EVERETT
WASHINGTON

March 31, 2022

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

RE: Everett Landfill – 2021 Landfill Gas Annual Report

Dear Sunny:

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

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. Alternatively, you can contact Kate Snider at Floyd & Snider, Inc.

Sincerely,

Randy Loveless, P.E.
Landfill Site Manager

Enclosure

Public Works

3200 Cedar Street
Everett, WA 98201

425.257.8800
425.257.8882 fax

everettpw@everettwa.gov
everettwa.gov/pw

2021 ANNUAL REPORT

LANDFILL GAS PERFORMANCE MONITORING
EVERETT LANDFILL SITE

Prepared for
City of Everett Public Works Department

Prepared by
Herrera Environmental Consultants, Inc.

HERRERA

2021 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.
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
Telephone: 206-441-9080

March 31, 2022

CONTENTS

TABLES

FIGURES

INTRODUCTION

Herrera Environmental Consultants, Inc. (Herrera) is contracted by City of Everett Public Works (the City) to support in the operations and maintenance of the landfill gas (LFG) system at the Everett Landfill. This Annual Report presents landfill gas monitoring techniques, data and results at and around the Everett Landfill for calendar year 2021, per the Compliance Monitoring and Contingency Plan (CMCP).

Previous landfill gas monitoring and annual reports were prepared by HWA Geosciences. Because of the change in consulting team responsibility for monitoring and annual reporting, this annual report also provides a thorough background summary of gas controls and monitoring probes installed at the site, and previous monitoring.

SUMMARY

This Annual Report outlines the background and current conditions of the overall Everett Landfill site, the collection and conveyance system, and landfill gas probe monitoring. It describes the monitoring work that was completed in 2021 per the requirements set forth on the site as part of the CMCP. Monitoring included quarterly probe reads, on-site and off-site methane surface monitoring, and blower discharge composition after a new segment was added to the landfill gas (LFG) collection system. All monitoring levels were below regulatory limits except for one probe read in December that had a flooded well and thus the read was invalid. This 2021 Annual Report demonstrates that the Everett Landfill site remains in compliance.

BACKGROUND OF LANDFILL SITE AND GAS MONITORING

The City of Everett Landfill (landfill) is a closed landfill located in the City of Everett, Washington (City). The landfill is approximately 70 acres in size and located in the new Riverfront section in the eastern part of the city. The Everett landfill actively collected waste until 1974 after 50 years of operation. The landfill was sold to Riverfront Commercial Investment, LLC and is being redeveloped into a mixed-use area consistent with the site's Department of Ecology Consent Decree.

In 2001, the City entered into a Consent Decree (CD) with the Department of Ecology. The Cleanup Action Plan (CAP) incorporated into the CD defined cleanup requirements for all exposure pathways for both existing undeveloped, and future developed conditions. In the CAP, required cleanup actions for landfill gas for undeveloped conditions included control measures

for existing on-site facilities, perimeter monitoring, and contingent installation of perimeter landfill gas migration controls. The CAP included the Compliance Monitoring and Contingency Plan (CMCP) defining monitoring requirements for all exposure pathways, including LFG and its constituents of concern (COCs) which were performed and described as part of this Annual Report.

LANDFILL GAS COLLECTION SYSTEM

Prior to being altered as part of the current development on the landfill site, the existing LFG collection system is composed of a manifold system that generally follows the outer perimeter of the 70-acre site. Several extensions of the manifold system pipes are routed into the landfill site. Collector (perforated) pipes within and along the landfill connect into the manifold system. The header and manifold pipes are typically solid-wall, 8-inch-diameter HDPE pipes, and the collector pipes are typically 4-inch or 6-inch perforated HDPE pipes. The landfill gas system has been installed in phases beginning in 2004. The following section describes the chronology of the system installation.

A landfill gas 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 in 2004. This trench was designed to prevent off-site migration by intercepting gas originating from the landfill at the site boundary. A northern extension of the perimeter gas interception trench was also constructed (in the same project) along the southern edge of the 36th Street right-of-way in 2004. A second landfill gas extraction trench was installed along the northern edge of the 36th Street right-of-way, parallel and north of the 2004 trench, in 2006. The 41st Street overcrossing gas extraction system was installed in 2006. An additional perimeter gas interception trench was installed along the eastern landfill boundary, utilizing the existing leachate collector trench in 2013. A new segment of gas interceptor was completed in 2018 along the southeastern landfill boundary, as an extension of the existing gas collector along the eastern boundary, also utilizing the existing leachate collector trench. A second, separate gas extraction trench was constructed in 2019 and 2020 from the southern tip of the landfill some 480 feet northward, east of the combined leachate collector/gas extraction trench. At present, almost the entire landfill perimeter is surrounded by active gas interception trenches.

In 2021, the initial phase of the Riverfront Development project on the landfill was completed, including the Riverfront Boulevard and its active LFG collection system. The Riverfront Boulevard LFG collection system connects to the north blower Facility. Dedication of Riverfront Boulevard occurred in July of 2021 at which time it became open for public use and the LFG collection system was officially active and under the control and monitoring of the City. As a result of coming online, monitoring of the surface emissions of Riverfront Boulevard began in 2021 and is described later in this report.

