

**ENVIRONMENTAL METHANE COMPLIANCE
REPORT OF FINDINGS**

Coffin Butte Landfill

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Signatory Page

**Environmental Methane Compliance - Report of Findings
Coffin Butte Landfill**

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I. Introduction

Guzi-West Inspection and Consulting, LLC (Guzi-West) was retained in May 2024 to provide environmental consulting services for the subject facility, Coffin Butte Landfill (CBL). CBL is located at 28972 Coffin Butte Road, Corvallis, OR 97330; see Figure 1, Appendix A. The CBL is owned and operated by Valley Landfills, Inc. (VLI). This report of findings presents the results of an independent review of the facility's management and permitting compliance of the landfill gas, methane, as well as if methane generation is likely to pose health concerns for the surrounding community. As explained in further detail below, our review focuses on monitoring events and corresponding reports from the third quarter of 2022 to the second quarter of 2024. Total methane production by the landfill and modeling of methane dispersement throughout the site and beyond are outside our scope of work. The report's findings, conclusions, and recommendations will not be submitted to regulatory agencies and/or other parties outside of VLI, unless Guzi-West is specifically authorized to do so by VLI. Guzi-West prepared the report in conjunction with GHD, a global, multidisciplinary professional services firm with expertise in the environmental, engineering, architecture, and design and construction fields. The Sections below present the air quality regulations governing the landfill; how the landfill controls, manages, and monitors methane and other landfill gases; the regulatory compliance record of CBL specific to methane; potential health effects of methane, carbon dioxide, and other landfill gases; and finally conclusions and recommendations. Again, this report primarily focuses on methane alone, but other landfill gases are briefly discussed where appropriate.

II. Regulatory Background

The facility began accepting waste in 1978, has a design capacity of approximately 39.7 million tons, and a projected closure date of 2041. The subject facility is regulated under numerous regulatory permits and as such numerous Plans, Manuals, and Documents go into varying levels of details based upon their specific topics; the additional Plans, Manuals, and Documents are available under separate cover by request. The primary regulations specific to air quality and the subject scope of work are as follows: the Clean Air Act (CAA), the National Emission Standards for Hazardous Air Pollutants (NESHAPs), the New Source Performance Standards (NSPS), and the landfill gas emission requirements specified within Oregon Administrative Rules (OAR) Chapter 340, Division 239. Title V of the CAA requires each state to develop a comprehensive operating permit program for major industrial sources of air pollution. Oregon's Department of Environmental Quality (DEQ) is the governing body responsible for enforcing facilities subject to Title V within the state of Oregon. CBL is an active municipal solid waste landfill (MSWLF) operating under Oregon DEQ Title V Operating Permit No. 02-9502-TV-01. CBL's Title V Permit was issued October 30, 2009 and was set to expire October 1, 2014 but has been administratively extended by Oregon DEQ to date; a copy of the permit is provided in Appendix B. The facility's Title V Permit imposes emission limits and standards, testing, monitoring, and recordkeeping requirements specified under the CAA, NESHAPs, and NSPS.

On March 10th, 2020, Oregon Governor, Kate Brown, signed Executive Order No. 20-04 which directed state agencies to reduce and regulate greenhouse gas emissions. In an effort to meet the Governor's directive, the Oregon Environmental Quality Commission (EQC) and DEQ subsequently conducted a formal Landfill Gas Emissions rulemaking where they evaluated regulations in effect in neighboring states and their approaches to regulating and reducing greenhouse gas emissions. This led to the adoption of Oregon-specific landfill gas emission rules.

CBL maintains greater than or equal to 200,000 tons of waste-in-place and as such is required to adhere to the emission limits and standards, testing, monitoring, and recordkeeping requirements specified within OAR Chapter 340 Division 239 (OAR 340-239), the conditions specified within OAR 340-239 are notably more stringent than federal regulations specified under the CAA, NESHAPs, and NSPS. Due to the increased requirements, CBL retained SCS Field Services (SCS-FS) in the Fall of 2022 to complete the required Surface Emissions Monitoring (SEM). As detailed in SCS-FS's quarterly reports and summarized immediately below, the following requirements are stricter than the NESHAP regulations 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 parts per million by volume (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 an existing requirement under Federal regulations, however the average methane concentration limit of 25 ppmv is unique to OAR 340-239.

SURFACE EMISSION RECORDKEEPING

340-239-0700 A landfill owner or operator subject to this division must maintain the following records for at least five years:

- 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, thus recordkeeping is now kept on emission points 100 ppmv or over. All repeatable instantaneous records of 100 ppmv or higher (taken during SEM) must be kept for 5 years AND recorded in the semi-annual reports.

Guzi-West's compliance review for the subject facility is presented in Section IV and focuses on CBL's compliance record when the more stringent rules under OAR 340-239 became effective in the third quarter of 2022.

III. Landfill Gas Collection & Control System (GCCS)

All municipal waste landfills produce landfill gases and must utilize engineering controls to manage and control their production. Typically, landfill gases comprise a mixture of methane 45%-60% and carbon dioxide 40%-60% by volume. Common contaminant gases and the processes by which they are generated include:

- methane generated from the decomposition of organic materials by bacterial action under anaerobic conditions;
- carbon dioxide typically generated by oxidation of methane in aerobic layers surrounding the landfill;
- other gases, including sulphur dioxide, helium, hydrogen, and gaseous alkanes and alkenes associated with wastes and degradation products within the landfill;
- and organic vapours associated with the presence of petroleum and other hydrocarbon products.

CBL maintains landfill gases (LFG) via the utilization of a gas collection and control system (GCCS). A new GCCS Design Plan was prepared by Energyneering Solutions and submitted to CBL on December 9, 2021 in order to meet new requirements specified within OAR 340-239. A copy of the Plan is included in Appendix C, and the description presented herein is based upon the information presented within the Plan. Generally speaking, a network of extraction wells and vertical and horizontal piping are utilized to capture LFG and route it to the nearby electrical generation plant owned and operated by the Pacific Northwest Generating Cooperative (PNGC); see Figure 2, Appendix A. A Master Design Plan exists for the facility's GCCS in order to accommodate placement of additional components as additional waste is placed into new landfill cells, see Appendix C.

The operation of CBL's GCCS has been designed in accordance with 340-239-0110(1)(c)(C) in order to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment. Because CBL already had an established GCCS, it was capable of calculating the actual maximum gas flow rate using the equation from 40 CFR 60.755(a)(1)(ii). The maximum expected LFG flow rate for the site was used for sizing the GCCS. The LFG generation rate calculations were performed using the United States Environmental Protection Agency (EPA) Landfill Gas Emission Model (LandGEM) (values - $k=0.04/\text{year}$ and $L_0=80 \text{ m}^3/\text{Mg}$), historical waste receipts and the permitted design capacity of the facility. The maximum LFG generation rate is projected to be approximately 6900 standard cubic feet per minute (SCFM). The LandGEM emissions model is a design tool which uses the information available to project future operating conditions. This model was developed based upon operating conditions at a cross-section of landfills within the United States and is approved for use by the EPA. Actual operating parameters may dictate changes in the system flow characteristics and process equipment as the system is developed. The LandGEM model meets the requirements of OAR 340-239-0110(2).

As of 2021, the GCCS specifically consisted of 312 active vertical extraction wells and horizontal collectors that each adhere to a 55 feet minimum depth and 15 feet minimum spacing between wells. The GCCS includes LFG piping capable of maintaining an adequate vacuum even under maximum load of gases, trenching & sloping that consists of a 3% grade to ensure proper drainage of liquids towards the landfill, and wellheads equipped with positive closing throttle valves, and two sampling ports to measure oxygen and nitrogen concentrations. All aspects of the GCCS have

been constructed using PVC, high density polyethylene (HDPE) pipe, fiberglass, corrosion resistant steel, neoprene gaskets, and other non-porous corrosion resistant materials. Condensate that forms in the GCCS piping is discharged to the leachate collection system (LCS) via direct connections to LCS clean/access riser or to condensate pump stations located around the perimeter of the disposal area. Condensates are disposed of with landfill leachate in accordance with the requirements of the facility Solid Waste Permit. Again, collected LFG is directed to an electrical generation plant owned and operated by the Pacific Northwest Generating Cooperative (PNGC) which consists of three 3516 Caterpillar engines and two 3520 Caterpillar engines; the engines are respectively capable of combusting approximately 287 SCFM and 527 SCFM each. PNGC's system also includes two backup utility flares to handle excess LFG totaling 3,000 SCFM. Essentially, LFG is captured by the GCCS and routed to the PNGC power plant where it's utilized to generate power; excess LFG, if present, is routed to the facility utility flares. Flare exhaust and LFG flow rates are continuously monitored using a thermocouple installed at the flare tip and an orifice plate along LFG pipes downstream of the flare system in accordance with OAR 340-239-0110 (2)(c)(A)(ii)(I).

IV. CBL Methane Monitoring and Regulatory Compliance Record Review

CBL is required to adhere to the Clean Air Act (CAA), the National Emission Standards for Hazardous Air Pollutants (NESHAPs), the New Source Performance Standards (NSPS), and the landfill gas emission requirements specified within OAR 340-239. The most stringent standards must be adhered to and at this time the conditions specified within OAR 340-239 are equally or more stringent than the conditions specified in the CAA, NESHAPs, and the NSPS. OAR 340-239 references three primary types of surface emission measurements for methane: instantaneous, integrated, and pressurized piping and/or components. Instantaneous measurements are collected at a specific location and time, while integrated measurements are averages of several measurements across an area or grid. Concentration limits for instantaneous and integrated measurements are specified within OAR 340-239 where additional monitoring requirements and corresponding corrective actions are imposed based upon exceedances of the established limits. The flowchart presented in Appendix D depicts how exceedances over given limits trigger additional follow-up monitoring, tighter monitoring grids, and requirements for GCCS system expansion if the follow-up monitoring identifies remaining exceedances. For instance, should any measurements from instantaneous or integrated routine monitoring be in exceedance of the instantaneous methane limit of 500 ppmv and/or the integrated methane limit of 25 ppmv, the first re-monitoring event must occur 10-days from the initial exceedance. If the first re-monitoring event finds a second exceedance over the 500 ppmv or 25 ppmv thresholds, a second re-monitoring must be performed within 10 days. If the second re-monitoring identifies exceedances over the 25 ppmv integrated thresholds, GCCS system expansion must be performed no later than 120 days after the date the third exceedance was identified. Instantaneous exceedances are re-monitored in an initial 10-day monitoring period, 2nd 10-day monitoring period, as well as a 1-month follow-up monitoring period; GCCS system expansion must be performed no later than 120 days after the date the fourth exceedance was identified. Similarly, GCCS pressurized piping and/or components containing landfill gas under positive pressure must also be monitored for leaks. If a component leak is found exceeding 500 ppmv methane, it must be tagged and repaired within 10 days. The flowchart provided in Appendix D identifies additional requirements/actions for methane concentrations found between 100-499 ppmv, <100 ppmv, <25 ppmv and provides a visual representation of the instantaneous and integrated monitoring process.

As previously noted, Surface Emissions Monitoring (SEM) at CBL is conducted by SCS Field Services (SCS-FS) and in accordance with OAR 340-239 requirements. Per SCS-FS documentation, the subject facility is divided into a grid of 105 separate 50,000 square foot areas; see Figure 3, Appendix A for an aerial photograph of the landfill with an overlay of the 105 separate grids. Surface emissions readings are recorded every five seconds while SCS-FS personnel walk monitoring pathways through the 105 grids. Meanwhile, instantaneous measurements are collected from cracks, holes, and other cover penetrations in the surface. Any instantaneous measurements exceeding the 100 or 500 ppmv standards (reporting and compliance levels, respectively) are GPS tagged and stake-marked for onsite personnel to perform remediation or repairs. The integrated averages for each grid are based on the readings collected every 5 seconds and stored on the instrument. The readings are downloaded, and the averages calculated for each grid using SCS eTools®. The most recent SCS-FS quarterly SEM report (Q2 2024) specifies monitoring is being performed on 25-foot pathways based on a prior inspection, in which exceedances were observed. 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 quarterly monitoring on a 100-foot spacing. Figure 4, Appendix A, depicts the monitoring pathway utilized by SCS-FS during the most recent field monitoring events conducted on June 11, 16, 18, 24, 26, and July 6, 16, and 26, 2024. The monitoring equipment includes a Thermo Scientific TVA 2020 Portable Flame Ionization Detector (FID) and a Weather Anemometer. The FID measures airborne methane between 1-50,000 ppmv and is calibrated in accordance with EPA Method 21. The Weather Anemometer records the weather conditions onsite, ensuring accurate measurement conditions (monitoring cannot be performed in wind exceeding 10mph or rain). To collect measurements, the FID inlet is held within 2 inches of the landfill surface while walking the grid in parallel paths. During monitoring for the pressurized pipe and components, the FID inlet is held a half inch from the component. Instantaneous monitoring results are recorded onsite if a reading above the 100 ppmv reporting threshold or the 500 ppmv compliance threshold is noted. Again, integrated monitoring results are calculated from the measurements collected every five seconds while SCS-FS traverses monitoring paths within each established grid; the measurements are stored on the FID and subsequently averaged to determine an integrated average for each of the 105 grids. The compliance summary presented below focuses on CBL's compliance record when the more stringent rules under OAR 340-239 became effective in the third quarter of 2022. Table 1, Appendix E, identifies the monitoring period, instantaneous, integrated, and pressurized piping and/or component monitoring results broken down by 'initial', '1st 10-day re-monitoring', '2nd 10-day re-monitoring', '1-month re-monitoring' (instantaneous only), as well as any notes made during Guzi-West's review.

Monitoring and determining compliance for an active landfill is uniquely challenging in that new material is constantly being added, settling, and decaying, which results in the generation of increasing amounts of landfill gas. OAR 340-239 appears to provide a structure for more frequent and stringent monitoring of landfill gas generation where initial exceedances are warning signs that trigger tighter monitoring pathways, frequency, recordkeeping, etc. Close follow-up is required for re-monitoring to determine if the landfill was able to implement corrective actions to reduce the initial exceedance below regulatory thresholds. In the event the exceedances remain above the thresholds for consecutive monitoring events, then corrective actions, ultimately involving system expansion, must be implemented. Thus, exceedances appear to be a relatively

expected outcome when operating an active municipal solid waste landfill. In our interpretation, the goal of OAR 340-239 is to cumulatively reduce landfill gas generation within the State of Oregon, thereby reducing greenhouse gas emissions within the state, by requiring landfill operators to more closely monitor and manage landfill gas generation. In that sense, we expect CBL's 'compliance' to be measured as much by the implementation of corresponding corrective actions after an exceedance, as by the record of compliance/exceedance of emission measurements alone.

As depicted on Table 1, Appendix E, eight individual quarters were evaluated for CBL during our review (Q3 2022 – Q2 2024) and instantaneous and/or integrated exceedances were identified in each of the eight quarterly monitoring events. Five quarters had individual exceedances which remained above regulatory threshold from the initial monitoring, 1st 10-day re-monitoring, 2nd 10-day re-monitoring, and 1-month re-monitoring events thereby requiring system expansion. Six quarters had integrated exceedances which remained above regulatory threshold from the initial monitoring, 1st 10-day re-monitoring, and the 2nd 10-day re-monitoring events thereby requiring system expansion. CBL, in turn, performed gas collection and control system expansions within 120 days following each individual and/or integrated exceedance during the subject review period (Q3 2022 – Q2 2024).

Due to the previously mentioned challenge of assessing landfill gas production for an active landfill, Guzi-West felt comparisons to other Oregon landfills would give the best representation of if CBL's methane exceedances and accompanying corrective actions were typical in the industry or not. Guzi-West submitted a freedom of information act request to the Oregon DEQ on October 31, 2024 for quarterly SEM reports from the third quarter of 2022 to the second quarter of 2024 for the Columbia Ridge, Knott, and Roseburg Landfills; all of which are representative landfills for comparison. Initially, a single quarterly SEM report was provided for Q2 2024 for the Roseburg Landfill; all other reports provided were annual and semi-annual summary reports. Unfortunately, the annual and semi-annual reports do not contain the level of detail quarterly reports do and thus statistical comparisons were generally not possible. Specifically, the annual and semi-annual reports do not include, and are not required to, the total number of integrated and instantaneous measurements for a given monitoring event, definitions for single measurements, etc. (i.e. the reports typically provide summaries of the number of total exceedances, but not how many overall measurements were collected for a given monitoring event where statistical analyses could be calculated and compared between landfills). Guzi-West made numerous additional requests for quarterly reports for the additional landfills; ultimately, Oregon DEQ Air Quality Permit Coordinator, Cynthia Ferris, explained that, "Generally, the SEM reports are hidden within the annual and semi-annual reports. We don't receive separate reports from the facilities each quarter. The permit only requires reporting of instantaneous surface methane readings greater than 100 ppm (Condition 51.a.i) and says nothing of reporting the integrated measurements, so we may not have that information, but the source is required to keep those records." Essentially, what is contained in the annual and semi-annual reports is all that is required to be kept by Oregon DEQ and by extension all that can be requested from them. Nevertheless, the one quarterly SEM report that was provided was the Q2 2024 report from the Roseburg Landfill does provide a direct comparison for a randomly selected snapshot in time; a copy of the report is provided in Appendix F. Both CBL and Roseburg Landfill are municipal solid waste landfills, with Roseburg Landfill being roughly a fifth of the size of CBL. Further, SCS Engineers performs the surface emissions monitoring at the Roseburg Landfill, the same firm that performs surface emissions monitoring for CBL, making it ideal for comparison as similar or identical equipment, employees, and standard operating procedures were utilized. We recognize and acknowledge comparison of a single

quarterly event is insufficient to determine compliance over time between the two facilities; however, the goal of making the comparison is to gauge what is typical in the industry. Even comparison of a single monitoring event can provide the general public, report readers, and CBL staff a valuable assessment of how CBL compares against industry peers. It should be noted the EPA collected instantaneous measurements for the CBL during the second quarter of 2024, but did not for the Roseburg Landfill. The most representative method of comparing the landfills is to utilize data only collected by SCS-FS due to the reasons specified above regarding the same employees, standard operating procedures, etc.; regardless, the data is presented and analyzed both including and excluding the EPA data. As shown in Table 2, Appendix E, 63% of the instantaneous measurements collected from the Roseburg Landfill exceeded the 500 ppmv methane limit in the initial monitoring event (12 of the 19 instantaneous measurements) compared to 56% of the CBL for the same period (22 of the 39 instantaneous measurements). If the EPA measurements are included for CBL, 78% of the instantaneous measurements exceeded the 500 ppm methane limit (63 of the 80 measurements). The Roseburg Landfill did not have any exceedances of the integrated methane limit, 25 ppm, and 42 grids were monitored out of the total 54 grids present. Grids are not monitored, or required to be, if active landfill operations are occurring in a given grid. Meanwhile, 7% of the CBL integrated grids monitored exceeded the integrated methane limit (3 of the 42 grids monitored). No integrated measurements were collected/calculated by the EPA.

The second component analyzed was how quickly were the instantaneous and integrated exceedances able to be corrected by either facility. The Roseburg Landfill was able to implement corrective actions wherein the first 10-day re-monitoring event showed no exceedances of the instantaneous limit remained; CBL was unable to implement successful corrective actions for 16 of the 17 instantaneous exceedances and system expansion was required in those areas. CBL was able to implement corrective actions for the integrated exceedances and all 3 integrated exceedances returned to below methane limits within the first 10-day monitoring event. Generally speaking, the number of exceedances between the two facilities is comparable, while the Roseburg Landfill was able to implement corrective actions more quickly to resolve the issues identified in the instantaneous exceedances. CBL was able to implement corrective actions to resolve the exceedances of the integrated limit, but the instantaneous exceedances identified led to the expansion of the gas collection and control system as corrective actions were unable to be implemented within one month. In summary, we expect this comparison to be typical of the industry where some landfills will have more exceedances than others in given quarters; corrective actions will be quickly and easily implemented for some areas where exceedances are required while other exceedances will identify areas wherein system expansion is required. Our interpretation remains that the regulation, by design, is meant to encourage continuous adaptive solutions to identified problems as the need arises. The triggers for re-monitoring and eventually system expansion are in place to allow a facility to attempt to rectify exceedances with small scale solutions until it becomes apparent that the system itself needs additional resources to handle the amount of gas that the landfill is producing. The purpose of the regulation is not to prevent exceedances, it is to use the identification of exceedances as a guide to address the facility's gas collection and control needs.

V. Potential Health Effects of Methane, Carbon Dioxide, and Other Landfill Gases

CBL requested Guzi-West objectively review the site's generation of the landfill gas, methane, and any potential health effects it could pose to the community surrounding the facility. Presented below is a discussion of the typical health effects associated with landfill gases, regulatory limits and health-based goals for the primary landfill gases (methane and carbon dioxide), the exposure paths landfill gases typically follow, and finally an evaluation of the subject facility's potential impacts to the community.

The primary gases produced by a landfill are methane and carbon dioxide making up 99%, or greater, of gases typically produced. In addition to methane and carbon dioxide, landfill gases can also contain trace amounts of other gases, including volatile organic compounds (VOCs) and hazardous air pollutants. According to the Agency for Toxic Substances & Disease Registry (ATSDR) (a federal public health agency of the U.S. Department of Health and Human Services), the short-term and long-term effects associated with landfill gases can include the following:

1. Short-Term Effects:

- o Odors: Unpleasant odors from sulfur compounds can cause headaches, nasal congestion, eye, nose, and throat irritation, cough, and nausea.
- o Respiratory Issues: Exposure to landfill gas can exacerbate asthma and other respiratory conditions.
- o Direct Exposure: People living near landfills may experience skin irritation or dermatitis from contact with contaminated soil or water.
- o Eye Irritation: Gases like H₂S can cause eye irritation, redness, and watering.

2. Long-Term Effects:

- o Mental Health: Persistent odors and health concerns can lead to stress and anxiety among community members.
- o Carcinogenic Risks: Though they are normally only present in landfill gas in small quantities and therefore unlikely to cause any community health effects, it is well known that VOCs such as benzene and other non-methane organic compounds pose a carcinogenic hazard to human health.
- o Chronic Exposure: Prolonged exposure to low levels of certain VOCs can lead to more serious neurological effects, including cognitive impairments.

Methane and carbon dioxide are both classified as simple asphyxiants meaning that, within enclosed areas, either gas can build up and displace oxygen creating an oxygen deficient atmosphere. Further, methane is considered a flammable gas while carbon dioxide is not. Regulatory limits and health-based values for both gases are discussed immediately below. The Occupational Safety and Health Administration (OSHA) defines an oxygen deficient atmosphere as an oxygen content below 19.5% by volume. OSHA has not established a Permissible Exposure

Limit (PEL) for methane; however, OR-OSHA has an established methane PEL of 1,000 parts per million (ppm) when evaluated as an 8-hour time weighted average, a 30-minute excursion limit of 3,000 ppm (3x the PEL), and a ceiling limit of 5,000 ppm (5x the PEL). Federal OSHA and OR-OSHA have established the same PEL for carbon dioxide at 5,000 ppm (0.5% CO₂ in air) averaged over an 8-hour workday, and OR-OSHA has further established 15,000 ppm as a 30-minute excursion limit (3x the PEL), and a ceiling limit of 25,000 ppm (5x the PEL). Per the National Institute for Occupational Safety and Health (NIOSH), methane is considered a flammable gas with a lower explosive limit (LEL) of 5% by volume and an upper explosive limit (UEL) of 15% by volume. NIOSH has established health-based immediately dangerous to life or health (IDLH) values which are set at 10% of the LEL for specific air contaminants, including methane, because the explosive hazards are deemed a greater risk; the IDLH for methane is 5,000 ppm (10% of the LEL for methane, which is 50,000 ppm). Carbon dioxide has an established IDLH of 40,000 ppm.

There are generally considered two main exposure paths that landfill gases can take to affect community health:

1. **Subsurface Migration:** Gases can move through the soil and enter structures or utility corridors adjacent to the landfill. These exposure routes can be mitigated and reduced by appropriate design of landfill gas collection systems and equipment as well as regular air quality monitoring. The 2021 Gas Collection and Control System Design Plan prepared by Energyneering Solutions (Appendix C) depicts and describes how landfill gases are captured, monitored, and reported in detail.
2. **Ambient Air:** Gases can migrate from the landfill surface into the surrounding air, carried by the wind. Figure 5, Appendix A, identifies the parcels owned by CBL, as well as parcels of surrounding property owners.

Subsurface migration of methane is a well-known concern for landfill facilities; again, the facility's gas collection and control system (Appendix C) addresses the engineering design for collection of landfill gases facility-wide, specifies how subsurface methane migration is monitored and reported, and identifies future expansion of the system. Each month CBL personnel measure methane concentrations down to 0.1% in six landfill gas probes installed in-ground to monitor any subsurface migration of landfill gases. As depicted in Figure 6, Appendix A, the sub surface gas probes are located along the south-southwestern portion of the landfill wherein CBL has gas and leachate collection lines are routed throughout the landfill to the PNGC power facility. No other power lines or other public utilities are present within the footprint of the CBL facility (i.e. the only subsurface utilities on-site are those associated with CBL's landfill gas and leachate collection system). In addition to the probe monitoring, each month CBL personnel measure methane concentrations down to 0.1% in the interiors of eight site buildings and structures owned and utilized by CBL. The monitoring results for landfill gas monitoring, including those associated with landfill gas probes around the perimeter of the landfill, are reported annually in the facility's Annual Environmental Monitoring Report. Based upon electronic records from 2006 to 2023, as well as an anecdotal information provided by Ian Macnab, CBL Environmental Manager, methane has not been detected in any monthly monitoring event within the six probes, nor within the interiors of the eight buildings and structures since at least 2006. Records prior to 2006 were not reviewed.

The second potential route of community exposure is migration through ambient air wherein landfill gases can escape from the landfill surface and be carried by the wind into the community.

This appears to be a significant concern in the community based upon local reporting where references to instantaneous measurements with concentrations exceeding 100,000 ppm have been identified on-site. Evaluating potential community impacts with instantaneous readings is inferior in our opinion to utilizing integrated readings. Instantaneous readings are typically collected from a given area of concern (i.e. a hole in a landfill liner, below temporary tarps and cover, etc.) and represent ‘hot spots’ wherein measurements are collected to determine if immediate corrective actions are required. This is demonstrated in the previously referenced CBL Q2 2024 SEM report where the EPA identified a methane concentration of 118,265 ppm in an instantaneous reading collected on June 26, 2024, from location A20 (this measurement is the highest single measurement ever identified from Q3 2022 to Q2 2024). As required by OAR 340-239, the same location was subsequently remeasured on July 6, 2024, following implementation of corrective actions and a methane concentration of 27 ppm identified. Similarly, the EPA identified 41 instantaneous readings above 500 ppm in their June 26, 2024 field inspection, all but 2 of those locations had fallen below 500 ppm when remeasured on July 6, 2024. In contrast, the integrated monitoring utilizes 105 separate grids divided evenly across the landfill, and methane measurements are automatically collected every five seconds with an FID as field personnel systematically traverse across the defined grids collecting measurements within 2-inches of the landfill surface. Averages are then calculated for each grid utilizing thousands of individual methane measurements and each grid average then compared against the 25 ppmv methane limit. By averaging thousands of measurements, the high measurements are still included but their significance can be seen as a whole for the entire grid, as well as for the landfill as a whole. For these reasons we believe the integrated monitoring measurements are the superior data set to evaluate the landfill’s cumulative methane generation and potential impacts to the community. The modeling of landfill gas migration is beyond our scope of work; however, landfill gases are well known to dissipate in ambient air the further away one travels from the landfill/source. Therefore, to provide a general understanding of the likelihood of impacts to the community, Guzi-West identified the highest integrated methane level identified for a given grid to date and subsequently compared that grid to the regulatory limits and health-based goals in order to provide a worst case scenario analysis specific to methane. That is, comparing the highest integrated methane concentrations identified on-site provides a worst-case scenario analysis as the concentrations are known to dissipate in ambient air as you move away from the landfill itself and toward the property boundary and the surrounding community. Since integrated monitoring began to be required under OAR 340-239 (third quarter of 2022), the highest average measurement for any single grid was 217.64 ppmv as measured during the second quarter of 2023; this is 4.5 times below the OR-OSHA PEL for methane (1,000 ppm), 22 times below the IDLH for methane (5,000 ppm), and 229 times below the lower explosive limit for methane (50,000 ppm).

VI. Conclusions and Recommendations

Guzi-West’s scope of work focused on evaluating the subject facility’s permitting compliance specific to the landfill gas, methane, in addition to evaluating if methane gas production from the facility is posing a health risk to the surrounding community. Our evaluation was done against the backdrop of a relatively newly implemented Oregon rule (OAR 340-239), which imposed more stringent requirements specific to landfills and methane production, monitoring, recordkeeping and reporting. As previously mentioned, monitoring and determining compliance for an active landfill is uniquely challenging in that new material is constantly being added, settling, and decaying, resulting in the generation of increasing amounts of landfill gas. Eight consecutive

quarterly reports were reviewed for the subject site starting in quarter three of 2022 and ending in quarter two of 2024; CBL had repeated individual exceedances in five quarters and repeated integrated exceedances in six quarters, which collectively triggered corrective actions and/or system expansion to be performed. As required by OAR 340-239, CBL implemented corrective actions within 120 days for each area wherein exceedances were identified. Guzi-West felt comparisons to other Oregon landfills would give the best representation of if CBL's methane exceedances and accompanying corrective actions were typical in the industry or not. Although obtaining quarterly reports for numerous landfills for the same monitoring period proved impossible, a quarterly SEM report from Roseburg Landfill was able to be obtained and provided a direct comparison for a representative facility. The number of exceedances between the two facilities was comparable, while the Roseburg Landfill was able to implement corrective actions more quickly to resolve the issues identified in the instantaneous exceedances for the subject monitoring period. In the end, we anticipate this comparison to be typical of the industry wherein some landfills will have more exceedances than others in given quarters; corrective actions will be quickly and easily implemented for some areas where exceedances are required while other exceedances will identify areas wherein system expansion is required. Our interpretation remains that the purpose of the regulation is not to prevent exceedances, it is to use the identification of exceedances as a guide to address the facility's gas collection and control needs. CBL is operating in compliance with OAR 340-239, and we expect their monitoring, reporting, and overall compliance record to be similar to that of their industry peers.

In the evaluation of landfill gases and potential impacts to the community surrounding the CBL facility, Guzi-West first assessed the potential exposure pathways landfill gases could follow. No measurable methane concentrations have been identified migrating in the subsurface since at least 2006 in the closest and most likely areas where landfill gases would be expected to migrate. Therefore, we conclude it is very unlikely subsurface migration of landfill gases is occurring and potentially impacting the surrounding community. A methane concentration of 100,000 ppm or greater was identified at the facility and is well above the lower explosive limit for methane (50,000 ppm), however re-monitoring of the same location following implementation of corrective actions resulted in a concentration of 27 ppm. These measurements were taken during instantaneous monitoring which, while useful for identifying precise locations of methane release, is not representative of the broader system, a metric that integrated monitoring captures more accurately. Further, methane and carbon dioxide can cause potential hazards within confined spaces (either due to the creation of an oxygen deficient atmosphere, and/or in the case of methane, due to the creation of an explosive risk); that said, neither gas is expected to pose asphyxiation or explosive concerns in ambient air to the community surrounding CBL. This opinion is largely based upon the results of the integrated monitoring conducted at the subject facility, which began to be required under OAR 340-239 at the start of the third quarter of 2022. The highest average methane emission for any single CBL grid was 217.64 ppm measured during the second quarter of 2023; this is 4.5 times below the OR-OSHA PEL for methane (1,000 ppm), 22 times below the IDLH for methane (5,000 ppm), and 229 times below the lower explosive limit for methane (50,000 ppm). This risk is further reduced in ambient air the farther one travels away from the landfill. In conclusion, it doesn't appear methane or carbon dioxide are likely to be present at concentrations that pose any immediate health concerns to the surrounding community. Community concerns regarding increasing greenhouse gas emissions from landfills and all sources is outside the scope of this project.

Although OAR 340-239 does not specifically require mapping and a detailed description of what the system expansion consisted of, we recommend CBL personnel keep a log of the components making up the system expansion, implementation date/s, along with mapping of what was added. Appendix G serves as a placeholder for this documentation. We recommend CBL consider implementation/expansion of continuous air monitoring devices around the property boundary to monitor and guide corrective actions on-site in regards to air quality, as well as to demonstrate to the local community CBL's commitment to continuous compliance with applicable air quality regulations. This, along with consistent community engagement, appear to be the key in developing/re-establishing community trust, and showing that CBL is now, and will continue to operate within compliance of all regulatory permits at the site.

VII. References

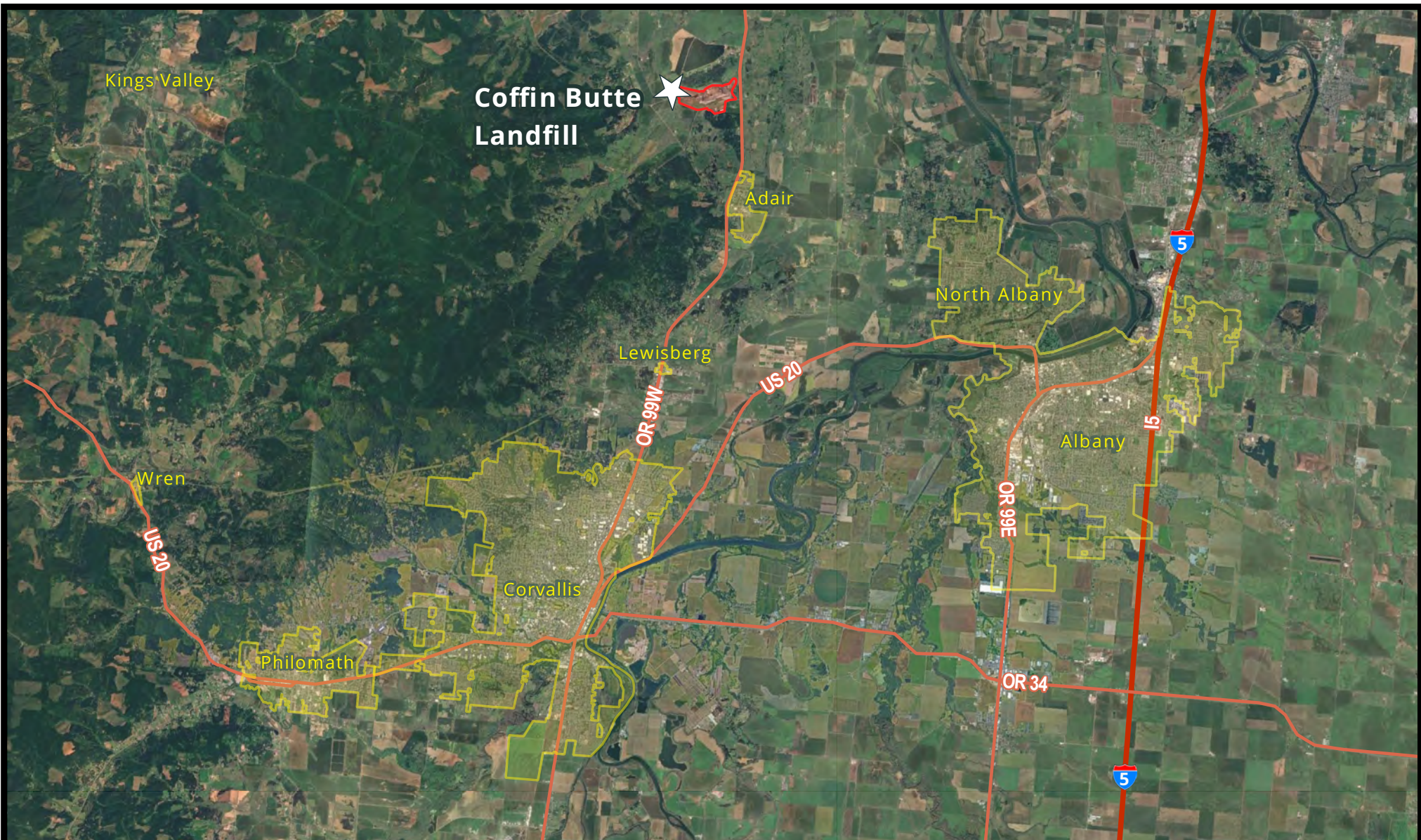
1. Oregon Department of Environmental Quality, Chapter 340 Division 239 Landfill Gas Emissions, Oregon Secretary of State Website, Oregon State Government, https://secure.sos.state.or.us/oard/displayDivisionRules.action;JSESSIONID_OARD=vLBhHxWySNDU4cA9c9f3TBy7UG2rlPassQ563SVBaem2TLpUJavH!-211748414?selectedDivision=6533
2. The Agency for Toxic Substances & Disease Registry 2001, ATSDR Website, U.S. Health and Human Services Department, U.S. Government, accessed 9/25/2024, <https://www.atsdr.cdc.gov/HAC/landfill/html/intro.html>
3. The National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards, NIOSH website, U.S. Centers for Disease Control (CDC), U.S. Government, accessed 9/25/2024, <https://www.cdc.gov/niosh/npg/default.html>
4. SCS Field Services, Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring Q3 & Q4 2022, Q1, Q2, Q3, & Q4 2023, Q1 & Q2 2024, Coffin Butte Landfill. 1/6/2023, 1/23/2023, 5/19/2023, 8/17/2023, 11/15/2023, 1/16/2024, 5/15/2024, 8/19/2024
5. Energyneering Solutions, 2021 Gas Collection and Control System Design Plan, Coffin Butte Landfill. 12/9/2021
6. Ian Macnab, Republic Services – Coffin Butte Landfill Environmental Manager, personal communication, 11/13/2024

APPENDIX A

Figures

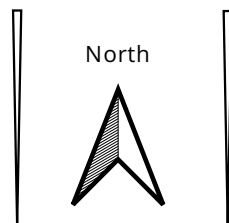
Exhibit 41

Page 16 of 249



0 1 2 mi

NOT TO SCALE - FOR APPROXIMATION ONLY
 Datum: North American Datum 1983
 Projection: StatePlane California I
 FIPS 0401 Feet
 Cartographer: Taylor Bradley



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 Job Number: 2024-377B

Figure 1 - Vicinity Map

Coffin Butte Landfill
 28972 Coffin Butte Road
 Corvallis, OR 97330

Exhibit 41

Disclaimer: Sample locations on map are estimated. They do not represent all homogenous areas where this material may be found. Map is not intended to function as architectural or engineering plans.



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Datum: North American Datum 1983

Projection: StatePlane California I

FIPS 0401 Feet

Cartographer: Taylor Bradley

Disclaimer: Sample locations on map are estimated. They do not represent all homogenous areas where this material may be found. Map is not intended to function as architectural or engineering plans.

North



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Job Number: 2024-377B

Figure 2 - Proximity to Power Station

Coffin Butte Landfill

28972 Coffin Butte Road

Corvallis, OR 97330

Exhibit 41



Original map created by:
SCS - Field Services
Original map name: Surface Emissions
Monitoring Site Grid Map

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Last Modified On: 9/19/2024
Job Number: 2024-377B

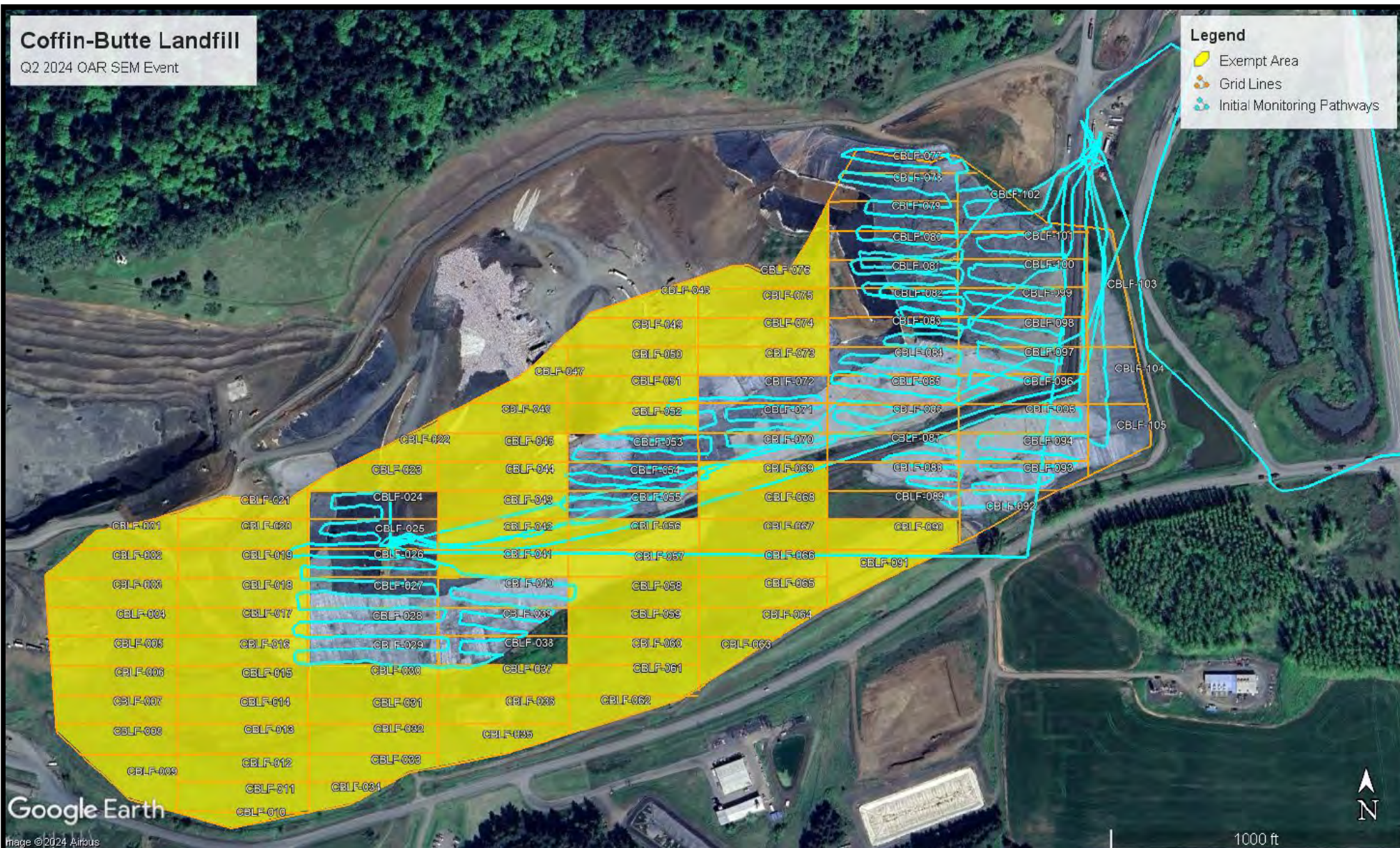
Figure 3 - SCS Monitoring Grid Map
Coffin Butte Landfill
28972 Coffin Butte Road, Corvallis, OR 97330
Exhibit 41

Coffin-Butte Landfill

Q2 2024 OAR SEM Event

Legend

- Exempt Area
- Grid Lines
- Initial Monitoring Pathways



Original map created by:

SCS - Field Services

Original map name: Second Quarter 2024

Initial Surface Emissions Monitoring Pathway

GūziWest
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Last Modified On: 9/19/2024

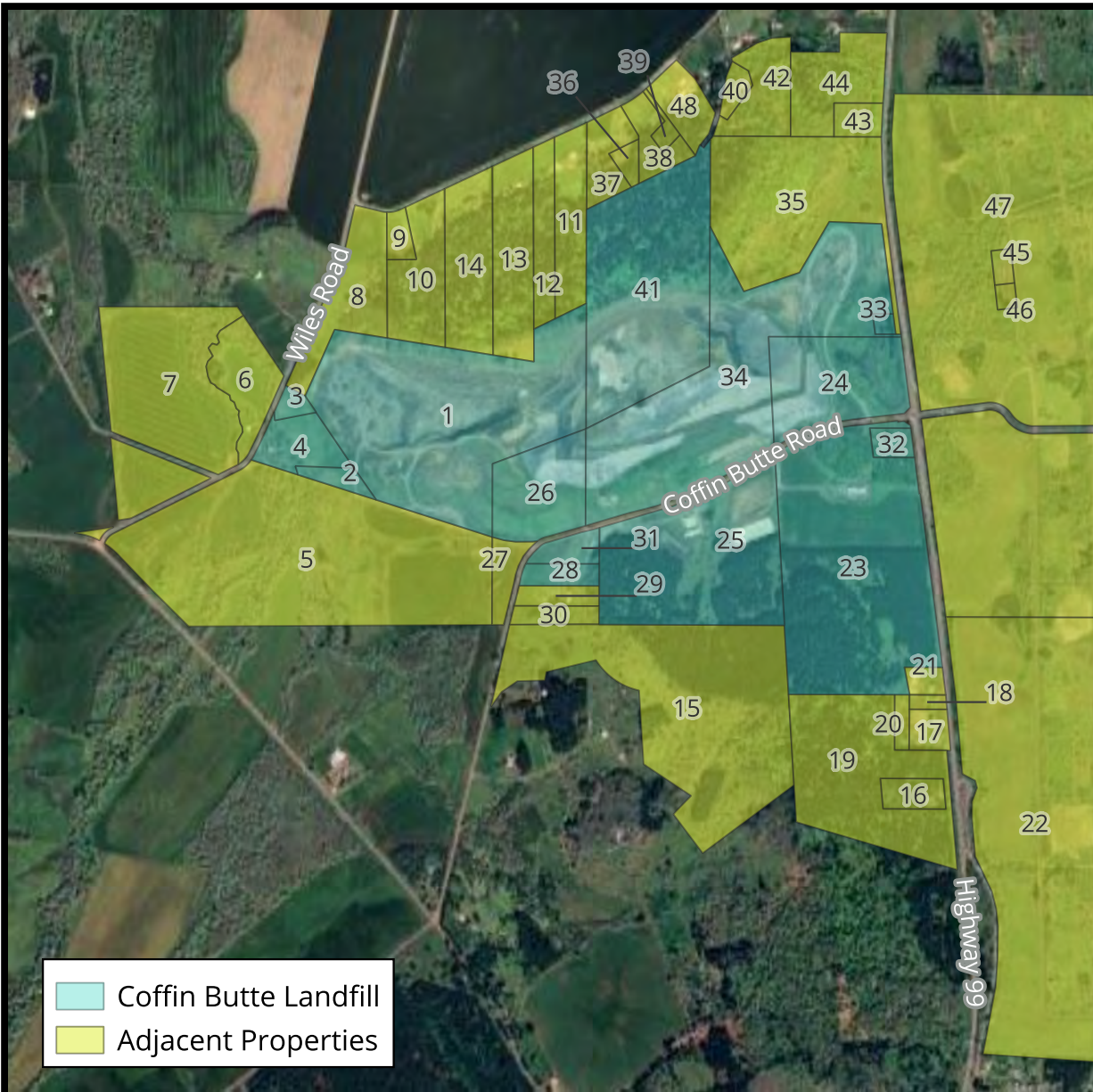
Job Number: 2024-377B

Figure 4 - SCS Emission Monitoring Pathway

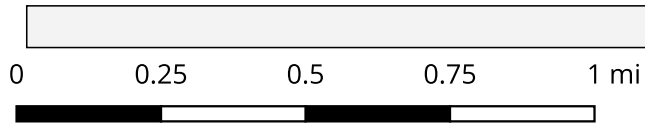
Coffin Butte Landfill

28972 Coffin Butte Road, Corvallis, OR 97330

Exhibit 41



No.	Taxlot Number	Party Name
1	105130001000	VALLEY LANDFILLS INC
2	105130000902	VALLEY LANDFILLS INC
3	105130000901	VALLEY LANDFILLS INC
4	105130000900	VALLEY LANDFILLS INC
5	105130000800	VALLEY LANDFILLS INC
6	105130000601	GOETZINGER DALE L & MONA G
7	105130000600	WINN TERRILL JAMES & APRIL DOVE
8	105130000400	BRISKEY JOINT REVOCABLE LIVING TRUST
9	105130000301	SEARS ROLLIN & DONNA JEANNE
10	105130000300	DENOMA JOHN T JR & SEARS DONNA J
11	105130000203	HARRISUE BERKLUND REV LIVING TRUST
12	105130000202	HARRISUE BERKLUND REV LIVING TRUST
13	105130000201	DAVID & DEBRA HACKLEMAN TRUST
14	105130000200	HACKLEMAN DAVID E & DEBRA M, TR
15	10419B001600	VALLEY LANDFILLS INC
16	104190000700	MORRELL JEFFREY J & PATRICIA D
17	104190000600	CRESS MERRILL
18	104190000500	GEIER JOEL E & REBECCA S SHERMAN
19	104190000402	ROBERT J & JULIE A KIPPER TRUST
20	104190000401	SEARLS JAMES CLUETT
21	104190000200	BRADLEY LOWELL THOMAS & MARY ERIN
22	104190000100	OREGON STATE GAME COMMISSION
23	104180001200	VALLEY LANDFILLS INC
24	104180001108	VALLEY LANDFILLS INC
25	104180001107	VALLEY LANDFILLS INC
26	104180001106	VALLEY LANDFILLS INC
27	104180001105	PELTIER REAL ESTATE CO
28	104180001104	VALLEY LANDFILLS INC
29	104180001103	PHILLIPS SAMUEL F & CHERYL G
30	104180001102	VALLEY LAND FILLS INC
31	104180001101	VALLEY LANDFILLS INC
32	104180001000	VALLEY LANDFILLS INC
33	104180000900	VALLEY LANDFILLS INC
34	104180000801	VALLEY LANDFILLS INC
35	104180000800	OREGON STATE FISH & WILDLIFE
36	104180000701	HOCKEMA JOSEPH E & JASMINE L
37	104180000700	HOCKEMA JOSEPH E & JASMINE L
38	104180000600	YOUNG CAROLYN
39	104180000500	YOUNG CAROLYN
40	104180000400	DUBIKIN ALEXANDRE & POLUSHKIN GLIKERIA
41	104180000301	VALLEY LANDFILLS INC
42	104180000300	DUBIKIN ALEXANDRE & POLUSHKIN GLIKERIA
43	104180000201	POWELL LYNN MAY & HEALD NATHAN LESLIE
44	104180000200	PELTIER REAL ESTATE CO
45	104180000102	BUREAU OF LAND MANAGEMENT
46	104180000101	CONSUMERS POWER INC
47	104180000100	OREGON STATE GAME COMMISSION
48	104070000900	WHITE JASON BYRON & JULIE B



NOT TO SCALE - FOR APPROXIMATION ONLY

Datum: North American Datum 1983
 Projection: StatePlane California I FIPS 0401 Feet
 Cartographer: Taylor Bradley
 Disclaimer: Map is not intended to function as architectural or engineering plans.

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Last Modified On: 11/6/2024
 Job Number: 2024-377B

Figure 5 - Adjacent Properties

Coffin Butte Landfill
 28972 Coffin Butte Road, Corvallis, OR 97330
Exhibit 41

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
OREGON TITLE V OPERATING PERMIT

Western Region-Salem Office
750 Front Street NE, Suite 120
Salem, OR 97301-1039
Telephone (503) 378-8240

Issued in accordance with the provisions of ORS 468A.040
and based on the land use compatibility findings included in the permit record.

ISSUED TO:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

INFORMATION RELIED UPON:

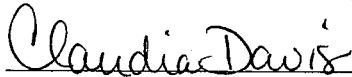
Application Number: 23594
Received: 01/30/09

PLANT SITE LOCATION:

Coffin Butte Landfill
Highway 99 & Coffin Butte Road
Corvallis, OR 97330

LAND USE COMPATIBILITY STATEMENT:

Issued by: Benton County
Dated: 03/06/97

ISSUED BY THE DEPARTMENT OF ENVIRONMENTAL QUALITY

Claudia Davis, Western Region Air Quality Manager

OCT 30 2009

Date

Nature of Business: Municipal Solid Waste Landfill

SIC: 4953

RESPONSIBLE OFFICIAL

Title: General Manager
Alternate: Vice President

FACILITY CONTACT PERSON

Name: Brian May
Title: General Manager
Phone: (541) 745-2018

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LIST OF ABBREVIATIONS THAT MAY BE USED IN THIS PERMIT

ACDP	Air Contaminant Discharge Permit	NA	Not applicable
Act	Federal Clean Air Act	NESHAP	National Emission Standard for
ASTM	American Society of Testing and		Hazardous Air Pollutants
	Materials	NMOC	Nonmethane organic compounds
Btu	British thermal unit	NO _x	Nitrogen oxides
CFR	Code of Federal Regulations	NSPS	New Source Performance
CO	Carbon monoxide		Standards
CPMS	Continuous parameter monitoring	O ₂	Oxygen
	system	OAR	Oregon Administrative Rules
DEQ	Department of Environmental	ODEQ	Oregon Department of
	Quality		Environmental Quality
dscf	Dry standard cubic feet	ORS	Oregon Revised Statutes
EF	Emission factor	O&M	Operation and maintenance
EPA	US Environmental Protection	Pb	Lead
	Agency	PCD	Pollution control device
EU	Emissions unit	PM	Particulate matter
FCAA	Federal Clean Air Act	PM ₁₀	Particulate matter less than 10
FSA	Fuel sampling and analysis		microns in size
gr/dscf	Grain per dry standard cubic feet (1	ppm	Parts per million
	pound = 7000 grains)	PSEL	Plant Site Emission Limit
HAP	Hazardous Air Pollutant as defined	SIP	State Implementation Plan
	by OAR 340-244-0040	SO ₂	Sulfur dioxide
HCFC	Halogenated Chloro-Fluoro-	SSM	Startup, shutdown, malfunction
	Carbons	ST	Source test
H ₂ S	Hydrogen sulfide	VE	Visible emissions
ID	Identification number or label	VMT	Vehicle miles traveled
I&M	Inspection and maintenance	VOC	Volatile organic compounds
LFG	Landfill gas		

Modified EPA Method 9: As used in this permit "Modified EPA Method 9" is defined as follows:

Opacity must be measured in accordance with EPA Method 9. For all standards, the minimum observation period must be six minutes, though longer periods may be required by a specific rule or permit condition. Aggregate times (e.g., 3 minutes in any one hour) consist of the total duration of all readings during the observation period that are equal to or greater than the opacity percentage in the standard, whether or not the readings are consecutive. Each EPA Method 9 reading represents 15 seconds of time. [See also the definition of "Opacity" in OAR 340-208-0010]

PERMITTED ACTIVITIES

1. Until such time as this permit expires or is modified or revoked, the permittee is allowed to discharge air contaminants from those processes and activities directly related to or associated with air contaminant source(s) in accordance with the requirements, limitations, and conditions of this permit. [OAR 340-218-0010 and 340-218-0120(2)]
2. All conditions in this permit are federally enforceable except as specified below:
 - 2.a. Conditions 6 through 12, G5, and G9 (OAR 340-248-0005 through 0180) are only enforceable by the state. [OAR 340-218-0060]

EMISSIONS UNIT (EU) AND POLLUTION CONTROL DEVICE (PCD) IDENTIFICATION

3. The emissions units regulated by this permit are the following [OAR 340-218-0040(3)]:

Table 1. EU and PCD IDENTIFICATION

Emission Unit Description	EU ID	Pollution Control Device Description	PCD ID
Landfill Gas Control System	Control	Open Flare	FL
Fugitive Landfill Gas, Cell 0	F-LFG1	None	NA
Fugitive Landfill Gas, Cells 1 to 4	F-LFG2	Landfill gas collection and extraction system	LFGCES-1
Vehicle traffic on paved roads	PIR	Water application	NA
Vehicle traffic on unpaved roads	UPR	Chemical suppressant and water application	NA
Tipper	TIP	None	NA
Petroleum contaminated soils	PCS	None	NA
Aggregate Insignificant activities:	AI		
Cell development, operation, and closing		None	NA
Wastewater treatment system operation		Baghouse	DC-1
Leachate collection and wastewater treatment		None	NA
Portable light plant		None	NA
Trash pumps		None	NA
Generator		None	NA

EMISSION LIMITS AND STANDARDS, TESTING, MONITORING, AND RECORDKEEPING REQUIREMENTS

The following tables and conditions contain the applicable requirements along with the testing, monitoring, and recordkeeping requirements for the emissions units to which those requirements apply.

Facility-wide Requirements**Table 2. Facility wide emission limits and standards**

Applicable Requirement	Condition Number	Pollutant/Parameter	Limit/Standard	Averaging Time	Testing Condition	Monitoring Condition
340-208-0210(2)	4	Fugitive emissions	Minimize	NA	NA	5
340-208-0300	6	Air contaminants	No nuisance	NA	NA	8
340-208-0450	7	PM >250μ	No fallout	NA	NA	8
340-248-0280(10)	9	Asbestos disposal	Handling procedures	Recordkeeping	NA	10
340-248-0280(11)	11	Asbestos cover	Maintain cover	Recordkeeping	NA	12

Fugitive Emissions

4. Applicable Requirement: The permittee must not allow or permit any materials to be handled, transported, or stored; or a building, its appurtenances, or a road to be used, constructed, altered, repaired, or demolished; or any equipment to be operated, without taking reasonable precautions to prevent particulate matter from becoming airborne. Such reasonable precautions must include, but not be limited to the following: [OAR 340-208-0210(2)]
- 4.a. use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;
 - 4.b. application of asphalt, oil, water, or other suitable chemicals on unpaved roads, materials stockpiles, and other surfaces which can create airborne dusts;
 - 4.c. full or partial enclosure of materials stockpiles in cases where application of oil, water, or chemicals are not sufficient to prevent particulate matter from becoming airborne;
 - 4.d. installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials;
 - 4.e. adequate containment during sandblasting or other similar operations; and,
 - 4.f. covering, at all times when in motion, open bodied trucks transporting materials likely to become airborne.
5. Monitoring Requirement: At least once each week for a minimum period of 30 minutes, the permittee must visually survey the plant for any sources of excess fugitive emissions using EPA Method 22. For the purpose of this survey, excess fugitive emissions are considered to be any visible emissions generated by fugitive sources that leave the plant site boundaries. The person conducting the observation does not have to be EPA Method 9 certified. However, the individual should be familiar with the procedures of EPA Method 9, including using the proper location to observe visible emissions. If sources of visible emissions are identified, the permittee must: [OAR 340-218-0050(3)(a)]
- 5.a. immediately take corrective action to minimize the fugitive emissions, including but not limited to those actions identified in Condition 4; or,
 - 5.b. conduct a Modified EPA Method 9 test within 24 hours;
 - 5.c. Recordkeeping: The permittee must maintain records of the fugitive emissions surveys, corrective actions (if necessary), and/or the results of any modified EPA Method 9 tests.

Nuisance Conditions

6. Applicable Requirement: The permittee must not cause or allow air contaminants from any source to cause a nuisance. Nuisance conditions will be verified by Department personnel. [OAR 340-208-0300] This condition is enforceable only by the State.
7. Applicable Requirement: The permittee must not cause or permit the emission of any particulate matter larger than 250 microns in size at sufficient duration or quantity, as to create an observable deposition upon the real property of another person. The Department will verify that the deposition exists and will notify the permittee that the deposition must be controlled. [OAR 340-208-0450] This condition is enforceable only by the State.
8. Monitoring Requirement: The permittee must maintain a log of each air quality complaint received by the permittee during the operation of the facility and must provide the Western Region-Salem Office of the Department with written notification within 5 days of all nuisance complaints regarding fugitive dust, odors, or particulate deposition received. Documentation shall include date of contact, time of observed nuisance condition, description of nuisance condition, location of receptor, status of plant operation during the observed period, and time of response to complainant. A plant representative must immediately investigate the condition following the receipt of the nuisance complaint and a plant representative must provide a response to the complainant within 24 hours, if possible. This condition is only enforceable by the State. [OAR 340-218-0050(3)(a)]

Asbestos Disposal and Cover

9. Applicable Requirement: The permittee must meet the asbestos-containing material handling and disposal requirements and procedures specified in OAR 340-248-0280(10) for active waste disposal sites. This condition is only enforceable by the state.
10. Monitoring Requirement: The permittee must monitor the asbestos-containing material handling and disposal procedures, provide notifications, and record the information required as specified in OAR 340-248-0280(10) for active waste disposal sites. This condition is only enforceable by the State.
11. Applicable Requirement: The permittee must meet the asbestos-containing material disposal and cover standards specified in OAR 340-248-0280(11) for inactive waste disposal sites. This condition is only enforceable by the State.
12. Monitoring Requirement: The permittee must monitor the asbestos-containing disposal and cover requirements and provide notifications as specified in OAR 340-248-0280(11) for inactive waste disposal sites. This condition is only enforceable by the State.

Facility Wide Requirements

13. The following requirements apply facility wide, including, but not limited to, the solid municipal waste landfill, unless an alternate requirement is specifically stated for a particular emissions unit.

Table 3. Summary of NSPS and NESHAP requirements:

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.1	40 CFR 60.7(a)(4); 40 CFR 60.7(b); 40 CFR 60.7(f)	Notification and recordkeeping.	Maintain records of the occurrence and duration of any startup, shutdown, or malfunction in the operation of the affected facility. Maintain a file of all measurements and performance testing measurements and all other information required by this part recorded in a permanent form suitable for inspection.	Permittee shall furnish prior written or e-mail notification of any physical or operational change which may increase the emission rate of any air pollutant (such as taking operating gas collection wells off line) to which a standard applies to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 [40 CFR 60.4(a)]
13.2	40 CFR 60.11(d)	Maintain and operate any affected emission unit with good air pollution control practice for minimizing emissions.	None specified.	No additional monitoring required.
13.3	40 CFR 60.12	Circumvention.	None specified.	No additional monitoring required.
13.4	40 CFR 60.752(b)(2)(i i)(A); 40 CFR 60.753(a); 40 CFR 60.755(b) (Landfill NSPS Subpart WWW)	Install, within 60 days, and operate active collection system wells that collect gas from each area, cell, or group of cells in the landfill in which solid waste has been placed for: (1) 5 years or more if active, OR (2) 2 years or more if closed or at final grade.	None specified.	No additional monitoring required.

