	Length & Number	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimen 2 (284 mm).	Not enough mass for metals analysis. PFC only
4	GA	FW08GA024	Ocmulgee River	32.69376	-83.61136	550559	Urban	6	08/02/2009	550559.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	190	Yes	P	Non-routine	Length & Number	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimen 2 (284 mm).	Not enough mass for metals analysis. PFC only
10	ID	FW08ID019	Spokane River	47.69645	-116.91528	546079	Urban	7	08/12/2009	546079.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	270	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
10	ID	FW08ID019	Spokane River	47.69645	-116.91528	546079	Urban	7	08/12/2009	546079.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	221	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
5	IL	FW08IL018	Kankakee River	41.15196	-87.91418	527179	Urban	6	09/28/2008	527179.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	450	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL018	Kankakee River	41.15196	-87.91418	527179	Urban	6	09/28/2008	527179.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	429	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL018	Kankakee River	41.15196	-87.91418	527179	Urban	6	09/28/2008	527179.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	420	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL018	Kankakee River	41.15196	-87.91418	527179	Urban	6	09/28/2008	527179.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	425	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL018	Kankakee River	41.15196	-87.91418	527179	Urban	6	09/28/2008	527179.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	426	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL022	Rock River	41.90002	-89.48215	526779	Urban	7	09/27/2008	526779.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	321	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL022	Rock River	41.90002	-89.48215	526779	Urban	7	09/27/2008	526779.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	350	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL022	Rock River	41.90002	-89.48215	526779	Urban	7	09/27/2008	526779.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL022	Rock River	41.90002	-89.48215	526779	Urban	7	09/27/2008	526779.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL022	Rock River	41.90002	-89.48215	526779	Urban	7	09/27/2008	526779.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	340	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL027	Fox River	42.21645	-88.18891	526789	Urban	6	09/25/2008	526789.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	330	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	IL	FW08IL027	Fox River	42.21645	-88.18891	526789	Urban	6	09/25/2008	526789.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	IL	FW08IL027	Fox River	42.21645	-88.18891	526789	Urban	6	09/25/2008	526789.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	336	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	IL	FW08IL035	Mississippi River	42.31051	-90.41706	543999	Urban	8+	06/25/2009	543999.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	365	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL035	Mississippi River	42.31051	-90.41706	543999	Urban	8+	06/25/2009	543999.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	350	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL035	Mississippi River	42.31051	-90.41706	543999	Urban	8+	06/25/2009	543999.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	327	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL035	Mississippi River	42.31051	-90.41706	543999	Urban	8+	06/25/2009	543999.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	315	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL035	Mississippi River	42.31051	-90.41706	543999	Urban	8+	06/25/2009	543999.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	315	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IL	FW08IL036	Salt Creek	40.15377	-89.67551	527439	Urban	6	10/09/2008	527439.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	452	No	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (452 mm).	
5	IL	FW08IL036	Salt Creek	40.15377	-89.67551	527439	Urban	6	10/09/2008	527439.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	294	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (452 mm).	
5	IL	FW08IL036	Salt Creek	40.15377	-89.67551	527439	Urban	6	10/09/2008	527439.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	325	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (452 mm).	
5	IL	FW08IL036	Salt Creek	40.15377	-89.67551	527439	Urban	6	10/09/2008	527439.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	307	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (452 mm).	
5	IL	FW08IL036	Salt Creek	40.15377	-89.67551	527439	Urban	6	10/09/2008	527439.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	300	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (452 mm).	
5	IN	FW08IN008	East Fork White River	38.83491	-86.52326	529969	Urban	6	09/04/2008	529969.1	1	*Aplodinotus grunniens*	Freshwater drum	Sciaenidae	Fillet	385	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	IN	FW08IN008	East Fork White River	38.83491	-86.52326	529969	Urban	6	09/04/2008	529969.2	2	*Aplodinotus grunniens*	Freshwater drum	Sciaenidae	Fillet	401	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	IN	FW08IN008	East Fork White River	38.83491	-86.52326	529969	Urban	6	09/04/2008	529969.3	3	*Aplodinotus grunniens*	Freshwater drum	Sciaenidae	Fillet	384	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	IN	FW08IN008	East Fork White River	38.83491	-86.52326	529969	Urban	6	09/04/2008	529969.4	4	*Aplodinotus grunniens*	Freshwater drum	Sciaenidae	Fillet	440	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	IN	FW08IN009	Saint Joseph River	41.69465	-85.91740	521509	Urban	5	07/01/2008	521509.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	410	Yes	P	Non-routine	Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimens 2 (262 mm), 4 (260 mm), and 5 (567 mm).	
5	IN	FW08IN009	Saint Joseph River	41.69465	-85.91740	521509	Urban	5	07/01/2008	521509.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	262	No	P	Non-routine	Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimens 2 (262 mm), 4 (260 mm), and 5 (567 mm).	
5	IN	FW08IN009	Saint Joseph River	41.69465	-85.91740	521509	Urban	5	07/01/2008	521509.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	380	Yes	P	Non-routine	Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimens 2 (262 mm), 4 (260 mm), and 5 (567 mm).	
5	IN	FW08IN009	Saint Joseph River	41.69465	-85.91740	521509	Urban	5	07/01/2008	521509.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	260	No	P	Non-routine	Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimens 2 (262 mm), 4 (260 mm), and 5 (567 mm).	
5	IN	FW08IN009	Saint Joseph River	41.69465	-85.91740	521509	Urban	5	07/01/2008	521509.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	567	No	P	Non-routine	Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimens 2 (262 mm), 4 (260 mm), and 5 (567 mm).	
5	IN	FW08IN013	Saint Joseph River	41.67527	-86.07586	528329	Urban	6	07/02/2008	528329.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	280	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IN	FW08IN013	Saint Joseph River	41.67527	-86.07586	528329	Urban	6	07/02/2008	528329.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	248	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IN	FW08IN013	Saint Joseph River	41.67527	-86.07586	528329	Urban	6	07/02/2008	528329.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	285	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IN	FW08IN013	Saint Joseph River	41.67527	-86.07586	528329	Urban	6	07/02/2008	528329.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	250	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IN	FW08IN013	Saint Joseph River	41.67527	-86.07586	528329	Urban	6	07/02/2008	528329.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	234	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	IN	FW08IN025	Elkhart River	41.66737	-85.94200	521419	Urban	5	07/08/2008	521419.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	231	No	P	Non-routine	Length	Process ONLY specimens 2, 4, and 5 as a 3-fish composite. Discard specimen 1 (231 mm).	All specimens inadvertently processed by prep lab.
5	IN	FW08IN025	Elkhart River	41.66737	-85.94200	521419	Urban	5	07/08/2008	521419.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	307	Yes	P	Non-routine	Length	Process ONLY specimens 2, 4, and 5 as a 3-fish composite. Discard specimen 1 (231 mm).	All specimens inadvertently processed by prep lab.
5	IN	FW08IN025	Elkhart River	41.66737	-85.94200	521419	Urban	5	07/08/2008	521419.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	234	No	P	Non-routine	Length	Process ONLY specimens 2, 4, and 5 as a 3-fish composite. Discard specimen 1 (231 mm).	All specimens inadvertently processed by prep lab.
5	IN	FW08IN025	Elkhart River	41.66737	-85.94200	521419	Urban	5	07/08/2008	521419.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	328	Yes	P	Non-routine	Length	Process ONLY specimens 2, 4, and 5 as a 3-fish composite. Discard specimen 1 (231 mm).	All specimens inadvertently processed by prep lab.
5	IN	FW08IN025	Elkhart River	41.66737	-85.94200	521419	Urban	5	07/08/2008	521419.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	268	Yes	P	Non-routine	Length	Process ONLY specimens 2, 4, and 5 as a 3-fish composite. Discard specimen 1 (231 mm).	All specimens inadvertently processed by prep lab.
7	KS	FW08KS011	Missouri River	39.72624	-94.91122	541489	Urban	8+	07/15/2009	541489.1	1	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	480	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS011	Missouri River	39.72624	-94.91122	541489	Urban	8+	07/15/2009	541489.2	2	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	525	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS011	Missouri River	39.72624	-94.91122	541489	Urban	8+	07/15/2009	541489.3	3	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	495	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS011	Missouri River	39.72624	-94.91122	541489	Urban	8+	07/15/2009	541489.4	4	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	470	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS011	Missouri River	39.72624	-94.91122	541489	Urban	8+	07/15/2009	541489.5	5	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	445	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS023	Kansas River	39.06027	-94.84195	554759	Urban	8+	09/10/2009	554759.1	1	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	702	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS023	Kansas River	39.06027	-94.84195	554759	Urban	8+	09/10/2009	554759.2	2	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	571	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS023	Kansas River	39.06027	-94.84195	554759	Urban	8+	09/10/2009	554759.3	3	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	671	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS023	Kansas River	39.06027	-94.84195	554759	Urban	8+	09/10/2009	554759.4	4	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	647	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
7	KS	FW08KS023	Kansas River	39.06027	-94.84195	554759	Urban	8+	09/10/2009	554759.5	5	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	642	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	KY	FW08KY032	Ohio River	37.82504	-87.15127	521839	Urban	8+	09/12/2008	521839.1	1	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	340	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
4	KY	FW08KY032	Ohio River	37.82504	-87.15127	521839	Urban	8+	09/12/2008	521839.2	2	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	330	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
6	LA	FW08LA029	Red River	31.37416	-92.56085	529079	Urban	7	07/18/2008	529079.1	1	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	453	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA029	Red River	31.37416	-92.56085	529079	Urban	7	07/18/2008	529079.2	2	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	452	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA029	Red River	31.37416	-92.56085	529079	Urban	7	07/18/2008	529079.3	3	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	342	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA029	Red River	31.37416	-92.56085	529079	Urban	7	07/18/2008	529079.4	4	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	389	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA029	Red River	31.37416	-92.56085	529079	Urban	7	07/18/2008	529079.5	5	*Mugil cephalus*	Striped mullet	Mugilidae	Fillet	389	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA044	Mississippi River	32.31668	-90.90508	528949	Urban	8+	08/18/2008	528949.1	1	*Morone chrysops*	White bass	Moronidae	Fillet	449	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	LA	FW08LA044	Mississippi River	32.31668	-90.90508	528949	Urban	8+	08/18/2008	528949.2	2	*Morone chrysops*	White bass	Moronidae	Fillet	420	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	LA	FW08LA044	Mississippi River	32.31668	-90.90508	528949	Urban	8+	08/18/2008	528949.3	3	*Morone chrysops*	White bass	Moronidae	Fillet	455	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	LA	FW08LA044	Mississippi River	32.31668	-90.90508	528949	Urban	8+	08/18/2008	528949.4	4	*Morone chrysops*	White bass	Moronidae	Fillet	398	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	LA	FW08LA067	Mississippi River	30.04690	-90.54005	535439	Urban	8+	11/05/2008	535439.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	420	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (318 mm).	
6	LA	FW08LA067	Mississippi River	30.04690	-90.54005	535439	Urban	8+	11/05/2008	535439.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	377	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (318 mm).	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
6	LA	FW08LA067	Mississippi River	30.04690	-90.54005	535439	Urban	8+	11/05/2008	535439.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	433	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (318 mm).	
6	LA	FW08LA067	Mississippi River	30.04690	-90.54005	535439	Urban	8+	11/05/2008	535439.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	355	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (318 mm).	
6	LA	FW08LA067	Mississippi River	30.04690	-90.54005	535439	Urban	8+	11/05/2008	535439.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	318	No	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (318 mm).	
6	LA	FW08LA070	Mississippi River	29.93991	-90.00287	534479	Urban	8+	12/02/2008	534479.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	301	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA070	Mississippi River	29.93991	-90.00287	534479	Urban	8+	12/02/2008	534479.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	285	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA070	Mississippi River	29.93991	-90.00287	534479	Urban	8+	12/02/2008	534479.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	355	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA070	Mississippi River	29.93991	-90.00287	534479	Urban	8+	12/02/2008	534479.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	300	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA070	Mississippi River	29.93991	-90.00287	534479	Urban	8+	12/02/2008	534479.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	358	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA088	Mississippi River	31.53964	-91.45261	532159	Urban	8+	09/08/2008	532159.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	418	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA088	Mississippi River	31.53964	-91.45261	532159	Urban	8+	09/08/2008	532159.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	483	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA088	Mississippi River	31.53964	-91.45261	532159	Urban	8+	09/08/2008	532159.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	474	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA088	Mississippi River	31.53964	-91.45261	532159	Urban	8+	09/08/2008	532159.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	494	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA088	Mississippi River	31.53964	-91.45261	532159	Urban	8+	09/08/2008	532159.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	489	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA131	Mississippi River	30.04066	-90.63435	535429	Urban	8+	11/13/2008	535429.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	340	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA131	Mississippi River	30.04066	-90.63435	535429	Urban	8+	11/13/2008	535429.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	413	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA131	Mississippi River	30.04066	-90.63435	535429	Urban	8+	11/13/2008	535429.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	319	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA131	Mississippi River	30.04066	-90.63435	535429	Urban	8+	11/13/2008	535429.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	390	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA131	Mississippi River	30.04066	-90.63435	535429	Urban	8+	11/13/2008	535429.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	322	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA134	Mississippi River	29.87322	-89.90432	535489	Urban	8+	11/19/2008	535489.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	423	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA134	Mississippi River	29.87322	-89.90432	535489	Urban	8+	11/19/2008	535489.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	432	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA134	Mississippi River	29.87322	-89.90432	535489	Urban	8+	11/19/2008	535489.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	450	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA134	Mississippi River	29.87322	-89.90432	535489	Urban	8+	11/19/2008	535489.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	507	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA134	Mississippi River	29.87322	-89.90432	535489	Urban	8+	11/19/2008	535489.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	509	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA182	Mississippi River	29.83838	-89.98985	535509	Urban	8+	11/18/2008	535509.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	421	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA182	Mississippi River	29.83838	-89.98985	535509	Urban	8+	11/18/2008	535509.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	382	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA182	Mississippi River	29.83838	-89.98985	535509	Urban	8+	11/18/2008	535509.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	387	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA182	Mississippi River	29.83838	-89.98985	535509	Urban	8+	11/18/2008	535509.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	389	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA182	Mississippi River	29.83838	-89.98985	535509	Urban	8+	11/18/2008	535509.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	342	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA195	Mississippi River	29.99782	-90.46133	535419	Urban	8+	11/04/2008	535419.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	406	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA195	Mississippi River	29.99782	-90.46133	535419	Urban	8+	11/04/2008	535419.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	372	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA195	Mississippi River	29.99782	-90.46133	535419	Urban	8+	11/04/2008	535419.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	435	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA195	Mississippi River	29.99782	-90.46133	535419	Urban	8+	11/04/2008	535419.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	430	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA195	Mississippi River	29.99782	-90.46133	535419	Urban	8+	11/04/2008	535419.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	332	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA198	Mississippi River	29.92105	-89.92791	533849	Urban	8+	12/03/2008	533849.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	578	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	LA	FW08LA198	Mississippi River	29.92105	-89.92791	533849	Urban	8+	12/03/2008	533849.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	556	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	LA	FW08LA198	Mississippi River	29.92105	-89.92791	533849	Urban	8+	12/03/2008	533849.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	495	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	LA	FW08LA227	Mississippi River	30.26708	-91.12171	530489	Urban	8+	10/22/2008	530489.1	1	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	275	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA227	Mississippi River	30.26708	-91.12171	530489	Urban	8+	10/22/2008	530489.2	2	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	244	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA227	Mississippi River	30.26708	-91.12171	530489	Urban	8+	10/22/2008	530489.3	3	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	273	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA227	Mississippi River	30.26708	-91.12171	530489	Urban	8+	10/22/2008	530489.4	4	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	246	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	LA	FW08LA227	Mississippi River	30.26708	-91.12171	530489	Urban	8+	10/22/2008	530489.5	5	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	260	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA003	Merrimack River	42.70064	-71.21798	554989	Urban	7	09/15/2009	554989.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	345	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
1	MA	FW08MA003	Merrimack River	42.70064	-71.21798	554989	Urban	7	09/15/2009	554989.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	325	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
1	MA	FW08MA005	Connecticut River	42.57836	-72.56958	555119	Urban	6	09/02/2009	555119.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	328	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	MA	FW08MA005	Connecticut River	42.57836	-72.56958	555119	Urban	6	09/02/2009	555119.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	256	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	MA	FW08MA005	Connecticut River	42.57836	-72.56958	555119	Urban	6	09/02/2009	555119.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	278	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	MA	FW08MA006	Taunton River	41.87494	-71.09397	526309	Urban	5	08/06/2008	526309.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	350	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA006	Taunton River	41.87494	-71.09397	526309	Urban	5	08/06/2008	526309.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	345	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA006	Taunton River	41.87494	-71.09397	526309	Urban	5	08/06/2008	526309.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	320	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA006	Taunton River	41.87494	-71.09397	526309	Urban	5	08/06/2008	526309.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA007	Merrimack River	42.81381	-71.00100	528139	Urban	7	07/23/2008	528139.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	170	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA007	Merrimack River	42.81381	-71.00100	528139	Urban	7	07/23/2008	528139.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	198	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA007	Merrimack River	42.81381	-71.00100	528139	Urban	7	07/23/2008	528139.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	183	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA007	Merrimack River	42.81381	-71.00100	528139	Urban	7	07/23/2008	528139.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	188	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA007	Merrimack River	42.81381	-71.00100	528139	Urban	7	07/23/2008	528139.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	205	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA013	Chicopee River	42.15884	-72.57666	528009	Urban	5	07/19/2008	528009.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	261	No	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (261 mm).	
1	MA	FW08MA013	Chicopee River	42.15884	-72.57666	528009	Urban	5	07/19/2008	528009.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	306	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (261 mm).	
1	MA	FW08MA013	Chicopee River	42.15884	-72.57666	528009	Urban	5	07/19/2008	528009.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	408	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (261 mm).	
1	MA	FW08MA013	Chicopee River	42.15884	-72.57666	528009	Urban	5	07/19/2008	528009.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	415	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (261 mm).	
1	MA	FW08MA013	Chicopee River	42.15884	-72.57666	528009	Urban	5	07/19/2008	528009.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	395	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (261 mm).	
1	MA	FW08MA017	Connecticut River	42.20402	-72.59054	526569	Urban	6	07/15/2008	526569.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	375	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite.	
1	MA	FW08MA017	Connecticut River	42.20402	-72.59054	526569	Urban	6	07/15/2008	526569.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	318	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite.	
1	MA	FW08MA017	Connecticut River	42.20402	-72.59054	526569	Urban	6	07/15/2008	526569.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	284	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite.	
1	MA	FW08MA017	Connecticut River	42.20402	-72.59054	526569	Urban	6	07/15/2008	526569.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	330	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite.	
1	MA	FW08MA017	Connecticut River	42.20402	-72.59054	526569	Urban	6	07/15/2008	526569.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	380	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite.	
1	MA	FW08MA019	Merrimack River	42.71030	-71.13399	554959	Urban	7	09/18/2009	554959.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	351	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	MA	FW08MA019	Merrimack River	42.71030	-71.13399	554959	Urban	7	09/18/2009	554959.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	330	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	MA	FW08MA019	Merrimack River	42.71030	-71.13399	554959	Urban	7	09/18/2009	554959.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	424	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	MA	FW08MA021	Connecticut River	42.60191	-72.57133	555249	Urban	6	08/31/2009	555249.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	281	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA021	Connecticut River	42.60191	-72.57133	555249	Urban	6	08/31/2009	555249.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	227	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA021	Connecticut River	42.60191	-72.57133	555249	Urban	6	08/31/2009	555249.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	241	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA021	Connecticut River	42.60191	-72.57133	555249	Urban	6	08/31/2009	555249.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	246	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA021	Connecticut River	42.60191	-72.57133	555249	Urban	6	08/31/2009	555249.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	247	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	MA	FW08MA023	Merrimack River	42.76553	-71.09351	554889	Urban	7	09/17/2009	554889.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	395	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA023	Merrimack River	42.76553	-71.09351	554889	Urban	7	09/17/2009	554889.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	395	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA023	Merrimack River	42.76553	-71.09351	554889	Urban	7	09/17/2009	554889.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	404	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	MA	FW08MA023	Merrimack River	42.76553	-71.09351	554889	Urban	7	09/17/2009	554889.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	430	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	MD	FW08MD008	Potomac River	39.06637	-77.38957	521489	Urban	7	07/17/2008	521489.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	540	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	MD	FW08MD008	Potomac River	39.06637	-77.38957	521489	Urban	7	07/17/2008	521489.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	530	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	MD	FW08MD008	Potomac River	39.06637	-77.38957	521489	Urban	7	07/17/2008	521489.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	530	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	MD	FW08MD009	Potomac River	39.59856	-77.88461	526059	Urban	6	07/15/2008	526059.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	420	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD009	Potomac River	39.59856	-77.88461	526059	Urban	6	07/15/2008	526059.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	440	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD009	Potomac River	39.59856	-77.88461	526059	Urban	6	07/15/2008	526059.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	420	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD009	Potomac River	39.59856	-77.88461	526059	Urban	6	07/15/2008	526059.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	460	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD009	Potomac River	39.59856	-77.88461	526059	Urban	6	07/15/2008	526059.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	430	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD014	Potomac River	38.65172	-77.12458	526039	Urban	7	07/23/2008	526039.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	430	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD014	Potomac River	38.65172	-77.12458	526039	Urban	7	07/23/2008	526039.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD014	Potomac River	38.65172	-77.12458	526039	Urban	7	07/23/2008	526039.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	345	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD014	Potomac River	38.65172	-77.12458	526039	Urban	7	07/23/2008	526039.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	410	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD014	Potomac River	38.65172	-77.12458	526039	Urban	7	07/23/2008	526039.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD018	Potomac River	38.61580	-77.16856	526009	Urban	7	07/24/2008	526009.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	442	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD018	Potomac River	38.61580	-77.16856	526009	Urban	7	07/24/2008	526009.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	360	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD018	Potomac River	38.61580	-77.16856	526009	Urban	7	07/24/2008	526009.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	370	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD018	Potomac River	38.61580	-77.16856	526009	Urban	7	07/24/2008	526009.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	444	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD018	Potomac River	38.61580	-77.16856	526009	Urban	7	07/24/2008	526009.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD020	Potomac River	39.45734	-77.79813	526089	Urban	6	07/14/2008	526089.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD020	Potomac River	39.45734	-77.79813	526089	Urban	6	07/14/2008	526089.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	300	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
3	MD	FW08MD020	Potomac River	39.45734	-77.79813	526089	Urban	6	07/14/2008	526089.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD020	Potomac River	39.45734	-77.79813	526089	Urban	6	07/14/2008	526089.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD020	Potomac River	39.45734	-77.79813	526089	Urban	6	07/14/2008	526089.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	MD	FW08MD027	North Branch Potomac River	39.62554	-78.75176	541959	Urban	5	06/09/2009	541959.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	392	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	MD	FW08MD027	North Branch Potomac River	39.62554	-78.75176	541959	Urban	5	06/09/2009	541959.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	450	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	MD	FW08MD027	North Branch Potomac River	39.62554	-78.75176	541959	Urban	5	06/09/2009	541959.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	355	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	MD	FW08MD027	North Branch Potomac River	39.62554	-78.75176	541959	Urban	5	06/09/2009	541959.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	392	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	ME	FW08ME019	Saco River	43.49885	-70.46423	531499	Urban	6	09/17/2008	531499.1	1	*Esox niger*	Chain pickerel	Esocidae	Fillet	314	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME019	Saco River	43.49885	-70.46423	531499	Urban	6	09/17/2008	531499.2	2	*Esox niger*	Chain pickerel	Esocidae	Fillet	347	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME019	Saco River	43.49885	-70.46423	531499	Urban	6	09/17/2008	531499.3	3	*Esox niger*	Chain pickerel	Esocidae	Fillet	268	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME019	Saco River	43.49885	-70.46423	531499	Urban	6	09/17/2008	531499.4	4	*Esox niger*	Chain pickerel	Esocidae	Fillet	260	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME019	Saco River	43.49885	-70.46423	531499	Urban	6	09/17/2008	531499.5	5	*Esox niger*	Chain pickerel	Esocidae	Fillet	275	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME026	Kennebec River	44.50109	-69.67614	526959	Urban	6	09/15/2008	526959.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	311	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME026	Kennebec River	44.50109	-69.67614	526959	Urban	6	09/15/2008	526959.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	347	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME026	Kennebec River	44.50109	-69.67614	526959	Urban	6	09/15/2008	526959.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	342	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME026	Kennebec River	44.50109	-69.67614	526959	Urban	6	09/15/2008	526959.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	344	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME026	Kennebec River	44.50109	-69.67614	526959	Urban	6	09/15/2008	526959.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	360	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME027	Androscoggin River	44.00309	-70.09861	530679	Urban	5	09/18/2008	530679.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	349	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME027	Androscoggin River	44.00309	-70.09861	530679	Urban	5	09/18/2008	530679.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	331	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME027	Androscoggin River	44.00309	-70.09861	530679	Urban	5	09/18/2008	530679.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	340	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME027	Androscoggin River	44.00309	-70.09861	530679	Urban	5	09/18/2008	530679.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	374	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	ME	FW08ME027	Androscoggin River	44.00309	-70.09861	530679	Urban	5	09/18/2008	530679.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	361	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI019	Grand River	43.05631	-85.59421	528079	Urban	6	07/10/2008	528079.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	345	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI019	Grand River	43.05631	-85.59421	528079	Urban	6	07/10/2008	528079.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	345	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI019	Grand River	43.05631	-85.59421	528079	Urban	6	07/10/2008	528079.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	355	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI019	Grand River	43.05631	-85.59421	528079	Urban	6	07/10/2008	528079.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	315	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI023	Saint Joseph River	42.06127	-86.42370	527129	Urban	6	08/13/2008	527129.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	314	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI023	Saint Joseph River	42.06127	-86.42370	527129	Urban	6	08/13/2008	527129.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	329	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI023	Saint Joseph River	42.06127	-86.42370	527129	Urban	6	08/13/2008	527129.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	301	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI023	Saint Joseph River	42.06127	-86.42370	527129	Urban	6	08/13/2008	527129.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	311	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI023	Saint Joseph River	42.06127	-86.42370	527129	Urban	6	08/13/2008	527129.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	293	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI036	Black River	43.00436	-82.52504	526579	Urban	5	07/07/2008	526579.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	305	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI036	Black River	43.00436	-82.52504	526579	Urban	5	07/07/2008	526579.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	302	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI036	Black River	43.00436	-82.52504	526579	Urban	5	07/07/2008	526579.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	334	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI036	Black River	43.00436	-82.52504	526579	Urban	5	07/07/2008	526579.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	305	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
5	MI	FW08MI037	Detroit River	42.33163	-83.00431	527489	Urban	6	10/16/2008	527489.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	313	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	MI	FW08MI037	Detroit River	42.33163	-83.00431	527489	Urban	6	10/16/2008	527489.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	405	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	MI	FW08MI037	Detroit River	42.33163	-83.00431	527489	Urban	6	10/16/2008	527489.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	316	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	MI	FW08MI046	Muskegon River	43.42079	-85.79340	532059	Urban	6	09/15/2008	532059.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	438	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite. Including the slightly undersized specimen 5.	
5	MI	FW08MI046	Muskegon River	43.42079	-85.79340	532059	Urban	6	09/15/2008	532059.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	440	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite. Including the slightly undersized specimen 5.	
5	MI	FW08MI046	Muskegon River	43.42079	-85.79340	532059	Urban	6	09/15/2008	532059.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	423	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite. Including the slightly undersized specimen 5.	
5	MI	FW08MI046	Muskegon River	43.42079	-85.79340	532059	Urban	6	09/15/2008	532059.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	356	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite. Including the slightly undersized specimen 5.	
5	MI	FW08MI046	Muskegon River	43.42079	-85.79340	532059	Urban	6	09/15/2008	532059.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	327	Yes	P	Non-routine	Length	Process all specimens in the 5-fish composite. Including the slightly undersized specimen 5.	
5	MI	FW08MI050	Thunder Bay River	45.08290	-83.49056	525149	Urban	5	07/20/2008	525149.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	382	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI050	Thunder Bay River	45.08290	-83.49056	525149	Urban	5	07/20/2008	525149.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	348	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI050	Thunder Bay River	45.08290	-83.49056	525149	Urban	5	07/20/2008	525149.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	303	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI050	Thunder Bay River	45.08290	-83.49056	525149	Urban	5	07/20/2008	525149.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	300	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI050	Thunder Bay River	45.08290	-83.49056	525149	Urban	5	07/20/2008	525149.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	318	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MI	FW08MI057	Muskegon River	43.67563	-85.46991	532879	Urban	5	09/16/2008	532879.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	370	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (312 mm).	
5	MI	FW08MI057	Muskegon River	43.67563	-85.46991	532879	Urban	5	09/16/2008	532879.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	416	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (312 mm).	
5	MI	FW08MI057	Muskegon River	43.67563	-85.46991	532879	Urban	5	09/16/2008	532879.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	325	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (312 mm).	
5	MI	FW08MI057	Muskegon River	43.67563	-85.46991	532879	Urban	5	09/16/2008	532879.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	420	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (312 mm).	
5	MI	FW08MI057	Muskegon River	43.67563	-85.46991	532879	Urban	5	09/16/2008	532879.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	312	No	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (312 mm).	
5	MN	FW08MN019	Mississippi River	45.29729	-93.57205	529119	Urban	6	09/22/2008	529119.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	360	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN019	Mississippi River	45.29729	-93.57205	529119	Urban	6	09/22/2008	529119.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	365	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN019	Mississippi River	45.29729	-93.57205	529119	Urban	6	09/22/2008	529119.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN019	Mississippi River	45.29729	-93.57205	529119	Urban	6	09/22/2008	529119.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	375	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN019	Mississippi River	45.29729	-93.57205	529119	Urban	6	09/22/2008	529119.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	385	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN024	Minnesota River	44.79956	-93.53312	529089	Urban	8+	09/09/2008	529089.1	1	*Morone chrysops*	White bass	Moronidae	Fillet	384	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN024	Minnesota River	44.79956	-93.53312	529089	Urban	8+	09/09/2008	529089.2	2	*Morone chrysops*	White bass	Moronidae	Fillet	385	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN024	Minnesota River	44.79956	-93.53312	529089	Urban	8+	09/09/2008	529089.3	3	*Morone chrysops*	White bass	Moronidae	Fillet	445	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN024	Minnesota River	44.79956	-93.53312	529089	Urban	8+	09/09/2008	529089.4	4	*Morone chrysops*	White bass	Moronidae	Fillet	370	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN024	Minnesota River	44.79956	-93.53312	529089	Urban	8+	09/09/2008	529089.5	5	*Morone chrysops*	White bass	Moronidae	Fillet	360	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN035	Mississippi River	45.23426	-93.49636	529799	Urban	7	09/23/2008	529799.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	420	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN035	Mississippi River	45.23426	-93.49636	529799	Urban	7	09/23/2008	529799.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN035	Mississippi River	45.23426	-93.49636	529799	Urban	7	09/23/2008	529799.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	360	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN035	Mississippi River	45.23426	-93.49636	529799	Urban	7	09/23/2008	529799.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	405	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN035	Mississippi River	45.23426	-93.49636	529799	Urban	7	09/23/2008	529799.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	410	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN036	Mississippi River	44.80659	-93.01163	527099	Urban	8+	09/11/2008	527099.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	387	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN036	Mississippi River	44.80659	-93.01163	527099	Urban	8+	09/11/2008	527099.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	345	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN036	Mississippi River	44.80659	-93.01163	527099	Urban	8+	09/11/2008	527099.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	394	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN036	Mississippi River	44.80659	-93.01163	527099	Urban	8+	09/11/2008	527099.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	350	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN036	Mississippi River	44.80659	-93.01163	527099	Urban	8+	09/11/2008	527099.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	MN	FW08MN049	Minnesota River	44.34015	-93.93940	532789	Urban	8+	10/02/2008	532789.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	530	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 5 as a 4-fish composite. Discard specimen 4 (404 mm).	
5	MN	FW08MN049	Minnesota River	44.34015	-93.93940	532789	Urban	8+	10/02/2008	532789.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	496	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 5 as a 4-fish composite. Discard specimen 4 (404 mm).	
5	MN	FW08MN049	Minnesota River	44.34015	-93.93940	532789	Urban	8+	10/02/2008	532789.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	435	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 5 as a 4-fish composite. Discard specimen 4 (404 mm).	
5	MN	FW08MN049	Minnesota River	44.34015	-93.93940	532789	Urban	8+	10/02/2008	532789.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	404	No	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 5 as a 4-fish composite. Discard specimen 4 (404 mm).	
5	MN	FW08MN049	Minnesota River	44.34015	-93.93940	532789	Urban	8+	10/02/2008	532789.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	545	Yes	BD	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 5 as a 4-fish composite. Discard specimen 4 (404 mm).	
5	MN	FW08MN057	Mississippi River	46.33313	-94.23262	554449	Urban	6	08/09/2009	554449.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	485	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	MN	FW08MN057	Mississippi River	46.33313	-94.23262	554449	Urban	6	08/09/2009	554449.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	440	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	MN	FW08MN057	Mississippi River	46.33313	-94.23262	554449	Urban	6	08/09/2009	554449.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	406	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
7	MO	FW08MO025	Missouri River	38.82912	-90.41661	526289	Urban	8+	08/13/2009	526289.1	1	*Ictiobus bubalus*	Smallmouth buffalo	Catostomidae	Fillet	510	Yes	BD	Non-routine	Number	Process both specimens as a 2-fish composite.	
7	MO	FW08MO025	Missouri River	38.82912	-90.41661	526289	Urban	8+	08/13/2009	526289.2	2	*Ictiobus bubalus*	Smallmouth buffalo	Catostomidae	Fillet	455	Yes	BD	Non-routine	Number	Process both specimens as a 2-fish composite.	
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.1	1	*Perca flavescens*	Yellow perch	Percidae	Fillet	215	No	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.2	2	*Perca flavescens*	Yellow perch	Percidae	Fillet	181	Yes	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.3	3	*Perca flavescens*	Yellow perch	Percidae	Fillet	147	Yes	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	

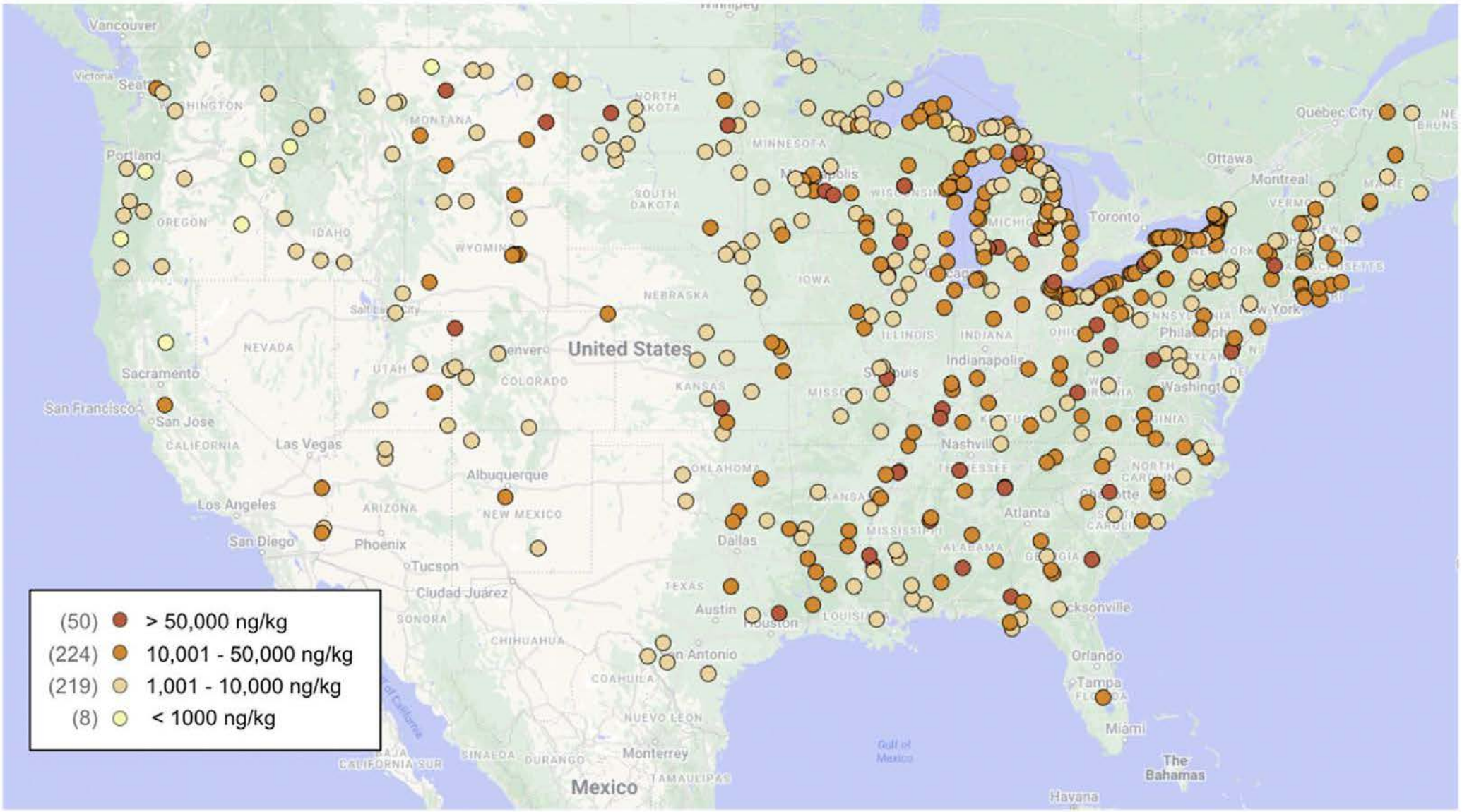
EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.4	4	*Perca flavescens*	Yellow perch	Percidae	Fillet	125	No	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.5	5	*Perca flavescens*	Yellow perch	Percidae	Fillet	152	Yes	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.6	6	*Perca flavescens*	Yellow perch	Percidae	Fillet	150	Yes	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	
8	MT	FW08MT043	Missouri River	47.45161	-111.30128	532489	Urban	7	09/17/2008	532489.7	7	*Perca flavescens*	Yellow perch	Percidae	Fillet	135	Yes	P	Non-routine	Number & Length	Process ONLY specimens 2, 3, 5, 6, and 7 as a 5-fish composite. Discard specimens 1 (215 mm) and 4 (125 mm).	
4	NC	FW08NC032	Yadkin River	35.99756	-80.41813	544189	Urban	6	06/16/2009	544189.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	380	Yes	BD	Non-routine	Number	Process both specimens as a 2-fish composite.	
4	NC	FW08NC032	Yadkin River	35.99756	-80.41813	544189	Urban	6	06/16/2009	544189.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	345	Yes	BD	Non-routine	Number	Process both specimens as a 2-fish composite.	
4	NC	FW08NC041	Neuse River	35.93954	-78.57553	544649	Urban	5	06/23/2009	544649.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	456	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	NC	FW08NC041	Neuse River	35.93954	-78.57553	544649	Urban	5	06/23/2009	544649.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	371	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	NC	FW08NC041	Neuse River	35.93954	-78.57553	544649	Urban	5	06/23/2009	544649.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	342	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	NH	FW08NH010	Merrimack River	43.19317	-71.52351	527239	Urban	7	07/08/2008	527239.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	480	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (270 mm).	
1	NH	FW08NH010	Merrimack River	43.19317	-71.52351	527239	Urban	7	07/08/2008	527239.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	371	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (270 mm).	
1	NH	FW08NH010	Merrimack River	43.19317	-71.52351	527239	Urban	7	07/08/2008	527239.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	270	No	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (270 mm).	
1	NH	FW08NH010	Merrimack River	43.19317	-71.52351	527239	Urban	7	07/08/2008	527239.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	422	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 4 as a 3-fish composite. Discard specimen 3 (270 mm).	
1	NH	FW08NH011	Connecticut River	43.35118	-72.39344	527229	Urban	6	07/11/2008	527229.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	420	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimen 2 (350 mm).	All specimens inadvertently processed by prep lab.
1	NH	FW08NH011	Connecticut River	43.35118	-72.39344	527229	Urban	6	07/11/2008	527229.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	350	No	P	Non-routine	Number & Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimen 2 (350 mm).	All specimens inadvertently processed by prep lab.
1	NH	FW08NH011	Connecticut River	43.35118	-72.39344	527229	Urban	6	07/11/2008	527229.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	498	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1 and 3 as a 2-fish composite. Discard specimen 2 (350 mm).	All specimens inadvertently processed by prep lab.
1	NH	FW08NH016	Connecticut River	42.84932	-72.55309	521569	Urban	6	09/03/2008	521569.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	430	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	NH	FW08NH016	Connecticut River	42.84932	-72.55309	521569	Urban	6	09/03/2008	521569.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	365	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	NH	FW08NH016	Connecticut River	42.84932	-72.55309	521569	Urban	6	09/03/2008	521569.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	340	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	NH	FW08NH016	Connecticut River	42.84932	-72.55309	521569	Urban	6	09/03/2008	521569.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	380	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	NH	FW08NH017	Connecticut River	43.43030	-72.39501	521719	Urban	6	07/10/2008	521719.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	NH	FW08NH017	Connecticut River	43.43030	-72.39501	521719	Urban	6	07/10/2008	521719.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	385	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	NH	FW08NH017	Connecticut River	43.43030	-72.39501	521719	Urban	6	07/10/2008	521719.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	390	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	NH	FW08NH017	Connecticut River	43.43030	-72.39501	521719	Urban	6	07/10/2008	521719.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	405	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	NH	FW08NH017	Connecticut River	43.43030	-72.39501	521719	Urban	6	07/10/2008	521719.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	395	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	NH	FW08NH018	Contoocook River	43.25604	-71.62250	521789	Urban	6	08/14/2008	521789.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	370	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (231 mm) and 4 (210 mm).	
1	NH	FW08NH018	Contoocook River	43.25604	-71.62250	521789	Urban	6	08/14/2008	521789.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	295	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (231 mm) and 4 (210 mm).	
1	NH	FW08NH018	Contoocook River	43.25604	-71.62250	521789	Urban	6	08/14/2008	521789.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	231	No	P	Non-routine	Number & Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (231 mm) and 4 (210 mm).	
1	NH	FW08NH018	Contoocook River	43.25604	-71.62250	521789	Urban	6	08/14/2008	521789.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	210	No	P	Non-routine	Number & Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (231 mm) and 4 (210 mm).	
2	NJ	FW08NJ005	Raritan River	40.50890	-74.46615	550359	Urban	6	07/07/2009	550359.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	595	Yes	BD	Non-routine	Length & Number	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimen 3 (355 mm).	
2	NJ	FW08NJ005	Raritan River	40.50890	-74.46615	550359	Urban	6	07/07/2009	550359.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	527	Yes	BD	Non-routine	Length & Number	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimen 3 (355 mm).	
2	NJ	FW08NJ005	Raritan River	40.50890	-74.46615	550359	Urban	6	07/07/2009	550359.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	355	No	BD	Non-routine	Length & Number	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimen 3 (355 mm).	
2	NJ	FW08NJ007	Passaic River	40.91251	-74.18684	551879	Urban	6	07/09/2009	551879.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	455	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (325 mm) and 5 (270 mm).	
2	NJ	FW08NJ007	Passaic River	40.91251	-74.18684	551879	Urban	6	07/09/2009	551879.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	454	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (325 mm) and 5 (270 mm).	
2	NJ	FW08NJ007	Passaic River	40.91251	-74.18684	551879	Urban	6	07/09/2009	551879.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	410	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (325 mm) and 5 (270 mm).	
2	NJ	FW08NJ007	Passaic River	40.91251	-74.18684	551879	Urban	6	07/09/2009	551879.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	325	No	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (325 mm) and 5 (270 mm).	
2	NJ	FW08NJ007	Passaic River	40.91251	-74.18684	551879	Urban	6	07/09/2009	551879.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	270	No	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (325 mm) and 5 (270 mm).	
2	NJ	FW08NJ009	Delaware River	40.33696	-74.93851	529639	Urban	6	07/08/2008	529639.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	478	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ009	Delaware River	40.33696	-74.93851	529639	Urban	6	07/08/2008	529639.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	411	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ009	Delaware River	40.33696	-74.93851	529639	Urban	6	07/08/2008	529639.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	449	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ009	Delaware River	40.33696	-74.93851	529639	Urban	6	07/08/2008	529639.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	485	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ009	Delaware River	40.33696	-74.93851	529639	Urban	6	07/08/2008	529639.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	457	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ011	Passaic River	40.86290	-74.10745	548529	Urban	6	07/08/2009	548529.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	310	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (225 mm).	
2	NJ	FW08NJ011	Passaic River	40.86290	-74.10745	548529	Urban	6	07/08/2009	548529.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	280	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (225 mm).	
2	NJ	FW08NJ011	Passaic River	40.86290	-74.10745	548529	Urban	6	07/08/2009	548529.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	270	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (225 mm).	
2	NJ	FW08NJ011	Passaic River	40.86290	-74.10745	548529	Urban	6	07/08/2009	548529.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	271	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (225 mm).	
2	NJ	FW08NJ011	Passaic River	40.86290	-74.10745	548529	Urban	6	07/08/2009	548529.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	225	No	P	Non-routine	Length	Process ONLY specimens 1, 2, 3, and 4 as a 4-fish composite. Discard specimen 5 (225 mm).	
2	NJ	FW08NJ013	Delaware River	40.45047	-75.06823	550679	Urban	6	07/13/2009	550679.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	508	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ013	Delaware River	40.45047	-75.06823	550679	Urban	6	07/13/2009	550679.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	508	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ013	Delaware River	40.45047	-75.06823	550679	Urban	6	07/13/2009	550679.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	530	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ013	Delaware River	40.45047	-75.06823	550679	Urban	6	07/13/2009	550679.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	524	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NJ	FW08NJ013	Delaware River	40.45047	-75.06823	550679	Urban	6	07/13/2009	550679.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	490	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY019	Chemung River	42.14603	-77.05409	526339	Urban	5	10/02/2008	526339.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	319	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY019	Chemung River	42.14603	-77.05409	526339	Urban	5	10/02/2008	526339.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	323	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY019	Chemung River	42.14603	-77.05409	526339	Urban	5	10/02/2008	526339.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	313	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY019	Chemung River	42.14603	-77.05409	526339	Urban	5	10/02/2008	526339.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	325	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY019	Chemung River	42.14603	-77.05409	526339	Urban	5	10/02/2008	526339.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	363	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY021	Mohawk River	42.82852	-73.98933	530399	Urban	6	09/29/2008	530399.1	1	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	260	Yes	P	Non-routine	Number	Process ONLY specimens 1, 2, 3, 4, and 6 (include specimen 5 in the composite ONLY if additional tissue is needed to meet analytical biomass requirements).	
2	NY	FW08NY021	Mohawk River	42.82852	-73.98933	530399	Urban	6	09/29/2008	530399.2	2	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	240	Yes	P	Non-routine	Number	Process ONLY specimens 1, 2, 3, 4, and 6 (include specimen 5 in the composite ONLY if additional tissue is needed to meet analytical biomass requirements).	
2	NY	FW08NY021	Mohawk River	42.82852	-73.98933	530399	Urban	6	09/29/2008	530399.3	3	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	248	Yes	P	Non-routine	Number	Process ONLY specimens 1, 2, 3, 4, and 6 (include specimen 5 in the composite ONLY if additional tissue is needed to meet analytical biomass requirements).	
2	NY	FW08NY021	Mohawk River	42.82852	-73.98933	530399	Urban	6	09/29/2008	530399.4	4	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	223	Yes	P	Non-routine	Number	Process ONLY specimens 1, 2, 3, 4, and 6 (include specimen 5 in the composite ONLY if additional tissue is needed to meet analytical biomass requirements).	
2	NY	FW08NY021	Mohawk River	42.82852	-73.98933	530399	Urban	6	09/29/2008	530399.5	5	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	215	No	P	Non-routine	Number	Process ONLY specimens 1, 2, 3, 4, and 6 (include specimen 5 in the composite ONLY if additional tissue is needed to meet analytical biomass requirements).	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
2	NY	FW08NY021	Mohawk River	42.82852	-73.98933	530399	Urban	6	09/29/2008	530399.6	6	*Ambloplites rupestris*	Rock bass	Centrarchidae	Fillet	220	Yes	P	Non-routine	Number	Process ONLY specimens 1, 2, 3, 4, and 6 (include specimen 5 in the composite ONLY if additional tissue is needed to meet analytical biomass requirements).	
2	NY	FW08NY023	Chenango River	42.16144	-75.85678	532589	Urban	6	09/29/2008	532589.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	420	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY023	Chenango River	42.16144	-75.85678	532589	Urban	6	09/29/2008	532589.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	343	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY023	Chenango River	42.16144	-75.85678	532589	Urban	6	09/29/2008	532589.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	372	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY023	Chenango River	42.16144	-75.85678	532589	Urban	6	09/29/2008	532589.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	364	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY023	Chenango River	42.16144	-75.85678	532589	Urban	6	09/29/2008	532589.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	455	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY028	Hudson River	42.47413	-73.78702	527989	Urban	7	09/23/2008	527989.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	494	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY028	Hudson River	42.47413	-73.78702	527989	Urban	7	09/23/2008	527989.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	446	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY028	Hudson River	42.47413	-73.78702	527989	Urban	7	09/23/2008	527989.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	470	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY028	Hudson River	42.47413	-73.78702	527989	Urban	7	09/23/2008	527989.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	439	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY028	Hudson River	42.47413	-73.78702	527989	Urban	7	09/23/2008	527989.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	506	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY030	Olean Creek	42.08065	-78.42363	529939	Urban	5	09/16/2008	529939.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	248	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY030	Olean Creek	42.08065	-78.42363	529939	Urban	5	09/16/2008	529939.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	293	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY030	Olean Creek	42.08065	-78.42363	529939	Urban	5	09/16/2008	529939.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	295	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY030	Olean Creek	42.08065	-78.42363	529939	Urban	5	09/16/2008	529939.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	265	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY030	Olean Creek	42.08065	-78.42363	529939	Urban	5	09/16/2008	529939.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	257	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY032	Allegheny River	42.06591	-78.46922	527199	Urban	6	09/15/2008	527199.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	312	No	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimen 1 (312 mm) and specimen 2 (323 mm).	
2	NY	FW08NY032	Allegheny River	42.06591	-78.46922	527199	Urban	6	09/15/2008	527199.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	323	No	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimen 1 (312 mm) and specimen 2 (323 mm).	
2	NY	FW08NY032	Allegheny River	42.06591	-78.46922	527199	Urban	6	09/15/2008	527199.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	413	Yes	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimen 1 (312 mm) and specimen 2 (323 mm).	
2	NY	FW08NY032	Allegheny River	42.06591	-78.46922	527199	Urban	6	09/15/2008	527199.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	416	Yes	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimen 1 (312 mm) and specimen 2 (323 mm).	
2	NY	FW08NY032	Allegheny River	42.06591	-78.46922	527199	Urban	6	09/15/2008	527199.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	448	Yes	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimen 1 (312 mm) and specimen 2 (323 mm).	
2	NY	FW08NY034	Seneca River	43.13767	-76.29551	527209	Urban	7	09/23/2008	527209.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	448	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY034	Seneca River	43.13767	-76.29551	527209	Urban	7	09/23/2008	527209.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	443	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY034	Seneca River	43.13767	-76.29551	527209	Urban	7	09/23/2008	527209.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	372	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY034	Seneca River	43.13767	-76.29551	527209	Urban	7	09/23/2008	527209.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	435	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY034	Seneca River	43.13767	-76.29551	527209	Urban	7	09/23/2008	527209.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY037	Mohawk River	42.93558	-74.19445	531139	Urban	6	09/25/2008	531139.1	1	*Sander vitreus*	Walleye	Percidae	Fillet	374	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY037	Mohawk River	42.93558	-74.19445	531139	Urban	6	09/25/2008	531139.2	2	*Sander vitreus*	Walleye	Percidae	Fillet	330	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY037	Mohawk River	42.93558	-74.19445	531139	Urban	6	09/25/2008	531139.3	3	*Sander vitreus*	Walleye	Percidae	Fillet	336	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY037	Mohawk River	42.93558	-74.19445	531139	Urban	6	09/25/2008	531139.4	4	*Sander vitreus*	Walleye	Percidae	Fillet	356	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY037	Mohawk River	42.93558	-74.19445	531139	Urban	6	09/25/2008	531139.5	5	*Sander vitreus*	Walleye	Percidae	Fillet	359	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY040	Hudson River	43.25553	-73.58640	530419	Urban	6	10/01/2008	530419.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	340	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY040	Hudson River	43.25553	-73.58640	530419	Urban	6	10/01/2008	530419.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	338	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY040	Hudson River	43.25553	-73.58640	530419	Urban	6	10/01/2008	530419.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	305	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY040	Hudson River	43.25553	-73.58640	530419	Urban	6	10/01/2008	530419.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	363	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY040	Hudson River	43.25553	-73.58640	530419	Urban	6	10/01/2008	530419.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	361	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
2	NY	FW08NY044	Hudson River	42.05576	-73.93195	528439	Urban	7	08/26/2008	528439.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	375	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
2	NY	FW08NY044	Hudson River	42.05576	-73.93195	528439	Urban	7	08/26/2008	528439.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	373	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
2	NY	FW08NY044	Hudson River	42.05576	-73.93195	528439	Urban	7	08/26/2008	528439.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	295	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
2	NY	FW08NY044	Hudson River	42.05576	-73.93195	528439	Urban	7	08/26/2008	528439.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	296	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
2	NY	FW08NY049	Mohawk River	43.12146	-75.26332	555129	Urban	5	08/23/2009	555129.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	405	Yes	P	Non-routine	Number	Process single specimen as a tissue sample.	
2	NY	FW08NY050	Oswego River	43.30450	-76.39770	531439	Urban	7	10/06/2008	531439.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	356	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
2	NY	FW08NY050	Oswego River	43.30450	-76.39770	531439	Urban	7	10/06/2008	531439.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	352	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
2	NY	FW08NY050	Oswego River	43.30450	-76.39770	531439	Urban	7	10/06/2008	531439.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	346	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	OH	FW08OH012	Paint Creek	39.30982	-82.96430	526929	Urban	5	08/18/2008	526929.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	560	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH012	Paint Creek	39.30982	-82.96430	526929	Urban	5	08/18/2008	526929.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	609	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH012	Paint Creek	39.30982	-82.96430	526929	Urban	5	08/18/2008	526929.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	520	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH012	Paint Creek	39.30982	-82.96430	526929	Urban	5	08/18/2008	526929.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	514	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH012	Paint Creek	39.30982	-82.96430	526929	Urban	5	08/18/2008	526929.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	526	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH017	Muskingum River	40.26612	-81.87411	521869	Urban	7	06/11/2008	521869.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	353	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH017	Muskingum River	40.26612	-81.87411	521869	Urban	7	06/11/2008	521869.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH017	Muskingum River	40.26612	-81.87411	521869	Urban	7	06/11/2008	521869.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	333	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH017	Muskingum River	40.26612	-81.87411	521869	Urban	7	06/11/2008	521869.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	325	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH017	Muskingum River	40.26612	-81.87411	521869	Urban	7	06/11/2008	521869.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	426	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH019	Little Miami River	39.13619	-84.34206	529209	Urban	6	09/23/2008	529209.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	575	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH019	Little Miami River	39.13619	-84.34206	529209	Urban	6	09/23/2008	529209.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	615	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH019	Little Miami River	39.13619	-84.34206	529209	Urban	6	09/23/2008	529209.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	570	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH019	Little Miami River	39.13619	-84.34206	529209	Urban	6	09/23/2008	529209.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	613	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH019	Little Miami River	39.13619	-84.34206	529209	Urban	6	09/23/2008	529209.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	550	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH031	Great Miami River	39.69271	-84.23254	521609	Urban	7	06/23/2008	521609.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	399	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH031	Great Miami River	39.69271	-84.23254	521609	Urban	7	06/23/2008	521609.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	356	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH031	Great Miami River	39.69271	-84.23254	521609	Urban	7	06/23/2008	521609.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	431	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH031	Great Miami River	39.69271	-84.23254	521609	Urban	7	06/23/2008	521609.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	388	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH031	Great Miami River	39.69271	-84.23254	521609	Urban	7	06/23/2008	521609.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH033	Kokosing River	40.39460	-82.50344	524309	Urban	5	07/07/2008	524309.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	400	Yes	P	Non-routine	Number & Length	Process all specimens in the 3-fish composite.	
5	OH	FW08OH033	Kokosing River	40.39460	-82.50344	524309	Urban	5	07/07/2008	524309.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	330	Yes	P	Non-routine	Number & Length	Process all specimens in the 3-fish composite.	
5	OH	FW08OH033	Kokosing River	40.39460	-82.50344	524309	Urban	5	07/07/2008	524309.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	298	Yes	P	Non-routine	Number & Length	Process all specimens in the 3-fish composite.	
5	OH	FW08OH035	Great Miami River	39.97683	-84.17017	521729	Urban	5	07/30/2008	521729.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	315	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH035	Great Miami River	39.97683	-84.17017	521729	Urban	5	07/30/2008	521729.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	292	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH035	Great Miami River	39.97683	-84.17017	521729	Urban	5	07/30/2008	521729.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	295	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH035	Great Miami River	39.97683	-84.17017	521729	Urban	5	07/30/2008	521729.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	355	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH035	Great Miami River	39.97683	-84.17017	521729	Urban	5	07/30/2008	521729.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	280	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH038	Rocky River	41.45313	-81.82335	528799	Urban	5	09/09/2008	528799.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	330	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH038	Rocky River	41.45313	-81.82335	528799	Urban	5	09/09/2008	528799.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	301	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH038	Rocky River	41.45313	-81.82335	528799	Urban	5	09/09/2008	528799.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	278	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH038	Rocky River	41.45313	-81.82335	528799	Urban	5	09/09/2008	528799.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	282	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	OH	FW08OH038	Rocky River	41.45313	-81.82335	528799	Urban	5	09/09/2008	528799.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	255	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	OK	FW08OK032	Washita River	34.22208	-96.70688	548659	Urban	6	07/20/2009	548659.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	400	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
6	OK	FW08OK032	Washita River	34.22208	-96.70688	548659	Urban	6	07/20/2009	548659.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	350	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
10	OR	FW08OR015	Rogue River	42.41324	-123.15797	532799	Urban	5	08/19/2008	532799.1	1	*Oncorhynchus clarkii*	Cutthroat trout	Salmonidae	Fillet	370	Yes	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (190 mm), 4 (230 mm) and 5 (220 mm).	
10	OR	FW08OR015	Rogue River	42.41324	-123.15797	532799	Urban	5	08/19/2008	532799.2	2	*Oncorhynchus clarkii*	Cutthroat trout	Salmonidae	Fillet	320	Yes	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (190 mm), 4 (230 mm) and 5 (220 mm).	
10	OR	FW08OR015	Rogue River	42.41324	-123.15797	532799	Urban	5	08/19/2008	532799.3	3	*Oncorhynchus clarkii*	Cutthroat trout	Salmonidae	Fillet	190	No	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (190 mm), 4 (230 mm) and 5 (220 mm).	
10	OR	FW08OR015	Rogue River	42.41324	-123.15797	532799	Urban	5	08/19/2008	532799.4	4	*Oncorhynchus clarkii*	Cutthroat trout	Salmonidae	Fillet	230	No	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (190 mm), 4 (230 mm) and 5 (220 mm).	
10	OR	FW08OR015	Rogue River	42.41324	-123.15797	532799	Urban	5	08/19/2008	532799.5	5	*Oncorhynchus clarkii*	Cutthroat trout	Salmonidae	Fillet	220	No	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (190 mm), 4 (230 mm) and 5 (220 mm).	
10	OR	FW08OR027	Willamette River	44.06547	-123.10635	529659	Urban	6	09/30/2008	529659.1	1	*Ptychocheilus oregonensis*	Northern pikeminnow	Cyprinidae	Fillet	330	No	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (330 mm).	
10	OR	FW08OR027	Willamette River	44.06547	-123.10635	529659	Urban	6	09/30/2008	529659.2	2	*Ptychocheilus oregonensis*	Northern pikeminnow	Cyprinidae	Fillet	320	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (330 mm).	
10	OR	FW08OR027	Willamette River	44.06547	-123.10635	529659	Urban	6	09/30/2008	529659.3	3	*Ptychocheilus oregonensis*	Northern pikeminnow	Cyprinidae	Fillet	260	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (330 mm).	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
10	OR	FW08OR027	Willamette River	44.06547	-123.10635	529659	Urban	6	09/30/2008	529659.4	4	*Ptychocheilus oregonensis*	Northern pikeminnow	Cyprinidae	Fillet	240	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (330 mm).	
10	OR	FW08OR027	Willamette River	44.06547	-123.10635	529659	Urban	6	09/30/2008	529659.5	5	*Ptychocheilus oregonensis*	Northern pikeminnow	Cyprinidae	Fillet	240	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (330 mm).	
10	OR	FW08OR028	Tualatin River	45.48478	-122.95994	528409	Urban	5	07/27/2009	528409.1	1	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	580	Yes	BD	Non-routine	Number	Process both specimens as a 2-fish composite.	
10	OR	FW08OR028	Tualatin River	45.48478	-122.95994	528409	Urban	5	07/27/2009	528409.2	2	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	550	Yes	BD	Non-routine	Number	Process both specimens as a 2-fish composite.	
10	OR	FW08OR060	North Santiam River	44.77924	-122.81647	521459	Urban	5	08/14/2008	521459.1	1	*Prosopium williamsoni*	Mountain whitefish	Salmonidae	Fillet	250	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	OR	FW08OR060	North Santiam River	44.77924	-122.81647	521459	Urban	5	08/14/2008	521459.2	2	*Prosopium williamsoni*	Mountain whitefish	Salmonidae	Fillet	330	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	OR	FW08OR060	North Santiam River	44.77924	-122.81647	521459	Urban	5	08/14/2008	521459.3	3	*Prosopium williamsoni*	Mountain whitefish	Salmonidae	Fillet	250	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	OR	FW08OR071	Willamette River	45.55286	-122.70538	529459	Urban	7	09/02/2009	529459.1	1	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	610	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	OR	FW08OR071	Willamette River	45.55286	-122.70538	529459	Urban	7	09/02/2009	529459.2	2	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	550	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	OR	FW08OR071	Willamette River	45.55286	-122.70538	529459	Urban	7	09/02/2009	529459.3	3	*Cyprinus carpio*	Common carp	Cyprinidae	Fillet	590	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	PA	FW08PA019	Susquehanna River	40.49180	-76.94813	554259	Urban	7	08/25/2009	554259.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	464	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	PA	FW08PA019	Susquehanna River	40.49180	-76.94813	554259	Urban	7	08/25/2009	554259.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	461	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	PA	FW08PA019	Susquehanna River	40.49180	-76.94813	554259	Urban	7	08/25/2009	554259.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	361	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
3	PA	FW08PA020	Beaver River	40.93107	-80.37396	556659	Urban	6	09/16/2009	556659.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	430	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA020	Beaver River	40.93107	-80.37396	556659	Urban	6	09/16/2009	556659.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	485	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA020	Beaver River	40.93107	-80.37396	556659	Urban	6	09/16/2009	556659.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	473	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA020	Beaver River	40.93107	-80.37396	556659	Urban	6	09/16/2009	556659.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	435	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA020	Beaver River	40.93107	-80.37396	556659	Urban	6	09/16/2009	556659.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	420	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA021	Susquehanna River	41.96990	-76.51192	547899	Urban	6	08/26/2009	547899.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	350	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimen 4 (270 mm).	
3	PA	FW08PA021	Susquehanna River	41.96990	-76.51192	547899	Urban	6	08/26/2009	547899.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	375	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimen 4 (270 mm).	
3	PA	FW08PA021	Susquehanna River	41.96990	-76.51192	547899	Urban	6	08/26/2009	547899.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	305	Yes	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimen 4 (270 mm).	
3	PA	FW08PA021	Susquehanna River	41.96990	-76.51192	547899	Urban	6	08/26/2009	547899.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	270	No	P	Non-routine	Number & Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimen 4 (270 mm).	
3	PA	FW08PA030	Schuylkill River	40.14318	-75.51026	541409	Urban	6	09/02/2009	541409.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	240	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	PA	FW08PA030	Schuylkill River	40.14318	-75.51026	541409	Urban	6	09/02/2009	541409.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	236	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	PA	FW08PA030	Schuylkill River	40.14318	-75.51026	541409	Urban	6	09/02/2009	541409.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	235	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	PA	FW08PA030	Schuylkill River	40.14318	-75.51026	541409	Urban	6	09/02/2009	541409.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	235	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	PA	FW08PA035	West Branch Susquehanna River	40.88572	-76.80151	530509	Urban	6	09/03/2008	530509.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	431	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 5 as a 3-fish composite. Discard specimens 3 (354 mm) and 4 (319 mm).	
3	PA	FW08PA035	West Branch Susquehanna River	40.88572	-76.80151	530509	Urban	6	09/03/2008	530509.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	381	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 5 as a 3-fish composite. Discard specimens 3 (354 mm) and 4 (319 mm).	
3	PA	FW08PA035	West Branch Susquehanna River	40.88572	-76.80151	530509	Urban	6	09/03/2008	530509.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	354	No	P	Non-routine	Length	Process ONLY specimens 1, 2, and 5 as a 3-fish composite. Discard specimens 3 (354 mm) and 4 (319 mm).	
3	PA	FW08PA035	West Branch Susquehanna River	40.88572	-76.80151	530509	Urban	6	09/03/2008	530509.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	319	No	P	Non-routine	Length	Process ONLY specimens 1, 2, and 5 as a 3-fish composite. Discard specimens 3 (354 mm) and 4 (319 mm).	
3	PA	FW08PA035	West Branch Susquehanna River	40.88572	-76.80151	530509	Urban	6	09/03/2008	530509.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	487	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 5 as a 3-fish composite. Discard specimens 3 (354 mm) and 4 (319 mm).	
3	PA	FW08PA036	Shenango River	41.24333	-80.50937	550189	Urban	6	09/13/2009	550189.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	344	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA036	Shenango River	41.24333	-80.50937	550189	Urban	6	09/13/2009	550189.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	346	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA036	Shenango River	41.24333	-80.50937	550189	Urban	6	09/13/2009	550189.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	322	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA036	Shenango River	41.24333	-80.50937	550189	Urban	6	09/13/2009	550189.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	346	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	PA	FW08PA036	Shenango River	41.24333	-80.50937	550189	Urban	6	09/13/2009	550189.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	336	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI003	Seekonk River	41.88014	-71.38130	555279	Urban	5	08/30/2009	555279.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	347	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI003	Seekonk River	41.88014	-71.38130	555279	Urban	5	08/30/2009	555279.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	335	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI003	Seekonk River	41.88014	-71.38130	555279	Urban	5	08/30/2009	555279.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	302	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI004	Pawcatuck River	41.39354	-71.84080	555099	Urban	5	09/13/2009	555099.1	1	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	455	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI004	Pawcatuck River	41.39354	-71.84080	555099	Urban	5	09/13/2009	555099.2	2	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	453	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI004	Pawcatuck River	41.39354	-71.84080	555099	Urban	5	09/13/2009	555099.3	3	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	478	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI005	Pawtuxet River	41.71547	-71.50367	545359	Urban	5	08/25/2009	545359.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	300	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	RI	FW08RI005	Pawtuxet River	41.71547	-71.50367	545359	Urban	5	08/25/2009	545359.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	275	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	RI	FW08RI005	Pawtuxet River	41.71547	-71.50367	545359	Urban	5	08/25/2009	545359.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	320	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	RI	FW08RI005	Pawtuxet River	41.71547	-71.50367	545359	Urban	5	08/25/2009	545359.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	350	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
1	RI	FW08RI006	Blackstone River	41.99036	-71.49176	544499	Urban	5	08/23/2009	544499.1	1	*Perca flavescens*	Yellow perch	Percidae	Fillet	275	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI006	Blackstone River	41.99036	-71.49176	544499	Urban	5	08/23/2009	544499.2	2	*Perca flavescens*	Yellow perch	Percidae	Fillet	207	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI006	Blackstone River	41.99036	-71.49176	544499	Urban	5	08/23/2009	544499.3	3	*Perca flavescens*	Yellow perch	Percidae	Fillet	245	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI009	Pawtuxet River	41.71960	-71.47102	554779	Urban	5	08/28/2009	554779.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	462	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI009	Pawtuxet River	41.71960	-71.47102	554779	Urban	5	08/28/2009	554779.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	386	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI009	Pawtuxet River	41.71960	-71.47102	554779	Urban	5	08/28/2009	554779.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	385	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
1	RI	FW08RI010	Blackstone River	41.97167	-71.46975	545729	Urban	5	08/26/2009	545729.1	1	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	458	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI010	Blackstone River	41.97167	-71.46975	545729	Urban	5	08/26/2009	545729.2	2	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	418	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI010	Blackstone River	41.97167	-71.46975	545729	Urban	5	08/26/2009	545729.3	3	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	350	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI010	Blackstone River	41.97167	-71.46975	545729	Urban	5	08/26/2009	545729.4	4	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	380	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI010	Blackstone River	41.97167	-71.46975	545729	Urban	5	08/26/2009	545729.5	5	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	458	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI013	Pawtuxet River	41.75829	-71.44014	554799	Urban	5	08/27/2009	554799.1	1	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	445	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI013	Pawtuxet River	41.75829	-71.44014	554799	Urban	5	08/27/2009	554799.2	2	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	455	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI013	Pawtuxet River	41.75829	-71.44014	554799	Urban	5	08/27/2009	554799.3	3	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	428	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI013	Pawtuxet River	41.75829	-71.44014	554799	Urban	5	08/27/2009	554799.4	4	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	427	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
1	RI	FW08RI013	Pawtuxet River	41.75829	-71.44014	554799	Urban	5	08/27/2009	554799.5	5	*Catostomus commersonii*	White sucker	Catostomidae	Fillet	415	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC008	Catawba River	34.95063	-80.92319	544139	Urban	6	06/18/2009	544139.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	480	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	SC	FW08SC008	Catawba River	34.95063	-80.92319	544139	Urban	6	06/18/2009	544139.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	474	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	SC	FW08SC008	Catawba River	34.95063	-80.92319	544139	Urban	6	06/18/2009	544139.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	415	Yes	BD	Non-routine	Number	Process all specimens in the 3-fish composite.	
4	SC	FW08SC013	Saluda River	34.64299	-82.45397	541769	Urban	5	06/09/2009	541769.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	465	Yes	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (313 mm), 4 (341 mm), and 5 (288 mm).	
4	SC	FW08SC013	Saluda River	34.64299	-82.45397	541769	Urban	5	06/09/2009	541769.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	389	Yes	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (313 mm), 4 (341 mm), and 5 (288 mm).	
4	SC	FW08SC013	Saluda River	34.64299	-82.45397	541769	Urban	5	06/09/2009	541769.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	313	No	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (313 mm), 4 (341 mm), and 5 (288 mm).	
4	SC	FW08SC013	Saluda River	34.64299	-82.45397	541769	Urban	5	06/09/2009	541769.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	341	No	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (313 mm), 4 (341 mm), and 5 (288 mm).	
4	SC	FW08SC013	Saluda River	34.64299	-82.45397	541769	Urban	5	06/09/2009	541769.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	288	No	P	Non-routine	Length	Process ONLY specimens 1 and 2 as a 2-fish composite. Discard specimens 3 (313 mm), 4 (341 mm), and 5 (288 mm).	
4	SC	FW08SC014	Waccamaw River	33.56171	-79.08679	545039	Urban	6	06/03/2009	545039.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	319	No	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (319 mm).	
4	SC	FW08SC014	Waccamaw River	33.56171	-79.08679	545039	Urban	6	06/03/2009	545039.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	405	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (319 mm).	
4	SC	FW08SC014	Waccamaw River	33.56171	-79.08679	545039	Urban	6	06/03/2009	545039.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	383	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (319 mm).	
4	SC	FW08SC014	Waccamaw River	33.56171	-79.08679	545039	Urban	6	06/03/2009	545039.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	395	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (319 mm).	
4	SC	FW08SC014	Waccamaw River	33.56171	-79.08679	545039	Urban	6	06/03/2009	545039.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	442	Yes	P	Non-routine	Length	Process ONLY specimens 2, 3, 4, and 5 as a 4-fish composite. Discard specimen 1 (319 mm).	
4	SC	FW08SC015	Savannah River	33.61109	-82.16243	553299	Urban	7	06/08/2009	553299.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	380	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC015	Savannah River	33.61109	-82.16243	553299	Urban	7	06/08/2009	553299.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	349	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC015	Savannah River	33.61109	-82.16243	553299	Urban	7	06/08/2009	553299.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	336	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC015	Savannah River	33.61109	-82.16243	553299	Urban	7	06/08/2009	553299.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	341	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC015	Savannah River	33.61109	-82.16243	553299	Urban	7	06/08/2009	553299.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	308	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC019	Black Creek	34.24266	-79.73193	551829	Urban	5	06/15/2009	551829.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	554	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC019	Black Creek	34.24266	-79.73193	551829	Urban	5	06/15/2009	551829.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	592	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC019	Black Creek	34.24266	-79.73193	551829	Urban	5	06/15/2009	551829.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	522	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC019	Black Creek	34.24266	-79.73193	551829	Urban	5	06/15/2009	551829.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	530	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
4	SC	FW08SC019	Black Creek	34.24266	-79.73193	551829	Urban	5	06/15/2009	551829.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	462	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	SC	FW08SC026	Waccamaw River	33.44769	-79.17217	545079	Urban	7	06/17/2009	545079.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	412	Yes	P	Non-routine	Number	Process single specimen as a tissue sample.	
8	SD	FW08SD075	Bad River	44.34478	-100.37127	550809	Urban	6	06/25/2009	550809.1	1	*Carpiodes carpio*	River carpsucker	Catostomidae	Fillet	481	Yes	BD	Non-routine	Number	Form a new 4-fish composite using specimens from both SD075 composites collected on 6/25/2009. Process ONLY specimens 1, 2, and 4 (481, 445, and 472 mm) plus specimen 1 from the duplicate sample (541 mm) and label it specimen 5.	
8	SD	FW08SD075	Bad River	44.34478	-100.37127	550809	Urban	6	06/25/2009	550809.2	2	*Carpiodes carpio*	River carpsucker	Catostomidae	Fillet	445	Yes	BD	Non-routine	Number	Form a new 4-fish composite using specimens from both SD075 composites collected on 6/25/2009. Process ONLY specimens 1, 2, and 4 (481, 445, and 472 mm) plus specimen 1 from the duplicate sample (541 mm) and label it specimen 5.	
8	SD	FW08SD075	Bad River	44.34478	-100.37127	550809	Urban	6	06/25/2009	550809.4	4	*Carpiodes carpio*	River carpsucker	Catostomidae	Fillet	472	Yes	BD	Non-routine	Number	Form a new 4-fish composite using specimens from both SD075 composites collected on 6/25/2009. Process ONLY specimens 1, 2, and 4 (481, 445, and 472 mm) plus specimen 1 from the duplicate sample (541 mm) and label it specimen 5.	
8	SD	FW08SD075	Bad River	44.34478	-100.37127	550809	Urban	6	06/25/2009	550809.5	5	*Carpiodes carpio*	River carpsucker	Catostomidae	Fillet	541	Yes	BD	Non-routine	Number	Form a new 4-fish composite using specimens from both SD075 composites collected on 6/25/2009. Process ONLY specimens 1, 2, and 4 (481, 445, and 472 mm) plus specimen 1 from the duplicate sample (541 mm) and label it specimen 5.	
4	TN	FW08TN012	Tennessee River	35.10401	-85.36090	547939	Urban	8+	07/09/2009	547939.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	357	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN012	Tennessee River	35.10401	-85.36090	547939	Urban	8+	07/09/2009	547939.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	305	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN012	Tennessee River	35.10401	-85.36090	547939	Urban	8+	07/09/2009	547939.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	326	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN012	Tennessee River	35.10401	-85.36090	547939	Urban	8+	07/09/2009	547939.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	315	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN012	Tennessee River	35.10401	-85.36090	547939	Urban	8+	07/09/2009	547939.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN018	Cumberland River	36.19969	-86.67293	527569	Urban	7	09/28/2008	527569.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	432	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
4	TN	FW08TN018	Cumberland River	36.19969	-86.67293	527569	Urban	7	09/28/2008	527569.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	410	Yes	P	Non-routine	Number	Process both specimens as a 2-fish composite.	
4	TN	FW08TN037	Wolf River	35.10422	-89.77037	556719	Urban	5	09/21/2009	556719.1	1	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	564	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN037	Wolf River	35.10422	-89.77037	556719	Urban	5	09/21/2009	556719.2	2	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	601	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN037	Wolf River	35.10422	-89.77037	556719	Urban	5	09/21/2009	556719.3	3	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	516	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN037	Wolf River	35.10422	-89.77037	556719	Urban	5	09/21/2009	556719.4	4	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	558	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN037	Wolf River	35.10422	-89.77037	556719	Urban	5	09/21/2009	556719.5	5	*Ictalurus punctatus*	Channel catfish	Ictaluridae	Fillet	458	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN039	Tennessee River	35.75372	-84.31074	523839	Urban	7	07/08/2009	523839.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	525	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (346 mm) and 5 (303 mm).	
4	TN	FW08TN039	Tennessee River	35.75372	-84.31074	523839	Urban	7	07/08/2009	523839.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	451	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (346 mm) and 5 (303 mm).	
4	TN	FW08TN039	Tennessee River	35.75372	-84.31074	523839	Urban	7	07/08/2009	523839.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	393	Yes	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (346 mm) and 5 (303 mm).	
4	TN	FW08TN039	Tennessee River	35.75372	-84.31074	523839	Urban	7	07/08/2009	523839.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	346	No	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (346 mm) and 5 (303 mm).	
4	TN	FW08TN039	Tennessee River	35.75372	-84.31074	523839	Urban	7	07/08/2009	523839.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	303	No	P	Non-routine	Length	Process ONLY specimens 1, 2, and 3 as a 3-fish composite. Discard specimens 4 (346 mm) and 5 (303 mm).	
4	TN	FW08TN085	Mississippi River	35.21967	-90.07278	529909	Urban	8+	09/09/2008	529909.1	1	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	495	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN085	Mississippi River	35.21967	-90.07278	529909	Urban	8+	09/09/2008	529909.2	2	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	463	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN085	Mississippi River	35.21967	-90.07278	529909	Urban	8+	09/09/2008	529909.3	3	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	461	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN085	Mississippi River	35.21967	-90.07278	529909	Urban	8+	09/09/2008	529909.4	4	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	435	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN085	Mississippi River	35.21967	-90.07278	529909	Urban	8+	09/09/2008	529909.5	5	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	416	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN097	Mississippi River	35.67628	-89.93773	526679	Urban	8+	09/12/2008	526679.1	1	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	484	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN097	Mississippi River	35.67628	-89.93773	526679	Urban	8+	09/12/2008	526679.2	2	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	515	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN097	Mississippi River	35.67628	-89.93773	526679	Urban	8+	09/12/2008	526679.3	3	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	513	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN097	Mississippi River	35.67628	-89.93773	526679	Urban	8+	09/12/2008	526679.4	4	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	508	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN097	Mississippi River	35.67628	-89.93773	526679	Urban	8+	09/12/2008	526679.5	5	*Ictalurus furcatus*	Blue catfish	Ictaluridae	Fillet	516	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN261	Mississippi River	35.14750	-90.06547	533649	Urban	8+	09/08/2008	533649.1	1	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	408	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN261	Mississippi River	35.14750	-90.06547	533649	Urban	8+	09/08/2008	533649.2	2	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	411	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN261	Mississippi River	35.14750	-90.06547	533649	Urban	8+	09/08/2008	533649.3	3	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	354	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN261	Mississippi River	35.14750	-90.06547	533649	Urban	8+	09/08/2008	533649.4	4	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	342	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
4	TN	FW08TN261	Mississippi River	35.14750	-90.06547	533649	Urban	8+	09/08/2008	533649.5	5	*Pylodictis olivaris*	Flathead catfish	Ictaluridae	Fillet	343	Yes	BD	Routine	None	Process all specimens in the 5-fish composite.	
6	TX	FW08TX030	Rio Grande	25.84893	-97.43996	523799	Urban	8+	08/20/2009	523799.1	1	*Centropomus undecimalis*	Common snook	Centropomidae	Fillet	361	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	TX	FW08TX030	Rio Grande	25.84893	-97.43996	523799	Urban	8+	08/20/2009	523799.2	2	*Centropomus undecimalis*	Common snook	Centropomidae	Fillet	316	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	TX	FW08TX030	Rio Grande	25.84893	-97.43996	523799	Urban	8+	08/20/2009	523799.3	3	*Centropomus undecimalis*	Common snook	Centropomidae	Fillet	291	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
6	TX	FW08TX038	Rio Grande	26.23520	-98.54719	530389	Urban	8+	08/18/2009	530389.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	339	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	TX	FW08TX038	Rio Grande	26.23520	-98.54719	530389	Urban	8+	08/18/2009	530389.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	280	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	TX	FW08TX038	Rio Grande	26.23520	-98.54719	530389	Urban	8+	08/18/2009	530389.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	290	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	TX	FW08TX038	Rio Grande	26.23520	-98.54719	530389	Urban	8+	08/18/2009	530389.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	329	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
6	TX	FW08TX059	Brazos River	31.55041	-97.09174	526169	Urban	7	05/12/2009	526169.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	460	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	TX	FW08TX059	Brazos River	31.55041	-97.09174	526169	Urban	7	05/12/2009	526169.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	370	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	TX	FW08TX059	Brazos River	31.55041	-97.09174	526169	Urban	7	05/12/2009	526169.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	407	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	TX	FW08TX059	Brazos River	31.55041	-97.09174	526169	Urban	7	05/12/2009	526169.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	421	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
6	TX	FW08TX059	Brazos River	31.55041	-97.09174	526169	Urban	7	05/12/2009	526169.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	351	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT011	Winooski River	44.48913	-73.14832	532079	Urban	5	10/08/2008	532079.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	290	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT011	Winooski River	44.48913	-73.14832	532079	Urban	5	10/08/2008	532079.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	277	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT011	Winooski River	44.48913	-73.14832	532079	Urban	5	10/08/2008	532079.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	265	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT011	Winooski River	44.48913	-73.14832	532079	Urban	5	10/08/2008	532079.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	254	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT011	Winooski River	44.48913	-73.14832	532079	Urban	5	10/08/2008	532079.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	240	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT016	White River	43.65977	-72.33974	529879	Urban	5	10/07/2008	529879.1	1	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	350	Yes	P	Non-routine	Number	Process all specimens as a 2-fish composite.	
1	VT	FW08VT016	White River	43.65977	-72.33974	529879	Urban	5	10/07/2008	529879.2	2	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	359	Yes	P	Non-routine	Number	Process all specimens as a 2-fish composite.	
1	VT	FW08VT018	Winooski River	44.31823	-72.72694	527479	Urban	5	10/02/2008	527479.1	1	*Salmo trutta*	Brown trout	Salmonidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT018	Winooski River	44.31823	-72.72694	527479	Urban	5	10/02/2008	527479.2	2	*Salmo trutta*	Brown trout	Salmonidae	Fillet	442	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT018	Winooski River	44.31823	-72.72694	527479	Urban	5	10/02/2008	527479.3	3	*Salmo trutta*	Brown trout	Salmonidae	Fillet	487	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT018	Winooski River	44.31823	-72.72694	527479	Urban	5	10/02/2008	527479.4	4	*Salmo trutta*	Brown trout	Salmonidae	Fillet	400	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
1	VT	FW08VT018	Winooski River	44.31823	-72.72694	527479	Urban	5	10/02/2008	527479.5	5	*Salmo trutta*	Brown trout	Salmonidae	Fillet	403	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
10	WA	FW08WA040	Spokane River	47.67982	-117.21719	535119	Urban	7	09/29/2008	535119.1	1	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	390	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	WA	FW08WA040	Spokane River	47.67982	-117.21719	535119	Urban	7	09/29/2008	535119.2	2	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	410	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
10	WA	FW08WA040	Spokane River	47.67982	-117.21719	535119	Urban	7	09/29/2008	535119.3	3	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	370	Yes	P	Non-routine	Number	Process all specimens in the 3-fish composite.	
5	WI	FW08WI029	Mississippi River	42.53137	-90.64118	531159	Urban	8+	09/17/2008	531159.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	425	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI029	Mississippi River	42.53137	-90.64118	531159	Urban	8+	09/17/2008	531159.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	358	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI029	Mississippi River	42.53137	-90.64118	531159	Urban	8+	09/17/2008	531159.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	427	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI029	Mississippi River	42.53137	-90.64118	531159	Urban	8+	09/17/2008	531159.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	350	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI029	Mississippi River	42.53137	-90.64118	531159	Urban	8+	09/17/2008	531159.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	335	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI034	Wisconsin River	44.97808	-89.63045	531209	Urban	5	08/14/2008	531209.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	346	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI034	Wisconsin River	44.97808	-89.63045	531209	Urban	5	08/14/2008	531209.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	416	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI034	Wisconsin River	44.97808	-89.63045	531209	Urban	5	08/14/2008	531209.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	362	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI034	Wisconsin River	44.97808	-89.63045	531209	Urban	5	08/14/2008	531209.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	334	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI034	Wisconsin River	44.97808	-89.63045	531209	Urban	5	08/14/2008	531209.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	314	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
5	WI	FW08WI048	Oconto River	44.88346	-87.85720	530449	Urban	5	07/29/2008	530449.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	344	No	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimens 1 (344 mm) and 2 (337 mm).	
5	WI	FW08WI048	Oconto River	44.88346	-87.85720	530449	Urban	5	07/29/2008	530449.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	337	No	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimens 1 (344 mm) and 2 (337 mm).	
5	WI	FW08WI048	Oconto River	44.88346	-87.85720	530449	Urban	5	07/29/2008	530449.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	505	Yes	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimens 1 (344 mm) and 2 (337 mm).	
5	WI	FW08WI048	Oconto River	44.88346	-87.85720	530449	Urban	5	07/29/2008	530449.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	452	Yes	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimens 1 (344 mm) and 2 (337 mm).	
5	WI	FW08WI048	Oconto River	44.88346	-87.85720	530449	Urban	5	07/29/2008	530449.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	456	Yes	P	Non-routine	Length	Process ONLY specimens 3, 4, and 5 as a 3-fish composite. Discard specimens 1 (344 mm) and 2 (337 mm).	
3	WV	FW08WV010	Ohio River	39.39873	-81.41908	521849	Urban	8+	09/04/2008	521849.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	420	Yes	P	Non-routine	Number	Process all specimens in the 5-fish composite.	
3	WV	FW08WV010	Ohio River	39.39873	-81.41908	521849	Urban	8+	09/04/2008	521849.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	330	Yes	P	Non-routine	Number	Process all specimens in the 5-fish composite.	
3	WV	FW08WV010	Ohio River	39.39873	-81.41908	521849	Urban	8+	09/04/2008	521849.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	360	Yes	P	Non-routine	Number	Process all specimens in the 5-fish composite.	

EPA Region	State	Site ID	River Name	Latitude	Longitude	EPA Sample ID	Site Type	Stream Order	Sample Date	Specimen ID	Spec Sort	Species - Scientific Name	Species - Common Name	Family	Tissue Type	Total Length (mm)	Included in composite?	Predator or Bottom Dweller	Composite Classification	Deviation	Instructions	Processing Issues
3	WV	FW08WV013	Kanawha River	38.32992	-81.58527	525969	Urban	6	06/24/2008	525969.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	305	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV013	Kanawha River	38.32992	-81.58527	525969	Urban	6	06/24/2008	525969.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	295	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV013	Kanawha River	38.32992	-81.58527	525969	Urban	6	06/24/2008	525969.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	276	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV013	Kanawha River	38.32992	-81.58527	525969	Urban	6	06/24/2008	525969.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	266	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV013	Kanawha River	38.32992	-81.58527	525969	Urban	6	06/24/2008	525969.5	5	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	252	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV014	Kanawha River	38.81709	-82.10041	528349	Urban	6	06/26/2008	528349.1	1	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	326	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV014	Kanawha River	38.81709	-82.10041	528349	Urban	6	06/26/2008	528349.2	2	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	266	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV014	Kanawha River	38.81709	-82.10041	528349	Urban	6	06/26/2008	528349.3	3	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	286	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV014	Kanawha River	38.81709	-82.10041	528349	Urban	6	06/26/2008	528349.4	4	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	256	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV014	Kanawha River	38.81709	-82.10041	528349	Urban	6	06/26/2008	528349.5	5	*Micropterus punctulatus*	Spotted bass	Centrarchidae	Fillet	315	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV027	Monongahela River	39.64843	-79.98747	525189	Urban	6	07/03/2008	525189.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	312	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV027	Monongahela River	39.64843	-79.98747	525189	Urban	6	07/03/2008	525189.2	2	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	280	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV027	Monongahela River	39.64843	-79.98747	525189	Urban	6	07/03/2008	525189.3	3	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	281	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV027	Monongahela River	39.64843	-79.98747	525189	Urban	6	07/03/2008	525189.4	4	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	297	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV027	Monongahela River	39.64843	-79.98747	525189	Urban	6	07/03/2008	525189.5	5	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	296	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV029	Pocatalico River	38.45406	-81.78075	521829	Urban	5	06/19/2008	521829.1	1	*Pomoxis annularis*	White crappie	Centrarchidae	Fillet	300	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV029	Pocatalico River	38.45406	-81.78075	521829	Urban	5	06/19/2008	521829.2	2	*Pomoxis annularis*	White crappie	Centrarchidae	Fillet	305	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV029	Pocatalico River	38.45406	-81.78075	521829	Urban	5	06/19/2008	521829.3	3	*Pomoxis annularis*	White crappie	Centrarchidae	Fillet	310	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV029	Pocatalico River	38.45406	-81.78075	521829	Urban	5	06/19/2008	521829.4	4	*Pomoxis annularis*	White crappie	Centrarchidae	Fillet	349	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV029	Pocatalico River	38.45406	-81.78075	521829	Urban	5	06/19/2008	521829.5	5	*Pomoxis annularis*	White crappie	Centrarchidae	Fillet	353	Yes	P	Routine	None	Process all specimens in the 5-fish composite.	
3	WV	FW08WV030	Ohio River	38.96767	-82.09232	521859	Urban	8+	09/17/2008	521859.1	1	*Micropterus salmoides*	Largemouth bass	Centrarchidae	Fillet	290	Yes	P	Non-routine	Number	Process single specimen as a tissue sample.	
3	WV	FW08WV034	Ohio River	39.57144	-80.99238	526849	Urban	8+	09/28/2009	526849.1	1	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	320	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	WV	FW08WV034	Ohio River	39.57144	-80.99238	526849	Urban	8+	09/28/2009	526849.2	2	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	342	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	WV	FW08WV034	Ohio River	39.57144	-80.99238	526849	Urban	8+	09/28/2009	526849.3	3	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	305	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
3	WV	FW08WV034	Ohio River	39.57144	-80.99238	526849	Urban	8+	09/28/2009	526849.4	4	*Micropterus dolomieu*	Smallmouth bass	Centrarchidae	Fillet	340	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
8	WY	FW08WY039	North Platte River	42.82884	-106.36679	550129	Urban	7	07/20/2009	550129.1	1	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	460	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
8	WY	FW08WY039	North Platte River	42.82884	-106.36679	550129	Urban	7	07/20/2009	550129.2	2	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	405	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
8	WY	FW08WY039	North Platte River	42.82884	-106.36679	550129	Urban	7	07/20/2009	550129.3	3	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	440	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	
8	WY	FW08WY039	North Platte River	42.82884	-106.36679	550129	Urban	7	07/20/2009	550129.4	4	*Oncorhynchus mykiss*	Rainbow trout	Salmonidae	Fillet	420	Yes	P	Non-routine	Number	Process all specimens in the 4-fish composite.	This specimen is possible hybrid - cutthroat trout x rainbow trout


(50) > 50,000 ng/kg
(224) 10,001 - 50,000 ng/kg
(219) 1,001 - 10,000 ng/kg
(8) < 1000 ng/kg
United States
Mexico
Vancouver
Victoria
Portland
OREGON
IDAHO
MONTANA
WYOMING
NEBRASKA
SOUTH DAKOTA
NORTH DAKOTA
MINNESOTA
Sacramento
San Francisco
San Jose
CALIFORNIA
NEVADA
UTAH
COLORADO
Las Vegas
Albuquerque
Los Angeles
San Diego
Phoenix
ARIZONA
NEW MEXICO
Tucson
Ciudad Juárez
SONORA
CHIHUAHUA
COAHUILA
NUEVO LEON
Monterrey
SINALOA
DURANGO
TAMAULIPAS
BAJA CALIFORNIA SUR
Gulf of California
Dallas
Austin
Houston
TEXAS
OKLAHOMA
KANSAS
IOWA
ILLINOIS
INDIANA
Indianapolis
Nashville
Atlanta
MISSISSIPPI
ALABAMA
LOUISIANA
Orlando
Tampa
Miami
The Bahamas
Havana
Gulf of Mexico
Toronto
Ottawa
Montreal
Quebec City
New York
Washington

From:	Community Development, Benton County, Oregon
To:	Benton Public Comment
Subject:	LU-24-027 Coffin Butte Proposed Expansion Written Feedback
Date:	Monday, May 12, 2025 12:28:13 PM

Subject of Testimony: Re Coffin Butte

Full Name: Cheryl Stevenson

Email: chesteve45@gmail.com

Street Address: 1457 Northwest 17th Street

Written Testimony:

I oppose the expansion of Coffin Butte. After studying various aspects of the proposeal, from water issues, to land, and road issues, I do not find the proposal in the hands of Republic Services to be in Benton County's interests. There are too many difficulties for us to be able to rely on a company with the history of unreliability and dishonesty that Republic has. I refer you, for example, to an illuinating film about Republic's behavior in Missouri called "Atomic Homefront."
It is a question of whom I believe, Republic or the testimony, including the public's own experts. I do not believe Republic. I believe the huge numbers of people who have taken the time to testify against the expansion. Please listen to them.
I am sure, after taking the time to study what the public is saying, that you will do so. Thank you very much.

--
This is a notification that a contact form was submitted on your website (Community Development, Benton County, Oregon https://cd.bentoncountyor.gov).
Submitter's IP Address: 73.164.247.45

From:	Ken Eklund
To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 12 of 12
Date:	Thursday, May 8, 2025 2:41:01 PM
Attachments:	writerguy-cube2.png

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

This is the second part of a Grist article on the Coffin Butte dump that is too big to email in one piece. – K



Ken Eklund, writerguy

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Corvallis OR 97330
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Creator of
World Without Oil
Ed Zed Omega
FutureCoast
and other storymaking games

pollutants." This August, the agency identified landfill methane as one of its three main climate-related enforcement priorities for 2024 to 2027.

Meanwhile, people living near landfills are increasingly concerned over the climate and safety impacts of these methane emissions. Kevin Kenaga, who lives near Republic Services' Corvallis facility, said explosive methane leaks could make the landfill "really, really problematic" in case of a wildfire, since it's flanked by forests. (Landfills can also start fires themselves; they frequently reach very high temperatures and have been known to spontaneously combust.) He and others have documented numerous holes in the landfill cover, some of which show weeds growing through them, or animal burrows.



Weeds poke out from underneath the tarp-like landfill cover at Coffin Butte Landfill near Corvallis, Oregon. ***Joel Geier***

To turn things around, environmental groups are pushing for more stringent requirements for landfill operators, beginning with better monitoring. Air-based monitoring, for example — performed by a drone — could be used to identify more leaks, more often than four times a year, and it could be combined with satellite imagery to identify where some of the biggest methane plumes are. These technologies already exist, and Blauvelt said they could be a "game-changer" if better applied to mitigating landfill methane emissions.

Blauvelt also called on regulators to create standards for the thickness and type of material used as landfill cover, since this cover is "the most important operational factor in slowing the release of methane." She also said more landfill operators should be required to put gas capture systems in place, and on a faster timeline. Right now, many smaller landfills don't have any requirements for gas capture, and the larger ones can drag their feet for five years before installing a system. They can "just sit there" emitting methane, she said.

Some of these changes may be in the works for Washington state, where the Department of Ecology is getting ready to propose a new rule fleshing out new requirements for the monitoring and mitigation of landfill-based methane emissions. That rule is expected to be finalized this fall. At the federal level, advocates are also awaiting updated landfill air quality rules from the EPA sometime in 2024. In response to Grist's request for comment, the EPA said it already uses satellite imagery and "other airborne monitoring technologies" to identify facilities that may be noncompliant with federal law, though landfill operators are not

required to use these technologies. The agency said it is "in the process of considering what, if any, next steps" it will take following its 2022 inspections in Oregon and Washington.

Perhaps the most effective way to address landfill methane emissions is to stop them from being created in the first place — and that means keeping organic material out of landfills, for example, by reducing food waste or diverting it to municipal composting programs. According to one estimate, sorting and treating organics separately from other trash can reduce landfill methane emissions by 62 percent.

Washington state recognized this strategy in a law passed last year to reduce organic waste disposal by 75 percent by 2030, and environmental groups say it should be prioritized elsewhere too — like in Corvallis, Oregon. "This community really wants alternatives to landfills," said Mason Leavitt, a GIS and spatial data coordinator at the Oregon-based nonprofit Beyond Toxics, referring to residents living near Republic Services' landfill. "We're really focused on ways to do that, and diverting organics is going to be a huge one."

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Date:	Thursday, May 8, 2025 2:40:09 PM
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This is the first part of a Grist article on the Coffin Butte dump that is too big to email in one piece. – K



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Landfills in Washington and Oregon leaked ‘explosive’ levels of methane last year

EPA inspection reports find methane exceedances are more common than operators say.



The King County Cedar Hills Regional Landfill near Seattle, where three readings during an EPA inspection showed methane concentrations above federal limits. ***Wolfgang Kaehler / LightRocket via Getty Images***



Joseph Winters
Staff Writer

Published	Oct 26, 2023
Topic	Climate + Accountability
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Landfills in Oregon and Washington repeatedly exceeded federal standards for methane emissions last year, according to documents obtained by an environmental group.

Although the Clean Air Act requires that large landfills operators keep methane concentrations below 500 parts per million, Environmental Protection Agency inspection reports from May and June 2022 show that this threshold was exceeded in dozens of readings taken at four landfills in Oregon and Washington. At one landfill near Corvallis, Oregon, there were so many exceedances that an inspector ran out of flags to mark them with. At another, the inspector's measuring instruments maxed out, indicating what he described as "explosive" concentrations of methane.

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Katherine Blauvelt, circular economy campaign director for the environmental group Industrious Labs, which obtained the documents through public records requests, said the reports highlight the need for better monitoring and mitigation of landfill methane emissions nationwide. These kinds of methane leaks are likely happening across the country, she said, much more frequently than the public knows, and regulators aren't using the best tools to stop them.

"Everyone's operating under the Windows 2000 system, and it's time for an upgrade," she said. "We've got to do better, because we're in a climate emergency and methane is a super-pollutant."

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Methane, a greenhouse gas 84 times more powerful than carbon dioxide over its first 20 years in the atmosphere, is released from landfills by decomposing organic material like food scraps,

cardboard, and yard trimmings. Already, EPA data pins landfills as the country's third-largest source of anthropogenic methane emissions after oil and gas infrastructure and animal agriculture, and in many states — including all three on the West Coast — landfills account for 80 percent or more of all industrial methane emissions.

Large landfill operators can't stop organic matter from releasing methane as it decomposes. But they are required by law to conduct quarterly monitoring of their facilities and prevent that methane from escaping into the atmosphere — in part due to safety concerns, since methane is highly combustible. When landfill operators find places where methane concentrations exceed 500 parts per million, they're supposed to report it — usually to their state's environmental authority — and take measures to bring that concentration down. These measures can include improving the covers that landfills are required to have — which often include tarps — or installing gas capture systems that transport the methane to a flare or a treatment center, where it can be used to generate electricity or converted into vehicle fuel.





A gas capture system at the King County Cedar Hills Regional Landfill near Seattle. ***Wolfgang Kaehler / LightRocket via Getty Images***

Sometimes, federal inspectors from the EPA visit to take their own measurements. They walk a loop around the landfill and take periodic measurements with a tool called a "toxic vapor analyzer." At minimum, they have to take measurements every 100 feet, but they also take measurements in places where they see potential signs of a methane buildup — for example, where air pressure appears to be lifting up a section of the landfill cover, or at a hole in the cover.

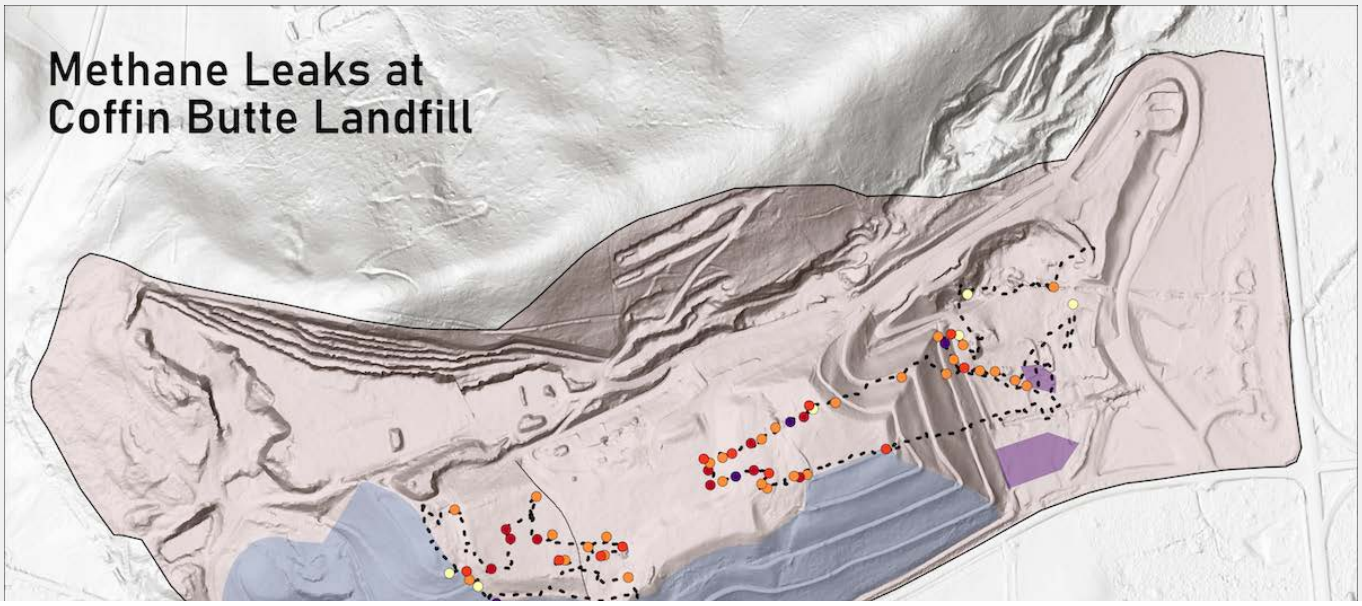
These measurements from the EPA don't always match up with the landfill operators' self-surveys.

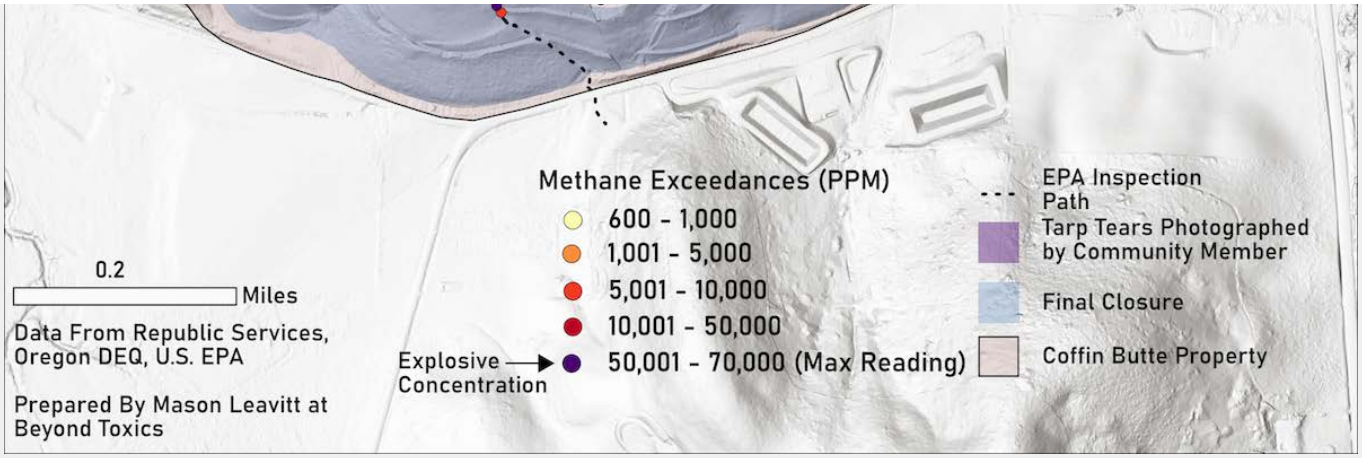
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For example, according to the EPA inspection reports seen by Grist, the company Republic Services found zero methane exceedances over five years of quarterly monitoring of its regional

landfill in Roosevelt, Washington, and between zero and six exceedances in recent quarterly surveys of its Coffin Butte landfill near Corvallis, Oregon. But when the EPA visited these landfills in June 2022, an inspector documented 16 points of exceedance at the Roosevelt facility and more than 60 at the Corvallis one. More than two dozen locations across both landfills showed methane concentrations above 10,000 parts per million, more than 20 times higher than the Clean Air Act limit. At both landfills, the inspector noted visible signs of methane leakage, including areas of the landfill cover that were "inflated with and leaking out landfill gas."

This was also the case at a Graham, Washington, landfill operated by the company Waste Connections, where the EPA inspector logged 38 points of exceedance and noted an "environmental concern and a safety hazard" caused by explosive levels of gas leaking out of the landfill cover. Another landfill near Seattle, operated by King County, showed just three methane exceedances, although one location had a methane concentration of 9,000 parts per million.





Methane leaks at Coffin Butte Landfill near Corvallis, Oregon. ***Courtesy of Beyond Toxics***

In response to Grist's request for comment, Republic Services said it has "differing perspectives" on the EPA's testing protocols and analyses from its inspections in 2022, and that it has "addressed the EPA's observations" at both its Corvallis and Roosevelt facilities. King County said it made immediate repairs to the landfill cover to address the largest exceedance identified by the EPA, and that it "increased the frequency of synthetic cover inspections to identify any potential damage and repair it as soon as possible." Waste Connections did not respond to Grist's request for comment.

The EPA inspection reports appear to reflect the agency's broader difficulties with quantifying and limiting landfill-based methane emissions nationwide. According to a recent study submitted to the journal Atmospheric Chemistry and Physics that has not yet undergone peer review, methane emissions from landfills could be 77 percent higher than the values reported by U.S. operators to the EPA, and the EPA itself has said that "widespread noncompliance" with federal rules for landfill-based methane releases may have contributed to "potentially tens of thousands of tons of unlawful emissions of greenhouse gases and other

From:	Ken Eklund
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I'm continuing to provide the Planning Commission the history of Coffin Butte Landfill in the press, covering many of the same issues that have come up in public testimony: PFAS, leachate, methane, EPA and DEQ investigations and actions, labor issues, Republic cover-ups of problems and information, fire hazards, misleading and dubious information about the economics of the landfill, and so on. – K



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POLITICS

Oregon legislation would require aerial, drone or satellite landfill monitoring



Tracy Loew
Salem Statesman Journal

Feb. 25, 2025, 4:03 a.m. PT

Key Points

- SB 726 proposes stricter methane monitoring and reporting requirements for landfills.
- The bill was introduced in response to methane leaks at Coffin Butte Landfill.
- Opponents argue alternative methods for measuring methane are not yet standardized or readily available.

Oregon landfills would have to improve methane monitoring and reporting under a bill being considered by the state Legislature.

Sen. Sara Gelser Blouin, D-Corvallis, introduced the bill in response to ongoing concerns about methane releases at Coffin Butte Landfill, near Adair Village.

In 2022, the U.S. Environmental Protection Agency found Coffin Butte was leaking methane at levels that exceed state and federal limits and what the landfill had publicly reported.

EPA investigators returned in 2024 and found more than 40 locations where methane exceeded limits, including at holes in the cover material.

“What this bill talks about is how we are able to track and measure the amount of methane that is leaking from our landfills,” Gelser Blouin said Monday during a hearing on the bill. “We want to encourage the use of these advanced technologies so that we can get more accurate information about specifically

where leaks might be."

Landfills are among the nation's largest sources of methane, a greenhouse gas that's more potent than carbon dioxide and a major contributor to climate change, according to the EPA.

The levels measured at Coffin Butte also could cause health problems for neighbors, and in some cases were high enough to potentially cause an explosion and fire, experts said.

Oregon could require aerial, drone or satellite landfill monitoring

Senate Bill 726 would require municipal solid waste landfills to use advanced technology, such as drones, planes or satellites, to measure methane releases.

It would require landfill owners to report the results to the state Department of Environmental Quality, in GIS software, which would make it easier to visualize.

And it would require landfills to fix any areas exceeding limits, and monitor that area again.

The bill calls for the state's Environmental Quality Commission to adopt rules for the program, which would begin by July 1, 2026.

More than 100 people testified in support of the bill, in person and in writing.

"Satellites and drones don't fudge results. They are impartial. Not only would they monitor the entire landfill, they can also pinpoint leaks at their source in such a way that cannot be denied or otherwise explained away by landfill operators," wrote Debbie Palmer, of Benton County-based Valley Neighbors for Environmental Quality and Safety.

Lane County Public Works Director Dan Hurley told the committee he started his career doing methane monitoring at Short Mountain Landfill near Eugene.

“The current method is a joke. It was developed over 40 years ago,” Hurley said. “The method only requires someone to carry around a handheld monitor. There are lots of opportunities to game these measurements.”

The bill’s opponents include the Oregon Refuse and Recycling Association and the Association of Oregon Counties. They argued the EPA does not have standards for alternative methods of measuring methane.

“The bill would make it a requirement for us to use technologies that are not available yet,” said Craig Campbell, government affairs director for ORRA. “It’s great if there’s a technology out there that’s perfect, but if you can’t get your hands on it, it’s useless.”

Coffin Butte Landfill expansion, air permit pending

The 178-acre Coffin Butte Landfill is owned by Phoenix-based Republic Services.

Coffin Butte currently takes most of Marion and Polk counties’ municipal waste, including some waste that previously went to the Reworld Marion incinerator in Brooks. Reworld stopped taking Marion County waste on Dec. 31.

Republic Services is in the process to trying expand the landfill.

Two years ago, the Benton County Planning Commission unanimously denied the company’s request for a conditional use permit to expand, following public testimony in opposition.

In July 2024, the company resubmitted its proposal, cutting the planned expansion in half. It is currently waiting for the county to decide whether the application is complete.

Meanwhile, in January, DEQ paused work on a new air quality permit for the landfill, saying the company had not provided all the information it needed to proceed.

The move, just days before a public hearing was scheduled, means Coffin Butte can continue operating under its existing permit, which expired more than a decade ago.

The landfill has been allowed to continue operating under the expired permit because the company filed a timely renewal application with DEQ in 2014.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

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LOCAL

US Forest Service moss study links heavy metal pollution to Brooks incinerator



Tracy Loew
Salem Statesman Journal

Updated Nov. 13, 2024, 12:40 p.m. PT

Key Points AI-assisted summary

- The study identified rare earth elements linked with burning medical waste.
- The researchers said the findings validate community concerns about emissions from the incinerator, located near a school, food processing plant and residences.

(This story has been updated to add new information).

A new study of pollutants in moss near the Reworld Marion garbage incinerator north of Salem in Brooks shows higher concentrations in samples taken closer to the facility and identified “signature” rare earth element concentrations linked with burning medical waste.

“The results, showing heavy metal contamination around this particular facility, which is located near a school, a food processing plant, and a rural community, validates the concerns community members have had for years about what is being emitted from waste incinerators,” said Sen. Deb Patterson, D-Salem.

The study’s lead author, U.S. Forest Service scientist Sarah Jovan, led similar testing in Portland a decade ago that uncovered high levels of heavy metals around two glass factories operating in residential neighborhoods.

Those findings led to a class-action lawsuit filed by neighbors and prompted

then-Gov. Kate Brown to launch the Cleaner Air Oregon program in 2016, to better evaluate companies' toxic air emissions and their health risks.

Reworld Marion was among the first companies called into that program, in March 2019, but has had multiple extensions and delays and has not yet completed its risk assessment.

The moss study was published Nov. 7 in the peer-reviewed scientific journal "Environmental Monitoring and Assessment." It was funded by the Forest Service and supported by the USDA National Institute of Food and Agriculture and the National Institute of Environmental Health Sciences.

"To the best of our knowledge, these results provide the first evidence of trace element contamination in the area, serving as an empirical starting point for stakeholders to discuss regulatory and community concerns," the researchers wrote.

"What we saw were pretty high associations for three of the elements that are most often associated with medical waste incineration: mercury, cadmium and lead," Joven told the Statesman Journal.

Company officials did not respond to the Statesman Journal's interview request Tuesday.

The 38-year-old incinerator, formerly called Covanta Marion, is owned by New Jersey-based Reworld, which operates more than 40 incinerators in North America, Europe and the United Kingdom.

Testing near Brooks incinerator finds heavy metals, MRI contrast material

Scientists have used moss as a biological indicator of air pollution since the late 1960s.

Moss data is an indicator of pollution levels but doesn't carry health thresholds. For that, the state Department of Environmental Quality would need to perform air monitoring, as it did following the Portland moss study.

“The moss data, they’re moss, they’re not humans so it’s hard to make connections directly to health. We can say some basic things about what contaminants are getting into the moss,” Jovan said. “The strength of correlation with the facility suggests to me maybe it’s worth looking into that more.”

This is the second study using moss as an indicator of pollution near the incinerator.

In 2022, Beyond Toxics, a Eugene environmental justice nonprofit, funded a small study of moss near the facility, using the same methods as in the Portland study.

It showed elevated levels of heavy metals from samples taken closest to the facility.

That study was too small to be conclusive, its authors said, but indicated a need for further testing. Beyond Toxics asked DEQ to follow up with air sampling, but the department did not act.

The latest study also began in 2022. Researchers collected 36 samples of moss along an approximately 20-mile transect running from the incinerator in Brooks northeast through Gervais and Woodburn to Canby. The path followed the dominant winds and did not include any other permitted polluters.

Researchers measured 40 elements in the moss, including 14 rare earth elements previously unexplored for solid waste incineration.

Concentrations of most elements correlated with distance from the facility, the study found, with most pollutants deposited within 3 to 6 miles.

“The chemical signatures in moss pointed to solid waste incineration as a source, through both stack and fugitive dust emissions,” the researchers wrote.

“These are powerful findings, considering that there is no safe dose of mercury, lead and other toxic metals this study shows are elevated near the incinerator,” Mike Ewall, executive director of the national nonprofit Energy Justice Network, told the Statesman Journal.

Elements often associated with soil and dust, such as arsenic and chromium, peaked within an eighth of a mile of the facility, possibly indicating fugitive emissions, the study showed.

“The key issue is there’s just not an easy way to monitor emissions around a pollution source. There just isn’t with the current technology. A lot of times we’re just guessing what those emissions are,” Jovan said.

With moss analysis, “Suddenly you can see something that’s normally invisible. It makes it apparent that there are emissions of these heavy metals,” she said.

The study also found gadolinium, a contrast agent for MRIs, likely reflecting medical waste incineration.

“Now we know much more about the heavy metals being emitted and that it definitely comes from the incinerator, I think it’s reasonable to conclude that burning medical waste is not a healthy practice, especially near people,” said Susann Kaltwasser, founder of Clean Air Now, which works on solid waste issues in the region.

DEQ does not have immediate plans to monitor or test to confirm the study's findings, spokesman Chris Varley said.

"However, many of the pollutants listed in it will be tested for as part of Senate Bill 488, legislation passed last year regulating municipal waste incinerators in Oregon. Reworld has also been called into Cleaner Air Oregon and was required

to perform extensive source testing for a number of heavy metals and other pollutants," Varley said.

Reworld Marion incinerator partnership with Marion County now ended

The incinerator was built as a partnership between Marion County and the company. A state law passed just before the burner opened in 1986 requires Marion County garbage collectors to take waste there.

Marion County issued $56 million in revenue bonds to build the burner, which is owned by Reworld. The county repaid those bonds with revenue from franchise fees, electricity sales and tipping fees, which garbage haulers pay to bring waste to the facility. Those fees were passed on to ratepayers in their garbage bills.

In July 2021, Reworld, then called Covanta Holding Corp., announced it would be acquired by Sweden-based investment conglomerate EQT Infrastructure. The $5.3 billion deal took the company private.

That same month, Marion County left the partnership, signing a three-year contract that paid Reworld a flat fee to take a set amount of the county's garbage.

In October 2024, EQT Infrastructure announced it would sell 25% of Reworld to Singaporean sovereign wealth fund GIC.

The incinerator now burns about half of Marion County's residential and commercial waste, less than required by the company's contract with the county. The rest goes to Coffin Butte Landfill in Adair, just north of Corvallis.

In addition to municipal waste, Reworld holds private contracts to burn industrial and medical waste, at higher rates, at the incinerator. It takes that waste from all over the western U.S. and Canada, a 2021 Statesman Journal investigation found.

Last month, the company told Marion County it would stop taking the county's waste on Dec. 31. Company officials have declined to say what will happen to the facility.

At the time, county commissioners said they were told the move was in response to increasing regulatory pressures, including Cleaner Air Oregon requirements and the requirements of Senate Bill 488, which requires Reworld Marion to continuously monitor 15 of the pollutants measured in the moss study.

After receiving a number of extensions, the company has missed the deadline to begin that monitoring.

"These heavy metals are associated with negative health effects for people who are exposed, which is why they were included in the emissions to be monitored," said Patterson, who sponsored the bill.

Jon Heynen, a spokesman for Marion County's three commissioners, said in an email that the county had not been made aware of the moss study results.

Neither Heynen nor the individual commissioners responded to the Statesman Journal's interview requests.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

statesman journal

LOCAL

Oregon regulators pause Coffin Butte Landfill air quality permit process



Tracy Loew
Salem Statesman Journal

Updated Jan. 10, 2025, 3:02 p.m. PT

The Oregon Department of Environmental Quality has paused work on a new air quality permit for Coffin Butte Landfill, saying the state needs more information before proceeding.

The permit regulates air pollution from the 178-acre landfill, located north of Corvallis near Adair Village.

DEQ has canceled a Jan. 14 public hearing on Coffin Butte's proposed air quality permit. It also has closed a public comment period that had been scheduled to run through Jan. 29.

Coffin Butte currently takes most of Marion and Polk counties' municipal waste, including waste that previously went to the Reworld Marion incinerator in Brooks. Reworld stopped taking Marion County waste on Dec. 31.

The landfill, owned by Phoenix-based Republic Services, also is in the middle of a controversial process to expand the landfill.

Why did DEQ pause Coffin Butte's air quality permit process?

DEQ has asked the company to provide a copy of a land use compatibility statement, or LUCS, that Benton County granted it in 1997 for the property where the landfill's flare is located.

The flare burns methane that is generated when solid waste in the landfill breaks down.

“They just haven’t been able to track down the actual copy of it,” DEQ spokesman Dylan Darling said.

The company has not provided an estimate of when it can provide the document, he said.

Coffin Butte’s air quality permit expired more than a decade ago. The landfill has been allowed to continue operating under its previous permit because the company filed a timely renewal application with DEQ in 2014.

The landfill will continue to operate under the expired permit while the process is on hold.

The permitting pause is not related to the expansion process, which is running in parallel, Darling said.

What is the status of the Coffin Butte’s expansion application?

Coffin Butte also has asked Benton County for a conditional use permit (CUP) that would allow it to expand.

The attempt comes two years after the Benton County Planning Commission unanimously denied the company’s request for a conditional use permit to expand, following public testimony in opposition. Among concerns were plans to close an access road and impacts on those who live nearby.

The planned expansion is 50% smaller than proposed in 2021 and would be on land owned by Coffin Butte and zoned for a landfill, according to the company.

In August 2024, Benton County officials told Republic Services its application was incomplete and gave the company until Jan. 15 to provide additional

information, including more information about potential impacts on the landfill's neighbors.

Once the county deems the application "complete," it will hold public hearings on the proposal.

Why is Coffin Butte's air quality permit and expansion controversial?

The permit renewal and expansion request come in the middle of a U.S. Environmental Protection Agency investigation into massive methane leaks at the landfill, employee complaints about health and safety, and neighbors' concerns about air and water pollution, and fire risks.

In October 2023, the Statesman Journal reported an EPA inspection found the landfill was leaking methane at levels that exceed state and federal limits and what the landfill had publicly reported.

EPA measured methane exceeding regulatory limits 61 times during its June 2022 inspection of the landfill. Twenty-one of those exceedances measured at more than 10,000 parts per million, or 20 times the 500 ppm limit set by Oregon and the EPA.

In April 2024, the Statesman Journal published an investigation into worker complaints about health, safety and environmental violations at the landfill. The Oregon Occupational Safety and Health Division cited the company for several of those issues.

In August 2024, members of Oregon's congressional delegation called for the U.S. Environmental Protection Agency to complete an investigation into concerns about the landfill.

Also in August 2024, DEQ issued a formal warning to Coffin Butte for not complying with new requirements to reduce methane emissions from the state's

landfills.

And landfill neighbors have organized to oppose the proposed landfill expansion. In addition to concerns about the methane leaks, neighbors have complained about odors, excessive truck traffic, fire danger and possible groundwater contamination.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

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EDITOR'S PICK

Letter: Landfill leachate ended up in water



On July 9, I attended the Republic Services Landfill Expansion Webinar.

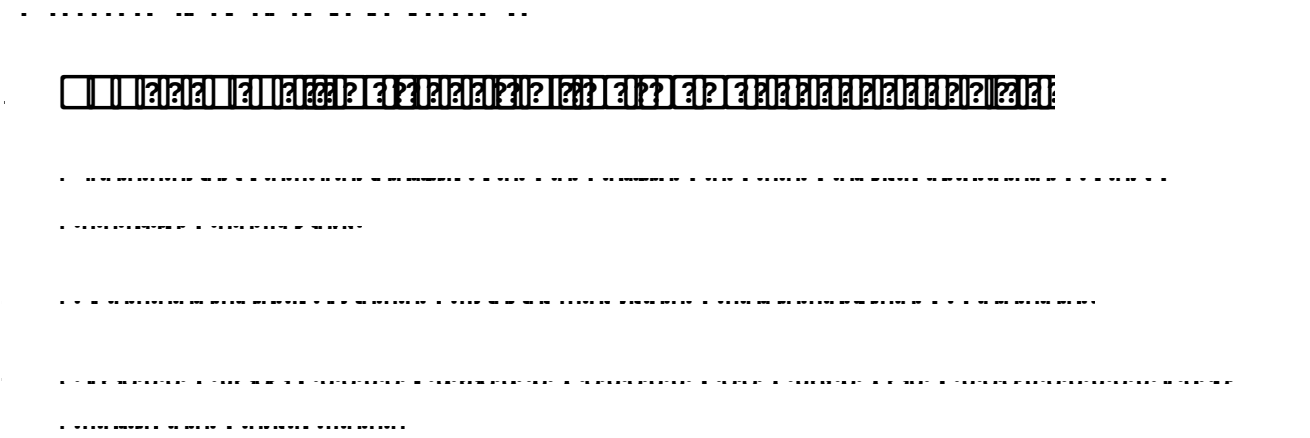
My question: Did the toxic fly ash from Covanta's Marion Waste incinerator, containing dioxin and heavy metals, used as daily cover at the landfill, contribute to toxicity of the leachate? I didn't get an answer.

Leachate is already a toxic cocktail that includes per- and polyfluoroalkyl substances (PFAs are known as forever chemicals — they don't break down easily in the environment or in our bodies), dioxin, heavy metals, etc. Some of these are

known cancer-causing chemicals.

In 2021, the landfill produced 31 million gallons of this toxic brew. Much of this ended up in our water supply.

We don’t know at this time what levels of these chemicals in our drinking water are considered safe. The Environmental Protection Agency recently finalized rules that set limits on six PFAs in public drinking water. That’s good news; however, the EPA has documented more than 14,000 PFAs.



These regulations will be implemented over a five-year period, and eventually we’ll be able to see what amounts of those PFAs we have in our water. (For more about PFAs, read “The Breakdown on PFAs: What to Know about ‘Forever Chemicals’ in Nutrition Action” — a publication by The Center for Science in the Public Interest.)

We don’t know the impact of toxic fly ash, and we don’t know what levels of PFAs and other chemicals are safe in our drinking water — isn’t it time Republic Services answered these questions before considering a landfill expansion?

Joanna Stockslager

Albany

statesman journal

ENVIRONMENT

Oregon corporate landfills using loophole to avoid methane monitoring, study finds



Tracy Loew
Salem Statesman Journal

March 6, 2025 | Updated March 7, 2025, 8:55 p.m. PT

Key Points AI-assisted summary

- Beyond Toxics found that corporate-owned landfills in Oregon are avoiding methane. monitoring on about half of their operating areas
- The study analyzed quarterly emission reports from eight out of 11 Oregon landfills subject to new methane regulations.
- Private landfills are more likely to exempt areas from monitoring than county-owned facilities.

This story has been updated with new information from the Oregon Department of Environmental Quality.

Oregon's corporate-owned landfills are using a loophole in state law to avoid methane monitoring on an average of about half of their operating surfaces, a new study concludes.

County-owned landfills, meanwhile, are exempting an average of 10% of their surfaces, according to the report released Thursday by the Eugene-based environmental group Beyond Toxics.

The researchers set out to determine how well Oregon's new landfill methane emission standards, the strictest in the nation, are working.

Landfills are among the nation's largest sources of methane, a greenhouse gas more potent than carbon dioxide and a major contributor to climate change, according to the U.S. Environmental Protection Agency.

Need a break? Play the USA TODAY Daily Crossword Puzzle.

Oregon's new rules, part of a larger state effort to curb greenhouse gas emissions, went into effect in October 2021.

The rules require quarterly monitoring of the landfill, by walking the surface with a handheld gas analyzer. Identified leaks measuring over 500 parts per million must be fixed within 10 days.

The rules allow landfills to use "alternative compliance options," including changing walking paths, to exclude monitoring where there are potential safety and other issues, such as steep or slippery slopes and physical obstructions.

Mason Leavitt, data analytics specialist for Beyond Toxics, said companies appear to be abusing that exemption.

For example, the 178-acre Coffin Butte Landfill, near Corvallis, exempted 40 acres in the third quarter of 2022 and 30 acres in the fourth quarter of the same year, citing "high vegetation," according to the report. The landfill continued to exempt those areas in 2023 without citing a reason.

Alternative options must be submitted in writing and receive written approval from the Oregon Department of Environmental Quality before they may be implemented, according to state rules. But Leavitt found no evidence that was happening.

"The reports we analyzed did not include information or details on alternative monitoring plans approved by DEQ, so it's difficult to evaluate exactly what agreements are made between private owner-operators and DEQ," the Beyond Toxics report states.

“Half of private landfill surface area is going completely unmonitored for methane leaks,” Leavitt told the Statesman Journal. “We’re blind to what’s happening in those sections of the landfill.”

The Oregon Department of Environmental Quality just received the report and is reviewing it, spokesman Dylan Darling said.

The findings come as the Oregon Legislature considers a bill to improve landfill methane monitoring and reporting.

Senate Bill 726 would require municipal solid waste landfills to use advanced technology, such as drones, planes or satellites, to measure methane releases.

It would require landfill owners to report the results to the DEQ, in GIS software, which would make it easier to visualize.

And it would require landfills to fix any areas exceeding limits, and monitor that area again.

No methane monitoring data for 3 Oregon landfills

Oregon’s new quarterly surface emissions monitoring rules apply to landfills with more than 200,000 tons of accumulated waste and methane emissions modeled to be greater than 664 tons.

Eleven landfills statewide met that criteria, according to the report.

Beyond Toxics asked DEQ for quarterly emission reports for all 11 landfills for 2023, the first full year of monitoring.

In response, the group received the reports for eight of those landfills.

Roseburg Landfill, managed by Douglas County, had not complied with the new rules. DEQ has issued a pre-enforcement notice to the landfill, warning that it could be cited and fined, Darling said.

The landfill began monitoring in second quarter 2024 and found two exceedances of the methane emission limits, he said.

Because of that, DEQ has given the landfill until June to submit a design plan to DEQ and until December 2026 to install and begin operation of a gas collection and control system. At that time, it will be required to resume methane emissions monitoring.

Hillsboro Landfill, owned by Waste Management, has until April to begin modeling under the terms of its air quality permit, according to DEQ.

And Baker Landfill, managed by a local private company, argued that it actually was two landfills, with each separately falling under the threshold for monitoring. One of the landfills, which are next to each other, closed in 2002, Darling said.

Beyond Toxics found companies exempted as much as 69% of landfill

Landfills provide data in their quarterly monitoring reports in print form, rather than using GIS software.

Leavitt, working with university students, spent about 300 hours translating it into spatial data, to map the areas monitored at each landfill each quarter. Without that work, it's difficult to know which areas of a landfill are unmonitored.

That's another shortcoming of the current rules, Leavitt said.

"That arcane system is currently what DEQ would have to rely on to be able to look at all of this in one place," he said.

The researchers determined the percentage of each landfill that was unmonitored each quarter. Here are the results:

Dry Creek Landfill, in Eagle Point, operated by Waste Connections: 69% each

quarter
Coffin Butte Landfill, near Adair Village, operated by Republic Services: Between 53% and 62%
Wasco County Landfill, in The Dalles, operated by Waste Connections: Between 46% and 62%
Finley Buttes Landfill, in Boardman, operated by Waste Connections: Between 27% and 58%
Columbia Ridge Landfill, in Arlington, operated by Waste Management: Between 12% and 19%
Knott Landfill, in Bend, operated by Deschutes County: Between 12% and 16%
Short Mountain Landfill, near Eugene, operated by Lane County: 8% each quarter
Crook County Landfill, in Prineville, operated by Crook County: Between 7% and 8%

U.S. EPA finds problems with methane monitoring

Beyond Toxics' conclusions mirror those in a recent U.S. Environmental Protection Agency report.

More than 100 EPA inspections over the past three years found that many municipal solid waste landfills across the country were not properly monitoring emissions.

"While the regulations allow municipal solid waste landfills to exclude certain areas from the surface emissions monitoring (e.g., areas with steep slopes or other dangerous areas), the EPA observed during recent inspections that areas that are not dangerous are improperly excluded from monitoring," the EPA report states.

"If a municipal solid waste landfill excludes areas from the surface emissions monitoring, the facility should document and explain the basis for excluding each area from monitoring in the surface emission design plan and SEM reports. The

regular side slopes of the landfill may not be excluded from monitoring per the regulations," the report reads.

Coffin Butte Landfill was among those the EPA inspected.

In 2022, the EPA found Coffin Butte was leaking methane at levels that exceed state and federal limits and what the landfill had publicly reported.

EPA investigators returned in 2024 and found more than 40 locations where methane exceeded limits, including at holes in the cover material.

EPA, rather than DEQ, is continuing to lead that investigation, Darling said.

Coffin Butte expansion decision expected by August

The findings come as Coffin Butte Landfill, which takes waste from Marion and Polk counties, has just passed a major hurdle in its yearslong effort to expand.

On Feb. 28, Benton County deemed the company's application for a conditional use permit for the expansion "complete."

Sometime this spring, the county will open a two-week public comment period and a public hearing on the application. The county's planning commission is expected to decide on the application by Aug. 11.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips: tloew@statesmanjournal.com or 503-399-6779. Follow her on X at @Tracy_Loew

The New York Times https://www.nytimes.com/2025/01/14/climate/epa-pfas-forever-chemicals-sludge-fertilizer.html

In a First, the E.P.A. Warns of 'Forever Chemicals' in Sludge Fertilizer

Levels of PFAS in sewage sludge used as fertilizer can pose risks that sometimes exceed safety thresholds "by several orders of magnitude," the agency said.

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By Hiroko Tabuchi

Jan. 14, 2025

For the first time, the Environmental Protection Agency on Tuesday warned that "forever chemicals" present in sewage sludge that is used as fertilizer can pose human health risks.

In an extensive study the agency said that, while the general food supply isn't threatened, the risk from contaminated fertilizer could in some cases exceed the E.P.A.'s safety thresholds "sometimes by several orders of magnitude."

A growing body of research has shown that the sludge can be contaminated with manmade chemicals known as per- and polyfluoroalkyl substances, or PFAS, which are used widely in everyday items like nonstick cookware and stain-resistant carpets. The chemicals, which are linked to a range of illnesses including an increased risk of cancer, do not break down in the environment, and, when tainted sludge is used as fertilizer on farmland, it can contaminate the soil, groundwater, crops and livestock.

Last year, The New York Times reported that 3M, which for decades has manufactured PFAS, found as early as 2000 that the chemicals were turning up in sludge samples from municipal wastewater plants across the country. In 2003, 3M told E.P.A. of its findings.

The E.P.A. has for decades encouraged the use of sludge from treated wastewater as inexpensive fertilizer with no limits on how much PFAS it can contain. But the agency's new draft risk assessment sets a potential new course. If finalized, it could mark what could be the first step toward regulating PFAS in the sludge used as fertilizer, which the industry calls biosolids. The agency currently regulates certain heavy metals and

pathogens in sewage sludge used as fertilizer, but not PFAS.

The Biden administration has tackled PFAS contamination elsewhere, setting limits on PFAS in drinking water for the first time and designating two kinds of PFAS as hazardous under the nation's Superfund cleanup law. Those rules came after the agency said in 2023 that there is no safe level of exposure to those two PFAS.

The new E.P.A. assessment "provides important information to help inform future actions by federal and state agencies," as well as sewage treatment plants and farmers, "to protect people from PFAS exposure," Jane Nishida, the E.P.A. acting administrator, said in a statement.

It's unclear what further steps the incoming Trump administration might take. President-elect Trump has been hostile to regulations. However, he spoke on the campaign trail of "getting dangerous chemicals out of our environment," and concerns about PFAS contamination in fertilizer have reached some deeply red states.

The E.P.A.'s risk study comes as farmers across the country have been discovering PFAS on their land.

In Maine, the first and only state that is systematically testing its farmland for PFAS, dozens of dairy farms have been found to be contaminated. In Texas, a group of ranchers sued the provider of sludge fertilizer last year after a neighboring farm used the fertilizer on its fields. County investigators found several types of PFAS in the ranchers' soil, water, crops and livestock, and the ranchers have since sued the E.P.A., accusing the agency of failing to regulate PFAS in biosolids. In Michigan, state officials shut down a farm where tests found particularly high concentrations in the soil and in cattle that grazed on the land.

The E.P.A. said its analysis did not suggest the general food supply was at risk. Sewage sludge is applied to less than 1 percent of the fertilized acreage of agricultural land a year, it said, a number that roughly aligns with industry data. And, not all farms where sewage fertilizer was used would present a risk.

Still, studies have found that, because PFAS is so persistent in the environment, tainted sludge applied years or even decades ago can continue to be a source of contamination. More than 2 million dry tons were used on 4.6 million acres of farmland in 2018, according to the biosolids industry. Farmers have obtained permits to use sewage sludge on nearly 70 million acres, or about a fifth of all U.S. agricultural land, the industry said.

Christopher Higgins, a professor of civil and environmental engineering at the Colorado School of Mines who has researched biosolids, said it was notable that the E.P.A. had

concluded that concentrations in sludge fertilizer posed risks at relatively low levels.

Historically, he said, sludge had been applied at concentrations greater than the levels now deemed risky by the E.P.A. “That implies there’s going be a lot of places where there might be an unacceptable risk,” he said.

The E.P.A. hasn’t changed its policy of promoting sludge fertilizer, which has benefits along with the risks. It is rich in nutrients, and spreading it on fields cuts down on the need to incinerate it or put it in landfills, which would have other environmental costs. Using sludge fertilizer also reduces the use of synthetic fertilizers that are based on fossil fuels.

The agency said that farmers who may be concerned about their use of sewage sludge should consult with local health officials, get their drinking water tested as a first step, and consider switching to an alternative fertilizer.

The E.P.A. said that, at farms which have used contaminated sludge, the highest human risks involved drinking milk from pasture-raised cows raised on a contaminated farm, from drinking contaminated water, from eating eggs from pasture-raised hens or beef from cattle raised on contaminated land, or from eating fish from lakes and ponds contaminated with runoff.

Particularly at risk were households that live near or relied on products from a contaminated source, for example milk or beef from a family farm contaminated with PFAS from sewage sludge, the agency said. It said in certain conditions, risks exceeded the E.P.A.’s acceptable thresholds by several orders of magnitude.

The general public, which is more likely to buy milk from a grocery store that sources its produce from many farms, was at less risk, the agency said. For its assessment, the E.P.A. focused on the two most commonly detected types of forever chemicals, called PFOA and PFOS, though many others exist.

The Food and Drug Administration does not set limits on PFAS levels in food. Since 2019, however, the agency has tested nearly 1,300 samples and said the vast majority were free of the types of PFAS the agency is able to test for.

Some public health experts and advocacy groups have questioned the testing methodology, and the agency itself says that “PFAS exposure from food is an emerging area of science and there remains much we do not yet know.” Last year, Consumer Reports said it had detected PFAS in some milk, including organic brands. Packaging is another source of PFAS in food.

Kyla Bennett, director of science policy at the Public Employees for Environmental Responsibility, an advocacy group working with the Texas ranchers, said the E.P.A.'s assessment was a good first step, but noted the agency had looked at only two kinds of PFAS, even as more were being detected on farmland. "Because we don't fully know how they interact with each other, and how they affect human health, I think the E.P.A. needs to do more," she said.

The National Association of Clean Water Agencies, which represents wastewater treatment plants across the country, said the findings reinforced that sludge fertilizer was not a risk to the public food supply. Sludge providers have argued that they should not be held responsible for PFAS contamination, saying the chemicals are simply passed onto them.

"Ultimately, the manufacturers of these chemicals must bear the responsibility and cost to remove these chemicals" from their products and environment, said Adam Krantz, the group's chief executive.

In the absence of federal action, states have started to take their own measures. Maine banned the use of sewage sludge on agricultural fields in 2022 and remains the only state to have done so. In December, a Texas lawmaker introduced a bill that would place limits on levels of certain kinds of PFAS in sewage sludge applied to farmland. Oklahoma lawmakers have also introduced a bill that would place a moratorium on the use of sludge on farmland.

An outright ban on the use of sludge as fertilizer would bring its own problems. Wastewater sludge still needs somewhere to go. Since Maine's ban, some wastewater treatment plants say they have been forced to ship sewage sludge out of state.