BLOWER SYSTEM

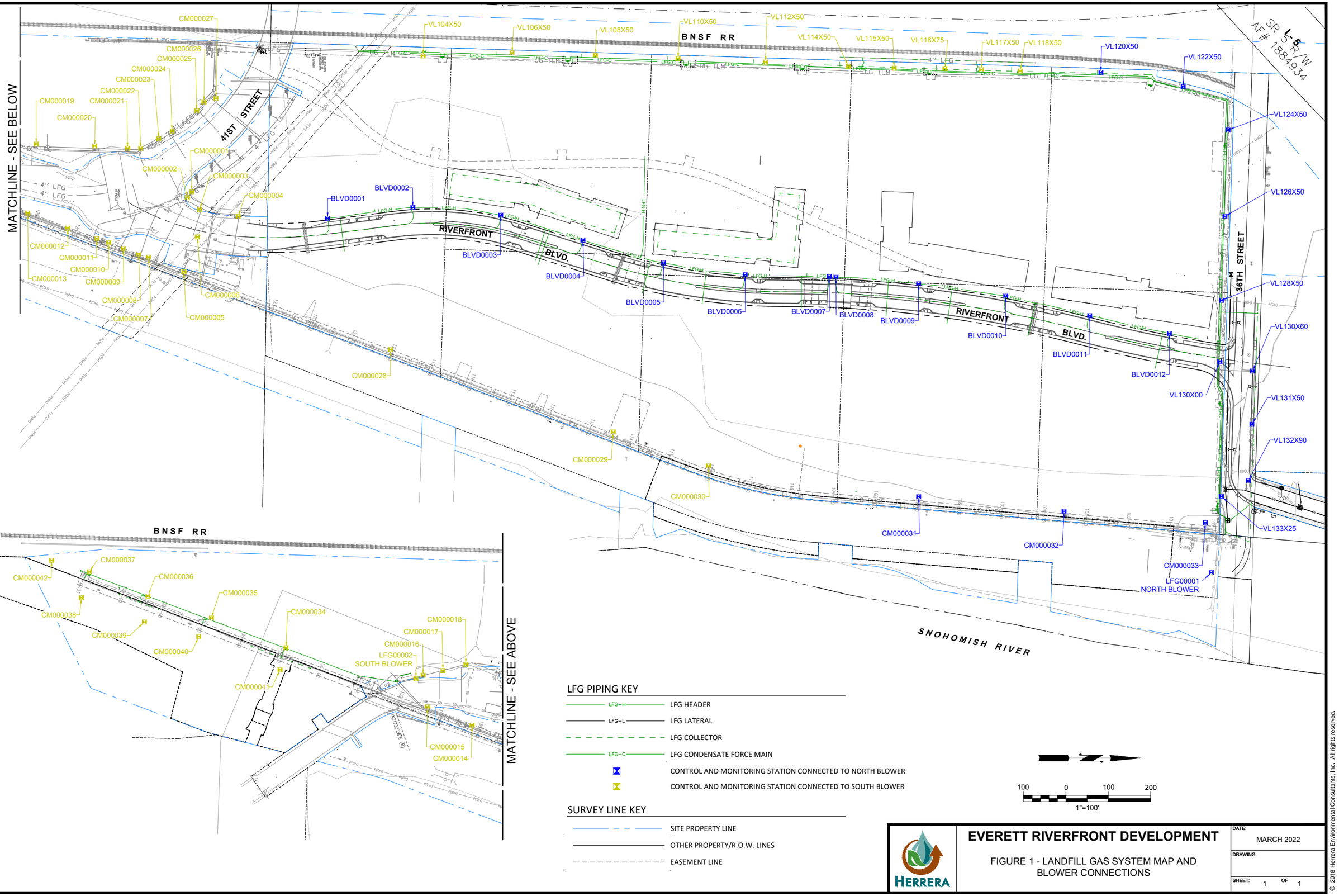
The overall LFG system is served by two blower facilities: the north blower facility is located near the intersection of 36th Street and Riverfront Boulevard and a south blower facility located immediately west of Riverfront Boulevard at the south end of the site, south of the 41st Street Roundabout. Both blower facilities have two blowers, one active and one backup located adjacent to each other with the same specifications. The north and south blower facilities provide vacuum for the existing perimeter, 41st Street, and now Riverfront Boulevard LFG collection systems at the site and represent the points of LFG emissions from active LFG collection. Table 1 and Figure 1 show which sections of the landfill gas collection system connect to the north blower and which connect to the south. Figure 1 also shows the current LFG collection and conveyance system as development has progressed on the site.

Sections of the LFG collection and conveyance system that connected to each blower in 2021 can be seen in Table 1 and Figure 1. The points of the system that are currently served by the north station are shown in blue and those that connect to the south station are shown in yellow. Generally, most of the west side of the landfill connects to the south blower and the central portion (Riverfront Boulevard) connects to the north. The east side nodes, where the Riverside Trail runs, is split between the south and the north. The term device nodes refers to sections of the landfill gas system where gas can be sampled and adjustments can be made to the valves to control the collection and conveyance of LFG at that location. The connection of groups of nodes to a particular blower can be modified as needed based on monitoring results and operational needs.

Table 1. List of Device Nodes and Blower Station Connections

Device	Blower	Device	Blower
BLVD0001	North	CM000027	South
BLVD0002	North	CM000028	South
BLVD0003	North	CM000029	South
BLVD0004	North	CM000030	South
BLVD0005	North	CM000031	North
BLVD0006	North	CM000032	North
BLVD0007	North	CM000033	North
BLVD0008	North	CM000034	South
BLVD0009	North	CM000035	South
BLVD0010	North	CM000036	South
BLVD0011	North	CM000037	South
BLVD0012	North	CM000038	South
CM000001	South	CM000039	South
CM000002	South	CM000040	South
CM000003	South	CM000041	South
CM000004	South	CM000042	South

CM000005	South	LFG00001	North Blower
CM000006	South	LFG00002	South Blower
CM000007	South	VL104X50	South
CM000008	South	VL106X50	South
CM000009	South	VL108X50	South
CM000010	South	VL110X50	South
CM000011	South	VL112X50	South
CM000012	South	VL114X50	South
CM000013	South	VL115X50	South
CM000014	South	VL116X75	South
CM000015	South	VL117X50	South
CM000016	South	VL118X50	South
CM000017	South	VL120X50	North
CM000018	South	VL122X50	North
CM000019	South	VL124X50	North
CM000020	South	VL126X50	North
CM000021	South	VL128X50	North
CM000022	South	VL130X00	North
CM000023	South	VL130X60	North
CM000024	South	VL131X50	North
CM000025	South	VL132X90	North
CM000026	South	VL133X25	North



LFG PIPING KEY

- LFG-H — LFG HEADER
- LFG-L — LFG LATERAL
- 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
- EASEMENT LINE

100 0 100 200
1"=100'

HERRERA

EVERETT RIVERFRONT DEVELOPMENT

FIGURE 1 - LANDFILL GAS SYSTEM MAP AND BLOWER CONNECTIONS

DATE: MARCH 2022
DRAWING:
SHEET: 1 OF 1

PERIMETER MONITORING PROBES

This section describes the location of monitoring probes and their history of installation and data collection. 2021 monitoring results are described in the next section.

Landfill Interior

Methane exceeding 5% by volume (which equals 100% of the lower explosive limit, or LEL) had been historically detected in most of the Landfill interior gas probes (which were completed in or near waste), as expected. By 2008, all gas probes within the landfill footprint except LG-14, LG-15, and LG-16 were decommissioned in accordance with Chapter 173-160 WAC in preparation for site development activities.

The three remaining probes which generally exhibit higher methane concentrations are not utilized as compliance probes but instead monitored to inform operations.

South End of Landfill

Three gas probes, LG-82, LG-83, and LG-84 were installed at the southeast perimeter of the landfill at the request of the Washington State Department of Ecology (Ecology) in June 2015. Because these three probes are completed in landfill waste they were not monitored for compliance in 2021. A new segment of gas interceptor was completed in 2018 along the southeastern landfill boundary, as an extension of the existing gas collector along the eastern boundary, also utilizing the existing leachate collector trench. A second, separate gas extraction segment was constructed in 2019 and 2020 from the southern tip of the landfill some 480 feet northward, east of the combined leachate collector/gas extraction trench.

