



April 11, 2024

Sunny Becker, Site Manager
Washington State Department of Ecology
Northwest Regional Office
3190 160th Ave SE
Bellevue, WA 98008-5452

RE: Everett Landfill – 2023 Landfill Gas Annual Report

Dear Sunny:

Herrera Environmental Consultants, Inc. has completed the Landfill Gas Performance Monitoring annual report for the Everett Landfill site during the 2023 calendar year.

The attached letter report presents data and results from the quarterly Landfill Gas Monitoring events and highlights several significant observations about various areas on and around the landfill site.

As you will see in the attached, the landfill site remains in compliance regarding the landfill gas exposure pathway requirements established in the CAP/CD.

If you have any comments or questions on the attached, please don't hesitate to contact me.

Sincerely,


A handwritten signature in blue ink, appearing to read 'Randy Loveless'.

Randy Loveless, P.E.
Senior Engineer, Landfill Site Manager

Enclosure

Public Works

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2023 Annual Report

Landfill Gas Performance Monitoring Everett Landfill Site

Prepared for
City of Everett Public Works Department

Prepared by
Herrera Environmental Consultants, Inc.



Note:

Some pages in this document have been purposely skipped or blank pages inserted so that this document will print correctly when duplexed.

2023 Annual Report

Landfill Gas Performance Monitoring Everett Landfill Site

Prepared for
City of Everett Public Works Department
3200 Cedar Street
Everett, WA 98201

Prepared by
Herrera Environmental Consultants, Inc.
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April 9, 2024

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CERTIFICATE OF PROFESSIONAL ENGINEER

This document has been prepared under the supervision of a professional engineer.



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INTRODUCTION

Herrera Environmental Consultants, Inc. (Herrera) is contracted by City of Everett Public Works (City) to support in the operations and maintenance of the landfill gas (LFG) system at the Everett Landfill Site. This Annual Report presents LFG monitoring techniques, data, and results at and around the Everett Landfill for the year 2023. This document satisfies the Gas Pathway reporting requirements of the landfill site Consent Decree (CD) between the City and Washington State Department of Ecology (Ecology) and the associated Cleanup Action Plan (CAP) and Compliance Monitoring and Contingency Plan (CMCP).

This annual report also provides a summary of the LFG collection and control system. It includes the chronology of installation for sections completed in previous years and sections currently being developed.

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SUMMARY

This Annual Report provides relevant information pertaining to the Landfill Gas (LFG) control and collection systems at the Everett Landfill Site, the results of the 2023 LFG compliance monitoring as set forth in the landfill site CD between the City and Ecology, and the associated CAP and CMCP. Annual LFG compliance monitoring for 2023 included quarterly methane monitoring at LFG probes, on-site and off-site methane surface monitoring, and LFG confirmational sampling at the blower stations following startup of new sections of the LFG collection system. Data presented in this report was collected both by City of Everett technicians and by Herrera staff.

Monitored methane concentrations were below the limits set forth in the CMCP at all compliance monitoring probes except for Probes LG-88 and LG-89. Due in large part to probe flooding caused by high groundwater, the elevated methane concentrations measured at Probes LG-88 and LG-89 are not valid results. The measurements are consistent with previous observed conditions at these locations. Data from nearby monitoring stations and surface monitoring performed in the vicinity of Probes LG-88 and LG-89 does not show elevated methane levels originating from the landfill.

The LFG compliance monitoring data for 2023 demonstrates that the Everett Landfill Site remains in compliance.

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BACKGROUND

The City of Everett Landfill (also known as landfill or landfill site) is a closed landfill located in the City of Everett, Washington. Approximately 70 acres in size, the landfill site is located in the new Riverfront section in the eastern part of the city. The landfill actively collected waste during 50 years of operation until 1974.

In 2001, the City entered into a CD with Ecology. The current property developer, Riverfront Commercial Investment, LLC, subsequently signed on to the CD. As an attachment to the CD, the CAP defines cleanup requirements for all exposure pathways for both existing undeveloped and future developed conditions. The CMCP is an attachment to the CAP. The CMCP defines the protocol for demonstrating that the landfill site complies with CD/CAP requirements. The City performs routine monitoring of the LFG collection system and landfill site engineering controls, as outlined in the CMCP. This report describes and presents the results of this monitoring during 2023, as required by Section 3.5.5 of the CMCP.

Riverfront Commercial Investment, LLC purchased the property in 2013. It is currently being redeveloped into a mixed-use area. A new roadway crossing the landfill site (Riverfront Boulevard) was completed in 2021, and the portion of the landfill site west of the roadway is under construction. This construction activity includes two mixed-use buildings located in the southwest quadrant of the landfill site, the first of which was finished and occupied in October 2023. The eastern portion of the landfill site currently remains undeveloped.

Landfill Gas Collection System

Beginning in 2004, the LFG system has been installed in phases. Before it was expanded to accommodate development, the LFG collection system was composed of manifold (header) pipes that generally followed the outer perimeter of the 70-acre landfill site. The expanded system includes several extensions of the header pipes throughout the portion of the landfill site that is currently under development. Perforated collector pipes within and along the landfill boundary connect into the header pipes. The header pipes are typically solid-wall, 8-inch diameter high-density polyethylene (HDPE), and the collector pipes are typically 4-inch or 6-inch diameter perforated HDPE. See Figure 1 for a map of the current LFG system. At present, almost the entire landfill perimeter is surrounded by active gas interception trenches. A summary of construction activities related to the LFG collection system is listed in Table 1.

Table 1. Summary of Landfill Construction Activities.

Date	Description
2004	<ul style="list-style-type: none"> ● An LFG extraction trench (also known as a gas interception or collection trench) was constructed along most of the northern portion of the west landfill boundary and commenced operation. This trench was designed to prevent off-site migration by intercepting gas originating from the landfill site. ● A northern extension of the perimeter gas interception trench was constructed along the southern edge of the 36th Street right-of-way.
2006	<ul style="list-style-type: none"> ● A second LFG extraction trench was installed along the northern edge of the 36th Street right-of-way, parallel to and north of the 2004 trench. ● The 41st Street overcrossing gas extraction system was installed.
2013	<ul style="list-style-type: none"> ● An additional perimeter gas interception trench was installed along the eastern landfill boundary, utilizing the existing leachate collector trench.
2018	<ul style="list-style-type: none"> ● A new segment of gas interceptor was completed along the southeastern landfill boundary, as an extension of the existing gas collector along the eastern boundary, also utilizing the existing leachate collector trench.
2020	<ul style="list-style-type: none"> ● A second, separate gas extraction trench was constructed from the southern tip of the landfill site some 480 feet northward, east of the combined leachate collector/gas extraction trench.
2021	<ul style="list-style-type: none"> ● The initial phase of the Riverfront Development project on the landfill site was completed, including the Riverfront Boulevard and its active LFG collection system.
2023	<ul style="list-style-type: none"> ● The collection system beneath the West Site Work Phase 1 development parking lot and two mixed-use buildings (Buildings A and B) was activated.