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.5	40 CFR 60.752(b)(2)(i)(A) (Landfill NSPS Subpart WWW)	Install an active collection system that is designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment.	To calculate maximum expected gas flow rate: $Q_m = \sum_{i=1}^n 2kL_o M_i (e^{-kt_i})$ where, Q_m =maximum expected gas generation flow rate, m ³ /yr k =methane generation rate constant, year ⁻¹ L_o =methane generation potential, m ³ /Mg solid waste M_i =mass of solid waste in the i^{th} section, Mg t_i =age of the i^{th} section, years [40 CFR 60.755(a)(1)(ii)]	Submit monthly report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 Monthly report shall include the date of installation and the location of each well or collection system expansion added. [40 CFR 60.757(f)]
13.6	40 CFR 60.752(b); 40 CFR 60.754(a); 40 CFR 60.757(b); 40 CFR 60.4(a) (Landfill NSPS Subpart WWW)	Calculate the NMOC emission rate for the landfill. If the calculated NMOC emission rate is less than 50 Mg/yr, the permittee shall recalculate the NMOC emission rate and submit emission reports to the Department until such time as the calculated NMOC emission rate is ≥ 50 Mg/yr, or the landfill is closed.	Calculate the NMOC emission rate: $M_{NMOC} = \sum_{i=1}^n 2kL_o M_i (e^{-kt_i})(C_{NMOC})(3.6 \times 10^{-9})$ where, M_{NMOC} =Total NMOC emission rate from the landfill (Mg/yr) k =methane generation rate constant=0.05 yr ⁻¹ or as determined using Tier 3 per 40 CFR 60.754 (a)(4) L_o =methane generation potential=170 m ³ /Mg solid waste M_i =mass of solid waste in the i^{th} section (Mg) t_i =age of the i^{th} section (yr) C_{NMOC} =4000 ppm per 40 CFR 60.754(a)(3) 3.6×10^{-9} =conversion factor The mass of the nondegradable solid waste may be subtracted from the total mass of solid waste in a particular section of the landfill when calculating the value for M_i if properly documented. [40 CFR 60.754(a)(1)(i)]	The permittee shall submit an NMOC emission rate report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 (1) annually, OR (2) if the estimated NMOC emission rate as reported in the annual report is less than 50 Mg/yr in each of the next 5 consecutive years, the permittee may elect to submit an estimate of the NMOC emission rate for the next 5-year period in lieu of the annual report. If option (2) is chosen, this estimate shall be revised at least once every 5 years. If the actual waste acceptance rate exceeds the estimated waste acceptance rate in any year reported in the 5-year estimate, a revised 5-year estimate shall be submitted to ODEQ at the address given above. The revised estimate shall cover the 5-year period beginning with the year in which the actual waste acceptance rate exceeded the estimated waste acceptance rate. The NMOC emission rate report shall include the current amount of solid waste-in-place and the estimated waste acceptance rate for each year of the 5 years for which an NMOC emission rate is estimated. The NMOC emission rate report shall include all the data, calculations, sample reports and measurements used to estimate the annual or 5-year emissions. ODEQ may request such additional information as may be necessary to verify the reported NMOC emission rate. [40 CFR 60.4(a), 40 CFR 60.757(b)]
13.7	40 CFR 60.752(b)(2)(i)(A); 40 CFR 60.759(a); 40 CFR 60.759(b) (Landfill NSPS Subpart WWW)	Install an active collection system that is designed to collect gas at a sufficient extraction rate, sited at a sufficient density throughout all gas producing areas, and designed to minimize off-site migration of subsurface gas.	None specified.	Keep for the life of the collection system an up-to-date, readily accessible plot map showing each existing and planned collector in the system and providing a unique identification location label for each collector. Keep up-to-date, readily accessible records of the installation date and location of all newly installed collectors. [40 CFR 60.758(d)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.8	40 CFR 60.753(b) (Landfill NSPS Subpart WWW)	Operate the LFG control system with negative pressure at each well-head except under the following conditions: (1) fire or increased well temperature; OR, (2) use of a geomembrane or synthetic cover; OR, (3) a decommissioned well. Passive gas collection wells do not have to meet this condition when approved in writing by the Department. Gas collection wells operating under an Alternative Operating and Monitoring Plan approved in writing by the Department do not have to meet this condition.	None specified.	Measure gauge pressure in the gas collection header at each individual well, monthly. If a positive pressure exists, action shall be initiated to correct the exceedance within 5 calendar days. If negative pressure cannot be achieved without excess air infiltration within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial measurement of positive pressure. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. [40 CFR 60.755(a)(3)] The annual report shall include record of instances when positive pressure occurred. [40 CFR 60.753(b)(1)]
13.9	40 CFR 60.753(c) (Landfill NSPS Subpart WWW)	Operate each interior wellhead in the LFG collection system with: (1) LFG temperature <55°C; AND, (2) either: (a) $N_2 < 20\%$; OR, (b) $O_2 < 5\%$. Passive gas collection wells do not have to meet this condition when approved in writing by the Department. Gas collection wells receiving a variance in writing from the Department concerning temperature do not have to meet this condition. Gas collection wells operating under an Alternative Operating and Monitoring Plan approved in writing by the Department do not have to meet this condition.	N_2 by RM 3C; O_2 by RM 3A, except that: (1) regulatory limit is between 20% and 50% of the span; AND, (2) data recorder not required; AND, (3) only 2 calibration gases are required; AND, (4) calibration error check not required; AND, (5) allowable sample bias, zero drift, and calibration draft are $\pm 10\%$. Install a sampling port and a thermometer or other temperature measuring device at each wellhead. [40 CFR 60.756(a)]	Measure the N_2 or O_2 concentration in the LFG, and the temperature of the LFG at each individual well, on a monthly basis. If a well exceeds one of the operating parameters, action shall be initiated to correct the exceedance within 5 calendar days. If correction of the exceedance cannot be achieved within 15 calendar days of the first measurement, the gas collection system shall be expanded to correct the exceedance within 120 days of the initial exceedance. Any attempted corrective measure shall not cause exceedances of other operational or performance standards. [40 CFR 60.756(a); 40 CFR 60.755(a)(5)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.10	40 CFR 60.753(d) (Landfill NSPS Subpart WWW)	Operate LFG collection system so that the methane concentration is <500 ppm above background at the surface of the landfill.	Conduct surface testing around the perimeter of the collection area along a pattern that traverses the landfill at 30 meter intervals and where visual observations indicate elevated concentrations of LFG, such as distressed vegetation and cracks or seeps in the cover per the surface monitoring design plan and topographical map of the monitoring route. Instrument specifications and procedures for surface monitoring devices: (1) portable analyzer shall meet the instrument specifications provided in section 3 of RM 21, except that "methane" shall replace all references to VOC; AND, (2) calibration gas shall be methane, diluted to a nominal concentration of 500 ppm in air; AND, (3) instrument evaluation procedures of section 4.4 of RM 21 shall be used; AND, (4) calibration procedures provided in section 4.2 of RM 21 shall be followed immediately before commencing a surface monitoring survey. [40 CFR 60.755(d)] Conduct surface monitoring with a portable monitor meeting the specifications provided. The background concentration shall be determined by moving the probe inlet upwind and downwind outside the boundary of the landfill at a distance of at least 30 meters from the perimeter wells. Surface emission monitoring shall be performed in accordance with section 4.3.1 of RM 21, except that the probe inlet shall be placed within 5 to 10 cm of the ground. Monitoring shall be performed during typical meteorological conditions. [40 CFR 60.755(c)]	Monitor for cover integrity on a monthly basis. Implement cover repairs as necessary. [40 CFR 60.755(c)(5)] Conduct surface monitoring on a quarterly basis. Any reading of ≥ 500 ppm above background at any location shall be recorded as a monitored exceedance and actions below taken. As long as the specified actions are taken, the exceedance is not a violation of these operational requirements. The location of each monitored exceedance shall be marked and the location recorded. Cover maintenance or adjustments to the vacuum of the adjacent wells to increase the gas collection in the vicinity of each exceedance shall be made and the location shall be re-monitored within 10 calendar days of detecting the exceedance. Any location that initially showed an exceedance but has a methane concentration <500 ppm methane above background at the 10-day re-monitoring, shall be re-monitored 1 month from the initial exceedance. If the 1-month re-monitoring shows a concentration <500 ppm above background, no further monitoring of that location is required until the next quarterly monitoring period. If the re-monitoring of the location shows a second exceedance, additional corrective action shall be taken and the location shall be monitored again within 10 days of the second exceedance. If the re-monitoring shows a third exceedance for the same location, a new well or other collection device shall be installed within 120 calendar days of the initial exceedance, OR an alternative remedy to the exceedance, such as upgrading the blower, header pipes or control device, and a corresponding timeline for installation may be submitted to the Administrator for approval. No further monitoring of that location is required until remedy has been taken. [40 CFR 60.755(c)] Submit monthly report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 Monthly report shall include the location of each exceedance of the 500 ppm methane concentration and the concentration recorded at each location for which an exceedance was recorded in the previous month. [40 CFR 60.757(f)]
13.11	40 CFR 60.753(e) (Landfill NSPS Subpart WWW)	Operate the collection system such that all collected gases are vented to the control system. In the event the LFG collection and control is inoperable, the gas mover system shall be shut down and all valves in the collection and control system contributing to venting of the gas to the atmosphere shall be closed within 1 hour.	None specified.	Records shall be kept of all periods when the LFG collection and control system is inoperable, the gas mover system is shut down, or the valves in the collection and control system are closed.

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.12	40 CFR 60.753(f) (Landfill NSPS Subpart WWW)	Operate the LFG control and treatment system at all times when the collected gas is routed to the system.	None specified.	No additional monitoring required.
13.13	40 CFR 60.755(e) (Landfill NSPS Subpart WWW)	The provisions of the NSPS apply at all times, except during periods of start-up, shutdown, or malfunction, provided that the duration of start-up, shutdown, or malfunction shall not exceed 5 days for collection systems.	None specified.	No additional monitoring required.
13.14	40 CFR 60.757(a)(3); 40 CFR 60.4(a) (Landfill NSPS Subpart WWW)	An amended design capacity report shall be submitted to the Department providing notification of any increase in the design capacity of the landfill.	None specified.	If triggered, the permittee shall submit an amended design capacity report to: ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 [40 CFR 60.4(a)]
13.15	40 CFR 60.758(a) (Landfill NSPS Subpart WWW)	Keep, for at least 5 years, up-to-date, readily accessible, on-site records of: (1) the maximum design capacity; AND, (2) the current amount of solid waste in-place; AND, (3) the year-by-year waste acceptance rate. Off-site records may be maintained if they are retrievable within 4 hours. Either paper copy or electronic formats are acceptable.	None specified.	No additional monitoring required.
13.16	40 CFR 60.758(b) (Landfill NSPS Subpart WWW)	Keep up-to-date, readily accessible records for the life of the control equipment of the following data, as measured during the initial performance test or compliance determination: (1) maximum expected gas generation flow rate as calculated in condition 15.5, AND, (2) the density of wells, horizontal collectors, surface collectors, or other gas extraction devices; And, (3) the average combustion temperature measured at least every 15 minutes and averaged over the same time period of the performance test; AND, (4) the percent reduction of NMOC determined as specified in conditions 16 and 17. Records of subsequent tests or monitoring shall be maintained for a minimum of 5 years. Records of the control device vendor specifications shall be maintained until removed.	None specified.	No additional monitoring required.
13.17	40 CFR 60.758(c) (Landfill NSPS Subpart WWW)	Keep for 5 years, up-to-date, readily accessible continuous records of the equipment operating parameters specified to be monitored in the NSPS as well as up-to-date, readily accessible records for periods of operation during which the parameter boundaries established during the most recent performance test are exceeded.	None specified.	No additional monitoring required.

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement								
13.18	40 CFR 61.154(a), (c), (d) (Asbestos NESHAP Subpart M)	In any active waste disposal site where asbestos-containing waste material has been deposited: (1) no visible emissions to the outside air; OR, (2) cover with ≥6 inches of compacted nonasbestos-containing material at the end of each operating day; OR, (3) cover with a chemical dust suppression agent (not to include any used, spent, or other waste oil) at the end of each operating day.	None specified.	No additional monitoring required.								
13.19	40 CFR 61.154(b) (Asbestos NESHAP Subpart M)	Areas of disposal of asbestos-containing waste material must: (1) have a natural barrier that adequately deters access by the general public; OR, (2) cover with ≥6 inches of compacted nonasbestos-containing material at the end of each operating day; OR, (3) install warning signs and fencing that meet the following: (a) display signs at all entrances and at intervals of ≤330 feet; AND, (b) signs posted such that legend is easily read; AND, (c) 20" x 14" upright format signs; AND, (d) sign legend, size, and style at least equal to (spacing between lines must be at least equal to the height of the upper text line): <table><tr><th>Legend</th><th>Notation</th></tr><tr><td>Asbestos Waste Disposal Site.</td><td>1 inch Sans Serif, Gothic, or Block</td></tr><tr><td>Do Not Create Dust</td><td>¾ inch Sans Serif, Gothic, or Block</td></tr><tr><td>Breathing Asbestos is Hazardous to Your Health.</td><td>14 point Gothic</td></tr></table> AND, (e) fenced in a manner adequate to deter access by the general public.	Legend	Notation	Asbestos Waste Disposal Site.	1 inch Sans Serif, Gothic, or Block	Do Not Create Dust	¾ inch Sans Serif, Gothic, or Block	Breathing Asbestos is Hazardous to Your Health.	14 point Gothic	None specified.	No additional monitoring required.
Legend	Notation											
Asbestos Waste Disposal Site.	1 inch Sans Serif, Gothic, or Block											
Do Not Create Dust	¾ inch Sans Serif, Gothic, or Block											
Breathing Asbestos is Hazardous to Your Health.	14 point Gothic											

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.20	40 CFR 61.154(e) (Asbestos NESHAP Subpart M)	Maintain waste shipment records for all asbestos-containing waste material received.	None specified.	Waste shipment records shall include: (1) name, address, and telephone number of the waste generator; AND, (2) name, address, and telephone number of the transporter(s); AND, (3) volume of waste; AND, (4) presence of improperly enclosed (leak-tight containers) or uncovered; AND, (5) date of waste receipt. Send a copy of the signed waste shipment record to the waste generator within 30 days of receipt of the waste. If significant amount of improperly enclosed or uncovered waste, report in writing (with copy of waste shipment record) to the Department for the waste generator (as indicated in the waste shipment record), ODEQ, Western Region – Salem Office 750 Front Street NE, Suite 120 Salem, OR 97301-1039 by the following working day. Submit reports (with copy of waste shipment record) of unreconciled waste quantity discrepancies within 15 days of waste receipt to ODEQ, at the address listed above. [40 CFR 61.154(e)(1), (2)]
13.21	40 CFR 61.154(f) (Asbestos NESHAP Subpart M)	Maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal area on a map or diagram of the disposal area.	None specified.	No additional monitoring required.
13.22	40 CFR 61.154(i) (Asbestos NESHAP Subpart M)	Furnish upon request, and make available during normal business hours for inspection by ODEQ, all records required by the Asbestos NESHAP.	None specified.	No additional monitoring required.
13.23	40 CFR 61.154(j) (Asbestos NESHAP Subpart M)	Notify ODEQ in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at the site and is covered.	None specified.	Notification shall include: (1) scheduled starting and completion dates; AND, (2) reason for disturbing waste; AND, (3) emission control procedures to be implemented; AND, (4) location of any temporary storage site and the final disposal site. [40 CFR 61.154(j)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.24	40 CFR 60.752(b)(2)(i) ii)(A) and 40 CFR 60.18 (Landfill NSPS Subpart WWW)	1. Route excess landfill gas not utilized by IC engines to an open flare (Emissions Unit Control) designed and operated in accordance with 40 CFR 60.18. 2. The flare shall be designed for and operated with no visible emissions except for periods not to exceed a total of 5 minutes during any 2 consecutive hours. [40 CFR 60.18(c)(1)] 3. The flare shall be operated with a flame present at all times. [40 CFR 60.18(c)(2)] 4. The flare shall be designed for and operated with an exit velocity less than 60 ft/sec. [40 CFR 60.18(c)(4)(i)] 5. The flare shall be operated at all times when excess landfill gas not utilized by IC engines is being vented to it. [40 CFR 60.18(e)]	Install, calibrate, maintain, and operate according to the manufacturer's specifications the following equipment: (1) a heat sensing device, such as an ultraviolet beam sensor or thermocouple, at the pilot light or the flame itself to indicate the continuous presence of a flame; and (2) a device that records flow to or bypass of the flare. The owner or operator shall either: (i) install, calibrate, and maintain a gas flow measuring device that shall record the flow to the flare at least every 15 minutes; or (ii) secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. [40 CFR 60.756(c)] Reference Method 22 shall be used to determine the compliance with the visible emissions standard. The observation period is 2 hours. [40 CFR 60.18(f)(1)] The net heating value of the gas being combusted in the flare shall be calculated by the equation in 40 CFR 60.18 (f)(3). The actual exit velocity of the flare shall be determined by dividing the volumetric flowrate (in units of standard temperature and pressure) as determined by Reference Methods 2, 2A, 2C, or 2D as appropriate by the unobstructed (free) cross sectional area of the flare tip. [40 CFR 60.18(f)(4)]	Monitoring 1. Operate the heat sensing device or thermocouple. [40 CFR 60.756(c)(1)] 2. Record the gas flow to the flare at least every 15 minutes or visually inspect the seal or closure mechanism at least monthly. [40 CFR 60.756(c)(2)] Recordkeeping 1. Records of the flare vendor specifications until removal of the flare. [40 CFR 60.758(b)] 2. Up-to-date, readily accessible records for the life of the flare of: a. visible emissions readings b. heat content determinations c. flow rate or bypass flow rate measurements d. exit velocity determinations e. continuous records of the flare pilot flame or flare flame monitoring f. all periods of operations during which the pilot flame or the flare flame is absent [40 CFR 60.758(b)((4) and (c)(4)]

Condition	Applicable Requirement	Description (for clarification purposes only, enforceable as listed under 'applicable requirement')	Monitoring and Analysis Procedure or Test Method	Monitoring, Recordkeeping, and Reporting Requirement
13.25	40 CFR 63.6(e)(3) (Landfill NESHAP Subpart AAAAA)	Develop and implement a written Startup, Shutdown, and Malfunction Plan (SSM Plan) by no later than January 16, 2004.	None specified.	Maintain written SSM Plan on site. If the SSM Plan fails to address, or inadequately addresses, a malfunction, revise the SSM Plan within 45 days after the event to include procedures for operating and maintaining the source during similar malfunctions, and a program of corrective actions for similar malfunctions. [40 CFR 63.6(e)(3)(viii)] Recordkeeping 1. Maintain records for each SSM Plan event which occurs. [40 CFR 63.10(b)(2)(i)] 2. Retain a copy of each previous (superceded) version of the SSM Plan for at least 5 years. [40 CFR 63.6(e)(3)(v)] Reporting 1. Report semiannually all SSM Plan actions that are consistent with the SSM Plan. [40 CFR 63.10(d)(5)(i)] 2. Notify DEQ within 2 days if an SSM event is not consistent with the SSM Plan and follow up with a letter within 7 days of the event. [40 CFR 63.6(e)(3)(iv)]

EMISSIONS UNITS PIR AND UPR

Table 4. Summary of requirements for Emissions Units PIR and UPR:

Applicable Requirement	Condition Number	Pollutant/Parameter	Limit/Standard	Averaging Time	Testing Condition	Monitoring Condition
340-208-0110(2)	14	Visible emissions	20% opacity	3 min. aggregate in 60 minutes	NA	15

14. Applicable Requirement: The permittee must not cause or allow the emissions of any air contaminant into the atmosphere for a period or periods aggregating more than three minutes in any one hour which is equal to or greater than 20% opacity, excluding uncombined water, from emissions units PIR and UPR. [OAR 340-208-0110(2) and 340-208-0110(3)(a)]
15. Monitoring Requirement: At least weekly, the permittee must visually survey the facility using EPA Method 22 for any sources of excess fugitive emissions. For the purpose of this survey, excess fugitive emissions are considered to be any visible emissions that leave the down wind plant site boundaries. The person conducting this survey does not have to be EPA Method 9 certified. However, the individual should be familiar with the procedures of EPA Method 9, including using the proper location to observe visible emissions. If sources of excess fugitive emissions are identified during the survey, the permittee shall perform one of the following:
- 15.a. immediately take corrective action to minimize the fugitive emissions; or,
 - 15.b. conduct a modified EPA Method 9 test on the device(s) causing the opacity problem within 24 hours.

- 15.c. Recordkeeping: The permittee must maintain records of all inspections and any corrective action performed.

EMISSIONS UNIT TIP

Table 5. Summary of requirements for Emissions Unit TIP:

Applicable Requirement	Condition Number	Pollutant/Parameter	Limit/Standard	Averaging Time	Testing Condition	Monitoring Condition
340-208-0110(2)	16	Visible emissions	20% opacity	3 min. aggregate in 60 minutes	NA	20
340-226-0210(1)(b)	17	PM/PM ₁₀	0.1 gr/dscf	Avg. of 3 test runs	NA	20

16. Applicable Requirement: The permittee must not cause or allow the emissions of any air contaminant into the atmosphere for a period or periods aggregating more than three minutes in any one hour which is equal to or greater than 20% opacity, excluding uncombined water, from emissions unit TIP. [OAR 340-208-0110(2) and 340-208-0110(3)(a)]
17. Applicable Requirement: The permittee must not cause or allow the emission of particulate matter in excess of 0.1 grain per standard cubic foot from emissions unit TIP. [OAR 340-226-0210(1)(b)]

Insignificant Activities Requirements

18. The Department acknowledges that insignificant emissions units (IEUs) identified by rule as either categorically insignificant activities or aggregate insignificant emissions as defined in OAR 340-200-0020 exist at facilities required to obtain an Oregon Title V Operating Permit. IEUs must comply with all applicable requirements. In general, the requirements that could apply to IEUs are incorporated as follows:
- 18.a. OAR 340-208-0110 (20% opacity)
 - 18.b. OAR 340-228-0210 (0.1 gr/dscf corrected to 12% CO₂ or 50% excess air for fuel burning equipment)
 - 18.c. OAR 340-226-0210 (0.1 gr/dscf for non-fugitive, non-fuel burning equipment)
 - 18.d. OAR 340-226-0310 (process weight limit for non-fugitive, non-fuel burning process equipment).

Unless otherwise specified in this permit or an applicable requirement, the Department is not requiring any testing, monitoring, recordkeeping, or reporting for the applicable emissions limits and standards that apply to IEUs. However, if testing were performed for compliance purposes, the permittee would be required to use the test methods identified in the definitions of "opacity" and "particulate matter" in OAR 340-208-0010 and perform the testing in accordance with the Department's Source Sampling Manual.

PLANT SITE EMISSION LIMITS

19. Applicable Requirement: The plant site emissions must not exceed the following limits for any 12 consecutive calendar month period: [OAR 340-222-0040 through OAR 340-222-0043]

Pollutant	Plant Site Emission Limit (Tons/yr)
PM	24
PM ₁₀	14
CO	99
NO _x	39
SO ₂	39
VOC	39
NMOC	49

19.a. The PSEL is based on the actual predicted emissions for the current operating conditions at the facility. A permit modification is required before the PSEL may be increased.

20. Monitoring Requirement: The permittee must determine compliance with the Plant Site Emission Limits established in Condition 19 of this permit by conducting monitoring in accordance with the following procedures, test methods, and frequencies: [OAR 340-218-0050(3)]

20.a. The permittee must monitor and maintain records of the following process parameters:

Table 6. PSEL Monitoring

Emissions Unit(s)	Process Parameter	Units	Measurement Frequency	Measurement Method
F-LFG1	Municipal solid waste in place in Cell 0	Mg or tons	Annually	Records
F-LFG2	Municipal solid waste in place in Cells 1, 2A/2B, 2C/2D, and 3	Mg or tons	Annually	Records
Landfill	Municipal solid waste accepted at landfill	Mg or tons	Annually	Records
F-LFG1 & F-LFG2	Landfill gas generated in each system	MMft ³ /month, MMft ³ /yr	Annually using EPA model calculation	Records
F-LFG2	Landfill gas collected and sent to IC engines and % methane	MMft ³ /month, MMft ³ /yr	Monthly/Annually	Records
PIR	Number of total vehicles on paved roads	Number	Monthly/Annually	Records
UPR 1	Number of total vehicles on unpaved road 1	Number	Monthly/Annually	Records
UPR 2	Number of commercial vehicles on unpaved road 2	Number	Monthly/Annually	Records
TIP	Number of hours operated	Hours	Monthly/Annually	Records
PCS	Petroleum contaminated soil received	Tons	Monthly/Annually	Records
Open Flare	Landfill gas collected and sent to open flare and % methane	MMft ³ /month, MMft ³ /yr	Monthly/Annually	Records

20.b. Emission factors for calculating pollutant emissions:

Table 7. Emission Factors

Emission Units(s)	Pollutant	Emission Factor	Emission Factor Units	Emission Factor Verification Testing	
				Yes/no	Test Method
F-LFG1	CO	10.3	lb/MMft ³ fugitive landfill gas	No	NA
	VOC	51.9	lb/MMft ³ fugitive landfill gas	No	NA
	NMOC	133.2	lb/MMft ³ fugitive landfill gas	No	NA
F-LFG2	CO	10.3	lb/MMft ³ fugitive landfill gas	No	NA
	VOC	51.9	lb/MMft ³ fugitive landfill gas	No	NA
	NMOC	133.2	lb/MMft ³ fugitive landfill gas	No	NA
PIR	PM	0.140	lb/vehicle	No	NA
	PM ₁₀	0.027	lb/vehicle	No	NA
UPR 1	PM	0.010	lb/vehicle	No	NA
	PM ₁₀	0.004	lb/vehicle	No	NA
UPR 2	PM	0.098	lb/vehicle	No	NA
	PM ₁₀	0.021	lb/vehicle	No	NA
Open Flare	PM/PM ₁₀	8.5	lb/MMft ³ combusted landfill gas	No	NA
	CO	110.0	lb/MMft ³ combusted landfill gas	No	NA
	NO _x	20.0	lb/MMft ³ combusted landfill gas	No	NA
	SO ₂	8.4	lb/MMft ³ combusted landfill gas	No	NA
	VOC	1.16	lb/MMft ³ combusted landfill gas	No	NA
	NMOC	2.71	lb/MMft ³ combusted landfill gas	No	NA
TIP	PM/PM ₁₀	0.253	lb/hr	No	NA
	CO	0.768	lb/hr	No	NA
	NO _x	3.57	lb/hr	No	NA
	SO ₂	0.236	lb/hr	No	NA
	VOC/ NMOC	0.289	lb/hr	No	NA
PCS	VOC/ NMOC	0.033	lb/ton PCS	No	NA

- 20.c. For the emissions unit F-LFG1 listed in Table 8, the permittee must determine monthly and 12-month rolling emissions by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

$$E = (\text{F-LFG1 generated}) * EF * K$$

where:

E = Emissions, tons
 EF = Emission factor, pounds/units
 K = conversion constant: 1 ton/2000 lbs

- 20.d. For the emissions unit F-LFG2 listed in Table 8, the permittee must determine monthly and 12-month rolling emissions by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

$$E = (F\text{-LFG2 generated} - F\text{-LFG2 collected to IC engines and flare}) * EF * K$$

where:

E = Emissions, tons
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

- 20.e. For the emissions unit Open Flare listed in Table 7, the permittee must determine monthly and 12-month rolling emissions by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

$$E = (\text{Open flare collected}) * EF * K$$

where:

E = Emissions, tons
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

- 20.f. For the emissions units PIR, UPR 1, UPR 2, TIP, and PCS listed in Table 7, the permittee must calculate monthly and 12-month rolling emission by multiplying the Process Parameter by the emission factor listed above for each pollutant. Calculations must be completed within 30 days of the end of each month.

$$E = MP * EF * K$$

where:

E = Emissions, tons
MP = Monitored parameter, units/month or units/year
EF = Emission factor, pounds/units
K = conversion constant: 1 ton/2000 lbs

- 20.g. The emission factors listed in Condition 20.b. are not enforceable limits unless otherwise specified in this permit. Compliance with PSELs must only be determined by the calculations contained in Conditions 20.c. through 20.f of this permit using the measured process parameters recorded during the reporting period and the emission factors contained in Condition 20.b.
21. The permittee must determine compliance with Condition 19 (Plant Site Emission Limits) by summing the emissions calculated in Condition 20 for each emissions unit for each month and each 12-month rolling period, and adding the Aggregate Insignificant emissions of 1 ton per year by pollutant, and comparing the resulting emissions to the Plant Site Emission Limits in Condition 19.

GENERAL TESTING REQUIREMENTS

22. Unless otherwise specified in this permit, the permittee must conduct all testing in accordance with the Department's Source Sampling Manual. [OAR 340-212-0120 and 40 CFR 60.8]
- 22.a. Unless otherwise specified by a state or federal regulation, the permittee must submit a source test plan to the Department at least 30 days prior to the date of the test. The test plan must be prepared in accordance with the Source Sampling Manual and address any planned variations or alternatives to prescribed test methods. The permittee should be aware that if significant variations are requested, it may require more than 30 days for the Department to grant approval and may require EPA approval in addition to approval by the Department.

- 22.b. Only regular operating staff may adjust the processes or emission control device parameters during a compliance source test and within two (2) hours prior to the tests. Any operating adjustments made during a compliance source test, which are a result of consultation during the tests with source testing personnel, equipment vendors, or consultants, may render the source test invalid.
- 22.c. Unless otherwise specified by permit condition or Department approved source test plan, all compliance source tests must be performed as follows:
- 22.c.i. at least 90% of the design capacity for new or modified equipment;
 - 22.c.ii at least 90% of the maximum operating rate for existing equipment; or
 - 22.c.iii. at 90 to 110% of the normal maximum operating rate for existing equipment. For purposes of this permit, the normal maximum operating rate is defined as the 90th percentile of the average hourly operating rates during a 12 month period immediately preceding the source test. Data supporting the normal maximum operating rate must be included with the source test report.
- 22.d. Each source test must consist of at least three (3) test runs and the emissions results must be reported as the arithmetic average of all valid test runs. If for reasons beyond the control of the permittee a test run is invalid, the Department may accept two (2) test runs for demonstrating compliance with the emission limit or standard.
- 22.e. Source test reports prepared in accordance with the Department's Source Sampling Manual must be submitted to the Department within 45 days of completing any required source test, unless a different time period is approved in the source test plan submitted prior to the source test.

GENERAL MONITORING AND RECORDKEEPING REQUIREMENTS

General Monitoring Requirements:

23. The permittee must not knowingly render inaccurate any required monitoring device or method. [OAR 340-218-0050(3)(a)(E)]
24. Methods used to determine actual emissions for fee purposes must also be used for compliance determination and can be no less rigorous than the requirements of OAR 340-218-0080. [OAR 340-218-0050(3)(a)(F)]
25. Monitoring requirements must commence on the date of permit issuance unless otherwise specified in the permit or an applicable requirement. [OAR 340-218-0050(3)(a)(G)]

General Recordkeeping Requirements

26. The permittee must maintain the following general records of testing and monitoring required by this permit: [OAR 340-218-0050(3)(b)(A)]
- 26.a. the date, place as defined in the permit, and time of sampling or measurements;
 - 26.b. the date(s) analyses were performed;
 - 26.c. the company or entity that performed the analyses;
 - 26.d. the analytical techniques or methods used;
 - 26.e. the results of such analyses;
 - 26.f. the operating conditions as existing at the time of sampling or measurement; and
 - 26.g. the records of quality assurance for continuous monitoring systems (including but not limited to quality control activities, audits, calibration drift checks).

27. Unless otherwise specified by permit condition, the permittee must make every effort to maintain 100 percent of the records required by the permit. If information is not obtained or recorded for legitimate reasons (e.g., the monitor or data acquisition system malfunctions due to a power outage), the missing record(s) will not be considered a permit deviation provided the amount of data lost does not exceed 10% of the averaging periods in a reporting period or 10% of the total operating hours in a reporting period, if no averaging time is specified. Upon discovering that a required record is missing, the permittee must document the reason for the missing record. In addition, any missing record that can be recovered from other available information will not be considered a missing record. [OAR 340-214-0110, 340-212-0160, and 340-218-0050(3)(b)]
28. Recordkeeping requirements must commence on the date of permit issuance unless otherwise specified in the permit or an applicable requirement. [OAR 340-218-0050(3)(b)(C)]
29. Unless otherwise specified, the permittee must retain records of all required monitoring data and support information for a period of at least five (5) years from the date of the monitoring sample, measurement, report, or application. Support information includes all calibration and maintenance records and all original strip-chart recordings (or other original data) for continuous monitoring instrumentation, and copies of all reports required by the permit. All existing records required by the previous Oregon Title V Operating Permit must also be retained for five (5) years from the date of the monitoring sample, measurement, report, or application. [OAR 340-218-0050(b)(B)]

REPORTING REQUIREMENTS

General Reporting Requirements

30. Excess Emissions Reporting The permittee must report all excess emissions as follows: [OAR 340-214-0300 through 340-214-0360]
 - 30.a. Immediately (within 1 hour of the event) notify the Department of an excess emission event by phone, e-mail, or facsimile; and
 - 30.b. Within 15 days of the excess emissions event, submit a written report that contains the following information: [OAR 340-214-0340(1)]
 - 30.b.i. The date and time of the beginning of the excess emissions event and the duration or best estimate of the time until return to normal operation;
 - 30.b.ii. The date and time the owner or operator notified the Department of the event;
 - 30.b.iii. The equipment involved;
 - 30.b.iv. Whether the event occurred during planned startup, planned shutdown, scheduled maintenance, or as a result of a breakdown, malfunction, or emergency;
 - 30.b.v. Steps taken to mitigate emissions and corrective action taken, including whether the approved procedures for a planned startup, shutdown, or maintenance activity were followed;
 - 30.b.vi. The magnitude and duration of each occurrence of excess emissions during the course of an event and the increase over normal rates or concentrations as determined by continuous monitoring or best estimate (supported by operating data and calculations);
 - 30.b.vii. The final resolution of the cause of the excess emissions; and
 - 30.b.viii. Where applicable, evidence supporting any claim that emissions in excess of technology-based limits were due to any emergency pursuant to OAR 340-214-0360.
 - 30.c. In the event of any excess emissions which are of a nature that could endanger public health and occur during non-business hours, weekends, or holidays, the permittee must immediately notify the Department by calling the Oregon Accident Response System (OARS). The current number is 1-800-452-0311.
 - 30.d. If startups, shutdowns, or scheduled maintenance may result in excess emissions, the permittee must submit startup, shutdown, or scheduled maintenance procedures used to minimize excess

- emissions to the Department for prior authorization, as required in OAR 340-214-0310 and 340-214-0320. New or modified procedures must be received by the Department in writing at least 72 hours prior to the first occurrence of the excess emission event. The permittee must abide by the approved procedures and have a copy available at all times.
- 30.e. The permittee must notify the Department of planned startup/shutdown or scheduled maintenance events.
 - 30.f. The permittee must continue to maintain a log of all excess emissions in accordance with OAR 340-214-0340(3). However, the permittee is not required to submit the detailed log with the semi-annual and annual monitoring reports. The permittee is only required to submit a brief summary listing the date, time, and the affected emissions units for each excess emission that occurred during the reporting period. [OAR 340-218-0050(3)(c)]
31. Permit Deviations Reporting: The permittee must promptly report deviations from permit requirements that do not cause excess emissions, including those attributable to upset conditions, as defined in the permit, the probable cause of such deviations, and any corrective actions or preventive measures taken. "Prompt" means within 15 days of the deviation. Deviations that cause excess emissions, as specified in OAR 340-214-0300 through 340-214-0360 must be reported in accordance with Condition 23.
32. All required reports must be certified by a responsible official consistent with OAR 340-218-0040(5);[OAR 340-218-0050(3)(c)(D)]
33. Reporting requirements must commence on the date of permit issuance unless otherwise specified in the permit. [OAR 340-218-0050(3)(c)(E)]

Addresses of regulatory agencies are the following, unless otherwise instructed:

DEQ – Western Region
750 Front Street NE, Suite 120
Salem, OR 97310
(503) 378-8240

DEQ – Air Quality Division
811 SW Sixth Avenue
Portland, OR 97204
(503) 229-5359

Air Operating Permits
US Environmental Protection Agency
Mail Stop OAQ-108
1200 Sixth Avenue
Seattle, WA 98101

Semi-annual and Annual Reports

34. The permittee must submit three (3) copies of reports of any required monitoring at least every 6 months, completed on forms approved by the Department. Six month periods are January 1 to June 30, and July 1 to December 31. One copy of the report must be submitted to the EPA and two copies to the DEQ regional office. All instances of deviations from permit requirements must be clearly identified in such reports: [OAR 340-218-0050(3)(c)(A) and 340-218-0080(6)(d)]
- 34.a. The first semi-annual report is due on July 30 and must include the semi-annual compliance certification, OAR 340-218-0080.
 - 34.b. The annual report is due on February 15 and must consist of the following:
 - 34.b.i. the emission fee report; [OAR 340-220-0100]
 - 34.b.ii. a summary of the excess emissions upset log; [OAR 340-214-0340]
 - 34.b.iii. the second semi-annual compliance certification; [OAR 340-218-0080]
 - 34.b.iv. the annual emission inventory report for the prior calendar year;
 - 34.b.v. greenhouse gas emissions in accordance with Division 215 of OAR Chapter 340. [OAR 340-215-0040(3)(a)]
35. The semi-annual compliance certification must include the following (provided that the identification of applicable information may cross-reference the permit or previous reports, as applicable): [OAR 340-218-0080(6)(c)]

- 35.a. The identification of each term or condition of the permit that is the basis of the certification;
 - 35.b. The identification of the method(s) or other means used by the owner or operator for determining the compliance status with each term and condition during the certification period, and whether such methods or other means provide continuous or intermittent data. Such methods and other means must include, at a minimum, the methods and means required under OAR 340-218-0050(3). *Note: Certification of compliance with the monitoring conditions in the permit is sufficient to meet this requirement, except when the permittee must certify compliance with new applicable requirements that are incorporated by reference into the permit. When certifying compliance with new applicable requirements that are not yet in the permit, the permittee must provide the information required by this condition.* If necessary, the owner or operator also must identify any other material information that must be included in the certification to comply with section 113(c)(2) of the FCAA, which prohibits knowingly making a false certification or omitting material information;
 - 35.c. The status of compliance with terms and conditions of the permit for the period covered by the certification, including whether compliance during the period was continuous or intermittent. The certification must be based on the method or means designated in OAR 340-218-0040(6)(c)(B). The certification must identify each deviation and take it into account in the compliance certification. The certification must also identify as possible exceptions to compliance any periods during which compliance is required and in which an excursion or exceedance, as defined under OAR 340-200-0020, occurred; and
 - 35.d. Such other facts as the Department may require to determine the compliance status of the source.
36. Notwithstanding any other provision contained in any applicable requirement, the owner or operator may use monitoring as required under OAR 340-218-0050(3) and incorporated into the permit, in addition to any specified compliance methods, for the purpose of submitting compliance certifications. [OAR 340-218-0080(6)(e)]

Monthly Reports

37. The permittee must report the following information for the preceding month within 30 days of the end of each calendar month to the Western Region-Salem office of the Department:
- 37.a. The cover integrity monitoring results and repairs, if necessary, as required by Condition 13.10;
 - 37.b. The results of the quarterly surface methane monitoring, if conducted during the month, and corrective actions taken as required by Condition 13.10;
 - 37.c. Any other information regarding upsets, maintenance required, or operational problems encountered during the month on the landfill gas collection or control systems;
 - 37.d. Information concerning the installation date and location of any newly installed wells or expansion of the landfill gas collection system as required by Condition 13.7;
 - 37.e. The amount of landfill gas collected and treated in both the IC engines and the flare;
 - 37.f. The total operating hours of the IC engines and flare during the month; and,
 - 37.g. Log of air quality complaints received during the month under Condition 8.

EMISSION FEES

38. Emission fees will be based on the Plant Site Emission Limits in Condition 19, unless the permittee elects to report actual emissions for one or more permitted processes/pollutants using the procedures in OAR 340 Division 220. If the permittee reports actual emissions for one or more permitted processes/pollutants, the permitted emissions for the remaining permitted processes/pollutants will be based on the following table: [OAR 340-220-0090]

Emission Source Description	Permitted Process Code (DEQ Codes)	PM ₁₀ (tons)	SO ₂ (tons)	NO _x (tons)	VOC (tons)
Roads	FS-1	3.1			
Open Flare	GS-1	2.2	2.2	5.2	0.3
Fugitive LFG	FS-2				11.0
Petroleum Cont. Soil	FS-2				0.8
Tipper	GS-1	0.3	0.2	3.6	0.3
AI	GS-1	1.0	1.0	1.0	1.0

NON-APPLICABLE REQUIREMENTS

39. State and Federal air quality requirements (e.g., rules and regulations) currently determined not applicable to the permittee are listed below along with the reason for the non-applicability: [OAR 340-218-0110]

<u>Applicable Requirement</u>	<u>Reason Code</u>	<u>Applicable Requirement</u>	<u>Reason Code</u>	<u>Applicable Requirement</u>	<u>Reason Code</u>	<u>Applicable Requirement</u>	<u>Reason Code</u>
OAR Chapter 340:		0250	I	All rules	C	0190	E
Division 202		Division 222		Division 242		Division 266	
All rules	I	0042	C	All rules	C	All rules	B
Division 204		0060	H	Division 248		40 CFR	
All rules	I	Division 224		0210 through 0230	B	Part 55	B
Division 206		0050	C	Division 250		Part 57	B
0050	C	0060	C	All rules	I	Part 60, except subparts A, WWW, and appendixes	B
0060 through 0070	I	Division 225		Division 252		Part 61, except subparts A, M, and appendixes	B
Division 208		0045	C	All rules	I	Part 63, except subparts A, AAAA, and appendixes	B
0500 through 0610	D	Division 226		Division 254		Part 68	B
Division 210		0400	H	All rules	E	Part 72 through 76	B
0100 through 0120	B	Division 228		Division 256		Part 77	B
Division 212		0100 through 0130	F	All rules	B	Part 78	B
0200 through 0280	J	0300 through 0530	B	Division 257		Part 82, except subpart F	B
Division 214		0600 through 0678	B	All rules	E	Part 85 through 89	B
0200 and 0220	C	Division 230		Division 258			
0400 through 0430	B	All rules	E	All rules	B		
Division 218		Division 232		Division 260			
0050(4)	B	All rules	C	All rules	B		
0050(8)	H	Division 234		Division 262			
0060	I	All rules	B	All rules	B		
0070	I	Division 236		Division 264			
0090	B	All rules	B	0100	D		
0100	B	Division 240		0120 through 0170	D		

Reason code definitions:

- A this pollutant is not emitted by the facility
- B the facility is not in this source category
- C the facility is not in a special control/nonattainment area
- D the facility is not in this county
- E the facility does not have this emissions unit
- F the facility does not use this fuel type

- G the rule does not apply because no changes have been made at the facility that would trigger these procedural requirements
- H this method/procedure is not used by the facility
- I this rule applies only to DEQ and regional authorities
- J there are no emissions units with add-on control devices or the pre-controlled potential emissions are less than 100 tons per year or the emissions units with add-on control devices and pre-controlled emissions greater than 100 tons per year are subject to emissions standards promulgated after November of 1990

GENERAL CONDITIONS

G1. General Provision

Terms not otherwise defined in this permit have the meaning assigned to such terms in the referenced regulation.

G2. Reference materials

Where referenced in this permit, the versions of the following materials are effective as of the dates noted unless otherwise specified in this permit:

- a. Source Sampling Manual; January 23, 1992 - State Implementation Plan Volume 3, Appendix A4;
- b. Continuous Monitoring Manual; January 23, 1992 - State Implementation Plan Volume 3, Appendix A6; and
- c. All state and federal regulations as in effect on the date of issuance of this permit.

G3. Applicable Requirements [OAR 340-218-0010(3)(b)]

Oregon Title V Operating Permits do not replace requirements in Air Contaminant Discharge Permits (ACDP) issued to the source even if the ACDP(s) have expired. For a source operating under a Title V permit, requirements established in an earlier ACDP remain in effect notwithstanding expiration of the ACDP or Title V permit, unless a provision expires by its terms or unless a provision is modified or terminated following the procedures used to establish the requirement initially. Source specific requirements, including, but not limited to TACT, RACT, BACT, and LAER requirements, established in an ACDP must be incorporated into the Oregon Title V Operating Permit and any revisions to those requirements must follow the procedures used to establish the requirement initially.

G4. Compliance [OAR 340-218-0040(3)(n)(C), 340-218-0050(6), and 340-218-0080(4)]

- a. The permittee must comply with all conditions of this permit. Any permit condition noncompliance constitutes a violation of the Federal Clean Air Act and/or state rules and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application. Any noncompliance with a permit condition specifically designated as enforceable only by the state constitutes a violation of state rules only and is grounds for enforcement action; for permit termination, revocation and re-issuance, or modification; or for denial of a permit renewal application.
- b. Any schedule of compliance for applicable requirements with which the source is not in compliance at the time of permit issuance is supplemental to, and does not sanction noncompliance with the applicable requirements on which it is based.
- c. For applicable requirements that will become effective during the permit term, the source must meet such requirements on a timely basis unless a more detailed schedule is expressly required by the applicable requirement.

G5. Masking Emissions:

The permittee must not install or use any device or other means designed to mask the emission of an air contaminant that causes or is likely to cause detriment to health, safety, or welfare of any person or otherwise violate any other regulation or requirement. [OAR 340-208-0400] This condition is enforceable only by the State.

G6. Credible Evidence:

Notwithstanding any other provisions contained in any applicable requirement, any credible evidence may be used for the purpose of establishing whether a person has violated or is in violation of any such applicable requirements. [OAR 340-214-0120]

G7. Certification [OAR 340-214-0110, 340-218-0040(5), 340-218-0050(3)(c)(D), and 340-218-0080(2)]

Any document submitted to the Department or EPA pursuant to this permit must contain certification by a responsible official of truth, accuracy and completeness. All certifications must state that based on information and belief formed after reasonable inquiry, the statements and information in the document are true, accurate, and, complete. The permittee must promptly, upon discovery, report to the Department a material error or omission in these records, reports, plans, or other documents.

G8. Open Burning [OAR Chapter 340, Division 264]

The permittee is prohibited from conducting open burning, except as may be allowed by OAR 340-264-0020 through 340-264-0200.

G9. Asbestos [40 CFR Part 61, Subpart M (federally enforceable), OAR Chapter 340-248-0005 through 340-248-0180 (state-only enforceable) and 340-248-0205 through 340-248-0280]

The permittee must comply with OAR Chapter 340, Division 248, and 40 CFR Part 61, Subpart M when conducting any renovation or demolition activities at the facility.

G10. Stratospheric Ozone and Climate Protection [40 CFR 82 Subpart F, OAR 340-260-0040]

The permittee must comply with the standards for recycling and emissions reduction pursuant to 40 CFR Part 82, Subpart F, Recycling and Emissions Reduction.

G11. Permit Shield [OAR 340-218-0110]

- a. Compliance with the conditions of the permit is deemed compliance with any applicable requirements as of the date of permit issuance provided that:
 - i. such applicable requirements are included and are specifically identified in the permit, or
 - ii. the Department, in acting on the permit application or revision, determines in writing that other requirements specifically identified are not applicable to the source, and the permit includes the determination or a concise summary thereof.
- b. Nothing in this rule or in any federal operating permit alters or affects the following:
 - i. the provisions of ORS 468.115 (enforcement in cases of emergency) and ORS 468.035 (function of department);
 - ii. the liability of an owner or operator of a source for any violation of applicable requirements prior to or at the time of permit issuance;

- iii. the applicable requirements of the national acid rain program, consistent with section 408(a) of the FCAA; or
 - iv. the ability of the Department to obtain information from a source pursuant to ORS 468.095 (investigatory authority, entry on premises, status of records).
- c. Sources are not shielded from applicable requirements that are enacted during the permit term, unless such applicable requirements are incorporated into the permit by administrative amendment, as provided in OAR 340-218-0150(1)(h), significant permit modification, or reopening for cause by the Department.

G12. Inspection and Entry [OAR 340-218-0080(3)]

Upon presentation of credentials and other documents as may be required by law, the permittee must allow the Department of Environmental Quality, or an authorized representative (including an authorized contractor acting as a representative of the EPA Administrator), to perform the following:

- a. enter upon the permittee's premises where an Oregon Title V Operating Permit program source is located or emissions-related activity is conducted, or where records must be kept under the conditions of the permit;
- b. have access to and copy, at reasonable times, any records that must be kept under conditions of the permit;
- c. inspect, at reasonable times, any facilities, equipment (including monitoring and air pollution control equipment), practices, or operations regulated or required under the permit; and
- d. as authorized by the FCAA or state rules, sample or monitor, at reasonable times, substances or parameters, for the purposes of assuring compliance with the permit or applicable requirements.

G13. Fee Payment [OAR 340-220-0010, and 340-220-0030 through 340-220-0190]

The permittee must pay an annual base fee and an annual emission fee for particulates, sulfur dioxide, nitrogen oxides, and volatile organic compounds. The permittee must submit payment to the Department of Environmental Quality, Business Office, 811 SW 6th Avenue, Portland, OR 97204, within 30 days of the date the Department mails the fee invoice or August 1 of the year following the calendar year for which emission fees are paid, whichever is later. Disputes must be submitted in writing to the Department of Environmental Quality. Payment must be made regardless of the dispute. User-based fees will be charged for specific activities (e.g., computer modeling review, ambient monitoring review, etc.) requested by the permittee.

G14. Off-Permit Changes to the Source [OAR 340-218-0140(2)]

- a. The permittee must monitor for, and record, any off-permit change to the source that:
 - i. is not addressed or prohibited by the permit;
 - ii. is not a Title I modification;
 - iii. is not subject to any requirements under Title IV of the FCAA;
 - iv. meets all applicable requirements;
 - v. does not violate any existing permit term or condition; and
 - vi. may result in emissions of regulated air pollutants subject to an applicable requirement but not otherwise regulated under this permit or may result in insignificant changes as defined in OAR 340-200-0020.
- b. A contemporaneous notification, if required under OAR 340-218-0140(2)(b), must be submitted to the Department and the EPA.

- c. The permittee must keep a record describing off-permit changes made at the facility that result in emissions of a regulated air pollutant subject to an applicable requirement, but not otherwise regulated under the permit, and the emissions resulting from those off-permit changes.
- d. The permit shield of Condition G9 does not extend to off-permit changes.

G15. Section 502(b)(10) Changes to the Source [OAR 340-218-0140(3)]

- a. The permittee must monitor for, and record, any section 502(b)(10) change to the source, which is defined as a change that would contravene an express permit term but would not:
 - i. violate an applicable requirement;
 - ii. contravene a federally enforceable permit term or condition that is a monitoring, recordkeeping, reporting, or compliance certification requirement; or
 - iii. be a Title I modification.
- b. A minimum 7-day advance notification must be submitted to the Department and the EPA in accordance with OAR 340-218-0140(3)(b).
- c. The permit shield of Condition G9 does not extend to section 502(b)(10) changes.

G16. Administrative Amendment [OAR 340-218-0150]

Administrative amendments to this permit must be requested and granted in accordance with OAR 340-218-0150. The permittee must promptly submit an application for the following types of administrative amendments upon becoming aware of the need for one, but no later than 60 days of such event:

- a. legal change of the registered name of the company with the Corporations Division of the State of Oregon, or
- b. sale or exchange of the activity or facility.

G17. Minor Permit Modification [OAR 340-218-0170]

The permittee must submit an application for a minor permit modification in accordance with OAR 340-218-0170.

G18. Significant Permit Modification [OAR 340-218-0180]

The permittee must submit an application for a significant permit modification in accordance with OAR 340-218-0180

G19. Staying Permit Conditions [OAR 340-218-0050(6)(c)]

Notwithstanding conditions G16 and G17, the filing of a request by the permittee for a permit modification, revocation and re-issuance, or termination, or of a notification of planned changes or anticipated noncompliance does not stay any permit condition.

G20. Construction/Operation Modification [OAR 340-218-0190]

The permittee must obtain approval from the Department prior to construction or modification of any stationary source or air pollution control equipment in accordance with OAR 340-210-0200 through OAR 340-210-0250.

G21. New Source Review Modification [OAR 340-224-0010]

The permittee may not begin construction of a major source or a major modification of any stationary source without having received an air contaminant discharge permit (ACDP) from the Department and having satisfied the requirements of OAR 340, Division 224.

G22. Need to Halt or Reduce Activity Not a Defense [OAR 340-218-0050(6)(b)]

The need to halt or reduce activity will not be a defense. It will not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

G23. Duty to Provide Information [OAR 340-218-0050(6)(e) and OAR 340-214-0110]

The permittee must furnish to the Department, within a reasonable time, any information that the Department may request in writing to determine whether cause exists for modifying, revoking and reissuing, or terminating the permit, or to determine compliance with the permit. Upon request, the permittee must also furnish to the Department copies of records required to be retained by the permit or, for information claimed to be confidential, the permittee may furnish such records to the Department along with a claim of confidentiality.

G24. Reopening for Cause [OAR 340-218-0050(6)(c) and 340-218-0200]

- a. The permit may be modified, revoked, reopened and reissued, or terminated for cause as determined by the Department.
- b. A permit must be reopened and revised under any of the circumstances listed in OAR 340-218-0200(1)(a).
- c. Proceedings to reopen and reissue a permit must follow the same procedures as apply to initial permit issuance and affect only those parts of the permit for which cause to reopen exists.

G25. Severability Clause [OAR 340-218-0050(5)]

Upon any administrative or judicial challenge, all the emission limits, specific and general conditions, monitoring, recordkeeping, and reporting requirements of this permit, except those being challenged, remain valid and must be complied with.

G26. Permit Renewal and Expiration [OAR 340-218-0040(1)(a)(D) and 340-218-0130]

- a. This permit expires at the end of its term, unless a timely and complete renewal application is submitted as described below. Permit expiration terminates the permittee's right to operate.
- b. Applications for renewal must be submitted at least 12 months before the expiration of this permit, unless the Department requests an earlier submittal. If more than 12 months is required to process a permit renewal application, the Department must provide no less than six (6) months for the owner or operator to prepare an application.
- c. Provided the permittee submits a timely and complete renewal application, this permit will remain in effect until final action has been taken on the renewal application to issue or deny the permit.

G27. Permit Transference [OAR 340-218-0150(1)(d)]

The permit is not transferable to any person except as provided in OAR 340-218-0150(1)(d).

G28. Property Rights [OAR 340-200-0020 and 340-218-0050(6)(d)]

The permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations, except as provided in OAR 340-218-0110.

G29. Permit Availability [OAR 340-200-0020 and 340-218-0120(2)]

The permittee must have available at the facility at all times a copy of the Oregon Title V Operating Permit and must provide a copy of the permit to the Department or an authorized representative upon request.

ALL INQUIRIES SHOULD BE DIRECTED TO:

Department of Environmental Quality
Air Quality Division
Western Region-Salem Office
750 Front Street NE, Suite 120
Salem, OR 97301-1039
(503) 378-8240



2021 GAS COLLECTION AND CONTROL SYSTEM DESIGN PLAN

FOR THE COFFIN BUTTE LANDFILL

PRESENTED TO:



PREPARED BY:



December 9, 2021

Exhibit 41

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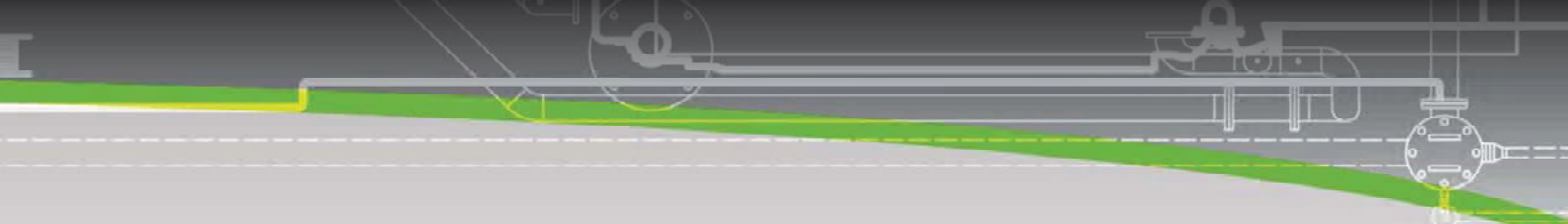


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1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide a design plan in accordance with the Oregon State Plan design requirements for the landfill gas (LFG) collection and control system (GCCS) at the Coffin Butte Landfill (CBLF). This document serves as the GCCS Design Plan and was prepared pursuant to OAR 340-239-0110. This GCCS Design Plan supersedes all other previously prepared GCCS Design Plan Submittals.

1.2 COMPLIANCE SUMMARY

A summary of applicable regulations and implementation of these regulations at Coffin Butte Landfill is presented in Appendix H of this Design Plan.

1.3 CERTIFICATION

This Design Plan for the GCCS at CBLF has been prepared by Energyneering Solutions (ESI), as authorized by Republic, which operates the GCCS at CBLF.

I certify that the GCCS as described in this plan meets the design requirements specified in OAR 340-239-0110. I further certify that this Design Plan was prepared by me or under my direct supervision, and that I am a duly registered Professional Engineer.



Benjamin Benson, P.E.

Certifying Engineer

Oregon P.E. License No. 80443



2 EXISTING SITE CONDITIONS

2.1 LANDFILL DESCRIPTION

Coffin Butte Landfill is located in Corvallis, in Benton County, Oregon. The landfill is owned and operated by Republic under Solid Waste Permit Identification Number 306 issued by the Oregon Department of Environmental Quality (DEQ). The landfill accepts municipal solid waste (MSW), construction and demolition landfill waste (CDL), and inert burn waste. The landfill began accepting waste in 1978 and has a design capacity of approximately 39.7 million tons at a projected closure date of 2041.

2.2 CURRENT GCCS

An active GCCS is in place and operating and will be expanded as waste continues to be placed. As of 2021, CBLF has 312 active vertical extraction wells and horizontal collectors in total. Existing vertical extraction wells have a well spacing ranging from 150 to 200 feet throughout the fill area. Whenever possible, existing wells were installed along permanent benches and at edges of plateaus. These locations made them easier to maintain, monitor, and install; additionally, this ensured the wells stayed out of the way of site filling operations. In other cases, some vertical wells and horizontal collectors were extended, replaced, or decommissioned as needed according to operation and compliance needs.



The elevation difference between ground surface and the operational layer at all wellhead locations is at a minimum 55ft (i.e. wells were not be drilled in waste less than 55ft deep), and there is a minimum of 15ft between the bottom of each well and the operational layer to ensure the liner is protected. All other vertical wells are drilled to their maximum depth to facilitate liquid collection and drainage to the base of the landfill. Where gravel chimneys or gabion baskets have been installed at the base of a cell, vertical wells are drilled to the top of the chimneys to encourage liquid drainage and collection. Borehole drilling locations were specified with coordinates by the Engineer in detailed designs. The selected drilling Contractor sent surveyed and staked well locations to the Engineer prior to drilling so that waste depths could be verified

Permanent lateral and header pipes were installed below grade and were constructed of high-density polyethylene (HDPE) pipe. Temporary piping was installed either above or below grade to accommodate ongoing waste placement operations as needed. LFG is currently conveyed through this pipe network to the electrical generation plant and backup utility flares, located southeast of the disposal area.

Condensate that forms in the GCCS piping is discharged to the leachate collection system (LCS) via direct connections to LCS clean/access riser or to condensate pump stations located around the perimeter of the disposal area. Condensate drained by gravity to the condensate pump stations is discharged through a force main(s) to the LCS. Condensate collected in condensate drains is transported via gravity directly to the LCS via leachate system access risers. The condensate is disposed of coincidentally with landfill leachate in accordance with the requirements of the facility Solid Waste Permit.

Additional information and drawings of the GCCS are included in Appendix A.

2.3 CONTROL SYSTEM

Currently, the landfill directs its LFG to an electrical generation plant owned and operated by the Pacific Northwest Generating Cooperative (PNGC) which consists of three 3516 Caterpillar engines each capable combusting of approximately 287 scfm and two 3520 Caterpillar engines each capable of combusting approximately 527 scfm each and has the ability for further expansion.

The PNGC facility has two backup utility flares for handling excess LFG. The blower skid and flare system equipment are located on the southeastern corner of the landfill. The complete system includes two LFG blowers and two candlestick flares with a combined 3,000 scfm capacity. One 2000 scfm capacity flare was installed with the initial GCCS, while an additional 1000 scfm flare was installed in 2015 after the LFG flow to the flare station rose following GCCS expansion. As of 2021, the flare station currently has a combined flow approximately 2000-2200 scfm with the remainder of the collected LFG being utilizes by the power generation facility that has up to 95% annual generation capacity.

The flares are designed to reduce NMOCs by 98 percent weight or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen, which meets 40 CFR §60.752(b)(2)(iii)(B), but not OAR 340-239-0110 (2)(b)(A) which requires a methane destruction efficiency of at least 99 percent by weight. Both current flares are equipped with continuous temperature recorders and flowmeters which meet the requirements of OAR 340-239-0110 (2)(c)(A)(i) and OAR 340-239-0110 (2)(c)(A)(ii).

In accordance with OAR 340-239-0110 (2)(c)(A)(ii)(I) the flare exhaust temperatures and LFG flow rate are monitored continuously. The flare exhaust temperature is monitored using a thermocouple installed at the flare tip. The LFG flow rate is measured using an orifice plate, installed along the LFG piping, downstream of the blowers. The utility flare is constantly monitored for the presence of a flame, indicating that combustion is occurring. Monitoring for the presence of a flame is accomplished by an ultraviolet flame scanner, thermocouple, or comparable device. In the event that a flame is not detected, indicating that the combustion process has been disrupted, the monitoring system will automatically:

- Cut power to the LFG blowers, and;

- Initiate the closure of a pneumatic-activated valve at the inlet to the blowers. There is no bypass around the control device.

Stopping the blowers will cause the LFG extraction process to cease. Closing the inlet valve to the blowers will eliminate the potential for direct venting of LFG through the control device system.

The backup utility flare consists of a 2,000 scfm capacity skid mounted utility flare system manufactured by LFG & E International in order to provide additional LFG control capacity. The utility Triton flare, model CF-2000, is 10-inch diameter and approximately 31-feet tall. The skid-mounted utility flare system also features a fail-closed valve, a main condensate knockout, a flow meter, a 2,000 scfm capacity New York blower, and a control valve for the blower. The blower is a single stage fan blower with direct drive 30 HP, 480 V AC, three phase motor, and shall be capable of generating 50 inches water column (W.C.) inlet vacuum and 15 inches W.C. discharge pressure.

In the event that LFG extracted from the landfill exceeds the capacity of the control systems, additional control mechanisms will be installed. These additional control mechanisms may include, but are not limited to, upgrading the existing control devices or installation of other beneficial-use facilities.

Visual inspections of all control mechanisms associated with the control system are performed monthly.

3 FUTURE GCCS

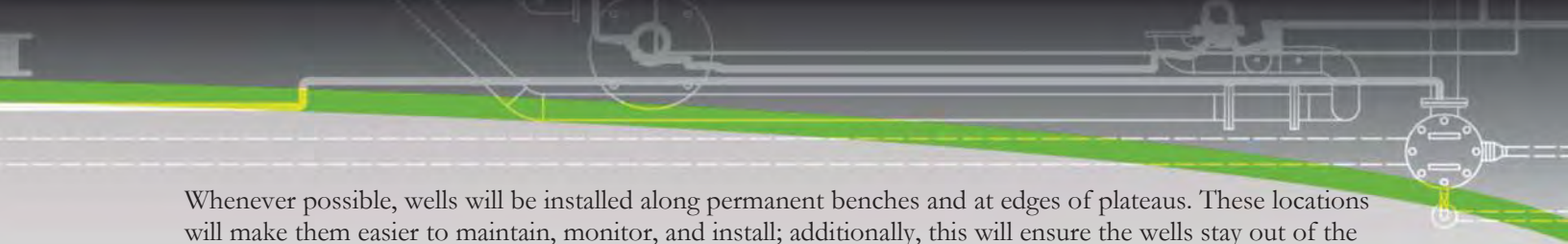
The Coffin Butte Landfill will continue to place waste in accordance with the solid waste permit. Installation of additional GCCS components is anticipated to be coordinated with fill development and as required by DEQ regulations regarding installation of GCCS components stipulated in OAR 340-239-0110: Gas Collection and Control System Requirements. Due to operational changes, the GCCS design plan presented in Appendix A may be altered to maintain compliance with the provisions of the DEQ and to accommodate actual field conditions at the time of construction.

3.1 VERTICAL WELLS

Vertical wells will be constructed of 6" diameter schedule 40 carbon steel or HDPE piping. Perforations of vertical wells will be at a suitable depth to prevent air intrusion, as calculated in Section 5.3. The borehole for vertical wells will be a minimum of 3ft in diameter with washed non-calcareous stone fill made up of stone from 1-3 inches in size. The borehole will have bentonite plug between the stone backfill and soil cover, as well as a secondary bentonite plug within the soil cover, to prevent migration of gas through the borehole. Where the wellhead comes above the landfill's cover tarping, a geomembrane boot will be installed. Vertical well material, size, connections, and backfill may be modified; however, vertical wells will maintain compliance to OAR 340-239-0110(1) and OAR 340-239-0110(2).

The elevation difference between ground surface and the operational layer at all wellhead locations will at a minimum be 55ft (i.e. wells will not be drilled in waste less than 55ft deep), and there will be a minimum of 15ft between the bottom of each well and the operational layer to ensure the liner is protected. All vertical wells will be drilled to their maximum depth, within the bounds described previously, to facilitate liquid collection and drainage to the base of the landfill. Where gravel chimneys or gabion baskets have been installed at the base of a cell, vertical wells will be drilled to the top of the chimneys to encourage liquid drainage and collection. Borehole drilling locations will be specified with coordinates by the Engineer in detailed designs. The selected drilling Contractor will send surveyed and staked well locations to the Engineer prior to drilling so that waste depths can be verified.

To maximize vertical well life, wells will only be drilled in areas of final, or interim final fill. Wells installed in interim final fill areas are designed to maximize collection from an area that will remain undisturbed for many years and will only be placed in areas with adequate waste depth. Eventually, as filling in these areas resumes, the wells will need extended or replaced to continue providing adequate collection.



Whenever possible, wells will be installed along permanent benches and at edges of plateaus. These locations will make them easier to maintain, monitor, and install; additionally, this will ensure the wells stay out of the way of site filling operations. Vertical wells will be spaced to ensure adequate LFG collection density in accordance with OAR 340-239-0110(1)(c)(J); spacing determination is further described in Section 5.3.

ESI is currently evaluating performance of carbon steel vertical well casing which have been installed over the previous few years. An adaptive design process should consider long term performance of all casing materials installed at this site to ensure the materials used provide the highest probability of long-term success.

Minimal corrosion of the carbon steel casings have been observed to date and no steel casings have collapsed under the forces of waste settlement. As a tentative plan, it is intended to continue installing carbon steel casings when installation is along a permanent side slope. The top 3 feet of these steel casings is to be an extension of SDR 11 HDPE to allow for wellhead lowering as necessary based on settlement. When vertical extraction wells are planned for installation on an intermediate slope, casing material should be reviewed on a case-by-case basis to determine if the cost of carbon steel casings is justified based on the anticipated life span for the installed location.

A typical vertical extraction well detail is shown on drawing sheet M3.01 in Appendix A. Carbon steel and PVC casings are to be slotted per Detail C shown on drawing sheet M3.08. HDPE casings, if used, are to be perforated per Detail D on the same drawing sheet. Carbon steel casings will be evaluated to see how the material performs for 10 or more years of use.

3.2 HORIZONTAL COLLECTORS

Horizontal collectors will be constructed of 6" diameter HDPE DR11. Collectors will be centered within a trench, a minimum of 2ft wide and 3ft deep, backfilled with washed non-calcareous stone (1-3 inches in size). A bentonite plug will be installed at the transition from solid to perforated pipe and a geomembrane boot provided where the pipe comes above the landfill cover tarping. Whenever possible, horizontal collectors will be designed to drain liquid back into the landfill, rather than out through wellheads. Like the vertical well design, horizontal collector design is subject to modification but will maintain compliance to OAR 340-239-0110(1) and OAR 340-239-0110(2).

As has been done previously in the existing GCCS, horizontal collectors will be used between waste lifts and in shallower areas of fill. These collectors will have a minimum 100 ft distance from perforated pipe to the edge of fill and will be spaced at 100ft from each other. They will typically not be collected from until there is at least 30ft of waste placed above them or otherwise sufficient LFG generation. Horizontal collectors will act as surface collectors if necessary, and the GCCS may be expanded by adding horizontal collectors near the perimeter of waste to prevent offsite migration as per OAR 340-239-0110(1)(c)(J). By following these guidelines for horizontal collectors, air intrusion will be prevented, and anaerobic decomposition promoted. Horizontal collectors are not shown on the master plan layout for clarity.

3.3 LFG PIPING

All lateral and header LFG piping will be butt fusion welded HDPE at a minimum thickness of SDR 17. Piping will be sized, as specified in Section 5.4, to maintain a adequate vacuum of at each wellhead, even during maximum expected LFG generation; the current blowers will be required to run at their full capacity, 50" W.C., to do this. As discussed in Sections 4.8 and 4.9 HDPE header and lateral piping will be suitably resistant to corrosion and to decomposition due to heat meeting requirement OAR 340-239-0110(2)(a)(I). The LFG piping will be installed in a manner that minimizes obstruction of filling operations as discussed in Section 4.6. Header and lateral piping will be in regions that have reached final fill unless the piping is specified as temporary in designs. When piping is temporary or in specific cases outlined in GCCS designs, it may be necessary to install piping above grade; however, the majority of LFG piping will be installed in a trench as discussed in Section 3.3.1.

3.3.1 Trenching and Slope

According to the US Army Corps of Engineer's *Landfill Gas Collection and Treatment Systems Engineer Manual*, when header pipe is within the Landfill boundaries, it should be on a 2% grade when condensate flow is in the same direction as LFG flow and a 4% grade when condensate flows opposite to LFG. This grade prevents differential settlement in the Landfill from causing low spots in the header piping. Considering this recommendation and ESI's experience, a 3% grade was selected for header and lateral piping at the Landfill to allow condensate drainage to the appropriate in-line condensate sumps located at low points and other strategic locations throughout the Landfill. A survey of the LFG piping path will be submitted to the Engineer during all construction projects by the Contractor so elevation and location can be verified.

Header and lateral piping will be buried with two strips of warning tape buried 3-6" above it; piping will be spaced 6" from any other pipes if it is in a shared trench. Pipe trenches will be backfilled with sand bedding that will support the pipe in resisting vertical loads. Each pipe will be buried at a minimum of 1 ft from pipe crown to the surface except where the LFG header crosses a bench in the landfill, in final closure areas, or when an above ground stub-up is specified in design drawings.