A linear saturated drainage/wetlands (part of Bigelow Creek) runs parallel to the eastern landfill boundary, part of the mapped Everett Riverfront Western Wetland Complex. Results of 2016 and 2019 bar hole surveys show elevated methane in shallow soils near the landfill (west of the wetlands), but none east of the wetlands. It is assumed that the wetlands (i.e., band of saturated ground) act as a hydraulic barrier mitigating potential soil gas migrating from the landfill. The shallow aquifer in this area is saturated and comprised of silt and peat deposits known as "the aquitard", down to depths of approximately 45 feet, below which is the deeper (fully saturated) aquifer. The gas collection trench installed in 2019-2020 is intended to intercept any potential landfill fill gas in the uppermost unsaturated soils at the southeast perimeter of the landfill.

Three gas probes (LG-88, LG-89, and LG-90) were installed in October 2019 (see Figure 2) west of the wetlands to monitor the potential for gas migration east of the landfill boundary.

Results from the 2020 gas monitoring showed minimal to no detections of methane, with a single detection of methane of 0.5% in probe LG-89 in March 2020. Results indicate that the active gas collection system is working and that the wetlands function as a passive gas barrier. These three new gas probes have been installed to replace Probes LG 82, 83, and 84, which were installed within the gas collection trench, and were not representative of gas migration from the landfill. These older probes should only be monitored as needed for operation of the active gas collection and are recommended to be excluded from site perimeter monitoring and future annual reports, with LG-88, LG-89 and LG-90 providing perimeter compliance monitoring for this segment of the landfill boundary.

West Side of Landfill

The number of probes with detected methane and the magnitude of methane concentrations along the western end of the landfill has decreased since startup of the landfill gas extraction system in 2004. Starting in October 2008, two probes along the western boundary, LG-27 and LG-28, started displaying elevated methane concentrations with a maximum concentration of 49% observed in LG-28 in January 2009, and a maximum of 74% observed in LG-27 in August 2012. Except for minimal detections of methane of 1% in LG-28 in July 2014 and of 0.2% in LG-27 and LG-28 in July 2015, methane has not been detected in either of these probes since January 2013. The elevated methane concentrations at LG-27 were suspected to be associated with preloading of adjacent areas within the landfill occurring during this time for future site development. The preload soils were removed from the landfill soon after 2014 and the probes along the western end of the landfill have not had any methane detections since 2016.
In 2002, LG-56, LG-57, and LG-58 were installed west of, uphill, and off-site of the landfill to monitor if methane was migrating from the landfill property onto adjoining properties on the west side of the landfill. These probes generally have not contained methane since installation, with a few isolated readings of up to 2.8%. LG-56 near the BNSF ROW was damaged in late 2015 and is no longer monitored, as BNSF will not provide access. LG-58 was not monitored in 2021 due to a field technician misunderstanding a statement in the 2020 Annual Report suggesting that LG-58 could be removed from the compliance probe network. Monitoring of LG-58 has resumed in 2022.

LG-76, LG-77, and LG-78 were installed on private property in 2008, also west of, uphill, and off-site of the landfill. LG-76 and LG-78 have not contained appreciable (above 0.2%) methane since installation. LG-77 began showing consistent methane concentrations exceeding the action level of 5% in January 2011. More frequent readings were collected at LG-77 from February through April 2011. Detections of methane ranged from 10 to 13% in 2019.

HWA conducted a shallow soil gas ("bar hole") survey of the area surrounding LG-77 in March 2011. No methane was detected in 11 of 12 holes at depths of 2 to 3.5 feet below ground

surface (bgs), and very low methane (0.05%) was measured in one hole. Surficial soils were saturated at shallow depths (2 to 4 feet bgs), and all readings were taken above shallow ground water level. LG-77 was screened at a depth of 15 to 35 feet bgs, corresponding to the elevation of the landfill, and encountered fill with wood below 10 feet, suggesting the methane detected in LG-77 may be coming from organic woody debris material in fill beneath the property. Results of the study are summarized in HWA's report *Landfill Soil Gas Survey, Buse Property, Everett, Washington* dated March 28, 2011.

In October 2019, GeoEngineers performed a remedial excavation in the areas near and around LG-77 and the gas probe was decommissioned to accommodate the remedial action. The cleanup was performed to address minor isolated detections of polynuclear aromatic hydrocarbons in the fill soils. A replacement gas probe, LG-95, was installed on March 5, 2020 and screened from 25 feet to 35 feet bgs. This screened elevation is below the fill material containing abundant woody debris but still screened with the elevation of waste in the landfill. Results from 2020 gas monitoring show that minor (0.6%) to no detections of methane occurred in LG-95; however, high levels of carbon dioxide (ranging from 20.9 to 21.8%) were detected. These levels are likely a product of anaerobic degradation of organic debris within the soils of the overlying fill material. The fill encountered at LG-77, some of which was removed during the 2019 cleanup, is above the elevation of landfill waste, and physically separated from the landfill by a gas extraction trench, highly permeable railroad ballast under three sets of railroad tracks, and a 10 foot layer of silt encountered in both LG-77 and LG-95. The absence of methane in LG-95 compared to LG-77 further confirms that the methane previously detected in LG-77 was locally derived, from fill soils, and not connected to the landfill.

Former landfill gas compliance issues for this area are further described in a letter dated May 1, 2020 titled *Gas Monitoring Probes, Northwest West Area of Landfill / LG-77 Area, Everett Landfill/Tire Fire Site, Everett, Washington,* which was submitted to Ecology.

East Side of Landfill

The leachate/gas collection trench runs along the entire eastern boundary of the landfill, but some landfill waste remains east of the trench, due to access issues at the time of construction. Although landfill gas probes LG-14, LG-15, and LG-16 at the east edge of the landfill have historically contained methane exceeding 5% by volume, the presence of methane in these probes is not unexpected, and the landfill Compliance Monitoring and Contingency Plan (CMCP) discusses that due to completion in fill, "the existing perimeter sampling locations along the eastern side of the landfill, LG-13 through LG-16, will continue to be used, but only for informational data, and not for site compliance."

Fill and debris extend just outside (east of) the leachate/gas collector trench likely only a few feet, as a drainage ditch associated with the former railroad tracks was located just east of the landfill east boundary. In an attempt to determine the extent of methane gas outside the leachate/gas collection trench, assumed to be associated with debris present east of the trench, HWA conducted a bar hole survey in April 2020 to investigate soil gas concentrations east of the landfill. Results indicated no detected methane east of LG-13, LG-14, or LG-15. At LG-16, the westernmost bar hole (closest to LG-16) had 5.4% methane, but 20 feet away from the leachate/gas collector trench the bar holes east of that had no detected methane. Besides limited gas generating materials outside the leachate/gas collector trench, the surrounding marsh type soils, surface water features, and high groundwater, all act as a hydraulic barrier to any soil gas from the landfill.