In 2021, the initial phase of the Riverfront Development project on the landfill site was completed. This initial phase included the Riverfront Boulevard and its active LFG collection system. Upon the dedication of Riverfront Boulevard in July of 2021, it became open for public use. The LFG collection system became officially active, under control and monitoring of the City. The Riverfront Boulevard LFG collection system was originally connected entirely to the north blower facility. As shown in Figure 1, it is now split between the north and south blower facilities.

In October 2023, the first Riverfront building (Building B) was completed and occupied. A portion of the development parking lot was also opened for public use. The collection system beneath the development parking lot and two mixed-use buildings was activated and connected to the south blower facility. All developed areas are underlain by an active LFG collection system that will continue to be expanded as development continues on the landfill site. Monitoring of LFG surface emissions across the open parking lot and inside the occupied building began in October 2023 and is described further in this report.

The LFG Collection system was modified and expanded to provide LFG collection beneath Building B and associated development amenities. Therefore, as required by CMCP Section 3.6, confirmational sampling at LFG discharge points was conducted on December 28, 2023. This sampling and the associated analysis and results are discussed further in this report.

Blower System

The LFG system is served by two blower facilities that apply vacuum to the header pipe network. The north blower facility is located near the intersection of 36th Street and Riverfront Boulevard. The south blower facility is located at the south end of the landfill site immediately west of Riverfront Boulevard and south of the 41st Street Roundabout. Each blower facility has two blowers, including one duty unit and one standby unit. The North Blower and South Blower facilities provide vacuum for the existing perimeter, 41st Street, Riverfront Boulevard, and West Site LFG collection system headers.

The blower facilities are also the LFG discharge points. The blower facilities vent collected LFG to atmosphere through a discharge stack that extends vertically from the blower skid. Table 2 and Figure 1 show which segments of the LFG collection system connect to the two blower facilities. By manipulating isolation and control and monitoring valves throughout the system, segments of LFG collection piping can be switched from one blower facility to the other, as needed, and the vacuum can be adjusted based on monitoring results and operational needs. City and Herrera personnel perform LFG monitoring, as well as system control and valve monitoring, on a monthly basis. Both the City and Herrera use a Landtec GEM 5000 for informational and operational purposes.

Both blower stations were upgraded in 2023. The South Blower piping was modified to accommodate a new flow meter that was installed on the dilution inlet pipe in September 2023. This new meter will enable more accurate analysis of the system. Electrical infrastructure for a new generator was also installed at the South Blower station to provide continued system operation during power outages. Due to prolonged procurement timelines for the new generator, a temporary generator will provide standby power at this location until the permanent generator arrives in early 2024. The North Blower station was replaced with a completely new skid; new blowers; updated electrical controls; condensate separators; and flow, pressure, and temperature sensors. In order to replace aging equipment, the new skid was installed about 60 feet southeast of the original blower station in December 2023. At City Lift Station 33, the North Blower Station was also connected to an existing power system that includes a backup power generator.

Table 2. List of Device Control and Monitoring Valves and Blower Station Connections.

Device/Node	Blower	Device/Node	Blower
CM-PER001	South	CM-PER052	North
CM-PER002	South	CM-PER053	North
CM-PER003	South	CM-PER054	North
CM-PER004	South	CM-PER055	North
CM-PER005	South	CM-PER056	North
CM-PER006	South	CM-PER057	North
CM-PER007	South	CM-PER058	North
CM-PER008	South	CM-PER059	North
CM-PER009	South	CM-PER060	North
CM-PER010	South	CM-PER061	South
CM-PER011	South	CM-PER062	South
CM-PER012	South	CM-PER063	South
CM-PER013	South	CM-BLVD001	South
CM-PER014	South	CM-BLVD002	South
CM-PER015	South	CM-BLVD003	South
CM-PER016	South	CM-BLVD004	South
CM-PER017	South	CM-BLVD005	South
CM-PER018	South	CM-BLVD006	South
CM-PER019	South	CM-BLVD007	South
CM-PER020	South	CM-BLVD008	South
CM-PER021	South	CM-BLVD009	North
CM-PER022	South	CM-BLVD010	North
CM-PER023	South	CM-BLVD011	North
CM-PER024	South	CM-BLVD012	North
CM-PER025	South	CM-SUBA001	South
CM-PER026	South	CM-SUBA002	South
CM-PER027	South	CM-SUBA003	South
CM-PER028	South	CM-SUBA004	South
CM-PER029	South	CM-SUBA005	South
CM-PER030	South	CM-SUBA006	South
CM-PER031	South	CM-SUBA007	South
CM-PER032	South	CM-SUBA008	South
CM-PER033	South	CM-SUBB001	South
CM-PER034	South	CM-SUBB002	South
CM-PER035	South	CM-SUBB003	South
CM-PER036	South	CM-SUBB004	South
CM-PER037	South	CM-SUBB005	South

Table 2 (continued). List of Device Control and Monitoring Valves and Blower Station Connections.