Environmental experts say what's important is limiting the amount of PFAS that ends up in wastewater and sewage in the first place. That could come from phasing out the use of PFAS in everyday products, or requiring manufacturers to treat polluted wastewater before sending it to municipal wastewater treatment plants.

Hiroko Tabuchi covers pollution and the environment for The Times. She has been a journalist for more than 20 years in Tokyo and New York.

A version of this article appears in print on , Section A, Page 1 of the New York edition with the headline: E.P.A. Warns of 'Forever Chemicals' in Fertilizer

https://gazettetimes.com/news/local/government-politics/article_245014e9-3341-5124-b237-3486d8dbe65a.html

TOP STORY EDITOR'S PICK

With Marion County's incinerator closed, where's the trash going?

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Following the recent closure of the state's only municipal garbage incinerator, Marion County will not send an additional 100,000 tons of trash to Coffin Butte Landfill, north of Corvallis, instead diverting waste to the Columbia River Gorge.

The local government serving the about-1,200-mile jurisdiction around Salem already is Coffin Butte Landfill's largest customer, hauling in about 230,000 tons each year. Marion County officials agreed in January not to increase that after they expected the tall, red-white-striped stack of Reworld Marion to fall silent.



The Reworld Marion Inc. incinerator, previously known as Covanta, is visible from near Interstate 5 on Thursday, Dec. 12, in Salem. Owners were slated to shutter the trash burning facility at the end of December.

Alex Powers, Mid-Valley Media

"We didn't want to put an additional burden on Coffin Butte," Marion Environmental Services Division Manager Brian May said by phone Jan. 27.

Currently Coffin Butte is caught up in two regulatory processes: Its corporate owners have applied with Benton County to expand the dump and with Oregon for a new air pollution permit.

Arizona-based trash hauler Republic Services has proposed a cap on annual tonnage at the dump, near Adair Village, and floated a 2037 closure date based on the company's projected annual trash intake.

Trash trucks, builders and industrial customers dump about 1.1 million tons at Coffin Butte each year. Marion County accounts for around 21% of the dump's tonnage.

"I think we are all pretty aware of their current circumstances, where they have around 12 years of life left," May said.

So trash that would have gone to the now-closed Reworld incinerator, formerly known as Covanta, is heading to the Wasco County Landfill, near The Dalles and nearly 130 miles via interstates 5 and 84.

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Oregonians each generated an average 7.8 pounds of trash per day in 2022, according to the state's most recent figures.

Both statewide population and per-person trash generation rates have increased in the 30 years since 1992, when Oregonians made 5.6 daily pounds of garbage.

"The volume has increased significantly," May said.

In a report published in May, the Oregon Department of Environmental Quality estimated that some resident, like those in Marion County, generated more: 3,591 pounds per person in a year, compared to 2,761 pounds per person in Linn County; and 2,426 pounds in Benton County.

Critics of Coffin Butte's role as a regional dump have argued for years that uneven use of the landfill is unjust and disproportionately burdens Benton County residents with environmental fallout, such as gas or trash-infused rainwater leaking from inside the dump.

Counties, including Benton, Linn, Marion, Polk and Yamhill, designated Coffin Butte as their destination landfill in 1974 despite pushback from the dump's neighbors.

"That was always our plan — to move that material out to Coffin Butte," May said.

Since 2020 Republic Services has been trying to expand its landfilling operation near Adair Village. The Arizona-based trash hauler applied with Benton County's planning department for permission to inter waste on land the company owns and effectively move the working face of the dump to the south, across Coffin Butte Road.

The incinerator literally burned through landfilling figures. People north of Albany and Corvallis sent all their trash to Reworld after Marion officials partnered with the company to site the incinerator near Brooks in 1984.

"Our generation was low enough that the incinerator was able to take all of our waste," May said.

Near the peak of its operation, the Marion County incinerator could burn around 187,000 tons and took household trash from Portland.

"To keep that fire lit, so to speak," May said.

Covanta's fires burned at 2,000 degrees and powered a steam turbine that generated 13 megawatts of electricity each year — enough to power Woodburn, according to Marion County's website, the city north of Salem with a population of more than 29,000 people.

The Reworld Marion Inc. incinerator, previously known as Covanta, visible from near Interstate 5

Nearly four decades later, Covanta

destroyed as much as 4% of waste generated statewide, according to the report.

on Thursday, Dec. 12, in Salem. Owners were slated to shutter the trash burning facility at the end of December.

Alex Powers, Mid-Valley Media

But the incinerator started showing its age. Oregon's environment department issued $15,722 in fines in 2022 to Covanta for emitting more pollution than allowed under state air quality permit; and $22,800 during summer 2024.

Oregon has sought tougher rules for air polluters as the state attempts to lower its emissions of greenhouse gases to levels below those in the early 1990s.

Industrial and medical waste found its way to Covanta, as did narcotics held as police evidence and retired uniforms.

Ashes from medical waste were laid down as daily cover at Coffin Butte. Republic Services now won't use the Covanta leftovers to layer over trash on the landfill's working face, where residents complained they could see ash billowing during the summer.

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Then Oregon legislators clamped down on Covanta.

"All of a sudden, we jumped a process where DEQ and the state had a very good process to not pick on just one entity," May said.

Sen. Deb Patterson, a health care executive and Democrat from Salem, introduced a law requiring incinerators to continuously monitor emissions for airborne pollution and capping their intake of medical waste. Signatories included Corvallis Sen. Sara Gelser Blouin.

Covanta rebranded as Reworld the following April, in 2024, and announced the incinerator's closure later that year.

"I think there are a lot of unintended consequences," May said. "We're hearing

from medical providers whose disposal costs have gone up 170%."

In December Marion County's elected officials blamed the state Legislature for hindering Reworld Marion.

County Commissioner Danielle Bethel said Reworld had been a financial risk and great investment return for Marion County, but Marion County couldn't stop the rollout of state law, according to meeting minutes.

Countywide, Marion waste collection generated more than 625,000 tons of trash in 2022. The local government sent 145,000 to 160,000 tons, more than 23%, to Covanta as recently as 2021, according to a contract.

May said he believes Marion County made the right decision not sending the trash to Coffin Butte. May and another commissioner, Kevin Cameron, participated in Benton County's wayfinding process in 2022 after planning officials denied Republic's last expansion attempt.

That workgroup, Benton County Talks Trash, recommended overhauling the county's waste stream to encourage polluters to generate less trash.

Subsequent meetings and committees have started talks that could last for years about potential financial incentives for packagers, or attempts to educate trash-makers about what happens to their garbage after they wheel a bin to the curb each week.

"Being led by the entity that feels like they're being dumped on is very proactive," May said.

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150-day timer starts on Coffin Butte expansion application

Pause in effort to update pollution permit for Coffin Butte more than a short one

Corvallis to stop accepting chemical soup from Coffin Butte Landfill

More Benton County news

Alex Powers (he/him) covers agri-business, Benton County, environment and city of Lebanon for Mid-Valley Media. Call 541-812-6116 or tweet @OregonAlex.

statesman journal

OREGON

Benton County staff recommend denying Coffin Butte Landfill expansion



Tracy Loew
Salem Statesman Journal

April 29, 2025 | Updated April 30, 2025, 10:42 a.m. PT

(*This story has been updated to correct an inaccuracy. If the Benton County Planning Commission denies the proposal to expand Coffin Butte Landfill, an appeal would go to the Board of Commissioners.*)

Benton County staff have recommended that the county's planning commission deny an application to expand Coffin Butte Landfill.

Phoenix-based Republic Services has requested a conditional use permit from the county, which would allow it to expand the 178-acre landfill located north of Corvallis.

In a staff report, county officials say Republic Services "did not provide sufficient evidence to support a finding that odor and noise impacts would not 'seriously interfere' with adjacent land uses."

The county has received more than 500 comments opposing the expansion, totaling more than 2,000 pages, ahead of public meetings on the proposal that begin April 29.

Those commenting cited a host of concerns about the expansion, including increased traffic, noise, odors and air pollution, potential landfill fires, documented methane exceedances, recent citations for worker health and safety violations, impacts to groundwater and more.

Coffin Butte Landfill accepts about a third of the Mid-Willamette Valley's garbage. Marion County is its biggest customer.

Coffin Butte Landfill's proposed expansion

Republic Services is the second-largest waste disposal company in the United States.

The expansion attempt comes more than two years after the Benton County Planning Commission unanimously denied a previous request for a conditional use permit, following public testimony in opposition. Among the concerns were plans to close an access road and its impact on those who live nearby.

Now, the planned expansion is 50% smaller than proposed in 2021 and would be on land owned by Coffin Butte and zoned for a landfill, according to the company.

It would add six years of life to the landfill, about half of what the company requested in 2021. And it would improve, rather than close Coffin Butte Road. The road has been a point of contention with neighbors, who say the road is their only escape route in the event of a fire or other natural disaster.

In its staff report, county officials say the proposal would exceed the regulatory noise thresholds set by the state Department of Environmental Quality, a standard the company had asked to be used.

County officials also noted inconsistencies in the model used to determine whether odors would be considered a nuisance. And the analysis didn't identify uses, such as residential use, that would be more likely to be sensitive to odor impacts than others, such as a farmed field.

On April 9, 2025, the Benton County Environment and Natural Resources Advisory Committee voted to recommend denial of the conditional use permit.

Benton County Republicans, Benton County Democrats and Linn-Benton Green

party all passed resolutions opposing the expansion.

State and local environmental groups also are asking the planning commission to deny the application.

Landfilling is not a safe or sustainable option for long-term waste management, the groups, including Beyond Toxics, Sierra Club, 350 Salem and Valley Neighbors for Environmental Quality and Safety (VNEQS), said in a news release.

“Approving this application to expand Coffin Butte would increase local fire hazard and risk, exacerbate local air quality and odor problems, and increase environmental damage done to the Willamette River and all who recreate, fish, and rely on its drinking water. It would be a decisive step in the opposite direction of responsible management of environmental resources for Oregonians,” said Mark Yeager, a landfill neighbor and VNEQS member.

How to weigh in on Coffin Butte Landfill’s expansion proposal

The Benton County Planning Commission will hold a series of public meetings on Coffin Butte Landfill’s expansion proposal beginning April 29.

Members of the public can sign up to give verbal testimony during the hearing. Written testimony will be accepted until the commission decides to close the public hearing.

Information about providing verbal and written testimony is available at www.bentoncountyor.gov/coffin-butte-landfill.

Here is the meeting schedule:

- 6 p.m. to 9 p.m. April 29: The county will deliver a staff report, Republic Services will deliver a presentation, and, if there is time, public testimony will begin.
- 6 p.m. to 9 p.m. May 1: Public testimony will start or continue.

6 p.m. to 9 p.m. May 6: Public testimony will continue.
6 p.m. until complete June 17: The planning commission will deliberate and make a decision.

All meetings will be held at the county's Kalapuya Building, at 4500 SW Research Way in Corvallis.

If the planning commission denies the proposal, an appeal would go to the county Board of Commissioners, which also would hold a public hearing before making a decision. The county expects that to happen by Aug. 11.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

This 'limited' expansion is another ruse

AS I SEE IT

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MARGE POPP

Proponents of Coffin Butte Landfill expansion claim Re-public Services' conditional use permit application requests only a "limited" expansion. This characterization is misleading and obscures the true impact of the project.

Republic Services aims to exploit a loophole in the 2020 franchise agreement to lift the 1.1 million-ton annual cap on trash intake, paving the way for importing

unlimited amounts of waste. This move would increase the profitability of its operations at the expense of our community and environment.

The expansion involves significant expenditure, with tens of millions of dollars allocated to moving leachate ponds and millions of pounds of dirt on the south side of Coffin Butte Road. This investment is purportedly for only six additional years of landfill lifespan?

The current landfill footprint already has an estimated 14 to 16 years of capacity remaining at current trash intake levels, making the economic rationale behind this expansion questionable.

Far from being "limited," this project is a large-scale endeavor designed to maximize landfill capacity, potentially leading to the eventual closure of Coffin Butte Road and transforming the valley into a vast waste disposal site for other counties.

An email exchange between Benton County Attorney Vance Croney and Republic Services employee Julie Jackson, dated Oct. 14, 2020 (obtained via a Public Records Request), reveals Republic Services' long-term ambitions for the site.

Vance Croney writes, "Hmm. Republic has a chunk of land south of Coffin Butte that is already zoned Landfill which only requires conditional use approval to begin use as a landfill cell. It also has many acres of EFUzoned land that certainly can be

used for additional cells, but would require rezoning. Are we both talking about the Landfill zoned acreage as creating an additional 15-20 years of life?"

Julie Jackson replies: "Vance, This is just the estimate for the cell area we are asking to rezone. We have many acres that could hold waste and that will likely be a future discussion with the County."

Republic Services has a history of inaccurate reporting and noncompliance with the conditions of use for the Coffin Butte Landfill, and Benton County has not taken appropriate action. The lack of consequences for noncompliance suggests a failure of our local government to protect our community and natural resources.

A 2023 EPA investigation revealed significant methane leakage exceedances, further underscoring Republic Services' lack of transparency and accountability. Recent communications between the EPA and Republic Services indicate further issues with the accuracy of information provided by the company.

The EPA's subpoena requiring written verification concludes with this sternly worded caution for the signatory:

"I am aware that there are significant penalties for submitting false information in response including the possibility of fine and imprisonment."

Interestingly, the landfill manager responsible for signing this document resigned about this time.

It is imperative that we demand honesty and transparency from both our county government and Republic Services. This requires a capable and proactive staff that can think critically and independently as well as engaged participation from the community.

Our county government and commissioners have become overly reliant on Republic Services to act responsibly, prioritizing the status quo over diligent oversight.

Similarly, complacent residents have placed too much trust in elected officials and county staff to act in their best interests.

With Benton County staff being well-compensated, we should expect and demand experienced and dedicated individuals who are committed to serving the community's interests.

It is time for us to recognize the true consequences of this expansion to our community and environment, and we must demand responsible governance and environmental stewardship.

We need to wake up and smell the dump!

Marge Popp is a retired information systems consultant. She is a longtime resident of Corvallis and Benton County.

TOP STORY EDITOR'S PICK

As I See It: The not-so-free revenues from Coffin Butte

In anticipation of coming economic headwinds, Benton County has implemented a hiring freeze. That's wise. But in addition to looking at expenses, it would also be wise to look at the cost of some revenues, specifically landfill revenues.

There is a lot of misinformation about landfill revenues; here are some facts:

Landfill revenues are not a big part of total revenues. Per the 2023-25 budget, Benton County's total revenues are roughly $185 million. Revenues from the landfill make up less than 1.6% of that total, or about $2.9 million. That's not much. And Benton County gets that money whether or not the landfill expands.

Whether or not the landfill expands, Benton County is guaranteed to receive $2.5 million per year through the year 2039. Per the 2020 franchise agreement, the landfill is obligated to pay Benton County a minimum of $2.5 million dollars a year through 2039. This amount is guaranteed even if the landfill stops accepting ANY waste.

At current volumes, an expansion will not result in much additional revenue for Benton County. If an expansion is approved, revenues increase by only about $500,000-$600,000 per year. That is less than one-third of 1% of total Benton County revenues.

Landfill revenues cost money now. Landfill revenues received are gross, not net. These revenues aren't free:

- Landfill trucks damage our roads; road repair costs a lot.
- First responders are called to landfill truck accidents (like the Republic Services truck from Sweet Home that flipped over in Philomath in a one-car accident on June 26, 2024), landfill truck fires (like the recent fire on April 6), and fires at the landfill itself (at least two in the past year alone).
- Finally, these revenues cost the county untold hours of staff/consultant time. The landfill operator, unable to take "no" for an answer in 1994, or again in 2021, has for the third time submitted a proposal to put garbage on the same 59 acres south of Coffin Butte Road. To deal with these repeated expansion requests, Benton County staff has worked probably thousands of hours, and shelled out probably $750,000 in consultant fees.

What do all of these expenditures total? Nobody knows; the county doesn't keep track. But I guarantee you that if it did, landfill revenue would look less attractive.

Finally, the costs cited above are not the big costs. The big costs are intangible costs, opportunity costs, costs of a future environmental disaster, and costs to our own health.

Intangible costs: As the landfill grows larger, smells worse and the health effects of landfilling become more well known, it is certain that the landfill costs Benton County reputationally. The landfill depresses property tax revenue countywide.

The landfill harms farmers of berry and grape crops, and windblown litter fouls agricultural equipment.

Opportunity costs: The landfill chills development of new residential subdivisions for miles, not only in Benton County, but in Linn and Polk counties too.

Environmental costs: Costs of a major fire, earthquake or liner failure could run into the hundreds of millions of dollars.

Health costs: Finally, there is the real possibility that the landfill is making us sick.

I’m glad that the county is finally starting to be a little more careful in its expenditures, but it’s time that it looks more closely at revenues as well. The dollars that the landfill brings in may look like a free lunch, but if the county looked at this meal more closely, it might find that what’s on the menu is literally garbage.

Nancy Whitcombe

Nancy Whitcombe likes words and numbers. She is a completely retired architect and a mostly retired accountant.

https://gazettetimes.com/news/local/government-politics/article_e57bf960-52b3-526e-956d-8d6ee48eb1cc.html

TOP STORY BREAKING

Benton County staff recommend denial of Coffin Butte Landfill expansion

Benton County staff have recommended the Planning Commission deny Republic Service's request to expand Coffin Butte Landfill.

Staff cite odor and noise impacts expected to "seriously interfere" with adjacent land uses and the character of the area as the primary reasoning behind their recommendation.

A hearing is scheduled for next week.

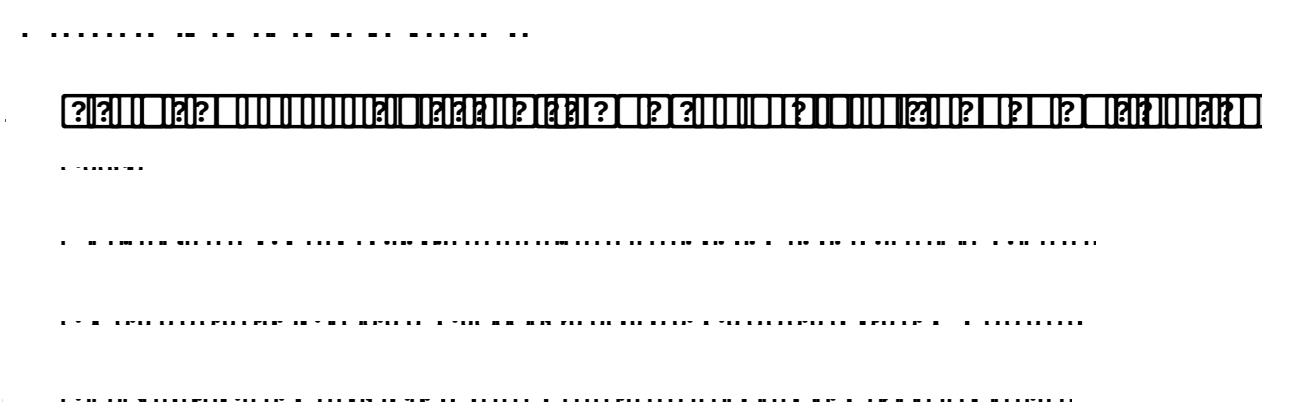
A tanker trailer takes on trash-imbued runoff called leachate in August at Coffin Butte Landfill, north of Corvallis. While the landfill's corporate owner has applied for a permit to expand the facility, Benton County staff is recommending against it.

Alex Powers, Mid-Valley Media (File 2024)

Landfill owner Republic Services has applied for a conditional use permit that would allow for expansion of the existing operations by moving the active disposal area south of Coffin Butte Road, constructing an 1,800-square-foot employee building with off-street parking, adding a shop and maintenance area and more.

The community, particularly members who live close to the landfill located north of Corvallis, has consistently vocalized resistance to the expansion and has raised suspicions the Phoenix-based

company's request was a fait de accompli.



In a staff report made available online, Benton County staff noted that the proposal for expansion seems to exceed the Department of Environmental Quality regulatory noise threshold proposed for use by the applicant.

It also cites concerns with the applicant's odor analysis.

"The analysis does not appear to identify adjacent uses that are likely to be more sensitive to odor impacts. For example, a residential use is likely to be more sensitive to odor impacts than a farmed field," it reads.

It goes on to state that several technical elements of the analysis seem inadequately supported.

This is not the first time Republic Services has struggled to get an expansion proposal off the ground. In 2021, the Benton County Planning Commission unanimously rejected its first attempt, expressing concerns about how the then-proposed closure of Coffin Butte Road would impact the surrounding neighborhood.

The Planning Commission also cited concerns — similar to those this go-around — about noise and odor, as well as other public health impacts, environmental and wildlife impacts.

Today's application no longer proposes the closure of Coffin Butte Road, instead proposing to widen a section of the road adjacent to the development site.

Republic Services submitted its new expansion application in July, attempting to preclude critics' concerns. But the next month the county deemed the proposal "incomplete," citing deficiencies in the application. It was resubmitted in November.

Benton County Public Information Officer Anne Thwaits told Mid-Valley Media that the county couldn't say much about the recently released staff report, citing the pending public hearing.

"We're just happy that the process is moving along as it should," she said.

The public hearing for the proposed expansion begins on April 29, and the public comment period is already open. As of 12 p.m. on April 22, according to the staff report, 135 written comments have already been received.

"We appreciate the county's feedback and are working diligently to address their concerns," a Republic Services spokesperson wrote to Mid-Valley Media. "We look forward to presenting our application at the Planning Commission meeting next week."

The deadline to reach a final decision on the proposed application is Aug. 11.

State pols consider forming a Coffin Butte Landfill task force

Coffin Butte Landfill expansion application deemed complete

Republic Services resubmits landfill expansion, here's what's new

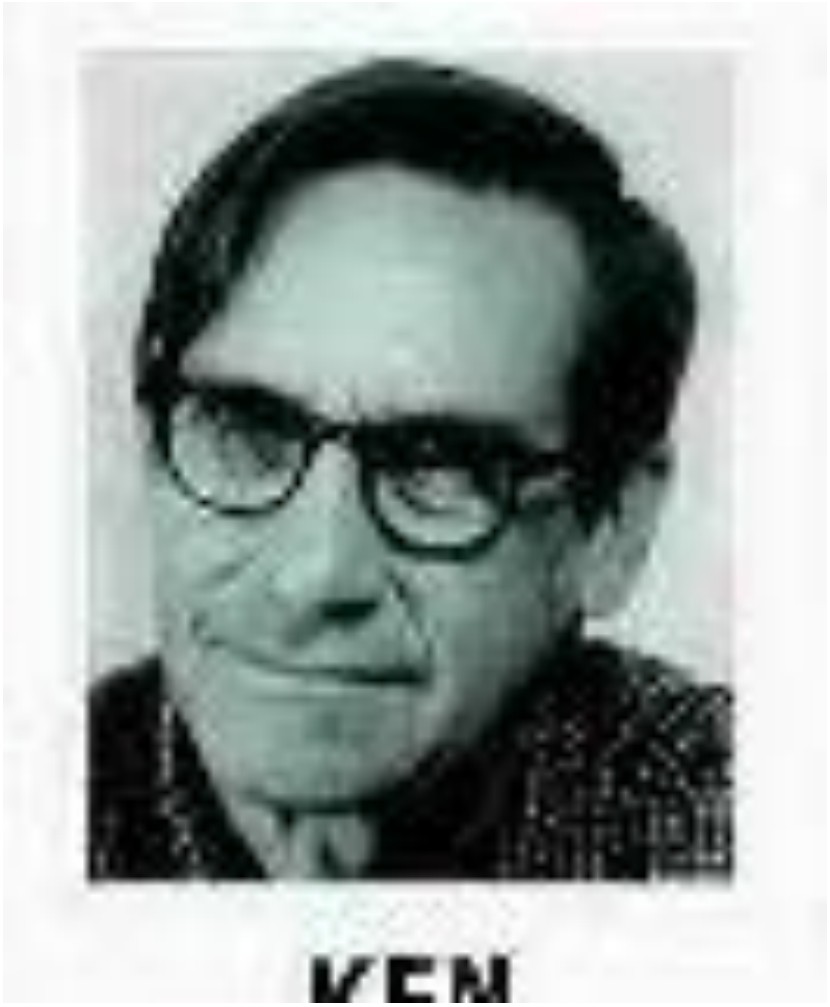
Benton: Coffin Butte Landfill expansion application incomplete

More Benton County news

Ella Hutcherson is a University of Oregon graduate who hails originally from the Southern Oregon coast. She covers Corvallis and Benton County and can be reached at .

Game over for expansion? If only

AS I SEE IT



KEN EKLUND

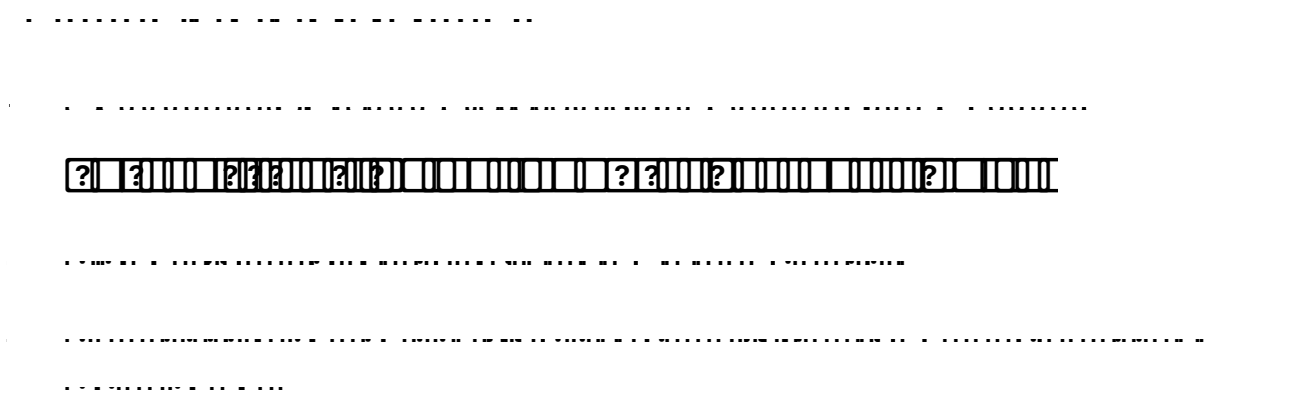
Let's call it Dump Karma. A day after Republic Service's public relations writes a letter to Benton County, assuring us that no enforcement action is pending against Coffin Butte dump, EPA enforcement takes action against Coffin Butte dump.

EPA filed a "Section 114 Information Request," but "request" is misleading; in

effect it's the EPA's equivalent of an IRS audit. We might call it an "Information Request with Benefits," where the benefits are possible fines if you're late and prison time if you lie.

The EPA enforcement action took place in January. Republic updated its expansion application in mid-March. Its update doesn't mention the EPA enforcement. Maybe because ...

The EPA enforcement seems like GAME OVER for the dump expansion. Republic has the burden of proof, i.e., its application must show that the landfill expansion won't cause significant harm to nearby properties, character of the area, etc., or it fails.



Representatives say their proof is "we comply with environmental regulations." So when the EPA said, "Let's see all your compliance records" explicitly to see if Republic really is complying, the EPA slapped big red question marks all over Republic's proof.

And a proof with question marks is no proof at all.

The thing is, Republic's "compliance" is basically self-declared. Like with taxes and the IRS, if you report regularly and they don't say anything, voila! You've "complied." Until you're audited, that is. Then you're not compliant until the auditor says so.

It seems clear the EPA has grounds to question Republic's self-declared compliance. Its inspections consistently turn up serious environmental problems. Last year the EPA administrator said definitively that Coffin Butte Landfill is "an active case, and we are laser-focused on this case."

The EPA's air enforcement officer recently confirmed this. (Neither could say more because it's an active legal action.)

And Republic notably is not trying to clear the air — instead, company officials are filing for delay, delay, delay.

So, as I said, this should be GAME OVER for the dump expansion. To approve it, a planning or county commissioner would have to affirm Republic's proofs as sufficient; they'd have to publicly certify that an expanded dump couldn't pose significant problems. Which seems iffy to do while the EPA is actively investigating the current dump for significant problems.

In case you missed it, a firestorm of protest is raging about the dump polluting nearby neighborhoods and recreation areas, super-emitting greenhouse gases to wreck the climate — which is what jump-started the EPA investigation in the first place. This should be GAME OVER — but never underestimate Republic's commitment to this expansion, or its ability to steamroll reality. Coffin Butte is Republic's only landfill in Oregon, and expanding it every few years is now the only way to keep growing its highly profitable waste disposal business across the state.

So buckle up for truly imaginative takes incoming from Republic PR — "an action by EPA enforcement is not an EPA enforcement action" or suchlike. And watch to see if county government doesn't do some logic and values-defying somersaults of its own regarding the EPA enforcement in its April 22 report to the Planning Commission.

Hey, if Republic won't tell the Planning Commission about the EPA enforcement, maybe we should? You can tell the commissioners:

(a) "There's EPA enforcement goin' on that Republic's not telling you about," and (b) "Deny application LU-24027 to keep Republic's HANDS OFF our local air, water and soil"?

If 50 people step forward, maybe we can reverse Republic's spin. Visit CoffinButteFacts.org to learn how to write the Planning Commission and to learn more.

Ken Eklund is a futurist and artist in game design, and a community volunteer on the Benton County Disposal Site Advisory Committee. He lives with his family in the Corvallis area.

The Corvallis ADVOCATE
(https://www.corvallisadvocate.com)

LANDFILL EXPANSION EDITORIAL: SOMETIMES, NIMBY IS THE RIGHT ANSWER

MARCH 24, 2025



Not always, but sometimes, NIMBY, or not in my backyard, is the right answer, and we suspect that's how our county should answer Republic Services' application to expand their Coffin Butte landfill facility.

In a perfect world, we might suspect differently, but that's not the world we're living in.

Landfills need substantive regulation and robust monitoring. They emit mixes of biogas and bioaerosols, they are a breeding ground for disease vectors, and they can discharge leachate into the area ground water supply. Communities that host these facilities can see increased incidences of cancer and respiratory diseases. And then there are the environmental impacts; some of them global, many of them local, and too many of them dauntingly long-lasting.

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So, what is the County to do. Regulation could be an answer, but we no longer live where County officials might, with a straight face, tell themselves or anyone else that we locals can rely on the EPA or Oregon's DEQ to monitor and regulate much of anything going into the future, including a landfill in our fair and small county. Maybe, back in the day, but not now.

The feds are going all-out chainsaw massacre on their own agencies – and a third of Oregon's budget comes from federal dollars. So, what happens to the state's DEQ if the flow of federal monies slows is anyone's guess.

If state budget writers suddenly need to scramble, the ongoing monitoring of a dump may seem like a lower priority than say, keeping schools open and needy children fed.

Some might think the County could take over regulation and monitoring. But promulgating the right regulations and monitoring regimen for a facility like this one isn't in the County's current wheelhouse. And even if they could cut-and-paste rules and practices from elsewhere, they are unlikely to have the right experts and equipment in place anytime soon.

Standing up a regulatory framework and staffing and a pay-for plan to fund all of that would likely be, optimistically, a couple yearslong process. None of this will happen before the legal deadline for the County to make a decision on Republic's expansion application.

In short, even with its past resources, the EPA has been slow to investigate problems at Coffin Butte over the years. And now state and federal regulatory resources are in flux and will almost certainly be reduced in the future.

We don't think County officials can demonstrate the appropriate know-how and capacity to regulate the landfill on their own, given they could not have anticipated the unprecedented prospective reductions in state and federal regulatory capacity.

The County could leave the door open for Republic to reapply. However, desperately needed housing has been envisioned for areas in the dump's proximity. So, the company may be better off seeking a new site in a slower growing county that could offer a location that is more remote. We also think that if Republic does approach another County, they should expect them to want adequate time to build an appropriate regulatory structure.

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statesman journal

NEWS

Overflow crowd urges Benton County to reject Coffin Butte Landfill expansion



Tracy Loew
Salem Statesman Journal

Updated May 7, 2025, 2:41 p.m. PT

An overflow crowd turned out May 6 for the third night of public meetings on a proposed expansion of Coffin Butte Landfill.

Phoenix-based Republic Services has asked the county for a conditional use permit that will allow it to expand the 178-acre landfill, located north of Corvallis.

In a staff report, county officials recommended denying the application, citing noise and odor impacts.

The meeting was the first time the public had the chance to speak in person on the proposal, following presentations from county staff and Republic Services. Hundreds of people also have submitted written testimony, totaling more than 2,800 pages, the majority in opposition to the expansion.

More than 70 people signed up to speak on May 6. Most urged the Benton County Planning Commission to reject the expansion.

Opponents cited concerns about increased traffic, noise, odors and air pollution, potential landfill fires, documented methane exceedances, recent citations for worker health and safety violations, impacts to groundwater and more.

Several speakers noted Republic Services is not complying with existing federal, state and county regulations, citing an ongoing U.S. Environmental Protection Agency investigation into methane releases, Oregon OSHA citations for worker safety violations, and the fact that Benton County has not enforced previous conditions it has set on the

landfill, according to a county task force report.

“I don’t believe that Republic Services has really performed to the standards of our community,” said Shelley Su of Corvallis.

Debbie Palmer, who lives near the landfill, pointed out that, unlike most Oregon counties, Benton County does not have a waste management plan.

“It’s absurd to expand this landfill before having a plan,” Palmer said. “It’s our future, not Republic’s that’s important here.”

Three people spoke in favor of the expansion. All accused opponents of having a “not in my backyard” mindset.

“Oregon’s landfills are renowned for their advanced waste handling methods,” said Zachary Dahl, of Dahl Disposal in Toledo.

Coffin Butte Landfill accepts about a third of the Mid-Willamette Valley’s garbage. Marion County is its biggest customer.

Expansion proposal scaled down after denial

The expansion attempt comes more than two years after the Benton County Planning Commission unanimously denied a previous request for a conditional use permit, following public testimony in opposition. Among the concerns were plans to close an access road and impacts on those who live nearby.

The planned expansion is now 50% smaller than proposed in 2021 and would be on land owned by Coffin Butte and zoned for a landfill, according to the company.

It would add six years of life to the landfill, about half of what the company requested in 2021. And it would improve, rather than close Coffin Butte Road. The road has been a point of contention with neighbors, who say the road is their only escape route in the event of a fire or other natural disaster.

What’s next for Coffin Butte Landfill’s expansion application

The planning commission ended its May 6 meeting with more than 30 people still signed

up waiting to speak. As a result, the commission has scheduled another meeting beginning at 6 p.m. on May 8 to hear from those people. No one else will be allowed to sign up.

The planning commission is scheduled to deliberate and make a decision on the application at a public meeting starting at 6 p.m. on June 17.

Both meetings will be held at the county's Kalapuya Building, at 4500 SW Research Way in Corvallis.

If the planning commission denies the proposal, an appeal would go to the county Board of Commissioners, which also would hold a public hearing before making a decision. The county expects that to happen by Aug. 11.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

From:	Ken Eklund
To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 9 of 12
Date:	Thursday, May 8, 2025 2:39:15 PM
Attachments:	writerguy-cube2.png

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Still more history of Coffin Butte Landfill in the press, covering many of the same issues that have come up in public testimony: PFAS, leachate, methane, EPA and DEQ investigations and actions, labor issues, Republic cover-ups of problems and information, fire hazards, misleading and dubious information about the economics of the landfill, and so on. – K



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Creator of
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Pressure mounts on methane-polluting Oregon landfill to clean up its act

Nearby residents have been sounding the alarm about Coffin Butte Landfill for years. Now Sen. Jeff Merkley and other members of Congress are demanding action.



By **Isobel Whitcomb**
19 August 2024



Coffin Butte Landfill (E.J. Harris)

Coffin Butte, a rapidly growing landfill in Oregon that is leaking explosive levels of methane, has caught the attention of state and federal officials. On August 8, Oregon's U.S. senators, Jeff Merkley and Ron Wyden, and one of its U.S. House members, Val Hoyle,

found 21 spots on the landfill where methane emissions exceeded 10,000 parts per million (ppm) – far over the federal limit of 500 ppm. Residents are concerned about the climate impacts of these emissions, the risk of wildfires posed by this highly flammable gas, and the health effects of exposure to toxic chemicals emitted alongside methane.

Merkley first learned about Coffin Butte Landfill at a town hall this February, where residents spoke about the landfill's effects on their day-to-day lives and how its emissions contribute to climate change (methane is a potent greenhouse gas that over 20 years traps 80 times as much heat in the atmosphere as carbon dioxide).

"Certainly, their concerns resonated with me, their concerns about fires, about the smell, and concerns about their health," Merkley told Canary Media. At a May hearing, the senator raised the issue with EPA Administrator Michael Regan. In response, Regan said he couldn't comment because Coffin Butte is the subject of an "active enforcement situation," but he assured Merkley that the EPA is "laser-focused" on the landfill. In June, the EPA conducted a second inspection of Coffin Butte Landfill, the results of which are forthcoming.

Republic Services, the company that operates Coffin Butte, "has had a lot of time to become a good community member and address all of this methane leakage. And now we're going to find out in this new report whether or not they have done so," Merkley said.

Meanwhile, Oregon's Department of Environmental Quality has issued warnings to Republic Services for not complying with 2021 state regulations mandating that landfills reduce methane emissions. The regulations required Republic Services to conduct emissions testing at two flares by March 2023. In July, the DEQ concluded that the testing was not "completed or attempted" and that Republic Services committed a Class I violation – the most serious level – of the requirement.

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Local advocacy has focused largely on a proposed landfill expansion that would add a second, 270-foot-tall pile of trash across the road from the original site. Republic Services initially filed an application for an even larger expansion in 2021, but that application was denied due to residents' concerns. A second application for a scaled-down expansion was filed on July 19, but on Friday it was deemed incomplete by Benton County. Republic Services has 180 days to refile.

The recent attention from state and federal officials, as well as increased media coverage, has bolstered the movement against the expansion, said Debbie Palmer, a resident of Benton County who lives 4 miles down the road from Coffin Butte. Environmental nonprofit Beyond Toxics and local advocacy group Valley Neighbors for Environmental Quality and Safety recently held a meeting to discuss the landfill. More than 100 people attended. "It was standing room only," Palmer said.

Coffin Butte isn't an anomaly among landfills. An Industrious Labs analysis published in May found that across eight states, 96 percent of EPA landfill inspections reported methane levels higher than federal standards. "It's a real example of what we're finding in landfill after landfill," Merkley said.

Over the past two years, Merkley has secured $5 million in federal funding to study methane emissions from landfills. Earlier this summer, he submitted an appropriations request to fund a pilot program that would continuously monitor methane at one landfill in the United States. The 2025 appropriations bill for the EPA and Interior Department, which includes funding for the program, passed the Senate on July 25. While the EPA

"If the problem persists, I'm going to be very much following up on the EPA's regulatory authorities and asking them to use those authorities to protect the community and the environment," Merkley said.

Methane | Policy & regulation

Isobel Whitcomb is a science and environmental journalist based in Portland, Oregon.

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ALERT FEATURED TOP STORY

Benton officials want landfill report to include methane concerns



Benton County resident Carrie Norris speaks to elected leaders Tuesday, Aug. 6, during a meeting of the Be expansion, I want to remind you of your obligation to represent the citizens of Benton County as opposed t company," Norris said.

Alex Powers, Mid-Valley Media

Alex Powers

n the recommendation of a Benton County committee often critical of Coffin

O Butte Landfill, and the county, elected leaders this week declined to approve an annual report about the dump until its operator adds verbiage about possible trouble ahead from federal regulators.

Landfill neighbors and opponents of Republic Services' proposed expansion of Coffin Butte have railed for months in public meetings and town hall-style seminars about the dump operator's historically slow or opaque response to complaints about methane gas.

The 30-page, high-level report before the Board of Commissioners was supposed to include an overview of complaints, dump statistics and policy changes at Coffin Butte in 2023. But it didn't discuss methane.

"Send it back to be rewritten. And this time, don't forget the methane," said Ken Eklund, who chairs the embattled county Disposal Site Advisory Committee.

Eklund and others spoke for an unusually long 40 minutes to the Benton County Board of Commissioners at a meeting Tuesday, Aug. 6, during the time set aside for anyone to speak.

Commissioner Xan Augerot said the Disposal Site committee previously vetted Republic's report "very carefully, with a lot of questions asked."

Augerot said she herself pushed for the company to include more, and more thorough, data.

“My leaning is to hear the report from Republic today but to leave the record open and not to accept the report until the Disposal Site Advisory Committee has had time to actually get their questions answered,” Augerot said.

“I agree with that,” Commissioner Nancy Wyse said.

The county is receiving advice about the landfill from several groups now that commissioners have demolished the appointed bodies meant to advise them about trash and its disposal.

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Public furor has grown since Republic Services applied in 2021 with Benton County’s land use department to expand Coffin Butte to the south, across Coffin Butte Road, near Adair Village.

Republic withdrew its expansion plans in 2022 after the county Planning Commission denied the application.

That was around the time commissioners appointed Eklund to the Disposal Site Advisory Committee.

Eklund said the county’s land use process netted around 300 complaints, and that the Disposal Site Advisory Committee is supposed to compile those complaints in an annual community concern report.

“There was an outpouring" because of the first application, Eklund said.

Commissioners empaneled a task force to determine what the local government's policy should look like ahead of Republic’s next attempt, sending some planning and trash advisers as liaisons to group it named "Benton County Talks Trash."

Except Talks Trash didn't accept public landfill complaints," "which was one of DSAC's core functions," Eklund said.

Talks Trash went well beyond its slated duration as members dug up thousands of local and state records. Along the way, the county dismissed two workgroup members who live near the dump.

Then the workgroup found Benton County had not adhered to its own policies in interacting with the private company franchised to haul trash and intern it north of Corvallis.

Workgroup participants clashed with Darren Nichols, head of the county's planning department. And commissioners suspended Eklund's committee, then permanently disbanded a related group, the Solid Waste Advisory Committee.

The county placed Nichols on administrative leave before he quit his post in late June.

Rachel McEneny, the county's top employee, confirmed in July that Nichols had resigned.

On July 19, Republic applied again to expand Coffin Butte.

Less than two weeks later, the Disposal Site Advisory Committee met for the first time in nearly a year, just a week before Tuesday's meeting when four ranking Republic Services workers sat before commissioners.

Benton County hasn't filed annual landfill reports from 2021, 2022 or 2023.

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Meanwhile, in 2022 the Environmental Protection Agency released a report that said the level of methane gas emissions independently tested at Coffin Butte is not only very concerning, it contradicted figures reported by Republic Services at the time.

A company public affairs director said Republic learned of possible EPA enforcement after a field representative for U.S. Sen. Jeff Merkley approached the company. The company received no formal notice, Republic Services' Ginger Rough said.

“We are not trying to withhold information from you,” Rough told commissioners Tuesday. “We are not trying to be inaccurate in our report.”

Rough also represented Republic during the Talks Trash process.

"We did pledge increased transparency, being cognizant that we need to be aggressive in our efforts to make the community aware of what's going on at the landfill," she said to commissioners.

An EPA spokesperson in early July told Mid-Valley Media that the agency is still investigating Coffin Butte and is “not anywhere close” to resolving its case. He would not say that penalties are pending against its operator.

“We’ve not completed our investigation. I don’t think we are going to be announcing anything any time soon,” Bill Dunlop said.

In its report, Republic mentions nine odor complaints. Users dumped about 11,150 tons more than the landfill’s 1 million-ton annual cap, according to the report.

A county employee provided another 25 complaints made locally.

There’s no mention of the 2022 EPA report when an environmental scientist recorded methane emissions well beyond explosive concentrations.

The agency clocked methane above its 500 parts per million safety threshold in 61 instances. In 21 of those, missions exceeded 10,000 parts per million.

“Republic Services was aware of the issue, so in the future it would be nice to see in the report an acknowledgement of past mistakes and maybe how you have gone to

remedy those," Wyse said to the company's representatives on Tuesday.

Augerot added that she's "really looking forward" to the company coming to the table to talk with Disposal Site Advisory Committee members.

That the company has not been able to answer to questions, "it generates a certain amount of skepticism," Augerot said, "especially in this community, where we have so many Ph.D.s and so many engineers, and they know how to look at all this."

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More Benton County news

Alex Powers (he/him) covers agri-business, Benton County, environment and city of Lebanon for Mid-Valley Media. Call 541-812-6116 or tweet @OregonAlex.

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TOP STORY EDITOR'S PICK

As I See It: The gentlefolk of the landfill



JOEL GEIER

In the parable “The Gentlemen of the Jungle” by Jomo Kenyatta, the first president of Kenya, an elephant asks to put his trunk inside a man’s hut to keep it out of the rain.

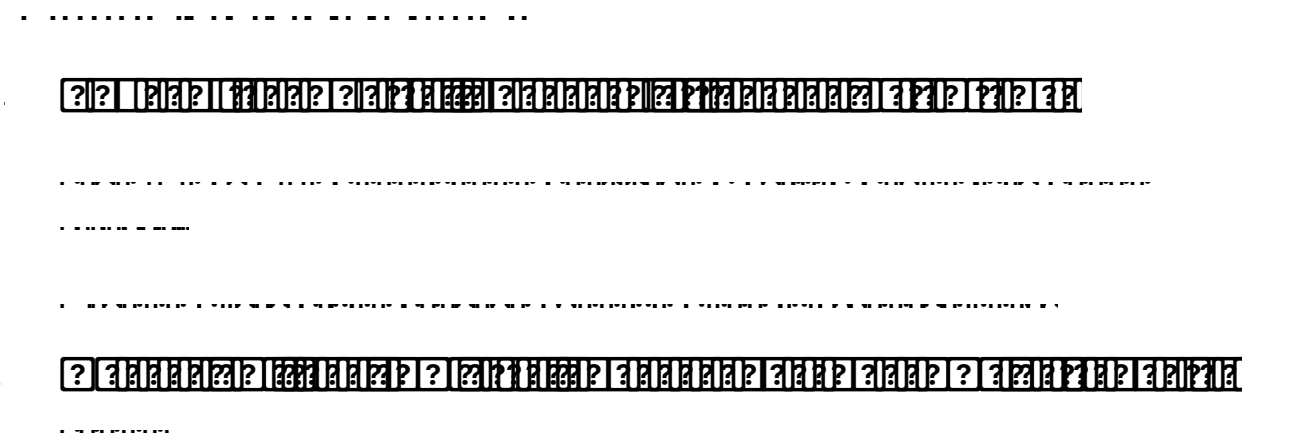
But once Mr. Elephant gets his trunk inside, he keeps pushing until he takes over

the entire hut.

Such is the situation facing Benton County, as the corporate behemoth Republic Services seeks to open a new landfill to the south of its existing landfill on Coffin Butte. Republic tried to expand southward twice before and was rejected, first in 1994 and again in 2021.

Now it's proposing "a much smaller" free-standing new landfill, but don't be fooled. Republic knows that if it can get a toehold in this new area, that will give it traction for further expansions in what will become an ever-growing mountain of trash.

In Kenyatta's tale, the aggrieved man appeals to local officials who appoint a Commission of Enquiry. But the commissioners — Mr. Rhinoceros, Mr. Buffalo, etc. — turn out to have interests aligned with Mr. Elephant's.



So, first they let Mr. Elephant speak: "I considered it necessary ... to turn the undeveloped space to a more economic use by sitting myself in it."

When the man tries to speak, the jungle commissioners tell him, "My good man, please confine yourself to relevant issues. All we wish you to tell us is whether the undeveloped space in your hut was occupied ...", and then they silence him entirely.

Here our Benton County government is already restricting avenues for public comment. It has removed dissenters from committees, and even dissolved one committee.

Lately the government realized the committee it had dissolved, the Solid Waste Advisory Council, had a defined role in county code. No problem; they swapped in a new entity, the Environmental and Natural Resource Committee, which has never previously dealt with landfill issues.

The members of this new committee have specifically been instructed not to hold any public hearings, no matter if they believe they could benefit from such hearings to inform their decision.

Residents will be allowed to testify only to the Planning Commission — and then only within narrow sidewalls of land-use criteria that were agreed on by county-appointed attorneys in concert with Republic's lawyers.

So, we can expect to hear, in some form, "Please confine yourself to relevant issues," in particular if we start to talk about the environmental issues that people are really concerned about:

- How will methane emissions affect climate?
- How will leachate from the landfill pollute the Willamette River?
- What will be the impact on groundwater, when the landfill starts to leak?

Kenyatta's story was an allegory of the colonial process in his homeland, where an outside empire imposed itself on the local society. Here we face corporate profiteerism, where an Arizona-based business empire built on trash is exploiting our community, with both tacit and overt assistance from Benton County officials.

In the story, the man finally sits down and says, "Ng'enda thi ndeagaga motegi." Or, as Kenyatta paraphrases, "You can fool people for a time, but not forever."

The people of Benton County are now awake to the motivations behind this new

landfill scheme. We will not be fooled.

Joel Geier is a hydrogeologist who works on evaluating risks of environmental contamination due to waste disposal. He grew up on a Minnesota dairy farm but has lived with his family in the Camp Adair area since 1995, and is active in prairie and grassland bird conservation efforts.

statesman journal

ENVIRONMENT

Wyden, Merkley, Hoyle call for EPA investigation into Coffin Butte Landfill



Tracy Loew
Salem Statesman Journal

Updated Aug. 8, 2024, 5:24 p.m. PT

Members of Oregon's congressional delegation are calling for the U.S. Environmental Protection Agency to complete an investigation into concerns about Coffin Butte Landfill, north of Corvallis.

"This 178-acre landfill accepts over 1 million tons of waste annually from nearly two dozen Oregon counties and southwest Washington," U.S. Sens. Ron Wyden and Jeff Merkley and U.S. Rep. Val Hoyle wrote in an Aug. 7 letter to EPA Administrator Michael S. Regan.

"Surrounding communities have long been concerned about methane leakage that contributes to fire risk and climate change, strong odors, and ultimately jeopardizes worker safety and public health," they wrote.

Merkley also has submitted an appropriations request for fiscal year 2025 that would fund a pilot project to monitor methane at Coffin Butte, according to Sophia Francia, a field representative for Merkley's office.

The landfill, near Adair, takes more than half of Marion County's municipal solid waste. Benton, Polk and Lane counties also send waste to the landfill. It's owned by Phoenix-based Republic Services, the second-largest waste disposal company in the U.S.

Need a break? Play the USA TODAY Daily Crossword Puzzle.

In October 2023, the Statesman Journal was the first to report on an EPA investigation into massive methane leaks at the landfill. In April 2024, the Statesman Journal published an investigation into worker complaints about health, safety and environmental violations at the landfill.

The lawmakers' request comes as Coffin Butte is trying for a second time to expand the landfill.

The Benton County Planning Commission unanimously denied a previous expansion application in 2021, following public testimony in opposition.

"As Republic Services and Benton County consider the potential for expansion of the landfill, it is more important than ever to have all the facts," the lawmakers wrote in their letter to Regan.

It also comes as the Oregon Department of Environmental quality is preparing to update the landfill's air quality permit, which expired a decade ago. The landfill has been allowed to continue operating under its previous permit because the company filed a timely renewal application with DEQ in 2014.

In response to an interview request, Republic Services sent the Statesman Journal a written, unattributed statement.

"Coffin Butte Landfill provides essential waste disposal services to the community, and its state-of-the-art gas collection and control system is three-times the industry standard. Since 2019, we have invested $9.4 million to upgrade the system and will invest an additional $1.2 million this year to further enhance it," the statement reads.

Methane leaks at Coffin Butte Landfill

In October 2023, the Statesman Journal reported a U.S. Environmental

Protection Agency inspection found the landfill was leaking methane at levels that exceed state and federal limits and what the landfill had publicly reported.

EPA measured methane exceeding regulatory limits 61 times during its June 2022 inspection of the landfill. Twenty-one of those exceedances measured at more than 10,000 parts per million, or 20 times the 500 ppm limit set by Oregon and the EPA.

In addition to contributing to climate change, the levels measured could cause health problems for neighbors and in some cases were high enough to potentially cause an explosion and fire, said Lisa Arkin, of the Eugene-based environmental group Beyond Toxics.

EPA officials told the Statesman Journal in April that the case still was open and likely would result in a negotiated settlement requiring changes at the landfill.

On May 1, Merkley questioned Regan, the EPA director, about the investigation during a Senate subcommittee hearing on the agency's 2025 budget request.

"This is now 23 months ago that the field inspection occurred. If you have a landfill which maxes out the instrumentation, which I think is quite rare, it should probably rise to the top of the list of places to act on," Merkley said.

Regan responded that he could not speak about an active enforcement case.

"But I can tell you that we are coordinating with the state of Oregon. It's an active case and we are laser-focused on this case," he said.

EPA conducted a follow-up inspection at Coffin Butte in June 2024 but has not released any information about its findings.

The Oregon Department of Environmental Quality attended the June 2024 inspection and will continue to coordinate with EPA on enforcement follow-up, DEQ spokesman Dylan Darling said.

EPA Region 10 spokesman Bill Dunbar declined to comment Thursday, citing the ongoing investigation.

Safety concerns at Coffin Butte Landfill

In April 2024, the Statesman Journal reported on landfill worker complaints around air and water quality and exposure to dangerous waste.

Oregon OSHA has completed two investigations into the complaints and cited the company for three "serious" violations and one "other than serious" violation.

The violations include not evaluating employee respiratory hazards, not providing proper safety training, not ensuring floors are dry and not preventing fall hazards.

The state agency recommended Coffin Butte address additional hazards workers complained about, warning that the company could be cited and fined for the items in future inspections.

OR-OSHA opened a third investigation concerning the site March 28. That investigation did not result in any citations, OR-OSHA spokesman Aaron Corvin said.

Workers say some of the concerns they've raised also could impact the landfill's neighbors.

Benton County Commission concerns about Coffin Butte

Benton County commissioners are concerned about the methane leaks, and water quality issues and worker safety, chairwoman Xan Augerot told the Statesman Journal on Thursday.

However, commissioners don't have authority over most of those issues, Augerot said.

“We’re really grateful to Senators Merkley and Wyden and Congresswoman Hoyle for elevating the issue with EPA administrator Regan,” Augerot said. “We’ll see whether that helps."

At a board meeting Tuesday, commissioners did not accept Republic Services annual report on the landfill, asking for more information about environmental monitoring.

“They omitted any mention of the EPA investigation,” Augerot said.

Commissioners ultimately will decide on the conditional use permit for the landfill’s proposed expansion.

But, Augerot said, “We cannot look at any current practices on the current site as part of our criteria. It has to be a look at the proposed action on the proposed site.”

“That makes it difficult to take into account the long-term record of the land owner and operator. But that’s the way the system is structured.”

Coffin Butte Landfill expansion plans

Coffin Butte’s proposed expansion is 50% smaller than proposed in 2021 and would take place entirely on land owned by Coffin Butte and zoned for a landfill. It would add six years of life to the landfill, about half of what was requested in 2021.

Company officials say there is less than one year of space left in the cell currently being used for disposal.

The proposal would improve, rather than close, Coffin Butte Road. That was a point of contention during the previous proposal, with neighbors saying the road could be their only escape route in the event of fire or other natural disaster.

The company also plans to expand into a bordering quarry, which would add

another 11 years, but that space is not yet ready, officials said.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

https://democratherald.com/tncms/asset/editorial/76f3b0ca-543e-11ef-ac14-d7df7ec16e97/

Letter: Two recent fires at landfill reported



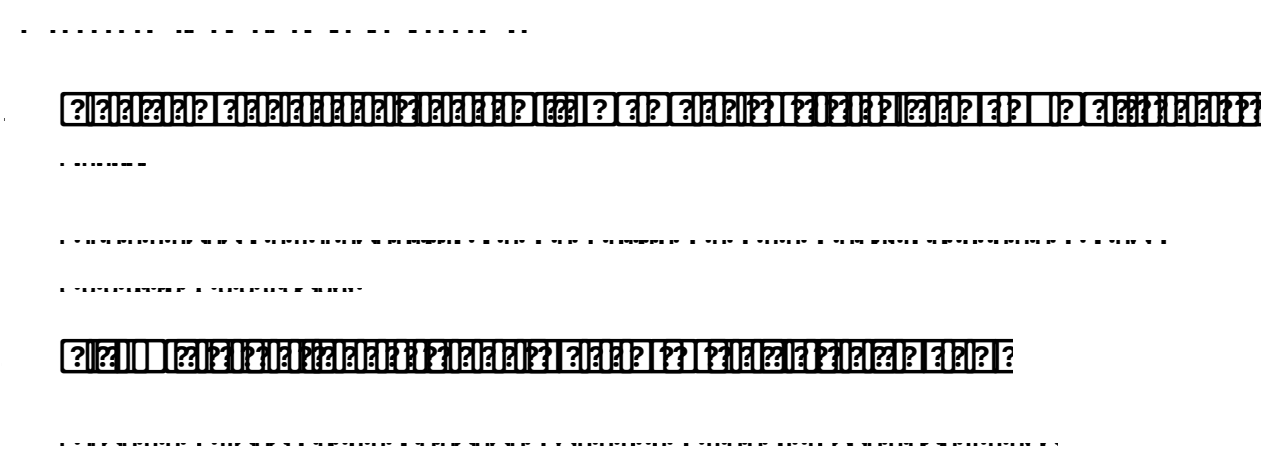
I appreciate that there has been significant attention to Republic Services' application to expand the Coffin Butte Landfill.

The consequences of this decision will affect local lives for decades, or longer. As the major source of local news, I think you should also report on the two fires that have taken place at the landfill in recent months.

As noted on the Adair Village Fire Department Facebook site, "At 7:04 p.m. Saturday, May 18, Adair Fire was dispatched to a smoke investigation at the top of

the Coffin Butte Landfill. Firefighters arrived to find burning trash damaging both hydraulic transfer truck lifts."

Just last month, KLCC news reported that "on July 24, 2024, firefighters responded to a grass fire near a flare stack which burns off methane gas from the landfill. The exact cause of the blaze is unknown. 'The obvious cause is the open flame stack that was close by,' said Adair Rural Fire & Rescue Chief Aaron Harris. 'But there's no way to corroborate that.'"



Benton County is fortunate, and should be thankful, that the Adair Village and Corvallis Fire departments responded so quickly and effectively to these fires. We all have to hope that the next fire does not ignite the "uncontrolled" methane leaks noted in this paper on Nov. 2, 2023.

I hope that you enhance reporting on these issues as the county and its citizens consider the expansion request.

Mark Henkels

Corvallis

Submit A Whistleblower Complaint (https://www.wyden.senate.gov/whistleblower-complaint)

Resources for Terminated Federal Employees (https://www.wyden.senate.gov/resources-for-terminated-federal-employees)

August 08, 2024

Wyden, Merkley, Hoyle Urge EPA to Investigate Landfill Concerns in Benton County

Washington D.C.—U.S. Senators Ron Wyden and Jeff Merkley and U.S. Representative Val Hoyle today urged the U.S. Environmental Protection Agency (EPA) to thoroughly and expeditiously complete its investigation into concerns about Republic Services Coffin Butte Landfill in Benton County.

"This 178-acre landfill accepts over 1 million tons of waste annually from nearly two dozen Oregon counties and southwest Washington. Surrounding communities have long been concerned about methane leakage that contributes to fire risk and climate change, strong odors, and ultimately jeopardizes worker safety and public health," the members wrote in a letter to EPA Administrator Michael S. Regan.

"We are aware that EPA's investigation in 2022 revealed dozens of methane leaks, a number of which reached highly flammable concentrations. We appreciate EPA Region 10's reinspection in June 2024 and its continued attention to concerns raised by our constituents. As Republic Services and Benton County consider the

potential for expansion of the landfill, it is more important than ever to have all the facts."

The full letter is below.

August 7, 2024

The Honorable Michael S. Regan Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue NW
Washington, D.C. 20460

Dear Administrator Regan,

We know the Environmental Protection Agency is in the process of an ongoing enforcement investigation of the Republic Services Coffin Butte Landfill in Benton County, Oregon, and we urge your thorough and expeditious completion of that process.

This 178-acre landfill accepts over 1 million tons of waste annually from nearly two dozen Oregon counties and southwest Washington. Surrounding communities have long been concerned about methane leakage that contributes to fire risk and climate change, strong odors, and ultimately jeopardizes worker safety and public health.

We are aware that EPA's investigation in 2022 revealed dozens of methane leaks, a number of which reached highly flammable concentrations. We appreciate EPA Region 10's reinspection in June 2024 and its continued attention to concerns raised by our constituents. As Republic Services and Benton County consider the potential for expansion of the landfill, it is more important than ever to have all the facts.

Thank you for your steadfast commitment to protecting the environmental and public health of communities in Oregon and across the nation. We stand ready to support in any way possible.

The Corvallis ADVOCATE
(https://www.corvallisadvocate.com)

GOVERNMENT: LOCAL LANDFILL SHEMOZZLE GOES FEDERAL, MARRIOTT PARKING APPEAL NIXED AGAIN, CITY PLANS WEB SERVICE OUTAGE

AUGUST 9, 2024

If there's an irony to the downtown Marriott seeking to replace an old bike shop with a few new parking spaces, it was lost on our fair burgh's city councilors as they tentatively nixed the hotel's ask at their meeting on Monday.

Originally, City staff had recommended an approval contingent on a long list of conditions, but last month the Corvallis Planning Commission voted unanimously to reject the proposal – so the hotel appealed to the City Council.

The Marriott is located on 1st Street, and they want to replace two buildings across the alley behind their hotel with 12 new parking places. They bought the buildings – one of which had housed Cyclotopia – in 2022 for $1.25 million.

The company has argued they have 176 guestrooms and meeting space for 120 with only a total of 133 parking spaces – which means they don't have enough parking for high and full occupancy. And, they have said their guests regularly complain about the lack of parking, and that their customers

don't feel safe at the suggested backup parking location, which is at the skate park and bridge area. They also said their senior citizen guests need more parking at the hotel.

Four councilors voted against a motion to reject: Napack, Cadena, Chaplen and Lytle.

Five councilors voted in favor of a rejection: Ellis, Lewis, Shepherd, Schaffer and Yee.

Among councilors, some of the arguments for allowing the project focused on supporting downtown business activity and showing support for the Marriott's investment in the downtown area. Arguments against centered on supporting bike and pedestrian safety – and that practically speaking, cars and trucks would wind up backing out of the spaces onto the sidewalk, or even the street.

Next up, City staff will prepare formal findings for the Council's final decision. After that, the Marriott could appeal to the state's Land Use Board of Appeals.

Republic Services Omits Key Info in Benton County Report

Republic Services lit a dumpster fire at Tuesday's Benton County Board of Commissioners meeting – where they submitted their 2023 Annual Hauling Report and the 2023 Annual Coffin Butte Pacific Region Compost Operational Report.

The basics: Republic's Coffin Butte landfill is being investigated by the EPA for overly high methane emissions, which they left out of their report. Also, their spokesperson said it was left out of the report because they were unaware they were being investigated when they submitted the report.

However, EPA Administrator Michael Regan said they were being investigated as early as during a May 2 hearing in Washington DC. Also, a field representative directly told Republic on June 28 they were being looked at for an enforcement action.

Anyhoo… Corvallis being an engineering town, there was plenty of public comment that was worth a listen, most all of it critical of Republic, and their landfill operation. But props to the Republic spokesfolks for keeping a straight face while talking themselves up after the big reveal that all those methane worries just happened to not make into their report to the Board, which we should note, is our community's publicly elected body.

Really, even if you don't usually view Board of Commissioners meetings, which is perfectly understandable, you really-really should view this one – click here to do that, you'll want to start at 16 minutes, 50 seconds. Even though it's two hours, we suggest listening to the public comments and the report, so think popcorn.

The Disposal Site Advisory Committee hasn't yet made any recommendations about accepting Republic's report – so the Commissioners will wait on their guidance before deciding for themselves.

But then, On Wednesday, Oregon's Congressional Delegation Chimed in: U.S. Senators Ron Wyden and Jeff Merkley and our U.S. Representative Val Hoyle urged the U.S. Environmental Protection Agency, or EPA, to thoroughly and expeditiously complete its investigation into concerns about Republic Services Coffin Butte Landfill.

In a joint letter to EPA Administrator Michael Regan, they wrote:

"We know the Environmental Protection Agency is in the process of an ongoing enforcement investigation of the Republic Services Coffin Butte Landfill in Benton County, Oregon, and we urge your thorough and expeditious completion of that process."

"This 178-acre landfill accepts over 1 million tons of waste annually from nearly two dozen Oregon counties and southwest Washington. Surrounding communities have long been concerned about methane leakage that contributes to fire risk and climate change, strong odors, and ultimately jeopardizes worker safety and public health."

"We are aware that EPA's investigation in 2022 revealed dozens of methane leaks, a number of which reached highly flammable concentrations. We appreciate EPA Region 10's reinspection in June 2024 and its continued attention to concerns raised by our constituents. As Republic Services and Benton County consider the potential for expansion of the landfill, it is more important than ever to have all the facts."

And, a Big Credible Rumor: The scuttlebutt is that Republic's application for a landfill expansion may not be complete. An outside land use planning consultant, Winterbrook Planning (https://cobentonorus-my.sharepoint.com/personal/cory_grogan_bentoncountyor_gov/Documents/hyperlink), is reviewing the application.

Legally, the County has until Friday, August 16 to determine if the application is complete and notify Republic in writing. If it's incomplete, the company will have the option to fulfill whatever is required, and then resubmit its application.

We're getting this from a high-ranking County official – but even they are saying it's a rumor, even if they're viewing it as a credible rumor.

City of Corvallis Web Services – Planned Outage

First, this has nothing to do with consumer internet services. Just making sure we're clear.

Okay, most City of Corvallis web services (vendor and employee portals, utility billing and court payments, Accela – permits and GIS/map services) will be down for maintenance from 8 pm August 13 through 4 am August 14. The City says these resources and services will not be available as the City internet access will be down for the duration. They also apologize for the inconvenience – no, really – the apology is in their press release.

Do you have a story for The Advocate? Email editor@corvallisadvocate.com (mailto:editor@corvallisadvocate.com)

(HTTPS://WWW.FACEBOOK.COM/SHARER/SHARER.PHP?U=HTTPS://WWW.CORVALLISADVOCATE.COM/2024/GOVERNMENT-LOCAL-LANDFILL-SHEMOZZLE-GOES-FEDERAL-MARRIOTT-PARKING-APPEAL-NIXED-AGAIN-CITY-PLANS-WEB-SERVICE-OUTAGE/)

(HTTPS://TWITTER.COM/INTENT/TWEET?URL=HTTPS://WWW.CORVALLISADVOCATE.COM/2024/GOVERNMENT-LOCAL-LANDFILL-SHEMOZZLE-GOES-FEDERAL-MARRIOTT-PARKING-APPEAL-NIXED-AGAIN-CITY-PLANS-WEB-SERVICE-OUTAGE/)

PREVIOUS ARTICLE (HTTPS://WWW.CORVALLISADVOCATE.COM/2024/EXPECT-OREGON-WILDFIRES-TO-BURN-UNTIL-FALLS-WET-WEATHER-SAY-FIRE-MANAGERS/)

EXPECT OREGON WILDFIRES TO BURN UNTIL FALL'S WET WEATHER, SAY FIRE MANAGERS (HTTPS://WWW.CORVALLISADVOCATE.COM/2024/EXPECT-OREGON-WILDFIRES-TO-BURN-UNTIL-FALLS-WET-WEATHER-SAY-FIRE-MANAGERS/)

NEXT ARTICLE (HTTPS://WWW.CORVALLISADVOCATE.COM/2024/CORVALLIS-CALENDAR-HAPPENING-MONDAY-TO-WEDNESDAY/)

CORVALLIS CALENDAR: HAPPENING MONDAY TO WEDNESDAY (HTTPS://WWW.CORVALLISADVOCATE.COM/2024/CORVALLIS-CALENDAR-HAPPENING-MONDAY-TO-WEDNESDAY/)

https://www.kezi.com/news/residents-environmental-groups-oppose-expansion-of-coffin-butte-landfill/article_8c201812-56b9-11ef-a0e6-a72ae181fb85.html

Residents, environmental groups oppose expansion of Coffin Butte Landfill

By: Julio Mora Rodriguez
Aug 9, 2024



Residents and environmental groups oppose expansion of the Coffin Butte Landfill by Republic Services citing health and environmental concerns.

CORVALLIS, Ore -- Over a million tons of waste are deposited every year in the Coffin Butte Landfill in Benton County. Republic Services is seeking to expand the site, but

faces stiff opposition.

Residents and environmental groups have come out against the expansion. Joel Geier is a hyrdrogeologist who lives in the area close to the landfill in north Benton County. He fears if Republic Services manages to expand the landfill, they'll continue until the whole area becomes a massive dumping ground. Geier initially moved into the area because he believed the landfill wouldn't last forever.

"They have no intention of closing it down ever. You can see there is tarps over the face of it that shows they're not planning to actually close it, that should have grass over it by now, but they just leaving it as it is now and that leaves their options open so they can keep expanding," he said.

According to the Environmental Protection Agency, they have investigated the site and

found dozens of methane leaks. The environmental group Beyond Toxics also cited issues with air pollution, most notably dust being kicked up into the air and descending on residents laced with arsenic, metals, and plastics. As a hydrogeologist, Geier worries about the ground water in the area.

"For folks down in Eugene, arsenic is a natural occurring problem in the ground water, especially around Spencer Butte, but in this area it's almost unheard of and we're getting levels of arsenic that are showing up that are really now close to what people worry about down by Eugene," he said.

The site covers 178 acres, and the high methane levels also make it vulnerable to wildfires. In a statement, Republic Services said:

"Gas collection and control system exceeds industry standards by three times. Since 2019, we have invested $9.4 million to upgrade the system and will invest an additional $1.2 million this year for further enhancements. We have implemented several improvements, including a new odor reporting portal on the landfill’s website and new enclosed flares to burn off excess methane gas more efficiently. We are also researching the latest technology, such as infrared cameras, to enhance our monitoring capabilities."

Residents and environmental groups have recommendations for the site. The prime thing is to stop sending organic waste and materials to the site. They want more sites built where metals, plastics, and food waste can be separated, Lisa Arkin, Executive Director of Beyond Toxics spoke in favor of one such site.

"And I'm really excited and proud that Lane County has committed itself to clean Lane project, which is building an advanced sorting facility." She said.

They also recommend using captured methane as a way of powering cars and homes as renewable gas.

Benton County government receives new application to expand Coffin Butte landfill

Julio Mora Rodriguez joined the KEZI 9 News team in October of 2022 as a news reporter. If you have any story ideas, you can email Julio at jrodriguez@kezi.com.

Julio Mora Rodriguez

Julio Mora Rodriguez joined the KEZI 9 News team in October of 2022 as a news reporter. If you have any story ideas, you can email Julio at jrodriguez@kezi.com.



Pfas

This article is more than **8 months old**

US landfills are major source of toxic PFAS pollution, study finds

New research shows toxic 'forever chemicals' gas may escape landfills and threaten the environment

Tom Perkins

Fri 9 Aug 2024 08.00 EDT

Toxic PFAS "forever chemicals" that leach from landfills into groundwater are among the major pollution sources in the US, and remain a problem for which officials have yet to find an effective solution.

Now new research has identified another route in which PFAS may escape landfills and threaten the environment at even higher levels: the air.

PFAS gas that emits from landfill waste ends up highly concentrated in the facilities' gas treatment systems, but the systems are not designed to manage or destroy the chemicals, and much of them probably end up in the environment.

The findings, which showed up to three times as much PFAS in landfill gas as in leachate, are "definitely an alarming thing for us to see", said Ashley Lin, a University of Florida researcher and the lead author of the study.

"These findings suggest that landfill gas, a less scrutinized byproduct, serves as a major pathway for the mobility of PFAS from landfills," the paper's authors wrote.

PFAS are a class of about 16,000 compounds used to make products resistant to water, stains and heat. They are called "forever chemicals" because they do not naturally break down and have been found to accumulate in humans. The chemicals are linked to cancer, birth defects, liver disease, thyroid disease, plummeting sperm counts and a range of other serious health problems.

As researchers have begun to understand the chemicals' dangers in recent years, the focus has largely been on water pollution, and regulators have said virtually all leachate from the nation's 200 landfills contain PFAS. But scientists are beginning to understand that PFAS air pollution is also a significant threat.

The chemicals concentrate in landfills because they are widely used across dozens of industries and are in thousands of consumer products that end up in the facilities at their lives' end. As the products decompose, the chemicals can turn into gas and be released into the air.

Much of that can be captured by landfills' gas collection systems. The captured gas in some cases is run through filters or burned off in a flare. However, PFAS are notoriously difficult to destroy, and flares are not an effective way to eliminate them.

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Typically, flares or incineration will simply break down PFAS into smaller forms of the chemicals instead of fully destroying them, and that waste will be sent into the air. For now, there is no clear picture of the levels, or how landfills can get a handle on the problem.

“That is a good question,” Lin said. “We need to understand that management aspect and what can happen with the different types of treatment technologies in place.”

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OREGON

Oregon warns Coffin Butte Landfill over methane emissions



Tracy Loew
Salem Statesman Journal

Updated Aug. 14, 2024, 8:28 a.m. PT

Oregon environmental regulators have issued a formal warning to Coffin Butte Landfill for not complying with new requirements to reduce methane emissions from the state's landfills.

Coffin Butte, located north of Corvallis, is operated by Phoenix-based Republic Services, the nation's second-largest waste disposal company. It takes more than half of Marion County's municipal solid waste.

The methane gas emission rules, which took effect in October 2021, required Coffin Butte to test emissions from its two gas flares by March 30, 2023. The flares are part of the landfill's gas collection system.

"The design of your current shrouded flare does not easily lend itself to be tested, and testing of the current flare was not completed or attempted," DEQ wrote in its warning letter, which concluded the landfill had committed a Class I violation, the most serious of three violation levels.

"In order to meet the testing requirement described above, the shrouded flare should have been fully enclosed to allow testing or replaced with a new enclosed flare. In early 2023 during multiple phone calls, DEQ informed you that you would need to install a new enclosed flare," the warning reads.

DEQ approved the company's plans to install a new, enclosed flare on Nov. 9, 2023, but that had not happened by July 10, when DEQ issued its warning.

In the warning, DEQ ordered the company to either install and operate enclosed flares by July 31 and test the flares by Oct. 31; or enclose the existing flares in a way that they can be tested, and do so by Oct. 31.

The company asked for an extension to the July deadline, saying a recent fire at the landfill destroyed some equipment needed for the enclosed flare to operate, DEQ spokesman Dylan Darling said. DEQ granted an extension until Aug. 6.

If the company doesn't perform the corrective actions, the matter is referred to DEQ's Office of Compliance and Enforcement for formal enforcement and civil penalty assessment, Darling said.

In a written, unattributed statement issued in response to the Statesman Journal's interview request, Republic Services said it has installed a new, enclosed flare and plans to test it in October. It will remove the existing flares within a few weeks, the company said.

New Oregon rules address landfill emissions

Landfills are the second-largest source of methane emissions in Oregon, accounting for about 25% of the state's total methane emissions.

In October 2021, the Environmental Quality Commission adopted new rules regulating landfill gas emissions. The rules require many landfills in Oregon to obtain an Air Contaminant Discharge Permit, to submit data on the landfill's characteristics and to conduct monitoring.

One of the specific requirements of these rules is that landfills with gas control devices must test those devices within a specified timeframe, Darling said.

"Like many landfills, Coffin Butte operates a gas control device called a flare,

which combusts excess methane and turns it into carbon dioxide — a less potent greenhouse gas. The flare must be tested to demonstrate that it can meet a 99% methane destruction efficiency," Darling said.

"The environmental consequence of Coffin Butte not timely complying with the flare testing requirement is that DEQ cannot determine whether the flare meets the methane destruction efficiency requirement," he said.

Methane leaks, worker complaints at Coffin Butte Landfill

The warning letter is the latest issue at the landfill, which is trying to expand for the second time.

In October 2023, the Statesman Journal reported on an EPA investigation that found massive methane leaks at the landfill. The EPA has not yet completed its investigation.

In April 2024, the Statesman Journal published an investigation into worker complaints about health, safety and environmental violations at the landfill. The Oregon Occupational Safety and Health Division cited the company for several of those issues.

Since then, neighbors have organized to oppose the proposed landfill expansion. In addition to concerns about the methane leaks, neighbors have complained about odors, excessive truck traffic, fire danger and possible groundwater contamination.

On Aug. 7, members of Oregon's congressional delegation called on the U.S. Environmental Protection Agency to complete an investigation into concerns about the landfill.

"This 178-acre landfill accepts over 1 million tons of waste annually from nearly two dozen Oregon counties and southwest Washington," U.S. Sens. Ron Wyden and Jeff Merkley and U.S. Rep. Val Hoyle wrote to EPA Administrator Michael S.

Regan.

The Benton County Planning Commission is expected to decide Friday whether Republic's application for a conditional-use permit to expand the landfill is complete. The decision whether to approve the expansion would be made by the Benton County Board of Commissioners.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

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Subject:	I oppose LU-24-027: reference articles and opinions in the press - 8 of 12
Date:	Thursday, May 8, 2025 2:37:56 PM
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Still more history of Coffin Butte Landfill in the press, covering many of the same issues that have come up in public testimony: PFAS, leachate, methane, EPA and DEQ investigations and actions, labor issues, Republic cover-ups of problems and information, fire hazards, misleading and dubious information about the economics of the landfill, and so on. – K



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Benton County residents report odor and fire risks at Coffin Butte landfill

KLCC | By Nathan Wilk

Published August 4, 2024 at 6:22 AM PDT

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Nathan Wilk / KLCC

The Coffin Butte landfill is permitted to accept 1.1 million tons of waste each year.

Residents in rural Benton County say they're concerned about odor and fire risk at the Coffin Butte landfill.

The site accepts over 1 million tons of garbage annually from across Oregon and Washington. It's located about 8 miles north of Corvallis along Oregon Highway 99W near the town of Adair Village.

Neighbors report experiencing frequent "bad-air days," when a strong acrid or

KLCC spoke to those community members during a tour led by the Eugene-based environmental group Beyond Toxics.

Mark Yeager lives about five miles from the landfill. He said the odor has become far more frequent over the last decade.

“This past winter, there were probably two dozen times that I would walk out on the deck and say ‘I can't go outside to run today,” said Yeager. “Or I don't think it's appropriate for me, because I really don't know what I'm breathing.”

Kate Harris, who lives in the Soap Creek community southwest of the landfill, has children who attend school in Adair Village.

“You're like, ‘oh, it's a dump day,’” said Harris, “and deciding whether or not we’re going to do recess outside, or take the kids home.”

In an unattributed statement emailed to KLCC, the landfill’s owner, Republic Services, said it provides daily coverage to its garbage, and it’s invested in state-of-the-art gas collection technology.

“We make every effort to limit on-site odors and offsite impacts,” the company wrote.



Nathan Wilk / KLCC

Soap Creek Valley resident Joel Geier said he nearly had to evacuate his home last month. He said the

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Reducing Fire Risk

On July 24, firefighters responded to a grass fire near a flare stack which burns off methane gas from the landfill. The exact cause of the blaze is unknown.

“The obvious cause is the open flame stack that was close by,” said Adair Rural Fire & Rescue Chief Aaron Harris. “But there's no way to corroborate that.”

Nearby resident Joel Geier said he nearly had to evacuate. He believes that if the fire jumped to nearby trees, it may have been just minutes before it reached his home.

“We've been aware for a while it could be a risk,” said Geier. “But when you're actually in the situation, it's extremely stressful, and you're trying to make immediate decisions on what you should grab, and are you going to have to leave some animals behind?”

Emergency responders extinguished the blaze within minutes, according to Harris. Republic said its operating manager arrived around 12 minutes after fire officials.

“We have robust monitoring and emergency management systems in place to protect employees, the community and the environment in the event of a fire,” Republic wrote in an email. “That system worked as designed.”

However, neighbors argue Republic should be doing more to monitor the area, shield the flare stacks, and reduce the density of trees on its property.

Geier said the company was slow to trim fuel on the landfill, even as the area experienced triple-digit temperatures this summer.

“Everyone in this area knows that you're supposed to mow, and not leave tall grass standing like that,” said Geier. “The fact they left that all the way into almost the end of July is a sign that they're not being diligent.”

Republic told KLCC it’s trying to prevent future fires by clearing away grass and undergrowth on its property. Company representatives have also said they’re working to comply with environmental standards.

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highly flammable concentrations. According to Republic, an unreleased EPA follow-up from June of this year also found surface emissions beyond the legal limit.



Nathan Wilk / KLCC

Completed covering at the Coffin Butte Landfill. Beneath the grass, there are filled-up garbage cells.

The Attempt to Expand

Last month, Republic submitted an application to Benton County to expand the landfill. The company said it needs more space, or the site will be full within around 13 years.

However, Harris—one of the nearby residents—said she's worried about the site's impact on efforts to expand housing in the area.

"The developer may have a hard time selling the homes and they may not be willing to expand Adair Village itself, if things go too far in the wrong direction," she said.

Geier said neighbors have long expected that the landfill would close once it was full.

"This makes us feel that this landfill is never going away, and instead their plan is just to keep expanding," said Geier. "That's really a different scenario than we were expecting when we moved here, and frankly, it makes me worry about the future of the whole neighborhood."

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expansion application. The decision could later be appealed to the Board of County Commissioners.

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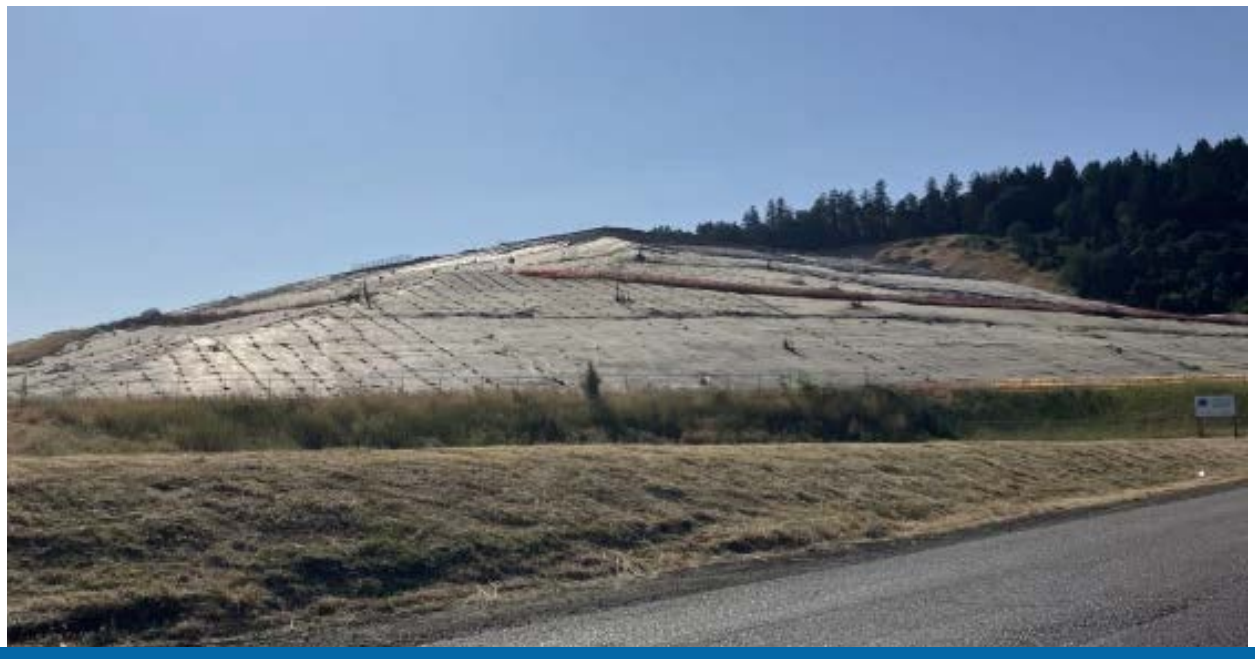


Nathan Wilk

Nathan Wilk joined the KLCC News Team in 2022. He is a graduate from the University of Oregon School of Journalism and Communication. Born in Portland, Wilk began working in radio at a young age, serving as a DJ and public affairs host across Oregon.

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Environment

Proposed landfill expansion in Benton County sees second attempt

Nathan Wilk, July 12, 2024

The owner of the Coffin Butte landfill in Benton County is once again trying to expand.

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6 August 2024

A huge landfill in Oregon is spewing methane. Its owners want to expand.

Numerous safety violations have been detected at the fast-growing landfill. It's part of a larger pattern of problems with how the U.S. handles waste.



ISOBEL WHITCOMB
Isobel Whitcomb is a science and environmental journalist based in Portland, Oregon.

In rural Benton County, brigades of waste-collection vehicles lumber through forested hills and wheat fields, each truck trailed by an acrid stench. They're hauling trash from across the western half of the state to Coffin Butte Landfill. The site accepts waste from nearly two dozen of Oregon's 36 counties, and the pile towers high enough that some locals call it "the Great Pyramid of Benton County." Joel Geier, who lives half a mile away from Coffin Butte, prefers the moniker "Coughing Butte," due to the noxious, chemical smell that sometimes emanates from it.

"It can be nauseating," Geier said. The smell, sweet like nail polish remover, reminds him of the Monsanto plant near his childhood home in St. Louis, Missouri. "There's the offensiveness of it, and the knowledge that you're breathing in something that probably

landfills emit a cocktail of chemicals known to irritate the lungs, increase the risk of cancer, and cause reproductive issues.

Over the past decade, the amount of garbage imported by Coffin Butte Landfill has more than doubled. To continue to accommodate Oregon's garbage, Republic Services, the company that owns Coffin Butte, says that the landfill needs to expand. Neighbors of the landfill, concerned about its climate impact and the community's safety, believe that there are better ways to deal with all the incoming refuse.

Coffin Butte Landfill rises between steep hillsides at the opening of Soap Creek Valley, a lush basin scattered with homes. Just a mile down highway 99 is Adair Village – a former World War II training camp where about 1,000 people now live. The roughly 3,000 residents of these two communities drive past Coffin Butte on their way to work, school, or nearby Corvallis to run errands. And in recent decades, they have seen the landfill grow in size. "It has quite literally risen into view," said Ken Eklund, a resident who moved to Soap Creek Valley in 2015. Since then, Eklund says that the landfill has doubled in height. Now, its tarped face is visible from his driveway.

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Coffin Butte Landfill is covered to prevent gases like methane from escaping, but EPA inspections found that the cover was eroding in places. (E.J. Harris)

For many residents of Soap Creek Valley and Adair Village, Coffin Butte Landfill wasn't a major concern until about a decade ago. Under the ownership of Republic Services, which had acquired Coffin Butte in 2008, the landfill was taking trash from a larger swath of Oregon – and even occasionally Washington state. Then in 2016, the closure of another regional landfill led to an unprecedented amount of waste being diverted to Coffin Butte: an addition of more than 400,000 tons over the next year. Geier and other residents started noticing more and more trucks moving through their neighborhoods. On some days the stench was unbearable. "I wouldn't let my kids play outside on those days, I wouldn't go on a walk," said Kate Harris, a resident of Soap Creek Valley.

In early 2021, Republic Services submitted an application for a permit to expand the landfill. At that point, the company was importing more than 1 million tons of trash to Coffin Butte each year – close to Benton County's 1.1-million-ton cap on waste deposited there annually. At this rate, the landfill would reach capacity within five years. The application proposed adding a second, 270-foot-tall pile of waste across Coffin Butte Road, which would buy the landfill another 12 years but close off what is the area's primary evacuation route in the event of wildfire. The proposal also sought to remove the tonnage cap on waste deposited at Coffin Butte.

In response, more than 100 community members rallied to oppose the expansion, giving testimony at hearings and writing letters to local newspapers. "The county thought that this was just going to slide in under the radar. They were completely caught off guard," Eklund said. "They were not ready for the scrutiny."

In December 2021, the Benton County Planning Commission denied the expansion request, but residents considered it only a temporary victory. Earlier this year, they began

The 2021 expansion proposal was a catalyst for activism in Benton County. Outside an old one-room schoolhouse, the tight-knit community of Soap Creek Valley began meeting to organize and share information about Coffin Butte's hazards.

When plastic, food scraps, and other waste get thrown into landfills, they're compacted, covered in dirt or ash, and then blanketed under tarps. As the waste piles up, aerobic bacteria, which live only in the presence of oxygen, consume food scraps and oxygen, producing carbon dioxide. Over time, these bacteria deplete the oxygen in the landfill, creating the perfect environment for methanogens. These microbes feed on the carbon dioxide produced by aerobic bacteria, churning out methane.

The methane and carbon dioxide created through this process make up 90 percent of the gases released by landfills, said Steve Gerritson, a board member at the Institute for Energy and Resource Management and former member of President Bill Clinton's Clean Air Advisory Committee. Neither methane nor CO_2 poses an immediate risk to human health, but the other 10 percent of landfill gases, emitted by waste more resistant to decomposition, do. Plastic water bottles emit vinyl chloride, a sweet-smelling gas associated with liver, brain, lung, and blood cancers. Cosmetics break down to form benzene, which is associated with leukemia. Finally, as the wind blows the landfill's dirt covering, tiny waste particles also get pulled along on the breeze, including heavy metals and dioxins. "These are very dangerous to human health," said Gerritson. "They're not easily controlled." Multiple studies have found elevated rates of cancer and reproductive complications among people living near landfills.

As the residents fighting the Coffin Butte Landfill expansion researched these effects, they turned to environmental nonprofit Beyond Toxics, based in the nearby city of Eugene. Beyond Toxics began setting up air-quality monitors around houses near the landfill to track emissions of nitrogen dioxide, or NO_2. In the short term, this gas, a byproduct of methane combustion, can cause respiratory irritation, increasing the risk of infections and asthma. In the long term, chronic exposure to NO_2 emissions can increase the risk of developing chronic lung disease. The monitors recorded NO_2 concentrations as high as

working near the landfill. One concerning discovery: Operators of Coffin Butte were using ash from a nearby waste incinerator as daily cover for the landfill. This practice isn't inherently unsafe, according to Philipp Schmidt-Pathmann, founder and CEO of the Institute for Energy and Resource Management, a nonprofit that advocates for sustainable waste management. However, the Oregon Department of Environmental Quality safety protocol states that landfill cover should be wetted down before application to prevent particulates from becoming airborne. Beyond Toxics found that landfill operators were skipping this step – photo and video evidence showed plumes of ash blowing from the landfill.

"The problem with incinerator ash is it's full of heavy metals," said Mason Leavitt, a cartographer and GIS technician at Beyond Toxics. "These can accumulate in the environment over time." Another airborne waste product detected at the landfill was dry fiberglass dust. "It can cause microtears in your lung tissue," Leavitt said. "It's technically not a hazardous substance, but it's a huge concern for workers and ... anyone working nearby."

In a statement to Canary Media, Republic Services noted that incinerator ash is approved as landfill cover by the Oregon DEQ and that it arrives at Coffin Butte in a wetted-down, cement-like form. "It is not an airborne, flyaway material," the statement read.

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The landfill viewed from Coffin Butte Road, Soap Creek Valley's primary evacuation route in case of wildfire. (Isobel Whitcomb)

Robert Orton, a former mechanic at Coffin Butte Landfill, has experienced acute health effects from exposure to waste and its byproducts: breathing issues, skin and eye irritation, rashes, and chemical burns. He says that poor handling of waste contributed to these unsafe conditions. Typical safety protocol involves pressure-washing equipment, which becomes caked in waste, on top of the landfill each day. That location is critical to containing harmful contaminants. However, Orton says that mechanics at Coffin Butte were instructed to wash the equipment at their shop to avoid wetting down the landfill and producing runoff that Republic Services would then have to remediate. Trash and human feces accumulated on the unlined and uncovered soil next to the shop. “There was no way to contain these things within the shop floor. There was no procedure for it,” Orton said. (Republic Services denies that trucks are cleaned on unlined soil, stating that all equipment is pressure-washed atop the landfill.)

In 2022, an EPA inspection found explosive levels of methane at Coffin Butte Landfill. While the federal limit for methane concentrations is 500 parts per million, the EPA reported 21 readings exceeding 10,000 parts per million.

Orton said the unusually high readings were likely due to the large volume of waste being collected and the lack of maintenance to the landfill’s methane-extraction system – a network of pipes running through the landfill that pumps methane and other gases to flares. Waste clogs the extraction system, and over time, as the contents of the landfill

methane indicated a major fire hazard. Fire isn't unusual at Coffin Butte – the last one took place this May. So far, fires have remained isolated to the landfill, but residents of Soap Creek Valley fear that the increasing severity of wildfire conditions in Oregon could cause one of these blazes to spread to the surrounding hills. "We're in a valley with limited ways out," Eklund said. He worries that if the landfill caught fire, Coffin Butte Road would be impassable due to flames and toxic smoke from burning waste. "It's a nightmare scenario."

Republic Services denies many of the criticisms raised by residents, including claims that its gas-collection system is poorly maintained. In a February 2024 memo, Director of Public Affairs Ginger Rough wrote that Coffin Butte has three times more gas-collection wells than industry best practices and that Republic Services has invested $7 million since 2019 to upgrade and expand the gas-collection system, including 57 new wells and 22,000 new feet of piping. She added that the company planned to add 4,500 more feet of piping in 2024.

However, the memo didn't alleviate residents' concerns. "None of these address the landfill's known problem with methane, which is … *it's leaking out of everywhere*," Eklund told Canary Media by email. "The large number of gas collection wells is just evidence that the landfill has a methane problem that they've been working to fix."

Carbon Mapper, a tool that tracks CO_2 and methane emissions, has detected plumes of methane over Coffin Butte exceeding 1,000 kilograms per hour. A plume exceeding even 100 kilograms per hour is designated by the EPA as a "super-emitter event," said Katherine Blauvelt, the circular-economy campaign director for Industrious Labs, a nonprofit working to clean up heavy industry.

disturbing results."

In the case of Coffin Butte, inspectors didn't just find explosive methane levels, they found malfunctioning extraction systems and eroding covers. Similar violations have repeatedly been discovered elsewhere. At Brent Run Landfill outside Flint, Michigan, an EPA inspector detected failures in the gas-extraction system and 19 methane leaks exceeding EPA limits. After an expansion of Los Angeles County's Chiquita Canyon Landfill, an EPA inspection uncovered 14 violations of national emissions standards, including failure to maintain the gas extraction system leading to the release of hazardous air pollutants. An Industrious Labs analysis published in May examining landfills across eight states found that nearly 96 percent of EPA inspections reported methane emissions exceeding the safe limit of 500 parts per million.

The EPA has committed to addressing these widespread regulatory failures – on July 23, the agency announced that it would update emissions standards for landfills in 2025. But tighter emissions standards don't address a major root cause of the problem.

There are financial incentives for landfill operators to minimize maintenance costs while bringing in more waste, says Schmidt-Pathmann of the Institute for Energy and Resource Management. "Waste is a profit-oriented business in the U.S.," he added. For landfills like Coffin Butte, more waste means more revenue. According to Beyond Toxics' Leavitt, Coffin Butte Landfill trucks in 30 percent of Oregon's market share of waste. Less than 6 percent of that waste originates in Benton County. Some municipalities like Benton County, which receives compensation from Republic Services for hosting the landfill, also have a financial incentive to maintain landfills. "It pays the bills," Schmidt-Pathmann said.

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Coffin Butte Landfill viewed from overhead, with Soap Creek Valley in the background. (E.J. Harris)

Activists believe there are alternatives to expanding Coffin Butte – and to landfills in general. Schmidt-Pathmann points out that most U.S. municipalities have little infrastructure in place to properly sort waste. As a result, recyclable materials easily become contaminated and wind up in landfills. But other countries, such as Germany and the Netherlands, have successfully implemented waste-sorting systems that have decreased the amount of waste disposed of at landfills to just 1 percent, while some German cities have achieved a zero-waste designation. A few municipalities in the United States are following that example.

In December 2023, Lane County, Oregon, which neighbors Benton County, voted to build a new resource recovery facility that will sort garbage, comingled recycling, and organic waste to produce biogas and marketable recycled materials. Advanced equipment will be able to recover recyclables that would otherwise head to the landfill. According to Lane County, it will be "the most technologically advanced waste processing facility in the country," diverting an estimated 80,000 tons from the county's landfill annually. If Benton County adopted this approach, the Coffin Butte expansion wouldn't be necessary, Beyond Toxics' Leavitt pointed out.

The 2024 application for expansion of Coffin Butte Landfill appears to take into

Schmidt-Pathmann believes it's in Benton County's best interest to consider the long-term costs – both monetary and nonmonetary – of hosting Coffin Butte. Long after that landfill runs out of space, it will need to be managed. "You will have to maintain a landfill forever. It's like taking a loan from the bank without ever planning to pay it back," Schmidt-Pathmann said. "At some point, the bank – or the environment – will come collecting."

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ALERT FEATURED TOP STORY

Coffin Butte mechanics still seeking adequate health care from Republic



Signs pointing residents toward the landfill with patches of snow still visible at the Coffin Butte Landfill after several days of impassable roads in Corvallis after a winter storm in January.
Jess Hume-Pantuso, Mid-Valley Media

Kosiso Ugwuede

Several bargaining meetings later, and the Coffin Butte Landfills' seven-man heavy-duty equipment mechanics have failed to reach an acceptable health care insurance agreement with Valley Landfills Inc., a subsidiary of the trash

company, Republic Services, which runs the landfill.

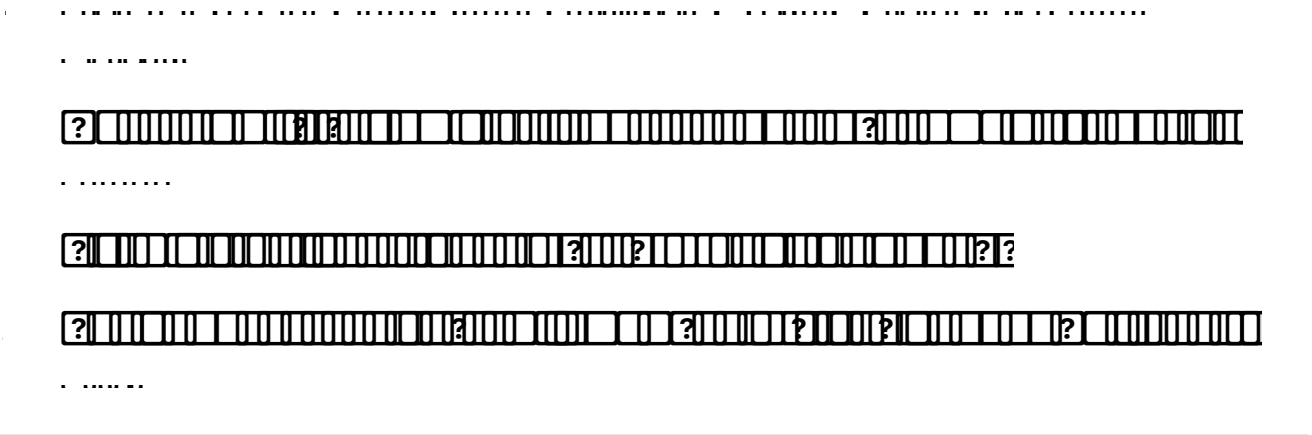
Last September, the mechanics embarked on an indefinite strike in protest of what they alleged were unsafe working conditions and unfair labor practices.

A Place to Sleep, episode 3: Corvallis

The employees make diesel, hydraulic and electrical repairs, as well as do welding and fabrication on Caterpillar D-9 bulldozers, Caterpillar compactors, and Caterpillar wheel-loaders, which are used for moving and compacting the landfill waste.

The strike, which lasted about two months, included a rally which drew Oregon House Speaker Dan Rayfield and several union leaders in attendance.

As an "olive branch," the mechanics returned to work last November after some improvements were made to their working conditions while negotiations continued with the company.



During a Jan. 3 bargaining meeting, the mechanics were presented with a potential new contract by Valley Landfills. It included a 17% wage increase spread out over a five-year period but failed to adopt the health care insurance plan offered by the International Union of Operating Engineers Local 701, which the mechanics joined after an election last year.

Union spokesperson Aurora Biggers said the union did not recommend the ratification of the contract, and when it was brought to a vote by the mechanics, it was unanimously rejected.

The family health care plan the union has offered the mechanics is a "self-insured" plan which adopts the same guidelines as Premera Blue Cross Blue Shield, according to Biggers.

Valley Landfills' health care insurance offer is through UnitedHealthcare which severed ties with Samaritan Health Services last September, impacting about 18,000 patients mostly in the mid-Willamette Valley.

Mechanics and union representatives have said that the company's plan is not only unaffordable, it does not offer the mechanics accessible and robust health care services that address the contaminants they are exposed to at the dump site on a daily basis.

To receive medical attention, mechanics now have to drive an hour to reach eligible providers, Biggers said in a statement.

"Medical care in the area is critical," Robert Orton, one of the landfill's heavy-duty mechanics, said via phone. But colleagues are coming in sick, forgoing or delaying the drive to Eugene or Salem to access health care services.

According to the union's representatives, the monthly premium for the mechanics excluding vision and dental care costs $2,020.43. A spokesperson for Republic Services said the cost is less than $1,000 per month.

Deductibles and out-of-pocket costs are also more expensive on the company's UnitedHealthcare plan compared to the union's self-packaged insurance, according to the union's representatives.

The union has said that the company stands to save money if it allows the mechanics to adopt the union's health care plans. Everyone at the bargaining table agrees that the union's insurance offers robust care at lesser costs, Orton said, "but even after admitting that, they say 'no'."

Republic Services, when contacted via its spokesperson, declined to respond to questions regarding health care sticking point between the union and the company.

Aside from the health care insurance, Orton said the last hurdle for the mechanics remains negotiating a bump in their wages, enough to get the mechanics to the lower end of the standard rates obtainable in the industry.

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It is unclear if the mechanics will return to the picket lines, but Orton said: "Nothing is off the table at this time," adding, "Our families, ourselves, our co-workers, we deserve to be healthy."

Editor's Note: This article has been updated to clarify that the 17% wage increase was spread out over a five-year period, and to include the monthly premium reported by Republic Services.

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Kosisochukwu Ugwuede (she/her) covers the cities of Corvallis, Philomath & Millersburg. She can be reached via e-mail at [redacted] or by phone via 541-812-6091

The New York Times https://www.nytimes.com/2024/03/28/climate/landfills-methane-emissions.html

'Garbage Lasagna': Dumps Are a Big Driver of Warming, Study Says

Decades of buried trash is releasing methane, a powerful greenhouse gas, at higher rates than previously estimated, the researchers said.



By Hiroko Tabuchi

Published March 28, 2024 Updated March 31, 2024

They're vast expanses that can be as big as towns: open landfills where household waste ends up, whether it's vegetable scraps or old appliances.

These landfills also belch methane, a powerful, planet-warming gas, on average at almost three times the rate reported to federal regulators, according to a study published Thursday in the journal Science.

The study measured methane emissions at roughly 20 percent of 1,200 or so large, operating landfills in the United States. It adds to a growing body of evidence that landfills are a significant driver of climate change, said Riley Duren, founder of the public-private partnership Carbon Mapper, who took part in the study.

"We've largely been in the dark, as a society, about actual emissions from landfills," said Mr. Duren, a former NASA engineer and scientist. "This study pinpoints the gaps."

Methane emissions from oil and gas production, as well as from livestock, have come under increasing scrutiny in recent years. Like carbon dioxide, the main greenhouse gas that's warming the world, methane acts like a blanket in the sky, trapping the sun's heat.

And though methane lasts for a shorter time in the atmosphere than carbon dioxide, it is more potent. Its warming effect is more than 80 times as powerful as the same amount of carbon dioxide over a 20-year period.

The Environmental Protection Agency estimates that landfills are the third largest source of human-caused methane emissions in the United States, emitting as much greenhouse gas as 23 million gasoline cars driven for a year.

But those estimates have been largely based on computer modeling, rather than direct

measurements. A big reason: It can be difficult and even dangerous for workers with methane "sniffers" to measure emissions on-site, walking up steep slopes or near active dump sites.

Organic waste like food scraps can emit copious amounts of methane when they decompose under conditions lacking oxygen, which can happen deep in landfills. Composting, on the other hand, generally doesn't produce methane, which is why experts say it can be effective in reducing methane emissions.

For the new study, scientists gathered data from airplane flyovers using a technology called imaging spectrometers designed to measure concentrations of methane in the air. Between 2018 and 2022, they flew planes over 250 sites across 18 states, about 20 percent of the nation's open landfills.

At more than half the landfills they surveyed, researchers detected emissions hot spots, or sizable methane plumes that sometimes lasted months or years. That suggested something had gone awry at the site, like a big leak of trapped methane from layers of long-buried, decomposing trash, the researchers said.

"You can sometimes get decades of trash that's sitting under the landfill," said Daniel H. Cusworth, a climate scientist at Carbon Mapper and the University of Arizona, who led the study. "We call it a garbage lasagna."

Many landfills are fitted with specialized wells and pipes that collect the methane gas that seeps out of rotting garbage in order to either burn it off or sometimes to use it to generate electricity or heat. But those wells and pipes can leak.

The researchers said pinpointing leaks doesn't just help scientists get a better picture of emissions, it also helps landfill operators fix leaks.

Overseas, the picture can be less clear, particularly in countries where landfills aren't strictly regulated. Previous surveys using satellite technology have estimated that globally, landfill methane makes up nearly 20 percent of human-linked methane emissions.

"The waste sector clearly is going to be a critical part of society's ambition to slash methane emissions," said Mr. Duren of Carbon Mapper. "We're not going to meet the global methane pledge targets just by slashing oil and gas emissions."

A growing constellation of methane-detecting satellites could provide a fuller picture. Last month, another nonprofit, the Environmental Defense Fund, launched MethaneSat, a satellite dedicated to tracking methane emissions around the world.

Carbon Mapper, with partners including NASA's Jet Propulsion Laboratory, Rocky Mountain Institute, and the University of Arizona, intends to launch the first of its own methane-tracking satellites later this year.

Hiroko Tabuchi covers the intersection of business and climate for The Times. She has been a journalist for more than 20 years in Tokyo and New York.

A version of this article appears in print on , Section A, Page 16 of the New York edition with the headline: Dumps Are Big Drivers of Warming, Study Says

RESEARCH ARTICLE | METHANE EMISSIONS

Quantifying methane emissions from United States landfills

DANIEL H. CUSWORTH, RILEY M. DUREN, ALANA K. AYASSE, RALPH JIORLE, [...], AND SUSAN THORNELOE +12 authors Authors Info & Affiliations

SCIENCE • 28 Mar 2024 • Vol 383, Issue 6690 • pp. 1499-1504 • DOI: 10.1126/science.adi7735

6,994 33 CHECK ACCESS

Editor’s summary

Methane is the most important trace greenhouse gas after carbon dioxide, and anthropogenic emissions account for more than half of the global total. Landfills containing solid waste are potentially major sources of methane, but their importance has remained poorly constrained. Cusworth *et al*. report data gathered by airborne imaging spectrometers from about 20% of open US landfills to show that considerable point source emissions can be detected at a majority of sites. These results underline the need for better monitoring of landfill emissions to help guide climate change mitigation policy. —H. Jesse Smith

Abstract

Methane emissions from solid waste may represent a substantial fraction of the global anthropogenic budget, but few comprehensive studies exist to assess inventory assumptions. We quantified emissions at hundreds of large landfills across 18 states in the United States between 2016 and 2022 using airborne imaging spectrometers. Spanning 20% of open United States landfills, this represents the most systematic measurement-based study of methane point sources of the waste sector. We detected significant point source emissions at a majority (52%) of these sites, many with emissions persisting over multiple revisits (weeks to years). We compared these against independent contemporaneous in situ airborne observations at 15 landfills and established good agreement. Our findings indicate a need for long-term, synoptic-scale monitoring of landfill emissions in the context of climate change mitigation policy.

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Supplementary Materials

This PDF file includes:

Materials and Methods

Supplementary Text

Figs. S1 to S8

References (*31*, *32*)

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Other Supplementary Material for this manuscript includes the following:

Carbon Mapper Emission Data

SA Data

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BY YUYANG DONG, YUTO KINOSHITA, *ET AL.*

Pancreatic cancer–restricted cryptic antigens are targets for T cell recognition

BY ZACKERY A. ELY, ZACHARY J. KULSTAD, *ET AL.*

TABLE OF CONTENTS >

LATEST NEWS

NEWS | 8 MAY 2025

AI predicted the next pope. Did it get it right?

NEWS | 8 MAY 2025

Bronze Age leprosy hitched rides along ancient copper and pottery trade route

SCIENCEINSIDER | 7 MAY 2025

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As I See It: Coffin Butte Landfill expansion

Republic Services may soon seek to expand the Coffin Butte Landfill.

Benton County citizens must carefully consider whether the facility's benefits outweigh its costs and risks. We should not consider opposition to the expansion as mere NIMBYism. This is our place, our home.

We are still discovering new problems related to the landfill, such as previously unrecognized methane emissions.

Meanwhile, Benton County officials seem more concerned with business arrangements than the ongoing and unending impacts of the facility. By contrast, neighboring Linn County officials listened and responded to their residents in a similar situation.

There is not enough room in a year's worth of this newspaper to fully explore the costs, risks and benefits. The "Benton County Talks Trash" final report's historical section, particularly pages 21 and 22, provides a useful perspective on how we got to this point. This report is available through the county's website.

Ultimately, Benton County residents bear the costs vis-à-vis property values, road conditions and litter cleanup related to waste transportation, as well as the risks associated with liquid and gas leakage, the management of leachate, and possible fires (as happened in the past here) — and earthquakes.

In exchange, Benton County government receives fees from Republic Services, between $2.5 million to $3.5 million per year. County officials seem to place this revenue and the company's interests foremost.

The Benton County Talks Trash report, which was reviewed by Republic Services and county staff, states: "The 2020 franchise agreement over landfill operations enhanced the financial incentive for the county to support increased solid waste intake" (page 37).

County staff justified these questionable incentives partially because Republic Services' "ability to pay higher fees was dependent on reducing cost or increasing capacity" (page 38). For perspective, Republic Services itself reported its net income for 2022 was $1.5 billion, or 11.2% of revenue.

The focus here should be on the interests of Benton County residents. Criticizing the opposition to expansion as simply NIMBYism is a distraction, and minimizes the current and permanent costs and risks the landfill poses.

Benton County's elected officials and staff should prioritize citizen interests before those of Republic Services or the refuse needs of the Metro area. We need to develop responsible policies regarding our waste, about 12% of the content placed in Coffin Butte.

We should work in collaboration with regional governments to reduce and properly dispose of local waste. Our recent contract with Republic Services that raised the limit to 1.1 million tons per year does not reflect local or regional

demands, but Republic Services' opportunities to expand its market.

Meanwhile, Linn County official responded strongly to the concerns of local farmers regarding how specific corporate poultry farms could destroy their quality of life and, possibly, their economic livelihood.

As this newspaper reported on Dec. 13, Linn County officials respected the NIMBY interests of their residents. Linn County legislators pushed state legislation enabling local governments to require setbacks on confined animal feeding operations.

Then Linn County commissioners passed a 1-mile setback requirement, effectively killing the current Foster Farms proposals and greatly limiting future ones. Linn County officials placed the interests of their citizens ahead of those of Foster Farms. The county will forego some property taxes, employment and other revenues as a result.

Benton County officials should take a cue from Linn County regarding their priorities. Let's extricate ourselves from a pattern of waste disposal that undervalues Coffin Butte Landfill's present and permanent local environmental impacts and risks, and the associated reduced property values.

Mark Henkels

Mark Henkels is a longtime resident of the Lewisburg area. He has taught public policy and administration at Western Oregon University since 1988, with a specialization in Oregon politics and government.

From: Virginia Scott
To: Benton Public Comment
Subject: LU-24-027: Information to add to the record regarding Number of People Opposed to the Landfill Expansion
Date: Sunday, May 4, 2025 6:18:59 PM

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Dear members of the Planning Commission and Community Development Department staff:

Please enter the the information below into the record for LU-24-027:

Benton County Residents Largely Oppose the Landfill Expansion

On Thursday May 1, 2025 during Republic Services testimony to the Planning Commission (2:03:45 time marker on the recording), Brian Rupe, the Area VP, Northwest from Republic Services "reminded" the planning commission members that, when considering the opposition comments, they need to keep in mind that only 0.2% of the Benton County population submitted comments in opposition and that the Planning Commission should remember the rest of the Benton County residents.

Rupe's statement has an unstated assumption, which is, *people who aren't being vocal don't agree with VNEQS*, or conversely are in favor of Republic's landfill expansion. There is no evidence for this.

In real life, it's a rule of thumb that for each person taking action, there are many behind them who agree, but are not taking visible action, for various reasons. Each activist is the "tip of an iceberg". Let's assume for our purposes that for every person taking action on the landfill issue, there are 20 who agree with them.

If we assume 20 behind the scenes supporters for each vocal supporter, then there are 40 people in Benton County who are pro-expansion and 6000 people who are anti-expansion. (Assuming the number of people active on the anti-landfill side is 300). (The pro side is only 2 people, since I've excluded the pro-expansion person who lives in Lincoln County.)

Along those lines, if you think that three-quarters of the people in Benton County don't care one way or another, then you have 24,725 who do care. And if we apply the percentages established above, that means that 24,560 of the people who care and do have an opinion, are people who are against the landfill expansion.

Benton County Population: 98,899 (2024)
Corvallis Population: 61,087 (2023?)

Below are the "group" testimonies that I am aware of, who are testifying as groups against the landfill expansion, and the number of people represented by each. You will note that these numbers are not totaled, as I am aware that, with the exception of the political parties where

voter registration limits an individual to one party, citizens may be part of several groups. The point in this table is that one comment does not equal one person in all cases, and that several comments were submitted on behalf of a group and its members in opposition to the landfill expansion.

Benton County Democrats Resolution (Registered Democrats in Benton County)	25,735
Benton County Republicans Resolution (Registered Republicans in Benton County)	12,242
Green Party Resolution (Registered Green Party in Benton County)	288
Mid-Willamette Bird Alliance	300
Marys Peak Group – Oregon Chapter of the Sierra Club	58,000
League of Women Voters – Corvallis	143
Willamette Broadband – Great Old Broads	300
VNEQS Petition Opposing the Landfill Expansion	1,300
Citizens registered for Oral Testimony (Air Table 5/2/25 3:57 PM)	63
Written Testimony submitted (Per Rupe)	200

Individual People Registered to Testify in Favor of the Expansion	2

Fools figure, and figures fool, but in this instance and by any manner in which these numbers are represented, the data illustrates strong and broad opposition to the landfill expansion.

Thank you for taking this information into consideration for your deliberations.

Yours sincerely,
Virginia Scott
37016 Soap Creek Road
Corvallis, OR 97330
:

From:	Ken Eklund
To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 6 of 12
Date:	Thursday, May 8, 2025 2:36:14 PM
Attachments:	writerguy-cube2.png

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Some more history of Coffin Butte Landfill in the press, covering many of the same issues that have come up in public testimony: PFAS, leachate, methane, EPA and DEQ investigations and actions, labor issues, Republic cover-ups of problems and information, fire hazards, misleading and dubious information about the economics of the landfill, and so on. – K

Ken Eklund, writerguy

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https://gazettetimes.com/news/local/business/employment/article_abb4c5f2-6951-11ee-b1de-e7cb9266d4ca.html

ALERT FEATURED TOP STORY

Union leaders, House Speaker show support for Coffin Butte mechanics at rally



Mechanics, fellow employees, and community members lined the sidewalk in front of Republic Services in s

Jess Hume-Pantuso, Mid-Valley Media

Kosiso Ugwuede

Striking Coffin Butte mechanics were joined by several union leaders, elected officials and concerned community members at a rally on Thursday, Sept. 12,

in front of the Corvallis Republic Services office.

Carrying placards, with an inflatable "Scabby the Rat" mascot standing guard, a small group came out in support of the seven heavy duty mechanics who have been striking since Sept. 11 at various locations around the Coffin Butte Landfill.

A Place to Sleep, episode 2: Albany, part II
Mid-Valley Media

The mechanics — who operate and maintain machinery used in moving and compacting the landfill — are protesting alleged unfair labor practices and unsafe work environment by Valley Landfills Inc. a subsidiary of the waste management company, Republic Services, which operates the Benton County-owned facility.

[illegible]

[illegible]

Since November 2022, the mechanics, who unanimously voted to join the International Union of Operating Engineers Local 701, have been in negotiations with the company to review their working conditions and wages.

According to one mechanic, Troy Paul, the negotiations were productive until conversations shifted into economic benefits, including pensions, wages and health insurance, which remains the knottiest issue on the table.

Jacob Stallings, attorney for Local 701, said last month that the company is rejecting the mechanics' proposal which would allow them to access insurance provided by the union. The plan offers them and their families more benefits for less money, an obvious win-win, he said.

An inflatable rat wielding a large banner highlighting the differences between the EPO900 United Healthcare Family Plan and I.U.O.E Family Healthcare Plan

Jess Hume-Pantuso, Mid-Valley Media

So far, Valley Landfills has responded to the demands of the mechanics with union-busting behavior, including intimidation, retaliation and canceled bargaining sessions, Stallings said last month.

"These workers have been demanding adequate and affordable health care, while being exposed to toxic chemical and dangerous machinery," Graham Trainor, Oregon chapter president of the AFL-CIO, said at the Thursday rally.

"It is our duty as Oregon labor to stand strong, shoulder-to-shoulder with them in this fight for however long it takes," Trainor said. "Whether it's a group of seven workers or 7,000, their fight matters."

- ---.. -------

Republic Services, when contacted repeated its earlier statement to Mid-Valley Media, saying via email: "Republic Services is in contract

negotiations with the union representing six maintenance technicians at our landfill in Benton County.

Graham Trainor, Oregon chapter president of the AFL-CIO, speaks at a rally for striking mechanics was held outside of the Republic Service office building, 110 NE Walnut Blvd. in Corvallis on Thursday, Oct. 12, 2023.

Jess Hume-Pantuso, Mid-Valley Media

"We respect the rights of our employees to engage in collective bargaining and look forward to reaching a fair and competitive contract that is beneficial for our employees, our customers, and our company."

Questions about the tenuous health insurance negotiations went unanswered.

Ed Eby, another mechanic who has been with the company for three years and on the maintenance unit for a year, said that so far, it has felt like the company wants to look the other way and ignore the mechanics.

"Stuff we're exposed to is just terrible, and then we take it home to our families who then get sick," said Lorne Nash, another mechanic who joined the company about a half-month before the strike began.



Rob Perdue gives a quick interview about the rally

regarding Republic Services and what comes next
for the mechanics on strike.

Jess Hume-Pantuso, Mid-Valley Media

"We don’t have the compensation to be able to afford to go to the doctor and when we have to go, it’ll just cripple us," Nash said.

He said he believes the pushback from the company stems from a lack of appreciation as well as a show of power. Without the backing of the union, Valley Landfills can exert control over the mechanics and keep them working in unsafe conditions, he added.

"We all understand that there is risk involved with our job, but some of that risk can be mitigated. But they refuse to," Nash said.

"Whether we’re breathing it in or laying down in it, we’re always exposed to something," said Logan Carter, who has been at the company for a year.

The mechanics, who work 10-hour shifts, said that they were exposed to all kinds of contaminants one might imagine results from a dump. Without a decontamination facility, the mechanics work only with basic personal protective equipment.

.

Paul accused the company of valuing profits over people and being solely focused on attracting more trash to the landfill.

"As long as the money is flowing in then they don’t really care, and that needs to change," Paul said at the Thursday rally.

Oregon House Speaker Dan Rayfield, who was at the rally, expressed his support for the striking mechanics.

"It can feel alone being on the picket line," Rayfield, D-Corvallis, said during brief remarks. "As someone who lives in this community, we appreciate what you do for this community, and we appreciate what you're fighting for."

Rayfield and a few colleagues have written to Republic Services in support of the mechanics' demands.

"Because having a fair contract is not an option and having safe workplace conditions especially in Oregon is not an option," Rayfield said.

Other elected officials at the event included state Sens. James Manning, D-Eugene, and Deb Patterson, D-Salem. Representatives and leaders from local chapters of the AFL-CIO and United Auto Workers were also at the rally.

"It's incredible to see the support that we have," Carter said about the turnout.

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"Labor has to support labor, that's what it's all about," Rob Perdue, UAW Local 492 president, said. "An injury to one is an injury to all."

Perdue and Local 492 have been striking in Beaverton for 21 days after UAW President Shawn Fain asked the unit to join the ongoing auto worker strike against Detroit car makers Stellantis, Ford and GM.

"It's kind of sad but it seems to be the norm over the last 20 or 30 years," Perdue said of the manner in which billion-dollar companies treat their workers.

"We've seen that companies have their investors and interests in mind more than their workers," Perdue said.

- Coffin Butte landfill mechanics on strike
- Who repressed speech at Coffin Butte event?
- Benton County commission unanimously rejects Coffin Butte landfill expansion plan
- Republic Services appeals county decision on Coffin Butte landfill expansion
- Republic Services pulls appeal on Coffin Butte landfill expansion
- Benton dump findings take shape
- More Benton County news
- More Corvallis news

Kosisochukwu Ugwuede (she/her) covers the cities of Corvallis, Philomath & Millersburg. She can be reached via e-mail at [redacted] or by phone at 541-812-6091

SPOTLIGHT

Communities can't recycle or trash disposable e-cigarettes. So what happens to them?

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. . ..

WASHINGTON — With the growing popularity of disposable e-cigarettes, communities across the U.S. are confronting a new vaping problem: how to safely get rid of millions of small, battery-powered devices that are considered hazardous waste.

For years, the debate surrounding vaping largely centered on its risks for high school and middle school students enticed by flavors like gummy bear, lemonade and watermelon.

But the recent shift toward e-cigarettes that can't be refilled has created a new environmental dilemma. The devices, which contain nicotine, lithium and other metals, cannot be reused or recycled. Under federal environmental law, they also aren't supposed to go in the trash.

Law enforcement members of New York Sheriff's Joint Compliance Task Force (SJCTF) confiscate and bag illegal vaping products, during raid of a tobacco shop, Wednesday Sept. 27, 2023, in New York. Communities across the U.S. are confronting a new vaping problem: how to get rid of millions of disposable e-cigarettes that are considered hazardous waste. The devices contain nicotine, lithium and other materials that cannot be reused or recycled. (AP Photo/Bebeto Matthews)

Bebeto Matthews

U.S. teens and adults are buying roughly 12 million disposable vapes per month. With little federal guidance, local officials are finding their own ways to dispose of e-cigarettes collected from schools, colleges, vape shops and other sites.

"We are in a really weird regulatory place where there is no legal place to put these and yet we know, every year, tens of millions of disposables are thrown in the trash," said Yogi Hale Hendlin, a health and environmental researcher at the University of California, San Francisco.

In late August, sanitation workers in Monroe County, New York, packed more than 5,500 brightly colored e-cigarettes into 55-gallon steel drums for transport. Their destination? A giant, industrial waste incinerator in northern Arkansas, where they would be melted down.

Sending 350 pounds of vapes across the country to be burned into ash may not sound environmentally friendly. But local officials say it's the only way to keep the nicotine-filled devices out of sewers, waterways and landfills, where their lithium batteries can catch fire.

"These are very insidious devices," said Michael Garland, who directs the county's environmental services. "They're a fire risk and they're certainly an environmental contaminant if not managed properly."

Elsewhere, the disposal process has become both costly and complicated. In New York City, for example, officials are seizing hundreds of thousands of banned vapes from local stores and spending about 85 cents each for disposal.

Law enforcement members of New York Sheriff's Joint Compliance Task Force (SJCTF) carry bags of confiscated vaping products, during a spot raid of a tobacco shop, Wednesday Sept. 27, 2023, in New York. Communities across the U.S. are confronting a new vaping problem: how to get rid of millions of disposable e-cigarettes that are considered hazardous waste. The devices contain nicotine, lithium

and other materials that cannot be reused or recycled. (AP Photo/Bebeto Matthews)

Bebeto Matthews

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Vaping critics say the industry has skirted responsibility for the environmental impact of its products, while federal regulators have failed to force changes that could make vaping components easier to recycle or less wasteful.

Among the possible changes: standards requiring that e-cigarettes be reusable or forcing manufacturers to fund collection and recycling programs. New York, California and several other states have so-called extended product responsibility laws for computers and other electronics. But those laws don't cover vaping products and there are no comparable federal requirements for any industry.

Environmental Protection Agency rules for hazardous waste don't apply to households, meaning it's legal for someone to throw e-cigarettes in the garbage at home. But most businesses, schools and government facilities are subject to EPA standards in how they handle harmful chemicals like nicotine, which the EPA considers an "acute hazardous waste," because it can be poisonous at high levels.

New York Sheriff's Chief of Detectives Philip Schaffroth, Jr., left, and Detective Veronica Robles, right, confiscate illegal vaping products, during a spot raid by New York Sheriff's Joint Compliance Task Force (SJCTF) of a tobacco store, Wednesday Sept. 27, 2023, in New York. Communities across the U.S. are confronting a new vaping problem: how to get rid of millions of disposable e-cigarettes that are considered hazardous waste. The devices contain nicotine, lithium and other materials that cannot be reused or recycled. (AP Photo/Bebeto Matthews)

Bebeto Matthews

In the U.S., the push to manage disposable e-cigarettes has chiefly come from schools, which can face stricter regulation if they generate more than a few pounds of hazardous waste per month. Monroe County schools pay $60 to dispose of each one-gallon container of vapes. More than two thirds of the e-cigarettes collected by the county come from schools.

"Our schools were very relieved because they had confiscated so much of this material," Garland said. "If you think of all the high schools across the country, they are in a very difficult place right now."

Lithium in e-cigarette batteries is the same highly sought metal used to power electric vehicles and cellphones. But the quantities used in vaping devices are too small to warrant salvage. And nearly all disposable e-cigarette batteries are soldered into the device, making it impractical to separate them for recycling.

Disposable e-cigarettes currently account for about 53% of the multi-billion U.S. vaping market, according to U.S. government figures, more than doubling since 2020.

Their rise is a study in unintended consequences.

Vaping products are bagged and confiscated, during a spot raid of a tobacco store by members of New York Sheriff's Joint Compliance Task Force (SJCTF), Wednesday Sept. 27, 2023, in New York. Communities across the U.S. are confronting a new vaping problem: how to get rid of millions of disposable e-cigarettes that are considered hazardous waste. The devices contain nicotine, lithium and other materials that cannot be reused or recycled. (AP Photo/Bebeto Matthews)

Bebeto Matthews

In early 2020, the Food and Drug Administration banned nearly all flavors from reusable e-cigarettes like Juul, the cartridge-based device blamed for sparking a nationwide surge in underage vaping. But the policy didn't apply to disposables, opening the door to thousands of new varieties of fruit and candy-flavored vapes, almost all manufactured in China.

In recent months the FDA has begun trying to block imports of several leading disposable brands, including Elf Bar and Esco Bar. Regulators consider them all illegal, but they have been unable to stop their entry to the U.S. and the devices are now ubiquitous in convenience stores, gas stations and other shops.

FDA's tobacco chief, Brian King, said in a statement that his agency "will continue to carefully consider the potential environmental impacts" of vaping products.

[illegible]

In 2020, New York City outlawed the vast majority of e-cigarette types, banning flavors that can appeal to youngsters.

City employees conduct thousands of inspections annually, and last year issued more than 2,400 citations to corner stores and bodegas selling illegal flavored products. Adding to the challenge are THC vapes sold at hundreds of unlicensed marijuana shops, a separate but related problem that has mushroomed since New York's legalization of recreational pot.

Since last November, officials have seized more than 449,000 vape units, according to city figures. New York City is spending about $1,400 to destroy each container of 1,200 confiscated vapes, but many more remain in city storage lockers.

"I don't think anyone ever considered the volume of these in our community," said New York Sheriff Anthony Miranda, who leads a task force on the issue. "There's a tremendous amount of resources going into this effort."

New York City's Sheriff Anthony Miranda, left, watches as members of New York Sheriff's Joint Compliance Task Force (SJCTF) carry bags of confiscated vaping products, during a spot raid of a tobacco shop, Wednesday Sept. 27, 2023, in New York. Communities across the U.S. are confronting a new vaping problem: how to get rid of millions of disposable e-cigarettes that are considered hazardous waste. The devices contain nicotine, lithium and other materials that cannot be reused or recycled. (AP Photo/Bebeto Matthews)

Bebeto Matthews

A recent lawsuit against four large vaping distributors aims to recoup some of the city's costs.

For now, New Yorkers who vape can bring their used e-cigarettes to city-sponsored waste-collection events.

Ultimately those vapes meet a familiar fate: They are shipped to Gum Springs, Arkansas, to be incinerated by Veolia, an international waste management firm. The company has incinerated more than 1.6 million pounds of vaping waste in recent years, mostly unsold inventory or discontinued products.

Veolia executives say burning e-cigarettes' lithium batteries can damage their incinerators.

"Ideally we don't want to incinerate them because it has to be done very, very slowly. But if have to, we will," said Bob Cappadona, who leads the company's environmental services division.

Veolia also handles e-cigarettes from Boulder County, Colorado, one of the only U.S. jurisdictions that actively tries to recycle e-cigarette batteries and components.

Historically, Boulder has had one of the highest teen vaping rates in the country,

peaking at nearly 33% in 2017.

"It was like someone flicked the switch. Suddenly e-cigarettes were everywhere," said Daniel Ryan, principal of Centaurus High School.

Beginning in 2019, county officials began distributing bins to schools for confiscated or discarded e-cigarettes. Last year, they collected 3,500.

County staffers sort the devices by type, separating those with removable batteries for recycling. Disposables are packed and shipped to Veolia's incinerator. Shelly Fuller, who directs the program, says managing vape waste has gotten more costly and labor intensive with the shift to disposables.

"I kind of miss the days when we had Juuls and I could take each battery out and recycle them very easily," Fuller said. "No one has time to dismantle a thousand Esco Bars."

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AP video journalist Joseph Frederick contributed to this story from New York.

The Associated Press Health and Science Department receives support from the Howard Hughes Medical Institute's Science and Educational Media Group. The AP is solely responsible for all content.

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[redacted]

A new study found insurance may not be the best way to save money on prescriptions, how to keep your pets safe during Halloween, and more videos to improve your life.

statesman journal

Methane leaks at Coffin Butte Landfill in Oregon pose 'potential safety concern,' EPA says

e so high during an inspection that instruments could not measure them.



Tracy Loew
Salem Statesman Journal

Oct. 20, 2023, 5:01 a.m. PT

Key Points

- Methane is a greenhouse gas that's more potent than carbon dioxide and a major contributor to climate change.
- EPA did not publicly release its inspection findings
- Waste disposal company Republic Services is considering significant expansion of the landfill

Coffin Butte Landfill is leaking methane at levels that exceed state and federal limits and what the landfill has publicly reported, a U.S. Environmental Protection Agency inspection has found.

Landfills are among the nation's largest sources of methane, a greenhouse gas that's more potent than carbon dioxide and a major contributor to climate change, according to the EPA.

EPA measured methane exceeding regulatory limits 61 times during its June 2022 inspection of the landfill. Twenty-one of those exceedances measured at more than 10,000 parts per million, or 20 times the 500 ppm limit set by Oregon and the EPA.

In addition to contributing to climate change, the levels measured could cause health problems for neighbors, and in some cases were high enough to potentially cause an explosion and fire, said Lisa Arkin, of the Eugene-based environmental group Beyond Toxics.

Coffin Butte, located off Highway 99W north of Corvallis, is operated by Republic Services, the second-largest waste disposal company in the U.S. The landfill is an integral part of Marion County's solid waste disposal system.

The inspection report noted there were so many exceedances that the inspector ran out of marking flags. In some cases, levels were so high instruments could not measure them. And multiple exceedances were measured several feet in the air, “indicating substantial landfill gas plumes,” according to the report.

Coffin Butte and local Republic Services officials acknowledged an interview request from the Statesman Journal but did not respond to any questions.

“While we have differing perspectives on the testing protocols and analyses from the EPA’s inspections in 2022, the EPA’s observations were addressed," Melissa Quillard a spokeswoman for Republic Services' media relations office in Phoenix said in an emailed statement.

"The landfill was already in the process of expanding the gas collection system at the time of the EPA inspection, which has since been completed. We added additional cover soil in some areas, added soil along the edge of tarps, patched small holes in a liner system, and strengthened seals around gas collection piping," she said.

EPA did not publicly release its inspection findings. Beyond Toxics, working with the climate group Industrious Labs, received a copy of the report in response to a request under the federal Freedom of Information Act.

The groups have since filed a complaint about the excessive methane emissions with EPA’s environmental violations tip line. Their complaint included photos taken by neighbors living near the landfill of holes and tears in tarps covering the landfill, which can allow methane to leak.

The findings come as Republic Services is considering a significant expansion of the landfill, which currently is permitted for 178 acres.

Coffin Butte Landfill's role in Marion County’s solid waste system

Much of Marion County’s garbage is burned at the Covanta municipal waste incinerator in Brooks.

About a quarter of the garbage burned at Covanta ends up as ash, which is trucked to Coffin Butte, to be used as “alternative daily cover.” Landfills are required to cover their active area at the end of each day to control vectors, fires, odors, blowing litter and scavenging.

About half of Coffin Butte's leachate — rainwater that trickles through the ash and garbage, picking up contaminants — then is trucked to the city of Salem's wastewater system, where it's treated and discharged to the Willamette River. The other half is treated by the city of Corvallis, which also discharges to the Willamette.

Salem began taking the landfill's leachate in 2012. During the three years between January 2020 and December 2022, the city was paid $1.28 million to treat 42.6 million gallons of leachate from Coffin Butte, as well as a Republic Services' garbage transfer station in Benton County.

Salem also processes leachate from LRI Landfill in Graham, Washington, and Recology Organics compost facilities in Aumsville and North Plains.

Marion County garbage that doesn't go to Covanta is taken to Coffin Butte, as is garbage from West Salem residents, who live in Polk County.

According to the landfill's most recent annual report, Coffin Butte accepts more waste from Marion County than from any other county it serves. In 2021, the landfill accepted 326,000 tons of waste from Marion County, 143,000 tons from Linn County, 115,000 tons each from Benton and Lincoln counties, and 73,000 tons from Polk County.

Oregon's new landfill rules strictest in nation

Coffin Butte, along with other landfills, operates a gas capture system for the methane, which is created as organic waste decomposes. The landfill partners with PNGC Power to generate 5.66 megawatts of power from gas collected on site, providing enough electricity for about 4,000 homes.

In October 2021, the Oregon Department of Environmental Quality Commission adopted new rules regulating landfill gas emissions. Oregon now has the strictest monitoring and methane reduction standards in the nation.

But landfill operators are basically on an honor system to test and report, said Katherine Blauvelt, of Industrious Labs.

"The landfill has to follow through and conduct effective monitoring," Blauvelt said. "That, in a nutshell is the real problem that this (EPA inspection report) is highlighting."

EPA questions Republic Services' monitoring

EPA environmental scientist Daniel Heins expressed concerns in the report about Republic Services' monitoring procedures.

In its monitoring reports, the company reported finding a total of six methane exceedances. Some reports had zero exceedances.

That compares with the 61 exceedances the EPA inspector found, "with 26 exceedances at gas collection wells that Republic should have specifically been monitoring on a quarterly basis," Heins wrote.

"Many flagged exceedances represented clusters of exceedances at multiple points or broad areas of exceedances," he wrote.

Heins found an area where a tarp was visibly inflated with and leaking landfill gas.

"Along the top of this section of tarp ... every post or tarp hole Daniel Heins monitored exceeded the surface methane standard, with readings of up to 7% (methane) shown before the instrument maxed out," the report reads.

Heins noted "such an accumulation of flammable gas creates a potential safety concern."

Heins was accompanied by Republic Services environmental specialist Phil Caruso. Neither could identify any place where the wind could be lifting the tarps, but Republic officials later "disputed that the tarps were inflated with landfill gas, claiming that the wind has blown them up," according to the report.

Heins also found methane exceedances in areas of the landfill that are supposed to be under final closure and sealed, so that nothing can escape.

The inspection was pre-scheduled, and EPA had offered Republic Services the opportunity to take its own readings to check EPA's monitoring results. Republic officials responded that it was company policy not to do so, according to the report.

"Phil Caruso did not dispute any of the readings, though noted that he would not have checked many of the exceedance locations, that he would have spent less time monitoring, or that he would have considered a higher location to be 'the ground' when placing his probe 5 to 10 centimeters above the ground per the surface emissions monitoring regulations," Heins wrote in the report.

Further action on monitoring methane

EPA requested additional information from the company, but it’s unclear what further action the agency has taken.

"EPA is still in the process of evaluating compliance at the Coffin Butte Landfill based, in part, on the inspection report you referenced," EPA Region 10 spokesperson Sam Lovell said in an email to the Statesman Journal.

"EPA works closely with state and local Clean Air Act permitting agencies on these and other issues, and the agency will continue coordinating with Oregon DEQ regarding any next steps at this landfill," Lovell said.

Blauvelt said she filed a FOIA request with the EPA for additional legal documents associated with the case and was told none were available.

DEQ spokesman Dylan Darling referred specific questions about the report's findings to the EPA.

But, he said, "As part of DEQ’s new landfill rules and regulations, the company has indicated to DEQ that it is working on expanding its collection-and-control system. The company continues to provide monthly and semiannual reports to DEQ as required under their Title V air permit."

Advocates say Oregon and the EPA should require better methane monitoring with off-the-shelf technology such as drones or satellites.

“You can deploy technology that will act as reconnaissance and spot these super-emitter events, significant methane leaks, and then fix them,” Blauvelt said.

“We can use technology to at least overcome this baseline issue, which is we have no way of knowing whether you’re living next to a landfill that has really significant issues,” she said.

Tracy Loew covers the environment at the Statesman Journal. Send comments, questions and tips:tloew@statesmanjournal.com or 503-399-6779. Follow her on Twitter at@Tracy_Loew

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Exploding lithium batteries are causing fires in Oregon's landfills



By Joni Auden Land (OPB)
Oct. 21, 2023 6 a.m.

Exploding lithium-ion batteries are leading to more fires in Oregon's landfills and recycling centers, prompting action from state and local governments.

Deschutes County Solid Waste Director Tim Brownell said his county's landfill has seen 21 lithium-related fires in the past three months. Staff went from seeing battery fires once a month to multiple times a week.

"(Lithium batteries) are everywhere in the system," Brownell said. "It's a public safety concern and it's a concern for the infrastructure that are taxpayer investments."

Lithium batteries can be found in a variety of household objects, ranging from cars to power tools and from e-bikes to birthday cards that play music when opened. When run over by tractors or crushed in a trash compactor, they have the potential to explode and catch fire.



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A mound of garbage at the Knott Landfill in Deschutes County in 2022. This landfill has seen 21 fires from exploding lithium batteries in the past three months.
Joni Land / OPB

Because of this, the batteries are considered hazardous and aren't allowed in the landfill. Many end up there anyway. Brownell said many people simply don't know that they shouldn't throw the batteries in the garbage.