The area east of the landfill is undeveloped, zoned to preclude development, and comprised primarily of wetlands and conservancy land. There are no receptors or confined spaces in this area, and no structures east of the leachate/gas collector trench. The only potential human receptors are people walking the public trail. Surface emission monitoring, described later in this report, monitors and confirms there are no elevated concentrations of methane gas along the trail that would pose a risk to trail users.

Former landfill gas compliance issues for the east side of the landfill are further described in a letter dated May 11, 2020 titled *Gas Monitoring Probes, East Side of Landfill, Everett Landfill/Tire Fire Site, Everett, Washington*, which was submitted to Ecology.

North End of Landfill

Methane exceeding 5% by volume was historically detected in one or more of the probes installed north of the landfill (LG-44, LG-45, LG-46, and LG-47). LG-44, LG-45, and LG-46, located on former Port of Everett Property (former Diversified recycling facility), are the furthest from the landfill and the gas extraction system. Before being covered during property development, these probes displayed relatively constant ranges of methane concentrations before and after construction of the two northern gas extraction trenches in 2004 and 2005, likely due to their completion and screening in peat layers and organics containing fill associated with historical activities on the property. Methane concentrations in probes along 36th street decreased to near zero after the northern gas extraction system was completed in 2005. Methane concentrations measured further north of the two gas extraction trenches are likely from off-site sources, as landfill gas from the landfill would likely have dissipated in the years following installation of both extraction trenches. Soils north of 36th street contain abundant debris, wood waste, and natural wood, which can generate methane. The recycling facility was closed in April 2014 and all buildings have since been demolished.

Gas probe LG-70, located at the northeast corner of the landfill, has historically not contained any appreciable methane since 2005, when the north segment of the gas extraction system was installed. Although elevated methane (6.5%) was detected in April and July of 2016, subsequent monitoring of this probe yielded little to no methane (maximum 0.5%) detected after 2016 to the present. The brief episode of slightly elevated methane at LG-70 was thought to be due to excavation and construction of a large pump station adjacent to this probe around that time. Pump station construction was completed in 2017.

Many of the landfill gas probes at the north end of the landfill are on private property that has been redeveloped, with activities including building demolition and major site grading. As a result, the following probes have been buried or damaged and cannot be monitored: LG-12, LG-44, LG-45, LG-46, LG-47, LG-61, LG-67, and LG-68. LG-62 was covered for several years but was uncovered in 2020 by construction excavation in the area. The probe was found to be functional and was fitted with a new monument in March 2020, after which it continued to be monitored. Four replacement probes (LG-91, LG-92, LG-93, and LG-94) were installed in the 36th Street right of way on March 4 and 5, 2020. Replacement probes were screened at similar depths (4 to 10 feet bgs) of previously damaged or buried gas probes and consistent with waste levels to the south in the landfill. Locations are shown on Figure 2.

Former landfill gas compliance for this area was further described in a letter dated June 2, 2020 titled *Gas Monitoring Probes and Compliance, North End of Landfill, Everett Landfill/Tire Fire Site, Everett, Washington,* which was submitted to Ecology.

Utilities

Gas probes installed in utility trenches (sewer, sewer force main, water, and natural gas) include:

I-5 / West End

In October 2008, gas probes LG-79, LG-80, and LG-81 were installed in utility trenches to replace gas probes damaged or decommissioned during BNSF railroad track construction (LG-63, LG-64, LG-65, and LG-66). Except for a reading of 0.1 % in November 2010 and April 2013, methane has not been detected in these probes since their installation in October 2008. All three of these replacement probes were damaged in October 2013 and are not usable. This area was used for log storage for Buse Timber, and the gas probes (LG-79, LG-80, and LG-81) were damaged by logs and heavy equipment operations after closure of 36th Street. None of the damaged probes (original or replacement probes) had methane above the action level from June 2004 to July 2013, when the last active probe was damaged. Three additional replacement probes (LG-85, LG-86, and LG-87) were installed in June 2015 at the north end of the landfill in utility trenches within 36th Street (away from Buse activity) to replace damaged probes LG-79, LG-80, and LG-81. LG-85 was obstructed for most of 2021 as a result of the Riverfront development's construction activities. It is accessible once again and monitoring has resumed in 2022.

Eclipse Mill Road / East End

Three gas probes installed in utility trenches in Eclipse Mill Road (LG-71, LG-72, and LG-73) were repaired in October 2008 by routing the sampling ports laterally to a central location at the side of Eclipse Mill Road, where they would not be subject to truck and heavy equipment damage. The newly constructed Riverfront Boulevard has replaced Eclipse Mill Road, and is located west of the former Eclipse Mill Road, such that the combined sampling ports are now east of Riverfront Boulevard. Methane has not been detected in these probes above 0.4% since their repair in October 2008. The probes were covered by fill for two monitoring rounds in 2012. The probes were located in January 2013 and subsequently monitored.

Buried / Damaged Gas Probes in 2021

None of the remaining probes that are sampled quarterly for this project were identified as having been damaged or buried during construction activities at and around the landfill during the 2021 sampling year. LG-85 was obstructed for most of 2021 as a result of the Riverfront development's construction activities but was not damaged and has resumed monitoring in 2022.

BUILDINGS

The Snohomish County Transfer Station formerly on the landfill was closed in January 2004, after which no further monitoring was conducted. The Everett Animal Shelter, formerly on the landfill, was vacated in April 2009 and demolished in June 2009. GTS Drywall Supply Co., north of the landfill, was not monitored after November 2002, when the building was vacated. 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 subsequently demolished. The north building was demolished in early 2016.

In 2021, Royell Manufacturing Inc. became the tenant of the former Sno Valley Process Solutions building.

LANDFILL GAS COLLECTION SYSTEM STATUS

LANDFILL GAS COLLECTION OPERATIONS AND MONITORING

Several LFG monitoring tasks were performed at the Everett Landfill in 2021 as part of compliance monitoring requirements for the gas environmental exposure pathway.

Four quarterly monitoring events conducted on the following dates are discussed:

- March 3, 2021
- June 23, 2021
- November 30, 2021
- December 14, 2021

The LFG compliance monitoring tasks performed this year include:

- Quarterly perimeter probe monitoring
- Quarterly landfill surface monitoring
- Quarterly off-site structures monitoring
- One time LFG discharge sampling at both blower stations

Landfill Gas Probe Monitoring

The City utilized a Landtec GEM 5000 unit for measuring gas concentrations and flows from probes surrounding the perimeter of the landfill site. Probe measurements were collected quarterly in March, June, September and December as per the CMCP. Thirty-six (36) probes are present and accessible around the perimeter of the landfill, within the boundary and nearby and were monitored in 2021. Thirty-three (33) of the probes were used for compliance monitoring and three were monitored to inform operations during 2021.

