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

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).*

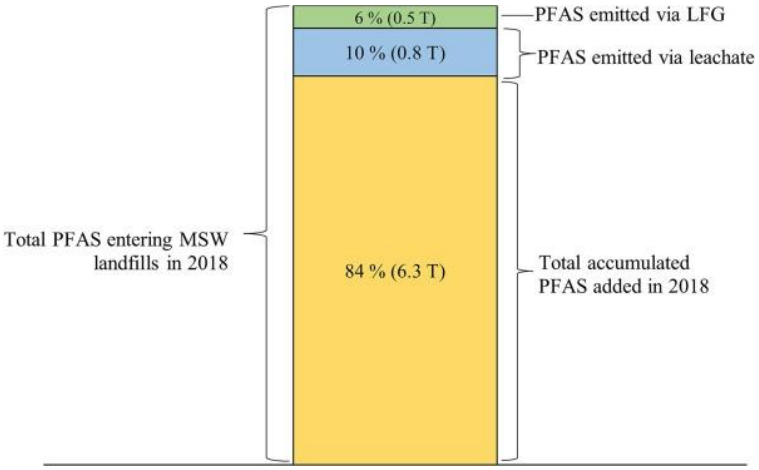


Figure 1. The fate of PFAS entering landfills

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).*

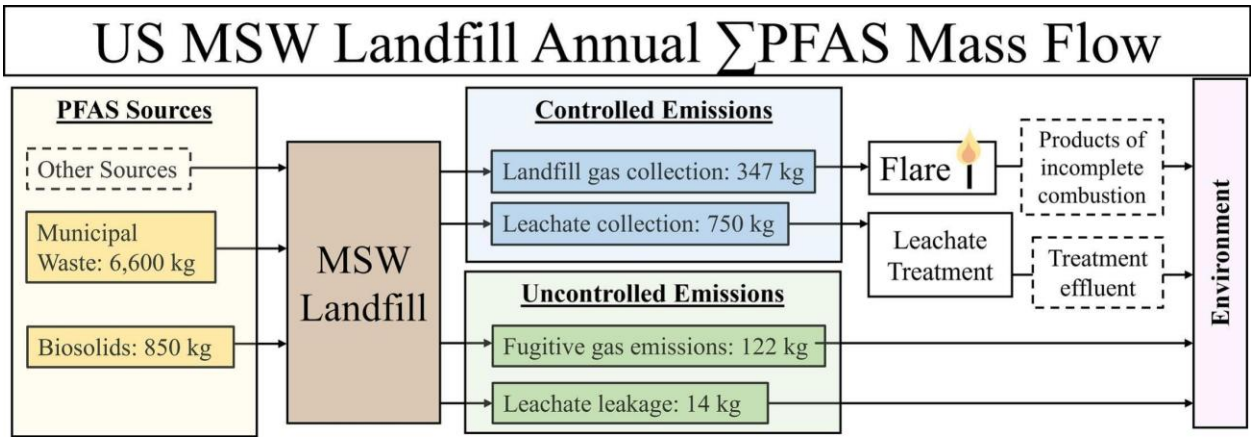


Figure 2. Flowchart depiction of annual sum PFAS loading and release at MSW and C&D debris landfills based on current understanding in the literature. Dashed lines represent PFAS streams which have not been quantified to any extent in the literature.