In some cases, it's leading to potentially dangerous situations. On multiple occasions, garbage trucks have arrived at the Deschutes County landfill with a fire smoldering in the back, Brownell said.

It's unclear how many injuries these types of fires have caused in Oregon.

As for which objects are causing fires, Brownell has seen cellphones, tablets and large batteries found in e-bikes and cars. Those larger ones are of particular concern because the fires are bigger.

"You might get flames that are three or four feet up in the air," Brownell said. "Once you get flames like that, you start to get concerned about it starting to catch the adjacent materials around it."

Battery fires aren't a new issue.

The federal Environmental Protection Agency issued a report in 2021 analyzing the impact of these batteries on fires in waste management facilities. The agency found 245 separate fires across 28 states, some of which led to entire buildings burning down. Recycling centers were at particular risk of fire damage.

The report mentioned Pacific Coast Shredding in Vancouver, Washington, which

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The problem appears to be worsening, which Brownell said could be related to lithium batteries appearing more widely in the marketplace. Reuters reported earlier this year that demand for lithium batteries is on the rise, with the market in the U.S. expected to rise six times by 2030.

State agencies have started taking notice. Earlier this year, the Oregon State Fire Marshal's Office started tracking fires stemming from lithium battery explosions, according to spokesperson Alison Green.

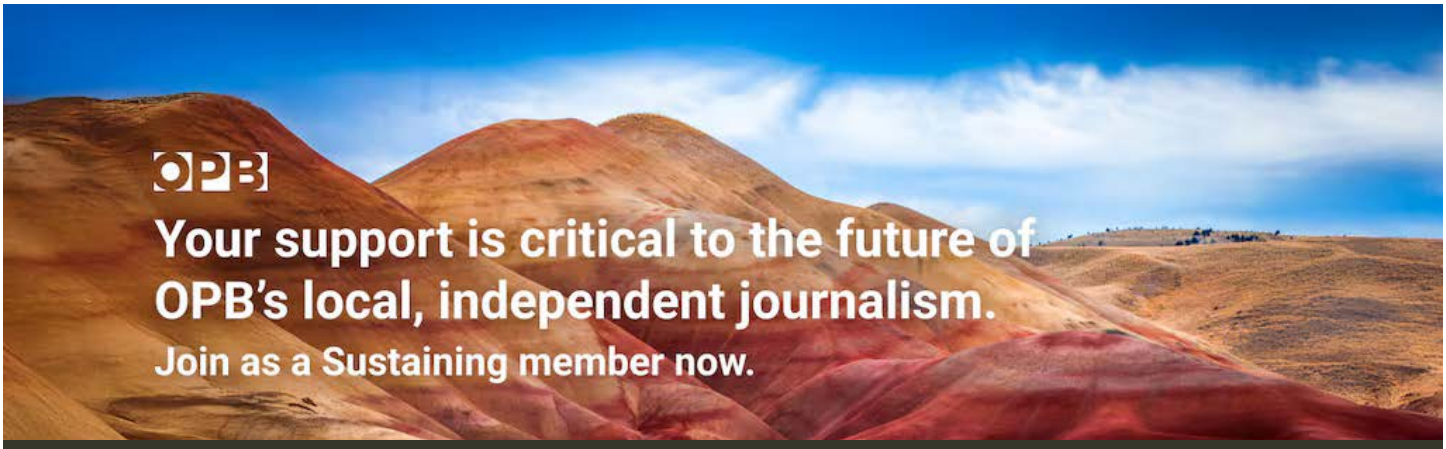
Green said it's still early to pull any findings from the data. The agency collects data on all structural fires in the state, and Green said the agency's hoping to understand how often lithium batteries are causing fires, what's causing them to explode and how that can be prevented.

At this early stage, it's still unclear how many fires lithium batteries are causing in Oregon. Brownell said more data is key to getting the public to understand the severity of the problem.

"If we're going to speak publicly about it, we have to get a better sense of how often it is happening," Brownell said.

Brownell said people looking to throw away lithium batteries should bring them directly to the landfill, where operators can discard them properly.

He said he hopes, in the future, "people who put (lithium batteries) into the marketplace bear some of the responsibility" for the fires.



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EPA: Methane gas levels at Coffin Butte landfill are concerning



A sign reminding Republic Services employee to "protect the environment and other driver by properly covering and securing you loads" stands in front of the Coffin Butte Landfill managed by Republic Services.

Jess Hume-Pantuso, Mid-Valley Media

Kosiso Ugwuede

It is no surprise that Coffin Butte, like many municipal landfills, produces high quantities of methane gas: Landfills are the third largest source of human-related methane emissions in the United States, according to the U.S Environmental Protection Agency.

But a 2022 report by the agency reveals that the level of methane gas emissions at Coffin Butte is not only very concerning, but contradicts figures reported by landfill operator, Republic Services, at the time.

A Place to Sleep, episode 4: Sweet Home

During a June 23, 2022, surface emission monitoring at the landfill, agency environmental scientist Daniel Heins identified 61 instances in which emissions went beyond the 500 parts per million threshold the agency has set as a safety line.

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[redacted]

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In 21 of those instances, emissions exceeded 10,000 parts per million, according to the report, which was obtained through a Freedom of Information Act request made by environmental justice nonprofit Beyond Toxics and think tank, Industrious Labs.

Reached by phone, Lisa Arkin, executive director at Beyond Toxics, said landfill neighbors had contacted her organization following its advocacy role in passing Senate Bill 488 to require emissions monitoring at Covanta Marion, a large municipal waste incinerator in northeast Salem.

The organization quickly began to see connections in the handling of waste at both facilities, Arkin said.

First, they tried to gather quantitative data to measure the experiences of residents.

"Because once you're armed with data, you can take the appropriate action. You cannot take action in ignorance," Arkin said.

A view of the Coffin Butte Landfill managed by Republic Services on Oct. 31, 2023.

Jess Hume-Pantuso, Mid-Valley Media

As a nonprofit, gathering data was going to come at a steep cost, so they worked with Corvallis High School students to measure air quality in the area. It was during this process that they learned about and were urged to get in touch with Katherine Blauvelt, circular economic director at Industrious Labs.

Together, they put out a public request to the U.S. Environmental Protection Agency for data regarding air quality at the landfill.

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What the report revealed is quite troubling, according to Blauvelt.

In the report seen by Mid-Valley Media, the agency carried out the inspection in two phases on June 23, 2022: first in a loop across the western portion of the landfill for about three hours in the morning, and later, another wider loop across the eastern portion of the landfill for about another three hours in the afternoon.

Exceedances, when emissions surpassed the 500 parts per million threshold, were measured both in clusters as well as over broad areas of the landfill.

Twenty-six times, exceedances were recorded at or near gas collection wells both active and abandoned/decommissioned. Eight times, exceedances were recorded at leachate cleanouts.

Six times, exceedances were recorded in what is known as final cover areas, that is, areas which have reached capacity and are being phased out.

During the afternoon monitoring, Heins found that not only were exceedances above the 500 parts per million threshold at various points, but multiple feet in the air and several feet from their source revealed "substantial landfill gas plumes," which Heins concluded posed safety concerns because of how easily flammable methane is.

One of the points where significant emissions were recorded was near an area with a tarp covering that was visibly inflated. Neither Heins nor Phil Caruso, an environmental scientist with Republic Services who accompanied the agency on the inspection, could identify wind as the cause of the ballooning.

Along this section, every point inspected by Heins exceeded surface methane

standards and readings went so high they maxed out the monitoring instrument, a ThermoFisher Toxic Vapor Analyzer 2020.

In reports supplied by Republic Services ahead of the monitoring exercise, the company said its own surface emission monitoring exercise had only shown six exceedances and in one instance, zero exceedances.

Caruso did not dispute the readings conducted by the agency, but the report showed that the company's inspection protocol differed greatly from that of the agency.

For instance, while the agency inspected leachate cleanouts, "Caruso stated that he does not monitor at these, and they are not fully penetrating the cover," according to the report.

In cell five's leachate rise, where Heins measured multiple exceedances, Caruso said he would not have measured it as it was outside of the waste mass, the report said.

When contacted, a Republic Services representative said that though the testing protocols and analyses differed, the company has since taken corrective actions to address the EPA's concerns.

"There were no violations issued against Coffin Butte as part of the 2022 report, and the landfill remains in compliance with all state and federal regulations," Melissa Quillard, senior manager, external communications, said in an email.

At the time, Quillard said, company officials were in the process of expanding the gas collection system at the landfill, which has now been completed.

"We added additional cover soil in some areas, added soil along the edge of tarps, patched small holes in a liner system, and strengthened seals around gas collection piping," Quillard wrote.

In 2019, the agency said the gas collection system at the landfill was converting 57% of its methane to carbon dioxide, a less potent greenhouse gas, as compared to other Oregon landfills such as Columbia Ridge (85%) and Dry Creek (80%), according to the recently released Benton County Trash Talks report.

But the company said in the report that by 2021, its gas collection system was 91.2% efficient.

Quillard said via email that the landfill currently meets and exceeds federal requirements of gas collection and control, and though not required, its gas collection and control system is evaluated annually to "ensure everything is operating as it should."

Beyond Toxics and Industrious Labs have since filed a complaint about the methane levels at the landfill to the agency.

[illegible]

According to Blauvelt, methane is a super pollutant that immediately begins to heat the planet once it is released. Compared to carbon dioxide, it is at least 28 times better at trapping heat in the atmosphere over a 100-year period, according to an Intergovernmental Panel on Climate Change report. Its effect is instant and universal.

Methane is also odorless, but is the precipitator of gasses like hydrogen sulfide and others that fall under the category of volatile organic compounds, like benzene. They come together to produce a stinky cocktail of gasses, according to Joel Geier, a landfill neighbor and member of the Benton County Disposal Site Advisory Committee.

"And every time an apple core or, you know, a banana peel is put in that landfill, that will contribute to more methane coming out of that landfill," Blauvelt said.

The size of the Coffin Butte landfill and its thus unsuccessful requests to expand

have become cause for great concern for many neighbors and community members. Many say are concerned about the amount of waste that the landfill continues to attract from other counties outside of Benton and Linn counties.

"The question is what keeps coming in," Geier said.

In 2022, Benton County formulated a workgroup, called Benton County Talks Trash, to look into several aspects of the landfill with the goal of developing a solid waste plan for the future. But Geier said a lot of the conversations focused on the landfill as an asset.

In addition, Geier said that at the time a neighborhood tour was organized as part of the workgroup's tasks, Republic Services was aware its methane emissions report was disputed by the federal environmental agency. But nobody during the September 2022 tour learned of it.

Ironically, comments by a neighbor on the tour, Kevin Higgins — who fought landfill fires at Coffin Butte in the 1990s and 2000s standing on tarps bubbling with gases underneath — were condensed in the final report, Geier said.

All the report says is "At the historic Soap Creek Schoolhouse, Kevin Higgins, a firefighter and employee with the Benton County Sherriff's Office, gave a talk on growing up in the area, landfill fires, types of items in landfill, and DEQ."

Mark Yeager who participated in two subcommittees within the workgroup said that in the course of devising its findings, it was clear mitigating conditions placed on the landfill were not enforced.

Quality journalism doesn't happen without your help

"There are explicit findings in the BCTT report that specify that the county has never and does not now monitor any of the conditions of approval that they've issued as part of any prior land use decisions," Yeager said by phone.

After several calls to the state Department of Environmental Quality, Yeager said there is still nothing to show that the agency is concerned about the experience of the landfill neighbors and the danger the landfill may pose both to those near the site and the rest of the community.

"It doesn't have to be something where you actually smell it to know that your life's being impacted," he said.

Beyond Toxics's Arkin said that the Environmental Protection Agency has not responded to the complaint yet, but she has been in touch with the Department of Environmental Quality to complain about the lack of oversight at Coffin Butte.

"For the record, the EPA sets the national standards for landfills across this country through the Clean Air Act standard, so this adds to the mountain of evidence that the EPA is overdue to act to update those standards to have monitoring that is more effective," Blauvelt said.

"The great news is that there is technology like drones, like remote direct sensing measurement technologies out there, that can help remove human error and provide transparency," she said.

"Unfortunately, regulation just hasn't caught up with the technology," she said. "That will at least be a game-changer from a transparency standpoint."

Geier hopes the concerns of the landfill neighbors will be taken more seriously and for the county to "really think about what they're getting into with an expansion."

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Kosisochukwu Ugwuede (she/her) covers the cities of Corvallis, Philomath & Millersburg. She can be reached via e-mail at [redacted] or by phone via 541-812-6091

[redacted]

From:	Ken Eklund
To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 5 of 12
Date:	Thursday, May 8, 2025 2:35:36 PM
Attachments:	writerguy-cube2.png

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More history of Coffin Butte Landfill in the press, covering many of the same issues that have come up in public testimony: PFAS, leachate, methane, EPA and DEQ investigations and actions, labor issues, Republic cover-ups of problems and information, fire hazards, misleading and dubious information about the economics of the landfill, and so on. – K

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TOP STORY

Ill wind sours plans to sell Emerson Vineyards

By David Hayes
Mar 2, 2023



In better times, Tom Johns touts a bottle of Emerson Vineyards' 2019 pinot noir.

YouTube video image

Itemizer-Observer

If all goes to plan, Emerson Vineyards will cease all operations by the end of April and owners Tom and Jane Johns will move on to their next adventure life – retirement.

However, as always for the couple, not everything in their lives went according to their carefully laid out plans. Plan A is they downsize to the quiet life. Plan B, they have to harvest one more season of grapes themselves.

The change in plans actually follows about a 20-year cycle for the couple. After the Vietnam War,

Johns went to college and got a degree in medical technology. He would work at, and eventually run, medical labs across the U.S. over the next couple decades – the last as senior vice president of manufacturing at a lab in Boca Raton, Florida.

By the year 2000, he was looking for something else to do. That's when he called his son Elliott, attending school at Oregon State University pursuing a degree in fermentation science.

"I asked him what do you want to do when you grow up?" Johns recalled. "He said own a small winery."

With experience working at the Elk Cove Winery in Gaston, Oregon, and time overseas at a winery in Spain and a harvest in New Zealand, Elliott envisioned owning a 10-acre vineyard.

So, Tom called a realtor and a month later found 127 acres with the right slope to plant grapes just off Airlie Road, just west of Highway 99. They purchased the property in 2001 and planted grapes in 2002. Tom said it took a while to get through the "morass" of paperwork from the county, state and federal governments to launch a vineyard.

"My first business plan back in Florida was having us profitable in three years, not knowing that once you plant grapes it takes about six years to grow once you plant them," Tom said. "I was off a little bit. It wasn't until 2014 that we actually broke even. My big nest egg from my previous job was gone."

Now "retired" and moved into a home at the edge of the vineyard, the Johns named the operation after his grandfather on his mother's side – Emerson Waldo Fisher.

Emerson Vineyards harvested about 3,500 cases of wine a year and never had problems selling out, Tom said. They even won in 2015 a Best in Show at the Newport Seafood and Wine Festival. Tom thought they had grown pretty popular over the years.

"We had a couple come in one day, just back from a trip to France. They tasted our Pinot (noir) and said, oh it's so good to come back and have a good pinot," he recalled.

Tom added it's been a fun ride going from just trying to get people through the door.

"In fact, we were the first non-grass seed farm in this valley by growing our grapes. Since,

filberts have bloomed up all over, blueberries, Christmas trees. This little valley is kinda cool," he said.

Tom eventually joined the board of directors at Visit Corvallis and worked with them trying to focus on wineries in the area. And Emerson was the second group to join the Willamette Winery Association. It now has almost 30 members, wineries, cideries and distilleries.

Next, the Johns became members of Harvest Host about 12 years ago, a self-contained RV travel company that encourages members to stay at vineyards for free with the promise to make purchases.

"It was good, especially during the pandemic, when everybody was out in their own bubble," Tom said. "That kept this thing going. Of course, it's hard to sip wine with a mask on."

To attract even more oenophiles, Emerson Vineyards started offering Friday Night Music.

"It was a big hit. It took a while. The last two years, it was kinda nice, seeing them under the trees, watching the show," Tom said.

Then, that 20-year landmark rolled around, and things began to change.

"Two years ago, I'd just turned 76, I had open heart surgery. So, it seemed about the right time to say, 'You know, I don't have to do this. It's time to try something else, you know, like retire, take naps, those kinds of things,' " Tom said.

In addition, his son Elliott was growing tired of the commute where his wife had a CPA business out of McMinnville. He gave his parents eight months' notice. With no one else to pass the business on to, that left the only option for Tom and Jane to sell.

So, the Johns put the entire property on the market as acreage and a vineyard, hoping to get a $1.5 million offer.

Two weeks ago, they had their buyers. A couple offered to buy the property but not the winery. The Johns accepted, decided to shut down and let all their employees go. Then a literal ill wind scuttled the deal.

“The day they decided to quit was the day a south wind blew up from the dump. He was allergic to it and got violent migraines. They cried about it, just couldn’t make it work,” Tom said, totally understanding, not wanting the potential buyers to discover the ailment after he and Jane were gone. “So, we’re back to square one.”

Tom said the buyers left behind “a chunk of money” after pulling out of the deal, so they’re okay for now. They’ve since re-listed the property but face the same problem – it’s too small for the big guys (who wanted 300 acres) and too big for the little guys.

So far, the only potential clients brought out had the false notion of buying the place, sitting by and letting the grapes take care of themselves. Tom said that doesn’t work.

“You have to touch each plant six times a year,” he said. “A couple from Shanghai didn’t want to do the work.”

If he can find a deal that does go through, Tom said he already has mapped out his next phase of retirement. He learned OSU has free classes for seniors 65 and older, just with no grades.

“I’m actually thinking about going back and trying large format photography,” Tom said. “We’re looking forward to not doing anything.”

With the land sale falling through, so too had the purchase of a house in north Albany. So, the downsizing plan is on hold for now. But the Johns realize the problems with downsizing from 127 acres to quarter acre are twofold. They have two dogs that were “raised with the coyotes” and free to roam. And Jane’s studio in the back barn grew to encompass seven sewing machines, bolts of crafting materials and mounds of painting supplies.

“We haven’t quite figured out how to put her 900-square-foot studio, the dogs and me in a 1,400-square-foot house,” Tom explained. “We may have to find a trailer for me, or a tent.”

Meanwhile, he’s left liquidating the inventory left, including a large “garage sale” inside their main barn. Additionally, he still has a 2019 pinot noir that distributors want more than they currently have. He’s sold their Bijou Viognier port to Harris Bridge winery and is working another winery for the rest. That includes judging nearby Airlie Winery’s interest in what remains in their four big tanks. And there’s still three pallets of bottled wine to distribute. Tom said his Oregon Liquor and Cannabis Commission license expires at the end of April.

“So, have to get rid of it by then,” he added.

The options are shrinking.

“Worst case scenario is having to stay in business to tend the latest crop still on the vine,” Tom said. “Eew, we’re going to have to prune the grapes, mow, tie down the trees, all that stuff in the field. That’s not my expertise. Nor do I want it to be. Gee, we may have to harvest again. So, if anyone wants to manage about 30 acres of grapes and buy them, that’s fine. I’ll work with you.”

https://democratherald.com/tncms/asset/editorial/06add418-c460-11ed-9576-fb4ed594e179/

ALERT

Your Ecological House: Slow global warming by cutting methane emissions now

> *"Acting now to reduce methane emissions will have immediate benefits for the climate ..."* — The Environmental Defense Fund

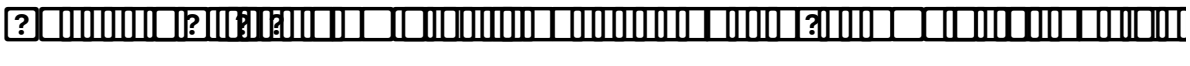
We need to hurry if we're to slow global warming.

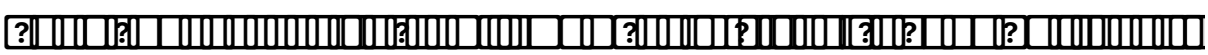
But why would we want to only slow warming, rather than completely stop it?

We must do both, of course, but trying to reverse the current warming trend is a long-term project. It will take at least until 2050 to cut global greenhouse gas emissions to nearly zero.

It will likely take much longer to remove our prior emissions from the atmosphere. And we don't have that kind of time to prevent global climate chaos from becoming "the new normal."

Which brings us to methane — because drastically curbing our methane emissions is the easiest and fastest way to slow warming, buying us precious time for tackling the larger problem of carbon dioxide (CO_2) emissions.





To understand why, we must look at the roles CO2 and methane, the primary greenhouse gases, play in warming. CO2 constitutes about 79% of all U.S. greenhouse gas emissions, while methane accounts for just 11%.

But although we emit far less methane than CO2, methane's "global warming potential" — the amount of heat it can trap — is, pound for pound, 80 times that of CO2 when it first enters the atmosphere.

However, over the course of 12 years, methane breaks down in the atmosphere — but mostly it turns into CO2, which can stay airborne for hundreds of years. Thus, methane's overall global warming potential over a century is still 30 times that of simple CO2.

Also, we keep emitting more methane, replenishing and gradually adding to its supply at its original potency. To date, methane has been responsible for a whopping 30% of all global warming.

There is some good news. Because there is much less methane than CO2 emitted, containing it could require fewer resources. Also, 54% of American methane emissions are from just three sources: Fossil fuel infrastructure (35%); landfills (16%); and buildings (3%).

Although these sources are widely distributed, they are relatively easy to pinpoint, and therefore amenable to repair or the capture of escaping emissions.

For example, much of the fossil fuel industry's methane emissions are from leaky pipes or storage facilities and improperly capped abandoned wells. These sources can be found and fixed.

Similarly, much landfill methane can be captured and used to power the very waste facilities emitting it. The smaller, but still important, role of methane from buildings — where it's usually called "natural gas" — can be greatly reduced by repairing pipes, but also by adjustments residents can make to their lifestyles, a topic we'll explore in upcoming columns.

Finally, according to a 2022 International Energy Institute report, "based on recent elevated natural gas prices, almost all of the (alternative energy) options to reduce emissions from oil and gas operations worldwide could be implemented at no net cost."

We should note that 41% of U.S. methane emissions are from widespread agriculture sources. Agricultural emissions are likely to subside only incrementally and gradually as agricultural practices evolve.

So, because we need quick results, we should primarily target the "low-hanging fruit" of fossil fuel infrastructure, landfill and building emissions.

While these facts about methane have been known for decades, controlling its emissions only recently has been seen as key to slowing climate change.

Fortunately, the current U.S. administration has taken note and is leading the way, pushing in 2021 for international rules and agreements on methane reduction, and in 2022 passing the Infrastructure Investment and Inflation Reduction Acts with their strong methane mitigation provisions, while empowering the EPA to establish a new Methane Emissions Reduction Program.

Unfortunately, instead of adjusting their business models to help slow global warming, most fossil fuel companies are pushing back, hard — a topic we'll explore next at our ecological house.

Philip S. Wenz

Philip S. Wenz is an environmental researcher and writer. Read more articles from his series *Your Ecological House* on his website at [redacted].

Letter: Dump's toxic brew poisons the river

What do you get when you take a huge pile of garbage (30% of our state's total tonnage) and let the heavy rainfall of Western Oregon percolate through it?

Answer: About 30 million gallons a year of toxic liquid contaminated with heavy metals and per- and polyfluorinated substances.

A 2020 industry study found nearly one-third of the PFAS in garbage flows out of landfills in the leachate. Cells closed 50 years ago at the dump are still producing millions of gallons of leachate each year. This is but one of the toxic legacies of Benton County's hosting one of the largest landfills in the Pacific Northwest.

The dump's toxic effluent is sent to both the Corvallis and Salem waste treatment plants. Since the PFAS and heavy metals are not removed by the treatment process, the city of Corvallis is making serious money (about $800,000 in fiscal year 2021-22) by essentially dumping this toxic brew into the Willamette River.

On March 14, the Environmental Protection Agency proposed drinking water

regulations for six PFAS. Research has shown that roughly 200 million Americans are impacted by PFAS in their drinking water, leading to thousands of deaths each year.

With pending regulation of PFAS in drinking water, it will become increasingly unconscionable for Corvallis and Salem to send these poisons into the Willamette River — the source of drinking water for a number of downstream communities, including Adair Village. Please urge our elected leaders and Corvallis Public Works to stop accepting this toxic brew!

Doug Pollock

Corvallis

https://gazettetimes.com/news/local/govt-and-politics/article_f0094390-d4dc-11ed-a843-c7169623bb4d.html

ALERT FEATURED TOP STORY

Benton task force: Coffin Butte expansion should be tied to monitoring

[illegible]
[illegible]

A Benton County task force has released its full findings from months of research into Coffin Butte Landfill, recommending — among many suggestions — that the local government proactively monitor the dump's operator as a condition of any expansion.

Work group members found county officials do not actively monitor whether some landowners are meeting the conditions tied to their operating permits, as outlined in local law. The landfill's operator is among them.

Instead, the county relies on complaints to enforce those conditions, despite having no readily accessible means to lodge and track those complaints.



A Republic Services tanker truck pulls away from a loading facility near Coffin Butte landfill.
Andy Cripe Mid-Valley Media

Republic Services, operating Coffin Butte as a regional landfill that serves as many as 39 counties via a franchise agreement with Benton County, assumed the company complied with Benton County upon purchasing the dump in 2008,

according to a draft report.

“County staff and (Republic Services) were working from alternate views,” report authors wrote.

The 14 voting members — including delegates from county trash and planning advisory bodies, Republic Services and the public — comprising the task force broadly agreed Benton County can do better ahead of drafting the plan that will guide the agency in how it oversees solid waste in the county, regardless of Republic expands the landfill or not.

Republic withdrew its expansion plans a year ago after the county Planning Commission denied the landfill operator a new permit. Initially, the company was going to appeal.

Shortly after, the county formed a task force to make recommendations about the landfill, which it calls Benton County Talks Trash. The work group has a draft circulating of its vision for solid waste management.





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The workload ballooned as the task force broke into subcommittees examining solid waste and Coffin Butte through lenses of county process, state law and history.

County officials budgeted about $63,000 for the contractor hired to facilitate the task force before work ran about three months beyond the scheduled end date of December.

Benton's elected leadership approved infusions, bringing the final Trash Talks budget to about $236,000.

As recently as late March, participants said they weren't comfortable with how fast they felt the group was moving through its task in guiding how Benton County should manage the flow of solid waste in the region.

Marge Popp, who represented the appointed body advising county commissioners on solid waste and disposal, said in a Thursday, April 6 interview that she felt Benton County has signaled the government isn't taking seriously its commitments laid out in the 2040 Thriving Communities Initiative.

“I certainly wish that the county did take those values more seriously,” Popp said.

Benton County has not received another application from Republic for an expansion and had committed on holding off until hearing elected official and public input on the Talks Trash findings.

The Board of Commissioners is scheduled to hear a report from the work group on Tuesday, April 11, which will open a period of public comment, expected to end May 26.

- Benton County to advisers about landfill: Stop advising us
- Benton dump findings take shape
- County awards more time, money to Coffin Butte workgroup; fires member
- Tour provides peek into landfill operations, Benton workgroup dynamics
- Republic Services pulls appeal on Coffin Butte landfill expansion
- Benton County commission unanimously rejects Coffin Butte landfill expansion plan
- More Benton County news

Alex Powers (he/him) covers agri-business, Benton County, environment and city of Lebanon for Mid-Valley Media. Call 541-812-6116 or tweet @OregonAlex.

Letter: We need a plan, not bigger landfill

A petition circulating about the landfill is causing quite the kerfuffle in county government.

So much so that a subcommittee of the Benton County Talks Trash workgroup created six new “findings” in an attempt to discredit it. The commissioners even issued a media release selectively changing the petition’s wording — and its meaning — thereby rejecting the concerns of nearly a thousand petition signers.

In a nutshell, the petition asks the commissioners to oppose any landfill expansion until the county has a sustainable materials management plan to guide them.

The twisted rewording says the petition asks them to delay consideration of any new land use at the landfill.

This is smoke and mirrors. The petition does not ask them to delay consideration.

The landfill already seriously interferes with uses on adjacent properties and the character of the area, and imposes an undue burden on public improvements, facilities and services. An expanded landfill will only make things much worse.

Landfilling here forever is not the only option. There are alternatives that can and must be explored and implemented before the dump is full (15 years).

Approving an expansion now renders moot any future materials management plan. Denying it this go-round (based on evidence — there will be plenty) allows the county time to gather the facts needed for a better future.

Curious? See for yourself. Search the internet for “VNEQS” (name of the group circulating the petition) and/or “Coffin Butte Landfill petition.”

Debbie Palmer

Corvallis

truthout

NEWS | ENVIRONMENT & HEALTH

Environmental Groups Urge EPA Action on Methane Emissions From Landfills

Methane has been identified by international climate experts as a key driver of planetary heating.

By Julia Conley, COMMON DREAMS
June 22, 2023



A San Francisco Recology truck drops about 20 tons of trash at the Waste Management landfill in Livermore, California, on December 26, 2012.

MICHAEL MACOR / THE SAN FRANCISCO CHRONICLE VIA GETTY IMAGES

Joined by two residents of a community where emissions from landfills have forced them to live in the "center of a toxic wasteland," more than a dozen environmental and community advocacy groups on Thursday filed a petition (https://environmentalintegrity.org/wp-content/uploads/2023/06/FINAL-Petition-for-Rulemaking-CAA-111-Landfills.pdf) with the Biden administration calling for a number of specific regulations to address the United States' third-largest source of methane pollution.

A month after the Environmental Integrity Project (EIP) published a report (https://www.commondreams.org/news/landfill-methane) detailing how the nation's roughly 1,100 city and county landfills emitted at least 3.7 million metric tons of methane in 2021, the group was joined by the Sierra Club (https://www.commondreams.org/tag/sierra-club), Black Warrior Riverkeeper,

Chesapeake Climate Action Network (CCAN), and several other organizations to demand the Environmental Protection Agency (EPA) take action.

Javian Baker and Gilda Hagan-Brown, residents of Waggaman, Louisiana, which is adjacent to a landfill, also joined the petition. The emissions coming from the landfill mean that residents' "right to a healthy, safe and clean environment [is] jeopardized," said Hagan-Brown in a statement, and that their "aspirations have been destroyed."

"The foul gassy smell lurking in our neighborhood inhibits me from bringing my fifteen-month-old outside to play," said Baker. "This petition offers a glimpse of hope when politicians in Jefferson Parish and landfill officials have yet to get to the root of the problem impacting our predominately Black community."

Only livestock and natural gas cause more methane emissions than landfills in the U.S., the petitioners noted. Methane has been identified (https://www.commondreams.org/news/2021/08/06/ipcc-say-drastic-methane-cuts-necessary-avert-climate-hell) by international climate experts as a key driver of planetary heating. It is 80 times more potent than carbon dioxide in its first two decades in the atmosphere and 28 times more potent over a 100-year period. Nearly 12% of the United States' contribution to climate change comes from methane emissions, *The Hill* reported (https://thehill.com/policy/energy-environment/4061660-environment-groups-ask-biden-to-crack-down-on-methane-emissions-from-landfills/) Thursday.

The yearly methane emissions from landfills are equivalent to 295 million metric tons of greenhouse gases over 20-year period, or 66 million gasoline-powered vehicles over a year.

Edwin LaMair, attorney for the Environmental Defense Fund, noted that technological advances in recent years, including the ability to conduct aerial surveys of methane emissions at landfills, offer the EPA "an enormous opportunity to update and strengthen its standards for landfill pollution."

"Landfill pollution poses serious public health threats, and protective landfill standards are an urgently needed addition to other significant actions EPA has recently taken to reduce climate-destabilizing and health-harming pollution," said LaMair.

In its report, *Trashing the Climate*, last month, EIP noted that landfills contribute to methane emissions mainly due to rotting food waste. Americans throw away roughly 40% of their food and food waste has soared in the last three decades.

The petition calls on the EPA to encourage composting and waste reduction to reduce landfill methane emissions.

The Rocky Mountain Institute, which was not involved in the petition, explained on social media earlier this week how diverting waste from landfills not only reduces emissions, but also allows the waste to be converted into valuable resources for communities.

> The most direct way to fight methane emissions?
>
> Keep organic matter out of landfills in the first place. 👏
>
> This can be done through upstream methods like reducing food waste and donating surplus, and downstream efforts to recycle the remaining organic waste. pic.twitter.com/uOJY90Ehg2 (https://t.co/uOJY90Ehg2)
>
> — RMI (@RockyMtnInst) June 20, 2023 (https://twitter.com/RockyMtnInst/status/1671266747431936000?ref_src=twsrc%5Etfw)

The groups on Wednesday also called on the EPA to:

- Require more landfills to install gas collection and control systems, including pipes that collect methane from garbage and covering materials, such as soil, that help absorb and destroy methane;
- Require flares that burn methane at landfills to have at least a 99% destruction efficiency, meaning they burn up almost all of the pollution;
- Require landfills to install gas capture systems within one year after the dumping of waste; and
- Impose better requirements for direct measurement of methane and support the development of equipment that can continuously monitor landfill emissions.

The petition also pointed out that many of the country's landfills are situated in predominantly low-income towns and communities of color.

"Virginia is home to eight 'mega-landfills,' many of which are sited in low-income communities of color," said Anne Havemann, general counsel for CCAN. "These landfills emit huge amounts of methane, a potent greenhouse gas, but have not received the attention they deserve for all the pollution they release. We look forward to EPA taking action on this under-the-radar issue."

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JULIA CONLEY (HTTPS://TRUTHOUT.ORG/AUTHORS/JULIA-CONLEY/)

Julia Conley is a staff writer for *Common Dreams*.

As I See It: We all owe it to them to draw the line now

As a member of Subcommittee E (“Community Education”) of the “Benton County Talks Trash” process that took place over the past year, I learned a great amount regarding Coffin Butte Landfill’s history and possibilities.

As a person who drives past the landfill multiple times per week and an avid user of the E.E. Wilson Wildlife Area, I have been observing developments of the facility for 25 years. Based on these experiences, I would like to clarify three things regarding the specter of expanding the landfill to the south of Coffin Butte Road.

First, no careful neutral analysis would have chosen this place for such a massive landfill. Coffin Butte Landfill began in the 1940s, when Benton County sought to divert people from privately dumping their refuse in the woods and rivers, as was practiced in the early 1900s.

There was no vision that this would be a massive industrial complex that receives over 88% of its nearly 1.1 million tons of refuse from outside the county.

The Benton County Trash Talks history notes that even when it was designated as one of several regional landfills in 1974, Coffin Butte was anticipated to close before 2000.

For contrast, Republic Services notes that its Roosevelt Landfill in Washington was specifically chosen for the low local population, relatively small or distant aquifers, and precipitation of 6 to 9 inches per year.

Second, Coffin Butte Landfill is already scheduled to expand to the west, where a quarry operates right now. The southward expansion is necessary only because the amount of waste going into the facility has nearly doubled in recent years, with nearly all of the increase coming from beyond Benton County, and much from beyond the mid-valley.

According to the Benton County Trash Talks final document, the amount deposited at Coffin Butte has increased from 552,978.53 tons in 2015 to 1,046,066.96 tons in 2021.

I recommend you go to E.E. Wilson sometime during the work week and observe the magnitude of the operation and the number of trucks coming from all over Western Oregon droning up the hill. I am not sure what is in each load, but last Friday I happened to watch a truck at the top of the heap unloading, surrounded by red dust or smoke.

Third, county officials make it sound as though Benton County residents may just have to accept the southward expansion because of previous commitments. This is not true. If Benton County officials all do their best, the expansion can be stopped.

The expansion does not fit the county's existing policy goals, nor is it in sync with the environmental and sustainability goals of many residents; it would significantly affect the livability of surrounding areas.

We should all expect or demand that Benton County officials oppose any

southward expansion, and do whatever it takes to make it so. Even if you disagree with this, it seems only reasonable for Benton County to have an approved long-term solid waste policy in place before we allow Republic Services to double in size by expanding to the east side of the landfill.

Whatever goes into that facility stays there forever, unless it leaches into our aquifers, is pumped out to be deposited in local sewage facilities or escapes as greenhouse gases (some of which does generate energy, but according to the BCTT, gas capture is about 57%).

I do not know if my descendants will live in Benton County, but someone's will, and we all owe it to them to draw the line now.

Mark Henkels

Mark Henkels is a longtime resident of the Lewisburg area. He has taught public policy and administration at Western Oregon University since 1988, with a specialization in Oregon politics and

government.

https://gazettetimes.com/news/local/business/employment/article_0c558480-51a8-11ee-b637-434909e9601d.html

ALERT FEATURED TOP STORY

Coffin Butte mechanics protest alleged unfair labor practices

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. ...



Workers stand in picket line, on strike, at the Coffin Butte Landfill on Tuesday, Sept. 12. Workers allege that attempt to stop operating engineers from unionizing.

Jess Hume-Pantuso, Mid-Valley Media

Kosiso Ugwuede

A seven-man unit of heavy-duty equipment mechanics are on an indefinite strike, picketing in front of the Coffin Butte Landfill in Corvallis.

The walkout, which began early on Monday, Sept 11, is in protest of what they say are unfair labor practices by Valley Landfills Inc., a subsidiary of the waste management company, Republic Services, which runs the Benton County dump.

Workers stand in picket line, on strike, at the Coffin Butte Landfill. Workers allege that Valley Landfills Inc has violated federal law in attempt to stop operating engineers from Local 701 from unionizing.

Jess Hume-Pantuso Mid-Valley Media

The employees make diesel, hydraulic and electrical repairs, as well as do welding and fabrication on Caterpillar D-9 bulldozers, Caterpillar compactors, and Caterpillar wheel-loaders, which are used for moving and compacting the landfill waste.

The striking unit first approached the International Union of Operating Engineers Local 701 around November last year with intentions to unionize. According to Jacob Stallings, attorney for Local 701, that desire has since been met with all kinds of typical union-busting responses from the employer.

. ...

. . ..

[redacted]

[illegible]

[illegible]

. ....-.

"Additionally, their regional director engaged in some conversation with our members that we interpret as intimidation tactics," Stallings said by phone.

According to Stallings, one of the mechanics who initiated contact with Local 701 about unionizing "had several disciplinary incidents that conveniently lined up with the same time as unionizing."

And a review-based bonus that staff received in the first quarter of the year was also withheld for the unionized unit while nonunionized staff received an unusually high bonus, he said.

"The company has violated federal law and is being investigated by the National Labor Relations Board right now," Local 701 Business Manager and Financial Secretary James Anderson said by phone.

Phoenix-based Republic Services has seen its share of controversies out of Coffin Butte. With predictions that the landfill is filling up fast, the company hopes to expand.

But Republic withdrew its plans at Coffin Butte in 2022 after the county Planning Commission denied the landfill operator a new permit to use land on the opposite side of Coffin Butte Road for storing trash.

The company first had sought to appeal the commission's decision before reversing course and pulling its application. Since then, a county-convened task force spent nearly a year looking at the region's trash needs.

. ..-. .--. --

The striking mechanics are non dues-paying union members following an election

last year. Stallings said bargaining efforts between the union and Valley Landfills has been an uphill task. Since November 2022, the company has sat for six sessions with the union to review the working conditions and wages of the unit.

Three of those meetings have been canceled by the company, the most recent being a session that was scheduled for Wednesday, Sept. 6.

The company offered no reason for canceling, he said.

"Each time we've tried to schedule a new session with them, they've been dragging their feet," Stallings said.

The contractual demands of the seven-person unit are not outrageous, according to Stallings, and agreements have been reached on all of the union's proposed changes except for wages, health and welfare, and pension.

The health insurance negotiations have been most contentious, Stallings said, although an agreement could be a win for both Valley Landfills and the mechanics.

"We have very affordable health insurance," Anderson said of the Local's insurance.

"We can save the company around $8,000 a year in health insurance, but they don't want to take our health insurance. They want to keep the guys paying $400 a month out of pocket," Anderson said.

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Stallings agreed that the company has been averse to considering the change in health insurance.

. …. .. … …. . . ….

The health concerns of the striking mechanics go beyond insurance.

Stallings said welfare negotiations are crucial, especially with recent exposures at

the Coffin Butte Landfill, from medical wastes like syringes to body parts and other kinds of biohazard risks.

"Getting all these safety issues addressed and having good health and welfare when they are not important to the members, and it does not seem like it's been taken seriously by the employer," Stallings said.

Wage-wise, Stallings said many of the heavy-duty mechanics in its network who work on the construction side earn around $50 per hour.

The mechanics employed by Valley Landfills earn around $35 per hour.

"We've been told at least one time that we're not going to see any proposals from the employer that include union health and welfare and union pension," Stallings said.

When contacted, officials with Republic Services declined to comment but eventually said via email: "Republic Services is in the early stages of contract negotiations with the union representing some of our technicians in Benton County. We respect the rights of our employees to engage in collective bargaining and look forward to reaching a fair and competitive contract that is beneficial for them, our company and the community."

Stallings said though bargaining was "early" considering the typical timeline for contract bargaining sessions such as this one, the union believed it was at the finish line.

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The goal of the strike action is to bring the employer back to the bargaining table and a meeting is scheduled for Thursday, Sept. 14.

Stallings said he hopes that it isn't canceled without reason.

"We're hopeful that we can have a good conversation at that point," he said.

- Benton County commission unanimously rejects Coffin Butte landfill expansion plan
- Republic Services appeals county decision on Coffin Butte landfill expansion
- Republic Services pulls appeal on Coffin Butte landfill expansion
- Benton dump findings take shape
- More Benton County news

From:	Ken Eklund
To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 4 of 12
Date:	Thursday, May 8, 2025 2:35:23 PM
Attachments:	writerguy-cube2.png

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This is the third and final part of a CHEJ pdf on landfills that is too big to email in one piece. – K



Ken Eklund, writerguy

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Creator of
World Without Oil
Ed Zed Omega
FutureCoast
and other storymaking games

International Journal of Epidemiology, 2016, Vol. 45, No. 3

Key Messages

- The evidence on the health of people living close to landfills is still controversial; most of the published studies are characterized by poor exposure assessment, use of health data at the aggregate level and limited possibility of adjusting for socioeconomic status.
- We evaluated the potential health effect of living near nine landfills (Lazio region, Italy), using a residential cohort approach and a dispersion model for exposure assessment.
- Exposure to landfills was associated with mortality from lung cancer and respiratory diseases and with hospitalizations for respiratory diseases, both in adults and in children.

Introduction

People who live close to municipal solid waste (MSW) landfills could be exposed to air pollutants emitted by the plants (landfill gas containing methane, carbon dioxide, hydrogen sulphide and other contaminants including volatile organic compounds, particulate matter and bioaresols) or to contaminated soil and water. The possible health effects related to residence close to these sites have been assessed in several original papers[1–9] and evaluated in systematic reviews.[10,11] Excess of mortality for some cancer sites (e.g. liver, pancreas, kidney, larynx) and non-Hodgkin lymphoma has been noted in some studies,[1–3] but the results have not been confirmed in other investigations.[4–6] In addition, some studies have indicated an increase of respiratory symptoms among residents close to biodegradable waste facilities.[12] In 2009, Porta *et al.*[10] concluded that evidence of an association between living close to a landfill and adverse health effects is inconclusive. Most of the published studies have methodological problems, including poor exposure assessment based only on distance from the source, use of health data at the aggregate level and limited possibility of adjusting for socioeconomic status. The quality of the epidemiological studies and scientific knowledge about the issue would be improved by using a residential cohort approach[13] and applying dispersion models to provide a better exposure assessment.[14]

This study aimed at evaluating the association between estimated exposure to hydrogen sulphide (H_2S, produced by anaerobic decomposition of sulphur-containing organic matter in landfills) and mortality and morbidity of a cohort of residents living within 5 km of the nine MSW landfills of the Lazio region (Central Italy, about 5 million inhabitants including the city of Rome). The study was part of a larger project on the characteristics of municipal solid waste treatment plants, their emissions and potential health effects in Lazio (www.eraslazio.it).

Methods

Study areas

Nine municipal solid waste landfills have been operating in Lazio for several decades. Only in the past two decades they were equipped with containments (including leachate collection and treatment, landfill cap construction and landfill gas collection and treatment). The main characteristics of the landfills (together with other potentially relevant environmental factors in the areas, e.g. arsenic contamination)[14] are described in Supplementary Table 1, Landfill characteristics, and in Supplementary Figure 2, Study areas, (available as Supplementary data at *IJE* online). The study area was defined for each landfill as a 5-km radius from the boundary of the landfills assessed using GIS software and regional technical maps with a scale of 1:5000. The World Geodetic System of 1984, with the Universal Transverse Mercator zone 33Nord projection (WGS84_UTM33N) was the reference for the geographical coordinates.

Exposure assessment

H_2S has been considered a surrogate measure of all contaminants emitted by landfills, and the airborne concentrations were predicted using a dispersion model. Dispersion models, such as the one we have been using here, have been recently used to assess the health effects of waste management processes.[15–17] We followed a process in three steps. First, yearly H_2S emissions from each sector of the landfills were estimated using a Landfill Gas Emissions Model.[18] Using several variables (the start and end dates of operations for each sector of the landfills, the waste capacity and waste acceptance rate), the annual emission rates for H_2S were calculated by means of a first-order decomposition rate equation:

$$Q_{H_2S} = \sum_{t=1}^{n} \sum_{j=0.1}^{1} KL_0 \left(\frac{M_t}{10}\right) e^{-kt_{ij}} \left($$

where:

QH_2S = annual emission rate (m^3/year)

t = age of the jth section of the landfill

i = 1 year time increment

n = (year of the calculation) – (initial year of waste acceptance)

j = 0.1 year time increment

K = hydrogen sulphide generation rate (year-1)

L_o = potential hydrogen sulphide generation capacity (m^3/Mg)

M_t = mass of waste accepted until t (in Mg)

tij = age of the waste mass accepted until the ith year (M_t) at the jth section

Mg = Megagram.

We used inventory defaults parameters derived from the US Environmental Protection Agency (EPA) Compilation of Air Pollutant Emission Factors[19] to define hydrogen sulphide generation rate (K) and potential hydrogen sulphide generation capacity (L_o), and Mt and tij were defined by the Lazio Environmental Protection Agency (EPA) using local data. Second, the EMMA software was used for the temporal and spatial modulation of the estimated emissions. EMMA approximates landfills shape as a regular grid with a resolution of 125 m x 125 m.[20] Finally, we used a Lagrangian particle model (SPRAY ver.5, ARIANET Srl, Italy) to simulate H_2S concentrations around the landfills and to produce maps of annual average concentrations around the sites; 2008 was chosen as the reference year for all the sites. The meteorological data were derived from regional measurements made by Lazio EPA in 2005 (that year is considered representative of the meteorological conditions in the area), and used in connection with RAMS data.[21] The Lagrangian model simulates the transport, dispersion and deposition of pollutants emitted using the orography, the meteorological data, the turbulence and the hourly spatial distribution (horizontal and vertical) of the emissions, based on the characteristics of the single source and on the mass fluxes. The model follows the path of fictitious particles in the atmospheric turbulent flow, and it is able to take into account complex situations, such as the presence of obstacles, breeze cycles, strong meteorological non-homogeneities and non-stationary, calm wind conditions.

Each subject in the cohort (see below) was assigned an H_2S exposure value corresponding to the estimated annual average value from the dispersion model at the baseline address. In other words, no exposure variation over time was considered and each person remained at the same exposure level during the all study period.

Enrolment of the cohort and follow-up procedures

All residents living within 5 km of the borders of the landfill on 1 January 1996, or those who later moved to the areas until 31 December 2008, were enrolled; datasets from 16 municipalities were used. Vital status was assessed using local registries until 31 December 2012. We considered subjects at risk until they died or moved out of the municipality.

Health outcomes

We analysed natural and cause-specific mortality and hospital admissions for cardiorespiratory diseases. The underlying cause of death for deceased subjects was retrieved from the Regional Registry of Causes of Death, and hospital admissions were obtained from the Regional Hospital Information System which collects information related to all hospital admissions that occur each year in public and private hospitals. Causes of death and diagnoses of hospitalization were coded according to the ICD 9 revision. For each subject, only the principal diagnosis that was the reason for the hospitalization was used and the event (i.e. failure in the Cox model) was defined at the time of the first hospitalization for a specific cause that occurred in the study period. Respiratory hospital admissions for children (residents under 14 years) were also analysed.

Covariates

We considered for each subject an area-based socioeconomic position (SEP) index, based on several characteristics at the census tract level (around 400 inhabitants) such as education level, occupation, housing conditions, family size and country of origin, classified into five levels (high, middle-high, medium, middle-low, low).[22] Modelled outdoor PM_{10} concentrations ($\mu g/m^3$) from primary emissions were assigned to the residential addresses of the cohort participants as a measure of background air quality.[23] The dispersion model was based on the integration between the meteorological Regional Atmospheric Modelling System [21] and the Eulerian Flexible Air Quality Regional Model (FARM, ARIANET Srl, Italy). As an additional indicator of long-term exposure to traffic-related air pollution at the baseline address, we used the Functional Road Class (FRC) (included in the TeleAtlasMultiNet road network) to classify the type of street: motorway (FRC = 0) and major traffic roads (FRC = 1–5). Presence of an industrial plant in the 2-km buffer from the residence was also considered. Information on individual lifestyle factors was not available.

Statistical analysis

The association between landfill H_2S exposure and mortality and hospital admissions was evaluated using Cox proportional hazard regression models [hazard ratios (HRs), 95% confidence intervals (CIs)], with age as the underlying time variable.

For mortality we defined a latency period of 5 years; therefore we considered all cohort participants who were residents of the area on 1 January 1996 (and started the follow-up on 1 January 2001) and those who subsequently moved to the areaup until 31 December 2003 (starting the follow-up 5 years after enrolment). No latency was allowed for the analyses of cardiorespiratory hospitalizations. We first compared the mortality and hospitalization risk of residents according to quartiles of the H_2S distribution. We then considered H_2S as a continuous variable, using the value of the annual mean exposure at residence. A linear association was estimated for increments equal to 1 ng/m^3 of H_2S. We considered as potential confounders socioeconomic position (SEP), PM_{10} background concentrations, residence within 150 m of main roads, 500 m from highways and within 1 or 2 km of industrial plants. With the exception of PM_{10}, which was a continuous variable, all other covariates were considered in the model as categorical variables. In addition, the analyses were performed stratifying in the Cox analysis by landfill sites, to take into account the possible different background rates in the various local areas, by gender and by calendar period (1996–2000, 2001–04, 2005–08, 2009–12), to take into account possible time-related changes in background rates of mortality and hospitalization. Diagnostic tools were used to check the proportional-hazard assumption for all categorical covariates. If any variable in the individual cohort models violated this assumption, effect estimates were compared with a stratified Cox analysis for that covariate. SAS (SAS Institute, NC) and STATA ver. 12 (StataCorp, TX) software programs were used for the statistical analyses.

Results

A total of 242 409 individuals were enrolled in the cohort from 1996 to 2008 (50.4% females), and H_2S concentrations were estimated for each of them at the address of recruitment. The annual average H_2S exposure levels of the population was rather low, 6.3 ng/m^3 [standard deviation (SD) 22.5]; as expected, people living close to the larger landfills (Latina and Rome) had higher H_2S exposure levels [mean =↽32.7 ng/m^3 (SD 76.3) and mean =↽45.8 ng/m^3 (SD 59), respectively].

The main characteristics of the study cohort according to H_2S concentrations (divided by quartiles of exposure) are described in Table 1. The distribution of gender, age and vital status was rather similar across exposure categories. However, people living in areas with higher concentrations of H_2S were more likely to be of lower SEP compared with people living in areas with lower exposure. PM_{10} background concentrations were higher in the most exposed group compared with those in the low exposure category. People in the higher exposure category tended to live farther from high traffic roads (500 m) but closer to highways and industrial plants (0–1 km). There was a good correlation between distance from landfill and H_2S exposure.

At the end of the follow-up there were 18 609 deaths (7.7%), and for 40 740 subjects (16.8%) the follow-up ended at the time of move away from the municipality of residence.

Table 2 shows the association between H_2S concentrations and cause-specific mortality; effect estimates are given for the quartile distribution of H_2S (25–50, 50 75 and >ψ 75 percentile of the distribution vs <⁄25 percentile) and for a linear increase of H_2S equal to 1 ng/m^3. There were associations between H_2S exposure and lung cancer (HR 1.34, 95% CI 1.06–1.71), and respiratory diseases (HR 1.30, 95% CI 0.99–1.70) when comparing residents in areas with H_2S concentrations greater than 75 percentiles to the reference group. These findings were confirmed when we consider H_2S exposure as linear (HR 1.10, 95% CI 1.02–1.19 for lung cancer and HR 1.09, 95% CI 1.00–1.19 for respiratory diseases). No other associations were noted.

Table 3 shows the results for cardiorespiratory hospital admissions. No association was detected for cardiovascular diseases. There was an association between the highest quartile of exposure to H_2S and hospitalizations for respiratory diseases (H 1.05, 95% CI 0.99–1.11) also when considering H_2S exposure as linear (HR 1.02, 95% CI 1.00–1.03). H_2S exposure was linked with respiratory diseases and acute respiratory infection hospital admissions among children (for the highest quartile, HR 1.11, 95% CI 1.01–1.22; HR 1.20, 95% CI 1.04–1.38, respectively) also when we considered H_2S exposure as a linear term in the model. We found an association with paediatric admissions for asthma but with wider confidence intervals.In both mortality and hospitalization analyses, we did not find effect modification by gender (data not shown).

Because of the peculiarity of the urban site in Rome ('Malagrotta') (where a large landfill, an incinerator of medical wastes, and a petrochemical refinery are located within just a few kilometres of each other[3]), we repeated the analyses excluding the subjects who live close to the Malagrotta landfill. There were no important changes in the results (See Supplementary Tables 3 'Mortality excluding Malagrotta landfill' and 4 'Morbidity excluding Malagrotta landfill', available as Supplementary data at *IJE* online). We did perform the same sensitivity analysis excluding each landfill at the time, and again the results were similar (see Supplementary Figures 7 'Lung cancer mortality', 8 'Respiratory mortality', 9 'Respiratory morbidity' and 10 'Respiratory morbidity in children', available as Supplementary data at *IJE* online).

Table 1. Descriptive individual and environmental characteristics of the cohort members by hydrogen sulphide (H_2S) exposure

	Total		H_2S exposure levels (ng/m^3)							
			<25°perc (<0.77)		25°–50°perc (0.77–2.1)		50°–75°perc (2.1–4.2)		>75°perc (>4.2)	
	No.	%	No.	%	No.	%	No.	%	No.	%
Total	242 409	100	60 927	100.0	60 775	100	63 962	100	56 745	100
Gender										
Males	120 232	49.6	29 781	49.0	30 137	49.6	31 979	50.0	28 335	49.9
Females	122 177	50.4	31 146	51.0	30 638	50.4	31 983	50.0	28 410	50.1
Vital status										
Alive	183 060	75.5	48 306	79.3	45 948	75.6	44 673	69.8	44 133	77.8
Migrant	40 740	16.8	8 169	13.4	10 228	16.8	14 446	22.6	7 897	13.9
Dead	18 609	7.7	4 452	7.3	4 599	7.6	4 843	7.6	4 715	8.3
Age at recruitment (years)										
0–14	53 082	21.9	12 246	20.0	13 011	21.4	16 266	25.4	11 559	20.4
15–44	112 754	46.5	27 380	45.0	28 383	46.7	30 661	47.9	26 330	46.4
45–64	50 146	20.7	13 296	22.0	12 584	20.7	11 727	18.3	12 539	22.1
>65	26 427	10.9	8 005	13.0	6 797	11.2	5 308	8.3	6 317	11.1
Area-based socioeconomic position										
High	23 589	9.7	10 012	16.0	6 033	9.9	4 779	7.5	2 765	4.9
Middle-high	41 955	17.3	7 843	13.0	8 834	14.5	9 548	14.9	15 730	27.7
Medium	42 286	17.4	7 447	12.0	8 588	14.1	13 958	21.8	12 293	21.7
Middle-low	50 394	20.8	5 364	9.0	16 816	27.7	17 563	27.5	10 651	18.8
Low	62 157	25.6	22 806	37.0	15 206	25.0	11 906	18.6	12 239	21.6
Missing	22 028	9.1	7 455	12.0	5 298	8.7	6 208	9.7	3 067	5.4
PM_{10} (μg/m^3)										
<11.99 (<50°perc)	121 222	50.0	44 371	73.0	29 696	48.9	23 986	37.5	23 169	40.8
11.99–17.69 (50°–90°perc)	96 369	39.8	16 556	27.0	28 967	47.7	31 661	49.5	19 185	33.8
>17.69 (>90°perc)	24 818	10.2	0	0.0	2 112	3.5	8 315	13.0	14 391	25.4
Distance from major roads (metres)										
<150 m	114 698	47.3	31 842	52.0	25 876	42.6	34 506	53.9	22 474	39.6
>150 m	127 711	52.7	29 085	48.0	34 899	57.4	29 456	46.1	34 271	60.4
Distance from highways (metres)										
<500 m	9 428	3.9	2 908	5.0	1 087	1.8	744	1.2	4 689	8.3
>500 m	232 981	96.1	58 019	95.0	59 688	98.2	63 218	98.8	52 056	91.7
Distance from industrial plants (km)										
0–1 km	12 863	5.3	376	1.0	2 676	4.4	1 130	1.8	8 681	15.3
1–2 km	50 503	20.8	1 138	2.0	9 589	15.8	28 809	45.0	10 967	19.3
>2 km	179 043	73.9	59 413	98.0	48 510	79.8	34 023	53.2	37 097	65.4
Distance from landfill (km)										
0–1 km	5 187	2.1	0	0.0	3	0.0	19	0.0	5 165	9.1
1–2 km	21 475	8.9	2	0.0	4 225	7.0	5 835	9.1	11 413	20.1
2–3 km	65 386	27.0	8 372	13.7	20 588	33.9	23 627	36.9	12 799	22.6
3–4 km	77 722	32.1	19 739	32.4	18 787	30.9	20 217	31.6	18 979	33.4
4–5 km	72 639	30.0	32 814	53.9	17 172	28.3	14 264	22.3	8 389	14.8

An additional analysis was performed using distance from the landfills (0–2 km, 2–3 km vs 3–5 km), instead of estimated H_2S concentration, as the exposure variable. Although the results for mortality using distance were not similar to what has been observed using H_2S concentrations (see Supplementary Table 5 'Mortality by distance', available as Supplementary data at *IJE* online) the results for hospitalizations were similar to those obtained using H_2S concentrations (see Supplementary Table 6 'Morbidity by distance', available as Supplementary data at *IJE* online).

Our final concern was that migration outside the areas could bias the results in the case of migration being associated with the exposure and if residents with pre-existing diseases were more likely to migrate. We compared the characteristics of people who migrated outside the study

Table 2. Associations between hydrogen sulphide (H_2S in quartiles and continuous) and cause specific mortality: number of deaths (No.) hazard ratios (HR) and 95% confidence intervals (95% CI)

Cause of death (ICD-9-CM)	H_2S concentrations														
	<25°-percentile[a]	25°-50°-percentile				50°-75°-percentile				>75°-percentile				Linear trend	
	No.	No.	Crude HR	HR	95% CI	No.	Crude HR	HR	95% CI	No.	Crude HR	HR	95% CI	HR	95% CI
Natural causes (001–799)	3 701	3 946	0.98	1.01	(0.96–1.06)	4 254	1.00	1.02	(0.97–1.08)	4 104	0.96	0.98	(0.91–1.05)	1.00	(0.98–1.02)
All cancers (140–239)	1 282	1 307	0.97	0.99	(0.91–1.08)	1 493	1.03	1.05	(0.95–1.16)	1 452	1.00	1.03	(0.91–1.16)	1.01	(0.98–1.05)
Stomach (151)	75	88	1.03	0.98	(0.70–1.37)	108	1.27	1.23	(0.84–1.79)	105	1.00	0.88	(0.54–1.42)	1.00	(0.87–1.16)
Colorectal (153–154,159)	154	170	0.99	1.00	(0.79–1.27)	176	0.96	0.97	(0.74–1.28)	159	0.93	0.91	(0.64–1.28)	0.97	(0.87–1.08)
Liver (155–156)	102	89	0.86	0.83	(0.61–1.13)	106	0.89	0.77	(0.53–1.11)	89	0.74	0.76	(0.48–1.2)	0.90	(0.78–1.05)
Pancreas (157)	68	64	0.92	0.93	(0.64–1.35)	69	0.92	0.95	(0.61–1.49)	72	0.69	0.73	(0.41–1.32)	0.93	(0.77–1.11)
Larynx (161)	17	15	0.81	0.72	(0.33–1.56)	11	0.38	0.40	(0.14–1.14)	23	0.43	0.26	(0.07–0.95)	0.64	(0.43–0.97)
Lung (162)	276	281	0.98	1.06	(0.89–1.27)	360	1.09	1.18	(0.97–1.45)	361	1.19	1.34	(1.06–1.71)	1.10	(1.02–1.19)
Bladder (188)	54	48	0.88	0.89	(0.59–1.36)	56	1.22	1.33	(0.81–2.16)	50	1.01	0.94	(0.5–1.80)	1.03	(0.85–1.26)
Kidney (189)	36	30	0.76	0.85	(0.51–1.43)	36	0.87	0.94	(0.52–1.70)	31	0.70	0.86	(0.41–1.83)	0.96	(0.75–1.22)
Brain (191)	23	29	1.26	1.25	(0.70–2.26)	38	1.63	1.63	(0.84–3.17)	41	1.70	1.76	(0.81–3.81)	1.22	(0.95–1.56)
Lymphatic and haematopoietic tissue (200–208)	108	115	1.03	1.16	(0.87–1.54)	106	0.94	0.96	(0.68–1.35)	102	1.06	1.12	(0.74–1.17)	1.02	(0.89–1.16)
Cardiovascular diseases (390–459)	1 457	1 681	1.02	1.05	(0.97–1.13)	1 676	0.96	1.00	(0.91–1.09)	1 641	0.90	0.91	(0.81–1.02)	0.98	(0.94–1.01)
Ischaemic heart diseases (410–414)	512	570	0.99	1.00	(0.88–1.14)	574	0.86	0.91	(0.78–1.06)	530	0.77	0.78	(0.64–0.95)	0.93	(0.87–0.99)
Respiratory diseases (460–519)	256	244	0.88	0.92	(0.76–1.11)	279	1.15	1.13	(0.90–1.40)	264	1.30	1.30	(0.99–1.70)	1.09	(1.00–1.19)
Digestive diseases (520–579)	158	163	0.93	0.97	(0.77–1.24)	218	1.06	1.09	(0.83–1.41)	186	0.94	0.97	(0.69–1.35)	1.01	(0.91–1.12)
Urinary system diseases (580–599)	58	92	1.49	1.54	(1.08–2.21)	74	1.25	1.28	(0.83–1.97)	67	1.26	1.42	(0.84–2.40)	1.11	(0.94–1.30)

[a]Reference category

Table 3. Associations between hydrogen sulphide (H_2S, in quartiles and continuous) and cardiorespiratory morbidity: number of people hospitalized (No.), hazard ratios (HR) and 95% confidence intervals (95% CI)

Diagnosis (ICD-9-CM)	H_2S concentrations															
	<25°percentile[a]		25°=50°percentile				50°=75°percentile				>75°percentile				Linear trend	
	No.		No.	Crude HR	HR	95% CI	No.	Crude HR	HR	95% CI	No.	Crude HR	HR	95% CI	HR	95% CI
Total cohort																
Cardiovascular diseases (390–459)	6 666		6 090	0.99	0.99	(0.95–1.03)	6 291	0.99	1.00	(0.96–1.04)	6 677	1.03	1.02	(0.97–1.07)	1.00	(0.99–1.02)
Cardiac diseases (390–429)	3 991		3 585	0.99	0.98	(0.93–1.03)	3 580	0.97	0.98	(0.92–1.04)	4 022	1.05	1.04	(0.97–1.11)	1.01	(0.98–1.03)
Ischaemic heart diseases (410–414)	1 393		1 347	1.03	1.02	(0.94–1.10)	1 288	0.94	0.94	(0.85–1.03)	1 426	1.01	0.99	(0.88–1.10)	0.99	(0.95–1.02)
Cerebrovascular diseases (430–438)	1 635		1 482	0.98	0.98	(0.91–1.06)	1 466	0.97	0.97	(0.89–1.06)	1 543	0.97	0.98	(0.88–1.10)	0.99	(0.96–1.03)
Respiratory diseases (460–519)	4 372		4 249	0.98	0.97	(0.92–1.01)	5 628	1.02	1.01	(0.96–1.06)	4 837	1.06	1.05	(0.99–1.11)	1.02	(1.00–1.03)
Acute respiratory infections (460–466,480–487)	1 447		1 441	1.00	0.96	(0.89–1.04)	1 721	1.00	0.97	(0.89–1.05)	1 509	1.09	1.07	(0.97–1.18)	1.02	(0.98–1.05)
COPD (490–492,494,496)	654		592	0.96	0.94	(0.84–1.06)	535	0.92	0.90	(0.78–1.04)	577	1.09	1.06	(0.90–1.25)	1.00	(0.95–1.05)
Asthma (493)	332		355	1.01	1.00	(0.86–1.17)	594	1.16	1.17	(0.99–1.38)	365	1.11	1.09	(0.90–1.33)	1.04	(0.98–1.11)
Children 0–14 years old																
Respiratory diseases (460–519)	1 457		1 522	1.00	0.99	(0.92–1.07)	2 420	1.07	1.08	(0.99–1.17)	1 499	1.10	1.11	(1.01–1.22)	1.04	(1.01–1.07)
Acute respiratory infections (460–466,480–487)	573		669	1.10	1.02	(0.91–1.15)	925	1.15	1.10	(0.97–1.25)	617	1.25	1.20	(1.04–1.38)	1.06	(1.02–1.11)
Asthma (493)	257		267	0.98	0.99	(0.83–1.19)	506	1.23	1.29	(1.06–1.55)	276	1.11	1.13	(0.91–1.41)	1.07	(0.99–1.14)

[a]Reference category

areas (40 740 subjects) with those who remained in the areas until the end of the follow-up (201 669 subjects) See Supplementary Table 11 'Comparison between migrant and not migrant', available as Supplementary data at *IJE* online). We considered gender, age, socioeconomic status and H_2S exposure as fixed variables. Since occurrence of hospitalizations before migration is a time-dependent variable, we compared subjects migrating in the period 2004–12 (19 695 subjects) with all subjects who did not migrate before that period (189 560 subjects), evaluating the occurrence of cardiorespiratory hospitalizations during1998–2003. Migration was associated with male gender, younger age and lower exposure to H_2S; no clear differences of migrants compared with non-migrants were found for socioeconomic status. In a multinomial logistic regression(data not shown), we found no major differences between the two groups for respiratory diseases, whereas migrants were less likely than non-migrants to suffer from two or more hospitalizations for cardiovascular disease (OR, 0.74, 95% CI 0.57–0.95) before migrating. All these results indicate that bias due to increased susceptibility of migrants is unlikely given that migrants are less exposed and tend to be healthier than non-migrants.

Discussion

We found a positive association between exposure to hydrogen sulphide (H_2S), that we used as a surrogate for all the pollutants co-emitted from the landfills, and mortality for lung cancer and respiratory diseases as well as hospital admissions for respiratory diseases, especially in children.

Previous studies have investigated the association between residence close to landfills and cancer incidence or cause-specific mortality, with conflicting results. A Canadian cohort study compared cancer incidence in males living close to a landfill with that of residents of farther away areas.[1] The distance from the landfill was assigned to each person based on the residential address at diagnosis. Excess risks for non-Hodgkin lymphoma and liver, pancreas and kidney cancers were found in male residents close to the site. Malagrotta (Rome) residents who lived near (in an area about 2 km^2) a large landfill of municipal solid waste, an incinerator and a petrochemical refinery showed an association between proximity to landfill and laryngeal cancer.[2] A more recent residential cohort study of the same area found that H_2S exposure from the landfill was related to higher risk of mortality from laryngeal cancer and bladder cancer in women, as well as hospitalizations for cardiorespiratory diseases.[3] Jarup *et al.* compared cancer incidence (bladder, brain and hepatobiliary cancers and leukaemias) in the population resident within 2 km of 9565 landfills in UK with cancer rates of

International Journal of Epidemiology, 2016, Vol. 45, No. 3

those who lived more than 2 km away.[4] Despite the large statistical power, the study did not show excess cancer risk associated with proximity to landfill sites. An ecological study compared mortality, hospital admissions and reproductive health of a population living near a landfill site in Wales with another population matched for socioeconomic status.[5] No differences between the two populations were found. A study in Brazil evaluated the association between residence close to solid waste landfill sites and cancer mortality.[6] The exposed areas were defined using a 2-km buffer radius around 15 sites. Standardized mortality ratios were analysed in Bayesian spatial models. The results did not indicate any excess risk for people close to landfills. Some elevated risks of bladder and liver cancer, and death due to congenital malformation were found, although they did not have statistical significance.

The results we found regarding respiratory diseases are consistent with others suggesting a relationship between living close to landfill areas and damage to the respiratory system,[24,25] as highlighted in a recent systematic review.[26] Occurrence of respiratory symptoms was documented among residents living close to waste sites[12] and was linked to inhalation exposure to endotoxin, microorganisms, and aerosols from waste collection and land filling.[27]

Occupational exposure to organic dust, particulate matters from microbial, plant or animal origin, has been associated with an increased risk of lung cancer in a pooled analysis of case-control studies.[25] High lung cancer mortality was found among male residents of Italian National Priority Contaminated Sites with industrial waste landfills or illegal dumps[29] and among residents living near incinerators and landfills of hazardous waste in Spain,[30] but the overall evidence that residing near landfills is associated with increased risk of lung cancer is still inadequate.[10]

This study attempted to overcome some of the limitations of the previously conducted studies, which included issues of study design, exposure assessment and confounding.[11] We used a residential cohort approach to provide a more detailed estimation of the population at risk. To each subject in the cohort we assigned an H_2S exposure value(corresponding to the estimated H_2S concentration at the baseline address). It was not possible to consider indexes of average or cumulative exposure based on the different residences, because only a few municipality databases provided information about changes of residence during the follow-up. For this reason, individual exposure reflects residence at the beginning of the follow-up.

Previous studies have considered distance from landfills as a proxy of exposure.[4,7,9] Distance-to source is easy to understand because it assumes that people living near the landfill are more exposed than people living further away. We used modelled H_2S concentrations as an exposure measure of the landfill gases, on the assumption that the pollution from landfills does not spread uniformly around the site but depends on the quantity of incoming waste, the prevailing winds and the orography of the area.[3] Our results for hospitalizations were confirmed when we used distance from the source as the exposure variable instead of modelled H_2S concentrations. There are, however, several aspects in the exposure assessment process we used that should be considered. H_2S generation rates were taken from EPA published material, and waste acceptance capacity and waste acceptance rates were from derived from legal authorized values. It is likely, then, that the derived absolute emissions data were more accurate for the recent period and less certain for the past. On the other hand, we used the shape of the H_2S concentrations on the ground to rank subjects as more exposed or less exposed, and this shape is of greater importance than the exact absolute values. Of course, the major limitation of our exposure assessment is related to the lack of a validation study with *in situ* measurements. Nonetheless, SPRAY is a consolidated model that has been validated using a 'conventional' validation framework,[31] and its performances and efficiency have been evaluated and validated in multiple real conditions with different orography, size of domain, number of grid cells in the domain, meteorological conditions and emission types.[32–34] The model has been already used in other locations to study health effects of waste management.[3,17] Another aspect of concern is the use of meteorological parameters that greatly influence the dispersion of the pollutants. We considered the year 2005 as representative of the study area meteorological conditions because there were no particular meteorological anomalies in that year. Running the dispersion model with meteorological data for different years could change the landfills footprint only in presence of extreme weather conditions that strongly affect the annual average. In our opinion, the difference among years is generally minimal and the uncertainty associated with the use of specific meteorological data is negligible.

Our results were adjusted for several confounders: age, socioeconomic position and variables related to the environmental context (proximity to roads with heavy traffic, proximity to industrial sites, air quality) that might otherwise distort the study association. In particular, high level of PM_{10} ($>$90 percentile of the distribution vs $<$50 percentile) was associated in our model with cardiovascular and respiratory hospitalizations (HR 1.08, 95% CI 1.01–1.16 and HR 1.03, 95% CI 0.96–1.12, respectively). However, no data were available on the personal habits of the subjects, which could have had a role in the diseases investigated, especially cigarette smoking but also alcohol use, physical activity and obesity. The collection of this

information, through telephone interviews or home visits, would have been prohibitive for such a large cohort, and the lack of this information may have biased the results because of confounding not controlled in the analysis. It should be noted, however, that many personal habits are associated with socioeconomic position. It is therefore reasonable to assume that the analysis that adjusted for socioeconomic index also took into account others individual variables, including smoking. Moreover, excess of hospitalizations for respiratory diseases were found also in children, and no excess mortality/morbidity for cardiovascular diseases (indicative of most of the unmeasured lifestyle factors including smoking) was found, despite the larger statistical power than for respiratory diseases. Therefore, although residual confounding cannot be excluded, it is unlikely that the observed relationship between H_2S exposure and respiratory disturbances could be entirely due to unmeasured smoking habits and other factors.

In conclusion, we found associations between H_2S exposure from landfills and mortality from lung cancer as well as mortality and morbidity for respiratory diseases. The link with respiratory diseases has been observed in other studies and it is potentially related to irritant gases and other organic contaminants. The excess of lung cancer is a relatively new finding.

Supplementary Data

Supplementary data are available at *IJE* online.

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Review

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Systematic review of epidemiological studies on health effects associated with management of solid waste

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Abstract

Background: Management of solid waste (mainly landfills and incineration) releases a number of toxic substances, most in small quantities and at extremely low levels. Because of the wide range of pollutants, the different pathways of exposure, long-term low-level exposure, and the potential for synergism among the pollutants, concerns remain about potential health effects but there are many uncertainties involved in the assessment. Our aim was to systematically review the available epidemiological literature on the health effects in the vicinity of landfills and incinerators and among workers at waste processing plants to derive usable excess risk estimates for health impact assessment.

Methods: We examined the published, peer-reviewed literature addressing health effects of waste management between 1983 and 2008. For each paper, we examined the study design and assessed potential biases in the effect estimates. We evaluated the overall evidence and graded the associated uncertainties.

Results: In most cases the overall evidence was inadequate to establish a relationship between a specific waste process and health effects; the evidence from occupational studies was not sufficient to make an overall assessment. For community studies, at least for some processes, there was limited evidence of a causal relationship and a few studies were selected for a quantitative evaluation. In particular, for populations living within two kilometres of landfills there was limited evidence of congenital anomalies and low birth weight with excess risk of 2 percent and 6 percent, respectively. The excess risk tended to be higher when sites dealing with toxic wastes were considered. For populations living within three kilometres of old incinerators, there was limited evidence of an increased risk of cancer, with an estimated excess risk of 3.5 percent. The confidence in the evaluation and in the estimated excess risk tended to be higher for specific cancer forms such as non-Hodgkin's lymphoma and soft tissue sarcoma than for other cancers.

Conclusions: The studies we have reviewed suffer from many limitations due to poor exposure assessment, ecological level of analysis, and lack of information on relevant confounders. With a moderate level confidence, however, we have derived some effect estimates that could be used for health impact assessment of old landfill and incineration plants. The uncertainties surrounding these numbers should be considered carefully when health effects are estimated. It is clear that future research into the health risks of waste management needs to overcome current limitations.

Introduction

"Waste management", that is the generation, collection, processing, transport, and disposal of solid waste is important for both environmental reasons and public health. There are a number of different options available for the management and treatment of waste including minimisation, recycling, composting, energy recovery and disposal. At present, an increasing amount of the resources contained in waste is recycled, but a large portion is incinerated or permanently lost in landfills. The various methods of waste management release a number of substances, most in small quantities and at extremely low levels. However, concerns remain about potential health effects associated with the main waste management technologies and there are many uncertainties involved in the assessment of health effects.

Several studies of the possible health effects on populations living in proximity of landfills and incinerators have been published and well-conducted reviews are available [1-4]. Both landfills and incinerators have been associated with some reproductive and cancer outcomes. However, the reviews indicate the weakness of the results of the available studies due to design issues, mainly related to a lack of exposure information, use of indirect surrogate measures, such as the distance from the source, and lack of control for potential confounders. As a result, there is great controversy over the possible health effects of waste management on the public due to differences in risk communication, risk perception and the conflicting interests of various stakeholders. Therefore, there is the need for an appropriate risk assessment that informs both policy makers and the public with the information currently available on the health risks associated with different waste management technologies. Of course, the current uncertainties should be taken into account.

Within the EU-funded INTARESE project [5], we aimed to assess potential exposures and health effects arising from solid wastes, from generation to disposal, or treatment. A key part in the health impact assessment was selecting or developing a suitable set of relative risks that link individual exposures with specific health endpoints. In this paper, we systematically reviewed the available epidemiological literature on health effects in the vicinity of landfills and incinerators and among workers at waste processing plants to derive usable excess risk estimates for health impact assessment. The degree of uncertainty associated with these estimates was considered.

Methods

We considered epidemiological studies conducted on the general population with potential exposures from collecting, recycling, composting, incinerating, and landfilling solid waste. We also considered studies of employees of waste management plants as they may be exposed to the same potential hazards as the community residents, even if the intensity and duration of the exposure may differ. However, to limit our scope, we did not consider studies on biomarkers of exposure and health effects.

Relevant papers were found through computerized literature searches of MEDLINE and PubMed Databases from 1/1/1983 through 31/12/2008, using the MeSH terms "waste management" and "waste products" and the subheading "adverse effects". We identified 144 papers with this method. We also conducted a free search with several combinations of relevant key words (waste incinerator or landfill or composting or recycling) and (cancer or birth outcome or health effects), and 285 papers were identified. In addition, articles were traced through references listed in previous reviews [1-3,6-9], and in publications of the UK Department for Environment, Food and Rural Affairs [10]. Finally, we used information from two recent reviews of epidemiological studies on populations with potential exposures from toxic and hazardous wastes for reproductive [4], and cancer [11] outcomes, respectively.

The eligibility of all papers was evaluated independently by three observers, and disagreements were resolved by discussion. As indicated, studies on sewage treatment and on biological monitoring were not included. We also excluded articles in languages other than English, not journal articles, and six studies [12-17] conducted at the municipal level (usually small towns) where it was not possible to evaluate the extent of the population potentially involved and the possibility of exposure misclassification was high.

Papers were grouped according to the following criteria:

• waste management technologies: recycling, composting, incinerating, landfilling (considering controlled disposal of waste land and toxic or hazardous sites);

• health outcomes: cancers (stomach, colorectal, liver, larynx and lung cancer, soft tissue sarcoma, kidney and bladder cancer, non-Hodgkin's lymphoma, childhood cancer), birth outcomes (congenital malformations, low birth weight, multiple births, abnormal sex ratio of newborns), respiratory, skin and gastrointestinal symptoms or diseases.

We have reported in the appropriate tables (in the online additional files) for each paper: study design (e.g. geographical, cohort, cross-sectional, case-control study, etc.), population characteristics (subjects, country, age, sex), exposure measures (e.g. occupational exposure to waste incinerator by-products, residence near a landfill, etc.), and the main results (including control for major

confounders) with respect to the quantification of the health effects studied. For each study we have evaluated the potential sources of uncertainty in the results due to design issues. In particular, the possibility that selection bias, information bias, or confounding could artificially increase or decrease the relative risk estimate has been noted in the tables using the plus/minus scale to indicate that effect estimates are likely to be overestimated (or underestimated) up to 20% (+/-), from 20 to 50% (++/--) and more than 50% (+++/---). Uncertainties were graded by two observers (SM and FF), who discussed the inconsistencies.

After a description of the available studies, the overall evaluation of the epidemiological evidence regarding the process/disease association was made based on the IARC (1999) criteria, and two categories were chosen, namely: "*Inadequate*" when the available studies were of insufficient quality, consistency, or statistical power to determine the presence or absence of a causal association; "*Limited*" when a positive association was observed between exposure and disease for which a causal interpretation is considered to be credible, but chance, bias, or confounding could not be ruled out with reasonable confidence. There were no instances where the category "sufficient" evidence could be used. Only when the specific process/disease association was judged as limited (suggestive evidence but not sufficient to infer causality) we decided to evaluate the strength of the association and to measure appropriate relative risks. For this purpose, we considered the set of studies providing the best evidence and assigned an overall level of scientific confidence of the specific effect estimate based on an arbitrary scale: very high, high, moderate, low, very low. This evaluation was made by three assessors (SM, DP, and FF).

Results

A total of 49 papers were reviewed: 32 concerning health effects in communities in proximity to waste sites, and 17 on employees of waste management sites. The majority of community studies evaluated possible adverse health effects in relation to incinerators and landfills. We found little evidence on potential health problems resulting from environmental or occupational exposures from composting or recycling, and very little on storage/collection of solid waste. A description of the main findings follows.

Studies of communities near landfills

One of the main problems in dealing with studies on landfill sites (an to some extent also for incinerators) is the distinction between sites for municipal solid wastes and sites for other wastes. The definition of different types of waste is far from being standardised across the world. The terms hazardous, special, toxic, industrial, commercial, etc, are variously applied in different countries and time periods to designate non-household wastes. In earlier time periods definitions were even less clear and some disposal sites may have switched categories (e.g. if they used to take industrial waste they may now only take municipal waste). Since two systematic reviews were already available for toxic wastes [4,11], we did not replicate the literature search, but summarized the evidence reported in the available reviews and tried to compare and discuss the results with studies where mainly municipal solid wastes were landfilled. The additional file 1 contain several details of the studies reviewed.

Cancer

Russi et al. [11] carried out Medline searches of the peer-reviewed English language medical literature covering the period from January 1980 to June 2006 using the keywords "toxic sites" and "cancer", and identified articles from published reviews. They included 19 articles which fit the following selection criteria: 1) the study addressed either cancer incidence or cancer mortality as an endpoint, 2) the study was carried out in a community or a set of communities containing a known hazardous waste site; 3) the study had to address exposure from a specific waste site, rather than from a contaminated water supply resulted from multiple point sources. As the authors recognized, some of the location investigated included both toxic wastes and municipal solid wastes as in the study from Goldberg et al. [18] or Pukkala et al. [19]. There are two investigations considered in this review that are important to evaluate because of the originality of the approach (cohort study, [19] and due to the large size [20].

In Finland, Pukkala et al. [19] studied whether the exposure to landfills caused cancer or other chronic diseases in inhabitants of houses built on a former dumping area containing industrial and household wastes. After adjusting for age and sex, an excess number of male cancer cases were seen, especially for cancers of the pancreas and of the skin. The relative risk slightly increased with the number of years lived in the area. However, some uncertainties were likely to affect the results of the study with regards to the exposure assessment (-), outcome assessment (+) and presence of residual confounding (-).

Jarup et al. [20] examined cancer risks in populations living within 2 km of 9,565 (from a total of 19,196) landfill sites that were operational at some time from 1982 to 1997 in Great Britain. No excess risks of cancers of the bladder and brain, hepato-biliary cancer or leukaemia were found, after adjusting for age, sex, calendar year and deprivation. The study was very large and had high power, however misclassification of exposure could have decreased the possibility of detecting an effect (--).

Based on the findings and on the evaluation of the quality of the studies, Russi et al. [11] concluded that epidemiological studies of populations living in the vicinity of a toxic waste site have not produced evidence of adequate quality to establish a casual link between toxic waste exposures and cancer risk. In our terms, the evidence may be considered as "inadequate".

In addition to the articles reviewed by Russi et al. [11], we reviewed the article by Michelozzi et al. [21], which investigated the mortality risk in a small area of Italy (Malagrotta, Rome) with multiple sources of air contamination (a very large waste disposal site serving the entire city of Rome, a waste incinerator plant, and an oil refinery plant). Standardised Mortality Ratios (SMRs) were computed in bands of increasing distance from the plants, up to a radius of 10 km. No association was found between proximity to the sites and cancer of various organs, in particular liver, lung, and lymph haematopoietic cancer, however, mortality from laryngeal cancer declined with distance from the pollution sources, and a statistically significant trend remained after adjusting for a four-level index of socio-economic status. The main uncertainty of the study is related to the exposure assessment (--) since only distance was considered thus decreasing the possibility of detecting an effect. There are also uncertainties in using mortality to estimate cancer incidence in proximity to a suspected source of pollution (+). On the other hand, even though the authors did adjust for an area-based index of deprivation, residual confounding (+) from socioeconomic status was likely.

In summary, there is inadequate evidence of an increased risk of cancer for communities in proximity of landfills. The three slightly positive studies from Goldberg et al. [18], Pukkala et al. [19] and Michelozzi et al. [21] are not consistent.

Birth defects and reproductive disorders

Saunders [4] reviewed 29 papers examining the relationship between residential proximity to landfill sites and the risk of an adverse birth outcome. The review included either studies on municipal waste or on hazardous waste. Eighteen papers reported some significant association between adverse reproductive outcome and residence near a landfill site. Two of the strongest papers conducted on hazardous waste landfill sites in Europe (EUROHAZCON) found similarly moderate but significant associations between residential proximity (within 3 km) to hazardous waste sites and both chromosomal [22] (Odds Ratio, OR: 1.41, 95%CI: 1.00-1.99) and non-chromosomal [23] (OR: 1.33, 95%CI: 1.11-1.59) congenital anomalies.

Included in the Saunders's review [4] is the national geographical comparison study on landfills in the UK by Elliott et al. [24]. This study investigated the risk of adverse birth outcomes in populations living within two km of 9,565 landfill sites in Great Britain, operational at some time between 1982 and 1997, compared with those living further away (reference population). The sites included 774 sites for special (hazardous) waste, 7803 for non-special waste and 988 handling unknown waste; a two km zone was defined around each site to detect the likely limit of dispersion for landfill emissions, including 55% of the national population. Among the 8.2 million live births and 43,471 stillbirths, 124,597 congenital anomalies (including miscarriage) that were examined, there were: neural tube defects, cardiovascular defects, abdominal wall defects, hypospadias and epispadias, surgical correction of gastroschisis and exomphalos; low and very low birth weights were also found , defined as less than 2500 g and less than 1500 g, respectively. The main analysis, conducted for all landfill sites during their operation and after closure, found a small, but still statistically significant, increased risk of total and specific anomalies (OR: 1.01, 95%CI: 1.005-1.023) in populations living within 2 Km, and also an increased risk of low (OR: 1.05, 95%CI: 1.047-1.055) and very low birth weight (OR: 1.04, 95%CI: 1.03-1.05). Additional analyses were carried out separately for sites handling special waste and non-special waste, and in the period before and after opening, for the 5,260 landfills with available data. After adjusting for deprivation and other potential confounding variables (sex, year of birth, administrative region), there was a small increase in the relative risks for low and very low birth weight and for all congenital anomalies, except for cardiovascular defects. The risks of all congenital anomalies were higher for people living near special waste disposals (OR: 1.07 CI95%:1.04-1.09) compared to non-special waste disposals (OR: 1.02, CI95%:1.01-1.03). There was no excess risk of stillbirth. On these bases, the author [4] concluded that while most studies reporting a positive association are of good quality, over half report no association with any adverse birth outcome and most of the latter are also well conducted. The review considered that the evidence of an association of residence near a landfill with adverse birth outcomes as unconvincing.

After the review by Saunders [4], we considered four additional studies examining reproductive effects of landfill emissions.

Elliot et al. recently updated the previous study [25] in order to evaluate whether geographical density of landfill sites was related to congenital anomalies. The analysis was restricted to 8804 sites operational at some time between 1982 and 1997. There were 607 sites handling special (hazardous) waste and 8197 handling non-special or

unknown waste type. The exposure assessment took into account the overlap of the two km buffers around each site, to define an index of exposure with four levels of increasing landfill density. Several anomalies (hypospadias and epispadias, cardiovascular defects, neural tube defects and abdominal wall defects) were evaluated. The analysis was carried out separately for special and non-special waste sites and was adjusted for deprivation, presence or absence of a local congenital anomalies register and maternal age. The study found a weak association between intensity of hazardous sites and some congenital anomalies (all, cardiovascular, hypospadia and epispadias).

The studies conducted in the United Kingdom suffer from the same limitations, namely the possibility that misclassification of exposure could have decreased the relative risk estimates to some extent (--); on the other hand, there are several uncertainties related to the quality of reporting and registration of congenital malformations. In the latter case, a positive bias is more likely (++). For the recent report by Elliott et al. [25], location uncertainties and differential data reliability regarding the sites, together with the use of distance as the basis for exposure classification, limit the interpretation of the findings (--).

In Denmark, Kloppenborg et al. [26] marked the geographical location of 48 landfills and used maternal residence as the exposure indicator in a study of congenital malformations. The authors found no association between landfill location and all congenital anomalies or of the nervous system, and a small excess risk for congenital anomalies of the cardiovascular system. Potential confounding from socioeconomic status is the major limitation of this study (+++).

Jarup et al. [27] studied the risk of Down's syndrome in the population living near 6829 landfills in England and Wales. People were considered exposed if they lived in a two-km zone around each site, people beyond this zone were the reference group. A two-year lag period between potential exposure of the mother and her giving birth to a Down's syndrome child was allowed. The analysis was adjusted for maternal age, urban-rural status and deprivation index. No statistically significant excess risk was found in the exposed populations, regardless of waste type.

Finally, Gilbreath et al. [28] studied births in 197 Native Alaskan villages containing open dumpsites with hazardous waste, scoring the exposure into high, intermediate and low hazard level on the basis of maternal residence. The authors found an association between higher levels of hazard and low birth weight and intrauterine growth retardation. The major limit of the study is the low specificity of the exposure definition.

In summary, an increased risk of congenital malformations and of low birth weight has been reported from studies conducted in the UK. When compared with the results from studies conducted in proximity of hazardous waste sites, studies in proximity of non-toxic waste landfills provide lower effect estimates. The main uncertainty of these studies is the completeness of data on birth defects, the use of distance from the sites for exposure classification, and the classification as toxic and non-toxic waste sites.

Respiratory diseases

A study conducted by Pukkala et al. [19] in Finland evaluated prevalence of asthma in relation to residence in houses built on a former dumping area containing industrial and household wastes. Prevalence of asthma was significantly higher in the dump cohort than in the reference cohort (living nearby but outside the landfill site). Unfortunately, this study has not been replicated and the overall evidence may be considered inadequate.

Studies of landfills workers

Only one study on landfill workers was reviewed. Gelberg et al. [29] conducted a cross-sectional study to examine acute health effects among employees working for the New York City Department of Sanitation, focusing on Fresh Kills landfill employees. Telephone interviews conducted with 238 on-site and 262 off-site male employees asked about potential exposures both at home and work, health symptoms for the previous six months, and other information (social and recreational habits, socio-economic status). Landfill workers reported a significantly higher prevalence of work-related respiratory, dermatological, neurologic and hearing problems than controls. Respiratory and dermatologic symptoms were not associated with any specific occupational title or task, other than working at the landfill, and the association remained, even after controlling for smoking status.

Studies of communities living near incinerators

Twenty-one epidemiologic studies conducted on residents of communities with solid waste incinerators have been reviewed and their characteristics are listed in the additional file 2.

Cancer

Eleven studies have been reviewed on cancer risk in relation with incinerators, usually old plants with high polluting characteristics. The studies are reported below by country.

In the United Kingdom, Elliott et al. [30] investigated cancer incidence between 1974 and 1987 among over 14 million people living near 72 solid waste incinerator plants. Data on cancer incidence among the residents, obtained from the national cancer registration programme, were compared with national cancer rates, and numbers of observed and expected cases were calculated after stratifying for deprivation, based on the 1981 census. Observed-expected ratios were tested for decline in risk up to 7.5 km away. The study was conducted in two stages: the first involved a stratified random sample of 20 incinerators and, based on the findings, a number of cancers were then further studied around the remaining 52 incinerators (second stage). Over the two stages of the study there was a statistically significant ($p < 0.05$) decline in risk with distance from incinerators for all cancers, stomach, colorectal, liver and lung cancer. The use of distance as the exposure variable in this study could have led to some degree of misclassification (--). On the other hand, the same authors observed that residual confounding (+) as well as misdiagnosis (+) might have increased the risk estimates. When further analyses were made, including a histological review of liver cancer cases [31], the risk estimates were lower (0.53-0.78 excess cases per 10^5 per year within 1 km, instead of 0.95 excess cases per 10^5 as previously estimated).

Using data on municipal solid waste incinerators from the initial study by Elliott et al. [30], Knox [32] examined a possible association between childhood cancers and industrial emissions, including those from incinerators. From a database of 22,458 cancer deaths that occurred in children before their 16th birthday between 1953 and 1980, he extracted 9,224 cases known to have moved at least 0.1 km in their life time, and using a newly developed technique of analysis, he compared distances from the suspected sources to the birth addresses and to the death addresses. The childhood-cancer/leukaemia data showed highly significant excesses of moves away from birthplaces close to municipal incinerators, but the specific effects of the municipal incinerators could not be separated clearly from those of nearby industrial sources of combustion. Misclassification of exposure is the main limit of this paper (--).

In France, Viel et al. [33] detected a cluster of patients with non-Hodgkin's lymphoma (NHL) and soft tissue sarcoma around a French municipal solid waste incinerator with high dioxin emissions. To better explore the environmental origin of the cluster suggested by these findings, Floret et al. [34] carried out a population-based case-control study in the same area, comparing 222 incident cases of NHL diagnosed between 1980 and 1995 and controls randomly selected from the 1990 census. The risk of developing lymphomas was 2.3 times higher among individuals living in the area with the highest dioxin concentration than among those in the area with the lowest concentration. Given that a model was used to attribute exposure to cases and controls, a random misclassification could have reduced the effect estimates (--). Based of these results, a nationwide study on NHL was conducted [35]. A total of 13 incinerators in France were investigated and dispersion modelling was used to estimate ground-level dioxin concentration. Information about the exposure levels and potential confounders was available at the census block level. A positive association between dioxin level and NHL was found with a stronger effect among females. Although the study represents an improvement regarding exposure assessment compared to investigations based on distance from the source, it should be noted that the analysis was conducted at the census block level and the possibility of misclassification of the exposure (-) as well as of residual confounding from socioeconomic status (+) remains.

Viel et al. [36] have recently reported the findings from a case-control study on breast cancer. There was no association or even a negative association between exposure to dioxin and breast cancer in women younger or older than 60 years, respectively, living near a French municipal solid waste incinerator with high exposure to dioxin. Design issues and residual confounding from age and other factors (---) limit the interpretations of the study.

In Italy, Biggeri et al. [37] conducted a case-control study in Trieste to investigate the relationship between multiple sources of environmental pollution and lung cancer. Based on distance from the sources, spatial models were used to evaluate the risk gradients and the directional effects separately for each source, after adjusting for age, smoking habits, likelihood of exposure to occupational carcinogens, and levels of air particulate. The results showed that the risk of lung cancer was inversely related to the distance from the incinerator, with a high excess relative risk very near the source and a very steep decrease moving away from it. The main problem of the study is the difficulty to separate the effects of other sources of pollution based on distance, and the possibility of potential confounding from other sources remains (++). An excess risk of lung cancer was also found in females living in two areas of the province of La Spezia (Italy) exposed to environmental pollution emitted by multiple sources, including an industrial waste incinerator [38]. Again in this study the limited exposure assessment could have decreased the risk estimates (--), but positive confounding from other sources is very likely.

A case-control study by Comba et al. [39] showed a significant increase in risk of soft tissue sarcomas associated with residence within two km of an industrial waste incin-

erator in the city of Mantua, with a rapid decrease in risk at greater distances. There is a slight likelihood that increased attention to the diagnosis for this form of cancer in the vicinity of the plant could have introduced a small bias (+) in the risk estimate. Another case-control study, carried out in the province of Venice by Zambon et al. [40] analyzed the association between soft-tissue sarcoma and exposure to dioxin in a large area with 10 municipal solid waste incinerators. The authors found a statistically significant increase in the risk of sarcoma in relation to both the level and the length of environmental modelled exposure to dioxin-like substances. The results were more significant for women than for men.

In summary, although several uncertainties limit the overall interpretation of the findings, there is limited evidence that people living in proximity of an incinerator have increased risk of all cancers, stomach, colon, liver, lung cancers based on the studies of Elliott et al. [30]. Specific studies on incinerators in France and in Italy suggest an increased risk for non-Hodgkin's lymphoma, and soft-tissue sarcoma.

Birth defects and reproductive disorders

Six studies examined reproductive effects of incinerator emissions (see additional file 2).

Jansson et al. [41] analysed whether the incidence of cleft lip and palate in Sweden increased since operation of a refuse incineration plant began. The results of this register study, based on information from the central register of malformations and the medical birth register, did not demonstrate an increased risk.

A study by Lloyd et al. [42] examined the incidence of twin births between 1975 and 1983 in two areas near a chemical and a municipal waste incinerator in Scotland: after adjusting for maternal age, an increased frequency of twinning in areas exposed to air pollution from incinerators was seen. In the same study areas, Williams et al. [43] investigated gender ratios, at various levels of geographical detail and using three-dimensional mapping techniques: analyses in the residential areas at risk from airborne pollution from incinerators showed locations with statistically significant excesses of female births.

To investigate the risk of stillbirth, neonatal death, and lethal congenital anomaly among infants of mothers living close to incinerators (and crematoriums), Dummer et al. [44] conducted a geographical study in Cumbria (Great Britain). After adjusting for social class, year of birth, birth order, and multiple births, there was an increased risk of lethal congenital anomaly, in particular spina bifida and heart defects.

Subsequently, Cordier et al. [45] studied communities with fewer than 50,000 inhabitants surrounding the 70 incinerators that operated for at least one year from 1988 to 1997 in France. Each exposed community was assigned an exposure index based on a Gaussian plume model, estimating concentrations of pollutants per number of years the plant had operated. The results were adjusted for year of birth, maternal age, department of birth, population density, average family income, and when available, local road traffic. The rate of congenital anomalies was not significantly higher in exposed compared with unexposed communities; only some subgroups of congenital anomalies, specifically facial cleft and renal dysplasia, were more frequent in the exposed communities.

Tango et al. [46] investigated the association of adverse reproductive outcomes with mothers living within 10 km of 63 municipal solid waste incinerators with high dioxin emission levels (above 80 ng international toxic equivalents TEQ/m^3) in Japan. To calculate the expected number of cases, national rates based on all live births, fetal deaths and infant deaths occurred in the study area during 1997-1998 were used and stratified by potential confounding factors available from the corresponding vital statistics records: maternal age, gestational age, birth weight, total previous deliveries, past experience of fetal deaths, and type of paternal occupation. None of the reproductive outcomes studied showed statistically significant excess within two km of the incinerators, but a statistically significant decline in risk with distance from the incinerators was found for infant deaths and for infant deaths with congenital anomalies, probably due to dioxin emissions from the plants.

In sum, there are multiple reports of increased risk of congenital malformations among people living close to incinerators but there are no consistencies between the investigated outcomes. The overall evidence may be considered as limited. The study by Cordier et al. [45] provides the basis for risk quantifications at least for facial cleft and renal dysplasia. Quantification for other reproductive disorders is more difficult.

Respiratory and skin diseases or symptoms

Four studies examined respiratory and/or dermatologic effects of incinerator emissions (see additional file 2).

Hsiue et al. [47] evaluated the effect of long-term air pollution resulting from wire reclamation incineration on respiratory health in children. 382 primary school children who resided in one control and three polluted areas in Taiwan were chosen for this study. The results revealed a decrement in pulmonary function (including forced vital capacity and forced expiratory volume in one second) of those residents in the vicinity of incineration sites.

Shy et al. [48] studied the residents of three communities having, respectively, a biomedical and a municipal incinerator, and a liquid hazardous waste-burning industrial furnace, and then compared results with three matched-comparison communities. After adjustment for several confounders (age, sex, race, education, respiratory disease risk factors), no consistent differences in the prevalence of chronic or acute respiratory symptoms resulted between incinerator and comparison communities. Additionally, no changes in pulmonary function between subjects of an incinerator community and those of its comparison community resulted from the study by Lee et al. [49], based on a longitudinal component from the Health and Clean Air study by Shy et al. [48].

Miyake et al. [50] examined the relationship between the prevalence of allergic disorders and general symptoms in Japanese children and the distance of schools from incineration plants, measured using geographical information systems. After adjusting for grade, socio-economic status and access to health care per municipality, schools closer to the nearest municipal waste incineration plant were associated with an increased prevalence of wheeze and headache; there was no evident relationship between the distance of schools from such plants and the prevalence of atopic dermatitis. The main factors that may have affected the relative risk estimates in this study could be reporting bias (++) and residual confounding from socioeconomic status (++).

In sum, although the intensive study conducted by Shy et al. [48] did not show respiratory effects, there are some indications of an increased risk of respiratory diseases, especially in children. However, the uncertainty related to outcome assessment and residual confounding is very high and the overall evidence may be considered inadequate.

Occupational studies on incinerator employees

Four studies conducted on incinerator employees were reviewed (see additional file 3).

In 1997, Rapiti et al. [51] conducted a retrospective mortality study on 532 male workers employed at two municipal waste incinerators in Rome (Italy) between 1962 and 1992. Standardized mortality ratios (SMRs) were computed using regional population mortality rates. Mortality from all causes resulted significantly lower than expected, and all cancer mortality was comparable with that of the general population. Mortality from lung cancer was lower than expected, but an increased risk was found for stomach cancer: analysis by latency since first exposure indicated that this excess risk was confined to the category of workers with more than 10 years since first exposure.

Bresnitz et al. [52] studied 89 of 105 male incinerator workers in Philadelphia, employed at the time of the study in late June 1988. Based on a work site analysis, workers were divided into potentially high and low exposure groups, and no statistically significant differences in pulmonary function were found between the two groups, after adjusting for smoking status.

A similar study was conducted by Hours et al. [53]: they analysed 102 male workers employed by three French urban incinerators during 1996, matched for age with 94 male workers from other industrial activities. The exposed workers were distributed into 3 exposure categories based on air sampling at the workplace: crane and equipment operators, furnace workers, and maintenance and effluent-treatment workers. An excess of respiratory problems, mainly daily cough, was more often found in the exposed groups, and a significant relationship between exposure and decreases in several pulmonary parameters was also observed, after adjusting for tobacco consumption and centre. The maintenance and effluent group, and the furnace group had elevated relative risks for skin symptoms.

In the same year, Takata et al. [54] conducted a cross-sectional study in Japan on 92 workers from a municipal solid waste incinerator to investigate the health effects of chronic exposure to dioxins. The concentrations of these chemicals among the blood of the workers who had engaged in maintenance of the furnace, electric dust collection, and the wet scrubber of the incinerator were higher compared with those of residents in surrounding areas, but there were no clinical signs or findings correlated to blood levels of dioxins.

In sum, there are some studies that suggest increased gastric cancer and respiratory problems among incinerators workers. However, there are a great number of uncertainties, which make it difficult to derive conclusions.

Epidemiological studies of health effects of other waste management processes

Twelve epidemiologic studies on the potential adverse health effects of other waste management practices are reviewed and listed in additional file 4.

Waste collection

Ivens et al. [55] investigated the adverse health effects among waste collectors in Denmark. In a questionnaire-based survey among 2303 waste collectors and a comparison group of 1430 male municipal workers, information on self-reported health status and working conditions was collected and related to estimated bioaerosol exposure. After adjusting for several confounders (average alcohol consumption per day, smoking status, and the psychosocial exposure measures support/demand), a dose-

response relationship between level of exposure to fungal spores and self-reported diarrhoea was indicated, meaning that the higher the weekly dose, the more reports of gastrointestinal symptoms.

In contrast with these results, a study of 853 workers employed by 27 municipal household waste collection departments in Taiwan did not find an excess of gastrointestinal symptoms [56]. The workers answered a questionnaire and were classified into two occupational groups by specific exposures based on the reported designation of their specific task. The exposed group included those working in the collection of mixed domestic waste, front runner or loader, collection of separated waste and special kinds of domestic waste (paper, glass, etc.), garden waste, bulky waste for incineration, and the vehicle driver; the control group included accountants, timekeepers, canteen staff, personnel, and other office workers. No significant differences were found in the prevalence of gastrointestinal symptoms, but results indicated that all respiratory symptom prevalence, except dyspnoea, were significantly higher in the exposed group, after adjusting for age, gender, education, smoking status, and duration of employment.

Composting facilities

In a German cross sectional study by Bünger et al. [57], work related health complaints and diseases of 58 compost workers and 53 bio-waste collectors were investigated and compared with 40 control subjects. Compost workers had significantly more symptoms and diseases of the skin and the airways than the control subjects. No correction was performed for the confounding effect of smoking, as there were no significant differences in the smoking habits of the three groups.

A subsequent study in Germany by Herr et al. [58] examined the health effects on community residents of bio-aerosol, emitted by a composting plant. A total of 356 questionnaires from residents living at different distances from the composting site, and from unexposed controls were collected: self-reported prevalence of health complaints over past years, doctors' diagnoses, as was residential odor annoyance; microbiological pollution was measured simultaneously in residential outdoor air. Reports of airway irritation were associated with residency in the highest bio-aerosol exposure category, 150-200 m (versus residency >400-500 m) from the site, and periods of residency more than five years.

Bünger et al. [59] conducted a prospective cohort study to investigate, in 41 plants in Germany, the health risks of compost workers due to long term exposure to organic dust that specifically focused on respiratory disorders. Employees, exposed and not exposed to organic dust, were interviewed about respiratory symptoms and diseases in the last 12 months and had a spirometry after a 5-year follow-up. Exposure assessment was conducted at 6 out of 41 composting plants and at the individual level. Eyes, airways and skin symptoms were higher in compost workers than in the control group. There was also a steeper decline of Forced Vital Capacity among compost workers compared to control subjects, also when smoking was considered.

Materials recycling facilities

There are no epidemiological studies of populations living near materials recycling facilities; only studies on employees are available.

In the already-quoted study by Rapiti et al. [51] on workers at two municipal plants for incinerating and garbage recycling, increased risk was found for stomach cancer in employees who had worked there for at least 10 years, while lung cancer mortality risk was lower than expected.

In the study by Rix et al. [60], 5377 employees of five paper recycling plants in Denmark between 1965 and 1990 were included in a historical cohort, and the expected number of cancer cases was calculated from national rates. The incidence of lung cancer was slightly higher among men in production and moderately higher in short term workers with less than 1 year of employment; there was significantly more pharyngeal cancer among males, but this may have been influenced by confounders such as smoking and alcohol intake.

Sigsgaard et al. [61] conducted a cross-sectional study to examine the effect of shift changes on lung function among 99 recycling workers (resource recovery and paper mill workers), and correlated these findings with measurements of total dust and endotoxins. Exposure to organic dust caused a fall in FEV_1 over the work shift, and this was significantly associated with exposure to organic dust; no significant association was found between endotoxin exposure and lung function decreases.

The same authors [62] also analysed skin and gastrointestinal symptoms among 40 garbage handlers, 8 composters and 20 paper sorters from all over Denmark, and found that garbage handlers had an increased risk of skin itching, and vomiting or diarrhoea.

In a nationwide study, Ivens et al. [63] reported findings of self-reported gastrointestinal symptoms by self-reported type of plant. A questionnaire based survey among Danish waste recycling workers at all composting, biogas-producing, and sorting plants collected data on occupational exposures (including questions on type of plant, type of waste), present and past work environment,

the psychosocial work environment, and health status. Prevalence rate ratios adjusted for other possible types of job and relevant confounders were estimated with a comparison group of non-exposed workers, and an association was found between sorting paper and diarrhoea, between nausea and work at plastic sorting plants, and non-significantly between diarrhoea and work at composting plants.

The health status of workers employed in the paper recycling industry was also studied by Zuskin et al. [64]. A group of 101 male paper-recycling workers employed by one paper processing plant in Croatia, and a group of 87 non-exposed workers employed in the food packing industry was studied for the prevalence of chronic respiratory symptoms, and results indicated significantly higher prevalence of all chronic respiratory symptoms were found in paper workers compared with controls.

Gladding et al. [65] studied 159 workers from nine materials recovery facilities (MRFs) in the United Kingdom. Total airborne dust, endotoxins, (1-3)-beta-D-glucan were measured, and a questionnaire-survey was completed. The results suggest that materials recovery facilities workers exposed to higher levels of endotoxins and (1-3)-beta-D-glucan at their work sites experience various work-related symptoms, and that the longer a worker is in the MRF environment, the more likely he is to become affected by various respiratory and gastrointestinal symptoms.

Choosing relative risk estimates for health impact assessment of residence near landfills and incinerators

The reviewed studies have been used to summarize the evidence available, as indicated in table 1. When the overall degree of evidence was considered "inadequate" we decided not to propose a quantitative evaluation of the relative risk; when we arrived to a conclusion that "limited" evidence was available, relative risk estimates were extracted for use in the health impact assessment process. Table 2 summarizes the relevant and reliable figures for health effects related to landfills and incinerators. For each relative risk the distance from the source has been reported as well as the overall level of confidence of the effect estimates based on an arbitrary scale: very high, high, moderate, low, very low.

Landfills

From the review presented above and following the work already made by Russi et al. [11], it is clear that the studies on cancer are not sufficient to draw conclusions regarding health effects near landfills, both with toxic and non-toxic wastes. The largest study conducted in England by Jarup et al. [21] does not suggest an increase in the cancer types that were investigated. Investigations of other chronic dis-

Table 1: Summary of the overall epidemiologic evidence on municipal solid waste disposal: landfills and incinerators.

HEALTH EFFECT	LEVEL OF EVIDENCE	
	LANDFILLS	**INCINERATORS**
All cancer	Inadequate	Limited
Stomach cancer	Inadequate	Limited
Colorectal cancer	Inadequate	Limited
Liver cancer	Inadequate	Limited
Larynx cancer	Inadequate	Inadequate
Lung cancer	Inadequate	Limited
Soft tissue sarcoma	Inadequate	Limited
Kidney cancer	Inadequate	Inadequate
Bladder cancer	Inadequate	Inadequate
Non Hodgkin's lymphoma	Inadequate	Limited
Childhood cancer	Inadequate	Inadequate
Total birth defects	Limited	Inadequate
Neural tube defects	Limited	Inadequate
Orofacial birth defects	Inadequate	Limited
Genitourinary birth defects	Limited*	Limited**
Abdominal wall defects	Inadequate	Inadequate
Gastrointestinal birth defects§	Inadequate	Inadequate
Low birth weight	Limited	Inadequate
Respiratory diseases or symptoms	Inadequate	Inadequate

"*Inadequate*": available studies are of insufficient quality, consistency, or statistical power to decide the presence or absence of a causal association.
"*Limited*": a positive association has been observed between exposure and disease for which a causal interpretation is considered to be credible, but chance, bias, or confounding could not be ruled out with reasonable confidence.
* Hypospadias and epispadias
** Renal dysplasia
§ The original estimates were given for "surgical corrections of gastroschisis and exomphalos"

Table 2: Relative risk estimates for community exposure to landfills and incinerators

Health effect	Distance from the source	Relative Risk (Confidence Interval)	Level of confidence**
Landfills			
Congenital malformations [24]			
All congenital malformations	Within 2 km	1.02 (99% CI = 1.01-1.03)	Moderate
Neural tube defects	Within 2 km	1.06 (99% CI = 1.01-1.12)	Moderate
Hypospadias and epispadias	Within 2 km	1.07 (99% CI = 1.04-1.11)	Moderate
Abdominal wall defects	Within 2 km	1.05 (99% CI = 0.94-1.16)	Moderate
Gastroschisis and exomphalos*	Within 2 km	1.18 (99% CI = 1.03-1.34)	Moderate
Low birth weight [24]	Within 2 km	1.06 (99% CI = 1.052-1.062)	High
Very low birth weight	Within 2 km	1.04 (99% CI = 1.03-1.06)	High
Incinerators			
Congenital malformations [45]			
Facial cleft	Within 10 km	1.30 (95% CI = 1.06-1.59)	Moderate
Renal dysplasia	Within 10 km	1.55 (95% CI = 1.10-2.20)	Moderate
Cancer [30]			
All cancer	Within 3 km	1.035 (95% CI = 1.03-1.04)	Moderate
Stomach cancer	Within 3 km	1.07 (95% CI = 1.02-1.13)	Moderate
Colorectal cancer	Within 3 km	1.11 (95% CI = 1.07-1.15)	Moderate
Liver cancer	Within 3 km	1.29 (95% CI = 1.10-1.51)	High
Lung cancer	Within 3 km	1.14 (95% CI = 1.11-1.17)	Moderate
Soft-tissue sarcoma	Within 3 km	1.16 (95% CI = 0.96-1.41)	High
Non-Hodgkin's lymphoma	Within 3 km	1.11 (95% CI = 1.04-1.19)	High

*The original estimates were given for "surgical corrections of..". **The following scale for the level of confidence has been adopted: very high, high, moderate, low, very low.

eases are lacking, especially of respiratory diseases, yet there is one indication of an increased risk of asthma in adults [19], but with no replication of the findings. Overall, the evidence that living near landfills may be associated with health effects in adults is inadequate.

A slightly different picture appears for congenital malformations and low birth weight, where limited evidence exists of an increased risk for infants born to mothers living near landfill sites. The relevant results come from the European EUROHAZCON Study [23] and the national investigation from Elliott et al. [24]. In the UK report, statistically significant higher risk were found for all congenital malformations, neural tube defects, abdominal wall defects, surgical correction of gastroschisis and exomphalos, and low and very low birth weight for births to people living within two km of the sites, both of hazardous and non-hazardous waste. Although several alternative explanations, including ascertainment bias, and residual confounding cannot be excluded in the study, Elliott et al. [24] provide quantitative effect estimates whose level of confidence can be considered as moderate.

Incinerators

Quantitative estimates of excess risk of specific cancers in populations living near solid waste incinerator plants were provided by Elliott et al. [30]. We have reported in table 2 the effect estimates for all cancers, stomach, colon, liver, and lung cancer based on their "second stage" analysis. There was an indication of residual confounding from socioeconomic status near the incinerators and a concern of misdiagnosis among registrations and death certificates for liver cancer. The histology of the liver cancer cases was reviewed, re-estimating the previously calculated excess risk (from 0.95 excess cases 10^{-5}/year to between 0.53 and 0.78 excess cases 10^{-5}/year). We then graded the confidence of the assessment for these tumours as "moderate" with the exception of liver cancer (high) since the misdiagnosis was reassessed and the extent of residual confounding was lower. In the study by Elliott et al. [30] no significant decline in risk with distance for non-Hodgkin's lymphoma and soft tissue sarcoma was found. However, the studies of Viel et al. [33] and Floret et al. [34] conducted in France and the studies from Comba et al. [39] and Zambon et al. [40] in Italy provide some indications that an excess of these forms of cancers may be related to emissions of dioxins from incinerators. As a result, we provided effect estimates in table 2 also for non-Hodgkin's lymphoma and soft tissue sarcoma as derived from the conservative "first stage" analysis conducted by Elliott et al. [30]. We graded the level of confidence of these relative risk estimates as "high".

With regards to congenital malformations near incinerators, Cordier et al. [45] provided effect estimates for facial cleft and renal dysplasia, as they were more frequent in the "exposed" communities living within 10 km of the sites. Other reproductive effects, such as an effect on twinning rates or gender determination, have been described; however the results are inadequate.

Conclusions

We have conducted a systematic review of the literature regarding the health effects of waste management. After the extensive review, in many cases the overall evidence was inadequate to establish a relationship between a specific waste process and health effects. However, at least for some associations, a limited amount of evidence has been found and a few studies were selected for a quantitative evaluation of the health effects. These relative risks could be used to assess health impact, considering that the level of confidence in these effect estimates is at least moderate for most of them.

Most of the reviewed studies suffer from limitations related to poor exposure assessment, aggregate level of analysis, and lack of information on relevant confounders. It is clear that future research into the health risks of waste management requires a more accurate characterization of individual exposure, improved knowledge of chemical and toxicological data on specific compounds, multi-site studies on large populations to increase statistical power, approaches based on individuals rather than communities and better control of confounding factors.

List of abbreviations used

EU: European Union; INTARESE: Integrated Assessment of Health Risks of Environmental Stressors in Europe; NHL: non-Hodgkin's Lymphoma; OR: Odds ratio; TEQ: Toxic Equivalent.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

DP participated in the design of the study, conducted the systematic review and drafted the manuscript. SM conducted the systematic review and contributed to draft the manuscript. AIL participated in the systematic review and contributed to draft the manuscript. CAP helped to conceive of the study and to write and revise the manuscript. FF conceived and coordinated the study and helped to write and revise the manuscript. All authors have read and approved the final manuscript.

Additional material

Additional file 1

***Studies on landfills**. The data provided represent a brief description of the studies on populations living near landfills.*
Click here for file
[http://www.biomedcentral.com/content/supplementary/1476-069X-8-60-S1.XLS]

Additional file 2

***Studies on incinerators**. The data provided represent a brief description of the studies on populations living near incinerators.*
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Additional file 3

***Studies on occupational exposures among incinerators and landfills workers**. The data provided represent a brief description of the studies on workers of waste management plants.*
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[http://www.biomedcentral.com/content/supplementary/1476-069X-8-60-S3.XLS]

Additional file 4

***Studies on other waste management processes**. The data provided represent a brief description of the studies on population living near plants using waste management technologies different from landfills and incinerators.*
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Health Effects of Residence Near Hazardous Waste Landfill Sites: A Review of Epidemiologic Literature

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This review evaluates current epidemiologic literature on health effects in relation to residence near landfill sites. Increases in risk of adverse health effects (low birth weight, birth defects, certain types of cancers) have been reported near individual landfill sites and in some multisite studies, and although biases and confounding factors cannot be excluded as explanations for these findings, they may indicate real risks associated with residence near certain landfill sites. A general weakness in the reviewed studies is the lack of direct exposure measurement. An increased prevalence of self-reported health symptoms such as fatigue, sleepiness, and headaches among residents near waste sites has consistently been reported in more than 10 of the reviewed papers. It is difficult to conclude whether these symptoms are an effect of direct toxicologic action of chemicals present in waste sites, an effect of stress and fears related to the waste site, or an effect of reporting bias. Although a substantial number of studies have been conducted, risks to health from landfill sites are hard to quantify. There is insufficient exposure information and effects of low-level environmental exposure in the general population are by their nature difficult to establish. More interdisciplinary research can improve levels of knowledge on risks to human health of waste disposal in landfill sites. Research needs include epidemiologic and toxicologic studies on individual chemicals and chemical mixtures, well-designed single- and multisite landfill studies, development of biomarkers, and research on risk perception and sociologic determinants of ill health. *Key words*: epidemiology, hazardous waste, health effects, landfill, residence, review. — *Environ Health Perspect* 108(suppl 1):101–112 (2000).
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The disposal of wastes in landfill sites has increasingly caused concern about possible adverse health effects for populations living nearby, particularly in relation to those sites where hazardous waste is dumped. Studies on the health effects of landfill sites have been carried out mainly in North America and existing reviews focus entirely on this literature (*1,2*). Recent publications of large studies both in and outside North America warrant an update of evidence presented in previous reviews. Up-to-date knowledge about epidemiologic evidence for potential human health effects of landfill sites is important for those deciding on regulation of sites, their siting and remediation, and for those whose task it is to respond to concerns from the public in a satisfactory way.

We intend to present a critical discussion of all major epidemiologic studies published since 1980 on health effects related to residence near landfill sites in North America, Europe, and elsewhere. Special attention is paid to recent studies and studies outside the United States that have not been included in previous reviews.

Methods

Throughout this review the term landfill is used for any controlled or uncontrolled disposal of waste to land. Relevant papers were found through computerized literature searches on MEDLINE (MEDLINE Database, National Library of Medicine, Bethesda, MD) (*www.biomednet.com*) and BIDS Databases, Joint Information Systems Committee, University of Bath, Bath, UK (*www.bids.ac.uk*) from 1980 through to 1998 using keywords "landfill" and "hazardous waste site." In addition, articles were traced through references listed in previous reviews. All papers found in this manner that studied health effects in residents near waste landfill sites and that were published in journals available through the British Library and libraries of the University of London were included in this review. A few papers referred to in previous reviews could not be traced because they were published in local journals in the United States. Published reports of recent studies that have not yet appeared in peer-reviewed journals have been included in the review. A few abstracts of European studies have been included, although full research papers of these studies have not been published because they reflect growing concerns about landfill in Europe. A total of 50 papers, reports, and abstracts are reviewed in this article. Investigations of the health risks to those employed in the handling, transport, clean-up, or maintenance of substances at landfill sites are very scarce and have not been included in this review. Many chemicals or groups of chemicals potentially present in landfill sites, including organic solvents, polychlorinated biphenyls (PCBs), and heavy metals, have shown adverse effects on human health or in animal experiments. A discussion of findings from either epidemiologic or toxicologic research on health effects related to specific chemicals is beyond the scope of this review.

Epidemiologic Studies on Health Effects of Landfill Sites

The majority of studies evaluating possible health effects in human populations living near landfill sites investigate communities near one specific waste disposal site (single-site studies), frequently in response to concerns from the public about reported contamination from the site or reported clusters of disease. A small number of studies have addressed the risks of living near waste sites, independent of whether the sites caused concern, by a priori specifying a number of sites for study. These will be referred to as multisite studies. Single- and multisite studies have different methodologic problems and are therefore discussed separately in this paper. Most individual studies are discussed in detail in this article. Where appropriate due to common methodologic issues (e.g., in studies of self-reported health outcomes and clusters of disease) or due to a common landfill site of concern (e.g., in the Love Canal studies and Santa Clara County studies), less emphasis was put on individual studies and more on common issues. Studies included in the review are summarized in Table 1 (single-site studies) and Table 2 (multisite studies). Discussion of individual single- and multisite studies is preceded by a discussion of issues common to the interpretation of all landfill studies.

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Table 1. Single-site studies.

Ref.	Study design	Study subjects	Exposure measure	Health outcomes studied	Reported findings
(7)	Geographical comparison	Love Canal census tract; comparison: New York State	Residence in Love Canal census tract	Cancer: liver, lymphomas, leukemia, other organ sites	No increased incidence
(8)	Cross-sectional	46 exposed residents; comparison: residents in adjacent census tract	Residence in houses where chemicals were detected	SCEs and CAs	No difference in frequency of chromosome changes
(9)	Cross-sectional	523 Love Canal children; 440 control children	Proximity to site; at least 5 months' residence in Love Canal area	Self-reported health problems: seizures, learning problems, hyperactivity, eye irritation, skin rashes, abdominal pain, and incontinence	Increased prevalence of all symptoms
(10)	Cross-sectional	428 Love Canal children; 493 control children	Born in Love Canal and more than 75% of life in Love Canal	Children's stature, weight, weight for stature	Shorter stature for Love Canal children. No difference in weight
(11)	Retrospective follow-up	174 births near site; 443 live births in rest of Love Canal area; all births in New York State	Residence in Love Canal area	LBW	Higher percentage of LBW in exposed area; excess in period of active dumping
(12)	Retrospective follow-up	239 exposed children; 707 unexposed	Residence in Love Canal area during pregnancy	LBW, birth defects	3-fold risk of LBW (homeowners only); increased risk for birth defects (homeowners and renters)
(26)	Retrospective follow-up	2,092 births in proximate area; 6,840 births in control area	Residence at birth in area closest to landfill	Average birth weight, LBW, preterm birth	Significantly lower average birth weight, higher proportion of LBW and prematurity during the time of heaviest pollution
(14)	Retrospective follow-up	25,216 births	Residence in census tract, proximate zone, and frequency of odor complaints	LBW, fetal mortality, infant mortality, prematurity	No difference over entire study period; moderate decrease in birth weight in high odor complaint zone in period of highest exposure
(27)	Case–control	7,977 LBW cases; 7,856 control births	Residence in areas adjacent to landfill and level of estimated exposure to landfill gas	LBW, very LBW, preterm birth, small for gestational age	Excess in LBW and small for gestational age births; no excess in very LBW or preterm birth
(21)	Geographical comparison	Residents of Montreal Island	Residence in areas adjacent to landfill and level of estimated exposure to landfill gas	Cancers of 17 organ sites for men; 20 organ sites for women.	Increase in incidence of stomach, liver, lung and prostate cancer for men, stomach and cervix–uteri cancer for women.
(15)	Cross-sectional	51 residents of exposed village incl. 11 children and 52 control persons	Residence in exposed village	SCEs	Higher frequency of SCEs in exposed population, particularly in children
(28)	Cross-sectional	47 children from exposed village; 45 unexposed children	Residence in exposed village and time of exposure	Chromosomal changes	Chromosome damage frequency returned to background levels after site remediation
(29)	Geographical comparison	Cancer deaths and birth defects compared to Pennsylvania and U.S.	Residence in counties surrounding waste site, incl. Clinton county, PA	Bladder cancer and cancers of other organ sites; birth defects	Increase in bladder cancer deaths in Clinton; increase in number of other cancers in Clinton and 3 surrounding counties; no excess in birth defects.
(16)	Cross-sectional	179 long-term exposed residents; 151 residents in comparison areas	Residence in area near waste site	14 self-reported diseases; 15 self-reported symptoms	Increased prevalence of skin problems and sleepiness
(17)	Cross-sectional	1,049 exposed; 948 unexposed residents	Residence in household close to site	36 self-reported health problems	Increased prevalence of minor respiratory symptoms (wheezing, cough, persistent cold), irregular heart beat, fatigue, bowel complaints
(30)	Retrospective follow-up	614 exposed households; 636 comparison households	Residence within 750 m of edge of site: long-/short-term residence	Self-reported health problems	Increased prevalence of mood disorders, narcotic symptoms, skin and respiratory disorders, eye problems, muscle weakness
(31)	Cross-sectional	403 exposed households; 203 comparison households	Residence in proximate area	19 self-reported diseases, 23 symptoms; mortality, cancer incidence, LBW, birth defects, spontaneous abortions	Increase in majority of self-reported diseases and symptoms. No significant association for mortality, cancer morbidity, reproductive effects
(32)	Cross-sectional	257 residents in exposed zones; 105 in comparison area	Distance based zones: zone 1: < 300 m zone 2: 300–1,000 m	Self-reported diseases and symptoms, miscarriages, stress levels	Increased reporting of majority of symptoms, miscarriages, stress
(18)	Follow-up survey	57 high-, 66 low-, 70 unexposed residents	Exposure zones based on odor zones	22 self-reported health problems	2-fold increase in 64% of reported symptoms
(33)	Cross-sectional	321 high-exposed persons; 351 persons with low/minimal exposure	Cumulative exposure index based on distance from sites and amount of chemicals present at sites	29 self-reported health problems	Excess in reporting of 11 of 29 symptoms: mainly neurologic symptoms

(*Continued*)

Table 1. *Continued.*

Ref.	Study design	Study subjects	Exposure measure	Health outcomes studied	Reported findings
(*34*)	Cross-sectional	456 exposed residents; 481 comparison persons	Residence near site	14 self-reported health problems	Increased reporting of 11 of 14 symptoms.
(*19*)	Retrospective follow-up	694 residents	Individual exposure index based on concentration of pollutants and daily activity of study subjects	Amount of prescribed medication for selected diseases (respiratory, ophthalmologic, dermatologic, gastrointestinal, neurologic)	No relationship between individual exposure index and drug consumption
(*20*)	Case–control	432 cases; 384 controls	Individual exposure index based on concentration of pollutants and daily activity of study subjects	Dermatologic, respiratory, eye, gastrointestinal diseases, psychologic disorders and other conditions	Relationship between exposure level and existing cases of respiratory and psychologic conditions
(*38*)	Geographical comparison	Three counties adjacent to waste dump compared to whole region	Communities near dump; distance of community to dump	Leukemia, multiple myeloma, malignant lymphoma	Excess in leukemia incidence
(*39*)	Geographical comparison	Ward surrounding landfill compared to whole region	Residence in landfill ward, surrounding wards, area downwind from landfill	All childhood cancers	No excess of childhood cancer
(*40*)	Geographical comparison	5 wards near landfill compared to 22 wards elsewhere	Wards near landfill	Mortality rates, hospital admissions for asthma, cancer, and other conditions, spontaneous abortions, birth defects, drug prescriptions	No consistent differences in mortality rates, hospital admissions, spontaneous abortions. Excess in birth defects before and after start of the landfill. Increase in prescriptions for certain medications
(*41*)	Geographical comparison	Cancer rates in 8 counties in Illinois compared to national rates	Residence in town with contaminated wells	Bladder cancer	Excess in bladder cancer in town with contaminated wells
(*44*)	Geographical comparison	Woburn cancer rates compared to national rates	Residence in Woburn	Childhood leukemia	More than 2-fold excess in childhood leukemia
(*45*)	Case–control	20 leukemia cases; 164 control children	Exposure index based on fraction of water supply in household from contaminated wells	Childhood leukemia	Significant association with exposure index
(*45*)	Retrospective follow-up	4,396 pregnancies; 5,018 children under 18	Exposure index based on fraction of water supply in household from contaminated wells	Childhood disorders; adverse pregnancy outcomes: spontaneous abortions, perinatal death, LBW, birth defects	Increase in eye/ear anomalies, CNS/chromosomal/cleft anomalies; perinatal deaths; kidney/urinary tract disorders, lung/respiratory disorders
(*46*)	Cross-sectional	28 family members of leukemia cases; 30 healthy controls	Being a family member of a Woburn leukemia case	Immunologic abnormalities, medical examination	Immunologic abnormalities in family members
(*47*)	Retrospective follow-up	Births in exposed census tracts compared to births in the entire county	Residence in census tract served by contaminated water supply	Congenital heart defects	2-fold excess in cardiac anomalies
(*48*)	Retrospective follow-up	Pregnancies in exposed census tract; pregnancies in unexposed census tract	Residence in census tract served by contaminated water supply	Spontaneous abortions, birth defects, LBW	Increase in spontaneous abortions and birth defects; no excess in LBW
(*49*)	Retrospective follow-up	Pregnancies in 2 exposed census tracts; pregnancies in 2 unexposed census tracts	Residence in 2 census tracts served by contaminated water supply	Spontaneous abortions, birth defects, LBW	No excess in spontaneous abortions or malformations in new exposed study area
(*50*)	Retrospective follow-up	Pregnancies in 2 exposed census tracts	% water in census tract from contaminated well; estimated concentration of solvents	Spontaneous abortions, birth defects	No relation between abortion or malformation rate and estimated exposure
(*51*)	Case–control	145 cases with cardiac malformations; 176 nonmalformed control births	Mother's consumption of home tap water	Congenital heart defects	Elevated risk for consumption of more than 4 glasses of tap water compared to none
(*52*)	Retrospective follow-up	349 pregnancies in 1 exposed and 1 unexposed census tract	Mother's consumption of home tap water	Spontaneous abortions, birth defects	Spontaneous abortions: significant trend with number of glasses tap water per day. Birth defects: no trend
(*53*)	Retrospective follow-up	1,016 pregnancies in exposed and unexposed areas	Mother's consumption of home tap water	Spontaneous abortions, birth defects, LBW	Spontaneous abortions: 7-fold risk for any versus no tap water. Birth defects: nonsignificant increase. No association with LBW
(*13*)	Cross-sectional and follow-up	49 exposed residents; 57 unexposed residents	Use of contaminated well water	Liver function	Abnormalities in liver function in exposed residents. Returned to normal 2 months later.
(*54*)	Cross-sectional	676 exposed residents; 778 unexposed residents	Residence in high-exposure area based on groundwater flow	Self-reported disease: cancer, liver disease, respiratory illness, skin disease, seizures	Statistically significant increase in respiratory disease and seizures, not significant after accounting for smoking
(*55*)	Cross-sectional	65 exposed residents; 66 residents from control households	Residence in households with contaminated well water	15 self-reported health symptoms; 14 self-reported diseases	Increased reporting of eye irritation, diarrhea, sleepiness.

Abbreviations: CAs, chromosomal aberrations; CNS, central nervous system; LBW, low birth weight; SCEs, sister chromatid exchanges.

Table 2. Multisite studies.

Ref	Study design	Study sties	Study subjects	Exposure measure	Health outcomes studied	Reported findings
(56)	Geographical comparison	593 NPL waste sites in U.S.	339 counties with waste site, more than 3,000 without	County with site	Cancer mortality	Increased rates of cancer of the lung, bladder, stomach, and rectum
(57)	Case–control	12 sites in New York State	339 deceased lung-cancer cases; 676 deceased controls	Residence in census tract with site; duration of residence	Lung cancer	No association
(58)	Case–control	38 sites with likely landfill gas migration in New York State	9,020 cancer cases; 9,169 deceased controls	Residence within 250 ft	Cancer of liver, lung, bladder, kidney and brain; non-Hodgkin lymphoma, leukemia	Excess of female bladder cancer and female leukemia
(59)	Case–control	300 sites in 1,072 census tracts in California	5,046 birth defects cases and 28,085 control births. 1,904,000 births for birth weight analysis	Residence in census tract with site and potential for human exposure	Birth defects, LBW	1.5-fold increase in risk of heart defects. Other malformations and birth weight not associated
(60)	Case–control	1,281 NPL sites in U.S.	17,407 births	Residence within 1 mile	Birth weight, birth defects, fetal deaths, infant deaths	No association between adverse pregnancy outcomes and living near a NPL site
(61)	Case–control	590 waste sites in New York State	9,313 live births with birth defects; 17,802 normal control births	Residence within 1 mile and hazard score of site	Birth defects	Increased risk for all malformations (12%), integument system, nervous system, musculoskeletal. Indications for dose–response relation with exposure risk
(62)	Case–control	643 waste sites in New York State	473 cases with central nervous system defects; 3,305 musculoskeletal cases; 12,436 control births	Ratings of exposure probability within 1 mile of each site	Central nervous system defects and musculo-skeletal defects	No association between two types of and proximity to waste sites
(64)	Case–control	317 waste sites in New York State	259 cases of end-stage renal disease and 259 controls	Residence within 1 mile, exposure probability; years of residence within 1 mile	End-stage renal disease	Nonstatistically significant increase in risk of renal disease for ever living within 1 mile, having lived within 1 mile for more than 12 years, and a medium/high probability of exposure
(65)	Case–control	105 NPL and 659 non-NPL sites in California	507 neural tube defects, 517 controls; 210 heart defects, 439 oral clefts, and 455 controls	Census tracts: no site, non-NPL site, NPL site; residence within 1 mile and residence within 1/4 mile	Birth defects: neural tube defects, heart defects, and oral clefts	No increased risks relating to residence in census tract with site. Small, nonsignificant increase in risk of NTD and heart defects for living within 1/4 mile
(66)	Case–control	21 sites in 5 European countries	1,089 cases with non-chromosomal birth defects; 2,366 control births	Residence within 3 km	Birth defects	Increased risk for all malformations (33%), NTD, cardiac defects

NTD, neural tube defect.

Issues Common to the Interpretation of Landfill Studies

A general problem in epidemiologic studies of landfill sites, whether studying single or multiple sites, is that there is insufficient information regarding potential human exposures from landfill sites. Although landfill sites are numerous and widespread, very few have been evaluated with respect to both the types of chemicals they contain and the extent to which they may be releasing chemicals. Most such work has been conducted in the United States under the Superfund program (*3*). In other countries, information is largely lacking. Moreover, although chemicals have been found to migrate off site at a number of sites that have been thoroughly investigated (*2*), we know very little about the extent to which residents living near a site are exposed to these chemicals. A few studies that have attempted to measure certain chemicals in blood and urine of populations near waste sites have generally not found increased levels of volatile organic compounds (VOCs) (*4*), mercury (*5*), or PCBs (*6*). Because knowledge of whether and to what extent substances from waste sites reach the human population is still largely lacking, and because resources are rarely available to carry out extensive exposure measurements or modeling, epidemiologic studies have based the assessment of exposure to landfills mainly on surrogate measures such as residence in an area close to a waste site or distance of residence from a waste site. The use of such surrogate, indirect exposure measurements can lead to misclassification of exposure which, if not different for diseased and nondiseased persons, will decrease the sensitivity of the study to find a true effect.

In addition to being hampered by insufficient exposure data, the study of landfill exposures is complicated by the fact that if residential populations are exposed to chemicals from landfill sites, it will generally be to low doses of mixtures of chemicals over long periods of time. Associations with such low-level environmental exposures in the general population are by their nature hard to establish. Low-dose exposures are generally expected to generate small increases in relative risk that will be difficult to distinguish from noise effects introduced by confounding factors and biases.

In most of the landfill studies reviewed in this article, residents near waste sites are studied without knowledge of the exact route(s) of exposure to chemicals from the site. Migration of hazardous substances into groundwater is often an important environmental concern in relation to landfill sites, which may represent a public health problem, especially when a site is located near aquifers supplying public drinking water. However, in many situations the drinking water supply of residents near waste sites does not originate

from the local area. For people living in the vicinity of these sites, other routes of exposure may be of more concern. Landfill sites may be a source of airborne chemical contamination via the off-site migration of gases and via particles and chemicals adhered to dust, especially during the period of active operation of the site. Very little is known about the likelihood of air exposure from landfill sites through landfill gases or dust. At some of the sites described below, low levels of volatile organic chemicals have been detected in indoor air of homes near landfill sites (*7–13*), in outdoor air in areas surrounding sites (*14–20*) or in on-site landfill gas (*21*). Other possible routes of exposure include contamination of soil, ground, and surface water, which may lead to direct contact or pollution of indoor air in the case of evaporation of VOCs into basements of nearby houses. Contamination via the food chain may sometimes be of concern for nearby residents in the case of consumption of home-grown vegetables. Drinking water is a possible route of exposure only if water for domestic use is locally extracted. If this is the case, other domestic water uses (bathing, washing) may also lead to exposure via inhalation of evaporated VOCs and/or direct contact (*13*).

Some issues related to specific health outcomes should be noted in both single- and multisite studies. A general problem in studies of cancer incidence is the long latency period between exposure and clinical manifestation of the cancer. Studies may not always allow for a long enough latency period, which reduces their power to pick up long-term effects. Moreover, because of the long latency period, a considerable number of people may have migrated into or out of the exposed areas between time of exposure and time of diagnosis, which will lead to misclassification of exposures. Studies of chromosome changes (chromosome aberrations and sister chromatid exchanges) are undertaken with the assumption that such changes are related to the mechanisms underlying cancer and possibly birth defects. Chromosomal changes are studied as biomarkers of early response or effect of exposure to mutagenic and carcinogenic chemicals. Sorsa et al. (*22*) point out that theoretically it is reasonable to assume that chromosome damage is directly related to cancer etiology, but the number of agents clearly shown to induce such damage in humans is still limited. Increased frequencies of chromosome changes may indicate exposure to mutagens and carcinogens, but it is not clear at present how well they predict cancer risk. Low birth weight is thought to be relatively sensitive to effects of chemical exposures (*23*). It is also relatively easy to collect accurate information on birth weight from birth certificates. However, a large number of risk factors are associated with low birth weight (including smoking, socioeconomic status, nutritional factors, parental height) (*24*), and these may act as confounding factors, giving biased estimates of association with residence close to a site. Birth defects have fewer established risk factors than other reproductive outcomes such as low birth weight, and studies of birth defects may therefore be less affected by confounding factors, although unknown risk factors could still play a confounding role. Also, birth defects represent an etiologically very heterogeneous set of conditions; analyses of the total malformation rate (all defects combined) have the advantage of larger numbers but may not be sensitive enough to pick up increases in risk of specific defects. The grouping of malformations into groups that are etiologically similar is difficult because of lack of knowledge on causes of specific defects. Grouping therefore always entails a compromise between large enough numbers and etiologic specificity.