The GEM 5000 samples and analyzes the methane, carbon dioxide and oxygen content of landfill gas with options for additional analysis. This handheld unit is portable and is manually carried by the user during the investigation. Landfill gas readings were taken by City staff from the probes quarterly and were sent to Herrera for reporting and analyzing. Table 2 describes what readings were collected from the probes by the GEM 5000 and what data is included in Table 4.

Table 2. Quarterly Data Collection Parameters

Compound	Units	Description
CH4	Percent	Methane concentration of sampled landfill gas.
CO2	Percent	Carbon dioxide concentration of sampled landfill gas.
O2	Percent	Oxygen concentration of sampled landfill gas.

The probes that were monitored for compliance in 2021 are shown on the map in Figure 2 in green. The three probes on the east perimeter trail – LG-14, LG-15, and LG-16 were not

monitored for compliance, but have been continued to be monitored to inform operations and are shown in Figure 2 in orange.

The quarterly methane, carbon dioxide and oxygen contents are shown in Table 4. The three non-compliance probe readings (LG-14, LG-15, and LG-16) are outlined in orange on Table 4 with readings above 5% highlighted orange.

Of the 33 monitored compliance probes, only LG-89 had a methane reading above 5% and the probe only had the exceedance for one quarterly reading. For the December 13, 2021 monitoring event, LG-89 had a reading of 17.7% methane. Table 4 shows the monitoring results of the compliance perimeter probes during 2021. Any probe reading with a methane exceedance is highlighted yellow for compliance probes.

While this one probe reading was over the 5% compliance limit, it was determined the reading was not valid. During this reading, LG-89 pulled water into the sample collection hose within 10 seconds of the collection reading. This high read was a result of the well being flooded. The three other LG-89 quarterly reads during 2021 had methane values below 1%.

Figure 5 shows the compliance perimeter probes that had at least one non-zero read throughout 2021. The red horizontal line shows the regulatory not-to-exceed methane content value of 5% for comparison.

Northern Probes

Southern Probes

Figure 2. Monitored Perimeter Probes

Landfill Gas Surface Monitoring

Gas monitoring is performed utilizing a flame ionization detector at selected buildings located north and west of the landfill. City personnel, with assistance from Herrera personnel, used a Landtec SEM 5000 unit to measure methane concentrations across the surface of the landfill within publicly accessible areas, and at off-site neighboring structures on a quarterly basis. This handheld unit is portable and is manually carried by the user during the investigation. The SEM 5000 unit is calibrated to the site location, considering the background methane concentrations in the vicinity. Each location typically includes interior and exterior monitoring points, where gas, if present, might accumulate or be concentrated.

On-Site Surface Monitoring

City personnel, with assistance from Herrera personnel, used a Landtec SEM 5000 unit walked the extents of the landfill to record surface methane concentrations. On-site gas surface monitoring occurred quarterly in March, June, September, and December. For the on-site surface monitoring, the SEM 5000 unit was calibrated to record the methane concentration and the corresponding GPS points where the methane concentration was read continuously at the ground surface of the four monitoring path sections: the gravel path south of the south blower station, the paved east perimeter/riverside trail, the west Riverfront Boulevard sidewalk, and the east Riverfront Boulevard sidewalk.

The landfill monitoring path began at the southernmost point of the Everett Landfill. The personnel walked past the south blower station and then turned southeast on Riverfront Boulevard towards the entrance for the Riverside Trail representing the eastern side of the landfill. The entire Riverside Trail was walked from south to north until its end at the north blower station after which the personnel walked west to the north end of Riverfront Boulevard. The personnel walked south on the east Riverfront Boulevard sidewalk until reaching the 41st roundabout. At the roundabout the personnel crossed the street to the west Riverfront Boulevard sidewalk and walked back north until reaching the north end of Riverfront Boulevard and the extents of the landfill once again.

The same walking and monitoring method was used for each of the four surface monitoring walking path sections. Every five seconds, a data point was logged showing the methane concentration reading and latitude and longitude. The Herrera personnel had the probe of the SEM 5000 positioned between five to ten centimeters above the ground surface and walked in a back and forth, "Serpentine", path that involved walking on one side of the trail for five steps and then crossing to the other side of the trail in a forward diagonal route. Then five more steps were taken on the opposite side of the trail and the trail would be crossed again in a forward diagonal route to get to the original side. The SEM 5000 operator walked slow enough to collect enough data points in a variety of positions across the trail. The probe was also positioned over the ground based on visual observations, e.g., distressed vegetation, cracks, or seeps in the

ground. The term 'trail' used in the walking technique can be replaced with path, or sidewalk to encapsulate the method used for each of the four landfill surface monitoring sections. 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*.

The regulatory threshold for the on-site monitoring elements is 500 ppm. None of the quarterly monitoring events that took place during 2021 had any regulatory exceedances. Serpentine monitoring was not conducted at the Riverfront Boulevard in March as it had not been dedicated to the City of Everett for public access. Serpentine data is not displayed for the June monitoring event as the data was lost during return of the SEM 5000 from the rental company. The real-time methane concentrations displayed on the SEM 5000 during the June serpentine monitoring event were observed closely and no exceedances were found. As shown in Figure 3, the landfill surface monitoring had a maximum of 113.4 ppm reading in September and a maximum of 16.60 ppm reading in December, well below the regulatory limit of 500 ppm.

SURFACE EMISSIONS MONITORING

Surface emissions monitoring recording methane concentrations (in parts per million) are collected quarterly with a Landtec SEM 5000 at these three locations:

1) Riverside Trail
2) Riverfront Boulevard
3) Four private buildings to the west of the landfill

The SEM 5000 unit is calibrated to the site location and continuously reads methane concentrations. Every five seconds, a data point is logged showing the methane concentration reading and latitude and longitude.

REGULATORY THRESHOLDS

These following regulatory thresholds apply to each of the three monitoring elements:

1) Riverside Trail: No methane exceedances over 500 ppm
2) Riverfront Boulevard: No methane exceedances over 500 ppm
3) Four private buildings to the west of the landfill: No methane exceedances over 100 ppm

2021 DATA COLLECTION SUMMARY

Serpentine monitoring was conducted on these following dates:

March 23, 2021: No regulatory exceedances for off-site buildings or Riverside Trail. Serpentine monitoring of Riverfront Boulevard was not conducted as it had not been dedicated to the City of Everett.