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

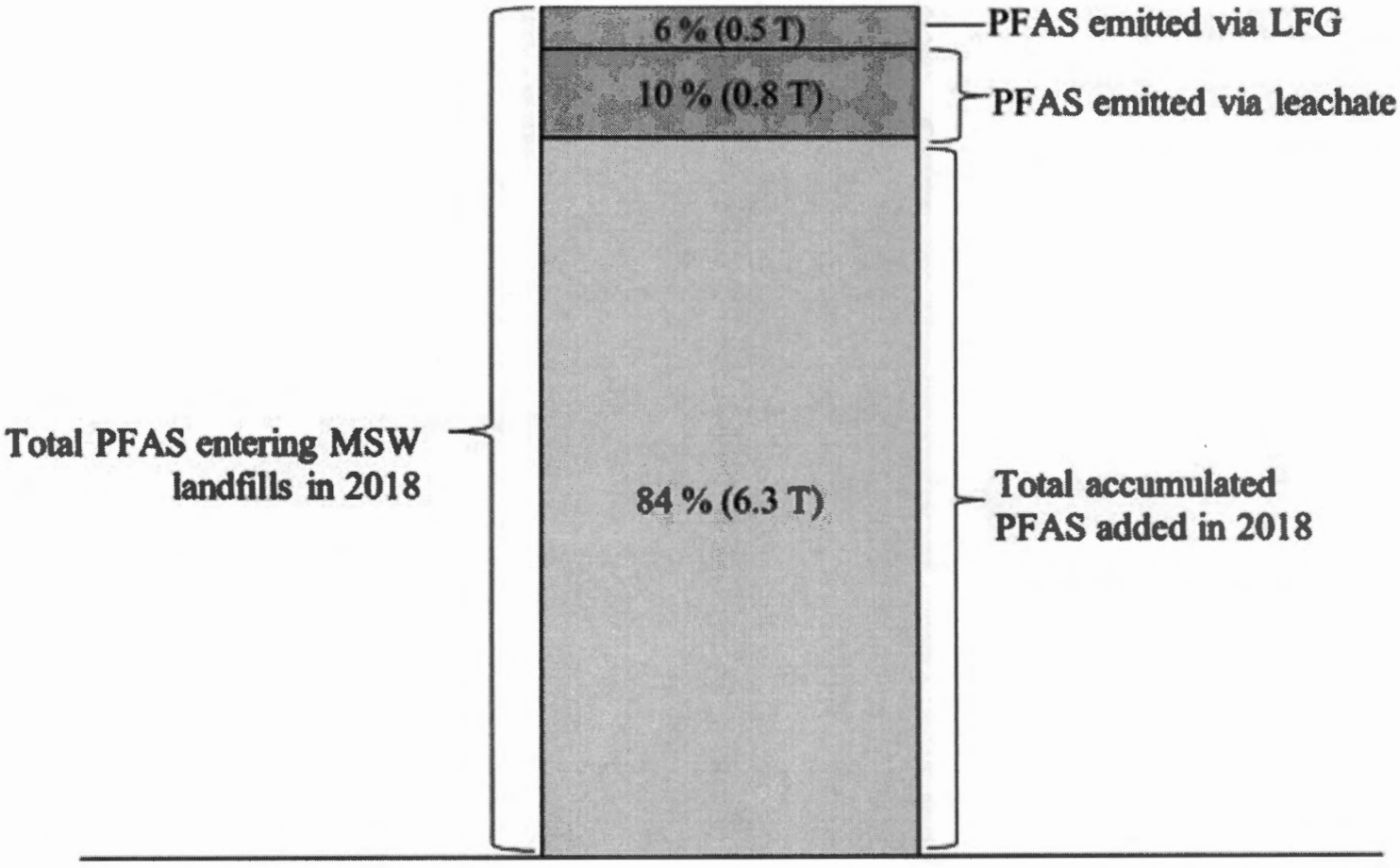
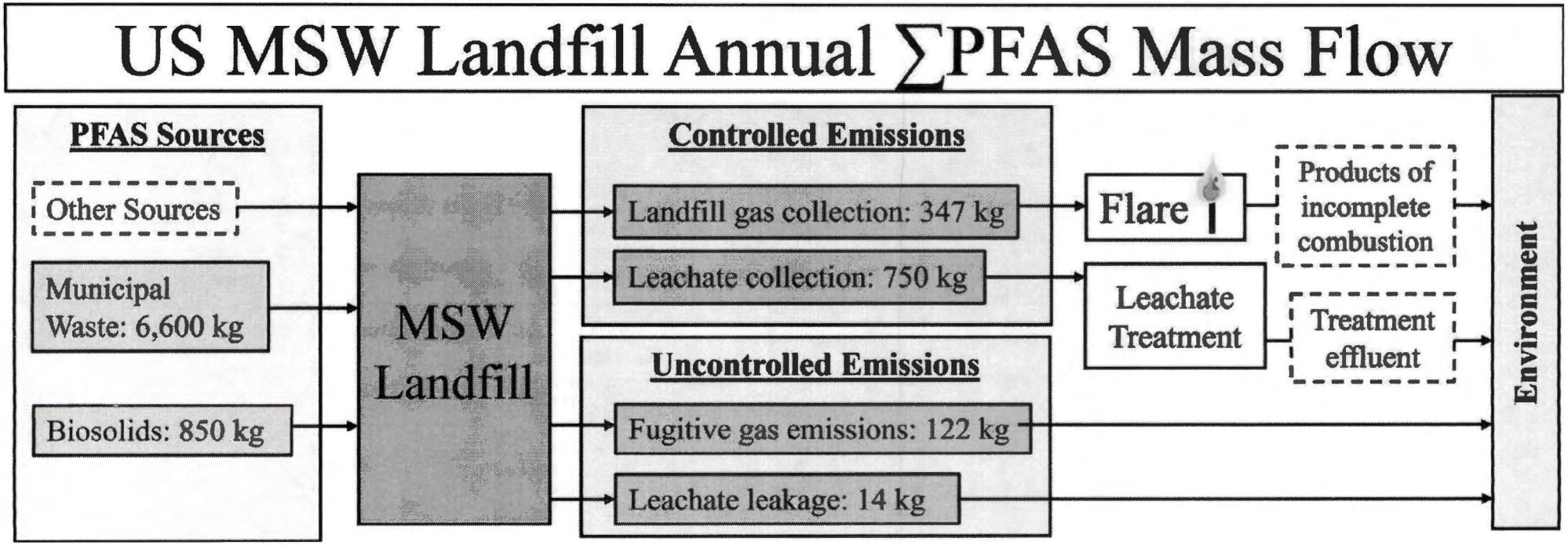