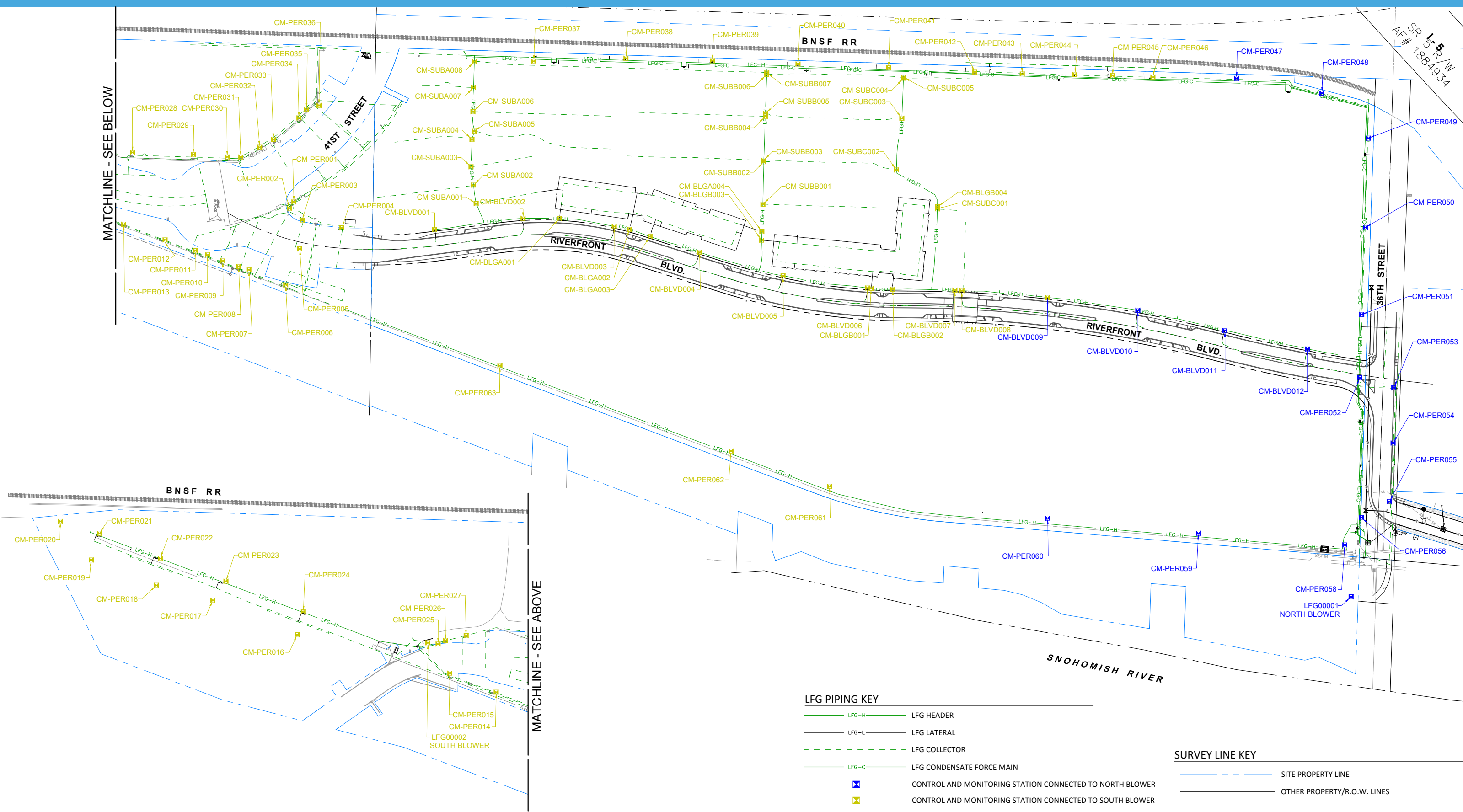
Device/Node	Blower	Device/Node	Blower
CM-PER038	South	CM-SUBB006	South
CM-PER039	South	CM-SUBB007	South
CM-PER040	South	CM-SUBC001	South
CM-PER041	South	CM-SUBC002	South
CM-PER042	South	CM-SUBC003	South
CM-PER043	South	CM-SUBC004	South
CM-PER044	South	CM-SUBC005	South
CM-PER045	South	CM-BLGA001	South
CM-PER046	South	CM-BLGA002	South
CM-PER047	North	CM-BLGA003	South
CM-PER048	North	CM-BLGA004	South
CM-PER049	North	CM-BLGB001	South
CM-PER050	North	CM-BLGB002	South
CM-PER051	North	CM-BLGB003	South
		CM-BLGB004	South

Device node is connected to south blower

Device node is connected to north blower

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Figure 1.
Landfill Gas System Map and Blower Connections.



LFG PIPING KEY

	LFG-H	LFG HEADER
	LFG-L	LFG LATERAL
	LFG-C	LFG COLLECTOR
	LFG-C	LFG CONDENSATE FORCE MAIN
		CONTROL AND MONITORING STATION CONNECTED TO NORTH BLOWER
		CONTROL AND MONITORING STATION CONNECTED TO SOUTH BLOWER

SURVEY LINE KEY

	SITE PROPERTY LINE
	OTHER PROPERTY/R.O.W. LINES



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LANDFILL GAS COLLECTION SYSTEM STATUS

LFG monitoring was completed at the Everett Landfill Site in 2023, according to CD/CAP requirements for the gas environmental exposure pathway. This monitoring is necessary to document compliance with cleanup action standards and to ensure protection of human health and the environment.

Four quarterly monitoring events were conducted on the following dates:

1. **First Quarter:** March 28, 2023
2. **Second Quarter:** June 29, and July 3, 2023
3. **Third Quarter:** September 19, September 20, and September 21, 2023
4. **Fourth Quarter:** December 14, December 18, and December 19, 2023

The LFG compliance monitoring tasks performed this year include:

- Quarterly perimeter probe monitoring
- Surface emissions monitoring
 - Biweekly monitoring for the first 3 months a building and/or exterior area is open for public access (Building B, Zone 1 of West Site Work Phase 1)
 - Quarterly monitoring for areas open for public access but not requiring biweekly monitoring (Riverfront Blvd., 41st Street Roundabout, East Perimeter Trail)
- Quarterly off-site structure monitoring (off-site structure monitoring program completed with January 2023 monitoring event)
- One time LFG discharge sampling at both blower stations (required after system modifications are completed)

Landfill Gas Perimeter Probe Monitoring

Background

A network of LFG compliance monitoring probes is established around the perimeter of the landfill site. The locations of these probes are shown in Figure 2. These probes are used to determine if LFG control systems are effective in preventing off-site migration of methane. The CAP and CMCP establish a contingency plan trigger of 5 percent methane by volume (percent), measured at any perimeter compliance monitoring probe. Measured methane concentrations below 5 percent by volume are thus considered in compliance with landfill site requirements.