3.4 WELLHEADS

Vertical wells and horizontal collectors will each have a wellhead comprised of, at minimum, a positive closing throttle valve and at least two sampling ports, as specified in OAR 340-239-0110(2)(a)(K). As feasible, new wellheads will be installed, and existing wellheads retrofitted, with flow meter devices and separate temperature sampling ports to ensure accurate flow readings. Standard wellhead pipe sizing will be 2"; wellhead sizing may be increased or decreased to accommodate unique flow conditions at specific wells. Well heads will be constructed of PVC, HDPE, fiberglass, stainless steel, or other nonporous material of suitable thickness.

4 DESIGN CONSIDERATIONS

Design considerations meet the requirements of OAR 340-239-0110(1)(c)(A), below, as described in Sections 4.1 through 4.15. Each GCCS design will be certified to achieve comprehensive control of surface gas emissions by a professional engineer before GCCS construction takes place.

OAR 340-239-0110(1)(c)(A) *The Design Plan must be prepared and certified by a professional engineer. The following issues must be addressed in the design: Depths of solid waste, solid waste gas generation rates and flow characteristics, cover properties, gas system expandability, leachate and condensate management, accessibility, compatibility with filling operations, integration with closure end use, air intrusion control, corrosion resistance, fill settlement, resistance to the solid waste decomposition heat, and ability to isolate individual components or sections for repair or troubleshooting without shutting down entire collection system.*

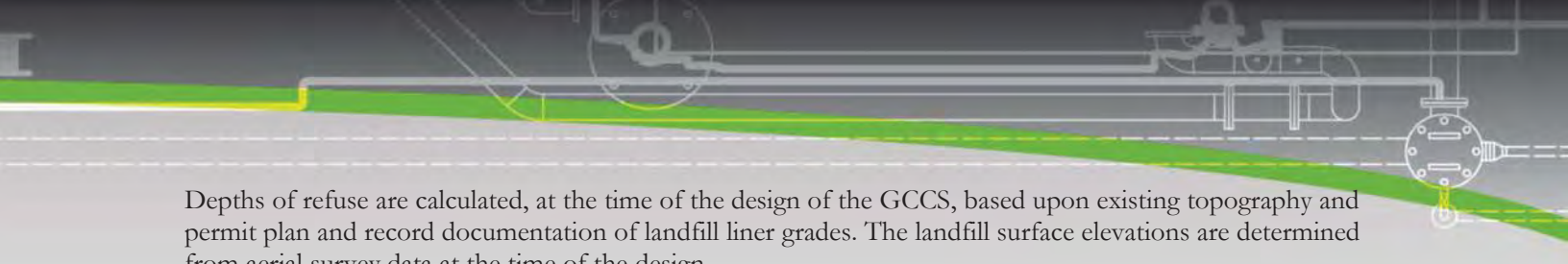
The GCCS has been designed to be consistent with DEQ requirements to achieve comprehensive control of both lateral migration and surface emissions of LFG.

Issues related to compliance with OAR 340-239-0110 (1)(c)(A) are discussed in the following sections.

Applicable information used in the design of the GCCS is included in Appendix A (GCCS Master Plan), Appendix B (LFG Generation Model), Appendix C (Pressure Loss Calculations in LFG Header and Lateral Piping), Appendix D (Radius of Influence Calculations), Appendix E (Compressor Sizing), Appendix F (Surface Emissions Plan), and Appendix G (Alternative Operation and Monitoring Plan).

4.1 DEPTH OF REFUSE

The GCCS master plan incorporates vertical gas extraction wells for regions of the landfill with at least 55-70' of waste depth. Horizontal gas collectors will be used throughout the landfill and placed between waste lifts to provide gas collection in the shallower regions of fill and in areas of active fill. As described in Section 3.1, there will be at least 15' between the operational layer and the bottom of each vertical well's borehole.



Depths of refuse are calculated, at the time of the design of the GCCS, based upon existing topography and permit plan and record documentation of landfill liner grades. The landfill surface elevations are determined from aerial survey data at the time of the design.

4.2 SOLID WASTE GAS GENERATION RATES AND FLOW CHARACTERISTICS

The maximum expected LFG flow rate for the site was used for sizing the GCCS. The LFG generation rate calculations were performed using the United States Environmental Protection Agency (EPA) Landfill Gas Emission Model (LandGEM) (values- $k=0.04/\text{year}$ and $L_0=80 \text{ m}^3/\text{Mg}$), historical waste receipts and the permitted design capacity of the facility. The maximum LFG generation rate projected to be approximately 6900 scfm.

The LandGEM emissions model is a design tool which uses the information available to project future operating conditions. This model was developed based upon operating conditions at a cross-section of landfills within the United States and is approved for use by the EPA. Actual operating parameters may dictate changes in the system flow characteristics and process equipment as the system is developed. The LandGEM model meets the requirements of OAR 340-239-0110(2).

LFG generation variables are discussed in Section 5.2 and LFG projections. The complete 2021 LandGEM report provided in Appendix B.

4.3 LANDFILL COVER PROPERTIES

The final cover design will incorporate a composite geosynthetic/low permeability soil barrier. The primary purpose of the final cover system units is to prevent precipitation infiltration that would generate additional leachate. However, the final cover system design also provides a significant barrier to LFG emission and air infiltration when combined with an active LFG extraction system. The GCCS will provide components for collecting LFG and relieving pressures from LFG from beneath the landfill covers.

4.3.1 Interim Cover

The size of the active operational areas of the Landfill is controlled using interim covers consisting of temporary plastic tarps. The interim soil cover, where used, will typically be a minimum of 12-inches thick. The temporary plastic covers are typically 12-mil, lightweight plastic with a nylon reinforcing scrim or 45-mil ethylene propylene diene monomer (EPDM) rubber. EPDM sheets are available in panels up to 200 feet by 200 feet. The cover material is held down by sandbags placed on a spacing of approximately 10 feet or anchored with specialized earth anchors in the case of EPDM cover. Sheet seams are sewn together, taped, or made by overlapping the sheets and placing sandbags along the seam. The seams will be shingled down slope to properly shed water. The interim cover will facilitate the control of landfill gas prior to final cover being put in place.

4.3.2 Final Cover

The final landfill cover inhibits the infiltration of stormwater and the migration of landfill gas. This cover will be installed periodically during the operating life and the closure of the Landfill. The final cover will consist of:

- An under-drainage layer to allow collection of landfill gas and control of landfill seeps.
- 24" of compacted low permeability soil having a maximum hydraulic conductivity of $1 \times 10^{-5} \text{ cm/s}$.
- Geomembrane, most-likely a 60-mil linear-low density polyethylene (LLDPE) or other approved geomembrane.
- Drainage layer, either 12 inches of gravel or a geocomposite drainage layer



- Plantings, which would include a diverse grass/forb seed mix of native species, shallow-rooted shrubs, and limited areas of mixed forest where topsoil would be deep enough to ensure the integrity of the cover system.

In areas of the landfill under final cover, LFG collection efficiency is expected to increase to as much as 90% due to enhanced effectiveness of the cover to limit air infiltration and LFG emissions. Sections of the landfill already at final grade are currently covered with a LLDPE geomembrane.

4.4 LANDFILL GAS SYSTEM EXPANDABILITY

Expandability of the GCCS is achieved by installing tees with blind flanges along the transmission piping or providing expansion capabilities for additional LFG control devices. These flanges or expansion points provide planned access for expansion of the LFG transmission piping and LFG control device facility(s) in the future. Coffin Butte Landfill may require the installation of supplemental GCCS components to comply with State and Federal regulations at some point in the future. If that need is determined, an alteration will be submitted to the DEQ for review and concurrence prior to the installation of those components. Any needed design component will be installed and operational no later than 60 days after the date on which the area requires control.

4.5 LEACHATE AND CONDENSATE MANAGEMENT

Condensate generated in header, lateral, and horizontal collector piping will maintain drainage from landfill high points to condensate and leachate sumps or leachate cleanouts and drains installed at low points in the Landfill. The current GCCS system includes condensate sumps at low points in the header piping, which will be utilized in future GCCS designs. As shown on the GCCS Master Plan, all LFG piping will slope towards a condensate pump. If necessary, sumps will be upsized to handle condensate for the Landfill. Additional sumps may also be installed if low points are encountered in future designs.

Leachate is pumped from the LCS to an onsite pond for storage. As warranted, leachate is trucked off site for permanent disposal. The LCS is designed according to Subtitle D standards (40 CFR§257 and §258) and is part of the Solid Waste Disposal Permit.

4.5.1 Compressed Air and Liquid Conveyance

2" diameter SDR 9 HDPE piping will provide compressed air to pneumatic pumps for dewatering vertical wells and sumps. The piping will be in a shared trench with the LFG and liquid conveyance piping (see next paragraph) wherever possible to limit the amount of trenching needed in each GCCS design. The compressed air line will stub-up at each vertical well with an isolation valve for isolating individual pumps. The compressed air line will also have isolation and blow-off valves installed at strategic locations in the Landfill. Blow-off valves will allow the compressed air line to be cleaned out and the pressure to be released if necessary.

A 4" diameter liquid conveyance line will stub-up with an isolation valve at each vertical well, along with every compressed air line stub-up. Like the compressed air line, the liquid conveyance line will share a trench with LFG piping whenever possible. Liquid conveyance cleanouts will be installed in the piping every 200ft, comprised of wye-fittings, ball valves, and camlock fittings. Cleanouts are included with these features and at this quantity to allow for easy access to every point in the piping for cleaning by vacuum trucks and water trucks.

4.5.2 Vertical Well Pumps

Leachate extraction pumps in vertical wells will be pneumatic. The pump will operate using the compressed air line with an in-line regulator and will discharge into the 4" liquid conveyance line. This type of pump was selected because it is commonly used for landfill vertical well leachate pumping and can easily be integrated into the liquid conveyance and compressed air lines. The pump will be of a diameter is so that it will fit within the 6" carbon steel or HDPE pipe used for vertical wells. The pump will also be installed with a stabilizer



LFG well cap that will allow the pump to be easily accessible. The pump model selection is subject to change in future designs depending on the site and well specific pumping requirements

4.5.3 Air Compressor

In 2021, CBLF installed a Sullair 3709VB Series 50 HP rotary screw compressor to replace the former model Sullair ST2208 30 HP screw compressor. This larger compressor has a typical lifetime of 15 years and is capable of supplying enough air to operate all proposed pneumatic leachate extraction pumps cycling simultaneously. For more information regarding compressor sizing, please refer to Section 5.5

4.6 COMPATIBILITY WITH FILLING OPERATIONS AND ACCESSIBILITY

Accessibility to the GCCS components is achieved by installing commonly accessed components (such as wellheads and monitoring ports) on relatively flat surfaces of the landfill or near the landfill's road network. Wellheads, piping risers, valves and monitoring ports will be installed above grade, or within vaults, to maintain accessibility.

At the time of this report, an active GCCS has been constructed and is operating in the Coffin Butte Landfill. Future additions or expansions of the GCCS will be designed to integrate the existing GCCS components currently operating at the Coffin Butte Landfill. As refuse filling operations proceed and portions of the site reach final or near-final grades, additional GCCS components will be installed. This method of installation allows GCCS components to be constructed while minimizing interference of the GCCS with ongoing filling operations.

4.7 INTEGRATION WITH CLOSURE AND END USE

Currently, the post-closure end-use for the site is unspecified and will likely be utilized as open space. Any modifications to the closure end-use must be approved by Coffin Butte Landfill personnel to evaluate their compatibility with the GCCS. Any items of concern related to maintaining and operating the GCCS will be mitigated by either altering the proposed post-closure end-use or by adjusting or modifying the GCCS in accordance with DEQ requirements.

4.8 AIR INTRUSION CONTROL

Air intrusion will be minimized throughout the entire Landfill by the interim cover and the final cover described in Section 4.3. Where collectors, wells, or piping pass through the cover, a geomembrane boot will be used to prevent these regions from becoming an air intrusion source. Monthly well tuning and regular maintenance of the cover will also be essential in preventing air intrusion. The radius of influence of vertical wells, which is described in Section 5.3, was used to determine the length of solid pipe and determine a recommended vacuum for wells both on waste plateaus and slopes. By using both these values, the potential for air intrusion due to overpulling at wells will be minimized

4.9 CORROSION RESISTANCE

Corrosion resistance of the GCCS is achieved through the use of corrosion resistant materials or materials that have a corrosion resistant coating. The primary components used in the construction of the GCCS are high density polyethylene (HDPE) and polyvinyl chloride (PVC) piping. All HDPE piping will have a minimum rating standard dimension ratio (SDR) of 17. All PVC piping will have a minimum rating of Schedule 40. Components will be inspected during routine GCCS monitoring for abrasion, chipping, or other potential deterioration of the components. If damage to the materials is observed that may be detrimental to the performance of the GCCS, the components will be replaced or repaired.



4.10 RESISTANCE TO DECOMPOSITION HEAT

Resistance of the GCCS to the heat generated as a result of refuse decomposition was achieved through the use of materials tested and proven to withstand temperatures well above those typically found in landfills. The GCCS will be inspected during routine LFG system monitoring for heat damage. If heat damage of the GCCS components is observed and is believed to be detrimental to the operation of the GCCS, the cause of the elevated landfill temperature will be investigated and the GCCS will be adjusted or modified to mitigate the effects of the elevated temperatures.

The primary point of observation during routine LFG system monitoring will be at the individual wellheads. Each wellhead possesses either an integral thermometer or a connection for the use of portable thermometer. The extraction wells will generally be operated at temperatures of less than 131 °F unless an alternative temperature parameter is approved for an individual monitoring point. All wellhead components are visually inspected, and the control valve and monitoring connection physically exercised during each monitoring event, to insure free operation of the components.

In the event that the monitored LFG temperature exceeds 150°F, the well casing will be inspected via fiber optic camera or other suitable means to ensure that the integrity of the casing has not been compromised. Vertical extraction well casings will be constructed of schedule 40 carbon steel. Legacy casings may be schedule 80 PVC or HDPE. A compromised PVC or HDPE casing will typically show signs of physical deformation or internal "bulges" if excessive heat has been applied for a prolonged period of time. In the event that damage has occurred that negatively impacted the operations of the extraction well, the DEQ will be notified and a remedy for that extraction point proposed for review and concurrence.

Since the LFG stream cools as it is drawn through the piping system, the lateral and header piping will be exposed to relatively cooler gas temperatures than will the extraction wells and wellheads. These components will be inspected only in the event that a surface fire or other disturbance is observed.

4.11 FILL SETTLEMENT

Settlement will occur due to decomposition of the refuse. To accommodate refuse settlement, the GCCS components will be designed and installed with several features to account for this settlement, including:

- LFG extraction wellheads connected to the LFG transmission piping via a flexible pipe or hose connection. This allows the LFG piping to accommodate changes in the orientation of the LFG transmission piping or LFG extraction well.
- LFG transmission piping sloped at sufficient grades (a minimum 3.0 percent within the waste limits, and 0.5 percent outside the waste limits) so that reasonable amounts of differential and total settlement may occur without causing pipe breakage or disrupting the overall flow gradient of the LFG transmission piping.
- HDPE piping used for the construction of the header piping and transmission system. HDPE piping is flexible and absorbs differential settlement without breaking or cracking.

4.12 ISOLATION OF INDIVIDUAL COMPONENTS

The GCCS will be designed to include isolation valves at gas header, air, and liquid forcemain junctions and branches so as to allow for the ability to isolate individual components or sections for repair or troubleshooting without shutting down the entire collection system



4.13 LANDFILL GAS EXTRACTION COMPONENT CONSTRUCTION

OAR 340-239-0110(2)(I) *The landfill gas extraction components must be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or other nonporous corrosion resistant material of suitable dimensions to: Convey projected amounts of gases; withstand installation, static, and settlement forces; and withstand planned overburden or traffic loads. The collection system must extend as necessary to comply with emission and migration standards. Collection devices such as wells and horizontal collectors must be perforated to allow gas entry without head loss sufficient to impair performance across the intended extent of control. Perforations must be situated with regard to the need to prevent excessive air infiltration.*

Design considerations related to compliance with OAR 340-239-0110(2)(I) are discussed in the following sections:

4.13.1 Materials

The GCCS components will be constructed of PVC, HDPE, fiberglass, corrosion resistant steel, Neoprene (gaskets and seals) and other non-porous corrosion resistant materials.

4.13.2 Component Sizing

The final development piping network, blowers, and flares are sized for a maximum estimated flow of 6,900 scfm with the ability for expansion. The GCCS facilities will be expanded as needed to handle 6,900 scfm as estimated by the EPA LandGEM emissions model. This accounts for the entire disposal area, at the final grade development elevations of the landfill. Capacity of the extraction and treatment system components will be phased in as LFG generation and extraction rates increase. Please see Section 3.5 for full discussion of the control systems.

4.13.3 Component Loading

The GCCS components were designed to withstand the estimated installation, static, settlement, overburden, and traffic loads. Installation loads were determined to be insignificant for GCCS components (PVC, HDPE, and carbon steel) based on the installation methods used. Static loads from the vacuums applied to the GCCS components and applied loads on the GCCS were both evaluated. Vacuum loads required for the GCCS operation were compared to, and found to be less than, the allowable vacuum loads for the GCCS components. Foundations used for GCCS components were designed to handle the applied loads. The applied loads on GCCS components within the landfill, as well as settlement forces, cannot accurately be predicted due to the non-homogeneous nature of the refuse within the landfill.

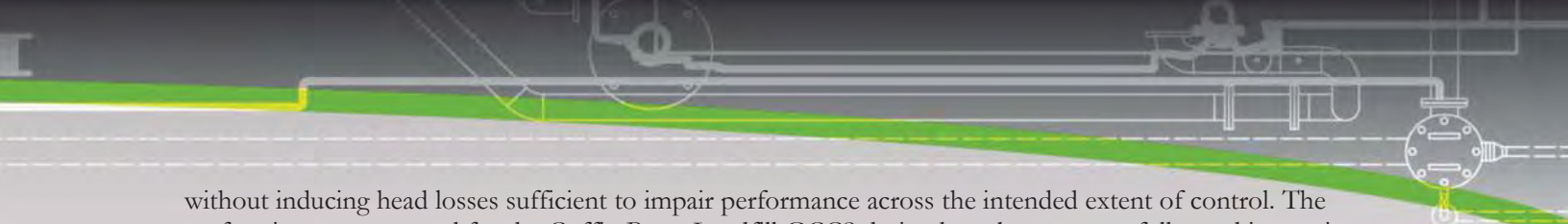
The GCCS components within the landfill are consistent with those at other landfills that have been in place for extended periods of time (in excess of 15 years) and verified to withstand applied static and settlement forces. Overburden and traffic loads for the LFG transmission piping are less than the allowable loads recommended by the piping manufacturer.

4.13.4 System Expansion

The GCCS shall be expanded as necessary to comply with DEQ requirements. The Coffin Butte Landfill will conduct monitoring and document compliance of the GCCS, in accordance with DEQ requirements. If the GCCS at the Coffin Butte Landfill does not meet the measures of performance set forth by DEQ, the GCCS will be adjusted or modified in accordance with DEQ requirements.

4.13.5 Component Perforation

The vertical well and interim horizontal trench collector elements will be perforated as shown on the design plans (Appendix A) or as approved by the design engineer at the time of installation, to allow LFG entry



without inducing head losses sufficient to impair performance across the intended extent of control. The perforation patterns used for the Coffin Butte Landfill GCCS design have been successfully used in previous LFG control applications.

4.13.6 Air Infiltration

The LFG collection elements were designed to prevent excessive air infiltration through the use of solid pipe and solid backfill near the ground surface for vertical LFG extraction wells and interim horizontal trenches in the perimeter slope area. Hydrated bentonite plugs and geomembrane seals, if warranted, will be provided around vertical well casings and interim horizontal trench access piping, where they penetrate the landfill final cover or interim cover systems. Further, air intrusion control will be accomplished through monitoring of the standard operational procedures (SOP) for the LFG collection elements in accordance with DEQ and NSPS requirements. If the GCCS does not meet the SOP, it will be adjusted or modified in accordance with DEQ and NSPS requirements.

Near surface collectors may be used on occasion to prevent surface emissions and are approved for operation with higher than normal oxygen readings.

4.14 LANDFILL GAS EXTRACTION COMPONENT INSTALLATION

OAR 340-239-0110(2)(J) *Vertical wells must be placed so as not to endanger underlying liners and must address the occurrence of water within the landfill. Holes and trenches constructed for piped wells and horizontal collectors must be of sufficient cross-section so as to allow for their proper construction and completion including, for example, centering of pipes and placement of gravel backfill. Collection devices must be designed so as not to allow indirect short circuiting of air into the cover, into the solid waste, into the collection system, or gas into the air. Any gravel used around pipe perforations should be of a dimension so as not to penetrate or block perforations.*

Design considerations related to compliance with OAR 340-239-0110(2)(J) are discussed in the following sections:

4.14.1 Component Placement

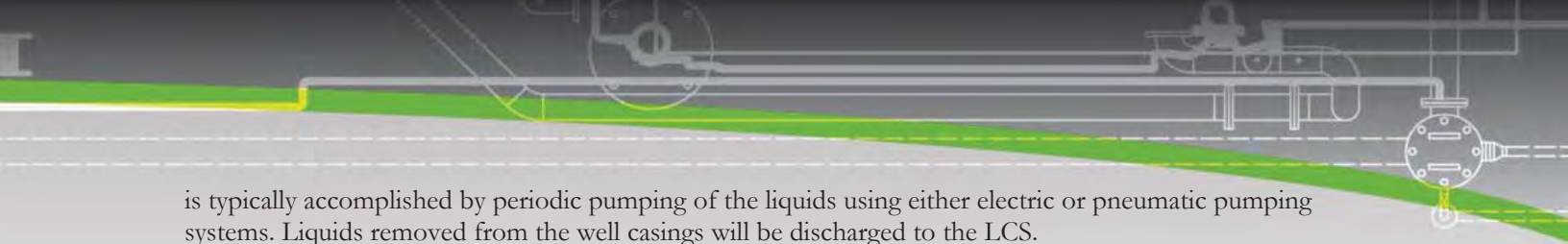
Depths of refuse were calculated, at the time of the design of the GCCS, based upon the permit plan final grades and record documentation of landfill liner grades. Vertical LFG extraction wells will be designed to extend from the landfill surface to a maximum depth of 15 feet above the landfill base. Any changes made to borehole depths during design or construction must be verified and acknowledged by the following representatives: QA/QC Reviewer, Design Engineer, CQA Inspector, Environmental Manager, Surveyor, and Driller. Under no circumstances shall drilling begin without providing all the aforementioned signatures. Any changes to well location or depth shall require signatures to be obtained again.

4.14.2 Leachate

The occurrence of leachate within the landfill will be addressed by the LCS as stated in Section 4.5 of this Design Plan. Leachate management within the landfill with a composite liner will be accomplished through the LCS which includes a leachate drainage layer, perforated collection piping, side slope risers with liquid pumping equipment, and liquid storage and disposal systems. A force main could then be used to convey the extracted liquids to the leachate storage facilities.

If free liquids are encountered, the drilling contractor will attempt to drill through the perched zone of liquids allowing drainage into the underlying waste mass and the LCS. In the event that the zone of perched liquids cannot be penetrated, the well installation may be terminated. If necessary, appropriate measures will be taken to complete the well installation procedure at a nearby location.

If perched liquids are observed within the extraction wells after installation, and it is determined that the liquid level is restrictive to efficient LFG extraction, attempts may be made to reduce the leachate level. This



is typically accomplished by periodic pumping of the liquids using either electric or pneumatic pumping systems. Liquids removed from the well casings will be discharged to the LCS.

4.14.3 Wells and Horizontal Trench Collectors

Vertical wells and interim horizontal trench collectors, constructed for LFG collection elements, are of sufficient cross-section to allow for their proper construction and completion, including centering of the pipes and placement of gravel backfill. The wells and interim trenches will be constructed under supervision of a construction quality assurance program implemented by the Coffin Butte Landfill and verified to be properly constructed, as indicated on the design plans in Appendix A.

4.14.4 Component Short Circuiting

LFG collection elements are designed to prevent air infiltration through the cover, refuse contamination of the collection elements, and direct venting of LFG to the atmosphere. Air intrusion control will be verified through monitoring of LFG quality at the extraction components (note exemption for near surface collectors in Section 4.13.6), monitoring of surface emission levels and maintenance of the landfill cover in accordance with DEQ requirements. Separation of the collection elements from the refuse is accomplished by placing gravel backfill in the annular borehole space around extraction wells casings and the interim horizontal trench pipes, providing a filter pack between the refuse and the LFG collection elements. Direct venting of the LFG to the atmosphere is avoided by operating the GCCS under a controlled application of vacuum and the quarterly monitoring of surface emissions.

4.14.5 Gravel Backfill

Gravel of sufficient size is specified to prevent penetration or blockages of the LFG collector pipe perforations. Gravel (non-calcareous) to be utilized will be a nominal 1 to 3-inch in size.

4.15 LANDFILL GAS EXTRACTION COMPONENTS CONNECTIONS TO LFG TRANSMISSION PIPING

OAR 340-239-0110(2)(K) *Collection devices may be connected to the collection header pipes below or above the landfill surface. The connector assembly shall include a positive closing throttle valve, any necessary seals and couplings, access couplings and at least one sampling port. The collection devices shall be constructed of PVC, HDPE, fiberglass, stainless steel, or other non-porous material of suitable thickness.*

The collection devices are connected to the collection header pipes using lateral piping. The lateral piping will be connected to the header piping either above or below the landfill surface, as required by field conditions at the time of installation. The connector assemblies and collection devices (vertical extraction wellheads) are detailed in section 3.4 of this design plan.

5 CALCULATIONS

The calculations described in this section serve to support the GCCS Design in Section 3 and the design considerations in Section 4.

5.1 PIPE LOADING

In addition to their suitability to resisting corrosion and decomposition due to heat, the GCCS components must withstand loading due to installation, static, and settlement forces as well as overburden or traffic loads per OAR 340-239-0110(2)(a)(I). Installation forces are negligible for the PVC and HDPE pipe selected as well as pressure due to applied vacuum within piping. The static pressure due to waste was determined at a depth of 230ft, which is the difference in elevation between the current surface and the well with the highest elevation per the GCCS Master Plan. Using a waste density of 2,000 lb/yd³ and the equation below, the maximum pressure in a vertical well was determined to be 118.3 psi. The maximum pressure was then compared to the collapse pressure for Schedule 80 PVC, which is 343 psi for 6" diameter pipe. This result indicates the static loading will not cause pipe collapse even at the deepest regions of fill.

$$P = \rho D$$

where,

$$P = \text{Static pressure,} \quad \rho = \text{Waste density,} \quad D = \text{depth of waste}$$

The pipe is assumed to be capable of resisting most settlement forces due to the materials use historically in Landfills. However, there is no accurate way to predict what settlement forces will be. Vertical extraction well casings are to be made of 6" schedule 40 carbon steel, which has a collapse pressure significantly higher than the PVC used in the above calculation. By installing most GCCS piping and vertical wells in areas that have reached final fill, the overall loading on the GCCS due to settlement will be reduced as some of the initial waste settlement will have occurred prior to pipe installation. Resistance of header and lateral piping to traffic loads will be considered on a case-by-case basis and will depend on the depth of pipe burial and weight of traffic loads. If necessary, corrugated metal or ductile iron pipe will be used to carry the gas collection piping and provide resistance to loads.

5.2 GAS GENERATION AND COLLECTION

As stated in 340-239-0110(1)(c)(C) the gas mover equipment must "be designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment". Because a gas collection and control system is already in place at Coffin Butte Landfill, actual flow data may be used to project the maximum expected gas generation flow rate along with the equation from 40 CFR 60.755(a)(1)(ii):

$$Q_m = \sum_{i=1}^n 2kL_0M_i(e^{-kt_i})$$

where,

Q_m = maximum expected gas generation flow rate, cubic meters per year

L_0 = methane generation potential, cubic meters per megagram solid waste

k = methane generation rate constant, year⁻¹

M_i = mass of solid waste in the i^{th} section, megagrams

t_i = age of the i^{th} section, years

The EPA's Landfill Gas Emissions Model was used for projecting maximum LFG generation rates. The results of the LandGEM model ran for CBLF is shown in Appendix B.

5.2.1 Waste Types

The LandGEM uses the waste placed each year, historically and in the future, as an input, which is represented by M_i in the equation above. Waste totals and waste composition for each year were provided by Republic and previous LandGEM models for CBLF. It was assumed that the future waste composition would remain the same as the current composition and that the Landfill would take in approximately 800,000 tons of waste each year. The waste was split into five different categories for the LandGEM: MSW (70.5%), Special Wastes (8%), Construction & Demolition (CDL) (3%), Organics (3%) and Inert (15.5%).

5.2.2 Methane Generation Rate and Methane Generation Potential

In 2021, The LandGEM was calibrated to determine past and future gas generation rates at the Landfill using a bulk waste model that was composed from an amalgamation of separate gas generation curves from each specific waste stream accounted for at the Landfill.

Coffin Butte Landfill accepts predominantly MSW waste, but also has a significant waste influx from burn waste and construction and demolition debris due to forest fires in the area. These waste streams contribute less to gas generation than typical MSW and in some cases are completely inert, as in the case of charred or burned debris. ESI opted to use an L_0 value of 80 m^3/Mg rather than the conventional value of 100 m^3/Mg , which would be typical of rural MSW landfills with limited recycling such as Coffin Butte, to account for these other waste streams.

In the bulk model, a k value of 0.04 $year^{-1}$ was used. This value is typical of a landfill within the climate range that Coffin Butte is located. Additional models were ran using k values of 0.03 and 0.05, but the best fit curve, when compared to actual gas collection records, was generated at a k value of 0.04.

The requisite parts that composed the final bulk model were LandGEM projections of each individual waste stream, each with their own specific k and L_0 values incorporated. These values are shown below in Table 1.

Table 1: The percent volume, gas generation rate and gas generation potential listed for each waste type that has been or will be accepted at Coffin Butte Landfill.

Waste Type	k (Units of $year^{-1}$)	L_0 (m^3/Mg)	Waste Stream (% volume)
MSW	0.04	115	70.5
C&D	0.03	20	3
Organics	0.05	130	3
Special Wastes	0.03	20	8
Inert	0	0	15.5

5.2.3 Landfill Gas Generation

Because the header and lateral piping is expected to be in use longer than 15 years, pipe sizing, which is discussed in Section 5.4, is based on the maximum gas generation rate for the waste mass shown in the GCCS Master Plan in Appendix A.

According to the EPA's AP-42, a collection efficiency of 75% is a recommended default assumption although it can range from 50-95%. Because Coffin Butte Landfill makes use of a temporary cover for active waste areas and has not recorded methane surface emissions, a collection efficiency of 75% is assumed to be a conservative collection efficiency from which to base the capacity of the GCCS design. This collection

efficiency will be reevaluated over time as more flare data and more accurate well flow data becomes available.

Table 2 shows the projected LFG generated and LFG collected for 15 years from now, when the waste placed in the Master Plan is complete, and when the LandGEM projects gas generation will be at a maximum. In 2036 the projected LFG Collected at the enclosed flare assuming a 75% collection efficiency is 4366 scfm. This is well over the 3,000 scfm capacity of the current blower/flare skid, excluding the utilization of the PNGC LFGTE plant. The LFG collected at the skid is expected to reach over 3,000 scfm in 2022. If the actual collected LFG matches the LandGEM projections, the flare system will need to be resized before this point. Pipe sizing for the GCCS Master Plan is based on the predicted LFG collected in 2047, which is two years after final waste placement is complete and the model is projecting the maximum LFG generation of 6900 scfm of LFG and 5223 scfm at 75% collection efficiency.

Table 2: Projected LFG Generated and LFG Collected with 75% collection efficiency for 2022, 2036, and 2045.

Year	Projected LFG Generated (cfm)	Projected LFG Collected (cfm)
2022	4381	3286
2036	6181	4366
2045	6900	5175

5.3 RADIUS OF INFLUENCE AND WELL SPACING

The DEQ requires that “active collection wells, horizontal collectors, surface collectors, or other extraction devices” be spaced as necessary to achieve compliance with OAR 340-239-0110(2). The sufficient density to achieve this point of compliance is met by the well spacing as shown on the GCCS Master Plan (Appendix A), which is based on the calculated radius of influence (ROI) for each well. The goal in the ROI calculation was to maximize the radius while preventing air intrusion and to determine the vacuum necessary to reach the maximum radius.

The calculation of ROI for each well is shown in Appendix D and is dependent on several factors including length of solid well piping, waste permeability to LFG both vertically and horizontally, waste density, methane generation rate per unit mass, well vacuum, and the slope on which a well is placed. For the purpose of this design, the radius of influence was calculated assuming higher waste density and typical waste horizontal permeability which are shown in Table 3. A higher waste density was chosen due to known historical operational standards and waste composition data provided by Republic For compacted waste, the ratio of horizontal to vertical permeability to LFG can range anywhere from 2:1 to 10:1. For this design, a permeability ratio of 6:1 was used because it is a standard value and because the landfill cover used at the Landfill should make the ratio even higher.

Table 3: Values that were used in calculating the radius of influence for wells at Coffin Butte Landfill.

Variable	Value
Permeability	$5 \cdot 10^{-4}$ cm/sec
Waste Density	2,000 lb/yd ³
Gas Generation	0.1

For the purpose of calculating radius of influence, wells at Coffin Butte Landfill were split into three different categories: wells on a 3:1 slope, wells on a 4:1 slope, wells on a 10:1 slope, and wells on a 1:0 slope (Waste Plateaus). Table 4 lists the ROI for each category of wells, and the ROI calculations for each individual well are also shown in Appendix D.

Table 4: ROI for each vertical well category along with solid pipe length and well vacuum needed.

Well Slope (run:rise)	Radius of Influence (ft)	Solid Pipe Length (ft)	Well Vacuum (in H2O)
3:1	72.0	30	1.83
4:1	84.9	30	2.65
10:1	111.4	30	4.88
1:0	120.0	30	5.76

5.4 LFG PIPE SIZING

The final GCCS headers and laterals will need to be sized for a total potential system LFG flow of 6900 SCFM. This LFG flow rate is based on the total projected gas generation simulated from the LandGEM (Shown in Appendix B). The Master Plan Drawings (shown in Appendix A) have the GCCS headers and laterals sized so that the pressure drop between the blowers and the LFG wellheads is less than 20" W.C. for the maximum projected flow rate. This is to ensure that sufficient vacuum is available to all wells. Additionally, header and lateral pipes are sized for a pressure drop less than 1" W.C. per 100 ft of pipe per Republic Standards section 3.7.7.

The final design will have an 18" diameter perimeter header with exception of the southern portion of pipe that will be 24" diameter pipe. The perimeter header will be installed outside of waste when possible. The 24" diameter header pipe will allow for a lower pressure drop to the wells in Cell 6. Sumps are installed along the parameter header at low points.

Currently, an 18" diameter perimeter header has been installed along the South and East side of Cells 4 and 5. Header piping over waste is designed to traverse along the haul roads whenever feasible. Installing the header along the haul road allows for ease of installation, repair, and system troubleshooting.

An 18" diameter crossover header is recommended to be installed to allow for multiple pathways to the wells on the North side of the landfill. This crossover header also allows a direct route for the gas coming from the top of the wellfield prior to completion of the landfill. The crossover over will be installed as the haul road extends each year until the landfill reaches final grades. See Appendix C for more information regarding pressure loss and header sizing.

The Darcy-Weisbach equation listed below is used to calculate the pressure loss through pipe segments. Drawing M2.04 shows the pipe length, the pipe size, the flow rates and the calculated pressure drops per section of pipe.

$$\Delta p = f_D \frac{L * \rho * V^2}{2 * D}$$

Δp – Pressure Loss

f_D – Darcy (Moody) Friction Factor

L – Length of Pipe

ρ – Density of Landfill Gas

V – Velocity of Landfill Gas

D – Inside Diameter of Pipe

Assumptions:

- Landfill gas consists of 50% Methane by volume and 50% Carbon Dioxide by volume.
- The gas is 100% saturated with water vapor
- The gas is at 100 degrees Fahrenheit
- The vacuum at the blowers is 50 inches of water column.
- Small radius of influence wells generate 30 SCFM of LFG.
- Large radius of influence wells generate 55 SCFM of LFG.
- Header piping in waste is assumed to be HDPE SDR 17 and outside of waste is assumed to be HDPE SDR 26 in accordance with Republic's SOP on Landfill Gas Design section 3.7.7.
- Header segment calculations use the longer distances or piping from points, even if shorter routes exist, this is to ensure piping is oversized, rather than undersized.
- These calculations assume all header isolation valves are open in order to accommodate proper liquid drainage.

See Appendix C for more information regarding pressure loss and header sizing.

5.5 COMPRESSOR SIZING

The compressor described in Section 4.5.1 will accommodate the air flow requirements of 160 QED AP4+ pneumatic pumps cycling simultaneously. This quantity of pumps was determined by taking the number of projected vertical wells installed in 2036 and multiplying by 70% which correlates with the current number of vertical wells that house leachate extraction pumps. This is a worst-case model of air requirements near the end of the estimated life of the air compressor equipment. The air compressor is adequately sized to serve every pump when the landfill has reached the extent of the current GCCS Master Plan; however, this is past the expected 15 year life of the compressor. A new air compressor will be selected and sized accordingly when the current compressor reaches the end of its operational life.

The air usage for each pump was determined from the pump specification sheet provided by QED and shown in Appendix E. The air consumption for one pump at an average well depth of 120ft is 1.1 SCF/gal. Based upon typical usage (pumps cycling at 40% capacity), we find that the gallons per minute used would be 5 gpm. These two values multiplied together give us the required air flow rate per pump and can be directly compared to compressor sizes for system sizing. A 120ft well depth on average was used because the air flow requirements at that depth are at a peak for our expected well depth range. These calculations can be viewed in Appendix E.



6 OPERATIONS

OAR 340-239-0110(2) outlines operational standards for collection and control systems. CBLF currently complies with their Title V Permit and the NSPS. In meeting these requirements, CBLF has submitted a Startup, Shutdown, and Malfunction Plan; and a Surface Emission Monitoring Plan. CBLF also operates the GCCS in a manner that complies with requirements and has provided all reports required by their permit.

The following sections will address new operational standards required by OAR 340-239-0110(2).

6.1 SURFACE EMISSION MONITORING

The Coffin Butte Landfill currently conducts, at a minimum, quarterly surface emissions monitoring in accordance with NSPS requirements. The landfill will continue to conduct surface monitoring in accordance with DEQ requirements in OAR 340-239-0600(1). If the GCCS at the Coffin Butte Landfill does not meet the measures of performance set forth in OAR 340-239-0200, the GCCS will be adjusted or modified in accordance with the DEQ to meet these requirements. These adjustments or modifications may include the installation of additional collection elements, cap and cover repairs, or other actions defined by field conditions at the time of monitoring.

All GCCS components containing LFG or under positive pressure will be monitored at minimum, quarterly for leaks. Any component leak exceeding 500 ppmv methane will be tagged and repaired within 10 days of discovery. Any component leak exceeding 250 ppmv will be recorded pursuant to OAR 340-239-0700(2)(a)(S). Quarterly testing at CBLF may be conducted prior to scheduled maintenance and planned outage time periods of PNGC's LFGTE facility.

6.2 EMISSION MITIGATION MEASURES

OAR 340-239-0110 (1)(c)(E) *The Design Plan must include a description of potential mitigation measures to be used to prevent the release of methane or other pollutants into the atmosphere during the installation or preparation of wells, piping, or other equipment; during repairs or the temporary shutdown of gas collection system components; or, when solid waste is to be excavated and moved.*

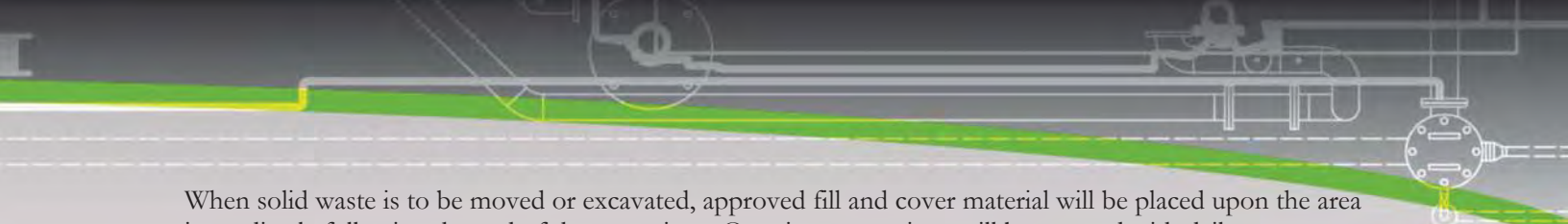
6.2.1 Installation Mitigations

In order to mitigate the release of LFG into the atmosphere during installation and expansion of the GCCS, vertical LFG extraction wells will be set and securely capped or connected to existing vacuum source within the GCCS infrastructure, immediately following drilling. Boreholes will then be backfilled as indicated in the design plans in Appendix A. Under no circumstances will a borehole be left open to atmosphere for times exceeding those needed for proper well setting and installation during construction.

Horizontal collectors will be installed and backfilled as indicated in the design plans in Appendix A immediately following trenching. If a collector is not able to be installed immediately, the trench will be backfilled in order to mitigate LFG release into the atmosphere. Installed collectors will remain securely capped until connected to existing GCCS infrastructure.

6.2.2 Operational Mitigations

During repairs or temporary shutdown of GCCS components, the system will be isolated, if possible, to not cause a complete shutdown of the system while repairs or expansions are being made. Repairs requiring the complete shutdown of the GCCS will be carried out in an expedited manner in which minimizes downtime or allows for partial operation of the GCCS via isolation if possible.



When solid waste is to be moved or excavated, approved fill and cover material will be placed upon the area immediately following the end of the operations. Ongoing excavations will be covered with daily cover as to mitigate LFG emissions into the atmosphere while active operations are not occurring.

In the event of any temporary shutdown due to an emergency, catastrophic event, or landfill fire, DEQ will be notified in accordance with OAR 340-239-0700(3)(n).

6.3 ASBESTOS AND NON-PRODUCTIVE WASTE

Outside of the designated asbestos areas, no areas of the landfill were determined to be non-productive; therefore, no areas of the landfill have been excluded from the coverage of the GCCS. As per OAR 340-239-0110(2)(a)(H), a non-productive area may be excluded from control if the total excluded area can be shown to contribute less than one percent (1%) of the total amount of methane emissions from the landfill. If an area(s) is determined to be non-productive at a future date, an application to exclude these areas from the operations of the GCCS will be submitted and all calculations, data, and documentation will be submitted to DEQ. Methane emissions from areas in question will be calculated with a method in accordance with OAR 340-239-0800(5).

All future active areas with active and passive collection systems will be installed with liners on the bottoms and all sides in which gas is to be collected. The liner will be installed as required by 40 C.F.R. § 258.40 design criteria.

6.4 ALTERNATIVE COMPLIANCE OPTIONS

Per NSPS 40 CFR §60.752(b)(2)(i)(B), the previous GCCS design plan included any alternatives to “the operational standards, test methods, procedures, compliance measures, monitoring, record keeping or reporting provisions of §60.753 through §60.753 proposed by the owner or operator.” The current approved AOMP for Coffin Butte Landfill is shown in Appendix G. The purpose of this AOMP is to ensure the wellfield can be reasonably operated to maintain compliance and prevent fugitive emissions.

The current AOMP will be reviewed and resubmitted to DEQ for approval in pursuant to OAR 340-239-0110(1)(c)(D).

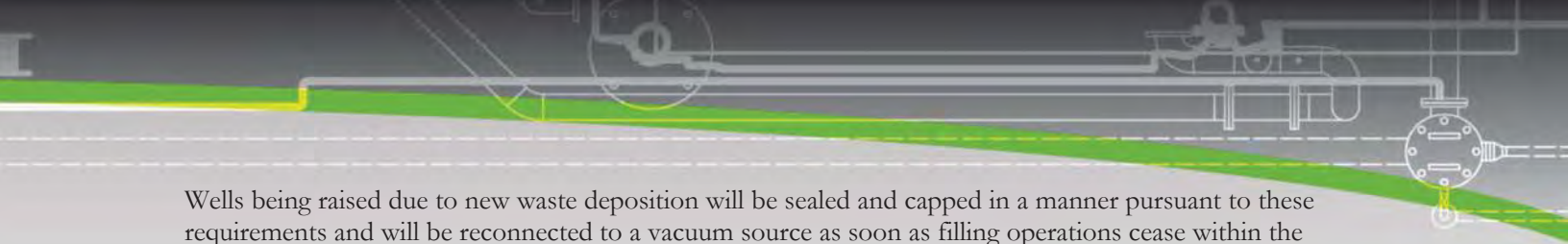
6.5 WELLHEAD SAMPLING

Each wellhead will have a sampling port and measuring devices to comply with the following, pursuant of OAR 340-239-0110(3):

- Sample port in which nitrogen and oxygen concentrations in the landfill gas may be monitored on a monthly basis as provided in OAR 340-239-0600(3).
- Sampling port in which landfill gas temperature may be monitored on a monthly basis as provided in OAR 340-239-0600(3).
- Sampling port in which gauge pressure in the gas collection header may be measured on a monthly basis as provided in OAR 340-239-0600(2)(d).

6.6 WELL RAISING

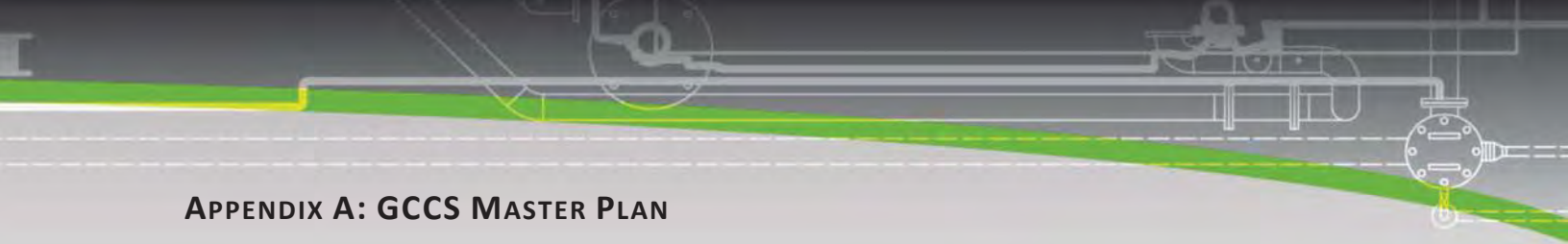
Continuous operation of the GCCS as detailed in requirements OAR 340-239-0110(2)(a)(A) and OAR 340-239-0110(2)(a)(B) do not apply to wells that are being raised, provided they are being raised due to new fill being added or compacted within the immediate vicinity around the well and that once installed the gas collection extension is sealed and capped until the well is reconnected to a vacuum source.



Wells being raised due to new waste deposition will be sealed and capped in a manner pursuant to these requirements and will be reconnected to a vacuum source as soon as filling operations cease within the immediate vicinity of the raised well.

6.7 GCCS OPERATION

The components and design considerations within this GCCS design plan allow for CBLF to operate the GCCS in accordance with all monitoring and operational practices detailed in OAR 340-239-0600. Currently the GCCS is monitored twice each month. A monthly SOP review is provided by the design engineer along with a report to address exceedances, operational concerns, and other compliance issues so that points of noncompliance with any section of OAR 340-239-0600 may be addressed in an expedient manner.



APPENDIX A: GCCS MASTER PLAN

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PROJECT LOCATION

LANDFILL OWNER

PROJECT DESCRIPTION

GCCS ENGINEER

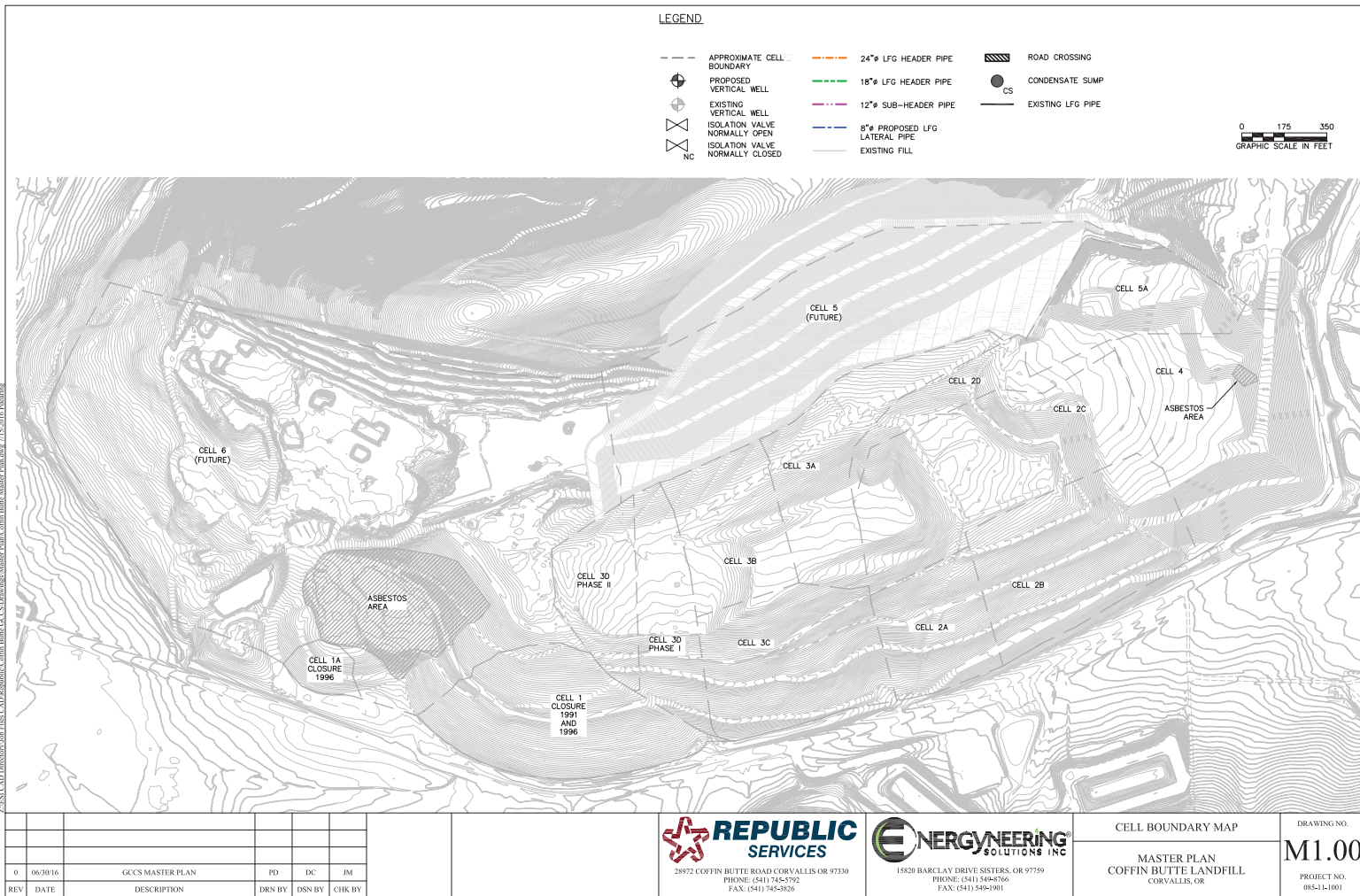
DRAWING INDEX

1. GAS COLLECTION

M3.01	VERTICAL WELL DETAILS I
M3.02	VERTICAL WELL DETAILS II
M3.03	VERTICAL WELL DETAILS III
M3.04	HORIZONTAL WELL DETAILS
M3.05	SUMP DETAILS
M3.06	TRENCH AND CROSSING DETAILS
M3.07	STUB-UP DETAILS
M3.08	MISC. DETAILS

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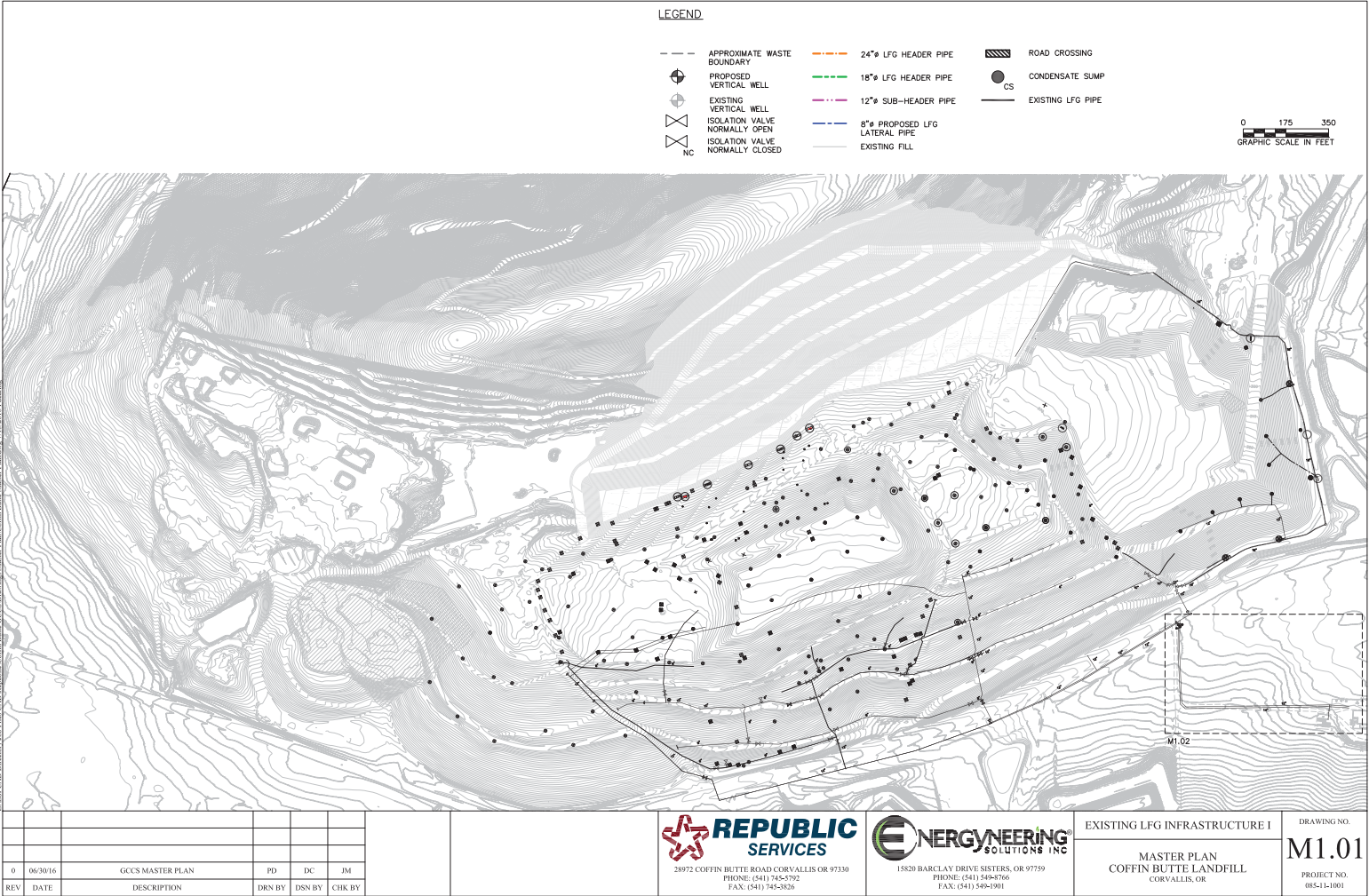
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REPUBLIC SERVICES
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330
PHONE: (541) 745-5792
FAX: (541) 745-3525

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

CELL BOUNDARY MAP	DRAWING NO.
MASTER PLAN COFFIN BUTTE LANDFILL CORVALLIS, OR	M1.00
	PROJECT NO. 085-11-1001

Z:\JSL\CAD\Drawings\Job Files\CAD\Republics Coffin Butte GCCS\Drawings\Master Plan\Coffin Butte Master Planning 11152016.dwg



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REV	DATE	DESCRIPTION	DRN BY	DSN BY	CHK BY

REPUBLIC SERVICES
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330
PHONE: (541) 745-5792
FAX: (541) 745-5826

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

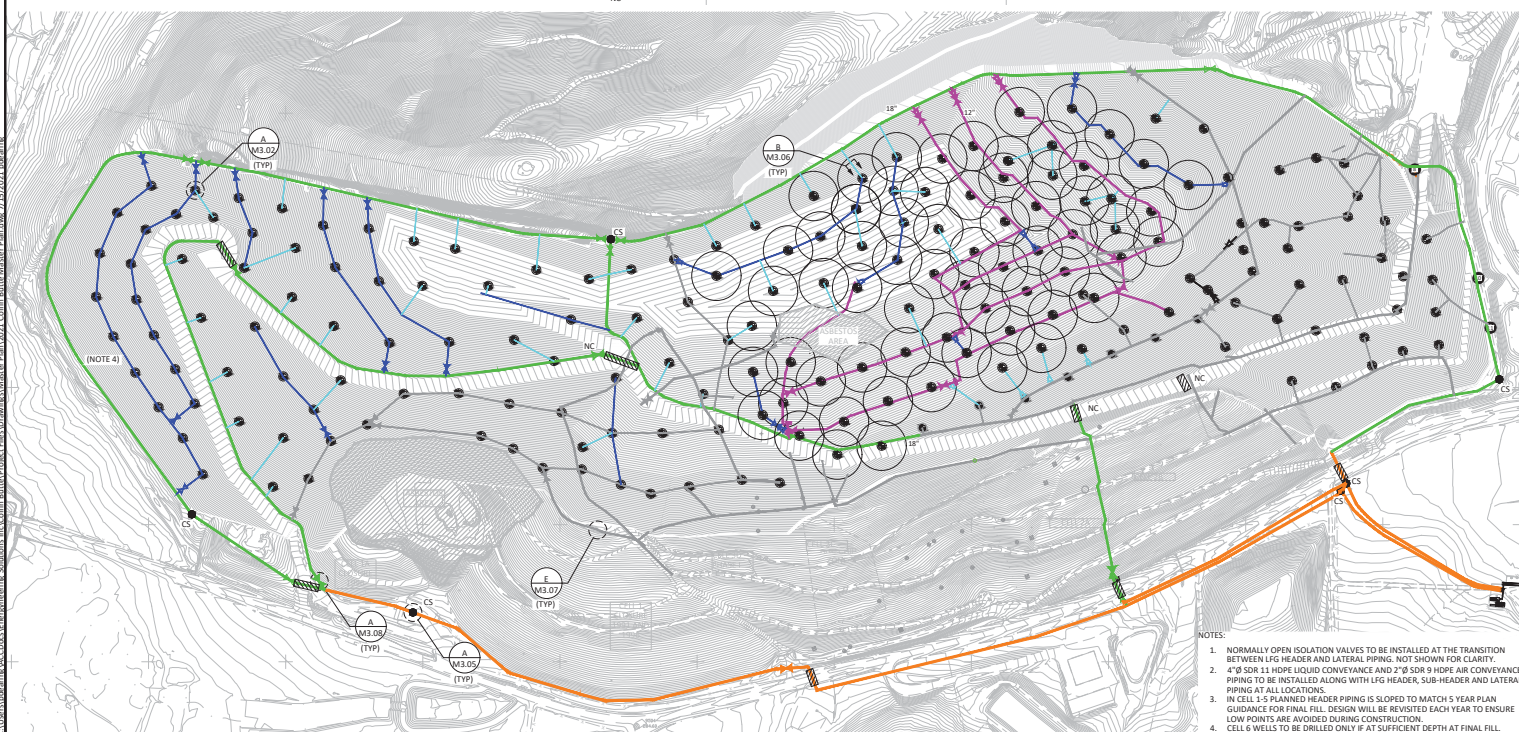
EXISTING LFG INFRASTRUCTURE I
MASTER PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M1.01
PROJECT NO.
085-11-1001

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LEGEND

---	APPROXIMATE WASTE BOUNDARY	24"Ø LFG PIPE	EXISTING FILL
⊙	PROPOSED VERTICAL WELL	18"Ø LFG PIPE	ROAD CROSSING
⊙	EXISTING VERTICAL WELL	12"Ø LFG PIPE	CONDENSATE SUMP
⊗	ISOLATION VALVE NORMALLY OPEN	8"Ø LFG PIPE	EXISTING LFG PIPE
⊗ NC	ISOLATION VALVE NORMALLY CLOSED	6"Ø LFG PIPE	



NOTES:

1. NORMALLY OPEN ISOLATION VALVES TO BE INSTALLED AT THE TRANSITION BETWEEN LFG HEADER AND LATERAL PIPING. NOT SHOWN FOR CLARITY.
2. 4"Ø SDR 11 HDPE LIQUID CONVEYANCE AND 2"Ø SDR 9 HDPE AIR CONVEYANCE PIPING TO BE INSTALLED ALONG WITH LFG HEADER, SUB-HEADER AND LATERAL PIPING AT ALL LOCATIONS.
3. IN CELL 1-5 PLANNED HEADER PIPING IS SLOPED TO MATCH 5 YEAR PLAN GUIDANCE FOR FINAL FILL. DESIGN WILL BE REVISITED EACH YEAR TO ENSURE LOW POINTS ARE AVOIDED DURING CONSTRUCTION.
4. CELL 6 WELLS TO BE DRILLED ONLY IF AT SUFFICIENT DEPTH AT FINAL FILL.

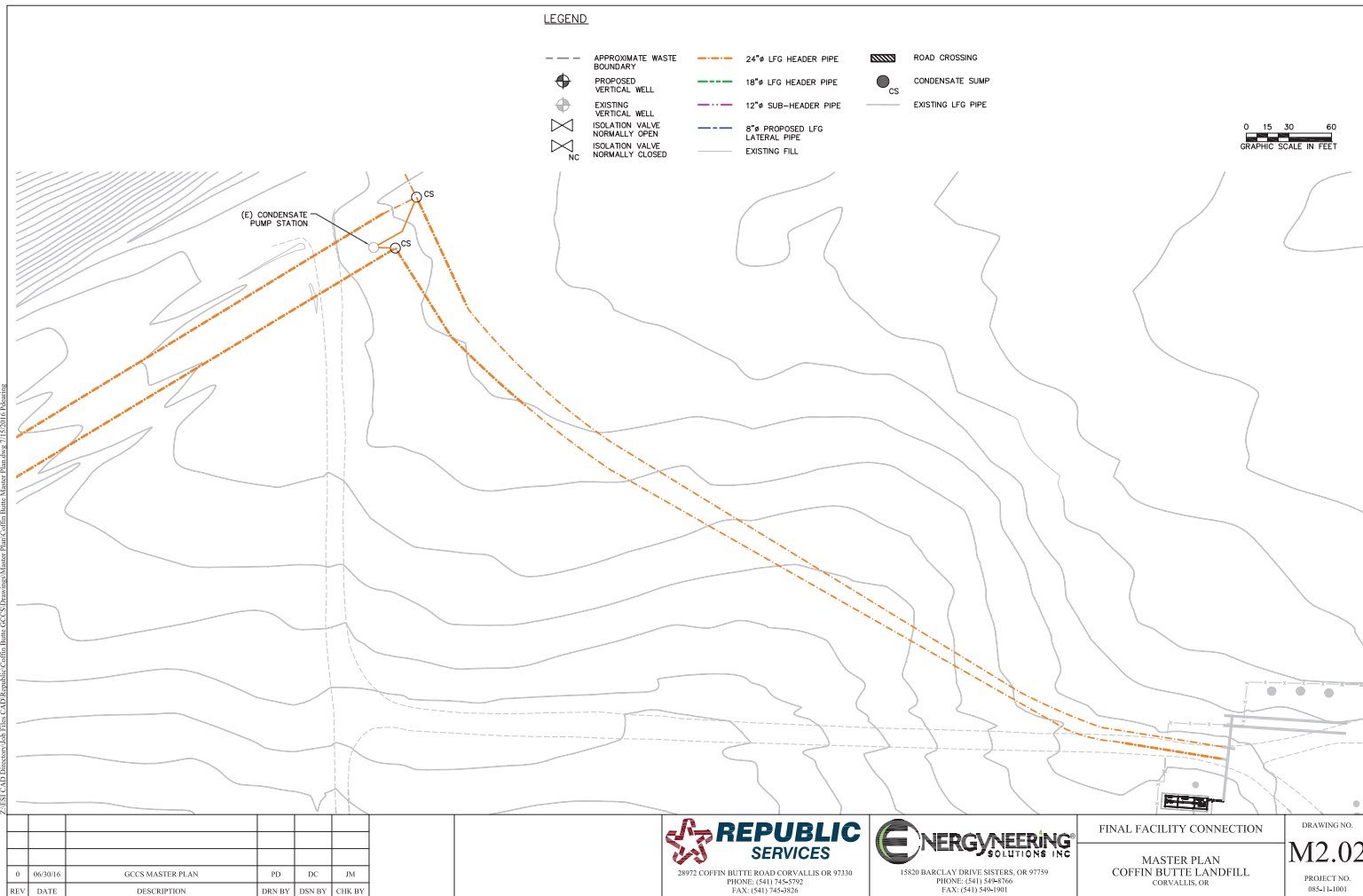
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REPUBLIC SERVICES, INC.
28972 COFFIN BUTTE ROAD CORVALLIS, OR 97330 PHONE: (541) 745-5792 FAX: (541) 745-3826

ENERGYENGINEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97159 PHONE: (541) 549-8766 FAX: (541) 549-1901

FINAL PIPING PLAN	DRAWING NO.
MASTER PLAN COFFIN BUTTE LANDFILL CORVALLIS, OR	M2.01
	PROJECT NO. 014.524

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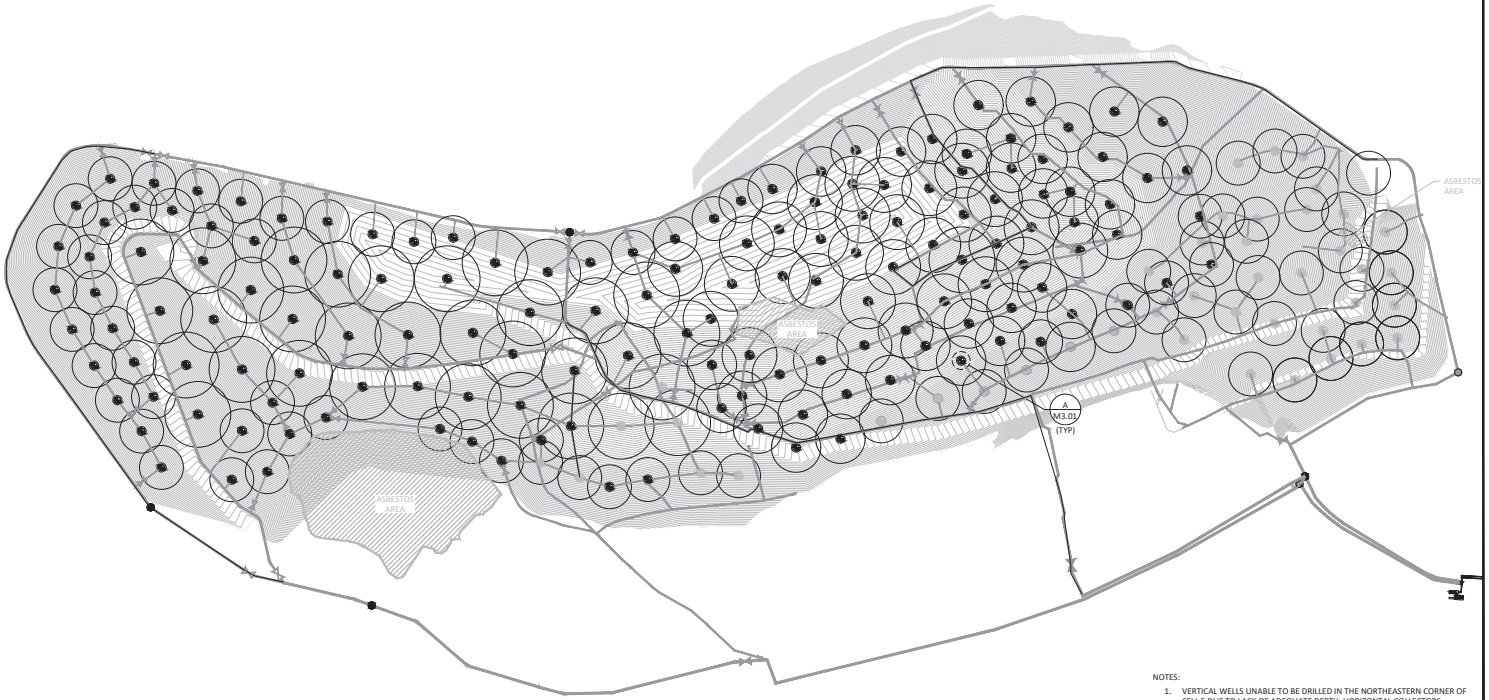


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LEGEND

---	APPROXIMATE WASTE BOUNDARY	24"Ø LFG PIPE	EXISTING FILL
⊕	PROPOSED VERTICAL WELL	18"Ø LFG PIPE	ROAD CROSSING
⊙	EXISTING VERTICAL WELL	12"Ø LFG PIPE	CONDENSATE SUMP
⊗	ISOLATION VALVE	8"Ø LFG PIPE	EXISTING LFG PIPE
		6"Ø LFG PIPE	

0 175 350
GRAPHIC SCALE IN FEET



NOTES:

1. VERTICAL WELLS UNABLE TO BE DRILLED IN THE NORTHEASTERN CORNER OF CELL 5 DUE TO LACK OF ADEQUATE DEPTH. HORIZONTAL COLLECTORS IMPLEMENTED IN DESIGN TO PROVIDE COLLECTION IN THIS AREA. NOT SHOWN FOR CLARITY.