Fig. 2


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*

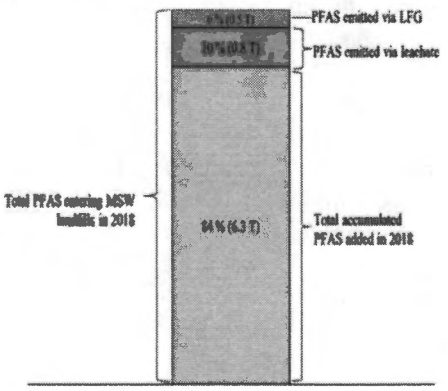


Figure 1. The fate of PFAS entering landfills

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*

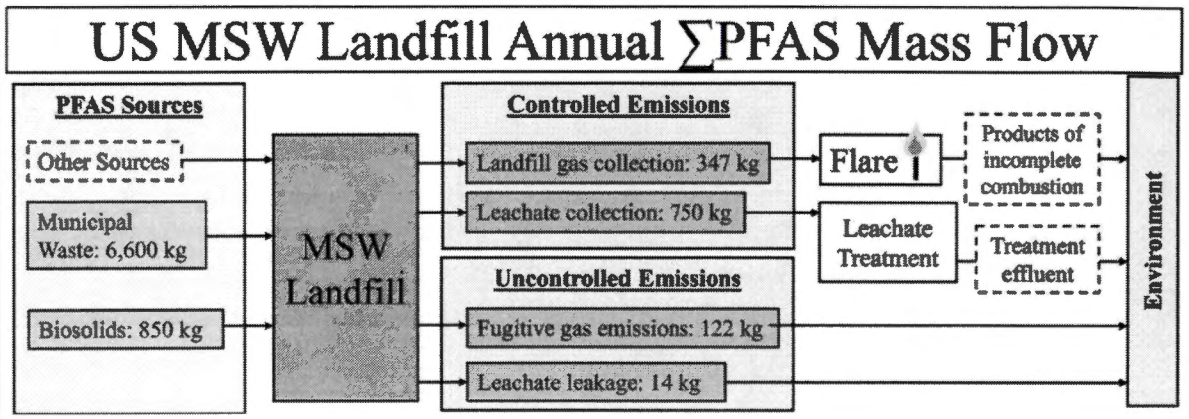


Figure 2. Flowchart of annual PFAS entering and leaving landfills.