Methods

The City utilized a Landtec GEM 5000 unit to measure gas concentrations and flows from probes surrounding the perimeter of the landfill site. Probe measurements are collected quarterly per the CMCP.

Thirty-nine (39) probes were monitored in 2023. Thirty-six (36) of the probes are used for compliance monitoring. Three probes (LG-14, LG-15, and LG-16) are not considered compliance probes, due to their completion in fill. These three are monitored solely to inform LFG system operations. Monitoring probes are shown on the map in Figure 2. Compliance probes are green, and information-only probes are orange.

The GEM 5000 is a handheld portable gas analyzer that samples the LFG and measures the concentrations of methane, carbon dioxide, and oxygen, as listed in Table 3. The GEM 5000 measures methane and carbon dioxide by dual wavelength infrared cell and oxygen by internal electrochemical cell. City staff took LFG readings at each probe on a quarterly basis and sent the readings to Herrera for reporting and analysis.

Table 3. Quarterly Data Collection Parameters.

Compound	Units	Measurement Method	Description
CH4	Percent by volume	Dual wavelength infrared cell	Methane concentration of sampled landfill gas
CO2	Percent by volume	Dual wavelength infrared cell	Carbon dioxide concentration of sampled landfill gas
O2	Percent by volume	Internal electrochemical cell	Oxygen concentration of sampled landfill gas

Results

Each of the 36 compliance probes were monitored each quarter and had methane levels below the contingency plan trigger of 5 percent, with the exception of those discussed in the following sections. Results from quarterly probe monitoring are shown in Table 4.

Figure 2.
LFG Monitoring Probes.



File Path: K:\Projects\2022\22-07824-100_Proj\Everett\LFG_System.aprx\Figure 1. LFG Monitoring Probes 8.5x11
 Author: bBagniewski
 Date: 2/9/2024

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Table 4. Perimeter Probe Monitoring Results.

Device ID	Date	CH ₄ (% by volume)	CO ₂ (% by volume)	O ₂ (% by volume)
LG000021	3/28/2023	0	0	20.8
LG000021	6/29/2023	0	0	20.8
LG000021	9/20/2023	0	0.1	20.5
LG000021	12/18/2023	0	0.1	21
LG000023	3/28/2023	0	0	20.8
LG000023	6/29/2023	0	0	20.7
LG000023	9/20/2023	0	0	20.6
LG000023	12/18/2023	0	0.1	21.2
LG000024	3/28/2023	0	0	20.9
LG000024	6/29/2023	0	0	20.7
LG000024	9/20/2023	0	0	20.6
LG000024	12/18/2023	0	0.1	21.4
LG000025	3/28/2023	0	0.1	20.9
LG000025	6/29/2023	0	0	20.8
LG000025	9/20/2023	0	0.1	20.5
LG000025	12/18/2023	0.1	0.1	22.6
LG000026	3/28/2023	0	0.2	20.3
LG000026	6/29/2023	0	0	20.8
LG000026	9/20/2023	0	1.6	18.7
LG000026	12/18/2023	0.1	0.1	22.6
LG000027	3/28/2023	0	0	21
LG000027	6/29/2023	0	0	20.8
LG000027	9/20/2023	0	0.1	20.5
LG000027	12/18/2023	0.1	0.1	22.8
LG000028	3/28/2023	0	1	19.9
LG000028	6/29/2023	0	1.6	19.3
LG000028	9/20/2023	0	1.3	19.1
LG000028	12/18/2023	0.1	0.6	20.5
LG000030	3/28/2023	0	1.6	19.3
LG000030	6/29/2023	0	2.3	18.8
LG000030	9/20/2023	0	2.4	18.8
LG000030	12/18/2023	0.1	2.8	19.1
LG000031	3/28/2023	0	0.1	21.2
LG000031	6/29/2023	0	3.1	18.2
LG000031	9/20/2023	0	3.8	17.8
LG000031	12/18/2023	0.1	0.2	22.7
LG000032	3/28/2023	0	4.6	13.8

Table 4 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH ₄ (% by volume)	CO ₂ (% by volume)	O ₂ (% by volume)
LG000032	6/29/2023	0	6.6	14.4
LG000032	9/20/2023	0	5.4	16.4
LG000032	12/18/2023	0.1	3.2	19.5
LG000033	3/28/2023	0	0.1	21
LG000033	6/29/2023	0	0.3	20.6
LG000033	9/20/2023	0	0.2	20.5
LG000033	12/18/2023	0.1	0.1	22.6
LG000034	3/28/2023	0	1.7	18.8
LG000034	6/29/2023	0	2.2	17.8
LG000034	9/20/2023	0	2.7	17.7
LG000034	12/18/2023	0.1	1.6	20.7
LG000035	3/28/2023	0	3.8	11.6
LG000035	6/29/2023	0	10.8	7.9
LG000035	9/20/2023	0	9.1	13.4
LG000035	12/18/2023	0.1	5.7	5.6
LG000041	3/28/2023	0	0.2	21.3
LG000041	7/3/2023	0	4.2	14.7
LG000041	9/19/2023	0	8.3	13.4
LG000041	12/18/2023	0.1	1.2	20.4
LG000055	3/28/2023	0	5.6	15
LG000055	7/3/2023	0	9	11.9
LG000055	9/19/2023	0	8.9	12.4
LG000055	12/14/2023	0	11.6	6.4
LG000057	3/28/2023	0	0.3	20.4
LG000057	7/3/2023	0	6.9	3.3
LG000057	9/21/2023	0	4.6	15.1
LG000057	12/19/2023	0	2.6	16.6
LG000058	3/28/2023	0	5.8	11.3
LG000058	7/3/2023	0	3.6	13.9
LG000058	9/21/2023	0	4.9	14.2
LG000058	12/19/2023	0.1	2.8	16.2
LG000059	7/3/2023	0	0.3	19.7
LG000059	9/19/2023	0	7.6	13.9
LG000059	12/14/2023	0	3.2	17.5
LG000062	3/28/2023	0	0.4	20.6
LG000062	7/3/2023	0	1.3	18.8
LG000062	9/20/2023	0	0.1	20.1