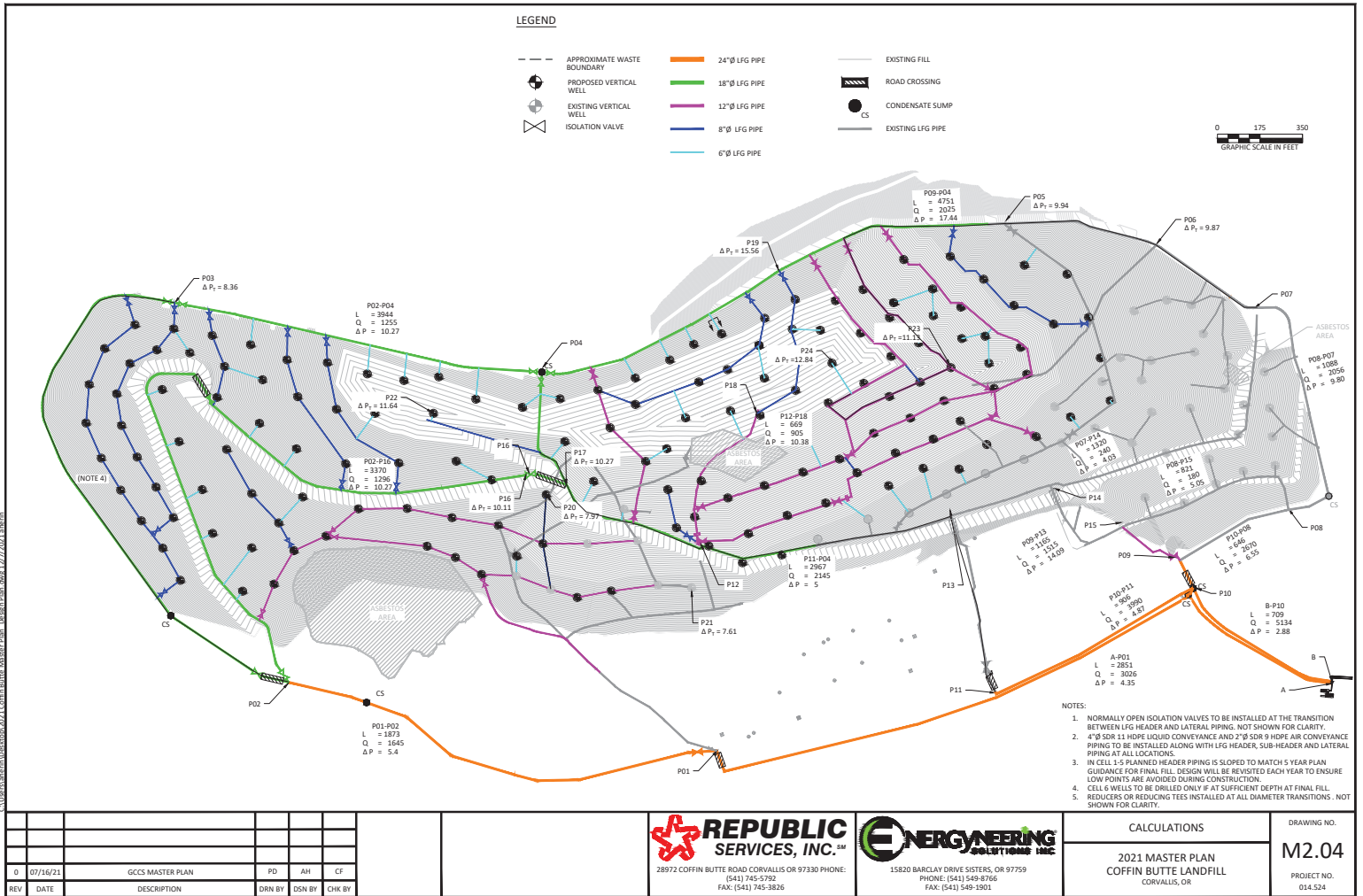
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28972 COFFIN BUTTE ROAD CORVALLIS OR 97330 PHONE: (541) 745-5792 FAX: (541) 745-3826

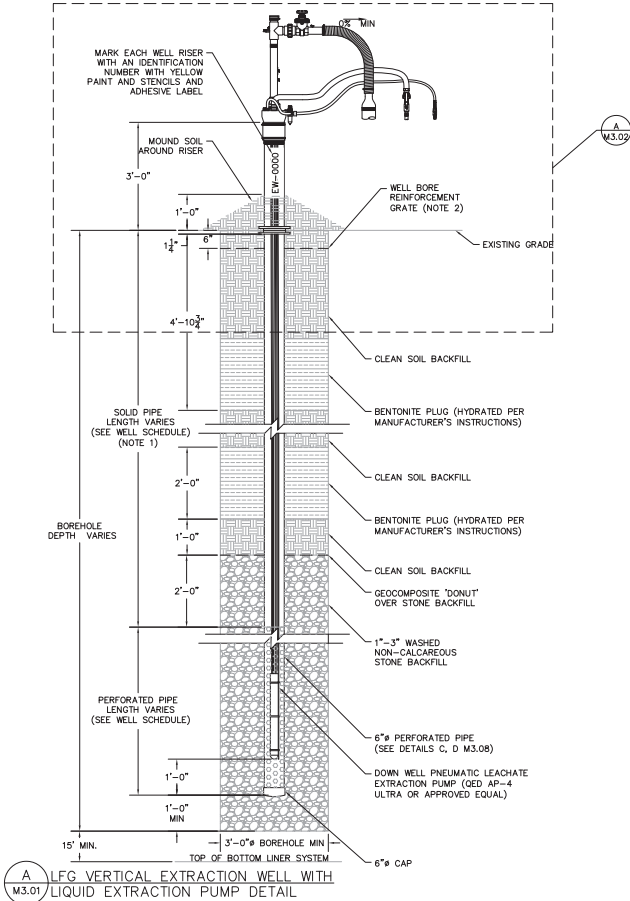
ENERGY ENGINEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97759 PHONE: (541) 549-8766 FAX: (541) 549-1901

FINAL VERTICAL WELL PLAN	DRAWING NO.
2021 MASTER PLAN COFFIN BUTTE LANDFILL CORVALLIS, OR	M2.03
	PROJECT NO. 014.524

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- NOTES:
1. VERTICAL EXTRACTION WELLS TO BE INSTALLED WITH 20" MINIMUM SOLID PIPE, 15' IF OTHERWISE NOTED AND EXPLAINED.
 2. WELL BORE REINFORCEMENT GRATES TO BE RELOCATED FROM ABOVE GRADE TO BELOW GRADE AFTER BACKFILLING COMPLETE. THESE GRATES ARE REQUIRED FOR ALL WELLS AND BOREHOLE ABANDONMENTS IN ORDER TO PROVIDE A SAFEGUARD FROM POTENTIAL COLLAPSE OF BACKFILL MATERIAL.
 3. AIR AND LIQUID CONVEYANCE STUB-UPS TO BE LOCATED AT EVERY VERTICAL LFG COLLECTION WELL AND WHERE APPLICABLE.

A
M3.01
LFG VERTICAL EXTRACTION WELL WITH
LIQUID EXTRACTION PUMP DETAIL

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0	06/30/16	GCCS MASTER PLAN	PD	DC	JM

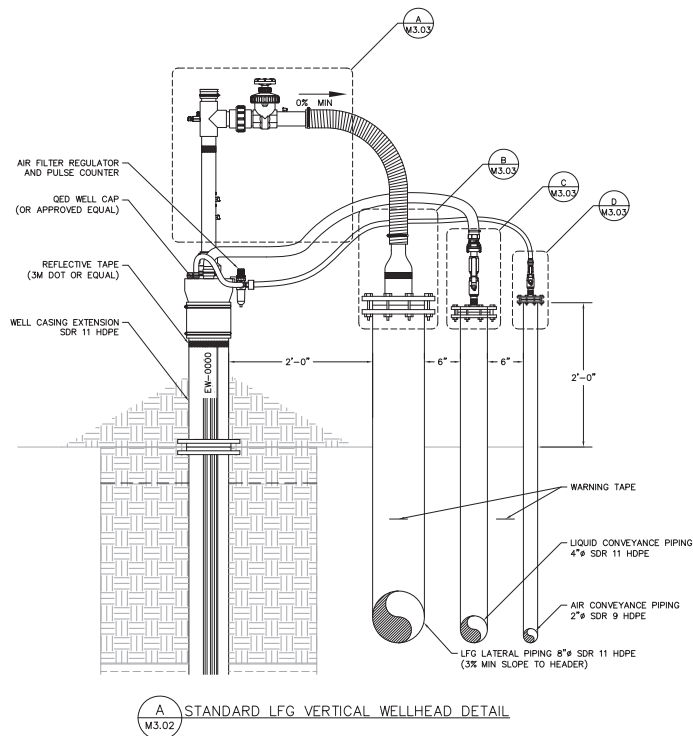
REPUBLIC SERVICES, INC.
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330
PHONE: (541) 745-5792
FAX: (541) 745-3039

ENERGYNEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97759
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FAX: (541) 540-1901

VERTICAL WELL DETAILS I
MASTER PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M3.01
PROJECT NO.
014-T06

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A
M3.02

STANDARD LFG VERTICAL WELLHEAD DETAIL

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0	06/30/16	GCCS MASTER PLAN	PD	DC	JM

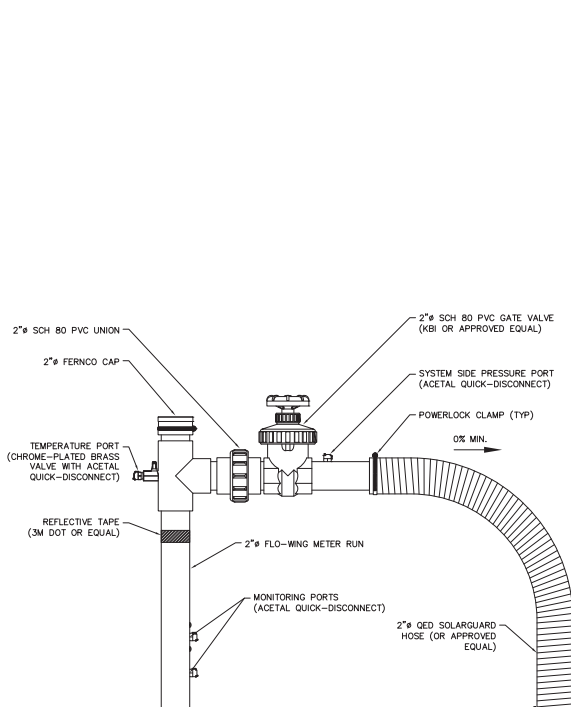
REPUBLIC SERVICES, INC.
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330
PHONE: (541) 745-5792
FAX: (541) 745-3039

ENERGYNEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97159
PHONE: (541) 540-8766
FAX: (541) 540-1901

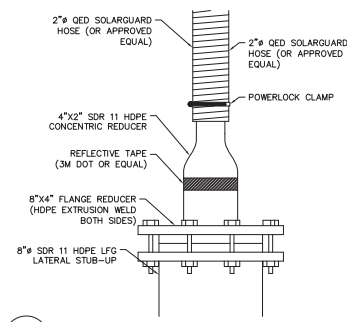
VERTICAL WELL DETAILS II
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COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M3.02
PROJECT NO.
014-T06

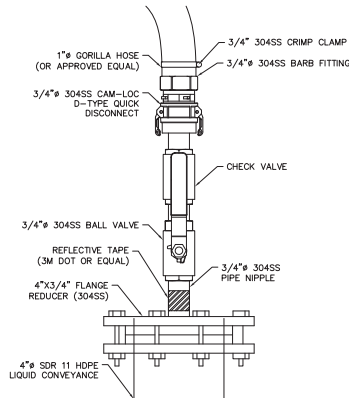
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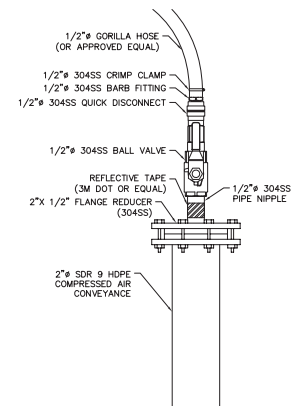
A STANDARD LFG WELLHEAD
M3.03



B STANDARD LFG LATERAL STUB-UP DETAIL
M3.03



C STANDARD LIQUID CONVEYANCE STUB-UP DETAIL
M3.03



D STANDARD AIR CONVEYANCE STUB-UP DETAIL
M3.03

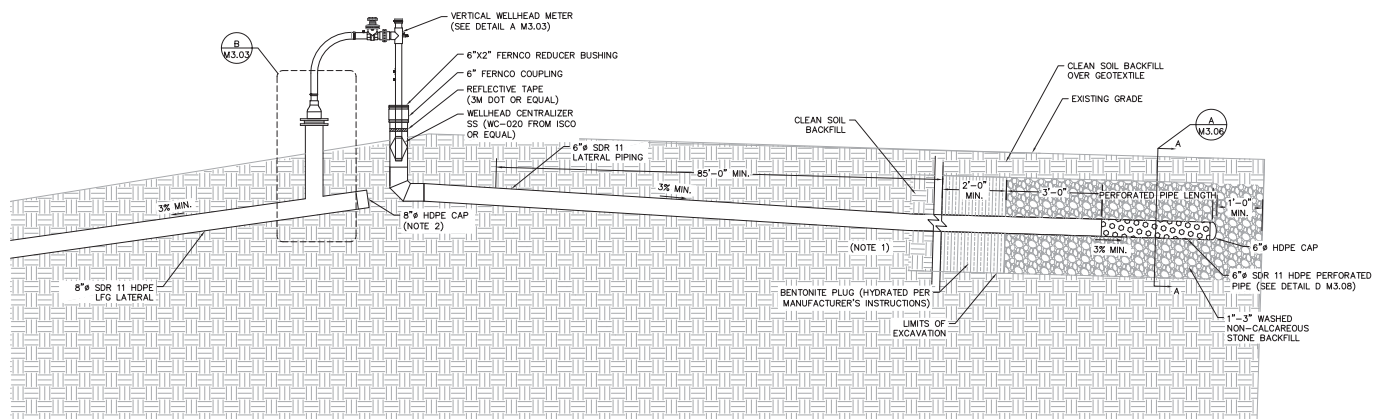
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REPUBLIC SERVICES, INC.
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330
PHONE: (541) 745-5792
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ENERGYNEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97759
PHONE: (541) 540-8766
FAX: (541) 540-1901

VERTICAL WELL DETAILS III
MASTER PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M3.03
PROJECT NO.
014-T06



A TYPE I UP-SLOPE LFG HORIZONTAL EXTRACTION WELL DETAIL

NOTES:

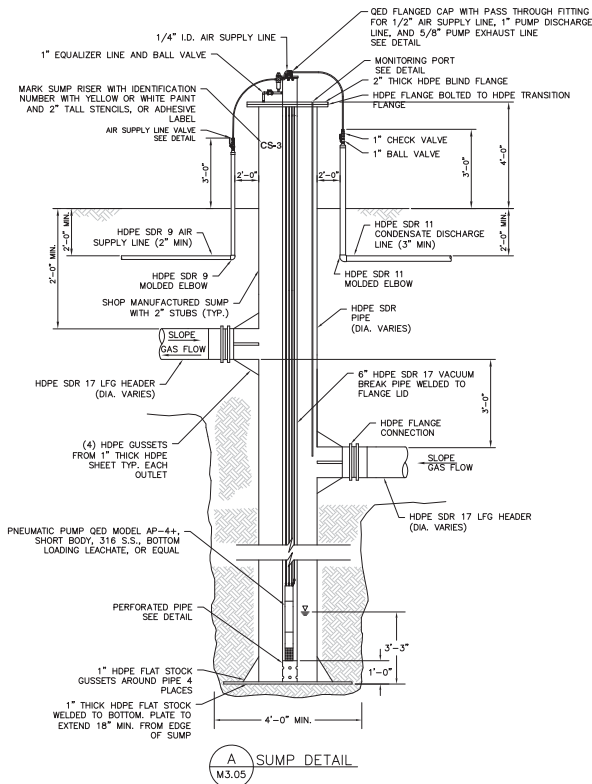
1. EXCAVATION NOT TO INTERFERE WITH THE LANDFILL LINER.

0	06/30/16	GCCS MASTER PLAN	PD	DC	JM
REV	DATE	DESCRIPTION	DRN BY	DSN BY	CHK BY

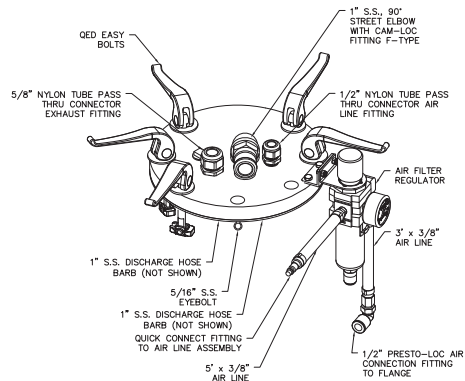


	HORIZONTAL WELL DETAILS	DRAWING NO.
	MASTER PLAN COFFIN BUTTE LANDFILL CORVALLIS, OR	M3.04 PROJECT NO. 014-T06

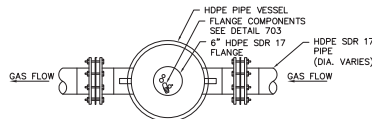
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A SUMP DETAIL
M3.05



B SUMP LID DETAIL
M3.05



C SUMP DETAIL TOP VIEW
M3.05

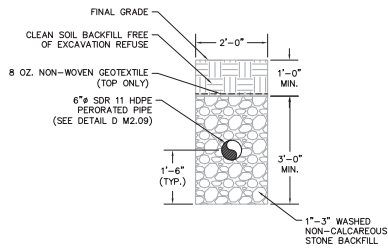
- NOTES:
1. EXCAVATION NOT TO INTERFERE WITH THE LANDFILL LINER.
 2. EXTEND AS FEASIBLE FOR EASE OF FUTURE CONNECTION.
 3. 6" HDPE SDR 17 VACUUM BREAK PIPE EXTRUSION WELDED TO FLANGE LID, 1'-0" OF PIPE TO PROTRUDE THROUGH TOP OF FLANGE. CENTER OF PIPE LOCATED 2" OFF CENTER OF BUND FLANGE.
 4. THOROUGHLY COAT ENTIRE SURFACE OF BOLTS, WASHERS, NUTS AND BACKUP RINGS WITH POLYCOAT RUBBERIZED PRIMER, OR EQUAL, AFTER TIGHTENING BOLTS. WRAP FLANGE IN PLASTIC WRAP PRIOR TO BACKFILLING.
 5. CONTRACTOR SHALL VERIFY CONDENSATE SUMP CONFIGURATION AND NECESSARY ELEVATIONS IN FIELD. ADJUSTMENTS SHALL BE APPROVED BY ENGINEER PRIOR TO INSTALLATION.

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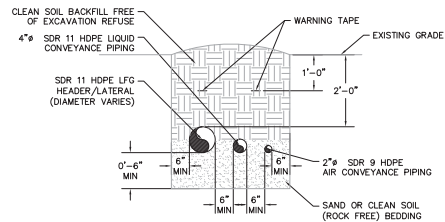


SUMP DETAIL	DRAWING NO.
MASTER PLAN COFFIN BUTTE LANDFILL CORVALLIS, OR	M3.05
	PROJECT NO. 014-T06

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A LFG HORIZONTAL EXTRACTION WELL TRENCH DETAIL
M3.06



B LFG HEADER TRENCH DETAIL
M3.06

- NOTES:
1. EXCAVATION NOT TO INTERFERE WITH THE LANDFILL LINER.
 2. LFG LATERALS WITHIN SLOPES OF WASTE (NOT INCLUDING ALONG ROADWAYS) MAY BE PLACED AT A 1'-0" DEPTH WITH THE WARNING TAPE INSTALLED AT 0'-6".

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0	06/30/16	GC33 MASTER PLAN	PD	DC	JM

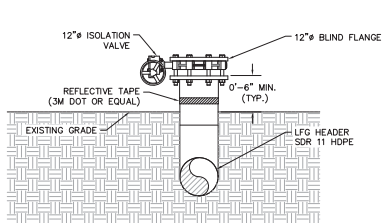
REPUBLIC SERVICES, INC.
28972 COFFIN BUTTE ROAD CORVALLIS, OR 97330
PHONE: (541) 745-5792
FAX: (541) 745-3030

ENERGYNEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97759
PHONE: (541) 540-8766
FAX: (541) 540-1901

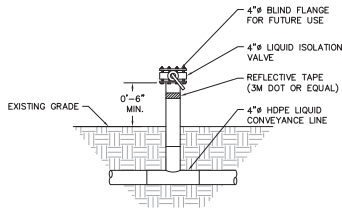
TRENCH DETAILS
MASTER PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M3.06
PROJECT NO.
014-T06

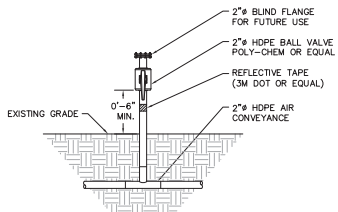
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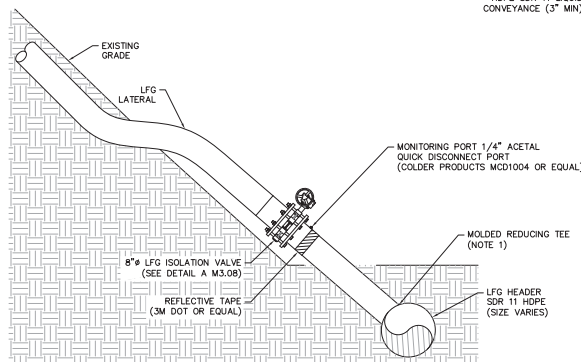
A LFG HEADER STUB-UP DETAIL
M3.07



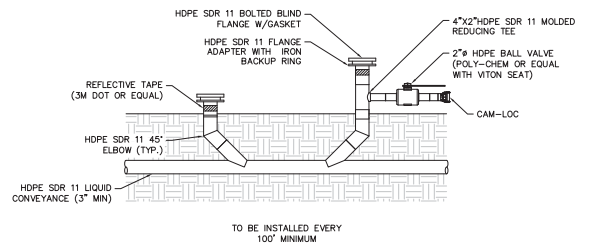
B LIQUID CONVEYANCE STUB-UP DETAIL
M3.07



D AIR CONVEYANCE STUB-UP DETAIL
M3.07



E LFG HEADER STUB-UP TO LATERAL DETAIL
M3.07



C LIQUID CONVEYANCE CLEAN-OUT DETAIL
M3.07

NOTES:
1. BRANCH SADDLE AND/OR COMBINATION REDUCING TEE AND BELL REDUCER MAY BE USED SUBJECT TO ANNUAL DESIGN AND AVAILABLE FITTINGS.

REV	DATE	DESCRIPTION	DRN BY	DSN BY	CHK BY
0	06/30/16	GC33 MASTER PLAN	PD	DC	JM

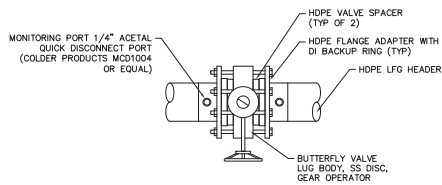
REPUBLIC SERVICES, INC.
28972 COFFIN BUTTE ROAD CORVALLIS OR 97330
PHONE: (541) 745-5792
FAX: (541) 745-3039

ENERGYENGINEERING SOLUTIONS INC.
15820 BARCLAY DRIVE SISTERS, OR 97759
PHONE: (541) 540-8766
FAX: (541) 540-1901

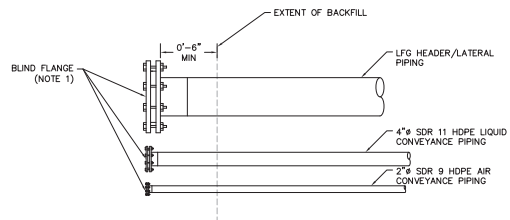
STUB-UP DETAILS
MASTER PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M3.07
PROJECT NO.
014-T06

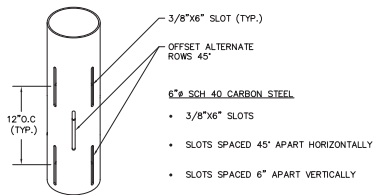
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A LFG HEADER ISOLATION
M3.08 VALVE DETAIL

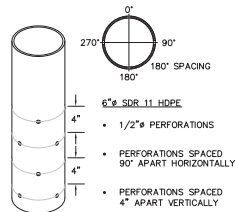


B LFG HEADER/LATERAL, AIR &
M3.08 LIQUID PIPE TERMINATION DETAIL



1. ALTERNATE SLOT DETAILS MAY BE SUBMITTED IF THE CONTRACTOR HAS PREFERRED FABRICATION OR AVAILABILITY.
2. ALTERNATES TO BE APPROVED BY THE DESIGN ENGINEER.

C CARBON STEEL SLOTTED WELL CASING DETAIL
M3.08



1. ALTERNATE PERFORATION DETAILS MAY BE SUBMITTED IF THE CONTRACTOR HAS PREFERRED FABRICATION OR AVAILABILITY.
2. ALTERNATES TO BE APPROVED BY THE DESIGN ENGINEER.

D HDPE PERFORATED WELL CASING DETAIL
M3.08

NOTES:
1. IF TERMINATING WITHIN THE WASTE, TERMINATE WITH AN HDPE CAP (INSTEAD OF A BLIND FLANGE) AND INCLUDE A STAKE LABELING PIPE SERVICE AND SIZE.

REV	DATE	DESCRIPTION	DRN BY	DSN BY	CHK BY
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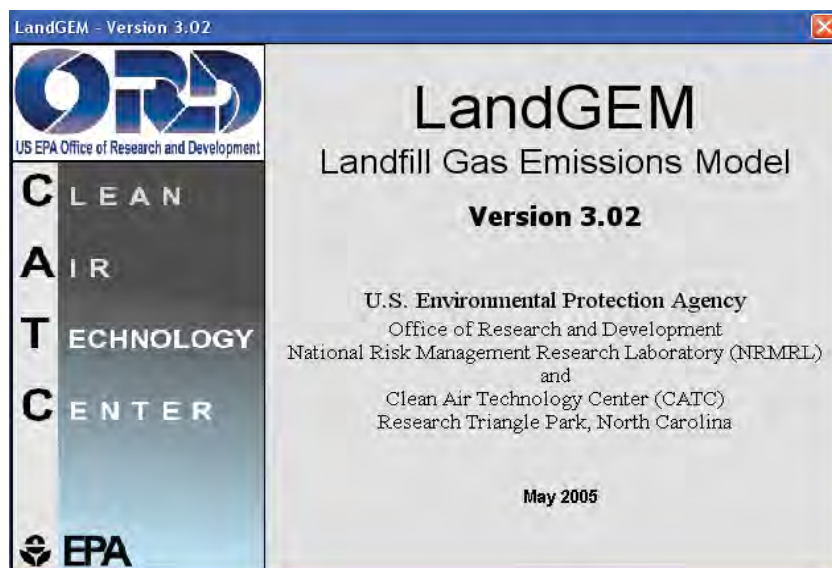


MISC. DETAILS I
MASTER PLAN
COFFIN BUTTE LANDFILL
CORVALLIS, OR

DRAWING NO.
M3.08
PROJECT NO.
014-T06



APPENDIX B: LFG GENERATION MODEL (LANDGEM)



Summary Report

Landfill Name or Identifier: Special Waste CB Landfill

Date: Monday, May 10, 2021

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year **1978**
 Landfill Closure Year (with 80-year limit) **2045**
 Actual Closure Year (without limit) **2045**
 Have Model Calculate Closure Year? **No**
 Waste Design Capacity *megagrams*

MODEL PARAMETERS

Methane Generation Rate, k **0.030** *year⁻¹*
 Potential Methane Generation Capacity, L₀ **20** *m³/Mg*
 NMOC Concentration **600** *ppmv as hexane*
 Methane Content **50** *% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1: **Total landfill gas**
 Gas / Pollutant #2: **Methane**
 Gas / Pollutant #3: **Carbon dioxide**
 Gas / Pollutant #4: **NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1978	0	0	0	0
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	40,984	45,082	0	0
1998	34,970	38,467	40,984	45,082
1999	33,476	36,824	75,954	83,549
2000	36,351	39,986	109,430	120,373
2001	38,282	42,110	145,781	160,359
2002	69,163	76,079	184,063	202,469
2003	197,915	217,707	253,225	278,548
2004	87,785	96,563	451,141	496,255
2005	75,921	83,514	538,925	592,818
2006	93,495	102,845	614,847	676,331
2007	81,486	89,634	708,342	779,176
2008	101,682	111,851	789,828	868,811
2009	137,438	151,182	891,511	980,662
2010	94,090	103,499	1,028,949	1,131,844
2011	68,905	75,796	1,123,039	1,235,342
2012	51,975	57,172	1,191,944	1,311,138
2013	63,013	69,314	1,243,919	1,368,311
2014	88,426	97,269	1,306,931	1,437,624
2015	103,883	114,272	1,395,358	1,534,893
2016	66,203	72,824	1,499,241	1,649,165
2017	86,699	95,369	1,565,444	1,721,989

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2018	123,351	135,686	1,652,144	1,817,358
2019	97,989	107,788	1,775,495	1,953,044
2020	61,484	67,632	1,873,484	2,060,832
2021	58,182	64,000	1,934,968	2,128,465
2022	58,182	64,000	1,993,150	2,192,465
2023	58,182	64,000	2,051,332	2,256,465
2024	58,182	64,000	2,109,513	2,320,465
2025	58,182	64,000	2,167,695	2,384,465
2026	58,182	64,000	2,225,877	2,448,465
2027	58,182	64,000	2,284,059	2,512,465
2028	58,182	64,000	2,342,241	2,576,465
2029	58,182	64,000	2,400,422	2,640,465
2030	58,182	64,000	2,458,604	2,704,465
2031	58,182	64,000	2,516,786	2,768,465
2032	58,182	64,000	2,574,968	2,832,465
2033	58,182	64,000	2,633,150	2,896,465
2034	58,182	64,000	2,691,332	2,960,465
2035	58,182	64,000	2,749,513	3,024,465
2036	58,182	64,000	2,807,695	3,088,465
2037	58,182	64,000	2,865,877	3,152,465
2038	58,182	64,000	2,924,059	3,216,465
2039	58,182	64,000	2,982,241	3,280,465
2040	58,182	64,000	3,040,422	3,344,465
2041	58,182	64,000	3,098,604	3,408,465
2042	58,182	64,000	3,156,786	3,472,465
2043	58,182	64,000	3,214,968	3,536,465
2044	58,182	64,000	3,273,150	3,600,465
2045	58,182	64,000	3,331,332	3,664,465
2046	0	0	3,389,513	3,728,465
2047	0	0	3,389,513	3,728,465
2048	0	0	3,389,513	3,728,465
2049	0	0	3,389,513	3,728,465
2050	0	0	3,389,513	3,728,465
2051	0	0	3,389,513	3,728,465
2052	0	0	3,389,513	3,728,465
2053	0	0	3,389,513	3,728,465
2054	0	0	3,389,513	3,728,465
2055	0	0	3,389,513	3,728,465
2056	0	0	3,389,513	3,728,465
2057	0	0	3,389,513	3,728,465

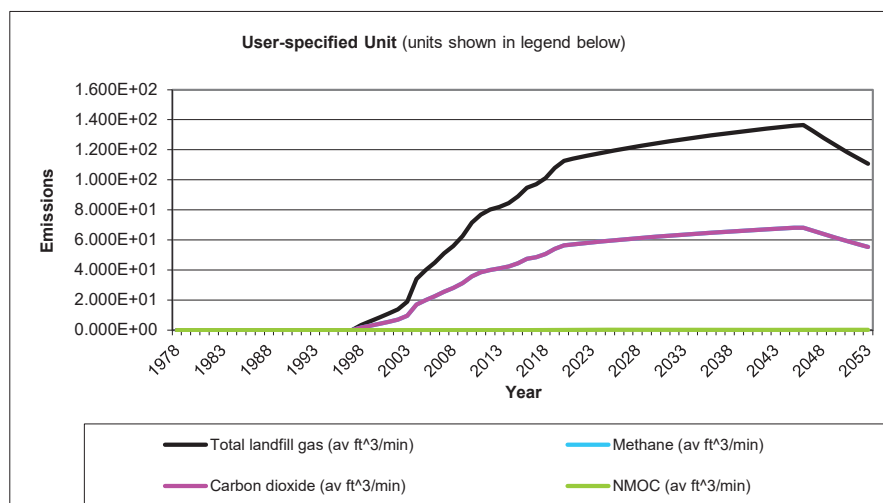
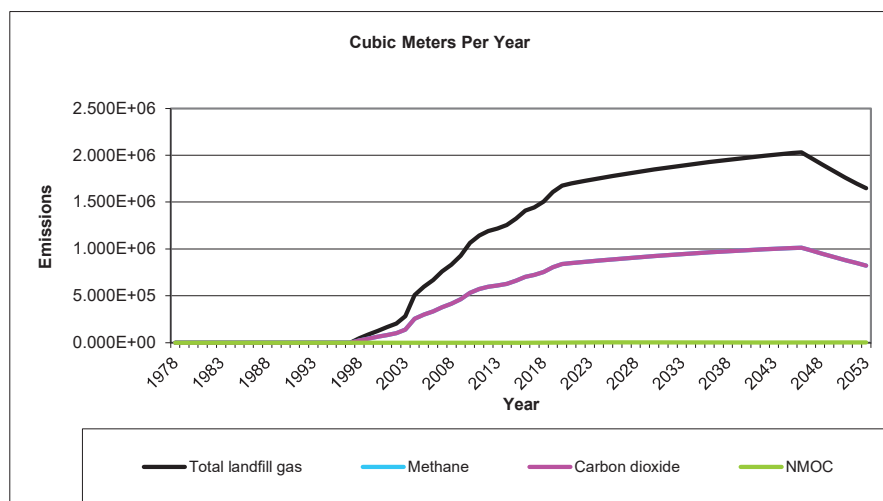
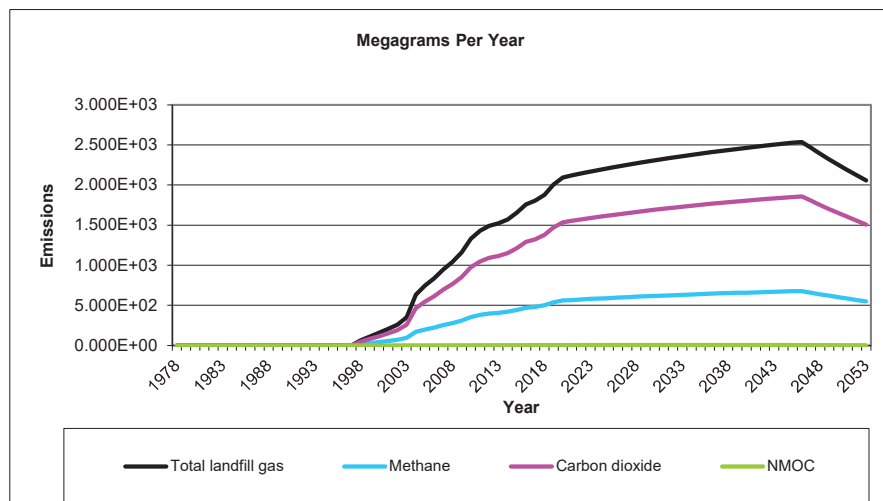
Pollutant Parameters

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2- Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	6.060E+01	4.852E+04	3.260E+00	1.619E+01	2.426E+04	1.630E+00
1999	1.105E+02	8.849E+04	5.946E+00	2.952E+01	4.425E+04	2.973E+00
2000	1.567E+02	1.255E+05	8.433E+00	4.187E+01	6.276E+04	4.217E+00
2001	2.059E+02	1.648E+05	1.108E+01	5.499E+01	8.242E+04	5.538E+00
2002	2.564E+02	2.053E+05	1.379E+01	6.848E+01	1.026E+05	6.897E+00
2003	3.511E+02	2.811E+05	1.889E+01	9.377E+01	1.406E+05	9.444E+00
2004	6.333E+02	5.071E+05	3.407E+01	1.692E+02	2.536E+05	1.704E+01
2005	7.444E+02	5.961E+05	4.005E+01	1.988E+02	2.980E+05	2.002E+01
2006	8.346E+02	6.683E+05	4.491E+01	2.229E+02	3.342E+05	2.245E+01
2007	9.482E+02	7.593E+05	5.102E+01	2.533E+02	3.796E+05	2.551E+01
2008	1.041E+03	8.333E+05	5.599E+01	2.780E+02	4.167E+05	2.800E+01
2009	1.160E+03	9.291E+05	6.242E+01	3.099E+02	4.645E+05	3.121E+01
2010	1.329E+03	1.064E+06	7.151E+01	3.550E+02	5.322E+05	3.576E+01
2011	1.429E+03	1.144E+06	7.688E+01	3.817E+02	5.721E+05	3.844E+01
2012	1.489E+03	1.192E+06	8.009E+01	3.976E+02	5.960E+05	4.005E+01
2013	1.522E+03	1.218E+06	8.186E+01	4.064E+02	6.092E+05	4.093E+01
2014	1.570E+03	1.257E+06	8.445E+01	4.193E+02	6.285E+05	4.223E+01
2015	1.654E+03	1.324E+06	8.899E+01	4.418E+02	6.622E+05	4.450E+01
2016	1.759E+03	1.408E+06	9.463E+01	4.698E+02	7.042E+05	4.731E+01
2017	1.805E+03	1.445E+06	9.710E+01	4.820E+02	7.225E+05	4.855E+01
2018	1.880E+03	1.505E+06	1.011E+02	5.020E+02	7.525E+05	5.056E+01
2019	2.006E+03	1.607E+06	1.079E+02	5.359E+02	8.033E+05	5.397E+01
2020	2.092E+03	1.675E+06	1.126E+02	5.588E+02	8.376E+05	5.628E+01
2021	2.121E+03	1.698E+06	1.141E+02	5.665E+02	8.492E+05	5.706E+01
2022	2.144E+03	1.717E+06	1.154E+02	5.728E+02	8.586E+05	5.769E+01
2023	2.167E+03	1.735E+06	1.166E+02	5.788E+02	8.676E+05	5.830E+01
2024	2.189E+03	1.753E+06	1.178E+02	5.847E+02	8.764E+05	5.889E+01
2025	2.210E+03	1.770E+06	1.189E+02	5.904E+02	8.850E+05	5.946E+01
2026	2.231E+03	1.786E+06	1.200E+02	5.959E+02	8.932E+05	6.002E+01
2027	2.251E+03	1.803E+06	1.211E+02	6.013E+02	9.013E+05	6.056E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	2.271E+03	1.818E+06	1.222E+02	6.065E+02	9.091E+05	6.108E+01
2029	2.290E+03	1.833E+06	1.232E+02	6.116E+02	9.167E+05	6.159E+01
2030	2.308E+03	1.848E+06	1.242E+02	6.165E+02	9.240E+05	6.208E+01
2031	2.326E+03	1.862E+06	1.251E+02	6.212E+02	9.312E+05	6.256E+01
2032	2.343E+03	1.876E+06	1.261E+02	6.258E+02	9.381E+05	6.303E+01
2033	2.360E+03	1.890E+06	1.270E+02	6.303E+02	9.448E+05	6.348E+01
2034	2.376E+03	1.903E+06	1.278E+02	6.347E+02	9.513E+05	6.392E+01
2035	2.392E+03	1.915E+06	1.287E+02	6.389E+02	9.576E+05	6.434E+01
2036	2.407E+03	1.928E+06	1.295E+02	6.430E+02	9.638E+05	6.476E+01
2037	2.422E+03	1.939E+06	1.303E+02	6.470E+02	9.697E+05	6.516E+01
2038	2.437E+03	1.951E+06	1.311E+02	6.508E+02	9.755E+05	6.555E+01
2039	2.451E+03	1.962E+06	1.318E+02	6.546E+02	9.811E+05	6.592E+01
2040	2.464E+03	1.973E+06	1.326E+02	6.582E+02	9.866E+05	6.629E+01
2041	2.477E+03	1.984E+06	1.333E+02	6.617E+02	9.919E+05	6.664E+01
2042	2.490E+03	1.994E+06	1.340E+02	6.651E+02	9.970E+05	6.699E+01
2043	2.503E+03	2.004E+06	1.346E+02	6.685E+02	1.002E+06	6.732E+01
2044	2.515E+03	2.014E+06	1.353E+02	6.717E+02	1.007E+06	6.765E+01
2045	2.526E+03	2.023E+06	1.359E+02	6.748E+02	1.011E+06	6.796E+01
2046	2.538E+03	2.032E+06	1.365E+02	6.778E+02	1.016E+06	6.827E+01
2047	2.463E+03	1.972E+06	1.325E+02	6.578E+02	9.860E+05	6.625E+01
2048	2.390E+03	1.914E+06	1.286E+02	6.384E+02	9.569E+05	6.429E+01
2049	2.319E+03	1.857E+06	1.248E+02	6.195E+02	9.286E+05	6.239E+01
2050	2.251E+03	1.802E+06	1.211E+02	6.012E+02	9.011E+05	6.055E+01
2051	2.184E+03	1.749E+06	1.175E+02	5.834E+02	8.745E+05	5.876E+01
2052	2.120E+03	1.697E+06	1.140E+02	5.662E+02	8.487E+05	5.702E+01
2053	2.057E+03	1.647E+06	1.107E+02	5.494E+02	8.236E+05	5.534E+01
2054	1.996E+03	1.598E+06	1.074E+02	5.332E+02	7.992E+05	5.370E+01
2055	1.937E+03	1.551E+06	1.042E+02	5.175E+02	7.756E+05	5.211E+01
2056	1.880E+03	1.505E+06	1.011E+02	5.022E+02	7.527E+05	5.057E+01
2057	1.824E+03	1.461E+06	9.816E+01	4.873E+02	7.304E+05	4.908E+01
2058	1.770E+03	1.418E+06	9.526E+01	4.729E+02	7.089E+05	4.763E+01
2059	1.718E+03	1.376E+06	9.244E+01	4.589E+02	6.879E+05	4.622E+01
2060	1.667E+03	1.335E+06	8.971E+01	4.454E+02	6.676E+05	4.485E+01
2061	1.618E+03	1.296E+06	8.706E+01	4.322E+02	6.479E+05	4.353E+01
2062	1.570E+03	1.257E+06	8.449E+01	4.194E+02	6.287E+05	4.224E+01
2063	1.524E+03	1.220E+06	8.199E+01	4.070E+02	6.101E+05	4.099E+01
2064	1.479E+03	1.184E+06	7.957E+01	3.950E+02	5.921E+05	3.978E+01
2065	1.435E+03	1.149E+06	7.721E+01	3.833E+02	5.746E+05	3.861E+01
2066	1.393E+03	1.115E+06	7.493E+01	3.720E+02	5.576E+05	3.747E+01
2067	1.352E+03	1.082E+06	7.272E+01	3.610E+02	5.411E+05	3.636E+01
2068	1.312E+03	1.050E+06	7.057E+01	3.503E+02	5.251E+05	3.528E+01
2069	1.273E+03	1.019E+06	6.848E+01	3.400E+02	5.096E+05	3.424E+01
2070	1.235E+03	9.891E+05	6.646E+01	3.299E+02	4.946E+05	3.323E+01
2071	1.199E+03	9.599E+05	6.449E+01	3.202E+02	4.799E+05	3.225E+01
2072	1.163E+03	9.315E+05	6.259E+01	3.107E+02	4.658E+05	3.129E+01
2073	1.129E+03	9.040E+05	6.074E+01	3.015E+02	4.520E+05	3.037E+01
2074	1.096E+03	8.773E+05	5.894E+01	2.926E+02	4.386E+05	2.947E+01
2075	1.063E+03	8.513E+05	5.720E+01	2.840E+02	4.257E+05	2.860E+01
2076	1.032E+03	8.262E+05	5.551E+01	2.756E+02	4.131E+05	2.776E+01
2077	1.001E+03	8.018E+05	5.387E+01	2.674E+02	4.009E+05	2.694E+01
2078	9.717E+02	7.781E+05	5.228E+01	2.595E+02	3.890E+05	2.614E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	9.429E+02	7.551E+05	5.073E+01	2.519E+02	3.775E+05	2.537E+01
2080	9.151E+02	7.328E+05	4.923E+01	2.444E+02	3.664E+05	2.462E+01
2081	8.880E+02	7.111E+05	4.778E+01	2.372E+02	3.555E+05	2.389E+01
2082	8.618E+02	6.901E+05	4.637E+01	2.302E+02	3.450E+05	2.318E+01
2083	8.363E+02	6.697E+05	4.500E+01	2.234E+02	3.348E+05	2.250E+01
2084	8.116E+02	6.499E+05	4.367E+01	2.168E+02	3.249E+05	2.183E+01
2085	7.876E+02	6.307E+05	4.238E+01	2.104E+02	3.153E+05	2.119E+01
2086	7.643E+02	6.120E+05	4.112E+01	2.042E+02	3.060E+05	2.056E+01
2087	7.417E+02	5.940E+05	3.991E+01	1.981E+02	2.970E+05	1.995E+01
2088	7.198E+02	5.764E+05	3.873E+01	1.923E+02	2.882E+05	1.936E+01
2089	6.986E+02	5.594E+05	3.758E+01	1.866E+02	2.797E+05	1.879E+01
2090	6.779E+02	5.428E+05	3.647E+01	1.811E+02	2.714E+05	1.824E+01
2091	6.579E+02	5.268E+05	3.540E+01	1.757E+02	2.634E+05	1.770E+01
2092	6.384E+02	5.112E+05	3.435E+01	1.705E+02	2.556E+05	1.717E+01
2093	6.196E+02	4.961E+05	3.333E+01	1.655E+02	2.481E+05	1.667E+01
2094	6.012E+02	4.815E+05	3.235E+01	1.606E+02	2.407E+05	1.617E+01
2095	5.835E+02	4.672E+05	3.139E+01	1.559E+02	2.336E+05	1.570E+01
2096	5.662E+02	4.534E+05	3.046E+01	1.512E+02	2.267E+05	1.523E+01
2097	5.495E+02	4.400E+05	2.956E+01	1.468E+02	2.200E+05	1.478E+01
2098	5.333E+02	4.270E+05	2.869E+01	1.424E+02	2.135E+05	1.435E+01
2099	5.175E+02	4.144E+05	2.784E+01	1.382E+02	2.072E+05	1.392E+01
2100	5.022E+02	4.021E+05	2.702E+01	1.341E+02	2.011E+05	1.351E+01
2101	4.874E+02	3.903E+05	2.622E+01	1.302E+02	1.951E+05	1.311E+01
2102	4.730E+02	3.787E+05	2.545E+01	1.263E+02	1.894E+05	1.272E+01
2103	4.590E+02	3.675E+05	2.469E+01	1.226E+02	1.838E+05	1.235E+01
2104	4.454E+02	3.567E+05	2.396E+01	1.190E+02	1.783E+05	1.198E+01
2105	4.323E+02	3.461E+05	2.326E+01	1.155E+02	1.731E+05	1.163E+01
2106	4.195E+02	3.359E+05	2.257E+01	1.120E+02	1.679E+05	1.128E+01
2107	4.071E+02	3.260E+05	2.190E+01	1.087E+02	1.630E+05	1.095E+01
2108	3.950E+02	3.163E+05	2.125E+01	1.055E+02	1.582E+05	1.063E+01
2109	3.834E+02	3.070E+05	2.063E+01	1.024E+02	1.535E+05	1.031E+01
2110	3.720E+02	2.979E+05	2.002E+01	9.938E+01	1.490E+05	1.001E+01
2111	3.610E+02	2.891E+05	1.943E+01	9.644E+01	1.446E+05	9.713E+00
2112	3.504E+02	2.806E+05	1.885E+01	9.359E+01	1.403E+05	9.426E+00
2113	3.400E+02	2.723E+05	1.829E+01	9.082E+01	1.361E+05	9.147E+00
2114	3.300E+02	2.642E+05	1.775E+01	8.814E+01	1.321E+05	8.877E+00
2115	3.202E+02	2.564E+05	1.723E+01	8.553E+01	1.282E+05	8.614E+00
2116	3.108E+02	2.488E+05	1.672E+01	8.301E+01	1.244E+05	8.360E+00
2117	3.016E+02	2.415E+05	1.623E+01	8.055E+01	1.207E+05	8.113E+00
2118	2.927E+02	2.343E+05	1.575E+01	7.817E+01	1.172E+05	7.873E+00

Results (Continued)

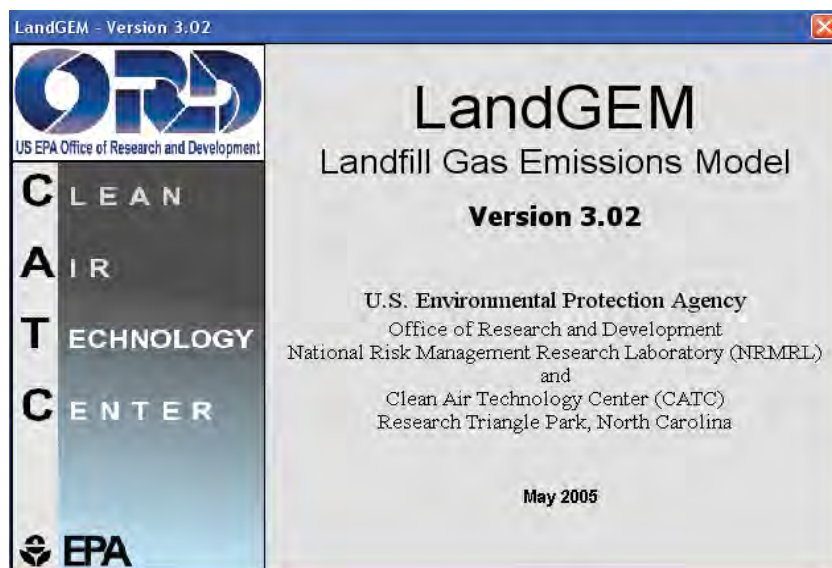
Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	4.441E+01	2.426E+04	1.630E+00	1.044E-01	2.911E+01	1.956E-03
1999	8.099E+01	4.425E+04	2.973E+00	1.903E-01	5.309E+01	3.567E-03
2000	1.149E+02	6.276E+04	4.217E+00	2.699E-01	7.531E+01	5.060E-03
2001	1.509E+02	8.242E+04	5.538E+00	3.545E-01	9.890E+01	6.645E-03
2002	1.879E+02	1.026E+05	6.897E+00	4.415E-01	1.232E+02	8.276E-03
2003	2.573E+02	1.406E+05	9.444E+00	6.046E-01	1.687E+02	1.133E-02
2004	4.641E+02	2.536E+05	1.704E+01	1.091E+00	3.043E+02	2.044E-02
2005	5.456E+02	2.980E+05	2.002E+01	1.282E+00	3.576E+02	2.403E-02
2006	6.117E+02	3.342E+05	2.245E+01	1.437E+00	4.010E+02	2.694E-02
2007	6.949E+02	3.796E+05	2.551E+01	1.633E+00	4.556E+02	3.061E-02
2008	7.627E+02	4.167E+05	2.800E+01	1.792E+00	5.000E+02	3.359E-02
2009	8.503E+02	4.645E+05	3.121E+01	1.998E+00	5.574E+02	3.745E-02
2010	9.741E+02	5.322E+05	3.576E+01	2.289E+00	6.386E+02	4.291E-02
2011	1.047E+03	5.721E+05	3.844E+01	2.461E+00	6.866E+02	4.613E-02
2012	1.091E+03	5.960E+05	4.005E+01	2.564E+00	7.152E+02	4.806E-02
2013	1.115E+03	6.092E+05	4.093E+01	2.620E+00	7.310E+02	4.912E-02
2014	1.150E+03	6.285E+05	4.223E+01	2.703E+00	7.542E+02	5.067E-02
2015	1.212E+03	6.622E+05	4.450E+01	2.849E+00	7.947E+02	5.340E-02
2016	1.289E+03	7.042E+05	4.731E+01	3.029E+00	8.450E+02	5.678E-02
2017	1.323E+03	7.225E+05	4.855E+01	3.108E+00	8.671E+02	5.826E-02
2018	1.377E+03	7.525E+05	5.056E+01	3.237E+00	9.030E+02	6.067E-02
2019	1.470E+03	8.033E+05	5.397E+01	3.455E+00	9.640E+02	6.477E-02
2020	1.533E+03	8.376E+05	5.628E+01	3.603E+00	1.005E+03	6.753E-02
2021	1.554E+03	8.492E+05	5.706E+01	3.653E+00	1.019E+03	6.847E-02
2022	1.572E+03	8.586E+05	5.769E+01	3.693E+00	1.030E+03	6.922E-02
2023	1.588E+03	8.676E+05	5.830E+01	3.732E+00	1.041E+03	6.995E-02
2024	1.604E+03	8.764E+05	5.889E+01	3.770E+00	1.052E+03	7.066E-02
2025	1.620E+03	8.850E+05	5.946E+01	3.807E+00	1.062E+03	7.135E-02
2026	1.635E+03	8.932E+05	6.002E+01	3.842E+00	1.072E+03	7.202E-02
2027	1.650E+03	9.013E+05	6.056E+01	3.877E+00	1.082E+03	7.267E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	1.664E+03	9.091E+05	6.108E+01	3.910E+00	1.091E+03	7.330E-02
2029	1.678E+03	9.167E+05	6.159E+01	3.943E+00	1.100E+03	7.391E-02
2030	1.691E+03	9.240E+05	6.208E+01	3.975E+00	1.109E+03	7.450E-02
2031	1.704E+03	9.312E+05	6.256E+01	4.005E+00	1.117E+03	7.508E-02
2032	1.717E+03	9.381E+05	6.303E+01	4.035E+00	1.126E+03	7.564E-02
2033	1.729E+03	9.448E+05	6.348E+01	4.064E+00	1.134E+03	7.618E-02
2034	1.741E+03	9.513E+05	6.392E+01	4.092E+00	1.142E+03	7.670E-02
2035	1.753E+03	9.576E+05	6.434E+01	4.119E+00	1.149E+03	7.721E-02
2036	1.764E+03	9.638E+05	6.476E+01	4.146E+00	1.157E+03	7.771E-02
2037	1.775E+03	9.697E+05	6.516E+01	4.171E+00	1.164E+03	7.819E-02
2038	1.786E+03	9.755E+05	6.555E+01	4.196E+00	1.171E+03	7.865E-02
2039	1.796E+03	9.811E+05	6.592E+01	4.220E+00	1.177E+03	7.911E-02
2040	1.806E+03	9.866E+05	6.629E+01	4.244E+00	1.184E+03	7.955E-02
2041	1.816E+03	9.919E+05	6.664E+01	4.266E+00	1.190E+03	7.997E-02
2042	1.825E+03	9.970E+05	6.699E+01	4.288E+00	1.196E+03	8.039E-02
2043	1.834E+03	1.002E+06	6.732E+01	4.310E+00	1.202E+03	8.079E-02
2044	1.843E+03	1.007E+06	6.765E+01	4.331E+00	1.208E+03	8.118E-02
2045	1.852E+03	1.011E+06	6.796E+01	4.351E+00	1.214E+03	8.155E-02
2046	1.860E+03	1.016E+06	6.827E+01	4.370E+00	1.219E+03	8.192E-02
2047	1.805E+03	9.860E+05	6.625E+01	4.241E+00	1.183E+03	7.950E-02
2048	1.752E+03	9.569E+05	6.429E+01	4.116E+00	1.148E+03	7.715E-02
2049	1.700E+03	9.286E+05	6.239E+01	3.994E+00	1.114E+03	7.487E-02
2050	1.650E+03	9.011E+05	6.055E+01	3.876E+00	1.081E+03	7.266E-02
2051	1.601E+03	8.745E+05	5.876E+01	3.762E+00	1.049E+03	7.051E-02
2052	1.553E+03	8.487E+05	5.702E+01	3.650E+00	1.018E+03	6.843E-02
2053	1.508E+03	8.236E+05	5.534E+01	3.543E+00	9.883E+02	6.640E-02
2054	1.463E+03	7.992E+05	5.370E+01	3.438E+00	9.591E+02	6.444E-02
2055	1.420E+03	7.756E+05	5.211E+01	3.336E+00	9.307E+02	6.254E-02
2056	1.378E+03	7.527E+05	5.057E+01	3.238E+00	9.032E+02	6.069E-02
2057	1.337E+03	7.304E+05	4.908E+01	3.142E+00	8.765E+02	5.889E-02
2058	1.298E+03	7.089E+05	4.763E+01	3.049E+00	8.506E+02	5.715E-02
2059	1.259E+03	6.879E+05	4.622E+01	2.959E+00	8.255E+02	5.546E-02
2060	1.222E+03	6.676E+05	4.485E+01	2.872E+00	8.011E+02	5.383E-02
2061	1.186E+03	6.479E+05	4.353E+01	2.787E+00	7.774E+02	5.223E-02
2062	1.151E+03	6.287E+05	4.224E+01	2.704E+00	7.544E+02	5.069E-02
2063	1.117E+03	6.101E+05	4.099E+01	2.624E+00	7.321E+02	4.919E-02
2064	1.084E+03	5.921E+05	3.978E+01	2.547E+00	7.105E+02	4.774E-02
2065	1.052E+03	5.746E+05	3.861E+01	2.472E+00	6.895E+02	4.633E-02
2066	1.021E+03	5.576E+05	3.747E+01	2.398E+00	6.691E+02	4.496E-02
2067	9.905E+02	5.411E+05	3.636E+01	2.328E+00	6.494E+02	4.363E-02
2068	9.613E+02	5.251E+05	3.528E+01	2.259E+00	6.302E+02	4.234E-02
2069	9.329E+02	5.096E+05	3.424E+01	2.192E+00	6.115E+02	4.109E-02
2070	9.053E+02	4.946E+05	3.323E+01	2.127E+00	5.935E+02	3.987E-02
2071	8.785E+02	4.799E+05	3.225E+01	2.064E+00	5.759E+02	3.870E-02
2072	8.526E+02	4.658E+05	3.129E+01	2.003E+00	5.589E+02	3.755E-02
2073	8.274E+02	4.520E+05	3.037E+01	1.944E+00	5.424E+02	3.644E-02
2074	8.029E+02	4.386E+05	2.947E+01	1.887E+00	5.264E+02	3.537E-02
2075	7.792E+02	4.257E+05	2.860E+01	1.831E+00	5.108E+02	3.432E-02
2076	7.562E+02	4.131E+05	2.776E+01	1.777E+00	4.957E+02	3.331E-02
2077	7.338E+02	4.009E+05	2.694E+01	1.724E+00	4.811E+02	3.232E-02
2078	7.121E+02	3.890E+05	2.614E+01	1.673E+00	4.668E+02	3.137E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	6.911E+02	3.775E+05	2.537E+01	1.624E+00	4.530E+02	3.044E-02
2080	6.707E+02	3.664E+05	2.462E+01	1.576E+00	4.397E+02	2.954E-02
2081	6.508E+02	3.555E+05	2.389E+01	1.529E+00	4.267E+02	2.867E-02
2082	6.316E+02	3.450E+05	2.318E+01	1.484E+00	4.140E+02	2.782E-02
2083	6.129E+02	3.348E+05	2.250E+01	1.440E+00	4.018E+02	2.700E-02
2084	5.948E+02	3.249E+05	2.183E+01	1.398E+00	3.899E+02	2.620E-02
2085	5.772E+02	3.153E+05	2.119E+01	1.356E+00	3.784E+02	2.543E-02
2086	5.602E+02	3.060E+05	2.056E+01	1.316E+00	3.672E+02	2.467E-02
2087	5.436E+02	2.970E+05	1.995E+01	1.277E+00	3.564E+02	2.394E-02
2088	5.276E+02	2.882E+05	1.936E+01	1.240E+00	3.458E+02	2.324E-02
2089	5.120E+02	2.797E+05	1.879E+01	1.203E+00	3.356E+02	2.255E-02
2090	4.968E+02	2.714E+05	1.824E+01	1.167E+00	3.257E+02	2.188E-02
2091	4.821E+02	2.634E+05	1.770E+01	1.133E+00	3.161E+02	2.124E-02
2092	4.679E+02	2.556E+05	1.717E+01	1.099E+00	3.067E+02	2.061E-02
2093	4.541E+02	2.481E+05	1.667E+01	1.067E+00	2.977E+02	2.000E-02
2094	4.406E+02	2.407E+05	1.617E+01	1.035E+00	2.889E+02	1.941E-02
2095	4.276E+02	2.336E+05	1.570E+01	1.005E+00	2.803E+02	1.884E-02
2096	4.150E+02	2.267E+05	1.523E+01	9.752E-01	2.720E+02	1.828E-02
2097	4.027E+02	2.200E+05	1.478E+01	9.463E-01	2.640E+02	1.774E-02
2098	3.908E+02	2.135E+05	1.435E+01	9.184E-01	2.562E+02	1.721E-02
2099	3.793E+02	2.072E+05	1.392E+01	8.912E-01	2.486E+02	1.671E-02
2100	3.681E+02	2.011E+05	1.351E+01	8.649E-01	2.413E+02	1.621E-02
2101	3.572E+02	1.951E+05	1.311E+01	8.393E-01	2.342E+02	1.573E-02
2102	3.466E+02	1.894E+05	1.272E+01	8.145E-01	2.272E+02	1.527E-02
2103	3.364E+02	1.838E+05	1.235E+01	7.904E-01	2.205E+02	1.482E-02
2104	3.264E+02	1.783E+05	1.198E+01	7.671E-01	2.140E+02	1.438E-02
2105	3.168E+02	1.731E+05	1.163E+01	7.444E-01	2.077E+02	1.395E-02
2106	3.074E+02	1.679E+05	1.128E+01	7.224E-01	2.015E+02	1.354E-02
2107	2.983E+02	1.630E+05	1.095E+01	7.011E-01	1.956E+02	1.314E-02
2108	2.895E+02	1.582E+05	1.063E+01	6.803E-01	1.898E+02	1.275E-02
2109	2.810E+02	1.535E+05	1.031E+01	6.602E-01	1.842E+02	1.238E-02
2110	2.727E+02	1.490E+05	1.001E+01	6.407E-01	1.787E+02	1.201E-02
2111	2.646E+02	1.446E+05	9.713E+00	6.218E-01	1.735E+02	1.166E-02
2112	2.568E+02	1.403E+05	9.426E+00	6.034E-01	1.683E+02	1.131E-02
2113	2.492E+02	1.361E+05	9.147E+00	5.856E-01	1.634E+02	1.098E-02
2114	2.418E+02	1.321E+05	8.877E+00	5.683E-01	1.585E+02	1.065E-02
2115	2.347E+02	1.282E+05	8.614E+00	5.515E-01	1.539E+02	1.034E-02
2116	2.278E+02	1.244E+05	8.360E+00	5.352E-01	1.493E+02	1.003E-02
2117	2.210E+02	1.207E+05	8.113E+00	5.194E-01	1.449E+02	9.735E-03
2118	2.145E+02	1.172E+05	7.873E+00	5.040E-01	1.406E+02	9.447E-03