June 23, 2021: No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

September 30, 2021: No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

December 14, 2021: No regulatory exceedances for off-site buildings, Riverside Trail or Riverfront Boulevard.

*Right: Data from the September 30, 2021 and December 14, 2021 collection. *Data from the June 23, 2021 collection was lost and cannot be displayed.*

SERPENTINE MONITORING
September 30, 2021

SERPENTINE MONITORING
December 14, 2021

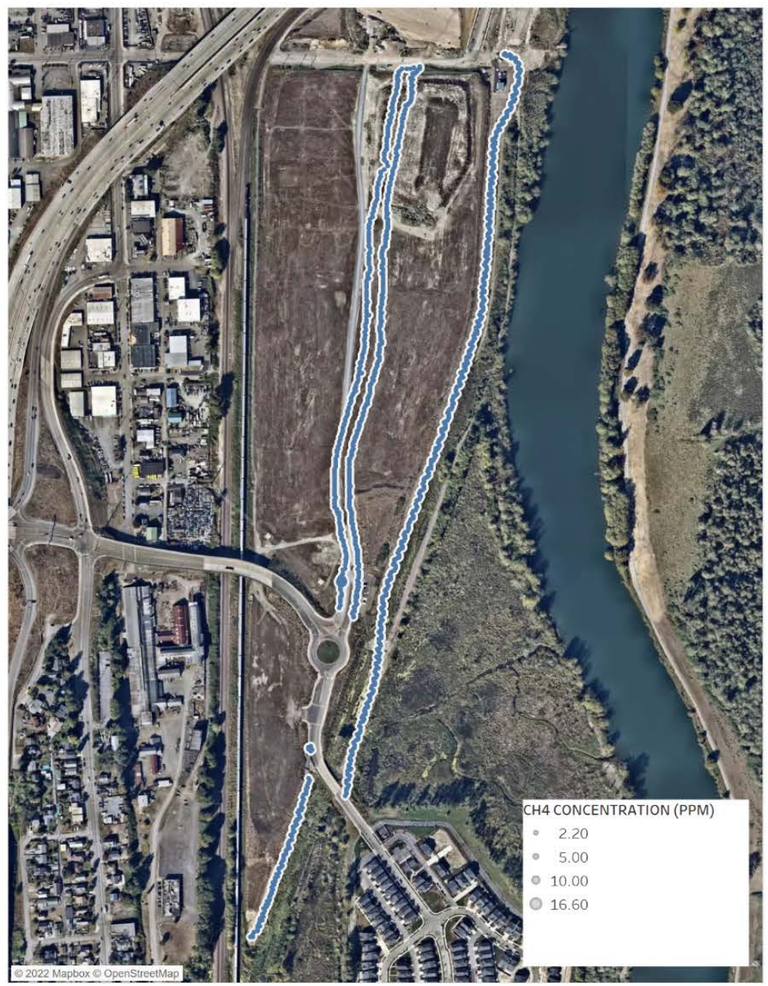


Figure 3. Quarterly Serpentine Monitoring Results

Off-Site Surface Monitoring

City personnel, with assistance from Herrera personnel, used a Landtec SEM 5000 unit and measured the surface methane concentrations at five off-site buildings that neighbored the Everett Landfill. The five off-site buildings are called out on the map in Figure 4.

Existing off-site structures monitored in 2021 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

Off-site structure gas surface monitoring occurred quarterly in March, June, September, and December as per the CMCP. Herrera personnel walked around and inside each building and read the SEM 5000 methane readings aloud for the City personnel to record. The SEM 5000 was positioned near observed slab cracks, drains, utility penetrations, elevator pits, and other notable locations where LFG could enter the building.

The regulatory threshold for the off-site monitoring elements is 100 ppm. Table 3 shows the surface monitoring results at the off-site structures. Of the off-site buildings, the highest methane concentrations were consistently found in the boiler room of the Everett Gospel Mission near the ceiling ventilation fan. The highest read was 6.8 ppm in September. The rest of the building reads did not exceed 3.1 ppm. No exceedances of methane regulatory thresholds occurred in any of the exterior and interior monitoring points of the off-site structures monitored during 2021.


EVERETT LANDFILL
CHESTNUT ST
Snohomish River
RIVERFRONT BLVD
41ST ST
Snohomish River
5
5
Legend
Everett Gospel Mission
H&R Mechanical Systems Inc.
Cascade Wholesale
Royell Manufacturing Inc.
Ron May Towing
Area of map detail
PACIFIC OCEAN
WASHINGTON
OREGON
Figure 4.
Vicinity Map of Everett Landfill
Off-Site Monitoring Locations
N
HERRERA
Snohomish County, Aerial (2017)
K:\Projects\Y2017\17-06595-000\Project\Report\Fig1_VicinityMap_letter.mxd

Table 3. Gas Monitoring Results at Off-Site Structures				
Structure/Address	**March**	**June**	**September**	**December**
Sample Location	Methane (ppm)	Methane (ppm)	Methane (ppm)	Methane (ppm)
Everett Gospel Mission – 3711 Smith Avenue				
Basement Floor and Flood Storage Area Floor Cracks	2.8	2.4-2.5	2.4-2.5	2.9
Elevator Shaft	2.5	2.4	2.5	2.9
Boiler Room Floor Drain	2.8	2.8	3.0	3.0
Boiler Room Ceiling Near Ventilation Fan	6.5	6	6.8	5.1
Bathroom Floor Drain	2.8	2.6	2.6	2.9
Roof Drains West Side of Building	2.7-2.8	2.4	2.4	2.9
Irrigation Control Vault North Side of Building	2.5	2.4	2.4	2.9
Cascade Wholesale – 2410 38th Street				
Basement Bathroom Floor and Ceiling	3.1	2.3	2.2	3.0-3.1
Basement Floor Cracks (multiple)	3.0	2.3-2.4	2.2-2.3	3.1
Basement Floor Drain	3.0	2.3	2.2	3.1
Roof Drains	2.8	2.3	2.2	2.9-3.0
Water Meter Vault East Site of Building	2.7	2.2	2.2	2.9
H&R Mechanical Systems Inc. – 2407 38th Street				
Floor Cracks (multiple)	2.8	2.4-2.5	2.2-2.3	2.9-3.0
Roof Drains East Side of Building	2.8	2.3-2.4	2.2	2.9
Driveway Cracks	2.8	2.3	2.2	2.9
Royell Manufacturing Inc. (Formerly Sno Valley Process Solutions) – 2420 38th Street				
Floor Cracks (multiple)	N/A [a]	2.3-2.4	2.3-2.4	2.9
Fireline Penetration Inside Building	N/A [a]	2.3	2.4	2.9
Floor Drain	N/A [a]	2.1	2.4	3.0
Roof Drains East Side of Building	2.8	2.4	2.3	2.7
Cracks in All Garage Door Entries	2.7-2.8	2.3-2.4	2.3-2.4	2.7-2.8
Water Meter Vault East Side of Building	2.8	2.3	2.3	2.8
Ron May Towing – 2406 39th Street				
Men's Bathroom Floor Drain	3.3	2.5	2.4	2.7
Men's Bathroom Ceiling	3.3	2.5	2.4	2.7

Women's Bathroom Crack	3.3	2.5	2.4	2.7
Between Sidewalk and Asphalt	3.2	2.5	2.4	2.7
Abandoned Fence Post Cut at Grade NE Site of Building	3.2	2.5	N/A	2.8

[a] Could not access interior of building at time of reads.