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)

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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

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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*

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

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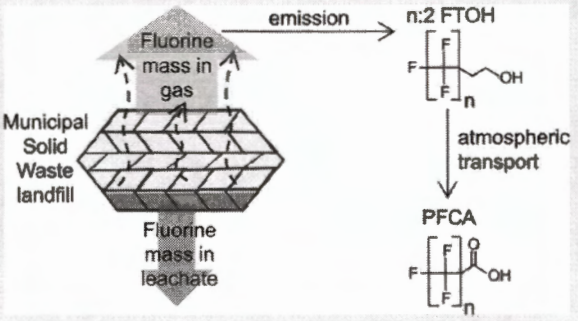
ABSTRACT: The undisclosed and ubiquitous use of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in consumer products has led to a growing issue of environmental pollution, particularly within the solid waste community, where the fate of volatile (neutral) PFAS in landfilled refuse is not well understood. 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*

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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Ref. B

Science of the Total Environment 905 (2023) 167185

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journal homepage: www.elsevier.com/locate/scitotenv

Review

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

Thabet Tolaymat [a,*], Nicole Robey [b], Max Krause [a], Judd Larson [c], Keith Weitz [c], Sameer Parvathikar [c], Lara Phelps [d], William Linak [d], Susan Burden [c], Tom Speth [a], Jonathan Krug [d]

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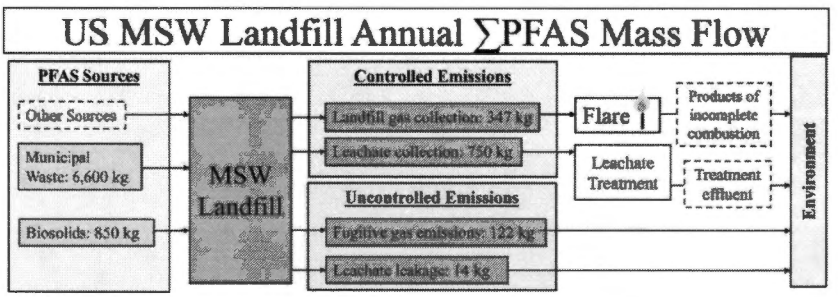
[e] Office of Science Advisor, Policy and Engagement, Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC, USA

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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Available online 19 September 2023
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Ref. C

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** ▾

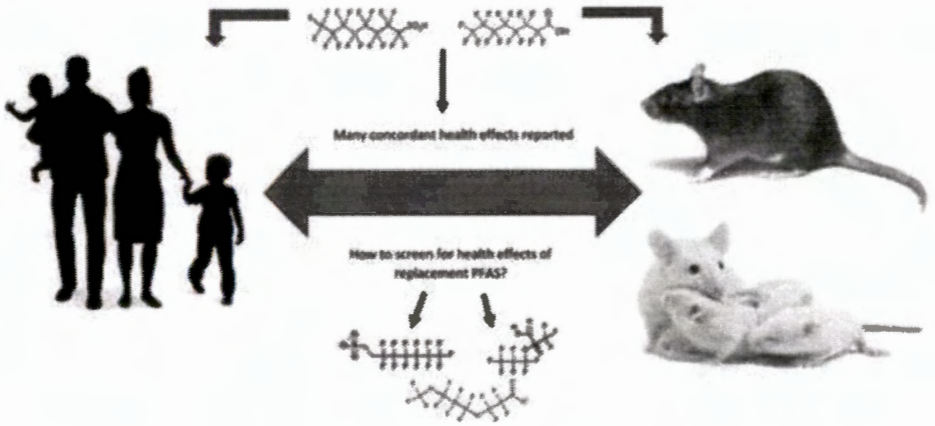
Abstract

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

Environmental Science & Technology

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pubs.acs.org/est

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

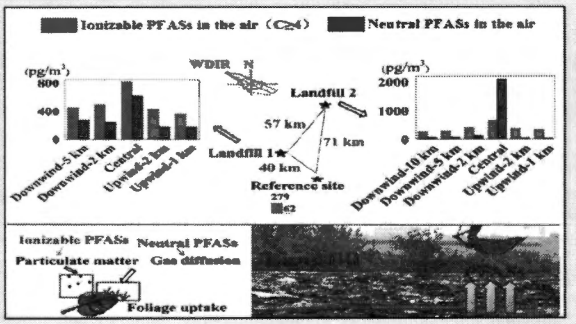
Ying Tian,[†] Yiming Yao,[†] Shuai Chang,[†] Zhen Zhao,[†] Yangyang Zhao,[†] Xiaojia Yuan,[†] Fengchang Wu,[‡] and Hongwen Sun*,[†]

[†]MOE Key Laboratory of Pollution Processes and Environmental Criteria, College of Environmental Science and Engineering, Nankai University, 300350 Tianjin, China

[‡]State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Science, 100012 Beijing, China

S *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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