Single-Site Studies

The investigation of single landfill sites has been important as a response to community concerns; many of the single-site studies discussed below are prompted by public concerns, often under considerable political pressure. This means that they are prone to recall and reporting biases that may weaken the investigations and partly explain increases in reported health outcomes. Single-site studies have examined a vast range of possible health outcomes, often without a specific disease hypothesis being proposed a priori. Such "fishing expeditions" are thought to be of less scientific value than studies that start with a clear hypothesis (*1*). Including these fishing expeditions in evaluating the consistency of findings across multiple studies is important nevertheless when assessing evidence for health risks.

A less avoidable problem in single-site studies is that the size of populations living near waste sites generally is small and, especially when the outcome is a rare disease, this can seriously limit the statistical power of an investigation.

Single-site studies discussed in this section are grouped into those examining hard end points such as cancer and reproductive outcomes, those studying self-reported health outcomes and symptoms, those following up reported clusters of disease near landfill sites with geographic comparisons of disease rates, and those specifically investigating the contamination of well water used for drinking or other domestic uses in relation to health effects. These last studies were discussed separately to determine whether conclusions can be drawn about specific pathways of exposure.

Studies of cancers, reproductive outcomes, and chromosomal damage. Large quantities of toxic materials (residues from pesticide production) were dumped at the landfill of Love Canal, New York State, during the 1930s and 1940s, followed by the building of houses and a school on and around the landfill in the 1950s. By 1977 the site was leaking and chemicals were detected in neighborhood creeks, sewers, soil, and indoor air of houses. This led to one of the most widely known and publicized incidents of environmental pollution from landfill. Exposure of Love Canal residents, although not well understood, may have occurred via inhalation of volatile chemicals in home air or via direct contact with soil or surface water (*10*). The drinking water supply was not contaminated. Chemicals detected at Love Canal were primarily organic solvents, chlorinated hydrocarbons and acids, including benzene, vinyl chloride, PCBs, dioxin, toluene, trichloroethylene, and tetrachloroethylene. Several studies were conducted to detect whether Love Canal residents suffered adverse health effects.

Janerich et al. (*7*) compared cancer incidence for the Love Canal area with data for the entire state from 1955 to 1977 and found no increase in cancer rates at Love Canal for any organ site. This included leukemia, lymphoma, and liver cancer, which were thought to be the cancers most likely to result from exposures to the chemicals found at the site. The study is limited in that no information was available on confounding factors such as socioeconomic status and smoking. Subsequently, Heath et al. (*8*) compared the frequencies of chromosome changes (sister chromatid exchanges and chromosomal aberrations) in residents who lived in the first ring of houses adjacent to Love Canal in 1978 with those of control persons from socioeconomically similar census tracts. No differences in frequencies of chromosome damage were found. Chromosome changes were measured in 1981 and 1982, a few years after people were evacuated from the first ring of houses and therefore were no longer exposed. The authors point out that chromosome damage may be a reversible effect, which may explain the negative findings.

Infants and children have been the subject of other Love Canal studies. A cross-sectional study (*9*) reported an increased prevalence of seizures, learning problems, hyperactivity, eye irritation, skin rashes, abdominal pain, and incontinence in children living close to the Love Canal site compared to controls from other areas, as reported by the parents of the children. It has been noted in previous reviews (*1,25*) that this study was conducted in 1980, 2 years after the residents of Love Canal had become aware of the hazardous

waste problem, when media and public interest were high, and people were being evacuated. This makes it likely that the results were biased by differential reporting of health problems. However, a similar population of children (spending 75% or more of their childhood in the Love Canal area) had significantly shorter stature for their age than control children after allowing for factors such as birth weight, socioeconomic status, and parental height (*10*). Vianna and Polan (*11*) found an excess of low birth weights (less than 2500 g) during the period of active dumping (1940–1953) in areas of Love Canal where exposure had been highest. Rates of low birth weight between 1960 and 1978 after the site had been closed were comparable to those in upstate New York as a whole. It is not clear whether exposure from Love Canal was highest during the active dumping period or during the period after the site was closed, when the building of houses near the site increased and the landfill was leaking. A study by Goldman et al. (*12*) reported a 3-fold risk of low birth weight for children exposed during gestational life to the Love Canal area compared to that for control children born elsewhere from 1965 to 1978. Data were analyzed separately for homeowners and renters so that groups of similar socioeconomic status were compared, and after allowing for confounding factors, the risk of low birth weight was significantly increased for homeowners only. This finding is difficult to interpret because there are no strong reasons to believe that homeowners would be more susceptible than renters to the effects of toxic chemicals. In the same study an increased risk of birth defects was observed for both homeowners and renters. Information on birth defects relied mainly on reports from parents. Some recall bias can therefore be suspected, in particular for defects of lesser severity, but this is unlikely to account for the entire association found for major birth defects.

Berry and Bove (*26*) studied birth weight at the Lipari Landfill in New Jersey, a site for municipal and industrial waste. Leachate from the site migrated into nearby streams and a lake adjacent to a residential area. Inhalation of volatile chemicals emitted from the landfill and contaminated waters was thought to be the most important exposure pathway. The site closed in 1971 after complaints of residents, but the heaviest pollution was estimated to have occurred during the late 1960s to the mid-1970s. The study found a convincing increase in proportion of low birth weight babies (< 2500 g) and a lower average birth weight in the population living closest (within a radius of 1 km) to the landfill in the time period when potential for exposure was thought to be greatest (1971–1975) compared to these factors in a control population. Although information on some confounding variables such as smoking, alcohol consumption, and socioeconomic status was not available, mothers in the exposed area were more highly educated and therefore appeared to be of higher socioeconomic status. One would expect higher birth weights in areas of higher socioeconomic status, so as the authors point out, confounding by socioeconomic status does not explain the lower birth weights found. In time periods before and after heavy dumping and off-site pollution, birth weights were higher in the area closer to the site than in the control area, which supports the hypothesis that pollution from the waste site may have been related to low birth weights in the community close to the site.

A range of reproductive effects including low birth weight was studied around the large BKK hazardous waste disposal site in Los Angeles County, California (*14*), after previous investigations of vital records found that trends in low birth weight and neonatal deaths corresponded closely with times and quantities of dumping at the landfill. Results for the whole study period showed no increase in adverse reproductive effects, but during the period of heaviest dumping, birth weights were significantly lower in exposed areas than in control areas using odor complaint frequency zones to classify exposure. All results were adjusted for education, income, and race. The decrease in mean birth weight found in the high-odor complaint zone was small (59 g) compared to that in the Lipari Landfill study (192 g) and was less than a third of birth-weight reductions caused by smoking during pregnancy (*26*). Odor complaint frequency zones corresponded better with vinyl chloride monitoring data and meteorology around the site than did census tract areas or distance-based (< 0.7 miles) exposure zones, and this was therefore thought to be the most accurate method for classifying exposure. Using census tract or distance-based exposure zones, smaller decreases in mean birth weight were found (35.2 g, $p = 0.02$ and 20.4 g, $p = 0.25$, respectively).

Miron Quarry, a large (the third largest in North America) municipal solid waste site in Montreal, Quebec has prompted studies on both reproductive outcomes (low birth weight and preterm births) (*27*) and cancers (*21*). Gas from the site was the main environmental and health concern and a range of VOCs, including a number of recognized or suspected human carcinogens, had been detected in the gas. An excess of 20% in low birth weight was found among babies of mothers who were living in the high-exposure area adjacent to the landfill at the time of delivery, taking account of confounding factors such as education and age of the mother. No excess was found in the low-exposure zone compared to a control area. Exposure zones were based on proximity to the site and accounted for the direction of dominant winds. Control areas were selected that were similar to exposure areas on a number of sociodemographic variables so as to limit the potential for confounding. The cancer study used the same exposure zones and control areas and increases were found in incidences of cancers of the stomach, liver, prostate, and lung for men, and stomach and cervix/uterus for women. Incidences of cancers of other organ sites were not increased in the exposed areas. Age and sex were the only confounders that could be controlled for directly and the authors admit that area matching for sociodemographic factors was based on fairly broad zones. The landfill started operation in 1968 and cancer incidence was studied between 1981 and 1988, which allowed a maximum latency of only 20 years among those residents in the area throughout the period.

In Mellery, Belgium, gases containing a complex mixture of VOCs escaped when the clay seal of a landfill site cracked. Because some of the detected chemicals were known mutagens and/or carcinogens, damage to chromosomes was studied and an increase in chromosome damage (sister chromatid exchanges) was found among Mellery residents but not in unexposed subjects in subgroups of both smokers and nonsmokers (*15*). In children 8–15 years of age, a more marked difference was found between exposed and unexposed groups than among adults. The findings indicated exposures similar to those of occupationally exposed populations. The adult unexposed comparison subjects were recruited from a volunteer blood donor list and may therefore have comprised a group with risk behavior and exposure to possible risk factors for chromosome damage different from those of the general population. They also reported less occupational exposure than the Mellery inhabitants. It is unclear how occupational exposure was defined and results have not been adjusted for it. A follow-up study after site remediation reduced the concentration of the atmospheric pollutants to background levels reported that chromosomal damages in Mellery children had returned to background levels and were no longer different from those for unexposed populations (*28*).

At the Drake Superfund Site, an industrial chemical dump in Pennsylvania, widespread on- and off-site contamination of groundwater, soil, and surface water with organic (benzene, chlorinated benzene, phthalates) and inorganic (arsenic, mercury) compounds prompted a

cancer mortality and birth defects study (*29*) and a community health survey (*16*). Air monitoring near the site identified a small number of organic compounds, but the main exposure route was thought to be direct contact with surface waters and soil in recreational areas near the site. Budnick et al. (*29*) found an increase in mortality from bladder cancer (cancer of primary a priori concern because of aromatic amines detected on and off site) in the male population of one of the counties surrounding the waste site compared to average mortality rates in the entire state and the United States. Bladder cancer in females did not show such an effect. The authors point out that an occupational effect for males working in the Drake chemical plant may explain the fact that the association was found in men only. No excess in risk of birth defects was found. The subsequent health survey (*16*) found increased reporting of sleepiness and skin problems in the exposed community and concluded that it was difficult to say whether toxic chemicals from the site, overreporting of symptoms by the exposed community (reporting bias), or other factors such as stress and occupational exposure caused these symptoms.

Studies of self-reported health symptoms. A number of other community health surveys have investigated a wide range of health problems, including respiratory symptoms; irritation of skin, nose, and eyes; gastrointestinal problems; fatigue; headaches; psychological disorders; and allergies. These studies have been conducted in response to concerns from the public, often triggered by smells and odors from the sites. In a number of studies, self-reported health problems were increased in exposed populations (people living close to the waste sites) compared to control populations [Drake Superfund Site (*16*); Lowell, Massachusetts (*17*); Hamilton, Ontario (*30*); Stringfellow, California (*31*); Queensland, Australia (*32*); McColl waste site, California (*18*); Houston, Texas (*33*); Harris County, Texas (*34*)] (see Table 1 for details). The majority of these health surveys rely on residents reporting symptoms and diseases through questionnaires or interviews. The possibility exists that higher reporting rates of symptoms in exposed areas are at least partly explained by reporting and/or recall biases. From a public health point of view, the findings of high symptom reporting, whether or not due to differential self-reporting, may indicate the impact that stress and concerns related to landfill can have on ill health and/or perceived ill health. In the survey by Ozonoff et al. (*17*), residents who indicated they were worried about neighborhood pollution reported more symptoms than those who were not worried, both in the exposed and the control area. Although this does not eliminate the possibility of an effect of toxic chemicals from the site, it suggests that stress and/or recall bias may have been responsible for the findings. Miller and McGeehin (*34*) and Dunne et al. (*32*) found increased symptom prevalence only in residents who indicated they were worried about, or aware of, an environmental problem in their neighborhood. The study by Lipscomb et al. (*18*) showed a 2-fold risk in most symptoms for residents who were worried compared to those who were not worried among the exposed population. The authors concluded that being worried, rather than a toxicologic effect from the site, explained the symptoms. Hertzman et al. (*30*) used medical records to confirm certain symptoms and found no over- or underreporting. They concluded that this finding indicated limited reporting bias; however, only a small proportion of the respondents' records were reviewed. Moreover, seeing a physician (and therefore having a medical record) may itself be related to concerns about the site. Baker et al. (*31*) studied self-reported health problems as well as mortality, cancer incidence, and pregnancy outcomes from medical registers at the Stringfellow waste dump in California. Self-reported diseases and symptoms were the only outcomes that differed between exposed and unexposed areas. Again, a higher perception of threat was related to a higher risk of nearly all self-reported symptoms.

The complicated relation between worry, odor perception, and symptom reporting related to hazardous waste landfill sites is further discussed by several authors (*35–37*).

Two recent studies around the French landfill of Montchanin used records of prescribed medication (*19*) and cases from general practitioners (GPs) (*20*) to define health outcome, in order to avoid biases related to self-reporting of symptoms. Exposure classification in both studies was based on an individual index, taking into account the concentration of airborne pollutants and daily activities of study subjects. High concentrations of VOCs were detected in areas near the site and both leachates and air from the site were reported to be highly toxic in 1988 and 1989, shortly after site closure. Consumption of drugs prescribed for most conditions from 1987 to 1989 did not show a trend with exposure level, although a slight trend was found for drugs taken for ear, nose, and throat, and pulmonary conditions. In the second study, patients with conditions thought to be associated with dump emissions were compared to other GP patients and an association was found for respiratory symptoms and psychological disorders. Again, consulting a doctor for such conditions and subsequent diagnosis of the conditions by the physician may be related to fears of adverse effects from the landfill rather than to toxic chemical effects.

Cluster Investigations. In addition to the above papers, a number of reports are available of geographical comparison studies initiated after high rates (clusters) of specific diseases were reported in the vicinity of landfill sites. For example, increased rates of leukemia found in communities nearest a toxic waste dump in North-Rhine Westfalia, Germany, supported a GP report of a cluster near the site (*38*). A cluster of childhood cancer reported by residents near a landfill site in Walsall, England, was not confirmed in a geographical comparison of rates in the ward containing the site to expected rates based on the regional average (*39*). Only short reports of these two investigations have been published.Concerns from residents and a GP about increased rates of congenital abnormalities (specifically gastroschisis, a defect in the abdominal body wall) among the population living near the Welsh landfill of Nant-y-Gwyddon were supported by the finding that rates of congenital abnormalities in exposed wards were almost 1.9-fold those in unexposed wards over the period from 1990 to 1996 (*40*). However, rates in the exposed wards were already high (1.9-fold those of unexposed wards) between 1983 and 1987 before the site opened, and it is unlikely, therefore, that these increased rates were due to the landfill. Four cases of confirmed gastroschisis indicated a significant 9-fold excess in rates of gastroschisis among exposed wards between 1989 and 1996. A cluster of bladder cancer cases in one town in Illinois in the United States, was observed by researchers and subsequently linked to the presence of two contaminated wells close to a landfill site (*41*).

A general problem in the interpretation of all cluster investigations is that localized areas of high disease density may occur even as part of a random pattern of disease. It is difficult to distinguish clusters derived from this random pattern from those where there is a common underlying local cause (*42,43*). Also, areas with higher disease densities, although part of the random pattern of disease, may be selectively picked for study.

Studies of drinking water contamination incidents. The presence of chemicals in groundwater and drinking water is an important factor in determining the risk posed by landfill sites. However, it does not tell us what effect, if any, the consumption of contaminated water has on human health. Studies of adverse health effects prompted by the contamination of well water used for drinking water and other domestic uses by hazardous substances from waste disposal sites (mainly sites where chemical waste drums were buried) are discussed below. Literature on contaminated water and potential health effects is more extensive than that presented

in this section, which focuses only on water contamination directly related to the disposal of waste. The 1991 review by the National Research Council (*2*) gives a more comprehensive review of studies on contamination of domestic water supplies and health effects and concludes that although the available literature is scanty and not conclusive, drinking water contamination could lead to adverse health effects. Most of the studies summarized below have been discussed extensively in previous reviews (*1,2*).

In Woburn, Massachusetts, toxic chemicals (industrial solvents, mainly trichloroethylene) from a waste disposal site were detected in municipal drinking water wells. Residents of Woburn reported a cluster of 12 leukemia cases in children, and a first study confirmed that this number was significantly higher than expected on the basis of national rates (*44*). The problems with cluster analyses are discussed above. Because of lack of information on exposure to the contaminated wells, it was not possible in this first report to link the leukemia cases with exposure to the well water. Lagakos et al. (*45*) followed up these findings by compiling an exposure score for residential zones in Woburn using information on what fraction of the water supply in each zone had come from the contaminated wells annually since the start of the wells. Childhood leukemia incidence, perinatal deaths, congenital anomalies, and childhood disorders were studied in relation to the exposure scores. A significant excess was found again comparing leukemia rates for Woburn with national rates, and an association was found between leukemia incidence and exposure scores. The pregnancy outcome survey found associations with eye/ear congenital anomalies and central nervous system/oral cleft/chromosomal anomalies (mostly Down syndrome) but not with low birth weight or most childhood disorders. Pregnancy outcomes were self-reported in this study, but because residents were not aware of their exact exposure scores, the authors conclude that it is unlikely that this led to substantial differential overreporting. Byers et al. (*46*) undertook a study of 28 family members of patients with leukemia in Woburn. Damage to the immune and nervous systems was found in exposed relatives but not in unexposed controls. Exposure in this study was not measured by exposure to contaminated well water but by being related to a leukemia patient in Woburn, which makes it difficult to interpret the findings. The authors point out that it is impossible to say whether the association is due to an inherited predisposition or to a common environmental exposure of family members to agents that damage the immune system.

A number of studies followed the contamination of two drinking-water wells in Santa Clara County, California, with chlorinated solvents that had leaked from an underground waste storage tank. Residents living near one of the contaminated wells reported a cluster of adverse pregnancy outcomes, mainly spontaneous abortions and congenital heart defects. A first investigation (*47*) confirmed a significant excess of cardiac anomalies in the service area of the water company that operated the contaminated well compared to those among residents of an unexposed area. The excess was found within the potentially exposed time period and not in an unexposed time period after the well was closed. The authors conclude that the solvent leak was an unlikely explanation for the excess of cardiac anomalies found because the excess occurred mainly in the first 12 months of the exposed time period, and there was a significant (p = 0.03) deficit of cases during the second 8 months corresponding to the time when exposure was thought to be more certain. However, it is unclear when the leak started and the potentially exposed period was defined beforehand as the full 20-month period. A second study in the same area reported an increased risk of all congenital malformations combined and spontaneous abortions (*48*). A follow-up study including a second exposed area did not observe an increase in either outcome in this second area, even though it was thought to have the same water exposure as the original area (*49*). An exposure study estimating monthly concentrations of solvents in each census tract found no difference in probability of exposure between women with adverse pregnancy outcomes and women with normal births (*50*). Subsequent studies investigating water consumption in Santa Clara County report significant associations between reported tap water consumption and risk of cardiac defects (*51*) and spontaneous abortions (*52,53*), regardless of whether women lived in areas that received contaminated water. As the authors of these studies point out, recall biases cannot be excluded.

In Hardeman County, Tennessee, well water used as drinking water by residents was found to be contaminated with high concentrations of carbon tetrachloride and other chlorinated compounds after complaints were received about the taste of the water. A nearby landfill where 300,000 barrels of pesticide waste had been buried was responsible for the contamination. Analysis of indoor air and bathroom air while showers were running both indicated detectable levels of carbon tetrachloride and other organic compounds in houses that received water from the contaminated wells. Carbon tetrachloride has been identified in toxicologic studies as a strong liver toxin. The investigation, conducted several months after the population had stopped using the water for drinking, showed abnormally high levels of liver enzymes (indicating liver damage) in residents who had used contaminated water compared to controls, who had not (*13*). The authors concluded that these high liver enzyme levels probably resulted mainly from exposure due to washing and toilet water uses, and possibly from previous exposure through drinking and cooking. Two months later, when use of the well had completely stopped, liver function in the exposed population had returned to normal. This study benefited from relatively well-documented exposure information and a clear hypothesis about the possible health effects (i.e., liver disease) related to exposure to carbon tetrachloride.

Leakage from an industrial dump of chemical waste drums in New Jersey caused contamination of groundwater and well water with organic chemicals (including benzene, toluene, trichloroethylene, and lead). Najem et al. (*54*) found higher self-reported prevalence of respiratory disease and seizures but not cancer, liver illness, and skin disease in people living in a high-exposure area estimated on the basis of groundwater flow patterns. Residents in the high-exposure area used private drinking-water wells, ate homegrown food, and smoked more often than populations living in unexposed areas, and when these factors were adjusted for, differences in health outcomes disappeared. Adjusting for possible exposure routes such as local food consumption and use of private wells may have led to overadjustment, however, which would explain why no differences in health outcome were found.

An ex-military base in Dauphin County, Pennsylvania contained drums of toxic chemicals, fly ash, and other waste; well water for homes located on the perimeter of the site was contaminated with trichloroethylene, PCBs, pesticides, and other chemicals (*55*). Residents were instructed to stop using the water. Higher rates of eye irritation, diarrhea, and sleepiness were reported by residents of households with contaminated well water than by residents of households not having contaminated water.

Multisite Studies

The problems with single-site studies prompted by community pressures have increasingly been recognized, and recently several large studies have investigated adverse health effects near sets of hundreds of sites selected independently of community concerns or reported disease clusters (Table 2). These studies have the additional advantage of large numbers of subjects, which would give them enough statistical power to detect

small increases in risk of rare diseases such as birth defects and specific cancers. On the other hand, their large scale makes exposure assessment even more complicated than in single-site studies, as adequate information must be collected for each of many sites. A number of the studies discussed below have used the U.S. National Priority Listing (NPL) of hazardous waste sites developed by the U.S. Environmental Protection Agency (U.S. EPA) to select their sites. The NPL ranks all hazardous waste sites in the United States deemed to be of considerable threat to the environment or public health. NPL sites have been relatively well assessed with respect to the potential or actual migration of hazardous chemical substances from the sites through groundwater, surface water, and air (*2*). Most multisite studies, however, were not able to distinguish between different types and pathways of contamination and, in absence of better exposure data, based their assessments of exposure on distance of residence from the sites or residence in an area with a site. Exposure misclassification, if nondifferential, may be expected to dilute true effects in these investigations. Multisite studies mainly investigated cancers and reproductive outcomes.

Cancer studies. Griffith et al. (*56*) identified 593 NPL sites over the entire United States where contamination of groundwater used for drinking water had been detected by laboratory analyses. Cancer mortality rates for counties containing one or more of these NPL sites were compared to those for counties not containing sites and raised levels of lung, bladder, stomach, and rectum cancer were found. These results were not adjusted for confounding factors such as socioeconomic status and smoking and are therefore difficult to interpret.

A case–control study in New York State (*57*) examined lung-cancer in relation to residence in a census tract with a waste site. Twelve waste sites known to contain suspected lung carcinogens were studied. A questionnaire survey among next of kin of the deceased cases and controls attempted to collect information on factors such as smoking, diet, education, and residential history. Smoking was significantly more frequent among cases, but there was no association between having lived in or duration of living in an exposed census tract and risk of lung cancer. Low response rates (around 60%) and possible recall bias limit this study.

A recent study in New York State (*58*) investigated cancer risks near 38 landfills where migration of landfill gas through soil was likely. Migration of soil gas could result in indoor exposure in nearby houses to hazardous VOCs carried with the landfill gas. Potential exposure areas were defined around each site, and extended 250 ft from the landfill at 36 sites and 500 ft at 2 sites. Incident cases of cancer collected from the New York State Cancer Registry were compared with a random selection of deaths from causes other than cancer, matched by age and sex. Only cancers of the liver, lung, bladder, kidney, and brain, and non-Hodgkin lymphoma and leukemia were studied, as they were regarded potentially sensitive to chemical exposures. Statistically significant excesses in the defined exposure areas were reported only for bladder cancer in women and leukemia in women. The results were adjusted for sociodemographic characteristics of the areas of residence. No information was available on individual factors such as smoking or on how long cases and controls had been living at certain addresses. The use of deceased controls makes interpretation of this study extremely complicated. The deceased population from which controls were selected may differ from the population from which the cases were drawn on a number of variables, including their residence locations.

Studies of reproductive outcomes. Shaw et al. (*59*) conducted a study on the risk of congenital malformations and low birth weight in areas with landfills, chemical dump sites, industrial sites, and hazardous treatment and storage facilities in the San Francisco Bay, California area. Census tracts were classified as *a*) no hazardous site in area, *b*) hazardous site in area but no evidence of human exposure, and *c*) hazardous site and plume in the area with evidence of potential human exposure. A small increase (1.5-fold) in risk was found for heart and circulatory malformations in the areas with potential human exposure. This increased risk was present across chemical classes and exposure routes. Risk of other malformations or low birth weight was not significantly increased. Results were adjusted for some potential risk factors (maternal age, race, sex of child, birth order) but not for socioeconomic status.

Reproductive outcomes have been studied in a number of other multisite studies. Sosniak et al. (*60*) investigated the risk of adverse pregnancy outcomes for people living within 1 mile of a total of 1,281 NPL sites over the entire United States. The risk for low birth weight and other pregnancy outcomes (infant and fetal death, prematurity, and congenital anomaly) was not associated with living near a site after taking into account a large number of potential confounding factors, including socioeconomic variables collected through questionnaires. However, only around 63% of women originally sampled for the study returned the questionnaire and were included in the study. Also, it is unclear how congenital anomalies were defined, and no subgroups of malformations were studied.

Geschwind et al. (*61*) investigated the risk of congenital malformations in the vicinity of 590 hazardous waste sites in New York State. A 12% increase in congenital malformations was found for people living within 1 mile of a site. For malformations of the nervous system, musculoskeletal system, and integument (skin, hair, and nails), higher risks were found. Some associations between specific malformation types and types of waste were evaluated and found to be significant. A dose–response relationship (higher risks with higher exposure) was reported between estimated hazard potential of the site and risk of malformation, adding support to a possible causal relationship. However, a follow-up study of Geschwind's findings (*62*) found no relation between two selected types of malformations (central nervous system and musculoskeletal) and living near a hazardous waste disposal site. The study did report an increased risk of central nervous system defects for those living near solvent- or metal-emitting industrial facilities. Subjects for the first 2 years of this study were also included in Geschwind's study, and 2 more years were studied. Marshall et al. (*62*) attempted to improve the exposure measurement in the first study by assessing the probability of specific contaminant–pathway combinations in 25 sectors of the 1-mile exposure zones (*63*). The risk of particular pathways or contaminant groups could not be investigated, however, because of limited numbers of cases in each subgroup. Hall et al. (*64*) used the same method of exposure assessment to study renal disease near 317 waste sites in 20 counties in New York State. Increased risks were found for associations between renal disease and residential proximity to a site (within 1 mile), the number of years lived near a site, and a medium or high probability of exposure, although the associations did not reach statistical significance.

A study by Croen et al. (*65*) based exposure measurement on both residence in a census tract containing a waste site and distance of residence from a site. Three specific types of birth defects (neural tube defects [NTDs], heart defects, and oral clefts) were studied; little or no increase in the risk was found using either measure of exposure. Risks of neural tube (2-fold) and heart defects (4-fold) were increased for maternal residence within 1/4 mile of a site, although numbers of cases and controls were too small (between 2 and 8) for these risk estimates to reach statistical significance. Births were ascertained from nonmilitary-base hospitals only, and the authors point out that the increased risk of NTDs may have resulted from lower ascertainment of exposed controls than exposed cases where exposure zones included military bases. Military base residents with pregnancies

affected by NTDs may have been more likely to deliver in nonmilitary hospitals than residents with unaffected pregnancies.

A first European multisite study recently reported a 33% increase in all nonchromosomal birth defects combined for residents living within 3 km of 21 hazardous waste sites in 10 European regions (*66*). Neural tube defects and specific heart defects showed statistically significant increases in risk. Confounding factors such as maternal age and socioeconomic status did not readily explain the results. The study included both open and closed sites that ranged from uncontrolled dumps to relatively modern controlled operations. This disparity makes it difficult at this stage to conclude, if indeed the association is causal, whether risks are related to landfill sites in general or whether specific types of sites may be posing the risks.

Conclusions

The presence of large quantities of mixtures of potentially hazardous chemicals in landfill sites close to residential populations has increasingly caused concern. Concerns have led to a substantial number of studies on the health effects associated with landfill sites. From this review we can conclude that increases in risk of adverse health effects have been reported near individual landfill sites and in some multisite studies. Although biases and confounding factors cannot be excluded as explanations for these findings, the findings may indicate real risks associated with residence near certain landfill sites.

For several reasons, evidence is limited for a causal role of landfill exposures in the health outcomes examined despite the large number of studies. Effects of low-level environmental exposure in the general population are by their nature difficult to establish. Also, existing epidemiologic studies are affected by a range of methodologic problems, potential biases, and confounding factors, making the interpretation of both positive (statistically significant increase in risk) and negative (no increase in risk) findings difficult (*67*). Lack of direct exposure measurement and resulting misclassification of exposure affects most studies and can limit their powers to detect health risks.

It is possible that studies not showing associations have been less likely to be included in this review because they may have been less likely to be submitted or selected for publication, thereby causing the review to be biased toward studies that did report positive associations. However, a number of so-called negative studies have been published and included in this review. We feel that most large, good-quality, epidemiologic investigations, particularly those starting with an a priori hypothesis rather than a specific cluster, would have resulted in publication, whether or not the findings were positive.

An increase in self-reported health outcomes and symptoms such as headaches, sleepiness, respiratory symptoms, psychological conditions, and gastrointestinal problems has been found consistently in health surveys around sites where local concerns were evident (*9,16–18,30–34,54,55*). In these health surveys symptoms were usually reported by the exposed population without further confirmation of the diagnoses by medical examination. It is not possible at this stage to conclude whether the symptoms are an effect of direct toxicologic action of chemicals present in waste sites, an effect of stress and fears related to the waste site, or an effect of reporting bias (the tendency of exposed people to remember and report more symptoms than unexposed people). Several authors have discussed the possibility that odor complaints and related worry about a site may trigger symptoms of stress-related disease or lead to an increased awareness of existing symptoms (*36,37*). Further research in this area is urgently needed to improve our understanding of the impact of social factors and risk perceptions on both actual and perceived ill health in waste site communities. Issues of environmental equity and environmental justice must form an integral part of such research.

Evidence for a causal relationship between landfill exposures and cancers is still weak. Cancers are difficult to study because of long latency periods, as discussed in previous sections. Also, cancer studies have mainly compared incidence or mortality rates between geographic areas without collecting adequate information on confounding factors. Excesses in bladder, lung, and stomach cancer and leukemia were reported in more than one study (*21,29,41,45,56,58*). Well-designed studies with long follow-up and good quality information about confounding factors such as smoking are needed to confirm these findings.

A number of studies have suggested a relationship between residential proximity to landfill sites and adverse pregnancy outcomes. An increase in infants with low birth weights has been the most consistent finding in single-site studies (*11,12,14,26,27*). These were generally well-designed studies and low birth weight is thought to be a sensitive marker of effects of chemical exposures. Small increases in the risk of birth defects and certain specific birth defects (cardiac defects, central nervous system defects, musculoskeletal defects) have been reported, mainly in multisite studies (*12,59,61,65,66*). Studies are still too few, however, to draw conclusions regarding causality. Fetuses, infants, and children are generally thought to be more vulnerable and therefore experience toxic effects at lower doses than the adult population (*25*). The finding of shorter stature in Love Canal children (*10*) may also be an example of this.

An increased presence of chromosomal changes was reported in the vicinity of a landfill site in Mellery, Belgium (*15,28*), but not in Love Canal (*8*). Findings in Mellery were related to children in particular, which may again be an indication that children are more susceptible to low-level exposures from waste sites. It is not clear at present how well chromosomal changes predict cancer risk in humans.

Other adverse health outcomes such as abnormalities in liver function (*13*) and in renal disease (*64*) have also been reported in relation to hazardous waste exposure, although in single studies only.

For the future planning and regulation of landfill sites it is important to know which types of sites are most likely to entail risks. Landfill sites may differ enormously in the conditions that render them hazardous, and conditions that determine the exposure to and resulting health risks posed by any waste site are likely to be unique to that particular site. Such conditions may include the types, quantities, and age of the waste present; hydrogeologic and metereologic factors; and site management and engineering practices. We have not in this review attempted to relate technical aspects of waste disposal to health effects. Much of the existing epidemiologic work investigates large, old sites, uncontrolled dumps, and sites where heavy off-site migration of chemicals was detected. On the basis of current evidence, we cannot extrapolate findings for these individual sites to landfill sites in general or conclude which landfill sites are more likely than others to affect the health of nearby human populations.

It is also not possible to determine whether sites with airborne or waterborne exposures are more likely to pose a risk to human health. Although drinking water contamination is usually the primary concern related to landfill sites, in most cases local water supplies do not originate from the local area. Most studies, therefore, concern landfill sites where no local drinking-water wells were present and potential exposure was either airborne or through other routes such as direct contact and consumption of homegrown vegetables.

At present information regarding adverse health effects of exposure to landfill sites in European countries is largely lacking.

Further Research Needs

Research into the health effects of landfill sites is relatively immature, and further research could improve our current understanding (*1,2,25,68*). Future studies of landfill sites would greatly benefit from a more

interdisciplinary approach, drawing from the fields of landfill engineering, environmental sciences, toxicology, and epidemiology.

Improvements in the base of toxicologic and epidemiologic data on effects of specific chemical exposures would improve our understanding of possible risks of the migration of these chemicals from landfill sites into the environment. Johnson and DeRosa (*69*), in a recent review of toxicologic hazards of Superfund waste sites, conclude that although a large body of toxicologic research is under way to assess the toxicity of chemicals commonly contaminating the environment surrounding waste sites, equally significant work is still to be done before these chemicals have adequate toxicity profiles that can be used by health and risk assessors. Johnson and DeRosa discuss data needs established by the Agency for Toxic Substances and Disease Registry and the U.S. EPA for research of individual chemicals and find these needs mainly in dose–response studies, reproductive studies, and immunotoxicology studies. Improved data on effects of individual chemical exposures would improve the quality of quantitative risk assessments that can be made for landfill exposures. However, quantitative risk assessments are based to a large extent on unverifiable assumptions, and therefore cannot negate the necessity for direct epidemiologic studies of people living near landfill sites.

More research into effects of chemical mixtures and possible interactions between single chemicals is needed to improve understanding of effects of multiple chemical exposures. Such research is complex, but new research initiatives are under way, mainly in the United States. For example, the U.S. EPA MIXTOX database, which contains toxicologic data on interactions of hundreds of pairs of chemicals, is a promising new development (*70*). Research developments and future directions in this field are discussed in detail by a number of authors (*70–72*).

The investigation of single landfill sites is important as a response to community concerns. More multisite studies with large study populations should also be conducted to draw conclusions about more general risks. Ideally, such multisite studies should attempt to classify sites in such a way that risks related to specific site characteristics can be investigated. However, systematic site assessments needed to underpin such classifications are at present totally lacking in Europe. There is little detailed information on waste inputs, especially for old landfills, and monitoring practices vary hugely for factors such as frequency of monitoring, the environmental media monitored, and types of chemicals monitored. Standardized waste-input recording systems and monitoring practices across European countries and the availability of summary reports of waste inputs and monitoring results would aid site classifications for epidemiologic studies as well as risk assessments. A recent report evaluating the use of a risk assessment tool on two U.S. and three U.K. landfill sites concluded that in the United Kingdom it is not possible to characterize the majority of landfills, even to the level at which a simple risk assessment framework can be employed on a site-specific basis. This particularly applies to the characterization of emplaced waste (*73*).

Epidemiology has increasingly made use of so-called biomarkers—biological monitors of either the internal dose of a chemical (biomarkers of exposure) or the biologic response to exposure (biomarkers of early effect). Biomarkers of the first type measure levels of chemicals in human tissue and fluids (e.g., blood, urine). These techniques can generally measure only a small number of chemicals, and their use is limited to situations in which environmental monitoring data indicate specific landfill chemicals that are of particular concern. The presence of chemicals in the body is currently difficult and costly to measure, but this may change. Biomarkers of the second type measure biological responses such as chromosomal changes (sister chromatid exchanges) and molecular changes (DNA adducts), and could be seen as early effect manifestations. Interpretation of these effect biomarkers is difficult; their link with clinically overt disease remains unclear, but their use could give studies much greater statistical power than studies of rare disease outcomes. Biomarker techniques have been used mainly in occupational settings and there has been less discussion of their use in environmental studies (*74,75*). Collaboration is required between epidemiologists and basic scientists to further develop biomarker techniques for use in studies of environmental exposures.

Specific areas of further research likely to prove most useful are

- The study of vulnerable groups—groups of the population likely to develop adverse health effects at levels of exposure lower than those of the general population. Such groups include: fetuses, infants, and children; elderly people; and people with impaired health.
- The study of people with higher exposures, for example, children (because they come into higher contact with potentially contaminated soil); people who eat local food products; workers at waste sites; people with life-styles (possibly socioeconomically determined) that lead to higher exposures.
- The study of worst-case landfills. In the absence of adequate exposure data, it is difficult to define worst-case sites. Ranking systems are in use, e.g., in the Superfund program (*76*), to rank waste sites according to their hazard potential, but their application generally requires extensive site investigations. Few epidemiologic studies would have the resources to carry out such investigations. It could be argued that identification of worst-case landfills should form part of regulatory practice in Europe. However, in the absence of systematic investigation of this kind, the study of sites where high off-site contamination has been detected and sites that have been subject to less regulation (possibly sites in developing countries or Eastern Europe) could be suitable for the study of worst-case scenarios provided appropriate health data can be collected.

It is possible with suitable investment to improve levels of understanding about risks of hazardous wastes to human health. However, because of the complicated nature of the exposure, it is likely that there will always remain a degree of uncertainty regarding health effects of landfill sites.

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Risk of adverse birth outcomes in populations living near landfill sites

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Abstract

Objective To investigate the risk of adverse birth outcomes associated with residence near landfill sites in Great Britain.

Design Geographical study of risks of adverse birth outcomes in populations living within 2 km of 9565 landfill sites operational at some time between 1982 and 1997 (from a total of 19 196 sites) compared with those living further away.

Setting Great Britain.

Subjects Over 8.2 million live births, 43 471 stillbirths, and 124 597 congenital anomalies (including terminations).

Main outcome measures All congenital anomalies combined, some specific anomalies, and prevalence of low and very low birth weight (<2500 g and <1500 g).

Results For all anomalies combined, relative risk of residence near landfill sites (all waste types) was 0.92 (99% confidence interval 0.907 to 0.923) unadjusted, and 1.01 (1.005 to 1.023) adjusted for confounders. Adjusted risks were 1.05 (1.01 to 1.10) for neural tube defects, 0.96 (0.93 to 0.99) for cardiovascular defects, 1.07 (1.04 to 1.10) for hypospadias and epispadias (with no excess of surgical correction), 1.08 (1.01 to 1.15) for abdominal wall defects, 1.19 (1.05 to 1.34) for surgical correction of gastroschisis and exomphalos, and 1.05 (1.047 to 1.055) and 1.04 (1.03 to 1.05) for low and very low birth weight respectively. There was no excess risk of stillbirth. Findings for special (hazardous) waste sites did not differ systematically from those for non-special sites. For some specific anomalies, higher risks were found in the period before opening compared with after opening of a landfill site, especially hospital admissions for abdominal wall defects.

Conclusions We found small excess risks of congenital anomalies and low and very low birth weight in populations living near landfill sites. No causal mechanisms are available to explain these findings, and alternative explanations include data artefacts and residual confounding. Further studies are needed to help differentiate between the various possibilities.

Introduction

Waste disposal by landfill accounts for over 80% of municipal waste in Britain.[1] Human exposure to toxic chemicals in landfill (which include volatile organic compounds, pesticides, solvents, and heavy metals[2–4]) may occur by dispersion of contaminated air or soil,[2] leaching or runoff,[5] or by animals and birds, although evidence for any substantial exposures is largely lacking.[6] Excess risks of congenital anomalies and low birth weight near landfill have been reported,[6–9] including from recent European and UK studies,[10 11] although some have reported less significant[12] or negative findings.[13] The aim of our present study was to examine risk of adverse birth outcomes associated with residence near landfill using data on all known sites in Great Britain.

Methods

Classification of populations near landfill sites

Data provided by the national regulatory agencies were merged in a geographical information system to give a database containing 19 196 sites. Data on boundaries were unavailable for most sites, so point locations had to be used. These comprised the site centroids for 70% of sites and, for the remainder, the location of the site gateway at the time of reporting. Data for site locations were of low accuracy (often rounded to 1000 metres), and data on area were inadequate to allow estimation of the extent of most sites. Landfill sites also change considerably over time as old areas are closed and new areas develop, while postcodes (used to define the location of cases and births) give only an approximation of place of residence, accurate to 10-100 metres in urban areas but >1 km in some rural areas; also, landfill sites are highly clustered, so that individual postcodes may lie close to 30 or more sites. Therefore, distance from nearest landfill site was not regarded as a meaningful proxy for exposure. As a compromise between the need for spatial precision and the limited accuracy of the data, we constructed a 2 km zone around each site (figure), giving resolution similar to or higher than that of previous studies,[10 11] and at the likely limit of dispersion for landfill emissions.[14] Postcodes within the 2 km buffer zone were classified hierarchically by operational status, year on year, such that sites still operating took precedence over those closed earlier in the study period, which took precedence over sites opening later in the study period.[15] People living more than 2 km from all known landfill sites during the study period comprised the reference population.

Because of concerns about the quality of landfill data for earlier years, and because health data were available only to 1998, we excluded 9631 sites (25% of the population) that closed before 1982 or opened after 1997 (to allow a one year lag period for the birth outcomes) or for which there were inadequate data. The remaining 9565 sites comprised 774 sites for special (hazardous) waste, 7803 for non-special waste, and 988 handling unknown wastes. The 2 km surrounding these sites included 55% of the national population; 20% were included in the reference area.

Health and denominator data

We used national postcoded registers held by the Small Area Health Statistics Unit. These comprised the National Congenital Anomaly System in England and

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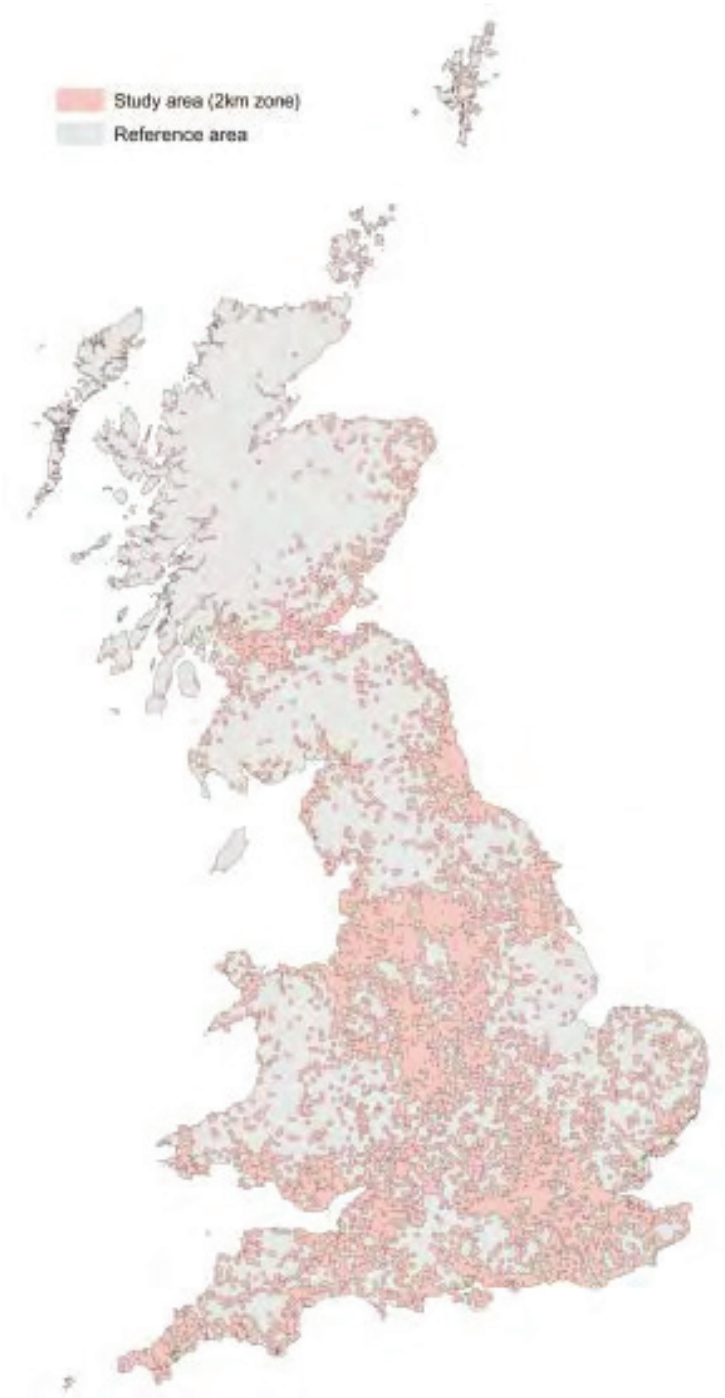
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Map of Great Britain showing 2 km zones around landfill sites and reference area

Wales, 1983-98, and data on terminations, 1992-8, performed for "grounds E" of the 1967 Abortions Act ("where there is a substantial risk that if the child were born it would suffer from such physical or mental abnormality as to be seriously handicapped"); congenital anomaly and terminations data for Scotland, 1988-94; hospital admissions data for England and Scotland, 1993-8 (Welsh data were considered unreliable); and national births and stillbirths data, 1983-98.

Cases were coded to ICD-9 (international classification of diseases, ninth revision) from 1983 to 1994, and to ICD-10 thereafter. Outcomes were all congenital anomalies combined (ICD-9 740-59; ICD-10 Q00-Q99); neural tube defects (ICD-9 740.0-740.2, 741.0-741.9, 742.0; ICD-10 Q00.0-Q00.2, Q05.0-Q05.9, Q01.0-Q01.9); cardiovascular defects (ICD-9 745.0-747.9; ICD-10 Q20.0-Q28.9); abdominal wall defects (ICD-9 756.7; ICD-10 Q79.2-Q79.4); hypospadias and epispadias (ICD-9 752.6; ICD-10 Q54.0-Q54.9, Q64.0); surgical correction of hypospadias and epispadias (M731, M732); and surgical correction of gastroschisis and exomphalos (T281). Multiple anomalies were counted under each outcome (once only for all anomalies combined).

Surgical corrections (England and Scotland only) were analysed by date of birth, not date of surgical procedure. For hypospadias and epispadias, we included only procedures carried out before the age of 3 years, and, for gastroschisis and exomphalos, in the first year of life only. Low and very low birth weights were defined as <2500 g and <1500 g respectively. The relevant denominators and years of analysis are shown in table 1.

Statistical methods

We calculated risks for the population within 2 km of landfill relative to the reference population by indirect standardisation, assuming a common relative risk for all landfill sites. We used model predictions from Poisson regression of data from the reference area to provide standard rates. The regression function included year of birth, administrative region ($n=10$), sex (for birth weight and stillbirths), and deprivation. We obtained deprivation by assigning postcodes to tertiles of the national distribution of the Carstairs' deprivation index[16] based on 1991 census statistics at enumeration district level (we used tertiles rather than quintiles of the Carstairs index because of the small number of events for the rarer outcomes in the most deprived part of the reference area). We used a descending stepwise selection procedure starting from the fullest model including all possible interactions. This was repeated without deprivation, and then the two models were constrained (where necessary) to differ only in terms of deprivation (table 2). For the hospital admissions data (where there were fewer years), unadjusted and deprivation-adjusted results only were obtained, and no modelling was done.

Some degree of overdispersion and a widening of the confidence intervals is to be expected if our model assumptions fail to hold (for example, because of data anomalies, unmeasured confounding, or sampling variability of the rates). We therefore calculated Poisson 99% (rather than 95%) confidence intervals, but this does not necessarily ensure that all additional variability has been captured—we emphasise estimation of relative risks and their stability (or otherwise) to choice of model confounders rather than significance testing.

We assessed the sensitivity of our results to model choice by using an alternative model for each birth outcome (table 2). We also included urban or rural status and examined risks for rural areas only, and for birth weight (where data were sufficient) we examined sensitivity to the use of quintiles (rather than tertiles) of the Carstairs index. For abdominal wall defects, we also examined maternal age (<20 and ≥ 20 years, available 1986-98 for England and Wales only).[17]

The main analysis identified at outset was for all landfill sites for the combined period during their

Table 1 Denominators and years for analyses of birth outcomes near landfill sites (within 2 km) and in reference area (≥2 km from any site), and before opening and during operation and after closure for sites that opened during the study period

			All operating and closed sites by waste type				Sites that opened during study period (all waste types) by operating status	
Analysis	Denominator	Years	All	Special waste	Non-special waste	Reference area	Before opening	During operation and after closure
Congenital anomalies*	Live births, stillbirths, and terminations	E, W 1983-98; S 1988-94	5 825 575	803 833	4 517 196	2 026 074	429 160	4 150 320
Surgical corrections (hypospadias and epispadias)†	Live male births	E, S 1993-5	585 414	67 281	469 149	199 974	9 982	424 271
Hospital admissions (abdominal wall defects) or surgical corrections (gastroschisis and exomphalos)†	Live births	E, S 1993-7	1 903 892	222 179	1 522 851	646 415	21 282	1 384 135
Stillbirths	Live births and stillbirths	E, S, W 1983-98	6 062 700	825 456	4 725 120	2 177 796	461 776	4 295 686
Low and very low birth weight	Live births	E, S, W 1983-98	6 030 429	821 124	4 699 860	2 166 596	459 358	4 272 510

E=England, W=Wales, S=Scotland.
*Includes terminations for England and Wales 1992-8, for Scotland 1988-94. For hypospadias and epispadias, denominator data are male live births and stillbirths only: numbers are 2 983 963 (all landfill sites), 412 201 (special waste sites), 2 313 135 (non-special waste sites), 1 037 320 (reference area), 220 227 (before opening of sites), 2 125 477 (after opening of sites).
†England and Scotland only.

operation and after closure. Subsidiary analyses examined risks separately for special and non-special waste sites, and in the period before and after opening for the 5260 landfill sites with available data.[17]

Results

Urban or rural status and Carstairs index were strongly correlated. Within the reference area, 49% of the most affluent tertile of areas was classified as rural (7% for the most deprived tertile), while for all outcomes rates were higher in the most deprived areas compared with the most affluent areas: the ratio ranged from 1.02 (surgical correction of hypospadias and epispadias) to 1.52 (very low birth weight).[17] The area within 2 km of the 9565 landfill sites tended to be more deprived than the reference area: 34% (v 23%) of the population were in the most deprived tertile of Carstairs score (36% for special waste sites). The area near landfill also had a higher proportion of births to mothers under 20 years of age (7.7% v 6.1%) and, among women aged 15-44, included (1991 census) a higher proportion of women of Indian, Pakistani, or Bangladeshi origin (4.8% v 3.2%) and a lower proportion of black women (2.0% v 3.4%).

Table 3 shows the numbers of cases for each birth outcome and relative risks for the area near landfill compared with the reference area. The relative risk for all congenital anomalies combined was 0.92 (99% confidence interval 0.907 to 0.923) unadjusted, and 1.01 (1.005 to 1.023) adjusted for deprivation and other confounders. After adjustment for deprivation (which reduced excess risks) relative risk was 1.05 (1.01 to 1.10) for neural tube defects, 1.08 (1.01 to 1.15) for abdominal wall defects (and 1.07 (0.98 to 1.18) for hospital admissions), 1.19 (1.05 to 1.34) for surgical correction of gastroschisis and exomphalos, and 1.05 (1.047 to 1.055) and 1.04 (1.03 to 1.05) for low and very low birth weight respectively. The risk was 0.96 (0.93 to 0.99) for cardiovascular defects and 1.07(1.04 to 1.10)

Table 2 Models chosen by the stepwise selection procedure in the reference area for each outcome*

Outcome	Model	No of parameters in chosen model	Terms added in alternative model†
Deprivation unadjusted			
All anomalies	Year+region+region:year	151	—
Neural tube defects	Year+region	25	Region:year
Cardiovascular defects	Year+region	25	Region:year
Hypospadias and epispadias	Year+region	25	Region:year
Abdominal wall defects	Year+region	25	Region:year
Stillbirth	Year+region+sex+region:sex	35	Region:year
Low birth weight	Year+region+sex	26	Region:year
Very low birth weight	Year+region	25	Region:year
Deprivation adjusted			
All anomalies	Deprivation+year+region+region:deprivation+region:year	171	Year:deprivation
Neural tube defects	Deprivation+year+region	27	Region:year
Cardiovascular defects	Deprivation+year+region+region:deprivation	45	Region:year
Hypospadias and epispadias	Deprivation‡+year+region	27	Region:year
Abdominal wall defects	Deprivation+year+region	27	Region:year
Stillbirth	Deprivation+year+region+sex+region:sex	37	Deprivation:year
Low birth weight	Deprivation+year+region+sex+region:deprivation+deprivation:sex	48	Region:year
Very low birth weight	Deprivation+year+region+region:deprivation	45	Deprivation:year

Interactions are denoted by ":"
*No modelling was done for the hospital admissions data.
†Terms added in alternative model used in sensitivity analysis, defined as the most important term excluded at the last step (no alternative is shown for all anomalies combined, deprivation unadjusted, because the model is already saturated).
‡Deprivation not selected by stepwise selection process but was added as a main effect.

Table 3 Risks of congenital anomalies, stillbirths, and low and very low birth weight in populations living within 2 km of a landfill site (all waste types) during operation or after closure compared with those in the reference area (≥2 km from any site)

	Near landfill (<2 km)		Reference area		Relative risk (99% CI)		
Birth outcome	No of cases	Rate (per 100 000 births)	No of cases	Rate (per 100 000 births)	Unadjusted	Adjusted (but not for deprivation)	Adjusted (and for deprivation)
Congenital anomalies (register and terminations data*)							
All congenital anomalies	90 272	1550	34 325	1694	0.92 (0.907 to 0.923)	1.01 (1.00 to 1.02)	1.01 (1.005 to 1.023)
Neural tube defects	3 508	60	1 140	56	1.07 (1.02 to 1.12)	1.08 (1.03 to 1.12)	1.05 (1.01 to 1.10)
Cardiovascular defects	6 723	115	2 716	134	0.86 (0.83 to 0.89)	0.95 (0.92 to 0.98)	0.96 (0.93 to 0.99)
Hypospadias and epispadias†	7 363	247	2 485	240	1.03 (1.00 to 1.06)	1.07 (1.04 to 1.10)	1.07 (1.04 to 1.10)
Abdominal wall defects	1 488	26	448	22	1.16 (1.08 to 1.23)	1.14 (1.06 to 1.22)	1.08 (1.01 to 1.15)
Congenital anomalies (hospital admissions)							
Hypospadias and epispadias‡	1 503	257	536	268	0.96 (0.90 to 1.02)	—	0.96 (0.90 to 1.02)
Abdominal wall defects	755	40	227	35	1.13 (1.03 to 1.24)	—	1.07 (0.98 to 1.18)
Gastroschisis and exomphalos‡	467	25	126	19	1.26 (1.12 to 1.42)	—	1.19 (1.05 to 1.34)
Stillbirths and birth weight							
Stillbirths	32 271	532	11 200	514	1.04 (1.02 to 1.05)	1.05 (1.03 to 1.06)	1.00 (0.99 to 1.02)
Low birth weight	422 149	7000	137 958	6367	1.10 (1.095 to 1.104)	1.11 (1.102 to 1.111)	1.05 (1.047 to 1.055)
Very low birth weight	62 191	1031	20 858	963	1.07 (1.06 to 1.08)	1.08 (1.07 to 1.09)	1.04 (1.03 to 1.05)

See table 1 for denominators and years of analysis and table 2 for adjustments.
*Terminations included for England and Wales 1992-8, Scotland 1988-94.
†Excludes terminations (3 cases).
‡Surgical corrections.

and 0.96 (0.90 to 1.02), respectively, for hypospadias and epispadias and their surgical correction (for which deprivation adjustment had little or no effect).

Table 4 summarises findings (adjusted for deprivation) for the special and non-special waste sites, and for the sites that opened during the study period. For special waste sites, risks above one were found for all but two outcomes, ranging up to 1.11 (1.03 to 1.21) for cardiovascular defects and for hypospadias and epispadias. For the specific anomalies, except neural tube and cardiovascular defects, risks were higher in the period before opening of a landfill site compared with after opening, especially for hospital admissions for abdominal wall defects. For birth weight and stillbirth, risks were higher after opening.

Sensitivity analysis showed that the risk estimates were robust to the different models used.[17] Urban or rural status did not materially alter results with deprivation included, though modelling of data for rural areas only (where numbers of cases were much lower than in the main analysis) did reduce risk estimates for neural tube defects and hypospadias and epispadias—relative risks (for all waste types, deprivation adjusted) were 0.99 (0.89 to 1.10) and 1.01 (0.94 to 1.09) respectively. Inclusion of maternal age as a confounder had only a small effect on risk of abdominal wall defects.[17]

Discussion

This is by far the largest study of associations between residence near landfill and adverse birth outcomes. We found a small excess risk of neural tube defects, abdominal wall defects, surgical correction of gastro-

Table 4 Estimated relative risks (99% confidence intervals) of birth outcomes for populations living within 2 km of a landfill site, adjusted for deprivation and other variables* according to waste type and to operating status for those sites that opened during the study period

	All operating and closed sites, by waste type			Sites that opened during study period (all waste types), by operating status†	
Birth outcome	All wastes	Special waste	Non-special waste	Before opening	During operation or after closure
Congenital anomalies (register and terminations data‡)					
All congenital anomalies	1.01 (1.005 to 1.023)	1.07 (1.04 to 1.09)	1.02 (1.01 to 1.03)	1.02 (0.99 to 1.05)	1.00 (0.99 to 1.01)
Neural tube defects	1.05 (1.01 to 1.10)	1.07 (0.95 to 1.20)	1.06 (1.01 to 1.12)	0.98 (0.82 to 1.16)	1.05 (0.99 to 1.10)
Cardiovascular defects	0.96 (0.93 to 0.99)	1.11 (1.03 to 1.21)	0.95 (0.91 to 0.98)	0.92 (0.81 to 1.04)	0.92 (0.88 to 0.95)
Hypospadias and epispadias§	1.07 (1.04 to 1.10)	1.11 (1.03 to 1.21)	1.07 (1.04 to 1.11)	1.08 (0.98 to 1.19)	1.05 (1.02 to 1.09)
Abdominal wall defects	1.08 (1.01 to 1.15)	1.03 (0.86 to 1.25)	1.07 (0.99 to 1.16)	1.24 (0.97 to 1.60)	1.06 (0.98 to 1.14)
Congenital anomalies (hospital admissions)					
Hypospadias and epispadias¶	0.96 (0.90 to 1.02)	0.98 (0.81 to 1.19)	0.96 (0.90 to 1.04)	1.42 (0.94 to 2.16)	0.93 (0.86 to 1.00)
Abdominal wall defects	1.07 (0.98 to 1.18)	1.08 (0.82 to 1.42)	1.05 (0.94 to 1.16)	2.26 (1.23 to 4.15)	1.12 (1.01 to 1.25)
Gastroschisis and exomphalos¶	1.19 (1.05 to 1.34)	1.10 (0.77 to 1.58)	1.18 (1.03 to 1.34)	1.33 (0.46 to 3.81)	1.24 (1.09 to 1.42)
Stillbirths and birth weight					
Stillbirths	1.00 (0.99 to 1.02)	0.99 (0.95 to 1.03)	1.00 (0.99 to 1.02)	1.01 (0.96 to 1.06)	1.02 (1.00 to 1.03)
Low birth weight	1.05 (1.047 to 1.055)	1.05 (1.04 to 1.06)	1.06 (1.052 to 1.062)	1.01 (0.99 to 1.02)	1.07 (1.062 to 1.072)
Very low birth weight	1.04 (1.03 to 1.05)	1.03 (1.00 to 1.06)	1.04 (1.03 to 1.06)	0.98 (0.94 to 1.02)	1.04 (1.03 to 1.05)

See table 1 for denominators and years of analysis.
*See table 2 for other variables adjusted for.
†522 landfill sites with available data for hospital admissions.
‡Terminations included for England and Wales 1992-8, Scotland 1988-94.
§Excludes terminations (3 cases).
¶ Surgical corrections.

schisis and exomphalos, low and very low birth weight. Findings for cardiovascular defects and hypospadias and epispadias were inconsistent, and there was no association with stillbirth. By including all landfill sites in Great Britain and using routine data sources, we avoided the possibility of bias from selective reporting[18 19] and maximised statistical power, but problems with data quality and confounding could have led to spurious associations.[20] These merit further discussion.

Exposure classification and data quality issues

In the absence of information on site or geological factors affecting emissions from landfill, we examined data for special waste sites as a proxy for potential hazard. The UK practice of co-disposal of special and non-special wastes (in contrast, for example, with US "superfund" sites[3]) means that most special waste sites handle small volumes of hazardous wastes. They are subject to stricter management and design standards than other UK sites, while hazardous wastes may have been disposed of, unreported, in non-special sites. Thus exposure risks from special waste sites may be no greater than from other sites. Exposures to environmental contamination from sources other than landfill may also be relevant because sites tend to be located in old mineral or other excavations, often on old industrial or contaminated land or close to current industrial activities.

A key issue was the possibility of misclassification from use of a 2 km zone to define proximity to landfill sites. However, in view of the low spatial resolution of the landfill data (hundreds of metres) and complex nature of landfill sites, using finer subdivisions of the 2 km zone or distance as a continuous measure to examine proxy dose-response relationships would not yield meaningful results. Misclassification of potential exposure to landfill may also have occurred if mothers moved home during the relevant period after conception.[21]

While the data for births and stillbirths are well recorded, the national congenital anomaly system in England and Wales is known to be incomplete[22] (though we found relative over-reporting in Scotland), and there were marked fluctuations in rates of anomalies over the study period, partly because of coding changes[23] and the dates that the terminations data became available. We adjusted for calendar year to deal with fluctuating rates, but ascertainment artefacts could have biased our results (in either direction) if they were differential with respect to landfill locations. Though we had no reason to suspect that this had occurred, such inconsistencies could explain differences of the order detected in this study. On the other hand, we included data on terminations to improve ascertainment, especially for neural tube defects, and included data on hospital admissions and surgical corrections to give an independent source of data for those specific anomalies.

Confounding

We addressed confounding in two ways. Firstly, analysis included potential confounders, with and without adjustment for deprivation. Residual confounding may persist if the adjustment did not account completely for relevant individual characteristics such as smoking,[24] drug use,[25] and infections during pregnancy.[26] As in the Eurohazcon study,[10] maternal age (for risk of abdominal wall defects[27]) did not seem to be a strong confounder, and, unlike in the United States,[28] location of waste sites near ethnic minority communities was not a key feature. Increased risks (about 1.5 to 2) of low and very low birth weight,[29 30] and (more weakly) of certain congenital anomalies (especially neural tube defects[31]) have been reported among offspring of women of South Asian origin,[32] but the higher proportions of women of Indian, Pakistani, or Bangladeshi origin living near landfill sites compared with the reference area would explain only around 1% excess in our study.

Secondly, we examined rates both before and after the opening of landfill sites that opened during the study period. Because this analysis is restricted to one set of areas, it is less subject to confounding by socio-demographic factors than comparisons between different areas—although confounding by temporal trends (which are strong for some of the health outcomes studied here[17]) is possible. Consequently, we did not compare the risks before and after opening directly but estimated each with respect to the reference region. We found excess risks for some specific anomalies in the period before opening (and which were higher than in the period during operation or after closure, especially for hospital admission for abdominal wall defects). This implies that factors other than landfill might be responsible. The Nant-y-Gwyddon study also noted an excess risk of all congenital anomalies combined before the site was opened.[11]

A possible causal association with landfill should also be considered. Given the large heterogeneity between landfill sites and the likelihood that the effect of any emissions would be greatest close to the sites,[33] causal effects related to particular landfill sites might have been greatly diluted. None the less, we know of no causal mechanism that might explain our findings, and there is considerable uncertainty as to the extent of any possible exposure to chemicals found in landfills.[6] Further understanding of the potential toxicity of landfill emissions and possible exposure pathways is needed in order to help interpret the epidemiological findings.

What is already known on this topic

Various studies have found excess risks of certain congenital anomalies and low birth weight near landfill sites

Risks up to two to three times higher have been reported

These studies have been difficult to interpret because of problems of exposure classification, small sample size, confounding, and reporting bias

What this study adds

Some 80% of the British population lives within 2 km of known landfill sites in Great Britain

By including all landfill sites in the country, we avoided the problem of selective reporting, and maximised statistical power

Although we found excess risks of congenital anomalies and low birth weight near landfill sites in Great Britain, they were smaller than in some other studies

Further work is needed to differentiate potential data artefacts and confounding effects from possible causal associations with landfill

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Contributors: PE and LJ initiated the project and, with DB and SM, drafted the paper. DB, CdH, CH, and IM performed the analysis of landfill sites. SM, CH, and IM performed the statistical analysis, overseen by JW and SR. TKJ contributed to the epidemiological analysis and interpretation. All authors contributed to and approved the final paper. PE is guarantor for the paper.

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Department of Health

News releases

Largest ever study into health of populations around landfill sites published

Published date: 16 August 2001

A major study into the possible health risks for populations living around landfill sites is published today. The Small Area Health Statistics Unit (SAHSU) studied the rates of birth defects, low birthweight, stillbirths, and of certain cancers in populations living within 2km of landfill sites. The group examined 9,565 landfill sites that were in operation between 1982 and 1997. It is the most extensive study into landfill sites anywhere in the world.

The study was commissioned in response to public concerns about the possible health effects of living close to landfill sites. SAHSU, an independent unit funded by government departments, found that 80 per cent of the population lives within 2 kilometres of a landfill site.

Results on birth outcomes of the SAHSU study will be published in the British Medical Journal on 17 August. The key findings are:

- the study found no increase in rates of cancer in populations living close to landfill sites
- the rate of congenital anomalies in populations living within 2km of all landfills is one per cent more than expected
- the rate of congenital anomalies in populations living within 2km of landfill sites containing hazardous waste is seven per cent more than expected
- rates of low birth weight babies are around five per cent higher near to landfill sites, but there is no difference in the rate of stillbirths
- rates of birth defects did not increase, and in some cases reduced, after landfill sites were opened in certain areas

The SAHSU study says that it is not clear at present that landfills are causing these effects and that other explanations are possible. These could include limits in the information available for the study, or the possibility that the study did not completely take into account other factors which increase the risk of birth defects or low birth weight. They recommend that further work is done to distinguish between these possibilities.

The Government's expert advisory Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) noted that the findings for the birth outcomes were not consistent and that the study provided no evidence that rates of anomalies increased after landfill sites opened. They commented that this made it difficult to draw conclusions about the possible health effects of landfill sites on the basis of this study. The COT recommended that the finding of a 7 per cent higher rate of congenital anomalies around special waste sites merited further investigation, whether or not it was related to the presence of the landfill sites.

Dr Pat Troop, Deputy Chief Medical Officer, said:

""This is an important study and the Government is taking it seriously. The results are difficult to interpret and we need to put them into context. We cannot say that there is no risk from landfill sites, but given the small numbers of congenital anomalies and the uncertainties in the findings, we are not changing our advice to pregnant women and they should continue with the recommended ante-natal programme.""

This study is part of an ongoing Government-funded research programme to investigate the possible impact of landfill sites on human health. In response to the recommendation of the COT, SAHSU will be asked to look further at the data to see if it is possible to identify any areas with particularly high rates of birth defects and to further investigate what these might be associated with.

Notes to editor

1. The Small Area Health Statistics Unit (SAHSU) was established in 1987, to investigate the incidence of disease around sources of environmental pollution and to advise government. It is wholly funded by government departments of Health; Environment, Food and Rural Affairs; Health and Safety Executive, Scottish Executive; National Assembly of Wales; Environment Agency; and Northern Ireland Department of Health, Social Security and Public Safety.
2. A full report of the study will be published on the DH website at: www.doh.gov.uk/landh.htm A paper publishing the results of the birth

outcomes analyses is published in the British Medical Journal on 17 August 2001.

3. In summer 1998, a report of the EUROHAZCON study was published in the Lancet. This investigated the incidence of congenital anomaly around 21 hazardous waste landfill sites in 5 European countries. It found an increased risk of congenital anomaly in babies whose mothers live close to the landfill sites. The study did not establish cause and effect, but concluded that there was a need for further work.
4. The SAHSU study was part of ongoing work to look at potential health impacts from landfill sites. Other research underway includes a review of the known causes of birth defects, a review of the potential for substances emanating from landfill sites to cause birth defects, a study of the geographical variation in overall rates of birth defects and the rates of specific anomalies, and a detailed study of emissions from landfill sites.
5. It is Government policy to reduce reliance on landfill. The Government's Waste Strategy 2000 set out a comprehensive strategy to reduce reliance on landfill, to reduce waste, to recycle it and to gain value from waste. The EU Landfill Directive which came into force on 16 July 2001 imposes stringent targets on the UK to reduce the amount of biodegradable municipal waste which it landfills to 35% of that produced in 1995 by 2020. The WS 2000 also sets challenging targets for increasing household recycling and composting and a target to reduce the amount of industrial and commercial waste landfilled. We produce over 100 million tonnes of waste a year from households, commerce and industry alone. Most waste produced in England and Wales goes to landfill. About 83% of municipal waste and 54% of commercial and industrial waste are managed in this way.
6. Landfills are subject to strict controls. The purpose of the licensing system is to ensure that waste is recovered or disposed of in ways which protect the environment and human health. Landfill sites are subject to strict licensing and regulatory controls by the Environment Agency in England and Wales and the Scottish Environment Protection Agency (SEPA) in Scotland. The purpose of the licensing system is to ensure that waste is recovered or disposed of in ways which protect the environment and human health. Details of landfill sites can be found on the public registers of the EA and SEPA, and information about landfill sites in England and Wales can be found at www.environment-agency.gov.uk/yourenv/
7. The EU Landfill Directive will impose additional requirements on landfill including banning some wastes from landfill altogether and requiring that waste is pre-treated before it is landfilled. Regulations to implement the Directive were issued for consultation on 8 August.
8. For further information contact Department of Health media centre on 0207 210570752334860 or DEFRA press office 0207 238 5391

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1: J Occup Environ Med. 1997 Nov;39(11):1103-10.

Health study of New York City Department of Sanitation landfill employees.

Gelberg KH.

New York State Department of Health, Bureau of Occupational Health, Albany 12203, USA.

Employees currently working at a large municipal landfill expressed concern that they experience higher rates of illness than other municipal sanitation workers. Therefore, this study was designed to examine acute health effects among employees working at the New York City Department of Sanitation, with special emphasis upon the landfill workers. Interviews conducted with 238 landfill and 262 off-site male employees asked questions about health symptoms experienced in the six months prior to the interview and about workplace exposures. This study found a higher prevalence among landfill employees of work-related dermatologic, neurologic, hearing, and respiratory symptoms, and sore and itching throats than among off-site employees. The respiratory and dermatologic symptoms were not associated with any specific occupational title or work task, other than working at the landfill. Off-site laborers experienced more neuromuscular symptoms and injuries.

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Relation between malodor, ambient hydrogen sulfide, and health in a community bordering a landfill ☆

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ABSTRACT

Background: Municipal solid waste landfills are sources of air pollution that may affect the health and quality of life of neighboring communities.
Objectives: To investigate health and quality of life concerns of neighbors related to landfill air pollution.
Methods: Landfill neighbors were enrolled and kept twice-daily diaries for 14 d about odor intensity, alteration of daily activities, mood states, and irritant and other physical symptoms between January and November 2009. Concurrently, hydrogen sulfide (H_2S) air measurements were recorded every 15-min. Relationships between H_2S, odor, and health outcomes were evaluated using conditional fixed effects regression models.
Results: Twenty-three participants enrolled and completed 878 twice-daily diary entries. H_2S measurements were recorded over a period of 80 d and 1-h average H_2S=0.22 ppb (SD=0.27; range: 0–2.30 ppb). Landfill odor increased 0.63 points (on 5-point Likert-type scale) for every 1 ppb increase in hourly average H_2S when the wind was blowing from the landfill towards the community (95% confidence interval (CI): 0.29, 0.91). Odor was strongly associated with reports of alteration of daily activities (odds ratio (OR)=9.0; 95% CI: 3.5, 23.5), negative mood states (OR=5.2; 95% CI: 2.8, 9.6), mucosal irritation (OR=3.7; 95% CI=2.0, 7.1) and upper respiratory symptoms (OR=3.9; 95% CI: 2.2, 7.0), but not positive mood states (OR=0.6; 95% CI: 0.2, 1.5) and gastrointestinal (GI) symptoms (OR=1.0; 95% CI: 0.4, 2.6).
Conclusions: Results suggest air pollutants from a regional landfill negatively impact the health and quality of life of neighbors.
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Annotated Resources on Landfills and Health Effects

1. **Porta, D. et al. Systemic Review of Epidemiological Studies on Health Effects Associated with Management of Solid Waste.** ***Environmental Health*** **(2009) 8:60-73.**

   This paper provides an overview of the studies in the published literature that evaluated the adverse health effects associated with different waste management methods including landfills. The authors also scored the reported effects in order to derive useable excess risk estimates for health impact assessment. The study design and potential biases in effect estimates were evaluated for each study included in the review. The authors found that for populations living with 2 kilometers of landfills, there was limited evidence of congenital anomalies and low birth weight with an excess risk of 2 percent and 6 percent, respectively. The excess risk tended to be higher when sites handled toxic waste. Many of the studies suffered from various limitations that are described in the review. Despite this, the authors concluded with a moderate degree of confidence that "we have derived some effect estimates that could be used for health impact assessment."

2. **Kouznetsova, M., et al. Increased Rate of Hospitalization for Diabetes and Residential Proximity of Hazardous Waste Sites.** ***Environmental Health Perspectives*** **(2007) 115(1): 75-79.**

   This study investigated whether residence near persistent organic pollutants (POPs)-contaminated hazardous waste sites increased rates of hospitalization for diabetes. The authors examined adult diabetes patients 25-74 years of age in New York State from 1993-2000. After controlling for major potential confounders, the study found a statistically significant increase in the rate of hospitalization for diabetes among patients residing in ZIP codes containing POPs-contaminated waste sites versus patients in "clean" sites. These results do not prove a cause and effect relationship; however, this study provides further support for the association between diabetes and exposure to environmental contaminants.

3. **Kuehn, C.M., et al. Risk of Malformations Associated with Residential Proximity to Hazardous Waste Sites in Washington State.** ***Environmental Research*** **(2007) 103: 405-412.**

   This study examines the relationship between malformations occurring in infants and maternal residential proximity to hazardous waste sites in Washington State. Maternal residence of infants born with malformations from 1987-2001 was compared to maternal residence of infants who were randomly selected and who were born without malformations during this same time period. The authors found that infants born within 5 miles of a hazardous waste site had an increased risk of malformations compared to infants born more than 5 miles away from a hazardous waste site.

4. **Gilbreath, S and Philip Kass. Adverse Birth Outcomes associated with open dumpsites in Alaska Native Villages.** ***American Journal of Epidemiology*** **(2006) 164(4): 518-528.**

   This study evaluates adverse birth outcomes in infants whose birth records indicate that the mothers lived in villages with dumpsites that were potentially hazardous to public health. The authors found that mothers who lived in villages with intermediate and high hazard dumpsite has a higher proportion of low birth weight infants than did mothers in the control group. More infants born to mothers who lived in the intermediate and high hazard villages suffered from intrauterine growth retardation.

5. **Palmer, S. et al. Risk of congenital anomalies after the opening of landfill sites. *Environmental Health Perspectives* (2005) 113(10): 1362-1365.**

   This study was conducted to investigate whether there was an increased risk of births with congenital malformations for mothers living near 24 landfill sites in Wales that opened between 1983 and 1997. Expected rates of congenital anomalies were compared to those of mothers living within 2 km of the sites, before and after opening of the landfills. Results showed risk of congenital anomalies for mothers living near the landfills increased when the sites were opened. However, the data could not establish a causal link between the landfills and the malformations because of a variety of biases that may have confounded the relationship. Nonetheless, the increase in risk associated with the opening of sites requires continued surveillance.

6. **Morgan, O., Vrijheid, M., Dolk, H. Risk of low birth weight near EUROHAZCON hazardous waste landfill sites in England. *Archives of Environmental Health* (2004) 59(3): 149-151.**

   This study evaluated risk of low birth weight near 10 English hazardous waste sites used in a previous study of congenital anomalies (see below). The authors found a small but not statistically significant increase in risk of low birth weight within 3 km of sites. The findings of this study suggests that previously reported results for congenital anomalies should not be extrapolated to a wider range of reproductive effects but instead evaluated separately for each outcome.

7. **Dummer, T., Dickinson, H., Parker, L. Adverse pregnancy outcomes near landfill sites in Cumbria, northwest England, 1950-1993. *Archives of Environmental Health* (2003) 58(11): 692-697.**

   This study evaluated the risks of stillbirth or neonatal death for mothers living near landfills. All stillbirths, neonatal deaths, and lethal congenital anomalies occurring among 287,993 births to mothers in Cumbria, northwest England during the period 1950-1993 were studied. For the period 1970-1993, a small but significant increase in risk of "other congenital anomalies of the nervous system" was found in mothers living near domestic waste landfill sites. This finding was consistent with other researchers, but a casual effect could not be inferred and the possibility that the results occurred by chance could not be ruled out.

8. **Vrijheid et al. Chromosomal congenial anomalies and residence near hazardous waste landfill sites. *Lancet* (2002) 359: 320-322.**

   This study revealed that there is an increased risk of chromosomal anomalies in people who live close to hazardous waste landfills. Adjustments were made for maternal age and socioeconomic status. The results of this study suggest that an increase in the risk of chromosomal anomalies is similar to that found for non-chromosomal anomalies.

9. **Elliot, P. et al. Risk of adverse birth outcomes in populations living near landfill sites. *British Medical Journal* (2001) 323: 363-368.**

   Between 1982 and 1997, a study was conducted to investigate the risk of adverse birth outcomes associated with residence near landfill sites. Individuals living 2 km from one of 9565 landfill sites throughout Great Britain were sampled. This has been the largest study of associations between residence near landfill and adverse birth outcomes thus far. It was concluded that residents near landfill sites are at risk of having children with congenital anomalies and low birth weight, however, further studies are needed to explain these findings.

10. McNamee, R., Dolk, H. Editorial: Does exposure to landfill waste harm the fetus? *British Medical Journal* (2001) 323: 351-352.

This editorial addresses issues concerning the article entitled "Risk of adverse birth outcomes in populations living near landfill sites" by Elliot et al. in the August 2001 edition of the British Medical Journal.

11. Pukkala, E and Antti Ponka. Increased incidence of cancer and asthma in houses built on a former dump area. Environmental Health Perspectives (2001) 109(11): 1121-1125.

This study evaluated the health of people who moved into twelve blockhouses in Helsinki, Finland that were built on a former dumpsite. Cancer and other chronic diseases were evaluated. The authors found a statistically significant increase in cancer for both sexes. The relative risk increased slightly with the number of years lived in the area. They also found increases in asthma and chronic pancreatitis. The authors concluded that the "possibility of a causal association between the dump exposure and incidence of cancer and asthma cannot be fully excluded." Nonetheless, the city council decided to demolish all houses in the dump area.

12. Berger, S., Jones P., White, M. Exploratory analysis of respiratory illness among persons living near a landfill. *Journal of Environmental Health* (2000) 62.6: 19.

Due to concern expressed by residents in two Staten Island, NY communities, the authors of this study evaluated the severity and frequency of respiratory symptoms occurring over a 12-month period among self-identified residents with asthma, severe breathing, or other respiratory conditions. Responses indicated that residents who lived adjacent to the landfill and those from the north-shore (seven miles from the landfill) had differing health problems, with landfill residents reporting higher rates of certain odors and eye, nose and throat irritation. The authors concluded that further investigation of respiratory illnesses should be conducted, as the study showed high rates of respiratory-related symptoms and conditions.

13. Vrijheid et al. Health effects of residence near hazardous waste landfill sites: a review of epidemiologic literature. *Environmental Health Perspectives* (2000) 108: (Suppl. 1) 101-112.

This review is an evaluation of current literature on the adverse health effects due to residence near landfill sites. It is difficult to make a conclusion about direct causes for adverse health effects and risks of landfills in general are hard to quantify. Of the studies reviewed, all proved to have insufficient exposure information. This article suggests that research of exposure to landfill sites needs to take a more interdisciplinary approach. Furthermore, epidemiologic and toxicologic studies need to be conducted for individual chemicals and chemical mixtures in order to understand what their effects may be on a population living near a landfill.

14. Knox, EG. Childhood cancers, birthplaces, incinerators and landfill sites. *International Journal of Epidemiology* (2000) 29: 391-397.

A study conducted in Great Britain between 1974 and 1987 found that children living near incinerators, both municipal and medical, were at more risk of getting cancer than those children living near landfill sites. This study targeted the sensitivity of children to carcinogenic emissions, but it failed to take into account the association of additional toxic sources in the vicinity. This study also did not account for the migration of families from areas of high toxicity to areas of low toxicity before, during, or after a child's birth.

15. State of New York Department of Health, Center for Environmental Health. Investigation of cancer incidence near 38 landfills with soil gas migration conditions: New York state, 1980-1989, 1998. Available from: New York State DOH, 2 University Place, Albany, NY 12203-3399. Phone: 1-800-458-1158.

Thirty-eight landfills throughout the state of New York were selected for a study to find out if people living near certain landfills had an increased risk of cancer compared to people living elsewhere. This study evaluated cancer incidence among people living around these 38 landfills between 1980 and 1989. All cases of leukemia, non-Hodgkin's lymphoma, liver, lung, kidney, bladder and brain cancer were identified and located on a map. Although this study had many limitations, it still found that women living near the landfills had a higher incidence of bladder cancer and leukemia. In comparison, men did not show an increased risk of any type of cancer despite their proximity to a landfill.

16. Dolk, H. et al. Risk of congenital anomalies near hazardous-waste landfill sites in Europe: the EUROHAZCON study. *Lancet* (1998) 352: 423-427.

This study examined seven regional registers of congenital anomalies in five different countries in Europe to determine if exposure from hazardous chemicals at landfills increased the risk of birth defects. Twenty-one sites were examined overall and among those sites mothers within a 3 km radius showed a significantly raised risk of having children with congenital anomalies. The results of this study were adjusted for maternal age and socioeconomic status. However, this study's findings are limited by a lack of information on exposures.

17. Berry, M., and Bove, F. Birth weight reduction associated with residence near a hazardous waste landfill. *Environmental Heath Perspectives* (1997) 105(8): 856-861.

Twenty-five years of birth certificate information (1961-1985) was collected in order to examine the relationship between birth weight and mother's residence near the Lipari Landfill located in New Jersey. The results indicated that there was a significant impact to infants born to residents who lived near the landfill during the time they would have been at greatest risk of exposure to hazardous chemicals. Many factors, including maternal health, cigarette and alcohol consumption during pregnancy, and socioeconomic status were not available for this study.

18. Goldberg, M. et al. Incidence of cancer among persons living near a municipal solid waste landfill site in Montreal, Quebec. *Archives of Environmental Health* (1995) 50(6): 416-424.

In a Canadian study, researchers from the Public Health Department in Montreal evaluated cancer incidence rates in people living around the Miron Quarry municipal landfill. Thirty-five volatile organic chemicals were identified in the landfill gases sampled, including known human carcinogens. When evaluating cancer incidence rates among persons living near the landfill, it was concluded that there might have been increased risks for certain cancers, such as stomach, liver, lung, prostate, and cervix uteri. The researchers also concluded that there were too many unknown factors to make any conclusions as to whether cancer incidence and proximity to the landfill were directly related.

19. Shaw, G. et al. Congenital malformations and birth weight in areas with potential environmental contamination. *Archives of Environmental Health* (March/April 1992) 47: 147-154.

Due to the public's increasing concern about reproductive damage as a result of exposure to environmental contamination, a study was conducted to determine if mothers living near contaminated sites were at a greater risk of having children with congenital malformations. This study did not reveal lower birth weight or increased risks

for most malformations among women who lived in contaminated areas. It did, however, show an elevated risk for infants with malformations of the heart and circulatory system.

20. Upton, A. et al. Public health aspects of toxic chemical disposal sites. *Annual Review of Public Health* (1989) 10:1-22.

This article provides a summary and overview of past health studies conducted around toxic waste disposal sites. The results of 16 published epidemiological studies of residential exposures to toxic waste sites are summarized in this report, many of which are landfills operated by local, state or federal agencies. Although many weaknesses were identified in this review, several adverse health impacts were also identified. These included decreased weight at birth, increase in the frequency of congenial malformations, increase in the occurrence of certain forms of cancer, decrease in the growth and maturation of children, and increased prevalence of central nervous system symptoms. Overall, this article provides evidence that health problems associated with exposure to toxic waste disposal sites are underestimated and poorly studied.

21. Hertzman, C. et al. Upper Ottawa Street landfill site health study. *Environmental Health Perspectives* (1987) 75:173-195.

As of 1987, there were few health studies conducted that found health problems in communities living around landfills that were published in the medical or scientific literature. To this day, there is still a lack of conclusive studies giving evidence that adverse health effects are caused by landfills alone. In a study conducted by Clyde Hertzman et al. a number of health problems in workers and residents living near the Upper Ottawa Street Landfill in Hamilton, Ontario were identified. A few of the problems found with the highest credibility included clusters of respiratory, skin, narcotic, and mood disorders. Evidence is presented in their study that supports the hypothesis that vapors, fumes or particulate matter emanating from the landfill site, as well as direct skin exposure, may have lead to the health problems found in excess in this particular area.

22. Paigen, B. et al. Growth of children living near the hazardous waste site, Love Canal. *Human Biology* (June 1987) 59(3): 489-508.

This is the third of a series of three studies that were conducted on children living near the Love Canal landfill. This study examined whether living near a hazardous waste site had an adverse impact on the growth patterns of children. Children are especially vulnerable to environmental contamination and it was hypothesized that exposed children would be smaller in comparison to control groups of children within a similar socioeconomic status. In earlier studies it was found that there was a significant effect between health problems and the closeness of homes near Love Canal, but in this study the difference in stature associated with birth and residence near Love Canal was not statistically significant. These findings suggest that length of exposure to chemicals may be more important to study rather than point of exposure.

23. Goldman, L., and Paigen, B. Low birth weight, prematurity and birth defects in children living near the hazardous waste site, Love Canal. *Hazardous Waste & Hazardous Materials* (1985) 2(2):209-223.

This is the second of a series of three studies that were conducted on children living near the Love Canal landfill. This study assessed birth weight, prematurity, gestational age, and birth defects in 239 children who were living in the Love Canal neighborhood before and shortly after birth. Overall the results showed no significant difference in prematurity, but there was an increase in low birth rate and birth defects. The outcomes of this study suggest that low birth weight is a good indicator of adverse health effects caused by exposure to low levels of chemicals.

24. Paigen, B., and Goldman, L. Prevalence of health problems in children living near Love Canal. *Hazardous Waste & Hazardous Materials* (1985) 2(1):23-43.

This is the first of a series of three health studies that were conducted on children living near the Love Canal landfill. This particular study looked at the overall health of children. The parents of 523 Love Canal and 440 control children were given questionnaires. It was found that children that lived near Love Canal had an increased prevalence of seven major health problems including, seizures, learning problems, hyperactivity, eye irritation, skin rashes, abdominal pain, and incontinence. This paper addresses many of the difficulties involved with conducting community health studies and recognizes the limitations of science when there are so many variables to contend with.

Updated September 2010

CHEJ Center for Health, Environment & Justice

USEFUL WEBSITES ABOUT LANDFILLS

Please note that web addresses change frequently. We apologize if you are not able to access a particular site and hope that you are still able to gain useful information from the other materials provided in this Fact Pack.

- Zero Waste, Landfill Page: http://www.zerowasteamerica.org/Landfills.htm

  Zero Waste America (ZWA) is an Internet-based environmental research organization that promotes the recycling of all materials back into nature or the marketplace. ZWA's Landfill page highlights the hazards associated with landfills and provides evidence as to why landfills always fail. This page has excellent statistics and provides links to numerous organizations, experts, and publications.

- Grassroots Recycling Network, End Landfilling Page: http://www.grrn.org/landfill/index.html

  The Grassroots Recycling Network helps to promote corporate accountability and encourages public policies to manage resources in order to achieve zero waste. This web page outlines how landfills are flawed and makes the argument that landfills are just wasting our resources and polluting our environment. GRRN has several campaigns and resources that are described on this site as well.

- Dr. Fred Lee's Home Page: http://www.gfredlee.com/

  Dr. G. Fred Lee and Dr. Anne Jones-Lee have prepared professional papers and reports about various issues surrounding domestic water supply, water quality, water and wastewater treatment, water pollution control, and the evaluation and management of the impacts of solid and hazardous wastes. Their web page allows readers to download the papers and reports they have written, many of which relate to the failures and risks of landfills.

- The Basics of Landfills: http://www.ejnet.org/landfills/

  This site is maintained by the Activists' Center for Training in Organizing and Networking and provides a basic understanding of what landfills are and why they fail. This page hasseveral links to useful articles and organizations that deal with landfill issues.

- The Alliance for a Clean Environment: http://www.acereport.org/

  The Alliance for a Clean Environment (ACE) is a local group from Pottstown, PA that has been fighting for the health and safety of their community, which is being threatened by a local hazardous waste landfill. Their site provides an example of how a local group can make a difference and provides proof that "people power" is effective in winning a fight.

- Concerned Citizens of Cattaraugus County, Inc. Home Page: http://www.homestead.com/concernedcitizens

  Concerned Citizens of Cattaraugus County is a larger than local nonprofit corporation located in New York State that advocates for clean air, soil and water through the implementation and enforcement of laws and policies that promote a clean and healthful environment. CCCC's main goal is to keep the public informed, especially about issues concerning waste disposal on the local and state level. Their web site addresses several of the issues being addressed in NY surrounding landfills and waste problems in general.

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Landfill Gas Explosions

Although landfill gas explosions are by no means common occurrences, a number of incidents known or suspected to have been caused by landfill gas explosions have been documented.

1999 An 8-year-old girl was burned on her arms and legs when playing in an Atlanta playground. The area was reportedly used as an illegal dumping ground many years ago. (Atlanta Journal-Constitution 1999)

1994 While playing soccer in a park built over an old landfill in Charlotte, North Carolina, a woman was seriously burned by a methane explosion. (Charlotte Observer 1994)

1987 Off-site gas migration is suspected to have caused a house to explode in Pittsburgh, Pennsylvania. (EPA 1991)

1984 Landfill gas migrated to and destroyed one house near a landfill in Akron, Ohio. Ten houses were temporarily evacuated. (EPA 1991)

1983 An explosion destroyed a residence across the street from a landfill in Cincinnati, Ohio. Minor injuries were reported. (EPA 1991)

1975 In Sheridan, Colorado, landfill gas accumulated in a storm drain pipe that ran through a landfill. An explosion occurred when several children playing in the pipe lit a candle, resulting in serious injury to all the children. (USACE 1984)

1969 Methane gas migrated from an adjacent landfill into the basement of an armory in Winston-Salem, North Carolina. A lit cigarette caused the gas to explode, killing three men and seriously injuring five others. (USACE 1984)

See the box above for a few of many documented situations where all the conditions for explosions were met and explosions actually occurred.

What types of gases can pose an explosion hazard?

- ***Methane.*** Methane is the constituent of landfill gas that is likely to pose the greatest explosion hazard. Methane is explosive between its LEL of 5% by volume and its UEL of 15% by volume. Because methane concentrations within the landfill are typically 50% (much higher than its UEL), methane is unlikely to explode within the landfill boundaries. As methane migrates and is diluted, however, the methane gas mixture may be at explosive levels. Also, oxygen is a key component for creating an explosion, but the biological processes that produce methane require an anaerobic, or oxygen-depleted, environment. At the surface of the landfill, enough oxygen is present to support an explosion, but the methane gas usually diffuses into the ambient air to concentrations below the 5% LEL. In order to pose an explosion hazard, methane must migrate from the landfill and be present between its LEL and UEL.
- ***Other landfill gases.*** Other landfill gas constituents (e.g., ammonia, hydrogen sulfide, and NMOCs) are flammable. However, because they are unlikely to be present at concentrations above their LELs, they rarely pose explosion hazards as individual gases. For example, benzene (an NMOC that may be found in landfill gas) is explosive between its

LEL of 1.2% and its UEL of 7.8%. However, benzene concentrations in landfill gas are very unlikely to reach these levels. If benzene were detected in landfill gas at a concentration of 2 ppb (or 0.0000002% of the air by volume), then benzene would have to collect in a closed space at a concentration 6 million times greater than the concentration found in the landfill gas to cause an explosion hazard.

Table 3-1 summarizes the potential explosion hazards posed by the important constituents of landfill gas. Keep in mind that methane is the most likely landfill gas constituent to pose an explosion hazard. Other flammable landfill gas constituents are unlikely to be present at concentrations high enough to pose an explosion hazard. However, the flammable NMOCs do contribute to total explosive hazard when combined with methane in a confined space.

Table 3-1: Potential Explosion Hazards from Common Landfill Gas Components

Component	Potential to Pose an Explosion Hazard
Methane	Methane is highly explosive when mixed with air at a volume between its LEL of 5% and its UEL of 15%. At concentrations below 5% and above 15%, methane is not explosive. At some landfills, methane can be produced at sufficient quantities to collect in the landfill or nearby structures at explosive levels.
Carbon dioxide	Carbon dioxide is not flammable or explosive.
Nitrogen dioxide	Nitrogen dioxide is not flammable or explosive.
Oxygen	Oxygen is not flammable, but is necessary to support explosions.
Ammonia	Ammonia is flammable. Its LEL is 15% and its UEL is 28%. However, ammonia is unlikely to collect at a concentration high enough to pose an explosion hazard.
NMOCs	Potential explosion hazards vary by chemical. For example, the LEL of benzene is 1.2% and its UEL is 7.8%. However, benzene and other NMOCs alone are unlikely to collect at concentrations high enough to pose explosion hazards.
Hydrogen sulfide	Hydrogen sulfide is flammable. Its LEL is 4% and its UEL is 44%. However, in most landfills, hydrogen sulfide is unlikely to collect at a concentration high enough to pose an explosion hazard.

How can I assess whether a landfill in my community poses an explosion hazard?

The checklist on the following page can help determine if a landfill may pose an explosion hazard. If your evaluation identifies the potential for an explosion, several actions can be taken to prevent harm to the community. Measures and controls to prevent explosion hazards are discussed in Chapter Five. Possible public health actions are described in Appendix B.

Landfill Gas Explosion Hazard Checklist

- ❑ **Is the landfill producing gas and, if so, how much?**
  Because methane and carbon dioxide are the main components of landfill gas and these chemicals are both odorless and colorless, monitoring data are necessary to answer this question. (See Chapter Four for information about how landfill gas is monitored.)
- ❑ **Is a landfill gas collection system in place?**
  Landfill gas collection systems reduce levels of gas migrating from the landfill to surrounding areas. (See Chapter Five for information about collection systems.)
- ❑ **Is gas migrating from the landfill?**
  Off-site monitoring data may be necessary to answer this question. (See Chapter Four.)
- ❑ **If gas is migrating from the landfill and reaching structures, are there places for gas to collect?**
  Uncontrolled gases escaping from a landfill may migrate to structures on the landfill itself or in the surrounding area. However, the further a structure is from the landfill, the less likely it is that gases are migrating to it at concentrations great enough to pose an explosion threat. The most common places for gases to collect are basements, crawl spaces, or buried utility entry ports. Homes with basements, especially those with pipes or cracks in the basement that would allow gas to enter, are more likely to collect gases.
- ❑ **Is gas collecting at concentrations that are high enough to pose an explosion hazard?**
  Monitoring data are needed to answer this question. Caution should be used in selecting sampling equipment to ensure that an ignition source is not introduced into the area. (See Chapter Four for information about monitoring.)
- ❑ **Is there an ignition source?**
  Gases can be ignited by many different sources, such as a furnace in the basement or a pilot light on a gas stove. Other sources may include candles, matches, cigarettes, or a spark. Because there are so many ignition sources, it is safest to assume that the potential for an ignition source is always present.

Asphyxiation Hazards

Landfill gas poses an asphyxiation hazard only if it collects in an enclosed space (e.g., a basement or utility corridor) at concentrations high enough to displace existing air and create an oxygen-deficient environment. The Occupational Safety and Health Administration (OSHA) defines an oxygen-deficient environment as one that has less than 19.5% oxygen by volume (OSHA n.d.a). Ambient air contains approximately 21% oxygen by volume. Health effects associated with oxygen-deficient environments are described in Table 3-2.

Any of the gases that comprise landfill gas can, either individually or in combination, create an asphyxiation hazard if they are present at levels sufficient to create an oxygen-deficient environment.

Carbon dioxide, which comprises 40% to 60% of landfill gas, may pose specific asphyxiation hazard concerns. Because it is denser than air, carbon dioxide that has escaped from a landfill and collected in a confined space, such as a basement or an underground utility corridor, may remain in the area for hours or days after the area has been opened to the air (e.g., after a man-

Science News Online

Landfills Make Mercury More Toxic- by Janet Raloff

Mercury, a nerve poison, is a major ingredient in many products—from thermometers and fluorescent bulbs to batteries and old latex paint. A new study finds that landfill disposal of such products can chemically alter the mercury in them, not only rendering it more toxic but also fostering its release into the air.

While open landfills (above) may expose wildlife directly to poisonous mercury, closed landfills can vent tainted gases through pipes (below).

Although even mercury in its elemental form is toxic, its most poisonous embodiment is methyl mercury, the result of a chemical modification by bacteria (SN: 3/9/91, p. 152). The finding of such a process in landfills underscores the importance of ensuring that mercury doesn't enter the municipal-waste stream, says study leader Steve E. Lindberg of Oak Ridge (Tenn.) National Laboratory.

The decomposition of interred landfill wastes creates methane. Some landfill managers burn the gas in flares as it exits pipes atop the waste field. Most managers, however, merely vent the gas—and any contaminants it may carry—into the air.

Two years ago, Lindberg's team found methyl mercury in the water vapor that condensed out of the gas emanating from a Florida landfill. Concentrations were at least 100 times those typically seen in water. The finding made sense, Lindberg recalls: In wetlands, researchers had previously identified certain bacteria that methylate natural, inorganic mercury derived from minerals. This same family of microbes resides in landfills.

However, methyl mercury comes in two forms—mono- and dimethyl-mercury—with the latter being the more toxic. To probe which form is made in landfills, Lindberg and his coworkers collected gases destined for flaring. In the August Atmospheric Environment, they report finding some 50 nanograms of dimethyl mercury per cubic meter of landfill gas.

That "is higher, by a factor of 30 or 40, than concentrations of total mercury in ambient air," Lindberg notes, and it's at least 1,000 times that of any dimethyl-mercury concentration ever recorded in open air. His team also detected lower concentrations of the less volatile mono-methyl mercury in the landfill gas.

Although chemists had detected methyl mercury in air and rain, "nobody had been able to demonstrate where it comes from," notes John W.M. Rudd of the Winnipeg (Manitoba) Freshwater Institute, part of Canada's Department of Fisheries and Oceans. The new study offers "the first real evidence that landfills might be a major source," he says.

Some 60,000 U.S. children are born each year with developmental impairments triggered by fetal exposure to methyl mercury, usually as a result of their moms having eaten tainted fish (SN: 7/29/00, p. 77). "If it doesn't get methylated, mercury doesn't get into fish," observes Edward Swain of the Minnesota Pollution Control Agency in St. Paul.

To limit the rain of mercury from human activities, regulators have focused on curbing emissions of inorganic mercury from coal burning. However, Lindberg notes, although chemists assumed that mercury could become methylated in the air, they couldn't show it.

Now, Swain posits, a "shift in paradigms" may be in order. He says that sending mercury-containing wastes to landfills may essentially be spoon-feeding copious amounts of the toxicant to methylating bacteria, which then cough the injurious forms into air.

The new findings point to the need to inventory emissions by landfills—especially the older ones, which hold the richest stores of mercury-tainted wastes—says Frank D'Itri of Michigan State University's Institute of Water Research in East Lansing.

Lindberg plans to embark on such an inventory. He says that the new data also suggest a need for technologies to capture methyl mercury from landfills before it can enter the atmosphere.

Vinyl In Landfills Most Likely to Blame For Toxic Gases

- *To*: press-releases@xs2.greenpeace.org
- *Subject*: Vinyl In Landfills Most Likely to Blame For Toxic Gases
- *Date*: Fri, 27 Nov 1998 13:26:19 -0800

VINYL IN LANDFILLS MOST LIKELY TO BLAME FOR TOXIC GASES
Municipalities across Canada urged to investigate

TORONTO - November 27, 1998 - Toxic substances found in the air downwind from Toronto area landfill sites are most likely caused by the dumping of PVC plastic (vinyl), according to Greenpeace, the Toronto Environmental Alliance, and City Councillor Jack Layton, Chair of Toronto's Environmental Task Force. The environmental organizations and Mr.. Layton are urging municipalities across Canada to investigate and take action after worrying levels of cancer-causing vinyl chloride were reported in a Ministry of Environment report obtained by the Globe and Mail.

Studies have shown that PVC provides between one-half and two-thirds of the chlorine present in municipal waste, making it the most probable source of a wide range of chlorine-containing gases emitted by landfills. Vinyl chloride is especially likely to originate from PVC because it is the basic chemical building block of the plastic. According to the U.S. Agency for Toxic Substances and Disease Registry, vinyl chloride is a known human carcinogen which causes liver cancer in people. In animals, it

causes numerous kinds of cancer.

A recent study by the New York State Department of Health reported that women living near municipal landfills where gas is escaping have a four-fold increased chance of bladder cancer or leukemia. A 1995 study of families living near Montreal's Miron Quarry landfill also found an elevated incidence of several cancers and a 20% increased likelihood of low birth weight among those most heavily exposed to gases from the landfill.

"These findings are of great concern and I will be urging the Canadian Federation of Municipalities to investigate and consider restrictions on PVC," said Mr. Layton. The Federation's Environment Committee is meeting next week in Laval, Quebec.

"This news from Toronto is a wake-up call for Canada's mayors to get chlorine - and chlorine-based materials - out of our dumps, " said Lois Corbett, executive director of the Toronto Environmental Alliance.

PVC waste is notorious for its environmental problems. In incinerators, which Environment Canada lists as the largest emitters of deadly dioxin to the atmosphere, PVC is the dominant source of chlorine without which the dioxin cannot be produced, and each kilo of PVC incinerated generates between one and two kilos of secondary hazardous waste. In 1997 when PVC plastic waste burned at the Plastimet recycling plant in Hamilton, the site became contaminated with extraordinarily high concentrations of dioxin. A U.S. study has shown that nearly 200 times more virgin PVC was produced between 1990 and 1996 than was recycled, the worst recycling ratio of any common plastic.

The production of PVC plastic also involves highly toxic precursors and generates hazardous emissions and wastes. And because it often requires hazardous additives such as phthalate esters, lead and cadmium, to make it functional, use of PVC products can also pose risks to human health. This was the case in Health Canada's recent advisory to parents to discard soft PVC teethers and rattles for infants.

"These toxic landfill emissions show there is no acceptable way

to deal with PVC waste - neither incineration, recycling or landfilling," said Greenpeace toxics specialist Dr. Matthew Bramley. "We've had mini-blinds, Plastimet, hazardous PVC children's products, and now landfill emissions. How many scandals does it take to get national action to restrict PVC?"

Greenpeace on the Internet at http://www.greenpeace.org

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Career, IT and Business Issues for the 21st Century

Business News

Old PCs toxic in landfill sites

Your computer equipment could contain highly toxic materials.
The European Union is developing a solution.
Composition of a Desktop Personal Computer
Risks related to some e-toxins found in computers

By: Lindsay Wood

Landfill and incinerator facilities are often the final resting-place for electronic waste. Computers, cell phones, electronic games, television sets - are piling up with increasing rapidity, ready to be burned or buried. But are you aware that these leftover gadgets are loaded with toxins that can leak into the groundwater or produce carcinogens and toxins?

Your computer equipment could contain highly toxic materials.

Computer equipment is a complicated assembly of more than 1,000 materials, many of which are highly toxic, such as chlorinated and brominated substances, toxic gases, toxic metals, biologically active materials, acids, plastics and plastic additives.

The average computer has a lifespan of less than two years, and hardware and software companies are constantly generating new programs that fuel the demand for more speed, memory and power. Y2K concerns generated an increase in the number of new systems bought. According to the National Safety Council, as recently as 1994, buyers held on to their computers from four to six years.

The San Francisco Toxic Coalition website states that three quarters of all computers ever bought in the US are sitting in people's attics and basements because they don't know what to do with them.

At the end of last year another 24 million computers in the United States had become "obsolete". Only about 14 percent (or 3.3 million) of these will be recycled or donated. The rest - more than 20 million computers in the U.S. -- will be dumped, incinerated, shipped as waste exports or put into temporary storage in attics, basements, etc.

In contrast, for major appliances such as washing machines, air conditioners, refrigerators, dryers, dishwashers and freezers, the proportion recycled in 1998 was about 70 percent of the number put on the market that year.

The "Electronic Product Recovery and Recycling Baseline Report" --published by the National Safety Council's Environmental Health Center states that by the year 2004, experts estimate that there will be over 315 million obsolete computers in the US.

SVTC say that recycling of hazardous products has little environmental benefit - it simply moves the hazards into secondary products that eventually have to be disposed of. Unless the goal is to redesign the product to use non-hazardous materials, such recycling is a false solution. Carnegie Mellon University estimate that, in four years, there will be 70 million computers in landfills.

To add to the list of injuries, a recent Swedish study found that when computers, fax machines or other electronic equipment are recycled, dust containing toxic flame-retardants is spread in the air.

SVTC also add that the stream of decay involved in electronic scrap significantly contributes to the heavy metals and halogenated substances contained in the municipal waste stream. Because of the variety of different substances found together in "electroscrap", incineration is particularly dangerous. For instance, copper is a catalyst for dioxin formation when flame-retardants are incinerated.

The introduction of waste computers into incinerators results in high concentrations of metals, including heavy metals, in the slag, in the fly ash, the flue gas and in the filter cake. In this context, more than 90 percent of the cadmium put to an incinerator is found in the fly ash and more than 70 percent of the mercury in the filter cake.

Municipal incineration is the largest point source of dioxins into the US and Canadian environments and among the largest point source of heavy metal contamination of the atmosphere.

The European Union is developing a solution.

The European Union is developing a solution that will make producers responsible for taking back their old products. This legislation - which includes "take-back" requirements and toxic materials phase-outs -- also encourages cleaner product design and less waste generation. Under current environmental regulations, a manufacturing facility is responsible for the environmental impacts of its activities; this responsibility does not cover environmental impacts from the products it manufactures.

Extended Producer Responsibility (EPR) encourages producers to prevent pollution and reduce resource and energy use in each stage of the product life cycle through changes in product design and process technology. The term was coined by Thomas Lindhqvist a Swedish professor of environmental economics and was first mandated in Germany on 1991.

Using the principle of EPR, product manufacturers are responsible for the total life-cycle environmental impact of their products, from raw materials extraction and manufacturing to use and disposal (i.e., the product system). The aim of EPR is to encourage producers to prevent pollution and reduce resource and energy consumption at each stage of the product's life cycle.

Examples are partnership agreements with suppliers, consumers, or others; mandatory or voluntary product labeling and disclosure of environmental information; government procurement policies; deposit-refund systems; product take-back programs; product stewardship programs; leasing systems; and life-cycle management programs.

The EC's proposals could cost as much as $18 billion US to $27 billion to implement, estimates the European industry group Orgaville. The electronics industry is lobbying for an extension of the phaseout timetable on the grounds that there are no alternative materials available at the moment.

Many companies have already taken the initiative and are producing cleaner products. Compaq Computer Corp takes back 200,000 computers a year in North America. Hewlett-Packard Company has developed a safe cleaning method for chips using carbon dioxide cleaning as a substitute for hazardous solvents. In 1998 IBM introduced the first computer that uses 100 percent recycled resin (PC/ABS) in all major plastic parts for a total of 3.5 pounds of resin per product.

Researchers at Delft University in Holland are investigating the design of a wind up laptop similar to the wind-up radio that plays one hour for every 20 seconds of hand winding.

Everyone, all those involved along the product chain share responsibility for life-cycle environment impacts of a product, whether buying in parts or complete products or recycling and reusing.

For information on what to do with your old computer see svtc.org for their clean computer campaign and recycling directory.

Composition of a Desktop Personal Computer

Source: Microelectronics and Computer Technology Corporation (MCC).

Plastics Lead Aluminum Germanium Gallium Iron Tin Copper Barium Nickel Zinc Tantalum Indium Vanadium Terbium Beryllium Gold Europium Titanium Ruthenium Cobalt Palladium Manganese Silver Antinomy Bismuth Chromium Cadmium Selenium Niobium Yttrium Rhodium Platinum Mercury Arsenic Silica

Risks related to some e-toxins found in computers

Source: Clean Water Action Alliance, SVTC, Clean Water Fund.

Lead - Found in cathode-ray tubes, solders. Each cathode-ray tube can contain five pounds of lead or more. Can cause damage to the central and peripheral nervous systems, blood system and kidneys in humans. Damage to a child's brain development has also been noted.

Cadmium - Printed circuit boards, semiconductors. By 2005, a total of more than 2 million pounds will exist in discarded computers. Cadmium and cadmium compounds accumulate in the human body, in particular in kidneys it is adsorbed through respiration but is also taken up with food. Cadmium can easily be accumulated in amounts that cause symptoms of poisoning.

Mercury - Batteries, switches. By 2005, 400,000 pounds across the US. Methylated mercury causes chronic damage to the brain.

Chromium - Used as corrosion protection in steel. By 2005, estimated 1.2 million pounds. Chromium VI can easily pass through membranes of cells and is easily absorbed producing various toxic effects within the cells. It causes strong allergic reactions even in small concentrations. Asthmatic bronchitis is another allergic reaction linked to chromium VI. Chromium VI may also cause DNA damage.

PVC Plastics - Cables and housings. Potential waste of 250 million pounds per year. An MCC study estimated that the largest volume of plastics used in electronics manufacturing (at 26%) was polyvinyl chloride (PVC), which creates more environmental and health hazards than most other type of plastic

Brominated Flame Retardants - Used in electronic products as a means for reducing flammability. In computers, they are used mainly in four applications: in printed circuit boards, in components such as connectors, in plastic covers and in cables. Scientific observations indicate that Polybrominated Diphenylethers (PBDE) might act as endocrine disrupters. Research has revealed that levels of PBDEs in human breast milk are doubling every five years and this has prompted concern because of the effect of these chemicals in young animals

These chemicals make computer recycling particularly hazardous to workers

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In Our Backyard: Environmental Racism in Dickson

colorlines.com/archives/2009/09/in_our_backyard_environmental_1.html

by Michelle Chen | Print |

You may not have heard of Dickson, Tennessee, but this weekend, the town is center stage in the movement for environmental justice. Civil rights leaders gathered there for a national summit on environmental racism to highlight environmental health issues facing communities of color.

The location was a pointed choice. For about a decade, the town of about 12,000 has been at the center of an environmental lawsuit involving a local family and a contaminated landfill, which is just a stone's throw from dozens of homes in a mostly Black community. The Holts claim that family members have been plagued by health problems due to a toxin from the landfill, trichloroethylene (TCE). Sheila Holt-Orsted and Beatrice Holt, together with the Natural Resources Defense Council, are suing the County alleging that the chemical has poisoned their water system and should be held accountable for the family's struggles with cancer and other ailments.

The federal Environmental Protection Agency has a mandate to support "fair treatment for people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies." But the challenge runs much deeper than regulatory statutes or a contaminated well.

> *The Town of Dickson purchased the land for a "city dump" in 1946. Sometime between 1946 and 1956, the newly acquired land, which was bounded by the old "Negro Coaling School," a one-room county school with grades 1 through 9 that dates back to 1895, became the Dickson "city dump," an open unlined dump….*

According to government records, in 1968, the same year Dr. Martin Luther King was assassinated in Memphis, Scovill-Shrader and several other local industries, buried drums of industrial waste solvents at an "open dump" landfill site…

For years, drums of toxic industrial waste solvents were dumped at the landfill, which later contaminated the groundwater.

Contaminated waste material was cleaned up from other areas in this mostly white county and was trucked to the landfill in the mostly black Eno Road community.

The report also compared the government's testing and monitoring of environmental hazards in Black and white areas and found that "the care and precaution that the government officials initiated to protect the health of the white families was not extended to the black Holt family."

The Holt family's plight is emblematic not just of the depth of environmental racism but of a warped paradigm of upward mobility that mires communities of color in a state of continual disenfranchisement. The report concludes:

> *After slavery, dozens of black families acquired hundreds of acres of land—not part of the empty "40 acres and a mule" government promise—and lived a quiet and peaceful existence in Dickson's historically black Eno Road community. That is, until their wells were poisoned by a county landfill….*
>
> *The Holt family's American Dream of land ownership has become a "toxic nightmare." For more than a decade, this black family has experienced the terror of not knowing what health problems may lay ahead for their children and their children's children.*

Perversely, the modest roots the Holts have struggled to put down now act as another kind of ball and chain.

The Dickson case has garnered national attention because it symbolizes the extremes of environmental racism's reach. But other neighborhoods and homesteads across the country bear the toxic burden more subtly—the kid in West Oakland whose bedroom overlooks a smog-laden highway, or the immigrant farmworker who comes home each night spattered in pesticide. In all these places, and in our backyard, the burden of pollution is heavy with the weight of history.

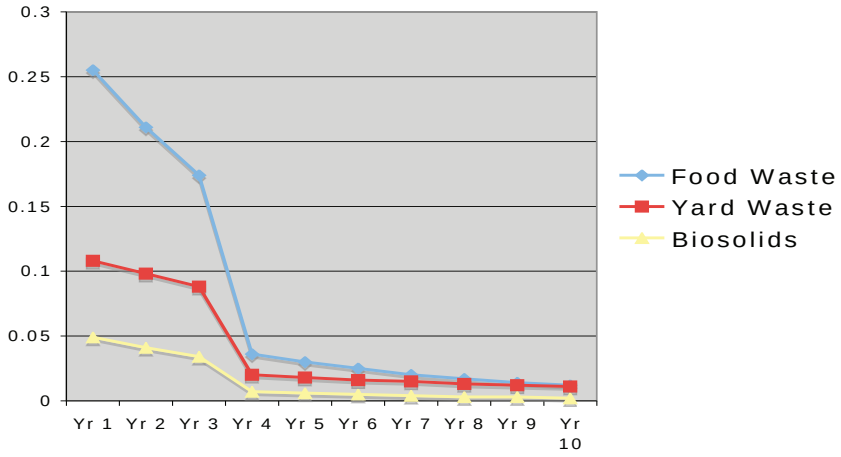
4. **Segregate remaining organics in landfills for the most effective and cost-efficient gas collection** (always maintaining high suction)**.**
5. **Keep out all liquids** from landfills (including not recirculating leachate) to reduce fugitive emissions.
6. **Cap landfills with temporary covers** over the working face to keep out rain and **then install permanent synthetic covers and gas collection systems as soon as possible** (within months is important). (The current 5-year NSPS requirement harms our environment and health.)
7. **All captured methane should be burned in a flare, boiler or a high efficiency turbine**, or used to replace natural gas for heating or fuel cells (after proper filtration to remove harmful gasses); internal combustion (IC) engines should not be used because of unburned methane releases.
8. **Stop new landfill gas to energy projects and don't give "renewable energy" credits to landfill gas** (unless capture rates over the entire landfill and destruction efficiencies are constantly monitored and demonstrated[30] to be equal to those of a flare.) (The argument that credits should be given if gas collection projects are installed earlier than local or NSPS requirements should not apply, since fugitive emissions have been found to be so large. The only way to eliminate these fugitive emissions is to eliminate organics from landfills, which would make landfill gas to energy projects uneconomic. Giving renewable energy credits to landfill gas allows it to undercut clean sources like wind and solar and, most importantly, puts source reduction, reuse, recycling, diversion, composting, and anaerobic digestion at a competitive disadvantage.)

[30] Peter Anderson mentions monitoring costs in "Critique of SCS Engineers' Report Prepared for California's Landfill Companies on Gas Collection Performance," Sept. 5, 2008, p. 12 (anderson@recycleworlds.net). However, a spectroscopy method developed by Picarro proposes efficient monitoring, Rella, Chris, et al., 2009, (http://www.picarro.com/assets/docs/Quantfying_Methane_Fluxes_Simply_and_Accurately_-_Trace_Dilution_Method.pdf).

32% in the first year alone) (see Figure 2.), usually before the gas cap and capture systems are put in place. The normal reason for the delay putting on the cover is the operator is still adding waste to that section of the landfill.

Figure 2. Over 80% of the Methane from Food Waste Escapes in the First 3 Years, Usually Before Capping

[Emissions in tons of methane (CO_{2e}) per wet ton of waste]

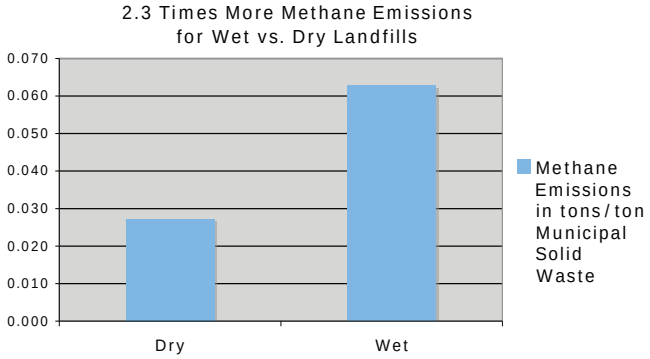


To get the above data, the Chicago Climate Exchange uses a decay model to calculate GHG emissions from a landfill, which is described in detail in their paper.[8] The bottom line is, if there are any organics in the landfill, we need to deal with the ongoing methane emissions from the remaining waste. For many years people installed impermeable caps and gas collection systems to capture the methane and put it into a flare to burn it. Every ton of methane captured and burned avoids the equivalent of adding 104 tons of CO2 to the atmosphere (calculated over a 20-year period).[9]

Wet vs. Dry Landfills

But then people thought, why waste that biomethane burning it in a flare? Why not use it to replace fossil fuels? It sounded like a good idea, except, if you take the methane from a dry landfill and try to burn it in an engine or turbine, it is inefficient. The normal methane flow from a "dry tomb" landfill is so slow and impure, that the operator doesn't make enough money to pay for the additional capital and operating expenses of an engine or turbine. So they need more moisture in the landfill. As the chart below from research done for the U.S. EPA shows, **wet** landfills generate 2.3 times more methane than **dry** ones (based only on measuring the collected gas, not the total emitted, which was not looked at in these studies).[10] If the collection efficiency were the same in both cases, the result is up to **2.3 times more GHG emissions** for energy recovery sites.[11]

Figure 3. Moisture Greatly Increases Methane Emissions



[8] Chicago Climate Exchange, Avoided Emissions from Organic Waste Disposal, Offset Project Protocol, 2009, p. 22. (https://www.theice.com/publicdocs/ccx/protocols/CCX_Protocol_Organic_Waste.pdf)
[9] Calculated from methane global warming factor 105 minus the 1 part CO_2 from the flare burning the methane.
[10] Reinhart, D.R. et al. First-Order Kinetic Gas Generation Model Parameters for Wet Landfills, report prepared for US EPA, 2005, p. 4-5. (nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100ADRJ.txt). See also Sally Brown, "Putting the Landfill Energy Myth to Rest," *BioCycle*, May 2010, p. 5.
[11] We note that these data are from experimental sites; some energy recovery sites may not be this wet.

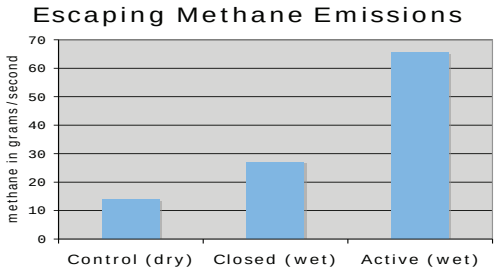
Since it is supposed to be illegal to deliberately add water to a landfill, waste engineers came up with a variety of ideas to increase the gas production in the short term and decrease costs so they could make more money, including such methods as[12]:

- Leaving the cap off as long as possible so more water from rain and snow can enter.
- Regrading the slopes to drain rain into the landfill.
- Recirculating the liquid leachate flowing from the bottom of the landfill back into the top.[13]
- Turning off gas collection wells on a rotating basis in order to give each field time to recharge moisture removed by the gas extraction process itself.
- Reducing the vacuum pump pull on gas collection wells when imperfections in the landfill cover allow air to be drawn into the waste mass. Pulling lower amounts into the collection system allows more methane to escape. (Note: While landfills that just flare gas can accept 3%-5% oxygen infiltration before risking igniting fires, those recovering energy are restricted to as low as 0.1% because a high rate of methane production depends upon having an oxygen-starved environment.)
- Installing more gas collection wells at the center of the landfill, where methane ratios are greatest, and less at the periphery, which could allow more gas to escape with no wells to capture it.

Result of Increasing Moisture is More Uncollected, Fugitive Emissions

The problem is that these aids to more profitable "energy recovery" result in much more uncaptured methane. A report for the US EPA analyzed fugitive emissions for three types of approaches: (1) normal dry tomb landfill, (2) closed landfill, but circulating leachate to provide moisture for energy recovery, and (3) active landfill circulating leachate to provide moisture for energy recovery. The results are shown in Figure 4. The closed, but wet landfill had 1.9 times more escaping emissions, while the active wet landfill designed for maximum energy production had 4.7 times more emissions.[14]

Figure 4. Moisture Increases Fugitive Methane Emissions from a Landfill, by up to 4.7 times



[12] List compiled in March 2010 by Peter Anderson, RecycleWorlds Consulting, based on these publications:
- Augenstein, Don, Landfill Operation for Carbon Sequestration and Maximum Methane, (http://www.osti.gov/bridge/purl.cover.jsp?purl=/795745-EMfXDz/native).
- Institute for Environmental Management (IEM), Emission Control: Controlled Landfilling Demonstration Cell Performance for Carbon Sequestration, Greenhouse Gas Emission Abatement and Landfill Methane Energy, Final Report, February 26, 2000.
- Augenstein, Don, et. al., Improving Landfill Methane Recovery - Recent Evaluations and Large Scale Tests (2007) (http://www.globalmethane.org/expo_china07/docs/postexpo/landfill_augustein_paper.pdf)
- Oonk, Hans, Expert Review of First Order Draft of Waste Chapter to IPCC's 4th Assessment Rpt, 2008 (available from Peter Anderson, anderson@recycleworlds.net)
- SCS Engineers, Technologies and Management Options for Reducing Greenhouse Gas Emissions From Landfills, 2008 (http://www.calrecycle.ca.gov/Climate/CATSubgroups/2008Feb26/Report.pdf).
- U.S. Environmental Protection Agency, 40 CFR Part 60 WWW (proposed and final rule).
- Sierra Club LFGTE Task Force, Sierra Club Report on Landfill-Gas-to-Energy, January 2010 (http://sierraclub.org/policy/conservation/landfill-gas-report.pdf)

[13] "[Director of Butte County's solid waste program] Mannel explained that in this process, liquid is introduced into the sealed "waste cells" in the landfill. The addition of the liquid improves the production of methane up to five times more than the unaugmented process." Chico Enterprise-Record, 6/14/2010 (chicoer.com/news/ci_15292646)

[14] Mark Modrak, et al., Measurement of Fugitive Emissions at a Bioreactor Landfill (2005) (available at http://clubhouse.sierraclub.org/people/committees/lfgte/docs/measurements_fugitivieemissions.pdf)

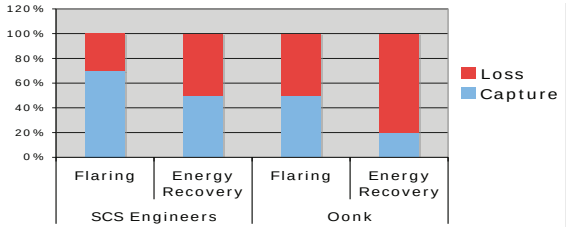
The IPCC estimated that, over the long term, including the extensive times (before and after installation of the gas capture systems) when there is little or no gas collection, the average total fraction captured may be as low as 20%.[15] U.S. EPA's *Compilation of Air Pollutant Emission Factors* (AP-42) assumes a range from 60 to 85 percent, with 75 percent as "typical" for sites having a well-designed active collection control system in place.[16] However, EPA gives no estimates of the amounts lost before the installation of the gas capture system and after landfill maintenance ends, which often are very large.[17]

A report by consultants for the solid waste industry[18] provides their view of the ranges of gas collection values: 50-70% for an active landfill, 54-95% for a inactive landfill or portions of a landfill that contain an intermediate soil cover, or 90-99% for closed landfills that contain a final soil and/or geomembrane cover systems. Their view is stated as, "The **high ends** of the range of these values are proposed for sites with NSPS or similar **quality LFG collection** systems which are designed for and achieve compliance with air quality regulations and surface emissions standards." "The **low end** of the range would be for full LFG systems that are installed and operated for other purposes, such as **energy recovery**, migration control, or odor management; . . ." (emphasis added). Our interpretation of these statements is the high ends of the ranges apply to sites using flaring, while the low ends apply to those doing energy recovery.

However, we note that the Palos Verdes landfill study in the 1990s, which was cited by SCS Engineers for its "capture efficiencies above 95%,"[19] was for a landfill that had been closed for nearly 20 years and had a 5-foot thick clay cap installed. That study was recently reevaluated by the California Air Resources Board, which found a collection rate of only 85%.[20] Thus for closed landfills with a final cover, 85% capture is a more substantiated upper limit, meaning that more than 15% is escaping.

In any event, the SCS report indicates the waste industry recognizes the potential losses in the collection efficiency of energy recovery compared to state of the art flaring. This means that an active landfill (shown in the left two columns in Figure 5 on the next page) using an energy recovery system could have a collection efficiency as low as 50%, compared to about 70% for one using flaring, which implies 1.6 times more methane is likely escaping when a landfill is used for energy recovery. A study of Dutch landfills[21] shown in the two right columns found that, averaged over the life of the landfill, flaring gas extraction systems designed for minimizing emissions could realize collection efficiencies only up to 50%, while energy recovery systems averaged only 20% efficiency. However, the numerical factor is the same, 1.6 times more methane is likely escaping when a landfill is used for energy recovery.

Figure 5. Methane Capture Efficiency at Flaring sites is 1.6 Times greater than at Energy Recovery sites.



[15] Intergovernmental Panel on Climate Change, *Fourth Assessment Report*, Waste Chapter 10, p. 600 (2008). (Note that 54% of all waste x 75% collection efficiency x 50% when collecting = 20%.)
[16] Office of Air Quality Planning and Standards and Office of Air and Radiation, *Emission Factor Documentation for AP-42, Section 2.4, Municipal Solid Waste Landfills* (Revised 1997) (http://www.epa.gov/ttnchie1/ap42/ch02)
[17] "Critique of SCS Engineers' Report Prepared for California's Landfill Companies on Gas Collection Performance," by Peter Anderson, Center for a Competitive Waste Industry, 2008 ().
[18] SCS Engineers, *Current MSW Industry Position and State-of-the-Practice on LFG Collection Efficiency, Methane Oxidation, and Carbon Sequestration in Landfills*, for the Solid Waste Industry for Climate Solutions (June 2008), p. 16-17 (http://www.scsengineers.com/Papers/FINAL_SWICS_GHG_White_Paper_07-11-08.pdf).
[19] California Integrated Waste Management Board, Overview of Climate Change and Analysis of Potential Measures to Implement Greenhouse Gas Emission Reduction Strategies, May 8, 2007.
[20] "Initial Statement of Reasons for the Proposed Regulation to Reduce Methane Emissions from Municipal Solid Waste Landfills," (May 2009) p. IV-5 and Appendix D (http://www.arb.ca.gov/regact/2009/landfills09/isor.pdf).
[21] Oonk and Boom, 1995, *Landfill gas formation, recovery and emissions*, Chapter 7, TNO-report 95-130.

We note that a recent report[22] by Patrick Sullivan, senior vice president of SCS Engineers, consultants for the solid waste industry, states, "Opponents of landfills claim development of LFGTE projects will increase methane emissions at landfills [in comparison with flaring]. . . This is simply not true." Some of the points he makes are quoted in italics below:

1. *"The landfill is required by federal regulations to achieve the same surface emission limits and LFG system operational requirements in either case."* Our response is the landfill operator must demonstrate there is no increase in fugitive emissions from practices that aid LFGTE, such as the six strategies mentioned on page 3 above.
2. *"Landfill opponents suggest that LFG engines, which represent the largest majority of LFGTE devices, do not destroy methane as well as flares. Indeed, the capacity of flares to destroy methane is greater than most LFGTE equipment, but the true difference between the two devices is very small with flares and other control devices achieving more than 99% control and lean-burn LFG engines achieving more than 98% control of methane (Solid Waste Industry for Climate Solutions [SWICS], 2007)."* He is referencing his own company report, but the report cited actually states that methane destruction efficiency of flares is 99.96% compared to internal combustion engines 98.34%. As we will show later, this **1.6% difference is very significant**, even using the outdated GHG multiplier of 21 (and much worse using the 20-year multiplier 105).[23] This means that it is impossible to use engines and have less net impact than flaring, but turbines with high destruction efficiency are acceptable, as are systems that inject the methane directly into natural gas pipelines for normal uses.
3. *"There are some landfills, which are not required by regulation to collect and control LFG, that are developed for LFGTE."* Our response is this is a valid point. Voluntary LFGTE projects undertaken before the NSPS standards require temporary capping and collection could significantly reduce GHG emissions compared to cases where operators wait as long as possible (up to 5 years is allowed for active cells) to cap and install collection systems. A consultant report found the very large collection of methane before the five year limit produced substantial carbon reduction credits.[24] However we feel the EPA needs to drastically tighten the NSPS standards, especially in light of the analyses reported above that the largest emissions from wet organics occur within the first three years.

Combining the Two Effects Produces Much More Net GHG Emissions for Energy Recovery

In addition to the 1.6 times increase in fugitive emissions at energy recovery sites, there is the effect reported above that **wet** landfills produce 2.3 – 4.7 times more methane than dry ones. If we combine these two observed effects, the net result would be **3.8 - 7.8 times more net GHG emissions for energy recovery compared to flaring** (this value is irrespective of the value of the GHG multiplier for methane, but the GHG impact is five times greater when using the 105 multiplier for methane).

The charts in Figure 6 indicate the actual global warming savings using the captured methane from energy recovery to replace the burning of fossil methane are very small (0.0007 tons of carbon dioxide equivalent per typical ton of municipal solid waste (MSW)), much less than the overall impacts of the escaping methane. The left chart shows a net increase of GHG emissions of 0.034 CO_2 equivalent tons/ MSW ton using the old (1995) multiplier of 21 (which is still used by the US EPA for "consistency").

The right chart shows a net increase of GHG emissions of 0.172 CO_2 equivalent tons/MSW ton using the latest (2009) multiplier of 105 over the next critical 20 years. Below the large right red bars for energy recovery in both figures, there is a very tiny blue line (that looks almost like a shadow) that

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[22] Patrick Sullivan, SCS Engineers, The Importance of Landfill Gas Capture and Utilization in the U.S., April 2010, p. 28-30. (http://www.scsengineers.com/Papers/Sullivan_Importance_of_LFG_Capture_and_Utilization_in_the_US.pdf)

[23] It is very unfortunate that EPA 40 CFR Part 98 allows the use of a default 99% destruction efficiency for methane for all types of LFG combustion devices, including engines, ignoring this large GHG impact.

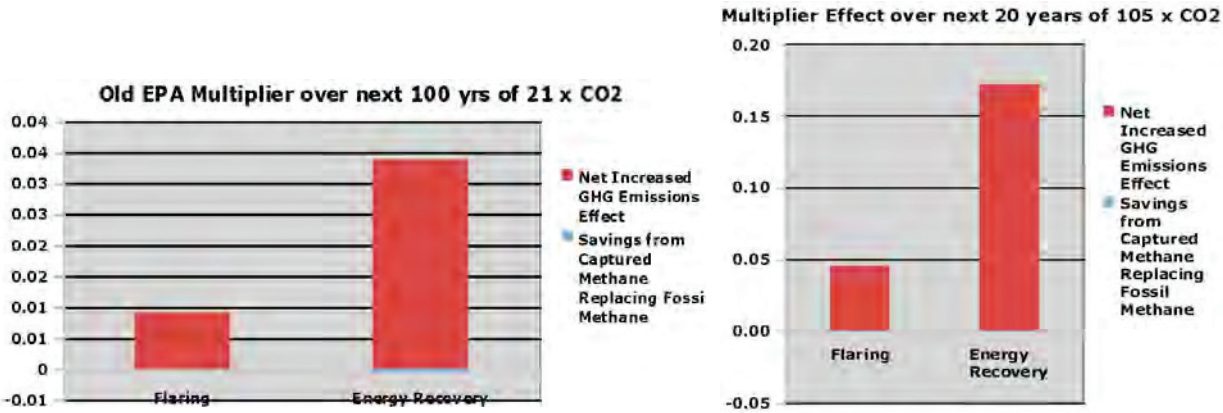
[24] McCommas Bluff LFGTE Project, Voluntary Carbon Standard Assessment, Jan. 2010, by Blue Source LLC, available from the author, Annika Colson, (212) 253-5348, acolston@bluesource.com

represents the amount of benefit from offsetting the use of fossil fuels, which in each case is only 0.0007 tons of carbon dioxide equivalent per typical ton of MSW.

Note that the charts essentially apply to landfills with active gas collection systems, and do not include the methane lost before the landfill is capped, or after the permanent landfill cap is no longer maintained and starts to leak, adding moisture from precipitation, which will increase methane emissions.

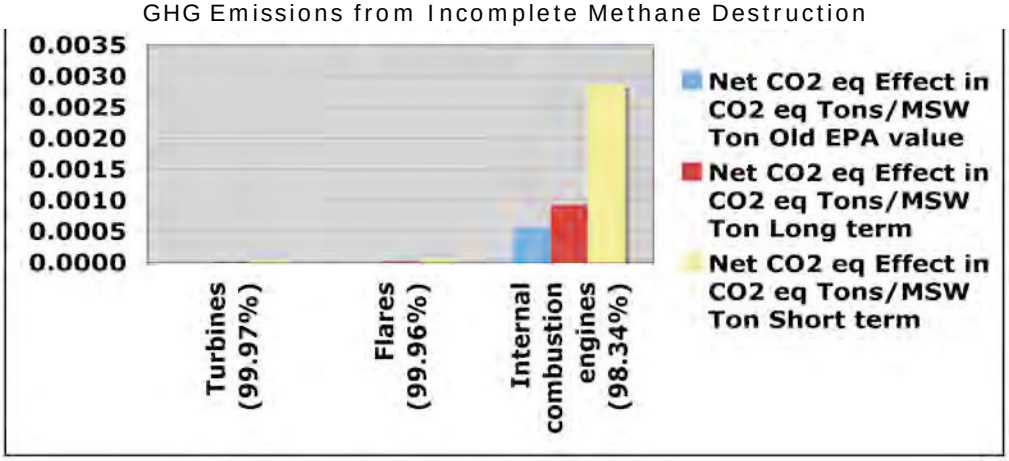
Figure 6. Energy recovery procedures increase global warming impact by at least 3.8 times using either multiplier of 21 or 105, even considering the savings from "energy recovery."

The GHG emissions from escaping methane are expressed in $CO_{2\ equivalent}$ Tons per MSW Ton



Methane Destruction Inefficiency of Internal Combustion Engines Increases GHG Impact

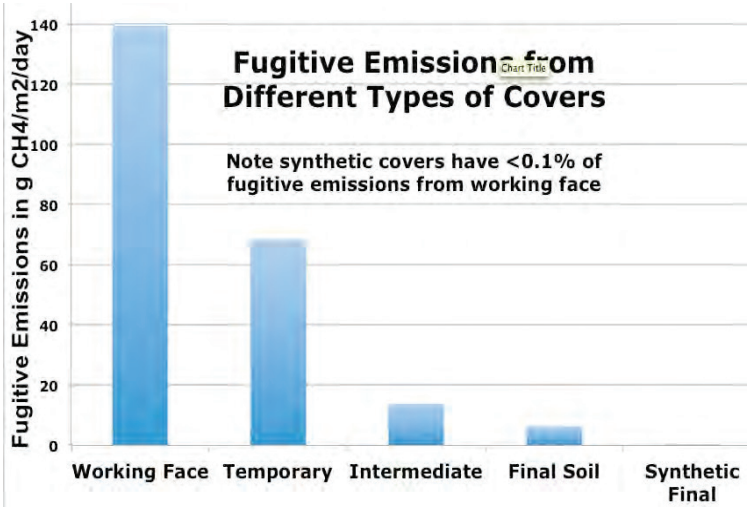
It is important to include recent data from the waste industry of average methane destruction efficiency of flares (99.96%) compared to internal combustion (IC) engines (98.34%) and turbines (99.97%).[25] Their analysis indicates turbine destruction efficiency is essentially equivalent to a flare, but an internal combustion engine adds significant GHG impact from its 1.6% lower destruction efficiency. An EPA report found that a boiler was similar to a flare.[26] But using an engine increases the GHG impact from energy recovery by 0.0006 CO_2 equivalent tons per MSW ton, using the old multiplier of 21, or 0.0028 CO_2 equivalent tons per MSW ton, using the latest 20-year multiplier of 105. The methane destruction **in**efficiency of an internal combustion **engine** (0.0006) essentially **negates its global warming savings** from replacing fossil methane at the old multiplier (0.0007). Using the short-term multiplier of 105 shows the GHG impacts of IC engines are 40 times those of flaring, turbines, or boilers.