Other Work Performed

Other work performed included the LFG discharge confirmational sampling at the blowers which, as stated in the Compliance Monitoring and Contingency Plan (CMCP), is to take place each time a new portion of the active LFG collection system becomes operational. Sampling is to occur 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 September 2021 occurred 90 days after the Riverfront Boulevard construction project (the first of several phases of development on the Everett Landfill) was completed, which included construction of an active LFG collection system beneath Riverfront Boulevard.

The confirmation sampling included collection of a gas sample at each of the two system emission locations, the North and South Blower Stations and analysis results presented in the *City of Everett Landfill Gas Emission - 2021 Confirmational Sampling Results* Technical Memorandum provided to Ecology and Puget Sound Clean Air Agency (PSCAA) on March 11, 2022 demonstrates that the Everett Landfill remains in compliance with emission requirements after the new addition of the Riverfront Boulevard to the Everett Landfill LFG collection system.

Table 4. Perimeter Probe Monitoring Results				
DEVICE ID	**DATE**	**%CH_4**	**%CO_2**	**%O_2**
LG000014	3/24/2021	74.8	13.5	11.7
LG000014	6/24/2021	72.2	15.2	10.4
LG000014	9/30/2021	61	20.1	18.8
LG000014	12/14/2021	61.6	17.9	20.4
LG000015	3/24/2021	17.1	2.3	15.5
LG000015	6/24/2021	59.9	19.4	2.7
LG000015	9/30/2021	0.2	0.2	20.6
LG000015	12/14/2021	66.1	10.8	18.8
LG000016	3/24/2021	0	0.1	21.3
LG000016	6/24/2021	0	0	19
LG000016	9/30/2021	37.8	12.9	2.4
LG000016	12/14/2021	0	0.2	19.7
LG000021	3/24/2021	0	0.1	21.1
LG000021	6/24/2021	0	0	20.4
LG000021	9/30/2021	0.1	0.1	21.3
LG000021	12/13/2021	0.1	0.1	20.9
LG000023	3/24/2021	0	0.1	21.2
LG000023	6/24/2021	0	0	20.4
LG000023	9/30/2021	0	0.1	21.3
LG000023	12/13/2021	0.1	0.1	21

LG000024	3/24/2021	0	0.1	21.2
LG000024	6/24/2021	0	0	20.3
LG000024	9/30/2021	0	0.1	21.3
LG000024	12/13/2021	0	0.1	21
LG000025	3/24/2021	0	0.2	21
LG000025	6/24/2021	0	0	20.4
LG000025	9/30/2021	0	0.2	21.3
LG000025	12/13/2021	0	0.9	20.9
LG000026	3/24/2021	0	0.1	21.2
LG000026	6/24/2021	0	0	20.4
LG000026	9/30/2021	0	0.2	21.2
LG000026	12/13/2021	0.1	0.2	21.1
LG000027	3/24/2021	0	0.1	21.1
LG000027	6/24/2021	0	0	20.5
LG000027	9/30/2021	0	0.1	21.2
LG000027	12/13/2021	0	0.2	19.8
LG000028	3/24/2021	0	1.7	19.1
LG000028	6/24/2021	0	2.9	16.9
LG000028	9/30/2021	0	2.3	16.7
LG000028	12/13/2021	0	1	19.6
LG000030	3/24/2021	0	3.4	17.4
LG000030	6/24/2021	0	3.4	16.6
LG000030	9/30/2021	0	3.6	17.5

LG000030	12/13/2021	0	3.2	17.4
LG000031	3/24/2021	0	0.2	21.1
LG000031	6/24/2021	0	3.5	16.4
LG000031	9/30/2021	0	5.1	16.6
LG000031	12/13/2021	0.1	0.2	21.3
LG000032	3/24/2021	0	5	8.8
LG000032	6/24/2021	0	12.1	8.3
LG000032	9/30/2021	0	9.4	12.3
LG000032	12/13/2021	0	2.9	17.9
LG000033	3/24/2021	0	0.4	20.6
LG000033	6/24/2021	0	0.2	20.3
LG000033	9/30/2021	0	0.3	20.6
LG000033	12/13/2021	0	0.1	21.5
LG000034	3/24/2021	0	5.6	13.8
LG000034	6/24/2021	0	6.6	9.6
LG000034	9/30/2021	0	8.4	9.1
LG000034	12/13/2021	0	1.7	20
LG000035	3/24/2021	0	6.2	4.2
LG000035	6/24/2021	0	13	2.1
LG000035	9/30/2021	0	6.2	13.1
LG000035	12/13/2021	0	5.6	1
LG000041	3/24/2021	0	0.4	21
LG000041	6/24/2021	0	10.6	6.5

LG000041	9/29/2021	0	9.5	9.2
LG000041	12/13/2021	0	0.5	20.9
LG000055	3/24/2021	0	11.4	8.3
LG000055	9/29/2021	0	9.6	10.8
LG000055	12/13/2021	0	15	4.3
LG000057	3/24/2021	2.6	5.5	0.4
LG000057	9/30/2021	0	2.7	18
LG000057	12/13/2021	0	1.2	20
LG000059	9/30/2021	0	9.5	11.7
LG000059	12/13/2021	0.2	13.9	1.1
LG000070	3/23/2021	0	9	11.6
LG000070	6/24/2021	0	7.5	9.9
LG000070	9/30/2021	0	4.3	9.2
LG000070	12/13/2021	0	3.2	9.8
LG000071	3/23/2021	0	1	20
LG000071	6/24/2021	0	1.4	18.7
LG000071	9/29/2021	0	7.8	5.3
LG000071	12/13/2021	0	0.1	20.5
LG000072	3/23/2021	0	0.8	20.4
LG000072	6/24/2021	0	1.6	18.3
LG000072	9/29/2021	0	2.1	17.5
LG000072	12/13/2021	0	0.3	20.3
LG000073	3/23/2021	0	0.1	21.3