Summary Report

Landfill Name or Identifier: Organic waste CB Landfill Model

Date: Monday, May 10, 2021

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year **1978**
 Landfill Closure Year (with 80-year limit) **2045**
 Actual Closure Year (without limit) **2045**
 Have Model Calculate Closure Year? **No**
 Waste Design Capacity *megagrams*

MODEL PARAMETERS

Methane Generation Rate, k **0.050** *year⁻¹*
 Potential Methane Generation Capacity, L₀ **130** *m³/Mg*
 NMOC Concentration **600** *ppmv as hexane*
 Methane Content **50** *% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1: **Total landfill gas**
 Gas / Pollutant #2: **Methane**
 Gas / Pollutant #3: **Carbon dioxide**
 Gas / Pollutant #4: **NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1978	0	0	0	0
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
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2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	2,610	2,871	0	0
2016	2,690	2,959	2,610	2,871
2017	2,807	3,088	5,300	5,830

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2018	2,781	3,059	8,107	8,918
2019	27,106	29,817	10,888	11,977
2020	17,744	19,518	37,994	41,794
2021	21,818	24,000	55,738	61,312
2022	21,818	24,000	77,556	85,312
2023	21,818	24,000	99,374	109,312
2024	21,818	24,000	121,192	133,312
2025	21,818	24,000	143,010	157,312
2026	21,818	24,000	164,829	181,312
2027	21,818	24,000	186,647	205,312
2028	21,818	24,000	208,465	229,312
2029	21,818	24,000	230,283	253,312
2030	21,818	24,000	252,101	277,312
2031	21,818	24,000	273,920	301,312
2032	21,818	24,000	295,738	325,312
2033	21,818	24,000	317,556	349,312
2034	21,818	24,000	339,374	373,312
2035	21,818	24,000	361,192	397,312
2036	21,818	24,000	383,010	421,312
2037	21,818	24,000	404,829	445,312
2038	21,818	24,000	426,647	469,312
2039	21,818	24,000	448,465	493,312
2040	21,818	24,000	470,283	517,312
2041	21,818	24,000	492,101	541,312
2042	21,818	24,000	513,920	565,312
2043	21,818	24,000	535,738	589,312
2044	21,818	24,000	557,556	613,312
2045	21,818	24,000	579,374	637,312
2046	0	0	601,192	661,312
2047	0	0	601,192	661,312
2048	0	0	601,192	661,312
2049	0	0	601,192	661,312
2050	0	0	601,192	661,312
2051	0	0	601,192	661,312
2052	0	0	601,192	661,312
2053	0	0	601,192	661,312
2054	0	0	601,192	661,312
2055	0	0	601,192	661,312
2056	0	0	601,192	661,312
2057	0	0	601,192	661,312

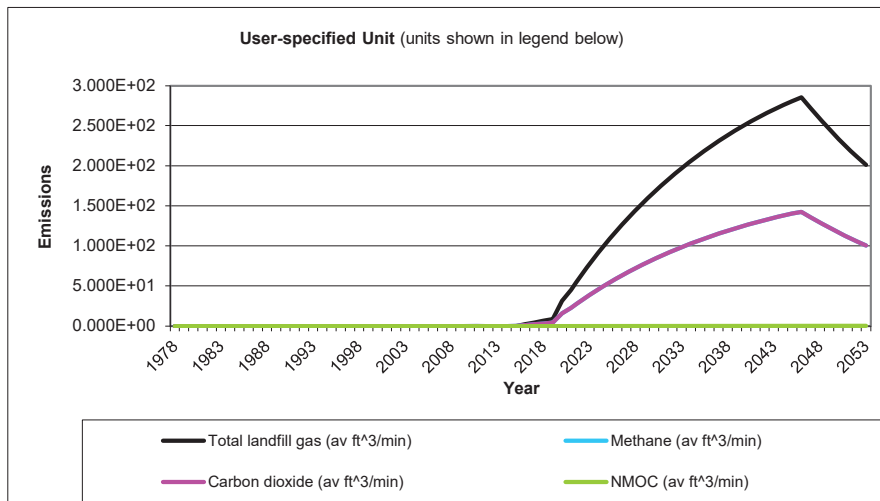
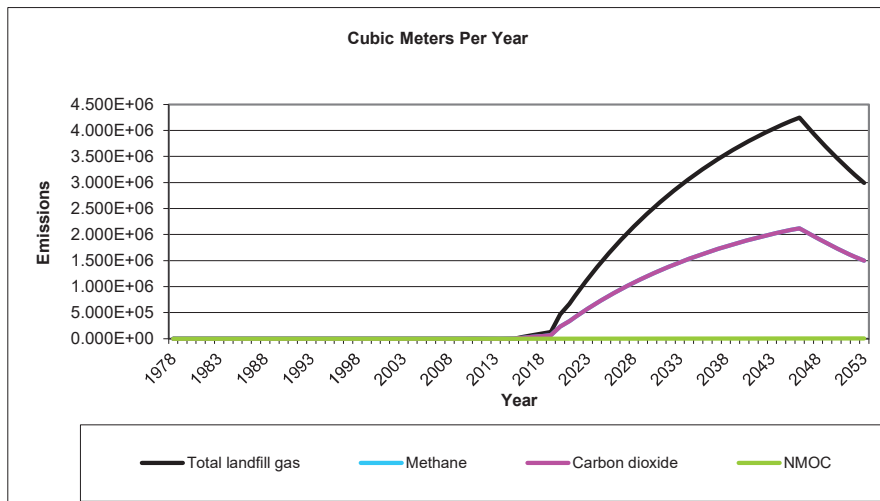
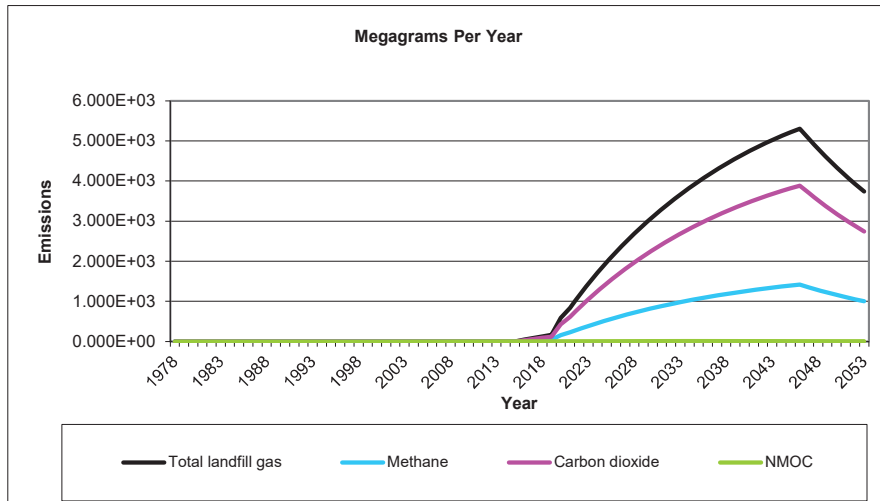
Pollutant Parameters

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1999	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2001	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2002	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2003	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2004	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2005	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2006	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2007	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2008	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2009	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2010	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2011	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2012	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2013	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2014	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2015	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2016	4.144E+01	3.318E+04	2.229E+00	1.107E+01	1.659E+04	1.115E+00
2017	8.212E+01	6.575E+04	4.418E+00	2.193E+01	3.288E+04	2.209E+00
2018	1.227E+02	9.823E+04	6.600E+00	3.277E+01	4.912E+04	3.300E+00
2019	1.608E+02	1.288E+05	8.654E+00	4.296E+01	6.440E+04	4.327E+00
2020	5.833E+02	4.671E+05	3.138E+01	1.558E+02	2.335E+05	1.569E+01
2021	8.365E+02	6.699E+05	4.501E+01	2.234E+02	3.349E+05	2.250E+01
2022	1.142E+03	9.145E+05	6.145E+01	3.051E+02	4.573E+05	3.072E+01
2023	1.433E+03	1.147E+06	7.709E+01	3.827E+02	5.737E+05	3.854E+01
2024	1.709E+03	1.369E+06	9.196E+01	4.566E+02	6.844E+05	4.598E+01
2025	1.972E+03	1.579E+06	1.061E+02	5.268E+02	7.897E+05	5.306E+01
2026	2.222E+03	1.780E+06	1.196E+02	5.936E+02	8.898E+05	5.979E+01
2027	2.460E+03	1.970E+06	1.324E+02	6.572E+02	9.851E+05	6.619E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	2.687E+03	2.151E+06	1.446E+02	7.177E+02	1.076E+06	7.228E+01
2029	2.902E+03	2.324E+06	1.561E+02	7.752E+02	1.162E+06	7.807E+01
2030	3.107E+03	2.488E+06	1.672E+02	8.299E+02	1.244E+06	8.358E+01
2031	3.302E+03	2.644E+06	1.776E+02	8.819E+02	1.322E+06	8.882E+01
2032	3.487E+03	2.792E+06	1.876E+02	9.314E+02	1.396E+06	9.381E+01
2033	3.663E+03	2.934E+06	1.971E+02	9.785E+02	1.467E+06	9.855E+01
2034	3.831E+03	3.068E+06	2.061E+02	1.023E+03	1.534E+06	1.031E+02
2035	3.991E+03	3.196E+06	2.147E+02	1.066E+03	1.598E+06	1.074E+02
2036	4.142E+03	3.317E+06	2.229E+02	1.106E+03	1.659E+06	1.114E+02
2037	4.287E+03	3.433E+06	2.306E+02	1.145E+03	1.716E+06	1.153E+02
2038	4.424E+03	3.543E+06	2.380E+02	1.182E+03	1.771E+06	1.190E+02
2039	4.555E+03	3.647E+06	2.451E+02	1.217E+03	1.824E+06	1.225E+02
2040	4.679E+03	3.747E+06	2.517E+02	1.250E+03	1.873E+06	1.259E+02
2041	4.797E+03	3.841E+06	2.581E+02	1.281E+03	1.921E+06	1.290E+02
2042	4.909E+03	3.931E+06	2.641E+02	1.311E+03	1.966E+06	1.321E+02
2043	5.016E+03	4.017E+06	2.699E+02	1.340E+03	2.008E+06	1.349E+02
2044	5.118E+03	4.098E+06	2.754E+02	1.367E+03	2.049E+06	1.377E+02
2045	5.215E+03	4.176E+06	2.806E+02	1.393E+03	2.088E+06	1.403E+02
2046	5.307E+03	4.250E+06	2.855E+02	1.418E+03	2.125E+06	1.428E+02
2047	5.048E+03	4.042E+06	2.716E+02	1.348E+03	2.021E+06	1.358E+02
2048	4.802E+03	3.845E+06	2.584E+02	1.283E+03	1.923E+06	1.292E+02
2049	4.568E+03	3.658E+06	2.458E+02	1.220E+03	1.829E+06	1.229E+02
2050	4.345E+03	3.479E+06	2.338E+02	1.161E+03	1.740E+06	1.169E+02
2051	4.133E+03	3.310E+06	2.224E+02	1.104E+03	1.655E+06	1.112E+02
2052	3.931E+03	3.148E+06	2.115E+02	1.050E+03	1.574E+06	1.058E+02
2053	3.740E+03	2.995E+06	2.012E+02	9.989E+02	1.497E+06	1.006E+02
2054	3.557E+03	2.849E+06	1.914E+02	9.502E+02	1.424E+06	9.570E+01
2055	3.384E+03	2.710E+06	1.821E+02	9.039E+02	1.355E+06	9.103E+01
2056	3.219E+03	2.577E+06	1.732E+02	8.598E+02	1.289E+06	8.659E+01
2057	3.062E+03	2.452E+06	1.647E+02	8.178E+02	1.226E+06	8.237E+01
2058	2.912E+03	2.332E+06	1.567E+02	7.780E+02	1.166E+06	7.835E+01
2059	2.770E+03	2.218E+06	1.491E+02	7.400E+02	1.109E+06	7.453E+01
2060	2.635E+03	2.110E+06	1.418E+02	7.039E+02	1.055E+06	7.089E+01
2061	2.507E+03	2.007E+06	1.349E+02	6.696E+02	1.004E+06	6.744E+01
2062	2.385E+03	1.909E+06	1.283E+02	6.369E+02	9.547E+05	6.415E+01
2063	2.268E+03	1.816E+06	1.220E+02	6.059E+02	9.082E+05	6.102E+01
2064	2.158E+03	1.728E+06	1.161E+02	5.763E+02	8.639E+05	5.804E+01
2065	2.052E+03	1.643E+06	1.104E+02	5.482E+02	8.217E+05	5.521E+01
2066	1.952E+03	1.563E+06	1.050E+02	5.215E+02	7.817E+05	5.252E+01
2067	1.857E+03	1.487E+06	9.992E+01	4.960E+02	7.435E+05	4.996E+01
2068	1.767E+03	1.415E+06	9.504E+01	4.719E+02	7.073E+05	4.752E+01
2069	1.680E+03	1.346E+06	9.041E+01	4.488E+02	6.728E+05	4.520E+01
2070	1.598E+03	1.280E+06	8.600E+01	4.270E+02	6.400E+05	4.300E+01
2071	1.520E+03	1.218E+06	8.180E+01	4.061E+02	6.088E+05	4.090E+01
2072	1.446E+03	1.158E+06	7.781E+01	3.863E+02	5.791E+05	3.891E+01
2073	1.376E+03	1.102E+06	7.402E+01	3.675E+02	5.508E+05	3.701E+01
2074	1.309E+03	1.048E+06	7.041E+01	3.496E+02	5.240E+05	3.520E+01
2075	1.245E+03	9.968E+05	6.698E+01	3.325E+02	4.984E+05	3.349E+01
2076	1.184E+03	9.482E+05	6.371E+01	3.163E+02	4.741E+05	3.185E+01
2077	1.126E+03	9.019E+05	6.060E+01	3.009E+02	4.510E+05	3.030E+01
2078	1.071E+03	8.580E+05	5.765E+01	2.862E+02	4.290E+05	2.882E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	1.019E+03	8.161E+05	5.483E+01	2.722E+02	4.081E+05	2.742E+01
2080	9.695E+02	7.763E+05	5.216E+01	2.590E+02	3.882E+05	2.608E+01
2081	9.222E+02	7.385E+05	4.962E+01	2.463E+02	3.692E+05	2.481E+01
2082	8.772E+02	7.024E+05	4.720E+01	2.343E+02	3.512E+05	2.360E+01
2083	8.344E+02	6.682E+05	4.489E+01	2.229E+02	3.341E+05	2.245E+01
2084	7.937E+02	6.356E+05	4.271E+01	2.120E+02	3.178E+05	2.135E+01
2085	7.550E+02	6.046E+05	4.062E+01	2.017E+02	3.023E+05	2.031E+01
2086	7.182E+02	5.751E+05	3.864E+01	1.918E+02	2.876E+05	1.932E+01
2087	6.832E+02	5.471E+05	3.676E+01	1.825E+02	2.735E+05	1.838E+01
2088	6.499E+02	5.204E+05	3.496E+01	1.736E+02	2.602E+05	1.748E+01
2089	6.182E+02	4.950E+05	3.326E+01	1.651E+02	2.475E+05	1.663E+01
2090	5.880E+02	4.709E+05	3.164E+01	1.571E+02	2.354E+05	1.582E+01
2091	5.593E+02	4.479E+05	3.009E+01	1.494E+02	2.239E+05	1.505E+01
2092	5.321E+02	4.261E+05	2.863E+01	1.421E+02	2.130E+05	1.431E+01
2093	5.061E+02	4.053E+05	2.723E+01	1.352E+02	2.026E+05	1.362E+01
2094	4.814E+02	3.855E+05	2.590E+01	1.286E+02	1.928E+05	1.295E+01
2095	4.580E+02	3.667E+05	2.464E+01	1.223E+02	1.834E+05	1.232E+01
2096	4.356E+02	3.488E+05	2.344E+01	1.164E+02	1.744E+05	1.172E+01
2097	4.144E+02	3.318E+05	2.229E+01	1.107E+02	1.659E+05	1.115E+01
2098	3.942E+02	3.156E+05	2.121E+01	1.053E+02	1.578E+05	1.060E+01
2099	3.749E+02	3.002E+05	2.017E+01	1.002E+02	1.501E+05	1.009E+01
2100	3.567E+02	2.856E+05	1.919E+01	9.527E+01	1.428E+05	9.594E+00
2101	3.393E+02	2.717E+05	1.825E+01	9.062E+01	1.358E+05	9.126E+00
2102	3.227E+02	2.584E+05	1.736E+01	8.620E+01	1.292E+05	8.681E+00
2103	3.070E+02	2.458E+05	1.652E+01	8.200E+01	1.229E+05	8.258E+00
2104	2.920E+02	2.338E+05	1.571E+01	7.800E+01	1.169E+05	7.855E+00
2105	2.778E+02	2.224E+05	1.494E+01	7.419E+01	1.112E+05	7.472E+00
2106	2.642E+02	2.116E+05	1.422E+01	7.057E+01	1.058E+05	7.108E+00
2107	2.513E+02	2.013E+05	1.352E+01	6.713E+01	1.006E+05	6.761E+00
2108	2.391E+02	1.914E+05	1.286E+01	6.386E+01	9.572E+04	6.431E+00
2109	2.274E+02	1.821E+05	1.224E+01	6.074E+01	9.105E+04	6.118E+00
2110	2.163E+02	1.732E+05	1.164E+01	5.778E+01	8.661E+04	5.819E+00
2111	2.058E+02	1.648E+05	1.107E+01	5.496E+01	8.239E+04	5.535E+00
2112	1.957E+02	1.567E+05	1.053E+01	5.228E+01	7.837E+04	5.266E+00
2113	1.862E+02	1.491E+05	1.002E+01	4.973E+01	7.455E+04	5.009E+00
2114	1.771E+02	1.418E+05	9.529E+00	4.731E+01	7.091E+04	4.764E+00
2115	1.685E+02	1.349E+05	9.064E+00	4.500E+01	6.745E+04	4.532E+00
2116	1.603E+02	1.283E+05	8.622E+00	4.281E+01	6.416E+04	4.311E+00
2117	1.524E+02	1.221E+05	8.202E+00	4.072E+01	6.103E+04	4.101E+00
2118	1.450E+02	1.161E+05	7.802E+00	3.873E+01	5.806E+04	3.901E+00

Results (Continued)

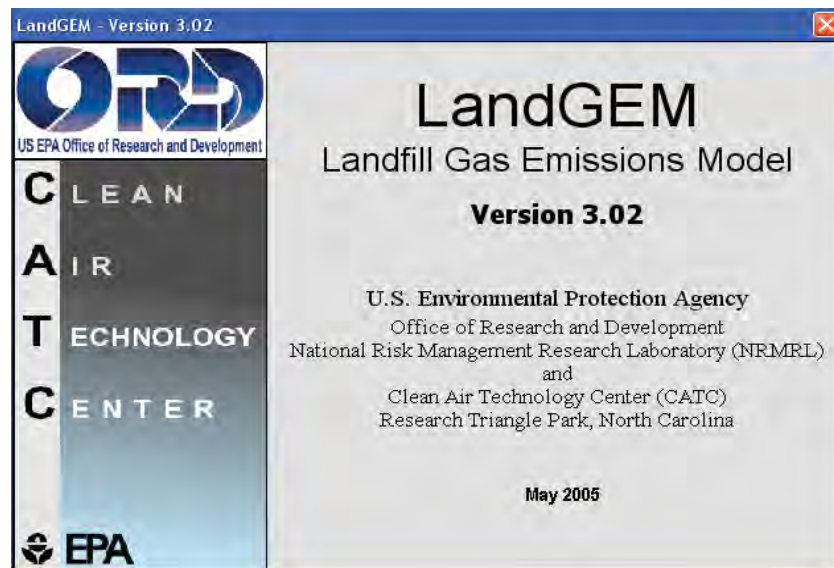
Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1999	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2001	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2002	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2003	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2004	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2005	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2006	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2007	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2008	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2009	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2010	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2011	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2012	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2013	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2014	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2015	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
2016	3.037E+01	1.659E+04	1.115E+00	7.136E-02	1.991E+01	1.338E-03
2017	6.018E+01	3.288E+04	2.209E+00	1.414E-01	3.945E+01	2.651E-03
2018	8.991E+01	4.912E+04	3.300E+00	2.113E-01	5.894E+01	3.960E-03
2019	1.179E+02	6.440E+04	4.327E+00	2.770E-01	7.728E+01	5.192E-03
2020	4.275E+02	2.335E+05	1.569E+01	1.005E+00	2.803E+02	1.883E-02
2021	6.131E+02	3.349E+05	2.250E+01	1.441E+00	4.019E+02	2.700E-02
2022	8.370E+02	4.573E+05	3.072E+01	1.967E+00	5.487E+02	3.687E-02
2023	1.050E+03	5.737E+05	3.854E+01	2.467E+00	6.884E+02	4.625E-02
2024	1.253E+03	6.844E+05	4.598E+01	2.944E+00	8.212E+02	5.518E-02
2025	1.445E+03	7.897E+05	5.306E+01	3.397E+00	9.476E+02	6.367E-02
2026	1.629E+03	8.898E+05	5.979E+01	3.827E+00	1.068E+03	7.174E-02
2027	1.803E+03	9.851E+05	6.619E+01	4.237E+00	1.182E+03	7.943E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	1.969E+03	1.076E+06	7.228E+01	4.627E+00	1.291E+03	8.673E-02
2029	2.127E+03	1.162E+06	7.807E+01	4.998E+00	1.394E+03	9.369E-02
2030	2.277E+03	1.244E+06	8.358E+01	5.351E+00	1.493E+03	1.003E-01
2031	2.420E+03	1.322E+06	8.882E+01	5.686E+00	1.586E+03	1.066E-01
2032	2.556E+03	1.396E+06	9.381E+01	6.005E+00	1.675E+03	1.126E-01
2033	2.685E+03	1.467E+06	9.855E+01	6.309E+00	1.760E+03	1.183E-01
2034	2.808E+03	1.534E+06	1.031E+02	6.598E+00	1.841E+03	1.237E-01
2035	2.925E+03	1.598E+06	1.074E+02	6.873E+00	1.917E+03	1.288E-01
2036	3.036E+03	1.659E+06	1.114E+02	7.134E+00	1.990E+03	1.337E-01
2037	3.142E+03	1.716E+06	1.153E+02	7.382E+00	2.060E+03	1.384E-01
2038	3.242E+03	1.771E+06	1.190E+02	7.619E+00	2.126E+03	1.428E-01
2039	3.338E+03	1.824E+06	1.225E+02	7.844E+00	2.188E+03	1.470E-01
2040	3.429E+03	1.873E+06	1.259E+02	8.058E+00	2.248E+03	1.510E-01
2041	3.516E+03	1.921E+06	1.290E+02	8.261E+00	2.305E+03	1.549E-01
2042	3.598E+03	1.966E+06	1.321E+02	8.455E+00	2.359E+03	1.585E-01
2043	3.676E+03	2.008E+06	1.349E+02	8.639E+00	2.410E+03	1.619E-01
2044	3.751E+03	2.049E+06	1.377E+02	8.814E+00	2.459E+03	1.652E-01
2045	3.822E+03	2.088E+06	1.403E+02	8.981E+00	2.505E+03	1.683E-01
2046	3.889E+03	2.125E+06	1.428E+02	9.139E+00	2.550E+03	1.713E-01
2047	3.700E+03	2.021E+06	1.358E+02	8.694E+00	2.425E+03	1.630E-01
2048	3.519E+03	1.923E+06	1.292E+02	8.270E+00	2.307E+03	1.550E-01
2049	3.348E+03	1.829E+06	1.229E+02	7.866E+00	2.195E+03	1.475E-01
2050	3.184E+03	1.740E+06	1.169E+02	7.483E+00	2.088E+03	1.403E-01
2051	3.029E+03	1.655E+06	1.112E+02	7.118E+00	1.986E+03	1.334E-01
2052	2.881E+03	1.574E+06	1.058E+02	6.771E+00	1.889E+03	1.269E-01
2053	2.741E+03	1.497E+06	1.006E+02	6.440E+00	1.797E+03	1.207E-01
2054	2.607E+03	1.424E+06	9.570E+01	6.126E+00	1.709E+03	1.148E-01
2055	2.480E+03	1.355E+06	9.103E+01	5.827E+00	1.626E+03	1.092E-01
2056	2.359E+03	1.289E+06	8.659E+01	5.543E+00	1.546E+03	1.039E-01
2057	2.244E+03	1.226E+06	8.237E+01	5.273E+00	1.471E+03	9.884E-02
2058	2.135E+03	1.166E+06	7.835E+01	5.016E+00	1.399E+03	9.402E-02
2059	2.030E+03	1.109E+06	7.453E+01	4.771E+00	1.331E+03	8.943E-02
2060	1.931E+03	1.055E+06	7.089E+01	4.538E+00	1.266E+03	8.507E-02
2061	1.837E+03	1.004E+06	6.744E+01	4.317E+00	1.204E+03	8.092E-02
2062	1.748E+03	9.547E+05	6.415E+01	4.107E+00	1.146E+03	7.698E-02
2063	1.662E+03	9.082E+05	6.102E+01	3.906E+00	1.090E+03	7.322E-02
2064	1.581E+03	8.639E+05	5.804E+01	3.716E+00	1.037E+03	6.965E-02
2065	1.504E+03	8.217E+05	5.521E+01	3.535E+00	9.861E+02	6.625E-02
2066	1.431E+03	7.817E+05	5.252E+01	3.362E+00	9.380E+02	6.302E-02
2067	1.361E+03	7.435E+05	4.996E+01	3.198E+00	8.922E+02	5.995E-02
2068	1.295E+03	7.073E+05	4.752E+01	3.042E+00	8.487E+02	5.703E-02
2069	1.232E+03	6.728E+05	4.520E+01	2.894E+00	8.073E+02	5.424E-02
2070	1.171E+03	6.400E+05	4.300E+01	2.753E+00	7.680E+02	5.160E-02
2071	1.114E+03	6.088E+05	4.090E+01	2.618E+00	7.305E+02	4.908E-02
2072	1.060E+03	5.791E+05	3.891E+01	2.491E+00	6.949E+02	4.669E-02
2073	1.008E+03	5.508E+05	3.701E+01	2.369E+00	6.610E+02	4.441E-02
2074	9.591E+02	5.240E+05	3.520E+01	2.254E+00	6.287E+02	4.225E-02
2075	9.123E+02	4.984E+05	3.349E+01	2.144E+00	5.981E+02	4.019E-02
2076	8.678E+02	4.741E+05	3.185E+01	2.039E+00	5.689E+02	3.823E-02
2077	8.255E+02	4.510E+05	3.030E+01	1.940E+00	5.412E+02	3.636E-02
2078	7.852E+02	4.290E+05	2.882E+01	1.845E+00	5.148E+02	3.459E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	7.470E+02	4.081E+05	2.742E+01	1.755E+00	4.897E+02	3.290E-02
2080	7.105E+02	3.882E+05	2.608E+01	1.670E+00	4.658E+02	3.130E-02
2081	6.759E+02	3.692E+05	2.481E+01	1.588E+00	4.431E+02	2.977E-02
2082	6.429E+02	3.512E+05	2.360E+01	1.511E+00	4.215E+02	2.832E-02
2083	6.116E+02	3.341E+05	2.245E+01	1.437E+00	4.009E+02	2.694E-02
2084	5.817E+02	3.178E+05	2.135E+01	1.367E+00	3.814E+02	2.562E-02
2085	5.534E+02	3.023E+05	2.031E+01	1.300E+00	3.628E+02	2.437E-02
2086	5.264E+02	2.876E+05	1.932E+01	1.237E+00	3.451E+02	2.318E-02
2087	5.007E+02	2.735E+05	1.838E+01	1.177E+00	3.282E+02	2.205E-02
2088	4.763E+02	2.602E+05	1.748E+01	1.119E+00	3.122E+02	2.098E-02
2089	4.530E+02	2.475E+05	1.663E+01	1.065E+00	2.970E+02	1.996E-02
2090	4.310E+02	2.354E+05	1.582E+01	1.013E+00	2.825E+02	1.898E-02
2091	4.099E+02	2.239E+05	1.505E+01	9.633E-01	2.687E+02	1.806E-02
2092	3.899E+02	2.130E+05	1.431E+01	9.163E-01	2.556E+02	1.718E-02
2093	3.709E+02	2.026E+05	1.362E+01	8.716E-01	2.432E+02	1.634E-02
2094	3.528E+02	1.928E+05	1.295E+01	8.291E-01	2.313E+02	1.554E-02
2095	3.356E+02	1.834E+05	1.232E+01	7.887E-01	2.200E+02	1.478E-02
2096	3.193E+02	1.744E+05	1.172E+01	7.502E-01	2.093E+02	1.406E-02
2097	3.037E+02	1.659E+05	1.115E+01	7.136E-01	1.991E+02	1.338E-02
2098	2.889E+02	1.578E+05	1.060E+01	6.788E-01	1.894E+02	1.272E-02
2099	2.748E+02	1.501E+05	1.009E+01	6.457E-01	1.801E+02	1.210E-02
2100	2.614E+02	1.428E+05	9.594E+00	6.142E-01	1.714E+02	1.151E-02
2101	2.486E+02	1.358E+05	9.126E+00	5.843E-01	1.630E+02	1.095E-02
2102	2.365E+02	1.292E+05	8.681E+00	5.558E-01	1.550E+02	1.042E-02
2103	2.250E+02	1.229E+05	8.258E+00	5.287E-01	1.475E+02	9.910E-03
2104	2.140E+02	1.169E+05	7.855E+00	5.029E-01	1.403E+02	9.426E-03
2105	2.036E+02	1.112E+05	7.472E+00	4.784E-01	1.335E+02	8.967E-03
2106	1.936E+02	1.058E+05	7.108E+00	4.550E-01	1.269E+02	8.529E-03
2107	1.842E+02	1.006E+05	6.761E+00	4.328E-01	1.208E+02	8.113E-03
2108	1.752E+02	9.572E+04	6.431E+00	4.117E-01	1.149E+02	7.718E-03
2109	1.667E+02	9.105E+04	6.118E+00	3.916E-01	1.093E+02	7.341E-03
2110	1.585E+02	8.661E+04	5.819E+00	3.725E-01	1.039E+02	6.983E-03
2111	1.508E+02	8.239E+04	5.535E+00	3.544E-01	9.886E+01	6.643E-03
2112	1.435E+02	7.837E+04	5.266E+00	3.371E-01	9.404E+01	6.319E-03
2113	1.365E+02	7.455E+04	5.009E+00	3.206E-01	8.945E+01	6.010E-03
2114	1.298E+02	7.091E+04	4.764E+00	3.050E-01	8.509E+01	5.717E-03
2115	1.235E+02	6.745E+04	4.532E+00	2.901E-01	8.094E+01	5.438E-03
2116	1.174E+02	6.416E+04	4.311E+00	2.760E-01	7.699E+01	5.173E-03
2117	1.117E+02	6.103E+04	4.101E+00	2.625E-01	7.324E+01	4.921E-03
2118	1.063E+02	5.806E+04	3.901E+00	2.497E-01	6.967E+01	4.681E-03



Summary Report

Landfill Name or Identifier: C&D CB Landfill Model

Date: Monday, May 10, 2021

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year **1978**
 Landfill Closure Year (with 80-year limit) **2045**
 Actual Closure Year (without limit) **2045**
 Have Model Calculate Closure Year? **No**
 Waste Design Capacity *megagrams*

MODEL PARAMETERS

Methane Generation Rate, k **0.030** *year⁻¹*
 Potential Methane Generation Capacity, L₀ **20** *m³/Mg*
 NMOC Concentration **600** *ppmv as hexane*
 Methane Content **50** *% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1: **Total landfill gas**
 Gas / Pollutant #2: **Methane**
 Gas / Pollutant #3: **Carbon dioxide**
 Gas / Pollutant #4: **NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1978	0	0	0	0
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	42,445	46,690	0	0
1998	45,738	50,312	42,445	46,690
1999	49,698	54,668	88,184	97,002
2000	47,705	52,476	137,882	151,670
2001	46,303	50,933	185,587	204,146
2002	45,715	50,287	231,890	255,079
2003	34,835	38,318	277,605	305,366
2004	15,247	16,772	312,440	343,684
2005	23,248	25,573	327,687	360,456
2006	29,273	32,200	350,936	386,029
2007	18,242	20,067	380,208	418,229
2008	10,279	11,307	398,451	438,296
2009	8,485	9,334	408,730	449,603
2010	6,258	6,884	417,216	458,937
2011	7,355	8,091	423,474	465,821
2012	6,330	6,963	430,829	473,912
2013	9,488	10,437	437,159	480,875
2014	21,376	23,514	446,647	491,312
2015	18,200	20,020	468,023	514,826
2016	12,848	14,133	486,223	534,845
2017	18,880	20,768	499,071	548,978

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2018	19,300	21,230	517,952	569,747
2019	26,133	28,747	537,251	590,977
2020	24,747	27,222	563,385	619,723
2021	21,818	24,000	588,132	646,945
2022	21,818	24,000	609,950	670,945
2023	21,818	24,000	631,769	694,945
2024	21,818	24,000	653,587	718,945
2025	21,818	24,000	675,405	742,945
2026	21,818	24,000	697,223	766,945
2027	21,818	24,000	719,041	790,945
2028	21,818	24,000	740,859	814,945
2029	21,818	24,000	762,678	838,945
2030	21,818	24,000	784,496	862,945
2031	21,818	24,000	806,314	886,945
2032	21,818	24,000	828,132	910,945
2033	21,818	24,000	849,950	934,945
2034	21,818	24,000	871,769	958,945
2035	21,818	24,000	893,587	982,945
2036	21,818	24,000	915,405	1,006,945
2037	21,818	24,000	937,223	1,030,945
2038	21,818	24,000	959,041	1,054,945
2039	21,818	24,000	980,859	1,078,945
2040	21,818	24,000	1,002,678	1,102,945
2041	21,818	24,000	1,024,496	1,126,945
2042	21,818	24,000	1,046,314	1,150,945
2043	21,818	24,000	1,068,132	1,174,945
2044	21,818	24,000	1,089,950	1,198,945
2045	21,818	24,000	1,111,769	1,222,945
2046	0	0	1,133,587	1,246,945
2047	0	0	1,133,587	1,246,945
2048	0	0	1,133,587	1,246,945
2049	0	0	1,133,587	1,246,945
2050	0	0	1,133,587	1,246,945
2051	0	0	1,133,587	1,246,945
2052	0	0	1,133,587	1,246,945
2053	0	0	1,133,587	1,246,945
2054	0	0	1,133,587	1,246,945
2055	0	0	1,133,587	1,246,945
2056	0	0	1,133,587	1,246,945
2057	0	0	1,133,587	1,246,945

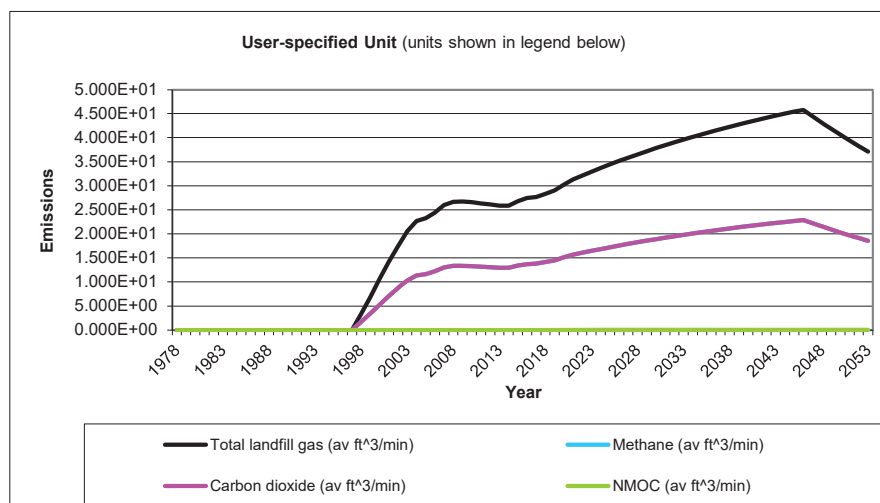
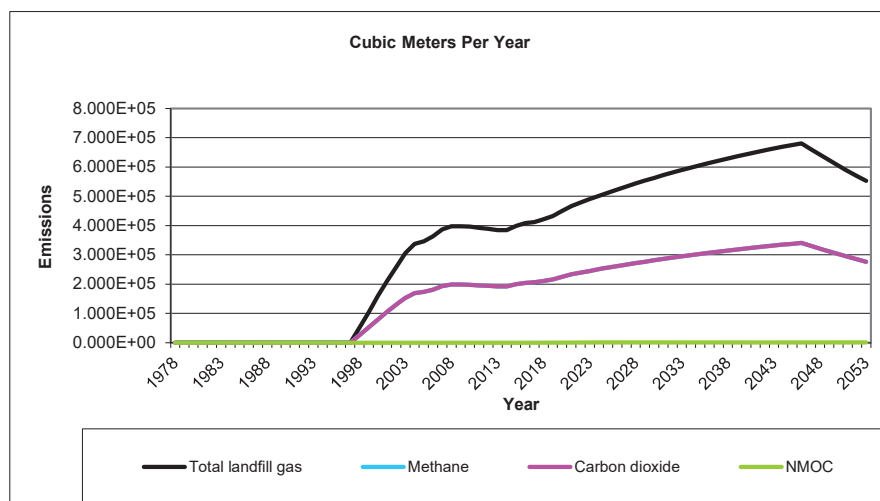
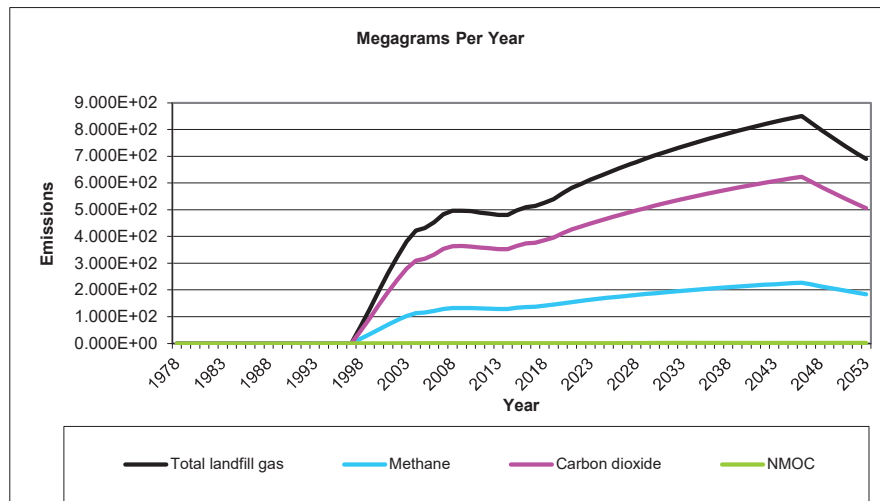
Pollutant Parameters

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2- Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	6.276E+01	5.025E+04	3.377E+00	1.676E+01	2.513E+04	1.688E+00
1999	1.285E+02	1.029E+05	6.915E+00	3.433E+01	5.146E+04	3.458E+00
2000	1.982E+02	1.587E+05	1.066E+01	5.294E+01	7.936E+04	5.332E+00
2001	2.629E+02	2.105E+05	1.414E+01	7.022E+01	1.053E+05	7.072E+00
2002	3.236E+02	2.591E+05	1.741E+01	8.643E+01	1.296E+05	8.705E+00
2003	3.816E+02	3.056E+05	2.053E+01	1.019E+02	1.528E+05	1.027E+01
2004	4.218E+02	3.378E+05	2.270E+01	1.127E+02	1.689E+05	1.135E+01
2005	4.319E+02	3.459E+05	2.324E+01	1.154E+02	1.729E+05	1.162E+01
2006	4.535E+02	3.632E+05	2.440E+01	1.211E+02	1.816E+05	1.220E+01
2007	4.834E+02	3.871E+05	2.601E+01	1.291E+02	1.935E+05	1.300E+01
2008	4.961E+02	3.972E+05	2.669E+01	1.325E+02	1.986E+05	1.335E+01
2009	4.966E+02	3.977E+05	2.672E+01	1.327E+02	1.988E+05	1.336E+01
2010	4.945E+02	3.960E+05	2.660E+01	1.321E+02	1.980E+05	1.330E+01
2011	4.891E+02	3.917E+05	2.632E+01	1.307E+02	1.958E+05	1.316E+01
2012	4.855E+02	3.888E+05	2.612E+01	1.297E+02	1.944E+05	1.306E+01
2013	4.806E+02	3.848E+05	2.586E+01	1.284E+02	1.924E+05	1.293E+01
2014	4.804E+02	3.847E+05	2.585E+01	1.283E+02	1.923E+05	1.292E+01
2015	4.978E+02	3.986E+05	2.678E+01	1.330E+02	1.993E+05	1.339E+01
2016	5.100E+02	4.084E+05	2.744E+01	1.362E+02	2.042E+05	1.372E+01
2017	5.139E+02	4.115E+05	2.765E+01	1.373E+02	2.058E+05	1.382E+01
2018	5.266E+02	4.217E+05	2.833E+01	1.407E+02	2.109E+05	1.417E+01
2019	5.396E+02	4.321E+05	2.903E+01	1.441E+02	2.160E+05	1.452E+01
2020	5.623E+02	4.503E+05	3.025E+01	1.502E+02	2.251E+05	1.513E+01
2021	5.823E+02	4.663E+05	3.133E+01	1.555E+02	2.331E+05	1.566E+01
2022	5.973E+02	4.783E+05	3.214E+01	1.596E+02	2.392E+05	1.607E+01
2023	6.119E+02	4.900E+05	3.292E+01	1.635E+02	2.450E+05	1.646E+01
2024	6.261E+02	5.014E+05	3.369E+01	1.672E+02	2.507E+05	1.684E+01
2025	6.399E+02	5.124E+05	3.443E+01	1.709E+02	2.562E+05	1.721E+01
2026	6.532E+02	5.231E+05	3.514E+01	1.745E+02	2.615E+05	1.757E+01
2027	6.662E+02	5.334E+05	3.584E+01	1.779E+02	2.667E+05	1.792E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	6.787E+02	5.435E+05	3.652E+01	1.813E+02	2.717E+05	1.826E+01
2029	6.909E+02	5.533E+05	3.717E+01	1.846E+02	2.766E+05	1.859E+01
2030	7.028E+02	5.627E+05	3.781E+01	1.877E+02	2.814E+05	1.891E+01
2031	7.143E+02	5.719E+05	3.843E+01	1.908E+02	2.860E+05	1.921E+01
2032	7.254E+02	5.809E+05	3.903E+01	1.938E+02	2.904E+05	1.951E+01
2033	7.362E+02	5.895E+05	3.961E+01	1.967E+02	2.948E+05	1.981E+01
2034	7.467E+02	5.979E+05	4.018E+01	1.995E+02	2.990E+05	2.009E+01
2035	7.569E+02	6.061E+05	4.072E+01	2.022E+02	3.031E+05	2.036E+01
2036	7.668E+02	6.140E+05	4.126E+01	2.048E+02	3.070E+05	2.063E+01
2037	7.764E+02	6.217E+05	4.177E+01	2.074E+02	3.109E+05	2.089E+01
2038	7.857E+02	6.292E+05	4.227E+01	2.099E+02	3.146E+05	2.114E+01
2039	7.948E+02	6.364E+05	4.276E+01	2.123E+02	3.182E+05	2.138E+01
2040	8.035E+02	6.434E+05	4.323E+01	2.146E+02	3.217E+05	2.162E+01
2041	8.120E+02	6.502E+05	4.369E+01	2.169E+02	3.251E+05	2.184E+01
2042	8.203E+02	6.569E+05	4.413E+01	2.191E+02	3.284E+05	2.207E+01
2043	8.283E+02	6.633E+05	4.457E+01	2.213E+02	3.316E+05	2.228E+01
2044	8.361E+02	6.695E+05	4.498E+01	2.233E+02	3.348E+05	2.249E+01
2045	8.436E+02	6.755E+05	4.539E+01	2.253E+02	3.378E+05	2.270E+01
2046	8.510E+02	6.814E+05	4.578E+01	2.273E+02	3.407E+05	2.289E+01
2047	8.588E+02	6.873E+05	4.613E+01	2.296E+02	3.436E+05	2.307E+01
2048	8.664E+02	6.930E+05	4.647E+01	2.319E+02	3.465E+05	2.325E+01
2049	8.739E+02	6.986E+05	4.680E+01	2.342E+02	3.494E+05	2.343E+01
2050	8.813E+02	7.041E+05	4.712E+01	2.365E+02	3.523E+05	2.361E+01
2051	8.886E+02	7.095E+05	4.744E+01	2.388E+02	3.552E+05	2.379E+01
2052	8.958E+02	7.148E+05	4.775E+01	2.411E+02	3.581E+05	2.397E+01
2053	9.029E+02	7.200E+05	4.806E+01	2.434E+02	3.610E+05	2.415E+01
2054	9.100E+02	7.252E+05	4.837E+01	2.457E+02	3.639E+05	2.433E+01
2055	9.170E+02	7.304E+05	4.868E+01	2.480E+02	3.668E+05	2.451E+01
2056	9.240E+02	7.356E+05	4.899E+01	2.503E+02	3.697E+05	2.469E+01
2057	9.310E+02	7.408E+05	4.930E+01	2.526E+02	3.726E+05	2.487E+01
2058	9.380E+02	7.460E+05	4.961E+01	2.549E+02	3.755E+05	2.505E+01
2059	9.450E+02	7.512E+05	4.992E+01	2.572E+02	3.784E+05	2.523E+01
2060	9.520E+02	7.564E+05	5.023E+01	2.595E+02	3.813E+05	2.541E+01
2061	9.590E+02	7.616E+05	5.054E+01	2.618E+02	3.842E+05	2.559E+01
2062	9.660E+02	7.668E+05	5.085E+01	2.641E+02	3.871E+05	2.577E+01
2063	9.730E+02	7.720E+05	5.116E+01	2.664E+02	3.900E+05	2.595E+01
2064	9.800E+02	7.772E+05	5.147E+01	2.687E+02	3.929E+05	2.613E+01
2065	9.870E+02	7.824E+05	5.178E+01	2.710E+02	3.958E+05	2.631E+01
2066	9.940E+02	7.876E+05	5.209E+01	2.733E+02	3.987E+05	2.649E+01
2067	1.001E+03	7.928E+05	5.240E+01	2.756E+02	4.016E+05	2.667E+01
2068	1.008E+03	7.980E+05	5.271E+01	2.779E+02	4.045E+05	2.685E+01
2069	1.015E+03	8.032E+05	5.302E+01	2.802E+02	4.074E+05	2.703E+01
2070	1.022E+03	8.084E+05	5.333E+01	2.825E+02	4.103E+05	2.721E+01
2071	1.029E+03	8.136E+05	5.364E+01	2.848E+02	4.132E+05	2.739E+01
2072	1.036E+03	8.188E+05	5.395E+01	2.871E+02	4.161E+05	2.757E+01
2073	1.043E+03	8.240E+05	5.426E+01	2.894E+02	4.190E+05	2.775E+01
2074	1.050E+03	8.292E+05	5.457E+01	2.917E+02	4.219E+05	2.793E+01
2075	1.057E+03	8.344E+05	5.488E+01	2.940E+02	4.248E+05	2.811E+01
2076	1.064E+03	8.396E+05	5.519E+01	2.963E+02	4.277E+05	2.829E+01
2077	1.071E+03	8.448E+05	5.550E+01	2.986E+02	4.306E+05	2.847E+01
2078	1.078E+03	8.500E+05	5.581E+01	3.009E+02	4.335E+05	2.865E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	3.162E+02	2.532E+05	1.701E+01	8.446E+01	1.266E+05	8.506E+00
2080	3.069E+02	2.457E+05	1.651E+01	8.196E+01	1.229E+05	8.255E+00
2081	2.978E+02	2.385E+05	1.602E+01	7.954E+01	1.192E+05	8.011E+00
2082	2.890E+02	2.314E+05	1.555E+01	7.719E+01	1.157E+05	7.774E+00
2083	2.804E+02	2.246E+05	1.509E+01	7.491E+01	1.123E+05	7.544E+00
2084	2.722E+02	2.179E+05	1.464E+01	7.270E+01	1.090E+05	7.321E+00
2085	2.641E+02	2.115E+05	1.421E+01	7.055E+01	1.057E+05	7.105E+00
2086	2.563E+02	2.052E+05	1.379E+01	6.846E+01	1.026E+05	6.895E+00
2087	2.487E+02	1.992E+05	1.338E+01	6.644E+01	9.959E+04	6.691E+00
2088	2.414E+02	1.933E+05	1.299E+01	6.448E+01	9.664E+04	6.493E+00
2089	2.342E+02	1.876E+05	1.260E+01	6.257E+01	9.379E+04	6.302E+00
2090	2.273E+02	1.820E+05	1.223E+01	6.072E+01	9.102E+04	6.115E+00
2091	2.206E+02	1.767E+05	1.187E+01	5.893E+01	8.833E+04	5.935E+00
2092	2.141E+02	1.714E+05	1.152E+01	5.718E+01	8.571E+04	5.759E+00
2093	2.078E+02	1.664E+05	1.118E+01	5.549E+01	8.318E+04	5.589E+00
2094	2.016E+02	1.614E+05	1.085E+01	5.385E+01	8.072E+04	5.424E+00
2095	1.957E+02	1.567E+05	1.053E+01	5.226E+01	7.834E+04	5.263E+00
2096	1.899E+02	1.520E+05	1.022E+01	5.072E+01	7.602E+04	5.108E+00
2097	1.843E+02	1.476E+05	9.914E+00	4.922E+01	7.378E+04	4.957E+00
2098	1.788E+02	1.432E+05	9.621E+00	4.776E+01	7.160E+04	4.810E+00
2099	1.735E+02	1.390E+05	9.337E+00	4.635E+01	6.948E+04	4.668E+00
2100	1.684E+02	1.349E+05	9.061E+00	4.498E+01	6.743E+04	4.530E+00
2101	1.634E+02	1.309E+05	8.793E+00	4.365E+01	6.543E+04	4.396E+00
2102	1.586E+02	1.270E+05	8.533E+00	4.236E+01	6.350E+04	4.266E+00
2103	1.539E+02	1.232E+05	8.281E+00	4.111E+01	6.162E+04	4.140E+00
2104	1.494E+02	1.196E+05	8.036E+00	3.990E+01	5.980E+04	4.018E+00
2105	1.449E+02	1.161E+05	7.799E+00	3.872E+01	5.803E+04	3.899E+00
2106	1.407E+02	1.126E+05	7.568E+00	3.757E+01	5.632E+04	3.784E+00
2107	1.365E+02	1.093E+05	7.344E+00	3.646E+01	5.465E+04	3.672E+00
2108	1.325E+02	1.061E+05	7.127E+00	3.538E+01	5.304E+04	3.564E+00
2109	1.286E+02	1.029E+05	6.917E+00	3.434E+01	5.147E+04	3.458E+00
2110	1.248E+02	9.990E+04	6.712E+00	3.332E+01	4.995E+04	3.356E+00
2111	1.211E+02	9.695E+04	6.514E+00	3.234E+01	4.847E+04	3.257E+00
2112	1.175E+02	9.408E+04	6.321E+00	3.138E+01	4.704E+04	3.161E+00
2113	1.140E+02	9.130E+04	6.135E+00	3.046E+01	4.565E+04	3.067E+00
2114	1.107E+02	8.860E+04	5.953E+00	2.956E+01	4.430E+04	2.977E+00
2115	1.074E+02	8.598E+04	5.777E+00	2.868E+01	4.299E+04	2.889E+00
2116	1.042E+02	8.344E+04	5.607E+00	2.783E+01	4.172E+04	2.803E+00
2117	1.011E+02	8.098E+04	5.441E+00	2.701E+01	4.049E+04	2.720E+00
2118	9.814E+01	7.858E+04	5.280E+00	2.621E+01	3.929E+04	2.640E+00

Results (Continued)

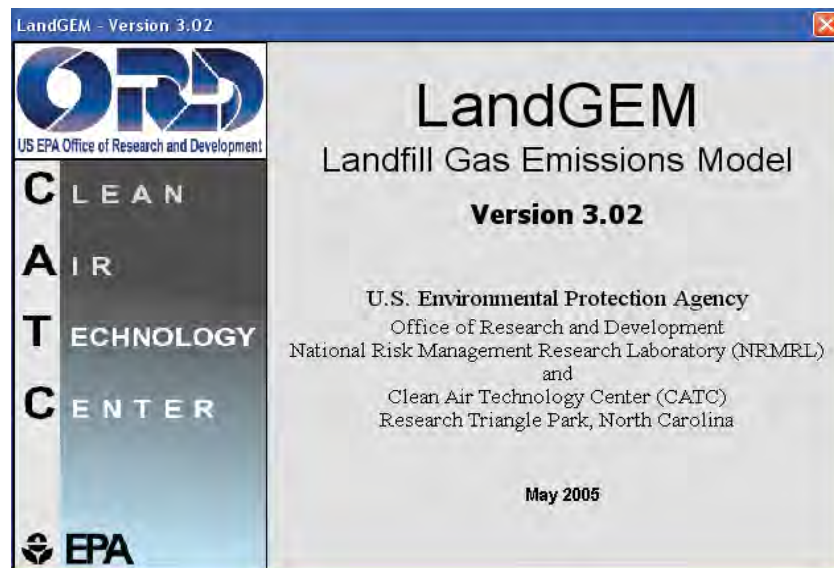
Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	4.599E+01	2.513E+04	1.688E+00	1.081E-01	3.015E+01	2.026E-03
1999	9.420E+01	5.146E+04	3.458E+00	2.213E-01	6.175E+01	4.149E-03
2000	1.453E+02	7.936E+04	5.332E+00	3.414E-01	9.523E+01	6.399E-03
2001	1.927E+02	1.053E+05	7.072E+00	4.527E-01	1.263E+02	8.486E-03
2002	2.371E+02	1.296E+05	8.705E+00	5.573E-01	1.555E+02	1.045E-02
2003	2.797E+02	1.528E+05	1.027E+01	6.572E-01	1.833E+02	1.232E-02
2004	3.092E+02	1.689E+05	1.135E+01	7.265E-01	2.027E+02	1.362E-02
2005	3.165E+02	1.729E+05	1.162E+01	7.438E-01	2.075E+02	1.394E-02
2006	3.324E+02	1.816E+05	1.220E+01	7.810E-01	2.179E+02	1.464E-02
2007	3.543E+02	1.935E+05	1.300E+01	8.325E-01	2.322E+02	1.560E-02
2008	3.636E+02	1.986E+05	1.335E+01	8.543E-01	2.383E+02	1.601E-02
2009	3.640E+02	1.988E+05	1.336E+01	8.553E-01	2.386E+02	1.603E-02
2010	3.624E+02	1.980E+05	1.330E+01	8.516E-01	2.376E+02	1.596E-02
2011	3.585E+02	1.958E+05	1.316E+01	8.424E-01	2.350E+02	1.579E-02
2012	3.559E+02	1.944E+05	1.306E+01	8.362E-01	2.333E+02	1.567E-02
2013	3.522E+02	1.924E+05	1.293E+01	8.276E-01	2.309E+02	1.551E-02
2014	3.521E+02	1.923E+05	1.292E+01	8.273E-01	2.308E+02	1.551E-02
2015	3.648E+02	1.993E+05	1.339E+01	8.573E-01	2.392E+02	1.607E-02
2016	3.738E+02	2.042E+05	1.372E+01	8.783E-01	2.450E+02	1.646E-02
2017	3.766E+02	2.058E+05	1.382E+01	8.850E-01	2.469E+02	1.659E-02
2018	3.860E+02	2.109E+05	1.417E+01	9.070E-01	2.530E+02	1.700E-02
2019	3.955E+02	2.160E+05	1.452E+01	9.293E-01	2.593E+02	1.742E-02
2020	4.121E+02	2.251E+05	1.513E+01	9.684E-01	2.702E+02	1.815E-02
2021	4.267E+02	2.331E+05	1.566E+01	1.003E+00	2.798E+02	1.880E-02
2022	4.378E+02	2.392E+05	1.607E+01	1.029E+00	2.870E+02	1.928E-02
2023	4.485E+02	2.450E+05	1.646E+01	1.054E+00	2.940E+02	1.975E-02
2024	4.589E+02	2.507E+05	1.684E+01	1.078E+00	3.008E+02	2.021E-02
2025	4.689E+02	2.562E+05	1.721E+01	1.102E+00	3.074E+02	2.066E-02
2026	4.787E+02	2.615E+05	1.757E+01	1.125E+00	3.138E+02	2.109E-02
2027	4.882E+02	2.667E+05	1.792E+01	1.147E+00	3.201E+02	2.150E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	4.974E+02	2.717E+05	1.826E+01	1.169E+00	3.261E+02	2.191E-02
2029	5.064E+02	2.766E+05	1.859E+01	1.190E+00	3.320E+02	2.230E-02
2030	5.151E+02	2.814E+05	1.891E+01	1.210E+00	3.376E+02	2.269E-02
2031	5.235E+02	2.860E+05	1.921E+01	1.230E+00	3.432E+02	2.306E-02
2032	5.316E+02	2.904E+05	1.951E+01	1.249E+00	3.485E+02	2.342E-02
2033	5.396E+02	2.948E+05	1.981E+01	1.268E+00	3.537E+02	2.377E-02
2034	5.473E+02	2.990E+05	2.009E+01	1.286E+00	3.588E+02	2.411E-02
2035	5.547E+02	3.031E+05	2.036E+01	1.304E+00	3.637E+02	2.443E-02
2036	5.620E+02	3.070E+05	2.063E+01	1.321E+00	3.684E+02	2.475E-02
2037	5.690E+02	3.109E+05	2.089E+01	1.337E+00	3.730E+02	2.506E-02
2038	5.758E+02	3.146E+05	2.114E+01	1.353E+00	3.775E+02	2.536E-02
2039	5.825E+02	3.182E+05	2.138E+01	1.369E+00	3.818E+02	2.566E-02
2040	5.889E+02	3.217E+05	2.162E+01	1.384E+00	3.861E+02	2.594E-02
2041	5.951E+02	3.251E+05	2.184E+01	1.398E+00	3.901E+02	2.621E-02
2042	6.012E+02	3.284E+05	2.207E+01	1.413E+00	3.941E+02	2.648E-02
2043	6.071E+02	3.316E+05	2.228E+01	1.426E+00	3.980E+02	2.674E-02
2044	6.128E+02	3.348E+05	2.249E+01	1.440E+00	4.017E+02	2.699E-02
2045	6.183E+02	3.378E+05	2.270E+01	1.453E+00	4.053E+02	2.723E-02
2046	6.237E+02	3.407E+05	2.289E+01	1.466E+00	4.088E+02	2.747E-02
2047	6.052E+02	3.306E+05	2.222E+01	1.422E+00	3.968E+02	2.666E-02
2048	5.873E+02	3.209E+05	2.156E+01	1.380E+00	3.850E+02	2.587E-02
2049	5.700E+02	3.114E+05	2.092E+01	1.339E+00	3.737E+02	2.511E-02
2050	5.531E+02	3.022E+05	2.030E+01	1.300E+00	3.626E+02	2.436E-02
2051	5.368E+02	2.933E+05	1.970E+01	1.261E+00	3.519E+02	2.364E-02
2052	5.209E+02	2.846E+05	1.912E+01	1.224E+00	3.415E+02	2.295E-02
2053	5.055E+02	2.762E+05	1.856E+01	1.188E+00	3.314E+02	2.227E-02
2054	4.906E+02	2.680E+05	1.801E+01	1.153E+00	3.216E+02	2.161E-02
2055	4.761E+02	2.601E+05	1.748E+01	1.119E+00	3.121E+02	2.097E-02
2056	4.620E+02	2.524E+05	1.696E+01	1.086E+00	3.029E+02	2.035E-02
2057	4.484E+02	2.449E+05	1.646E+01	1.054E+00	2.939E+02	1.975E-02
2058	4.351E+02	2.377E+05	1.597E+01	1.022E+00	2.852E+02	1.917E-02
2059	4.223E+02	2.307E+05	1.550E+01	9.922E-01	2.768E+02	1.860E-02
2060	4.098E+02	2.239E+05	1.504E+01	9.629E-01	2.686E+02	1.805E-02
2061	3.977E+02	2.172E+05	1.460E+01	9.344E-01	2.607E+02	1.752E-02
2062	3.859E+02	2.108E+05	1.417E+01	9.068E-01	2.530E+02	1.700E-02
2063	3.745E+02	2.046E+05	1.375E+01	8.800E-01	2.455E+02	1.650E-02
2064	3.634E+02	1.985E+05	1.334E+01	8.540E-01	2.383E+02	1.601E-02
2065	3.527E+02	1.927E+05	1.295E+01	8.288E-01	2.312E+02	1.554E-02
2066	3.423E+02	1.870E+05	1.256E+01	8.043E-01	2.244E+02	1.508E-02
2067	3.322E+02	1.815E+05	1.219E+01	7.805E-01	2.177E+02	1.463E-02
2068	3.223E+02	1.761E+05	1.183E+01	7.574E-01	2.113E+02	1.420E-02
2069	3.128E+02	1.709E+05	1.148E+01	7.351E-01	2.051E+02	1.378E-02
2070	3.036E+02	1.658E+05	1.114E+01	7.133E-01	1.990E+02	1.337E-02
2071	2.946E+02	1.609E+05	1.081E+01	6.923E-01	1.931E+02	1.298E-02
2072	2.859E+02	1.562E+05	1.049E+01	6.718E-01	1.874E+02	1.259E-02
2073	2.774E+02	1.516E+05	1.018E+01	6.519E-01	1.819E+02	1.222E-02
2074	2.692E+02	1.471E+05	9.883E+00	6.327E-01	1.765E+02	1.186E-02
2075	2.613E+02	1.427E+05	9.591E+00	6.140E-01	1.713E+02	1.151E-02
2076	2.536E+02	1.385E+05	9.307E+00	5.958E-01	1.662E+02	1.117E-02
2077	2.461E+02	1.344E+05	9.032E+00	5.782E-01	1.613E+02	1.084E-02
2078	2.388E+02	1.305E+05	8.765E+00	5.611E-01	1.565E+02	1.052E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	2.317E+02	1.266E+05	8.506E+00	5.445E-01	1.519E+02	1.021E-02
2080	2.249E+02	1.229E+05	8.255E+00	5.285E-01	1.474E+02	9.906E-03
2081	2.182E+02	1.192E+05	8.011E+00	5.128E-01	1.431E+02	9.613E-03
2082	2.118E+02	1.157E+05	7.774E+00	4.977E-01	1.388E+02	9.329E-03
2083	2.055E+02	1.123E+05	7.544E+00	4.830E-01	1.347E+02	9.053E-03
2084	1.995E+02	1.090E+05	7.321E+00	4.687E-01	1.308E+02	8.786E-03
2085	1.936E+02	1.057E+05	7.105E+00	4.548E-01	1.269E+02	8.526E-03
2086	1.878E+02	1.026E+05	6.895E+00	4.414E-01	1.231E+02	8.274E-03
2087	1.823E+02	9.959E+04	6.691E+00	4.284E-01	1.195E+02	8.029E-03
2088	1.769E+02	9.664E+04	6.493E+00	4.157E-01	1.160E+02	7.792E-03
2089	1.717E+02	9.379E+04	6.302E+00	4.034E-01	1.125E+02	7.562E-03
2090	1.666E+02	9.102E+04	6.115E+00	3.915E-01	1.092E+02	7.338E-03
2091	1.617E+02	8.833E+04	5.935E+00	3.799E-01	1.060E+02	7.121E-03
2092	1.569E+02	8.571E+04	5.759E+00	3.687E-01	1.029E+02	6.911E-03
2093	1.523E+02	8.318E+04	5.589E+00	3.578E-01	9.982E+01	6.707E-03
2094	1.478E+02	8.072E+04	5.424E+00	3.472E-01	9.687E+01	6.509E-03
2095	1.434E+02	7.834E+04	5.263E+00	3.370E-01	9.400E+01	6.316E-03
2096	1.392E+02	7.602E+04	5.108E+00	3.270E-01	9.123E+01	6.130E-03
2097	1.350E+02	7.378E+04	4.957E+00	3.173E-01	8.853E+01	5.948E-03
2098	1.311E+02	7.160E+04	4.810E+00	3.080E-01	8.591E+01	5.773E-03
2099	1.272E+02	6.948E+04	4.668E+00	2.989E-01	8.337E+01	5.602E-03
2100	1.234E+02	6.743E+04	4.530E+00	2.900E-01	8.091E+01	5.436E-03
2101	1.198E+02	6.543E+04	4.396E+00	2.815E-01	7.852E+01	5.276E-03
2102	1.162E+02	6.350E+04	4.266E+00	2.731E-01	7.620E+01	5.120E-03
2103	1.128E+02	6.162E+04	4.140E+00	2.651E-01	7.395E+01	4.968E-03
2104	1.095E+02	5.980E+04	4.018E+00	2.572E-01	7.176E+01	4.822E-03
2105	1.062E+02	5.803E+04	3.899E+00	2.496E-01	6.964E+01	4.679E-03
2106	1.031E+02	5.632E+04	3.784E+00	2.422E-01	6.758E+01	4.541E-03
2107	1.000E+02	5.465E+04	3.672E+00	2.351E-01	6.559E+01	4.407E-03
2108	9.709E+01	5.304E+04	3.564E+00	2.281E-01	6.365E+01	4.276E-03
2109	9.422E+01	5.147E+04	3.458E+00	2.214E-01	6.177E+01	4.150E-03
2110	9.143E+01	4.995E+04	3.356E+00	2.149E-01	5.994E+01	4.027E-03
2111	8.873E+01	4.847E+04	3.257E+00	2.085E-01	5.817E+01	3.908E-03
2112	8.611E+01	4.704E+04	3.161E+00	2.023E-01	5.645E+01	3.793E-03
2113	8.356E+01	4.565E+04	3.067E+00	1.964E-01	5.478E+01	3.681E-03
2114	8.109E+01	4.430E+04	2.977E+00	1.906E-01	5.316E+01	3.572E-03
2115	7.870E+01	4.299E+04	2.889E+00	1.849E-01	5.159E+01	3.466E-03
2116	7.637E+01	4.172E+04	2.803E+00	1.795E-01	5.007E+01	3.364E-03
2117	7.411E+01	4.049E+04	2.720E+00	1.742E-01	4.859E+01	3.265E-03
2118	7.192E+01	3.929E+04	2.640E+00	1.690E-01	4.715E+01	3.168E-03