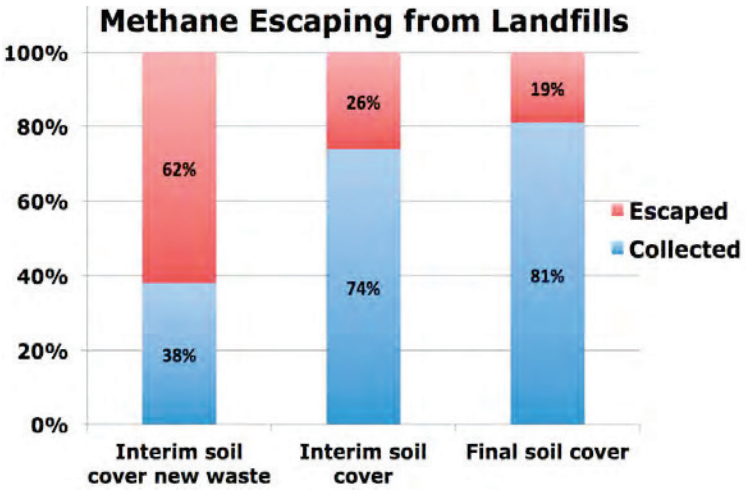
[25] SCS Engineers, *Current MSW Industry Position and State-of-the-Practice on Methane Destruction Efficiency in Flares, Turbines and Engines*, prepared for the Solid Waste Industry for Climate Solutions (July 2007), p. 2.
[26] Roe, S.M., Fields, P.G., and Coad, R. Methodologies for Quantifying Pollution Prevention Benefits from Landfill Gas Control and Utilization. EPA/600/SR-95/089, July 1995. (http://www.p2pays.org/ref/07/06277.pdf)

Effects of Different Types of Covers

A recent paper by Goldsmith et al.[27] compares the efficacies of different types of flat landfill covers in reducing fugitive emissions. Goldsmith et al. discuss the impact of different climates on the fugitive emissions, but since they found such a wide range of emissions for a given cover type within each climate zone, this chart compares the averages of all the results they obtained for the five cover types. Even a temporary cover reduces emissions by over 50%, an intermediate cover by 90%, final soil by 95%, and a synthetic final cover by 99.9%.



A recent EPA report[28] using tracer gas data and optical remote sensing measurements to analyze fugitive emissions from both the tops and side slopes found collected gas for intermediate covers ranged from 70% to 77% for a site with interim soil cover and 73-88% for a site with a final soil cover. Both sites had not accepted waste for years. The one that had just stopped receiving new waste had only 38% capture rate. The gas was being flared with no energy recovery. Note that this EPA report contradicts the report mentioned in footnote 17, by SCS Engineers, consultants for the solid waste industry, which claims collection efficiencies of 90-99% for closed landfills that contain a final soil cover. The results of the Goldsmith and EPA reports make it even more urgent that all landfills install a waterproof, airproof synthetic final cover and efficient gas collection system as soon as each small cell is filled, preferably within a few weeks.



Policy Recommendations

In summary, to reduce global warming requires the following steps to be implemented immediately:

1. Use current GHG impact value of 33 (over 100 years) or 105 (over 20 years) for methane to calculate the **impacts of methane** emissions from landfills.
2. **Divert all organics** (except sewage sludge) from landfills to reduce uncollected emissions.[29]
3. **Either compost all organics or digest them in sealed processors** that capture all methane.

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[27] Goldsmith, Jr., C.D., Chanton, J., Abichou, T., Swan, N., Green, R., and Hater, G., *Journal of the Air & Waste Management Association*, 62(2):183–197, 2012.

[28] Quantifying Methane Abatement Efficiency at Three Municipal Solid Waste Landfills. EPA/600/R-11/033, report prepared in 2012 by ARCADIS U.S. for Susan A. Thorneloe.

[29] We note that clean organics can be processed by aerobic composting or by anaerobic digesters that can capture all the methane for energy purposes and produce high quality compost, with only small amounts of inert waste remaining for a landfill. However, toxic contaminated organics such as sewage sludge/"biosolids" digestate should be monofilled in separate cells in existing landfills because of the high contamination.

4. **Segregate remaining organics in landfills for the most effective and cost-efficient gas collection** (always maintaining high suction)**.**
5. **Keep out all liquids** from landfills (including not recirculating leachate) to reduce fugitive emissions.
6. **Cap landfills with temporary covers** over the working face to keep out rain and **then install permanent synthetic covers and gas collection systems as soon as possible** (within months is important). (The current 5-year NSPS requirement harms our environment and health.)
7. **All captured methane should be burned in a flare, boiler or a high efficiency turbine**, or used to replace natural gas for heating or fuel cells (after proper filtration to remove harmful gasses); internal combustion (IC) engines should not be used because of unburned methane releases.
8. **Stop new landfill gas to energy projects and don't give "renewable energy" credits to landfill gas** (unless capture rates over the entire landfill and destruction efficiencies are constantly monitored and demonstrated[30] to be equal to those of a flare.) (The argument that credits should be given if gas collection projects are installed earlier than local or NSPS requirements should not apply, since fugitive emissions have been found to be so large. The only way to eliminate these fugitive emissions is to eliminate organics from landfills, which would make landfill gas to energy projects uneconomic. Giving renewable energy credits to landfill gas allows it to undercut clean sources like wind and solar and, most importantly, puts source reduction, reuse, recycling, diversion, composting, and anaerobic digestion at a competitive disadvantage.)

[30] Peter Anderson mentions monitoring costs in "Critique of SCS Engineers' Report Prepared for California's Landfill Companies on Gas Collection Performance," Sept. 5, 2008, p. 12 (anderson@recycleworlds.net). However, a spectroscopy method developed by Picarro proposes efficient monitoring, Rella, Chris, et al., 2009, (http://www.picarro.com/assets/docs/Quantfying_Methane_Fluxes_Simply_and_Accurately_-_Trace_Dilution_Method.pdf).

POLICY. SCIENCE. BUSINESS.

EPA

Court orders agency to address landfill emissions

Ellen M. Gilmer, E&E News reporter

Published: Tuesday, May 7, 2019



Solid waste landfills, like this one in Arizona, are a source of methane emissions. Alan Levine/Flickr

The Trump administration violated the Clean Air Act by not taking action on harmful emissions from landfills, a federal court ruled yesterday.

The U.S. District Court for the Northern District of California **found** EPA failed to meet its statutory obligation to restrict climate-warming methane and various conventional pollutants that spew from municipal solid waste landfills across the country.

The waste sites are the third-largest emitters of human-caused methane in the United States. They also release benzene and other pollutants that can harm human health.

The Obama administration crafted landfill emissions guidelines in 2016 after years of consideration, but Trump officials have not taken the requisite next steps to review state implementation plans or craft a federal program.

"There is no denying EPA's clear failure to meet its nondiscretionary duties," Judge Haywood Gilliam Jr. wrote.

Proponents of tight restrictions on landfill pollutants cheered the ruling as another rebuke to Trump officials' efforts to delay or roll back various environmental standards.

"Courts are showing no patience for EPA's blatant violations of law," David Hayes, executive director of the State Energy & Environmental Impact Center, said in a statement.

"Thankfully, California Attorney General Xavier Becerra and other state attorneys general are holding the Trump Administration accountable for outrageously flouting the rule of law," he added later.

Government lawyers did not dispute allegations that EPA shirked its mandatory duties; instead, they argued that the coalition of states challenging the agency lacked legal standing to bring the case because they failed to show a clear connection between EPA's inaction and specific harm the states would face.

Gilliam, an Obama appointee, rejected the argument, citing the "special solicitude" afforded to sovereign states in litigation, as laid out in the landmark *Massachusetts v. EPA* ruling in which the Supreme Court ruled Massachusetts could challenge EPA's refusal to regulate greenhouse gases.

The state coalition in the landfill case included California, Illinois, Maryland, New Mexico, Oregon, Pennsylvania, Rhode Island and Vermont.

"Noxious landfill emissions affect everyone, but disproportionately hurt our most vulnerable communities, impacting their health, environment, and standard of living," Becerra (D) said in a statement. "Once again, we've held the EPA accountable for its failure to

perform its mandatory duties under the Clean Air Act, and for its unwillingness to protect public health."

The Environmental Defense Fund intervened in the case on the states' side.

"I definitely see this as part of the streak of Trump administration rollbacks that are not holding muster in court," EDF attorney Rachel Fullmer told E&E News.

Under the court's order, EPA must make final decisions approving or disapproving existing state plans by Sept. 6 and finalize a federal plan by Nov. 6 — keeping the court apprised of its progress through status reports every 90 days.

EPA said it is reviewing the decision.

The agency is separately working on a proposal to formally delay implementation deadlines for landfills. The new deadlines would more closely align with those in the Trump administration's proposed replacement for the Obama-era Clean Power Plan, which targeted greenhouse gas emissions from the power sector.

Reporter Jennifer Hijazi contributed.

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EPA United States Environmental Protection Agency

News Releases from Region 09

EPA resolves Clean Water Act violations with Honolulu and Waste Management at Waimanalo Gulch Landfill

04/29/2019

Contact Information:
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415-947-4149

For Immediate Release: April 29, 2019

HONOLULU – The U.S. Department of Justice, U.S. Environmental Protection Agency, and Hawaii Department of Health (DOH) have settled with the City and County of Honolulu (CCH) and Waste Management of Hawaii, Inc. (WMH), over Clean Water Act violations at the Waimanalo Gulch Sanitary Landfill in Kapolei, Oahu.

CCH and WMH will pay a combined penalty of $425,000, which will be split evenly between the U.S. and the State of Hawaii. The state will use the funds for coral reef and habitat restoration, monitoring and conservation on the leeward coast of Oahu.

The agreement also calls for a series of facility upgrades to maintain compliance with stormwater regulations. CCH and WMH will retrofit the landfill's existing stormwater drainage pipeline, install a trash screen, revise their stormwater pollution control plan, comply with specific operational and monitoring limits for the stormwater basin, and apply for an individual stormwater permit for the facility. The consent decree is subject to a 30-day public comment period.

"Today's action requires the City and County of Honolulu and Waste Management to improve their stormwater drainage, controls, and monitoring program at Waimanalo Gulch Sanitary Landfill," said EPA Pacific Southwest Regional Administrator Mike Stoker. **"Managing stormwater runoff is critical to protecting residents' health and Oahu's coastal waters."**

"Actions detailed in this consent decree will help prevent future harmful discharges from the landfill and provide resources to restore corals that were impacted by the violations," said Hawaii DOH Deputy Director of Environmental Health Keith Kawaoka. **"The consent decree concludes years of dispute over the horrific discharges of medical waste and sediment that occurred during the winter of 2010."**

Today's settlement marks the end of a long-term effort by EPA and the state of Hawaii to bring the landfill – the largest on Oahu – into compliance with laws designed to protect public health, natural ecosystems, and wildlife.

Waste Management operates the Waimanalo Gulch landfill, which is owned by the City and County of Honolulu. In 2009, WMH and CCH began work on a landfill expansion and new stormwater diversion structure. During construction, Waste Management used temporary stormwater pipes to divert stormwater around the landfill.

Before completion of the permanent stormwater diversion structure, WMH began placing waste in the landfill expansion area. In December 2010 and January 2011, several large storms overwhelmed the temporary pipes and flooded the expanded area of the landfill. The flooding discharged stormwater contaminated with leachate, trash, and medical waste into the Pacific Ocean. Medical waste washed up on area beaches for several weeks, prompting leeward Oahu area beach closures.

EPA issued an order in January 2011 requiring cleanup of leachate, trash, and medical waste discharged during the storms. EPA issued an additional Clean Water Act order in 2012 requiring WMH and CCH to: complete construction of the facility's stormwater diversion system; finish a study of the landfill's detention basin to evaluate its capacity to store and treat stormwater; and develop an interim stormwater monitoring plan. WMH and CCH have completed the requirements in those orders.

In July 2015, WMH pleaded guilty to criminal violations for negligent discharge of pollutants on seven days in violation of the Clean Water Act. The company paid $400,000 in criminal fines, and $200,000 in restitution.

The consent decree for this settlement will be lodged in the federal district court by the U.S. Department of Justice and is subject to a 30-day public comment period and final court approval. A copy of the decree will be available on the Department of Justice website at: https://www.justice.gov/enrd/consent-decrees

For more information on EPA's Stormwater Program please see:
https://www.epa.gov/npdes/stormwater-discharges-industrial-activities

For Hawaii's Stormwater program, please see:
http://health.hawaii.gov/cwb/permitting/industrial-storm-water/

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WASTEDIVE

BRIEF

Report identifies factors in Advanced Disposal landfill slope failure that left one dead

By Igor Geyn

Published Feb. 7, 2019

Dive Brief:

- The Pennsylvania Department of Environmental Protection (DEP) has approved a third-party root cause analysis (RCA) report identifying the source of a fatal Feb. 2017 slope failure at the Advanced Disposal Services Greentree Landfill in Kersey, PA.
- According to the report, the "placement of non-conventional waste streams … including low shear strength sludges" interacted with an inability to install necessary gas well infrastructure to displace 15.5 acres of waste, resulting in the death of William Pierce.
- The report identified three categories of "factors" as the "primary focus" of the incident investigation team: operational factors, leachate and landfill gas factors (which subsequently contributed to "excessive pore pressure"), and geometric factors “associated with cell configuration and management of waste within [the] configuration.”

Dive Insight:

The 2017 incident led to the DEP requiring Advanced Disposal to pay $695,000 in civil penalties, as well as remediate the slope

failure area and consent to restrictions on sludge acceptance. The company was also responsible for $12,000 in OSHA fines. The company's most recent quarterly filing indicates it had incurred $6.4 million in expenses, net of insurance recoveries, as of June 2018 due to the incident.

Advanced Disposal did not respond to a request for comment on this new report.

In its RCA report, Geosyntec Consultants identified a series of operational conditions that factored into the failure, but said that none "led to (or would have led to)" the collapse in isolation. In combination with pore fluid pressures and geometric factors, Advanced Disposal's use of oil and gas drill cuttings for interim cover, implementation of a "100-ft plus" setback in the affected landfill cell and installation of a segregation layer "led to an unstable waste mass that resulted in the Slope Failure."

Although Greentree staff acted "aggressively" to implement landfill gas well infrastructure, and met both permit conditions and industry standards in individual decisions, the combination of these operational decisions created a section of concentrated, hydrologically nonconductive low shear strength waste (LSSW) that produced bulging, eruption and the eventual collapse.

In a separate lecture on the geotechnical stability of waste fills, Geosyntec Chairman and Senior Principal Dr. Rudolph Bonaparte explained how the lack of timely gas well installation and concentration of more than 40% LSSW in the Greentree Landfill cell exploited the slope's weak zones. Bonaparte also connected the observations from the Greentree failure to a need for greater understanding of "unintended consequences" of waste fill operations, including the management of special waste.

The Advanced Disposal site, which has been in operation since 1986, is permitted for an average of 5,500 daily tons of waste and currently accepts an average of 3,000 tons. It's included in the solid waste plans of several Pennsylvania counties and has contracts with multiple generators in the region.

According to the Bureau of Labor Statistics (BLS), three of the 63 fatalities in the "waste management and remediation services" category occurred at landfills in 2017. While this is a small number relative to the 30 fatalities among collection workers — which often receive more regular attention in safety discussions — it indicates that risks are still present at closed sites. While official 2018 BLS data won't be available until later this year, anecdotal reports indicate that there have already been at least two fatalities at landfills so far in 2019.

WASTEDIVE

BRIEF

Waste Management reaches $4.1M settlement over Ohio landfill

By Rina Li

Published Dec. 5, 2018

Dive Brief:

- Waste Management will pay $4.1 million in a class-action lawsuit over the Stony Hollow Landfill in Dayton, Ohio, reports Dayton Daily News. The settlement was finalized in federal district court on Nov. 26.
- The suit, which was filed in 2016 following numerous odor complaints from neighboring communities, claims Waste Management "failed to sufficiently collect, capture, and destroy landfill gas generated at its landfill to prevent fugitive emissions and to otherwise prevent odors from the landfill from invading the homes and property."
- An estimated 2,000 individuals will share $1.875 million provided by the settlement, according to court documents. In addition to doling out funds to class-action members, Waste Management will also be required to implement $1.45 million worth of improvements to the landfill by the end of 2022 in order to reduce odor emissions.

Dive Insight:

The 169-acre landfill, which takes in an average of 1,100 tons of waste per day, has been an ongoing source of grief for adjacent

communities; odor emissions have prompted hundreds of complaints from area residents since April 2016. While Waste Management has acknowledged the odors — and, according to the landfill's website, taken "significant action" to address underlying structural issues — community members and city officials remain frustrated with the lack of progress.

The suit marks the culmination of a series of odor-related headaches centered around Stony Hollow Landfill. The Ohio EPA issued the site a $16,000 fine for emissions last year, while odor issues have prompted Montgomery County to explore alternative options for solid waste disposal. In addition, Dayton barred the landfill from discharging waste into the city's sanitary sewers after the presence of prohibited chemicals forced cleanup crews to seek medical attention.

Strained relations between landfills and neighboring communities have become increasingly common in recent months: odor emissions from a Waste Connections-owned landfill in Louisiana have prompted multiple pending class-action suits, while another Waste Management landfill in New York was hit with its own class-action suit over odors this past summer.

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

For Release: Monday, February 5, 2018

DEC Cites High Acres Landfill for Failure to Reduce Odors

Notice of Violation Issued to Waste Management of New York, LLC, for Ongoing Violations of State's Air Pollution Control Requirements and Solid Waste Management Regulations

New York State Department of Environmental Conservation (DEC) Commissioner Basil Seggos today announced that on Friday, Feb. 2, 2018, DEC issued a Notice of Violation (NOV) to Waste Management of New York, LLC, operator of the High Acres Western Expansion Landfill located in the towns of Perinton in Monroe County and Macedon in Wayne County, for ongoing violations of the state's solid waste management regulations, as well as the state's air pollution control requirements related to ongoing odor issues.

DEC Commissioner Basil Seggos said, "The odor condition at High Acres Landfill is unacceptable. New York's stringent rules and regulations governing waste exist to ensure facilities in our state are adhering to the safest practices and highest standards possible to protect public health and the environment. DEC takes any violation of these policies seriously and is taking necessary action to hold these violators accountable. The communities next door to the High Acres Landfill deserve no less."

DEC has received numerous complaints from the neighboring community of persistent unpleasant odors emanating from the landfill that are adversely impacting properties and quality of life. In response to these concerns, DEC immediately bolstered its monitoring of the landfill to determine the nature and extent of the odors, including increased on-site inspections. In addition, DEC has been working in cooperation with the town of Perinton and its Conservation Board to resolve the issue.

Under the terms of the NOV, Waste Management, LLC, must implement operational modifications to ensure best management practices are being applied at High Acres Landfill and undertake several structural improvements to strengthen the integrity of the facility's gas collection and odor mitigation systems to achieve significant odor reductions as expeditiously as possible.

DEC will continue to closely monitor operations and air quality conditions at the landfill and in surrounding communities and will provide strict oversight as the required corrective actions and modifications are implemented by March 16, 2018. Some of the corrective actions are already underway. In addition, DEC is continuing its increased presence at the site to ensure implementation of these measures until the odor issue is resolved.

Waste Management, LLC, may be liable for penalties for past or future violations.

The complete NOV is available (PDF, 212 KB).

BREAKING NEWS

AG Koster releases new expert reports concluding radiation and other pollutants have migrated off-site at Bridgeton Landfill

Sep 3, 2015, 10:06 AM

-- Data also indicates that underground fire has moved beyond the interceptor wells separating the North and South quarries --

Jefferson City, Mo. – Attorney General Chris Koster released today new reports from expert witnesses in the case he is prosecuting against Republic Services, Inc. relating to the subsurface fire at the Bridgeton Landfill. Collectively, the reports paint a troubling picture of the environment surrounding the landfill site. Contamination in groundwater outside the landfill perimeter has been identified, including radiological contamination detected in trees surrounding the site. Further, data indicate that the fire has moved past the two rows of interceptor wells positioned at the neck of the landfill, closer to the North Quarry.

Koster's office gathered the reports to better understand the facts relevant to the lawsuit Koster filed in 2013 against Republic Services for alleged violations of law associated with the still-burning fire. The Attorney General's Office is publicly releasing the reports because they contain information important to the health and safety of the people who live and work near the landfill.

The reports may be viewed below. Their conclusions are briefly summarized as follows:

- Drs. Joel Burken and Shoaib Usman, Environmental Engineering Professor and Nuclear Engineering Associate Professors, respectively, at Missouri University of Science and Technology (S&T), detected radiological and organic contamination in trees on the property of neighboring landowners. According to the report, these findings "indicate the off-site migration of RIM [radiologically impacted material], either in groundwater or aerial transport of particulate matter[,]" and similar off-site migration of organic pollutants, likely through movement of leachate-impacted groundwater.
- Peter Price, a scientist with the Missouri Geological Survey, and Dr. David Wronkiewicz, a Geology Associate Professor at Missouri S&T, discovered volatile organic compounds, including benzene, acetone, and 2-butanone, in high concentrations in the groundwater in wells outside the perimeter of the landfill. They are able to trac the contamination to the landfill by comparing its characteristics to leachate taken from the landfill.
- Drs. Tony Sperling, a landfill-fire expert and professional engineer, and Ali Abedini, a landfill-gas specialist, concluded that the data show the fire has moved beyond both lines of gas interceptor wells at the "neck" of the landfill, in the direction of the OU-1 radiological area. Drs. Sperling and Abedini also concluded that Republic Services "was negligent in aggressively over-extracting the gas system well outside industry best practices." They note that oxygen intrusion caused by over-extraction the leading cause of subsurface fires and smolders in municipal solid waste.
- Todd Thalhamer, a civil engineer from California with extensive experience investigating landfill fires, concluded that what he described as a "catastrophic event" at the landfill "was foreseeable and preventable." He stated that business decisions by the landfill's operators to overdraw gas-collection systems and inadequately maintain th soil cover on the site were factors causing the fire to occur.
- Dr. Timothy Stark, PhD and professional engineer, performed three separate personal inspections of the landfill site. He observed significant slope degradation and area where the waste mass had settled, suggesting the underground waste had been consumed by a smoldering / combustion event.
- Don Wright, a consultant specializing in odor assessment, captured an odor profile from the air surrounding the landfill and was able to identify a dominant odor "emitted by and carried a considerable distance downwind from the Bridgeton Landfill source."
- Kenny Hemmen, a registered geologist at Geotechnology, Inc., conducted a feasibility study to analyze remediation options related to potential groundwater contamination. He examined five alternative approaches with the objective of protecting human health and the environment.

In addition to publicly releasing the reports, the Attorney General's Office forwarded copies to the Environmental Protection Agency, the Missouri Department of Natural Resources, the Missouri Department of Health and Senior Services, and the St. Louis County Public Health Department. Koster encouraged those agencies to carefully review the information in the reports and take further remedial action as appropriate to ensure that the people around the landfill are protected.

"These reports underscore what has been clear from the beginning—Republic Services does not have this site under control," Koster said. "No only does the landfill emit a foul odor, it appears that it has poisoned its neighbors' groundwater and vegetation. The people of Missouri can't afford to wait any longer—Republic needs to get this site cleaned up."

Koster's suit against Republic Services is set for trial in March 2016. He has alleged that Republic's management of the landfill was negligent and that the company has violated the State's environmental laws. The suit seeks penalties, actual damages, and punitive damages as a consequence of Republic's allegedly unlawful conduct.

Full reports:

- **West Lake Landfill Organic Pollutant Phytoforensic Assessment - Burken**
- **Westlake Landfill Phytoforensic Assessment using Gamma Spectroscopy - Usman**
- **Westlake Landfill Tree Core Analysis – Burken/Usman**
- **Bridgeton Sanitary Landfill Groundwater Investigation – Price/Wronkiewicz**
- **Subsurface Self Sustaining Reaction Incident – Sperling/Abedini**
- **Bridgeton Sanitary Landfill Incident – Thalhamer**
- **Field Inspection Reports – Stark**
- **Bridgeton Landfill Downwind Odor Assessment - Wright**
- **Feasibility Study – Groundwater Remediation – Hemmen**

The Rogersville Review
In Historic Rogersville, Tennessee
Your Community Partner Since 1885 - Serving Hawkins County, Rogersville, Mooresburg, Bulls Gap, Surgoinsville, and Church Hill

Carter's Valley landfill listed as possible site for radioactivity

Last updated: 5:05 PM, 08/03/2009

Source: The Rogersville Review



By Jim Beller Staff writer | (jbeller@xtn.net)
KINGSPORT - Just when you thought Hawkins County was a safe place to raise a family, think again. Clean water watchdogs announced Thursday that Carter Valley Landfill is leaking into the groundwater and has been accepting nuclear waste. Officials from The Tennessee Clean Water Network (TCWN) and Nuclear Information and Resource Service (NIRS) addressed the media Thursday at Mead Auditorium in the Kingsport Public Library. "People around regular trash landfills will be shocked to learn that radioactive contamination from nuclear weapons production is ending up there, either directly released by the Department Of Energy or via brokers and processors," stated Diane D'Arrigo, NIRS. TCWN Director of Community Organizing, Rachael Bliss, cited the Hawkins County landfill as a prime example of the Tennessee Department of Environment and Conversation's (TDEC) failure to control leaking landfills contaminating ground and surface water. "Thirty-one percent of our landfills are leaking," said Bliss. "Add to this, the Nuclear Information and Resource Service recent report showing that the state of Tennessee is a leader in licensing processors that can release radioactive materials to a municipal landfill. "There are nine landfills in Northeast Tennessee that are leaking and one is accepting special radioactive waste, Carter Valley Landfill in Hawkins County," she said. "Radioactive waste should not be accepted in our municipal dumps since TDEC has already demonstrated an inability to properly protect our water and communities from toxic landfill leachate. "Last year, statistics from TDEC showed of the 225 permitted landfills across the state, 69 or 31% were leaking," Bliss said. "Landfill leachate, contaminates drinking water sources like groundwater and surface water with toxic pollutants that are known to cause birth defects, cancer, learning disabilities and other health problems. "As recent as May of 2006, the Hawkins County landfill was assessed more than $70,000 in damages and penalties by TDEC for groundwater contamination," Bliss said, adding that "this is after two and a half years of warnings and violations notices that failed to resolve the leak problem. "TDEC claimed that communities surrounding the landfill were in no danger from the leak.

Violations range from lack of litter control to leachate leaks in groundwater, leaks migrating into storm water control structure, problems with collection, inadequate erosion control and leaking pipes. "According to the Johnson City TDEC field office there was no deadline set for BFI, who manages the landfill, to complete its repair of the Carter Valley Landfill leaks in exchange for a negotiated settlement with the Solid Waste Disposal Control Board for its violations." Bliss continued: "As of two days ago, the work was still ongoing. In the absence of a remedy to stop the leaks, Carter Valley Landfill is hauling its leachate by trucks to the Eastman Wastewater Treatment Facility. "According to TDEC records, the landfill is still on a monitoring basis of two times a year," Bliss said. "Evidently, TDEC doesn't think this is serious enough to require quarterly monitoring." Bliss said fewer than five of Tennessee's leaking landfills have "any corrective action being taken to stop the toxic landfill leachate." "TDEC's data from 2006 shows 44% of Class I landfills are leaking," she said. "Class I landfills are sanitary municipal landfills, like Carter's Valley. This means approximately 40 percent of Tennessee's landfills that are held the highest existing design standards that are actively accepting waste are leaking." Bliss said action needed by the Department to control Tennessee's leaking landfills include the regulation of landfills according to TDEC's Division of Solid Waste Management. Among these regulations are remediation of groundwater contamination, monitoring groundwater and methane gas. Another step in this process is requiring the 69 leaking landfills to come into compliance with TDEC's regulations. "TDEC's consistent and efficient enforcement of landfill regulations can prevent an entire community's exposure to toxic leaks from landfills and this can improve our ground and surface water and our right to clean water." D'Arrigo is one author of the recently released report, "Out of Control - On Purpose: DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products." The report was commissioned to track if and how the Department of Energy (DOE) releases some of the low radioactive wastes from nuclear bomb production. The report said Tennessee is a leader in licensing processors that can release radioactive materials into our municipal landfills. "The DOE has on its own, actually in contradiction to the federal and Congressional revocation of these kinds of policies in the early '90s, determined its own levels it decided are acceptable for radiation exposure above the normal background. Several systems within the Department Of Energy allow that radioactive waste to go out to regular garbage or to be recycled into the marketplace or re-used. Equipment can be re-used or concrete and asphalt used again." There are four Class I landfills authorized to receive such wastes: Chestnut Ridge in Anderson County, North Shelby County, Middle Point in Rutherford County, and Carter Valley in Hawkins County. Bliss said local residents who prided themselves on the clean water from private wells before the Carter Valley Landfill began operations, finally took up a petition to receive utility district water when people downstream from the landfill discovered their wells were contaminated. TDEC issued civil fines and penalties at Carter Valley Landfill in October 2006 after 2005 groundwater monitoring found contamination in the groundwater. Additionally, TCWN found that of the 69 landfills across the state known to be leaking, TDEC required corrective action for groundwater contamination at less than 5 of those landfills, including Dickson County, Sevier County, City of McKenzie, and Smelter Services Class 2 landfill in Mt. Pleasant. Dickson County's landfill received national attention for what is believed to be the community's exposure to trichloroethene from leachate in drinking water supplies causing birth defects. The contamination occurred despite the landfill being built under stringent EPA guidelines and the old landfill's closure in 2003. Bliss said Hawkins County has the second highest incidence of birth defects in the state. "We should have a concern about Hawkins County. We need to find a reason and work toward mitigating the impact on the environment. We live in a nuclear neighborhood. Oak Ridge is the home of the atom bomb. Tennessee has a number of nuclear processors, including two in Erwin. There's the Aerojet Ordinance Plant in Jonesborough. Now we know nuclear waste is being accepted at Carter's Valley Landfill." For more information visit http://www.tcwn.org . To read Out of Control - On Purpose: DOE's Dispersal of Radioactive Waste into Landfills and Consumer Products visit: http://www.nirs.org/radwaste/outofcontrol/outofcontrol .htm.

Australia: Methane gas landfill leak forces residents to evacuate suburb

By Peter Byrne

25 September 2008

On September 11, Country Fire Authority chief officer Russell Rees advised owners of about 250 houses in the working class outer-Melbourne suburb of Cranbourne to move out after methane levels of 60 to 65 percent were found in some houses. Concentrations of 5-15 percent are considered an explosion risk.

The gas emanated from a closed landfill bordering the Brookland Greens housing development. Since the evacuation notice was issued, it has been revealed that the state government planning review body approved the housing development after ignoring Environmental Protection Agency safety warnings.

Residents were initially advised they would have to stay away for a year, and that it could be as long as 24 months before measures were put in place to fix the leakage problem. While the Victorian state government offered paltry conditional emergency grants of $8,500, it was left up to households to organise their own accommodation. With few options available, only 33 of the 230 households in the affected zone initially moved out. In the past week, at least 21 of those have returned following zero readings from methane gas monitors.

The immediate danger of home gas explosions seems to have passed, but hundreds of residents are now faced with ongoing safety fears and a continuing methane stench. Many, including those with large mortgages, also face a devastating collapse in the value of their homes, threatening their income security and retirement nest-egg.

The land developer, local council and the Victorian state Labor government and its planning regulatory bodies are now engaged in a mutual blame-shifting exercise. But what emerges is the complicity of all those who had material interests in the development project—yet another expression of the impact of a profit-driven system in which the rights of ordinary people to decent, safe and affordable housing are sacrificed to corporate interests. This fundamental problem has been compounded by a lack of rational urban planning. A chronic housing shortage in Melbourne—which has fuelled rents and property prices particularly in inner-city suburbs—has led to a situation in which many working people can only afford to live in housing developments in outlying areas, often with grossly inadequate public transport, recreational facilities, and other critical social infrastructure.

Brookland Greens, located nearly 50 kilometres south-east of Melbourne, adjoins an exhausted sand quarry in Stevensons Road, which the City of Casey operated as a rubbish tip from 1996 to 2005. About 100,000 tonnes of household waste was dumped each year. Contrary to best practice, the landfill was never lined with clay. Instead, the site was capped with a layer of soil and a gas collection and burning system was installed, designed to collect all the methane produced. This is now failing. According to the EPA, an estimated 1,300 cubic metres of methane per hour are produced with a proportion—several hundred—leaking sideways and percolating up through the ground outside the capped area of the landfill site.

The EPA and council have been monitoring gas problems and fielding complaints about the landfill for at least eight years. Residents have reported skin rashes, eye infections, asthma, burning sensations and headaches.

If there was a substantial buffer-zone between the landfill and residential buildings, then the methane would find its way to the surface and (being lighter than air) simply escape through the ground and into the atmosphere. But when the gas is restricted by an impermeable object like a home's concrete floor slab, it can be channelled through a pipe or cabling penetration and then build up to explosive concentrations in unventilated cupboards or wall cavities. This is what happened two weeks ago in Brookland Greens.

EPA safety warning ignored

Western Australian-based developer Peet Limited bought what was then farmland, adjoining the former Stevensons Road landfill site, in June 1998 for $3.5 million and planned Brookland Greens as a staged subdivision with some 800 lots. Revenue was projected at $100 million over a 10-year period.

In 2000 the council rezoned the land for residential subdivision on condition that a 200-metre buffer between houses and the landfill site would be maintained until declared safe by the EPA and the council. But in 2003 Peet Limited applied to have the buffer effectively junked, based on its assertion that because the tipping of rubbish had ceased in some parts, the 200-metre boundary should move to reflect the point of distance from the active area of the site. Had the company waited for the projected 25 years for the

methane gas leakage to abate, about one third of the 800 lots in Brookland Greens could have been blocked. This would have had a significant impact on the company's bottom line, which last year recorded an annual profit of $48 million.

Casey City Council initially refused the application to remove the buffer zone. In response, Peet Limited successfully appealed to the Victorian Civil and Administrative Tribunal (VCAT), the state government planning review body.

Established in 1998, VCAT has been utilised by successive Liberal and Labor state governments as a means of fast-tracking developers' appeals against unfavourable council planning decisions. The *Age* newspaper reported: "Angry talkback callers have filled the radio airwaves with their own 'tribunal horror stories' since news broke of the gas emergency. Many of the callers have been upset with what they saw as a lack of accountability and transparency."

The Labor government of Premier John Brumby has denied any responsibility for the situation in Brookland Greens. Its position, however, is untenable. The entire land usage regulatory system presided over by the government is geared towards the corporate developers. Underscoring the close relationship between these interests and the state government, it has emerged that Peet donated $10,000 to the Victorian Labor Party between 2003 and 2005.

The council has similarly denied all responsibility and pointed to its denial of Peet's initial application on the buffer zone. But it has been suggested that the local body had an interest in the development and the additional development contribution fees, taxes and rates it would bring. Ben Hardwick, a lawyer acting for Brookland Greens' residents who are considering a class action suit, noted: "[I]t is common practice, for political reasons, for local councils to refuse developers' applications or decline to make a decision, safe in the knowledge that VCAT will make the hard decision for them."

Details of the 2004 VCAT decision, overruling the local council and the EPA on the need for a buffer-zone, provide a damning portrait of the scant regard shown by official state bodies for public safety. The review body simply dismissed out of hand the EPA's recommendation that the buffer should be increased from 200 metres to 500 metres because of the serious problems with the unlined leaking landfill. The environmental agency had fined tip operator Grosvenor Lodge three times and imposed 19 enforcement actions for odour emissions.

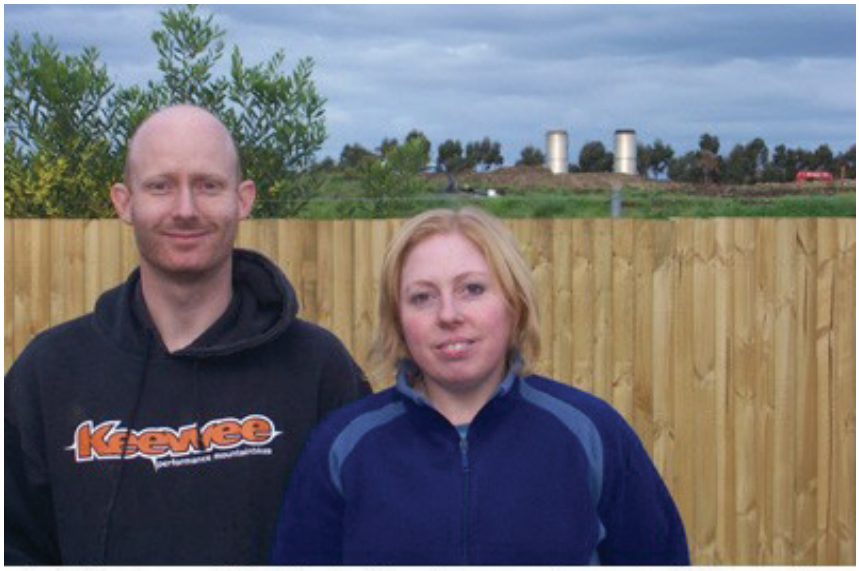
After the successful appeal, Peet Limited quickly built 47 homes in the contested area, garnering revenue of $16.45 million. As the landfill was progressively closed, the buffer was effectively eliminated, with new houses abutting the edge of the capped landfill.

There are indications that Brookland Greens is no isolated incident. The EPA has announced an investigation into dozens of landfill sites in Victoria, while the federal Liberal Party has called on Prime Minister Kevin Rudd to convene a national inquiry and an audit of every landfill site in Australia.

"The land should never have been sold"

The *World Socialist Web Site* spoke to a number of residents whose houses back on to the landfill site. They explained that no government agency warned them of any potential danger before they bought their land.

Andy Rhodes, mechanical engineer, and Nixz Kerr, finance clerk, bought land for $300,000 in March 2007 and moved in later that year.



Andy Rhodes and Nixz Kerr (with methane gas burners in background)

"We liked this particular block because we were told by the developers that the culprit behind us would be a park by about now," Andy explained. "We specifically asked if there would be any problems or had been any problems, and we were told it's all behaving as normal, everything's on schedule. When we bought the land, we were told the tip had been closed for a couple of years. Now the proposed park is years away."

Nixz said: "I think that the land should never have been sold. They didn't know that it was going to be 100 percent OK, so they shouldn't have sold it in the first place. Obviously the developer needs to take some blame because they were already doing monitoring. But we never heard anything until we moved in, although we did ask and were told everything was OK."

Andy added: "I personally think all three are equally to blame—the developer, the council and VCAT. The council hasn't done enough to mitigate the problems and deal with their own landfill. Then VCAT probably jumped the gun. The developer probably pushed pretty hard and they made a lot of money out of the land. We've heard that this is highly unusual; that this is only one of two rubbish dumps that did this. They're supposed to line the bottom and sides. When they cap it they put a layer on top that the methane gas can't come through.

"The smell gets really bad sometimes but we can't move out. We don't have the option and haven't got anywhere to go. We've got a [methane gas measure] monitor but haven't had any positive readings. Technically we're still in the danger zone and we probably shouldn't have a house here. We're worried on a number of counts. What are the health effects? They've said it doesn't harm your health but it can't be good for you either. There's obviously other stuff coming out of the ground when it smells. Is that harmful? We're worried about the potential danger to property if it does explode. And obviously no-one can sell their house. No one's going to buy here, not for decent market value anyway."

Another resident, Antony Krause, moved from Sydney six months ago to be closer to his daughter and look after his grandchild. Now retired, he worked for 21 years at the Reckitt Benckiser factory in Sydney, and paid $295,000 for a house that backs onto the landfill site. "I never heard anything about the gas," he explained. "We do get the smells, the bad egg smells every week or so, only outside. When I bought this house I asked the real estate agent about the tip and he said 'don't worry about that, they're going to build parkland'. And the next day I phoned the council and they sent me a letter that said there's nothing to worry about, we're building a park. I didn't know it was going to be so serious. I can't move out because I planted all my money here and I don't have money to buy another house."



Graeme Hiam

Retired factory manager Graeme Hiam moved into his house 16 months ago. He paid $130,000 for the land and another $190,000 for the house.

"We were never told anything," he told the WSWS. "From the time we purchased the land there was never any mention of the tip. One would assume they didn't know or they weren't telling. Ever since we've been here we've seen people putting rods down the drains. They first put a [methane gas measure] meter in my house a month ago. The house next door had the high reading that has been reported. My opinion is that blame rests between Peet and VCAT. But everyone's blaming someone else."

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http://www.wsws.org/articles/2008/sep2008/mgas-f25.shtml

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Ombudsman's damning report on landfill leak

Tuesday, 20 October 2009
Garth Lamb

Lawyers representing nearly 600 residents of Brookland Greens Estate, who were allegedly effected by landfill gas leaking out of the old Stevensons Road landfill in the Melbourne suburb of Cranbourne last year, have welcomed a damning report by Victoria's independent Ombudsman. Released last week, it found EPA Victoria mainly to blame for the gas migration, which saw hundreds of people evacuated and ongoing claims of depressed property prices.



The Ombudsman traced the problem back to 1992 when the EPA granted works approval for the Shire of Cranbourne (the predecessor of the City of Casey Council). The EPA intended the landfill to be lined with compacted clay if it was to accept putrescible waste – a "favored" but not compulsory practice at the time – but ultimately the regulator bowed to pressure and allowed an unlined facility to be built.

The Ombudsman found the Shire's 1992 contention that a landfill liner would be expensive ($500,000) to install should not have been taken into account by the EPA: "Clearly, environmental standards should not be compromised for the sake of an agency saving money."

While it was the lack of a liner which ultimately saw gas migration become such a high profile issue last September, the Ombudsman was equally scathing about other aspects of site design and operation.

"My investigation identified that the EPA's assessments of the Shire's works approval applications were inadequate," states 289-page, 65-recommendation report, which has been tabled in Parliament.

"The applications contained errors and the EPA failed to properly explore all assertions. The EPA also failed to properly assess the Shire's applications for works approval partly through lack of expertise and partly through allowing the outcome to be the subject of negotiation."

One significant error of the EPA, "was to ignore the condition of the *State Environment Protection Policy (Siting and Management of Landfills Receiving Municipal Waste) 1991* that prohibited landfilling below the level of the water table, 'unless written permission from the Authority has been obtained'".

"Without addressing this condition explicitly in the assessment of the works approvals, the EPA should not have granted permission for the landfill which was not only below the level of the water table, but interrupted a substantial nearby aquifer," states the report.

EPA Victoria CEO Terry A'Hearn rejected claims the EPA did not do its job, telling the *ABC* things hadn't been done perfectly, but "we believe that at all times what we've done is prioritise the safety of the people on the estate".

The Ombudsman was also highly critical of the Shire of Cranbourne and the City of Casey Council, finding "in its narrow focus on the economics of landfilling, the Shire failed to take account of other factors, namely environmental standards".

Perhaps the most acute display of the all round failure of the system is the ongoing series of failures to adequately address the problems, despite multiple opportunities for this to occur.

"I concluded that while there have been significant technological developments in landfill design since the works approval was issued by the EPA in 1992, design standards at the Stevensons Road landfill effectively stood still.

"Essentially, a landfill conceived in the late 1980s, approved in 1992 and licensed in 1996 continued to operate with no landfill liner up until 2005 when it was closed. In the granting of the works approval for an unlined landfill and the subsequent lost opportunities to require a landfill liner, the EPA failed to set conditions for the protection of the environment."

Last November law firm Slater & Gordon launched a class action in the Supreme Court of Victoria seeking unspecified damages from the City of Casey on behalf of residents affected by the gas leak. Lawyer Ben Hardwick said it is now "imperative that the City of Casey and EPA come to the table and try to resolve the matter through mediation".

"Now that the Ombudsman has made his findings, the next step is to fix the problem," he said. "Rather than protracted and expensive legal action through the courts, the City of Casey should sit down and talk with us."

He said the Ombudsman catalogued "a litany of bureaucratic bungling, mismanagement and blame-shifting" and pointed to a particular comment in the report supporting his class action lawsuit.

The Ombudsmand stated, "it is clear to me that the local community has endured considerable anxiety, distress and inconvenience as a result of methane gas leaking from the landfill into the estate and the way that some government agencies handled this issue. On this basis, affected residents should be compensated accordingly".

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Scotland board puts end to landfill project

Jun. 8--LAURINBURG -- The Scotland County Board of Commissioners voted Monday night to end a controversial landfill expansion project.

County officials had considered expanding a closed landfill to create a regional dump as a way to bring in revenue for the struggling county.

But many residents opposed the plan, saying it would turn the county into a dumping ground for trash from all over the state.

Monday's meeting officially killed the project, when commissioners unanimously voted on two items meant to quash the plan for good.

J.D. Willis, chairman of the board and proponent of another regional landfill proposal in 2007, issued a motion to stop plans for the landfill at Patterson Road.

Commissioner John Alford, before voting on the motion, asked that it include language to stop all regional landfill proposals in the county.

Willis agreed.

The motion was passed without dissent.

Immediately afterwards, Bob Davis, a longtime opponent of regional landfills in the county, submitted a detailed resolution banning the Patterson Road landfill expansion.

The resolution stated that "Scotland County discontinue the employment of engineering firms, outside legal counsel and all other firms or companies engaged to assist with the condemnation and/or more expansive plans for disposition of waste."

The resolution asked that the county manager notify all waste management companies that Scotland County was, in effect, out of the landfill business.

It, too, was passed unanimously.

Only Commissioner Guy McCook was absent. Willis said McCook had been hospitalized that morning.

Willis said the landfill had become a divisive issue in the county, and that officials would be better served by channeling resources into other things.

"Having said that, it is my opinion that the climate is not conducive to expanding our existing landfill," he said.

Willis, a longtime board member, was defeated in the May primaries, after refusing to say whether he would vote for or against the landfill expansion project.

Many residents believed Willis was in favor of the project.

In 2007, he was one of five of the board's seven commissioners to vote in favor of a dump that was expected to produce about $4 million a year in revenue for the county.

Eddie Carmichael, a farmer who had spoken out against the Patterson Road landfill, said he was pleased with the board's decision, but remained skeptical.

"It's good they finally listened to the people," Carmichael said.

But, he said, with a wary shrug: "It's politics. They could come in next month with a whole, new

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State officials file suit over dump site health hazards

March 11, 2010 - By MARY ANN GREIER

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LISBON - State officials resorted to legal action Wednesday against A & L Salvage in an effort to stop a health threat and environmental hazard caused by the odorous dump outside of Lisbon.

Ohio Attorney General Richard Cordray's office filed the 20-count complaint and preliminary injunction request in Columbiana County Common Pleas Court, asking the court to order A & L Salvage to cover the 42-acre dump site with an additional 12 inches of cohesive earthen material within six weeks of the order.

The preliminary injunction request also asked for immediate access to the site for the Ohio Environmental Protection Agency and its contractors and an immediate elimination of all off-site odors. The case has been assigned to Judge C. Ashley Pike.

The construction and demolition debris landfill stopped operations a year ago, but the odors from hydrogen sulfide remained and became worse in recent months to the point of causing people to become ill with headaches and nausea, a joint press release from the OEPA and OAG said.

The OEPA and OAG offices have been working with the company for a final closure plan to cover the site for over a year with no resolution for a consent decree. OEPA Director Chris Korleski said "enough is enough," according to OEPA spokesman Mike Settles.

"This situation cannot continue as is," Korleski said in a press release. "The odors need to be stopped and the landfill needs to be properly stabilized and closed once and for all."

Residents suffering from the stench have been putting up with the problem for several years, complaining to the Columbiana County Health Board at one point, then going to the OEPA after the state started overseeing C&DD landfills in the county. Settles said Korleski knows how frustrated they've been.

"I am personally grateful for the hard work the OEPA has done. I am also hopeful this court action will finally bring relief for all of us who live around the landfill," state Route 45 resident Don Kibler said in an e-mail.

"We have given A&L Salvage's owners every opportunity to comply with Ohio law and properly close that landfill," Cordray said in the press release. "Instead, they have allowed conditions to deteriorate to a point where we now need the court's help to make things right."

Besides naming A & L Salvage LLC as a defendant, the complaint also named four additional defendants who allegedly own property the OAG has identified as part of the site. Those defendants include Amato Properties LLC, Jack Amato and Jeffrey Aldrich, all of Wellsville, and the Amato Family Trust of East Liverpool.

Dr. Jack Amato serves as chairman of the Columbiana County Health Board, the entity which issued the dump's original permit to operate. A call was made to his home Wednesday evening, but he couldn't be reached for comment.

When asked what those defendants have to do with the dump, OAG spokesman Ali Lehman said they own property that is considered part of the landfill. According to the county Auditor's Web site, A & L Salvage owns about 375 acres along state Route 45 and Black Road. The active part of the dump only covered 42 acres, with the rest being buffer, although the company originally had plans to eventually use the other acreage for dumping.

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Fact Box

The OEPA recently asked for help with the site from the U.S. EPA. Those two agencies, the Ohio Department of Health and the Agency for Toxic Substances and Disease Registry are tracking hydrogen sulfide odors around the site and using gas monitoring wells to see if other gases are leaving the site.

Residents experiencing nuisance odors can call the OEPA odor hotline at 1-800-686-6330 ext. 1212. Information about possible health effects from hydrogen sulfide exposure can be obtained from Greg Stein at the ODH at 614-995-7017 or online at www.odh.ohio.gov

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The company and OEPA reached an environmental pact last year, prohibiting the use of any of the property owned by A & L Salvage as any type of dump in the future. The pact also prohibits any future owners from operating a dump on the land.

The county Auditor's Web site lists Amato Properties, Jack Amato and Jeffrey Aldrich as owners of some land on Black Road, but their names weren't listed on the environmental pact filed in the Recorder's Office. Their names also weren't listed on the numerous complaints filed against A & L Salvage for violations of environmental law.

Those violations form the basis for the lawsuit which requests monetary penalties along with the injunctive relief to alleviate the odors. The violations included acceptance of pulverized debris and solid waste, which is prohibited at a C&DD landfill, improper asbestos handling, and creating a nuisance from the hydrogen sulfide, or rotten egg, smell.

The complaint also noted cliffing of debris, which happens when it's not spread out and compacted on the working face of the dump, improper use of unloading zone, failure to manage surface water and allowing a discharge into Patterson Creek, failing to apply weekly cover to debris, failure to comply with Korleski's orders to implement an explosive gas monitoring plan, failure to pay disposal fees, causing a nuisance with dust, failure to properly dispose and bury asbestos or cover asbestos, failure to surround the asbestos disposal site with fencing, failure to display asbestos warning signs, failure to maintain equipment to wet asbestos or prevent dust emissions from asbestos operations, and failure to minimize dust on roads.

The civil penalties being sought exceed $25,000, with no exact estimate available for each violation. Penalties for at least nine violations were listed as $10,000 per day per violation, with the penalties for another 10 violations listed at $25,000 per day per violation. A tax of $300 was requested against each defendant and their property for the statutory nuisance complaint.

The time period for the complaint began in 2005 and continued to the present. The preliminary injunction request said the landfill "is releasing extremely intense odors and has elevated temperatures indicating the possible presence of a subsurface fire."

Jerry Weber, an OEPA environmental specialist responsible for inspections at the site, wrote the OEPA has received at least 350 odor complaints about the site since October 2003, causing him to issue numerous violations. In February, he documented odors which caused him to have a burning throat.

Settles explained that a hydrogen sulfide monitor placed at a nearby residence recorded readings as high as 110 parts per billion. They become concerned about the possible effects to public health when levels exceed 70 parts per billion.

He also said gas monitoring at the site this week showed strong levels of carbon monoxide and a landfill temperature of 191 degrees Fahrenheit, both good indicators that a subsurface fire exists.

By requiring additional soil cover on the site, the odors could be cut down, along with the amount of oxygen fueling a possible subsurface fire, he said.

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Bird Flu Virus Can Survive Two Years in Landfill

Posted in: Cold, Flu, and Sinus



Photo: Scott Bauer, US Agricultural Research Service

FRIDAY, June 5 (HealthDay News) — Poultry carcasses infected with the bird flu virus can remain infectious in municipal landfills for as long as two years, say Nebraska researchers.

Hundreds of millions of chickens and ducks infected with bird flu have died or been killed worldwide in an effort to control the spread of the disease, they noted. The remains are disposed of in different ways, including burial in landfills. For example, the carcasses of more than 4 million poultry that were culled or died during a 2002 outbreak in Virginia were placed in municipal landfills, according to a news release from the American Chemical Society.

But the safety of landfill disposal has received little attention, said the researchers who conducted the study. They found that the bird flu virus can survive in landfill leachate — liquid that drains from a landfill — for at least 30 days and up to two years.

Factors that most reduced the virus' survival times were elevated temperatures and acidic or alkaline pH, the news release noted.

"Data obtained from this study indicate that landfilling is an appropriate method of disposal of carcasses infected with avian influenza," concluded Shannon L. Bartelt-Hunt and colleagues, who noted that landfills are designed to hold material for much longer than two years.

The study is to be published in the June 15 issue of the journal *Environmental Science & Technology*.

Department of Justice

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Nevada Landfill Operator Agrees to $36 Million Plan to Close Landfill Site

Republic Services to pay $1 Million Civil Fine

WASHINGTON— Republic Services of Southern Nevada, the current operator of the Sunrise Mountain Landfill located in Clark County, Nev., has agreed to construct and operate a comprehensive remedy for the site and to pay a $1 million civil fine in order to resolve alleged violations of the Clean Water Act, the Justice Department and U.S. Environmental Protection Agency announced today.

The consent decree, filed today in U.S. District Court in Las Vegas, requires Republic Services of Southern Nevada to implement extensive storm water controls, an armored engineered cover, methane gas collection, groundwater monitoring, and long-term operation and maintenance.

"Today's settlement will minimize the risk to Clark County residents from polluted water runoff and hazardous waste discharges from the Sunrise Mountain landfill," said Ronald J. Tenpas, Assistant Attorney General for the Justice Department's Environment and Natural Resources Division. "This settlement reflects the federal government's commitment to protecting valuable natural resources like Lake Mead and its watershed."

The settlement will ensure effective long-term control of the landfill, which contains over 49 million cubic yards of waste. The remedy, which is expected to take roughly two years to build, will be designed to withstand a 200-year storm and is expected to cost over $36 million. Upon completion, the remedy is estimated to prevent the release of over 14 million pounds of contaminants annually, including stormwater pollutants, methane gas and landfill leachate.

"Landfill operators must ensure that effective safeguards are in place to protect the

environment and nearby communities," said Wayne Nastri, administrator of the EPA's Pacific Southwest region. "With today's agreement, Republic is required to properly close the landfill and ensure long-term waste containment."

Sunrise Landfill, a 440-acre closed municipal solid waste landfill, is located three miles outside of Las Vegas city limits. The landfill cover failed during a series of storms in September 1998, sending waste into the Las Vegas Wash. The landfill is located two miles above the Las Vegas Wash, which discharges directly into Lake Mead -- a primary drinking water resource for southern Nevada, including the Las Vegas metro area, as well as the lower Colorado River, the Phoenix metro area and southern California.

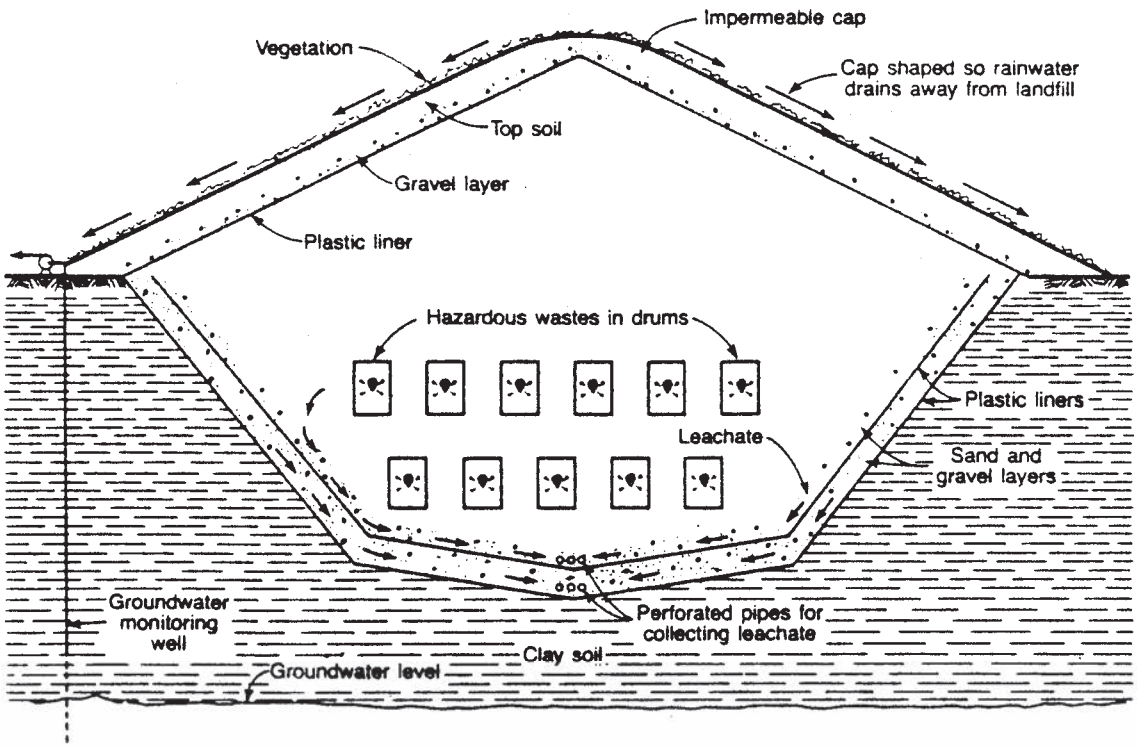
The landfill was operated on behalf of the County by entities related to Republic Services of Southern Nevada from the 1950's through 1993. Following the landfill cover failure in 1998, the EPA ordered Republic Dumpco, a company related to Republic Services of Southern Nevada, and the Clark County Public Works Department to correct violations of the federal clean water laws and to immediately stabilize the site.

Sunrise Mountain Landfill is unlined and contains more than 49-million cubic yards of waste including: municipal solid waste, medical waste, sewage sludge, hydrocarbon-contaminated soils, asbestos, and construction waste.

The proposed consent decree, lodged in the U.S. District Court for the District of Nevada, is subject to a 30-day public comment period and approval by the federal court. A copy of the consent decree is available on the Department of Justice Web site at http://www.usdoj.gov/enrd/open.html.

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08-698



Hazardous waste landfills: some lessons from New Jersey



New Jersey's experience with operational problems at four hazardous-waste landfills points up ways landfill regulations could be improved.

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A SECURE LANDFILL IS a carefully-engineered depression in the ground into which hazardous wastes are put. (3,4) The intention is to avoid any hydraulic connection between the wastes and the surrounding environment, particularly the groundwater. To this end, there are four critical elements in a secure landfill: a bottom liner, a leachate collection system, a cover, and the natural hydrogeologic setting.

The *natural setting* can be selected to minimize the possibility of wastes escaping to groundwater beneath a landfill. The other three elements must be engineered. The *bottom liner* may be one or more layers of clay or a synthetic membrane (or a combination of these); the liner effectively creates a bathtub in the ground. The *leachate collection system* consists of sloping the bottom of the landfill and placing pipes in the low places to pump out contaminated water and other fluids (leachate) that accumulate; the pumped leachate is treated at a wastewater treatment plant. The *cover* will generally consist of several sloped layers—clay or a membrane liner (to prevent rain from intruding), overlain by a very permeable layer of sandy or gravelly soil (to promote rain runoff), overlain by topsoil in which vegetation can root (to stabilize the underlying layers of the cover).

Each of these elements is critical to success. If a liner fails, hazardous wastes may migrate directly into the environment. If leachate is not removed from a landfill, fluids can build up in the bathtub; the resulting hydraulic head is the main force that will drive wastes out into the environment if the liner fails. If the cover is not maintained intact, rain will enter the landfill, solubilizing and mobilizing wastes, resulting in buildup of leachate—even to the point where the bathtub can overflow its sides.

Four secure landfills in New Jersey

New Jersey's industries produce roughly 750,000 tons of hazardous

wastes annually (9,13) but the state's last commercially-operated chemical landfill closed in 1976. By 1977 five major firms were making plans to operate their own secure landfills for on-site disposal of chemical wastes. All five landfills were eventually constructed and are operating today. However, four of the five have experienced operational problems.

E.I. DuPont de Nemours & Co., Inc.

DuPont applied in April, 1978, to the New Jersey Department of Environmental Protection (DEP) for a permit to operate a 10-acre double-lined secure landfill for chemical waste disposal in Carneys Point, N.J. Two five-acre cells were constructed, each with two liners of 0.03 inch (0.76 mm) nylon-reinforced Hypalon®—a tough polymer film—and each with a leak detector, or telltale, between the two liners.

A leak detector consists of pipes that collect any fluids that accumulate between the two liners. Presence of liquids in the leak detector is a signal that something may be going wrong with the upper liner.

The new landfill went into operation in January, 1979. Three months later DuPont management reported the presence of fluids in the leak detector area, accumulating at 124 gallons (469 liters) per day. The company argued that the fluids were rainwater that had been trapped between the liners during construction. The state feared that the primary liner (the upper liner, closest to the wastes) was leaking. The state immediately restricted the kinds of wastes that could be landfilled at the site, but subsequently relented after reaching an agreement with DuPont.

Under the agreement DuPont would analyze samples of the fluids being collected in the leak detector. (By this time the rate of accumulation had decreased to a steady 50 gallons (189 liters) per day.) DuPont suggested, and the state agreed, that an increase in four indicators—total dissolved solids (TDS), chemical oxygen demand (COD), phenol compounds, and color—would signal a leak occurring as distinct from rainwater accumulating. My statistical analysis of these data indicates that a significant increase has occurred in at least half of the indicators. By the criteria established in the agreement, the landfill's primary liner probably should be judged to be leaking.

New Jersey's experience with hazardous-waste landfills shows that synthetic liners are prone to problems—and that clay liners also have their troubles. Also, landfill covers are vulnerable to attack from: erosion; vegetation; soil-dwelling mammals; sunlight; subsidence; and human activities.

Monsanto Industrial Chemical Corp.

Monsanto Industrial Chemical Corp. sought permission from the DEP in 1977 to establish a 6-acre single-lined landfill for chemical waste disposal in Bridgeport, N.J. The DEP persuaded Monsanto that a double-lined landfill with a leak detector made best sense and the company proceeded with construction.

The Monsanto site had previously been used by the U.S. Army Corps of Engineers for disposal of material dredged from the bottom of the nearby Delaware River. DEP engineers therefore feared that soil on the site would be subject to compaction in the future as the waste load increased in the landfill. Monsanto therefore mechanically compacted the soil to 2700 pounds per square foot and installed a 0.9-inch (23 mm) fabric liner of BIDIM®, a proprietary polyester fiber somewhat like the felt pads that people sometimes put beneath rugs—except that BIDIM is lighter, stronger, and more durable than felt, and water passes through it more easily. Monsanto sells BIDIM to provide subsurface support for roadways, railway roadbeds, and construction sites. Above the BIDIM liner, Monsanto placed 12 in. (30.5 cm) of clay with a coefficient of permeability of 5×10^{-8} cm/sec. Such a coefficient of permeability would permit water to flow through 1.6 cm (0.6 in.) of such clay in a year's time. Above that layer of clay came the leak detector; above that came another 18 in. (45.7 cm) of the same clay.

The new landfill went into operation in mid-August, 1978. Within a month Monsanto officials had written to the DEP saying fluids were collecting in the leak detector area. The accumulation rate varied from 26 gallons (98 liters) to 48 gallons (182 liters) per day.

Monsanto hired consulting hydrologists Geraghty and Miller to help find the leak but after four years the effort has not been successful.

J.T. Baker Chemical Co.

J.T. Baker Chemical Co. of Phillipsburg, N.J., applied to the DEP in 1976 for permission to add several new landfills for disposal of chemical wastes. As finally constructed in summer, 1979, the new landfills consist of two liners of 0.03 inch (0.76 mm) polyvinyl chloride (PVC) film, with a leak detector between them. By October, fluids were collecting in the leak detector area between the liners at the rate of about 3 gallons (11 liters) per day; and DEP officials had ordered the firm to analyze samples of the fluids regularly for 13 characteristics.

There are four key elements in a secure landfill: a bottom liner; a leachate collection system; a cover; and the natural hydrogeologic setting. Each of these elements is critical to success.

Using the same procedure agreed to by DuPont and the state (designating an early set of data as baseline and comparing subsequent data to it, to see if concentrations of contaminants are increasing), statistical analysis of the J.T. Baker sites convinces me that the primary liners of two of the landfills are leaking. J.T. Baker officials continue to believe that the fluids, which are now accumulating at the rate of about 1 gallon (4 liters) per day, represent only rainwater trapped during construction.

Toms River Chemical Corp.

Toms River Chemical (TRC), a subsidiary of Ciba-Geigy, sought permission in 1976 to create a secure chemical landfill in Dover, N.J. As constructed, the lower liner is 0.02 inch (0.5 mm) PVC and the upper liner is 0.03 inch (0.76 mm) PVC with a leak detector between them.

The permit to operate the site requires the firm to add a lithium salt to the wastes as a tracer. If lithium appears in the leak detector area, it is a signal that leakage through the upper liner is occurring. The new landfill began operation in January, 1979. And in April DEP officials visiting the site discovered four feet of liquids standing in the leak detector area. Subsequently, company officials determined that the leak rate averages anywhere from 60 gallons (227 liters) to 131 gallons (495 liters) per day. Lithium has consistently been detected at low levels in the leak detector fluids.

I have described my study of these four landfills in greater detail elsewhere.(11) I must stress here that I have no evidence that any of these landfills is contaminating groundwater or significantly impacting the environment. There are groundwater monitoring wells around each of the sites but I have not yet analyzed the monitoring data.

New Jersey's experience with secure landfills should be of use to people in

What constitutes failure of a hazardous-waste landfill?

From New Jersey's experience I can see other potential problems in the federal program. First, EPA's interim regulations (20, p. 33194) call for groundwater monitoring for four parameters to signal landfill leakage (similar to my study of New Jersey's four landfills). However, EPA's regulations omit a key element: they do not say what will constitute the baseline period, to which "new" observations will be compared. This is an important omission that will cause uncertainty and dispute. As I demonstrated in my study, selection of different baseline periods can change the results of the analysis (11).

Second, it is not clear from the regulations how many monitored parameters must increase before a landfill is declared leaking. If one out of four increases, is leakage occurring? Two out of four? In New Jersey, even with many parameters increasing, owners and operators of landfills cannot believe that their landfill liners have failed.

A related problem is construction of landfills on contaminated sites. At two of the four New Jersey sites I studied, contaminated soil was used in construction of the landfill. This makes it very difficult to discern residual contamination from new landfill leakage. There are many reasons to want to build on contaminated sites but this can only increase the difficulty of monitoring new activities.

A way out of these problems would be to require that a *tracer* be added to the wastes. Many tracers have been proposed; unfortunately, all but one have the advantage that they may be degraded or chemically bound up by wastes, particularly as the waste stream changes unpredictably.

Tritium (radioactive hydrogen), however, does not suffer from these disadvantages. If thoroughly mixed with the wastes, it will travel with the leachate. It is easily detected. It has a half-life of 12.3 years so it will disappear in roughly 120 years. For any landfill that doesn't accept tritium-contaminated wastes, and which is built over an aquifer free of tritium contamination, tritium would seem to be a perfect tracer, easy to distinguish from residual non-radioactive contamination.

Lastly, many states (including New Jersey) require construction of landfills out of "impermeable" materials with impermeable defined as a leak rate of 10^{-7} cm/sec. It became clear in New Jersey, when the state tried to enforce this standard at the Toms River Chemical site, that there is no way to reach agreement on the permeability of a leaking membrane liner. The EPA acknowledges that a 10^{-7} cm/sec permeability standard is not appropriate for membrane liners (21, pp. 2837 and 2838). Yet many states have not recognized the problem. Leakage through a membrane liner will occur through a pinhole or through a tear—a concentrated stream of contamination, which is quite different in effect from a slow permeation through the entire bottom and sides of a clay-lined landfill. Permissible leakage through membrane liners should be specified in gallons (or liters) per unit time.

This matter of defining failure goes to the heart of a regulatory philosophy. Although Congress passed the Resource Conservation and Recovery Act (RCRA) six years ago and although roughly 80% of the nation's hazardous wastes go into landfills(8), the EPA has not yet promulgated final criteria for landfills.

On two occasions the Agency has announced elaborate landfill regulations, only to withdraw them later. The first set of regulations(23) established fairly rigid facility design requirements. The Agency said at the time they were using this approach because "the state-of-the-art for predicting discharges or releases from landfills is poor and [the Agency] thus believes that the only option available to ensure protection or human health and the environment is to prescribe design and operating standards which will provide maximum containment in landfills . . . .[T]he Agency is not aware of any method for designing landfills to allow specific constituent release rates, nor is the Agency aware of any method to determine what release rates would be acceptable."(23, p. 58989)

The Agency prescribed facility design requirements such as, the bottom and sides of a landfill had to have a synthetic membrane liner overlain by 6" (30 cm) of sand or soil, overlain by 3 feet (1 meter) of soil with a permeability of 10^{-7} cm/sec, overlain by a leachate collection system, and so on. Subsequently the Agency decided this approach was "not completely adequate to assure ground-water protection"(19, p. 66817) and a new approach was announced.

The new approach(19,24) calls for *risk assessment* of any facility. The Agency now acknowledges that all landfills will eventually leak. The question becomes: how much risk is thereby created? The Agency says, " . . . many organic constituents are stable (degrade very slowly); other hazardous constituents (e.g., toxic metals) never degrade. Yet the existing technology for disposing of hazardous wastes on or in the land cannot confidently isolate these wastes from the environment forever." Such wastes "will remain potentially dangerous for many thousands of years". And "[s]ince disposing of hazardous wastes in or on the land inevitable [sic] results in the release of hazardous constituents to the environment at some time, any land disposal facility creates some risk."(24, p. 28315)

Using the new approach, the permitting authority (whether the federal EPA or a state agency that has assumed RCRA duties) would somehow decide how much risk is acceptable from what rates of release of what kinds of hazardous wastes.

As I see it, the major problem with this approach would be our inability to define failure. We do not have quantitative measures of adverse health or environment effects for the vast majority of hazardous wastes. Under this regulatory approach, we would not know when a facility had "failed" until measurable health or environmental damage had occurred and by then it would probably be too late to do anything about it. In any case, the EPA has withdrawn the proposal.

The EPA is under court order to promulgate yet another plan for regulating landfills. It will be among the most difficult regulatory tasks ever undertaken.

other states and to the federal effort to regulate landfills. The main conclusions from that experience:

• (1) Synthetic liners are prone to problems (5,7,14,22 p. 11128, 23 p. 58989, 25); but clay also has problems (1,6,8,12,17).

• (2) Leachate collection systems only work so long as someone is keeping the pumps going and preventing the pipes from clogging (18,24, p. 28324, 22 p. 11128).

• (3) Covers are vulnerable to attack (10,15,16) from at least six sources:

• (a) *Erosion* by natural weathering (rain, hail, snow, freeze-thaw cycles, and wind).

• (b) *Vegetation*, such as shrubs and trees that continually complete with grasses for available space, sending down roots that will relentlessly seek to penetrate the cover;

• (c) *Burrowing or soil-dwelling mammals*, reptiles, and insects, which will present constant threats to the integrity of the cover;

• (d) *Sunlight* (if any of these other natural agents should succeed in uncovering a portion of the umbrella) will dry out clay (permitting cracks to develop), or destroy membrane liners through the action of ultraviolet radiation;

• (e) *Subsidence*—an uneven slumping of the cap caused by settling of wastes or organic decay of wastes, or by loss of liquids from landfill drums—can result in cracks in clay or tears in membrane liners, or result in ponding on the surface, which can make a clay cap mushy or can subject the cap to freeze-thaw pressures;

• (f) *Human activities* of many kinds.

Contingency plans needed

EPA calls for a contingency plan for all failures, including "non-sudden" occurrences (20, p. 33237). The plan must be kept up to date and must spell out who is to do what in the event of any problems. Two key elements, however, have been omitted from these federal regulations:

• (1) There is no requirement that waste generators must have laternative sites to which they can take their wastes. In New Jersey, the regulatory agency has acknowledged pressures in the past not to close sites that are contaminating the environment because the sites are needed—generators say they have no other place to take their wastes. This compromises the regulatory agency, damaging its credibility.

• (2) Federal regulations require a closure fund and a post-closure maintenance fund—money set aside during the operating life of the facility to assure that the owner/operator can afford proper closure and post-closure maintenance for 30 years. What happens to this fund if a facility fails and has to be closed early? The fund will not build up and will not be available for closure or post-closure maintenance. EPA acknowledges that this is a problem (21 p. 2824) but offers no solution. Clearly this will be an inducement for a regulatory agency to allow inadequate facilities to continue operating so that they can build up the closure and post-closure funds. To solve this problem, the closure and post-closure funds could be required *in toto* before the facility begins operation. ▽



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Article

Socio-Environmental and Hematological Profile of Landfill Residents (São Jorge Landfill–Sao Paulo, Brazil)

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Abstract: We are experiencing an unprecedented urbanization process that, alongside physical, social and economic developments, has been having a significant impact on a population's health. Due to the increase in pollution, violence and poverty, our modern cities no longer ensure a good quality of life so they become unhealthy environments. This study aims to assess the effect of social, environmental and economic factors on the hematologic profile of residents of Santo André's landfill. In particular, we will assess the effect of social, economic, and environmental factors on current and potential disease markers obtained from hematological tests. The research method is the observational type, from a retrospective cohort, and by convenience sampling in Santo André in the Greater ABC (municipalities of Santo André, São Bernardo do Campo and São Caetano do Sul, southeast part of the Greater São Paulo Metropolitan Area, Brazil). The study determined a socio-environmental profile and the hematologic diseases screening related to a close location to the landfill. The disease manifests itself within a broad spectrum of symptoms that causes changes in blood count parameters. The objective of this work is to show that there is an association between social, environmental and economic factors and a variety of serious disease outcomes that may be detected from blood screening. A causal study of the effect of living near the landfill on these disease outcomes would be a very expensive and time-consuming study. This work we believe is sufficient for public health officials to consider policy and attempt remediation of the effects of living near a landfill.

Keywords: landfill; waste; socio-environmental impact; hematologic diseases

1. Introduction

Nowadays, due to higher levels of pollution, violence and poverty, cities can no longer ensure a good quality of life for everyone and have become unhealthy environments for a great many local inhabitants [1]. An unprecedented urbanization, along with physical, social and economic developments, is having a significant impact on the health of the population [1,2].

Besides the continuous demographic growth, these factors have an implicit effect on the amount of resources that have to be consumed in order to sustain all citizens of the Earth. This increases waste production, which invariably affects society dynamics in general.

Landfill disposal remains the main destination in waste management, and it is expected to remain so for the next decades [3–5]. It is estimated that at the worldwide scale, over five million people die every year due to waste-related diseases [2]. The adverse effects of municipal solid waste on the environment, not to mention on public and individual health, are widely recognized by several authors [6], who point out a deficiency in the implemented systems and especially the lack of a strong policy emphasizing health safeguards [7].

A few authors state that societies all over the world are focused on consumption, and, therefore, there are significant losses of organic and inorganic materials: waste type [8,9], which would imply an uncertain future for Public Health. The improvement suggestion would be educating the population for a sustainable consumption and a strategic waste management system [9], such as: recycling and treating degraded soils; and to which extent these landfill sites would be usable.

The large amount of waste was not a concern for an extensive period due to the distance between disposal sites and urban areas. Meanwhile, with the population growth, it has been difficult to reduce the distance between them [10]. Another emerging problem linked to population growth is the unsystematic construction of homes in hazardous locations and quite vulnerable environmental areas, which usually lack urban infrastructure (sanitation, electricity), among other things [11,12].

It has been scientifically shown that residences on or near a landfill have impacts on the residents' health and on the environment: air quality, water quality, and soil pollution. The effects of landfills are major public health issues. Consequently, waste, waste treatment and disposal are major sanitary and environmental concerns to cities [3,13,14].

The environmental degradation scenario is unquestionable, and there is a lack of policies to prevent and ameliorate the crisis. The complexity of analyzing all impacts demands studies on the various effects of waste produced daily by the population [15,16]. The first step is to identify any adverse health outcomes using blood tests, which can be an important tool for the evaluation of various situations, such as diagnosis and progression of hematologic diseases, detection of infections and therapeutic monitoring [17].

Therefore, a hemogram can guide the initial suspicions supported by clinical files. The importance of the hematologic analysis is assumed to be an important diagnosis tool, providing useful information for a better handling of these cases.

It is necessary to adopt a set of measures that include politics' globalization, government social efficiency and social participation growth. It is the government's duty to ensure that change is not only possible but always sustained in clear objectives as well in results well defined and with special properly defined interventions [18–20].

Santo André has an area of 174.38 square kilometers and is located in the Greater ABC (municipalities of Santo André, São Bernardo do Campo and São Caetano do Sul, southeast part of the Greater São Paulo Metropolitan Area, Brazil), 18 km from the capital city of São Paulo. The city is strategic for the logistics sector, as it lies in the main economic center of the country. Santo André has 678,486 inhabitants and is the tenth largest city in the state of São Paulo. The landfill of São Jorge (217,000 m^2) is located in Santo André, and is surrounded by the slum São Jorge—about 1400 families. Every month, the landfill receives about 13 thousand tons of household waste and 250 tons of sterilized medical waste [11].

Around the landfill of São Jorge, there are signs that the environment has suffered both physical and social impacts [21,22]. The landfill began to operate in the 1980s and is located in the São Jorge District. Santo André's landfill is a facility that provides treatment and disposal of solid waste produced in the municipality. Therefore, it evolved from a non-official dumping location to a controlled one with good environmental practices. Nowadays, it is an area destined to receive solid waste produced in Santo André and is the most suitable and sustainable destination for the waste.

This study aims to measure the socio-environmental and hematologic profile of residents of Santo André's landfill—the "*Espírito Santo* suburbs"—by using the social and demographic data of the studied area and association between socio-environmental factors and the alterations in hematological parameters as precursors to diseases. This fieldwork will allow better urban planning and Public Health policies for residential areas on and near landfills, as well as a greater degree of social and environmental responsibility for all sectors of society.

2. Method

The research method is observational with a retrospective cohort study where the samples are obtained by convenience in Santo André in the Greater ABC region. The study consists of the elaboration of a demographic and environmental profile and assesses the prevalence of potential diseases identified by hematological screening that may be the result of housing conditions and/or exposure to environmental contaminants from the landfill. The study must be understood as a primary tracking diagnosis, and it will be the kick-off for a transversal study of *Espírito Santo* inhabitants that will be performed in the near future.

The exposed group lives in the vicinity of the landfill. There is a very little knowledge about the reality of this population due to the fact that national entities do not have permission to enter the area to study and help this community. Furthermore, this study got a special permit to develop a campaign for being the spin-off of a more transversal study. The community inhabits a place that was a dumping ground and it is actually contiguous to the landfill; therefore, the study's aim was to establish connections among the location and the community's health.

The study was conducted in two phases. The first phase consisted of a survey and research profile of the residents as the following variables: age, gender, type of house, water treatment, water supply and type of sewage, based on interviews and completing a questionnaire. The second phase consisted of the collection of blood samples into two distinct groups: a group of people living in the community (experimental group) and a group of random people attending a health facility located in the central city (control group).

According to the data obtained, a descriptive and comparative analysis of the differences in hematologic patterns between both groups was made.

The blood samples were collected through peripheral venopunction using the vacuum method. After recovery, the blood was added to the tube with EDTA. The samples were homogenized for 10 min and evaluated through flux cytometry with ABX Pentra 120 equipment (Horiba Medical, Montpellier, France). The serial evaluations were performed in blades using the Leishman method in order to obtain the procedures approached. The analysis was carried out according to good biomedical practices.

Quantitative and qualitative alterations in blood count (viral, bacterial and parasitic) were measured by reading lamina by Fernando Luiz Affonso Fonseca (hematologist)—a blood sample.

A total of 100 blood samples were harvested, but only 62 of them were considered biologically viable. The viability of the blood sample complied with good practices in clinical analyses. Thus, samples hemolyzed with jaundice or still lipemic were not included in the hematological analysis.

Therefore, in a group of inhabitants of the central region, 30 individuals were included (unexposed group). From the group of inhabitants of the vulnerable region (exposed group), 84 were included. However, from these, only 32 consented to having their blood harvested.

The information gathering tool used in this study was a questionnaire taken from the database developed by SEMASA, the Bureau of Environmental Issues of Santo André, São Paulo, Brazil, the institute responsible for the approval of construction, basic sanitation and water supply, as well as for assessing the regularity of housing developments. The applicants were the work's researchers, supervised by the head researcher of the University.

From a total of 100 questionnaires filled out, 84 were considered adequate (valid questionnaires). Thus, 16 were discarded, due to inadequacies in the information provided or a lack of consent from the individuals.

A descriptive analysis of all variables presented was performed in terms of their relative and absolute terms. In order to evaluate the association between the qualitative variables, a chi-square test was used, and/or the exact Fisher test. The level of significance was 5%. The data were processed and treated in the statistics software SPSS 21.0 (Released 2012, IBM SPSS Statistics for Windows, Version 21.0, IBM Corp., Armonk, NY, USA).

At last, an exact Fisher test was applied, in order to evaluate whether there is a connection between the hematological results and the type of exposure, as well as the quantity of hematological changes. The exact Fisher test is used to calculate the association of the analyzed features when the total amount of data is small and when the expected values in one or more of the cells of the 2×2 table is less than or equal to five. Thus, in small samples, this test should be used, since it produces fewer distortions than the chi-square test.

The sample was only gathered after the theme enlightening and authorization of the individuals. Anonymity as well as the confidentiality of the data obtained were guaranteed.

All subjects granted their informed consent for inclusion before participating in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Secretária Municipal de Saúde, Santo André (1.587.630).

3. Results

3.1. First Phase

Questionnaires were distributed with the purpose of establishing a social, demographic and biographic profile of the location. Table 1 shows the most significant variables of the community.

Table 1. Socio-biodemographic characteristics of the inhabitants.

Variables	Community Sample	
	n	**%**
Gender		
Female	55	65.5
Male	29	34.5
Age group		
(6–12)	7	8.3
(13–18)	6	7.1
(19–30)	30	35.7
(31–50)	31	36.9
(51–60)	8	9.5
(+60)	2	2.4
House type		
Bricks	53	63.1
Wood	20	23.8
Mix	5	6.0
Another	6	7.1
Income *		
Less than 2	67	79.8
Between 3–5	16	19.0
Between 5–10	1	1.2
Plus 10	0	0.0
Sanitation		
Yes	54	64.3
No	30	35.7
Total	84	100

* Minimum Wage (M.W.) = 724 Reais.

The several variables that were incorporated in the study and tabulated the appropriate statistical program mentioned above are the best ways of reflecting the social and demographic landscape of the target population. It is important to note that the variable "Sanitation" in Table 1 corresponds to the presence of the official public water, sewage and electricity networks.

As can be seen by observing Table 1, there is a predominance of females and the age groups from 19 to 30 and from 31 to 50 are the most prevalent in respondents. It was also verified that the income was below two Brazilian minimum wages (M.W.), which indicates that we face a special group in terms of economic capacity. It is also noted that there is a prevalence of masonry houses (63.1%) and houses with in-door plumbing/sanitation (64.3%).

3.2. Second Phase

In order to obtain plausible conclusions to the case study, it was necessary to compare the effects of the convenience sampling of another group of people that were not exposed to the several harmful environmental factors (Non-Exposed Group) to those who were exposed (Exposed Group).

Of the 84 individuals described in Table 1, 32 were randomly chosen and were designated as the "Exposed Group". The Non-Exposed Group was interviewed at the same time as they did the blood sample. In total, 30 people were interviewed, which corresponds to the amount of blood samples.

As described earlier, in order for the importance of the two groups to share the same characteristics, it appears that the percentages are similar, where the female gender was the most prevalent, with 75% in the "Exposed Group" and 66.7% in "Non-Exposed Group".

Regarding the age, the range between 31–50 years was the most commonly reported, with 11 people (36.7%) in the "Non-Exposed Group" and 19–30 in the "Exposed Group", with 13 persons (40.6%).

It appears that the housing and financial realities are significantly different in each group, where 84.4% of the "Exposed Group" presents an income of less than two minimum wages, while 56.7% of the "Non-Exposed Group" have similar income.

Regarding the "Non-Exposed Group", a greater purchasing power is observable, and, therefore, all of the respondents live in masonry houses and nearly all have sanitation. Table 2 describes the exposure type according to socio-biographic characteristics.

According to the analyzed variables, we observe that both groups have a significant association with the variables' sewage ($p = 0.004$) house type ($p < 0.0001$) and income ($p = 0.025$) with the exception of the variables gender and age group ($p > 0.05$).

It is noted that of the totality of the individuals with sewage (82.3%), 94.4% of them live in the vicinity of the landfill.

According to house type, the totality of the non-exposed live in brick houses, and, from the total of individuals that live in this type ($n = 50$), the majority (62.5%) is exposed to the landfill.

The total of individuals that own an income lower than 2 M.W. is 44 (71%), as 27 of them (84.4%) are exposed to the landfill and (56.7%) correspond to the non-exposed.

In order to verify the association among hematologic changes towards socio-biodemographic characteristics, the next table was prepared (Table 3).

During the analysis of the hematologic changes, no significant association to any variables was observed.

Regarding the age group variable, among the age groups of 6–12 and 51–60, there is a great disparity among changes found. Overall, most (51.6%) do not show hematologic changes.

Regarding the sewage variable, there is a balance in terms of percentages, and we infer that (51.6%) do not have any hematologic changes. As regards the income variable, 44 individuals (71%) have an income lower than two minimum wages.

In order to investigate the existence of an association between exposure type and hematologic changes in individuals, a statistical analysis was carried out. The results of hemogram differences were summarized in Table 4.

Table 2. Association of the socio-biodemographic characteristics with the exposition type.

Socio-Biographic Characteristics		Exposition Type						*p*-Value
		Non-Exposed		Exposed		Total		
		n	%	*n*	%	*n*	%	
Gender	Female	20	66.7	24	75	44	71	0.471
	Male	10	33.3	8	25	18	29	
	Total	30	100	32	100	62	100	
Age Group	(6–12)	2	6.7	6	18.8	8	12.9	0.309
	(13–18)	1	3.3	3	9.4	4	6.5	
	(19–30)	9	30	13	40.6	22	35.5	
	(31–50)	11	36.7	6	18.8	17	27.4	
	(51–60)	5	16.7	3	9.4	8	12.9	
	≥60	2	6.7	1	3.1	3	4.8	
	Total	30	100	32	100	62	100	
Sanitation	Yes	29	96.7	22	84.4	51	82.3	0.004 *
	No	1	3.3	10	15.6	11	17.7	
	Total	30	100	32	100	62	100	
Type of House	Brick	30	100	20	62.5	50	80.6	<0.001 *
	Wood	0	0	12	37.5	12	19.4	
	Total	30	100	32	100	62	100	
Income	Less 2 M.W.	17	56.7	27	84.4	44	71	0.025 *
	Among 3–5 M.W.	9	30	5	15.6	14	22.6	
	Among 5–10 M.W.	4	13.3	0	0	4	6.5	
	Total	30	100	32	100	62	100	

* Statistical significance (chi-square test; exact Fisher).

Table 3. Hematologic changes discovered in individuals' hemograms.

Variable	Description	Hematologic Changes						*p*-Value
		Yes		No		Total		
		n	%	*n*	%	*N*	%	
Gender	Female	20	45.5	24	54.5	44	29.0	0.470
	Male	10	55.6	8	44.4	18	71.0	
	Total	30	45.5	32	54.5	62	100	
Age Group	(6–12)	5	62.5	3	37.5	8	12.9	no assumptions
	(13–18)	2	50.0	2	50.0	4	6.5	
	(19–30)	11	50.0	11	50.0	22	35.5	
	(31–50)	9	52.9	8	47.1	17	27.4	
	(51–60)	2	25.0	6	75.0	8	12.9	
	≥60	1	33.3	2	66.7	3	4.8	
	Total	30	48.4	32	51.6	62	100	
Sanitation	Yes	25	49.0	26	51.0	51	82.3	no assumptions
	No	5	45.5	6	54.5	11	17.7	
	Total	30	48.4	32	51.6	62	100	
House Type	Masonry	25	50.0	25	50.0	50	80.6	0.604
	Timber	5	41.7	7	58.3	12	19.4	
	Total	30	48.4	32	51.6	62	100	
Income	Less 2 M.W.	17	56.7	27	84.4	44	71	no assumptions
	Between 3–5 M.W.	9	30	5	15.6	14	22.6	
	Between 5–10 M.W.	4	13.3	0	0	4	6.5	
	Total	30	100	32	100	62	100	

Table 4. Association among exposure type with hematologic change.

Groups			Hematologic Change		
			Change	**No Change**	**Total**
Exposure Type	Non-Exposed	*n*	10	20	30
		% Line	33.3%	66.7%	100.0%
		% Column	33.3%	62.5%	48.4%
		% Total	16.1%	32.3%	48.4%
	Exposed	Count	20	12	32
		% Line	62.5%	37.5%	100.0%
		% Column	66.7%	37.5%	51.6%
		% of Total	32.3%	19.4%	51.6%

$p = 0.022$.

In Table 4, we can observe an association among the variables of Exposure Type and Hematologic Change as being significant from a statistical perspective ($p < 0.05$). We verified a pattern of association between exposure and the presence/absence of hematologic changes ($p = 0.022$).

From the sum of people exposed to landfills (32 cases), the majority had hematological disorders (62.5%). It was found that, from 30 cases where the presence of hematological abnormalities was found, most are exposed to the landfill (66.7%).

As noted in Table 4, there was a 50% increase in changes in the screening performed in the "Exposed Group" compared to the "Non-Exposed Group", which indicates that the population is not in its best health.

The chance of occurrence of hematological disorders is 3.33 times higher in subjects exposed to the landfill compared to those who presented hematological changes in the "Non-Exposed Group". It is recognized, by the observation data, that 10 individuals from the "Non-Exposed Group" showed alterations in parameters, whereas the incidence in the "Exposed Group" was significantly higher, with 20 individuals undergoing changes.

Diseases such as leukocytosis, anemia, lymphocytosis and neutropenia were the major findings, and changes are evident in the "Exposed Group" compared to the "Non-Exposed Group".

4. Discussion

Analyzing the changes in vital functions of living beings, it is possible to know the effects of exposure to pollutants before their occurrence and the existence of any other significant damages [18,23–26].

It is considered that proving the cause–effect connection with environmental exposures that may trigger chronic manifestations in humans requires specific studies that prove to be costly and time-consuming [27–30]. It is necessary for the data to be collected in the field so as to be compared with experimental observations, in order to demonstrate the process and how the interactions occur regarding study dynamics [16].

The effects of human exposure to environmental pollutants are manifested typically in the long term and are masked by other causes. Adding to this, the fact that the probability of harmful elements' synergy and exponentiation of the risk is generally unknown, and it is thus extremely difficult to corroborate it with science based on laboratory tests, without incorporating other relevant factors, such as corporate interests, and industrial or professional regulators who hinder the analysis and detection of any effects on human health [20,24,26,30].

Given these considerations, as well as relying on the limitations of the health system itself in identifying peculiarities in the epidemiological profile of the population, a methodology was defined that aims to fully understand the exposure process. There are five parameters that are difficult to materialize including individual characteristics, duration of exposure, frequency of exposure, average time and "contact rate", always bearing in mind that the characteristics of the individual vary by age, gender, occupation, and body weight [31].

The focus of the study is the exposure of individuals to organisms, as well as to social, economic and environmental processes in anticipation of models that historically focus on the monitoring and maintenance of health [21,22]. Several papers have been published that address the role that the landfill can play in people's health [30–32]. There is no doubt that a landfill should be viewed from a holistic point of view, in that it must manage the direct and indirect effects that it may have [3,18,32].

Despite the existence of federal government programs for vulnerable populations, there do not seem to have been any improvements in the living conditions of this community [13,14]. The hemogram exam (counting blood cells—CBC) is used as a tool to promote the indicative tracking and respective improvements to minimize ongoing risks in analyses of a certain population. Given its great potential as a monitoring method, CBC integrates a set of parameters that describe the number and characteristics of some elements in the blood. The CBC consists of three basic features, namely erythrocyte evaluation (or red series), leukocytes evaluation (white or series), review of erythrocytes and platelets (platelet or series) [33].

Lymphocytosis is characterized by an increase in the number of lymphocytes (sub-group of white blood cells). The disease neutropenia indicates a low number of neutrophils that are a subset of leukocytes originating in the bone marrow, thus revealing an immune susceptibility. The increase of leukocytes is a sign of a viral infection, i.e., people near the landfill tend not to have viral and bacterial infections [33]. The disease leukocytosis reveals an increased number of leukocytes that reveals the existence of an infection, since they are the elements that are linked to immune system defenses against foreign bodies. The greater the leukocytosis is, the more contaminated the landfill will probably be, which can be interpreted as a parameter that reveals and establishes causal links. The disease of anemia is more complex, so the causes are more comprehensive and diversified. This immediately implies a more detailed investigation into these cases [33–35].

The lymphocytosis, neutropenia and leukocytosis diseases can be understood as correlated, although they have opposite directions of growth, as previously conveyed [35].

The results express the presence of discrepancies in the health of the São Jorge population, compared with the other subjects in the study, which requires the completion of further studies to detect the most common causes and the consequences for the residents in order to enable the development of a continuous and systematic supervision program for the residents. The suggestion is to carry out a more in-depth study in order to make improvements in this type of group exposed to potential health hazards, such as those identified in this study, in comparison with the Non-Exposed Group.

The problems derived from municipal solid waste are still present and without a proper solution [36]. There is no alternative but a behavioral change in relation to waste, given the reduction in its production, and in order to gradually implement technologies that are within our technical capabilities and to leverage resources to gradually develop a greater level of control over the environmental and health effects caused by waste [37].

The prevention measures and control of public health consequences of urban solid waste lack information and epidemiological data in which causal relationships can be established. There is a colossal deficiency in studies on the recovery of areas degraded by disposal of urban solid waste. In this context, this article seeks to contribute to a consolidation of the state-of-the-art related to the theme, in order to raise awareness of the elements that improve the quality of urban areas and hence the quality of life of their citizens [31,36].

Supporting research of this kind is a priority. The development of greater technical training, in view of the environmental and health issues, as well as the involvement of professionals in integrated waste management systems, in the medium and long term, may introduce these variables in projects and plans [15,37,38].

Data from this study should be compared to other data, which may involve a characterization of the epigenetic profile of the population [39] and even a characterization of the study areas for the presence of particulate material [40]. The challenge is to continue collecting more valid and reliable data in order to achieve an extrapolation between environmental and respective consequences for the

health of population's risk factors to make a comparison on a national and global scale [18]. The study described is the first step in a study involving the whole *Espírito Santo* community.

The data obtained in this tracking study indicate that strategies for prevention and health promotion should include joint actions established between citizens and the management of services and should always be aimed at improving living conditions, particularly urban planning, implementation educational programs, as well as raising awareness about behavioral changes, once isolated actions are considered ineffective in reducing any problems [38,41].

It can be inferred that this study has a purpose of consolidating knowledge, which contributes to the prevention and detection of either known or unknown adverse health effects [40,41] to the public that are related to environmental exposure. The study should be understood as a primary screening indicating some pathologies, which, in addition to enabling us to assess the state of health of the inhabitant, may be indicative of the level of pollution of landfill, insofar as the conditions are reflected on the inhabitants of the landfill.

We must identify priorities at the community level, which is why the understanding of environmental health problems is essential. Sustainable planning may be a possible tool to implement a research-oriented future intervention, and thus to address the issues of greatest importance. However, this process is not simple in communities featuring persistent health disparities and a historical lack of confidence in health professionals [40,41].

The main alterations found in the completed study were anemia, leukocytosis, lymphocytosis and neutropenia. These data show that this is a group with greater immune susceptibility, adding that some elements of the exposed group already have infections, which are consistent with exposure to contaminants, supporting the existence of a pattern. Aiming at the promotion of health, it is suggested that the project should continue to be monitored in order to gather a greater quantity of evidence in support of the result of the tracking work carried out and described [42,43].

Based on the study, the exposed group is 3.33 times more likely to develop hematological abnormalities, taking as reference its exposure to the landfill, as opposed to the group that was not exposed. There is much [8,44] research on urban landfills, but none involving the social and hematological profile have been found in the literature.

Although the results only show the events occurred at the São Jorge landfill, in the Greater ABC region. They also provide important information on the expansion of knowledge concerning the assessment of this risk in residential areas around the planet. The demand for a thorough investigation is urgent in order to spread information related to the potential effects of human exposure to contaminants from multiple sources that affect public health.

A recent bibliographical survey study about the difficulty of assessing the impacts on the health of populations exposed to waste [45] shows that the biggest difficulty is the access to immediate and recent results of studies about biomonitoring of the effects of waste exposure on human health [45]. It is noted that this occurs due to several factors: identifying the profile of the exposed population, characterization and diversity of the analyzed area, socio-economic factors (education, unemployment, home ownership, family structure and access to health services), as well as government interests.

The analysis provides evaluation of quantitative data on the environment. However, the complexity and specificity related to historical and cultural features of this population caused some limitations in this study, such as: it was a convenience sampling, the way people moved to the landfill area, and, mainly, whether these blood changes in people living near the waste were due to their displacement alone. Besides those, there are limited potential confounders, such as population diet, family history and other risk factors that were not controlled in the analyses.

Future investigations may include concepts like nanoparticles and epigenetics, in order to promote a holistic view of the causes, mechanisms and consequences caused by the exposure of humans to a multitude of organisms, thereby complementing the present study and scientific knowledge, eliminating existing cross-limitations.

5. Conclusions

The full blood element count analysis was performed and it found that the blood counts of residents living near the landfill had positive results for hematological changes, and diseases such as leukopenia, anemia, neutropenia and lymphocytosis were the most frequently encountered changes. However, proving the cause-effect relation with environmental exposure factors that may trigger chronic manifestations in humans requires specific studies, which often are very costly and time-consuming.

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Conflicts of Interest: The authors declare no conflict of interest.

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Original article

Environmental Exposures and Cancer

Morbidity and mortality of people who live close to municipal waste landfills: a multisite cohort study

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Abstract

Background: The evidence on the health effects related to residing close to landfills is controversial. Nine landfills for municipal waste have been operating in the Lazio region (Central Italy) for several decades. We evaluated the potential health effects associated with contamination from landfills using the estimated concentration of hydrogen sulphide (H_2S) as exposure.

Methods: A cohort of residents within 5 km of landfills was enrolled (subjects resident on 1 January 1996 and those who subsequently moved into the areas until 2008) and followed for mortality and hospitalizations until 31 December 2012. Assessment of exposure to the landfill (H_2S as a tracer) was performed for each subject at enrolment, using a Lagrangian dispersion model. Information on several confounders was available (gender, age, socioeconomic position, outdoor PM_{10} concentration, and distance from busy roads and industries). Cox regression analysis was performed [Hazard Ratios (HRs), 95% confidence intervals (CIs)].

Results: The cohort included 242 409 individuals. H_2S exposure was associated with mortality from lung cancer and respiratory diseases (e.g. HR for increment of 1 ng/m^3 H_2S: 1.10, 95% CI 1.02–1.19; HR 1.09, 95% CI 1.00–1.19, respectively). There were also associations between H_2S and hospitalization for respiratory diseases (HR = 1.02, 95% CI 1.00–1.03), especially acute respiratory infections among children (0–14 years) (HR = 1.06, 95% CI 1.02–1.11).

Conclusions: Exposure to H_2S, a tracer of airborne contamination from landfills, was associated with lung cancer mortality as well as with mortality and morbidity for respiratory diseases. The link with respiratory disease is plausible and coherent with previous studies, whereas the association with lung cancer deserves confirmation.

Key words: waste, landfills, residential cohort study

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To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 1 of 12
Date:	Thursday, May 8, 2025 2:33:10 PM
Attachments:	writerguy-cube2.png

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Benton County Planning Commissioners
c/o Planning Division 4500 SW Research Way, Corvallis, OR 97333
May 8, 2025
#dumppress

RE: Please Deny LU-24-027, the Conditional Use Permit Application Regarding Landfill Expansion

Dear Chair Fowler and Members of the Benton County Planning Commission:

I'm realizing that Planning Commission members haven't necessarily seen the various press articles and print opinions about Coffin Butte Landfill, and so I've gathered together some of the main ones from the last four years and am attaching them here and to succeeding emails as necessary. These articles of course cover many of the same issues that have come up in public testimony, namely, PFAS, leachate, methane, EPA and DEQ investigations and actions, labor issues, Republic cover-ups of problems and information, misleading and dubious information about the economics of the landfill, and so on.

The PDFs each begin with a number, so that you can read them in chronological sequence; 1 = oldest.

Thank you for your attention,

Ken Eklund

Ken Eklund, writerguy

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and other storymaking games

Landfills
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Center for Health, Environment & Justice

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Mentoring a Movement

Empowering People

Preventing Harm

About the Center for Health, Environment & Justice

CHEJ mentors the movement to build healthier communities by empowering people to prevent the harm caused by chemical and toxic threats. We accomplish our work by connecting local community groups to national initiatives and corporate campaigns. CHEJ works with communities to empower groups by providing the tools, strategic vision, and encouragement they need to advocate for human health and the prevention of harm.

Following her successful effort to prevent further harm for families living in contaminated Love Canal, Lois Gibbs founded CHEJ in 1981 to continue the journey. To date, CHEJ has assisted over 15,000 groups nationwide. Details on CHEJ's efforts to help families and communities prevent harm can be found on www.chej.org.

Table of Contents

Chapter		Page
1	Introduction	1
2	Different Types of Landfills	3
3	How Landfills Work	8
4	Problems with Landfills	11
5	The Flow of Waste	25
6	Communities Fighting Back	28
7	Taking Action	33
8	Regulations and the Permitting Process	38
9	Troublesome Alternatives	42
10	Real Solutions: Zero Waste	45
11	Myths and Counter Arguments	50
	Appendix: Annotated Bibliography	53
	References	61

Chapter 1
Introduction

Today, every American will generate 4.4 pounds of trash. Of your junk mail, orange peels, paper towels, plastic wrappers, take-out containers, band-aids, newspapers and water bottles, almost 55% goes to a landfill. In 1960, only two-thirds of that amount – 2.68 pounds – went to the dump. Landfills contaminate the water and poison the air, yet the "need" for them continues to expand. Landfills have grown unabated for the past fifty years as capacity has soared to accommodate ever-increasing amounts of trash. In order to bring a halt to this garbage explosion, we must believe that zero waste is achievable – no landfills, no incinerators, just a holistic approach to the lifecycle of every item.

Zero waste is an idea that encompasses many environmental tenets (recycling, reusing, composting, reducing, conserving, etc) in order to fulfill its goal of eliminating the waste stream. But for this seemingly impossible concept, it's not the end result that matters as much as the reach for it. Stretching to achieve zero waste – doing all that we can to reduce garbage at its source – is the ultimate objective of the zero waste concept. We must strive for the impossible to reach the edge of possibility. By aiming for zero waste, we will achieve substantial garbage reduction and realize we don't have to settle for a lesser "solution" like burning trash. If in the end, when every imaginable step has been taken and all possibilities extinguished, some garbage remains, then landfilling may be used. But we need to see such unsavory action as an absolute last resort rather than an easy fix; otherwise, we'll never truly deal with our trash load, and landfills will remain the common response.

Stopping a proposed landfill or landfill expansion in your community is a critical first step toward redefining the management of our waste. We do not need more landfills. **All landfills will eventually fail, polluting the environment and placing people at risk.** If your community is willing to fight for your right to clean air and water, history has shown that you can succeed in opposing a proposed landfill. It will not be quick or easy, and it requires a great deal of planning

and organization, but we believe in your ability to win and protect your health, the health of your family, and your neighbors.

The best way to win is to organize your community. By organizing, we mean bringing people together for a common purpose and for mutual support to get the power needed to influence the outcome of a local issue. Power is obtained in two ways, either by engaging and organizing people or by spending money. Most community groups have little money and are often battling huge corporations, who can always outspend citizen groups. That's why we encourage activists to stress the "people power" side when organizing.

The first step, however, is deciding to get involved yourself. Maybe it's because of your children, or because of the way you were treated at a public meeting, or maybe you decided that you're just not going to take it anymore. The next step is to get more people involved. The best way to do this is with face-to-face contact and communication. Talk to your friends and family and have them talk with their friends and family. Go door-to-door in your neighborhood, host your own community meeting or speak at churches, clubs, schools, etc.

As you engage your neighbors, you'll want to work together to define what you, as a community, want to accomplish. This will lead to forming an organization that has its primary focus to address the issue that brought you and your neighbors together. Together you'll want to define your goals, both short term and long term. Be realistic in setting your goals. Pick goals that you can win. One or two are enough; don't choose more than three or four.

There are four basic steps to achieving your goals:

1. Organize a community group
2. Decide what you want
3. Find out who can give you what you want
4. Develop strategies that target the decision-makers so that they give you what you want

Once you've organized into a group, defined your goals, and identified who can give you what you want, you'll need to develop strategies that target the decision makers so that they have no choice but to do what you want. This does not come about easily. Government and political officials are influenced by many factors and forces and you will quickly realize that to be successful, you have to create more pressure on the politicians and government officials than anyone else.

For advice on how to form a successful community-based group, see CHEJ's Organizing Handbook available for free from CHEJ or from our website at http://chej.org/wp-content/uploads/Organizing%20Handbook%20-%20PUB%20059.pdf.

The purpose of this guidebook is to serve as a resource for people opposing a new landfill or landfill expansion. It provides an overview of landfill design, regulations, and the reasons that landfills are inherently flawed. We have included information to assist you in organizing your community to fight the landfill, and some alternatives to our current waste management system.

We hope that this guidebook makes your own struggle a little easier. As you fight for justice, remember that many people have won these struggles. Until we move away from a society where waste is 'out of sight, out of mind,' these fights will continue.

Chapter 2

Different Types of Landfills

A landfill is a depression in the ground for the disposal of unwanted materal considered "waste." Landfills that do not contain covers are called open dumps. If the trash is covered to keep rodents, people and wind from dispersing the material, then the site is called a sanitary or municipal landfill.

A site that still operates and accepts waste is considered an active landfill. Conversely, a landfill that is filled to capacity and no longer accepts waste is referred to as a closed landfill.

Even though only one type of landfill is denoted as "hazardous waste," in truth, all of the landfills listed in Table 1 can contain toxic chemicals that threaten the air, water, and the public's health. Municipal Solid Waste (MSW) landfills hold electronics which, especially when crushed, leak out their poisonous components of lead, mercury, and cadmium. Construction and Demolition (C&D) landfills emit hydrogen sulfide (a compound which smells like rotten eggs), and store paint, lacquers, and wood preservatives which contain harmful chemicals like arsenic (SLee 2006, USEPA 1995a, Turley 2006). Industrial landfills are home to heavy metals and organic compounds like pesticides and polychlorinated biphenyl (PCBs) which can pollute surface water (USEPA 2010b). Hazardous Waste landfills also pose health risks: in 2014 there were 3,779 hazardous waste facilities which needed to take "corrective action" – requiring action to clean up contamination (USEPA 2014). Across the board, landfills are harmful additions to a community.

Municipal Solid Waste (MSW) is what we generally call garbage. It consists of:

- Durable items (appliances, tires, batteries)
- Nondurable items (newspapers, books, magazines)
- Containers and packaging
- Food waste
- Yard trimmings
- Various organic waste from non-production sources (homes, businesses, institutions) (USEPA 2006)

Recycling, composting, zero waste – all are environmentally-friendly alternatives to landfills. See Chapter 10 for more information on these **realistic** solutions.

Table 1: Types of Landfills	
Municipal Solid Waste	Primarily accepts items categorized as MSW (see box on page 3). Additionally, these landfills accept a limited amount of *household hazardous waste*, such as batteries, paint, florescent light bulbs and drain cleaners. These landfills also take "special" waste such as municipal wastewater sludge, coal ash waste, and incinerator ash.
Industrial	Industrial landfills deal with hazardous and non-hazardous waste from commercial production sources. These can include the waste generated by factories, mills, agricultural operations, logging and mining.
Construction & Demolition	C&D landfills are exclusively for waste generated during the construction, renovation and demolition of buildings, roads and bridges. C&D landfills contain bulky items such as concrete, wood, asphalt, metals and bricks. These landfills also contain mixed hazardous waste found in buildings such as asbestos, PVC, mercury switches, lead paint, batteries, and electronics..
Hazardous Waste	Hazardous waste landfills contain non-liquid waste which is classified as hazardous under *Subtitle C* of the Resource Conservation and Recovery Act (USEPA 2008). These landfills have more stringent regulations, monitoring systems and inspections than municipal solid waste landfills.
Post-Disaster	While disasters have always generated large amounts of waste, the amount of waste generated by Hurricanes Katrina in Louisiana and Sandy in New York/New Jersey highlighted the issues around landfills in disaster areas. Many types of debris, including chemicals, oil, personal property, building rubble, soil, trees, ash, and charred wood require quick disposal in large quantities. In times of crisis, it remains crucial that citizens and municipalities work with state environmental agencies to make sure that debris is disposed of in a safe manner.
Superfund	Some landfills have been granted Superfund status, meaning that they are contaminated with hazardous waste and considered a risk to human health and the environment. Many Superfund sites are former landfills, including over ten percent of the *411 Most Dangerous Superfund Sites* listed by the Center for Public Integrity (CPI 2007). Superfund landfill sites are not limited to hazardous waste landfills, but include MSW and other types of landfills that have significantly contaminated the soil, water and air.

Brief History of Landfills in the United States

"Historically, the goal of municipal solid waste and industrial 'nonhazardous' waste management has been to get the waste out of sight in the least costly manner."

- Dr. G. Fred Lee (2005)

Pre-1960s: Open Dumps

Landfills are one of the oldest waste disposal methods. Waste has long been deposited on low-value areas away from urban areas, such as wetlands. Starting in the late nineteenth century, land began to be excavated prior to dumping

waste (Lee 2005). Most municipal solid waste was then either burned or allowed to decompose in open dumps. Generally, these landfills worked well because only biodegradable waste was disposed in them, allowing soil bacteria to break the waste down in a relatively short period of time.

Starting in the 1950s, landfill operators began to place a layer of soil over the waste at the end of the day. When landfills were closed, additional soil was placed as a cover, upon which buildings or parks were built. While this eliminated some public health concerns – odors, vermin, etc. - it did little to address the increasing problems of soil and water contamination (Lee 2002).

The 1960s: The First Government Regulations

With the advent of plastics, pesticides and petroleum products, landfills became more toxic and difficult to maintain (Lee 2002). This waste decomposes at a much slower rate than biological matter. Moreover, the chemicals contained in these types of waste (or the chemicals released when they break down) create air, soil and water pollution when they are emitted with landfill gases or mix with rainwater and leach into the soil (Montague 1989).

The discovery of these contamination problems around landfills in the 1960s brought about major changes in landfill design in concert with the first federal law for solid waste, the 1965 *Solid Waste Disposal Act*. The bill focused on improving the efficiency of disposal, providing states and municipalities with financial assistance and creating federal standards for building and maintaining safer landfills (Fletcher 2005).

Though the technology continued to evolve, landfill design remained problematic. In the mid-1970s, the concept of the "secure" or *double-lined landfills* emerged. Here, two liners are separated from each other by 1-2 feet of sand or gravel. To boost popular appeal, they have also been called "scientific" landfills. However, history continues to provide evidence that all landfills, even 'secure' scientific ones, eventually fail.

Creation of the USEPA

After the creation of the Environmental Protection Agency (EPA) in 1970, the federal government continued to issue landfill regulations. The Resource Conservation and Recovery Act (RCRA) (usually pronounced "wreck-rah") passed by Congress in 1976 as an amendment to the Solid Waste Disposal Act, created the framework for regulating waste (USEPA 2006). RCRA also banned industrial and commercial sources from putting large amounts of industrial waste into MSW landfills, such as 55-gallon drums of chemical solvents (Lee 2002).

Assorted amendments to RCRA continued to increase landfill safety measures, siting rules and government regulation of waste. The Hazardous and Solid Waste Amendments of 1984 signified a move toward preventing future cleanup problems. The amendments prohibited the disposal of untreated hazardous waste, implemented stronger leachate (liquid runoff from waste) collection requirements, and set deadlines for the closure of facilities not meeting standards (Fletcher 2005). At the same time, mounting concerns about air pollution spurred decreased rates of MSW incineration. Fewer landfills, less burning and more trash helped to grow the burgeoning recycling industry (USEPA 2007).

The 1990's: Subtitle D

As the percentage of MSW sent to landfills peaked in 1990, the EPA continued to refine RCRA (USEPA 2007). A set of regulations for MSW disposal referred to as "Subtitle D," created partly in response to lawsuits against the EPA, went into

effect in October of 1993. The hallmark of this legislation is the concept of "dry tomb" landfilling.

Since groundwater contamination occurs when water mixes with waste, dry tomb landfills are designed to isolate waste with a liner and cap, thus preventing pollution (Lee 2005). The minimum standard for a landfill under Subtitle D requires both a plastic and a compacted clay liner (Lee 2002). These "dry tomb" landfills are now the most common type of landfill built in the U.S. Since biodegradable waste breaks down much slower due to the lack of moisture and oxygen, and the composition of waste in landfills shifted to long-lasting items, such as plastics, the decomposition of "dry tomb" landfills has greatly slowed (Freudenrich 2000).

Additional Subtitle D provisions state that MSW landfills must have liners, leachate collection systems, groundwater monitoring and corrective action (Fletcher 2005). Similar to Superfund, the corrective action program works with current landfill operators to clean up contamination released into the environment (USEPA 2007a).

In 1996, the government began regulating emissions of certain chemicals and compounds in large landfills under the Clean Air Act (Fletcher 2005). Other subsequent minor changes to landfill policy are discussed later in Chapter 8.

The 21st Century: Alternatives?

The design of landfills has not changed drastically in recent years, nor have new liner systems prevented leaks in aging liners. CHEJ's Landfill fact pack, *Landfill Failures: The Buried Truth*, elaborates on landfill designs and their downfalls (available from CHEJ and at www.chej.org). Initially, municipal solid waste "alternatives" focused on waste prevention, recycling and energy production from the gases (mainly methane) emitted by landfills. However, the latter two also pose environmental risks, as discussed later.

More recently, the concept of zero waste has been introduced, which offers a sustainable and safe solution to landfills. Its advantages and benefits can be found in Chapter 10: *Real Solutions – Zero Waste*.

Facts and Figures on MSW

There is a clear downward trend in the number of landfills in the U.S. (see Figure 1). In 2012

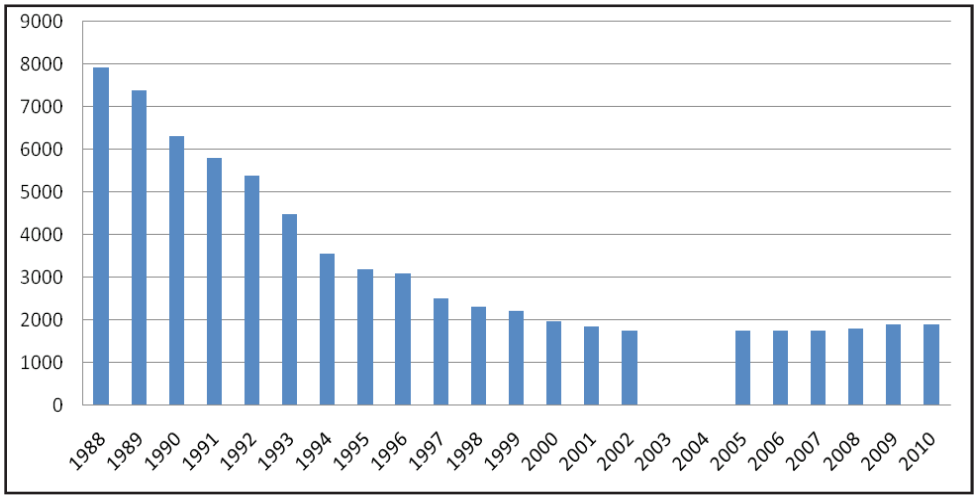


Figure 1: Number of Landfills in the United States, 1988-2010 (USEPA 2010)
Note: Data unavailable for 2003-2004

there were only 1,908 landfills, compared to 7,924 in 1988 (USEPA 2014a). Unfortunately, fewer landfills do not mean less waste. The remaining landfills are larger than before, since the amount of garbage produced over the past half century has almost doubled since 1960 (USEPA 2014a).

In 2012, U.S. consumers produced approximately 4.38 pounds of MSW per person per day, totaling almost 251 million tons, compared to only 88 million tons in 1960! While "recovery" – recycling and composting – helps to divert waste away from landfills, close to 55% of the waste still ends up going to landfills, with another 11.7% being incinerated (USEPA 2014a).

Commercial waste (generated by stores, office buildings, apartment complexes and institutions) accounts for approximately 40% of all MSW. Private corporations usually manage commercial waste, and are increasingly contracting with municipalities to manage residential MSW as well (McCarthy 2000).

Newer landfills are much larger than in the past. This is primarily due to the difficulties in siting new landfills and the consolidation of the waste industry. The Southeast United States contains the most landfills – more than all in the Midwest and Northeast combined. As the number of landfills declines, MSW continues to travel increased distances before landfill disposal. Urban areas, especially those in the Northeast, export garbage to landfills in the Southeast.

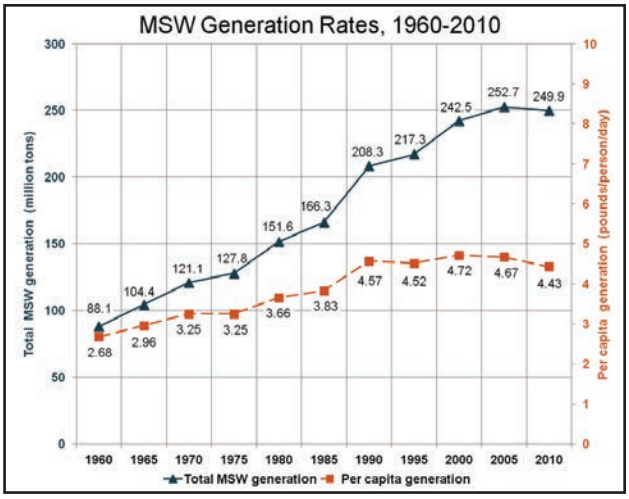


Figure 2: MSW Generation Rates 1960-2010 (US EPA 2009)

The National Solid Wastes Management Association asserts that the U.S. currently has the landfill capacity to last roughly 20 years. However, certain states including Alaska, Connecticut, Delaware, North Carolina, New Hampshire, and Rhode Island have less than five years worth of available space left (NSWMA 2010).

GENERAL RESOURCES ON LANDFILLS

- A list of common household hazardous wastes: http://www.longwood.edu/assets/safety/epalchhw_brochure.pdf
- Industrial Landfills: http://www3.epa.gov/epawaste/nonhaz/industrial/
- C&D Landfills, see: https://www.epa.gov/landfills/industrial-and-construction-and-demolition-cd-landfills
- HazardousWaste Landfills: https://www.epa.gov/hwpermitting/hazardous-waste-management-facilities-and-hazardous-waste-management-units#landfills
- EPA website about disaster debris: http://www3.epa.gov/epawaste/conserve/imr/cdm/debris.htm
- EPA Superfund information: http://www.epa.gov/superfund/
- Wasting Away - Center for Public Integrity: http://www.publicintegrity.org/environment/health-and-safety/wasting-away
- RCRA Orientation Manual: http://www2.epa.gov/hwgenerators/resource-conservation-and-recovery-act-rcra-orientation-manual
- History of Waste Management timeline: http://beginwiththebin.org/resources/for-education

Chapter 3

How Landfills Work

In its most basic form, a landfill is simply a "bathtub" in the ground. A municipal solid waste landfill is designed so that waste is placed on the ground in a pot, spread in layers, compacted to the smallest practical volume, and covered with soil at the end of each day (USEPA 1995).

Most landfills built today are designed based on the "dry tomb" concept, as specified in Subtitle D of the RCRA. The basic setup of a modern "dry tomb" landfill can be seen in Figure 3.

Bottom Liner System

The bottom liner system of a landfill is in effect the "tub" that separates the contents of the landfill from the soil around it. The liner system is the main barrier against soil and water contamination from garbage, leachate, and landfill gas.

The liners for MSW landfills are usually 30-100 millimeters thick and made of a durable synthetic plastic (polyethylene, high-density polyethylene (HDPE), or polyvinyl chloride).

Under Subtitle D, landfills are now typically required to have an additional layer of compacted clay soil underneath the plastic liner. There may also be an additional fabric mat (geotextile mat) surrounding the plastic liner to guard against tearing from surrounding rock (Freudenrich 2000).

Cells

Waste is stored in a series of "cells" within the landfill. Each cell contains one day's trash, which has been compacted and covered in soil. The amount of trash in a cell is usually 2,500 tons, which is then compacted by bulldozers, balers, rollers and other equipment to 1,500 pounds per cubic yard (Freudenrich 2000).

Storm Water Drainage System

Plastic drainage pipes and storm liners are used to keep out and remove rainwater. The collected water is channeled to drainage ditches and ponds around the base of the landfill. The water is tested

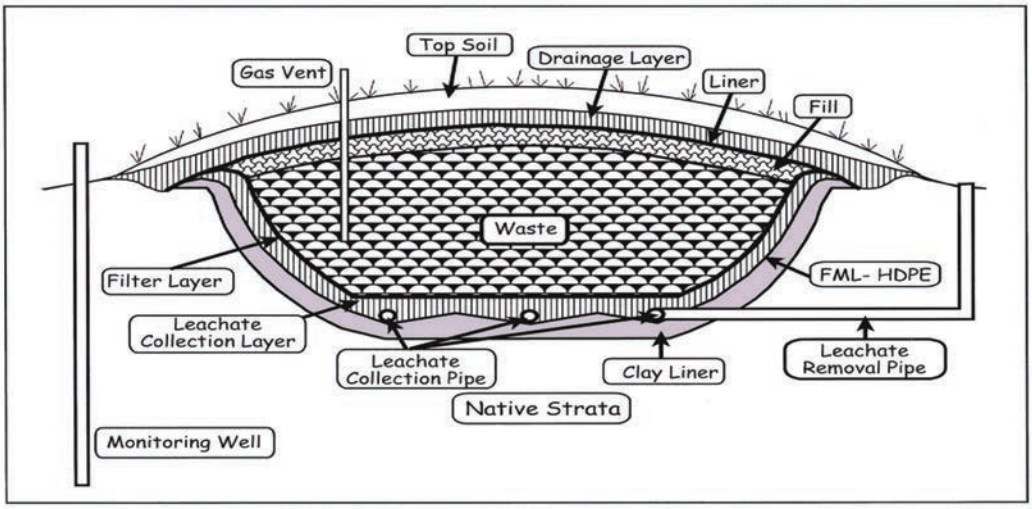


Figure 3: Single Liner Landfill Containment System (Lee 2004)

for chemicals and is pumped off-site once soil sediments have settled.

Leachate Collection & Monitoring System

Despite measures to prevent water from entering the landfill, some water always gets inside. The water moves through the garbage, mixing with contaminants (chemicals, metals, waste products of decomposition) and forms "leachate".

In order to collect leachate, modern landfills contain a leachate collection system between the composite (clay and plastic) liner and the waste cells (see Figure 3). Beneath the waste is a filter layer, designed to keep the waste from migrating downward but allowing leachate to move freely. The leachate collection system is between the filter layer and the plastic sheeting. Leachate moves through a porous material, such as gravel, and slides off the plastic sheeting to collection pipes (Lee 2005).

The collection pipes lead out to a removal pipe. The removal pipe pumps or sprays ("aerates") leachate into a collection pond outside the landfill. There, leachate is tested for contaminants and then treated, returning the solids to the landfill.

One concern about aerating the leachate is that volatile chemicals in the leachate will evaporate into the air and become airborne. This may pose health risks to residents living nearby.

Landfill Gas Collection System

The decomposition of waste by bacteria produces landfill gas, composed primarily of methane and carbon dioxide. Its production depends upon a number of factors, including the type of waste, moisture content in the landfill, amount of oxygen present and temperature (ATSDR 2001).

In compliance with the Clean Air Act, "large" landfills (those with a capacity at or above 2.5 million cubic meters) that emit at least 50 metric tons of non-methane organic chemicals (NMOCs) per year must have a landfill gas collection system, which reduces NMOC emissions by 98 percent. This series of pipes snakes through the landfill, and collects landfill gas. The gas is either released (vented) or burned. In some cases, the gas is captured and burned as an energy source. NMOCs typically represent 1 percent of landfill gas. Included in NMOCs are toxic volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) such as benzene,

toluene, ethyl benzene and vinyl chloride (USEPA 2008e). Additional information on landfill gas can be found in *Chapter 4: Problems with Landfills*, under the subsection entitled "Landfill Gas and Air Emissions."

Cover/Cap

For an operating landfill, a covering of six inches of soil is placed on the top of the day's compacted waste. This covering aims to keep animals and insects from getting into the landfill, and to keep garbage from escaping.

When a landfill is closed, it is first covered with a layer of soil (fill), followed by a low-permeability polyethylene (plastic) sheeting. On top of the cap lies a one to two foot high porous drainage layer. Up to a foot of topsoil covers the drainage layer to promote vegetation growth and prevent erosion (Lee 2005).

Groundwater Monitoring System

Groundwater monitoring wells are placed around the perimeter of the landfill, usually several hundred feet apart (Lee 2015). At these stations, pipes are sunk deep enough to reach the groundwater. The groundwater is then periodically sampled for temperature, pH levels and the presence of leachate chemicals.

Chapter 4

Problems with Landfills

All landfills lead to environmental pollution. Even a landfill that complies with every EPA law and regulation will, by the nature of its design, emit harmful gases and leachate into the water, soil and air. Landfill waste takes hundreds, if not thousands, of years to completely decompose.

As the waste degrades, so do the liners and caps meant to contain them. The leachate and gas collection systems, and monitoring wells will need maintenance and upkeep, for which there is no funding after 30 years post-closure. Each new truckload of garbage dumped into a landfill leads to an unknown amount of environmental pollution, expensive remediation costs, and health threats to those who live and work near the site and everyone affected by the wider issue of global climate change.

These, and the following issues underscore the need for serious consideration of the zero waste principle, a safer answer to the alarming problem of our waste and landfills.

Exposure Pathways

People are exposed to chemicals in landfills through four basic routes of exposure – air (breathing), skin absorption (direct contact), consumption (ingesting drinking water or food contaminated by chemicals) or from the mother via the placenta (while a fetus) or from breast milk. Figure 4 below offers a simple visual of these pathways.

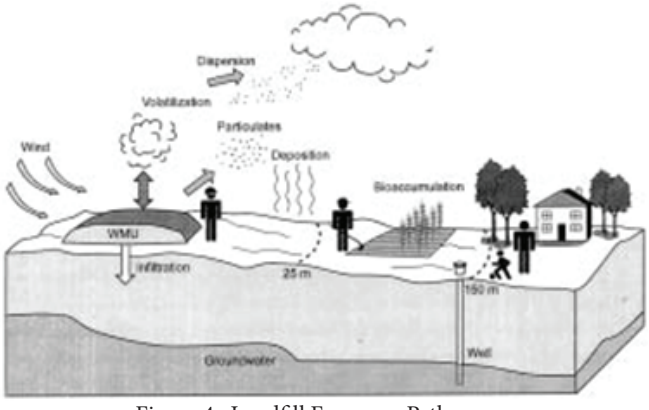


Figure 4: Landfill Exposure Pathways

Design Problems

Subtitle D landfills are designed to seal off waste from contaminating the surrounding air and water. However, most organic materials require air and water to decompose into nutrient-rich matter, which can then be reclaimed by the land and fertilize it. This leads to a classic catch-22 scenario: open landfills contaminate the environment more easily than closed ones, but closed, dry landfills slow down organic (and non-organic) waste decomposition, thus producing gas and leachate over a prolonged time-span. This is not to imply that unlined, open dumps are a better alternative to Subtitle D landfills. Rather, these modern landfills, even more than their predecessors, are fundamentally problematic.

Liner Failures

Liners are placed at the bottom of the landfill to contain waste and separate it from the surrounding soil and groundwater. They are usually made of durable synthetic plastic, in combination with compacted clay soils. Though liners are designed to avoid breakage, deterioration and punctures, industry experts and the EPA acknowledge that leakage is inevitable after a certain number of years (USEPA 1988).

After the Leak: Effects of a Flawed Liner

The Dewey Loeffel toxic dump in Nassau, New York operated from 1952 until 1968. It was only in 1980, however, that state officials discovered the landfill had been leaking PCBs into local waterways and Nassau Lake, a fishing and recreational haven that now lies devoid of activity. The fish are unsafe to eat, and residents are scared to even dip their toes in the water. With cleanup still being bogged down by General Electric, the primary user of the dump, the prospect of a speedy recovery for the region is dim; the landfill serves as a stark reminder of the potential impact of faulty liners (Cooney 2010, Gardiner 2002).

All liners are permeable to some degree and are often punctured with pinholes caused by the manufacturing and welding process (Montague 1992). Uneven soil or sharp rocks underneath the liner can tear the plastic or cause stress to the clay liner. Additionally, household products, including vinegar, alcoholic beverages, margarine, and household cleaners, can permeate through the plastic liner, degrade it, soften it, or make it brittle and cause it to crack (Pellerano 2005). Depending on the composition of the waste, leachate can be comprised of many chemical contaminants. Unfortunately, even with an intact liner, many of these contaminants can migrate into the surrounding soil. Organic chemicals, such as chlorinated solvents, benzene, and vinyl chloride, have been found to readily pass through a fully functional liner relatively quickly (Haxo 1988).

The clay and plastic liners should have surface-to-surface sealed contact. When this occurs, even if the plastic sheeting is cracked, initial leakage into the clay layer will be limited. However, if the clay and plastic liners are not in direct contact, such as when the plastic sheet develops a fold, leachate can flow out through the hole and widely disperse across and through the clay liner, eventually contaminating groundwater (Lee 2005). Such liner failures and subsequent water contamination are quite common. For instance, a survey of Virginia landfills in 2003 found contaminated groundwater in the monitoring wells of 62% of the sites (deFur 2003).

New Doesn't Mean Safe

An example of a faulty liner occurred in a Toms River Chemical landfill in Dover, New Jersey in 1979. There, just three months after the landfill opened, Department of Environmental Protection officials found that the double-lined landfill cells were leaking between 60 to 131 gallons of leachate per day (Montague 1982a).

Leachate Collection and Monitoring System Failures

When rainwater or other precipitation mixes with waste, leachate is formed. Though landfill operators seek to minimize leachate generation by covering waste daily, this is only effective up to a point. In theory, once a landfill is capped, water can no longer enter, and thus a landfill ceases to generate new leachate. However, as discussed more in later chapters, landfill caps always allow a certain amount of moisture into the landfill, thus continuing to create leachate.
If a landfill liner fails, the leachate collection system cannot work as designed. Leachate is supposed to move to the bottom of the landfill and slide off the plastic liner to collection pipes. However, if a liner has cracks or holes, the leachate can drain outside of the landfill, rather than being funneled into the collection system (Lee 2005).

Even if the liner is currently intact, the leachate collection system can still fail. Drainage and collection pipes can become clogged by silt or microorganisms, weakened by chemicals, or crushed by overlying waste and soil. Leachate pumps that drain collected leachate out of the landfill can also fail, allowing leachate to build up and leak. All of these circumstances cause leachate to pool at the bottom of the landfill, placing additional pressure on the liner, and eventually leading to a failure in which leachate is released into the soil (Montague 1989). Some states have regulations requiring landfill operators to notify nearby residents when a leachate leak occurs (deFur 2003). However, this provision is useless if leaks are not identified.

Collection system failures are difficult to detect and often require extensive testing, which can be expensive and time consuming with no guarantee of success. For example, a lack of leachate flow through the collection system can be misinterpreted as an end to leachate generation, when in fact a pipe may be blocked. If a landfill does not have manholes connecting the collection pipes, there is no physical way to find out if the collection system is intact. TV cameras and specialized "snaking" tools can be used to find a blockage and clear it, or a chemical tracer can be added to the waste to see if it reaches the collection system, but both of these methods require extra money that landfill operators may not be willing to spend.

Groundwater detection or monitoring systems are intended to identify liner and leachate collection system failures. Monitoring wells can only detect leaks if the leachate passes by one of the monitoring wells surrounding the landfill. A typical plume of leachate in sand, gravel or silt soils is between 10 and 20 feet wide (Lee 2005). Thus, if monitoring wells are placed 200 feet apart,

Landfill Failures – In Their Own Words

For the past 20 years, research on Subtitle D modern landfills has continually concluded that all liners eventually fail.

When adopting the Subtitle D regulations, the Environmental Protection Agency wrote in the 1988 draft regulations (USEPA 1988):

Even the best liner and leachate collection system will ultimately fail due to natural deterioration.

The U.S. Geological Survey wrote in 2003 (Christenson):

Modern landfills are designed to minimize contamination of ground water, but modern landfills eventually may leak contaminants in the environment.

as per government regulation (requirements range between 100 to 200 feet depending on the state), and each well monitors a one-foot area, even a 20-foot wide flume could easily pass between wells without detection (see Figure 5).

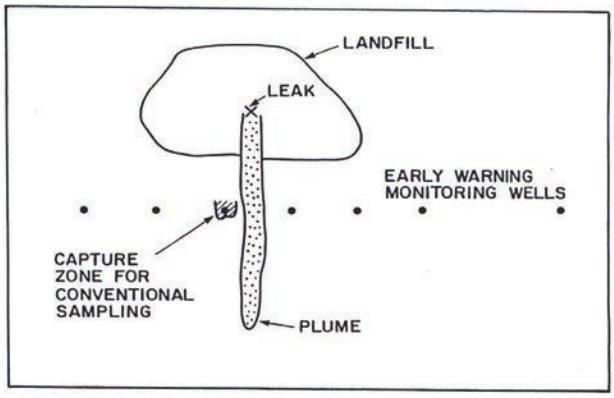


Figure 5: Leaking Leachate Escapes Detection (Lee 2004)

Leachate and other pollutants also pose a threat to groundwater upon leaving the landfill. Spills can occur while handling leachate, and the ponds that hold leachate, usually lined with HDPE sheeting, can leak and contaminate groundwater. In addition, ponds for storm water can flood and contaminate surface and goundwater (Lee 2005).

Due to the unreliability of groundwater monitoring, some states, such as Michigan, require landfills to contain a double-plastic liner, with a leak-detection system between the two layers. The very fact that these leak-detection systems catch failures from the upper liner illustrates the vulnerabilities of liners and importance of locating leaks before groundwater contamination occurs (Lee 2002).

Leachate Problems

"A landfill is a bathtub in the ground, and a bathtub can leak two ways: it can leak through a hole in the bottom (failure of its bottom liner), or it can fill up with fluid and spill over its sides. Either way, it's bad news." - Peter Montague (1989)

Toxic Leachate

When moisture filters through a landfill and mixes with decomposing organic waste, plastics, batteries, electronics, diapers, cleaners and a multitude of other items, the leachate formed can contain bacteria, heavy metals and other carcinogenic compounds. Even assuming that no items classified as "hazardous waste" by RCRA end up in a municipal landfill (an *extremely* improbable assumption), the combination of water with chemicals from many household products can create toxic leachate.

Leachate can contain a variety of chemical contaminants, depending on the specific waste disposed of in the landfill. Table 2 shows the types of chemicals present in a MSW landfill. The toxicity of leachate in landfills is due in part to the prevalence of industrial and commercial chemicals and toxic products, such as vinyl (also known as polyvinyl chloride or PVC) plastic. PVC is found in pipes and vinyl siding, in addition to everyday products, such as shower curtains, food containers, vinyl flooring, cosmetic packaging, and many kids' toys. PVCcontains plasticizer molecules that easily seep out into the leachate (Meriowski 1999).

The majority of plasticizers are phthalates or heavy metals such as lead and cadmium, both of which the National Toxicology Program classifies as a human carcinogen (ATSDR 2003). When leachate includes these chemicals, it becomes toxic. The Environmental Protection Agency estimates that in 2012, 870,000 tons of PVC went to landfills (USEPA 2014a).

Another major source of toxicity in leachate comes from discarded electronic items. Table 3 lists some of the hazardous chemicals found in such waste. In 2012, 2.42 million tons of unwanted consumer electronics were discarded in landfills, estimated at 1.5% of the municipal solid waste

stream (USEPA 2014a). Electronic waste, or *e-waste,* encompasses not just computers, but a broad range of devices, including refrigerators, washers, dryers, air conditions, cellular phones, televisions, foluorescent lamp bulbs, and personal stereos. Cathode ray tubes (CRTs) found in computer monitors, televisions and other display devices, contain significant amounts of lead and heavy metals. While appliances containing CRTs are classified as hazardous waste, they often end up in MSW landfills.

A computer monitor or television screen contains an average of 4 to 8 pounds of lead. When monitors are crushed in landfills, the lead is released and, as an EPA publication notes, can "leach out under conditions typical of municipal landfills" (USEPA 2000). Consumer electronics have been estimated to account for 40% of lead and 70% of heavy metals found in landfills (Scanlon 2001).

Table 2: Sample of Chemicals Found in MSW Landfill Leachate

Chemical	Sources	Health Risks
Cobalt	Magnets, cutting tools, alloys, colored glass or ceramics	Heart and lung damage, dermatitis
Ammonia	Fertilizers, household cleaners	Skin, mouth, lung and throat irritation
Arsenic	Wood preservatives, pesticides, sawdust	Skin discoloration, blood vessel damage, abnormal heart rhythm, cancer
Lead	Cathode ray tubes, batteries, metal pipes, old paints	Brain and kidney damage, muscle weakness, decreased mental abilities
Mercury	Electronics, thermometers, batteries	Brain and kidney damage, lung damage, skin rashes
Toluene	Paint, lacquers, adhesives, fingernail polish, paint thinners	Fatigue, weakness, confusion, memory loss, nausea
Benzene	Plastics, resins, nylons, rubbers, dyes, lubricants, pesticides, detergents	Anemia, leukemia, bone marrow damage, immune system damage
Di (2-ethylhexyl) phthalate (DEHP)	Plastic products like tablecloths, floor tiles, upholstery, dolls, shoes, rainwear	High, prolonged levels may cause liver damage

Note: This table represents some of the typical chemicals found in leachate. The composition of waste and its decomposition time can cause leachate composition to vary greatly from landfill to landfill.