LG000073	6/24/2021	0	0.2	19.7
LG000073	9/29/2021	0	0.3	19.7
LG000073	12/13/2021	0	0.1	20.6
LG000076	3/24/2021	0	5.1	13.4
LG000076	9/30/2021	0	0.5	20.4
LG000076	12/13/2021	0	5.5	13.4
LG000078	3/24/2021	0	7.5	8.4
LG000078	6/24/2021	0	2.5	16.9
LG000078	9/29/2021	0	0.7	19.7
LG000078	12/13/2021	0	10.1	6.2
LG000086	3/24/2021	0	5.5	13.8
LG000086	6/24/2021	0	12.7	4.6
LG000086	9/29/2021	0	15.6	3.8
LG000086	12/13/2021	0	0.2	18.9
LG000087	3/24/2021	0	3	18.9
LG000087	6/24/2021	0	6.4	12.1
LG000087	9/29/2021	0	0.1	20.6
LG000087	12/13/2021	0	4.9	13.3
LG000088	6/24/2021	0	0	19.9
LG000088	9/30/2021	4.8	2.1	17.6
LG000088	12/13/2021	0.1	0.2	20.6
LG000089	3/24/2021	0.4	0.6	20.7
LG000089	6/24/2021	0.6	2	15.7

LG000089	9/30/2021	0.1	0.2	20.1
LG000089	12/13/2021	17.7	2.8	6.1
LG000090	3/24/2021	0	1.2	19.3
LG000090	6/24/2021	0	1.8	17.9
LG000090	9/30/2021	0.1	1.9	17.7
LG000090	12/13/2021	0	0.9	19.2
LG000091	3/24/2021	0	7.1	8.2
LG000091	9/29/2021	0	7	11.6
LG000091	12/13/2021	0.2	8.1	7.3
LG000092	3/24/2021	0	0.2	20.5
LG000092	6/24/2021	0	0.9	18.3
LG000092	9/29/2021	0	0.4	19.9
LG000092	12/13/2021	0.1	0.3	20.3
LG000093	3/24/2021	0	0.5	19.8
LG000093	6/24/2021	0	0.7	18.5
LG000093	9/29/2021	0	0.6	19.4
LG000093	12/13/2021	0	0.5	20.5
LG000094	3/24/2021	0	0.3	20
LG000094	6/24/2021	0	0.6	18.9
LG000094	9/29/2021	0	0.5	19.6
LG000094	12/13/2021	0	1.2	18.6
LG000095	3/24/2021	0	18	4.8
LG000095	6/24/2021	0	0.2	20.3

LG000095	9/29/2021	0	5.9	14.4
LG000095	12/13/2021	2.4	21.6	0.6

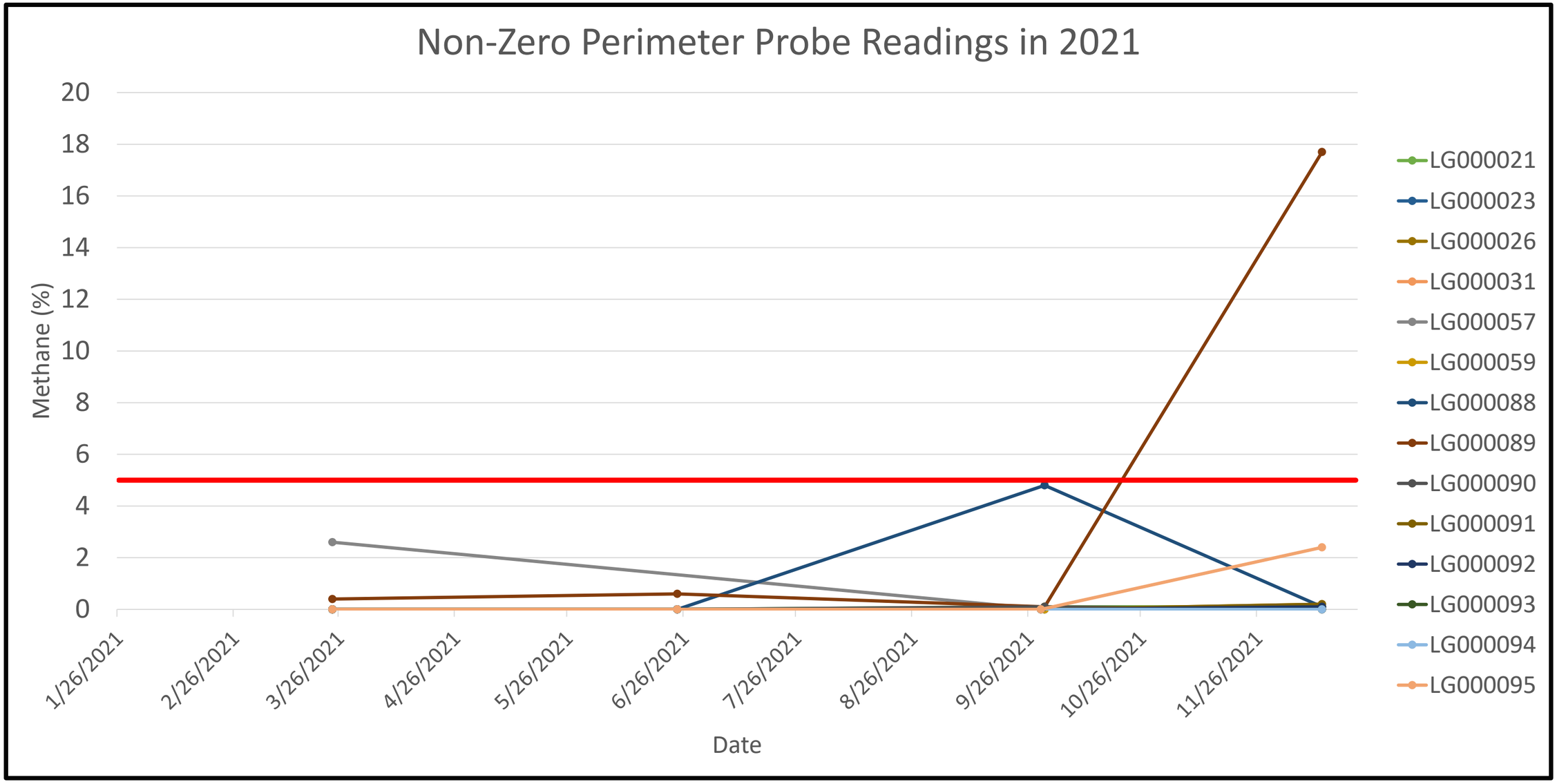


Figure 5. 2021 Non-Zero Perimeter Probe Readings