Summary Report

Landfill Name or Identifier: MSW CB Landfill Model

Date: Monday, May 10, 2021

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year **1978**
 Landfill Closure Year (with 80-year limit) **2045**
 Actual Closure Year (without limit) **2045**
 Have Model Calculate Closure Year? **No**
 Waste Design Capacity *megagrams*

MODEL PARAMETERS

Methane Generation Rate, k **0.040** *year⁻¹*
 Potential Methane Generation Capacity, L₀ **110** *m³/Mg*
 NMOC Concentration **600** *ppmv as hexane*
 Methane Content **50** *% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1: **Total landfill gas**
 Gas / Pollutant #2: **Methane**
 Gas / Pollutant #3: **Carbon dioxide**
 Gas / Pollutant #4: **NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1978	0	0	0	0
1979	0	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	241,684	265,852	0	0
1998	257,632	283,395	241,684	265,852
1999	272,325	299,558	499,315	549,247
2000	256,927	282,620	771,641	848,805
2001	270,794	297,873	1,028,568	1,131,425
2002	279,144	307,058	1,299,362	1,429,298
2003	228,960	251,856	1,578,505	1,736,356
2004	380,068	418,075	1,807,465	1,988,212
2005	384,370	422,807	2,187,534	2,406,287
2006	408,215	449,037	2,571,904	2,829,095
2007	379,773	417,751	2,980,120	3,278,132
2008	332,140	365,354	3,359,893	3,695,882
2009	283,487	311,836	3,692,033	4,061,236
2010	277,094	304,803	3,975,520	4,373,072
2011	292,743	322,017	4,252,614	4,677,875
2012	302,796	333,075	4,545,357	4,999,893
2013	279,005	306,905	4,848,153	5,332,968
2014	307,494	338,243	5,127,157	5,639,873
2015	345,213	379,734	5,434,651	5,978,116
2016	380,642	418,706	5,779,863	6,357,850
2017	666,969	733,666	6,160,505	6,776,556

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2018	709,929	780,922	6,827,474	7,510,222
2019	697,614	767,375	7,537,403	8,291,143
2020	547,133	601,847	8,235,017	9,058,519
2021	512,727	564,000	8,782,150	9,660,365
2022	512,727	564,000	9,294,877	10,224,365
2023	512,727	564,000	9,807,605	10,788,365
2024	512,727	564,000	10,320,332	11,352,365
2025	512,727	564,000	10,833,059	11,916,365
2026	512,727	564,000	11,345,787	12,480,365
2027	512,727	564,000	11,858,514	13,044,365
2028	512,727	564,000	12,371,241	13,608,365
2029	512,727	564,000	12,883,968	14,172,365
2030	512,727	564,000	13,396,696	14,736,365
2031	512,727	564,000	13,909,423	15,300,365
2032	512,727	564,000	14,422,150	15,864,365
2033	512,727	564,000	14,934,877	16,428,365
2034	512,727	564,000	15,447,605	16,992,365
2035	512,727	564,000	15,960,332	17,556,365
2036	512,727	564,000	16,473,059	18,120,365
2037	512,727	564,000	16,985,787	18,684,365
2038	512,727	564,000	17,498,514	19,248,365
2039	512,727	564,000	18,011,241	19,812,365
2040	512,727	564,000	18,523,968	20,376,365
2041	512,727	564,000	19,036,696	20,940,365
2042	512,727	564,000	19,549,423	21,504,365
2043	512,727	564,000	20,062,150	22,068,365
2044	512,727	564,000	20,574,877	22,632,365
2045	512,727	564,000	21,087,605	23,196,365
2046	0	0	21,600,332	23,760,365
2047	0	0	21,600,332	23,760,365
2048	0	0	21,600,332	23,760,365
2049	0	0	21,600,332	23,760,365
2050	0	0	21,600,332	23,760,365
2051	0	0	21,600,332	23,760,365
2052	0	0	21,600,332	23,760,365
2053	0	0	21,600,332	23,760,365
2054	0	0	21,600,332	23,760,365
2055	0	0	21,600,332	23,760,365
2056	0	0	21,600,332	23,760,365
2057	0	0	21,600,332	23,760,365

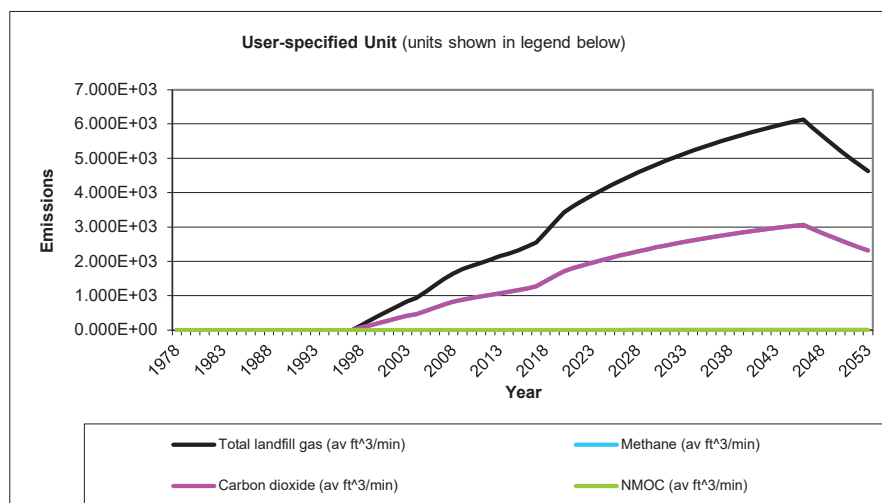
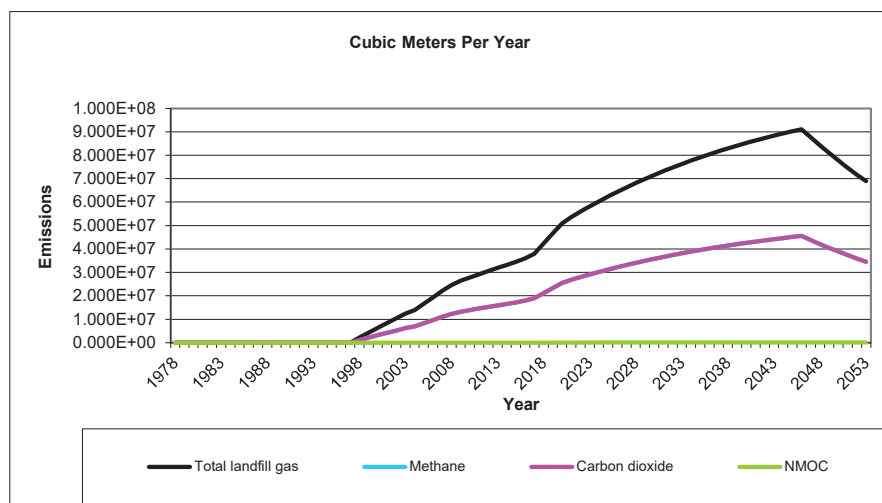
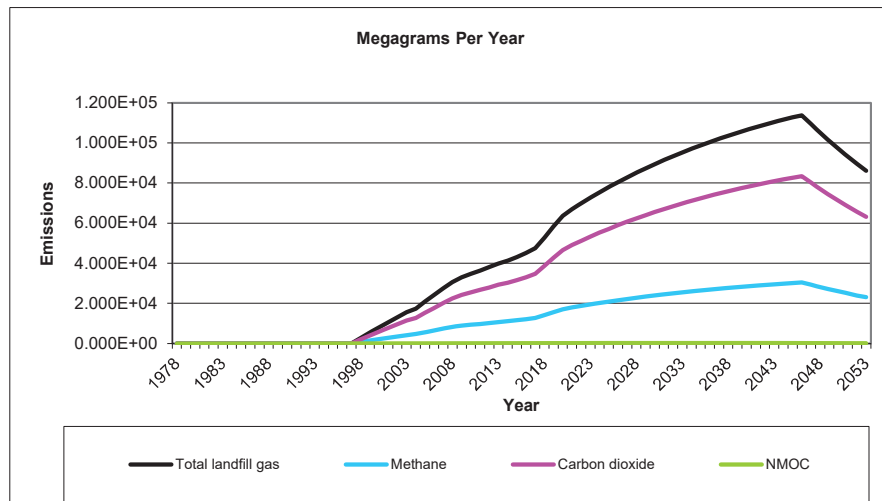
Pollutant Parameters

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2- Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

<i>Gas / Pollutant Default Parameters:</i>				<i>User-specified Pollutant Parameters:</i>	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	2.609E+03	2.089E+06	1.404E+02	6.968E+02	1.045E+06	7.018E+01
1999	5.287E+03	4.234E+06	2.845E+02	1.412E+03	2.117E+06	1.422E+02
2000	8.020E+03	6.422E+06	4.315E+02	2.142E+03	3.211E+06	2.157E+02
2001	1.048E+04	8.391E+06	5.638E+02	2.799E+03	4.195E+06	2.819E+02
2002	1.299E+04	1.040E+07	6.989E+02	3.470E+03	5.201E+06	3.495E+02
2003	1.549E+04	1.241E+07	8.336E+02	4.139E+03	6.204E+06	4.168E+02
2004	1.736E+04	1.390E+07	9.339E+02	4.637E+03	6.950E+06	4.670E+02
2005	2.078E+04	1.664E+07	1.118E+03	5.551E+03	8.320E+06	5.590E+02
2006	2.411E+04	1.931E+07	1.297E+03	6.441E+03	9.655E+06	6.487E+02
2007	2.758E+04	2.208E+07	1.484E+03	7.366E+03	1.104E+07	7.418E+02
2008	3.059E+04	2.450E+07	1.646E+03	8.172E+03	1.225E+07	8.230E+02
2009	3.298E+04	2.641E+07	1.774E+03	8.809E+03	1.320E+07	8.872E+02
2010	3.475E+04	2.782E+07	1.869E+03	9.281E+03	1.391E+07	9.347E+02
2011	3.637E+04	2.913E+07	1.957E+03	9.716E+03	1.456E+07	9.785E+02
2012	3.811E+04	3.052E+07	2.050E+03	1.018E+04	1.526E+07	1.025E+03
2013	3.988E+04	3.194E+07	2.146E+03	1.065E+04	1.597E+07	1.073E+03
2014	4.133E+04	3.310E+07	2.224E+03	1.104E+04	1.655E+07	1.112E+03
2015	4.303E+04	3.446E+07	2.315E+03	1.149E+04	1.723E+07	1.158E+03
2016	4.507E+04	3.609E+07	2.425E+03	1.204E+04	1.804E+07	1.212E+03
2017	4.741E+04	3.796E+07	2.551E+03	1.266E+04	1.898E+07	1.275E+03
2018	5.275E+04	4.224E+07	2.838E+03	1.409E+04	2.112E+07	1.419E+03
2019	5.835E+04	4.672E+07	3.139E+03	1.558E+04	2.336E+07	1.570E+03
2020	6.359E+04	5.092E+07	3.421E+03	1.698E+04	2.546E+07	1.711E+03
2021	6.700E+04	5.365E+07	3.605E+03	1.790E+04	2.683E+07	1.802E+03
2022	6.991E+04	5.598E+07	3.761E+03	1.867E+04	2.799E+07	1.881E+03
2023	7.270E+04	5.822E+07	3.912E+03	1.942E+04	2.911E+07	1.956E+03
2024	7.539E+04	6.036E+07	4.056E+03	2.014E+04	3.018E+07	2.028E+03
2025	7.796E+04	6.243E+07	4.195E+03	2.082E+04	3.121E+07	2.097E+03
2026	8.044E+04	6.441E+07	4.328E+03	2.149E+04	3.221E+07	2.164E+03
2027	8.282E+04	6.632E+07	4.456E+03	2.212E+04	3.316E+07	2.228E+03

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	8.511E+04	6.815E+07	4.579E+03	2.273E+04	3.408E+07	2.290E+03
2029	8.731E+04	6.991E+07	4.697E+03	2.332E+04	3.496E+07	2.349E+03
2030	8.942E+04	7.160E+07	4.811E+03	2.388E+04	3.580E+07	2.405E+03
2031	9.145E+04	7.323E+07	4.920E+03	2.443E+04	3.661E+07	2.460E+03
2032	9.339E+04	7.479E+07	5.025E+03	2.495E+04	3.739E+07	2.512E+03
2033	9.527E+04	7.629E+07	5.126E+03	2.545E+04	3.814E+07	2.563E+03
2034	9.707E+04	7.773E+07	5.222E+03	2.593E+04	3.886E+07	2.611E+03
2035	9.879E+04	7.911E+07	5.315E+03	2.639E+04	3.956E+07	2.658E+03
2036	1.005E+05	8.044E+07	5.405E+03	2.683E+04	4.022E+07	2.702E+03
2037	1.021E+05	8.172E+07	5.491E+03	2.726E+04	4.086E+07	2.745E+03
2038	1.036E+05	8.295E+07	5.573E+03	2.767E+04	4.147E+07	2.787E+03
2039	1.051E+05	8.412E+07	5.652E+03	2.806E+04	4.206E+07	2.826E+03
2040	1.065E+05	8.526E+07	5.728E+03	2.844E+04	4.263E+07	2.864E+03
2041	1.078E+05	8.635E+07	5.802E+03	2.880E+04	4.317E+07	2.901E+03
2042	1.091E+05	8.739E+07	5.872E+03	2.915E+04	4.370E+07	2.936E+03
2043	1.104E+05	8.840E+07	5.939E+03	2.949E+04	4.420E+07	2.970E+03
2044	1.116E+05	8.936E+07	6.004E+03	2.981E+04	4.468E+07	3.002E+03
2045	1.128E+05	9.029E+07	6.067E+03	3.012E+04	4.515E+07	3.033E+03
2046	1.139E+05	9.118E+07	6.127E+03	3.042E+04	4.559E+07	3.063E+03
2047	1.094E+05	8.761E+07	5.886E+03	2.922E+04	4.380E+07	2.943E+03
2048	1.051E+05	8.417E+07	5.656E+03	2.808E+04	4.209E+07	2.828E+03
2049	1.010E+05	8.087E+07	5.434E+03	2.698E+04	4.044E+07	2.717E+03
2050	9.703E+04	7.770E+07	5.221E+03	2.592E+04	3.885E+07	2.610E+03
2051	9.323E+04	7.465E+07	5.016E+03	2.490E+04	3.733E+07	2.508E+03
2052	8.957E+04	7.173E+07	4.819E+03	2.393E+04	3.586E+07	2.410E+03
2053	8.606E+04	6.891E+07	4.630E+03	2.299E+04	3.446E+07	2.315E+03
2054	8.269E+04	6.621E+07	4.449E+03	2.209E+04	3.311E+07	2.224E+03
2055	7.945E+04	6.362E+07	4.274E+03	2.122E+04	3.181E+07	2.137E+03
2056	7.633E+04	6.112E+07	4.107E+03	2.039E+04	3.056E+07	2.053E+03
2057	7.334E+04	5.873E+07	3.946E+03	1.959E+04	2.936E+07	1.973E+03
2058	7.046E+04	5.642E+07	3.791E+03	1.882E+04	2.821E+07	1.896E+03
2059	6.770E+04	5.421E+07	3.642E+03	1.808E+04	2.711E+07	1.821E+03
2060	6.504E+04	5.208E+07	3.500E+03	1.737E+04	2.604E+07	1.750E+03
2061	6.249E+04	5.004E+07	3.362E+03	1.669E+04	2.502E+07	1.681E+03
2062	6.004E+04	4.808E+07	3.230E+03	1.604E+04	2.404E+07	1.615E+03
2063	5.769E+04	4.619E+07	3.104E+03	1.541E+04	2.310E+07	1.552E+03
2064	5.543E+04	4.438E+07	2.982E+03	1.481E+04	2.219E+07	1.491E+03
2065	5.325E+04	4.264E+07	2.865E+03	1.422E+04	2.132E+07	1.433E+03
2066	5.117E+04	4.097E+07	2.753E+03	1.367E+04	2.049E+07	1.376E+03
2067	4.916E+04	3.936E+07	2.645E+03	1.313E+04	1.968E+07	1.322E+03
2068	4.723E+04	3.782E+07	2.541E+03	1.262E+04	1.891E+07	1.271E+03
2069	4.538E+04	3.634E+07	2.442E+03	1.212E+04	1.817E+07	1.221E+03
2070	4.360E+04	3.491E+07	2.346E+03	1.165E+04	1.746E+07	1.173E+03
2071	4.189E+04	3.354E+07	2.254E+03	1.119E+04	1.677E+07	1.127E+03
2072	4.025E+04	3.223E+07	2.165E+03	1.075E+04	1.611E+07	1.083E+03
2073	3.867E+04	3.097E+07	2.081E+03	1.033E+04	1.548E+07	1.040E+03
2074	3.715E+04	2.975E+07	1.999E+03	9.924E+03	1.488E+07	9.995E+02
2075	3.570E+04	2.858E+07	1.921E+03	9.535E+03	1.429E+07	9.603E+02
2076	3.430E+04	2.746E+07	1.845E+03	9.161E+03	1.373E+07	9.226E+02
2077	3.295E+04	2.639E+07	1.773E+03	8.802E+03	1.319E+07	8.865E+02
2078	3.166E+04	2.535E+07	1.703E+03	8.457E+03	1.268E+07	8.517E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	3.042E+04	2.436E+07	1.637E+03	8.125E+03	1.218E+07	8.183E+02
2080	2.923E+04	2.340E+07	1.572E+03	7.807E+03	1.170E+07	7.862E+02
2081	2.808E+04	2.249E+07	1.511E+03	7.501E+03	1.124E+07	7.554E+02
2082	2.698E+04	2.160E+07	1.452E+03	7.206E+03	1.080E+07	7.258E+02
2083	2.592E+04	2.076E+07	1.395E+03	6.924E+03	1.038E+07	6.973E+02
2084	2.491E+04	1.994E+07	1.340E+03	6.652E+03	9.971E+06	6.700E+02
2085	2.393E+04	1.916E+07	1.287E+03	6.392E+03	9.580E+06	6.437E+02
2086	2.299E+04	1.841E+07	1.237E+03	6.141E+03	9.205E+06	6.185E+02
2087	2.209E+04	1.769E+07	1.188E+03	5.900E+03	8.844E+06	5.942E+02
2088	2.122E+04	1.699E+07	1.142E+03	5.669E+03	8.497E+06	5.709E+02
2089	2.039E+04	1.633E+07	1.097E+03	5.447E+03	8.164E+06	5.485E+02
2090	1.959E+04	1.569E+07	1.054E+03	5.233E+03	7.844E+06	5.270E+02
2091	1.882E+04	1.507E+07	1.013E+03	5.028E+03	7.536E+06	5.064E+02
2092	1.808E+04	1.448E+07	9.730E+02	4.831E+03	7.241E+06	4.865E+02
2093	1.738E+04	1.391E+07	9.349E+02	4.641E+03	6.957E+06	4.674E+02
2094	1.669E+04	1.337E+07	8.982E+02	4.459E+03	6.684E+06	4.491E+02
2095	1.604E+04	1.284E+07	8.630E+02	4.284E+03	6.422E+06	4.315E+02
2096	1.541E+04	1.234E+07	8.291E+02	4.116E+03	6.170E+06	4.146E+02
2097	1.481E+04	1.186E+07	7.966E+02	3.955E+03	5.928E+06	3.983E+02
2098	1.423E+04	1.139E+07	7.654E+02	3.800E+03	5.696E+06	3.827E+02
2099	1.367E+04	1.094E+07	7.354E+02	3.651E+03	5.472E+06	3.677E+02
2100	1.313E+04	1.052E+07	7.065E+02	3.508E+03	5.258E+06	3.533E+02
2101	1.262E+04	1.010E+07	6.788E+02	3.370E+03	5.052E+06	3.394E+02
2102	1.212E+04	9.707E+06	6.522E+02	3.238E+03	4.854E+06	3.261E+02
2103	1.165E+04	9.327E+06	6.267E+02	3.111E+03	4.663E+06	3.133E+02
2104	1.119E+04	8.961E+06	6.021E+02	2.989E+03	4.480E+06	3.010E+02
2105	1.075E+04	8.610E+06	5.785E+02	2.872E+03	4.305E+06	2.892E+02
2106	1.033E+04	8.272E+06	5.558E+02	2.759E+03	4.136E+06	2.779E+02
2107	9.925E+03	7.948E+06	5.340E+02	2.651E+03	3.974E+06	2.670E+02
2108	9.536E+03	7.636E+06	5.131E+02	2.547E+03	3.818E+06	2.565E+02
2109	9.162E+03	7.337E+06	4.929E+02	2.447E+03	3.668E+06	2.465E+02
2110	8.803E+03	7.049E+06	4.736E+02	2.351E+03	3.524E+06	2.368E+02
2111	8.458E+03	6.772E+06	4.550E+02	2.259E+03	3.386E+06	2.275E+02
2112	8.126E+03	6.507E+06	4.372E+02	2.171E+03	3.253E+06	2.186E+02
2113	7.807E+03	6.252E+06	4.201E+02	2.085E+03	3.126E+06	2.100E+02
2114	7.501E+03	6.007E+06	4.036E+02	2.004E+03	3.003E+06	2.018E+02
2115	7.207E+03	5.771E+06	3.878E+02	1.925E+03	2.886E+06	1.939E+02
2116	6.925E+03	5.545E+06	3.726E+02	1.850E+03	2.772E+06	1.863E+02
2117	6.653E+03	5.327E+06	3.579E+02	1.777E+03	2.664E+06	1.790E+02
2118	6.392E+03	5.119E+06	3.439E+02	1.707E+03	2.559E+06	1.720E+02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1978	0	0	0	0	0	0
1979	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1980	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1981	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1982	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1983	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1984	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1985	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1986	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1987	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1988	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1989	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1990	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1991	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1992	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1993	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1994	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1995	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1996	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1997	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1998	1.912E+03	1.045E+06	7.018E+01	4.493E+00	1.253E+03	8.422E-02
1999	3.875E+03	2.117E+06	1.422E+02	9.106E+00	2.540E+03	1.707E-01
2000	5.878E+03	3.211E+06	2.157E+02	1.381E+01	3.853E+03	2.589E-01
2001	7.680E+03	4.195E+06	2.819E+02	1.805E+01	5.034E+03	3.383E-01
2002	9.521E+03	5.201E+06	3.495E+02	2.237E+01	6.241E+03	4.194E-01
2003	1.136E+04	6.204E+06	4.168E+02	2.668E+01	7.444E+03	5.002E-01
2004	1.272E+04	6.950E+06	4.670E+02	2.989E+01	8.340E+03	5.604E-01
2005	1.523E+04	8.320E+06	5.590E+02	3.579E+01	9.984E+03	6.708E-01
2006	1.767E+04	9.655E+06	6.487E+02	4.153E+01	1.159E+04	7.785E-01
2007	2.021E+04	1.104E+07	7.418E+02	4.749E+01	1.325E+04	8.902E-01
2008	2.242E+04	1.225E+07	8.230E+02	5.269E+01	1.470E+04	9.876E-01
2009	2.417E+04	1.320E+07	8.872E+02	5.680E+01	1.584E+04	1.065E+00
2010	2.547E+04	1.391E+07	9.347E+02	5.984E+01	1.669E+04	1.122E+00
2011	2.666E+04	1.456E+07	9.785E+02	6.264E+01	1.748E+04	1.174E+00
2012	2.793E+04	1.526E+07	1.025E+03	6.563E+01	1.831E+04	1.230E+00
2013	2.923E+04	1.597E+07	1.073E+03	6.868E+01	1.916E+04	1.287E+00
2014	3.029E+04	1.655E+07	1.112E+03	7.118E+01	1.986E+04	1.334E+00
2015	3.154E+04	1.723E+07	1.158E+03	7.410E+01	2.067E+04	1.389E+00
2016	3.303E+04	1.804E+07	1.212E+03	7.761E+01	2.165E+04	1.455E+00
2017	3.475E+04	1.898E+07	1.275E+03	8.165E+01	2.278E+04	1.530E+00
2018	3.866E+04	2.112E+07	1.419E+03	9.084E+01	2.534E+04	1.703E+00
2019	4.276E+04	2.336E+07	1.570E+03	1.005E+02	2.803E+04	1.883E+00
2020	4.660E+04	2.546E+07	1.711E+03	1.095E+02	3.055E+04	2.053E+00
2021	4.910E+04	2.683E+07	1.802E+03	1.154E+02	3.219E+04	2.163E+00
2022	5.123E+04	2.799E+07	1.881E+03	1.204E+02	3.359E+04	2.257E+00
2023	5.328E+04	2.911E+07	1.956E+03	1.252E+02	3.493E+04	2.347E+00
2024	5.525E+04	3.018E+07	2.028E+03	1.298E+02	3.622E+04	2.434E+00
2025	5.714E+04	3.121E+07	2.097E+03	1.343E+02	3.746E+04	2.517E+00
2026	5.895E+04	3.221E+07	2.164E+03	1.385E+02	3.865E+04	2.597E+00
2027	6.070E+04	3.316E+07	2.228E+03	1.426E+02	3.979E+04	2.674E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2028	6.238E+04	3.408E+07	2.290E+03	1.466E+02	4.089E+04	2.747E+00
2029	6.399E+04	3.496E+07	2.349E+03	1.504E+02	4.195E+04	2.818E+00
2030	6.553E+04	3.580E+07	2.405E+03	1.540E+02	4.296E+04	2.887E+00
2031	6.702E+04	3.661E+07	2.460E+03	1.575E+02	4.394E+04	2.952E+00
2032	6.845E+04	3.739E+07	2.512E+03	1.608E+02	4.487E+04	3.015E+00
2033	6.982E+04	3.814E+07	2.563E+03	1.641E+02	4.577E+04	3.075E+00
2034	7.114E+04	3.886E+07	2.611E+03	1.672E+02	4.664E+04	3.133E+00
2035	7.241E+04	3.956E+07	2.658E+03	1.701E+02	4.747E+04	3.189E+00
2036	7.362E+04	4.022E+07	2.702E+03	1.730E+02	4.826E+04	3.243E+00
2037	7.479E+04	4.086E+07	2.745E+03	1.757E+02	4.903E+04	3.294E+00
2038	7.592E+04	4.147E+07	2.787E+03	1.784E+02	4.977E+04	3.344E+00
2039	7.700E+04	4.206E+07	2.826E+03	1.809E+02	5.047E+04	3.391E+00
2040	7.803E+04	4.263E+07	2.864E+03	1.834E+02	5.115E+04	3.437E+00
2041	7.903E+04	4.317E+07	2.901E+03	1.857E+02	5.181E+04	3.481E+00
2042	7.999E+04	4.370E+07	2.936E+03	1.880E+02	5.244E+04	3.523E+00
2043	8.091E+04	4.420E+07	2.970E+03	1.901E+02	5.304E+04	3.564E+00
2044	8.179E+04	4.468E+07	3.002E+03	1.922E+02	5.362E+04	3.603E+00
2045	8.264E+04	4.515E+07	3.033E+03	1.942E+02	5.417E+04	3.640E+00
2046	8.346E+04	4.559E+07	3.063E+03	1.961E+02	5.471E+04	3.676E+00
2047	8.018E+04	4.380E+07	2.943E+03	1.884E+02	5.256E+04	3.532E+00
2048	7.704E+04	4.209E+07	2.828E+03	1.810E+02	5.050E+04	3.393E+00
2049	7.402E+04	4.044E+07	2.717E+03	1.739E+02	4.852E+04	3.260E+00
2050	7.112E+04	3.885E+07	2.610E+03	1.671E+02	4.662E+04	3.132E+00
2051	6.833E+04	3.733E+07	2.508E+03	1.606E+02	4.479E+04	3.010E+00
2052	6.565E+04	3.586E+07	2.410E+03	1.543E+02	4.304E+04	2.892E+00
2053	6.307E+04	3.446E+07	2.315E+03	1.482E+02	4.135E+04	2.778E+00
2054	6.060E+04	3.311E+07	2.224E+03	1.424E+02	3.973E+04	2.669E+00
2055	5.822E+04	3.181E+07	2.137E+03	1.368E+02	3.817E+04	2.565E+00
2056	5.594E+04	3.056E+07	2.053E+03	1.315E+02	3.667E+04	2.464E+00
2057	5.375E+04	2.936E+07	1.973E+03	1.263E+02	3.524E+04	2.367E+00
2058	5.164E+04	2.821E+07	1.896E+03	1.213E+02	3.385E+04	2.275E+00
2059	4.962E+04	2.711E+07	1.821E+03	1.166E+02	3.253E+04	2.185E+00
2060	4.767E+04	2.604E+07	1.750E+03	1.120E+02	3.125E+04	2.100E+00
2061	4.580E+04	2.502E+07	1.681E+03	1.076E+02	3.003E+04	2.017E+00
2062	4.401E+04	2.404E+07	1.615E+03	1.034E+02	2.885E+04	1.938E+00
2063	4.228E+04	2.310E+07	1.552E+03	9.935E+01	2.772E+04	1.862E+00
2064	4.062E+04	2.219E+07	1.491E+03	9.545E+01	2.663E+04	1.789E+00
2065	3.903E+04	2.132E+07	1.433E+03	9.171E+01	2.559E+04	1.719E+00
2066	3.750E+04	2.049E+07	1.376E+03	8.812E+01	2.458E+04	1.652E+00
2067	3.603E+04	1.968E+07	1.322E+03	8.466E+01	2.362E+04	1.587E+00
2068	3.462E+04	1.891E+07	1.271E+03	8.134E+01	2.269E+04	1.525E+00
2069	3.326E+04	1.817E+07	1.221E+03	7.815E+01	2.180E+04	1.465E+00
2070	3.195E+04	1.746E+07	1.173E+03	7.509E+01	2.095E+04	1.407E+00
2071	3.070E+04	1.677E+07	1.127E+03	7.214E+01	2.013E+04	1.352E+00
2072	2.950E+04	1.611E+07	1.083E+03	6.931E+01	1.934E+04	1.299E+00
2073	2.834E+04	1.548E+07	1.040E+03	6.660E+01	1.858E+04	1.248E+00
2074	2.723E+04	1.488E+07	9.995E+02	6.399E+01	1.785E+04	1.199E+00
2075	2.616E+04	1.429E+07	9.603E+02	6.148E+01	1.715E+04	1.152E+00
2076	2.514E+04	1.373E+07	9.226E+02	5.907E+01	1.648E+04	1.107E+00
2077	2.415E+04	1.319E+07	8.865E+02	5.675E+01	1.583E+04	1.064E+00
2078	2.320E+04	1.268E+07	8.517E+02	5.452E+01	1.521E+04	1.022E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2079	2.229E+04	1.218E+07	8.183E+02	5.239E+01	1.461E+04	9.820E-01
2080	2.142E+04	1.170E+07	7.862E+02	5.033E+01	1.404E+04	9.435E-01
2081	2.058E+04	1.124E+07	7.554E+02	4.836E+01	1.349E+04	9.065E-01
2082	1.977E+04	1.080E+07	7.258E+02	4.646E+01	1.296E+04	8.709E-01
2083	1.900E+04	1.038E+07	6.973E+02	4.464E+01	1.245E+04	8.368E-01
2084	1.825E+04	9.971E+06	6.700E+02	4.289E+01	1.197E+04	8.040E-01
2085	1.754E+04	9.580E+06	6.437E+02	4.121E+01	1.150E+04	7.724E-01
2086	1.685E+04	9.205E+06	6.185E+02	3.959E+01	1.105E+04	7.422E-01
2087	1.619E+04	8.844E+06	5.942E+02	3.804E+01	1.061E+04	7.131E-01
2088	1.555E+04	8.497E+06	5.709E+02	3.655E+01	1.020E+04	6.851E-01
2089	1.494E+04	8.164E+06	5.485E+02	3.512E+01	9.797E+03	6.582E-01
2090	1.436E+04	7.844E+06	5.270E+02	3.374E+01	9.413E+03	6.324E-01
2091	1.380E+04	7.536E+06	5.064E+02	3.242E+01	9.043E+03	6.076E-01
2092	1.325E+04	7.241E+06	4.865E+02	3.114E+01	8.689E+03	5.838E-01
2093	1.273E+04	6.957E+06	4.674E+02	2.992E+01	8.348E+03	5.609E-01
2094	1.224E+04	6.684E+06	4.491E+02	2.875E+01	8.021E+03	5.389E-01
2095	1.176E+04	6.422E+06	4.315E+02	2.762E+01	7.706E+03	5.178E-01
2096	1.129E+04	6.170E+06	4.146E+02	2.654E+01	7.404E+03	4.975E-01
2097	1.085E+04	5.928E+06	3.983E+02	2.550E+01	7.114E+03	4.780E-01
2098	1.043E+04	5.696E+06	3.827E+02	2.450E+01	6.835E+03	4.592E-01
2099	1.002E+04	5.472E+06	3.677E+02	2.354E+01	6.567E+03	4.412E-01
2100	9.624E+03	5.258E+06	3.533E+02	2.262E+01	6.309E+03	4.239E-01
2101	9.247E+03	5.052E+06	3.394E+02	2.173E+01	6.062E+03	4.073E-01
2102	8.885E+03	4.854E+06	3.261E+02	2.088E+01	5.824E+03	3.913E-01
2103	8.536E+03	4.663E+06	3.133E+02	2.006E+01	5.596E+03	3.760E-01
2104	8.201E+03	4.480E+06	3.010E+02	1.927E+01	5.377E+03	3.612E-01
2105	7.880E+03	4.305E+06	2.892E+02	1.852E+01	5.166E+03	3.471E-01
2106	7.571E+03	4.136E+06	2.779E+02	1.779E+01	4.963E+03	3.335E-01
2107	7.274E+03	3.974E+06	2.670E+02	1.709E+01	4.769E+03	3.204E-01
2108	6.989E+03	3.818E+06	2.565E+02	1.642E+01	4.582E+03	3.078E-01
2109	6.715E+03	3.668E+06	2.465E+02	1.578E+01	4.402E+03	2.958E-01
2110	6.451E+03	3.524E+06	2.368E+02	1.516E+01	4.229E+03	2.842E-01
2111	6.199E+03	3.386E+06	2.275E+02	1.457E+01	4.063E+03	2.730E-01
2112	5.955E+03	3.253E+06	2.186E+02	1.399E+01	3.904E+03	2.623E-01
2113	5.722E+03	3.126E+06	2.100E+02	1.345E+01	3.751E+03	2.520E-01
2114	5.498E+03	3.003E+06	2.018E+02	1.292E+01	3.604E+03	2.422E-01
2115	5.282E+03	2.886E+06	1.939E+02	1.241E+01	3.463E+03	2.327E-01
2116	5.075E+03	2.772E+06	1.863E+02	1.193E+01	3.327E+03	2.235E-01
2117	4.876E+03	2.664E+06	1.790E+02	1.146E+01	3.196E+03	2.148E-01
2118	4.685E+03	2.559E+06	1.720E+02	1.101E+01	3.071E+03	2.063E-01

Coffin Butte 2021 Gas Generation Model

Assumptions and Notes

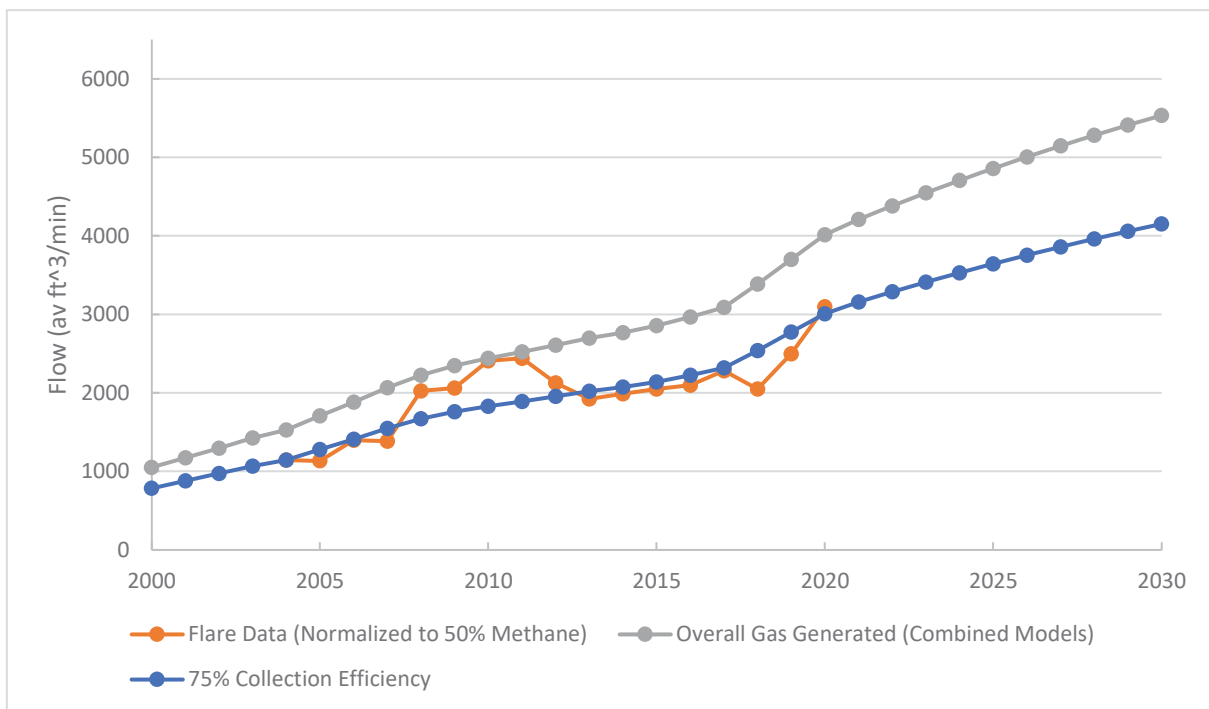
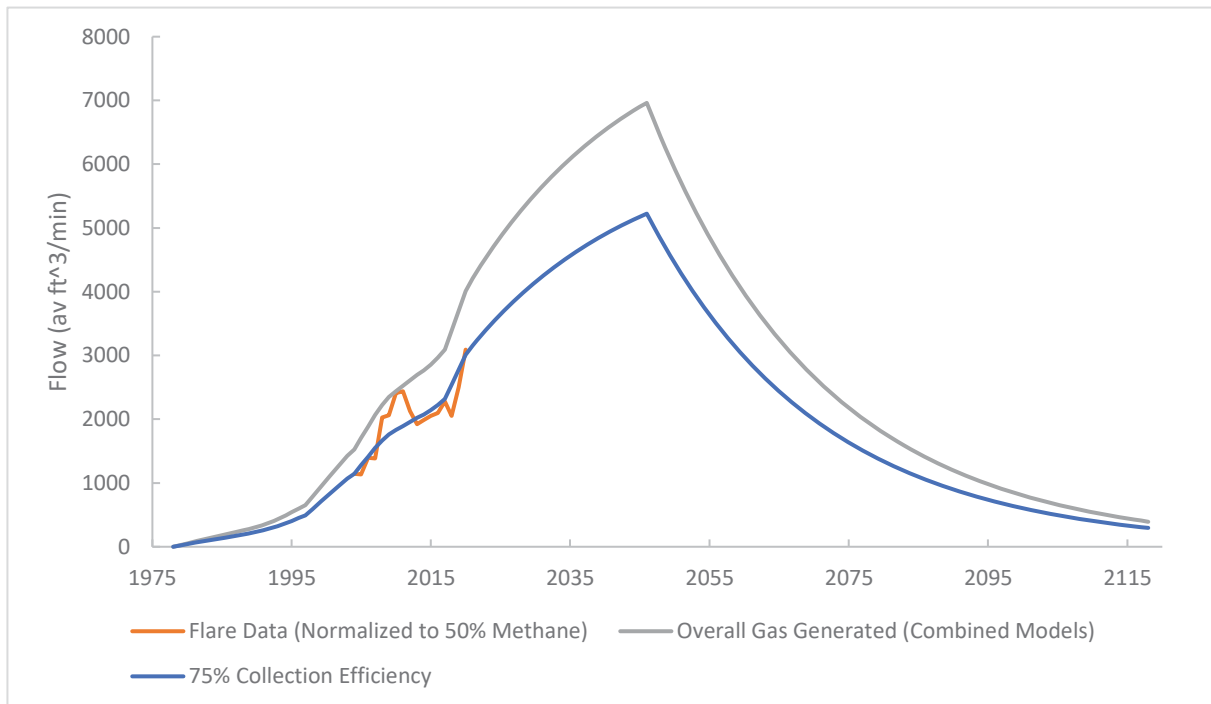
- 1) Waste composition from 2020 to end of model based on historical and current waste composition.
 - **MSW:** 70.5%, **C&D:** 3%, **Inert:** 15.5%, **Organics:** 3%, **Special:** 8%
- 2) Collection efficiency was calculated using historical collection data and the model's projected generation
- 3) Waste categories have the L₀ and k values listed in the "Gas Production by Waste Type" tab.
- 4) Waste acceptance in 2021 to end of of model will be 800,000 tons, as suggested by Republic
- 5) Flare data was provided by Republic from SCSe tools.

	Waste Accepted	Flare Data (Normalized to 50% Methane)	Overall Gas Generated (Combined Models)	Collection Efficiency	75% Collection Efficiency
Year	(tons)	(av ft ³ /min)	(av ft ³ /min)	(%)	(%)
1978	75000		0.00		0.00
1979	78000		25.92		19.44
1980	81000		51.86		38.89
1981	84000		77.82		58.36
1982	87000		103.79		77.84
1983	90000		129.79		97.34
1984	94000		154.07		115.55
1985	98000		178.71		134.03
1986	102000		203.69		152.77
1987	104000		228.99		171.74
1988	114000		253.96		190.47
1989	146000		279.02		209.26
1990	151000		312.93		234.69
1991	155000		347.04		260.28
1992	200000		381.05		285.78
1993	255937		427.54		320.66
1994	269063		484.48		363.36
1995	269063		542.97		407.23
1996	269063		599.16		449.37
1997	379210		653.16		489.87
1998	395447		780.92		585.69
1999	408055		913.21		684.91
2000	409851		1049.49		787.12
2001	425993		1171.20		878.40
2002	453458		1296.67		972.50
2003	550660		1424.75		1068.56
2004	586561.65	1146.03	1526.80	75.1%	1145.10
2005	572347.22	1134.59	1706.44	66.5%	1279.83
2006	618341.00	1396.16	1881.40	74.2%	1411.05
2007	546998.22	1386.53	2065.92	67.1%	1549.44
2008	527316.09	2024.98	2224.17	91.0%	1668.13
2009	500692.92	2060.32	2348.33	87.7%	1761.24
2010	458587.75	2407.60	2440.84	98.6%	1830.63
2011	483034.63	2439.52	2522.30	96.7%	1891.73
2012	473551.03	2126.14	2608.21	81.5%	1956.15
2013	479108.83	1922.90	2695.45	71.3%	2021.58
2014	499769.33	1988.07	2765.96	71.9%	2074.47
2015	528945.79	2049.93	2854.01	71.8%	2140.50
2016	555899.04	2099.45	2964.76	70.8%	2223.57
2017	944842.77	2279.49	3089.36	73.8%	2317.02
2018	1013887.57	2049.67	3385.14	60.5%	2538.86
2019	1043494.30	2496.95	3698.36	67.5%	2773.77
2020	859924.27	3094.66	4011.17	77.2%	3008.38
2021	800000		4209.18		3156.89
2022	800000		4381.42		3286.06

	Waste Accepted	Flare Data (Normalized to 50% Methane)	Overall Gas Generated (Combined Models)	Collection Efficiency	75% Collection Efficiency
Year	(tons)	(av ft ³ /min)	(av ft ³ /min)	(%)	(%)
2023	800000		4546.77		3410.07
2024	800000		4705.50		3529.12
2025	800000		4857.88		3643.41
2026	800000		5004.18		3753.13
2027	800000		5144.62		3858.47
2028	800000		5279.45		3959.59
2029	800000		5408.90		4056.68
2030	800000		5533.18		4149.88
2031	800000		5652.49		4239.37
2032	800000		5767.04		4325.28
2033	800000		5877.02		4407.77
2034	800000		5982.61		4486.96
2035	800000		6083.99		4562.99
2036	800000		6181.32		4635.99
2037	800000		6274.77		4706.08
2038	800000		6364.50		4773.37
2039	800000		6450.65		4837.99
2040	800000		6533.37		4900.02
2041	800000		6612.79		4959.59
2042	800000		6689.04		5016.78
2043	800000		6762.26		5071.70
2044	800000		6832.57		5124.43
2045	800000		6900.07		5175.06
2046			6964.89		5223.67
2047			6690.83		5018.12
2048			6427.59		4820.69
2049			6174.75		4631.06
2050			5931.89		4448.92
2051			5698.63		4273.97
2052			5474.57		4105.93
2053			5259.36		3944.52
2054			5052.64		3789.48
2055			4854.08		3640.56
2056			4663.35		3497.51
2057			4480.14		3360.11
2058			4304.17		3228.12
2059			4135.13		3101.35
2060			3972.75		2979.57
2061			3816.78		2862.59
2062			3666.96		2750.22
2063			3523.04		2642.28
2064			3384.79		2538.59
2065			3251.98		2438.99
2066			3124.41		2343.31
2067			3001.86		2251.40
2068			2884.14		2163.11
2069			2771.05		2078.29
2070			2662.42		1996.81
2071			2558.06		1918.54
2072			2457.80		1843.35
2073			2361.49		1771.12
2074			2268.97		1701.73
2075			2180.09		1635.07
2076			2094.71		1571.03

	Waste Accepted	Flare Data (Normalized to 50% Methane)	Overall Gas Generated (Combined Models)	Collection Efficiency	75% Collection Efficiency
Year	(tons)	(av ft ³ /min)	(av ft ³ /min)	(%)	(%)
2077			2012.68		1509.51
2078			1933.88		1450.41
2079			1858.17		1393.63
2080			1785.44		1339.08
2081			1715.57		1286.68
2082			1648.44		1236.33
2083			1583.95		1187.97
2084			1522.00		1141.50
2085			1462.47		1096.85
2086			1405.29		1053.97
2087			1350.35		1012.76
2088			1297.56		973.17
2089			1246.85		935.14
2090			1198.13		898.59
2091			1151.31		863.49
2092			1106.34		829.75
2093			1063.13		797.35
2094			1021.61		766.21
2095			981.72		736.29
2096			943.40		707.55
2097			906.58		679.93
2098			871.20		653.40
2099			837.20		627.90
2100			804.54		603.41
2101			773.16		579.87
2102			743.01		557.26
2103			714.04		535.53
2104			686.20		514.65
2105			659.45		494.59
2106			633.75		475.31
2107			609.06		456.79
2108			585.33		439.00
2109			562.53		421.90
2110			540.62		405.47
2111			519.57		389.68
2112			499.34		374.51
2113			479.90		359.93
2114			461.23		345.92
2115			443.28		332.46
2116			426.03		319.53
2117			409.46		307.10
2118			393.54		295.15

Overall Gas Generated



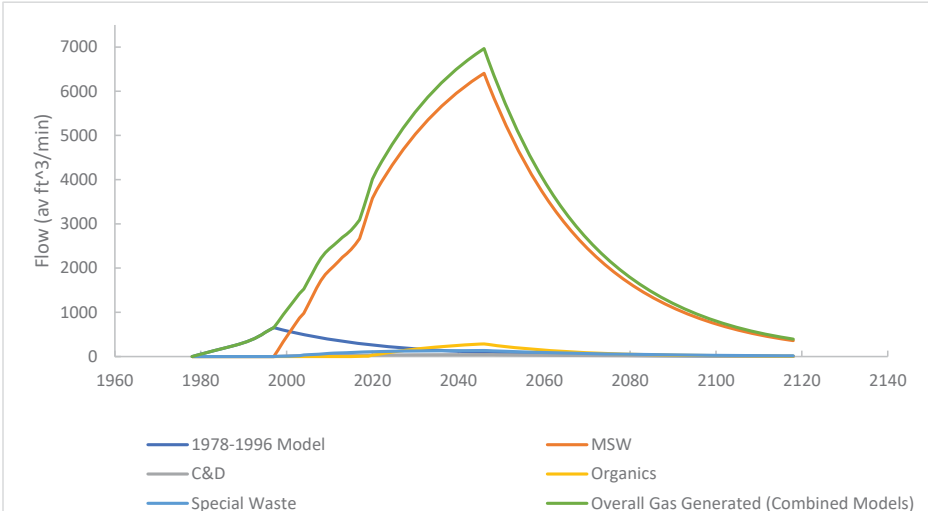
Gas Generation and Waste Accepted by Waste Type

Year	1978-1996 Model		MSW		C&D		Organics		Special Waste		Inert		Overall Gas Generated (Combined Models)					
	L ₀ : 80 k: 0.04	L ₀ : 115 k: 0.04	L ₀ : 130 k: 0.05	L ₀ : 20 k: 0.03	L ₀ : 20 k: 0.03	L ₀ : 0 k: 0	L ₀ : 0 k: 0	L ₀ : 0 k: 0										
	Waste Accepted (tons)	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	
1978	75000	0.00			0.00			0.00			0.00			0.00			75000.0	0.00
1979	78000	25.92			0.00			0.00			0.00			0.00			78000.0	25.92
1980	81000	51.86			0.00			0.00			0.00			0.00			81000.0	51.86
1981	84000	77.82			0.00			0.00			0.00			0.00			84000.0	77.82
1982	87000	103.79			0.00			0.00			0.00			0.00			87000.0	103.79
1983	90000	129.79			0.00			0.00			0.00			0.00			90000.0	129.79
1984	94000	154.07			0.00			0.00			0.00			0.00			94000.0	154.07
1985	98000	178.71			0.00			0.00			0.00			0.00			98000.0	178.71
1986	102000	203.69			0.00			0.00			0.00			0.00			102000.0	203.69
1987	104000	228.99			0.00			0.00			0.00			0.00			104000.0	228.99
1988	114000	253.96			0.00			0.00			0.00			0.00			114000.0	253.96
1989	146000	279.02			0.00			0.00			0.00			0.00			146000.0	279.02
1990	151000	312.93			0.00			0.00			0.00			0.00			151000.0	312.93
1991	155000	347.04			0.00			0.00			0.00			0.00			155000.0	347.04
1992	200000	381.05			0.00			0.00			0.00			0.00			200000.0	381.05
1993	255937	427.54			0.00			0.00			0.00			0.00			255937.0	427.54
1994	269063	484.48			0.00			0.00			0.00			0.00			269063.0	484.48
1995	269063	542.97			0.00			0.00			0.00			0.00			269063.0	542.97
1996	269063	599.16			0.00			0.00			0.00			0.00			269063.0	599.16
1997	653.16	265852.0	70.1	0.00	46690.0	12.3	0.00		45082.0	11.9	0.00	21586.0	5.7	0.00	379210.0	653.16		
1998	627.55	283395.0	71.7	146.74	50312.0	12.7	3.38		38467.0	9.7	3.26	23273.0	5.9	0.00	395447.0	780.92		
1999	602.94	299558.0	73.4	297.41	54668.0	13.4	6.92		36824.0	9.0	5.95	17005.0	4.2	0.00	408055.0	913.21		
2000	579.30	282620.0	69.0	451.09	52476.0	12.8	10.66		39986.0	9.8	8.43	34769.0	8.5	0.00	409851.0	1049.49		
2001	556.58	297873.0	69.9	589.40	50933.0	12.0	14.14		42110.0	9.9	11.08	35077.0	8.2	0.00	425993.0	1171.20		
2002	534.76	307058.0	67.7	730.71	50287.0	11.1	17.41		76079.0	16.8	13.79	20034.0	4.4	0.00	453458.0	1296.67		
2003	513.79	251856.0	45.7	871.54	38318.0	7.0	20.53		217707.0	39.5	18.89	42779.0	7.8	0.00	550660.0	1424.75		
2004	493.64	418075.3	71.3	976.38	16772.0	2.9	22.70		96563.0	16.5	34.07	55151.4	9.4	0.00	586561.7	1526.80		
2005	474.29	422807.3	73.9	1168.86	25573.2	4.5	23.24		83513.5	14.6	40.05	40453.2	7.1	0.00	572347.2	1706.44		
2006	455.69	449037.0	72.6	1356.40	32200.0	5.2	24.40		102845.0	16.6	44.91	34259.0	5.5	0.00	618341.0	1881.40		
2007	437.82	417750.7	76.4	1551.07	20066.6	3.7	26.01		89634.5	16.4	51.02	19546.5	3.6	0.00	546998.2	2065.92		
2008	420.66	365353.5	69.3	1720.83	11307.4	2.1	26.69		111850.7	21.2	55.99	38804.5	7.4	0.00	527316.1	2224.17		
2009	404.16	311835.9	62.3	1855.02	9334.0	1.9	26.72		151182.2	30.2	62.42	28340.8	5.7	0.00	500692.9	2348.33		
2010	388.31	304803.2	66.5	1954.41	6884.0	1.5	26.60		103498.7	22.6	71.51	43401.8	9.5	0.00	458587.8	2440.84		
2011	373.09	322017.5	66.7	2046.01	8090.8	1.7	26.32		75795.7	15.7	76.88	77130.6	16.0	0.00	483034.6	2522.30		
2012	358.46	333075.3	70.3	2143.53	6963.0	1.5	26.12		57172.4	12.1	80.09	76340.4	16.1	0.00	473551.0	2608.21		
2013	344.40	306905.1	64.1	2243.33	10436.7	2.2	25.86		69313.8	14.5	81.86	92453.3	19.3	0.00	479108.8	2695.45		
2014	330.90	338242.9	67.7	2324.76	23514.0	4.7	25.85		97269.0	19.5	84.45	40743.4	8.2	0.00	499769.3	2765.96		
2015	317.92	379734.0	71.8	2420.31	20019.7	3.8	26.78	2871.2	0.5	0.00	114271.8	21.6	88.99	12049.0	2.3	0.00	528945.8	2854.01
2016	305.46	418705.8	75.3	2535.00	14133.0	2.5	27.44	2958.6	0.5	2.23	72823.7	13.1	94.63	47278.0	8.5	0.00	555899.0	2964.76
2017	293.48	733666.1	77.6	2666.72	20768.3	2.2	27.65	3088.1	0.3	4.42	95369.3	10.1	97.10	91951.0	9.7	0.00	944842.8	3089.36
2018	281.97	780921.6	77.0	2967.11	21229.9	2.1	28.33	3059.1	0.3	6.60	135685.9	13.4	101.12	72991.0	7.2	0.00	1013887.6	3385.14
2019	270.92	767375.4	73.5	3281.81	28746.8	2.8	29.03	29816.3	2.9	8.65	107788.4	10.3	107.95	109767.4	10.5	0.00	1043494.3	3698.36
2020	260.29	601846.5	70.0	3576.69	27222.0	3.2	30.25	19517.9	2.3	31.38	87632.2	7.9	112.55	143705.6	16.7	0.00	859924.3	4011.17
2021	250.09	564000.0		3768.64	24000.0		31.33	24000.0		45.01	64000.0		114.12	124000.0		0.00	800000.0	4209.18
2022	240.28	564000.0		3932.18	24000.0		32.14	24000.0		61.45	64000.0		115.37	124000.0		0.00	800000.0	4381.42
2023	230.86	564000.0		4089.30	24000.0		32.92	24000.0		77.09	64000.0		116.59	124000.0		0.00	800000.0	4546.77
2024	221.81	564000.0		4240.27	24000.0		33.69	24000.0		91.96	64000.0		117.77	124000.0		0.00	800000.0	4705.50
2025	213.11	564000.0		4385.31	24000.0		34.43	24000.0		106.11	64000.0		118.92	124000.0		0.00	800000.0	4857.88
2026	204.76	564000.0		4524.67	24000.0		35.14	24000.0		119.57	64000.0		120.03	124000.0		0.00	800000.0	5004.18
2027	196.73	564000.0		4658.56	24000.0		35.84	24000.0		132.38	64000.0		121.12	124000.0		0.00	800000.0	5144.62
2028	189.01	564000.0		4787.20	24000.0		36.52	24000.0		144.56	64000.0		122.16	124000.0		0.00	800000.0	5279.45
2029	181.60	564000.0		4910.80	24000.0		37.17	24000.0		156.14	64000.0		123.18	124000.0		0.00	800000.0	5408.90
2030	174.48	564000.0		5029.55	24000.0		37.81	24000.0		167.16	64000.0		124.17	124000.0		0.00	800000.0	5533.18
2031	167.64	564000.0		5143.65	24000.0		38.43	24000.0		177.64	64000.0		125.13	124000.0		0.00	800000.0	5652.49
2032	161.07	564000.0		5253.27	24000.0		39.03	24000.0		187.62	64000.0		126.06	124000.0		0.00	800000.0	5767.04
2033	154.75	564000.0		5358.60	24000.0		39.61	24000.0		197.10	64000.0		126.96	124000.0		0.00	800000.0	5877.02
2034	148.68	564000.0		5459.79	24000.0		40.18	24000.0		206.12	64000.0		127.84	124000.0		0.00	800000.0	5982.61

	1978-1996 Model		MSW				C&D				Organics				Special Waste				Inert				Overall Gas Generated (Combined Models)	
	L_0: 80 k: 0.04		L_0: 115 k: 0.04		L_0: 20 k: 0.03		L_0: 130 k: 0.05		L_0: 20 k: 0.03		L_0: 0 k: 0													
Year	Waste Accepted (tons)	Flow (av ft³/min)	Waste Accepted (tons)	% Total	Flow (av ft³/min)	Waste Accepted (tons)	% Total	Flow (av ft³/min)	Waste Accepted (tons)	% Total	Flow (av ft³/min)	Waste Accepted (tons)	% Total	Flow (av ft³/min)	Waste Accepted (tons)	% Total	Flow (av ft³/min)	Waste Accepted (tons)	% Total	Flow (av ft³/min)	Waste Accepted (tons)	Flow (av ft³/min)		
2035		142.85	564000.0		5557.02	24000.0		40.72	24000.0		214.71	64000.0		128.69	124000.0		0.00	800000.0		6083.99				
2036		137.25	564000.0		5650.43	24000.0		41.26	24000.0		222.87	64000.0		129.51	124000.0		0.00	800000.0		6181.32				
2037		131.87	564000.0		5740.18	24000.0		41.77	24000.0		230.64	64000.0		130.31	124000.0		0.00	800000.0		6274.77				
2038		126.70	564000.0		5826.41	24000.0		42.27	24000.0		238.02	64000.0		131.09	124000.0		0.00	800000.0		6364.50				
2039		121.73	564000.0		5909.26	24000.0		42.76	24000.0		245.05	64000.0		131.84	124000.0		0.00	800000.0		6450.65				
2040		116.96	564000.0		5988.86	24000.0		43.23	24000.0		251.73	64000.0		132.58	124000.0		0.00	800000.0		6533.37				
2041		112.37	564000.0		6065.35	24000.0		43.69	24000.0		258.09	64000.0		133.29	124000.0		0.00	800000.0		6612.79				
2042		107.97	564000.0		6138.83	24000.0		44.13	24000.0		264.14	64000.0		133.98	124000.0		0.00	800000.0		6689.04				
2043		103.73	564000.0		6209.43	24000.0		44.57	24000.0		269.89	64000.0		134.64	124000.0		0.00	800000.0		6762.26				
2044		99.67	564000.0		6277.26	24000.0		44.98	24000.0		275.37	64000.0		135.29	124000.0		0.00	800000.0		6832.57				
2045		95.76	564000.0		6342.43	24000.0		45.39	24000.0		280.57	64000.0		135.92	124000.0		0.00	800000.0		6900.07				
2046		92.00			6405.05			45.78			285.52			136.53						6964.89				
2047		88.40			6153.90			44.43			271.60			132.50						6690.83				
2048		84.93			5912.61			43.12			258.35			128.58						6427.59				
2049		81.60			5680.77			41.84			245.75			124.78						6174.75				
2050		78.40			5458.02			40.61			233.77			121.09						5931.89				
2051		75.33			5244.01			39.41			222.37			117.52						5698.63				
2052		72.37			5038.39			38.24			211.52			114.04						5474.57				
2053		69.53			4840.83			37.11			201.21			110.67						5259.36				
2054		66.81			4651.02			36.02			191.39			107.40						5052.64				
2055		64.19			4468.65			34.95			182.06			104.23						4854.08				
2056		61.67			4293.43			33.92			173.18			101.15						4663.35				
2057		59.25			4125.09			32.92			164.73			98.16						4480.14				
2058		56.93			3963.34			31.94			156.70			95.26						4304.17				
2059		54.70			3807.93			31.00			149.06			92.44						4135.13				
2060		52.55			3658.62			30.08			141.79			89.71						3972.75				
2061		50.49			3515.17			29.19			134.87			87.06						3816.78				
2062		48.51			3377.33			28.33			128.29			84.49						3666.96				
2063		46.61			3244.91			27.49			122.04			81.99						3523.04				
2064		44.78			3117.67			26.68			116.09			79.57						3384.79				
2065		43.03			2995.43			25.89			110.42			77.21						3251.98				
2066		41.34			2877.97			25.13			105.04			74.93						3124.41				
2067		39.72			2765.13			24.38			99.92			72.72						3001.86				
2068		38.16			2656.71			23.66			95.04			70.57						2884.14				
2069		36.66			2552.53			22.96			90.41			68.48						2771.05				
2070		35.23			2452.45			22.29			86.00			66.46						2662.42				
2071		33.85			2356.29			21.63			81.80			64.49						2558.06				
2072		32.52			2263.89			20.99			77.81			62.59						2457.80				
2073		31.24			2175.13			20.37			74.02			60.74						2361.49				
2074		30.02			2089.84			19.77			70.41			58.94						2268.97				
2075		28.84			2007.89			19.18			66.98			57.20						2180.09				
2076		27.71			1929.16			18.61			63.71			55.51						2094.71				
2077		26.62			1853.52			18.06			60.60			53.87						2012.68				
2078		25.58			1780.84			17.53			57.65			52.28						1933.88				
2079		24.58			1711.01			17.01			54.83			50.73						1858.17				
2080		23.61			1643.92			16.51			52.16			49.23						1785.44				
2081		22.69			1579.47			16.02			49.62			47.78						1715.57				
2082		21.80			1517.53			15.55			47.20			46.37						1648.44				
2083		20.94			1458.03			15.09			44.89			45.00						1583.95				
2084		20.12			1400.86			14.64			42.71			43.67						1522.00				
2085		19.33			1345.93			14.21			40.62			42.38						1462.47				
2086		18.57			1293.16			13.79			38.64			41.12						1405.29				
2087		17.85			1242.45			13.38			36.76			39.91						1350.35				
2088		17.15			1193.73			12.99			34.96			38.73						1297.56				
2089		16.47			1146.93			12.60			33.26			37.58						1246.85				
2090		15.83			1101.96			12.23			31.64			36.47						1198.13				
2091		15.21			1058.75			11.87			30.09			35.40						1151.31				
2092		14.61			1017.23			11.52			28.63			34.35						1106.34				
2093		14.04			977.35			11.18			27.23			33.33						1063.13				

Year	1978-1996 Model		MSW			C&D			Organics			Special Waste			Inert			Overall Gas Generated (Combined Models)	
	L_0: k:		L_0: k:			L_0: k:			L_0: k:			L_0: k:			L_0: k:			0 0	
	Waste Accepted (tons)	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	% Total	Flow (av ft³3/min)	Waste Accepted (tons)	Flow (av ft³3/min)
2094		13.49			939.02			10.85			25.90			32.35					1021.61
2095		12.96			902.21			10.53			24.64			31.39					981.72
2096		12.45			866.83			10.22			23.44			30.46					943.40
2097		11.96			832.84			9.91			22.29			29.56					906.58
2098		11.49			800.18			9.62			21.21			28.69					871.20
2099		11.04			768.81			9.34			20.17			27.84					837.20
2100		10.61			738.66			9.06			19.19			27.02					804.54
2101		10.19			709.70			8.79			18.25			26.22					773.16
2102		9.79			681.87			8.53			17.36			25.45					743.01
2103		9.41			655.14			8.28			16.52			24.69					714.04
2104		9.04			629.45			8.04			15.71			23.96					686.20
2105		8.69			604.77			7.80			14.94			23.26					659.45
2106		8.35			581.05			7.57			14.22			22.57					633.75
2107		8.02			558.27			7.34			13.52			21.90					609.06
2108		7.70			536.38			7.13			12.86			21.25					585.33
2109		7.40			515.35			6.92			12.24			20.63					562.53
2110		7.11			495.14			6.71			11.64			20.02					540.62
2111		6.83			475.73			6.51			11.07			19.43					519.57
2112		6.57			457.07			6.32			10.53			18.85					499.34
2113		6.31			439.15			6.13			10.02			18.29					479.90
2114		6.06			421.93			5.95			9.53			17.75					461.23
2115		5.82			405.39			5.78			9.06			17.23					443.28
2116		5.59			389.49			5.61			8.62			16.72					426.03
2117		5.38			374.22			5.44			8.20			16.23					409.46
2118		5.16			359.55			5.28			7.80			15.75					393.54