Table 4 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH ₄ (% by volume)	CO ₂ (% by volume)	O ₂ (% by volume)
LG000062	12/14/2023	0	1.2	20.3
LG000070	3/28/2023	0	4.7	6.5
LG000070	6/29/2023	0	6.3	12.6
LG000070	9/19/2023	0	7.3	11.8
LG000070	12/14/2023	0	2.9	12.6
LG000071	3/28/2023	0	0.8	20.6
LG000071	6/29/2023	0	0.6	20.1
LG000071	9/19/2023	0	10.3	4.8
LG000071	12/14/2023	0	3.2	16.3
LG000072	3/28/2023	0	0.6	20.2
LG000072	6/29/2023	0	0.9	19.4
LG000072	9/19/2023	0	1.3	18.9
LG000072	12/14/2023	0	0.8	20.7
LG000073	3/28/2023	0	0.1	20.9
LG000073	6/29/2023	0	0.1	20.3
LG000073	9/19/2023	0	0.6	20.1
LG000073	12/14/2023	0	0.1	21.4
LG000076	3/28/2023	0	4.7	13.3
LG000076	7/3/2023	0	2.5	13.8
LG000076	9/21/2023	0	4.1	13.2
LG000076	12/19/2023	0	2.9	16
LG000078	3/28/2023	0	6.3	10
LG000078	7/3/2023	0	5.7	12.7
LG000078	9/21/2023	0	7.5	10.5
LG000078	12/18/2023	0.1	8.9	7.3
LG000085	3/28/2023	0	4	14.3
LG000085	7/3/2023	0	6.9	10.4
LG000085	9/20/2023	0	12.9	7.3
LG000085	12/18/2023	0.1	5.5	15.3
LG000086	3/28/2023	0	0	21.5
LG000086	7/3/2023	0	12	5.9
LG000086	9/20/2023	0	14.8	5.7
LG000086	12/18/2023	0.1	6.6	8.1
LG000087	3/28/2023	0	0	21.5
LG000087	7/3/2023	0	5.1	13
LG000087	9/20/2023	0	8.6	11.7
LG000087	12/18/2023	0.1	3.5	18.2

Table 4 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH ₄ (% by volume)	CO ₂ (% by volume)	O ₂ (% by volume)
LG000088	3/28/2023	0	0.1	20.2
LG000088	7/3/2023	25.3	1.6	10.8
LG000088	9/19/2023	0.4	0.1	21
LG000088	12/18/2023	0.1	0.1	22
LG000089	3/28/2023	0	0.1	20.2
LG000089	7/3/2023	21.8	4	4.8
LG000089	9/19/2023	36.1	5.3	4.9
LG000089	12/18/2023	0.1	0.1	22.1
LG000090	3/28/2023	0	0.5	20
LG000090	7/3/2023	0	0.7	19.9
LG000090	9/19/2023	1.1	0.6	20.4
LG000090	12/18/2023	0.1	0.1	22.1
LG000091	3/28/2023	0	2.8	17.9
LG000091	7/3/2023	0	4.9	14.4
LG000091	9/19/2023	0	4.1	16.1
LG000091	12/14/2023	0	4.3	14.2
LG000092	3/28/2023	0	0.1	20.9
LG000092	7/3/2023	0	0.3	20
LG000092	9/20/2023	0	0.3	19.9
LG000092	12/14/2023	0	0.1	21.6
LG000093	3/28/2023	0	0	21
LG000093	6/29/2023	0	0.3	19.6
LG000093	9/20/2023	0	0.6	19.6
LG000093	12/14/2023	0	0.4	21.1
LG000093	12/14/2023	0	1.2	20.1
LG000094	3/28/2023	0	1.3	19.4
LG000094	6/29/2023	0	1.9	18
LG000094	9/20/2023	0	2.4	18.1
LG000094	12/14/2023	0	1.2	20
LG000095	3/28/2023	0.5	18.6	0.8
LG000095	7/3/2023	0	12.4	4.8
LG000095	9/21/2023	0	4.5	14.5
LG000095	12/18/2023	0.1	18.6	1.2
LG000014	3/28/2023	61.4	12.8	13.5
LG000014	7/3/2023	70.2	16.5	13.3
LG000014	9/21/2023	59.6	20.5	19.9
LG000014	12/19/2023	5.4	2.2	19.9




Table 4 (continued). Perimeter Probe Monitoring Results.

Device ID	Date	CH ₄ (% by volume)	CO ₂ (% by volume)	O ₂ (% by volume)
LG000015	3/28/2023	9.8	2.2	15.5
LG000015	7/3/2023	39.3	18.1	3.2
LG000015	9/21/2023	30.5	25.3	0
LG000015	12/19/2023	5.5	1.4	18.2
LG000016	3/28/2023	0.6	0.1	20.7
LG000016	7/3/2023	0	0	21.1
LG000016	9/21/2023	67.6	32	0
LG000016	12/19/2023	0.4	0.2	20.8

Notes:

 Information-only probe

 Methane exceedance observed at information-only probe

 Methane exceedance observed at compliance probe

Notable Areas/Probes

Landfill Perimeter – South End – LG-88 and LG-89

Of the 36 compliance monitoring probes, only LG-88 and LG-89 had methane readings above 5 percent in any quarter. Exceedances were observed during the second and third quarters. For the July 2023 monitoring event, LG-88 had a reading of 25.3 percent methane and LG-89 had a reading of 21.8 percent methane. For the September 2023 monitoring event, LG-89 had a reading of 36.1 percent methane. These compliance probes with a methane exceedance above 5 percent are highlighted yellow in Table 4.

While these probe readings were over the 5 percent compliance limit, it was determined that the readings were not valid. During these monitoring events, both LG-88 and LG-89 pulled water into the sample collection hose within 30 seconds of the GEM 5000 pump running on the analyzer. This suggests that the groundwater elevation at the time of sampling was above the probe screen and prevented soil gas from entering the probe to produce an accurate measurement. Obtaining a valid reading requires the stagnant air in the upper portion of the probe to be purged, evidenced by a lengthy pump run with readings that converge and stabilize on a final result. The results are not valid, because a complete sampling sequence was not possible at these locations.