Source: Kjeldsen (2002), ASTDR (2004b, 2004c, 2007b, 2007,1999a, 2000a, 2007a, 2002a) (in order of chemicals listed, top to bottom)

Table 3: Select Chemicals Found in Landfill Leachate from Electronic Waste		
Chemical	**Sources**	**Health Risks**
Cadmium	Plastics in computers	Kidney disease, lung damage, fragile bones
Chromium (VI)	Anti-corrosion agent in steel computer parts	Allergic reactions, bronchitis, respiratory problems, DNA damage
Lead	Glass panels in screens and monitors	Severe brain and kidney damage, miscarriage, high blood pressure, anemia
Mercury	Circuit breakers, switches, other electronic equipment	Brain and nervous system damage, kidney problems, ulcers, high blood pressure
Polybrominated Diphenyl Ether (PBDE)	Flame retardant additive in plastics and textiles	Liver and thyroid problems
Polychlorinated Biphenyls (PCBs)	Though banned by Congress in 1977, PCBs exist in older electrical equipment	Negative effects on the liver and endocrine system; skin and eye problems; impaired immune system; neurological effects in children; low birth weight; reproductive organ damage; cancer
Source: ATSDR (2008, 2007, 2004a, 2000, 1999, 1999a), Scanlon (2001)		

Unfortunately, heavy metal contaminants do not break down into inert forms, but rather continually contaminate the surrounding soil and water (Lee 2004). Furthermore, treatment systems for leachate are often unable to remove heavy metals (Anthony 2001).

A study done in the early 1990s on the toxicity of MSW leachate found that all samples were acutely toxic; three of four were genetically toxic, and two of four contained concentrations of US EPA priority pollutants exceeding standards for drinking water. Based on their results, the authors concluded that leachate from MSW landfills was as acutely and chronically toxic as that of hazardous waste landfills (Schrab 1993).

Just the mere inclusion of MSW landfill sites on the Superfund National Priorities List indicates that dangerous toxic contamination does occur at these landfills. Superfund sites are the worst of the worst among toxic contamination sites in the country. MSW landfills that are on the Superfund list include the Marine Corps Logistics Base landfill in Georgia, Operating Industries, Inc. landfill in California, and the "Hastings Groundwater Contamination" landfill in Nebraska (Wang 2009). In EPA Region I (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont), 17 out of the 117 Superfund sites were once municipal solid waste landfills (USEPA 2010e). According to the EPA, approximately 20% of all Superfund sites are MSW landfills (USEPA 2015).

Toxic Leachate and Groundwater Contamination

"It is prudent public health policy to assume that any contamination of groundwaters by MSW landfill leachate represents a hazardous situation to the public health of those who consume the waters, even if the concentrations of all regulated contaminants measured in the groundwater are below the drinking water standards."
- Dr. Fred Lee (1994)

Though the public health risks of toxic leachate remain largely unknown, it is important to remember that all chemicals can be toxic to human health, depending on the concentration and duration of exposure. There are over 84,000 chemicals used in the manufacturing and processing of everyday products, and fewer than 200 of them are measured when testing groundwater for leachate contamination (USEPA 2010a, Lee 2010). Groundwater near landfills may have thousands of chemicals at unknown concentrations, yet if the tested chemicals for established drinking water standards are at low enough levels, water is considered "safe". Furthermore, different chemical contaminants have differing health effects, and people drinking contaminated water may be exposed to different concentrations.

In addition to risks from chemicals, landfills also contain biological contaminants. Landfill waste includes fecal matter from diapers, septic tanks and pet manure. While bacteria and viruses found in fecal matter have a short lifespan, cyst-forming protozoa can survive and mix into the leachate (Sulfita 1992). These risks may be small, but they cannot be ignored.

When leachate-contaminated groundwater discharges to surface waters, such as springs, aquatic life can be impacted. Toxic chemicals can bioaccumulate (become concentrated) in the aquatic life, and as the fish are eaten, move up the food chain, which impacts people who live outside of the immediate proximity of the landfill. Other negative effects of leachate contaminated water include aesthetic problems (odor, discoloration, etc.) and a shortened lifespan of appliances, plumbing and washed clothes (Lee 1994).

While studies have not definitively "proven" a link between leachate-contaminated groundwater and health problems (see Appendix A), the known health effects of many contaminants found in groundwater from leaking landfills highlight the need to employ a precautionary approach. Why place the public at risk, knowing that all landfills will eventually leak, when safer alternatives (recycling, compost, etc.) exist?

Holding Ponds and Leachate Disposal

Leachate disposal can take many forms. Many times leachate is collected and sent to wastewater treatment plants to be treated, though this can adversely impact the plant due to the high levels of ammonia found in leachates (Abbas 2009).

Another disposal option involves letting the leachate stand in a holding pond for a period of time so that microbacteria can breakdown the chemical compounds. Leachate collection systems funnel the leachate to pipes, which then deposit the waste runoff into a pond. These open air ponds also allow the leachate to evaporate into the air, thereby reducing its volume and creating a more solid sludge that is then dumped back into a landfill, or even burned (Abbas 2009). These volatile chemicals are released into the air as another source of air pollution.

Upon arriving at the holding pond, the leachate may be sprayed out of the pipe and through the air. Spraying the leachate causes its volatile components - compounds which can be toxic – to evaporate quickly and pollute the surrounding air.

Besides sitting in holding ponds, leachate may also be transported to another part of the landfill where it is then sprayed over the trash (ESD 2007). Besides not solving the issue of leachate, the spraying of the leachate creates air pollution that can affect nearby residents.

None of the leachate disposal methods discussed above truly address the issue before them: what to do with leachate in the long run. Leachate, even if reduced in volume or treated by a wastewater facility, still leaves behind a residue that must be dealt with (Abbas 2009). As with the landfill itself, these are temporary fixes for a long-term problem.

Landfill Gas and Air Emissions

Unfortunately, leaking leachate is not the only problem plaguing landfills. Gas emissions are always released during the decomposition of waste. In addition to being an odor nuisance, these greenhouse gases can contain toxic contaminants harmful to the health of those who breathe the surrounding air. Like liners and leachate collection systems, measures to contain gas emissions are moderately successful at best. Fugitive emissions from landfills continue post-closure. Today's waste will contribute to global climate change and air pollution for many years into the future.

Landfills emit gasses for three reasons (ATSDR 2001):

- Bacteria break down organic waste, releasing methane and carbon dioxide.
- Certain chemicals in landfills are *volatized* when they break down, changing from a liquid or a solid into vapor.
- Certain chemicals combined in a landfill react with each other to form a gas.

Of the three, the first category – decomposition – represents the largest proportion of landfill gas generation. Decomposing organic waste produces methane and carbon-dioxide. Each gas compromises 40-60% of the total emissions, depending on the make-up of the waste. Methane is only produced by anaerobic (oxygen-independent) bacteria, so very dense landfills which allow little oxygen access to its waste may produce more methane than carbon dioxide. Other factors influencing the amount of gas emissions include moisture content (more water leads to more bacteria which leads to more gas) and the temperature (warmer landfills promote bacterial growth).

Landfill gas is usually produced under the surface of the landfill. It then tries to move away from the landfill, in a process called *landfill gas migration*. The gas will take the path of least resistance, which is generally upward. This is especially the case with gases lighter than air, such as methane. However, if the landfill is very compact, the methane may migrate sideways to other parts of the landfill or out of the landfill entirely, where it can then move upward. Landfill gas migration has been observed for distances of over 1500 feet (ATSDR 2001). Gases which are heavier than air, such as carbon dioxide, will collect in channels beneath the surface of the landfill.

Landfill gases often permeate out of the top covering of soil on open landfills, leading to air pollution. Due to the questionable long-term success of landfill caps, closed landfills can also allow the escape of landfill gas. After a landfill is capped, grass and other vegetation are usually planted on the surface to prevent erosion. However, landfill gas often seeps through the cracked cover or cap of a landfill. If carbon dioxide continues to be released, it can prevent the plant roots from taking up oxygen. Landfills with faulty caps are often characterized by large swaths of non-vegetated land as a result of landfill gas (Lee 1994).

Landfill Gas and Climate Change

One of the biggest concerns with landfill gases are their contribution to global climate change. Both methane and carbon dioxide are greenhouse gases (GHGs), a term which refers to gases that absorb heat emanating from the earth's surface and then radiate a portion of that energy back down to earth, thereby increasing the surface temperature more so than if the gases were not present. Global warming is attributed in part to this greenhouse gas effect. Municipal Solid Waste landfills were responsible for 17% of anthropogenic (human-caused) methane emissions in 2009, making such landfills the third largest anthropogenic source of methane (USEPA 2012).

Estimates on how much landfills contribute to global greenhouse gas production vary greatly, based on the percentage of gas produced by landfills that is captured through gas collection wells. However, as solid waste planning expert Peter Anderson writes "there is virtually no field data on the amount of fugitive gas emissions from landfills," so the EPA claim that 75% of landfill gas is captured may be grossly overestimated (Anderson 2007).

"Large" (at or above 2.5 million cubic meters for capacity) landfills are not required to have a gas collection system in place for the first five years of active waste storing (or, if the landfill closes within two years, then two years after initial garbage collection). Moreover, after a landfill closes permanently, "the [gas] collection and control system must have been in continuous operation a minimum of 15 years" – a time period that includes gas collection during active waste storing – and NMOCs emission rates need only be below 50 metric tons per year before the gas collection system can be removed. There are significant portions of time that the landfill emits greenhouse gases unchecked. "Small" landfills, or those that emit less than 50 metric tons of non-methane organic compounds (NMOCs) per year, aren't even required to have gas collection systems (USEPA 1996). The Agency for Toxic Substances and Disease Registry (ATSDR) estimates that the peak gas production occurs five to seven years after the waste was dumped.

However, Lee asserts that this model is based on un-bagged, homogenous waste which interacts with moisture (Lee 2005). In reality, dry tomb landfills are sealed off from moisture and waste is often contained in plastic bags. When plastic bags eventually decay, likely decades after the lifespan of the gas collection system, the waste will break down and release gas into the soil (Lee 2002). The Intergovernmental Panel on Climate Change (IPCC) estimates that over the lifetime of a landfill, the gas recovery rate is merely 20% (Bogner 2007).

If 80% of the lifetime emissions from a landfill are released into the atmosphere, finding landfill alternatives seems imperative as citizens, scientists and governments seek to address the issue of global climate change.

Landfill Gas, Air Quality and Public Health

Air pollution from landfills remains a more local, though no less important, concern. Chemicals, even in small amounts, can be transmitted out of the landfill into the air and soil with fugitive methane and carbon dioxide emissions. This places residents of the surrounding community at risk to toxic exposure (Lewis 1998). Captured landfill gas, often vented straight into the air, also places residents at risk. Many landfills do not have high enough stacks to adequately dilute these gaseous pollutants through dispersion. Thus, much of the polluted air remains near the landfill site (Raloff 1999).

Low levels of organic compounds are present in landfill gases, including a number of hazardous air pollutants (HAPs) and volatile organic

compounds (VOCs). Table 4 shows common volatile organic compounds found in landfill gas. According to the EPA, these include suspected and probable carcinogens such as toluene, benzene, chloroform, carbon tetrachloride, vinyl chloride (much of which originates from PVC), perchloroethylene, and methylene dichloride (USEPA 1995). Even though these chemicals make up a small portion of landfill emissions, most can have toxic effects at very low levels.

Odors and Particulate Matter

The extent of health effects from landfill gases depends on the toxicity of the chemicals and the extent of exposure. Methane is a major contributor to the formation of ozone, which can cause or aggravate respiratory conditions (ATSDR 2001). Landfill odors can be overpowering for those living and working within a mile of a landfill, especially where a landfill has been built with insufficient buffer land surrounding it (Lee 2005). Odors are likely caused by landfill gases like sulfides (which produce the rotten egg smell), ammonia, and certain NMOCs, such as vinyl chloride (ATSDR 2001). In addition to causing headaches, nausea and sleep disturbances, strong odors can trigger asthma attacks.

Landfill dust is created when waste is dumped, when the daily cover is removed or added, and from truck traffic. The presence of this dust could create a nuisance or possible health threat to property owners nearby. Substantial amounts of litter can blow off the top of open landfills on a windy day (Lee 2005).

Moreover, landfill odors serve as a reminder of the economic and psychological implications of living near a landfill – including lower property values and social stigma. In a study in Pennsylvania, landfills negatively affected property values for almost a 2-mile radius, farther and more significantly than roads or factory farms (Ready 2003).

Table 4: Common Volatile Organic Compounds Found in Landfill Gas
(Number of times found in 46 landfills)

Trichlorofluomethane (46)	Carbon tetrachloride (37)
Benzene (45)	1,2-dichloroethene (37)
Trichloroethene (44)	Chloroform (36)
Vinyl chloride (42)	1,1-dichloroethane (33)
Toluene (40)	1,1-dichloroethene (32)
Tetrachlorethene (39)	Ethyl benzene (31)
1,1,1-trichloroethane (38)	
Methylene chloride (37)	Chloromethane (30)
1,2 dichloroethane (37)	

Source: EPA (1990)

Burning Landfill Gas

Landfill gas may also contain various heavy metals, such as mercury. Mercury is a potent neurotoxin (nerve poison). Mercury in its elemental form is present in many products, including thermometers, the currently popular incandescent light bulbs, and batteries (Raloff 2001). When these products are disposed of in landfills, microbes in the landfill can convert the mercury to its highly poisonous methyl mercury form (Lindberg 2001).

A 2001 study found that high concentrations of methyl mercury, 1,000 times higher than any concentration of methyl mercury ever found in ambient air, were present in the water vapor condensed from landfill gas in Florida (Raloff 2001). This study indicated that landfills are likely

a major source of methyl mercury in air and rain.

Flaring (burning) landfill gas can destroy methyl mercury, but not inorganic (elemental) mercury. Mercury is released from products when crushed in the landfill and it can easily dissolve in leachate and contribute to water and soil contamination (NEWMOA 2006). The major route of exposure to methyl mercury for most Americans is from eating contaminated fish or shellfish, but people living in areas surrounding landfills or other industry may be affected from associated air and water pollution.

Exposure to high levels of mercury in all its forms can cause permanent damage to the brain, kidneys, and developing fetus (passed from an exposed mother). There is also evidence that methyl mercury may damage the cardiovascular system in both adults and children (NRC 2000).

Flaring landfill gas can also release dioxins and furans, which are by-products of burning plastics such as PVC, polychlorinated biphenyls (PCBs), and brominated flame retardants (BFRs). Dioxin, a name given to a family of chemical compounds, is one of the most dangerous chemicals produced by humans. Its most toxic form, tetrachlorodibenzo-p-dioxin or TCDD, is a known human carcinogen (NTP 2005). Exposure to dioxin is also associated with reproductive and developmental health problems and can impair the immune system (Birnbaum 2003).

Landfill gas has the potential to cause serious physical injury due to its high level of combustibility. Fires in landfills can occur spontaneously, placing landfill employees and nearby residents at additional risk for toxic exposure. FEMA estimates that an average of 8,400 landfill fires occur each year (FEMA 2002). Landfill fires also generate dioxin and dioxin-like compounds, and could be a large source of such compounds (USEPA 2006b). Regardless, the fact that landfill fires produce such noxious byproducts enhances their danger and underlines their seriousness (USEPA 2006b).

Working at a Landfill

Some studies have also found associations between working in a landfill and various health problems. One study found those employees who worked at a large municipal landfill experienced higher rates of work-related dermatologic, neurological, hearing and respiratory symptoms, and sore/itchy throats than off-site employees (Gelberg 1997). Another study of landfill workers in Virginia found elevated work-related dermatological, neuromuscular, respiratory, hearing, and gastrointestinal symptoms and injuries (Kitsantas 2000).

The fatality rate for sanitation workers has been up to ten times higher than the national job fatality rate (IBT 2008).

Landfill Gas Migration

Landfill gas can also migrate into the ground through porous soil, fractured rock and other pathways (ATSDR 2001). Gases which migrate through the soil can enter buildings through cracks in the foundation or basement. If leaked landfill gas (composed mainly of methane) mixes with oxygen and builds up in a small space (utility pipe corridors, crawl spaces, basements, etc.), it can cause an explosion. Though rare, these explosions can result in property damage, serious physical injury or death. A study by the USEPA identified 40 methane migration-related explosions and fires between 1967 and 1984 (USEPA 1990).

Asphyxiation can also occur if either methane or carbon dioxide accumulates in small spaces (USEPA 1990). Carbon dioxide is denser than air, so it can remain in a location even after the space has been opened to outside air circulation. High carbon dioxide concentrations can result in a range of serious physical symptoms – headaches, dizziness, rapid heartbeat, difficulty breathing, unconsciousness and even death.

Cover/Cap Failure

"A dry tomb landfill will, through leachate and gas releases, be a threat to public health and the environment forever."– Dr. G. Fred Lee (2005a)

When a landfill is closed, a cover of plastic sheeting or clay is used to "cap" it. According to dry tomb design, water that filters down through the vegetation to reach the cap should slide off to the sides and into the nearby soil. However, in addition to problems occurring from faulty installation, many different failures can occur with a landfill cap, including, as adapted from Montague (1982):

- Cracking of the cap due to settlement of waste and drying
- Collapse of the cap due to settling of waste
- Pooling of water in depressions
- Erosion due to weather
- Burrowing animals, trees and plant roots penetrating the cap
- Deterioration of the plastic
- Problems when structures or parks are built on top

In accordance with Subtitle D regulations, monitoring of the landfill cover occurs for 30 years after closure. This usually consists of visually looking at the vegetation and filling in any obvious cracks or depressions with additional soil. However, there is no monitoring of the actual cap, which is the layer preventing moisture from reaching the waste and becoming leachate.

If the cracks occur after the 30 year post-closure monitoring period, an increase in leachate would not be detected, posing a public health risk (Lee 2005).

When the cap inevitably deteriorates, the moisture which enters helps speed up decomposition of waste in formerly "dry" cells. This generates landfill gas that may have been dormant for years, which can migrate into the soil, groundwater and air.

Capped landfills are often viewd as ideal locations for new housing developments, schools, and parks. However, the risks of soil, water and air contamination remain high and development should be limited if not avoided. For example, agricultural activity (including gardening) should not occur, since gas emissions can damage crops (Lee 2005).

The Difficulty in Proving Adverse Health Effects

Few studies have detected, with certainty, increases in adverse health effects in populations living around landfills. This is due primarily to the limited ability of epidemiological studies and other methods to accurately assess the health impact of exposure to toxic chemicals leaking from landfills. Nonetheless, there have been a good number of studies that have identified increased risks in populations living near landfills.

Health studies are notorious for not 'proving' harm from a landfill. Small populations of affected people, the long latency period that occurs before many cancers manifest, and privacy concerns are just a few of the challenges communities encounter when trying to show a statistically significant, and thus credible, connection between health problems and landfill proximity (Montague 1989a).

In 1995, a study was published on cancer rates in people living near a municipal solid waste

landfill located in a densely populated area in Montreal, Quebec (Goldberg 1995). Due to the fact that the area derived drinking water from other sources, the main exposures of concern for nearby residents were derived from the landfill's release of gas into the air and soil, noise, diesel fumes, and dust. Exposure risk was characterized by proximity to the landfill. Elevated risks for cancers of the stomach, liver and intrahepatic bile duct, trachea, bronchus, and lung were found for males living closest to the site. Additionally, in one of the "proximal exposure subzones," prostate cancer was elevated. In women, rates of stomach and breast cancer were lower than expected. According to the authors, a previous study had also indicated increased low birth weight for children born to mothers living near the site. In both studies, however, it was not possible to definitively link the excess cancer and reproductive effects to the landfill gas (Goldberg 1995).

A study of residents living near 38 landfills with soil gas migration in New York State in the years 1980-1989 found some evidence of elavated cancer incidence rates. Most of the landfills included in the study were constructed prior to 1970 and were not lined or capped and only 22 had gas collection systems. At the time of the study, none of the landfills were active (open). Results showed increased incidence of bladder cancer and leukemia for females living within 250 feet of the landfill boundary. However, lack of data on smoking, presence of other contaminants, and length of residence created uncertainty in the strength of association between the landfill and cancer rates (Lewis 1998).

In 2000, an exploratory study evaluated the severity and frequency of respiratory symptoms occurring over a 12-month period among residents of Staten Island, NY who reported having asthma, severe breathing, or other respiratory conditions. Responses indicated that residents who lived adjacent to the Fresh Kills municipal solid waste landfill and those from the north-shore (seven miles from the landfill) had differing health problems, with landfill residents reporting higher rates of certain odors and eye, nose and throat irritation. The authors concluded that further investigation of respiratory illnesses should be conducted, as the study showed high rates of respiratory-related symptoms and conditions (Berger 2000). For more health studies, see Appendix A.

Health Studies of Populations Living Near Landfills

Studies have been published that have found a link beween living near landfills and adverse health outcomes. Many of the studies are annotated and included in Appendix A. Several of these studies are briefly described below.

A study in Great Britain compared populations living within 1.2 miles of 9565 landfill sites, to those living farther away, in an effort to determine the risk of birth defects in relation to living in close proximity to a landfill. The study examined data from hazardous waste, municipal waste, and unknown waste sites. The authors found slight increased risks for neural tube defects, abdominal wall defects, and low and very low birth weight. They also concluded that, "findings for special [hazardous] waste sites did not differ from those for non-special sites" (Elliot 2001).

Another study in Cumbria, northwest England examined the risks of stillbirth and neonatal death for mothers living near landfill sites. For the period 1970-1993, a small but significant increase in risk of "other congenital anomalies of the nervous system" was found in mothers living near domestic waste landfill sites. This finding was consistent with other research, but a causal effect could not be inferred and the possibility that the results occurred by chance could not be ruled out (Dummer 2003). More studies are listed in Appendix A of this guide.

Chapter 5

The Flow of Waste

Transfer Stations

After garbage is collected from the street, it is often taken to a transfer station. There the garbage collection trucks "tip" their waste load onto the "tipping floor," and drive off. The garbage is then swept into a lower level compartment, compacted into tight bales of trash, and loaded into tractor-trailers or rail cars. These vehicles then transport the garbage to distant landfills, or other waste disposal facilities such as incinerators (Gornto 2010).

Transfer stations may process large amounts of waste for an urban area. Community concerns around transfer stations include odors, noise and emissions from heavy truck traffic (McCarthy 2007). Communities are right to be worried; health studies conducted in New York City and London have show elevated levels of particulate matter (miniscule bits of liquid or solids such as smoke, water, dust, and other pollutants) near waste transfer stations. Airborne particulate matter (PM) is considered a type of air pollution and has been shown to harm the respiratory system. A recent study in Erith, London found that the PM from a transfer station there contained trace amounts of metals like lead, and concluded "WTS [waste transfer station] activity should be considered a potential health risk to the nearby residential community" (Godri 2010).

For more information about transfer stations, view CHEJ's *Waste Transfer Stations* fact pack: http://chej.org/assistance/publications/135-waste-transfer-stations-fact-pack/

Exporting Urban Garbage to Rural Areas

In 1994, the Supreme Court overturned flow control laws, which had allowed municipalities to designate where solid waste generated within their jurisdiction was taken. This was generally used to guarantee MSW (and thus profit) for specific disposal sites, which had been paid for by revenue bonds. Opponents argued that it created local monopolies and violated interstate commerce clauses of the Constitution (McCarthy 1995).

While the pros and cons of flow control laws continue to be debated, the outcome of the 1994 ruling has contributed to three trends in waste management:

- A shift from many small local landfills to a few large regional disposal sites.
- Consolidation of waste management companies.
- Increased distance between MSW collection and disposal, often across state lines.

Private waste management companies may choose to ship waste to their own facility, even at a greater distance, than pay to dispose locally in a landfill owned by a competitor (McCarthy 2000). In 2005, over 42 million tons of MSW crossed state lines, over 17% of all generated waste. Most travels from urban areas to rural landfills: New York City sends its waste to Pennsylvania and Virginia, Chicago exports garbage to Wisconsin and Illinois (McCarthy 2007). As a result, lower-income rural communities often shoulder a disproportional share of the environmental burden and health risks associated with landfills.

Sending Trash Abroad

Most municipal waste generated in the U.S. stays within our borders.[1] However, exporting items abroad for recycling is a growing trend. This is especially true for electronics and certain plastics, which are sent to developing countries. Whether these exported electronics are actually recycled or dumped is a question (see Silicon Valley Toxics Coalition). If these electronics get dumped, this is unacceptable. Other countries often have less stringent guidelines about handling hazardous items than here in the U.S., placing workers at risk of toxic exposure.

The issue of e-waste disposal is burgeoning. Global e-waste generation balloons every year by roughly 40 million tons. The United Nations Environment Programme released a report in 2010 forecasting a 500% increase in e-waste for India, compared to 2007. Places like Nigeria, Brazil, China, and Mexico would also see sharp increases (UNU 2010). E-waste from the U.S. exported abroad is a contributor to this growing problem, but things are changing. The EPA has assisted in the identification and disruption of the illegal collection, recycling, export, import, and shipping of e-waste (USEPA 2014b). Starting in 2012, 240 tons of illegally-traded e-waste was seized and 40 companies were criminally investigated (USEPA 2014b).

Profiting from Garbage

Before being brought to a landfill or recycling center, garbage must be collected and sometimes stored. These services can be provided by the local government, a private firm contracted by the government, or a private firm that has contracted to residents (LGEAN 2003). In the late 1960s to early 1970s, the "corporatization of garbage" (Rogers 2005) led to large national companies replacing thousands of small private waste management providers (Hickman 2000). These large waste management companies have been in fierce competition ever since, frequently merging and buying each other to become even larger. This has resulted in a virtual takeover of the waste management market by a small number of large, private firms.

Waste management firms make money in direct proportion to the amount of waste that gets thrown away and make the most money when garbage is placed in landfills, as opposed to composted or otherwise diverted. Their pursuit of profit is clearly reflected in their priorities today. It is much more appealing to these companies to invest in landfill technology such as bioreactors, which allow them to fit more garbage in each landfill, than in waste reduction strategies (Rogers 2005).

1 With a few exceptions involving agreements between states and Canadian provinces

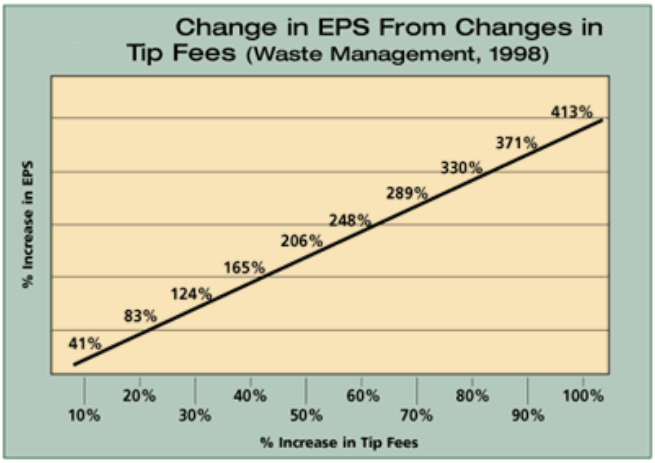


Figure 7: WMI Changes in Earnings Per Share From Increased Tip Fees

Case Study: Waste Management, Inc.

In 2015, out of 100 firms dealing with MSW, the top ten comprised 83.6% of industry revenue at $44.6 billion. Waste Management was first on the list at just under $14 billion, while Republic Services came in second at $8.8 billion (Waste360 2016). These firms take an integrated approach, operating not just landfills, but local garbage collection, recycling, transfer stations, and transportation, often across state lines.

The largest waste management company in the United States is Waste Management, Inc. (formerly WMX) of Houston, Texas. A massive global corporation, Waste Management offers collection, transfer, disposal, recycling, and "renewable" energy services. They operate 390 collection operations, 300 transfer stations, 267 active landfill disposal sites, 120 recycling plants, 17 waste-to-energy plants (burning garbage), and 113 "beneficial-use landfill gas projects" (burning landfill gas) (WMI 2011, 2013, 2014).

Despite efforts to market their company as "green", the abuses of Waste Management are longstanding and pandemic. The corporation has a documented history of ignoring environmental laws, monopolizing the waste disposal industry in communities and then raising prices, placing landfills and transfer stations in low-income and/or minority neighborhoods, and lobbying the federal government on environmental policies.

The corporation has 75 current sites on the Federal Superfund register (in addition to 3 proposed and 9 removed sites). Also, according to the center for Responsive Politics, WM spent over $12.2 million in lobbying between 1998-2014, and almost $4.5 million in campaign contributions during the same period (CRP 2016, 2015). Waste Management was inducted into the Corporate Accountability International (formerly INFACT) Hall of Shame in 1996, "because of its long history of manipulating policy affecting the environment and public health, while engaging in practices that are detrimental to both" (Infact 1998).

For information and local news articles about Waste Management, Inc, visit the Stop Waste Management at: http://www.stopwmx.org/waste-management/

Chapter 6

Communities Fighting Back

As evident from the preceding chapters, landfills are unsustainable, unreliable, unsafe, and provide false "solutions" to our increasing waste stream. Fighting their construction is the first step towards moving to a zero waste approach, and as the following case studies show, resistance to landfills is fiercely alive.

Big Run Landfill, Kentucky

Group
Citizens of Boyd County Environmental Coalition, Inc. (CBCEC)
http://www.citizensofboydcountyenvironmentalcoalition.com/

Background
Managed by EnviroSolutions Inc. (ESI), Big Run Landfill recieved its permit for construction in 2001, started operating in 2004, and was granted a second permit for expansion a year later. One of the busiest sites on the East Coast, the landfill takes in more waste than any other landfill in the state. At an average of 3,298 tons per day, the amount of waste brought in by the company reached 1.5 million tons in 2014. During that year, 90.25% of the total waste collected was imported via railroad from out of state.

Environmental Concerns
For the citizens living within and around Boyd County, receiving excessive amounts of waste from other states apart from Kentucky causes much concern. In most cases, odors and gases emitted from landfill waste are substantial enough to draw complaints from the community. But in this case, when the majority of the waste within the landfill comes from out of state and continuously adds to the problem, the effects are magnified - creating a much bigger need for control.

There were 135 complaints filed against Big Run in 2013. That same year, the landfill suffered a major trash landslide, which affected 8 acres of land on-site. Since then, complaints about odors originating from Big Run have increased greatly - a total of 593 complaints were filed during 2014.

Community Organizing
In efforts to protect the community and show opposition to the landfill, CBCEC has filed a number of complaints, as well as requested the Boyd County Fiscal Court to reduce the volume of imported MSW to the landfill. They have also asked the Division of Air Quality (DAQ) to reconsider a 2:1 dilution ratio, in place of the 7:1 ratio set by the Kentucky Department of Environmental Protection.

Working with Ohio Valley Environmental Coalition and the Appalachian Mountain Advocates, CBCEC filed a lawsuit in June 2015 against ESI on the premise that the permit granting Big Run expansion in 2005 was unconstitutional.

Keeping in touch with the community through their Facebook page, the coalition posts about current happenings in regards to nearby landfills and environmental health, as well as reminders about what members can do to alert authorities of the continued impact of Big Run on their community. They encourage members to call and report odors to the DAQ. According to CBCEC's Facebook, there were 3,211 calls made in 2015 alone.

Current Status
An agreement was reached in November 2015 between CBCEC, the Fiscal Court of Boyd County, and River City Disposal LLC with goals to decrease the size of the landfill, as well as create a safer environment for the community. Under this agreement, the importation of MSW by rail will cease to be a part of the company's operation by July 2016, as Big Run is no longer allowed to accept sewage wastes from areas outside of Boyd and surrounding counties. The agreement also allows county and CBCEC personnell to visit the landfill and inspect ongoing operation in order to verify compliance.

Increased environmental protection systems will also be put into place. There will be fence line monitoring for hydrogen sulfide and methane, as well as the further develpment of a project resulting in better air quality. ESI has partnered with Enerdyne Inc., a company that specializes in the creation of gas control and collection systems, in hopes of capturing the waste gas produced by the landfill.

Complaints from community members have decreased since the creation of the agreement as the surrounding environmental conditions are slowly improving. Though still working towards their ultimate goal of closing the Big Run landfill, this agreement was a huge victory for CBCEC.

Sunshine Canyon Landfill, California

Group
North Valley Coalition of Concerned Citizens (NVC)
http://www.nodump.com/

Background
Owned by Republic Services Inc., Sunshine Canyon Landfill (SCL) is a giant city/county landfill built on top of the L.A. city and county border. Over the years, both city and county sides have been closed and reopened, due to the division in governing power. The City closed its dump between 1991-1999, followed by an expansion in 2006. The County side reopened for expansion in 1995, and over a decade later in 2009, both city and county sides were combined into the giant landfill it is today. Having to take trash from Lopez Canyon when it closed in 1996, Sunshine Canyon has become one of the largest sites in the nation.

Community Concerns
A plan called Renew L.A. was established in 2005, which called for a limitation on the amount of trash the landfill would be allowed to accept -

hoping to decrease intake by 600 tons per day. However, as of August 2015, it received an average of 8,300 tons of MSW per day - still much more than what Renew L.A. had planned.

Since the opening of the combined city/county landfill in 2009, there have been 8,410 complaints reported against SCL, to both the South Coast Air Quality Management District (SCAMQD) and the landfill itself. 1,795 of those complaints were filed in 2015 alone.

With 2015 seeing the highest number of complaints so far, a group of parents, whose children attend Van Gogh St. Elementary school, came forward during a meeting led by the Community Advisory Committee (SCL-CAC) to address this ongoing issue at Sunshine Canyon. Located only two miles from the landfill, the school is unavoidably exposed to odors from the landfill, and parents are concerned about the lasting effect it will have on the children. Two other schools are located within a two mile radius of the landfill, which causes concern for not only this group of parents, but for the rest of the community as well.

Community Organizing

North Valley Coalition provides technical advice about SCL, as well as advises groups in their efforts to combat the landfill. With the help of NVC, the group of parents from Van Gogh have been gathering data in support of the closure of SCL by looking into past records to find any evidence of noncompliance by the landfill.

A meeting was organized by North Valley Coalition in February 2016, which addressed the health concerns due to living near the landfill. During this meeting, the Van Gogh parents requested an analysis report of the 2013 air sampling data from AQMD, in order to see which toxins they are being exposed to in the air, and how severe those toxins can be to their health. As of late, this has been their biggest focus.

Some members of NVC are also part of the SCL-CAC, a committee comprised of concerned members of the communities surrounding the landfill. Other members of this committee include Republic Services, SCAQMD, and the Los Angeles Unified School District (LAUSD). In order to keep updated with activities associated with the landfill, SCL-CAC holds meetings to discuss current administration and assure compliance. Also, any concerns by community members are addressed during these meetings.

Current Status

SCL is currently participating in a pilot program to test effectiveness of Environmental Products, Inc.'s (EPI) ExtendedEnviro cover. This is in place of the 9 inches of soil used as daily cover material. With hopes to control odors, blowing litter, vectors, fires, and scavenging, the implementation of this geosynthetic cover started in 2015.

Since 2009, the systems for gas control/collection at Sunshine Canyon have continuously been upgraded. Republic has also recently implemented a landfill gas-to-energy (LFGTE) project at SCL, in partnership with DTE Biomass Energy and Aria Energy. The goal of this project is to convert the gas generated by the landfill and turn it into a more renewable energy source. This project is estimated by EPA to immensely decrease carbon emissions of the landfill.

Though the L.A. school district has placed air filters within the Van Gogh's air conditioning system, this does nothing to prevent or reduce exposure to toxins when the children are outside. Members of NVC and the Van Gogh group continue to monitor Sunshine Valley by attending SCL-CAC meetings in hopes that one day, the battle against SCL will end in a victory, as Lopez Canyon did over two decades ago.

Scotland County Landfill, North Carolina

Group
Scotland County of Tomorrow (SCOT)
http://www.nomegadump.org/

Background
In 2007, North Carolinian chapters of Blue Ridge Environmental Defense League (BREDL) and their allies successfully pushed for a statewide moratorium on new, huge garbage landfills called "mega dumps." However, this was only a temporary fix. In early 2010, after the moratorium had lifted, it was proposed that a closed landfill be expanded in Scotland County, North Carolina, near its border with the town of Maxton. This mega dump would help produce revenue for the struggling county. Strong and vocal opposition from both Scotland County of Tomorrow (SCOT) and the Maxton Board of Commissioners squashed the proposition.

Community Organizing
As a chapter of BREDL, SCOT was able to use many of its resources in order to effectively organize their opposition. In March, SCOT hosted a meeting with Neil Seldman, the President of Institute for Local Self Reliance, to talk about environmentally-friendly alternatives to the landfill, such as recycling hubs. SCOT sent copies of this video to local leaders. They also circulated material on the landfill through their website, as well as made posters showing where the landfill would be located, and leaflets asking where commission candidates stood to get votes in the primary. Maxton held a forum in which sixteen people spoke against the landfill, including other BREDL chapter members. The Maxton Commissioners voted unanimously to send a resolution in opposition to the landfill.

Current Status
Their efforts came to fruition in early June, 2010. The Scotland County Board of Commissioners voted unanimously to pass a resolution that officially ended any chances for the regional landfill. They also went a step farther, calling for a ban on any future landfill proposals in the county. Scotland County's fight was the first test for the state after it had passed its Municipal Solid Waste Act of 2007. It was a great success and should give hope to future landfill battles in North Carolina (Calhoun 2010, BREDL 2010).

Pottstown Landfill, Pennsylvania

Group
Alliance for a Clean Environment (ACE)
http://www.acereport.org/

Background
Pottstown has six landfills in a 35-mile radius, the highest concentration in the state. The Pottstown Landfill is an old, unlined forty-acre landfill operated by Waste Management. The site accepted hazardous waste from other states and counties and 17 kinds of radiation were found in leachate testing in 2005.

As early as the 1980's, the Pennsylvania Department of Environmental Protection (DEP) verified that toxic gases were traveling through the soil and into residents' homes. Yet, the DEP did not investigate this, or a host of other resident complaints about air and water quality.

Community Organizing
ACE members are an example of strong, successful grassroots organizing. They refused to share their neighborhood with a landfill that polluted their soil, air and water, and fought extremely diligently to close the landfill down.

ACE's tactics included distributing fliers about the landfill throughout the town, press releases, and attending every meeting possible with the town, county, local commissioners, zoning board, economic development council, etc. Members

made it clear that they wanted the landfill closed, and would not accept a compromise on the issue.

In addition, ACE reached out to community leaders, finding allies who supported their efforts in local politicians, businesses and a hospital. Like the group in Marin County, ACE held workshops and public forums on the issue, educating residents and keeping the landfill problems in the public spotlight even when there seemed to be little progress on the issue.

ACE used the health problems in their community as a platform in fighting the landfill. They focused on the toxic chemicals present in the landfill gas, making maps that indicated disease patterns pointing to the landfill as a primary cause. When Waste Management proposed building a pipeline and selling the landfill gas to a PVC plant on the other side of the town, ACE members organized a massive opposition to defeat the proposal.

Current Status

After twelve years of organizing, ACE declared a victory in 2004 when the DEP denied Waste Management's expansion permit. Since the landfill was at capacity, this meant that it needed to be closed. The DEP had previously never denied Waste Management a permit in its history; so much of this groundbreaking victory can be credited to the hard work of ACE.

ACE members continue today to monitor the closing procedures of the landfill. They are advocating for the filtering of leachate before it reaches the sewer line and drains into the local watershed, testing of drinking water wells within a fifteen mile radius for leachate contamination, and a new cap which will help prevent toxic air emissions.

Chapter 7

Taking Action

Organizing To Win Around Landfills

Every day, people facing threats to their health and environment speak out. They look for proof that a landfill leaks, or seek to undertake a health study to link emissions from an incinerator to cancer, or find evidence that a polluting company has a bad environmental record. However, simply speaking the truth about landfills, incinerators, toxic products or previous violations won't stop the poisoning of our bodies and the environment.

The truth is, it is only a start. In order for things to change, the truth has to be understood by a large group of people who then use this knowledge to fuel their efforts to win justice. The truth won't stop the poisoning, but mobilizing and organizing will.

According to Webster's dictionary, organizing is "uniting in a body or becoming systematically arranged." Organizing to protect our communities from environmental harm means pulling together a large enough, diverse enough, active enough group of people to convince the government and corporations that they have to stop making people sick with negligent waste practices.

Organizing is how we restore the balance between the rights of people to safe environments and healthy communities, and the rights of corporations to profit. We will never have as much money as the BIG Companies. We will never be able to afford their Madison Avenue media campaigns or their twenty-four hour access to elected officials. But we can build our own power to overcome their influence. We can do this by organizing to demonstrate the strength of our numbers and the righteousness of our demands.

Successful organizing happens when a group of people find visible ways to use the truth to wake up the conscience of a larger group. In an era where politics is defined by scandals and sound bytes, organizing can remind the American people that political life is supposed to be about self-government, justice and the common good.

After years of doing it, we've come to the conclusion that organizing is more of an art

than a science. At the same time, there are some basic rules for organizing that usually hold true. These rules are not always applicable, but they are right often enough that you should consider them if you start to get organized around an environmental issue in your community.

Basic Organizing Rules

Power determines the outcome.
If two or more groups care about an issue, and one of them has a lot more power, that group will get what it wants, no matter what the facts are or who will be hurt.

Our power comes from people, while corporations' and government's power comes from money.
Communities need to use strategies that depend on people's creativity, courage and caring. The corporations and government will use strategies that depend on things that can be paid for, like experts and lawyers.

Polluters and government agencies write the rules so they can win using experts and lawyers, which are their strength.
You can assume going in that if you play exactly according to the rules of their game, you will lose most of the time, whether you are at the slot machines in Atlantic City or the hearing process of your state environmental agency. Create your own rules instead.

To win, communities need to work harder than polluters and government agencies do.
Landfill operators and environmental agencies are doing what they do because they are paid. They have done it before, and they know most of the facts before the fight even starts. You are opposing them because you believe your health and your community are at risk. This gives you an unmatched motivation for working harder than they do.

These rules may seem harsh because they are. Sometimes things turn out to be easier than these rules would lead you to expect. But when your community is at stake, it is important to start out vigilant, alert and ready to face the challenges ahead.

Experience has taught us that organizing is not easy. Recognizing this should help you to be forgiving of each other and yourselves. We are trying to build a democratic society without adequate blueprints and models, so our trial-and-error method has to leave room for experimentation and mistakes. Recognizing how necessary organizing is should help you to be inclusive and persistent. There are no magic facts. There are no perfect heroes to give perfect speeches that will convince the polluters to stop polluting. There is only the dogged determination of people working together to protect their own health, their family's health and the health of their communities. This is why we organize.

Ten Key Steps To Organizing

1. Talk and Listen
If you are one, two or three individuals without an organization, you'll need to talk with other people in your community to build a group. If you are already part of an organization, then your next step is to talk to the people in your organization about initiating a campaign around a landfill issue in your community. Brainstorm a list of groups and individuals whose interests are most directly affected by the landfill, and then determine who you need to talk with first.

Who are the people that are most directly affected? Who are the leaders in that neighborhood? What other organizations are involved in protecting the community's health?

You can work out the answers to these questions in a brainstorming exercise at an early meeting

with your group. Brainstorm a list of the groups of people whose self interests are most directly affected, then figure out who has contacts with these groups or individuals.

2. Create and Distribute Fact Sheets
Create an attractive, easy-to-read and accurate fact sheet to educate the community about the problems and how these problems relate directly to their lives. A simple one-page fact sheet will serve the purpose.

3. Recruit People, One at a Time
Recruiting will help you build the relationships, resources and critical mass to act effectively for change. Reach out to a wide range of local groups to build the broadest possible coalition. It will be much more difficult for decision-makers to ignore your concerns if your campaign represents a wide cross-section of your community. All recruiting is a form of door knocking. If you are trying to organize a neighborhood, the doors line the streets. If you are trying to build a different kind of group or coalition, the doors may spread all over town and you may need appointments to open them.

There are several ways to make knocking on doors easier. First, come up with a 'rap'— "I am..." "We are..." "This is..." "We want..." "You can..." Also, consider circulating a petition. Not only will the petition help you get the names and addresses of community supporters and show community support to those in power, it also begins the process of getting the people you are talking with involved in the issue. Make sure to listen closely to the concerns of the people you are talking with and link the landfill problems to their interests and concerns.

4. Hold Meetings That Make People Want to Come Back and Bring Their Friends
People will come to a meeting if:

- They have made a commitment to come
- They have a role or responsibility in the meeting
- They have an immediate and specific self-interest in the work of the organization
- They have past, positive experiences with similar meetings

To have a successful meeting, your recruitment efforts must satisfy the first and third of these conditions. The second and fourth conditions will depend on how you run the meeting. There are several different kinds of meetings to suit different purposes.

House Meetings - This is the kind of meeting many groups hold when they are first forming. The meeting is held at a member's house and the style is informal. One of the biggest benefits of this kind of meeting is the greater comfort level among members.

Planning Meetings - Leaders or other key decision makers within the group get together to set their agenda, review the work that has been done, and plan activities. Planning meetings should not be decision-making meetings, but rather they should establish the agenda and process by which decisions will be made at a general membership meeting, or define a plan to carry out an activity that has already been decided upon by the membership.

General Membership Meetings - These meetings are important to ensure that all members of the organization share the responsibility for decision making and carrying out the activities of the organization. The time and location should always be chosen to accommodate the maximum number of people. The meeting should always start with an agenda, and when possible, get the agenda out to people prior to the meeting in the form of a flier (this will also serve as a reminder for the meeting). Make sure you pass around a sign-in sheet to collect names and addresses of

those who attended so you can contact them in the future. People will come to the next meeting if they enjoyed the first one, if it started and ended on time and was not a bore, if it produced concrete results, if it was lively and exciting, and if it delivered what was promised.

5. Set Goals

It is critically important to have long-term, intermediate and short-term goals to help members understand where they are going and the steps they have mastered along the way. Ask yourselves: What do we want? What is our bottom line? Do we want to deny the permit for a new landfill or landfill expansion? This could be your long-term goal.

Next, identify different strategies and tactics that will lead you to your goal, such as getting your city or county council to extend the public comment period or require a more extensive environmental impact assessment of the proposal. This could be your intermediate or short-term goal.

Groups that successfully oppose landfill expansions often actively support broader issues of waste in their community. Consider advocating a zero-waste policy (see Chapter 10), and expanding municipal recycling and composting programs. If you defeat a landfill proposal, but the waste from your community is sent to a landfill or incinerator in someone else's community, is it really a victory?

Within your group, it is important to come to a consensus on how much you are willing to compromise. For example, your group could choose to accept a landfill if the operators agreed to a double liner, monitoring for 50 years post closure (instead of 30) or leak-detection systems in the cover. We believe that all landfills will eventually leak, regardless of technology. However, you should discuss within your group how, if corporations or government agencies offer them, to approach these compromises, helping to avoid group divisiveness later down the road.

6. Identify Your Targets

Once you have identified what it is that you want, the next step is to identify who can give it to you. Pinpoint the actions and the people that have the power to help you reach your goal. The people who could impede the achievement of your goal are often referred to as the targets of the campaign. This does not mean that they are evil or bad. It simply means that because they have the power to give you what you want. It makes sense to focus your attention and actions on them. The target of your campaign must always be a person or persons. You can't fight City Hall because City Hall is a building, but you can target the person with the power at City Hall to get others to act.

To help your group identify your targets, answer these three questions.

- Who is responsible for the situation you want to change?
- Who can make the changes you want to happen?
- How can you convince them to act on your issue?

7. Research Is an Essential Tool

Research is a tool, not an end product. You need to do research to gather enough information to achieve your goals, not to know absolutely everything there is to know. Research should tell you who has the power to give you what you want and should help you figure out what arguments your targets will probably use against you. Once you know this, you can create counter arguments. This guide will provide general information, but research on your specific local issue needs to be undertaken as well.

8. Take Direct Action

An action is any step you take to advance your group's goals. Petitions, letter-writing campaigns and educational meetings are all actions that advance your group's goals. A direct action is the most dramatic type of action, involving confrontation and demands. Direct action begins after your efforts at education, information sharing and persuasion are ignored. Use direct action when your group is ready to confront a decision maker with its frustrations and to make specific demands. Direct actions move your organization outside the established rules for meetings and discussion. It takes your group into a forum in which you make the rules and where elected representatives and corporate executives are less sure of themselves and how to handle the situation.

Before taking direct action, however, understand the rules surrounding such confrontations. Confer with lawyers or local law enforcement on the legality of your proposed direct action, so that you know exactly what you are doing. Direct action is not for everyone, and your whole group doesn't have to be involved. Make sure those who want to participate are aware of the possible consequences. A direct action often provides the necessary pressure to force your target to act on your group's issue.

9. Target the Media

Who are the media decision-makers who need to be convinced that your story should be covered? What will it take to convince them? In most media outlets, the decision-makers are the editors, and the way you get to them is to spoon-feed them a story they can use without much work.

It is important to develop a media strategy for your campaign that you can constantly refine and develop. But don't be fooled into believing that the media is the only way to get your story out.

Keep creating your own media through fact sheets, cable access television programs, newsletters, call-ins to radio talk shows, letters to the editor, statements at public hearings, barbecues, rallies, auctions, concerts and videotapes.

Also, don't hesitate to use social media to create pressure. Create a FaceBook page or Twitter account to keep people up to date with your group and the status of the issue you're fighting.

- Add us on Facebook: https://www.facebook.com/CHEJfans/
- Follow us on Twitter: https://twitter.com/chej

10. Celebrate the Victories and Keep Applying Pressure

Savor the victories no matter how large or small. A meeting with the City Council is a small victory and denial of a permit is a larger victory. Celebrate all victories because it helps members to see that you are moving forward and winning. No one wants to join a losing organization.

For more information pertaining to organizing, see the following handbooks written by CHEJ:

- *Fight to Win: The Leadership Handbook* *http://chej.org/assistance/publications/002-fight-to-win-leadership-handbook/*
- *Organizing Handbook* *http://chej.org/wp-content/uploads/Organizing-Handbook-PUB-059.pdf*

Chapter 8

Regulations and the Permitting Process

Who Regulates Landfills

Solid waste is primarily regulated by state and local governments. However, legislation passed by Congress (such as RCRA) and EPA-issued guidelines provide minimum standards for landfill management (USEPA 2006). It is important to note that these guidelines are the *mimimum* - you and your community are encouraged to lobby your local leaders and state agencies for more comprehensive regulations.

The following is a brief overview of two important landfill regulations.

RCRA Subtitle D

The key piece of legislation affecting modern landfills is Subtitle D of the Resource Conservation and Recovery Act (RCRA), first implemented in 1976. RCRA has been amended several times, and the EPA developed and adopted the Subtitle D requirements in 1991, with requirements being phased in by 1997 (McCarthy 2000).

Estimated Annual EPA Cost: $330 million (McCarthy 2000)[2]

RCRA affects new landfills or landfill expansion projects, but has little impact on existing sites. Though the number of landfills in the US continues to decline, existing landfills are expanding, thus falling under RCRA regulations.

Location: Landfills must meet certain standards before being sited on flood plains, wetlands, seismic fault zones or near airports (birds are attracted to landfills and can pose a risk to air traffic) (USEPA 2006). It is important to note that landfills are not *prohibited* from being built in these high-risk areas, but merely subject to stricter regulation.

Design: Subtitle D regulations are based on the "dry tomb" approach to landfilling, in which waste is isolated in a plastic-sheet and clay-lined landfill. The regulations require landfills to have a

2 Comparison Cost: Though costs can very wildly, estimates put the average cost of a Superfund cleanup between $25 million and $30 million (NHDES 2008)

.06-inch thick high-density polyethylene (plastic) liner on top of two feet of compacted clay soils. These landfills must also have a leachate collection system (Lee 2002).

Operation: Landfill operators are required to cover the waste daily with soil, control landfill gas emissions and prevent unauthorized access to the site (USEPA 2006).

Groundwater Monitoring: Subtitle D contains a variety of specific requirements intended to protect against environmental contamination, specifically of groundwater. Landfills must have a groundwater monitoring system in place to detect leachate leaks. Unfortunately, as described earlier, groundwater monitoring systems often fail to detect leachate leakage (see Chapter 4).

Corrective Action: If a landfill is found to be leaking into the soil and groundwater, the operator of the landfill must take *corrective action* to clean up the contamination. Corrective action denotes a process of assessment (find the source of contamination), investigation (determine compounds involved, severity of contamination, health risks), interim measures (contain the contamination temporarily to alleviate adverse health effects), planning and implementation of a clean-up method, and monitoring the landfill afterwards to guarantee no harm befalls the environment or humans (USEPA 2010c).

Closure and Post-Closure Care: Operators are required to collect and monitor landfill gas and continue maintenance of the landfill for 30 years after its closure (Lee 2002).

Financial Assurance Criteria: Before building a landfill or expanding an existing site, the owners and operators must prove that they have the financial resources to maintain the landfill, perform corrective action as needed, and conduct closure and post-closure activities for 30 years (USEPA 2006). One of the consequences of this statute is that it favors large landfill companies (such as Waste Management).

Critiques of RCRA

Since RCRA limits the amount of hazardous waste that can be disposed of in a MSW landfill, it implies that MSW landfills are not toxic. However, as discussed previously, leachate from MSW landfills often contains hazardous chemicals which are a threat to public health and the environment. Despite the RCRA focus on defined hazardous waste, the risks of MSW leachate (which may or may not contain hazardous chemicals) should not be overlooked (Lee 2002). Subtitle D does not require any sort of minimum buffer zone between a landfill site and adjacent properties, placing the surrounding community at risk when contamination eventually occurs.

Subtitle D, first passed in 1976, was phased in by 1997, making current Subtitle D landfills at least 19 years old. However, many of the problems associated with aging liners have not yet occurred in these landfills. Proponents note that groundwater contamination has not been found in Subtitle D landfills. However, in addition to the unreliability of groundwater monitoring systems, unless the site was very poorly constructed, it is unlikely that leachate would even pass through the clay soils for 25 years (Lee 2002).

While leak-detectable covers for landfills exist, they are not required by Subtitle D. The plastic-sheeting cap on a landfill will eventually deteriorate, creating polluting leachate. By allowing operators to visually monitor caps, Subtitle D legislation encourages a lowest-cost approach which fails to take adequate measures for cover maintenance (Lee 2002).

After the first 30 years of a landfill closure, there is no guarantee of funding for any clean-up needed

because of leachate contamination. It is possible that a properly installed and non-punctured liner could prevent groundwater pollution from leachate through the 30-year post-closure period. Thus, a liner could begin to show signs of aging and leakage after the landfill owner ceases to be responsible for it. However, holding private companies or even public agencies responsible for remediation costs will prove difficult, if not impossible. A 2001 audit report by the US EPA Inspector General affirms this, stating that:

"Many landfills may need more than 30 years of post-closure care. However, most of the state agencies in our sample had not developed a policy and process to determine whether post-closure care should be extended beyond 30 years, and there is no EPA guidance on determining the appropriate length of post-closure care." (USEPA 2001)

As landfill engineering expert Dr. Fred Lee writes, "this situation virtually assures that there will be future "Superfund" sites at today's municipal Subtitle D landfills" (2002).

While Subtitle D made strides towards improving landfill construction and operation, there are many areas that could be improved. When new landfills are built, citizens need to advocate above and beyond Subtitle D for best technologies to protect public health and the environment from landfill pollution.

Clean Air Act, Section 111

In 1996, the EPA began to regulate air pollution from landfills under the Clean Air Act, requiring that MSW landfills must "control emissions to the level achievable by the best demonstrated system of continuous emission reduction, considering costs, non-air quality health, and environmental and energy impacts" (USEPA 1996). This regulation applies to landfills that meet the following criteria (USEPA 1999):

- Built, expanded or remodeled since 1991
- Have a capacity of at least 2.5 million cubic meters
- Emit at least 50 metric tons per year of non-methane organic compounds (NMOCs), such as benzene, toluene and vinyl chloride

The annual cost of implementing this regulation is $94 million (McCarthy 2000).

As of 2014, 1,000 US landfills meet these criteria (USEPA 2014c). These landfills must have a gas control system in place which reduces landfill gas emissions by 98 percent. Interestingly, the EPA chose not to base the criteria on green house gas emissions, but NMOCs. While it is important to regulate NMOCs, it seems that a more comprehensive regulation system would include both types of emissions.

For more information on landfill regulations:
- EPA: *Laws and Regulations for Waste:* http://www2.epa.gov/regulatory-information-topic/waste
- EPA: *Air Regulations for MSW Landfills*: https://www3.epa.gov/ttn/atw/eparules.html

The Permitting Process

When opposing a new landfill or expansion, it is important to be aware of the opportunities for public participation for you and your group. While each situation is different, we have laid out a general chronology of the permitting process for landfills.

Pre-application meetings
The permit applicant (i.e. the landfill operator) is required to hold a public meeting at least 30 days before filing for a RCRA permit (USEPA 2006). Though they are required to advertise in

the affected community, these meetings are often poorly-publicized with low attendance. It is likely that your group did not learn about the proposal until after the permit was filed.

Public comments

After the operator files the permit, the permitting agency (such as the local board of commissioners) sends a notice to everyone who attended the meeting that the application is available for public review. The permitting agency will decide to provisionally grant or deny the permit. Once the decision has been made, a public comment period of at least 45 days begins. The agency must also prepare a fact sheet about their decision. You can request a copy of it, and the original application, from the agency.

Members of your group can submit written concerns and suggestions to the agency. The permitting agency is required to respond to all "significant" comments raised (though the definition of "significant" is open to interpretation) (USEPA 2006).

Public hearings

Your group can request a public hearing during the comment period by submitting written notice of your opposition (or support) for the agency's decision. The agency may also decide to hold public hearings, giving at least 30 days notice (USEPA 2006). These are extremely important opportunities for you and your group to speak out against a proposed landfill and show the agency (and the media) the degree of public opposition.

Regulatory agencies and landfill operators often seek out landfill consultants to testify as to the viability of the proposed landfill. However, if these independent consultants give negative feedback on the proposal, they risk not being hired for future work by the same companies and agencies. As a result, expert consults tend to be extremely supportive of proposed landfills (Lee 2002). Remember – you need to create your own rules for the struggle, focusing on a strong grassroots opposition rather than technical details.

Final decision

Once the comment period closes, the agency will issue a final decision. If it is not in your favor, don't give up! Re-evaluate your group's goals and tactics, and determine how you want to proceed with this new obstacle.

Chapter 9

Troublesome Alternatives

There is no "away" place where our garbage can collect without harming anyone. Our ability to safely dispose of waste is flawed. When fighting a landfill in your community, we encourage you and your group to explore alternatives to landfilling, such as the zero waste concept mentioned earlier. A few of these alternatives involve new types of landfills, and are often touted by industry, government agencies, the media and sometimes even environmental groups as "clean" and "safe" options. Yet, it is critical to remember, **there are no good landfills**. They may break down waste faster, or produce gas for energy, but they will eventually fail and contaminate the surrounding water, soil and air.

Don't settle for the 'lesser of two evils.' Remember your group's goals, and be wary of "greenwashing" tactics, i.e. a company's portrayal of its practices as being environmentally friendly when in reality, they are not. Any risk to the health of your community is too much.

Bioreactors, Mechanical Biological Treatment, and Leachate Recycling

Some landfills are being created as or converted to "bioreactor" or "wet cell" landfills. This involves the introduction of moisture to the landfill, typically by "recycling" leachate that has been drained from the landfill. In theory, the moisture in the landfill speeds up the breakdown of waste in the landfill, which increases available space.

Bioreactors are often advocated because it reduces the cost of leachate management, but in reality, it creates a situation where, if the groundwater is contaminated, the cleanup costs far exceed any savings (Lee 2004a). The recycling of leachate increases the toxicity of the leachate, which can then contaminate groundwater in more potent forms than if the leachate wasn't reused (Jones-Lee 2000). The additional moisture also adds to the rate of methane formation (Anderson 2007). In addition, much of the garbage in landfills is contained in plastic bags, which significantly reduces the speed of waste breakdown. While "wet cell" methods could be a viable alternative

if waste is shredded *and* additional groundwater pollution controls are utilized (such as secure liner designs and perpetual and comprehensive groundwater monitoring), at this point bioreactors are generally not a safer alternative to dry tomb landfilling (Lee 2010a).

Energy Recovery

As the concern over global climate change continues to mount, the EPA and several states have actively supported landfill-gas-to-energy (LFGTE) projects as a way to reduce greenhouse gas emissions. For instance, the EPA touts their Landfill Methane Outreach Program (LMOP), which "promotes the use of landfill gas as a renewable, green energy source" (USEPA 2008b). Landfill gas is 40% to 60% methane. Gas is extracted using wells, blowers or a vacuum system, and processed to generate energy in the form of either electricity (via internal combustion engines or gas turbines) or heat (via boilers) (Ewall 2007). As of July 2012, there were 576 LMOP projects in the U.S., with 540 of those being MSW landfills (USEPA 2012).

Given the overall low rate of landfill gas collection discussed previously, LFGTE projects remain troublesome. If only a small portion of methane from landfill gas is actually being captured, and the LFGTE unit uses a highly polluting internal combustion engine, which releases carbon dioxide into the atmosphere, the greenhouse gas reduction is minimal at best. In a report to the California Air Resources Board on landfills and greenhouse gas production, Peter Anderson (2007) asserts that only 1% of the methane sequestered by LFGTE projects can be considered a greenhouse gas offset, writing that:

"Landfill-gas-to-energy is a non-productive approach that fails to overcome the fact that, especially in a world concerned with climate change, land disposal alone, or all the other options to manage discards, creates the enormous volumes of methane that are among the most significant contributors to anthropogenic greenhouse gas emissions." (Anderson, 2007)

Burning natural gas is not considered a "green" energy project, yet it releases less pollution per unit of energy produced than burning landfill gas, which is viewed as a "renewable" energy source (Ewall 2008). Since landfill gas is often marketed as a "green" alternative, states can use it to meet their Renewable Portfolio Standard (the required percentage of electricity generated from renewable sources). Landfill operators are thus given incentives to produce as much gas as possible. This may also mean delaying the covering of the landfill to allow more moisture to enter the landfill (and thus generate more methane during decomposition), exposing the community to increased rates of odors and toxic chemicals (Ewall 2008).

Combusting landfill gas for energy can be dangerous. The EPA regulations state that when landfill gas mitigation techniques are in place, 98% of emissions are reduced. Even overlooking the problematic nature of gas collection, that still leaves 2% of the toxic gas emitted into the atmosphere. When certain non-methane organic compounds in the gas (such as chlorine, fluorine or bromine) are burned in the presence of methane, dioxins and furans are formed. Dioxins can form at low temperatures (200 °C to 400 °C), such as when the gases are cooling down after the combustion process (Ewall 2007). A review of 20 studies on dioxin releases found that on average, LFGTE projects released more dioxin than shrouded flaring (burning gas without trying to convert it to energy) of landfill gas (Caponi 1998).

Finally, LFGTE projects tacitly imply that there are no other ways to reduce methane production in landfills, and operators must simply make the best of a bad situation. Alternatives, including the removal and composting of organic matter before waste is sealed, can also reduce the amount of methane produced from landfills. Moreover, truly "green" and renewable energy options, such as solar and wind power, should be pushed as alternative energy options instead of LFGTE projects (Ewall 2007).

Incineration

The burning of waste is arguably even more dangerous to the environment and public health than landfills. Incinerators release dioxins, mercury, heavy metals, acid gases (which lead to acid rain), particulate matter (which compromises lung function) and greenhouse gases. Even incinerators which meet pollution control standards still create ash, which is classified as hazardous waste. In addition, no air pollution controls are 100% effective. Overall, incinerators waste more energy than they produce (Tangri 2003).

Incineration is not a solution to landfills, nor vice versa. Rather, we should work for alternatives which divert materials away from landfills or incinerators and actually reduce the waste stream.

For a detailed analysis of the problems of incineration, we recommend an excellent report by the Global Alliance for Incinerator Alternatives (GAIA) entitled "Why incineration is a very bad idea in Twenty First Century," available at: http://www.no-burn.org/why-incineration-is-a-very-bad-idea-in-the-twenty-first-century.

Chapter 10

Real Solutions: Zero Waste

"Waste is tangible evidence of economic inefficiency and lost resources."
– Neil Tangri, GAIA, 2003

While throwing away an item (or burning it) will always have health and environmental repercussions, alternatives exist. Though landfills are currently the least expensive option for disposing of waste, their true cost is rarely taken into consideration. Consider the thousands of dollars spent on the cleanup of Superfund landfills, the health care bills for those with cancer or respiratory ailments, or the loss of property values for nearby homeowners. And what is the value of clean air and water? Certainly more than the limited economic benefit a community receives from taxes and a handful of new jobs at a local landfill.

We encourage you and your group to become advocates for a comprehensive approach to managing waste. This prevents your opponents from accusing you of NIMBY-ism[3] and gives your group more leverage and legitimacy in the eyes of elected officials. Some of the most successful groups we've seen, have not only defeated landfill proposals, but led to improved commercial recycling and composting facilities, passed waste-reduction ordinances in their municipalities, and created a public discourse on the problems (and solutions) to issues of waste. You and your group have the potential to create a more sustainable future for your community – we look forward to hearing how you act on it!

3. Literally, "Not In My BackYard", this term has negative connotations and denotes a belief where people only protest an action when it affects them directly, rather than being concerned with the broader problem.

An Introduction to Zero Waste

Zero waste is a systemic approach to eliminating, rather than managing, waste. It is not just community based actions – reducing, reusing, and recycling – but includes industrial responsibility to design products and packaging in sustainable ways. It targets every stage in the lifecycle of a product, from design to disposal, resource extraction to recycling (NWNZT 2003). The overarching philosophy of zero waste imagines our industrial system as a closed-loop system, in which everything is reused and recycled into future uses (Connett 2001).

At first, the concept of zero waste seems impossible to wrap your head around, but it really is possible. Communities around the world have passed zero-waste ordinances, from California to Nova Scotia to New Zealand (GRRN 2007). These local municipalities are using zero waste as a guiding principle, and are achieving tangible results – increased recycling rates, new jobs from recovery industries and better air quality (Connett 2001).

For a wealth of information on zero waste, including sample policies and strategies for working with elected officials, visit the Grassroots Recycling Network (GRRN) site: http://www.grrn.org/zerowaste/. For the worldwide perspective, see Global Alliance for Incinerator Alternatives (GAIA) on the zero waste campaign, visit: http://www.no-burn.org/section.php?id=91 .

Source Reduction

The U.S. is the epitome of a consumer society. Since the 1950s, our consumption rates have skyrocketed – and so have our trash rates. For a nation with 5% of the world's population, we have already consumed 30% of the earth's resources. Interestingly enough, and perhaps most telling, our happiness as a nation has declined ever since consumerism became our country's focus (Leonard 2007). Our current pattern of "buy-use-throw" is impractical and unsustainable, which is why one of the most important components of zero waste is source reduction. This is pretty straightforward – consume less, and thus throw away less.

On a consumer level, this entails not just reducing the amount of stuff we use, but reusing existing items. Source reduction can be on a smaller, simpler scale– printing on both sides of a piece of paper, donating used clothing – or be a bigger

5 Tenets of Zero Waste

Redesign Products and Packaging.
Limit resource consumption, toxicity and waste, while recovering materials through reuse, recycling or composting.

Producer Responsibility.
Hold manufacturers responsible for the waste and environmental impact their product and packaging creates, rather than passing that responsibility on to the consumer. Encourage manufacturers to redesign products that reduce material consumption and facilitate reuse, recovery and recycling. (For more information, visit http://www.upstreampolicy.org/.)

Invest in Infrastructure, Not Landfills.
Have communities use the tax base to invest in new recycling and compost facilities rather than landfills - the technological advances of the 1990s can easily support the diversion of 90% of society's discards.

End Taxpayer Subsidies for Wasteful and Polluting Industries.
Remove tax subsidies that make using virgin resources for raw materials the least expensive option. Assign economic penalties to landfill operators for the emissions, contamination and public health risks they create.

Create Jobs and New Businesses from Discards.
Separating and processing recyclables employs ten times more jobs on a per-ton basis than landfills (ILSR 2006).

- adapted from "Beyond Recycling! Zero Waste… Or Darn Near" by Eric Lombardi (EcoCycle. '01)

commitment, such as not owning a car. This saves money for both consumers - who buy less stuff, and municipalities - who have less waste they must pay to dispose of (USEPA 2008c).

One way that communities can encourage source reduction is by developing "pay-as-you-throw" programs (PAYT). These programs charge each resident or business for trash collection based on how much they throw away. This has been shown to be very effective; not surprisingly, people respond well to financial incentives. When Austin, Texas implemented a PAYT program in 1997, recycling rates increased 11 percent in just over a year (CWMI 2001). Municipalities across the country, small and large, have similar success stories.

A final piece of source reduction focuses on industry. Manufacturers can create products which require less packaging, create less waste during production, and have a longer lifespan (USEPA 2008d).

For a creative and clever presentation of consumerism in the United States, watch Annie Leonard's "The Story of Stuff" at www.storyofstuff.com.

Recycling

Source reduction is not always possible, such as when an item has reached the end of its lifespan. It is important to have recycling programs set up in your community to handle waste that would otherwise be sent to landfills. Sometimes recycling remakes the same product (such as paper), and sometimes it creates completely different items. Your plastic containers could be made into park benches or carpets and your glass bottles could be an ingredient of a paved road.

A Special Note on Electronics Recycling

Recycling of electronic waste is the safest and most cost effective strategy for dealing with the problems created by obsolete technological items. Valuable materials can be harvested for reuse, reducing the amount of disposed hazardous waste. Unfortunately, the recycling of e-waste remains an expensive proposition for both consumers and local governments. Too often, e-waste recycling exposes workers to dangerous levels of toxic chemicals, or is exported overseas, where cheap labor and lax environmental laws exist.

The European Union has introduced Extended Producer Responsibility (EPR) for dealing with e-waste. EPR dictates that producers must work to find less-toxic alternatives for their products, labeling e-waste and improving recycling capabilities. Costing only 1-3% of retail cost, EPR holds industry responsible for the solutions (Scanlon 2001). While some US computer manufacturers have made limited promises to improve electronic recycling, toxic e-waste continues to fill landfills at a growing rate.

For more information on electronic recycling and how to safely dispose of e-waste:

- Electronics Take Back Coalition: www.electronicstakeback.com
- Silicon Valley Toxics Coalition: www.svtc.org
- Greenpeace: www.greenpeace.org/international/campaigns/toxics/electronics
- EPA eCycling Program: www.epa.gov/recycle/

Unfortunately, just because recycling is a good thing doesn't mean that it is always cost-effective. Putting waste in a landfill is often more affordable for municipalities than diverting items to a material recovery facility (MRF) to be sorted. Once at the MRF, items become commodities, with prices that fluctuate based on market forces. If the costs for a MRF operator to transport brown glass to the manufacturing site are higher than the price they will receive, it is unlikely they will continue to recycle brown glass. According to the EPA, recycling programs diverted 60.8 million tons of material away from the waste stream in 2008. However, 135.0 million tons still went to landfills (USEPA 2014a).

Recycling is a fast growing sector with many opportunities for new jobs. Unions, such as the International Brotherhood of Teamsters, have focused organizing and recruitment efforts on workers in material recovery industries (IBT 2015). A study by the National Recycling Coalition found that recycling creates 1.25 million jobs (five times the number of jobs in waste disposal), which pay approximately $3,000 above the national average wage (Beck 2001).

You can support recycling on two levels. First, learn what you can recycle in your community and maximize it. Look around your community – where are these opportunities to recycle at work or school, places of worship, and on the street corners? Brainstorm how to make recycling more convenient. Most people support recycling, but aren't willing to carry their waste with them until they find an appropriate receptacle. Some offices and schools have actually found that they saved money when participating in a recycling program, since they paid less for disposing less waste.

As a consumer, try to buy recycled products when possible. Look for items that contain "post-consumer" content. Encourage your workplaces, schools, religious institutions, libraries, and government offices to purchase items with recycled content.

Composting (commercial level)

The removal of biodegradable waste from the waste stream is an important step towards reducing the harmful environmental and health effects of landfills. In addition to simply having less waste to landfill, the removal of organic matter limits the production of the methane gas (a by-product of anaerobic decomposition).

In the 1999 Landfill Directive, the European Union required member states to reduce the amount of organic waste going to landfills by 75% by 2006, with additional benchmarks for further reduction (CEU 1999). As of 2005, 12 nations had submitted plans, with most already having met the goals, or on target to do so (CEC 2005).

Composting involves diverting lawn trimmings, food and other biodegradable items from the waste stream and allowing them to decompose. This is becoming an increasingly vital alternative, since the dry tomb landfill design limits the breakdown of organic matter. While compost bins in individual homes are valuable, it is unlikely that they have the capacity to reduce the waste stream in an area. Thus, it remains important that local municipalities take on the composting of organic matter on a large scale.

A few points to stress when speaking to local leaders (SCDHEC 2002):

- Composting reduces the amount of waste generated and extends the life of landfills
- Less waste reduces the threat of groundwater contamination and hazardous air emissions
- Composting can help meet local and state waste reduction goals
- Facilities create profit for local communities through the sale of soil and mulch

Some communities have no composting programs, some have drop-off sites for yard trimmings, others have weekly curbside collections for yard and food waste. What can and cannot be included also varies greatly. Find out about the options available in your area. Tell your mayor and local elected officials that you would like to see an improved commercial composting program in your community.

Composting may also include "biosolids" from wastewater treatment plants. Such places treat contaminated water to reduce contaminants, but they produce solid or semi-solid residue or sludge ("biosolid") that then needs to be disposed of. This sludge can be rich in nutrients, but it also contains toxic chemicals that are not removed by the treatment process. Toxic chemicals get into waste water when small business and light industry dump their waste chemicals into the same sewage system that residential homes use. Consequently, this sludge cannot be used as fertilizer, no matter what EPA and others say about how "safe" it is to use. The disposal of waste water sludge is regulated by 40 CFR Part 503 of the EPA.

For additional resources:

- Cornell Waste Management Institute: http://cwmi.css.cornell.edu/composting.htm
- EPA Composting Home Page: http://www.epa.gov/compost/
- EPA State and Regional Composting Programs: http://www.epa.gov/wastes/conserve/composting/index.htm

Working with municipal governments to enact alternatives

In order to fight landfills and reduce the waste produced by your community, it is crucial to work with local agencies and elected officials. This may seem daunting, but remember, they are there to serve you and your community members. Besides, your asking for changes might be the catalyst needed to start some real change! Use the organizing guidelines discussed previously to shape your strategy and approach.

Some helpful resources for working with municipalities:

- EPA - Comprehensive Procurement Guidelines for 'buy-recycled' programs: http://www3.epa.gov/epawaste/conserve/tools/cpg/
- California Integrated Waste Management Board - "Incentive Programs for Local Government Recycling and Waste Reduction:" http://www.calrecycle.ca.gov/publications/Detail.aspx?PublicationID=914
- Greenpeace (UK) - "How to comply with the Landfill Directive without incineration:" http://www.greenpeace.org.uk/media/reports/how-to-comply-with-the-landfill-directive-without-incineration

Chapter 11

Myths and Counterarguments

Below are a number of arguments or "myths" raised by landfill supporters and counterarguments to these "myths." These statements apply equally to hazardous or municipal waste; some counterarguments specifically address landfills, but others apply equally to other land disposal methods.

Myth: "Landfills are a "safe" way to dispose of trash."

Counterarguments:

- Even when built with today's technology, all landfills will fail after a certain amount of time.
- Current federal regulations do not provide enough protection against problems that may occur during and after a landfill is closed.
- Many researchers consider municipal solid waste landfills to have the same health effects and cancer risk as hazardous waste landfills.
- Today's common "dry tomb" landfills are considered "storage" for waste, rather than appropriate disposal solutions. Most waste in modern landfills cannot break down quickly due to landfill design or because the product is not biodegradable.
- Years after they are closed, many landfills will become Superfund sites.

Myth: "It's State-of-the-Art Technology."

Counterarguments:

- This really means, "This is the best we can do now." It's not a good solution and there is no guarantee of safety.
- The technology used for most landfills has not changed drastically in the last couple of decades and they continue to fail.
- "State-of-the-art" landfills have no track record, so what proof is there that they will be any better?
- That's what was said about the "double lined" landfill, yet they also fail.
- Is this the time to build more landfills? Isn't it better to use safer alternatives?

Myth: "The aquifer is already polluted; a little more won't hurt anything."

Counterarguments:

- As a society, we can't afford to "write off" aquifers.
- We want the aquifer cleaned up.
- Let's not make it any worse. There's no reason to continue doing so.
- If we take that attitude on all contaminated aquifers, we are in deep trouble.
- If people are drinking water from this aquifer, you already have a sensitized population; don't make it worse.
- We have a right to clean water for our children.
- We have a moral responsibility to do something. If someone has cancer you do not just let the person die, you do something!

Myth: "Not many people will be affected."

Counterarguments:

- In many cases now, this is no longer true. There are numerous landfills in densely populated, urban centers.
- In the case of more rural locations, rural aquifers are often the drinking water source for many cities. Animals and crops–food for cities–are raised on rural water sources.
- The lives of exposed populations are just as important as those of everyone else.
- It is equally important to protect the environment and the public.

Myth: "What else can we do with waste? What is the alternative?"

Counterarguments:

- We should reduce waste at the source. Less waste means less need for disposal space.
- Safe alternatives to landfilling do exist (See Chapter 10).
- We are smart enough to realize landfilling does not work.
- Include tax on final products to cover costs of proper disposal, recovery and recycling. If costs become too high, let the free market reflect this. It is okay if some products die, rather than people. Stop making products that produce toxic waste.

Myth: "If you shut down the landfill, we have to close and take our jobs elsewhere."

Counterarguments:

- Jobs are not lost permanently. They change.
- Landfilling is not labor intensive.
- Wherever the company goes, workers are still needed; skilled workers may be transferred to new locations.
- Plants can change practices, sometimes with large savings; industrial revenue bonds are available to help reduce costs.
- Most threats are just bluffs.
- Jobs are not worth the cost of sick children.
- Workers can get sick too.

Myth: "You are politically motivated."

Counterarguments:

- Right, but so what? These decisions are mainly driven by politics.
- If government and industry handled waste responsibly, residents would not become upset.
- Political participation, especially on decisions that affect people's lives, is a basic American right.
- Decisions are made by politicians, not scientists or engineers.

Myth: "We are the experts, not you. We know what we are doing."

Counterargument:

- We know how to read too. We have

common sense. Who are the real experts, anyway? Experts gain expertise gradually. Few have any real answers and most make mistakes.
- People who live there know the land.
- Experts disagree because science/ engineering is so uncertain, so what do the experts really know?
- We have proven we know our stuff. We are experts too–experts on our community!

Myth: "There is no direct scientific evidence that landfills cause health problems."

Counterargument:
- And there is no evidence that they **do not** cause health problems.
- Why must the burden of proof fall to us to prove harm exists? With people's health at stake, we should enforce the precautionary principle, and say that the burden of proof falls to the industry to show that no harm exists!
- Many scientific studies have found a link bewteen living near landfills and adverse health outcomes as compiled in the Appendix

Myth: "Zero Waste is impossible and impractical."

Counterarguments:
- Many things once deemed 'impossible' have become a reality; look at flying, computers, and vaccinations.
- How do you know it is impossible if you do not try?
- It is not about literally making zero waste; it is about setting an incredibly high bar so that we try our absolute best to grasp it, and in the process achieve new heights in waste reduction and recycling. It is about viewing landfills as a dire last resort rather than a quick fix, and seeing what we can accomplish if we act like there are no landfills.
- The chemical industry did not think it could drastically reduce dioxin levels, but here we are now, with a 90% decrease in dioxin levels. Who is to say we cannot do that with waste?

Appendix

Annotated Resources on Landfills and Health Effects

Though it may seem obvious to communtiy members that their health problems are associated with living near a landfill, few formal studies have supported this link. Most research has focused on studies of people living near hazardous waste sites, rather than municipal landfills. We have included some of these studies, recognizing that many MSW landfills contain a percentage of hazardous waste.

Though these can serve as helpful tools in supporting your argument, there are always errors within experimental study designs which can lead to skewed results. There is no way to be one hundred percent certain of the materials in a landfill, just as there is no way to definitively "prove" that health problems are a result of landfill proximity. We encourage you to use these studies as a tool in your fight. However, it is ultimately your organizing and advocacy that will make the most impact, rather than any health study.

1. **Shibata, T., Wilson, J. L., Watson, L. M., Nikitin, I. V., A., Ane, R. L., & Maidin, A. (2015). Life in a landfill slum, children's health, and the Millennium Development Goals.** *Science of The Total Environment*, **536, 408-418.**

   This study, conducted in Indonesia, evaluated the living and working conditions of those living in landfill slum. Through face-to-face interviews with the population, researchers analyzed the demographic and population characteristics, as well as ambient air and MSW contamination. Results of this study concluded that children from the landfill slum were more likely to suffer from diarrhea and acute respiratory infections.

2. **Mattiello, A., Chiodini, P., Bianco, E., Forgione, N., Flammia, I., Gallo, C., . . . Panico, S. (2013). Health effects associated with the disposal of solid waste in landfills and incinerators in populations living in surrounding areas: A systematic review.** *International Journal of Public Health Int J Public Health*, **58(5), 725-735.**

This report compiles the results of 60 relevant papers within literature that describe health problems related to landfills and incinerators. Researchers found that through their review, the most consistent result was found to be the occurrence of congenital anomalies, as well as increased rates of hospitalization, due to residency near waste landfills.

3. **Cabral, M. et al. Low-level environmental exposure to lead and renal adverse effects: A cross-sectional study in the population of children bordering the Mbeubeuss landfill near Dakar, Senegal.** *Human Experimental Toxicology* **(2012) 31:1280-1291.**

   This article examines the effect of lead exposure on children living near a landfill in Senegal. Soil and air samples collected near the landfill indicated metal contamination. The authors designed a study that examined multiple factors that indicated lead contamination in humans. The study concluded that the landfill poses a significant health risk for children. The biomarkers used to indicate the presence of lead showed high levels of lead absorption. An excess production of reactive oxygen species in specific organs may be involved in lead-induced renal injury. The authors suggest that these environmental problems be considered as part of future development programs in poor countries.

4. **De Felice, B. et al. Telomere shortening in women residents close to waste landfill sites.** *Gene* **(2012) 500:101-106.**

   This study examines the effect of environmental pollution from illegal landfills on pregnant women in Campania, Italy. Specifically, the study looks at the effect on telomere length which has implications for early onset of age-related diseases. The authors determined that the pollution caused by illegal dumping has resulted in higher oxidative stress, shorter telomere length and lower telomerase activity, which are known determinants of cell senescence and aging-related meiotic dysfunction in women.

5. **Heaney, C. D., Wing, S., Campbell, R. L., Caldwell, D., Hopkins, B., Richardson, D., & Yeatts, K. (2011). Relation between malodor, ambient hydrogen sulfide, and health in a community bordering a landfill.** *Environmental Research***, 111(6), 847-852.**

   This study looked at the health and quality of life of a community of North Carolina residents affected by exposure to numerous waste facilities. For ten months in 2009, participants of this study used methods of self-reporting to keep track of irritant and physical symptoms they experienced due to exposure from living near a landfill. Results found that experience of malodor was common to those who live near waste sites, and that it negatively impacts the well-being of those populations.

6. **Mari, M., Nadal, M., Schuhmacher, M., & Domingo, J. L. (2009). Exposure to heavy metals and PCDD/Fs by the population living in the vicinity of a hazardous waste landfill in Catalonia, Spain: Health risk assessment.** *Environment International,* **35(7), 1034-1039.**

   This study examines a population in Catalonia, Spain which is exposed to heavy metals from a hazardous waste landfill. Researchers specifically looked at the health effects associated with air inhalation, soil and dust ingestion, as well as dermal absorption. With their results, they concluded that concentrations of metals found within the area were relatively higher in the nearest village to the landfill- indicating closer proximity to a landfill equals higher exposure to the pollutants released by said landfill.

7. **Porta, D. et al. Systemic Review of Epidemiological Studies on Health Effects Associated with Management of Solid Waste**. *Environmental Health* **(2009) 8:60-73.**

   This paper provides an overview of the studies in the published literature that evaluated the adverse health effects

associated with different waste management methods including landfills. The authors also scored the reported effects in order to derive useable excess risk estimates for health impact assessment. The study design and potential biases in effect estimates were evaluated for each study included in the review. The authors found that for populations living with 2 kilometers of landfills, there was limited evidence of congenital anomalies and low birth weight with an excess risk of 2 percent and 6 percent, respectively. The excess risk tended to be higher when sites handled toxic waste. Many of the studies suffered from various limitations that are described in the review. Despite this, the authors concluded with a moderate degree of confidence that "we have derived some effect estimates that could be used for health impact assessment."

8. **Kouznetsova, M., et al. Increased Rate of Hospitalization for Diabetes and Residential Proximity of Hazardous Waste Sites.** *Environmental Health Perspectives* **(2007) 115(1): 75-79.**

This study investigated whether residence near persistent organic pollutants (POPs)-contaminated hazardous waste sites increased rates of hospitalization for diabetes. The authors examined adult diabetes patients 25-74 years of age in New York State from 1993-2000. After controlling for major potential confounders, the study found a statistically significant increase in the rate of hospitalization for diabetes among patients residing in ZIP codes containing POPs-contaminated waste sites versus patients in "clean" sites. These results do not prove a cause and effect relationship; however, this study provides further support for the association between diabetes and exposure to environmental contaminants.

9. **Kuehn, C.M., et al. Risk of Malformations Associated with Residential Proximity to Hazardous Waste Sites in Washington State.** *Environmental Research* **(2007) 103: 405-412.**

This study examines the relationship between malformations occurring in infants and maternal residential proximity to hazardous waste sites in Washington State. Maternal residence of infants born with malformations from 1987-2001 was compared to maternal residence of infants who were randomly selected and who were born without malformations during this same time period. The authors found that infants born within 5 miles of a hazardous waste site had an increased risk of malformations compared to infants born more than 5 miles away from a hazardous waste site.

10. **Gilbreath, S and Philip Kass. Adverse Birth Outcomes associated with open dumpsites in Alaska Native Villages.** *American Journal of Epidemiology* **(2006) 164(4): 518-528.**

This study evaluates adverse birth outcomes in infants whose birth records indicate that the mothers lived in villages with dumpsites that were potentially hazardous to public health. The authors found that mothers who lived in villages with intermediate and high hazard dumpsite has a higher proportion of low birth weight infants than did mothers in the control group. More infants born to mothers who lived in the intermediate and high hazard villages suffered from intrauterine growth retardation.

11. **Palmer, S. et al. Risk of congenital anomalies after the opening of landfill sites.** *Environmental Health Perspectives* **(2005) 113(10): 1362-1365.**

This study was conducted to investigate whether there was an increased risk of births with congenital malformations for mothers living near 24 landfill sites in Wales that opened between 1983 and 1997. Expected rates of congenital anomalies were compared to those of mothers living within 2 km of the sites, before and after opening of the landfills. Results showed risk of congenital anomalies for mothers living near the landfills increased when the sites were opened. However, the data could not establish a causal link between the landfills and the malformations because of a variety of biases that may have confounded the relationship. Nonetheless, the increase in risk associated with the opening of sites requires continued surveillance.

12. Morgan, O., Vrijheid, M., Dolk, H. Risk of low birth weight near EUROHAZCON hazardous waste landfill sites in England. *Archives of Environmental Health* **(2004) 59(3): 149-151.**

This study evaluated risk of low birth weight near 10 English hazardous waste sites used in a previous study of congenital anomalies (see entry #14 below). The authors found a small but not statistically significant increase in risk of low birth weight within 3 km of sites. The findings of this study suggests that previously reported results for congenital anomalies should not be extrapolated to a wider range of reproductive effects but instead evaluated separately for each outcome.

13. Dummer, T., Dickinson, H., Parker, L. Adverse pregnancy outcomes near landfill sites in Cumbria, northwest England, 1950-1993. *Archives of Environmental Health* **(2003) 58(11): 692-697.**

This study evaluated the risks of stillbirth or neonatal death for mothers living near landfills. All stillbirths, neonatal deaths, and lethal congenital anomalies occurring among 287,993 births to mothers in Cumbria, northwest England during the period 1950-1993 were studied. For the period 1970-1993, a small but significant increase in risk of "other congenital anomalies of the nervous system" was found in mothers living near domestic waste landfill sites. This finding was consistent with other researchers, but a casual effect could not be inferred and the possibility that the results occurred by chance could not be ruled out.

14. Vrijheid et al. Chromosomal congenial anomalies and residence near hazardous waste landfill sites. *Lancet* **(2002) 359: 320-322.**

This study revealed that there is an increased risk of chromosomal anomalies in people who live close to hazardous waste landfills. Adjustments were made for maternal age and socioeconomic status. The results of this study suggest that an increase in the risk of chromosomal anomalies is similar to that found for non-chromosomal anomalies.

15. Elliot, P. et al. Risk of adverse birth outcomes in populations living near landfill sites. *British Medical Journal* **(2001) 323: 363-368.**

Between 1982 and 1997, a study was conducted to investigate the risk of adverse birth outcomes associated with residence near landfill sites. Individuals living 2 km from one of 9565 landfill sites throughout Great Britain were sampled. This has been the largest study of associations between residence near landfill and adverse birth outcomes thus far. It was concluded that residents near landfill sites are at risk of having children with congenital anomalies and low birth weight, however, further studies are needed to explain these findings.

16. McNamee, R., Dolk, H. Editorial: Does exposure to landfill waste harm the fetus? *British Medical Journal* **(2001) 323: 351-352.**

This editorial addresses issues concerning the article entitled "Risk of adverse birth outcomes in populations living near landfill sites" by Elliot et al. in the August 2001 edition of the British Medical Journal (see entry #15 above).

17. Pukkala, E and Antti Ponka. Increased incidence of cancer and asthma in houses built on a former dump area. *Environmental Health Perspectives* **(2001) 109(11): 1121-1125.**

This study evaluated the health of people who moved into twelve blockhouses in Helsinki, Finland that were built on a former dumpsite. Cancer and other chronic diseases were evaluated. The authors found a statistically significant increase in cancer for both sexes. The relative risk increased slightly with the number of years lived in the area. They also found increases in asthma and chronic pancreatitis. The authors concluded that the "possibility of a causal association between the dump exposure and incidence of cancer and asthma cannot be fully excluded." Nonetheless, the city council decided to demolish all houses in the dump area.

18. Berger, S., Jones P., White, M. Exploratory analysis of respiratory illness among persons living near a landfill. *Journal of Environmental Health* **(2000) 62.6: 19.**

Due to concern expressed by residents in two Staten Island, NY communities, the authors of this study evaluated the severity and frequency of respiratory symptoms occurring over a 12-month period among self-identified residents with asthma, severe breathing, or other respiratory conditions. Responses indicated that residents who lived adjacent to the landfill and those from the north-shore (seven miles from the landfill) had differing health problems, with landfill residents reporting higher rates of certain odors and eye, nose and throat irritation. The authors concluded that further investigation of respiratory illnesses should be conducted, as the study showed high rates of respiratory-related symptoms and conditions.

19. Vrijheid et al. Health effects of residence near hazardous waste landfill sites: a review of epidemiologic literature. *Environmental Health Perspectives* **(2000) 108: (Suppl. 1) 101-112.**

This review is an evaluation of current literature on the adverse health effects due to residence near landfill sites. It is difficult to make a conclusion about direct causes for adverse health effects and risks of landfills in general are hard to quantify. Of the studies reviewed, all proved to have insufficient exposure information. This article suggests that research of exposure to landfill sites needs to take a more interdisciplinary approach. Furthermore, epidemiologic and toxicologic studies need to be conducted for individual chemicals and chemical mixtures in order to understand what their effects may be on a population living near a landfill.

20. Knox, EG. Childhood cancers, birthplaces, incinerators and landfill sites. *International Journal of Epidemiology* **(2000) 29: 391-397.**

A study conducted in Great Britain between 1974 and 1987 found that children living near incinerators, both municipal and medical, were at more risk of getting cancer than those children living near landfill sites. This study targeted the sensitivity of children to carcinogenic emissions, but it failed to take into account the association of additional toxic sources in the vicinity. This study also did not account for the migration of families from areas of high toxicity to areas of low toxicity before, during, or after a child's birth.

21. Goldberg, M. et al. Risks of developing cancer relative to living near a municipal solid waste landfill site in Montreal, Quebec, Canada. *Archives of Environmental Health* **(1999) 54:291-296**

The study examines the effect of a municipal solid waste landfill in Montreal, Quebec, Canada on male residents' potential for developing cancer. Men who lived near the Miron Quarry municipal solid waste landfill were compared to individual who lived in more remote locations. Elevated risks were observed for cancers of the pancreas, liver, and prostate in individuals living nearest to the site. A high risk was found for pancreatic cancer and non-hodgkin's lymphomas in residents living downwind from the site. The authors concluded that men living near the landfill site may have been and may continue to be at excess risk of cancers of the liver, kidney, pancreas, and non-hodgkin's lymphomas.

22. State of New York Department of Health, Center for Environmental Health. Investigation of cancer incidence near 38 landfills with soil gas migration conditions: New York state, 1980-1989, 1998. Available from: New York State DOH, 2 University Place, Albany, NY 12203-3399. Phone: 1-800-458-1158.

Thirty-eight landfills throughout the state of New York were selected for a study to find out if people living near certain landfills had an increased risk of cancer compared to people living elsewhere. This study evaluated cancer incidence among people living around these 38 landfills between 1980 and 1989. All cases of leukemia, non- Hodgkin's lymphoma, liver, lung, kidney, bladder and brain cancer were identified and located on a map. Although this study had many limitations, it still found that women living near the landfills had a higher incidence of bladder cancer and leukemia. In comparison, men did not show an increased risk of any type of cancer despite their proximity to a landfill.

23. Dolk, H. et al. Risk of congenital anomalies near hazardous-waste landfill sites in Europe: the EUROHAZCON study. *Lancet* **(1998) 352: 423-427.**

This study examined seven regional registers of congenital anomalies in five different countries in Europe to determine if exposure from hazardous chemicals at landfills increased the risk of birth defects. Twenty-one sites were examined overall and among those sites mothers within a 3 km radius showed a significantly raised risk of having children with congenital anomalies. The results of this study were adjusted for maternal age and socioeconomic status. However, this study's findings are limited by a lack of information on exposures.

24. Berry, M., and Bove, F. Birth weight reduction associated with residence near a hazardous waste landfill. *Environmental Heath Perspectives* **(1997) 105(8): 856-861.**

Twenty-five years of birth certificate information (1961-1985) was collected in order to examine the relationship between birth weight and mother's residence near the Lipari Landfill located in New Jersey. The results indicated that there was a significant impact to infants born to residents who lived near the landfill during the time they would have been at greatest risk of exposure to hazardous chemicals. Many factors, including maternal health, cigarette and alcohol consumption during pregnancy, and socioeconomic status were not available for this study.

25. Goldberg, M. et al. Incidence of cancer among persons living near a municipal solid waste landfill site in Montreal, Quebec. *Archives of Environmental Health* **(1995) 50(6): 416-424.**

In a Canadian study, researchers from the Public Health Department in Montreal evaluated cancer incidence rates in people living around the Miron Quarry municipal landfill. Thirty-five volatile organic chemicals were identified in the landfill gases sampled, including known human carcinogens. When evaluating cancer incidence rates among persons living near the landfill, it was concluded that there might have been increased risks for certain cancers, such as stomach, liver, lung, prostate, and cervix uteri. The researchers also concluded that there were too many unknown factors to make any conclusions as to whether cancer incidence and proximity to the landfill were directly related.

26. Shaw, G. et al. Congenital malformations and birth weight in areas with potential environmental contamination. *Archives of Environmental Health* **(March/April 1992) 47: 147-154.**

Due to the public's increasing concern about reproductive damage as a result of exposure to environmental contamination, a study was conducted to determine if mothers living near contaminated sites were at a greater risk of having children with congenital malformations. This study did not reveal lower birth weight or increased risks for most malformations among women who lived in contaminated areas. It did, however, show an elevated risk for infants with malformations of the heart and circulatory system.

27. Upton, A. et al. Public health aspects of toxic chemical disposal sites. *Annual Review of Public Health* **(1989) 10:1-22.**

This article provides a summary and overview of past health studies conducted around toxic waste disposal sites. The results of 16 published epidemiological studies of residential exposures to toxic waste sites are summarized in this report, many of which are landfills operated by local, state or federal agencies. Although many weaknesses were identified in this review, several adverse health impacts were also identified. These included decreased weight at birth, increase in the frequency of congenial malformations, increase in the occurrence of certain forms of cancer, decrease in the growth and maturation of children, and increased prevalence of central nervous system symptoms. Overall, this article provides evidence that health problems associated with exposure to toxic waste disposal sites are underestimated and poorly studied.

28. Hertzman, C. et al. Upper Ottawa Street landfill site health study. *Environmental Health Perspectives* **(1987) 75:173-195.**

As of 1987, there were few health studies conducted that found health problems in communities living around landfills that were published in the medical or scientific literature. To this day, there is still a lack of conclusive studies giving evidence that adverse health effects are caused by landfills alone. In a study conducted by Clyde Hertzman et al. a number of health problems in workers and residents living near the Upper Ottawa Street Landfill in Hamilton, Ontario were identified. A few of the problems found with the highest credibility included clusters of respiratory, skin, narcotic, and mood disorders. Evidence is presented in their study that supports the hypothesis that vapors, fumes or particulate matter emanating from the landfill site, as well as direct skin exposure, may have lead to the health problems found in excess in this particular area.

29. Paigen, B. et al. Growth of children living near the hazardous waste site, Love Canal. Human Biology (June 1987) 59(3): 489-508.

This is the third of a series of three studies that were conducted on children living near the Love Canal landfill. This study examined whether living near a hazardous waste site had an adverse impact on the growth patterns of children. Children are especially vulnerable to environmental contamination and it was hypothesized that exposed children would be smaller in comparison to control groups of children within a similar socioeconomic status. In earlier studies it was found that there was a significant effect between health problems and the closeness of homes near Love Canal, but in this study the difference in stature associated with birth and residence near Love Canal was not statistically significant. These findings suggest that length of exposure to chemicals may be more important to study rather than point of exposure.

30. Goldman, L., and Paigen, B. Low birth weight, prematurity and birth defects in children living near the hazardous waste site, Love Canal. *Hazardous Waste & Hazardous Materials* **(1985) 2(2):209-223.**

This is the second of a series of three studies that were conducted on children living near the Love Canal landfill. This study assessed birth weight, prematurity, gestational age, and birth defects in 239 children who were living in the Love Canal neighborhood before and shortly after birth. Overall the results showed no significant difference in prematurity, but there was an increase in low birth rate and birth defects. The outcomes of this study suggest that low birth weight is a good indicator of adverse health effects caused by exposure to low levels of chemicals.

31. Paigen, B. & Goldman, L. (1985). Prevalence of health problems in children living near Love Canal. *Hazardous Waste & Hazardous Materials, 2***(1), 23-43.**

This is the first of a series of three health studies that were conducted on children living near the Love Canal landfill. This particular study looked at the overall health of children. The parents of 523 Love Canal and 440 control children were given questionnaires. It was found that children that lived near Love Canal had an increased prevalence of seven major health problems including, seizures, learning problems, hyperactivity, eye irritation, skin rashes, abdominal pain, and incontinence. This paper addresses many of the difficulties involved with conducting community health studies and recognizes the limitations of science when there are so many variables to contend with.

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Mailbag: We might as well change those signs

[redacted]

Coming home to our county from north, south, east or west, we see signs that read “Benton County: At your service.”

We take pride in our county, especially for our shared goals of sustainability. We work together to reduce waste and to preserve our shared environment.

But garbage haulers entering our county take a different message from those signs. Did you know that, of all the tons of garbage dumped annually at the Coffin Butte Landfill near Adair Village, less than 12% comes from Benton County?

In 2020, Marion, Washington,and Linn counties accounted for more than half of the waste dumped here, with Lincoln County adding another 10% to the pile. That’s more than half a million tons of garbage per year, but that’s barely half of it. Where did the rest come from? As far away as Clark County, Washington!

Republic Services, the Arizona-based company that operates the landfill, would like us all to make room in Benton County for still more garbage. They’ve filed an application to radically expand the disposal area right across the top of Coffin Butte Road — a vital emergency route for hundreds of rural residents. Discussions by our county’s Solid Waste Advisory Council reveal that taking more waste from the Portland metro area is part of the calculation.

[redacted]

Do we really want to become the destination for more garbage haulers, from an ever-widening area? I'd say no. Otherwise, we might as well change those signs to say, "Benton County: At your disposal."

Joel Geier

Corvallis

ALERT TOP STORY

Coffin Butte: Benton County hears more opposition to landfill expansion



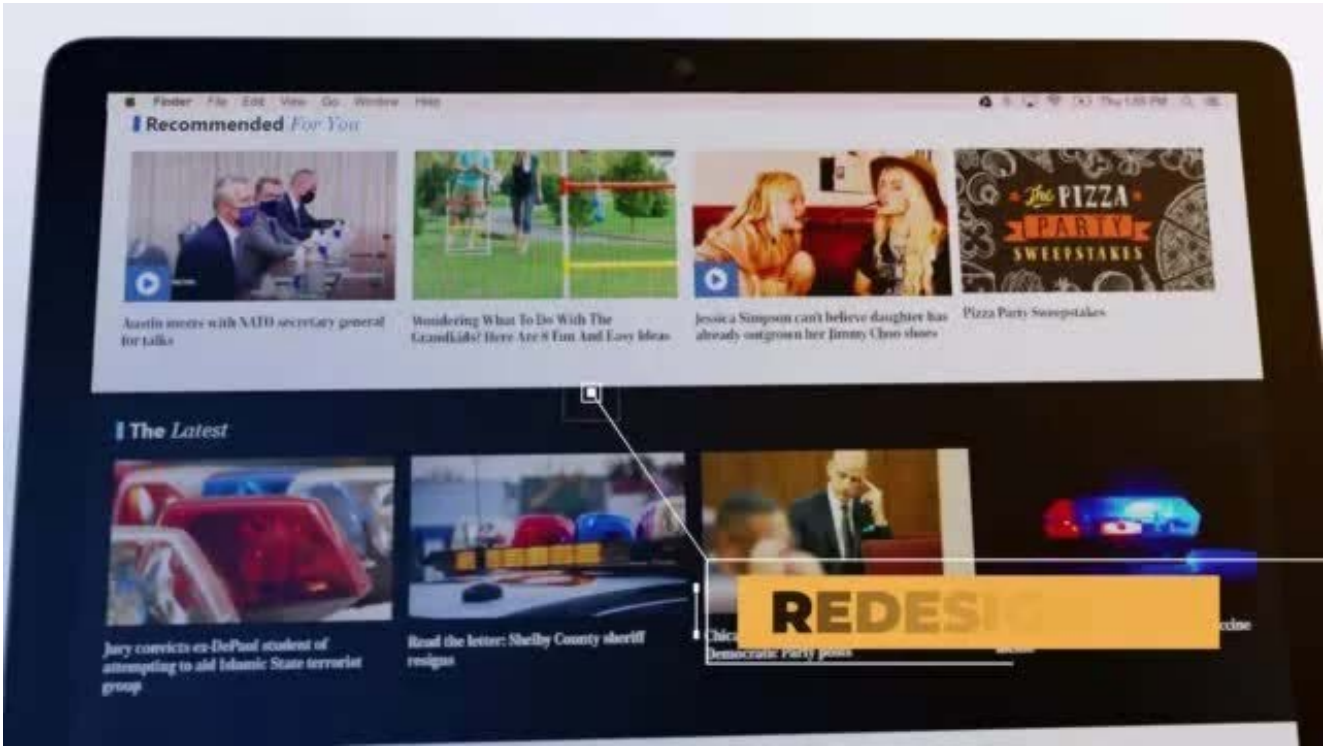
Road access at this corner near the Coffin Butte landfill will be reworked if Republic Services' landfill expansion plans proceed. Motorists would have to use a new northern route via Robison Road or a southern route via Tampico Road to get to Highway 99 because Soap Creek Road (left fork) would no longer connect to the highway.
Andy Cripe, Mid-Valley Media(file 2021)

Jim Day

The Benton County Planning Commission heard almost 2.5 hours of public testimony Tuesday night, Nov. 16 regarding plans by Republic Services to expand its Coffin Butte landfill. Residents were nearly unanimous in their opposition to the proposal.

No deliberations or vote took place, with commissioners expected to take those actions at their Dec. 7 meeting. Republic needs a conditional use permit from the

county to move forward.



An update will be happening for our website this week! Here's what things will look like.

A total of 19 individuals testified in the virtual session, with all but one expressing opposition to the proposal. The lone backer was Tyrone Belgarde of Knife River, the company that operates a quarry on the Coffin Butte property.

Those testifying in opposition largely raised similar themes shared in the 4.5-hour public hearing on Nov. 2. The length of that session led commissioners to decide to continue the public hearing until this week and allow all who had signed up to testify orally.

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Key concerns expressed by residents, many of whom live within a mile or less of the landfill, are the closure of Coffin Butte Road, odor and noise issues, the impact of the project on wildlife, water quality and contamination, methane and leachate pollution and whether the expansion is needed. Coffin Butte Road would be "vacated" because it would be covered by the expansion of the landfill pile.

"Republic is not a good partner," said Marge Popp, citing her concerns about its environmental record.

"These issues are complex, life changing and permanent," said Mark Yeager, who previous served on the county's Solid Waste Advisory Council. Yeager also noted, as did many others, that the proposed closing of Coffin Butte Road at Soap Creek Road created an "undue burden."

"We humans are not good at thinking about the future," Ken Hoechlin said. "Republic wants to speed up the methane factory to the max before updated regulations get here. I know you know all this, so I don't understand how all this is happening. There should be someone besides us saying, 'No, oh god, no.' That's why we have the Planning Commission, to stop the process once it goes rogue."

Said Carrie Norris: "There are so many gaps in this plan that I'm frankly astonished that it has gotten this far."

One resident testified mockingly by pretending to be participating in a meeting at which "greedy" Republic Service officials were going over their “talking points.”

A total of 32 people testified in public during the two hearings, with the comment portion of the proceeding consuming more than four hours. Following the public testimony Republic officials and their representatives offered a brief rebuttal of the

testimony, although they noted that their final argument, due by Dec. 6, will be more substantial.

“The Coffin Butte landfill is an important resource in this county that fills a critical need,” said Jeff Condit, an attorney with Miller Nash of Portland. “Republic has an excellent track record at Coffin Butte and has been a good neighbor.”

Should the expansion not move forward, Condit added, local customers would face much higher rates to route trash to the Arlington landfill along the Columbia River. That facility is approximately 200 miles away from Coffin Butte.

One key point of contention that remains unresolved involves Tampico Road. The county wants Republic to improve the road because of the additional traffic it likely would pick up when Coffin Butte Road is closed to through traffic.

Republic officials say a new northern route that would connect the Soap Creek Road/Tampico Road area with Highway 99W via Robison Road would take care of the extra traffic issues. County officials instead prefer that improvements be directed to Tampico, saying that traffic that was no longer able to use Coffin Butte Road was more likely wind up on Tampico than the northern route.

The county preference on Tampico is one of the conditions of approval county staff have recommended be required of Republic to move forward with the project. The Planning Commission will make the final call on any conditions attached to the permit.

In the only vote that has taken place to date the county's Solid Waste Advisory Council recommended on a 5-1 vote that the Planning Commission approve the permit.

- More Benton County news

Contact reporter James Day at [redacted] or 541-812-6116. Follow at [redacted] or [redacted].

. .. .

Here is a look at what’s next on the Coffin Butte Landfill expansion application:

. .. .. : Republic Services submits its noise study.

. .. . : The written record closes for additional public comment.

. .. .. : Republic submits its final argument.

. .. .. : The commission meets virtually at 7 p.m. to deliberate and vote on the application. No public testimony will be taken at that time. A link to the session will be posted at . . . .

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BREAKING FEATURED TOP STORY

Benton County commission unanimously rejects Coffin Butte landfill expansion plan

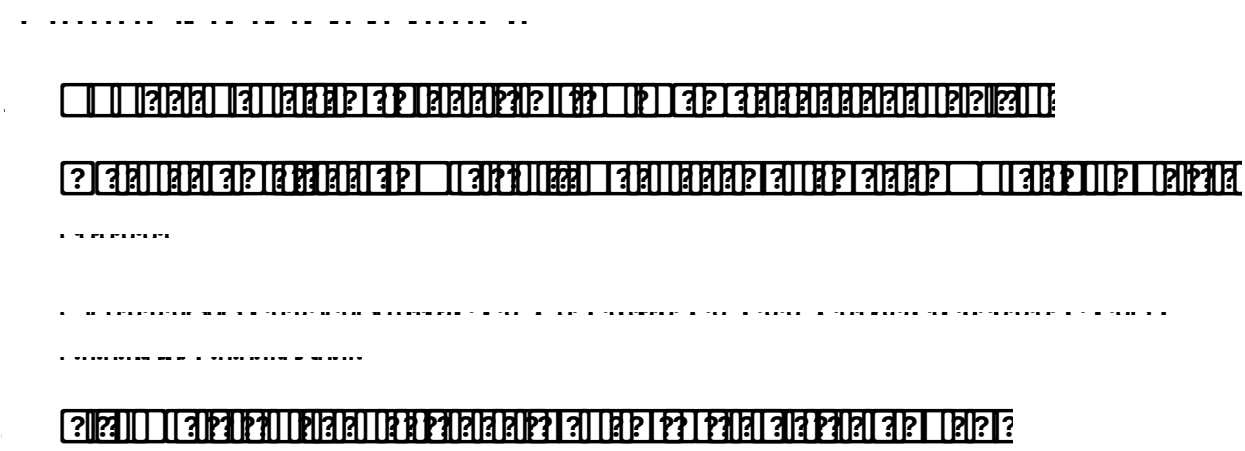


The Benton County Planning Commission has rejected Republic Services' plans to expand the Coffin Butte
Andy Cripe, Mid-Valley Media (File 2021)

Jim Day

The Benton County Planning Commission on Tuesday, Dec. 7 unanimously rejected a proposal by Republic Services to expand its Coffin Butte landfill.

Chairman Ken Kenaston, who initiated deliberations by reading a lengthy statement, said the proposed closing of Coffin Butte Road would create an “undue burden” on the surrounding neighborhood and that Republic had not effectively answered questions from the community on noise, odor and other public health impacts of the expansion as well as its effects on the environment and wildlife.



The 6-0 vote by the commission at Tuesday night’s virtual session almost assuredly will be appealed, although Republic Services officials chose not to discuss what its future steps will be.

“No comment tonight,” Julie Jackson, the municipal and community relations manager for Republic Services, said in an email Tuesday night seeking Republic’s view of the decision. Attempts to get further comment Wednesday were not successful.

Republic has 14 days to appeal the decision to the Benton County Board of Commissioners. In the meantime the county’s Community Development Department will gather findings based on commissioner deliberations and forward them to the Board of Commissioners as well as members of the community who participated in the process.

The six members of the Planning Commission who voted to reject the Republic application during the 80-minute session were Kenaston, Nick Fowler, Evelyn Lee,

Scott Scorvo, John McEvoy and Jennifer Gervais.

“The unanimous support of the commissioners,” Fowler said, “speaks volumes that this application failed the fundamental test of the conditional use permit.”

Indeed. By the time McEvoy spoke — he was the fifth commissioner to chime in — so much information had been brought forward that McEvoy said “he didn’t feel the need to repeat the points made by others because I am already inclined to vote negatively.”

Republic needed the conditional use permit to expand the current disposal cell south beyond the current route of Coffin Butte Road. The proposal includes the aforementioned closing of Coffin Butte Road with the construction of a private road that would encircle the new disposal area and terminate at a locked gate at Soap Creek Road.

Republic also proposed constructing a new northern route that would link the Soap Creek Road/Tampico Road area to Highway 99W via Robison Road in an effort to replace the highway access lost with the closure of Coffin Butte Road. Residents would continue to have access to Highway 99W via Tampico Road, although many testified that Tampico is less safe than Coffin Butte Road.

Republic plans also included two leachate ponds in the new disposal area. The Phoenix, Arizona-based company said it needs the expansion because the current landfill site will fill up in approximately four years, with the adjacent Knife River quarry not available to accept waste for perhaps another eight to 10 years.

The quarry, Republic officials said, has a potential disposal lifespan of 15 years before it reaches capacity. In all, Republic said, approval of the permit would add 30 years of life to the landfill.

Quality journalism doesn't happen without your help

The application and review process was a lengthy one, with Republic requesting

postponement of the original Sept. 7 date for the public hearing because the trash hauler wanted to modify its proposal.

On Oct. 19 the county's Solid Waste Advisory Council recommended on a 5-1 vote that the Planning Commission approve the application, although members of that board also included reservations about the project in a letter to the planning body.

Commissioners then held public hearings Nov. 2 and Nov. 16, and more than 30 people testified orally at the two sessions, with dozens more providing written comment. In addition, more than 20 individuals have sent letters to the editor on the subject. Virtually all of the responses — public comment and letters — have come from individuals opposed to the project.

Rejection of the application starts a clock on the possible closure of Coffin Butte and the insertion of a massive question mark into the landfill equation.

"It is very unlikely that the state would approve a new landfill in the Willamette Valley," Benton County Counsel Vance Croney has said.

That means the closure of Coffin Butte would send all of the regional trash more than 200 miles away to the massive Waste Management facility in Arlington along the Columbia River. The extra distance the trucks would have to travel, Croney said, would have an obvious impact on rates.

- More Benton County news

Contact reporter James Day at [redacted] or 541-812-6116. Follow at [redacted] or [redacted].

[redacted]

• The Coffin Butte landfill, which is operated by Republic Services of Phoenix, Arizona, occupies 740 acres in northern Benton County near Adair Village. Most of the acreage serves as buffer zones surrounding the landfill. The buffer zones are a mix of wetlands, forested property and farm fields.

• Coffin Butte is a “regional” landfill designed to primarily serve Benton, Linn, Lane, Lincoln, Polk and Marion counties. Approximately 70% of the trash comes from those six counties, with about 12% from Benton and 15% from Linn. About 30% of the trash comes from elsewhere, mainly the Portland area.

• Benton County is in the first year of a 20-year franchise agreement with Republic. Because the county “hosts” the landfill, Republic pays the county $2 million per year.

• Corvallis, Philomath and Albany have franchise agreements with Republic Services that allow the trash hauler to operate in those markets. But the main financial relationship in those agreements is the fees the residents and commercial accounts pay Republic to haul away the trash, recyclables and yard waste.

https://democratherald.com/tncms/asset/editorial/20f217be-097c-57e6-b0c9-77961ead9771/

BREAKING ALERT TOP STORY

Republic Services pulls appeal on Coffin Butte landfill expansion



The current Coffin Butte landfill extends up the hill to the left in this view looking toward the east. The landf
Learning program on Thursday, Sept. 29.

James Day, Mid-Valley Media (File 2021)

Cody Mann

Republic Services has withdrawn its appeal of a denied conditional use permit for the Coffin Butte landfill expansion, according to a news release from Benton County.

The Benton County Board of Commissioners was informed on Tuesday, March 15 that Valley Landfills Inc./Republic Services Inc. withdrew its appeal of the Planning Commission's denial of the permit effective last Friday, March 11, according to the release.

Republic Services intends to file a new application for a revised landfill expansion project in the near future, according to a letter sent to the county. Company representatives could not be immediately reached for comment.

The letter was dated March 11 and addressed to Inge Williams, associate planner with Benton County Community Development Department. It was sent by Ryan Lawler, Republic Services area president, who wrote that the decision to withdraw the appeal was made "after careful analysis and consideration of alternatives."

"We will continue to engage with the community, listen to, and incorporate feedback," Lawler wrote. "And we look forward to being part of Benton County's long-term waste management and diversion solutions."

Before this latest development in the bid to expand the landfill, appeal hearings were expected to resume Monday, March 21, which marked the end of a 90-day pause requested by Republic on Dec. 21.

"Coffin Butte Landfill is an extremely important asset to our community," County

Commissioner Nancy Wyse said in a statement. “My fellow commissioners and I were very pleased to hear that Republic is utilizing this opportunity to take more time to re-engage with our community to help shape a more constructive path for the future of solid waste.”

Planning commissioners found that Republic’s proposal would create an “undue burden” on the surrounding neighborhood and that Republic had not effectively answered community questions about noise, odor, air quality and public health impacts as well as effects on the environment and wildlife.

Republic challenged the Planning Commission’s findings, claiming the evidence doesn’t support the commission’s conclusion with regard to odor, air quality or noise, and that the landfill has maintained compliance with Oregon Department of Environmental Quality’s air quality permit regulations.

The company also argued that improvements to Robison and Tampico roads will mitigate the closure of Coffin Butte Road, and that it would address wildlife impacts as part of its DEQ permit.

On Dec. 7, the Benton County Planning Commission voted 6-0 to reject the application for a proposed expansion at Coffin Butte. The rejection started the clock on a 14-day period during which appeals could be filed with the Board of Commissioners.

Republic needed the conditional use permit to expand the current disposal cell south beyond the current route of Coffin Butte Road, which would be closed. A new private road would encircle the new disposal area and terminate at a locked gate at Soap Creek Road.

Republic also proposed constructing a new northern route that would link the Soap Creek Road/Tampico Road area to Highway 99W via Robison Road in an effort to replace the highway access lost with the closure of Coffin Butte Road. Residents

would continue to have access to Highway 99W via Tampico Road.

The Phoenix-based company said it needs the expansion because the current landfill site will reach maximum capacity in approximately four years. The adjacent Knife River quarry will not be available to accept waste for perhaps another eight to 10 years.

The quarry, Republic officials said, has a potential disposal lifespan of 15 years. In all, Republic said, approval of the permit would add 30 years of life to the landfill.

Rejection of the application also started a clock on the possible closure of Coffin Butte and the insertion of a massive question mark into the state's landfill equation.

"It is very unlikely that the state would approve a new landfill in the Willamette Valley," Benton County Counsel Vance Croney has said in the past.

That means the closure of Coffin Butte would send all of the regional trash more than 200 miles away to the massive Waste Management facility in Arlington along the Columbia River. The extra distance the trucks would have to travel would likely impact rates.

. .....

Corvallis resident Amy Luhn, a critic of the expansion plan, was elated to hear the news.

"Oh good, we didn't need anything like that in our county," she said.

Luhn, who has lived in the area for 30 years, said she is not anti-development, but the expansion wasn't planned for the residents of Benton County but to help Republic Service's bottom line in serving a much larger region that goes beyond state lines.

"A quantum expansion of the landfill would not be an improvement to me," she

said.

- More Corvallis news

Cody Mann covers Benton County and the cities of Corvallis and Philomath. He can be contacted at 541-812-6113 or . . .

https://democratherald.com/corvallis/news/opinion/as-i-see-it/as-i-see-it-assessing-our-trash-future/article_618f21e8-03c7-11ed-9ceb-7f871d7ac18f.html

As I See It: Assessing our trash future

If you're not up on what's been happening with our county trash management lately, that's understandable.

It's kinda icky, for one thing, and for another, you're not alone. Benton County itself is still operating with a trash management plan from circa 1977.

But I urge you to take a moment now to catch up because it turns out this is pretty important for the health of the county. And our commissioners will be mulling over what to do in their meeting on Tuesday, July 19, and looking for public input.

In March, the county commissioned a third-party assessment of its trash situation, and that assessment dropped July 12. The assessment focuses first on the lack of "common understandings" ("facts") that surround our trash management, and in particular, the Coffin Butte Landfill just north of Corvallis. Let me call out a few understandings we should look for in particular:

How did the county lose control? I expect Benton County residents regard Coffin Butte (if they think of it at all) as “our landfill” — which it once was. Reviewing landfill history, however, will show that’s certainly not the case today.

It appears the landfill’s now taking in about a million tons of trash a year, and only 66,000 tons (6.6%) of that comes from Benton County, according to the Oregon Department of Environmental Quality. (I think Linn County’s number is similar.) Benton County pays 100% of the landfill’s environmental cost, however, and takes 100% of its risks.

What happened to operating rules? Unbridled trash intake is only one aspect of loss of county control over the landfill. The assessment calls for an accounting of prior “conditions for use” — obligations that the county’s imposed on the landfill that came to nothing.

It seems there are rules in place governing hours of operation, visual screening, litter and so on that are on the books but which a quick trip to the dump will establish are not being heeded.

Chief among these, maybe: landfill leachate. I learned only recently that water that enters the landfill (either in trash or as rainfall on the dump) needs to be pumped out daily lest it threaten groundwater — and it’s toxic with per- and polyfluoroalkyl (“forever”) chemicals and many other pollutants.

Earlier, apparently, the landfill agreed to treat all leachate on site, but now it doesn’t, and so millions of gallons of toxic leachate have to be trucked to the Corvallis treatment plant and passed into the Willamette River.

Greenhouse gases: how much? Perhaps the biggest “understanding” we lack is: How much methane is leaking from the landfill? Strangely, although methane is a highly destructive greenhouse gas and therefore the focus of federal, state and county action against the climate crisis, it seems to fall through the cracks at Coffin Butte. The assessment recommends that Benton County address this by clarifying

which government body has jurisdiction over shared responsibilities such as methane.

Which is important, because, by my math, Coffin Butte's methane already inflicts climate damage equal to a small coal-fired power plant — and these emissions go up with each new ton of garbage.

Once the county documents these understandings, the assessment urges the county to form a work group to advise the commissioners on a new trash management plan. This is where you, dear reader, enter the picture.

That work group is mostly community members, and it operates with public review and input. With your help, we can begin to reestablish control over our trash habit and insist on planning our future with all the facts in place.



Ken Eklund

Ken Eklund is a futurist and artist in game design, and chair of the Benton County Solid Waste Advisory Council. He lives with his family in Corvallis.

https://democratherald.com/tncms/asset/editorial/e81aa154-9c2b-11ed-bfb0-3762ba86d0d8/

ALERT FEATURED TOP STORY

'Complex chemical stew': Leachate concerns in Corvallis

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A look at the Coffin Butte Landfill near Adair Village.
\Mid-Valley Media (File 2021)

Cody Mann

Corvallis officials are expected this spring to review a city practice of processing polluted liquid from Benton County's regional landfill.

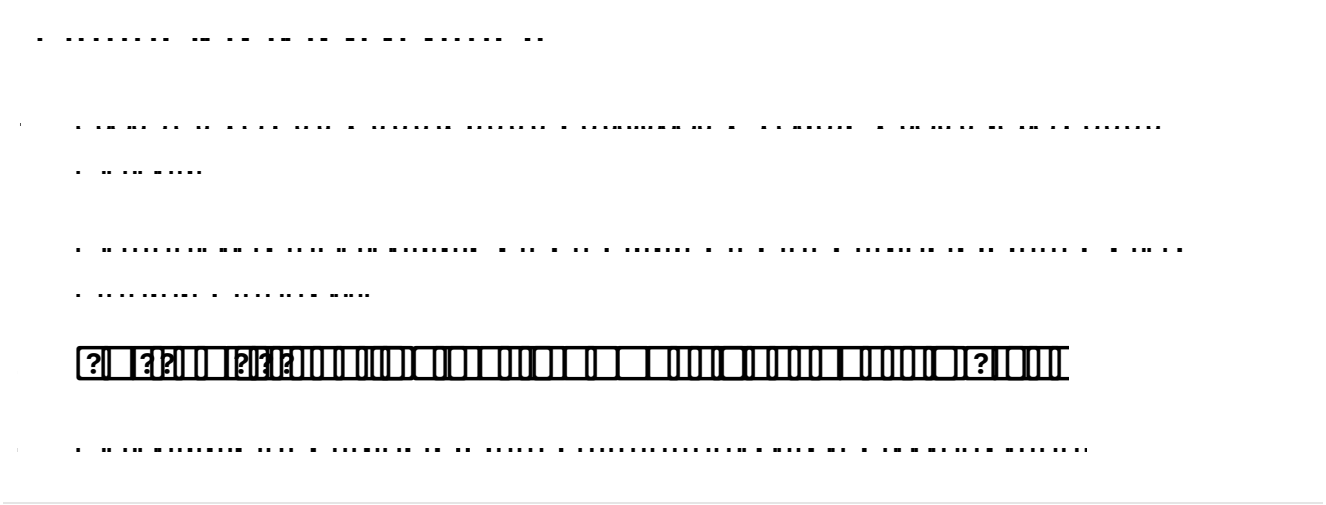
Concerned about the city of Corvallis accepting a liquid pollutant that's hauled in

for disposal at its wastewater plant, Benton County resident Mark Yeager is beseeching the City Council to reconsider the practice.

Yeager is a registered civil and environmental engineer who said he's worked for many years on water quality issues. He spoke to the council during its meeting Jan. 17.

Landfill leachate, derived from liquids in garbage that are dumped in the landfill and from decomposing trash, can be harmful to people and the environment, Yeager said, adding that rainwater flowing through landfills picks up chemicals as it trickles through.

"Leachate is a complex chemical stew containing a high nutrient load, heavy metals like arsenic, lead, mercury, cadmium, etc.," Yeager said, "as well as pesticides, pharmaceuticals, personal care products, and high concentrations of what we're hearing more and more about these days — the forever chemical, PFAS."



PFAS is an abbreviation for perfluoroalkyl and polyfluoroalkyl substances, a group of synthetic, potentially harmful chemicals used in a wide variety of household products and industrial processes, some of which don't degrade naturally and may linger indefinitely in the environment.

Corvallis City Manager Mark Shepard confirmed the issue of accepting leachate

from Republic Services-owned Coffin Butte Landfill is slated for a council work session April 20. He told the councilors they will probably get a staff recommendation “very similar” to Yeager’s public testimony.

“There are definitely cost ramifications and impacts,” Shepard said. “Likely you’ll be seeing us recommend we stop that practice moving forward, but it’s important you understand the implications because there are significant financial implications.”

The city took in $797,000 for processing the leachate in fiscal year 2020-2021 and $596,000 for 2021-2022, according to Shepard.

A spokesperson for Republic Services did not provide details about how much leachate goes to which destinations or what it pays for disposal.

A 2021 Coffin Butte report does not elaborate on the ultimate fate of leachate hauled from the landfill or costs related to hauling or disposal, but it does note the city of Salem also held a permit to process leachate from Coffin Butte.

The report cites more than a million tons of solid waste received by the landfill in 2021. A breakdown of landfill users by county of origin shows Marion County sent more than 325,000 tons, whereas Linn generated more than 142,000 tons and Benton more than 114,000 tons.

More than 32 million gallons of leachate was produced by the site in the “water year” ending Sept. 30, 2021, according to the report. The past five years of annual reports show a range of 25-31 million gallons of leachate produced yearly at Coffin Butte.

Putting that into perspective, Yeager said, moving that much leachate would take 18 tanker trucks, each hauling 5,500 gallons of leachate, coming from the landfill six days a week.

Yeager is also concerned about whether Corvallis’ sewer plant properly treats the

complex suite of chemicals in leachate. He said published research he's read says conventional treatment plants like the city's aren't designed for leachate and let most of the toxic pollutants pass through untreated.

"I am concerned because discharge of these chemicals into the Willamette River has impacts on wildlife through bioaccumulation and recreational uses, such as swimming, boating and fishing," he told Corvallis councilors.

"It also impacts downstream drinking water systems that include Adair Village, Wilsonville, Sherwood, and Tualatin Valley Water that rely on the Willamette River as their source of supply," he said.

Shepard confirmed in an email Corvallis takes leachate from Coffin Butte. He said in calendar year 2022 the wastewater plant processed 12.7 million gallons of leachate, with 18.7 million gallons handled in 2021, and 15.5 million gallons in 2020.

Regarding the wastewater plant's capabilities and downstream impacts, Shepard said the facility is able to accept leachate and still meet regulatory requirements in the city's current Oregon Department of Environmental Quality discharge permit.

The city of Salem also processed some of the leachate from Coffin Butte in past years. Salem did not respond to questions about amounts of leachate accepted or compensation, instead requiring a public records request for that information. It's not clear if Salem will continue the practice of processing leachate.

Continued acceptance of the waste material in Corvallis, in light of evolving regulatory requirements, would put the city in a difficult position in future DEQ discharge permits, Yeager said at the council meeting.

"I urge you to reconsider your practice of accepting this waste into your system, and to evaluate the cost-benefit of accepting this waste, weighed against the liability for any related environmental impacts," he said.

More Corvallis news

Cody Mann covers the cities of Corvallis and Philomath. He can be contacted at 541-812-6113 or . . .

https://democratherald.com/corvallis/opinion/letters/letter-what-is-source-of-the-gaseous-smell/article_009c3902-a723-11ed-baf4-038b8df2d38b.html

Letter: What is source of the gaseous smell?

> If methane and natural gas are odorless, what is the source of the very strong gaseous smell I get when driving by Coffin Butte landfill, particularly at night?

Michael Cairns

Independence

From:	Ken Eklund
To:	Benton Public Comment
Subject:	I oppose LU-24-027: reference articles and opinions in the press - 2 of 12
Date:	Thursday, May 8, 2025 2:33:03 PM
Attachments:	writerguy-cube2.png

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This is the first part of a CHEJ pdf on landfills that is too big to email in one piece. – K



Ken Eklund, writerguy

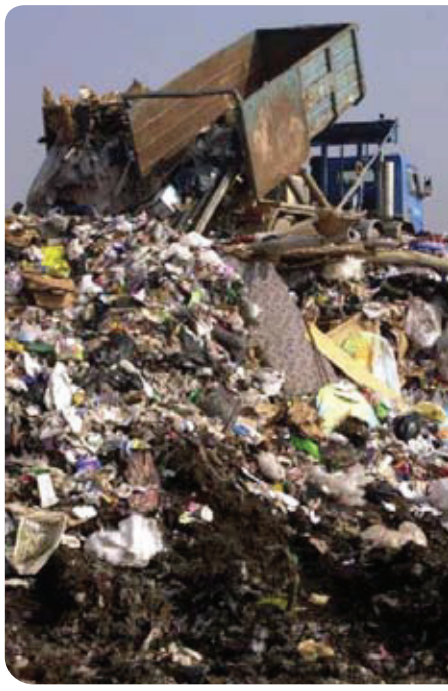
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Landfill Failures
The Buried Truth

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Landfill Failures
the Buried Truth

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Mentoring a Movement

Empowering People

Preventing Harm

About the Center for Health, Environment & Justice

CHEJ mentors the movement to build healthier communities by empowering people to prevent the harm caused by chemical and toxic threats. We accomplish our work by connecting local community groups to national initiatives and corporate campaigns. CHEJ works with communities to empower groups by providing the tools, strategic vision, and encouragement they need to advocate for human health and the prevention of harm.

Following her successful effort to prevent further harm for families living in contaminated Love Canal, Lois Gibbs founded CHEJ in 1981 to continue the journey. To date, CHEJ has assisted over 15,000 groups nationwide. Details on CHEJ's efforts to help families and communities prevent harm can be found on www.chej.org.

Table of Contents

Introduction to Landfill Problems

- The Basics of Landfills: How They Are Constructed and Why They Fail – *Environmental Research Foundation* 1
- The Normal Landfill Environmental Research Site; What Happens to Waste in Landfills - *USGS* 3
- Solid Waste Landfill Technology: A Documented Failure – *Blue Ride Environmental Defense League* 4
- New Evidence that All Landfills Leak – *Rachel's Environment & Health News* 5
- Plastics Part 2: Why Landfill Linters Always Fail – *Rachel's Environment & Health News* 7
- Leachate Collection Systems: The Achilles' Heel of Landfills – *Rachel's Environment & Health News* 9
- The Catch-22s of Landfill Design – *Rachel's Environment & Health News* 11

Landfill Liner & Leachate Problems

- Emerging Contaminants at a Closed and Operating Landfill in Oklahoma – *Groundwater Monitoring And Remediation* 12
- Updated Review of the "Flawed Technology" of US EPA Subtitle D MSW Landfilling – *G.Fred Lee and Anne Jones-Lee* 13
- Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste – *G. Fred Lee and Anne Jones-Lee* 15
- Detecting Failure of Subtitle D Landfilling Systems – *G. Fred Lee* 19
- Assessing the Potential of Minimum Subtitle D Lined Landfills to Pollute: Alternative Landfilling Approaches – *G. Fred Lee and Ann Jones-Lee* 23
- Impact of Municipal and Industrial Non-Hazardous Waste Landfill on Public Health and the Environment: An Overview – *G. Fred Lee and Ann Jones-Lee* 24
- Plastic Dump Liners Have Been Slow in Coming – *Wall Street Journal* 28
- Unexpected Leakage Through Landfill Liners – *Science News* 30
- Document Shows Landfill Operator Fined for Design Failures – *Hawaii News Now* 32
- Health Effects Associated with the Disposal of Solid Waste in Landfills – *Swiss School of Public Health* 33
- Effect of Aging on the Leachate Characteristics From Municipal Solid Waste Landfill – *Naveen, Sivapullaiah, & Sitharam* 44
- Landfill Leachate Released to Wastewater Treatment Plants and other Environmental Pathways Contains a Mixture of Contaminants including Pharmaceuticals – *USGS Toxic Substances Hydrology Program* 50

Landfill Gas Problems

- Landfill Gas Safety and Health Issues – *Agency for Toxic Substances and Diseases Registry* 53
- Landfills Make Mercury More Toxic – *ScienceNews* 58
- Vinyl in Landfills Most Likely to Blame for Toxic Gases – *Greenpeace* 59
- Old PCs Toxic in Landfill Sites – *Galt Global Review* 62
- In Our Backyard: Environmental Racism in Dickinson – *Colorlines* 65
- Landfill Gas-to Energy Project May Release More Greenhouse Gases Than Flaring – *Stewart* 66

News Articles about Local Landfill Problems

- Court Orders Agency to Address Landfill Emissions– *Environment & Energy News* 74

- EPA resolves Clean Water Act violations with Honolulu and Waste Management at Waimanalo Gulch Landfill– *EPA* 76
- Report identifies factors in Advanced Disposal landfill slope failure that left one dead– *Waste Dive* 78
- Waste Management reaches $4.1M settlement over Ohio– *Waste Dive* 81
- DEC Cites High Acres Landfill for Failure to Reduce Odors– *New York Department of Environmental Conservation* 83
- AG Koster releases new expert reports concluding radiation and other pollutants have migrated off-site at Bridgeton Landfill – *Missouri Attorney General* 84
- Carter's Valley Landfill Listed as Possible Site for Radioactivity – *The Rogersville Review* 85
- Australia: Methane gas landfill leak forces residents to evacuate suburb – *World Socialist Website* 87
- Ombudsman's Damning Repot on Landfill Leak – *Inside Waste Website* 90
- Scotland Board Puts End to Landfill Project – *Fay Observer* 92
- State Officials File Suit Over Dump Site Health Hazards – *Salem News* 93
- Bird Flu Virus Can Survive Two Years in Landfill – *HealthDay News* 95
- Nevada Landfill Operator Agrees to $26 Million Plan to Close Landfill Site – *USDO* 96
- Hazardous Waste Landfills: Some Lessons from New Jersey – *Civil Engineering* 98

Academic Studies

- Socio-Environmental and Hematological Profile of Landfill Residents– *Environmental Research and Public Health* 102
- Morbidity and Mortality of people who live close to municipal waste landfills: a multisite cohort study – *Environmental Exposures and Cancer* 114
- Systemic Review of Epidemiologic Studies on health Effects Associated With Management of Solid Waste – *Environmental Health* 124
- Health Effects of Residence Near Hazardous Waste Landfill Sites: A Review of the Epidemiological Literature – *Environmental Health Perspectives* 138
- Risk of Adverse Birth Outcomes in Populations Living Near Landfill Sites – *British Medical Journal* 150
- Largest Ever Study Into Health of Populations Around Landfill Sites Published – *UK Department of Health* 156
- Health Study of New York City Department of Sanitation Landfill Employees – *Journal of occupational and Environmental Medicine* 158
- Relation Between Malodor, ambient hydrogen sulfide and health – *Elsevier Environmental Research* 159

Reference Material

- Annotated Resources on Landfills and Health Effects 160
- Useful Websites on Landfills 166
- Bibliographic Information 167

The Basics of Landfills-
How They Are Constructed And Why They Fail

WHAT IS A LANDFILL?

A secure landfill is a carefully engineered depression in the ground (or built on top of the ground, resembling a football stadium) into which wastes are put. The aim is to avoid any hydraulic [water-related] connection between the wastes and the surrounding environment, particularly groundwater. Basically, a landfill is a bathtub in the ground; a double-lined landfill is one bathtub inside another. Bathtubs leak two ways: out the bottom or over the top.

WHAT IS THE COMPOSITION OF A LANDFILL?

There are four critical elements in a secure landfill: a bottom liner, a leachate collection system, a cover, and the natural hydrogeologic setting. The natural setting can be selected to minimize the possibility of wastes escaping to groundwater beneath a landfill. The three other elements must be engineered. Each of these elements is critical to success.

THE NATURAL HYDROGEOLOGIC SETTING:

You want the geology to do two contradictory things for you. To prevent the wastes from escaping, you want rocks as tight (waterproof) as possible. Yet if leakage occurs, you want the geology to be as simple as possible so you can easily predict where the wastes will go. Then you can put down wells and capture the escaped wastes by pumping. Fractured bedrock is highly undesirable beneath a landfill because the wastes cannot be located if they escape. Mines and quarries should be avoided because they frequently contact the groundwater.

WHAT IS A BOTTOM LINER?

It may be one or more layers of clay or a synthetic flexible membrane (or a combination of these). The liner effectively creates a bathtub in the ground. If the bottom liner fails, wastes will migrate directly into the environment. There are three types of liners: clay, plastic, and composite.

WHAT IS WRONG WITH A CLAY LINER?

Natural clay is often fractured and cracked. A mechanism called diffusion will move organic chemicals like benzene through a three-foot thick clay landfill liner in approximately five years. Some chemicals can degrade clay.

WHAT IS WRONG WITH A PLASTIC LINER?

The very best landfill liners today are made of a tough plastic fi lm called high density polyethylene (HDPE). A number of household chemicals will degrade HDPE, permeating it (passing though it), making it lose its strength, softening it, or making it become brittle and crack. Not only will household chemicals, such as moth balls, degrade HDPE, but much more benign things can cause it to develop stress cracks, such as, margarine, vinegar, ethyl alcohol (booze), shoe polish, peppermint oil, to name a few.

WHAT IS WRONG WITH COMPOSITE LINERS?

A Composite liner is a single liner made of two parts, a plastic liner and compacted soil (usually clay soil). Reports show that all plastic liners (also called Flexible Membrane Liners, or FMLs) will have some leaks. It is important to realize that all materials used as liners are at least slightly permeable to

liquids or gases and a certain amount of permeation through liners should be expected. Additional leakage results from defects such as cracks, holes, and faulty seams. Studies show that a 10-acre landfill will have a leak rate somewhere between 0.2 and 10 gallons per day.

WHAT IS A LEACHATE COLLECTION SYSTEM?

Leachate is water that gets badly contaminated by contacting wastes. It seeps to the bottom of a landfill and is collected by a system of pipes. The bottom of the landfill is sloped; pipes laid along the bottom capture contaminated water and other fluid (leachate) as they accumulate. The pumped leachate is treated at a wastewater treatment plant (and the solids removed from the leachate during this step are returned to the landfill, or are sent to some other landfill). If leachate collection pipes clog up and leachate remains in the landfill, fluids can build up in the bathtub. The resulting liquid pressure becomes the main force driving waste out the bottom of the landfill when the bottom liner fails.

WHAT ARE SOME OF THE PROBLEMS WITH LEACHATE COLLECTION SYSTEMS?