Gas Generation by Waste Type





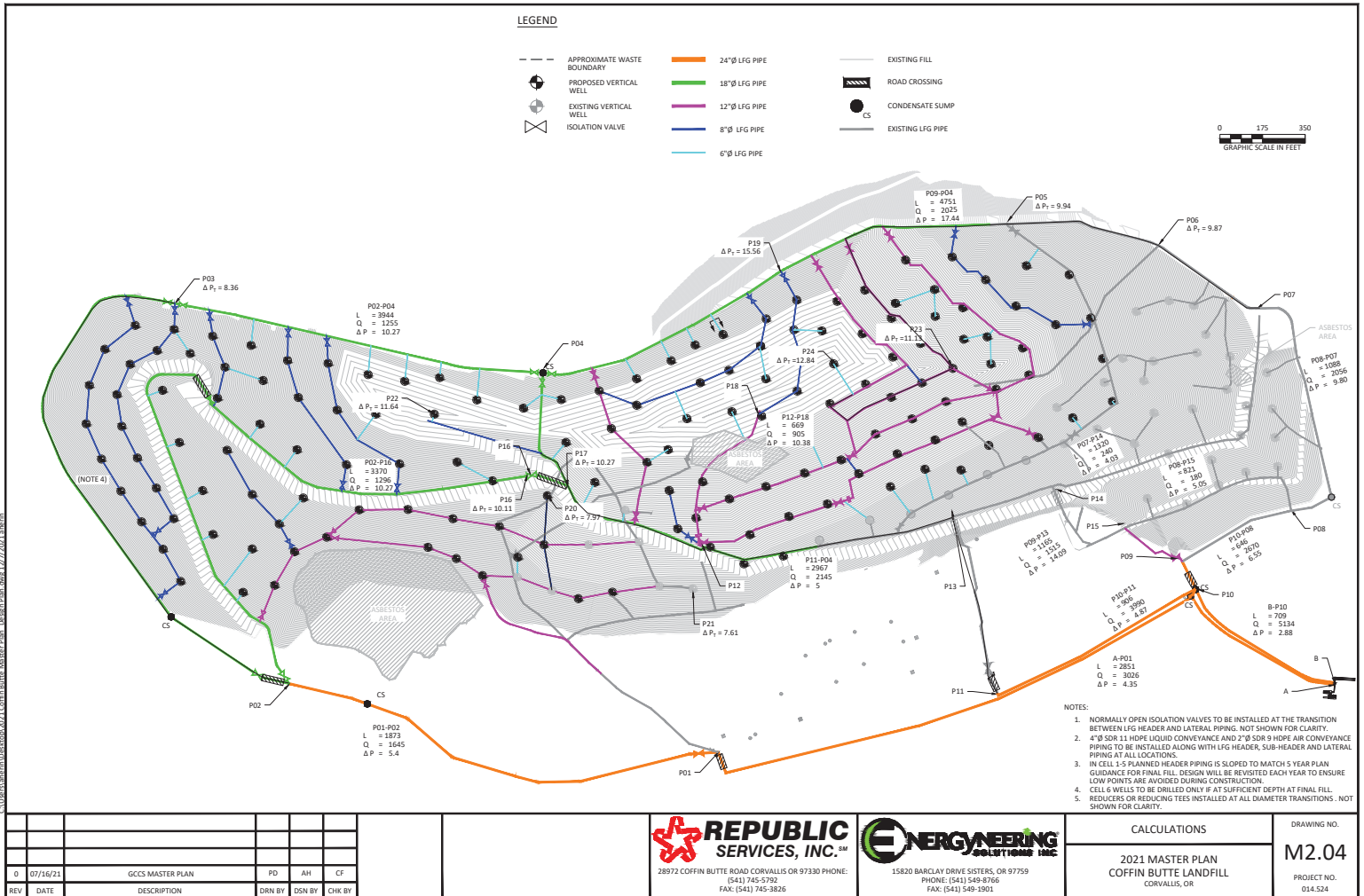
APPENDIX C: PRESSURE LOSS CALCULATIONS FOR LFG HEADER AND LATERAL PIPING

Coffin Butte Master Plan 2021

# Deep Wells	# Shallow Wells	Total Flow	LandGEM Flow (2047)
47	146	6965	6900

Blower Vacuum: 50" W.C.	Flow per Well	
Minimum Vacuum Need: 30" W.C.	Deep	Shallow
	55	30

Segments (Route from Facility to Point)						
Route	Deep	Shallow	Flow (Q)	Length (L)	Pipe Size (in)	Total Pressure Loss (ΔP_T)
A--1	17	55	2585	2851	24	4.4
B--10	30	91	4380	709	24	2.28
10--11	30	68	3690	906	24	4.87
9--13	15	23	1515	1165	12	14.09
11--4	15	44	2145	2967	18	5
1--2	7	42	1645	1873	24	5.4
2--4	7	29	1255	3944	18	10.27
2--16	19	10	1345	1296	18	10.11
11--12	8	33	1430	1815	18	8.01
12--18	11	10	905	669	12	10.38
18--19	5	1	305	657	8	15.56
9--4	15	40	2025	4751	18	17.44
7--14	0	8	240	1320	12	4.03
8--15	0	6	180	646	12	5.05
10--8	18	56	2670	646	18	6.55



LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment A - 21

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	2851
Flow (SCFM)	3026
Fluid Velocity (ft/min)	1,640.62
Fluid Velocity (ft/s)	27.34
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	4.44
Pressure Loss_sum (in WC)	4.44

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2269

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	2138
Flow (SCFM)	550
Fluid Velocity (ft/min)	1,042.58
Fluid Velocity (ft/s)	17.38
Pressure Loss/m (kPa/m)	0.0012
Pressure Loss (in WC)	3.17
Pressure Loss_sum (in WC)	7.61

< 3,500 ft/min
 < 58 ft/s
 < 0.2112

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment A - 20

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	2851
Flow (SCFM)	3026
Fluid Velocity (ft/min)	1,640.62
Fluid Velocity (ft/s)	27.34
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	4.44
Pressure Loss_sum (in WC)	4.44

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2269

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	1565
Flow (SCFM)	635
Fluid Velocity (ft/min)	1,203.70
Fluid Velocity (ft/s)	20.06
Pressure Loss/m (kPa/m)	0.0016
Pressure Loss (in WC)	3.00
Pressure Loss_sum (in WC)	7.44

< 3,500 ft/min
 < 58 ft/s
 < 0.212

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	8
Pipe Length (ft)	338
Flow (SCFM)	200
Fluid Velocity (ft/min)	821.22
Fluid Velocity (ft/s)	13.69
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	0.53
Pressure Loss_sum (in WC)	7.97

< 3,500 ft/min
 < 58 ft/s
 < 0.2094

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment B - 24

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	646
Flow (SCFM)	2670
Fluid Velocity (ft/min)	2,547.37
Fluid Velocity (ft/s)	42.46
Pressure Loss/m (kPa/m)	0.0040
Pressure Loss (in WC)	3.14
Pressure Loss_sum (in WC)	6.55

< 3,500 ft/min
 < 58 ft/s
 < 0.2165

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	1088
Flow (SCFM)	2056
Fluid Velocity (ft/min)	1,943.30
Fluid Velocity (ft/s)	32.39
Pressure Loss/m (kPa/m)	0.0024
Pressure Loss (in WC)	3.25

< 3,500 ft/min
 < 58 ft/s
 < 0.2003

Pressure Loss_sum (in WC)	9.80
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LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach
 Colebrook-White

SCFM is assumed with Standard Conditions

Segment B - 23

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	646
Flow (SCFM)	2670
Fluid Velocity (ft/min)	2,547.37
Fluid Velocity (ft/s)	42.46
Pressure Loss/m (kPa/m)	0.0040
Pressure Loss (in WC)	3.14
Pressure Loss_sum (in WC)	6.55

< 3,500 ft/min
 < 58 ft/s
 < 0.2165

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	1088
Flow (SCFM)	2056
Fluid Velocity (ft/min)	1,943.30
Fluid Velocity (ft/s)	32.39
Pressure Loss/m (kPa/m)	0.0024
Pressure Loss (in WC)	3.25
Pressure Loss_sum (in WC)	9.80

< 3,500 ft/min
 < 58 ft/s
 < 0.2003

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	496
Flow (SCFM)	390
Fluid Velocity (ft/min)	365.11

< 3,500 ft/min

Fluid Velocity (ft/s)	6.09	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0001	< 0.1999
Pressure Loss (in WC)	0.07	
Pressure Loss_sum (in WC)	9.87	

Length 2 (next closest to vacuum source)		
Type of Pipe	SDR_17_HDPE	
Pipe Size (in)	18	
Pipe Length (ft)	636	
Flow (SCFM)	330	
Fluid Velocity (ft/min)	308.87	< 3,500 ft/min
Fluid Velocity (ft/s)	5.15	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0001	< 0.1995
Pressure Loss (in WC)	0.07	
Pressure Loss_sum (in WC)	9.94	

Length 2 (next closest to vacuum source)		
Type of Pipe	SDR_17_HDPE	
Pipe Size (in)	18	
Pipe Length (ft)	677	
Flow (SCFM)	700	
Fluid Velocity (ft/min)	655.04	< 3,500 ft/min
Fluid Velocity (ft/s)	10.92	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0003	< 0.1981
Pressure Loss (in WC)	0.29	
Pressure Loss_sum (in WC)	10.23	

Length 2 (next closest to vacuum source)		
Type of Pipe	SDR_17_HDPE	
Pipe Size (in)	12	
Pipe Length (ft)	712	
Flow (SCFM)	510	
Fluid Velocity (ft/min)	950.35	< 3,500 ft/min
Fluid Velocity (ft/s)	15.84	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0010	< 0.1937
Pressure Loss (in WC)	0.89	
Pressure Loss_sum (in WC)	11.13	

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: B - 22

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	906
Flow (SCFM)	3690
Fluid Velocity (ft/min)	1,983.39
Fluid Velocity (ft/s)	33.06
Pressure Loss/m (kPa/m)	0.0018
Pressure Loss (in WC)	1.99
Pressure Loss_sum (in WC)	4.87

< 3,500 ft/min
 < 58 ft/s
 < 0.2248

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	2630
Flow (SCFM)	1845
Fluid Velocity (ft/min)	1,752.62
Fluid Velocity (ft/s)	29.21
Pressure Loss/m (kPa/m)	0.0020
Pressure Loss (in WC)	6.52
Pressure Loss_sum (in WC)	11.38

< 3,500 ft/min
 < 58 ft/s
 < 0.1924

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	8
Pipe Length (ft)	487
Flow (SCFM)	110
Fluid Velocity (ft/min)	446.47

< 3,500 ft/min

Fluid Velocity (ft/s)	7.44	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0004	< 0.1911
Pressure Loss (in WC)	0.26	
Pressure Loss_sum (in WC)	11.64	

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach
 Colebrook-White

SCFM is assumed with Standard Conditions

Segment 10 - 8

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	646
Flow (SCFM)	2670
Fluid Velocity (ft/min)	2,547.37
Fluid Velocity (ft/s)	42.46
Pressure Loss/m (kPa/m)	0.0040
Pressure Loss (in WC)	3.14
Pressure Loss_sum (in WC)	6.55

< 3,500 ft/min
 < 58 ft/s
 < 0.2165

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: 8 - 15

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	2670
Flow (SCFM)	760
Fluid Velocity (ft/min)	725.09
Fluid Velocity (ft/s)	12.08
Pressure Loss/m (kPa/m)	0.0004
Pressure Loss (in WC)	1.36
Pressure Loss_sum (in WC)	4.77

< 3,500 ft/min
 < 58 ft/s
 < 0.2253

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	821
Flow (SCFM)	240
Fluid Velocity (ft/min)	454.50
Fluid Velocity (ft/s)	7.58
Pressure Loss/m (kPa/m)	0.0003
Pressure Loss (in WC)	0.28
Pressure Loss_sum (in WC)	5.05

< 3,500 ft/min
 < 58 ft/s
 < 0.2239

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment 7 - 14

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	287
Flow (SCFM)	150
Fluid Velocity (ft/min)	285.22
Fluid Velocity (ft/s)	4.75
Pressure Loss/m (kPa/m)	0.0001
Pressure Loss (in WC)	0.04
Pressure Loss_sum (in WC)	3.45

< 3,500 ft/min
 < 58 ft/s
 < 0.2319

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	450
Flow (SCFM)	210
Fluid Velocity (ft/min)	399.26
Fluid Velocity (ft/s)	6.65
Pressure Loss/m (kPa/m)	0.0002
Pressure Loss (in WC)	0.12
Pressure Loss_sum (in WC)	3.57

< 3,500 ft/min
 < 58 ft/s
 < 0.2313

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	1354
Flow (SCFM)	240
Fluid Velocity (ft/min)	456.13

< 3,500 ft/min

Fluid Velocity (ft/s)	7.60	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0003	< 0.229
Pressure Loss (in WC)	0.46	
Pressure Loss_sum (in WC)	4.03	

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment 9 - 4

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	4751
Flow (SCFM)	2025
Fluid Velocity (ft/min)	1,932.00
Fluid Velocity (ft/s)	32.20
Pressure Loss/m (kPa/m)	0.0024
Pressure Loss (in WC)	14.03
Pressure Loss_sum (in WC)	17.44

< 3,500 ft/min
 < 58 ft/s
 < 0.1622

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: 18-19

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	906
Flow (SCFM)	3990
Fluid Velocity (ft/min)	2,144.64
Fluid Velocity (ft/s)	35.74
Pressure Loss/m (kPa/m)	0.0021
Pressure Loss (in WC)	2.29
Pressure Loss_sum (in WC)	5.17

< 3,500 ft/min
 < 58 ft/s
 < 0.2233

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	1815
Flow (SCFM)	1430
Fluid Velocity (ft/min)	1,357.17
Fluid Velocity (ft/s)	22.62
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	2.84
Pressure Loss_sum (in WC)	8.01

< 3,500 ft/min
 < 58 ft/s
 < 0.2092

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	669
Flow (SCFM)	905
Fluid Velocity (ft/min)	1,697.47

< 3,500 ft/min

Fluid Velocity (ft/s)	28.29	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0029	< 0.1974
Pressure Loss (in WC)	2.37	
Pressure Loss_sum (in WC)	10.38	

Length 2 (next closest to vacuum source)		
Type of Pipe	SDR_17_HDPE	
Pipe Size (in)	8	
Pipe Length (ft)	657	
Flow (SCFM)	501	
Fluid Velocity (ft/min)	2,039.46	< 3,500 ft/min
Fluid Velocity (ft/s)	33.99	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0065	< 0.1716
Pressure Loss (in WC)	5.19	
Pressure Loss_sum (in WC)	15.56	

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach
 Colebrook-White

SCFM is assumed with Standard Conditions

Segment 12 - 18

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	906
Flow (SCFM)	3990
Fluid Velocity (ft/min)	2,144.64
Fluid Velocity (ft/s)	35.74
Pressure Loss/m (kPa/m)	0.0021
Pressure Loss (in WC)	2.29
Pressure Loss_sum (in WC)	5.17

< 3,500 ft/min
 < 58 ft/s
 < 0.2233

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	1815
Flow (SCFM)	1430
Fluid Velocity (ft/min)	1,357.17
Fluid Velocity (ft/s)	22.62
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	2.84
Pressure Loss_sum (in WC)	8.01

< 3,500 ft/min
 < 58 ft/s
 < 0.2092

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	669
Flow (SCFM)	905
Fluid Velocity (ft/min)	1,697.47

< 3,500 ft/min

Fluid Velocity (ft/s)	28.29	< 58 ft/s
Pressure Loss/m (kPa/m)	0.0029	< 0.1974
Pressure Loss (in WC)	2.37	
Pressure Loss_sum (in WC)	10.38	

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: 11 - 12

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	906
Flow (SCFM)	3990
Fluid Velocity (ft/min)	2,144.64
Fluid Velocity (ft/s)	35.74
Pressure Loss/m (kPa/m)	0.0021
Pressure Loss (in WC)	2.29
Pressure Loss_sum (in WC)	5.17

< 3,500 ft/min
 < 58 ft/s
 < 0.2233

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	1815
Flow (SCFM)	1430
Fluid Velocity (ft/min)	1,357.17
Fluid Velocity (ft/s)	22.62
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	2.84
Pressure Loss_sum (in WC)	8.01

< 3,500 ft/min
 < 58 ft/s
 < 0.2092

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment 2 - 16

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	2851
Flow (SCFM)	3026
Fluid Velocity (ft/min)	1,640.62
Fluid Velocity (ft/s)	27.34
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	4.44
Pressure Loss_sum (in WC)	4.44

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2269

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	1873
Flow (SCFM)	1645
Fluid Velocity (ft/min)	880.06
Fluid Velocity (ft/s)	14.67
Pressure Loss/m (kPa/m)	0.0004
Pressure Loss (in WC)	0.95
Pressure Loss_sum (in WC)	5.40

< 3,500 ft/min
 < 58 ft/s
 < 0.2222

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	3370
Flow (SCFM)	1345
Fluid Velocity (ft/min)	1,275.64
Fluid Velocity (ft/s)	21.26
Pressure Loss/m (kPa/m)	0.0011
Pressure Loss (in WC)	4.72
Pressure Loss_sum (in WC)	10.11

< 3,500 ft/min
 < 58 ft/s
 < 0.1987

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach
 Colebrook-White

SCFM is assumed with Standard Conditions

Segment 2 - 4

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	2851
Flow (SCFM)	3026
Fluid Velocity (ft/min)	1,640.62
Fluid Velocity (ft/s)	27.34
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	4.44
Pressure Loss_sum (in WC)	4.44

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2269

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	1873
Flow (SCFM)	1645
Fluid Velocity (ft/min)	880.06
Fluid Velocity (ft/s)	14.67
Pressure Loss/m (kPa/m)	0.0004
Pressure Loss (in WC)	0.95
Pressure Loss_sum (in WC)	5.40

< 3,500 ft/min
 < 58 ft/s
 < 0.2222

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	3944
Flow (SCFM)	1255
Fluid Velocity (ft/min)	1,190.28
Fluid Velocity (ft/s)	19.84
Pressure Loss/m (kPa/m)	0.0010
Pressure Loss (in WC)	4.88
Pressure Loss_sum (in WC)	10.27

< 3,500 ft/min
 < 58 ft/s
 < 0.1979

LFG Header Pressure Loss Calculations

1. Input data into **green** text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: 1 - 2

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	2851
Flow (SCFM)	3026
Fluid Velocity (ft/min)	1,640.62
Fluid Velocity (ft/s)	27.34
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	4.44
Pressure Loss_sum (in WC)	4.44

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2269

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	1873
Flow (SCFM)	1645
Fluid Velocity (ft/min)	880.06
Fluid Velocity (ft/s)	14.67
Pressure Loss/m (kPa/m)	0.0004
Pressure Loss (in WC)	0.95
Pressure Loss_sum (in WC)	5.40

< 3,500 ft/min
 < 58 ft/s
 < 0.2222

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment 11 - 4

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	906
Flow (SCFM)	3690
Fluid Velocity (ft/min)	1,983.39
Fluid Velocity (ft/s)	33.06
Pressure Loss/m (kPa/m)	0.0018
Pressure Loss (in WC)	1.99
Pressure Loss_sum (in WC)	4.87

< 3,500 ft/min
 < 58 ft/s
 < 0.2248

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	18
Pipe Length (ft)	2145
Flow (SCFM)	238
Fluid Velocity (ft/min)	226.08
Fluid Velocity (ft/s)	3.77
Pressure Loss/m (kPa/m)	0.0001
Pressure Loss (in WC)	0.14
Pressure Loss_sum (in WC)	5.00

< 3,500 ft/min
 < 58 ft/s
 < 0.2242

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach
 Colebrook-White

SCFM is assumed with Standard Conditions

Segment 9 - 13

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	840
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	3.41
Pressure Loss_sum (in WC)	3.41

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2321

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	12
Pipe Length (ft)	1165
Flow (SCFM)	1515
Fluid Velocity (ft/min)	2,880.73
Fluid Velocity (ft/s)	48.01
Pressure Loss/m (kPa/m)	0.0075
Pressure Loss (in WC)	10.69
Pressure Loss_sum (in WC)	14.09

< 3,500 ft/min
 < 58 ft/s
 < 0.1789

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH4 + 50%CO2.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment 10 - 11

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

Length 2 (next closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	906
Flow (SCFM)	3690
Fluid Velocity (ft/min)	1,983.39
Fluid Velocity (ft/s)	33.06
Pressure Loss/m (kPa/m)	0.0018
Pressure Loss (in WC)	1.99
Pressure Loss_sum (in WC)	4.87

< 3,500 ft/min
 < 58 ft/s
 < 0.2248

LFG Header Pressure Loss Calculations

1. Input data into green text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: B - 1

SCFM is assumed with Standard Conditions

Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	709
Flow (SCFM)	5134
Fluid Velocity (ft/min)	2,783.53
Fluid Velocity (ft/s)	46.39
Pressure Loss/m (kPa/m)	0.0033
Pressure Loss (in WC)	2.88
Pressure Loss_sum (in WC)	2.88

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"
 Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2348

LFG Header Pressure Loss Calculations

1. Input data into **green** text cells
2. LFG 'Rule of Thumb': Fluid Velocity < ~3,500 ft/min
3. Gases and Vapors General 'Rule of Thumb': Fluid Velocity < 15-30 m/s
4. Gases and Vapors General 'Rule of Thumb': kPa/m < 0.02 percent of line pressure

Assumptions

Standard Conditions
 Temperature: 68
 Relative Humidity: 0%
 Barometric Pressure: 14.7 psi
 Viscosity based off 50%CH₄ + 50%CO₂.
 Density:

Fittings are not incorporated in this program

Equations Used:

Darcy-Weisbach

Colebrook-White

Segment: A - 1

SCFM is assumed with Standard Conditions

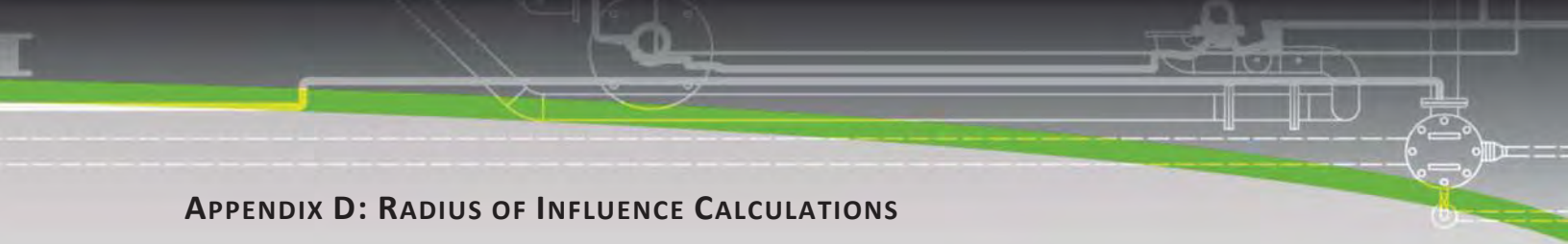
Site Conditions	
System Vacuum (in WC)	50
Fluid Temp (F)	100
Fluid Relative Humidity (%)	100%
Local Barometric Pressure (psi)	14.7

add equations Darcy, colebrook-white
 reference conditions
 SCFM defined at 68, 0%, 14.7 psi
 add "no fittings"

Length 1 (closest to vacuum source)	
Type of Pipe	SDR_17_HDPE
Pipe Size (in)	24
Pipe Length (ft)	2851
Flow (SCFM)	3026
Fluid Velocity (ft/min)	1,640.62
Fluid Velocity (ft/s)	27.34
Pressure Loss/m (kPa/m)	0.0013
Pressure Loss (in WC)	4.44
Pressure Loss_sum (in WC)	4.44

Verify density
 add "viscosity 50%50%"

< 3,500 ft/min
 < 58 ft/s
 < 0.2269



APPENDIX D: RADIUS OF INFLUENCE CALCULATIONS

ESI Radius of Influence Calculator

Site: Coffin Butte Landfill
Location: Corvallis, Oregon
Project: 2021 GCCS Design Plan

How to use program:

1. Input length of solid pipe. (Min 20 feet)
2. Select a Permeability Ratio.
3. Select the type of grade if near a slope, or flat surface.
4. Selete type of Landfill Conditions, or Select "User Input" if the conditions are known.

Assumptions:

- Verticle Well located at the edge of slope (if a slope is used).
- The location of the pressure is a foot away from the center of the pipe and assuming. the edge of the ROI is zero. Pressure at well head would need to be slightly higher than the one calculated.

The drawing on the right will automatically update as inputs are calculated. This gives a basic visual representation of what is happening inside of the landfill.

Pipe Conditions			
Length of Solid Pipe (ft)	20	MIN. 20 ft	
Length of Perferated Pipe (ft)	60		
Permeability Ratio	4:1 (Average)		
Slope of Grade	3:1 (Typical)		
Landfill Conditions			
Waste Type	Higher Density	Values based on Selected Waste Type	
G _M (User Input Only) (ft ³ /lb-yr)		G _M	0.1
ρ _w (User Input Only) (lb/yd ³)		ρ _w	2000
K (User Input Only) (cm/sec)		K	0.0005
Max Radius of Influence			
Max Radius of Influence (ft)	48.0		
Vacuum Pressure Needed to obtain ROI			
Vacuum Pressure (in WC)	-0.72		

Definitions:

G_M = LFG generation rate per unit mass

ρ_w = Waste Density

K = Horizontal or radial landfill permeability with respect to LFG

If user is unsure about these values or conditions of the landfill, use the typical value where needed.

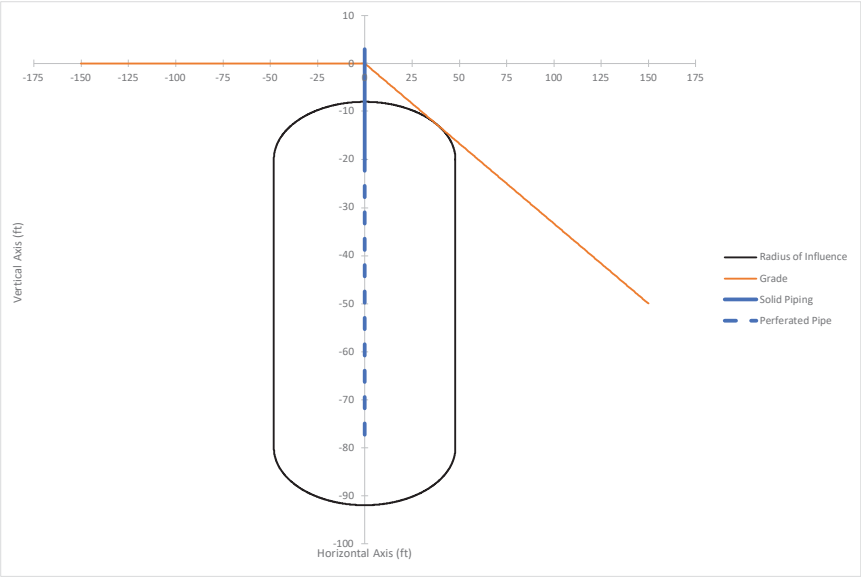
Equation Used:

$$\Delta\Psi = \frac{1}{3} \frac{G_M \rho_w}{K} \left(R_i^2 \ln R_i - \frac{1}{2} R_i^2 + \frac{1}{2} \right)$$

R_i = Radius of Influence

ΔΨ = Vacuum Headed

*Refer to Dillalah-McCarron-Balwinder SCS Model Report



ESI Radius of Influence Calculator

Site: Coffin Butte Landfill
Location: Corvallis, Oregon
Project: 2021 GCCS Design Plan

How to use program:

1. Input length of solid pipe. (Min 20 feet)
2. Select a Permeability Ratio.
3. Select the type of grade if near a slope, or flat surface.
4. Selete type of Landfill Conditions, or Select "User Input" if the conditions are known.

Assumptions:

- Verticle Well located at the edge of slope (if a slope is used).
- The location of the pressure is a foot away from the center of the pipe and assuming. the edge of the ROI is zero. Pressure at well head would need to be slightly higher than the one calculated.

The drawing on the right will automatically update as inputs are calculated. This gives a basic visual representation of what is happening inside of the landfill.

Pipe Conditions			
Length of Solid Pipe (ft)	20	MIN. 20 ft	
Length of Perferated Pipe (ft)	60		
Permeability Ratio	4:1 (Average)		
Slope of Grade	10:1 (Slight Slope)		
Landfill Conditions			
Waste Type	Higher Density	Values based on Selected Waste Type	
G _M (User Input Only) (ft ³ /lb-yr)		G _M	0.1
ρ _w (User Input Only) (lb/yd ³)		ρ _w	2000
K (User Input Only) (cm/sec)		K	0.0005
Max Radius of Influence			
Max Radius of Influence (ft)	74.3		
Vacuum Pressure Needed to obtain ROI			
Vacuum Pressure (in WC)	-1.96		

Definitions:

G_M = LFG generation rate per unit mass

ρ_w = Waste Density

K = Horizontal or radial landfill permeability with respect to LFG

If user is unsure about these values or conditions of the landfill, use the typical value where needed.

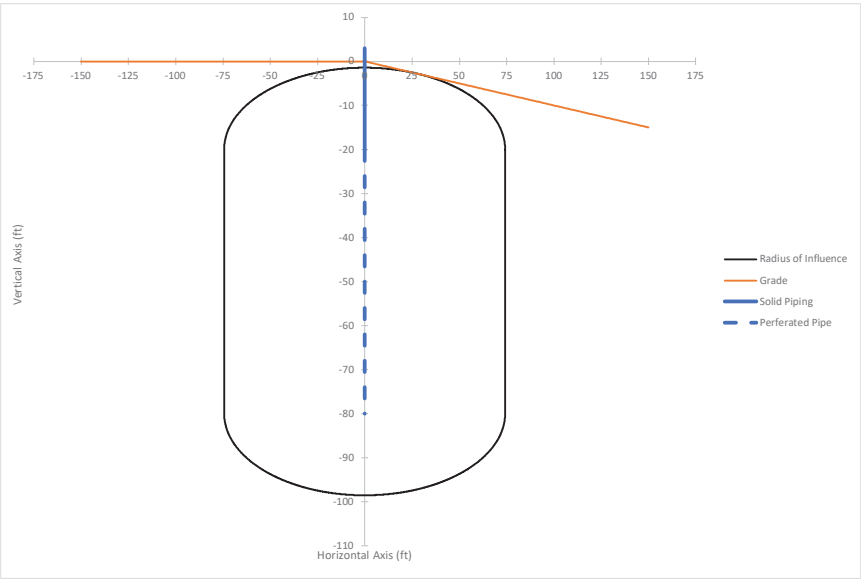
Equation Used:

$$\Delta\Psi = \frac{1}{3} \frac{G_M \rho_w}{K} \left(R_i^2 \ln R_i - \frac{1}{2} R_i^2 + \frac{1}{2} \right)$$

R_i = Radius of Influence

ΔΨ = Vacuum Headed

*Refer to Dillah-McCarron-Balwinder SCS Model Report



ESI Radius of Influence Calculator

Site: Coffin Butte Landfill
Location: Corvallis, Oregon
Project: 2021 GCCS Design Plan

How to use program:

1. Input length of solid pipe. (Min 20 feet)
2. Select a Permeability Ratio.
3. Select the type of grade if near a slope, or flat surface.
4. Selete type of Landfill Conditions, or Select "User Input" if the conditions are known.

Assumptions:

- Verticle Well located at the edge of slope (if a slope is used).
- The location of the pressure is a foot away from the center of the pipe and assuming. the edge of the ROI is zero. Pressure at well head would need to be slightly higher than the one calculated.

The drawing on the right will automatically update as inputs are calculated. This gives a basic visual representation of what is happening inside of the landfill.

Pipe Conditions			
Length of Solid Pipe (ft)	20	MIN. 20 ft	
Length of Perferated Pipe (ft)	60		
Permeability Ratio	4:1 (Average)		
Slope of Grade	4:1 (Gradual)		
Landfill Conditions			
Waste Type	Higher Density	Values based on Selected Waste Type	
G _M (User Input Only) (ft ³ /lb-yr)		G _M	0.1
ρ _w (User Input Only) (lb/yd ³)		ρ _w	2000
K (User Input Only) (cm/sec)		K	0.0005
Max Radius of Influence			
Max Radius of Influence (ft)	56.6		
Vacuum Pressure Needed to obtain ROI			
Vacuum Pressure (in WC)	-1.06		

Definitions:

G_M = LFG generation rate per unit mass

ρ_w = Waste Density

K = Horizontal or radial landfill permeability with respect to LFG

If user is unsure about these values or conditions of the landfill, use the typical value where needed.

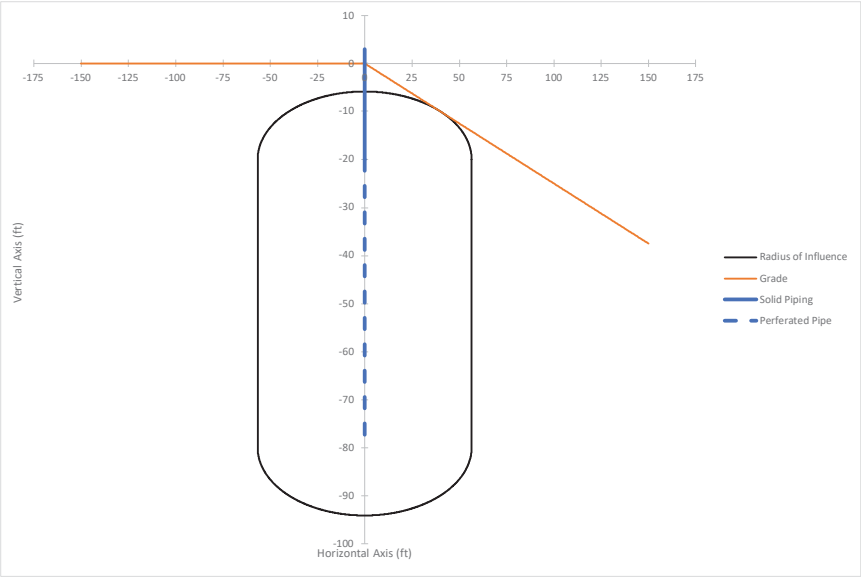
Equation Used:

$$\Delta\Psi = \frac{1}{3} \frac{G_M \rho_w}{K} \left(R_i^2 \ln R_i - \frac{1}{2} R_i^2 + \frac{1}{2} \right)$$

R_i = Radius of Influence

ΔΨ = Vacuum Headed

*Refer to Dillalah-McCarron-Balwinder SCS Model Report



ESI Radius of Influence Calculator

Site: Coffin Butte Landfill
Location: Corvallis, Oregon
Project: 2021 GCCS Design Plan

How to use program:

1. Input length of solid pipe. (Min 20 feet)
2. Select a Permeability Ratio.
3. Select the type of grade if near a slope, or flat surface.
4. Selete type of Landfill Conditions, or Select "User Input" if the conditions are known.

Assumptions:

- Verticle Well located at the edge of slope (if a slope is used).
- The location of the pressure is a foot away from the center of the pipe and assuming. the edge of the ROI is zero. Pressure at well head would need to be slightly higher than the one calculated.

The drawing on the right will automatically update as inputs are calculated. This gives a basic visual representation of what is happening inside of the landfill.

Pipe Conditions			
Length of Solid Pipe (ft)	20	MIN. 20 ft	
Length of Perferated Pipe (ft)	60		
Permeability Ratio	4:1 (Average)		
Slope of Grade	1:0 (Flat)		
Landfill Conditions			
Waste Type	Higher Density	Values based on Selected Waste Type	
G _M (User Input Only) (ft ³ /lb-yr)		G _M	0.1
ρ _w (User Input Only) (lb/yd ³)		ρ _w	2000
K (User Input Only) (cm/sec)		K	0.0005
Max Radius of Influence			
Max Radius of Influence (ft)	80.0		
Vacuum Pressure Needed to obtain ROI			
Vacuum Pressure (in WC)	-2.32		

Definitions:

G_M = LFG generation rate per unit mass

ρ_w = Waste Density

K = Horizontal or radial landfill permeability with respect to LFG

If user is unsure about these values or conditions of the landfill, use the typical value where needed.

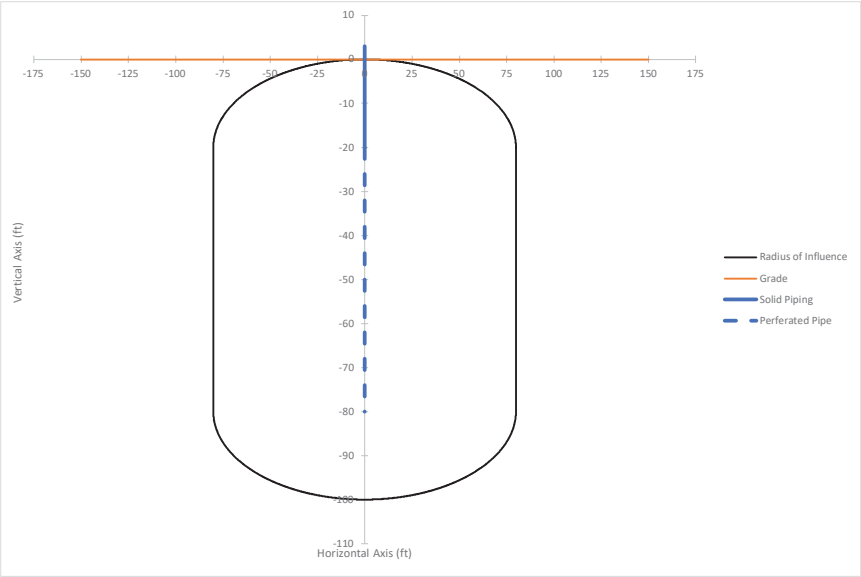
Equation Used:

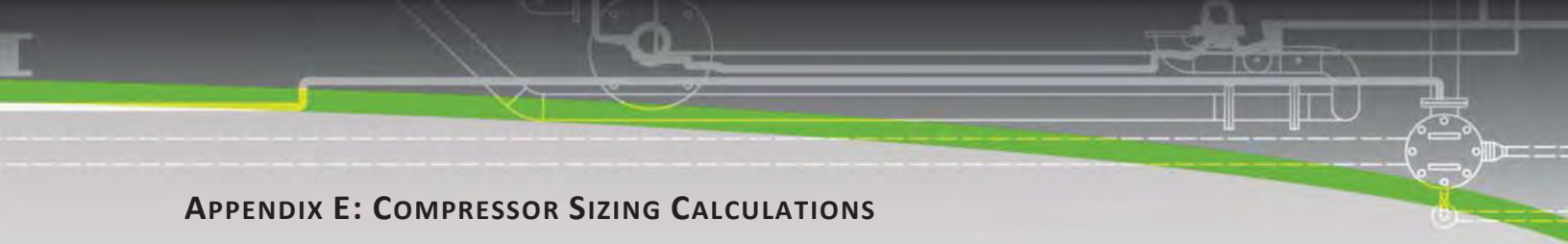
$$\Delta\Psi = \frac{1}{3} \frac{G_M \rho_w}{K} \left(R_i^2 \ln R_i - \frac{1}{2} R_i^2 + \frac{1}{2} \right)$$

R_i = Radius of Influence

ΔΨ = Vacuum Headed

*Refer to Dillah-McCarron-Balwinder SCS Model Report





APPENDIX E: COMPRESSOR SIZING CALCULATIONS

ESI Air Compressor System Sizing Calculator

Input value

Calculated value

Selected Equipment

Project: Coffin Butte Landfill
Date: 4/5/2021

Assumptions:

- 1) All wells that have pumps cycle simultaneously.
- 2) The QED AP4.5 Ultra pump is used in all wells with 1" I.D. discharge pipe.
- 3) Average well depth is modeled as 120 ft.

Calculations

Description	Value	Notes
Air Usage (scf/gal)	1.1	From QED AP4.5 Ultra Specification Sheet
Liquid Discharge rate (gpm)	5	Based on typical usage (pump cycles at ~40% capacity)
System Air Pressure (psig)	100	Pressure that will be used to operate the pumps
Air Flow Req. per Pump (scfm)	5.5	See Equation 1
Percent of Wells with Pumps	70%	
Compressor Used	Sullair 3709VB Series	

Results

Years from Present	# of Wells ^A	Air Flow Req. ^B (SCFM)	Air Flow Req. @ 100 psig ^C (ACFM)	Capacity of wells pumped simultaneously
5	110	424	62	100%
10	130	501	74	100%
15	160	616	91	100%

^A Values from the 2016 GCCS Master Plan and 2020 5-year plan. Includes only vertical wells.

^B See Equation 2

^C See Equation 3

Equations

Equation 1

$$\left(\frac{SCF}{gal}/pump\right) * \left(\frac{gal}{min}\right) = SCFM/Pump$$

Equation 2

$$\left(\frac{SCFM}{Pump}\right) * \# \text{ of wells} = SCFM \text{ req.}$$

Equation 3

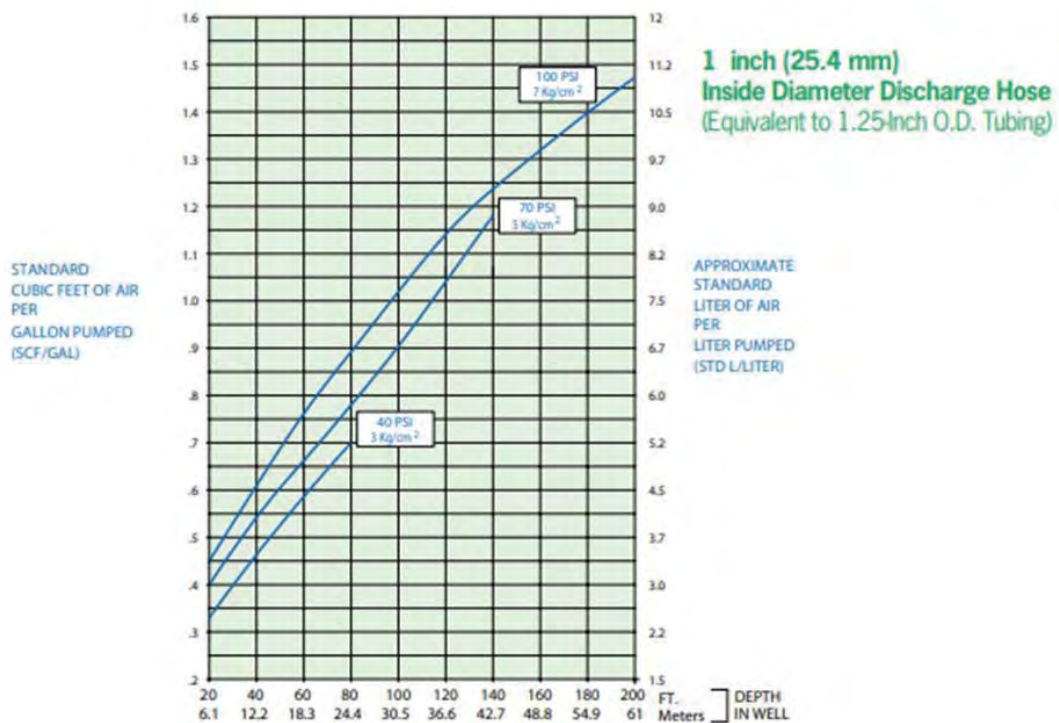
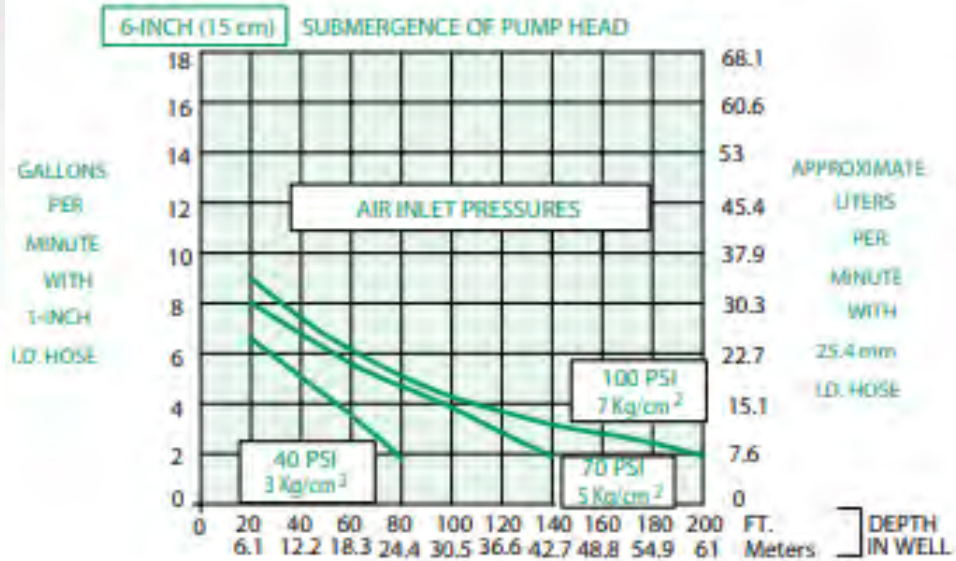
$$SCFM \text{ req.} * \left(\frac{14.7}{100}\right) = ACFM \text{ req.}$$

Preferred Equipment - Reference Values

Compressor Options	Installed HP	ACFM (@100 psig)	Max Pressure (psig)
Sullair ST2208	30	127	175
Sullair 3709VB Series	50	225	210

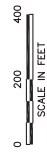
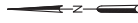
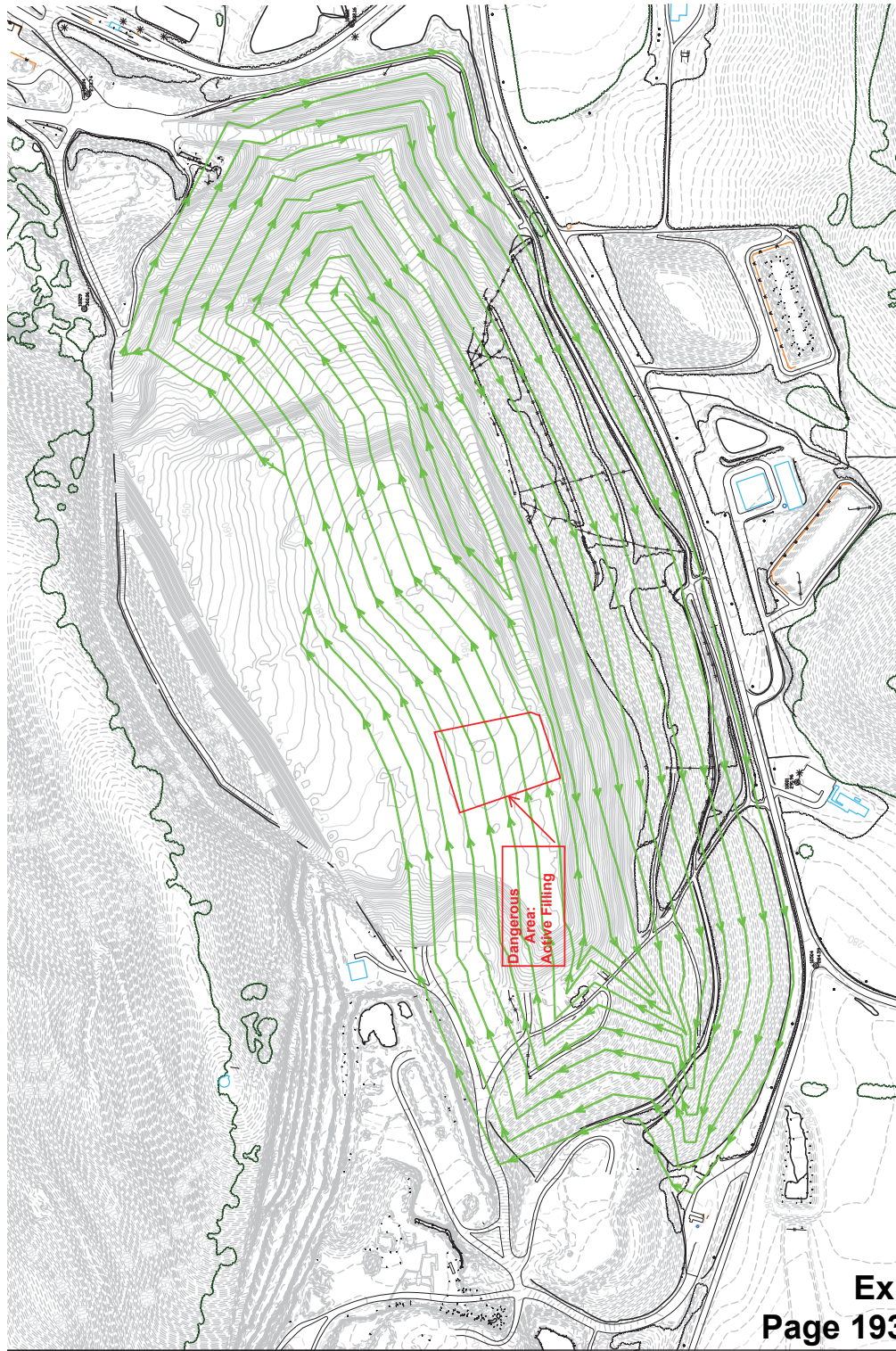
QED AP4+ Pneumatic Pump Curves

1 inch (25.4 mm) Inside Diameter Discharge Hose (Equivalent to 1.25-Inch O.D. Tubing)





APPENDIX F: SURFACE EMISSION MONITORING PLAN



LEGEND:

- 300 --- EXISTING CONTOUR 4/7/20
- 470 --- EXISTING CONTOUR 1/14/21
- SEM WALKING PATH



APPENDIX G: ALTERNATIVE OPERATION AND MONITORING PLAN (AOMP)

E ALTERNATIVES TO THE NSPS

§60.752(b)(2)(i)(B) The collection and control system design plan shall include any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, record keeping or reporting provisions of §60.753 through §60.758 proposed by the owner or operator.

Per 40 CFR §60.752(b)(2)(i)(B), the design plan includes proposed alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping, and reporting provisions of §60.753 through §60.758 of the NSPS. This section addresses exemptions/alternatives proposed in this submittal. All of these alternatives are acceptable to and have previously been approved by the USEPA for municipal solid waste landfills in areas of the United States.

E.1 Exclude Steep Slopes and Dangerous Areas from Surface Scan Monitoring Requirements

§60.753(d) Operational Standards: "A surface monitoring design plan shall be developed that includes a topographical map with the monitoring route and the rationale for any site-specific deviations from the thirty meter intervals. Areas with steep slopes or other dangerous areas may be excluded from the surface testing."

The Coffin Butte Landfill is proposing to widen the spacing between intervals from 30-meters to 60-meters in areas that have a geomembrane final cover system placed. The geomembrane cover is expected to provide an excellent barrier to surface emissions, to be demonstrated by routine surface emissions monitoring conducted at the facility. The facility proposes to demonstrate this to the Oregon Department of Environmental Quality (ODEQ) by conducting surface scans initially using a 30-meter spacing. Upon demonstration that the geomembrane-covered areas are compliant for three consecutive quarters, the facility petitions to widen the spacing to 60-meters in these areas.

The facility also proposes to exclude dangerous areas such as roads, the active fill area, truck traffic areas, construction areas, areas with snow or ice cover, and slopes steeper than or equal to 5:1 from surface testing.

E.2 Determination of Oxygen Levels at LFG Monitoring Points

§60.753(c)(2) Operational Standards: "Unless an alternative test method is established as allowed by § 60.752(b)(2)(i) of this subpart, the oxygen shall be determined by an oxygen meter using Method 3A or 3C..."

When applicable, the Coffin Butte Landfill is proposing to use an on-site multi-gas analyzer, in lieu of a laboratory method, for determining the oxygen content of the

landfill gas at each well and monitoring point. The site will be using a portable meter, such as a Landtec GEM-500 or equivalent, calibrated to the manufacturer's specifications, to determine the oxygen content of the gas.

E.3 Operation of Passive Wells Installed in Areas Outside of Condition 13.4

Coffin Butte Landfill requested alternative operation of the passive wells installed in areas outside of condition 13.4, Oregon Title V Operation Permit number 02-9502. This request was approved in June 9, 2006 by ODEQ. The attached request letter and approval letter can be found following this appendix.

E.4 Surface Emissions Monitoring Correction Variance

§60.755(c)(4): "Any reading of 500 ppm or more...shall be recorded as a monitored exceedance...cover maintenance or adjustments to the vacuum....shall be made and the location shall be remonitored within 10 calendar days after detecting the exceedance..."

Coffin Butte Landfill is proposing for the Landfill that a variance to the 10 day window be allotted for adjustments to the cover and/or collection system. Industry experience with facilities suggests that this 10 day time frame is not reasonable to effect comprehensive repairs during all quarters of a typical year. For example, if the Landfill experiences a precipitation event following a surface scan, it may take several days or even weeks for the side slopes of the landfill to dry out enough to support construction equipment for cover repairs. If the side slopes are not sufficiently dry, the repair equipment can cause more damage to the cover (and subsequently higher emissions) than the original erosion or crack.

Poor weather conditions can prevent cover maintenance, leading the follow-up rescans 10 days later to automatically fail. This can ultimately force the installation of an unneeded extraction well, when all that was really required was enough time to make a cover repair.

Coffin Butte Landfill is therefore requesting that the 10 day rescan time frame be extended by an additional two weeks, in the event of adverse weather conditions after a quarterly surface scan (should it be determined that the cover was the cause of the failing reading). Coffin Butte Landfill is proposing to receive this two week extension automatically, upon providing written notification to the ODEQ that the extra time is needed due to adverse weather conditions. Coffin Butte Landfill will place the notification letter in the NSPS files, along with a summary of the adverse weather conditions or other condition creating the need for additional time.

E.5 Monitoring and New/Extended Extraction Wells

*§60.756: "Except as provided in §60.752(b)(2)(i)(B),
(a) Each owner or operator seeking to comply with §60.752(b)(2)(ii)(A) for an*

active gas collection system shall install a sampling port and a thermometer or other temperature measuring device at each wellhead and:

- (1) Measure the gauge pressure in the gas collection header on a monthly basis as provided in §60.755(a)(3); and*
- (2) Monitor nitrogen or oxygen concentration in the landfill gas on a monthly basis as provided in §60.755(a)(5); and*
- (3) Monitor temperature of the landfill gas on a monthly basis as provided in §60.755(a)(5)."*

New vertical LFG extraction wells are often placed in the active area of the landfill several years before the waste has reached final grades. This is in compliance with the NSPS. However, since the wells are placed in active areas, they periodically need to be "raised" (i.e., the well casing extended 15 to 25 feet vertically) in order to not be buried under later lifts of waste. When they are raised, the HDPE lateral line which provides the applied vacuum is temporarily disconnected until the surrounding lift of trash is brought high enough to reconnect the well. The time frame between when a well is disconnected and raised, and when the waste height is high enough to reconnect the lateral, can often range from a few weeks to a few months. This can result in missed monthly readings at the well, since the well casing is too high for the technician to safely reach.

Since the NSPS allows for exclusion of surface monitoring in "dangerous areas" of the site, Coffin Butte Landfill believes it is reasonable to request exclusion to monitoring the wells raised in active areas. The facility proposes that readings will be missed at a particular well as long as the well cannot be safely accessed. If the facility cannot bring the waste height up to the new grade and re-attach the well within a reasonable amount of time (4 months), then modifications to the lateral/wellhead, such as lowering the wellhead monitoring equipment, will be made for monitoring purposes. This request is in accordance with §60.752(b)(2)(i)(B), which allows the facility to propose alternatives to the monitoring procedures in the NSPS.

E.6 Start-Up of New Wells or Collection System

§60.755(a)(4) does not require the landfill to expand the well field due to positive pressure within the first 180 days of system operation. During the first 180 days of collection and control system operations, where oxygen and/or temperature exceedances are monitored, Coffin Butte Landfill proposes to apply all applicable corrective measures to achieve the operating standards with the following exception: expansion of the collection system to address the exceedances within 120 days. In addition, for new individual wells installed at the Landfill, Coffin Butte Landfill proposes to not expand the well field during the first 180 days of operation for any individual well in which pressure, temperature and/ or either oxygen exceedances are monitored.

E.7 Monitoring of New or Replacement Extraction Wells

GCCSs are typically built in phases to accommodate for sequential waste placement as well as to replace various wells from time to time due to damage from settlement, etc. Installation of only a few additional wells can cause challenges with balancing the entire GCCS and therefore additional time may be needed to not only achieve negative pressure in all wells but to also maintain the operating standard for oxygen and/or temperature.

Per §60.755(a)(4), Coffin Butte Landfill is not required to expand the system during the first 180 days after GCCS start-up where pressure exceedances were recorded at one or more wells. SWANA recommends that, given the well field balancing challenges, USEPA should clarify that the exemption from system expansion applies to any individual well or series of wells associated with the new well(s) upon start-up.

USEPA Response: Request approval for alternative timeline procedure as part of the Design Plan or amendment to the Design Plan.

Pursuant to this response from the USEPA, Coffin Butte Landfill proposes to bring new and replacement wells into compliance within 180 days of installation. During this time period, the extraction wells will be monitored, however they will not be subject to the operational and monitoring constraints under §60.753.

E.8 Monitoring of Interim LFG Collectors

SWANA has requested clarification from the USEPA as to whether additional wells or collectors, voluntarily established by the landfill operator, but not specified by the Gas Collection and Control System (GCCS) Design Plan, are subject to NSPS Operational Requirements.

This issue frequently arises when “extra” collectors are added or the leachate collection system is connected to the GCCS to control odors, to increase the quantity of LFG available for beneficial use, or to meet other landfill operating needs beyond regulatory compliance with the rule. Since a professional engineer certified that the GCCS Design Plan would meet the required level of LFG control without the use of the “extra” collectors and the Administrator approved the Design Plan, SWANA does not believe that the operating requirements should be beyond that required by the NSPS rule. Further, because these devices are installed for purposes other than to meet the requirements of the NSPS rule (i.e., odor control, energy recovery projects, etc), their design may preclude their ability to meet the stipulated operation requirements.

An example of this situation is when the leachate collection system is connected to the GCCS for odor mitigation purposes. Because the leachate collection layer extends close to the landfill surface and during initial cell development portions may even be exposed directly to air, a large amount of air can be drawn directly through the leachate system causing elevated oxygen concentrations at the wellhead. In this situation it is often impossible to limit the oxygen concentration to less than the regulatory standard of 5 percent. This, however, does not cause an operational problem as the air never moves through the waste and therefore does not increase the risk of a subsurface fire.

Another example is when LFG is collected from the leachate collection system and the leachate level rises above the perforated portion of the leachate collection riser pipe. In this situation, LFG does not move through the riser and an unrepresentative but elevated oxygen concentration can be measured if a small quantity of air accidentally enters the top of the riser.

Yet a third example is where a landfill owner or operator decides to install and operate wells in areas not yet required to have collection (i.e., initial waste placed is less than 5 years old in active fill area). There is no obligation to collect the LFG and therefore, there should be no monitoring requirements for these wells until the age of the initial waste requires such operation.

Although the NSPS rules may allow for regulatory approval of alternative oxygen standards to resolve some of these issues, regulatory agencies have been extremely reluctant to grant such alternatives due to unfamiliarity with LFG control technology. A simpler solution would be to clarify in guidance that additional voluntary wells on collectors may be excluded from the performance standards used for wells to establish NSPS compliance.

USEPA Response: If the collectors are located in an area of the landfill not yet required to have control (i.e., initial waste in place is not yet 2 years in closed or final grade area or 5 years old in active areas) then the monitoring and operational requirements would not apply. If however, the collectors are located in areas of the landfill which require gas control, then the collectors must be monitored and achieve operating limits for pressure, oxygen and temperature. Alternative monitoring procedures and/or operating parameters for these collectors may be requested as part of the Design Plan or addendum to the Design Plan.

Pursuant to this response from the USEPA, Coffin Butte Landfill proposes that all GCCS connections to leachate management structures or to interim LFG collectors located in an area of the landfill not yet required to have control (i.e., initial waste in place is not yet 2 years old in closed or final grade area or 5 years old in active areas) be excluded from the NSPS operating and monitoring requirements at the Landfill.

E.9 Decommissioning LFG Collectors

Filling around LFG wells may lead to numerous vertical extensions of the vertical LFG collectors. With differential settlement that may occur with time, some vertical LFG wells may fail and cease to provide significant LFG flow. In this situation, LFG does not move through the LFG wellhead and an unrepresentative but elevated oxygen concentration can be measured if a small quantity of air accidentally enters the top of the LFG wellhead. As wells are documented to provide little or no LFG flow, the vertical wells will be decommissioned. Decommissioned wells will be documented in the site records and the semi-annual reports. No additional approval or documentation will be required to decommission wells. No future LFG wellhead monitoring will be conducted on decommissioned LFG wells. Should surface emissions or other NSPS requirements

warrant, replacement wells will be added in accordance with the NSPS to replace decommissioned wells.

The following steps will be taken when a well is decommissioned:

- Close valves;
- Disconnection of well from collection system (removal of flex hose, capping of header lateral, etc.);
- Once disconnected, monthly wellhead monitoring will not be performed on the well; and
- Physical abandonment (i.e., cut off wellhead below ground, cap and backfill). Physical abandonment may not be performed immediately following well disconnection. Timing of the physical abandonment of the well will depend on weather and landfill operating conditions or the potential for the well to recover sufficient LFG flows.

A decommissioned well may be reconnected to the system at a later date if LFG flows recover. This may be possible where a pinched well casing later shears allowing the now open pipe to extract LFG from the surrounding gravel pack. At this time monthly wellhead monitoring will be resumed.

E.10 Additional Alternatives

Coffin Butte Landfill may request additional Alternatives to the NSPS from the USEPA under a site-specific determination request. Alternatives that are subsequently approved by the USEPA will be submitted to the ODEQ as an amendment to this GCCS Design Plan.



Oregon

Theodore R. Kulongoski, Governor

Department of Environmental Quality

Western Region - Salem Office

750 Front St. NE, Ste. 120

Salem, OR 97301-1039

(503) 378-8240

(503) 378-3684 TTY

June 9, 2006

Clyde Moore, PE
Farallon Consulting
320 3rd Ave. NE
Issaquah, WA 98027

RE: AQ-Valley Landfills
Title V Permit 02-9502
Benton County
Operation of Passive Landfill Gas Wells

Dear Mr. Moore:

The Department has received and reviewed your letter of 6/7/06 regarding operation of the passive landfill gas wells at the Valley Landfills, Coffin Butte Landfill. The Department agrees with your assessment that these passive gas wells do not need to be operated in accordance with the requirements in permit conditions 13.8 and 13.9. Because these passive gas wells are not required under condition 13.4 of the permit, they do not have to meet the New Source Performance Subpart WWW requirements.

The Department commends Valley Landfills for its ongoing efforts to reduce odorous emissions from the landfill by installing gas collection systems well in advance of any rule requirements.

If you have any questions regarding this approval, please do not hesitate to call me at 503/378-8240, ext. 234.

Sincerely,

Gary Andes

Natural Resource Specialist

Cc: Brian May
Valley Landfills
28972 Coffin Butte Road
Corvallis, OR 97330

Melissa Green
Valley Landfills
28972 Coffin Butte Road
Corvallis, OR 97330

DEQ/WVR-101 1-03

June 7, 2006

Mr. Gary Andes
Oregon Department of Environmental Quality
750 Front Street NE
Salem, Oregon 97301-1039

**RE: REQUEST FOR APPROVAL OF CHANGE IN OPERATION OF PASSIVE
WELLS INSTALLED IN AREAS OUTSIDE CONDITION 13.4,
OREGON TITLE V OPERATING PERMIT NUMBER 02-9502
COFFIN BUTTE LANDFILL
HIGHWAY 99 AND COFFIN BUTTE ROAD, CORVALLIS, OREGON
FARALLON PN: 845-002**

Dear Mr. Andes:

On behalf of Valley Landfills, Inc. (VLI), Farallon Consulting, L.L.C. (Farallon) is writing to request approval of special operation of landfill gas wells located outside the areas prescribed by Condition 13.4 of Title V Operating Permit Number 02-9502 for the Coffin Butte Landfill in Corvallis, Oregon, last updated October 27, 2004 (Operating Permit). The requested change applies to certain surface and near-surface horizontal landfill gas (LFG) collection wells and pertains to the following issues:

- Operating the LFG control system with negative pressure at each well-head;
- Maintaining nitrogen concentrations in the LFG to less than 20 percent at the well-head; and
- Maintaining oxygen concentrations in the LFG to less than 5 percent at the well-head.

The basis for the requested change is provided below. The requested change does not include a request for an increase in allowable emission rates for any pollutants. Rather, the requested change actually would result in collection of a greater amount of generated LFG.

VLI is attempting to prevent emission of LFG that could potentially cause problematic odors from all areas of the Coffin Butte Landfill. Initial steps to accomplish this goal included more aggressive installation of vertical LFG collection wells in 2003, and installation of deep horizontal LFG collection pipe wells in 2005. The deep horizontal perforated pipes are installed before additional lifts of solid waste are placed, and only the connector pipes extend to the new landfill surface.

VLI personnel frequently monitor the landfill surface for odors to assess whether additional collection facilities are needed. The monitoring conducted by VLI includes the portions of the landfill where LFG collection wells are not yet required by the Operating Permit, as specified in



Permit Condition 13.4. In some cases, in areas where LFG collection wells are not required by Permit Condition 13.4, VLI would like to install passive LFG collection wells where monitoring has determined that one or more of the following limiting conditions make standard LFG well installations impractical:

- The solid waste depth is too shallow to install vertical LFG collection wells;
- Vertical LFG wells would be buried by additional solid waste layers within 6 months; and
- Deep horizontal LFG collection pipes cannot be installed because overlaying solid waste has already been placed.

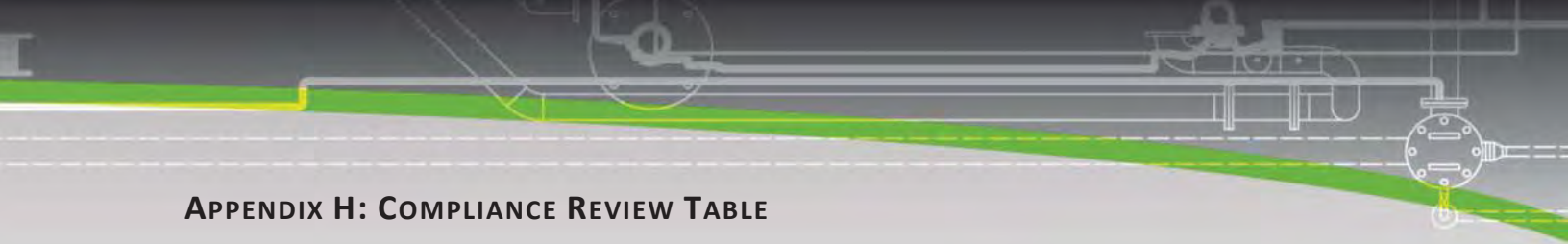
In locations outside the areas where LFG wells are required by Permit Condition 13.4 and where one or more of these limiting conditions exist, VLI is installing near-surface horizontal LFG collection perforated pipes in shallow trenches or on the surface of the landfill to collect LFG and to control odors. These collection pipes either will be surrounded by gravel and covered with soil, or will be covered with a temporary membrane cap. VLI refers to these near-surface LFG collection wells as "passive wells." The basic purpose of the passive wells is to collect LFG emissions and control odors in areas where control using other means is not practical.

The operation of passive wells will exhibit a very large LFG flow response to applied vacuum because the soil or a temporary membrane cap seal over the perforated collector pipes will be only partially effective. It will be impossible to develop any significant vacuum in the passive wells because of this weak seal. In addition, the passive wells do not create a vacuum within the underlying solid waste. Even a small applied vacuum in a passive well will draw a large flow, and has the potential to quickly draw excessive air into the collection pipe. Therefore, only a very mild vacuum, enough to produce adequate flow to collect LFG emissions from the landfill surface, would be applied to the passive wells. The mild vacuum applied typically will not be strong enough to be measured using standard LFG monitoring equipment.

Properly designed and maintained passive wells will not operate within some of the parameters required under the Operating Permit. Specifically, the following Operating Permit conditions would not be achievable for proper operation of the passive wells:

- Operating Permit Condition 13.8: "Operate the LFG control system with negative pressure at each well-head."