A lack of compliance confirmation in this portion of the landfill site is not particularly concerning. These probes are located very close to linear saturated drainage/wetlands (part of Bigelow Creek) that run parallel to the eastern landfill boundary (part of the mapped Everett Riverfront Western Wetland Complex) and are often flooded as a result. LG-88, LG-89, and LG-90 were installed in October 2019 to monitor the potential for gas migration east of the landfill boundary. These probes were installed as replacements for former compliance monitoring probes (LG-82, LG-83, and LG-84). Results of 2016 and 2019 bar hole surveys showed elevated methane in shallow soils near the landfill site (west of the wetlands) but none east of the wetlands. Therefore, the wetlands (i.e., band of saturated ground) are believed to act as a hydraulic barrier that mitigates potential soil gas migrating from the landfill site. The

shallow aquifer in this area is saturated and comprised of silt and peat deposits that form an aquitard down to depths of approximately 45 feet, below which is the deeper (fully saturated) aquifer. The gas collection trench installed in 2020 is intended to intercept any potential LFG in the uppermost unsaturated soils at the southeast perimeter of the landfill. LG-88, LG-89, and LG-90 are all screened from a depth of 3 feet to a depth of 10 feet. At the time of installation, the surrounding soils were identified as silty, poorly graded, and gravelly sands that were moist to wet.

Results from 2020 gas monitoring showed minimal to no methane in LG-88, LG-89, and LG-90, with a single occurrence of methane detection (0.5 percent in probe LG-89 in March 2020). A few methane detections above 5 percent were observed in 2021 and 2022. Each of these instances occurred due to the probes being flooded with water.

Landfill Interior – East Side – LG-14, LG-15, and LG-16

In Figure 2, the three probes on the east perimeter trail—LG-14, LG-15, and LG-16—are shown in orange. Methane concentrations were above 5 percent in each of these probes at least once during 2023. These three probes are not compliance monitoring probes, due to their completion in fill, but the City continues to monitor them to inform operations.

Landfill Gas Surface Emissions Monitoring

City and Herrera personnel used a Landtec SEM 5000 Tunable Diode Laser Absorption Spectroscopy (TDLAS) detector to measure methane concentrations across the surface of the landfill within publicly accessible areas per CD requirements. Surface monitoring was also collected at off-site neighboring structures in January of 2023. The SEM 5000 unit is calibrated to the landfill site location and adjusts measurements based on the background methane concentrations measured upwind and downwind.

In order to keep surface monitoring data aligned with perimeter probe monitoring data, surface monitoring data is collected as close as possible to the time of the quarterly LFG compliance probe monitoring. City and Herrera staff collected surface monitoring data, and Herrera analyzed the data after each event.

On-Site Surface Monitoring

Background

The CMCP requires that the landfill surface be monitored for methane emissions to evaluate the performance of the LFG collection system, cap/barriers, etc. In 2023, this involved monitoring the gravel path south of the LFG South Blower Station, the paved east perimeter trail, the west Riverfront Boulevard sidewalk, and the east Riverfront Boulevard sidewalk on a quarterly basis.

Completed in October 2023, the open/parking lot areas associated with Building B (Zone 1 of West Site Work Phase 1) are now included in the on-site surface monitoring program. Per the CMCP, this periodic surface monitoring was performed every 2 weeks for the first 3 months after the building and exterior

area was opened for public access. Monitoring frequency will switch to quarterly when monitored methane levels remain in compliance for 3 consecutive months.

Methods and Results

Monitoring personnel used a Landtec SEM 5000 unit and walked the extents of the landfill to record surface methane concentrations. The SEM 5000 unit was calibrated on each day of monitoring to accurately record the methane concentrations and the corresponding GPS points. City personnel monitored the gravel path south of the south blower station, the paved east perimeter trail, the west Riverfront Boulevard sidewalk, and the east Riverfront Boulevard sidewalk. Herrera personnel monitored the interior and exterior of Building B and the publicly accessible parking area (following a serpentine path). All surface gas monitoring procedures were conducted following the Environmental Protection Agency (EPA) Code of Federal Regulations (CFR) Part 60 Subpart WWW *Standards of Performance for Municipal Solid Waste Landfills*. Surface monitoring paths and results for the City and Herrera are shown in Figures 3 and 4, respectively. The maximum observed levels are summarized in Table 5.

The SEM 5000 uses GPS to geolocate recorded methane concentrations in real time. When GPS signal is lost inside the building, the stored location is logged with the coordinate of the last location before the connection was lost. Consequently, the datapoints shown within and beside the building on Figure 4 do not necessarily appear in the correct location.

The threshold for the on-site monitoring identified in the CAP is 100 ppm inside buildings and 500 ppm for exterior areas. None of the concentrations recorded during 2023 quarterly monitoring events exceeded these thresholds. As shown in Figures 3 and 4, the maximum methane concentration measured for exterior areas in 2023 was 18.6 ppm (well below the 500 ppm threshold). As shown in Table 5, the maximum methane concentration measured for interior areas was 4.2 ppm. Each dot on the figures represents a collected air monitoring read. The highest methane concentration observed during each monitoring event is called out on Figures 3 and 4.

Figure 4 shows monitoring data from November 8, 2023, through December 21, 2023 (the last surface monitoring event of 2023). Due to incorrect settings on the SEM 5000, data from the October 12, 2023 and October 26, 2023 monitoring events was not saved. Because the data from these events was not captured, those dates are not included in Figure 4. Even though the data was not recorded, Herrera's monitoring personnel continuously observed the measured methane concentrations shown on the screen of the SEM 5000 during these monitoring events and noted the maximum interior and exterior methane results each day (Table 5). Once the settings error was discovered, the issue was remedied. It should not occur again.

Table 5. Publicly Open Building and Parking Lot Surface Monitoring Results Summary.

Date	Interior Air Results (Compliance Threshold is 100 ppm)	Exterior Air Results (Compliance Threshold is 500 ppm)
Highest Methane Level Recorded (ppm)		
Thursday, October 12, 2023	2.9	3.2
Thursday, October 26, 2023	3.9	2.9
Wednesday, November 8, 2023	4.2	3.2
Tuesday, November 21, 2023	3.9	14.3
Friday, December 8, 2023	3.3	7.4
Thursday December 21, 2023	3.3	3.7

Figure 3.
Quarterly Monitoring Results for City-Monitored Areas.