Leachate collection systems can clog up in less than a decade. They fail in several known ways: they clog up from silt or mud; they can clog up because of growth of microorganisms in the pipes; they can clog up because of a chemical reaction leading to the precipitation of minerals in the pipes; or the pipes become weakened by chemical attack (acids, solvents, oxidizing agents, or corrosion) and may then be crushed by the tons of garbage piled on them.

WHAT IS A COVER?

A cover or cap is an umbrella over the landfill to keep water out (to prevent leachate formation). It will generally consist of several sloped layers: clay or membrane liner (to prevent rain from intruding), overlain by a very permeable layer of sandy or gravelly soil (to promote rain runoff), overlain by topsoil in which vegetation can root (to stabilize the underlying layers of the cover). If the cover (cap) is not maintained, rain will enter the landfill resulting in buildup of leachate to the point where the bathtub overflows its sides and wastes enter the environment.

WHAT ARE THE PROBLEMS WITH COVERS?

Covers are vulnerable to attack from at least seven sources: 1) Erosion by natural weathering (rain, hail, snow, freeze-thaw cycles, and wind); 2) Vegetation, such as shrubs and trees that continually compete with grasses for available space, sending down roots that will relentlessly seek to penetrate the cover; Burrowing or soil- dwelling mammals (woodchucks, mice, moles, voles), reptiles (snakes, tortoises), insects (ants, beetles), and worms will present constant threats to the integrity of the cover; 3) Sunlight (if any of these other natural agents should succeed in uncovering a portion of the umbrella) will dry out clay (permitting cracks to develop), or destroy membrane liners through the action of ultraviolet radiation; 5) Subsidence--an uneven cave-in of the cap caused by settling of wastes or organic decay of wastes, or by loss of liquids from landfilled drums--can result in cracks in clay or tears in membrane liners, or result in ponding on the surface, which can make a clay cap mushy or can subject the cap to freeze-thaw pressures; 6) Rubber tires, which “float” upward in a landfill; and 7) Human activities of many kinds.

Prepared by: Environmental Research Foundation

THE NORMAN LANDFILL ENVIRONMENTAL RESEARCH SITE WHAT HAPPENS TO THE WASTE IN LANDFILLS?

U.S. Geological Survey Fact Sheet 040-03
August 2003

By Scott C. Christenson and Isabelle M. Cozzarelli

This Factsheet is also available as pdf (949KB).

DO LANDFILLS LEAK?

We call it "garbage" or "trash" but it is "municipal solid waste" to your city government and the waste industry. Municipal solid waste is a combination of non-hazardous wastes from house holds, commercial properties, and industries. The U.S. Environmental Protection Agency (USEPA) reports that the United States produced about 230 million tons of solid waste in 1999, about 57 percent of which is disposed of in landfills (U.S. Environmental Protection Agency, 1999).

Disposal of municipal solid waste in landfills was largely unregulated prior to the 1970s. Most solid waste was deposited in unlined pits. Precipitation and ground water seeping through this waste produces leachate, which is water contaminated from the various organic and inorganic substances with which it comes in contact as it migrates through the waste. Leachate seeping from a landfill contaminates the ground water beneath the landfill, and this contaminated ground water is known as a plume. The normal movement of ground water causes the leachate plume to extend away from a landfill, in some cases for many hundreds of meters. Many studies have shown leachate plumes emanating from old unlined landfills. Estimates for the number of closed landfills in the United States are as high as 100,000 (Suflita and others, 1992).

Federal and state regulations were passed in the 1980s and 1990s to manage disposal of solid waste. Those regulations require that most landfills use liners and leachate collection systems to minimize the seepage of leachate to ground water. Although liners and leachate collection systems minimize leakage, liners can fail and leachate collection systems may not collect all the leachate that escapes from a landfill. Leachate collection systems require maintenance of pipes, and pipes can fail because they crack, collapse, or fill with sediment. The USEPA has concluded that all landfills eventually will leak into the environment (U.S. Environmental Protection Agency, 1988). Thus, the fate and transport of leachate in the environment, from both old and modern landfills, is a potentially serious environmental problem.

SOLID WASTE LANDFILL TECHNOLOGY
A DOCUMENTED FAILURE

HIGH DENSITY POLYETHYLENE LINERS (HDPE) ARE NOT EFFECTIVE BARRIERS TO LANDFILL LEACHATE.

Two major classes of chemicals are responsible for HDPE failure. Aromatic hydrocarbons such as benzene and naphthalene, "permeate excessively and cause package deformation," and halogenated hydrocarbons such as trichlorethylene and methylene chloride can permeate HDPE and cause,"softening, swelling, and part deformation."

Marlex Polyethylene TIB 2 Packaging Properties, Plastics Division, Phillips 66 Company, Bartlesville, OK 74004

The "best demonstrated available technology" for composite liners (clay and plastic) allow leakage rates from .02 to 1.0 gallons per acre per day. This would result in 730 to 36,500 gallons per year from a 100 acre landfill.

Geoservices Inc. Background Document on Bottom Liner Performance in Double-lined landfills and Surface Impoundments, April 1987

LANDFILL CAPS ARE SUBJECT TO NATURAL ELEMENTS AND LEAKAGE

Lightning bolts striking the ground typically five million volts and 2,500 to 220,000 amperes can bore holes in the ground eight inches in diameter and fifteen feet deep. In western North Carolina, an average number of lightning strikes per hundred acres is 2.96 per year.

AT&T Telecommunication Electrical Protection, AT&T Technologies, Inc. 1985

Burrowing animals can move 5.3 tons of soil to the surface per acre per year. "Similar activity would have a dramatic impact on landfill cap integrity...synthetic liners, measured in mils are not likely to impede these same animals." Clay presents little barrier to such animals.

Johnson & Dudderar, WASTE AGE, March 1988, p.108-111

LEAK TESTING OF NEW LANDFILL LINERS REVEALS MAJOR FLAWS

Tests of the new municipal solid waste liner after burial by an Arizona contractor revealed that even with the most careful construction and quality assurance testing at every stage of emplacement, the liners had holes and punctures. ***American City and County, July 1991***

EVEN EPA PREDICTS FAILURE OF THE NEW LANDFILL TECHNOLOGY

"First, even the best liner and leachate collection systems will ultimately fail due to natural deterioration…" ***Federal Register p.33345 August 30, 1988***

BLUE RIDGE ENVIRONMENTAL DEFENSE LEAGUE
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Rachel's Environment & Health News
#316 - New Evidence That All Landfills Leak
December 15, 1992

Starting in the 1970s and continuing throughout the 1980s, U.S. Environmental Protection Agency [EPA] funded research which showed that burying household garbage in the ground poisons the groundwater. On several occasions, EPA spelled out in detail the reasons why all landfills leak. (For example, see RHWN #37, #71, and #116)

Then in late 1991, after several years of deliberation, EPA chief William Reilly issued final landfill regulations that allow the continued burial of raw garbage in landfills. (See RHWN #268.) EPA's 1991 regulations require an expensive landfill design: two liners in the ground and an impervious plastic cover over the landfill after it has been filled with garbage. This is "state of the art" technology, the very best that modern engineers can build. However, EPA officials still expect such landfills to fail and eventually poison groundwater.

As early as 1978, EPA knew why all landfills eventually leak. The main culprit is water. Once water gets into a landfill, it mixes with the garbage, producing a toxic leachate ("garbage juice"), which is then pulled downward by gravity until it reaches the groundwater. Therefore, the goal of landfill designers (and regulators) is to keep landfills dry for the length of time that the garbage is dangerous, which is forever.

Now a 1992 report from a California engineering-consulting firm, G. Fred Lee & Associates, has examined recent scientific studies and has confirmed once again why modern "dry tomb" landfill technology will always fail and should always be expected to poison groundwater.[1]

The new report, authored by Fred Lee and Anne Jones, reviews recent evidence--much of it produced by government-funded research--that landfill liners leak for a variety of reasons; that leachate collection systems clog up and thus fail to prevent landfill leakage; that landfill leachate will remain a danger to groundwater for thousands of years; that even low-rainfall areas are not safe for landfill placement; that gravel pits and canyons are particularly dangerous locations for landfills; that maintaining a single landfill's cap for the duration of the hazard would cost hundreds of billions, or even trillions, of dollars; that groundwater monitoring cannot be expected to detect landfill leakage; that groundwater, once it is contaminated, cannot be cleaned up and must be considered permanently destroyed; and that groundwater is a limited and diminishing resource which modern societies grow more dependent on as time passes.

A 1990 examination of the best available landfill liners concluded that brand-new state-of-the-art liners of high density polyethylene (HDPE) can be expected to leak at the rate of about 20 gallons per acre per day (200 liters per hectare per day) even if they are installed with the very best and most expensive quality-control procedures.[2] This rate of leakage is caused by pinholes during manufacture, and by holes created when the seams are welded together during landfill construction. (Landfill liners are rolled out like huge carpets and then are welded together, side by side, to create a continuous field of plastic.) Now examination of actual landfill liners reveals that even the best seams contain some holes.

In addition to leakage caused by pinholes and failed seams, new scientific evidence indicates that HDPE (high density polyethylene, the preferred liner for landfills) allows some chemicals to pass through it quite readily. A 1991 report from University of Wisconsin shows that dilute solutions of common solvents, such as xylenes, toluene, trichloroethylene (TCE), and methylene chloride, penetrate HDPE in one to thirteen days. Even an HDPE sheet 100 mils thick (a tenth of an inch)--the thickness used in the most expensive landfills) is penetrated by solvents in less than two weeks.

Another problem that has recently become apparent with HDPE liners is "stress cracking" or "brittle fracture." For reasons that are not well understood, polyethylenes, including HDPE, become brittle and develop cracks. A 1990 paper published by the American Society for Testing Materials revealed that HDPE liners have failed from stress cracks in only two years of use. Polyethylene pipe, intended to give 50 years of service, has failed in two years. Lee and Jones sum up (pg. 22), "While the long-term stability of geomembranes (flexible membrane liners) in landfills cannot be defined, there is no doubt that they will eventually fail to function as an impermeable barrier to leachate transport from a landfill to groundwater. Further, and most importantly at this time, there are no test methods, having demonstrated reliability, with which to evaluate long-term performance of flexible membrane liners."

Recent scientific studies of clay indicate that landfill liners of compacted clay leak readily too. For example, a 1990 study concludes,

[I]F A NATURALLY OCCURRING CLAY SOIL IS COMPACTED TO HIGH DENSITY, THEREBY PRODUCING A MATERIAL WITH VERY LOW HYDRAULIC CONDUCTIVITY, AND IF IT IS MAINTAINED WITHIN THE SAME RANGES OF TEMPERATURE, PRESSURE, AND CHEMICAL AND BIOLOGICAL ENVIRONMENT, IT WOULD BE EXPECTED TO FUNCTION WELL AS A SEEPAGE BARRIER INDEFINITELY. IN WASTE CONTAINMENT APPLICATIONS, HOWEVER, CONDITIONS DO NOT REMAIN THE SAME. THE PERMEATION [PENETRATION] OF A COMPACTED CLAY LINER BY CHEMICALS OF MANY TYPES IS INEVITABLE, SINCE NO COMPACTED CLAY OR ANY OTHER TYPE OF LINER MATERIAL IS EITHER TOTALLY IMPERVIOUS OR IMMUNE TO CHEMICAL INTERACTIONS OF VARIOUS TYPES

The 1992 study by Lee and Jones is an excellent resource for anyone wanting to understand why landfills always fail. In their footnotes, they cite 18 other studies of landfill problems that they themselves have authored, so their expertise is unquestionable, their information reliable, their arguments solid.

There has been sufficient scientific evidence available for a decade to convince any reasonable person that landfills leak poisons into our water supplies, and are therefore anti-social.

The question remains: what will it take to convince government--specifically EPA--to base policy on its own scientific studies and its own understanding?

The new EPA administrator is Carol M. Browner, an avowed environmentalist from Florida. Asked to describe Ms. Browner's style, John Sheb, head of Florida's largest business trade association, said: "She kicks the door open, throws in a hand grenade, and then walks in to shoot who's left. She really doesn't like to compromise."

Maybe Ms. Browner could start with a wake-up grenade in the Office of Solid Waste.

--Peter Montague

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[1] G. Fred Lee and Anne R. Jones, MUNICIPAL SOLID WASTE MANAGEMENT IN LINED, "DRY TOMB" LANDFILLS: A TECHNOLOGICALLY FLAWED APPROACH FOR PROTECTION OF GROUNDWATER QUALITY (El Macero, Calif.: G. Fred Lee & Associates, March, 1992). Available from: G. Fred Lee & Associates, 27298 East El Macero Drive, El Macero, CA 95618-1005. Phone (916) 753- 9630. 67 pgs.; free.

[2] Rudolph Bonaparte and Beth A. Gross, "Field Behavior of Double- Liner Systems," in Rudolph Bonaparte (editor), WASTE CONTAINMENT SYSTEMS: CONSTRUCTION,

REGULATION, AND PERFORMANCE [Geotechnical Special Publication No. 26] (New York: American Society of Civil Engineers, 1990), pgs. 52-83.

CLARIFICATION: RIGHTS OF CORPORATIONS

Last week we suggested the need for a Constitutional amendment declaring that a corporation is not a natural person and is therefore not protected by the Bill of Rights and the 14th amendment to the Constitution. Such an amendment would level the playing field somewhat, giving communities and individuals a greater chance of controlling anti-social corporate behavior. As we noted in earlier newsletters (RHWN #308, #309), corporations are now literally out of control. Shareholders cannot control them; boards of directors cannot control them; workers cannot control them; in a competitive world market, even managers have lost control. In some cases, of course, management doesn't care about the environment or the community. But even when managers, as individuals, want to do the right thing, the logic of corporate growth and short-term gain often dictates choices that do not serve the environment or the community. Since corporate behavior is at the root of nearly all environmental problems, stripping corporations of some of their rights (such as the Constitutional protections guaranteed to individual citizens, which the Supreme Court extended to corporations in 1886), would help communities assert control over corporate behavior. Merely DEBATING such an amendment would get people thinking about power in the modern world, asking who has a legitimate right to control what. Ask yourself: who ever gave private corporations the right to manufacture and sell products that can destroy the planet as a place suitable for human habitation? In suggesting such a Constitutional amendment, we omitted reference to the original source of the idea, author Richard Grossman.

For historical background on control of corporations, get: Richard Grossman and Frank T. Adams, TAKING CARE OF BUSINESS; CITIZENSHIP AND THE CHARTER OF INCORPORATION (Cambridge, Mass.: Charter, Inc., 1992). For a copy, send $4.00 plus a self-addressed, stamped envelope containing 52 cents postage to: Charter, Inc., P.O. Box 806, Cambridge, MA 02140. --Peter Montague

Descriptor terms: corporations; constitution; us; landfilling; landfill liners; leachate collection systems; groundwater; epa; waste disposal technologies; high density polyethylene; waste treatment technologies; msw;

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Rachel's Environment & Health News
#217 - Plastics -- Part 2: Why Plastic Landfill Liners Always Fail
January 22, 1991

In the landfill business, government and industry say plastic liners are going to save the day. For example, U.S. Environmental Protection Agency (EPA) and industry both argue that incinerator ash can be safely "disposed of" in a double-lined ash "monofill." A "monofill" is a landfill that contains only ash, no raw garbage. Like any other landfill, the basic design is a bathtub in the ground. The bottom of the bathtub is formed by a huge sheet of plastic. In an expensive landfill, you have two sheets of plastic separated by about two feet of sand and gravel--thus creating one bathtub inside another bathtub. Therefore, a doublelined ash monofill is a landfill (which is really just a polite word for a dump) in the form of a bathtub created by two plastic liners, containing incinerator ash and nothing else.

The theory behind the monofill is that ash contains only small amounts of aggressive organic chemicals that might eat a hole in the plastic liner, so the plastic liner will remain intact and protect us against the lead and cadmium and other toxic metals contained in the ash. (See RHWN #92.) As always, the key question is: what is the duration of the hazard and what is the duration of the protection provided by the plastic liner? (The "cap" or umbrella covering a landfill will also be made of the same plastic, so a landfill is really a "baggie" in the ground, containing toxins. What is the lifetime of this baggie? How long will it protect us?)

What is the duration and nature of the hazard from metals in incinerator ash? As we saw earlier (in RHWN #92) incinerator ash is rich in toxic metals. For example, it typically contains anywhere from 3000 parts per million (ppm) to 30,000 ppm of lead. U.S. Environmental Protection Agency Region (Boston), and the Harvard University School of Public Health have recommended a cleanup action level of 1000 ppm for lead in soil--in other words, they recommended that remedial action, as would be needed at a Superfund site, should be undertaken wherever lead in soils exceeds 1000 ppm.[1] In recommending the 1000 ppm action level, EPA and Harvard wrote, "While we believe a greater margin of safety would be achieved with an action level of 500 ppm, we think it necessary to set priorities for remedial activity." (What they meant was that there are so many places in urban America where there is 500 ppm lead in soil that EPA would be overwhelmed with work if 500 ppm were set as the threshold for remedial action--so 1000 ppm is a more "realistic" cleanup action level even though it's not as safe as the nation's children really need it to be.)

Given that EPA Region I and the Harvard School of Public Health have recommended that Superfund-type cleanup be initiated whenever soils contain more than 1000 parts per million (ppm) of lead, we know immediately that every ash monofill will have to be cleaned up at some time in the future because all incinerator ash contains more than 1000 ppm lead. (Ash also contains dangerous amounts of other toxic metals-- cadmium, arsenic, chromium, and perhaps others, so lead is not the only reason why a cleanup might be needed.) Therefore, when we create ash monofills we know we are creating Superfund sites that our children will pay for--either in damage to their brains and nervous systems, or in enormous outlays of money--or both.

Because lead and cadmium and other metals never degrade into anything else, but remain toxic forever, the duration of the hazard is perpetual, everlasting, eternal. The danger will never go away.

The incineration industry, and its acolytes in government, argue that the plastic liners will protect us and our children forever. Unfortunately, this idea is based on a misunderstanding (or more likely an intentional misrepresentation) of what happens to plastics as they get older. Plastics are not inert; they do not stay the same as time passes. They change. They come apart spontaneously.

A recent book by Deborah Wallace, Ph.D., describes this process well. [2] The book is about the dangers of plastics in fires, but in telling the story of "Why today's fires are so dangerous," (the answer is because burning plastics give off toxic gases that kill people who breathe them), Dr. Wallace included a section on the makeup of plastics at the molecular level, which helps us understand why all plastics eventually fall apart.

The building blocks of plastics are found in natural gas, coal, and wood, but the major source is oil. Oil (like coal and natural gas) is a mixture of molecules of different sizes and structures. To separate out the different molecules, crude oil is distilled in an oil refinery. The oil is boiled and smaller, lighter molecules are separated from the larger, heavier molecules. The heavier molecules are then "cracked" to break up the large, heavy molecules into smaller, lighter molecules.

The result of this distillation and cracking is organic chemicals, which is the name for chemicals containing carbon and other elements (chiefly hydrogen, oxygen, and nitrogen). These organic chemicals form the building blocks of pesticides, glues, and plastics. Other chemicals (such as chlorine and lead) are added to give the raw materials new characteristics (strength, stiffness, color, and so forth).

After the building blocks are manufactured, they are turned into plastic resin by a process called polymerization. A polymer is a large, organic, chain-like molecule made of repeated units of smaller molecules. Polymerization usually requires heating the raw materials in the presence of helper chemicals called catalysts, until the building blocks form long chains. Even with the catalysts, a great deal of heat is used in the polymerization process. "Because of this heat, the long chains, even during manufacture, may decompose slightly and have defect points along them," Dr. Wallace explains. The defect points are in the chemical bonds, which absorb the energy used in the manufacturing process. The law of conservation of energy states that the amount of energy in a system after the reaction is the same as the amount of energy before the reaction. The large amounts of energy (heat) thus must go somewhere; they go into the bonds between the atoms of the plastic and are stored there. But nature does not favor this gain of energy--nature favors low energy chemical bonds, and high energy bonds tend to release their energy by breaking spontaneously. These are defect points. Although polymer scientists have striven to reduce the number of defect points, they have not been able to completely eliminate them from synthetic polymers.

Dr. Wallace continues, "The physical and chemical defects that are produced by ordinary processes in the manufacture and use of plastics demonstrate the fragile and unstable character of these long chains of molecules that are joined by high energy chemical bonds. When the resin is further processed to become the finished marketable product, additional defect points are created because the product is again heated and handled."

As time passes, plastics decompose--their molecules come apart spontaneously--beginning at the defect points. Polymer scientists refer to this decomposition as "aging." All plastics "age" and there is nothing that can be done about it. Within a few years (at most a few decades), all plastics degrade, come apart, and fail. They become brittle, lose their strength, crack, break into fragments. At that point, any protection the plastic may have afforded against the toxic dangers lurking in an ash monofill is gone. By that time, the people who created the ash monofill will have taken their profits and left town, but the deadly residues they leave behind--the ash--will remain to plague the community forever, poisoning the community's children with toxic lead and other metals.

The only affordable solution to this problem is a simple one: prevent the creation of incinerator ash.

--Peter Montague

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[1] P.L. Ciriello and T. Goldberg, "Lead-contaminated Soil Cleanup

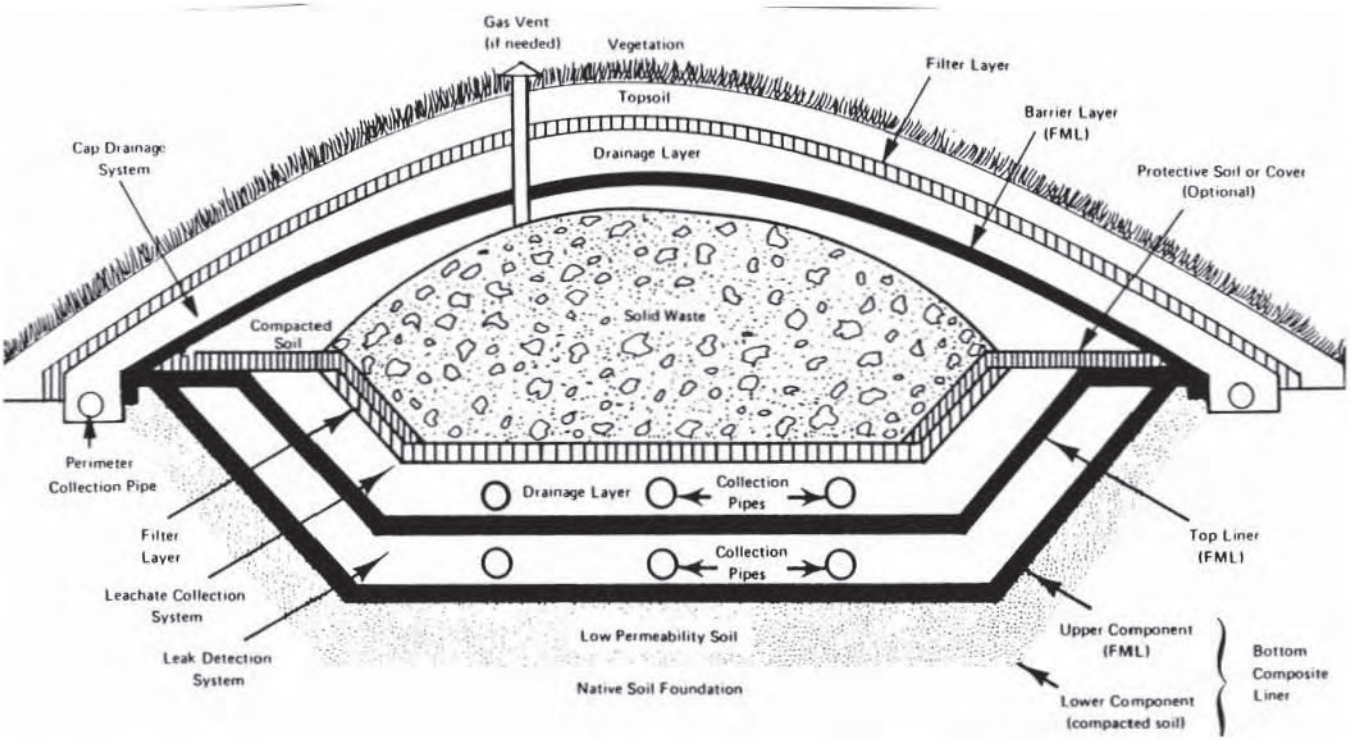
Draft Report" which appears as Appendix E in: Agency for Toxic Substances and Disease Registry, THE NATURE AND EXTENT OF LEAD POISONING IN CHILDREN IN THE UNITED STATES: A REPORT TO CONGRESS (Atlanta, Ga: Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services [1600 Clifton Rd. -Mail Stop E-33, Atlanta, Ga 30333; phone (404) 639-0730], July, 1988). Free while supplies last."

[2] Deborah Wallace, IN THE MOUTH OF THE DRAGON (Garden City Park, NY: Avery Publishing Group [120 Old Broadway, Garden City Park, NY 11040; phone (516) 741-2155], 1990). $17.95.

Descriptor terms: epa; landfilling; plastic liners; harvard university school of public health; studies; remedial action; ash monofills; heavy metals; deborah wallace; polymerization; leaks;

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Rachel's Environment & Health News
#119 – Leachate Collection Systems: The Achilles' Heel Of Landfills
March 7, 1989



A landfill is a bathtub in the ground, and a bathtub can leak two ways: it can leak through a hole in the bottom (failure of its bottom liner), or it can fill up with fluid and spill over its sides. Either way, it's bad news. The basic problem is the fluid. If a landfill begins to fill up with fluid, the weight of the fluid puts pressure on the bottom of the landfill, increasing the likelihood of bottom liner failure, so any fluid inside a landfill is a potential source of trouble.

To prevent fluid from causing problems, every modern landfill has a system for draining liquids out of the landfill. This is called a leachate collection system. What is leachate? Think of a landfill as being like a drip coffee maker. The dry coffee is the garbage, the water you pour in the top is rainwater, and the dark, brewed coffee dripping out the bottom is leachate. You might want to drink coffee, but you definitely do not want to drink leachate: it has many toxic and dangerous characteristics. It is badly polluted with chemicals and with micro-organisms (bacteria and viruses) that would make you sick.

The picture below represents a closed landfill; the heavy dark line represents the plastic baggie (bottom liner and top cover) that is supposed to keep leachate from entering the environment. The round circles between the two bottom liners represent collection pipes which have many holes drilled along their length (making these pipes resemble a swiss cheese); they are supposed to collect any leachate that flows to the bottom of the landfill. In theory, these pipes carry off the leachate to a wastewater treatment plant, where the leachate is processed to remove the toxic chemicals. (At the wastewater treatment plant, some of the chemicals are released into the air, and the remaining ones are collected [they're now in a mud-like sludge] and they are sent to another landfill somewhere.)

One of the least-studied aspects of landfill design is how to make a leachate collection system that will work for many decades (much less many hundreds of years). The fact is, leachate collection systems can clog up in less than a decade and, when that happens, fluids begin to build up inside the landfill—a dangerous situation, as we have noted above.

Leachate collection systems fail in several known ways. First, they can clog up from silt or mud. Second, they can clog up because of the growth of microorganisms in the pipes. Third, they can clog because of a chemical reaction leading to the precipitation of minerals in the pipes; anyone who has boiled a pot of "hard" water and seen the whitish crusty residue in the bottom of the pot knows what "precipitated chemicals" look like. Fourth, the pipes themselves can be weakened by chemical attack (acids, solvents, oxidizing agents, or corrosion) and may then be crushed by the tons of garbage piled above them.

The book, AVOIDING FAILURE OF LEACHATE COLLECTION AND CAP DRAINAGE SYSTEMS, by Jeffrey Bass, discusses these four failure mechanisms. The first problem (silt) can sometimes be avoided, or at least reduced, by installing a "filter layer" above the leachate collection system. The filter layer may be made up of gravel or of a rug-like plastic material called "geotextile." Since the oldest leachate collection systems

date from the early 1970s, humans have very little experience with the long-term performance of leachate collection systems. The hope is that a "filter layer" will solve the siltclogging problem, but after many decades the entire filter layer itself may clog. Only time will tell.

The growth of microorganisms seems to be an uncontrollable problem. The conditions for growth of slime-forming microorganisms are not well understood. Even if they were understood, we could not control chemical and physical conditions (temperature, pH, etc.) at the bottom of a landfill because of the thousands of tons of wastes heaped up in the landfill.

The problem of chemical precipitation also appears to be uncontrollable. The chemical conditions that lead to precipitation may be knowable, but again the conditions in the leachate collection system cannot be controlled because the system is not accessible once wastes have begun to be dumped into the landfill.

The last problem—chemical attack on the leachate collection pipes, leading to destruction of the pipes themselves—also appears to be an unsolvable problem. Mr. Bass suggests, in best ivory tower fashion, that the way to control chemical attack on the pipes is to select pipes that are resistant to the chemicals that you know will make their way into the landfill. In principal, this is a good idea. But in the real world, how do you know what's going to be put into your landfill next week? Next year? With 1000 brand new chemicals being put into commercial use each year, over the next 10 years, today's leachate collection pipes may come into contact with 10,000 new chemicals that don't even exist today. Any of those chemicals may attack the pipes. In addition, chemicals mixing together inside a landfill will create new chemical combinations that may produce heat or may otherwise attack the pipes.

Mr. Bass's book is misnamed because it seems to suggest that the failure of leachate collection systems can be avoided. However, as the text of Mr. Bass's book makes abundantly clear, if such failures were to be avoided, it would be by dumb luck, not by engineering design. Only a fool trusts dumb luck.

Mr. Bass's book is overpriced at $36.00 from: Noyes Data Corporation, Mill Road, Park Ridge, NJ 07656. No telephone orders accepted.

--Peter Montague

Descriptor terms: landfilling; landfill failure mechanisms; leachate collection systems; msw;

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Rachel's Environment & Health News
#109 - The Catch-22s Of Landfill Design
December 25, 1988

The waste hauling industry knows that all landfills will eventually leak because their own industry trade journals are now telling the story. WASTE AGE is the main magazine for the waste industry. The editors of WASTE AGE are not sympathetic to environmental groups. For example, it was in WASTE AGE'S columns that you may have read,

"The NIMBY [not in my back yard] syndrome is a public health problem of the first order. It is a recurring mental illness that continues to infect the public.

"Organizations that intensify this illness are like the viruses and bacteria which have, over the centuries, caused epidemics such as the plague, typhoid fever, and polio.

"....It is time solid waste management professionals stopped wringing their hands and started a campaign to wipe out this disease." (WASTE AGE, Mar., 1988, pg. 197.)

Clearly WASTE AGE is no friend of the grass roots environmental movement. Yet it has been publishing articles that say what we've been saying all along: the security and safety of landfills is dependent upon the landfill cap, and the landfill cap is inevitably destroyed by natural forces.

WASTE AGE has run a series of articles over the past two years saying why landfills will inevitably leak, and suggesting that the only solution to the problem is perpetual maintenance of the closed landfill. Since humans have no experience maintaining anything in perpetuity, perpetual maintenance is an untested and unproven, and, one can only say, silly non-solution. If we took it seriously, perhaps we would develop a large army of landfill maintainers whose only job in life will be to maintain the toxic garbage left behind by their parents and their parents' parents and their parents' parents' parents and so on for generation after generation.

Despite the silly suggestion that perpetual maintenance of landfill caps is a way out of our present garbage problem, these articles contain much good information about why landfills leak.

Remember, a landfill is nothing more than a bathtub in the ground (perhaps, in the case of a double-lined landfill, one bathtub inside another). A bathtub will leak if its bottom develops a hole, or it can simply fill up with water (for example, rainfall) and leak over its sides. Either way, a landfill can contaminate the local environment. Therefore, a "cap" is placed over the landfill when the landfill is full. The "cap" is supposed to serve as an umbrella to keep rain out, to keep the bathtub from spilling over its sides.

Writing in WASTE AGE, Dr. David I. Johnson and Dr. Glenn R. Dudderar of the Michigan State University Department of Fisheries and Wildlife, have argued,

"There is evidence that the engineered integrity of a cap will not be maintained over the landfill's extended life." (This is somewhat fancy language for "All landfills will eventually leak.")

Johnson and Dudderar go on to say, "Regulations may require bonding for five to 20 years. Yet from a biological and geophysical point of view this time period is a totally inadequate maintenance requirement." (Translation: It may take nature more than 20 years to destroy a landfill cap, but nature has all the time in the world, so you'd better be prepared to maintain a landfill for the long haul--forever.)

Catch 22 #1: A landfill cap is intended to be impermeable--to keep water out. This means water is supposed to run off the surface. But this, in turn, invites soil erosion. "But in the runoff process, cap soil will be carried with the runoff, causing sheet and rill erosion and, ultimately, gullying of the cap." When you get gullies in the cap, it's all over.

Other physical forces working constantly to destroy a landfill cap are freezethaw and wet-dry cycles. Soil shrinkage during dry weather can cause cracks. Rain penetrates the cracks. In winter, rain freezes to ice and expands, widening the cracks. And so on, year in, year out, century after century. The cracks not only let in water, they also provide pathways for plant roots and for burrowing animals.

Catch 22 #2: To minimize soil erosion, and to minimize changes due to wet-dry cycles, you need to establish vegetation on the cap. However, plants maintain their physical stability, and they gather water and nutrients, through roots, which can penetrate a landfill cap, destroying the cap's integrity. Furthermore, plants provide cover (and food) for burrowing animals, which then burrow into the cap, destroying it.

A study of a solid radioactive waste landfill reveals that mice, shrews, and pocket gophers can move 10,688 pounds (5.3 tons) of soil to the surface per acre per year. "Similar activity would have a dramatic impact on landfill cap integrity," Johnson and Dudderar observe. Burrowing animals of concern include woodchucks, badgers, muskrats, moles, ground squirchipmunks, gophers, prairie dogs and badgers. Clay presents little barrier to such animals; "synthetic liners, measured in mils [of thickness], are not likely to impede these same mammals," Johnson and Dudderar observe. Non-mammals are also a problem: crayfish, tortoises, mole salamanders, and "a variety of worms, insects and other invertebrates" can make holes in a landfill cap.

Earthworms alone can have a devastating impact on a landfill cap. Earthworms pass two to 15 tons of soil through their digestive tracts per acre per year. "The holes left as they move through the soil to feed increase water infiltration," Johnson and Dudderar comment. They give evidence that worm channels allowed plant roots to grow to a depth of nine feet in Nebraska clay soils.

In a section called "The fundamental dilemma," Johnson and Dudderar sum up:

"At this point you may well say: 'If we plant, we're encouraging plant and animal penetration of the clay cap. If we don't plant, we get erosion or freeze-thaw destruction of the cap.'

"Unfortunately, that is one of the fundamental dilemmas left us by the normal processes of change in the natural world, be they the progressive conversion of a grassy field to a forest or the utilization of cracks in concrete sidewalks by ants and dandelions.

"This same successional development process, so intensively studied in the ecological literature, will detrimentally affect long-term landfill integrity." So there you have it, right from the pages of Waste Age: the forces of nature, left to themselves, will destroy landfill caps, the key element intended to prevent landfills from leaking.

What hope is there? Perpetual care. A perfectly silly idea. What reasonable hope is there? None whatsoever. All landfills will eventually leak. Happy new year.

For further information, see: David I. Johnson, "Caps: The Long Haul," WASTE AGE March, 1986, pgs. 83-89; David I. Johnson, "Capping Future Costs," WASTE AGE August, 1986, pgs. 77-86; David I. Johnson and Glenn R. Dudderar, "Can Burrowing Animals Cause Groundwater Contamination?" WASTE AGE March, 1988, pgs. 108-111; see also David I. Johnson and Glenn R. Dudderar, "Designing and Maintaining Landfill Caps for the Long Haul," JOURNAL OF RESOURCE MANAGEMENT AND TECHNOLOGY, Vol. 16 (April, 1988), pgs. 34-40. Dr. Johnson [phone 517/353-1997] and Dr. Dudderar [phone 517/353-1990] are with Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824.

Emerging Contaminants at a Closed and an Operating Landfill in Oklahoma

by William J. Andrews, Jason R. Masoner, and Isabelle M. Cozzarelli

Abstract

Landfills are the final depositories for a wide range of solid waste from both residential and commercial sources, and therefore have the potential to produce leachate containing many organic compounds found in consumer products such as pharmaceuticals, plasticizers, disinfectants, cleaning agents, fire retardants, flavorings, and preservatives, known as emerging contaminants (ECs). Landfill leachate was sampled from landfill cells of three different age ranges from two landfills in Central Oklahoma. Samples were collected from an old cell containing solid waste greater than 25 years old, an intermediate age cell with solid waste between 16 and 3 years old, and operating cell with solid waste less than 5 years old to investigate the chemical variability and persistence of selected ECs in landfill leachate of differing age sources. Twenty-eight of 69 analyzed ECs were detected in one or more samples from the three leachate sources. Detected ECs ranged in concentration from 0.11 to 114 μg/L and included 4 fecal and plant sterols, 13 household\industrial, 7 hydrocarbon, and 4 pesticide compounds. Four ECs were solely detected in the oldest leachate sample, two ECs were solely detected in the intermediate leachate sample, and no ECs were solely detected in the youngest leachate sample. Eleven ECs were commonly detected in all three leachate samples and are an indication of the contents of solid waste deposited over several decades and the relative resistance of some ECs to natural attenuation processes in and near landfills.

Introduction

There are 90,000 to 100,000 closed municipal landfills and about 3100 operating landfills (Zero Waste America 2011) in the United States. The closed landfills, many of which are unlined and poorly capped, may be sources of a large number of organic compounds known as emerging contaminants (ECs) to surrounding groundwater and surface water. ECs consist of household and industrial compounds in wastes and consumer products that include fecal and plant sterols, pharmaceuticals, food additives, soaps and detergents, solvents, cleaning agents, fire retardants, plasticizers, perfumes, and pesticides. ECs, although they generally occur in small concentrations in water (<1 mg/L), may singly or in aggregate cause health problems for humans and wildlife ingesting water containing these compounds.

In 2008, approximately 135 million tons of municipal solid waste (MSW) was deposited in landfills in the United States, making landfilling the most common method of MSW disposal (U.S. Environmental Protection Agency 2009). Landfills are the final depositories for a large number of anthropogenic organic compounds, including ECs (Slack et al. 2005). Pharmaceutical compounds may occur in concentrations of approximately 8.1 mg/kg in typical MSW (Musson and Townsend 2009). Having been discarded in landfills, ECs may be degraded/metabolized, adsorbed to solids, or dissolved in leachate (Musson and Townsend 2009). Anaerobic conditions in landfills and nearby groundwater receiving organic-rich leachate from landfills (Cozzarelli et al. 2011) are likely to slow metabolism/breakdown of organic compounds in leachate and groundwater compared to aerobic conditions that are more common in shallow groundwater (Bedient et al. 1997). In groundwater downgradient from an abandoned unlined landfill near Elkhart, Indiana, detergent metabolites, plasticizers, disinfectants, fire retardants, pharmaceuticals, and an antioxidant were detectable at concentrations in the low parts-per-billion range (Buszka et al. 2009). Huset et al. (2011) reported on detection of 24 fluorochemicals in landfill leachates, primarily short-chain (C4-C7) carboxylates or sulfonates associated with paper, textiles, and carpets.

Leaching of organic chemicals from both old and modern landfills to groundwater and surface water is a potentially important environmental problem, with such chemicals potentially being toxic, estrogenic, and carcinogenic to both terrestrial and aquatic organisms (Cozzarelli et al. 2011; Huset et al. 2011; Matejczyk et al. 2011). Some reports have indicated that mixtures of dilute concentrations of ECs in water may deleteriously affect human health, as had been

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Updated Review of the "Flawed Technology"
of US EPA Subtitle D MSW Landfilling

G. Fred Lee, PhD, PE, BCEE, F.ASCE and Anne Jones-Lee, PhD

June 7, 2010

The current US EPA Subtitle D landfilling regulations, adopted in 1992, were crafted under the hand of litigation settlement. They were not developed through considered input of and evaluation by the experienced technical community or with scrupulous peer review for the ability of the regulatory specifications to ensure true protection of public health and environmental quality for as long as the landfilled wastes would represent a threat. In fact, during the Subtitle D development process, the US EPA repeatedly indicated that the proposed landfilling regulations would not be protective of groundwater quality over the period that the wastes in the prescribed "dry tomb" (plastic-sheeting and compacted soil-lined) landfill could be a threat. Indeed, the US EPA noted that the "dry tomb" landfills as prescribed and allowed by the regulations could be expected to fail to prevent production of landfill leachate and the migration of that leachate to groundwater. It was clear from the outset that the Subtitle D regulations represented a fundamentally flawed technology. The fundamental flaws of the Subtitle D specifications have not been overcome in the implementation of the regulations over the past 18 years since it adoption.

In the early 1990s Drs. G. Fred Lee and Anne Jones-Lee developed an extensive overview discussion of public health and environmental quality problems that can be caused by landfilling of municipal and industrial solid wastes under the applicable US EPA Subtitle D regulations. The review, which was posted on their website [www.gfredlee.com], was based on their professional experience in reviewing the impacts of proposed and existing landfills, their university research on landfill liner integrity issues, their search and review of the professional literature, and the provisions, requirements, allowances, and implementation of Subtitle D regulations. It included an overview of a number of key deficiencies in Subtitle D with regard to landfill siting, design, construction, operation, closure, and post-closure monitoring and maintenance for the protection of public health and environmental quality for as long as the wastes in the landfill represent a threat to public health, water resources, air quality, and the interests of those in the sphere of influence of a landfill. In addition to highlighting regulatory shortcomings, the review also discussed key elements that need to be incorporated into the landfilling of non-recyclable solid waste components in order to more reliably protect public health, environmental quality, and the interests of those in the sphere of influence of a landfill. It also included substantial references to, and internet links for, professional literature where additional information on the issues discussed could be obtained. Based on their experience and findings, they described the Subtitle D regulations in their review as advancing and enabling a "Flawed Technology" that falls far-short of protecting groundwater and surface water quality from pollution by municipal and industrial solid waste leachate (garbage juice) for as long as the landfilled wastes will be a threat.

Periodically over the past two decades, Lee and Jones-Lee have updated their "Flawed Technology" review with new information on the topics discussed and the addition of discussion of new issues that have come to light since the previous update. In June 2010, Drs. Lee and

Jones-Lee again updated their "Flawed Technology" review, and incorporated an additional nine pages of text and references. The updated, now 94-page, review is available as:

Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Updated June (2010). http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

In addition to improved clarity of presentation, the June (2010) updated review includes several new or expanded sections on a variety of issues including:

- additional statements by the US EPA acknowledging the inevitability of failure of landfill liner systems,
- monitoring stormwater runoff from landfills and hazardous chemical sites,
- unregulated, potentially hazardous and otherwise deleterious chemicals in municipal solid wastes,
- Subtitle D or equivalent landfills in other countries, including in a new proposed landfill in Alberta, Canada,
- the inappropriate development of a landfill atop a fractured rock, sole-source aquifer system in an area that is subject to intense seismic (earthquake) activity,
- the inadequacy of information published by SWANA on bioreactor landfills,
- the potential for leachate and landfill gas produced in construction and demolition (C&D) waste landfills to pollute groundwater and lead to offsite explosions.

The abstract and table of contents for the June (2010) update of the "Flawed Technology" review is attached.

The authors anticipate continuing to update this review periodically as new information and experience comes to light. Therefore, if you identify topics that are not covered in this review, or if you have comments or questions about this review, please contact G. Fred Lee at gfredlee@aol.com.

Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste

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Updated June 2010

Abstract

This report presents a review of the information available pertinent to public health and environmental quality protection issues for proposed and existing Subtitle D landfills. Based on this review it is concluded that this type of landfill will at most locations cause groundwater pollution by landfill leachate and be adverse to the health, welfare and interests of nearby residents and property owners/users. As discussed, there is normally significant justification for those near a proposed Subtitle D landfill to oppose the development of the landfill and the existence of an operating Subtitle D landfill.

Typically landfilling regulations require that,
(a) the solid waste facility shall not pose a substantial endangerment to public health or safety or the environment;
(b) the solid waste facility shall not cause an environmental nuisance.
Frequently in review of a proposed landfill, the regulatory agency staff do not adequately or reliably evaluate the potential for a proposed landfill to endanger public health, safety and the environment, and cause nuisance on adjacent properties.

Subtitle D landfills have the potential to generate leachate (garbage juice) that will pollute groundwater with hazardous and deleterious chemicals that are a threat to human health and the environment for thousands of years. These landfills have the potential to generate landfill gas that will contain hazardous and obnoxious chemicals for a long period of time well beyond the current minimum 30-year funded postclosure period. Specific deficiencies in the siting, design, operation, closure and postclosure care provisions for Subtitle D landfills include:

- a single composite landfill liner that will eventually fail to prevent leachate pollution of groundwater,
- a landfill cover that will eventually allow rainfall to enter the landfilled wastes which will generate leachate that will pollute groundwater,
- a grossly inadequate groundwater monitoring system that has a low probability of detecting leachate-polluted groundwater before it leaves the landfill owner's property,
- inadequate postclosure funding for landfill monitoring, maintenance and remediation of polluted groundwater for as long as the wastes in the landfill will be a threat,
- inadequate buffer lands between where wastes will be deposited and adjacent properties, which will result in adverse impacts on nearby property owners/users from landfill releases, including odors, dust, vermin, and noise and lights from landfill activities,
- decreased property values for owners of nearby properties.

In addition, at some locations there is an environmental justice issue associated with the development of a landfill that will be adverse to minority communities.

Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste

Table of Contents

Abstract i
Table of Contents ii
Tables and Figures iv
Acronyms and Definitions v

Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste

Overview of Landfilling Regulations 1
Qualifications to Provide Comments 2
Evolution of Subtitle D Landfills 3
Leachate Generation Potential Will Continue for Thousands of Years 8
Effect of Climate on Leachate Generation 8
Subtitle D Landfill Design Will Not Protect Groundwater for as Long as Leachate Can Be Generated 9
Expected Performance of Subtitle D Landfill Liner System 10
Liner Failure Inevitable 11
NRC Committee Report 13
Desiccation Cracking of Liner 14
Cation Exchange-Related Failure 14
Permeation through the Liner 15
*Diffusion can be Important*1 16
Potential Problems with Geosynthetic Clay Liners 16
Leachate Collection and Removal System Problems 19
Plugging of Leachate Collection Systems 20
Unreliable Evaluation of the Long-Term Integrity of Landfill Covers 20
Leak-Detectable Covers 22
Alternative Cover Design 22
Landfill Cover Area Reuse 24
Closing Unlined Landfills 24
Landfills at Superfund Sites 25
Unreliable Groundwater Monitoring 27
Initial Liner Leakage Can Produce Narrow Plumes of Leachate-Polluted Groundwater 28
Monitoring of Some Fractured Rock Aquifers Nearly Impossible 32
Regulatory Agency Should Evaluate Ability of Groundwater Monitoring System to Detect Initial Groundwater Pollution 35
Potential Change in Direction of Groundwater Flow 35
Evaluation of Leachate Density 36
State's Responsibility to Require Reliable Groundwater Monitoring 36
Responsibility for Long-Term Monitoring 36
Frequency of Groundwater Monitoring 37
Vertical Migration of Leachate Polluted Groundwater in Wells 37
Unreliable Information on Detection of Landfill Liner Failure 37
Impact of Seismic Activity on Integrity of Landfill Containment Systems 38
Landfill Gas and Airborne Emission Problems 38
Threat of Landfill Gas to Wildlife 41

Table of Contents (cont.)

Landfill Odor Control Problems and Impacts 41
Landfill Dust Control Problems 43
Stormwater Runoff Pollution Impacts/Control 43
Monitoring Stormwater Runoff from Hazardous Chemical Sites 45
Inadequate Stormwater Runoff Parameter Monitoring 46
Safe Drinking Water Act Source Protection Issues 47
Inadequate Postclosure Monitoring and Maintenance 48
Hazardous versus Nonhazardous Waste Classification 51
Inadequate Waste Screening for Prohibited Wastes 52
Hazardous Characteristics of MSW 53
Construction and Demolition Waste Landfilling 57
PCBs in Caulk in Older Buildings 58
Hazards of Living/Working near Landfills 62
Recommended Approach 63
Landfill Siting Issues 64
Justified NIMBY 64
Inadequate Buffer Lands 65
Other Impacts of Landfill Releases and Activities 66
Vermin-Disease Vectors 66
Noise Pollution 66
Light Pollution 67
Stormwater Flooding Problems 67
Decreased Values of Nearby Property 67
Host Fees 68
Impact on the Three Rs 68
Environmental Justice Issues 68
Professional Ethics Issues 68
Improving Landfilling of MSW 69
Siting 69
Design 69
Closure 69
Monitoring 69
Landfill Gas Collection 69
Maintenance 69
Funding 70
Improving Public Health and Environmental Protection from Inadequately Developed Landfills 70
Need for Improved Hydrogeological Characterization 71
Subtitle D Landfills in Other Countries 72
Comments on Environment Alberta July 1, 2009 Draft Standards for Landfills 72
Offsite Groundwater, Water Supply Well, and Surface Water Monitoring 73
Hazardous Waste Landfilling 74
Addressing the Flawed Technology of Subtitle D Landfilling 75
Fermentation leaching of MSW 76
References 77

Tables and Figures

Tables

Table 1 – Causes of Liner Failure 11
Table 2 - Adverse Impacts of "Dry Tomb" Landfills on Adjacent/Nearby Property Owners/Users 66

Figures

Figure 1 – Single Composite Liner Landfill Containment System 4
Figure 2 – Factors Affecting Landfill Cover Integrity 21
Figure 3 – Pattern of Landfill Leakage-Groundwater Contamination from unlined Landfills 29
Figure 4 – Pattern of Landfill Leakage-Groundwater Contamination from Lined Landfills 30
Figure 5 – Zones of Capture of Standard Monitoring Wells Must Overlap to Detect Leakage from Lined Landfills 31
Figure 6 – Double Composite Liner Landfill Containment System 33
Figure 7 - Chemical Analysis Output for a Typical Environmental Sample 47
Figure 8 - Comparison of Pattern of Landfill Gas Generation over Time at Classical Sanitary Landfill and "Dry Tomb" Landfill 50
Figure 9 - Impact of Moisture on Landfill Gas Formation 51
Figure 10 – Chemical Sources for California Coastal Water 57

Detecting Failure of Subtitle D Landfill Liner Systems

G. Fred Lee, PhD, PE, DEE
G. Fred Lee & Associates, El Macero, California
November 1999

Periodically landfill applicants and some regulators who want to prove that today's Subtitle D landfills are protective will assert that there are no recorded failures of Subtitle D landfills. This is an issue that I have addressed previously in my report, "Detection of the Failure of Landfill Liner Systems," (1996) which is available from my web site, www.gfredlee.com, in the Landfill section.

The statement about "no recorded failures" of Subtitle D landfills is likely correct. I don't know of any recorded failures. However, as discussed in my review, except under extremely sloppy construction and highly lucky groundwater monitoring, the failure of Subtitle D landfills at this time would not be expected to be detected. This is the result of several situations.

First, Subtitle D landfills have only been used for a few years. It should take about 25 years for leachate that passes through holes in the flexible membrane liner to pass through the clay liner.

Second, as discussed in the paper, "Deficiencies in Subtitle D Landfill Liner Failure and Groundwater Pollution Monitoring," (1998) which is also available in the Landfill section of my web site, the typical groundwater monitoring program allowed by regulatory agencies for Subtitle D landfills involving the use of monitoring wells at the point of compliance, which have zones of capture of about one foot, but which are spaced hundreds of feet apart, means that there must be widespread, general failure of the liner system before these monitoring wells can be expected to detect failure.

The initial failure of the liner system will not be through general leakage throughout the bottom of the landfill, but will be through holes, rips, tears, or points of deterioration in the plastic sheeting flexible membrane liner. As discussed by Cherry in 1990, the initial liner failures will produce finger-like plumes of leachate that will have a high probability of passing between the monitoring wells and not being detected by them.

As discussed in my comprehensive review of the deficiencies in the Subtitle D landfilling approach, "Assessing the Potential of Minimum Subtitle D Lined Landfills to Pollute: Alternative Landfilling Approaches," (1998), which is also available from my web site, based on the properties of the wastes allowed in Subtitle D landfills and the characteristics of the liner systems and groundwater monitoring systems, there is no question about the fact that for Subtitle D landfills sited at geologically unsuitable sites where the base of the landfill is connected through a vadose zone to usable groundwaters, it is only a matter of time until those groundwaters are polluted by landfill leachate, rendering them unusable for domestic and many other purposes. This is not a debatable issue.

Many of the components of the wastes in Subtitle D landfills will be a threat to pollute groundwaters forever. The liner systems being allowed at best only postpone when groundwater pollution occurs. The

groundwater monitoring systems being allowed are largely cosmetic in detecting off-site groundwater pollution before widespread pollution occurs. Anyone who claims otherwise either doesn't understand the basic issues involved, or is deliberately distorting the readily available information on these issues.

Additional Information on Reliability of Groundwater Monitoring at Subtitle D Landfills

In response to my recently summarizing the fundamentally flawed nature of Subtitle D landfilling of municipal solid wastes in protecting public health and the environment for as long as the waste in a Subtitle D landfill will be threat, a "landfill engineer" suggested that the typical groundwater monitoring well array that is used at Subtitle D landfills will detect leachate-polluted groundwater before off-site adjacent property pollution of groundwater occurs due to dispersion of the leachate-polluted groundwater plume. While dispersion plays a role in determining the ability of a monitoring well array to detect a leak from a small area source, it cannot be relied on to insure with a high degree of reliability that the typical groundwater monitoring well array that is being used today at Subtitle D landfills will detect groundwater pollution when it first reaches the point of compliance for groundwater monitoring. Dispersion can be an important factor for slow-moving groundwater pollution plumes at considerable distances from the source. However, contrary to the "landfill engineer's" suggestion, the situation in monitoring around a leaking tank is not the same as the typical monitoring situation at Subtitle D landfills. It is my experience that rarely are monitoring wells near a leaking tank somewhat randomly spaced hundreds to a thousand or so feet apart along the down groundwater gradient edge of the tank, as they are with Subtitle D landfills.

Detection of Leaks from Underground Tanks Versus Detecting Landfill Liner Leaks

When investigating leaking underground storage tanks, the potential source of the leak, i.e., the tank and its associated plumbing, are confined to a small area. To determine whether a tank has leaked sufficiently to pollute groundwaters, it is necessary to define, through the use of three monitoring wells, the direction of groundwater flow. Once this direction has been defined, then the placement of monitoring wells to detect leaks is usually straightforward for relatively homogeneous aquifer systems. However, for landfills, which can occupy hundreds to a thousand or more acres, the initial leakage point is unknown. Therefore, it is not possible to strategically locate monitoring wells downgradient which would reliably detect the leak when it first reaches the point of compliance for groundwater monitoring.

In accord with Subtitle D regulations, the point of compliance can be no more than 150 meters from the down groundwater gradient edge of the landfill, and must be on the landfill owner's property. Since there are no restrictions on landfilling to the edge of the property, I have repeatedly seen landfills with waste deposition areas within a few feet of the adjacent property line. Further, in some states, such as California, the point of compliance for Subtitle D landfill groundwater monitoring is the down groundwater gradient edge of the waste deposition area. This means that there can be little distance between where leaks can occur along the down groundwater gradient edge of the landfill, and the point of compliance for groundwater monitoring. While dispersion might be important for helping to detect leaks from the up groundwater gradient side of the landfill for slow-moving groundwater pollution plumes, it is of limited value in detecting leaks on the down groundwater gradient side of the landfill.

Dr. Cherry and his associates at the University of Waterloo examined the lateral dispersion that occurs in a relatively homogeneous aquifer system from a two-foot-long line source of a tracer. This group found that the two-foot-wide source had spread to about ten feet within 150 meters of the source. This means that monitoring wells would have to be spaced no more than 10 to 20 feet apart in order to reliably detect down groundwater gradient side of the landfill leaks. With monitoring wells spaced at least hundreds of feet apart at distances less than 150 meters from the down groundwater gradient edge of the landfill, there is appreciable distance between the monitoring wells, where substantial leachate plumes could pass without being detected.

It is inappropriate to suggest that detecting leaks from underground storage tanks is similar to detecting liner leaks from municipal landfills. The two situations are obviously significantly different.

Detecting Leaks from Landfills Sited above Fractured Rock Aquifer Systems

There are many Subtitle D landfills sited above fractured rock aquifer systems where it is impossible to reliably monitor landfill liner leakage, even if the monitoring wells are spaced only a few feet apart. Under most of these types of situations dispersion will not overcome the fundamental problems of monitoring the eventual failure of the landfill liner system.

Support of Dr. Cherry's Conclusions on the Unreliability of Groundwater Monitoring at FML-Lined Landfills

The work of Dr. John Cherry and his associates at the University of Waterloo has been supported by a number of competent hydrogeologists with whom I have worked, in review of the potential of proposed Subtitle D landfills to pollute groundwaters, as well as the ability of a proposed groundwater monitoring well array to detect this pollution in accord with Subtitle D requirements, when the pollution first reaches the point of compliance for groundwater monitoring.

Detecting Leaks in Fast and Slow-Moving Plumes

For fast-moving plumes in homogenous aquifer systems, dispersion will not necessarily be adequate to significantly improve the reliability of the typical Subtitle D monitoring well array. There are many places within a landfill footprint where leaks could occur and not be detected at the point of compliance for groundwater monitoring. For slow-moving plumes, there are important questions about whether the monitoring system will be maintained and operated when these plumes reach the point of compliance for groundwater monitoring. With no assured post-closure funding after 30 years, there is no assurance that groundwater monitoring systems will still be maintained and operated when they are needed, when the slow-moving plume with its dispersion reaches the point of compliance for ground water monitoring.

Recommended Approach for Permitting of Landfills

It has been my recommendation at landfill permitting hearings, that rather than assuming that arbitrarily spaced groundwater monitoring wells will reliably detect landfill liner leaks in accord with Subtitle D requirements, i.e., when the leachate-polluted groundwater first reaches the point of compliance for groundwater monitoring, the landfill applicant should be required to provide reliable information on the

monitoring well spacing, considering the site-specific characteristics of the geology-hydrology of the aquifer system that will be polluted when the Subtitle D liner system fails to prevent significant leakage of leachate through the liner. The burden of proof for the reliability of the groundwater monitoring system should be on the landfill applicant and not the public whose groundwater could be polluted if the arbitrarily developed groundwater monitoring system fails to detect the leachate-polluted groundwater at the point of compliance. It should be the responsibility of the landfill applicant to define, based on the site-specific characteristics of the aquifer, the monitoring well array needed to have a 95% probability of detecting one to two-foot-long rips, tears, or points of deterioration in the landfill FML liner at the point of compliance for groundwater monitoring, when the leachate-polluted groundwater first reaches this point.

Adopting this approach would quickly show what is well understood, that today's groundwater monitoring systems at many Subtitle D landfills are cosmetic and provide little in the way of reliable monitoring of leachate-polluted groundwaters before widespread liner deterioration occurs. At many Subtitle D landfills, the leaks through the liners will likely first be detected in off-site production wells, rather than by the groundwater monitoring system.

Assessing the Potential of Minimum Subtitle D Lined Land lls to Pollute: Alternative Land lling Approaches

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Abstract

The US EPA Subtitle D regulations specify as a minimum, MSW land lls be lined with a single composite liner which is part of a leachate collection and removal system. Upon reaching the land ll capacity, a low-permeability cover is installed. A groundwater monitoring system is used to detect liner failure during the 30-year mandated post-closure care period. The waste in a minimum Subtitle D Adry tomb@ land ll will be a threat to pollute groundwaters by leachate, effectively forever. The land ll liner and cover have a nite period of time when they can be expected to function effectively to keep moisture out of the land ll that generates leachate and to collect leachate formed within the land ll. The groundwater monitoring systems typically used with monitoring wells having zones of capture of about one foot on each side, spaced hundreds of feet apart, have low probabilities of detecting land ll liner failure that leads to groundwater pollution before off-site pollution occurs. The 30 years of mandated post-closure care is an in nitesimally small part of the time that the waste in a minimum Subtitle D Adry tomb@ land ll will be a threat to generate leachate that can pollute groundwater. Fundamentally, the minimum Subtitle D MSW land ll is a technologically awed approach that, at best, only postpones when groundwater pollution occurs for those land lls sited at geologically unsuitable sites, i.e. those without natural groundwater quality protection. The US EPA Subtitle D regulations also fail to address the justi able NIMBY associated with active life releases (odors, dust, blowing paper, etc.) from the land ll to the surrounding area. This paper discusses the de ciencies in minimum Subtitle D land lling of MSW and provides guidance on alternative land lling approaches that can protect public health, groundwater resources, environment and the interests of those within the sphere of in uence of the land ll.

Impact of Municipal and Industrial Non-Hazardous Waste Land lls on Public Health and the Environment: An Overview

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Prepared for California Environmental Protection Agency's Comparative Risk Project, May (1994).

Executive Summary

Classical unlined sanitary land lls are well-known to release large amounts of hazardous and otherwise deleterious chemicals to nearby groundwater and to the air, via leachate ("garbage juice") and land ll gas. It is known that such releases contain a wide variety of potential carcinogens and potentially toxic chemicals that represent a threat to public health. However, little quantitative information exists on the total hazard that land lls represent to those who live or otherwise use properties near the land ll. Epidemiological studies of the "exposed" populations near land lls and Superfund sites have not detected a clearly discernable increase in the incidence of cancer in those populations. This is to be expected because of the insensitivity of epidemiological methods for detecting small increases in cancer incidence in limited populations over the normal lifetime cancer risk for the US population of one cancer in three people. It would be rare that a suf cient number of individuals near Superfund site land lls would experience an average increased cancer risk of 1 in 1,000.

The leachate from MSW land lls is a highly concentrated "chemical soup," so concentrated that small amounts of leachate can pollute large amounts of groundwater rendering it unsuitable for use for domestic water supply. In addition to potential carcinogens and highly toxic chemicals, MSW leachate contains a variety of conventional pollutants that render a leachate-contaminated groundwater unusable or highly undesirable due to tastes and odors, reduced service life of appliances (e.g., dishwashers, hot water heaters, plumbing), fabric (clothes), etc. Furthermore, both gas and leachate from MSW land lls contain many organic chemicals that have not been characterized with respect to speci c chemical content or their associated public health or other hazards. These "non-conventional pollutants" include more than 95% of the organics in MSW leachate.

There are more than 65,000 chemicals in US commerce today; about 1,000 new chemicals are being developed each year. Of those chemicals, only about 200 are regulated and measured in studies of MSW land ll leachate-contamination. Given the highly concentrated nature of MSW land ll leachate, that a large portion of the organics in MSW leachate are of unknown character and hazard, and that a comparatively few chemicals are regulated, it should not be assumed that the fact that a leachate-contaminated groundwater meets all drinking water MCL's (maximum contaminant lev-

els) means that the water should be considered safe to consume. Furthermore, once a groundwater is contaminated by MSW land ll leachate of the type produced in today's Subtitle D land lls, it and the associated aquifer cannot be cleansed so as to render a water that can be considered reliable for consumption and certain other uses. The contaminated portion of the aquifer must be abandoned for future use as a domestic water supply source and for conjunctive use storage of surplus surface waters for use during drought periods. Therefore, it is prudent public health and water resource management policy to assume that any contamination of groundwater by MSW land ll leachate represents a signi cant threat to public health and the environment and should cause termination of the use of the water for domestic water supply purposes.

Land ll gas emissions also contain large amounts of obnoxious and otherwise deleterious chemicals that are highly detrimental to nearby property owners and users. The methane in land ll gas releases, while odorless, poses a threat of explosions in enclosed structures and contributes to the greenhouse gases that promote global warming. Both methane and C02 in land ll gas can also be highly detrimental to vegetation on the land ll cover and near the land ll. The obnoxious odors that are emitted from MSW land lls can persist for a mile or more from the land ll. Such odors provide a tracer for non-odorous as well as odorous hazardous chemicals in gaseous emissions. Because of the large amounts of non-conventional pollutants in land ll gas, the detection of land ll odors on offsite properties should warn of a signi cant public health threat. Odors and other adverse conditions created by land ll operations cause property values to decrease within a mile or so of the land ll.

New Subtitle D regulations prescribe a "dry tomb" land lling approach in which untreated MSW is placed in plastic-sheeting- and compacted-soil-lined land lls in an attempt to isolate the wastes from water for as long as the wastes will be a threat. Evaluation of the character of the systems incorporated relative to physical, chemical, and biological processes as they occur in such systems, and the nature of the materials placed in them shows the "dry tomb" land lling approach to be a awed technology that will not protect the public health, or groundwater and air resources under and above the land ll and adjacent properties. At best, it will only postpone the leakage of leachate and gas to adversely affect public health and environmental quality.

MSW in a "dry tomb" land ll will be a threat to public health, groundwater resources, and the environment forever. The effectiveness of Subtitle D land ll liner systems in preventing leachate migration is compromised after installation, and will deteriorate over time allowing increasing amounts of leachate to pass through the liner into the groundwater system hydraulically connected to the bottom of the land ll.

The US EPA and states' Subtitle D groundwater monitoring approach of using vertical monitoring wells spaced hundreds to a thousand or more feet apart at the groundwater monitoring point of compliance is grossly inadequate for detecting incipient groundwater pollution from lined land lls. Unlike leakage from unlined land lls in homogeneous hydrological settings, the initial leakage from plastic sheeting-lined Subtitle D land lls will be through holes, tears, or imperfections in the sheeting. Such point-source leakage results in the emanation of " ngers" of leachate-contaminated groundwater which are a few feet wide at the point of compliance for groundwater monitoring. Vertical monitoring wells have effective zones of capture of leachate-contaminated groundwater of only about one foot around the wells. With the spacing of such wells allowed, the US EPA Subtitle D groundwater monitoring approach will not detect groundwater pollution, much less incipient land ll

leakage, before widespread groundwater pollution has occurred.

The municipal solid waste stream of today and of the future potentially contains less industry-de ved hazardous chemicals than the classical sanitary land ll. However, it does, and will continue to, contain large amounts of highly hazardous and otherwise deleterious chemicals that will render groundwaters contaminated by such leachate unusable for domestic water supply purposes.

RCRA set forth a minimum post-closure care period of 30 years; that period was also used by the US EPA in implementing Subtitle D regulations. However, 30 years is an imperceptibly small, and insigni cant part of the total time that MSW in Subtitle D "dry tomb" land lls will be a threat to public health, groundwater resources, and the environment. Insuf cient funds are being collected from waste generators and set aside to meet the inevitable and unending needs for post-closure care monitoring and maintenance, and groundwater and land ll remediation for Subtitle D land lls. The Subtitle D land lling approach and requirements adopted by the US EPA are super cial and only serve as a stop-gap measure for managing MSW. They enable today's society to continue to enjoy solid waste "disposal" without the responsibility and expense of preventing them from causing future problems. This is being enjoyed at the expense of future generations' public health, groundwater resources, and welfare.

Contrary to claims made by the US EPA in implementing Subtitle D land ll regulations in October 1991, Subtitle D land ll requirements do not address the justi able "NIMBY" concerns and problems associated with the active life of land lls or the post-closure care impacts on those who own or use properties within several miles of the land lls. In not recognizing the potential signi cance of non-conventional pollutants, the nature of processes within the land lls, the nature and limitations of the liner systems and monitoring approaches, and the perpetual threat of contaminants in land lls, the US EPA Subtitle D and state regulations do not protect public health or groundwater resources for as long as the wastes represent a threat. Since Subtitle D land lls only postpone groundwater pollution, and for many land lls, gas emission problems, Subtitle D land lls do not signi cantly alleviate the threat of land ll gas and leachate to those who own or use properties within the sphere of in uence of the land ll. The "dry tomb" land lling approach should be recognized as "temporary" storage for MSW that will ultimately require exhumation and treatment of the wastes unless groundwaters hydraulically connected to them are to be abandoned as water resources.

More protective alternatives to US EPA Subtitle D "dry tomb" land lls are available to address both the near-term and long-term threats that such land lls represent to public health, groundwater resources and the environment, as well as to the welfare of those within the sphere of in uence of the land ll. The additional costs for such approaches are insigni cant compared to the long-term costs that will have to be paid by future generations for today's waste management mistakes. One such alternative is a fermentation/leaching "wet-cell" approach. In brief, that approach includes the recycling of land ll leachate in a double-composite-lined land ll that contains shredded MSW followed by a decade or so of clean-water washing (leaching) of the solid waste to produce non-polluting residues. The lower composite "liner" serves not for last-resort containment, but rather as a lysimeter leak detection system for the upper-composite liner. Associated with that waste treatment/management concept is required the setting aside of suf cient funding in a dedicated trust fund derived from increased disposal fees to exhume the wastes when leakage through the upper-composite liner

cannot be stopped. To address justi able active-life NIMBY concerns and problems, it is necessary that the land ll be sited with an adequate land ll owner-owned land buffer of at least one mile about the outer reaches of the land ll. The land ll buffer would be used to dilute the adverse impacts of the land ll, such as odors, seagulls, etc. that occur with today's land lling operations. The estimated initial cost of this approach is about 10 to 15 cents/person/day more than that paid for solid waste management in Subtitle D land lls. Expenditures of this amount will not only address justi able NIMBY issues of today's land lls, but also signi cantly improve the protection of future generations from adverse impacts of gaseous and leachate emissions. Further information on each of these issues is provided in this report and in references contained therein.

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THE WALL STREET JOURNAL.

Plastic dump liners have been slow in coming

Bailey, Jeff. **Wall Street Journal**. (Eastern edition). New York, N.Y.: Nov 14, 1996. pg. A4, 5 pgs

Abstract (Summary)

Five years after federal rules were rolled out aimed at requiring environmental protecting plastic liners under garbage dumps, the liners are installed at only about one third of the nation's dumps, a consultant's study found. What's more, the EPA is gearing up to allow increasing varieties and amounts of industrial wastes, some of them formerly channeled to hazardous-waste-only disposal sites, to go to regular trash dumps.

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Five years after federal rules were rolled out aimed at requiring environment-protecting plastic liners under garbage dumps, the liners are installed at only about one third of the nation's dumps, a consultant's study found.

What's more, the Environmental Protection Agency is gearing up to allow increasing varieties and amounts of industrial wastes, some of them formerly channeled to hazardous-waste-only disposal sites, to go to regular trash dumps.

In addition to raising environmental concerns, these two developments are angering waste-handling companies that compete against dumps, particularly trash and hazardous-waste incinerators that already have much higher operating costs.

The Integrated Waste Services Association, which represents operators of more than 100 big trash-to-energy plants, objects to what it considers unequal treatment. The waste-burning plants are just beginning a $400 million retrofit to comply with Clean Air Act regulations, and some have been suffering because a glut of disposal capacity has driven disposal prices downward in some big markets.

"It's not fair," said Maria Zannes, president of the Washington-based association. "These guys get all the breaks."

The study was conducted by Environmental Information Ltd., a Minneapolis consulting and publishing concern. The firm has accepted funding from hazardous-waste handlers to perform other studies, but funded this study entirely on its own, said Jeff Smith, a senior associate.

According to the study, only 960 of the nation's 2,931 active dumps have synthetic liner systems.

The liner-installation shortfall arose as the EPA delegated to states the implementation of dump rules, and allowed the states to exempt many disposal facilities from any synthetic-liner requirement. Most commonly exempted were dumps in some remote areas, those that take smaller volumes of waste, and, those in arid climates where low rainfall reduces the likelihood that water contaminated by waste would seep into groundwater.

But some large and active dumps, particularly those owned by municipalities, continue to accept waste into unlined areas because the rules allowed "vertical expansion" to continue on top of older, unlined dump areas.

This shows how even a simple environmental safeguard -- itself far from an absolute protection against fouling groundwater -- ends up being watered down as the EPA, states, local government and the waste industry all get involved in the implementation of federal rules.

To be sure, the biggest and busiest dumps in the U.S. tend to have synthetic liner systems, which include piping to extract and treat garbage juice known as leachate.

Browning-Ferris Industries Inc., the nation's No. 2 dump operator, said 80 of its 82 active U.S. trash dumps have such liner systems. WMX Technologies Inc., No. 1 among dump operators, said it has synthetic liners in all of its dumps horizontally expanded since 1993 -- about 80% of its more than 100 U.S. sites. Some of the remaining 20%, though not all, also have such liners.

It's not only the big dumps that are of concern. Many of the nastiest Superfund cleanup sites, born during the dump-it-anywhere days before regulations, were in fact small facilities.

Adding a synthetic liner costs $25,000 or more an acre at dumps, according to the EPA, while cleaning up even small contaminated dump sites can costs millions of dollars. "The EPA and states seem to prefer a pound of cure to an ounce of prevention,"

Environmental Information's Mr. Smith said.

The EPA itself doesn't keep track of how many dumps have synthetic liners, leaving that to states. "I'm not shocked," said Bob Dellinger, acting director of the agency's municipal and industrial solid-waste section, of the study's finding about the lack of synthetic liner systems. Mr. Dellinger said the EPA expected about 800 dumps to qualify under the "small, dry and remote" exemptions, and that many of the other dumps without liners are probably still piling trash on top of older, unlined areas.

Proximity to groundwater and the mix of wastes that go into a dump are considered by many waste experts to be as important -- or more so -- than whether a site has a synthetic liner. Mr. Dellinger said the rules and various exemptions were designed to require liners at dumps that pose greater threats.

Credit: Staff Reporter of The Wall Street Journal

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Unexpected leakage through landfill liners.Janet Raloff. ***Science News*** 135.n11 (March 18, 1989): pp164(1). (757 words)

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Unexpected Leakage Through Landfill Liners

For years, the standard way to dispose of hazardous chemicals was to bury them in landfills. Intended as permanent resting places, most of these graves incorporated a bathtub-shaped liner of compacted clay to keep water -- and buried toxic wastes -- from escaping. While clay does limit water leaks fairly well, new field research shows it fails to block the major route by which many toxic chemicals, such as organic solvents, escape.

The researchers say this finding carries grave implications not only for the safety of hazardous-waste landfills begun prior to 1985, but also for the adequacy of current techniques of containing landfill leaks and toxic chemicals spilled on land.

Water provides the two primary means by which pollutants move from landfills. Through a "vehicular" pathway, water can carry dissolved wastes as it flows from areas of high pressure, such as pools collected on the inside of a landfill, to regions of low pressure, such as drier soils underneath. A second pathway uses water quite differently -- as a potentially fixed "conduit" through which dissolved contaminants "diffuse" from regions where their concentrations are higher to areas where they are lower.

Today, notes Richard Johnson, an environmental scientist at the Oregon Graduate Center in Beaverton, engineers work at controlling the vehicular pathway only. Until recently, the standard approach was to line landfills with "impermeable" clay barriers -- ones designed to leak no more than 89 gallons of water per acre daily, according to Environmental Protection Agency (EPA) engineer Kenneth Skahn of Washington, D.C. Diffusion control was all but ignored, Skahn says, because of a prevailing attitude that "diffusion really will never be much of a factor" in landfill leaks. Unfortunately, Johnson says, this attitude fostered a false sense of security.

Johnson's research, reported in the March ENVIRONMENTAL SCIENCE AND TECHNOLOGY, shows significant toxic-chemical diffusion into the barrier of a five-year-old, clay-lined hazardous-waste landfill in Sarnia, Ontario. As expected, there was wide variability in contaminant mobility, with the most water-soluble pollutants moving fastest. Chloride ions, for example, had penetrated about 28 inches into the clay floor. Less water-soluble organic chemicals spent more of their time preferentially clinging to carbon in the clay. Acetone and ketones, among the more water soluble of these organics, traveled only about 5 inches -- three to 20 times farther than would be expected for far less soluble solvents, like benzene and toluene.

Owing to the unusual depth of this landfill's natural clay floor -- about 130 feet -- no contaminant broke through this barrier. However, Johnson says, if the clay's thickness had been more typical of hazardous-waste landfills -- perhaps 3 feet -- his data suggest the more mobile contaminants might have broken through in just five years, and slower ones, like benzene, in 70 years.

So closely do these field data mirror theory, Johnson says, "that if I know what a contaminant's solubility is, and the [barrier's] organic carbon content, I can now predict how fast a chemical will [diffuse through]."

Comments Donald H. Gray, a civil engineer at the University of Michigan in Ann Arbor, "There are

important implications here for the design and construction of containment envelopes around hazardous-waste landfills." The new findings show that once water permeability is well controlled, diffusion becomes the dominant exit route for interred wastes.

Since 1985, EPA has banned landfilling of solvents -- like benzene -- and required that new hazardous-waste landfills use multiple barriers of clay and synthetic materials. Less water-permeable than clay, plastics also provide a major barrier to diffusion. Thus, Johnson says, the real concern is with landfills built before 1985. EPA's Robert Landreth says agency officials don't know how many U.S. hazardous-waste landfills rely on clay barriers, but a good guess might be "more than 10 and less than 50." Johnson says a more likely estimate is "at least hundreds."

The new findings are relevant also to current containment efforts, says Walter Weber, a colleague of Gray's at the University of Michigan. Today, engineers commonly cordon off chemical spills in soil and leaking landfills by digging a thick trench around them, preferably down to a natural clay deposit, and filling the trench with a slurry of clay and soil. Once it hardens, the slurry wall becomes relatively impermeable to water. However, this barrier -- often the only one surrounding the toxic chemicals -- offers little protection from diffusion, Weber notes. So he and Gray are studying ways to increase its carbon content -- currently by incorporating fly ash -- to slow the diffusion of trapped organics.

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HAWAII NEWS NOW

Document shows landfill operator fined for design failures

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By Ben Gutierrez - bio | email

KAPOLEI (HawaiiNewsNow) - A document has come to light, showing that the operator of the Waimanalo Gulch landfill and the city were fined $424,000 last year for design failures at the landfill.

The fine was in a notice of violation issued in May 2010, which contended that Waste Management and the city failed to follow design specifications for a liner that was supposed to cover waste, and built the west berm of the landfill too high. According to the notice, the liner was of a lower quality than specified.



Carroll Cox

Carroll Cox, of the environmental group EnviroWatch, noted that the company had paid an even bigger fine. "That comes on the heels of a $2.8 million dollar fine that they paid earlier, for earlier violations. So this is just a constant dripping, so to speak, of one big problem after the other," Cox said.



The huge fine was assessed in 2006; according to the notice of violation, the design process involved in the latest fine began the same year.

Cox contends that the failure to follow the design contributed to the problems that arose when floodwaters went through the landfill and spread refuse and medical waste along the Leeward Oahu coast. "I think I would probably not be here doing this interview, and we wouldn't see the people of Ko Olina, who are rightfully outraged," said Cox. "We wouldn't have the general public querying this one big question: How did medical waste get into the environment, get into the ocean?"

Ko Olina residents were present at a Kapolei Neighborhood Board meeting Wednesday night to discuss the problems at the landfill. Meantime, the city announced Wednesday that the landfill would reopen Friday to allow city crews to dispose of backlogged waste. It will reopen to the general public next week Wednesday.

Cox says the document also points to continuing problems at Waste Management, which have been only made worse by the heavy rain.

"What they are really facing now is having to work in the mud now, in that area. Not just from that storm, but also from water that had gotten behind the liner, and gotten into the cell and presenting a bigger problem," Cox said.

The city's Environmental Services Department said the fine had been settled with the state Health Department. But Cox said it's no longer just an environmental cost, but a cost to taxpayers, because of the fines.

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REVIEW

Health effects associated with the disposal of solid waste in landfills and incinerators in populations living in surrounding areas: a systematic review

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Abstract
Objectives Potential health hazards for the environment and people living nearby landfills and incinerators are claimed to be related to several methods of waste management. Independent systematic review of the scientific literature is a key procedure to support the lay public and policy makers to achieve informed decisions.
Methods The study design and potential biases of papers retrieved in this comprehensive literature search were analyzed.
Results The most consistent result is that the risks of congenital anomalies and hospitalization due to respiratory disease are likely to be real nearby special waste landfills. From the very little information on exclusively urbanwaste depots it is reasonable to say that correct management of landfill does not increase the risk of these health effects. It is confirmed that historically incinerators are an important source of pollution and harm for the health of populations living nearby; however, changes in technology are producing more reassuring results.
Conclusions A moderate level of confidence is possible in limited areas of knowledge, implying the need to overcome the limitations of current studies about exposure assessment and to control confounders at the individual level.

Keywords Incinerator · Landfill · Environmental exposure · Environmental diseases · Population health

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Electronic supplementary material The online version of this article (doi:10.1007/s00038-013-0496-8) contains supplementary material, which is available to authorized users.

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Introduction

Management of solid waste disposal is a priority issue in the organization of modern societies. In spite of the increasing recycling activities, landfills and incinerators are widely used to manage the final phase of waste disposal. Potential health hazards for the environment and people living nearby are claimed to be related to waste management, which is known to release potentially harmful substances although in small quantities and at very low levels. Many uncertainties surround the assessment of health effects, and the need for independent systematic reviews of the current scientific information is urgent in order to provide the lay public and policy makers with reliable lines of scientific knowledge. A number of reviews are already available (Vrijheid 2000; Hu and Shy 2001; Rushton 2003; Dolk and Vrijheid 2003; Department for

Environment, Food and Rural Affairs (DEFRA) 2004; Franchini et al. 2004; Michaels and Monforton 2005; Minichilli et al. 2005; Linzalone and Bianchi 2007; World Health Organization (WHO) 2007; Russi et al. 2008; Signorelli et al. 2008; Giusti 2009; Porta et al. 2009). The reviews underline the difficulties in interpreting data from primary studies because of the lack of accurate exposure information and control of potential confounders. This problematic interpretation further complicates a scenario where risk communication is poorly manageable, risk perception is greatly biased, and conflicting interests become the dominant issues for discussion, implying huge difficulties in managing public health issues affecting the safety of communities. This review updates the evaluation of evidence (19 more papers on landfills and 13 on incinerators included in the tables in the "Electronic supplementary material") derived from the literature on the health effects of landfills and incinerators in people living in their proximity and discusses the degree of uncertainty associated with the risk estimates, thereby providing researchers, citizens, and institutions with an updated independent piece of evidence. This process has been promoted by the Italian authorities after the dramatic garbage management failures in Campania, an Italian area where the safety of communities has been put in danger by very bad organization and the presence of several illegal landfills; the resultant potential health hazards in some areas of Campania are associated with higher mortality rates for various diseases in comparison with those in other regional areas (Altavista et al. 2004; Comba et al. 2006; Martuzzi et al. 2009; Fazzo et al. 2008, 2011).

Methods

The scientific literature was scrutinized through computerized literature searches using PubMed, Embase, Web of Science, and the Cochrane Library from 1 January 1983 to 1 June 2012. The search strategy consisted in the use of various combinations, in line with the specific database language, of the terms "incinerat* OR "refuse disposal" OR "refuse disposals" OR landfill*", "population* OR habitant*", "environmental exposure", "environmental disease"; the search was subsequently improved using more restrictive terms related to both exposure to disposal sites and disease outcomes. Primary publications on the health effects of landfills and/or incinerators on the population living in the proximity were the subject of this systematic review. Other types of papers (systematic reviews, biomonitoring of toxic agents in the proximity of waste disposal sites, environmental impact estimation) were consulted in order to integrate all the available scientific information for the interpretation of the results. The search was completed using the references identified in the retrieved papers and any highlighted by the working group. A total of 201 relevant papers were identified, 101 on landfills and 100 on incinerators. The papers were screened for eligibility by two independent reviewers; disagreements were resolved by discussion. Out of 100 papers on landfills, 71 were excluded (1 systematic review, 1 duplicate paper, 1 focused on occupational exposure, 34 biological studies, 34 other non-relevant types of papers); therefore 29 papers were evaluated (4 cohort studies, 8 case–control studies, 17 ecological studies). Out of 100 papers on incinerators, 69 were excluded (2 systematic reviews, 1 duplicate paper, 1 focused on occupational exposure, 29 biological studies, 36 other non-relevant types of papers); therefore 31 papers were evaluated (2 cohort studies, 9 case–control studies, 17 ecological studies, 3 cross-sectional studies). The list of excluded papers is reported in Appendix A (Electronic supplementary material).

Information on study subjects (number, age, gender, country), exposure assessment, outcome assessment, estimated effects, and potential bias were independently abstracted by three observers using a predefined format, and disagreements were resolved by discussion. Characteristics of the studies are reported in Appendices B and C (Electronic supplementary material) for landfills and incinerators, respectively. The tables therein are arranged by outcome.

To assess the size and direction of potential biases an evaluation scale is proposed that envisages exposure assessment, outcome assessment, and confounding control (Table 1). For each item the null value (0) indicates that no influence on the estimation is likely, a positive sign that the effect estimates could be less (+) or more (++) overestimated, and a negative sign that the effect estimates could be less (−) or more (− −) underestimated. As for exposure assessment, underestimation is considered according to the study designs; conversely for outcome and confounding assessment, overestimation is considered (Porta et al. 2009; WHO 2007; Franchini et al. 2004; Giusti 2009). The results of this evaluation were discussed among three authors (SP, EB, and PC) and the grade was assigned according to the majority rule in case of inconsistencies.

An attempt to define the relationship between the process (landfill/incinerator) and the various diseases in terms of potential cause–effect evaluation was performed according to Porta et al. (2009), using the International Agency for Research on Cancer (IARC) criteria for carcinogenesis (IARC–WHO, 2013). The results of this evaluation were discussed among three authors (SP, EB, and PC) and the relationship was assigned according to the majority rule in case of inconsistencies.

Table 1 Qualitative assessment of internal validity of the reviewed studies

Item	Risk of bias	Evaluation criteria
Exposure	−	If defined by both the distance from the site and some measurement of polluting substances
	− −	If defined only by the distance from the site or by an exposure area
	0	Use of individual data
Outcome	0	If reported from cancer registries or direct measure of incidence
	+	If reported by death registries
	++	If reported by hospital discharge forms or detected through questionnaires
Confounding	0	Use of individual data
	+	Control at a population level (including deprivation index)
	++	No control

Results

Studies on communities living near landfills

Twenty-nine papers on the health effects in communities living in the proximity of landfills were evaluated. One of the major issues in the evaluation was the difficulty in distinguishing between solid urban waste and other types of wastes. There is not yet a standardized definition of the various types of wastes. The terms dangerous, special, toxic, industrial, and commercial are not uniformly used in different countries and over time periods. Moreover, the types of wastes disposed in a landfill may have changed over time. The outcomes considered in the papers were all cancers, birth defects, respiratory diseases, and total mortality. In some papers multiple outcomes were evaluated.

Cancer

The relationship between landfills and cancer has been evaluated in seven studies (5 ecological, 1 cohort, and 1 case–control)

Colorectal A cohort study carried out in Finland compared the incidence of colorectal cancer in a community in the proximity of a landfill containing industrial and urban wastes to that in a control cohort (Pukkala and Pönkä 2001). No difference was found, but the low number of cases and the lack of adjustment for confounders, beside age and sex, make the results less reliable. An ecological study in Australia evaluated mortality and incidence in populations living nearby a landfill containing urban special and dangerous wastes, both liquid and solid, did not find any risk excess, but again involved a low number of cases (Williams and Jalaludin 1998).

Liver In an ecological study that analyzed mortality in a community living in an Italian area containing a landfill, an incinerator, and a refinery, liver cancer mortality was not different in populations living at various distances from the sites, after adjustment for age and deprivation index and separately by sex (Michelozzi et al. 1998). In another Italian study a potential risk was found in males, but no adjustment was made and information on outcomes cannot be related to the distance from the landfills (Minichilli et al. 2005). A Canadian case–control study found no significant trend in populations living at various distances from an urban waste landfill, adjusting for some confounders (Goldberg et al. 1999). Multiple comparisons on 30 cancer sites and the low number of cases suggest that caution be adopted in interpreting these results. A Brazilian ecological study of urban landfills in Sao Paolo found no difference comparing people living at less and more than 2 km from several sites (Gouveia and Ruscitto do Prado 2010a).

Bladder A large national ecological study, carried out in the UK, analyzed the incidence of bladder cancer in populations living at various distances from a landfill site (Jarup et al. 2002) and did not detect any association, nor when only special wastes were considered. Two other studies were unable to detect any association (Williams and Jalaludin 1998; Gouveia and Ruscitto do Prado 2010a).

Larynx A significant decrease of mortality rates as the distance from the sites increased was reported in Italy, but with low numbers (Michelozzi et al. 1998). Another study in Canada did not detect any association (Williams and Jalaludin 1998).

Lung None of the three evaluated studies was able to detect any association (Williams and Jalaludin 1998; Michelozzi et al. 1998; Pukkala and Pönkä 2001).

Kidney Two studies found a modest non-significant increase in risk (Michelozzi et al. 1998; Goldberg et al. 1999).

Lymphomas Only one study (Goldberg et al. 1999) found a significant association, whereas those by Williams and Jalaludin (1998) and Michelozzi et al. (1998) did not.

Leukemia Two studies in children (Jarup et al. 2002; Gouveia and Ruscitto do Prado 2010a) and four in adults (Williams and Jalaludin 1998; Michelozzi et al. 1998; Jarup et al. 2002; Gouveia and Ruscitto do Prado 2010a) were unable to detect any association.

Brain No association was found in a UK study (Jarup et al. 2002). An increased risk only in males living in the proximity of the landfill was detected in a US study (Williams and Jalaludin 1998), limited by low numbers of cases.

Other cancers In a previously described study no association was found for breast, uterus, prostate, stomach, and skin cancers (Williams and Jalaludin 1998). Goldberg found an increased risk for pancreatic cancer but not for prostate (Goldberg et al. 1999). Another study found an increased risk for skin and pancreatic cancers only in males (Pukkala and Pönkä 2001).

Birth defects and reproductive disorders

Out of the 22 studies analyzing the relationship between these disorders and the presence of landfills, 13 are ecological, 2 cohort, and 7 case–control.

Birth defects in general

Six studies found statistically significant associations (Fielder et al. 2000, 2001; Elliott et al. 2001, 2009; Palmer et al. 2005; Vrijheid et al. 2002), but five other studies (Morris 2003; Dummer et al. 2003b; Boyle et al. 2004; Kloppenborg et al. 2005; Gouveia and Ruscitto do Prado 2010a) did not. In the UK an ecological study of residential distance from a site, the risk of congenital malformations was higher; however, that risk was also detected by analyzing data before the opening of the landfill (Fielder et al. 2000). A national UK study analyzed congenital anomalies and low birth weight in populations living at different distances from a large number of waste sites (19,196) (Elliott et al. 2001). A statistically significant association was found (RR 1.05), but it disappeared for urban solid waste (RR 0.99) when analyzed separately from toxic waste (RR 1.08) (Elliott et al. 2009). A Danish national ecological investigation found no association in comparing people living at different distances from the sites (Kloppenborg et al. 2005). Evaluating the rates before and after the opening of 24 landfills in Wales, Palmer et al. (2005) found a significant increase over time. Among residents of areas close to 15 landfills in Brazil no association was detected comparing rates of people living at less than 2 km and the whole city, after adjustment for sex and age (Gouveia and Ruscitto do Prado 2010a). Another UK study reported on a landfill where all kinds of wastes (urban solid, industrial, and special) were transferred, and compared three areas close to site and 26 distant areas (Fielder et al. 2001). After the opening of the site a significant risk increase in the closest areas was found, but the authors cautiously interpreted the findings owing to poor accuracy and incompleteness of data. A Scottish investigation found no association in residents at less than 2 km from the site compared with those at more after adjustment for age and deprivation index (Morris 2003). A multicenter case–control study (EUROHAZCON), carried out in five countries (Belgium, Denmark, France, Italy, and the UK), found a significant increase in congenital malformations in people living nearby sites containing dangerous substances (Vrijheid et al. 2002). Caution is suggested in interpreting the results owing to the difficulty in correctly classifying the sites according to their dangerousness. A previous investigation on dangerous waste landfills had found conflicting results (Geschwind et al. 1992). In a UK retrospective cohort study stratifying by three time periods and four types of landfills, Dummer et al. (2003b) found no association. A similar lack of association was found in a study on urban solid wastes in Northern Ireland (Boyle et al. 2004).

Non-chromosomal birth defects

The EUROHAZCON case–control study detected an increase in risk of non-chromosomal birth defects in people living at less than 3 km from landfills containing both urban solid and industrial or toxic wastes (Dolk et al. 1998). In this study a statistically significant increased risk was found in the subgroups of neural-tube defects (OR 1.86), malformations of the cardiac septa (OR 1.49), and anomalies of great arteries and veins (OR 1.81).

Nervous system birth defects

In a UK retrospective cohort study in which data were stratified by three time-periods and four types of landfills, congenital anomalies were significantly higher close to urban solid waste landfills (Dummer et al. 2003b), whereas a previous study had not found this relationship (Croen et al. 1997). Another study confirmed the association for a landfill containing toxic substances (Marshall et al. 1997).

Cardiovascular defects, hypo- and epispadias, oral defects

Statistically significant higher risk of hypo- and epispadias was detected in children living close to industrial toxic wastes (Geschwind et al. 1992). For cardiovascular and oral anomalies no such risk was found in another investigation (Croen et al. 1997).

Down syndrome

No association was found for Down syndrome in the analysis of 6,829 sites (Jarup et al. 2007).

Sirenomelia and cyclopia

The two studies on this malformations analyzed four cases of sirenomelia and four of cyclopia (Castilla and Mastroiacovo 2008; Orioli et al. 2009). The identification of a possible cluster of sirenomelia has to be interpreted cautiously in the light of this very low number of observations.

Low birth weight

A retrospective cohort study in Alaska took into account several confounders and classified sites according to dangerousness, finding a risk nearby the sites with intermediate and high dangerous levels (Gilbreath and Kaas 2006). An ecological study in the UK, part of the EUROHAZCON on mixed sites, found a small significant risk increase in residents at less than 3 km, evaluating seven areas close to ten sites (Morgan et al. 2004). A case control study in Quebec found a small increase in risk which persisted after adjustment for several confounders; however, it did not find any association with preterm births (Goldberg et al. 1995). As reported in a previous section a nationwide UK study reported an increase, with no distinction between the types of waste disposed (Elliott et al. 2001). Only an ecological UK study, described above, found no association (Fielder et al. 2000).

Respiratory diseases

A retrospective Finnish study on a site containing urban and industrial wastes reported an increase of asthma incidence (Pukkala and Pönkä 2001), and an ecological investigation in the UK found an increase in hospitalization for respiratory diseases, again dealing with a waste site also containing industrial wastes (Fielder et al. 2001). In another retrospective US cohort study the results suggested an increased rate of hospitalization for asthma and respiratory diseases (Ma et al. 2007).

Total mortality

Three ecological studies reported on this association: no association was reported in one (Williams and Jalaludin 1998), whereas in two there was some indication of a positive association (Fielder et al. 2001; Minichilli et al. 2005). However, in the study by Williams and Jalaludin (1998) the detected risk was consistent with that reported before the opening of the site; in the other studies there is no indication of the distance from the site. No association was found in a US cohort study (Gensburg et al. 2009).

Studies of communities living near incinerators

Thirty-one papers on the health effects in the communities living in the proximity of incinerators were evaluated. The following outcomes were considered: cancers (15), birth defects (10), respiratory diseases (5), cardiovascular diseases (1), total mortality (1), and skin disease (1). In some papers multiple outcomes were evaluated.

Cancer

Fifteen studies analyzed the relationship between incinerators' activity and cancer. Most studies are ecological or case–control and only one is based on a retrospective cohort.

All cancers Three ecological (Elliott et al. 1996; Goria et al. 2009; Federico et al. 2010) and one retrospective cohort study (Ranzi et al. 2011) evaluated the association between incinerators and all cancers in adults. In a UK ecological study the incidence increased; however, no adjustment for relevant confounders was performed and the authors claimed to be cautious in their interpretation (Elliott et al. 1996). In an Italian study no association was reported in the four geographical areas analyzed (Federico et al. 2010), whereas another Italian cohort study reported an increase in all-cancer mortality (RR 1.47) in women exposed to elevated levels of heavy metals (>2 ng/m^3) (Ranzi et al. 2011). In a modeling risk estimation study a linear relationship was found, but limitations in study design and patient selection imply problems of interpretation (Goria et al. 2009). In an ecological study no excess risk of cancer mortality was found in children aged less than 5 years (Gouveia and Ruscitto do Prado 2010b), but according to analyses coming from a companion study to that of Elliott et al. (1996) the influence of population migration might influence the results owing to poor accuracy of the case findings (Knox 2000). Overall, the evidence appears weak and conflicting.

Non-Hodgkin lymphomas Three ecological studies and one cohort study found no association (Elliott et al. 1996, Federico et al. 2010; Gouveia and Ruscitto do Prado 2010b; Ranzi et al. 2011), whereas two case–control studies and one ecological study found a positive association with dioxin levels (Viel et al. 2000; Floret et al. 2003; Viel et al. 2008a), especially in women (Viel et al. 2008a); however, some exposure measurement errors may misestimate the effects. An ecological Italian study reported higher Standardized Mortality Ratio (SMR) between 1986 and 1992 for non-Hodgkin lymphomas (not for Hodgkin lymphomas) in a municipality where an incinerator had operated until 1985 (Biggeri and Catelan 2005).

Sarcoma and soft tissues Six ecological (Elliott et al. 1996; Viel et al. 2000; Floret et al. 2004; Biggeri and Catelan 2005; Viel et al. 2008a; Federico et al. 2010), two case–control (Comba et al. 2003; Zambon et al. 2007), and one cohort studies (Ranzi et al. 2011) provide data. No association was shown in five (Elliott et al. 1996; Floret et al. 2004; Biggeri and Catelan 2005; Federico et al. 2010; Ranzi et al. 2011). The other studies reported: (a) significant risk increase associated with living less than 2 km from the site, but based on five cases and with a very wide confidence interval (Comba et al. 2003); (b) significant risk increase by level and duration of exposure, especially in women (Zambon et al. 2007); (c) risk increase but at exposure levels higher than those detectable in more modern incineration technologies (Viel et al. 2000, 2008a). The evidence of risk due to an old-generation plant is convincing.

Breast No association was found in a case–control and a cohort study (Viel et al. 2008b; Ranzi et al. 2011). A small association was found in a study designed to compare different ways of modeling exposure and confounding, and the results are strongly limited by this study objective (Goria et al. 2009).

Lung Two ecological studies and one case–control study reported a risk excess in people living close to the emission site (Elliott et al. 1996; Biggeri et al. 1996; Parodi et al. 2004). In the studies carried out in Italy, there might be an exposure misclassification because other pollution sources were present but not identified (Biggeri et al. 1996; Parodi et al. 2004). More recent investigations, with better exposure measurement, found no association (Federico et al. 2010; Gouveia et al. 2010b; Ranzi et al. 2011).

Colorectal An increased risk with distance from the site was reported in the UK, but the authors cautiously suggest possible overestimation due to poor control of confounding factors (Elliott et al. 1996). No risk was found in an ecological study in Italy, with a good outcome measurement (Federico et al. 2010). In the same region another cohort study found higher mortality in men and higher incidence in women, but the increased risk was found at heavy metal exposure levels of 1–2 ng/m^3 and not at higher levels (Ranzi et al. 2011).

Liver Recent studies found no association (Federico et al. 2010; Gouveia et al. 2010b; Ranzi et al. 2011). A less recent investigation in the UK had found a significant risk increase associated with smaller distances from the sites (Elliott et al. 1996). A subsequent analysis of this data and including a histological evaluation of cancer cases confirmed the findings. (Elliott et al. 2000). A Brazilian study carried out in rural deprived areas found an association, but its validity is diminished by flaws in the study design (Goria et al. 2009).

Larynx Three ecological studies and one cohort study found convincing associations (Elliott et al. 1996; Federico et al. 2010; Gouveia et al. 2010b; Ranzi et al. 2011)

Leukemia An Italian ecological study found a modest risk increase in residents between 2 and 3.5 km from the site, but not at shorter distances; the authors suggest that this risk is hardly linkable with the distance from the site (Federico et al. 2010). No association was found in a cohort study in adults in Italy (Ranzi et al. 2011) and in an ecological study in children in Brazil (Gouveia et al. 2010b). A UK ecological study in children under 16 years found a risk increase but with a mixed exposure (incinerator and industrial combustion) (Knox 2000).

Stomach An ecological study found a significant risk increase associated with the distance from the site, but control of confounding factors was poor (Elliott et al. 1996). An Italian cohort study reported a risk increase for women exposed to heavy metal levels of 1–2 ng/m^3, but not for those exposed to higher levels (Ranzi et al. 2011).

Bladder No association was found either in a UK ecological study (Elliott et al. 1996) and in an Italian cohort study (Ranzi et al. 2011).

Cerebral, myeloma, lymphatic system, prostate Only one study reported on these cancers (Ranzi et al. 2011); no association was found between incidence and mortality for these diseases and exposure to heavy metals in populations living nearby two incinerators.

Birth defects and reproductive disorders

Ten studies were evaluated (Lloyd et al. 1988; Jansson and Voog 1989; Williams et al. 1992; ten Tusscher et al. 2000; Cresswell et al. 2003; Dummer et al. 2003a; Tango et al. 2004; Cordier et al. 2004; Vinceti et al. 2008; Cordier et al.

2010): eight ecological, one case–control, and one retrospective cohort study. The results are often inconsistent; however, the paper by Cordier is relevant for interpretation because confounders were controlled for on an individual basis, through a questionnaire (Cordier et al. 2010).

Orofacial defects No risk increase was found for cleft palate by a Swedish study (Jansson and Voog 1989), whereas both in France and the Netherlands a risk increase was detected (ten Tusscher et al. 2000; Cordier et al. 2004). However, the site analyzed in the Dutch study was open to many chemical substances (ten Tusscher et al. 2000).

Urinary tract defects The French study by Cordier showed a risk increase (around double after adjustment) for congenital urinary tract defects when women, resident within 10 km from 21 active incinerators, were exposed to atmospheric dioxin and dioxin deposits in the ground during the first months of pregnancy (Cordier et al. 2010). The authors also suggest a possible role of the dioxin in contaminating locally produced food. These data together with those for renal dysplasia require special attention.

Other congenital anomalies Two studies reported a modest risk increase of spina bifida, cardiac defects, and renal dysplasia in the areas proximal to the incinerator (Dummer et al. 2003a; Cordier et al. 2004). No significant association was found for low birth weight and reproductive defects (Tango et al. 2004), chromosomal and non-chromosomal anomalies (Cresswell et al. 2003), spontaneous abortion and other studied reproductive outcomes (Vinceti et al. 2008). Occurrence of twin and female births were increased (Williams et al. 1992; Lloyd et al. 1988).

Respiratory diseases

Two studies reported a decrease in respiratory function and an increase in respiratory wheezing in children living in the proximity of an incinerator (Hsiue et al. 1991; Miyake et al. 2005). Increased prevalence of chronic respiratory symptoms was detected in other studies comparing populations resident at various distances from the site (Lee and Shy 1999; Shy et al. 1995). In an Italian retrospective cohort a higher respiratory disease mortality was found in men exposed to heavy metals levels of 0.5–1 ng/m^3; however, no risk was detected in individuals exposed to higher levels (Ranzi et al. 2011). In the same investigation no difference was found for total mortality and hospitalization for respiratory diseases.

All-cause mortality and cardiovascular diseases

Ranzi found that total mortality in women was associated with the presence of an incinerator at any level of exposure to heavy metals, and an increase in cardiovascular disease mortality in women, in hospitalization for chronic cardiac insufficiency and acute myocardial infarction in men in the mid-category exposure (0.5–1 ng/m^3) to heavy metals, but not for the highest (higher than 2 ng/m^3) (Ranzi et al. 2011).

Skin diseases

A Japanese study found no association with atopic dermatitis (Lee and Shy 1999), but a reporting bias and poor control of confounding factors indicate a unsatisfactory quality of the paper.

Discussion

The evaluation of the possible health effects has to be done taking into account two relevant issues: (a) in the majority of the papers on landfills it is virtually impossible to distinguish the role of urban solid from other types of waste coming from different sources; (b) the evolving technology of modern incinerators, with improved control of dioxin and heavy metals emission, may enhance the inconsistencies of the results. Because of these constraints any conclusion has to be viewed in the light of variability and some uncertainty in the results. Nevertheless, this review appears to have new important information if compared with the latest published systematic review (Porta et al. 2009).

Landfills

For total mortality evidence is insufficient to indicate a role of urban solid waste; moreover, the lack of control of important confounding factors in most papers is a real issue. For cancers the inadequate level of evidence already reported in previous reviews (Porta et al. 2009) is supported by more recent data (Gouveia et al. 2010a). More intriguing are the results on birth defects and reproductive disorders. An effect is detectable for toxic wastes, as pointed out by old and more recent papers, but this is much less clear when only urban solid wastes are considered. The evaluation of 9,565 landfills in the UK in which Elliott et al. (2009) distinguished between deposits of non-special from special or unknown waste confirmed an effect of the latter and no evidence of harm from the former. The environmental impact evaluation performed by the INTARESE group in three European countries (Italy, Slovakia, and the UK) on residents living at less than 2 km from a landfill with mixed waste estimated an excess risk of 1.96 newborns with defects in the period 2001–2030 (Forastiere et al. 2011). It is reasonable to conclude that the risk of

congenital anomalies is likely to be real. Within the framework of a correct management of landfill of strictly urban waste, the risk of these defects is less likely, indicating that solid waste should be very accurately selected before being thrown in a landfill.

Incinerators

Papers dealing with the health effects of incinerators active in the years 1969–1996 consistently report a detectable risk of some cancers in the populations living nearby. The good quality studies confirm these data, as pointed out in other reviews (Franchini et al. 2004; Linzalone and Bianchi 2007; Porta et al. 2009). The large UK study by Elliott et al. (1996) on 72 incinerators found a risk excess for all cancers, stomach, colorectal, liver, lung, and non-Hodgkin lymphomas; other studies carried out in Italy, France, and the UK indicate some suggestive but not consistent results for non-Hodgkin lymphomas and soft tissue sarcomas (Elliott et al. 1996; Viel et al. 2000; Comba et al. 2003; Floret et al. 2004; Zambon et al. 2007; Viel et al. 2008a; Federico et al. 2010; Ranzi et al. 2011). One study that did not detect any association is quite interesting for a number of reasons (Ranzi et al. 2011): the investigation was carried out on a technologically advanced plant which had undergone a number of improvements; the observations were based on a complex model of dispersion as an estimate of exposure; morbidity and mortality were quite accurately evaluated. The paper also provides an interesting analysis comparing emissions at different time periods relative to a different technology: the ratios of concentrations of released substances in 2008 compared with the period 1994–1996 are 0.214 for total suspended particulate, 0.20 for mercury and cadmium, and 0.0001 for dioxins [polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)]. These data suggest a dramatic change in the amount of dangerous emissions and the need for accurate monitoring of pollution. In the comparison between older and newer observations, the results for cancer incidence and mortality are largely not consistent.

Attention should be paid to the risk excess for urinary tract defects as reported in a well-designed study by Cordier et al. (2010), even if other studies are inconsistent. Orofacial defects are reported to be associated with exposure to special waste incinerators, whereas no risk is found for reproductive disorders such as spontaneous abortion (Vinceti et al. 2008).

A first general comment is that, historically, incinerators have been consistently indicated as an important source of pollution and harm for the health of populations living nearby the sites. Studies on biomarkers support this: populations exposed to emissions more than others have higher biological levels of released substances (Gonzalez et al. 2000; Reis et al. 2007). Where an incinerator had been the only source of pollution in a defined area for many years in the past, the harmful effects on the health have been consistently detected in a later period (Viel et al. 2000). Second, where a health impact of the change of technology has been reported (as for the Italian study by Ranzi et al. 2011) the results appear reassuring; however, this implies new challenges for the evaluation of environmental impact on health in other societal environments. New objectives of evaluation are needed: (a) the size of incinerators, accurate measurement of nanoparticles; (b) markers of "minor", but not less important health outcomes (respiratory symptoms, annoyance of the residents, stress-induced risk conditions). The evaluation of the aforementioned conditions in public health should include both incinerators and landfills owing to their association with the quality of life of residents during the time of exposure (de Wet et al. 2011).

Main methodological issues

Environmental epidemiology of waste disposal suffers from limitations conducive to inadequate or contrasting results: because most disease are "rare" in populations, a large number of individuals have to be observed for a long time period to identify a potential determinant, and studies carried out in small communities for a limited number of years lack statistical power; specific attention is often given to communities where exposure is "visibly" higher compared with others, thereby emphasizing the effect; exposure is mostly not based on individual measurements or accurate modeling of differences in population groups; potential concomitant causes of harm to health should be measured and controlled for in the analyses as confounders such as the socioeconomic conditions; the lack of information on individual risk factors competitive for many diseases such as smoking, dietary habits, alcohol use, and occupation, is mostly common. This large variety of conditions impaired the calculation of summary estimates of risks through meta-analyses.

Cause–effect relationship

A summary table (Table 2), using the IARC criteria for cause–effect evaluation, as described in the methods (IARC–WHO) is proposed. Although this classification is applied to evaluate the causal role of potential carcinogens, it allows us to compare the conclusions proposed by us with those by Porta et al. (2009), the latest comprehensive systematic review performed before ours. Only two categories (*limited* and *inadequate*) have been used because of the insufficient design of the evaluated studies that suffer from poor exposure measurement, outcome definition, and

Table 2 Evaluation of the evidence according to IARC criteria for evaluated diseases

Health effect	Level of evidence	
	Landfills	Incinerators
All cancers	Inadequate	Limited
Stomach	Inadequate	Inadequate
Colorectal	Inadequate	Inadequate
Liver	Inadequate	Inadequate
Larynx	Inadequate	Inadequate
Lung	Inadequate	Inadequate
Soft tissues sarcoma	Inadequate	Limited
Kidney	Inadequate	Inadequate
Bladder	Inadequate	Inadequate
Lymphomas	Inadequate	Inadequate
Leukemia	Inadequate	Inadequate
Brain	Inadequate	Inadequate
Children's cancers	Inadequate	Inadequate
Other cancers	Inadequate	Inadequate
All birth defects and reproductive disorders	Limited	Limited
Neural tube defects	Limited	Inadequate
Orofacial defects	Inadequate	Limited
Genitourinary tract defects	Limited	Limited
Abdominal wall defects	Inadequate	Inadequate
Gastrointestinal defects	Inadequate	Inadequate
Cardiac defects	Inadequate	Inadequate
Low birth weight	Limited	Inadequate
Respiratory diseases or symptoms	Limited[a]	Inadequate
Cardiovascular diseases	Inadequate	Inadequate
Skin diseases	Inadequate	Inadequate

[a] Data confined to industrial waste

adjustment for confounding factors. Nevertheless, we have important hints. The category *limited* is used for some disease, indicating points-of-attention for etiology, the estimation of risks, and their management in public health. One reassuring point is that we should appreciate the continuous improvement in research design and analysis of the relevant investigations. The choices on the mode of waste disposal management are not "neutral"; powerful political and economic interests play a great role "like the choices on energy production, mode of transportation or greenhouse gas emission" and often stand "predominant over the epidemiological evidence" (Forastiere et al. 2008). Within this framework—similarly to other public health decisions taken on a scientific basis—in order to overcome issues of conflicts of interest in scientific production and to avoid the construction of false reassurances or deplorable uncertainties (Michaels and Monforton 2005), it is advantageous to rely on independent systematic reviews where transparency of methods and rigorous evaluation criteria can be checked by the readers.

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Effect of aging on the leachate characteristics from municipal solid waste landfill

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ABSTRACT

Leachate emanating from solid waste deposited in landfill possess dissolved or an entrained environmentally harmful substances. They consist of soluble organic and inorganic compounds as well as suspended particles. These leachates also have a distinguishing characteristic in that they are highly variable and contain significantly elevated concentrations of undesirable material derived from the waste. Depending on whether leachate flow increases (during rainy season) and decreases (during dry/summer season) can change the composition. The concentration of waste change dramatically changes over the life of the landfill due to chemical degradation and biological decay of organic matter present. Consequently, the physical characteristics also vary considerably depending on the age of the waste. This paper brings out the effect of aging on the leachate characteristics from a municipal solid waste located at the Terra Firma Biotechnologies Ltd situated at Gundlahalli village in Doddaballapur taluk, near Bangalore. For the sake of comparison the leachates from two different parts of the site one from the location where old waste was dumped and another from the location where the waste was dumped relatively recently during the same period. Thus the two leachate samples from the same site representing different stages degradation of waste were collected to represent leachate from old waste and another from relatively fresh waste. The samples were analyzed for various physicochemical parameters to estimate its pollution potential. The results showed that most of the parameters examined in the leachate samples such as colour, conductivity, hardness, BOD, COD, TOC were found higher in the fresh leachate than aged leachate. In addition, low BOD/COD ratio of <0.1 in aged leachate and BOD/COD ratio of 0.33 in fresh leachate are observed. This shows that the major portion is organic matter which is not quickly biodegradable in the leachate from Terra Firma Biotechnology. The compost site is non-engineered solid waste landfill, which has neither bottom liner system nor any leachate collection and treatment system. Hence, leachate may percolate through subsoil causing pollution to ground water and surface water resources. Further the properties of soil below can change due to changing composition of the pore fluid.

Keywords: Aging, BOD, COD, Leachate, Municipal Solid Waste.

1. INTRODUCTION

Leachate is a contaminated liquid that drains through the bottom of the solid waste disposal facilities such as landfills. Its composition varies widely depending on the composition of waste as well as the age of waste. It contains number of dissolved and suspended materials. After municipal solid waste landfill site is closed, landfill will continue to produce contaminated leachate and this process can last for 30-50 years which can have significant environmental impact when released untreated into the environment(Peter et al., 2002). Quality of leachate is site-specific and even at a single landfill site the quality of leachate is strongly variable. Variability caused by many factors such as rainfall regime, geology, landfill age, composition of solid waste, physico-chemical conditions at the landfill (Zgajnar et al., 2009).

Within the land fill waste mass, biodegradable waste includes food waste, green waste and certain wastes arising from commercial and industrial sources. This kind of waste will easily decompose within the first few months of disposal. Non biodegradable waste like paper, wood and plastics also yield organic compounds to leachate, but only in small percentage over long periods of time. The majority of inorganic compounds are readily soluble and the ions released usually appear within a short time. Heavy metals contained in the solid waste are usually released slowly into the leachate and the process may take up to several years. Moreover, there is a complex interplay between leaching of ionic species and the maturity of the solid waste landfill site. This affects the compositional characteristics of the leachate (Renou et al., 2005).

As landfill passes through different phases of its life cycle, the leachate composition also varies widely

through the successive aerobic, acetogenic, methanogenic and stabilization stages. The degradation process of the waste in a landfill passes through different phases. The first phase which is normally short is characterized by the aerobic degradation of organic matter, CO2 is produced and the temperature of waste can increase up to 80^0C, this can affect the later stage of leachate production. In this phase, leachate contributes moisture during compaction as well as from precipitation through the buried waste (Kjeldsen et al., 2002). The amount of leachate leaving the landfill is limited due to the water holding by the waste, until the leachates reaches the collection system and is drained to the collection basin(Armstrong and Rowe,1999). This stage usually lasts only a few weeks and consequential phase appears when the oxygen is depleted, the degradation continues anaerobically. The anaerobic degradation process consists of two major fermentation phases, the acidogenic phase generating young, biodegradable leachate and the methanogenic phase, generating old, stabilised leachate (Bhala et al., 2012).

Young leachate from the early acidogenic phase contains large amounts of readily biodegradable organic matter. The complex organic compounds are fermented anaerobically, yielding mainly soluble organic acids such as free volatile fatty acids (VFAs), amino acids, other low molecular weight compounds and gases like H_2 and CO_2 (Harmsen, 1983). The concentration of VFAs can be quite significant, representing 95% of the TOC, leading to low pH (less than 5). BOD5/COD will have high ratio values of 0.5-0.7 indicate large amounts of biodegradable organic matter (Granet et al., 1986). COD values are 3,000-60,000 mg/l (Aisien et al., 2010). During this phase the metals are more soluble because of lower pH and the bonding with the VFAs, leading to relative high concentrations of Fe, Mn, Ni and Zn (Harmsen, 1983).

Old leachate will be in the methanogenic phase with lower concentration of VFAs (Chain and Dewalle, 1976). This is due to their conversion into methane and carbon dioxide (CO2) as gaseous end products during this second fermentation period. VFAs and other readily biodegradable organic compounds in the leachate decreases, the organic matter in the leachate becomes dominated by refractory compounds, such as humic like compounds and fulvic acid like substances (Chian and Dewalle,1976). Thus BOD5/COD will have low ratio values, most often close to 0.1, is a characteristic value for stabilised leachates. The dark colour in leachate is mainly due to humic substance. The decrease of VFAs results in an increase in pH. A characteristic pH value for stabilised leachate is close to 8 (Granet et al., 1986). The concentration of metal ions is in general low due to the decreasing solubility of many metal ions with increasing pH. In case of lead, it forms very stable complexes with the humic acids (Harmsen, 1983). Due to the effect of the shifting pH on metal-ions, reduction of sulphate to sulphide during methanogenic phase, this increases the precipitation of metals ions.

Generally, leachate strength get reduces with time due to biological breakdown of organic compounds and precipitation of soluble elements like heavy metals. With increasing age of leachate production, the organic compounds decrease more rapidly than the inorganic compounds. Hence, the ratio of total volatile solids to total fixed solids decreases with the age of the landfill (Robinson and Gronow, 1993)

The aim of our study is to bring out the effect of aging on the leachate characteristics from a municipal solid waste of Terra Firma Biotechnologies Ltd situated at Gundlahalli village in Doddaballapur taluk, near Bangalore. Two leachate samples were collected at different locations from the same site representing different stages of degradation of waste. Further the leachate contamination potential has been assessed based on the concept of leachate pollution index (LPI).

2 SITE DESCRIPTION

Terra Firma Biotechnologies Ltd(TFBL) is situated at Gundlahalli village, 18 km from Doddaballapur taluk of Karnataka state,India. TFBL receives about 1,000 tons of MSW daily from BBMP while remaining 400 tons of MSW is collected from hotels, IT parks..etc. The MSW collected is treated through composting, biomethanation and landfill facility. The first leachate (sample-1) originated from the old part of the landfill as show in fig 1.



Fig. 1 Leachate location from the Old part of the Landfill

The second leachate (sample-2) was sampled at the same landfill but it is active part of the landfill as show in fig 2.



Fig. 2. Leachate location from the fresh dump site

3. SAMPLING AND ANALYSES

A municipal solid waste leachate sample was collected in the month of April from the Terra Firma Biotechnologies Ltd in Bangalore. Glass bottles were used to collect leachate samples for chemical analyses, whereas, samples preserved for BOD and COD tests were collected in polyethylene bottles covered with aluminium foils. A few drops of concentrated nitric acid were added to the leachate sample collected for heavy metals analysis to preserve the samples. The samples were then transported in cooler boxes at temperature below 5°C, and transported immediately to the laboratory. Sample of leachate were stored in refrigerator at 4°C before proceeding for the analysis. The analysis is carried out according to standard methods for examination of water and wastewater unless otherwise stated (APHA, 1998).

3.1 Determination of Physico-chemical parameters

Table 1. Method of determination of Physico-chemica parameters

Parameters	Method of determiantion
pH	pH meter
Conductivity, µS/cm	Conductivity meter
TDS, mg/l	TDS meter
COD, mg/l	Open reflux method
BOD_3 , mg/l	Winkler's method
Sulphate, mg/l	Titration
Chloride, mg/l	Titration
Calcium, mg/l	EDT titration
Alkalinity, mg/l	EDT titration
Sodium, mg/l	flame photometer method
Potassium , mg/l	flame photometer method
Nitrate,mg/l	Spectrophotometer method
Heavy metal	Absorption Spectrophotometer

4 RESULTS AND DISCUSSION

The physico-chemical properties of both leachates are presented in Table 2.

Table 2. Leachate characteristic of TFBL

Details	Sample-1	Sample-2
pH	7.38	5.7
Colour	Brownish	Dark Black
Odour	Very High	Medium
Temperature,ºC	29	29
Conductivity, µS/cm	2750	1050
Turbidity (NTU)	470	80
TDS, mg/l	1375	310
COD, mg/l	498	4960
BOD_5, mg/l	40	1680
Sulphate, mg/l	42	30
Chloride, mg/l	960	2300
Calcium, mg/l	159	680
Hardness, mg/l	26000	30000
Alkalinity, mg/l	-Nil-	2500
Iron, mg/l	5.28	6.61
Copper, mg/l	0.001	0.223
Silver, mg/l	0.785	0.192
Chromium, mg/l	BDL	BDL
Cadmium, mg/l	0.026	0.015
Lead, mg/l	0.252	0.145
Zinc, mg/l	48	0.2
Nickel, mg/l	0.074	BDL
Sodium, mg/l	260	508
Potassium , mg/l	200	508
Nitrate,mg/l	82.73	8.91

The Sample-1 leachate originating from the old landfill had typical properties of leachate from landfill in the methonogenic phase (Kjeldsen et al., 2002). High pH, low concentration of organic matter and typically very low BOD_5/ COD ratio (<0.1), indicating low biodegrability potential.

On the other hand, leachate from the active part of the landfill (sample-2) was significantly more polluted, it contained high concentrations of chlorides, sulphate, calcium and its pH was lower (5.7) indicate that the landfill is at the end of the acidic anaerobic phase (waste buried in the landfill is about 4 years) and it will proceed to another phase i.e. methanoenic.

The sample -2 leachate is a strongly odoured black coloured liquid when it comes from a landfill site. The

smell is acidic and offensive because of sulfur, hydrogen and nitrogen rich organic species such as an organosulfur compound As it becomes oxygenated it tends to turn brown because of the presence of Iron salts in solution and in suspension. It also quickly develops a bacterial flora often comprising substantial growths of Sphaerotilus.

Concentrations of metals were low in both leachates samples except for Fe and Zn. Generally heavy metals appear in the municipal solid waste from Batteries, consumer electronics, ceramics, light bulbs, house dust and paint chips, lead foils such as wine bottle closures, used motor oils, plastics, and some inks and glass. Concentration of heavy metals in a landfill is generally higher at earlier stages because of higher metal solubility as a result of low pH caused by production of organic acids. It is now recognized that most trace elements are readily fixed and accumulate in soils, and because this process is largely irreversible, repeated applications of amounts in excess of plant needs eventually contaminate a soil and may either render it non-productive or the product unusable. Although plants do take up the trace elements, the uptake is normally so small that this alone cannot be expected to reduce appreciably the trace element. It is interesting to note that the zinc levels are very high in leachate from old waste compared to leachate from fresh waste. However the concentrations of iron is about the same in the both the leachate samples.

4.1 Indications from BOD and COD values

The BOD/COD ratio can used to indicate the age of the waste fill. Relatively BOD levels decrease with age faster than COD due to rapid disintegration of bio degradable waste. Thus generally the ratio of BOD/COD will decrease with age and can be used to indicate the age of the waste.. Any waste water, having its BOD_5/COD ratio more than 0.63 can be considered to be quite controlled to biological treatment.

Table 3. Age of waste based on BOD & COD values of leachate (Hui, 2005).

BOD5/COD	Age of fill	COD
≥ 0.5	Young (< 5yr.)	>10,000
0.1-0.5	Medium(5yr -10yr)	500-10,000
<0.1	Old(>10 yr)	<500

From table 3, it shows that BOD_5 was 1290 mg/l and the value of COD was 13400 mg/l. The ratio of BOD_5/COD is 0.09 for sample-1 leachate. The value of BOD_5/COD can characterize the age of the landfill according to the leachate constituents (Table 3). The value of COD and BOD_5/COD from Table 3 shows that the leachate (sample-1) in this study was collected from the landfill with a age of more than 10 years and (sample-2) leachate found to be in medium age between 5 and 10 years.

5. LEACHATE POLLUTION INDEX CONCEPT

LPI provides an efficient method for evaluating the leachate contamination potential. The leachate pollution index (LPI) and it is formulated based on the Delphi technique. The LPI is a quantitative tool by which the leachate pollution data of the landfill sites can be reported uniformly. LPI formulation process involves selecting variables, deriving weights for the selected pollutant variables, formulating their sub indices curves, and finally aggregating the pollutant variables to arrive at the LPI (Kumar and Alappat, 2003).

LPI process involves: Selection of pollutant variables, Pollutant weights are assigned, formulating their sub indices curves and aggregating the pollutant variables to arrive at the LPI.

The LPI is calculated using the following equations:

$$LPI = \sum_{i=1}^{n} WiPi \qquad (1)$$

Where LPI= the weighted additive LPI, Wi= the weight for the ith pollutant variable, Pi = the sub index score of the ith leachate pollutant variable, n= number of leachate pollutant variables used in calculating LPI.

However, when the data for all the leachate pollutant variables included in LPI are not available, the LPI can be calculated using the concentration of the available leachate pollutants. In that case, the LPI can be calculated by the equation:

$$LPI = \frac{\sum_{i=1}^{m} WiPi}{\sum_{i=1}^{m} Wi} \qquad (2)$$

Where m is the number of leachate pollutant parameters for which data are available, but in that case, $m<18$ and $\Sigma W<1$ contamination from the pollutant to the overall leachate pollution.

LPI values were calculated for leachate sample of Terra Firma site. Tables 4 show the calculations for LPI values of leachate samples in Terra Firma site.

Table 4. LPI for the landfill leachate (sample-1)

Pollutant, mg/l	Sample 1	W_i	P_i	(P_iW_i)
pH	7.38	0.055	5	0.275
TDS	1375	0.050	8	0.40
BOD_5	40	0.061	55	3.36
COD	498	0.062	80	4.96
TKN	831	0.053	95	5.035
AN	1	0.051	100	5.10
Iron	5.28	0.044	5	0.22
Copper	0.001	0.050	5	0.25
Nickel	0.074	0.052	5	0.26
Zinc	48	0.056	5	0.28
Lead	0.252	0.063	5	0.31
Chromium	0.011	0.064	10	0.64
Chlorides	960	0.048	5.3	0.2544
Final LPI value	= 13.22			

Table 5. LPI for the landfill leachate (sample-2)

Pollutant, mg/l	Sample 2	W_i	P_i	(P_iW_i)
pH	5.7	0.055	5	0.275
TDS	310	0.050	8	0.40
BOD_5	1680	0.061	55	3.36
COD	4960	0.062	80	4.96
TKN	485	0.053	95	5.035
AN	350	0.051	100	5.10
Iron	6.61	0.044	5	0.22
Copper	0.223	0.050	5	0.25
Nickel	0.001	0.052	5	0.26
Zinc	0.2	0.056	5	0.28
Lead	0.145	0.063	5	0.31
Chromium	0.001	0.064	10	0.64
Chlorides	2300	0.048	5.3	0.2544
Final LPI value	= 16.11			

The results indicate that the leachate sample has high LPI value and therefore, has relatively more contamination potential. Terra Firma leachate sample can therefore pose threat to the environment and human health and hence, measures and continuous monitoring must be ensured. This threat potential does not seem to be reducing even with increase of the leachate.

It is interesting to note that the LPI of both the leachates is not much different. While pollution threat from Leachate 1 (from old waste) is less from BOD and COD, its threat is mainly due to high concentrations of Zinc, TDS and Total Kjeldahl Nitrogen (TKN). On the contrary the pollution threat from fresh leachate arises mainly form high BOD, COD and chloride levels. However the threat exists from leachates from both fresh waste and aged leachate.

6. CONCLUSIONS

1. Based on the physico-chemcial analysis the leachate from the active part (fresh waste) of the landfill, it has been inferred that anaerobic acidic phase is established.
2. The leachate from the closed part showed typical characteristics of leachates generated during the methanogenic phase of the landfill life phase.
3. Based on BOD_5/COD ratio suggested that the leachate (sample-1) (closed part of landfill) from the landfill with the age more than 10 years and (sample-2) leachate (fresh waste) found to be in medium age.
4. The LPI is a quantitative tool by which the leachate pollution data of the landfill sites can be reported uniformly. High LPI values indicate that the leachates generated from landfill site are not yet stabilized even after 10 years, resulting in high pollution threat. While pollution threat from Leachate 1 (from old waste) is less from BOD and COD, its threat is mainly due to high concentrations of Zinc, TDS and TKN. On the contrary the pollution threat from fresh leachate arises mainly form high BOD, COD and chloride levels.

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USGS science for a changing world

Environmental Health - Toxic Substances Hydrology Program

Landfill Leachate Released to Wastewater Treatment Plants and other Environmental Pathways Contains a Mixture of Contaminants including Pharmaceuticals

Signup

New scientific research from the U.S. Geological Survey (USGS) details how landfill leachate, disposed from landfills to environmental pathways, is host to numerous contaminants of emerging concern (CECs).

Landfills are the final repository for a heterogeneous mixture of liquid and solid waste from residential, industrial, and commercial sources, and thus, have the potential to produce leachate—a liquid waste product that consists of a diverse mixture of chemicals as precipitation or applied water moves through the waste. Landfills are often not the final repository for leachate which can be discharged to surface waters following onsite or offsite wastewater treatment.



Sample bottels like these filled with leachate were analyzed for contaminants of emerging concern (CECs) including pharmaceuticals, industrial chemicals, household chemicals, steroid hormones, and plant/animal sterols. Photo Credit: Dana W. Kolpin, USGS

In this national-scale study, scientists provide an assessment of CECs in landfill leachate disposed offsite that has undergone treatment or storage processes (final leachate) at landfills across the United States to gain a greater understanding of this potential contaminant source to the environment. This study follows and advances previous USGS research of leachate prior to onsite treatment, storage processes, and offsite disposal (fresh leachate).

In this study, final leachate samples from 22 landfills were collected and analyzed for 190 CECs including pharmaceuticals, industrial chemicals, household chemicals, steroid hormones, and plant/animal sterols. The sampling network included municipal and private landfills with varying landfill waste compositions; geographic and climatic settings; ages of waste, waste loads, and leachate production; and leachate management strategies.

Scientists determined that final leachate samples contained 101 of the 190 chemicals analyzed for the study, with chemicals present in every final leachate sample collected at levels ranging from as low as 2 nanograms per liter (ng/L) to as high as 17,200,000 ng/L. The most frequently detected CECs were lidocaine (local anesthetic, found in 91 percent of samples), cotinine (nicotine breakdown product, 86 percent), carisoprodol (muscle relaxant, 82 percent), bisphenol A (component for plastics and thermal paper, 77 percent), carbamazepine (anticonvulsant, 77 percent), and N,N-diethyltoluamide (DEET, insect repellent, 68 percent).

A detailed comparison of CEC concentrations between final leachate in landfills included in this study and the previous study of fresh leachate indicated that levels of CECs were significantly less in final leachate compared to those observed in fresh leachate samples. Nevertheless, final leachate still contained a complex mixture of CECs at concentrations that may be potential cause for concern if released to the environment.

This research is part of continuing USGS efforts to quantify the contribution of contaminants in leachate released from landfills to various pathways that ultimately lead to the environment. Use of landfills as a means of waste disposal will likely

increase as the global population continues to increase. Despite advancements in recycling, source reduction, and composting, the amount of municipal solid waste discarded in U.S. landfills increased from 150 million tons in 1985 to 165 million tons in 2010. The study is intended to inform landfill managers, stakeholders, and regulators about chemicals present in landfill leachate disposed offsite to environmental pathways.

The study was supported by the USGS Toxic Substances Hydrology Program.



In some cases USGS scientists collected leachate samples from manhole access points like this one. Photo Credit: Dana W. Kolpin, USGS

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Masoner, J.R., Kolpin, D.W., Furlong, E.T., Cozzarelli, I.M., Gray, J.L., and Schwab, E.A., 2014, Contaminants of emerging concern in fresh leachate from landfills in the conterminous United States: Environmental Science--Processes and Impacts, v. 16, no. 10, p. 2335-2354, doi:10.1039/C4EM00124A.

More Information

- For more information contact Dana W. Kolpin, USGS Iowa Water Science Center, or Jason R. Masoner, USGS Oklahoma Water Science Center
- Frequently Asked Questions about this Science Feature Article
- USGS Technical Announcement: Storage and Treatment of Liquid Waste from Landfills Doesn't Remove All Contaminants, Including Pharmaceuticals
- USGS Emerging Contaminants in Landfill Leachate
- Pesticide Contamination and Environmental Exposure Investigation

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- Chemicals Found in Treated Wastewater are Transported from Streams to Groundwater
- Pharmaceuticals and Other Chemicals Common in Landfill Waste
- Chemicals from Land-Applied Biosolids Persist in Soil
- Complex Mixture of Contaminants Persists in Streams Miles from the Source
- Hormones in Land-Applied Biosolids Could Affect Aquatic Organisms
- Biosolids, Animal Manure, and Earthworms: Is There a Connection?
- Household Chemicals and Drugs Found in Biosolids from Wastewater Treatment Plants

More Science Features

CHAPTER

3 Landfill Gas Safety and Health Issues

This chapter provides information about health and safety issues associated with landfill gas—specifically, possible explosion and asphyxiation hazards and issues related to odors emanating from the landfill and low-level chemical emissions. It also contains information about health and safety issues associated with landfill fires (which may or may not be the direct result of landfill gas). This chapter also describes the tools that can be used to help environmental professionals respond to community health concerns. It provides information about what is known and unknown about the short-term and long-term health effects associated with landfill gas emissions, which can be mixtures of hundreds of different gases.

When reading this chapter, keep in mind that if people are not being exposed to landfill gases, no adverse health effects are expected. Exposures occur only if the landfill is producing harmful levels of gases *and* if the gases are migrating from the landfills *and* reaching people. Responding to community concerns about the possible health impacts of known or potential landfill gas emissions can often be difficult. Data (at the point of exposure) are needed to fully evaluate exposures, and these data are often limited or not available (see Chapter Four).

How are people exposed to landfill gas?

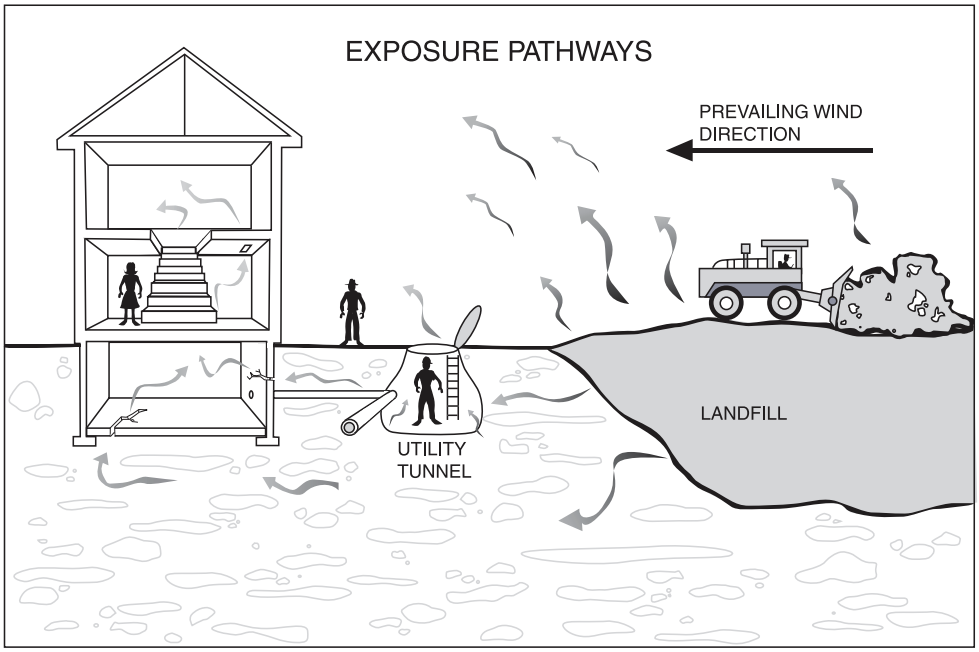
People may be exposed to landfill gases either at the landfill or in their communities. As discussed in Chapter Two, landfill gases may migrate from the landfill either above or below ground. Gases can move through the landfill surface to the ambient air. Once in the air, the landfill gases can be carried to the community with the wind. Odors from day-to-day landfill activities are indicative of gases moving above ground. Gases may also move through the soil underground and enter homes or utility corridors on or adjacent to the landfill. Figure 3-1 illustrates the movement of landfill gases and potential exposure pathways. The levels of gases that migrate from a landfill and to which people are exposed are dependent on many factors, as described in Chapter Two. Landfill gas collection and control systems have the greatest impact on gas migration and exposures. If a collection or control system is in place and operating properly, migration and exposures should be minimal.

Explosion Hazards

Landfill gas may form an explosive mixture when it combines with air in certain proportions. This section provides information about:

- The conditions that must be met for landfill gas to pose an explosion hazard.
- The types of gases that may potentially pose explosion hazards.
- What can be done to assess whether a landfill is posing an explosion hazard.

Figure 3-1: Potential Exposure Pathways to Landfill Gas



When does landfill gas pose an explosion hazard?

The following conditions must be met for landfill gas to pose an explosion hazard:

- ***Gas production.*** A landfill must be producing gas, and this gas must contain chemicals that are present at explosive levels.
- ***Gas migration.*** The gas must be able to migrate from the landfill. Underground pipes or natural subsurface geology may provide migration pathways for landfill gas (see Chapter Two, "What factors affect landfill gas migration?"). Gas collection and treatment systems, if operating properly, reduce the amount of gas that is able to escape from the landfill. (See Chapter Five.)
- ***Gas collection in a confined space.*** The gas must collect in a confined space to a concentration at which it could potentially explode. A confined space might be a manhole, a subsurface space, a utility room in a home, or a basement. The concentration at which a gas has the potential to explode is defined in terms of its lower and upper explosive limits (LEL and UEL), as defined at right.

Lower and Upper Explosive Limits (LEL and UEL)
The concentration level at which gas has the potential to explode is called the explosive limit. The potential for a gas to explode is determined by its lower explosive limit (LEL) and upper explosive limit (UEL). The LEL and UEL are measures of the percent of a gas in the air by volume. At concentrations below its LEL and above its UEL, a gas is *not* explosive. However, an explosion hazard may exist if a gas is present in the air between the LEL and UEL and an ignition source is present.

Please accept this addendum to my "Superfund Site" written testimony of April 21,2025.
This addendum includes:

my oral testimony (I ceded my oral testimony time)
four articles from the Gazette-Times 1977
twelve articles from the GT 1979

Please note this was a cursory -and by no means exhaustive- search of the literature related to **radioactive waste from Wah-Chang dumped at Coffin Butte** during the mid/late seventies over a roughly five year period. Wah-Chang became a superfund site in 1983. Through a rigorous federal process Wah-Channg landed on the National Priorities List and from there became a designated Superfund Site. Radioactive waste including radium 226 which has a half life of 1600 years went to Coffin Butte. This is a history that no doubt bears further scrutiny.
One article concerns picric acid from Chedelin Middle School disposed at Coffin Butte.
I mention this to point out that a more thorough research effort would no doubt turn up other toxic waste of concern. Things were more lax then.
Context, history is everything.... It is critical that Coffin Butte be looked at over its long and complicated history.