The intent of Condition 13.8 is to ensure that adequate LFG control system vacuum is available at every well-head, and that no LFG pressure builds up within the well in the solid waste. Vacuums at other landfills often are considered adequate with at least 10 inches of water column. The Coffin Butte LFG control system has an unusually strong vacuum of 35 inches of water column available throughout the well field; therefore, the adequacy of available vacuum is not in question. The passive wells are installed at or very near the top of the solid waste; therefore, properly designed and maintained passive wells will exhibit little, if any, vacuum, which may not be measurable.



APPENDIX H: COMPLIANCE REVIEW TABLE

Compliance Summary of Landfill Gas Collection and Control System Design Plan

Regulatory Citation	Report Section References	Report Appendix References	Regulatory Requirement	Implementation Summary
OAR 340-239-0110(1)(a)	N/A		If a gas collection and control system which meets the requirements of section (2) of this rule has not been installed, the owner or operator of a landfill must submit a Design Plan to DEQ within one year of becoming subject to this rule.	The GCCS at CBLF is an existing system that now is subject to this rule.
OAR 340-239-0110(1)(b)	1.1		If an owner or operator of a landfill is modifying an existing gas collection and control system to meet the requirements of this division, the owner or operator must submit an amended Design Plan to DEQ that includes any necessary updates or addenda, in accordance with OAR 340-239-0700(3)(j).	This amended design plan was submitted to DEQ within one year of CBLF becoming subject to this rule.
OAR 340-239-0110(1)(c)(A)	1.3 & 4	A	The Design Plan must be prepared and certified by a professional engineer. The following issues must be addressed in the design: Depths of solid waste, solid waste gas generation rates and flow characteristics, cover properties, gas system expandability, leachate and condensate management, accessibility, compatibility with filling operations, integration with closure end use, air intrusion control, corrosion resistance, fill settlement, resistance to the solid waste decomposition heat, and ability to isolate individual components or sections for repair or troubleshooting without shutting down entire collection system.	This plan was prepared and certified by a registered Professional Engineer licensed in the state of Oregon. The design considerations in Section 4 of this plan address all requirements listed in this rule.
OAR 340-239-0110(1)(c)(B)	3, 4, 5, 6	A, B, C, D, E, F, G	The Design Plan must provide for the control of the collected gas through the use of a gas collection and control system meeting the requirements of OAR 340-239-0110(2) or an alternative method approved pursuant to OAR 340-239-0500.	The design plan meets all requirements pursuant to OAR 340-239-0110(2). The Alternative monitoring and operation plan in Appendix G is in pursuant of OAR 340-239-0500.
OAR 340-239-0110(1)(c)(D)	6.4	G	The Design Plan must include any proposed alternatives to the requirements, justification for the need for any proposed alternatives, test methods, procedures, compliance measures, monitoring, and recordkeeping or reporting requirements pursuant to OAR 340-239-0500.	The existing AOMP plan was approved by DEQ in 2006.
OAR 340-239-0110(1)(c)(E)	6.2		The Design Plan must include a description of potential mitigation measures to be used to prevent the release of methane or other pollutants into the atmosphere during the installation or preparation of wells, piping, or other equipment; during repairs or the temporary shutdown of gas collection system components; or, when solid waste is to be excavated and moved.	CQA and operations follow the guidelines detailed in Section 6.2 of this plan.
OAR 340-239-0110(1)(c)(F)	6.3	A	For active landfills, the design plan must identify areas of the landfill that are closed or inactive.	There are currently no inactive areas at CBLF. Closed areas are detailed on drawing M1.00

OAR 340-239-0110(1)(c)(G)	5, 6.1	A, B, C, F	The gas collection and control system must be designed to collect gas at an extraction rate to comply with the surface methane emission limits in OAR 340-239-0200, component leak standard in OAR 340-239-0600(2)(c), and be sufficient to meet all operational and performance standards in this division. The expected gas generation flow rate from the landfill must be calculated pursuant to OAR 340-239-0800(5).	The GCCS is sized to accommodate the maximum gas generation projected in the LandGEM. New protocols for SEM monitoring and leak standards are detailed in Section 6.1
OAR 340-239-0110(1)(c)(I)	4.8, 4.13.5, 4.13.6, 5.4, 6.1, 6.2	B, C, D, G	The gas collection and control system must be designed to maintain a negative pressure at all wellheads in the collection system without causing air infiltration, including any wellheads connected to the system as a result of expansion or excess surface emissions	LFG piping is sized to maintain at least 30" W.C. at maximum projected LFG generation. ROIs and perforations of wells are calculated and sized to mitigate air intrusion.
OAR 340-239-0110(1)(c)(H)	6.3	A	Any areas of the landfill that contain only asbestos-containing waste, or nondecomposable solid waste may be excluded from collection provided that the owner or operator submits documentation to DEQ containing the nature of the waste, date of deposition, location and amount of asbestos or non-decomposable solid waste deposited in the area. This documentation may be included as part of the Design Plan.	Asbestos areas are detailed in GCCS layout drawings. Republic tracks waste composition at scale house and deposits asbestos-containing waste within designated areas only.
OAR 340-239-0110(1)(c)(J)	3.1, 3.2, 3.3, 4.13.5, 4.14.1	A, D	The density of wells, horizontal collectors, surface collectors, or other gas extraction devices necessary to achieve compliance with section (2) of this rule.	Wells and collectors are placed according to ROI to ensure proper coverage of active areas.
OAR 340-239-0110(1)(d)	2.2, 2.3	A	The owner or operator of an active landfill must install and operate a gas collection and control system not later than 18 months after the date that the landfill is required to comply with this rule.	CBLF has an active GCCS system and currently meets all requirements with the exception of control devices that meet the requirements of OAR 340-239-0110(2)(c)(b). Republic is planning on fulfilling this requirement via the installation of new control devices prior to the 1/1/24 deadline.
OAR 340-239-0110(1)(e)	N/A	N/A	The owner or operator of a closed or inactive landfill must install and operate a gas collection and control system not later than 30 months after the date that the landfill is required to comply with this rule.	CBLF currently operates an active GCCS.
OAR 340-239-0110(1)(f)	4.4	A	The owner or operator of a controlled landfill must place each well or design component as specified in the approved Design Plan. Following initial construction, each new component must be installed no later than 60 days after the date on which the area controlled by the well is required to be controlled pursuant to this division.	All wells and design components are installed as specified in this design plan. New components are installed within 60 days of an area becoming controlled.
OAR 340-239-0110(1)(g)	2.1, 6		The owner or operator of a landfill must operate, maintain and expand the gas collection system in accordance with the procedures and schedules in the approved Design Plan.	Republic currently operates the landfill according to this design plan.
OAR 340-239-0110(2)(a)(A)	2.3	A	Route all collected gas to a gas control device or devices, and operate the gas collection and control system continuously except as provided in sections (4) and (5) of this rule.	All collected LFG will continue to be continuously diverted to the PNCG plant and/or the existing destruction devices except in the case of emergency shutdowns or required maintenance and expansions.

OAR 340-239-0110(2)(a)(C)	2.3	A	Design and operate the gas collection system to draw all the gas toward the gas control device or devices.	All collected LFG will continue to be continuously diverted to the PNCG plant and/or the existing destruction devices.
OAR 340-239-0110(2)(a)(D)	4.3, 4.14.1, 4.14.3, 6.1, 6.2	A, F	Design and operate the gas collection system to minimize off-site and on-site migration of subsurface gas in compliance with OAR chapter 340, divisions 093, 094, and 095.	The GGC is designed to provide LFG collection to all controlled areas. Surface emission testing is used to verify that the system is functioning as intended.
OAR 340-239-0110(2)(a)(E)	2.3		In the event the collection or control system is inoperable, the gas mover system shall be shut down and all valves in the collection and control system contributing to venting of the gas to the atmosphere shall be closed within one hour of the collection or control system not operating.	If the flame is not detected at the flare, power is cut to the LFG blowers and the LFG inlet valve closes immediately.
OAR 340-239-0110(2)(a)(F)	4.12, 6.6, 6.7		Efforts to repair the collection or control system must be initiated and completed in a manner such that downtime is kept to a minimum, and the collection and control system must be returned to operation.	Republic currently operates the GCCS according to minimize system downtime, operating the GCCS in sections if necessary to minimize total system shutdowns.
OAR 340-239-0110(2)(a)(G)	4.5	A	Install all passive collection systems with liners on the bottom and all sides in all areas in which gas is to be collected. The liners must be installed as required under 40 C.F.R. § 258.40.	The current leachate control system is designed according to Subtitle D standards, which fulfill 40 C.F.R. § 258.40.
OAR 340-239-0110(2)(a)(H)	6.3	A	Any area of the landfill may be excluded from control, provided that the total of all excluded areas can be shown to contribute less than one percent (1%) of the total amount of methane emissions from the landfill. The amount, location, and age of the material must be documented and provided to DEQ. If data on actual amounts and age is not available, the landfill owner or operator must estimate based on known information and provide all documentation used to make the estimates. A separate methane emissions estimate must be made for each section proposed for exclusion, and the sum of all such sections must be compared to the methane emissions estimate for the entire landfill, and all calculations, data and documentation used to perform the calculations must be submitted to DEQ. The methane emissions from each section proposed for exclusion must be computed using the methods provided in OAR 340-239-0800(5).	CBLF currently has no inactive areas. Any future areas will be submitted for approval by DEQ as per OAR 340-239-0800(5).
OAR 340-239-0110(2)(a)(I)	4.13, 5.1, 5.3	A, D	The landfill gas extraction components must be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or other nonporous corrosion resistant material of suitable dimensions to: Convey projected amounts of gases; withstand installation, static, and settlement forces; and withstand planned overburden or traffic loads. The collection system must extend as necessary to comply with emission and migration standards. Collection devices such as wells and horizontal collectors must be perforated to allow gas entry without head loss sufficient to impair performance across the intended extent of control. Perforations must be situated with regard to the need to prevent excessive air infiltration.	Republic currently follows these sections of the design plan. Perforations are calculated and designed in such a way to minimize air infiltration.

OAR 340-239-0110(2)(a)(J)	3.1, 3.2, 3.3.1, 4.14	A, D	Vertical wells must be placed so as not to endanger underlying liners and must address the occurrence of water within the landfill. Holes and trenches constructed for piped wells and horizontal collectors must be of sufficient cross-section so as to allow for their proper construction and completion including, for example, centering of pipes and placement of gravel backfill. Collection devices must be designed so as not to allow indirect short circuiting of air into the cover, into the solid waste, into the collection system, or gas into the air. Any gravel used around pipe perforations should be of a dimension so as not to penetrate or block perforations.	Republic currently operates according to these rules. Fulfillment of each item is found in section 4.14 and its subsections.
OAR 340-239-0110(2)(a)(K)	3.4, 4.15	A	Collection devices may be connected to the collection header pipes below or above the landfill surface. The connector assembly must include a positive closing throttle valve, any necessary seals and couplings, access couplings and at least one sampling port. The collection devices must be constructed of PVC, HDPE, fiberglass, stainless steel, or other nonporous material of suitable thickness.	Republic currently implements this approach in their GCCS design.
OAR 340-239-0110(2)(a)(L)(i)	4.2, 5.2	B	For existing collection systems, the flow data must be used to project the maximum flow rate. If no flow data exists, the procedures in subparagraph (2)(a)(L)(ii) of this rule must be used	The design engineer uses flow data from the PNCG facility flowmeters at the generation plant and flares to compare to modeled projections generated by the EPA LandGEM.
OAR 340-239-0110(2)(a)(L)(ii)	N/A	N/A	For new collection systems, the maximum flow rate must be determined in accordance with OAR 340-239-0800(5).	CBLF has an existing GCCS.
OAR 340-239-0110(2)(b)	N/A	N/A	Requirements for Enclosed Flares. A landfill owner or operator who operates an enclosed flare must route the collected gas to an enclosed flare that meets all of the following requirements:	CBLF does not currently have enclosed flares.
OAR 340-239-0110(2)(c)	2.3		Requirements for open flares: A landfill owner or operator who operates an open flare must route the collected gas to an open flare that meets the requirements of 40 C.F.R. § 60.18.	CBLF has two open flares, both of which comply with 40 C.F.R. § 60.18.
OAR 340-239-0110(2)(c)(A)	2.3		(A) Install, calibrate, maintain, and operate the following equipment according to the manufacturer's specifications: (i) A heat sensing device, such as an ultraviolet beam sensor or thermocouple, at the pilot light or the flame itself to indicate the continuous presence of a flame; and (ii) A device that records flow to the flare and bypass of the flare (if applicable). The owner or operator must: (I) Install, calibrate, and maintain a gas flow rate measuring device that records the flow to the control device at least every 15 minutes; and (II) Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism must be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.	The existing flares have thermocouples, flowmeters, and UV flame detectors that operate continuously. Flowmeters are calibrated in accordance to manufacturer's specifications. A visual inspection of all mechanisms is performed monthly. There are no bypass lines around the control devices.

OAR 340-239-0110(2)(c)(B)	2.3		An open flare installed and operating prior to August 1, 2021, may operate until January 1, 2024, but is thereafter prohibited except as provided in paragraph (2)(c)(C) of this rule.	Both flares operating at CBLF were installed prior to 8/1/2021. They will be replaced by control devices that meet DEQ requirements before 1/1/24.
OAR 340-239-0110(2)(c)(C)	2.3		Operation of an open flare on or after January 1, 2024, is only allowed with DEQ's written approval, which DEQ will determine based on whether the owner or operator demonstrates to the satisfaction of DEQ that one of the following conditions apply: (i) The methane generation rate is less than 664 metric tons per year pursuant to OAR 340-239-800(2) and is insufficient to support the continuous operation of an enclosed flare or other gas control device; (ii) The owner or operator is seeking to temporarily operate an open flare during the repair or maintenance of the gas control system, or while awaiting the installation of an enclosed flare, or to address offsite gas migration issues. An owner seeking to temporarily operate an open flare under this subparagraph must submit a written request to DEQ pursuant to OAR 340-239-0500; (iii) The owner or operator has landfill gas emissions that are unable to be controlled using enclosed flare gas control devices in the gas control system. These emissions being controlled using an open flare may not exceed 664 metric tons (732 tons) per year of methane. An owner seeking to operate an open flare under this subparagraph must submit a written request to DEQ pursuant to OAR 340-239-0500. The request must include an analysis verifying that there is no feasible alternative control device configuration that would use the landfill gas emissions without use of an open flare; or (iv) The owner or operator otherwise has received written approval from DEQ to operate an open flare pursuant to OAR 340-239-0500.	Republic will replace the existing flares with control devices that meet these requirements prior to the 1/1/24 deadline.
OAR 340-239-0110(2)(d)(B)(i)	2.3		(B) Route the collected gas to an energy recovery device, or series of devices that meets all of the following requirements: (i) Achieves a methane destruction efficiency of at least 99 percent by weight pursuant to OAR 340-239-0800(6). Lean burn internal combustion engines must reduce the outlet methane concentration to less than 3,000 ppmv, dry basis, corrected to 15 percent oxygen.	CBLF diverts a majority of LFG generated to the PNCG power facility which uses lean burn internal combustion engines that meet these requirements. All remaining LFG is combusted by the flares.
OAR 340-239-0110(2)(d)(B)(ii)	2.3		For new gas control devices, the destruction efficiency or parts per million by volume required according to OAR 340-239-0110(2)(d)(A)(i) must be established by an initial performance test to be completed no later than 180 days after the initial startup of the approved control system using the test methods specified in OAR 340-239-0800(6) and the DEQ Source Test Manual.	New control equipment will be selected based off on manufacturer's specifications and emission reduction guarantees. Performance testing will be performed following the commissioning phase of new control devices using methods in the DEQ Source Test Manual within 180 days of startup.
OAR 340-239-0110(2)(d)(B)(iii)	2.3		Existing gas control devices must demonstrate compliance with this rule not later than 180 days from the effective date of this rule using the performance test methods specified in OAR 340-239-0800(6) and the DEQ Source Test Manual.	The current flares have a methane destruction efficiency of 98 percent. They are to be replaced by new control devices that meet these requirements.

OAR 340-239-0110(2)(d)(B)(iv)	2.3		Operate the gas control device within the parameter ranges established during the initial or most recent performance test that demonstrates compliance with the standard in OAR 340-239- 0110(2)(d)(A)(i). Until a performance test is performed, operate the gas control device within engineering or manufacturer's established parameter ranges.	All control devices are currently operated according to this rule.
OAR 340-239-0110(2)(d)(C)	N/A	N/A	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. The owner or operator must prepare a site-specific treatment monitoring plan to include all of the following: (i) Monitoring records of parameters that are identified in the treatment system monitoring plan and that ensure the treatment system is operating properly for each intended end use of the treated landfill gas. At a minimum, records must include records of filtration, de-watering, and compression parameters. 14 (ii) Monitoring methods, frequencies, and operating ranges for each monitored operating parameter based on manufacturer's recommendations or engineering analysis for each intended end use of the treated landfill gas. (iii) Documentation of the monitoring methods and ranges, along with justification for their use. (iv) List of responsible staff (by name and job title) for data collection. (v) Processes and methods used to collect the necessary data. (vi) Description of the procedures and methods that are used for quality assurance, maintenance, and repair of all continuous monitoring systems (CMS).	CBLF does not utilize a gas treatment system. All LFG collected is diverted to the PNGC facility and/or the flares.

OAR 340-239-0110(2)(d)(e)	N/A	N/A	The owner or operator complying with section (2)(d) of this rule by using a landfill gas treatment system must calibrate, maintain, and operate according to the manufacturer's specifications a device that records flow to the treatment system and bypass of the treatment system (if applicable). The owner or operator must maintain and operate all monitoring systems associated with the treatment system in accordance with the site-specific treatment system monitoring plan required by paragraph (2)(d)(C) of this rule. The owner or operator must: (A) Install, calibrate, and maintain a gas flow rate measuring device that records the flow to the treatment system at least every 15 minutes; (B) Install liners or equivalent non-permeable materials on the bottom and all sides in all areas in which gas is to be collected. The liners must be installed as required under 40 C.F.R. 258.40; and (C) Secure the bypass line valve in the closed position with a car-seal or a lock-and-key type configuration. A visual inspection of the seal or closure mechanism must be performed at least once every month to ensure that the valve is maintained in the closed position and that the gas flow is not diverted through the bypass line.	CBLF does not utilize a gas treatment system. All LFG collected is diverted to the PNGC facility and/or the flares.
OAR 340-239-0110(2)(d)(f)	2.3		Performance Test Requirements. The owner or operator must conduct annual performance tests for any gas control device(s) subject to the requirements of section (2) of this rule using the test methods identified in OAR 340-239-0800(6). Following an initial performance test, the owner or operator must conduct a complete annual performance test each calendar year, no later than 45 days after the anniversary date of the initial performance test. Performance tests must be conducted in compliance with all of the following requirements:	Annual performance testing is performed on all destruction devices annually. The current flares in operation do not meet the 99 percent methane destruction efficiency. New destruction devices that do meet these requirements will be installed and operational prior to the 1/1/24 deadline.
OAR 340-239-0110(3)	3.4, 6.5, 6.7	A	Wellhead sampling. A landfill owner or operator required to comply with section (2) of this rule for an active gas collection system must install a sampling port and measuring devices, or an access port for measuring devices, at each wellhead and comply with the following, using measuring devices that meet the requirements of OAR 340-239-0800(7):(a) Monitor nitrogen or oxygen concentration in the landfill gas on a monthly basis as provided in OAR 340-239-0600(3); (b) Monitor temperature of the landfill gas on a monthly basis as provided in OAR 340-239-0600(3); and (c) Measure the gauge pressure in the gas collection header on a monthly basis as provided in OAR 340-239-0600(2)(d).	All active wellheads have 3 sampling ports, a temperature port, and integrated flow devices. These ports allow for temperature, oxygen, nitrogen, methane, gauge pressure and flow to be monitored and recorded. Current operations monitor each wellhead at minimum once monthly.

OAR 340-239-0110(3)	6.6		Well Raising. The requirements of paragraph (2)(a)(A), paragraph (2)(a)(B), and section (3) of this rule do not apply to individual wells involved in well raising provided the following conditions are met: (a) New fill is being added or compacted in the immediate vicinity around the well; and (b) Once installed, a gas collection well extension is sealed or capped until the raised well is reconnected to a vacuum source.	Republic currently operates under this rule.
OAR 340-239-0110(4)	6.2.1, 6.2.2		Repairs and Temporary Shutdown of Gas Collection System Components: The requirements of paragraphs (2)(a)(A) and (2)(a)(B) do not apply to individual landfill gas collection system components that must be temporarily shut down in order to repair the components due to emergencies, catastrophic events such as earthquakes, to extinguish landfill fires, to prevent landfill fires, to connect new landfill gas collection system components to the existing system, to perform construction activities pursuant to OAR 340-239-0300, or to conduct performance testing, provided the following requirements are met: 16 (a) Any new gas collection system components required to maintain compliance with this division must be included in the most recent Design Plan pursuant to section (1) of this rule. The owner or operator must comply with applicable provisions of the Notice of Construction requirements in OAR chapter 340, division 210 and permit modification requirements of OAR chapter 340, division 216 or 218 prior to the construction, installation and operation of new landfill gas collection system components; (b) Methane emissions are minimized during shutdown pursuant to paragraph (1)(a)(E) of this rule; and (c) The owner or operator must submit a notification to DEQ after any temporary shutdown due to an emergency, catastrophic event or landfill fires in accordance with OAR 340-239-0700(3)(n).	Republic currently operates under this rule.

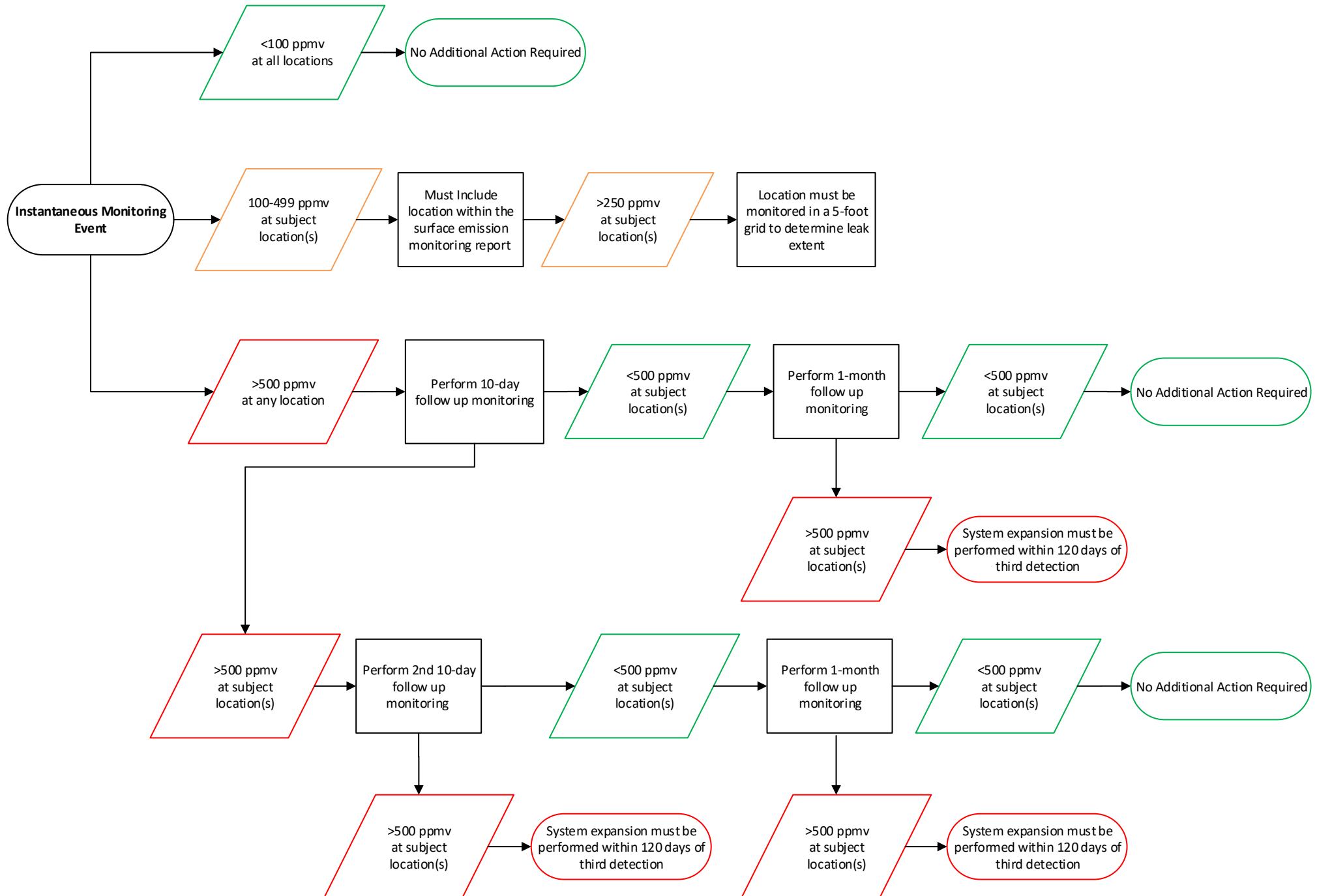
APPENDIX D

Instantaneous and Integrated Monitoring Flowcharts

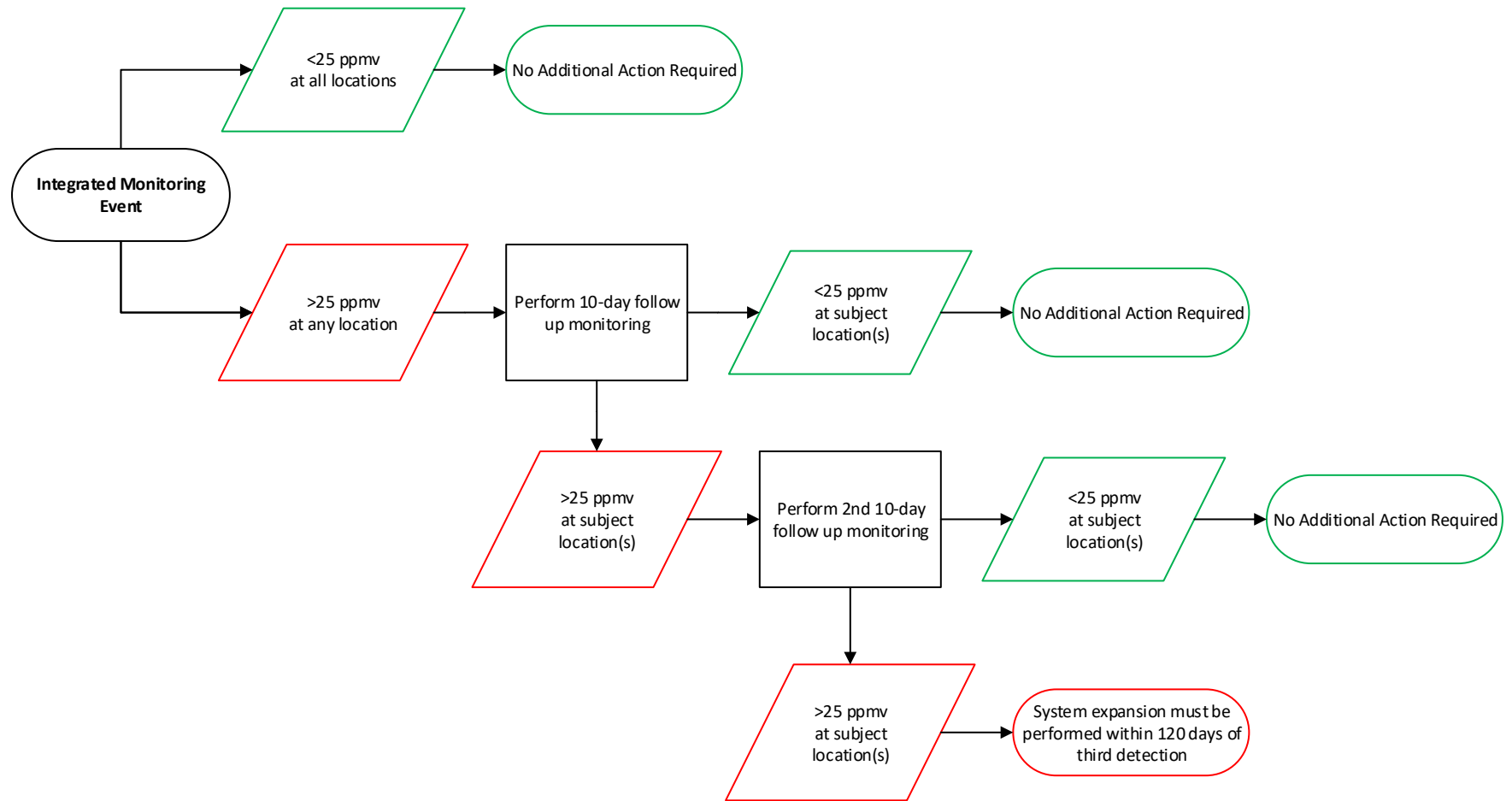
Exhibit 41

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Oregon Landfill Gas Instantaneous Monitoring Flowchart



Oregon Landfill Gas Integrated Monitoring Flowchart



APPENDIX E
Table 1 - Instantaneous & Integrated Exceedances -
Methane Surface Emissions

Exhibit 41

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	Table 1 - Instantaneous & Integrated Exceedances of - Methane Surface Emissions									
	Instantaneous Exceedances (Number of Individual Readings >500 ppmv)					Integrated Exceedances (Number of Grids with Average Readings >25 ppmv)				Pressurized Piping (>500 ppmv)
	Initial	1st 10-day Re-Monitoring	2nd 10-day Re-Monitoring	1-Month Re-Monitoring	System Expansion Required (Y/N)	Initial	1st 10-day Re-Monitoring	2nd 10-day Re-Monitoring	System Expansion Required (Y/N)	Initial
Q3 2022*	101	27	0	0	N	19	14	See notes	Y	0
Notes:	No exceedances above 500 ppmv were identified in the 2nd 10-day or the 1-month re-monitoring events following system adjustments and remediation by SCS and site personnel.					SCS-FS notes within their report that a second 10-day re-monitoring event was conducted, but the report only presents results for completing the first 10-day remonitoring event. The gas collection and control system was expanded in November 2022 in the subject area.				NA
Q4 2022*	18	0	NA	NA	N	23	See notes	See notes	Y	0
Notes:	No exceedances above 500 ppmv were identified in the first 10-day re-monitoring following system adjustments and remediation by SCS and site personnel.					SCS-FS notes the required first and second 10-day follow-up monitoring events were unable to be performed due to weather. Based on these monitoring results with accordance with the OMR, (with initial concentrations in exceedance not corrected) the site is required to perform a system expansion within 120-days of the third detected exceedance. The gas collection and control system was expanded in the subject areas in November 2022.				NA
Q1 2023*	6	0	NA	NA	N	15	15	11	Y	0
Notes:	No exceedances above 500 ppmv were identified in the first 10-day re-monitoring following system adjustments and remediation by SCS and site personnel.					Based on these monitoring results with accordance with the OMR, (with initial concentrations in exceedance not corrected) the site is required to perform a system expansion within 120-days of the third detected exceedance. The gas collection and control system was expanded in the subject areas in March 2023.				NA
Q2 2023*	18	14	4	4	Y	19	13	11	Y	0
Notes:	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. The gas collection and control system was expanded in the subject areas in June 2023.					Based on these monitoring results with accordance with the OMR, (with initial concentrations in exceedance not corrected) the site is required to perform a system expansion within 120-days of the third detected exceedance. SCS-FS report appears to have a typographic error where they note only two (2) of the nineteen integrated exceedances were reduced below the 25 ppmv threshold following completion of the 1st and 2nd 10-day re-monitoring events; however, Table 2 within Attachment 4 provides all measurements and following completion of both monitoring events, eleven (11) integrated monitoring results remain above the 25 ppmv threshold. The gas collection and control system was expanded in the subject areas in June 2023.				NA
Q3 2023*	1	0	NA	0	N	5	3	3	Y	0
Notes:	No exceedances above 500 ppmv were identified in the first 10-day or the 1-month re-monitoring events following system adjustments and remediation by SCS and site personnel.					Based on these monitoring results with accordance with the OMR, (with initial concentrations in exceedance not corrected) the site is required to perform a system expansion within 120-days of the third detected exceedance. The gas collection and control system was expanded in the subject area in September 2023.				NA
Q4 2023*	5	3	2	2	Y	8	4	1	Y	0
Notes:	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. The gas collection and control system was expanded in the subject areas in March 2024.					Based on these monitoring results with accordance with the OMR, (with initial concentrations in exceedance not corrected) the site is required to perform a system expansion within 120-days of the third detected exceedance. The gas collection and control system was expanded in the subject areas in March 2024.				NA
Q1 2024*	11	9	8	See notes	Y	4	0	NA	N	0
Notes:	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. SCS doesn't report results of the 1-month remonitoring event in the subject quarterly report and it's unclear if/why it wasn't conducted. Regardless, the gas collection and control system was expanded in the subject areas in March 2024.					No exceedances above 25 ppmv were identified in the first 10-day re-monitoring event following system adjustments and remediation by SCS and site personnel; therefore, no additional monitoring was required for the quarter.				NA
Q2 2024* EPA conducted initial monitoring event, SCS conducted the re-monitoring events	41	2	1	1	Y	Integrated data not prepared/available for the monitoring performed by the EPA				0
Notes:	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. No system expansion reported during Q2 2024, although system expansions were performed in the last month of Q1 2024 (March) and the last month of Q3 2024 (September).									NA
Q2 2024* SCS monitoring data only	22	15	15	15	Y	3	0	NA	N	0
Notes:	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. No system expansion reported during Q2 2024, although system expansions were performed in the last month of Q1 2024 (March) and the last month of Q3 2024 (September).					No exceedances above 25 ppmv were identified in the first 10-day re-monitoring event following system adjustments and remediation by SCS and site personnel; therefore, no additional monitoring was required for the quarter.				NA

* Quarterly report notes several grids were not monitored, in accordance with the OAR, due to active landfilling activities, unsafe conditions, overgrown vegetation, or no waste in place.

APPENDIX E

Table 2 – Roseburg Landfill & CBL – Methane Exceedance Comparison

Exhibit 41

Page 218 of 249

Table 2 - Roseburg Landfill & CBL – Methane Exceedance Comparison			
		Coffin Butte Landfill	Roseburg Landfill
Total Measurements	Instantaneous	39	19
	Instantaneous*	80	NA
	Integrated (# of Grids Monitored)	42	44
Exceedances	Initial Instantaneous >500 ppmv	22	12
	Initial Instantaneous >500 ppmv*	63	NA
	% exceedance of instantaneous measurements	56.41%	63.16%
	% exceedance of instantaneous measurements*	78.75%	NA
	1st 10-Day Re-Monitoring Event >500 ppmv*	17	0
	2nd 10-Day Re-Monitoring Event >500 ppmv*	16	N/A
	1-month Re-Monitoring Event*	16	N/A
	Integrated >25 ppmv	3	0
	1st 10-Day Re-Monitoring Event >25 ppmv	0	NA
	% exceedance of integrated grids	7.14%	0.00%

* Includes EPA instantaneous readings collected at CBL. The EPA did not collect integrated measurements.

May 17, 2024
File No. 04217027.23

Mr. Nick Frisinger
Roseburg Landfill 1036 SE
Douglas Ave RM 308 Roseburg
OR, 97470

Subject: Roseburg Landfill– Roseburg, Oregon

Surface Emissions Monitoring for the Second Quarter of 2024.

Dear Mr. Nick Frisinger,

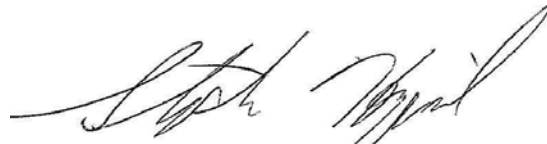
SCS Field Services (SCS-FS) is pleased to provide the Douglas County Solid Waste Department with the enclosed report summarizing the surface emissions monitoring services performed by SCS-FS at Roseburg Landfill (Site) during the second quarter of 2024. This report includes the results of the surface scan, component emissions, and blower/flare station emissions monitoring for the Site.

SCS-FS appreciates the opportunity to be of assistance to Roseburg Landfill on this project. As you review the enclosed information, please contact Stephen 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 Data Analyst
SCS Field Services



Stephen Harquail
PNW Region Manager
SCS Field Services

Roseburg Landfill Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring Second Quarter 2024

Presented to:

Nick Frisinger
Douglas County Solid Waste Director
1036 SE Douglas Ave RM 308
Roseburg OR, 97470

SCS FIELD SERVICES

File No. 04217027.23 | May 17, 2024

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

Roseburg Landfill

Oregon Landfill Gas Emissions Rule (OAR) and Surface Emissions Monitoring Second Quarter 2024

INTRODUCTION

This letter provides the results of April 8, 9, 16, and May 8, 2024, OAR landfill surface emissions monitoring (SEM) performed by SCS Field Services (SCS) at the Roseburg Landfill. All work was performed in accordance with our approved Work Scope, and the OAR requirements.

SITE BACKGROUND

Roseburg Landfill began receiving waste in 1932 and was privately owned and operated until 1975. The County purchased the landfill in 1975 and has operated the facility since that time.

From 1932 until the 1960s, Roseburg Landfill was operated as a burning dump. Disposal operations proceeded past the current landfill entrance gate westward up the valley of the Main Fill. Additionally, some ash and unburnt waste disposal occurred in the area now occupied by the Lateral Expansion. In the late 1960s operations changed from burning to conventional waste disposal (e.g., landfilling). Waste disposal operations shifted to the main valley (now called the Main Fill). Between 1997 and 2000, the County constructed the Lateral Expansion that is adjacent to and hydraulically upgradient to cross-gradient of the Main Fill. The Lateral Expansion is approximately 20 acres and is constructed to Subtitle D standards and comprised of three lined cells: Cell 1, Cell 2, and Cell 3. Groundwater drainage systems were constructed beneath the Lateral Expansion that includes the GWC and SDS.

In 2000 and 2001, the County installed seven LFG extraction wells in the Main Fill, just south of the interface with the Lateral Expansion, and a candle stick flare southwest of PV-1. Before waste was placed in the Lateral Expansion, VOCs were detected in discharges from the GWC, SDS, and SLCS. After the LFG collection and control system (GCCS) was installed and operating, VOCs were either no longer detected or only sporadically detected in liquid samples from these locations. A private entity, Roseburg LFG Energy, LLC, operates and maintains the GCCS, which now consists of over 50 LFG extraction wells and a landfill gas-to-energy plant.

2024 State Regulatory Applicability

Roseburg Landfill is subject to the Oregon-specific landfill gas emission regulations in OAR Chapter 340 Division 239. These SEM regulations are detailed below.

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 (NESHAP) 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;

In compliance with OAR, all emissions points 100 ppmv or over will be documented. 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 Roseburg landfill was done on a 25-foot pathway based on no prior inspections provided.

On April 8, and 9, 2024, SCS performed second quarter 2024 surface emissions monitoring testing as required by the Oregon Landfill Gas Emission Rule. Instantaneous surface emissions monitoring results indicated that twelve (12) locations exceeded the 500 ppmv maximum concentration on the above-mentioned dates (Table 1 in Attachment 3). The required first 10-day (OAR) monitoring indicated that all areas returned to below regulatory compliance limits following system adjustments and remediation by 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 Douglas County/Roseburg Landfill surface is divided into 54 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 no areas observed to exceed the 25 ppmv OAR integrated average threshold (Table 2 in Attachment 4). 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. If any instantaneous location records above 250 ppmv, it must be monitored in a 5-foot grid around the location to determine the extent of the methane leak. During this reporting period, six (6) 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.

SURFACE EMISSIONS MONITORING

On April 8, 9, 16, and May 8, 2024, the instantaneous and integrated SEM was performed over the surface of the subject site. The monitoring intended 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-foot pathway 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 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 as required under the OAR. The monitoring intended 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 April 8, and 9, 2024, SCS performed the second quarter of 2024 instantaneous emissions monitoring testing as required by the Oregon DEQ/OAR. During this monitoring, surface emissions results indicated that twelve (12) locations exceeded the 500 ppmv maximum concentration. The required first 10-day (OAR) follow-up monitoring performed on April 16th, 2024, and the 1-month (OAR) follow-up monitoring event performed on May 8, 2024, indicated that all locations returned below compliance limits as required, following system adjustments and remediation by site personnel. 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).

During this monitoring event, several grids 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 2024.

PRESSURIZED PIPE AND COMPONENT LEAK MONITORING

On April 9, 2024, 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 third quarter of 2024 surface emissions testing event is scheduled to be performed by the end of September 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

Roseburg Landfil

Surface Emissions Monitoring Grid Map

Legend

- Grid Line
- Grid Number

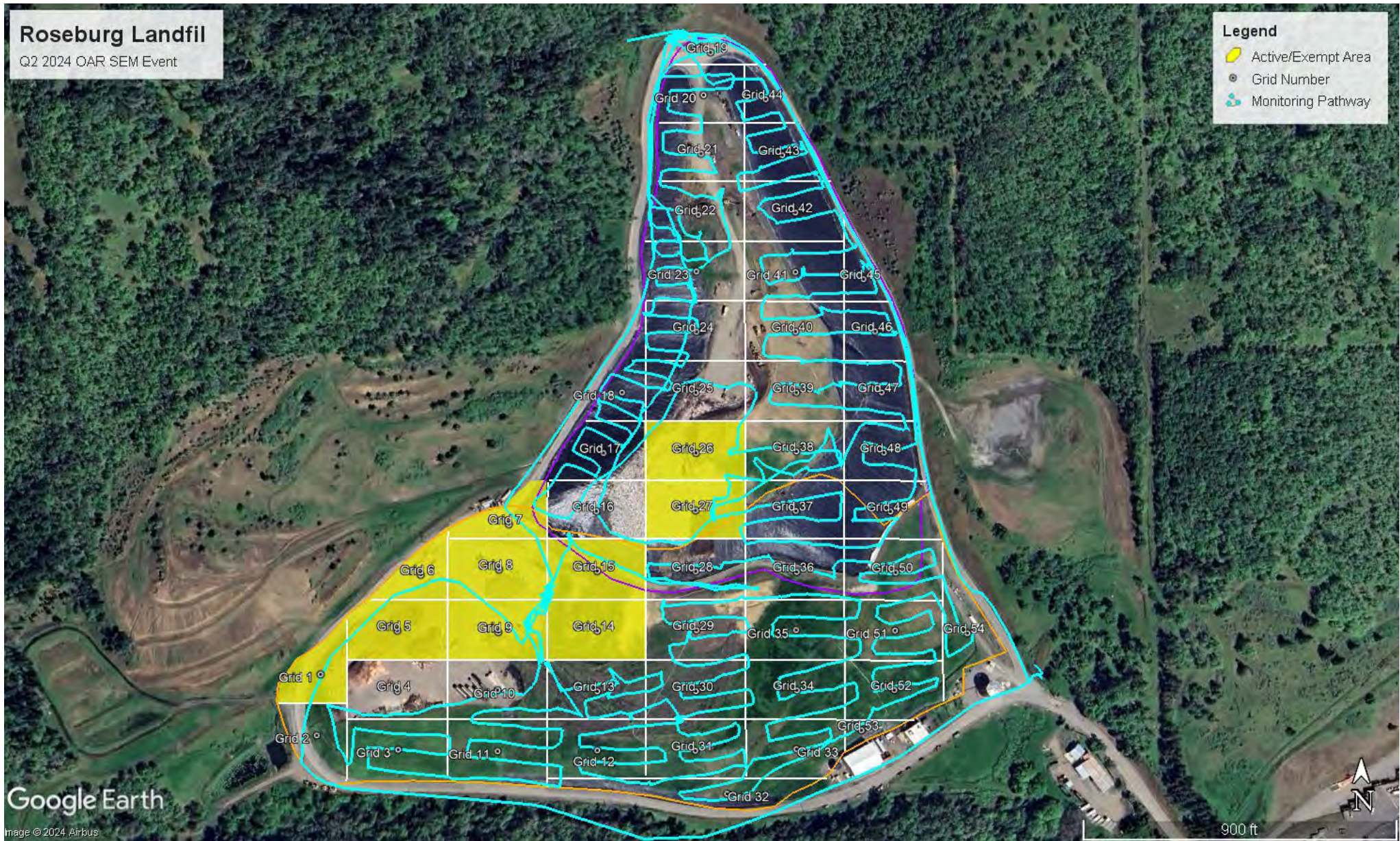


Attachment 2

Surface Pathway

Roseburg Landfill

Q2 2024 OAR SEM Event

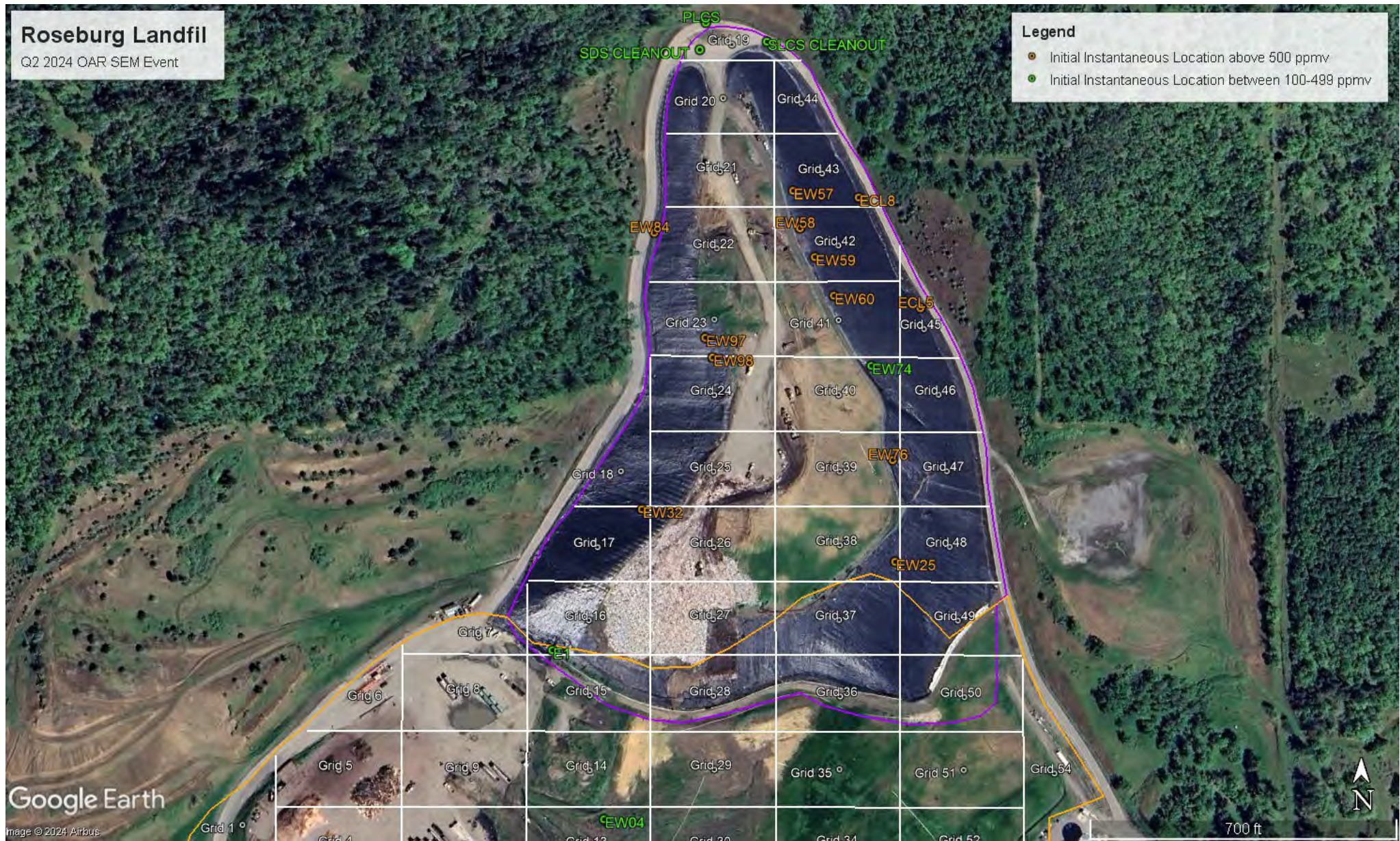


Attachment 3

Instantaneous and Component Emissions Monitoring Results

Roseburg Landfil

Q2 2024 OAR SEM Event



Instantaneous Data Report for April 8, 9, 16, and May 8, 2024

Location (Surface)	Initial Monitoring Results (ppmv) April 8, 2024	Initial Monitoring Results (ppmv) April 9, 2024	First 10-Day Recheck Monitoring Results (ppmv) April 16, 2024	1-Month Confirmation Monitoring Results (ppmv) May 8, 2024	Latitude	Longitude
EW98	6054	N/A	154	71	43.18934798	-123.382636
EW32	3100	N/A	47	210	43.18840502	-123.383238
EW97	2182	N/A	2	82	43.18947103	-123.382699
EW25	2132	N/A	4	72	43.18807896	-123.381081
EW84	1237	N/A	2	227	43.19012398	-123.383133
EW60	N/A	8522	47	32	43.18973204	-123.381603
ECL5	N/A	3359	26	12	43.18965501	-123.380865
ECL8	N/A	1256	2	126	43.19034199	-123.381391
EW59	N/A	1236	96	76	43.18997202	-123.381765
EW57	N/A	1217	9	5	43.19038399	-123.381951
EW76	N/A	896	31	122	43.18871104	-123.381102
EW58	N/A	507	16	136	43.19015097	-123.381892
E1	394	N/A	N/A	N/A	43.18753003	-123.384002
PLCS	216	N/A	N/A	N/A	43.19137104	-123.382656
SLCS CLEANOUT	180	N/A	N/A	N/A	43.19137397	-123.38261

Location (Surface)	Initial Monitoring Results (ppmv) April 8, 2024	Initial Monitoring Results (ppmv) April 9, 2024	First 10-Day Recheck Monitoring Results (ppmv) April 16, 2024	1-Month Confirmation Monitoring Results (ppmv) May 8, 2024	Latitude	Longitude
SDS CLEANOUT	163	N/A	N/A	N/A	43.191379	-123.38263
EW04	118	N/A	N/A	N/A	43.18648003	-123.383562
EW74	N/A	209	N/A	N/A	43.18929601	-123.381284

Pressurized Pipe and Component Results

Route	Date	Concentration (ppmv)
FLARE STATION	April 9, 2024	5.00

No other exceedances of the 500 ppmv threshold were observed during the second quarter of 2024 monitoring. The highest observed reading was 8,522.0 ppmv.

Attachment 4

Integrated Monitoring Results

Point Name	Record Date	FID Concentration (ppm)	Comments
Grid 1	--	--	Exempt
Grid 2	4/8/2024	3.03	
Grid 3	4/8/2024	2.77	
Grid 4	4/8/2024	3.30	
Grid 5	--	--	Exempt
Grid 6	--	--	Exempt
Grid 7	--	--	Exempt
Grid 8	--	--	Exempt
Grid 9	--	--	Exempt
Grid 10	4/8/2024	3.03	
Grid 11	4/8/2024	2.91	
Grid 12	4/8/2024	1.02	
Grid 13	4/8/2024	2.92	
Grid 14	--	--	Exempt
Grid 15	--	--	Exempt
Grid 16	4/8/2024	0.77	
Grid 17	4/8/2024	1.35	
Grid 18	4/8/2024	0.30	
Grid 19	4/8/2024	3.82	
Grid 20	4/8/2024	3.75	
Grid 21	4/8/2024	6.41	
Grid 22	4/8/2024	2.87	
Grid 23	4/8/2024	1.73	
Grid 24	4/8/2024	1.01	
Grid 25	4/8/2024	1.55	
Grid 26	--	--	Exempt
Grid 27	--	--	Exempt
Grid 28	4/8/2024	1.05	
Grid 29	4/8/2024	0.70	
Grid 30	4/8/2024	0.62	
Grid 31	4/8/2024	0.77	
Grid 32	4/8/2024	0.63	
Grid 33	4/8/2024	0.28	
Grid 34	4/8/2024	0.46	
Grid 35	4/8/2024	0.64	
Grid 36	4/8/2024	0.00	
Grid 37	4/8/2024	3.52	
Grid 38	4/8/2024	4.50	
Grid 39	4/9/2024	5.21	
Grid 40	4/9/2024	8.46	
Grid 41	4/9/2024	15.32	
Grid 42	4/9/2024	4.47	
Grid 43	4/9/2024	2.52	
Grid 44	4/9/2024	3.40	

Point Name	Record Date	FID Concentration (ppm)	Comments
Grid 45	4/9/2024	11.08	
Grid 46	4/9/2024	3.24	
Grid 47	4/9/2024	1.62	
Grid 48	4/8/2024	0.64	
Grid 49	4/8/2024	0.36	
Grid 50	4/8/2024	0.00	
Grid 51	4/8/2024	0.00	
Grid 52	4/8/2024	0.68	
Grid 53	4/8/2024	0.12	
Grid 54	4/8/2024	0.11	

Attachment 5

Calibration Logs

**CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA**

Date: 4/8/2024

Site Name: Coffin Butte Landfill

WEATHER OBSERVATIONS

SCS Employee Riley Baksic

Wind Speed: 8 MPH Wind Direction: NW Barometric Pressure: 30.25

Air Temperature: 49 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 = $\frac{\text{Average Difference}}{\text{Cal Gas Concentration}} \times 100\%$
= $\frac{0}{500} \times 100\%$
= 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 NW side. Reading: 0.4 ppm

Downwind SE side of site Reading: 1.7 ppm

NOTES:

**CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA**

Date: 4/9/2024

Site Name: Roseburg Landfill

WEATHER OBSERVATIONS

SCS Employee Riley Baksic

Wind Speed: 3 MPH Wind Direction: NW Barometric Pressure: 30.31

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	499	1
2	0	500	0
3	0	501	1

Average Difference: 0.00

Calibration Precision = $\frac{\text{Average Difference}}{\text{Cal Gas Concentration}} \times 100\%$
= $\frac{0}{500} \times 100\%$
= 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 NW side. Reading: 0.9 ppm

Downwind SE side of site Reading: 2.4 ppm

NOTES:

**CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA**

Date: 4/16/2024 Site Name: Roseburg Landfill

WEATHER OBSERVATIONS

SCS Employee Riley Baksic

Wind Speed: 9 MPH Wind Direction: NE Barometric Pressure: 30.42

Air Temperature: 55 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 = $\frac{\text{Average Difference}}{\text{Cal Gas Concentration}} \times 100\%$
= $\frac{0}{500} \times 100\%$
= 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 NE side. Reading: 0.3 ppm

Downwind SW side of site Reading: 1.7 ppm

NOTES:

**CARBON EMISSION MONITORING
CALIBRATION AND PERTINENT DATA**

Date: 5/8/2024

Site Name: Roseburg Landfill

WEATHER OBSERVATIONS

SCS Employee Riley Baksic

Wind Speed: 5 MPH Wind Direction: N Barometric Pressure: 30.23

Air Temperature: 51 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	501	1
3	0	499	1

Average Difference: 0.00

Calibration Precision = $\frac{\text{Average Difference}}{\text{Cal Gas Concentration}} \times 100\%$
= $\frac{0}{500} \times 100\%$
= 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 N side. Reading: 0.9 ppm

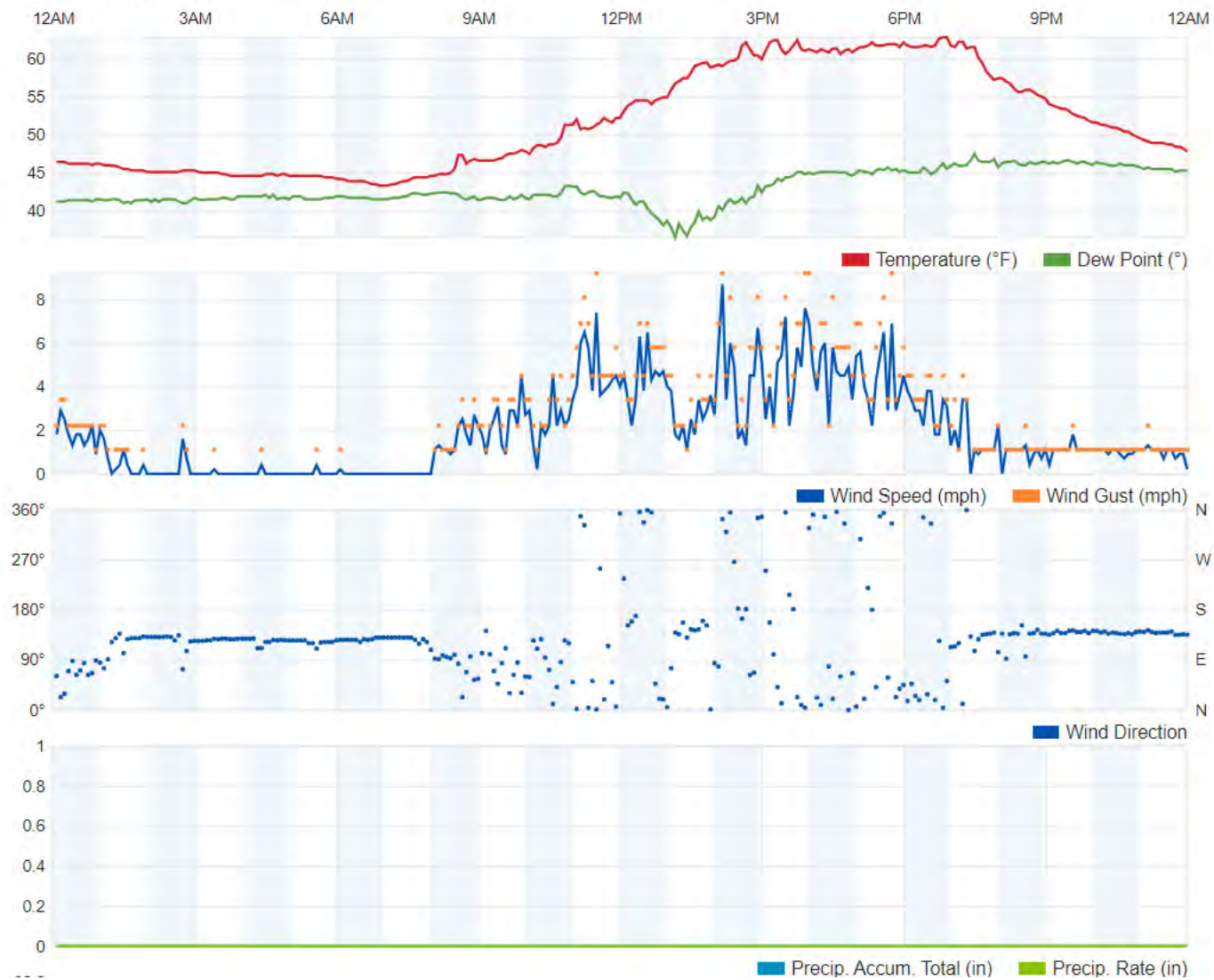
Downwind S side of site Reading: 1.6 ppm

NOTES:

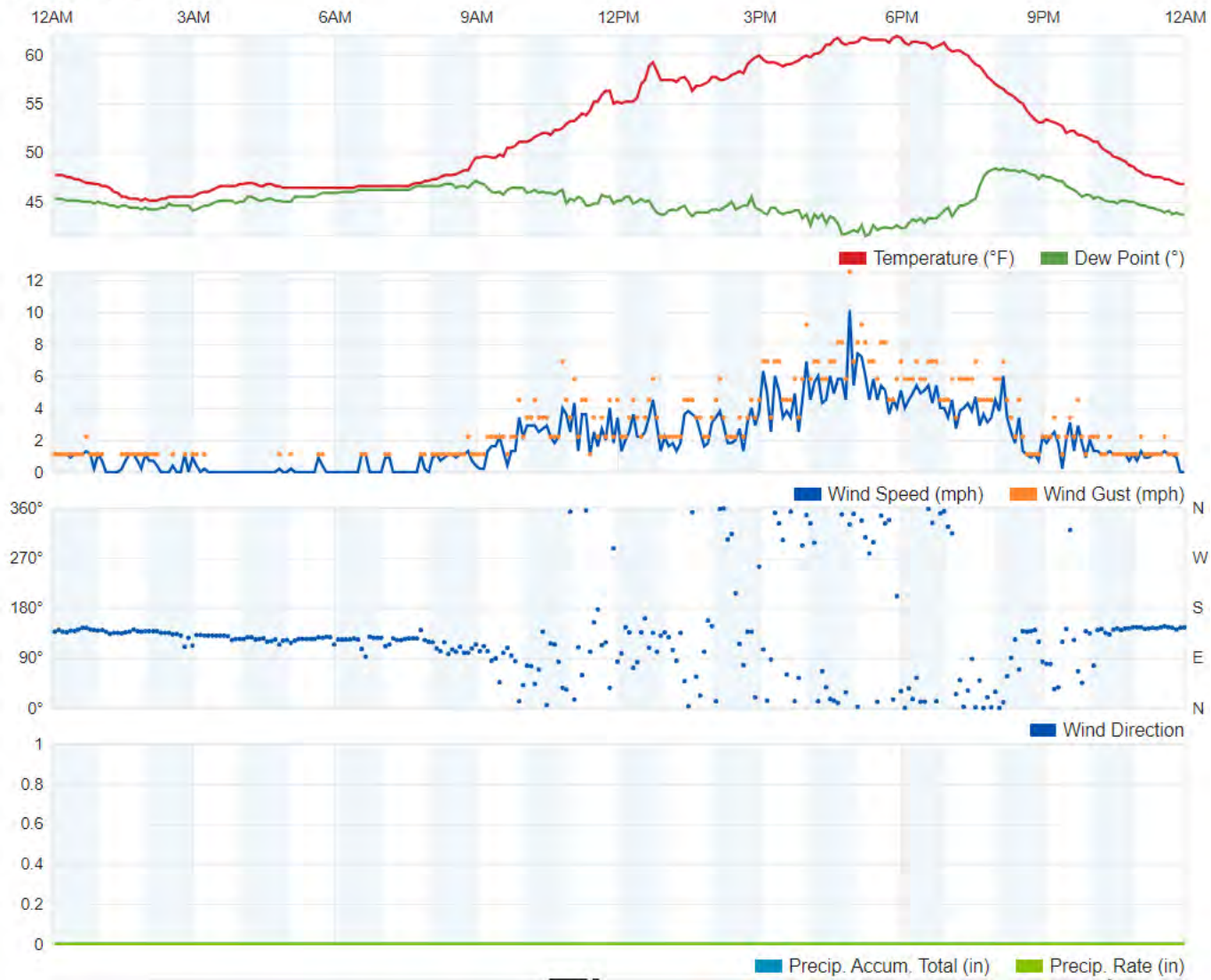
Attachment 6

Weather Data

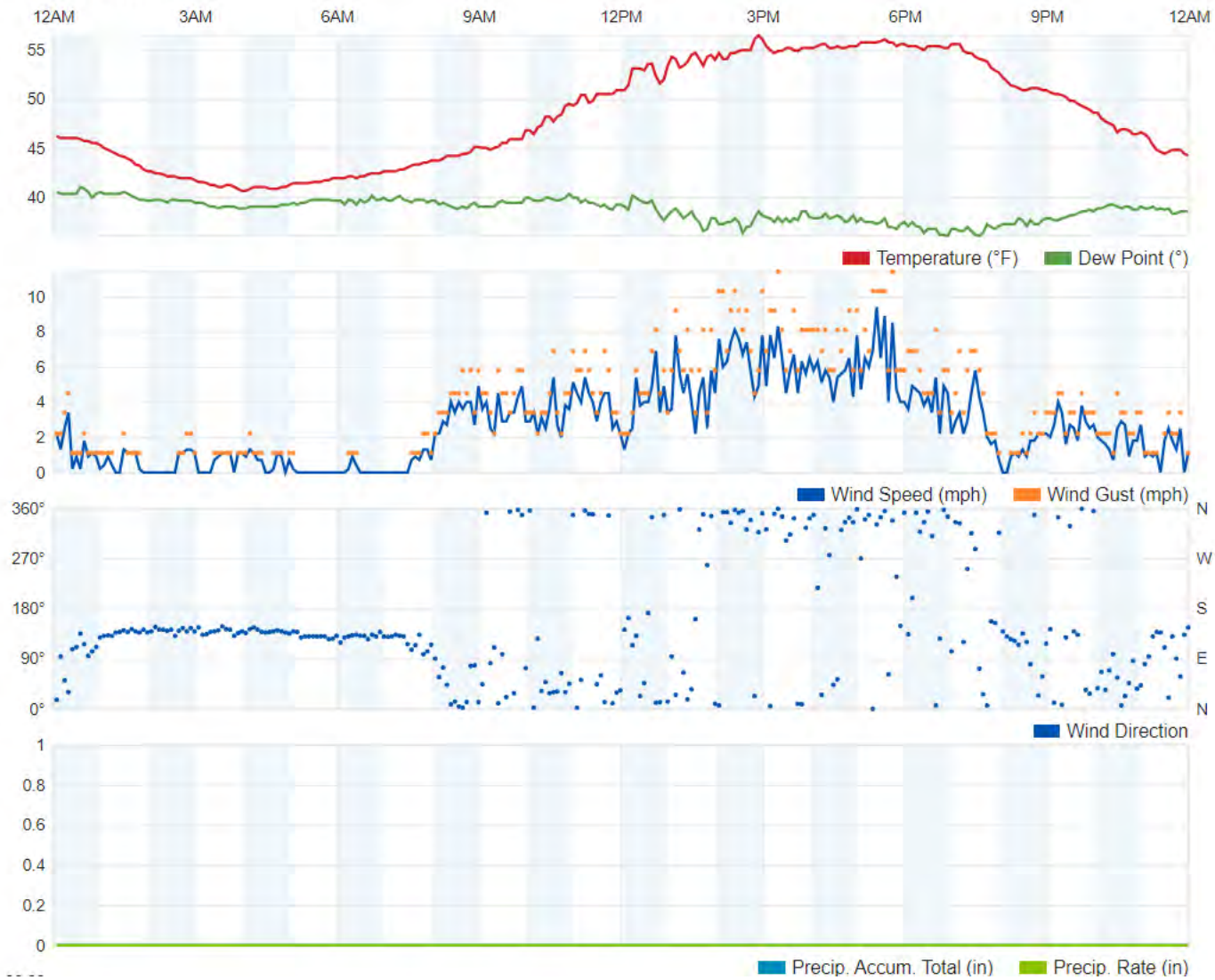
April 8, 2024



April 9, 2024



April 16, 2024



May 8, 2024