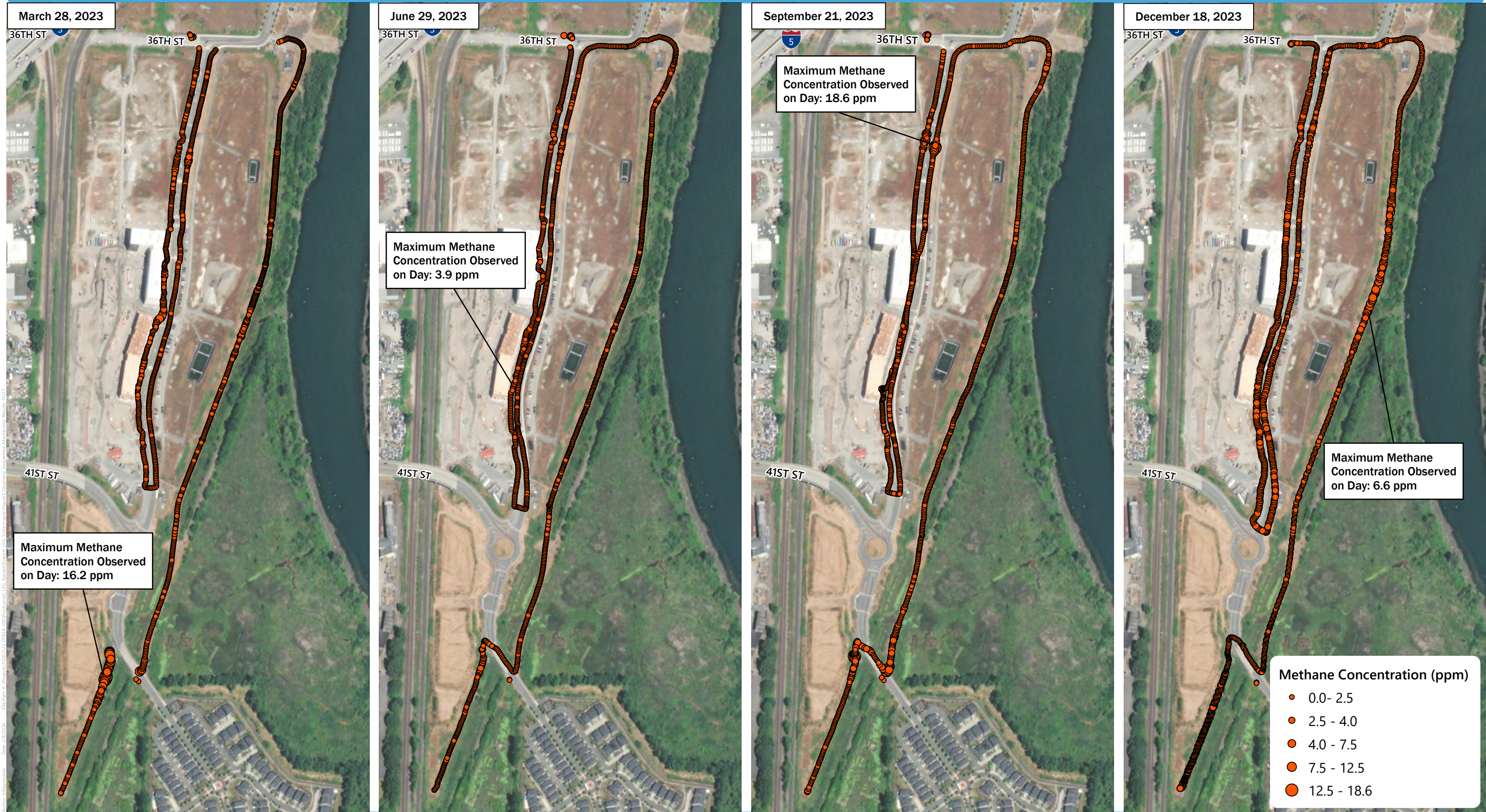
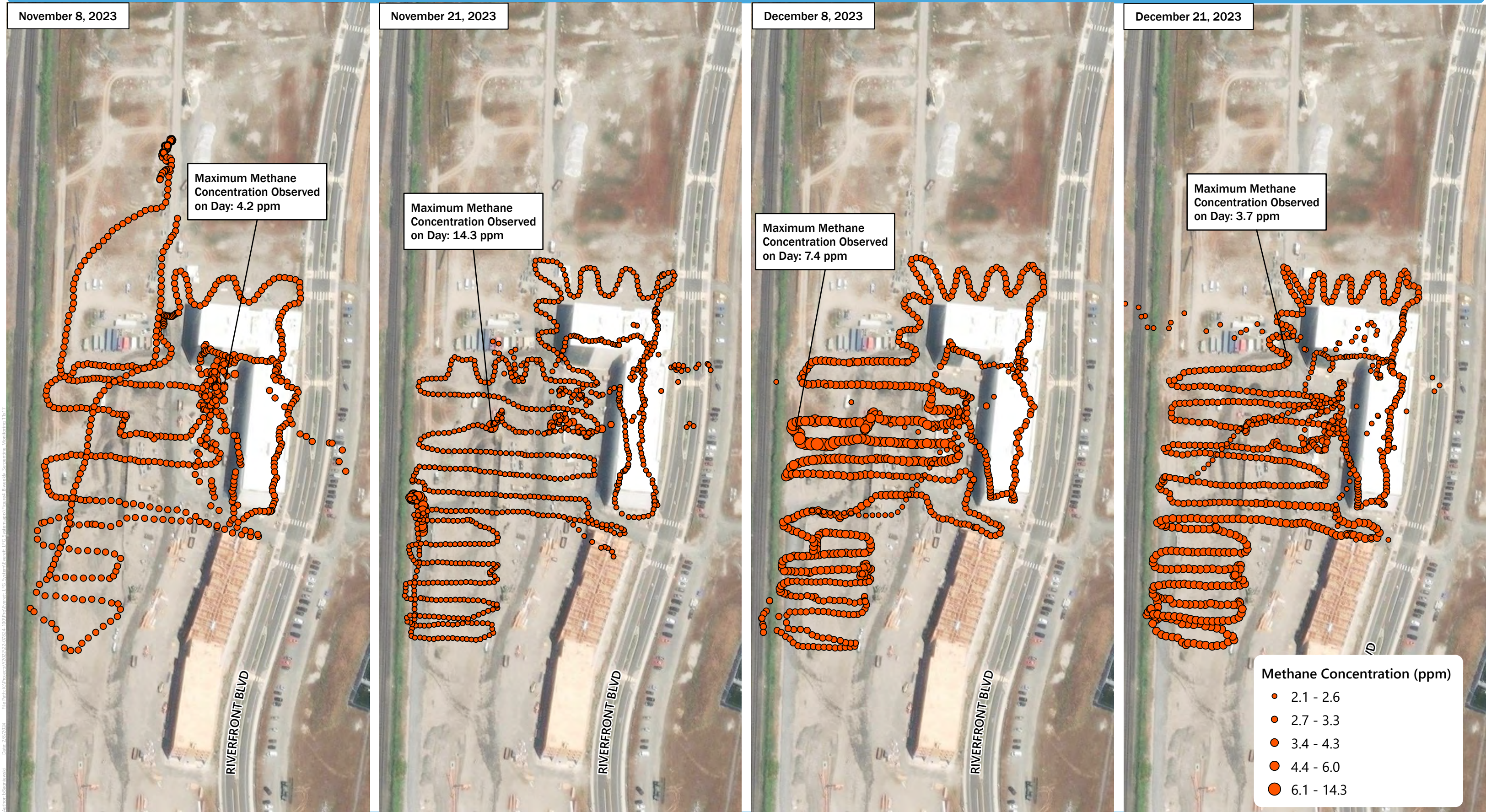