DATE RECEIVED: 5/8/25
FROM: Elizabeth Conover
PHONE OR EMAIL: egconover1@gmail.com

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DATE RECEIVED: 5/8/25
FROM: Elizabeth Conover
PHONE OR EMAIL: egconover1@gmail.com

April 20, 2025
TO: Benton County Planning Commission, Nick Fowler, Chair
RE: LU-24-027

RECEIVED
APR 21 2025
By

As a resident of Benton County, I strongly oppose the application to expand the landfill.

Welcome to Corvallis: We have a superfund site.

It's called United Chromium Products.
Because superfund sites include so many forever chemicals, they are our forever friends.
But, we might actually have another Superfund site; that will be for you to decide.

In the late 1970s, toxic waste dumps such as Love Canal received national attention when the public learned about the risks to human health and the environment posed by contaminated sites. In response, Congress in 1980 established the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) CERCLA is informally called Superfund. Superfund was created to address health and environmental risks posed by contaminated toxic waste sites. Through a federal process sites like Love Canal-1984, Rocky Flats-1989 and Hanford-1988 ended up on the NPL (the National Priorities List) and became designated Superfund sites.
Oddly, the Hanford site is also in Benton Co, Benton County Washington on the Columbia River.

United Chrome Products is a superfund site just south of Corvallis and owned by the city. Past activities contaminated the soil and groundwater with chromium and other hazardous wastes. EPA added the site to the Superfund list in **1984**. **Chromium contaminated soils were taken off site for disposa**l. Today 40+ years later, the city pumps and treats groundwater to remove contamination and continues to perform long term groundwater monitoring. Forever chemicals, forever friends.
Where were the chromium contaminated soils taken?
I don't know the answer to that question, but I do know that at the Superfund site next door in Linn County waste went to Coffin Butte.

That site, **Teledyne (now Wah Chang)** was added to the Superfund list in **1983.** It is one of the country's largest producers of rare earth metals and alloys. Waste from Teledyne/Wah Chang went to Coffin Butte moreover, it apparently went into an unlined cell. After it began leaking and contaminating groundwater, DEQ required it to be moved to a lined cell in 1992.

So if Teledyne/Wah Chang is a Superfund site, and its waste went to Coffin Butte, maybe Coffin Butte too is a Superfund site.

Consumers Power Inc (CPI) formerly located in Corvallis near Ninth and Circle (now Buffalo Wild Wings, Jimmy Johns and Walmart) produced soil contaminated waste containing wood preservatives (used to treat power poles) and PCB's from leaking transformers. It went to Coffin Butte.

Following the Santiam wildfires in 2020, the EPA identified and removed about 300,000 pounds of hazardous waste from affected properties. It's a long list but included: fuel, petroleum, car batteries, solvents, pesticides, propane tanks, ammunition and asbestos. It went to Coffin Butte.

Toxic fly ash from Covanta's Marion Waste Incinerator containing dioxin and heavy metals is used as a daily cover at the landfill.

The following are headlines from the Gazette-Times:
1976 "Wah Chang waste ignites, landfill operator cannot use water for fear of explosion"
1977 "Radioactive material found at Coffin Butte, Radium 222, as deadly as plutonium, concerns about groundwater contamination"
1979 "Commissioners require home developer to notify buyers of proximity of home to dump"
~~1979 "Diesel soaked pot plants to be taken to landfill"~~

GT more

1996 "Local Landfill got OK to pump polluted water into Willamette"

All this toxic waste **deposited** over decades at Coffin Butte produces leachate -in 2021, 31 million gallons- which is pumped and trucked to local municipal wastewater treatment facilities unequipped to deal with it, so many toxics including PFAS -forever chemicals- pass through the plant and are discharged into the Willamette River. The subsurface geology at CB is poorly understood, so the extent of groundwater contamination is unclear, but groundwater connects to surface water and the landfill is only about ten miles from the Willamette River.

Finally ENRAC -the Environment and Natural Resources Advisory Committee for the county, after lengthy and extensive research published a substantive report on the Coffin Butte Expansion and voted 5-1 to recommend denial of Republic's application to expand the landfill.

Welcome to our town.
I understand the local theater company is contemplating a production of An Enemy of the People.
We have a superfund site, we may soon have another.

Respectfully,
Elizabeth G. Conner
1465 NW 13th St
Corvallis, OR 97330

Oral Testimony
Elizabeth Conover
(note I ceded my time, but wish to include my oral testimony as part of this addendum)

Welcome to Corvallis: We have a superfund site.
It's called United Chromium Products.
But, we might actually have another; that will be
for you to decide.
In the late 1970s, toxic waste dumps such as Love Canal
received national attention when the public
learned about the risks to human health and the environment
posed by contaminated sites. In response,
Congress in 1980 established the Superfund. Love Canal, Rocky
Flats and Hanford became designated Superfund sites.
Because superfund sites include so many forever chemicals, they
are our forever friends.
United Chrome Products is owned by the city. EPA added the
site to the Superfund list in 1984. Soil and groundwater was
contaminated with chromium and other hazardous wastes. Today
over 40 years later, the city pumps, treats and monitors
groundwater. Forever chemicals, forever friends.
Next door in Linn County is Teledyne/ Wah Chang a major
producer of rare earth metals including zirconium.
By products of zirconium production include: water soluble
radioactive chloride and radium 226.
Radium 226 has a half life of over1,600 years.
For about 5 years in the mid-70's Coffin Butte received an
unknown quantity of radioactive
industrial waste from Wah Chang.
It was deposited in an unlined cell. After it began leaking and
contaminating groundwater,
DEQ -in 1992- required it to be moved to a lined cell.
So if Teledyne/Wah Chang is a Superfund site, and its waste went
to Coffin Butte, does that make Coffin Butte a Superfund site.
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Welcome to our town.
I understand the local theater company is contemplating a production of An Enemy of the People.
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Corvallis Gazette-Times (Corvallis, Oregon) · Fri, May 20, 1977 · Page 1

Printed on Jan 30, 2022

Wah Chang 'trash' blows up

By William Monroe
Of The Gazette-Times

ADAIR VILLAGE — A bulldozer operator at the Coffin Butte landfill, a few miles northwest of here, narrowly escaped being badly burned this morning when several barrels of unidentified waste exploded beneath his machine, which then caught fire.

The fire occurred in a pit used only by Teledyne Wah Chang, a Millersburg firm which manufactures rare metals, to dump wastes.

The driver of the bulldozer, Mark "Cal" Elliott, 2315 NW Green Circle, was not hurt by the explosion and drove the bulldozer, which had caught on fire, out of the flaming waste.

After he drove about 30 yards, he leaped off, moments before the fuel tank containing 125 gallons of diesel fuel exploded. The bulldozer was engulfed in flames.

"She was red hot, I'll tell you," Elliott said. "It (the bulldozer) just blew up, like gasoline."

The Adair Rural Volunteer Fire Department arrived within minutes and fought the blaze in the bulldozer. However, firemen are under instructions not to try to put out flames in the Wah Chang waste area. They stand by until the blaze in the pit died down.

Members of the department said it was the sixth time they have been called to the Wah Chang pit since the first of the year.

Elliott said he was working the Wah Chang pit about 9:30 a.m., spreading out piles of trash and barrels before starting to push dirt over the waste.

"I was up above and all of a sudden I saw this huge mushroom-shaped cloud," said Paul Archibek, the foreman of the Coffin Butte Landfill. "I ran to the edge and there was Cal backing the cat off the fire, but it was on fire, too. When I got down there, he had jumped off and ran up a ways. He was really out of breath."

An hour after the first explosion, while Archibek and Elliott stood at the edge of the pit talking with reporters, smaller explosions continued to go off in the middle of the smoldering area.

Archibek himself nearly died last year, during another fire in the pit, when he inhaled smoke from the burning material. Since then, he has been on daily medication to assist his breathing.

"We're going to have to complain about this," he said. "It's just too dangerous."

Dennis Williams, Teledyne Wah Chang's fire chief, was also at the scene and said that there is no zirconium waste brought to the landfill from the Albany firm. Zirconium is the rare metal produced in Albany for use in nuclear reactors.

Williams was asked what wastes are brought to the pit.

"Trash," he replied before leaving the area, "just trash."

The landfill is operated by Corvallis Disposal Co., Corvallis, but officials of the firm weren't available for comment.

The explosion today came on the heels of an announcement Thursday that Wah Chang will be issued a state citation charging the industry with exposing employes to hazardous levels of chlorine, hydrochloric acid and ammonia without providing adequate protection.

Mike Rodia, assistant manager of the occupational health section of of the State Accident Prevention Division, said, however, that the citation concerns past occurrences at the Millersburg plant, and is not for any disposal problems at Coffin Butte.

"This is the first we've really heard about the explosion or the hazard to any landfill employes by the firms, for that matter," Rodia told the Gazette-Times in a telephone interview late this morning.

"The DEQ (Oregon Department of Environmental Quality), you know, was supposed to be looking into these fires, but I think we might have to take a look at it ourselves if the safety of employes is involved."

Rodia said that in the past, before Wah Chang was taking trash to Coffin Butte, his department investigated numerous explosions at the Millersburg plant.

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Corvallis Gazette-Times (Corvallis, Oregon) · Mon, May 23, 1977 · Page 1

Printed on Jan 30, 2022

Wah Chang must tighten checks of what it dumps

By William Monroe
Of Gazette-Times

ADAIR VILLAGE — Cleaning up the act of Teledyne Wah Chang at the Coffin Butte landfill site, a few miles northwest of here, was being given top priority today by the landfill's operators, state officials and Wah Chang itself.

And the Millersburg rare metals firm may be asked to start dumping its wastes somewhere else.

A bulldozer operator at the dump leaped from his burning machine Friday after it caught fire in an explosion in the special Wah Chang dumping area at the site. It was the latest of several fires in the pit in the past several months.

Tom Nelson, an environmental biologist at Wah Chang, a rare metals firm in Millersburg, near Albany, said that the fire was apparently caused by contamination of the firm's waste with zirconium particles.

The Oregon Department of Environmental Quality (DEQ) has given Wah Chang until Tuesday to submit a plan for a more rigid inspection process on waste material leaving the Millersburg plant for disposal at Coffin Butte.

"What we have done is to make a change in the process of inspections," Nelson said today in a telephone interview. "We've made it 10 times more rigorous."

Nelson said that the plant is supposed to send only office papers, boxes and wood to the landfill site.

In the past, he said, the waste material at seven disposal sites in the plant has been inspected by one person. Starting today, however, that inspection process has been expanded to include plant supervisors and the Wah Chang fire chief, Dennis Williams.

Valley Landfill, Inc., which operates the site, is also investigating the fire and Richard Eisenbrandt, general manager of Corvallis Disposal Co. (both firms have the same major stockholders) said that his firm will begin discussions this week with Wah Chang to ask the metals firm to either insure that no more fires

(Continued on page 12)

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Corvallis Gazette-Times (Corvallis, Oregon) · Mon, May 23, 1977 · Page 12
Printed on Jan 30, 2022

– Wah Chang

(Continued from page 1)

will occur in the Wah Chang waste or find another place to take it.

Eisenbrandt said that the presence of the special dumping area poses no threat to the public using other portions of the landfill.

According to DEQ spokesmen, the issue of whether or not Wah Chang can dump its waste at the landfill is between the disposal corporation and the firm.

"All we do is issue permits," said Dave Gemma, a spokesman for DEQ. "We check to make sure that the material is environmentally safe, that is to say that there are no poisons or toxic substances getting into the environment."

Gemma said that the problem at the dump has been one of handling the wastes, which have been contaminated with the zirconium dust to varying degrees at several times in the past, with the knowledge of the DEQ.

The presence of zirconium in the waste materials creates a material which is highly combustible and could explode with little jarring or jostling around.

Normally, according to Nelson, zirconium filings (particles) are reprocessed at the plant.

But zirconium, while posing a hazard to the lives of its handlers, is not considered by the DEQ to be toxic to the environment and for that reason and the fact that the permit issued to Wah Chang is based on an agreement between the firm and Valley Landfill to "minimize" and not eliminate zirconium from the waste, Wah Chang will not likely be fined for Friday's explosion and fire, Gemma said.

Meanwhile, the DEQ is investigating the fire from the standpoint of safety for the handlers of the Wah Chang waste.

It may not be the only state agency involved, either.

Mike Rodia, assistant manager of the occupational health section of the State Accident Prevention Division, said Friday that his agency may step in and investigate the incident.

Rodia was not available for comment today.

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from Scott's legacy finds 3 of 4

Corvallis Gazette-Times (Corvallis, Oregon) · Wed, May 25, 1977 · Page 1
Printed on Jan 30, 2022



Wah Chang faulted

Radioactive waste found at landfill

Corvallis Gazette-Times

Most districts OK school levies

Philomath budget, mayor in trouble

Fired general testifies to fear of war in Korea

Walla Walla pen lockup ends quietly

Podgorny ouster lacks impact

Mohaccan's date for death passes without incident

Inside The Gazette-Times

Rare metals refinery

Wash natural ~ 100? x 400?? more radioactive than allowed by OR law

public health hazard

found ?? Waste removed ??

Radium 226 a radioactive isotope ψ as hazardous as plutonium

WC uses ψ

Geiger Counter vs micro roentgen meter

"No immediate danger." How do THEY know?

level of radioactivity at WC deposit site 2.9 x higher than in "natural soils

ψ & contamination water table

trying to determine gaseous structural study

Radium 226 decays v. slowly half life 1,600 yrs

ready now to determine the

site radioactivity detected at WC estimated exceeded by 400X hazard level established for Radium 226 in drinking water

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Corvallis Gazette-Times (Corvallis, Oregon) · Wed, May 25, 1977 · Page 12

Printed on Jan 30, 2022

Radioactive waste

(Continued from page 1)

has placed the order for one.

Parrott said a more immediate health risk from radioactivity may exist in the vicinity of the Wah Chang refinery itself. There an estimated 4,000 tons of radioactive wastes have been disposed of inside the company's compound and on a nearby field where sludge from the company's settling ponds has been dumped.

The company has been ordered to remove that material at once for disposal at the Hanford nuclear reservation in Washington or at a disposal site in Nevada.

Parrott said the health division's investigation began in Feburary, when an inspector noticed an apparent change in the company's zirconium manufacturing process. Residue from a chlorinating process used in the extraction of zirconium from ground sand was found to be 6,000 to 10,000 times more radioactive than allowed by law. The radiation, which was detected by company inspectors and reported to the health division, led to the inspection of Wah Chang's wastes at Coffin Butte, Parrott said.

The penalty for violating Oregon's radioactive waste-disposal law is a $1,000 fine or a year in jail, or both. State law also empowers the Department of Environmental Quality to impose additional fines for uncorrected violations. Parrott said the health division has not yet discussed possible punitive action against Wah Chang.

The important thing now is to get the situation neutralized, he said. "Then we'll see whether anything else needs to be done."

Bill Webber, general manager of Valley Landfills, Inc., Corvallis, said he asked the health division to test Wah Chang's disposal area at the landfill for radioactivity as a result of recent publicity about radioactivity being detected in wastes at the Wah Chang plant.

Prior to that time, he said, "I had no knowledge whatever, nor any reason to suspect that radioactive wastes were being disposed of at Coffin Butte. Otherwise I never would have permitted it."

Webber added that waste material going from Wah Chang to Coffin Butte is being monitored for radioactivity before it leaves the plant, "so that under no circumstances is radioactive material coming in now."

Of more immediate concern to him, he said, is the problem of explosive wastes from Wah Chang being buried at the landfill.

A bulldozer operator at the landfill leaped from his burning machine last Friday after it caught fire when wastes in the Wah Chang dumping site exploded.

Most districts

(Continued from page 1)

1,621-1,418 vote.

Crook — Crook County voters approved a $1.5 million levy.

Douglas — Glide district faced an automatic recount as its levy request lost by one vote, 339 to 329. Sutherlin and Yoncalla levies approved.

Harney — Levies approved included Burns Union High, Burns Elementary, Suntex, Drewsey and Pine Creek.

Lake — Lakeview levy request for $909,289 defeated.

Lane — Springfield, Crow-Applegate and Oakridge levies pushed. Lowell's rejected.

Linn — Levies approved for Lebanon Union High, Lebanon Elementary, Knox Butte, Gore Elementary and Santiam High. Scio levy defeated.

Marion — West Stayton and North Santiam levies approved. Aumsville's budget request ended in a tie vote, causing the proposal to fail.

Umatilla — Levies defeated for McLoughlin Union High, Milton-Freewater Elementary and Echo.

Philomath

(Continued from page 1)

this year is now up to the City Council.

Meanwhile, Collins is to appear in Corvallis Municipal Court June 2.

Police said Collins was released to the custody of a friend after taking a breathalyzer test at the Benton County Jail.

Collins' car was stopped by police in the 100 block of NW 5th Avenue at 2:24 a.m. today after the arresting officer said he had seen the car turn off NW 9th Street onto NW Buchanan Avenue against a red light.

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Corvallis Gazette-Times (Corvallis, Oregon) · Thu, Jun 9, 1977 · Page 1

Printed on Jan 30, 2022

N. Albany septic checks

By Michael Bradley
Of The Gazette-Times

Benton County's health department is pushing the state to continue a survey to determine if failing septic tanks are a health hazard in the North Albany area of northeast Benton County.

That's what Mark Magenheim, county health director, told the county board of commissioners Wednesday. The commissioners were meeting as the board of health.

The Oregon Health Division has said it has made a survey of the area and has found that no serious sanitary problems exist.

However, Magenheim isn't satisfied with that and wants the health division to continue the survey. If the health division isn't willing to continue the tests, the Oregon Department of Environmental Quality has indicated it is, said Roger Heyden, county sanitarian.

If septic tanks were found to be a hazard, the health division could order the area annexed to the City of Albany. This would open the way for a sewage disposal program that would connect to Albany's sewage treatment plant. North Albany voters turned down a plan to finance their own sewage treatment system.

The health division has said its survey indicated the hazard was not sufficient to order annexation to Albany. Since 1975 the Department of Environmental Quality has banned housing subdivisions of more than four tracts in the North Albany because of possible health hazards that might come from the added septic tanks.

Magenheim said the survey was made during the driest winter on record and was not a true indication of conditions as they might be during a normal winter. He agreed that the information that was gathered justified the health division's conclusions under the circumstances. But he believes the survey should be made during a more normal winter, when higher water tables and more surface water spread effluent that leaks from failing septic tanks.

The health division said it was closing its books on the survey.

Heyden said he had talked to officials of Department of Environmental Quality and was told that the department was willing to make further studies if the health division doesn't. However, health division action is necessary to force annexation without an election.

The commissioners approved of the health department's actions in pressing for a continuation of the survey.

"It is not fair to the citizens" for the county to be satisfied with the state health division's conclusions at this point, Commissioner Barbara Ross said.

The county has sent a letter to the health division expressing its views, Magenheim said, but it has not received a reply. It will press for an answer before taking further action, he said.

Discovery of radioactive material at the Coffin Butte garbage dump in north Benton County has the county health department concerned, Magenheim told the commissioners.

He has asked the state health division to determine how much radioactivity there is and its possible effect, he said.

There is a possibility of wells being contaminated, he said. But because of the apparent lack of danger at this time, there is no need for a moratorium on the use of the landfill site west of Highway 99W about seven miles north of Corvallis, he said.

Wells are being sampled, Magenheim said, and anyone with a well in the area who feels concern should contact the health department.

The radioactivity, caused by the dumping of waste from the Teledyne Wah

(Continued on page 14)

$537,000 gift to go for jobs

By William Monroe
Of The Gazette-Times

After a day of scurrying around to find out exactly where the gift came from, officials of the City of Corvallis, the Corvallis School District and Benton County are now wondering what to do with all or part of a $537,000 windfall from the federal government announced Wednesday.

The city and the school district have been told they will share $343,000, and Benton County must spread its $194,000 around the county.

The grant is from the second phase of the Public Works Employment Act, which will bring an additional $55.7 million to Oregon this year to put people to work.

The purpose of the act is to provide money to local governments to reduce unemployment.

Whoever claims what parts of the $537,000 in grants, the final decisions about the disposition of the money will be left to elected officials.

The grants to Corvallis and the Benton County area were among the lowest received by governmental agencies in the mid-Willamette Valley.

Last fall, Communities, governments and school districts submitted requests to the Economic Development Administration for labor-intensive projects to be financed under the act.

Corvallis got money for the SE Alexander Avenue paving and sidewalk improvement project and several other sidewalk projects now under construction throughout the city.

Although Benton County government and the Corvallis School District also submitted applications for money, neither received any.

Now, in essence, the federal agency is saying that it cannot decide which projects are the most deserving, so the federal government will leave it up to local governments to split the spoils.

And local governments don't

(Continued on page 14)

start

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— County

(Continued from page 1)

Chang-Albany rare metals plant north of Albany, is of concern because the amount found at Coffin Butte exceeds the amount permitted under state law. However, the state law is more strict than that of other states and a similar amount would be within the tolerances allowed in other states, Magenheim said.

Wah Chang has taken steps to prevent future dumping of radioactive material at the site, he said.

Questioned by Sheriff John T. Dolan, who lives in the area about the distance the radioactivity may reach, Magenheim said that radioactivity that escapes into the air drifts with the wind and "it's hard to know exactly where it goes." Also, he said, radioactivity from long-lived elements can accumulate in fish to the point of being hazardous.

END

The commissioners appointed five new members to the North Albany service district board of directors to replace five whose terms had expired. The board is advisory to the commissioners and is designed primarily to help the commissioners determine how to proceed regarding sewer services in the district.

Named to represent the Fairmount school district were Charles Knoll, to a three-year term, and Stephen Evans, to a one-year term; representing the North Albany school district, Philip Griffin, three years; representing Oak Grove-Fir Grove school districts, Dennis Davis, two years; at large, Kenneth Cosler, three years.

They replace Joseph Novak, at large; Thomas Hewson and Marshall Swink, Fairmount; William Wisecup, North Albany, and Edward Thorn, Oak Grove-Fir Grove.

Still on the board with terms to expire at the end of the year are Lou H. Hildebrandt and Danton Paulson.

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Corvallis Gazette-Times (Corvallis, Oregon) · Sat, Apr 28, 1979 · Page 10
Printed on Jan 30, 2022

Schools around state remove dangerous acid

By The Associated Press

Calls poured into state police offices Friday as schools across Oregon found old bottles of potentially explosive picric acid in laboratories and cobwebby storage areas and moved to comply with a state directive to get rid of it.

Verne Duncan, state superintendent of public instruction, has called the chemical a serious danger and ordered it removed from the schools.

The substance is used in laboratory experiments and dye work. But when it's old and crystallized, it becomes explosive. The Japanese used it in bombs and hand grenades in World War II.

Al Davidson, executive assistant in the Oregon Department of Education, said picric acid generally has been replaced with less dangerous chemicals. He said experts in the state science department say there is no reason for school laboratories to have the chemical around.

Oregon State Police Lt. Jim Forney said his office was flooded with calls from school districts throughout the state Friday, reporting finds of the acid to be removed.

State officials expect the reported findings to continue to increase as word of its potential danger spreads through the state's more than 300 school districts.

Davidson said high schools reporting picric acid to be removed Friday included:

Milwaukie, West Linn, Gladstone, Yoncalla, Scio, Tigard, Prairie City, Ashland, Sherman County, Siuslaw and Fern Ridge.

In Corvallis, a bottle of the crystallized acid was removed Friday from Cheldelin Intermediate school by Corvallis police.

Officers took the bottle to the Coffin Butte landfill about 4:30 p.m Friday and attempted to detonate it by gunfire, but the bottle merely blew apart from the impact of the bullet, dispatcher Bob Eastland said.

Picric acid was also found at Oregon State University and was awaiting disposal Friday, according to an earlier statement by safety officer John Campbell.

Campbell could not be reached today for comment on the disposal process.

No picric acid was found in other Corvallis or Benton County public schools, officials said.

In Portland, two additional high schools — Wilson and Roosevelt — had some picric acid picked up by the city bomb squad. This followed the removal of the substance from six other city high schools on Thursday. It was detonated in a compound near Portland International Airport.

Also on Thursday some of the acid was detonated after being found at South Salem High School and at Tillamook and Neah-Kah-Nie high schools on the North Coast.

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Picric acid
Cheldel → CB
OSU ??
Stb around
old, crystalized → explosive
Japanese used in bomb WWII

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Corvallis Gazette-Times (Corvallis, Oregon) · Sat, May 5, 1979 · Page 1
Printed on Jan 30, 2022

Coffin Butte water safe, tests show

The water around Coffin Butte is more than safe enough to drink, state Health Department officials said Friday — based on their tests this spring.

However . . .

The federal Environmental Protection Agency has decided to evaluate the Health Department's testing procedures and has taken some samples of its own from the Coffin Butte area.

Concern about the radium content of water from Coffin Butte first brought Health Department inspectors to north Benton County earlier this year.

The preliminary results showed a higher-than-allowable radium content, indicating contamination of the water table by dumped materials — most likely those from Teledyne Wah Chang of Albany, which was suspected of dumping low-level radioactive waste at the dump.

But the first test samples used muddy water, the department said, which resulted in faulty readings.

The latest samples were collected in February and April and radium levels were found in only two of nine collection points, both in test wells. Ground water and residential water supplies near the butte were clear of radioactive contamination.

The radioactivity that was found was one-fifth of the tolerable limits allowed by the department, inspectors said.

The issue is not dead, however, since the EPA's tests still must be run.

Benton and Polk County officials have not been successful in their attempts to get either the state or federal agencies to take more samples from the dump itself to find out what types of materials Wah Chang disposed of in a special section of the butte.

Some of the industrial material ignites upon the slightest contact, officials say, and should not be disturbed. Wah Chang has said it does not know what it was dumping at Coffin Butte.

Karil can't tell with only 2 samples on multiple acres
Bolton Inc make you feel safe?
Or Health Dpt safe
EPA ... well maybe

Radium Content
Healt

preliminary results showed Contamination of water table

2 of 9
in Feb 79 sufficient
Apr 79

Core samples
regarded by State Fed ??
why not
??

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Corvallis Gazette-Times (Corvallis, Oregon) · Tue, Jun 5, 1979 · Page 8
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AMBULANCE CALLS

Monday

2 p.m. the Adair Rural Fire Department responded to a call from the Coffin Butte Landfill. A fire in the waste disposal area of Teledyne Wah Chang. No damage was reported from a fire that apparently ignited inside a partially empty paint can. Firefighters said the blaze was not related to any burning industrial waste in Wah Chang's pit. The fire was extinguished and buried by about 6:30 p.m.

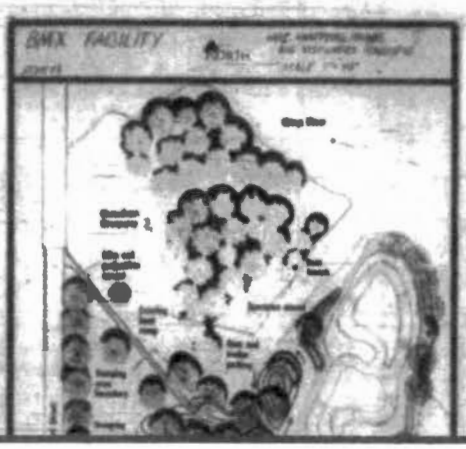
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Corvallis Gazette-Times (Corvallis, Oregon) · Fri, Jun 15, 1979 · Page 11
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Coffin Butte problems not from zirconium, officials say

Motocross part of work on new park



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Zirconium pyrophoric lots of speculation

dumps of Z waste prohibited a year ago in Jun '70

plastics? Steel liners w/ trace (Z)??

residue removed... & recycle or sale

Shredded → to dump

products of (Z)
- Magnesium
- Mg chloride

OUTCOME:

temporary ↑ in more liners to dump but maybe resolved...??

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Corvallis Gazette-Times (Corvallis, Oregon) · Fri, Jul 13, 1979 · Page 9

Printed on Jan 30, 2022

Radioactive waste no problem at dump

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RTC

test water samples from monitoring wells

if no elev. readings all is well !!!

OR officials have/ long known of elevated levels of radioactivity at the surface of CB above buried waste fr. WC Zirconium production operations

Radium 225

leave undisturbed unless radioactivity in monitoring wells

how many where etc etc

dump site (also Valley)

Wah Chang production waste buried @ Roche Road for 2 mos Aug/Sept 1975

no estimate of tonnage given

no elev. levels of radioactivity found @ surface of 1 acre area flagged by Valley ?!

(as containing the waste)

waste overlain by 15' of dirt

RECRA RTC

CWA

CAA

Superfund

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Corvallis Gazette-Times (Corvallis, Oregon) · Mon, Jul 23, 1979 · Page 9
Printed on Jan 30, 2022

Well water east of Corvallis being checked for radiation

By Ronald J. Schleyer
Of The Gazette-Times

State radiation control officials have collected water samples from monitoring wells surrounding the Roche Road landfill east of Corvallis.

Five samples from water quality monitoring wells around the dump were taken July 13 in response to a request by Michael M. Randolph, public works director for Corvallis.

According to George Toombs, Portland-based supervisor of the state Health Division's environmental radiation surveillance program, there is no reason to anticipate elevated levels of radioactivity in the water.

According to an earlier report by Randolph to the City Council, the precautionary tests are to reassure citizens there is no danger from industrial waste dumped at Roche Road in August and September 1975.

Waste of unknown composition and quantity was buried at Roche Road by Valley Landfills Inc., of Corvallis, for Teledyne Wah Chang-Albany Corp. of Millersburg.

Similar waste buried at Coffin Butte landfill 10 miles northwest of Corvallis has produced measurably elevated surface levels of radioactivity but no significant radioactivity in area ground water, according to tests.

The radiation at Coffin Butte comes from radioactive radium particles mixed with tons of paper, metal, sand and other trash from Wah Chang.

State officials have said they think the radium is bound up in insoluble compounds and is not likely to migrate as ground water passes through the waste.

Surface-level radiation tests at Roche Road, requested by Randolph under a July 2 mandate from the City Council, revealed no elevated radiation in an area flagged by Valley Landfills as containing the four-year-old waste.

However, the waste is said to be overlain by 15 feet of dirt. Earth is an effective shield against radiation.

At the Health Division, Toombs said measurement of the Radium-226 content of the Roche Road water samples will not be complete for at least 20 days.

Meanwhile, he said, another series of tests is being done on new water samples collected July 13 from monitoring wells surrounding Coffin Butte.

In addition, Toombs said, the division is planning to sample domestic water wells near Coffin Butte later this year, possibly in September.

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7

—Radiation levels

(Continued from page 1)

jury" from fires and explosions at the site caused by pyrophoric (self-igniting) zirconium particles also mixed in with the trash at a section of the landfill, Owens noted.

"We have repeatedly asked for core sampling to find out what is there," Owens added.

Meanwhile, state Rep. Nancie Fadeley, D-Eugene, whose House Environment and Energy Committee called for the federal agency's water testing at Coffin Butte, said she is not satified.

Without core testing at Coffin Butte, there is no way to be certain that the buried waste is no threat to public safety, Fadeley said in a telephone interview this morning.

"When it (the radioactivity) does get out, it is not just Coffin Butte that we'll have to clean up, but everywhere it moves in the water supply," she said.

Although it might not include core testing, a study of radioactive waste disposal sites in Oregon required by Senate Bill 394 — now law — will include Coffin Butte, according to Fadeley, whose committee dealt with the bill.

"The (state) Health Division is to contract with an independent agency to find out what radioactive waste we have in the state," she said.

"The bill says the study must find out what is there (at Coffin Butte)."

In the Coffin Butte case, Wah Chang has to pay for the study, she added.

The Health Division has not yet let the contract for the SB 394 study, according to David Wagstaff of the Health Division.

School board plans to award contracts

The Corvallis School Board has scheduled a special meeting for Wednesday to award contracts for $300,000 in painting and roofing work on Corvallis elementary, intermediate and high schools.

The board, to meet at the district administration building, 1555 S.W. 35th St., at 12:30 p.m., will decide whether to accept, modify or reject the bid recommendations of its building and finance committee.

The scheduled bids have no connection with work planned by the school district to deal with the problem of flaking asbestos materials in some Corvallis schools, according to Fred Quale, assistant superintendent.

What did it find?

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Corvallis Gazette-Times (Corvallis, Oregon) · Thu, Sep 6, 1979 · Page 11
Printed on Jan 30, 2022

Landfill may be part of radioactivity study

By Ronald J. Schleyer
Of The Gazette-Times

The Coffin Butte landfill north of Corvallis soon may be on a list of radioactive waste disposal sites to be scrutinized for safety by a state-sponsored, independent investigator.

The Oregon Health Division plans to let a contract for the year-long study by Nov. 1, according to George Toombs, the division's health physicist in Portland.

About 20 query letters already have been sent to potential investigators, Toombs said, most of them out-of-state companies that might be interested in the project.

"It calls for an independent study of public health hazards associated with the storage of radioactive wastes," Toombs said in a telephone interview Wednesday afternoon.

The study of radioactive wastes, required under SB 394, which was passed by the 1979 Oregon Legislature, also would examine "what methods are available for disposal of such waste."

In a Gazette-Times interview July 31 the chairman of the House Committee on Environment and Energy, Rep. Nancie Fadeley, D-Eugene, said Coffin Butte will be among the sites studied.

However, on Wednesday Toombs said no list of potentially hazardous sites falling under the mandate of the bill yet exists.

He said he and Marshall Parrott, state radiation control manager for the Health Division, plan to meet with Fadeley Sept. 11 in Eugene to "define what the study should encompass" and "pin down what must be done."

Toombs said the U.S. Environmental Protection Agency's Seattle office also would be involved in the discussions of the study required by SB 394.

Between 1975 and mid-1978, according to a report to the Legislature by Gov. Vic Atiyeh, the privately owned Coffin Butte received an unknown quantity of radioactive industrial waste from Teledyne Wah Chang Albany Corp. of Millersburg.

In state-sponsored tests since — at the prodding of worried citizens in Polk and Benton counties — slightly elevated levels of radioactivity have been documented at the surface of the area of the landfill reserved for Wah Chang.

But state and federal tests for radioactivity in subsurface water adjacent to the butte have revealed no migration of radioactivity — now known to be some insoluble compound of Radium-226 — into well water.

Furthermore, Parrott and Kenneth Feigert, head of the federal environmental agency's waste management branch in Seattle, say it is sufficient to monitor well water in the area regularly to ensure public safety.

The officials, especially Parrott, have received calls from Fadeley and from Polk County's commissioners for drilling into the Wah Chang waste to assess its radioactive content.

Parrott has pointed out that the waste is not only radioactive but "pyrophoric" in nature — it can explode at when disturbed and could endanger the lives of core-drilling investigators.

Toombs said the Health Division's regular monitoring program will be expanded in October to include domestic water wells in the vicinity of Coffin Butte which lies in Benton County near the boundary of Polk County.

Polk County is concerned because subsurface water in the area is believed to flow north from the butte.

According to county planner Jim Owens, Polk County has received no answer to a late-July request to the Environmental Protection Agency that Coffin Butte be placed under federal jurisdiction as a hazardous waste site.

LBCC to be closed

The Linn-Benton Community College campus and its community centers will be closed Monday for the college's annual in-service meetings.

All campus business and student services offices will be closed from 8:30 a.m. to 4 p.m. The community education centers in Corvallis, Lebanon and Sweet Home will be closed all day.

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SB 394

Between 1975 and 1978 CB received an unknown quantity of radioactive industrial waste fr T/ Wah Chang

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another article says DEQ 1973 and mid 1977

4 Sections, 44 Pages CORVALLIS, OREGON FRIDAY, SEPTEMBER 14, 1979

State says landfill's wa

By Ronald J. Schleyer
Of The Gazette-Times

ADAIR VILLAGE — State officials say the Coffin Butte landfill north of Corvallis contains some of the same radioactive waste now routinely shipped to the Hanford Nuclear Reservation, but not enough to worry about.

The waste — technically called water-soluble radium chloride, containing long-lived radium-226 — came from Teledyne Wah Chang Albany Corp. of Millersburg in occasional truck loads between 1973 and mid-1977, say the officials.

By state order, radium chloride, a byproduct of Wah Chang's zirconiam production plant, is now carefully packaged and shipped to Hanford, Wash., according to Marshall Parrott, state radiation control manager.

Parrott and two other state officials reviewed the problem for the North Benton Citizens Advisor[illegible] Thursday night at the invitation of committee chairman Shirley Deardorff, of Soap Creek Valley.

Parrott told the small group at the Adair Clubhouse, the presence of small amounts of radium choride is not a "problem" in his view.

He said radiation measurements on the land surface and in shallow and deep wells show what little radioactivity there is at Coffin Butte is not going anywhere.

Nevertheless, the officials said, test wells around Coffin Butte will require quarterly monitoring and there should be no human habitation between the Butte and nearby Soap Creek for an indefinite time because of the potential for contamination of well water.

Parrott said the Health Division conferred with Coffin Butte's operators, Valley Landfills Inc. of Corvallis, and dumping as soon as it was discovered in May 1977.

However, information released in mid-June by Gov. Vic Atiyeh revealed that the Department of Environmental Quality — which supervises landfills — did not prohibit the dumping of other unidentified radioactive industrial waste from Wah Chang until March 1978.

To this day, Parrott said, the Health Division has been unable to compile a complete list of the kinds and amounts of radioactive materials buried at Coffin Butte.

And even though the presence of radium chloride has been confirmed, Parrott said, the division hasn't the faintest idea how much is there.

"But we know it can't be very much," Parrott said, because the amount shipped to Hanford — 5,500 tons — appears to equal the amount produced at the plant, so not much could have ended up at Coff-

In addition, the Wah [illegible] dumping zone at Coffi[illegible] only about 6,000 cubic [illegible] tle, said Parrott, to wa[illegible] of digging it up and sh[illegible]

The North Benton [illegible] tee, which exists to [illegible] commissioners on la[illegible] also heard from Geo[illegible] tion surveillance chi[illegible] Division, and William [illegible] the Water Resources [illegible]

Toombs reported [illegible] measurements of the [illegible] showed the particula[illegible] can produce a radiati[illegible] what comes from no[illegible] sources in the sky and[illegible]

However, he said, a[illegible] distribution of the wast[illegible] produces an elevated [illegible] only about three time[illegible] less than levels consid[illegible]

As for radium-226

‹ › Corvallis Gazette-Times › Fri, Sep 14, 1979 › Page: 1

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Printed on Jan 30, 2022

says landfill's waste no threat

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And even though the presence of radium chloride has been confirmed, Parrott said, the division hasn't the foggiest idea how much is there.

"But we know it can't be very much," Parrott said, because the amount shipped to Hanford — 3,300 tons — appears to equal the amount produced at the plant, so not much could have ended up at Coffin Butte.

In addition, the Wah Chang radioactive dumping zone at Coffin Butte occupies only about 6,000 cubic feet — far too little, said Parrott, to warrant the expense of digging it up and shipping it away.

The North Benton advisory commission, which exists to advise the county commissioners on land-use questions, also heard from George Toombs, radiation surveillance chief of the Health Division, and William Bartholomew, of the Water Resources Department.

Toombs reported that radiation measurements of the radium chloride showed the particular waste involved can produce a radiation dose 100 times what comes from normal background sources in the sky and earth.

However, he said, at Coffin Butte the distribution of the waste is scattered and produces an elevated radiation reading only about three times normal, but far less than levels considered dangerous.

As for radium-226 in underground water, a summary of measurements taken from test and domestic wells surrounding the butte show water there contains no more radium than water in the Willamette River at Buena Vista and in wells at Independence.

Indeed, said the officials, they have found radium-226 in water all around Oregon in amounts comparable to those found at Coffin Butte — in all cases less than a fifth of the maximum allowable under federal rules.

Rep. Mae Yih of Albany, who represents most of north Benton County, listened to the presentation and said she was fully satisfied with the state analysis.

"The numbers from the surface measurements show there is no problem, the numbers from the deep wells show there is no problem, so I think people should take what these men have to say and let their fears to rest," she said.

In a telephone interview this morning, Parrott said the Health Division will decide within 30 days whether to include Coffin Butte among about 30 radioactive waste sites to be studied under a measure passed by the Legislature this year.

Parrott said that if Coffin Butte is included, it probably will be studied only to check what the state and federal measurements have already discovered — that Coffin Butte is not a hazard to public health.

He said core sampling and other study methods which will be used in some of the sites would "cost a small fortune" at Coffin Butte because of the soil-spraying character of the Wah Chang waste.

The cost of the study will be paid by the company that created the waste — in this case Wah Chang — but Parrott said the state Emergency Board will have to authorize spending to get the study moving.

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Corvallis Gazette-Times (Corvallis, Oregon) · Fri, Sep 14, 1979 · Page 1

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State says landfill's waste no threat

By Ronald J. Schleyer
Of The Gazette-Times

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The waste — technically called water-soluble radium chloride, containing long-lived radium-226 — came from Teledyne Wah Chang Albany Corp. of Millersburg in occasional truck loads between 1971 and mid-1977, say the officials.

By state order, radium chloride, a byproduct of Wah Chang's zirconium production plant, is now carefully packaged and shipped to Hanford, Wash., according to Marshall Parrott, state radiation control manager.

Parrott and two other state officials reviewed the problem for the North Benton Citizens Advisory Committee Thursday night at the invitation of committee chairman Shirley Deardorff, of Soap Creek Valley.

Parrott told the small group at the Adair Clubhouse, the presence of small amounts of radium chloride is not a "problem" in his view.

He said radiation measurements on the land surface and in shallow and deep wells show what little radioactivity there is at Coffin Butte is not going anywhere.

Nevertheless, the officials said, test wells around Coffin Butte will require quarterly monitoring and there should be no human habitation between the Butte and nearby Soap Creek for an indefinite time because of the potential for contamination of well water.

Parrott said the Health Division contracted with Coffin Butte's operators, Valley Landfills Inc., of Corvallis, and ordered an end to the radium chloride dumping as soon as it was discovered in May 1977.

However, information released in mid-June by Gov. Vic Atiyeh revealed that the Department of Environmental Quality — which supervises landfills — did not prohibit the dumping of other unidentified radioactive industrial waste from Wah Chang until March 1978.

To this day, Parrott said, the Health Division has been unable to complete a complete list of the kinds and amounts of radioactive materials buried at Coffin Butte.

And even though the presence of radium chloride has been confirmed, Parrott said, the decision hasn't the faintest idea how much is there.

"But we know it can't be very much," Parrott said, because the amount shipped to Hanford — 3,500 tons — appears to equal the amount produced at the plant, so not much could have ended up at Coffin Butte.

In addition, the Wah Chang radioactive dumping zone at Coffin Butte occupies only about 4,000 cubic feet — far too little, said Parrott, to warrant the expense of digging it up and shipping it away.

The North Benton advisory committee, which exists to advise the county commissioners on land-use questions, also heard from George Toombs, radiation surveillance chief of the Health Division, and William Bartholomew, of the Water Resources Department.

Toombs reported that radiation measurements of the radium chloride showed the particular waste involved can produce a radiation dose 100 times what comes from normal background sources in the sky and earth.

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"The numbers from the surface (measurements) show there is no problem, the numbers from the deep wells show there is no problem, so I think people should take what these men have to say and lay their fears to rest," she said.

In a telephone interview this morning, Parrott said the Health Division will decide within 30 days whether to include Coffin Butte among about 10 radioactive waste sites to be studied under a measure passed by the Legislature this year.

Parrott said that if Coffin Butte is included, it probably will be studied only to check what the state and federal measurements have already discovered — that Coffin Butte is not a hazard to public health.

He said core sampling and other study methods which will be used in some of the sites would "cost a small fortune" at Coffin Butte because of the self-igniting character of the Wah Chang waste.

The cost of the study will be paid by the company that created the waste — in this case, Wah Chang — but Parrott said the state Emergency Board will have to authorize spending to get the study moving.

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10

State OKs probe of radioactivity in 18 dumps

By Ronald J. Schleyer
Of The Gazette-Times

The state Health Division is preparing to award a $100,000-plus contract for studying 18 radioactive waste locations in Oregon, including two sites near Corvallis — the Coffin Butte and Roche Road landfills.

"The study is to establish whether and to what extent such waste presents a hazard to the health and safety of the people," according to George Toombs, supervisor of the agency's environmental radiation program.

The study is in addition to a state Department of Environmental Quality safety review of abandoned sites of hazardous waste disposal operations. That review is being conducted in cooperation with the U.S. Environmental Protection Agency.

An announcement earlier this month by the state environmental department said the survey of 20 Oregon locations includes both Coffin Butte and Roche Road landfills. Results are scheduled for released early in 1980.

In a telephone interview from his Portland office this morning, Toombs said only Coffin Butte, about 10 miles north of Corvallis, and four other sites will be studied in detail by the Health Division.

The others, including Roche Road immediately east of Corvallis, will be "looked at to see if they merit further study," until December.

Previous state announcements have revealed that until about mid-1978, the privately operated Coffin Butte landfill was licensed to receive slightly radioactive waste from Teledyne Wah Chang Albany Corp. of Millersburg.

It has been further established that Wah Chang waste, some of it a soluble sand-like substance containing Radium-226, also was allowed into the Roche Road landfill for at least two months in 1975.

Both sites are operated by Valley Landfills Inc., a Corvallis firm.

Toombs said the new study, at a cost "to exceed" $100,000 paid by Teledyne and other waste producers, is scheduled to be completed in draft form by Nov. 15, 1980, for eventual submission to the 1981 Legislature.

Besides establishing whether the waste is a hazard, the study would determine what methods are available and appropriate for disposing of the waste if removal if found advisable.

State officials have repeatedly stated, to reporters and in public forums, that Wah Chang waste in Coffin Butte poses no hazard to the public and should not be moved because of its self-igniting properties.

There have been fires at Coffin Butte when heavy equipment has disturbed the zirconium-containing waste. Finely pulverized zirconium can explode and burn when disturbed.

A network of monitoring wells around Coffin Butte, monitored quarterly by the Health Division and the state Department of Environmental Quality, has revealed little migration of the Radium-226 into ground water.

Toombs said similar tests of ground water, collected from wells around the Roche Road landfill on July 12, have been completed and reveal "no detectable radium."

The Roche Road well water tests were requested by the Corvallis public works director, Michael M. Randolph, who was ordered by the City Council to investigate Roche Road after it was revealed that it received radioactive waste.

Toombs said the Health Division expects to award the study contract by Dec. 1.

?? Radium 226

Chem to life of Zirconium

Still monitoring for radium 226

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Printed on Jan 30, 2022

E-Board action on studies criticized

By Gerald J. Schleyer
Of The Gazette-Times

The state Health Division plans to report Dec. 21 on a legislatively mandated study of radioactive waste dumps in Oregon, following orders by the Emergency Board not to include two sites near Corvallis.

Earlier this month, the legislative Emergency Board reduced the scale of a $250,000 study suggested by the Health Division to comply with terms of a law passed by the 1979 Legislature at the urging of the House environment and energy committee.

In so doing, according to Larry Rocha of the division's radiation control section in Portland, the board forced the division to delete the two Corvallis sites due to lack of funds.

The interim House committee will not be pleased with the Health Division's decision, according to Nancie Fadeley, D-Eugene, the chairman of the committee.

Rocha said on Friday that only four major sites are left in the proposed study — now planned to cost $302,000 and to focus on two locations in Albany and two in Portland.

Rocha said a contract for the year-long study, to be done by a private contractor, is scheduled to be awarded by mid-December.

As late as last month, the proposed study included Coffin Butte and Roche Road landfills, located north and east of Corvallis, respectively.

Zirconium production waste from Teledyne Wah Chang Albany Corp. of Millersburg, containing radioactive radium-226, was dumped at the Corvallis sites at various times within the last five years, according to a report of a state investigation released by Gov. Vic Atiyeh earlier this year.

Rocha said members of a committee of the Emergency Board clearly questioned the division representative on the need for further study of the privately operated Coffin Butte and Roche Road landfills.

He said the committee was told that water from test wells adjacent to both sites had been sampled and tested for radium-226 that could move into groundwater — with negative results.

The monitoring at Coffin Butte, about 10 miles north of Corvallis, is continuing quarterly, according to the Health Division.

At Roche Road, immediately east of Corvallis, the division found "no detectible" radioactivity in the samples, Rocha said.

At Coffin Butte, the measurable levels found were within — and in some cases below — the natural range of radium-226 generally found in Oregon water supplies.

Fadeley, chairman of the House environment and energy interim committee, said Friday that the seven-member committee still strongly favors including Coffin Butte in the Health Division study.

"The legislature was clear that Coffin Butte was to be included in the study," she said.

"The legislature still calls for a study at Coffin Butte," she said. "If this study as authorized doesn't do it, we'll have to go at it again."

In response, Fadeley said, the committee might suggest to the Emergency Board that it consider providing more money for the study of Coffin Butte — estimated by Rocha to be another $50,000.

Noting that the law provides that Wah Chang pay for the parts of the study involving its waste, Fadeley said Wah Chang is resisting having Coffin Butte included in the study.

Rocha confirmed that the division is anxious to keep costs low because the industries involved have warned that the law's provision requiring that they pay for the study is unenforceable.

The dropping of the Corvallis sites from the study [illegible] radioactive dumps [illegible] still leaves Coffin Butte, Roche Road among [illegible] "hazardous-waste disposal operations" now being [illegible] by the Department of Environmental Quality.

Results of the environmental department's study scheduled for release next year.

The Emergency Board's decision legislative financial [illegible] ers whose the Legislature [illegible] in session.

For $2 million, they'll name it after you

OSU needs money for buildin

The Oregon State University Foundation has appealed to [illegible] announcement this month from [illegible] Y. B. Giustina, foundation [illegible] Donors will be recognized in the order in which their contributions were received, [illegible] the cluster dressing rooms, according to the pledge [illegible] the building possible.

"This Hall of Honor w[illegible] permanent part of the C[illegible]

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CB + RP initially included in study (radioactive waste dumps in OR)
$ funded by T/WA, ult. concluded unenforceable

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Corvallis Gazette-Times (Corvallis, Oregon) · Wed, Dec 26, 1979 · Page 9
Printed on Jan 30, 2022

Legislator to ready bill for probe of Coffin Butte

By Ronald J. Schleyer
Of The Gazette-Times

Legislation will be geared first the 1981 Legislature to force reluctant Oregon officials to investigate the allegedly radioactive Coffin Butte landfill northeast of Corvallis or angry state representative says.

"We will prepare legislation . . . to make it clear that we're not to find out what is in there," said Rep. Maurice Fadeley, D-Eugene, chairman of the House environment and energy interim committee.

In addition, Fadeley said he will ask the U.S. Environmental Protection Agency to test Coffin Butte to determine its contents as soon as the federal agency has the manpower to do so.

Fadeley made the statements today following a report last week to her committee by the state Health Division on an independent study of radioactive waste which originally was scheduled to examine Coffin Butte.

The decision this fall ordered state Emergency Board backing to drop Coffin Butte from the radioactive waste dump study mandated by the 1979 Legislature and promoted by Fadeley's committee. The Emergency Board — made up of 11 legislators — makes state spending decisions between legislative sessions.

During 1978, both the federal environmental agency and state officials collected water from monitoring wells surrounding the butte's privately operated landfill, where an unknown amount of radium-226 was dumped during the mid-1950s.

No illegal pollution of groundwater by radium was found, officials reported.

The waste, a byproduct of uranium production, was buried by Valley Landfills Inc. of Corvallis for Teledyne Wah Chang Albany Corp. of Millersburg.

Although state officials have said they don't know exactly how much radioactive material is buried at the butte (some material also went to Rustler Road landfill east of Corvallis), they have said it is too dangerous to find out because of an additional ingredient in the waste: explosive zirconium particles.

Officials including Marshall Parrott, Oregon's radiation control manager in Portland, have said repeatedly that monitoring the groundwater is sufficient to protect public health.

They have said it is too dangerous to dig up the Wah Chang waste in drilling into the now-buried pits to sample their contents. There have been fires and explosions at the butte.

"They said just keep testing (the well water) till you'll know when it gets into the environment," Fadeley said. "But then it would be too late."

Fadeley said she was flabbergasted by the argument made late last week to her committee by the Health Division representative who said there is no place for Coffin Butte in the radioactive waste study.

"The idea was that because it's got more than just one kind of hazardous waste . . . it shouldn't be covered by a bill that applies to radioactivity only," Fadeley said.

"We will be more specific" in the bill the committee will draft for the next Legislature, Fadeley vowed.

"We must find out what is in that place (Coffin Butte), and if it poses a threat to the health and safety of those who live around it, we must get it out," she said.

Fadeley said the reasons for disregarding Coffin Butte are partly political, partly fiscal and partly a matter of scientific disagreement on the best approach to public safety.

Health Division officials "do have one good point though — as long as we have the explosive stuff as well as Coffin Butte — it's a real Mulligan stew — it will be extremely dangerous to investigate," she said.

"The moral of all that seems to be, if you are a polluter, make the stuff dangerous so nobody can find out what you have."

She said she sympathizes with the reluctance of Oregon officials, who do not, she admitted, have the money to study Coffin Butte safely.

But she noted that the study they was to include Coffin Butte provided for an independent investigation by a qualified contractor with full credit to be reimbursed by Wah Chang.

"The EPA is really more interested in hazardous wastes like Love Canal," Fadeley said, referring to an update New York case in which non-radioactive chemical wastes were buried and then caused health problems for residents of homes built in the area.

"But they are going to find out that low-level radioactive waste may be even more dangerous in the long run," she continued.

"It stands up on you," Fadeley said.

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Testimony

LU-24-027 Testimony - May 8th

Kevin Kenaga
37461 Soap Creek Rd.
North Benton County
Corvallis, Oregon 97330

DATE RECEIVED: 5/8/25 #63
FROM: Kevin Kenaga
PHONE OR EMAIL: kjkenaga@gmail.com

Good evening Chair Fowler and members of the planning commission.
Thank you for your volunteer service.

I oppose LU-24-027 under BCC 53.205 and 53.215 due to the increasing changes to the character of the area and the increasing undue burden placed on Benton County and Planet Earth largely due to Republic Services mismanagement.

I planned to give you handouts but I was told that I could not.

Deck 1 images show the landfills exposed area for the 7 days that satellite data are available for the last five years, so of 7 images, Republic Services was out of compliance on 6 of the 7 days available for an 86% noncompliance rate.

By exceeding the agreed upon exposed area Republic Services can take in more trash because they have a larger working area for the tippers and trucks to dump trash. This larger exposed area releases more methane, odors and toxins into our environment.

Methane Oxidation in landfills is a natural process where methane gas, a byproduct of decomposition, is converted into carbon dioxide and water by bacteria within landfill cover soil.
That is if soil is used as a daily cover. Federal rules require 6" of soil as daily cover but Oregon DEQ has issued Republic Services an alternative daily cover permit which is why we see tarps in the photos. Tarps do not trigger methane oxidation yet DEQ issued this permit. By operating under this permit Republic Services is putting an additional undue burden on Benton County and Planet Earth.

Deck 2
photo 1) shows birds scavenging on the landfills exposed area, birds that later go off and do crop damage which is documented in others testimony. Please consider this photo when reading the Mid Valley Bird Alliance testimony and in considering Republic Services Wildlife consultant's report.
photo 2) shows tarps as an alternative daily cover on only 1/2 the exposed area
photo 3) shows alternative daily cover completely lacking on the exposed area
photo 4) shows the newly installed enclosed flare billowing smoke.

Concerns also extend to the use of Covanta/Reworld incinerator ash that had previously been used as Alternative Daily cover. The 2024 publication in the journal, Environmental Monitoring and Assessment, was submitted in written testimony. It documents signature heavy metal contaminants found in the moss around the Covanta/Reworld incinerator. The researchers are working towards the publication of the companion study focused on Coffin Butte Landfill expected out sometime this year.

Benton County Talks Trash found that there has never ever been any enforcement of prior conditions of approval at Coffin Butte Landfill, you also heard Petra Schuetz state that Benton County does not have the staff to enforce conditions of approval . So any conditions of approval, just as in the past, would mean nothing. The situation with Oregon DEQ is very similar. DEQ does one annual inspection at Coffin Butte Landfill. DEQ makes an appointment to visit the Landfill. Republic Services gets the dump all cleaned up for the inspection. These inspections are like realtor open houses.

Having called DEQ several times over the years I have never been able to get them to make an unannounced site visit. On one occasion I sent numerous photos covering a period of several months showing that daily cover and/or alternative daily cover was minimal or nonexistent. DEQ then received one photo from Republic Services showing that daily cover had been applied on one, yes, just one day. DEQ then considered the case closed without any penalty imposed. So much for any DEQ enforcement.

Deck 3
photo 1) Rohner family on their farm on the south slope of Coffin Butte pre 1945.
photo 2) Coffin Butte distant view circa 1900
photo 3) Coffin Butte annual tonnage in millions of tons

Republic Services could quickly double the life expectancy of the existing landfill, yes double, by simply returning to pre 2017 annual tonnage. But no this corporation is putting profits over people and Planet Earth. If Republic Services did reduce the annual tonnage they would lessen the change to the character of the area and would also be reducing the existing undue burden on Benton County. Having one blighted slope has already changed the character of the area. And now with this expansion application Republic Services is asking to blight yet another slope which would further degrade the character of the Soap Creek Valley area while continuing to place an undue burden on Benton County and Planet Earth. This is an unacceptable request.

Prior to Republic Services ownership of the Coffin Butte Landfill an expansion application was proposed in the 1980s and was shot down by Benton County residents. An expansion application submitted in the 1990s was denied. Then under the ownership of Republic Services an application was submitted in 2021 and in 2022 that application was unanimously denied by the Benton County planning commission. These landfill expansion applications have become a generational issue and we need to make sure that future generations don't have to go through this undue burden. This application and the 2021 application have put an undue burden on Benton County, Benton County staff, (where there appears to be a complete turnover in the Planning Department largely due to the 2021 application) and also on the residents of Benton County.

Comparing Republic Services expansion application to a landlord tenant agreement or maybe more likely for all of us ,to the experience of an overnight houseguest, one that you wouldn't invite back.

How did we get here?

I find it more than troubling that our County Council has never taken any action to enforce any, not even one, of the past conditions of approval. Non enforcement of all previous conditions of approval is documented in Benton County Talks Trash in which County Council participated and acknowledged. County Counsel has the legal right to enforce Conditions of Approval and has chosen not to act.

Lastly with all the health concerns associated with landfills. it is very disturbing that our Benton County health department has been allowed to decline from making any testimony. How can this be when landfills are known to create an undue burden on our health and our environment?

Republic Services has not been a good tenant nor have they been a good neighbor, yet here they are asking "to stay for 6 more years".

I ask you our planning commission to deny this expansion application.

I thank you for the time to give oral testimony.

Deck 1

VLI DAILY WORK AREA OF EXPOSED REFUSE

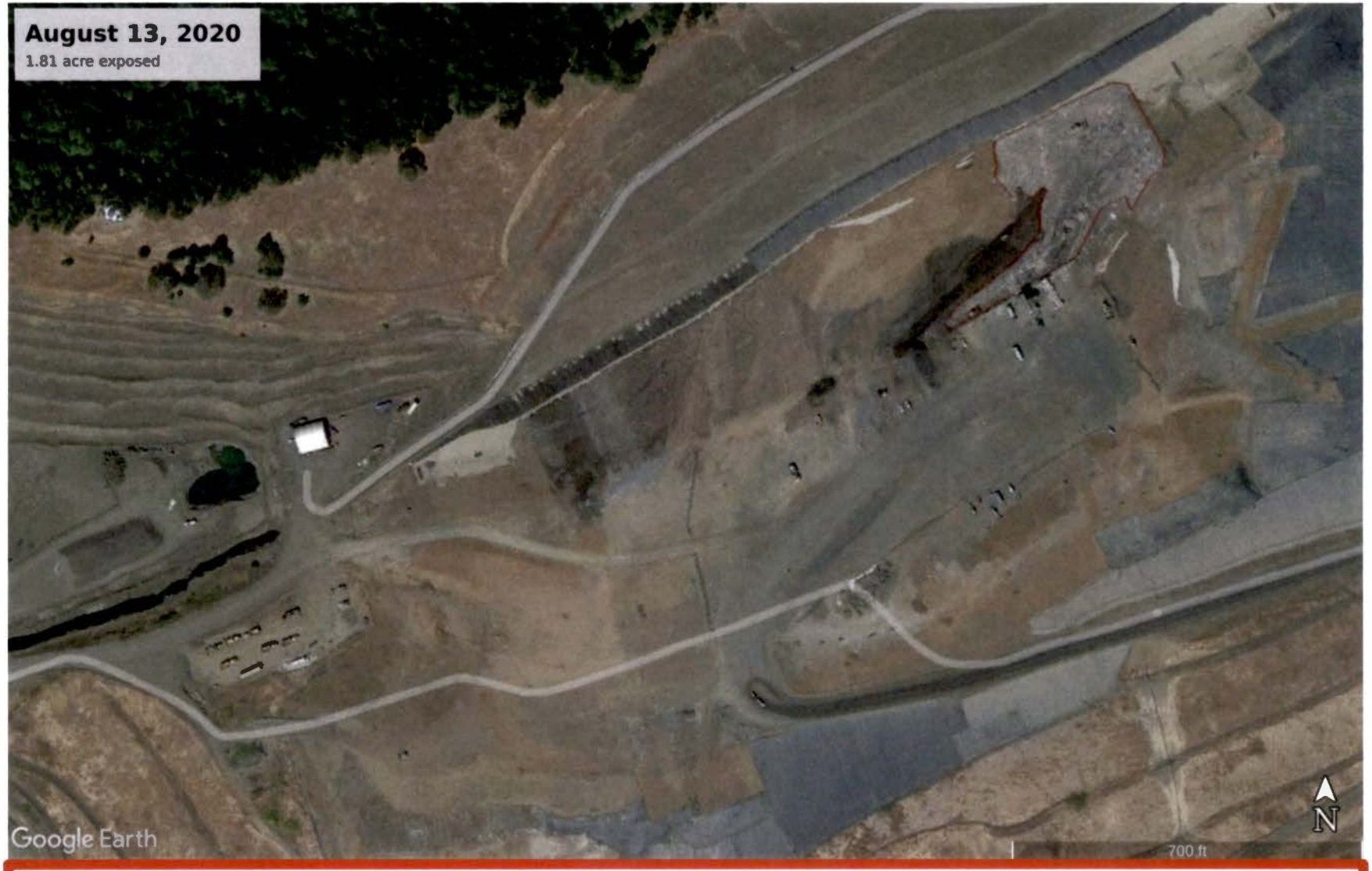
These 7 images show the situation for all of the dates in the past 5 years for which Google Earth has satellite images available.

2020-08-13 1.81 acres exposed (out of compliance)
2022-06-22 1.23 acres exposed (out of compliance)
2022-07-14 2.1 acres exposed (out of compliance)
2023-04-29 1.00 acre exposed (in compliance)
2024-04-19 2.59 acres exposed (out of compliance)
2024-07-02 1.04 acres exposed (out of compliance)
2025-03-26 2.26 acres exposed (out of compliance)

Compliance area based on from BCTT p. 792:

"The current (and future) permit addresses requiring daily compaction of refuse and require exposed refuse areas to not exceed 2 acres during the periods of October 15 to June 1 and to not exceed ¾ of an acre during all other periods. This shall be adhere to."

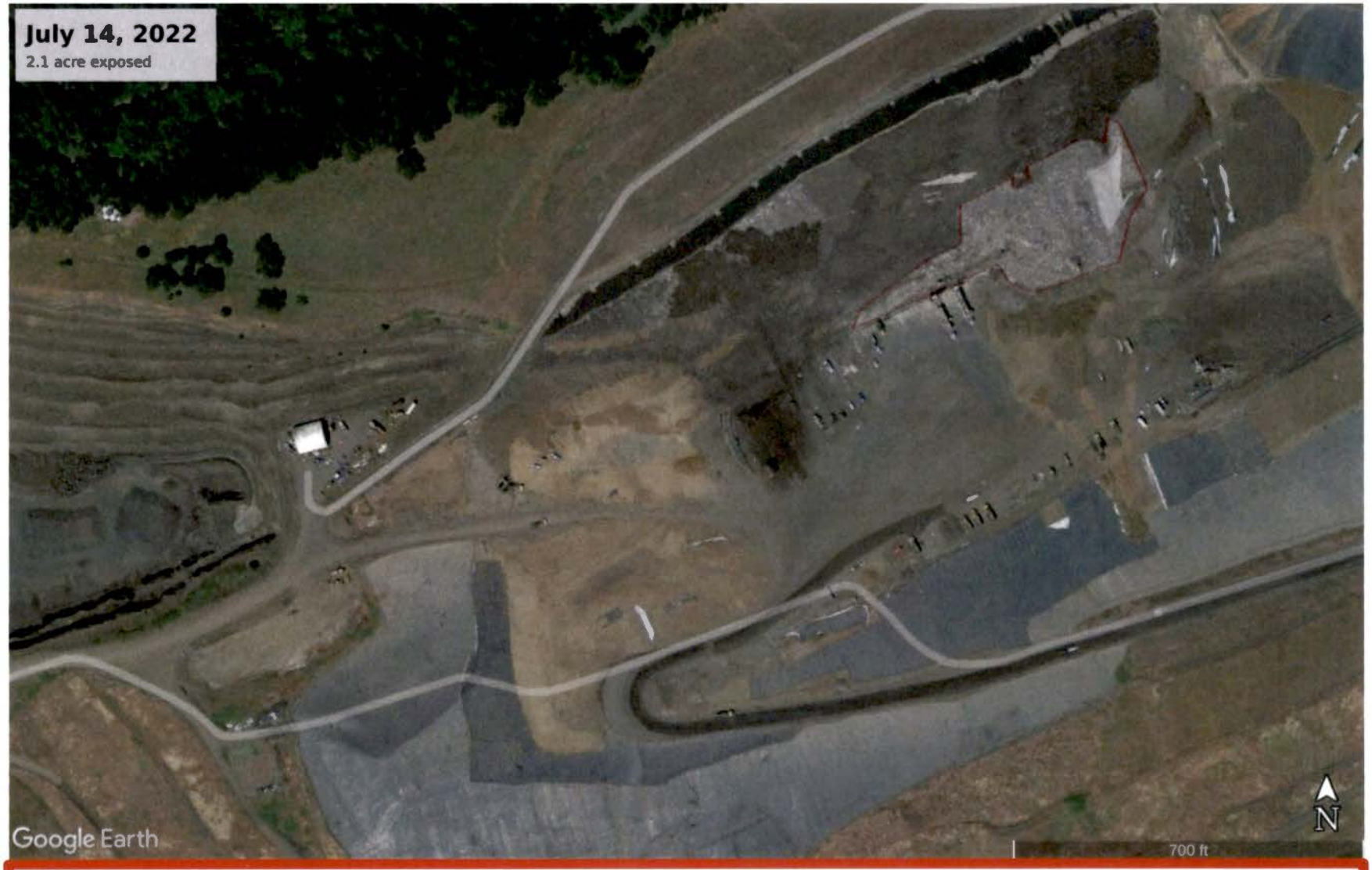
Out of 7 days for which satellite data are available from the past 5 years, VLI was out of compliance on 6 out of 7 for an 86% noncompliance rate.



Out of Compliance: 1.81 acres exposed. Maximum ¾ acre allowed during this period.



Out of Compliance: 1.23 acres exposed. Maximum ¾ acre allowed during this period.



Out of Compliance: 2.1 acres exposed. Maximum ¾ acre allowed during this period.



In Compliance: 1.0 acre exposed. Maximum 2 acres allowed during this period.



Out of Compliance: 2.59 acres exposed. Maximum 2 acres allowed during this period



Out of Compliance: 1.04 acres exposed. Maximum ¾ acre allowed during this period



Out of Compliance: 2.26 acre exposed. Maximum 2 acres allowed during this period.

Deck 2



When viewing this photo consider the Mid-Valley Bird Alliance testimony regarding the undue burden the landfill creates on wildlife. Also consider the testimony of Republic Services wildlife consultant on how the concentration of eagles preyed on the Great Blue Heron rookery. CORRECTION: Date should be 01/22/2023.



Alternative Daily Cover lacking on over half of the working face.

CORRECTION: Date should be 01/15/2023



Alternative Daily Cover completely lacking on the working face.

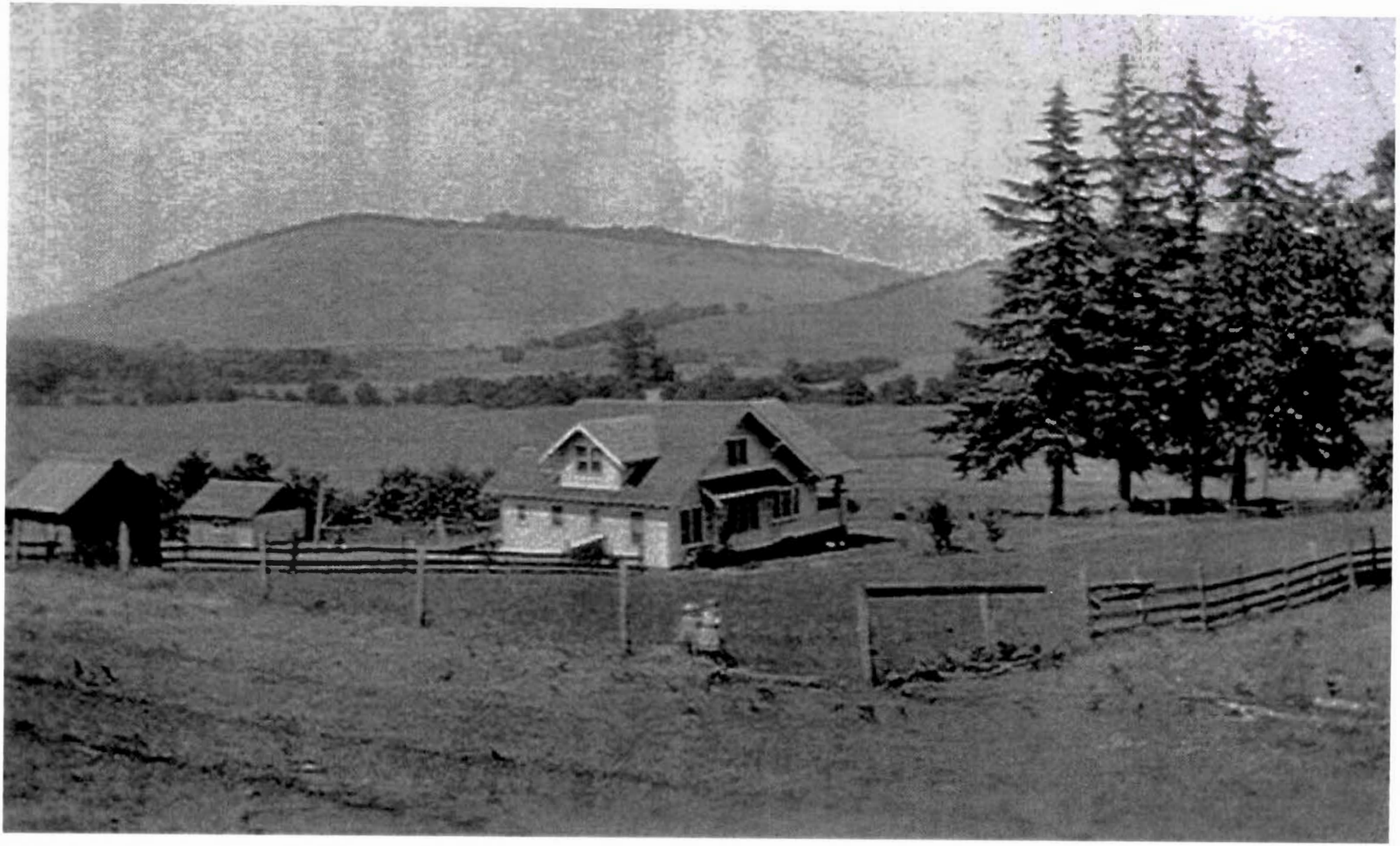
CORRECTION: Date should be 12/25/2022.

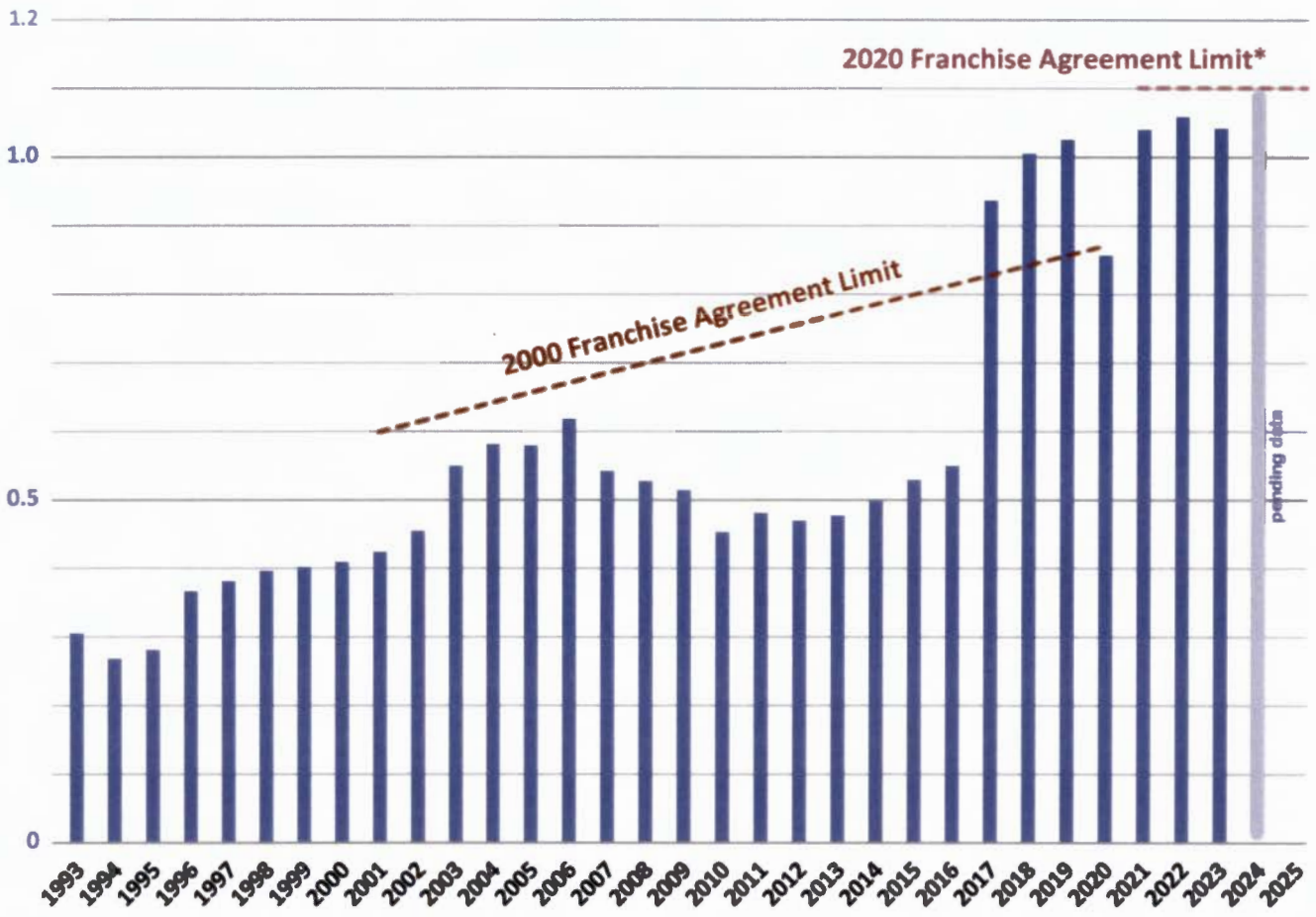


The newly installed enclosed flare at Coffin Butte Landfill power generation facility

Deck3







COFFIN BUTTE LANDFILL ANNUAL INTAKE VOLUMES IN MILLIONS OF TONS

* limit is waived if landfill is expanded

Oral testimony Dr. Shelley Su May 6, 2025 (#6)
References attached as requested by BCPC

Three Minute Oral Testimony – Benton County Landfill

To the Benton County Planning Commission
May 6, 2025

DATE RECEIVED: 5/8/2025
FROM: Shelley Su
PHONE OR EMAIL: 541-619-8412

Greg Warburton has ceded his time to me.

Mr. Chairman, members of the Planning Commission, attendees:

My name is Dr. Shelley Su. I am a PhD toxicologist, a former EPA employee, a former OSU faculty member, and a long-time cancer researcher. I am qualified to speak about the dangers the landfill poses to our community and to our environment.

Last Thursday as I sat through the testimony given by Republic Services in their efforts to secure a conditional use permit, I noted several omissions and inaccuracies presented to the Planning Commision and the public which I thought should be addressed.

For example, Republic Services has not performed to the standards of our community with respect to Benton County's long-standing commitment to worker safety. Last year union workers at the landfill were forced to go on strike due to lack of attention to workplace hazards, such as chronic respiratory exposures, improper safety training and other issues. Last year the company gave annual raises to all their non-union employees, but **NOT** to the union workers, and the company is under investigation by the National Labor Relations Board.

Republic Services has not been transparent in reporting methane emissions from the Coffin Butte, and is currently under investigation by the EPA. The EPA encountered a lack of cooperation in measuring methane leaks at the site. Last Thursday evening Republic Services was still presenting incorrect information about methane leaks. They testified that explosions are not a concern because none of the methane emission reach concentrations requisite for explosive conditions. **This is simply not true**. The EPA has documented emission plumes that **exceeded 100,000 ppm** air concentrations at CBL, which would produce profound explosive events if an ignition source were present (1).

In fact, methane emissions from CBL are so high the EPA has now designated the landfill as a "super-emitter", a term used to describe the worst of the worst of heavy industrial polluters. (And speaking of methane, I was amused to hear a Republic Services representative say last Thursday that methane gas is **HEAVIER** than air, when in fact, it is **LIGHTER** than air. If methane was heavier than air, we wouldn't have to worry about it getting into our upper atmosphere and creating havoc). **But whatever!** I will move on.

Coffin Butte Landfill stinks, and while methane is, in fact, **odorless**, that smell you are detecting is probably hydrogen sulfide gases. Republic Services did

not seem too concerned about hydrogen sulfide gases, but there is substantial and alarming data linking hydrogen sulfide exposure to lung cancer (2).

In addition, during the discussions regarding PFAS chemicals in leachate, chemical that are notorious endocrine disruptors and carcinogens, I heard no mention of the fact that they can also be expelled in **landfill** gas emissions. These emitted PFAS "burps" can be highly toxic when inhaled and can be transported long distances. Recent studies by the Florida Department of Environmental Protection and other agencies now suggest that the levels of PFAS leaving landfills through gas emissions could be similar to, or even greater than, the amount leaving the landfill through leachates. Again, I did not hear any mention of this by Republic Services (3).

The landfill is nearing the end of its lifetime, and granting Republic Services an expansion provides only a temporary Band-Aid on the myriad of environmental problems, and does nothing to address the long-term future problems facing Benton County with respect to their waste disposal needs.

I think it important to point out also that granting an expansion of the landfill is in **DIRECT OPPOSITION** to the Mission Statements and objectives guiding the operations of our county government. Benton County has a long history of commitment to Economic and Environmental Sustainability. Benton

County has a Climate Action Plan, to reduce carbon emissions from all county operations and to be a net-zero carbon emitter by the year 2050." It is laughable to suggest that buying a few electric busses and replacing some cars and trucks with hybrid vehicles will make a dent in the county's greenhouse emissions when more than 1,000 tons of methane gas is leaking annually from the county landfill. Benton County's website proclaims that the county government's primary purpose is to "protect and improve the health of individuals and our community" to "secure healthy and prosperous communities now and for the future," and that they are committed to a "vibrant, livable community with access to a "high quality environment for all". **These are all good things. This is what our government is supposed to do!!! Let us hope these are not just empty words.**

I encourage Benton County to live up to their mission statements and other programs promising this commitment to the health and well-being of the citizens of this county and the environment. Granting an expansion to Republic Services is in serious misalignment with those stated priorities and responsibilities. A responsible government would:

a) Decline Republic Services' request for an extension, and
b) focus on the work of securing a new landfill site to meet Benton County's future landfill needs.

Thank you for your time.

References:

1) Wilk, Nathan. EPA Inspection Uncovered Methane Leaks at Benton County Landfill. *KLCC News.* Jan. 17, 2025

2) Yang, Yi-Lun, *et al.* (2022) A Review: The Role of Hydrogen Sulfide in the Development and Progression of Lung Cancer. *Molecules, 2022, pp. 1-18.* https://doi.org/10.3390/molecules27249005

3. 3) Lin, Ashley M., *et al.* Landfill Gas: A Major Pathway for Neutral Per-and and Polyfluoroalkyl Substance (PFAS) Release. *Environmental Science and Technology Letters, Vol. 11, No. 7, (2024)* Copyright 2024 American Chemical Society.

Ref #1

EPA inspection uncovered methane leaks at Benton County landfill

KLCC News | By Nathan Wilk
Published January 17, 2025 at 3:57 PM PST

An EPA inspection last summer found dozens of methane leaks at the Coffin Butte landfill in Benton County.

The site accepts more than 1 million tons of garbage annually. It's located about eight miles north of Corvallis, near the town of Adair Village. Residents living there have shared concerns about odor and fire hazards.

EPA inspectors did a partial walk-through of the site on June 21. This month, the environmental watchdog group Industrious Labs obtained the report through a public records request.

During their visit, inspectors noted tearing in Coffin Butte's covering, and plants growing through the tarp. They recorded 41 places where methane emissions exceeded the legal maximum of 500 parts-per-million.

In one area, a gas extraction well was missing its cap, and yielded a methane reading of more than 100,000 parts-per-million. Methane is explosive at around half that concentration, according to the NOAA.

"That is an enormous oversight," said Mason Leavitt, a Data Analytics Specialist with Beyond Toxics, a Eugene-based nonprofit that's been monitoring the situation at Coffin Butte. "At landfills, there are a variety of sources that can start fires, including lithium batteries, operating equipment, and the flare."

In an email to KLCC, Melissa Quillard—a spokesperson for Republic Services, which owns and operates the landfill—said the company shares the community's concern about methane emissions.

Following the inspection, she said the landfill's ownership has taken steps to address the EPA's findings: patching tears, upgrading its flare, and expanding the gas control and collection system.

However, Mark Yeager—who lives about five miles from the landfill—said conditions for neighbors haven't improved since last summer. He said acrid odors still carry as far as northern Corvallis, and sometimes for multiple days in a row.

Methane itself is odorless, but not all of the gasses produced in a landfill are.

“There are so many aspects of the landfill operations that need to change, and that's not going to come from Republic just deciding they want to do a better job," said Yeager. "There's going to need to be some degree of enforcement.”

Quillard said the EPA has not notified Republic Services of any impending enforcement action.

"Coffin Butte Landfill provides essential waste disposal services to the community and is highly engineered with multiple safety measures in place," she said. "The landfill meets or exceeds all regulatory requirements."

Application to Expand

Meanwhile, Republic Services is looking to expand the Coffin Butte landfill. On Jan.15, Benton County received additional documents as part of the company's application.

If staff determine the application to be complete, they will schedule a public comment period and a hearing with the Benton County Planning Commission. The county estimates that this application process will be complete in June of this year.

At the same time, the state has paused work on Republic Services' air quality permit process until it gets additional documents. The permit was last renewed in 2009, and expired in 2014—but has received administrative extensions since then.

molecules

Ref #2

MDPI

Review

The Role of Hydrogen Sulfide in the Development and Progression of Lung Cancer

Yi-Lun Yang [1,2], Ka Zhang [3], Ze-Tao Zhou [3], Zhi-Liang Jiang [1,3], Yi Liu [2], Yan-Xia Zhang [1], Zhi-Hui Liu [4,*], Xin-Ying Ji [1,5,6,*] and Dong-Dong Wu [1,2,*]

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Abstract: Lung cancer is one of the 10 most common cancers in the world, which seriously affects the normal life and health of patients. According to the investigation report, the 3-year survival rate of patients with lung cancer is less than 20%. Heredity, the environment, and long-term smoking or secondhand smoke greatly promote the development and progress of the disease. The mechanisms of action of the occurrence and development of lung cancer have not been fully clarified. As a new type of gas signal molecule, hydrogen sulfide (H_2S) has received great attention for its physiological and pathological roles in mammalian cells. It has been found that H_2S is widely involved in the regulation of the respiratory system and digestive system, and plays an important role in the occurrence and development of lung cancer. H_2S has the characteristics of dissolving in water and passing through the cell membrane, and is widely expressed in body tissues, which determines the possibility of its participation in the occurrence of lung cancer. Both endogenous and exogenous H_2S may be involved in the inhibition of lung cancer cells by regulating mitochondrial energy metabolism, mitochondrial DNA integrity, and phosphoinositide 3-kinase/protein kinase B co-pathway hypoxia-inducible factor-1α (HIF-1α). This article reviews and discusses the molecular mechanism of H_2S in the development of lung cancer, and provides novel insights for the prevention and targeted therapy of lung cancer.

Keywords: hydrogen sulfide; lung cancer; signaling pathway; molecular mechanism

check for updates

Citation: Yang, Y.-L.; Zhang, K.; Zhou, Z.-T.; Jiang, Z.-L.; Liu, Y.; Zhang, Y.-X.; Liu, Z.-H.; Ji, X.-Y.; Wu, D.-D. The Role of Hydrogen Sulfide in the Development and Progression of Lung Cancer. *Molecules* **2022**, *27*, 9005. https://doi.org/10.3390/molecules27249005

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1. Introduction

Lung cancer is a common malignant tumor that seriously threatens human life and health [1]. Its morbidity and mortality are at the top of the list in most countries [2]. As the early clinical symptoms of lung cancer are not obvious, most of the patients are diagnosed with a serious condition. According to the pathological classification, lung cancer can be divided into small-cell lung cancer (SCLC) and non-small-cell lung cancer (NSCLC). SCLC is the most malignant type of lung cancer, with an incidence of about 15–20%. NSCLC is mainly divided into squamous cell carcinoma, adenocarcinoma and large cell carcinoma, with an incidence about 80–85% [3–5]. At present, the main strategies for the treatment of lung cancer are surgery combined with radiotherapy and chemotherapy; however, the side effects are obvious. Therefore, it is urgent to develop novel methods for the treatment of lung cancer.

H_2S is a new type of gas signal molecule after nitric oxide (NO) and carbon monoxide (CO) [6], and it is a colorless, flammable, and water-soluble gas with a rotten egg smell [7–9].

H_2S is mainly produced by cystathionine β-synthase (CBS) and cystathionine γ-lyase (CSE) [10–12]. The third enzyme, 3-mercaptopyruvate sulfurtransferase (3-MST), can also generate endogenous H_2S in the presence of a reductant using 3-mercaptopyruvate (3-MP) as substrate [13,14]. In addition, tobacco cigarette smoke, industrial gases, NaHS, GYY4137, AP39, etc., may produce exogenous H_2S. H_2S is reported to be involved in the development of many diseases [15] and it has both pro-apoptotic and anti-apoptotic effects in cultured cells [16,17]. H_2S can participate in the occurrence and development of tumors through the mitogen-activated protein kinase-extracellular signal-regulated kinase (MAPK-ERK1/2) pathway, endoplasmic reticulum stress, and ion channels [18,19]. H_2S has been shown to be involved in the occurrence and development of lung cancer [20]. In this article, the mechanism, therapeutic potential, and some unsolved problems of H_2S and hydrogen sulfide donors in lung cancer are reviewed and discussed.

2. Synthesis and Metabolism of H_2S in Lung Cancer

2.1. CSE

H_2S is mainly produced by CBS and CSE [10–12]. The third enzyme, 3-MST, can also promote the production of endogenous H_2S from 3-MP in the presence of reducing agents [13,14]. 3-MST exists in both mitochondria and cytoplasm, while CBS and CSE mainly exist in the cytoplasm [21]. Analysis of NSCLC biopsies and adjacent non-tumor tissues showed selectively high levels of endogenous H_2S-producing enzymes, namely CBS, CSE, and 3-MST [22,23].

CSE is a homo-tetramer composed of pyridoxal 5′-phosphate (PLP)-bound 45 kDa subunits, and is the second enzyme to form H_2S in the transsulfuration pathway. CSE mainly decomposes cysteine, a byproduct of CBS, into cysteine, α-ketobutyrate, and ammonia. Like CBS, CSE can also decompose cysteine and produce H_2S (Figure 1). The PLP-CSE interaction is required for enzymic activity [23]. Hypoxia is a typical feature of solid tumors, including NSCLC [24]. CSE activity is a key driver of the transsulfuration pathway, cysteine catabolism, and H_2S production. Tumor angiogenesis is induced by H_2S mediated via hypoxia. H_2S can increase the ability of endothelial cell invasion and duct formation [22]. H_2S also plays a protective role in tumor-induced oxidative stress [25].

The typical role of CSE in the transsulfuration pathway is to cleave cysteine to form cysteine, ammonia, and α-ketobutyrate. Different from CBS, only homocysteine is used as the substrate of CSE in the formation of H_2S [14]. Due to the low specificity of the CSE substrate, cystathionine, cysteine, and homocysteine can be regulated in the same binding capsule, where they compete with PLP to form Schiff base, while CBS has no binding site for PLP; therefore, H_2S produced by CSE is more sensitive to homocysteine [12].

The protein and mRNA levels of CSE in tumor tissues are higher than in adjacent tissues. Compared with the corresponding levels in normal lung epithelial cell line BEAS-2B, NSCLC cell lines (A549 and 95D) showed the selective up-regulation of protein and mRNA expression of all three H_2S-producing enzymes. It can be concluded that NSCLC cells selectively over-express CSE, thus inducing H_2S production and promoting cell proliferation, migration, and invasion [22]. However, some studies have shown that compared with CBS, the clinical correlation between the expression of CSE in tumors and the prognosis of patients is not significant. There is no difference in clinical outcomes between high and low CSE expression in most cancers [26].

2.2. CBS

CBS is a homologous tetrameric enzyme with about 63 kDa subunits, which binds to two cofactors, PLP and heme [27]. The first and committed step in the transsulfuration pathway of the catalytic conversion of H_2S by CBS is to use homocysteine instead of serine to form cystathionine and water. When the substrate is cysteine instead of serine, the products of the reaction are cysteine and H_2S. CBS also catalyzes other reactions of cysteine to H_2S [14]. Through the gene knockout experiment, it can be concluded that CSE is necessary for the synthesis of cysteine through sulfur transfer, and its gene destruction

deprives CBS of one of the substrates needed to produce H_2S. Thus, the disruption of CSE genes affects CSE- and CBS-dependent H_2S synthesis and reduces H_2S production. In contrast, disruption of the CBS gene results in the accumulation of homocysteine, a substrate for H_2S production by CSE [10,14].

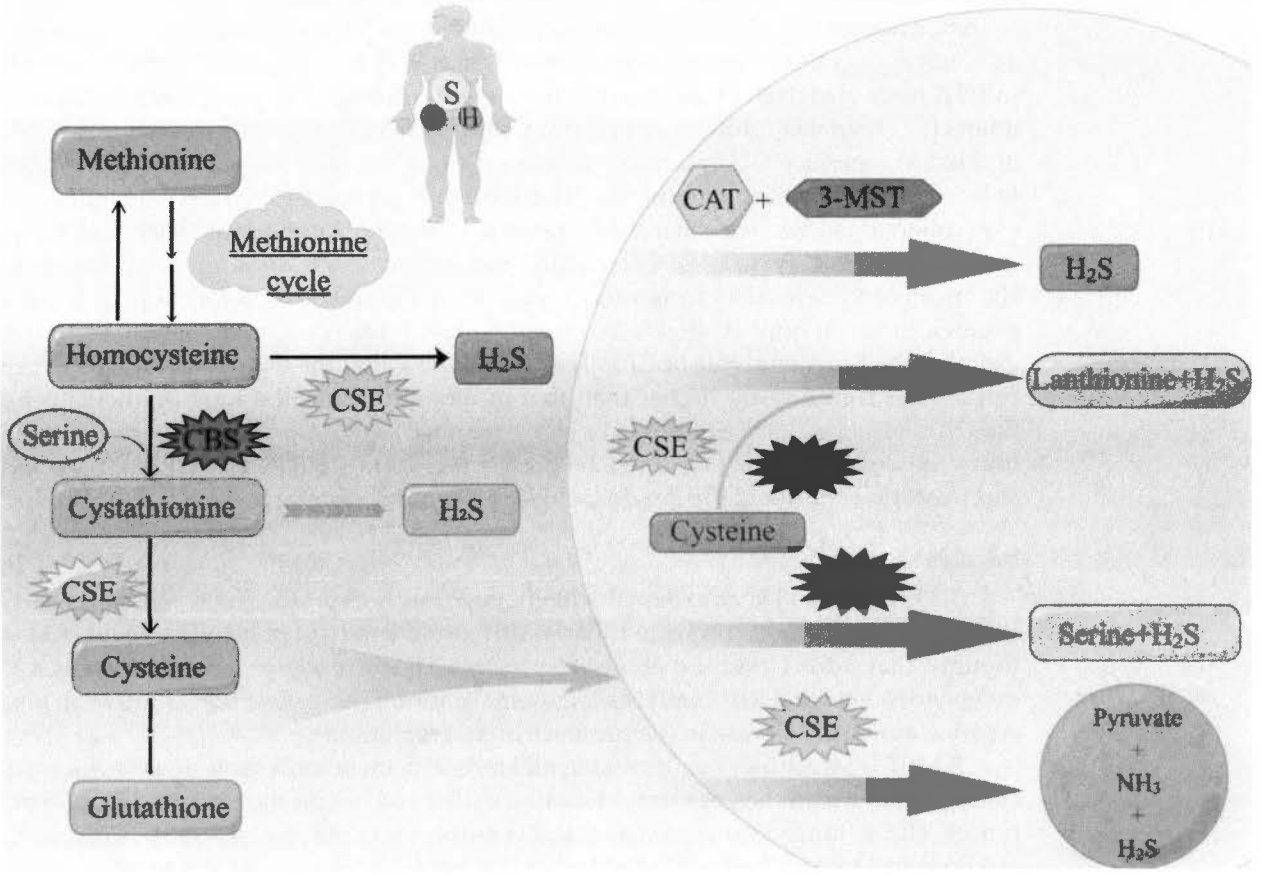


Figure 1. The body produces H_2S through the anti-sulfide pathway. The sulfur transfer pathway plays an important role in redox regulation and cellular sulfur metabolism. The sulfur in this pathway is transferred from homocysteine to cysteine via mesocysteine, which is the only pathway for the endogenous production of cysteine in mammals. Methionine is converted to homocysteine in a reversible two-step process catalyzed by SAM and S-adenosine homocystease (not shown). Homocysteine is introduced into serine to produce cystathionine under the mediation of CBS, and this step can produce H_2S. CSE can use homocysteine or cystathionine as substrate, the former to produce H_2S, the latter to produce cysteine to continue the synthesis of H_2S mediated by CSE, CBS, and 3-MST. Additionally, this part of the cysteine is involved in the synthesis of glutathione. 3-MST can cooperate with CAT to participate in the generation of H_2S. CSE and CBS can mediate the generation of H_2S with the addition of serine together, and they can also separately mediate the generation of H_2S. Abbreviations; CBS: cystathionine β-synthase; CSE: cystathionine γ-lyase; 3-MST: 3-mercaptopyruvate sulfurtransferase; H_2S: hydrogen sulfide; SAM: S-adenosylmethionine; GSH: glutathione; CAT: cysteine transaminase. (By Figdraw).

CBS exists mainly in the cytoplasm under normal physiological conditions [21]; however, CBS can be transferred to mitochondria in response to hypoxia or ischemia, a process that is partly the result of Lon protease regulating mitochondrial CBS stability [28]. Several studies have shown that hypoxia can be a condition that induces CBS translocation into the mitochondria. In fact, CBS can be detected in both the cytosolic and mitochondrial parts of HCT116 cells and A2780 cells [29,30]. The translocation of CBS to mitochondria may have

important implications for the regulation of cancer cell bioenergy and survival [31]. It may be the result of threonine acylation that CBS enters the nucleus [32].

NSCLC cells selectively over-express CBS, which induces H_2S production and promotes cell proliferation, migration, and invasion [22]. For example, in human non-small-cell lung adenocarcinoma, Western blot analysis of tumor tissue compared with normal adjacent lung tissue (n = 20) showed that CBS protein is significantly increased about five-fold in tumor homogenate; furthermore, these tissues also produce approximately two times as much H_2S as their surrounding normal tissues [33]. Increased levels of CBS protein or mRNA have also been reported in two different collections of lung cancer clinical specimens [8]. Hypoxia, glucose deprivation, and hydrogen peroxide treatment have been applied to various HCC and breast cancer cells to generate repaired cells, which are partially resistant to subsequent injury and exhibit the up-regulation of CBS; therefore, in this experimental model, oxidative stress seems to be the most important factor leading to the up-regulation of CBS [34,35]. CBS mRNA and protein levels are slightly up-regulated in chemically hypoxic A549 lung cancer cells treated with cobalt chloride [22]. Lung adenocarcinoma cell lines A549, H522, H1944, Calu-6 cells, A549, and 95D cells are used to examine the functional role of CBS. The results show that the expression of CBS in cancer cell lines is significantly higher than that in the untransformed lung epithelial cell line Beas2B control [8,22,33]. Studies have shown that CBS mRNA is induced in response to the transcription factor Nrf2 [36], and CBS protein levels are regulated by both transcriptional and post-transcriptional processes, including ubiquitination [31].

2.3. 3-MST

3-MST is a 33 kDa zinc-dependent enzyme and H_2S-producing enzyme. As early as 1959, Hylin and Wood confirmed that 3-MST could produce polysulfides [37]. Kamoun thought that 3-MST had the ability to produce H_2S as early as 2004. 3-MST is a PLP-independent enzyme that catalyzes L-cysteine to form H_2S. In addition, 3-MST can bind to cysteine aminotransferase in the presence of α-ketoglutarate [38].

3-MST is structurally expressed in all kinds of somatic cells, as well as various cancer cells. Wrobel's team has performed related earlier studies on the expression of 3-MST in cancer cells: in human tumor cell lines (U373 astrocytoma cell line; SH-SY5Y neuroblastoma cell line; and two melanoma cells lines, A375 and WM35), they found a large amount of 3-MST expression and enzymatic activity. The expression and activity of 3-MST in these cell lines are significantly higher than those of CSE, so it can be concluded that 3-MST is a more important source of H_2S [39,40]. Western blotting indicates [33] that 3-MST expression is either considerably greater or marginally higher in human lung cancer tumors compared with adjacent non-cancer tissues. However, the expression of 3-MST in human papillary thyroid carcinoma tumors is not different from that in surrounding non-cancer tissues [41], and the expression level of 3-MST in renal cell carcinoma tumors is highly variable [42]. At present, a variety of lung adenocarcinoma cell lines (A549 H522~H1944) have been proven to have 3-MST expression/catalytic activity [33,43].

One of the characteristics of lung cancer is angiogenesis, and this process can supply the oxygen and nutrients required for the growth of lung cancer cells; furthermore, it also creates the potential for tumor spread. It is reported that H_2S has the ability to promote new blood vessels [44,45]. Related studies have shown that 3-MST-derived H_2S produced by endothelial cells plays a certain role in vasodilation, endothelial cell proliferation, migration, and angiogenesis, especially under hypoxic conditions [13,46–48]. Some studies have shown that silent 3-MST can reduce the proliferation rate of A549 cells (human lung adenocarcinoma cell line) and decrease the repair rate of mitochondrial DNA [37]. To summarize, 3-MST participates in the generation and development of lung cancer and plays an important role. Furthermore, we compare CSE, CBS, and 3-MST in Table 1.

Table 1. Abbreviations: CSE: cystathionine γ-lyase; EMT: epithelial–mesenchymal transition; H_2S: hydrogen sulfide; CBS: cystathionine β-synthase; NSCLC: non-small-cell lung cancer; 3-MST: 3-mercaptopyruvate sulfurtransferase.

Table	Location	Transfer	Expression and Activity	The Effect after Inhibition
CSE	Cytoplasm [21]	CSE can be transferred from the cytoplasm to the mitochondria in response to cellular stress, such as increased intracellular Ca^{2+} levels [29,30,49].	The clinical correlation between CSE expression in tumor and patient prognosis was not significant. In most cancers, there was no difference in clinical outcomes between high and low CSE expression [26].	Silencing H_2S synthase, especially CSE, inhibits the EMT process in NSCLC cells [22].
CBS	Cytoplasm [21]	Hypoxia may be a condition that leads to the translocation of CBS into mitochondria, which is of great significance for the regulation of biological energy and survival in cancer cells [28,31].	Oxidative stress seems to be the most important factor leading to the upregulation of CBS. Cells with overexpression of CBS show higher metabolism, proliferation, aggressiveness, dedifferentiated dry state, chemotherapy resistance, and immune cell resistance [8,22,33].	CBs-derived H_2S has been identified as a target for tumor growth factors and anticancer drugs, and loss of CBS blocks the density and curl of CD31-positive blood vessels between tumor tissues, indicating reduced tumor angiogenesis [29].
3-MST	Mitochondria and cytoplasm [21]	Lack of coverage.	Cancer cell lines with 3-MST expression/catalytic activity include various lung adenocarcinoma cell lines. 3-MST is involved in the occurrence and development of lung cancer and plays an important role. 3-MST can play an effective role in the treatment of lung cancer; however, its mechanism is not clear and more research is needed [48].	H_2S synthesis decreased after 3-MST inhibition [50–52].

2.4. Catabolism of H_2S in Lung Cancer

CSE and CBS are primarily expressed in human airway smooth muscle cells (SMCs), pulmonary blood vessels and endothelial cells, and the airway SMCs of mouse lung. Some studies have shown a higher expression of CSE in the airway and peripheral lung tissue of rat pulmonary blood vessels [53]. The primary steps in H_2S catabolism include exhalation, lung ventilation, methylation modification, and oxidation. Large quantities of H_2S cause the mitochondria to generate thiosulfate, which is converted to sulfate by rhodanese. Thiol S-methyltransferase, on the other hand, catalyzes the methylation of H_2S in the cytoplasm, where it is transformed into methanethiol and dimethyl sulfide [23]. Methanethiol is converted into dimethyl sulfide by S-methyltransferase. In conclusion, H_2S may be quickly expelled from the body as a gas in the respiratory system and can be eliminated in the urine as sulfate and thiosulfate.

3. Mechanism of Endogenous H_2S in Lung Cancer

3.1. CSE

CSE can be transferred from cytoplasm to mitochondria under cellular stress, such as an increase in intracellular Ca^{2+} levels [29,30,49]. Under hypoxia, changes in cellular ion channels will lead to an increase in intracellular Ca^{2+} levels [54], which promotes the transfer of CSE to mitochondria. This process is mediated by adventitia transferase 20 (Tom20) [49]. CSE translocation to mitochondria contributes to the reduction of mitochondrial cysteine through dehydration [55]. The metabolites of cysteine, such as H_2S, act as antioxidants [25]. In SMC, CSE is the only enzyme that produces H_2S in vascular smooth muscle cells. Increasing ATP synthesis is a method of mitochondrial CSE transport and H_2S generation to improve hypoxic tolerance. However, considering that most cancer cells use the energy of aerobic glycolysis, CSE mitochondrial translocation in cancer cells may not be necessary [49]. In addition, CSE can be modified by small ubiquitin-like modified protein (SUMO). SUMO is usually considered as a nuclear location signal [32,56].

Endogenous H_2S produced by CSE can also act as a bioenergy stimulant [31]. CSE activity is a key driver of the transsulfuration pathway, cysteine catabolism, and H_2S production [23]. Silencing H_2S synthase, especially CSE, can inhibit the epithelial–mesenchymal transition (EMT) process of NSCLC cells [22].

3.2. CBS

Studies have shown that in human non-small-cell lung adenocarcinoma, tumor cells express more CBS than adjacent normal lung tissue cells [33].

H_2S produced by CBS is used to (I) support tumor growth and proliferation by maintaining the energy supply of colon cancer cells and (II) provide blood and nutrients to tumors by promoting angiogenesis and vasodilation. According to the current research results, CBS-derived H_2S is identified as the target of tumor growth factor and anticancer drugs [29].

CBS catalyzes several reactions, typical of which is the β-displacement reaction of L-serine with L-homocysteine to form L-cysteine and water without H_2S production. CBS can catalyze a variety of H_2S formation reactions, including the condensation of L-cysteine and L-homocysteine to form L-cysteine sulfide and H_2S. The condensation of two L-cysteine molecules to form L-blue-thionine and H_2S-L-homocysteine. The β-γ replacement reaction of L-homocysteine with L-cysteine to form L-cysteine sulfide and H_2S. L-cysteine persulfide is formed from L-cysteine. Furthermore, L-cysteine persulfide releases H_2S or partially transfers sulfane sulfur to the receptor protein in the presence of a reducing agent [31]. It has been found that the control or inhibition of CBS can reduce the intracellular content of the essential antioxidant glutathione (GSH + GSSG) and lead to the apoptotic cascade [57]. Meanwhile, p53 is increased and the expression of NF-KB-RelA/p65 subunits is decreased. CBS inhibition can also increase mitochondrial ROS production, decrease the NAD/NADH ratio, reduce ATP synthesis, and increase the ADP/ATP ratio. Mitochondrial oxygen consumption can be reduced by CBS [30]. Loss of CBS blocks the density and crimp of CD31-positive blood vessels between tumor tissues, indicating decreased tumor angiogenesis [29].

Overall, the cells overexpressing CBS show higher metabolic, proliferative, invasive, dedifferentiated dry state, chemo-resistant, and immune cell resistance phenotypes. In tumor cells with high CBS expression, silencing or inhibition of CBS can obtain "mirror" biological responses, such as the inhibition of cell proliferation, invasion, and cell bioenergetics [31].

3.3. 3-MST

3-MST is one of the endogenous H_2S synthase and is mainly expressed in mitochondria. There may be two molecular mechanisms of 3-MST-mediated H_2S formation: (i) The nucleophilic cysteine (Cys247) of sulfur is transferred from 3-MP to its active site to form a stable persulfide. Then, the persulfide is attacked by sulfur-containing compounds to form a new persulfide molecule, which is reduced by thioredoxin (Trx) to produce H_2S. (ii) When the substrate is a dithiol compound, some sulfur atoms may be reduced to H_2S by the self-reduction process [58–60].

3-MST exists in the equilibrium form of monomer dimmer and its C-terminal has catalytic activity. Cys247 is the catalytic site, while Cys154 and Cys263 are located on the surface of the enzyme. Cys247 has redox activity and can be oxidized to sulfonyl cysteine, which in turn is reduced to the active form by Trx. Cys247 is used as a redox sensor switch in the subunit. H_2S is produced by 3-MST in the presence of Trx or dihydrolipoic acid (DHLA). 3-MST reacts with 3-MP to form H_2S through the reaction of persulfide intermediates. Trx or DHLA receives a sulfur atom from the persulfide, which is attacked by another mercaptan and releases H_2S [58–60]. Cys154 and Cys263 are involved in the formation of intermolecular disulfide and affect the activity of the enzyme. 3-MST contains a key catalytic site, cys247, which is sensitive to redox [58]. Therefore, oxidative stress has been shown to inhibit the catalytic activity of 3-MST, thus inhibiting the production of H_2S mediated by

3-MST [50–52]. The mechanism of 3-MST in vasodilation and angiogenesis is related to the regulation of the 3-MST system in endothelial cell bioenergetics and metabonomics [48]. Existing data show that 3-MST can play an effective role in the treatment of lung cancer; however, its mechanism has not been clearly explored and more research is needed.

4. Mechanism of Exogenous H_2S in Lung Cancer

4.1. NaHS

Although smoking is the main cause of lung cancer, World Health Organization data show that about 75% of lung cancer patients are smokers, which means that about 25% of lung cancer patients are non-smokers. The data suggest that there are other risks that can lead to lung cancer. At present, epidemiology has shown that nickel compounds can increase the mortality of lung cancer [61].

Nickel is a common environmental factor and can be found in soil and water resources [62]. Nickel compounds are common environmental and occupational carcinogens. Recent studies have shown that nickel chloride plays a certain role in the migration of lung cancer cells [63]. In the process of the invasion and migration of tumor cells, epithelial cells will produce EMT in different degrees. EMT refers to the process of epithelial cells losing apical polarity and intercellular adhesion into cells with an interstitial phenotype, which plays a key role in the development of lung cancer [64]. Nicl2 is reported by many studies as inducing the EMT process of A549 cells [65]. Recently, several studies have shown that exogenous H_2S is feasible in promoting cancer radiotherapy and anticancer therapy [66,67]. A total of 100 μM NaHS pretreatment can alleviate the morphological changes of A549 cells induced by NiCl2 and also alleviate the effect of NiCl2 treatment on the protein levels of E-cadherin and vimentin. Therefore, NaHS can inhibit the migration of A549 cells by preventing the EMT of A549 cells [65].

GF-β1 plays a regulatory role in a variety of biological processes [67], while TGF-β1 has important anticancer effects in early tumorigenesis and mediates EMT [68]. Some studies have shown that $NiCl_2$ can up-regulate the levels of TGF-β1, p-Smad2, and p-Smad3 in a time-dependent manner, while exogenous NaHS reduces the up-regulation of $NiCl_2$-dependent TGF-β1, p-Smad2, and p-Smad3 [65]. These results show that NaHS can inhibit the migration ability of A549 cells induced by $NiCl_2$ via the TGF-β1/Smad2/Smad3 signal pathway. In addition, the migration and invasion of A549/DDP cells can be inhibited by enhancing their sensitivity to cisplatin [66]. Therefore, NaHS is expected to be used as a therapeutic strategy for the treatment of cisplatin-resistant NSCLC.

4.2. GYY4137

GYY4137 is not only a water-soluble compound, but also one of the donors of H_2S. H_2S can be released by hydrolysis [69,70]. In the experiment of exploring the effects of NaHS and GYY4137 on cell growth and viability, Zheng Wei Lee et al. treated MCF-7, MV4-11, and HL-60 cancer cells with NaHS, GYY4137, and ZYJ1122. It was found that GYY4137 significantly decreased the proliferation of these three cancer cells compared with NaHS and ZYJ1122. In addition, they used 400 mM and 800 mM of GYY4137 and ZYJ1122 to treat other cancer cell lines (HeLa, HCT-116, USOS, and HepG2 cells). The results showed that GYY4137 has a more profound effect on cell survival at the same concentration, with a mortality rate of 30–70% for all cancer cell lines treated with GYY4137, and has the greatest impact on the death courses caused by HepG2, HL-60, MV4-11, MCF-7, and U2OS cells [71].

Some studies have proposed that GYY4137 slowly decomposes to produce H_2S, which inhibits tumor growth by blocking the cell cycle and promoting cell apoptosis [71]. Although there is no related research on the role of GYY4137 in the treatment of lung cancer, according to the data we have collected, GYY4137 may provide new ideas for the treatment of lung cancer in the future.

4.3. AP39

The repair of mitochondrial DNA (mtDNA) can be regulated by H_2S. It has been discovered that mtDNA encodes a group of proteins necessary for preserving oxidative phosphorylation. In many malignancies, somatic mtDNA mutations contribute to the selective advantage of carcinogenesis [72–74].

According to recent reports, the degree of mtDNA damage can influence the loss of cancer cells' capacity to proliferate to some amount [75]. In a study, Bartosz Szczesny's team demonstrated that inhibition of tumor H_2S production leads to time-dependent accumulation of mtDNA damage in A549 cells, and inhibition of H_2S biosynthesis makes A549 cells more susceptible to mtDNA oxidative damage [33]. To counteract oxidative mtDNA degradation, A549 cells might receive the mitochondrial-targeted H_2S donor (AP39) [33]. As a result, we are aware that H_2S is crucial in avoiding oxidative mtDNA damage and can improve mtDNA repair. Another study revealed that AP39 performs a stimulatory function in mtDNA repair and safeguards mtDNA integrity in endothelial cells under oxidative stress [76]. According to the data, AP39 has the function of stimulating mitochondrial electron transport and cellular bioenergy at low concentrations (30–100 nM), while they are inhibited at high concentrations (300 nM) [52,76]. This is in line with H_2S having an effective response that has a bell-shaped distribution (many actions are helpful and benign at low doses but harmful to cells at high concentrations) [77,78].

In conclusion, certain H_2S-generating enzyme inhibitors or specific H_2S clearance agents paired with chemotherapeutic medicines that decrease mitochondrial DNA repair capacity and oxidative phosphorylation can cause mitochondrial malfunction. As a result, chemotherapy medications particularly affected lung adenocarcinoma cancer cells (Figure 2), increasing the effectiveness of the therapy [33]. More research is required since there are few data on H_2S and mtDNA, and the molecular mechanism of mtDNA integrity preservation in cancer cells has not been thoroughly examined.

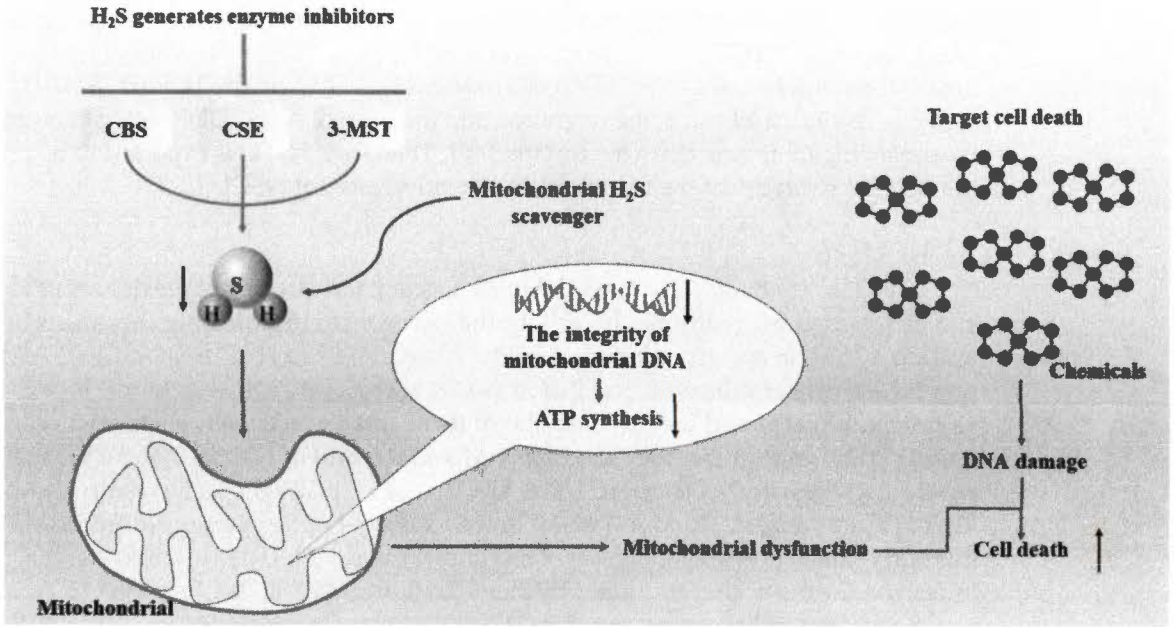


Figure 2. Mechanism of inducing mitochondrial dysfunction in lung adenocarcinoma cells. H_2S-generating enzyme inhibitors, such as AOAA, which is commonly used in CBS and CSE, or mitochondrial H_2S scavengers, are used to reduce intracellular H_2S levels, thereby inducing mitochondrial dysfunction and improving the sensitivity of lung adenocarcinoma cells to chemotherapy drugs. Abbreviations: AOAA: aminooxyacetic acid; CBS: cystathionine β-synthase; CSE: cystathionine γ-lyase.

5. Mechanism of H_2S Donor in Natural Products in Lung Cancer

5.1. DATS

Diallyl trisulfide (DATS) is one of the garlic-derived compounds, accounting for 45% of garlic oil, and has anti-tumor, anti-inflammatory, immunomodulatory, and chemical-preventive effects [79]. In cancer chemoprevention, DATS can reduce the induction rate of carcinogens and inhibit the proliferation and activity of various cancer cells. Studies have shown that its mechanism may be related to cell cycle arrest, induction of apoptosis, and the regulation of carcinogenic signal transduction pathway [80]. At present, it has been reported that DATS has a significant anticancer effect on lung cancer [81].

Cisplatin (DDP) is a common chemotherapeutic drug in cancer treatment, which plays a significant role in tumor treatment; however, its side effects also limit its extensive application in tumor treatment, such as acute kidney injury (AKI) induced by DDP administration [82]. In the process of tumorigenesis, unlimited cell proliferation is one of the markers of tumorigenesis; therefore, the induction of cell cycle block can be used as a target for the treatment of cancer [83]. Members of the Bcl-2 family play an important role in the regulation of apoptosis [84]. The activation of caspase and the activities of PI3K/Akt, MAPK/ERK, MAPK/JNK, and MAPK/p38 pathways play an important role in the proliferation and metastasis of cancer cells [85]. The related research report of Xiaoyan Jiang's team [81] showed: (i) Through the verification of in vivo and in vitro experiments, the results showed that DATS combined with DDP can enhance the anti-tumor ability by inducing apoptosis; (ii) after DATS treatment of NCI-H460 cells, the proportion of apoptotic cells increased in a dose-dependent manner, so DATS has good anti-proliferative activity for NCI-H460 lung cancer cells [81]. The mechanism is to stabilize the cell cycle in the G1 phase. It is related to the increase in the intracellular G1 phase and the decrease in the intracellular G2max M phase [86]; (iii) ATS+DDP treatment has fewer side effects, such as improving the oxidative damage induced by DDP treatment. After DATS treatment, the expression of E-cadherin increased and the expression of MMP-9 decreased, which contributed to the inhibition of the EMT process; (iv) the apoptosis of NCI-H460 cells induced by DATS mainly depends on the activation of caspase and regulates the inhibition of Bcl-2 family proteins; (v) the combination of DDP and DATS can increase the activity of DATS and increase the apoptosis of tumor cells.

In summary, DATS plays an important role in the treatment of lung cancer, and the combination of DATS and DDP may provide a new idea for the clinical treatment of lung cancer (Figure 3).

5.2. DADS

A large number of studies have confirmed that garlic and its allyl sulfides have anti-tumor effects, and diallyl disulfide (DADS) is a fat-soluble active ingredient, accounting for about 60% of garlic oil. Studies have shown that DADS can inhibit plaque formation and reduce the risk of hypertension and coronary artery disease [87]. In recent years, a number of studies have shown that DADS can inhibit tumorigenesis induced by a variety of carcinogens and inhibit the formation of various tumor cells. Additionally, DADS can induce apoptosis of human leukemia, colon cancer, prostate cancer, and breast cancer cells [88]. In addition, some studies have shown that DADS can induce apoptosis in NSCLC H1299 cells [89].

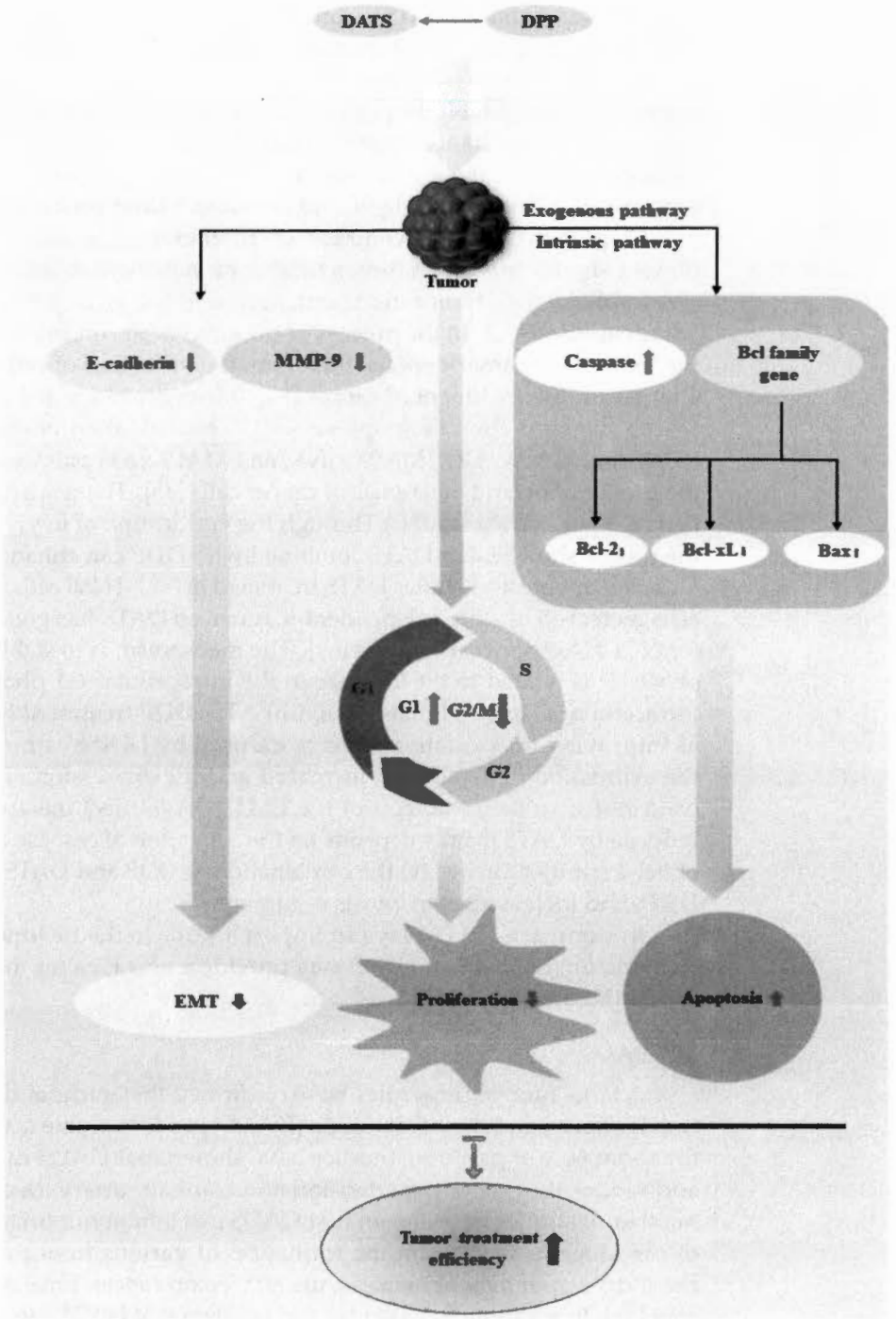


Figure 3. Therapeutic mechanism of DATS combined with DDP in lung cancer cells. When DATS is combined with DDP, DDP can enhance the activity of DATS. After DATS treatment of lung cancer tumors, the expression level of E-cadherin increased and the expression level of MMP-9 decreased, which inhibited the EMT process in tissues. At the same time, DATS activates caspases through endogenous and exogenous pathways and inhibits Bcl-family proteins, among which the expression level of pro-apoptotic factor Bax increases and the expression level of pro-growth factors Bcl-xl and Bcl-2 decreases, thus promoting the apoptosis of tumor cells. In addition, DATS increased the level of G1 phase and decreased the level of G2/M phase in tumor cells to inhibit the proliferation of tumor cells. Through the above process, the efficiency of lung cancer treatment can be improved. Abbreviations: DATS: diallyl trisulfide; DDP: cisplatin.

Recently, the results of quantitative reverse transcriptase polymerase chain reaction and Western blot analysis showed that DADS induced caspase-dependent apoptosis of human cancer cells through Bax (Figure 4). Therefore, it can be speculated that the mitochondrial pathway may be used as a target for DADS in chemoprevention or chemotherapy [90]. Hui Cao's team explored the effect of DADS on human NSCLC H1299 cells [89]. Their results showed that: (i) DADS can induce apoptosis of the H1299 cells; (ii) DADS can block the G2 phase of H1299 cell cycle; (iii) DADS-induced apoptosis depends on the classical mitochondrial pathway; (iv) H1299 cells were treated with DADS at concentrations of 0, 20, 50, and 100 μmol/L, respectively. After 10 min, it was found that the increase in phosphorylated-p42hammer 44 is concentration-dependent. The results showed that the activation of phosphorylated p42/44MAPKs plays an important role in the mechanism of apoptosis induced by DADS [89].

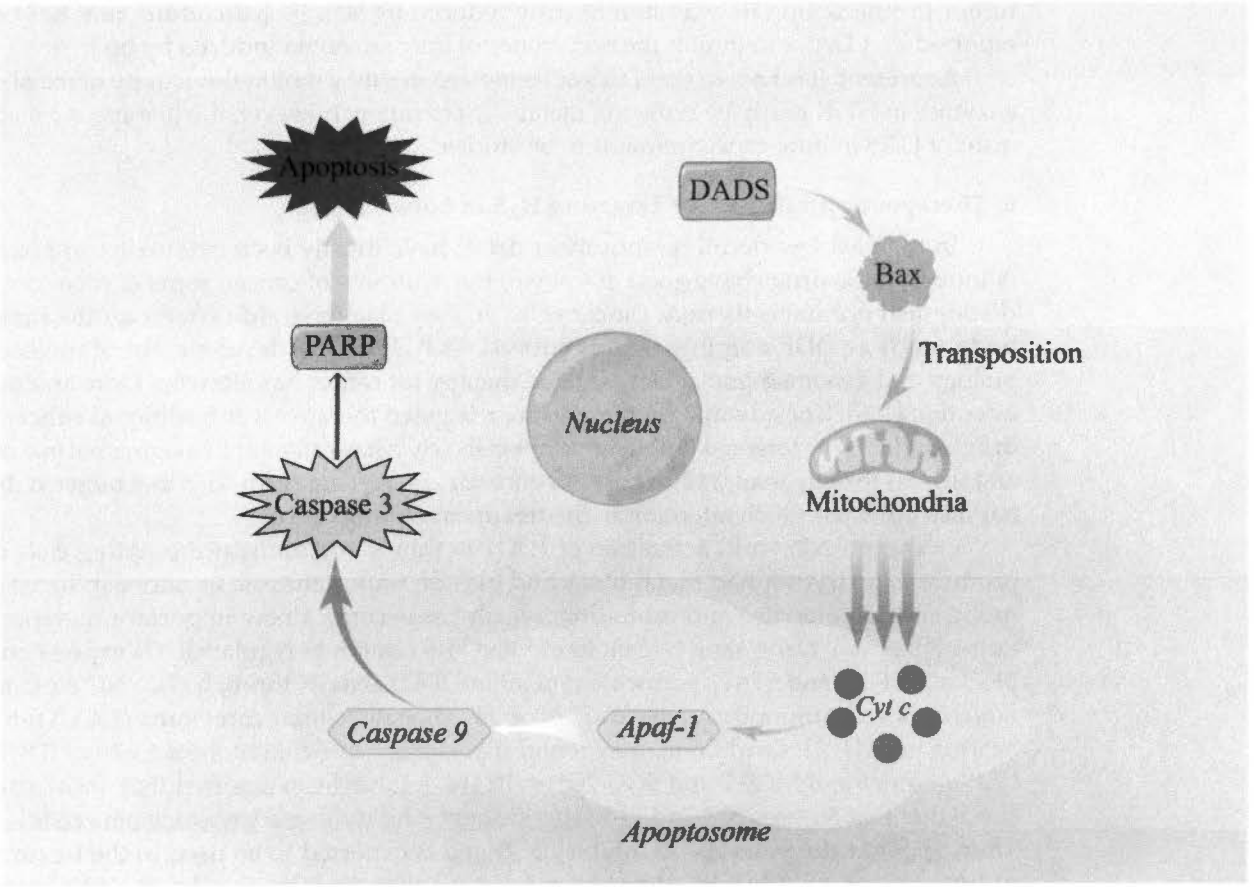


Figure 4. The molecular mechanism of apoptosis induced by DADS. DADS stimulates the translocation of pro-apoptotic protein Bax from cytoplasm to mitochondrial membrane, which increases the permeability of mitochondrial membrane and promotes the release of cytochrome C from mitochondria. Apoptotic enzyme activator binds with cytochrome C to form a polymer, and Caspase-9 is recruited and processed to form an apoptotic complex. Finally, the downstream apoptosis factor Caspase-3 is activated, which leads to apoptosis. Abbreviations: DADS: diallyl disulfide. (By Figdraw).

At present, the study of H_2S in the treatment of lung cancer has become a hot topic. In view of the low toxicity of DADS and its inhibitory effect on a variety of tumor cells, an in-depth study of the mechanism of DADS in lung cancer will be of great significance for the clinical treatment of DADS in lung cancer.

5.3. DAS

Diallyl sulfide (DAS) is not only an effective component of garlic but also a lipophilic sulfide, which can be oxidized to diallyl sulfoxide and diallyl sulfone mediated by cytochrome P450 enzymes [91]. It selectively inhibits and induces some P450 enzymes [91–94], which play a certain role in tumor treatment and chemical prevention. In addition, DAS can inhibit DNA binding and AFB1-, vinyl carbamate-, and NDMA-related cancer-induced mutations [95,96].

NNK is a potent tobacco carcinogen and is one of the important causes of oral cancer in tobacco chewers and lung cancer in smokers [97]. Some studies have shown that DAS can inhibit the oxidative metabolism of NNK in the lungs of mice in a dose-dependent manner [98]. In research, a team used the lung cancer model of A/J mice to show that DAS inhibits NNK metabolism. When DAS 200 mg/kg was given 3 days and 2 h before a single NNK treatment, the tumor incidence was significantly reduced by 60% and the tumor proliferation rate was significantly reduced by 90% [98]. In addition, it has been reported that DAS can inhibit the occurrence of lung adenoma induced by bp [99].

At present, it is known that DAS or its metabolites may inhibit the activity of metabolic enzymes in NNK partly by reducing metabolic activation; however, the therapeutic mechanism of DAS in lung cancer remains to be studied.

6. Therapeutic Strategies for Targeting H_2S in Lung Cancer

In the past few decades, anticancer drugs have mostly been cytotoxic compounds. Although these drugs have good efficacy in the treatment of cancer, some of them cannot distinguish normal cells from cancer cells, so they also have side effects on the human body (such as DDP-administration-induced AKI). With the development of molecular biology and genomics, molecular targeted therapy for cancer has attracted more and more attention [100]. The advantages of molecular targeted therapy over traditional anticancer drugs are [101]: (i) targeted killing of tumor cells while basically not damaging normal cells and (ii) less toxicity than traditional anticancer drugs. Among them, H_2S as a targeted drug has also attracted much attention in the treatment of lung cancer.

Overexpression and activation of IDO1 in tumor and antigen-presenting cells can produce toxic tryptophan metabolites and play an important role in tumor-induced immune system tolerance and inhibition, which has become a new important therapeutic target [102–104]. Dang Yang 's team found that H_2S can down-regulate IDO1 expression by blocking NF-κB and STAT3 pathways and inhibit IDO1 activity through H_2S/NO cross-talk, which has an immunotherapeutic effect on H22 hepatocellular carcinoma (HCC) tumor-bearing mice [105]. In addition, they found that H_2S can also inhibit the activity of IDO1 in $CSE^{-/-}$ mice and MCF-7 and SGC-7901 cells [105]. It has been reported that nosh-aspirin (a mixture that releases NO and H_2S) significantly inhibits lung adenocarcinoma cells [106]. Thus, H_2S has the potential to inhibit IDO1 and is expected to be used in the treatment of lung cancer. In addition, it has been reported that the introduction of a H_2S-release structure to valproic acid (VPA) can more potently inhibit the growth and metastasis of lung cancer cells, increasing the sensitivity of lung cancer cells to chemotherapeutic drugs [107].

At present, the specific mechanism of H_2S-targeted therapy in lung cancer has not been studied clearly, but from the existing research we can know that H_2S-targeted therapy for lung cancer has great potential. In addition, H_2S-based treatment technology can provide new ideas for future lung cancer treatment.

7. Conclusions and Future Prospect

H_2S is a new type of gas signaling molecule that has attracted much attention in recent years and is widely involved in the regulation process of the respiratory system and digestive system. H_2S plays a key role in the regulation of cell activity (such as oxidative stress, apoptosis, cell differentiation, and inflammation). It may play a significant role in the occurrence and development of lung cancer, in which the increase of H_2S level is closely related to angiogenesis and EMT in lung cancer tissue. Inhibition of H_2S-producing

enzymes by specific scavengers or reduction of intracellular H_2S levels can lead to mitochondrial dysfunction and make lung adenocarcinoma cells sensitive to chemotherapeutic drugs. However, the molecular mechanism of how H_2S regulates the integrity of mitochondrial DNA and how these processes play an important role in the tumorigenic potential of cancer cells is not clear [27,33]. However, it has been reported that both endogenous and exogenous H_2S may regulate mitochondrial energy metabolism and mitochondrial DNA integrity and participate in the inhibition of lung cancer cells through a variety of signaling pathways. The above different results may be explained by the clock effect of H_2S. For a long time, the bell-shaped effect of H_2S has attracted much attention. H_2S has a certain concentration range to promote tumor cell proliferation, which can be achieved by reducing the production of endogenous H_2S or the application of exogenous H_2S for therapeutic purposes. Among them, there are many reports on the use of exogenous H_2S to treat cancer (or disease). It has been reported that when exogenous H_2S inhibits the concentration of tumor cells, normal tissue will be damaged. Additionally, some studies have found that cancer cells can be selectively killed when exposed to a relatively small amount of H_2S for a relatively long time; therefore, the optimal time and concentration of H_2S in the treatment of lung cancer remain to be studied. In addition, there are many reports that hydrogen sulfide inhibitors and the addition of H_2S release structures play a significant role in the treatment of lung cancer and are expected to be developed into clinical anticancer drugs. Endogenous H_2S is mainly synthesized by CBS, CSE, and 3-MST. The elevation of enzyme expression in lung cancer cells and the synthesis of H_2S have been widely reported; however, there are still few studies on the use of the endogenous H_2S synthesis pathway and H_2S pathway in the treatment of lung cancer. At present, the problem of how H_2S (3-mst-derived or other) interacts with various components of the cell microenvironment has not been solved. Therefore, further research is needed to establish a literature basis for the possibility of H_2S as a diagnostic tool or therapeutic target.

In addition, numerous studies have reported that some H_2S donors and some components of garlic can effectively inhibit the proliferation of lung cancer cells and can be combined with other anticancer drugs to reduce side effects or increase drug activity (for example, sodium hydrosulfide increases the sensitivity of cisplatin against cisplatin in lung cancer cells, and DATS and DDP increase the therapeutic effect). However, because of the complexity, the mechanism and specific function of its action have not been studied clearly.

Taken together, the role of H_2S in tumor prevention, detection, and treatment has great potential; however, there are still many challenges, including the complexity of the free diffusion of H_2S into the cell membrane, remaining to be studied. In order to find new therapeutic targets, a large number of experimental studies are needed to confirm and deepen the mechanism and role of the H_2S donor combined with DDP in the treatment of lung cancer. It is expected to provide new ideas for the treatment of lung cancer. In addition, we believe that a clear study of the mechanism of H_2S in the development of lung cancer and its interaction with tumor cell microenvironment can provide new therapeutic methods and means for the treatment of lung cancer.

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Ref #3

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Article

Landfill Gas: A Major Pathway for Neutral Per- and Polyfluoroalkyl Substance (PFAS) Release

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Abstract

The undisclosed and ubiquitous use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in consumer products has led to a growing issue of environmental pollution, particularly within the solid waste community, where the fate of volatile (neutral) PFAS in landfilled refuse is not well understood. Here, three municipal solid waste landfills in Florida were assessed for neutral PFAS in landfill gas and ionic PFAS in landfill leachate to compare the relative mobility between the two pathways. Landfill gas was directly sampled using a high volume, XAD-2 resin based sampling approach developed for adsorption and analysis of 27 neutral PFAS. Across sites, 13 neutral PFAS were identified from fluorotelomer alcohol (FTOH), fluorotelomer olefin (FTO), secondary FTOH, fluorotelomer acetate (FTOAc), and fluorotelomer methyl acrylate (FTMAc) classes; however, FTOHs dominated concentrations (87–97% total neutral PFAS), with most detections surpassing utilized calibration levels. Even under conservative assumptions, the mass of fluorine leaving in landfill gas (32–76%) was comparable to or greater than the mass leaving in landfill leachate (24–68%). These findings suggest that landfill gas, a less scrutinized byproduct, serves as a major pathway for the mobility of PFAS from landfills.

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DATE RECEIVED: 4/29/19
FROM: Elliot Foley
PHONE OR EMAIL:

To Whom it May Concern,

I was reading the paper, particularly "In Opposition of Expansion," and it included the surprising detail that of hundreds of public comments regarding the landfill expansion there were only two pieces of written testimony in favor of the landfill expansion. I am writing today to make that three. I want to provide counterargument for all of the, in my opinion, flimsey, selfish, and evil arguments presented in opposition to expansion as written in the article, as well as provide a few additional positive arguments in support of expansion.

Teardown:

The first argument listed in the Gazette-Times article was the smell. In particular, residents have complained that the smell has become more obvious. It is a landfill, and full landfills produce higher volumes of both smell and less-full landfills. However, this is an extremely temporary problem. I remember going to visit the Buttle landfill as a school field trip about 5 years ago, and the operation area of the smell was not that far. The vast majority of Benton County residents have never been near the landfill, all the while paying the rewards.

The second argument concerned leaching. Leaching is certainly an issue deserving of concern, but denying this landfill expansion does literally nothing to prevent it. Leaching happens when rain water runs through landfills, full of trash. Their argument goes that since Benton County ceases operation, we should close our current landfill. As for as post-hoc justifications go, this is pretty reasonable. However, the trash doesn't just disappear; it will be taken to other counties. There are two possibilities here, both of them grim. Firstly, if the new landfill location is near this county, then the rainfall situation doesn't get any better. In this situation, we would have been better off just expanding our own landfill location to make the leaching containment simpler and less risky. The other possibility is that the landfill location is far away from Benton County. While this would help with leaching, it runs the risk of causing great financial harm to the people of Benton County by significantly increasing their trash removal costs.

There were a few additional arguments listed in the article, but they were either inconsequential (ie wildlife or noise) or required additional data to refute that would take me some more serious time to properly refute (misalignment of Benton County priorities or accusations of fabricating data). As such, I will stop here and advance on to make my case for expansion.

→

Build up:

As a Benton County resident for all my life, I have always appreciated Republic Services. They haven't ever missed my trash, and they have been easy to work with. However, it was only when I moved out that I began to fully realize how great we have it here. During my first time receiving my bill, I dreaded the electricity bill, hated the water bill in the winter, despised our rollcart, but can I really complain about the [illegible] and reasonable rates for my trash bill. Right now, a horde of NIMBYs are trying to tell my local government to make garbage trucks go routes out of this area, undoubtedly raising all of our collective garbage bills. I say no. I support our incredible [illegible] trash collectors. I support the family of the people who work for this business. Maybe these folks aren't the most educated with luxury skills, but I think I speak for all of us when I say that this is not appreciated. Keep our prices affordable and don't fall for the organizations of greedy rich people who only care because they live near a landfill expansion on Coffin Butte.

Best,

Elliot Foley