Figure 4.
Biweekly Monitoring Results for Herrera-Monitored Areas.



Off-Site Structure Monitoring

Background

The CD required certain nearby off-site structures to be monitored for elevated methane levels.

GTS Drywall Supply Co., north of the landfill, was not monitored after the building was vacated in November 2002. The GTS building was then demolished in 2007. The Diversified Recycling facility north of the landfill was closed in April 2014, and the south building was subsequently demolished. The north building on the Diversified Recycling facility was demolished in early 2016.

In 2021, Royell Manufacturing Inc. became the tenant of the former Sno Valley Process Solutions building. Beginning in 2022, Royell Manufacturing Inc. was included in the list of off-site structure monitoring.

Methods and Results

City personnel used a Landtec SEM 5000 unit to measure the surface methane concentrations at five off-site buildings that neighbor the Everett Landfill to the west in January 2023. The five off-site buildings are shown on Figure 5.

Existing off-site structures monitored in 2023 included:

- Everett Gospel Mission, 3711 Smith Avenue
- H&R Mechanical Systems Inc., 2407 38th Street
- Cascade Wholesale, 2410 38th Street
- Royell Manufacturing Inc. (formerly Sno Valley Process Solutions), 2420 38th Street
- Ron May Towing, 2406 39th Street

City personnel walked around and inside each building and recorded the SEM 5000 methane readings by hand. The SEM 5000 was positioned near observed slab cracks, drains, utility penetrations, elevator pits, and other locations where LFG could potentially enter the building.

The methane threshold identified in the CAP and CMCP for the off-site structures is 100 ppm. Table 6 shows the surface monitoring results at these off-site structures. Of the off-site buildings, the highest methane concentration was found near the ceiling ventilation fan in the boiler room of the Everett Gospel Mission. The measured methane concentration at this location was 3.2 ppm. No exceedances of CAP/CMCP thresholds for off-site structures occurred during 2023.

Off-site monitoring was discontinued in the off-site structures after the January 2023 monitoring event. Per the CMCP, "off-site monitoring will be discontinued after 3 years if there is no confirmed LFG detection in any monitored off-site building." Quarterly monitoring for off-site structures has been completed for 3 consecutive years (November 2019 through January 2023) with no exceedances.



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Date: 2/13/2024
Author: bbagniewski

Table 6. Gas Monitoring Results at Off-Site Structures in January 2023.

Structure/Address	
Sample Location	Methane Concentration (ppm)
Everett Gospel Mission – 3711 Smith Avenue	
Basement Floor and Flood Storage Area Floor Cracks	2.5–2.6
Elevator Shaft	2.4
Boiler Room Floor Drain	2.7
Boiler Room Ceiling Near Ventilation Fan	3.2
Bathroom Floor Drain	2.4
Roof Drains West Side of Building	2.4
Irrigation Control Vault North Side of Building	2.5
Cascade Wholesale – 2410 38th Street	
Basement Bathroom Floor and Ceiling	2.4
Basement Floor Cracks (multiple)	2.4–2.5
Basement Floor Drain	2.5
Roof Drains	2.5
Water Meter Vault East Side of Building	2.5
H&R Mechanical Systems Inc. – 2407 38th Street	
Floor Cracks (multiple)	2.4
Roof Drains East Side of Building	2.5
Driveway Cracks	2.4
Royell Manufacturing Inc. (Formerly Sno Valley Process Solutions) – 2420 38th Street	
Floor Cracks (multiple)	2.3–2.4
Fireline Penetration Inside Building	2.3
Floor Drain	2.4
Roof Drains East Side of Building	2.3
Cracks in All Garage Door Entries	2.3–2.4
Water Meter Vault East Side of Building	2.3
Ron May Towing – 2406 39th Street	
Men's Bathroom Floor Drain	2.4
Men's Bathroom Ceiling	2.4
Women's Bathroom Crack	2.4
Crack Between Sidewalk and Asphalt	2.4
Abandoned Fence Post Cut at Grade NE Side of Building	2.4

Other Work Performed

The LFG discharge confirmational sampling at the blowers, in accordance with the CMCP, is to take place each time a new portion of the active LFG collection system becomes operational. Sampling is to be performed at each landfill gas emission vent pipe one time after the active gas collection system has reached stable operating conditions after any new portion of the system becomes active (no sooner than 30 days after system start-up and no later than 90 days after system start-up, per the CMCP). The LFG confirmational sampling in December 2023 occurred 89 days after activation of the active LFG collection system beneath Phase 1 of the West Site development area (including Buildings A and B). The confirmation sampling included collection of a gas sample at each of the two system emission locations (the North and South Blower Stations). Per the CMCP, a laboratory analyzed the samples under chain of custody for sulfur compounds and volatile organic compounds by EPA Method TO-15 and major gases by EPA Method 3C. Sampling results were analyzed and found to be in compliance with CD emissions requirements. Results will be further discussed and presented in a separate Technical Memorandum provided to Ecology and Puget Sound Clean Air Agency (PSCAA). Confirmational gas samples were previously collected in 2021 when the Riverfront Boulevard LFG collection system was brought online and was also in compliance.