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# SPPD PROPERTY LANDFILL GAS COLLECTION AND CONTROL SYSTEM OPERATION, MAINTENANCE, AND MONITORING PLAN

## SOUTH PARK LANDFILL SITE
## SEATTLE, WASHINGTON

**Submitted by:**
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**Farallon PN: 408-002**

**For:**
**South Park Property Development, L.L.C.**
**c/o SEACON, L.L.C.**
**165 Northeast Juniper Street, Suite 100**
**Issaquah, Washington**

June 7, 2016

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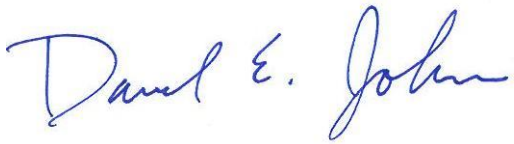

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| Agreed Order | Agreed Order No. 6706 executed by South Park Landfill Site Potentially Liable Persons and the Washington State Department of Ecology |
| Discharge Authorization | No Control Document Required to Discharge determination by King County Industrial Waste Program per reference No. 400185-01, effective April 1, 2015 |
| Ecology | Washington State Department of Ecology |
| Engineering Design Report | *Engineering Design Report, Landfill Gas Collection and Control System South Park Landfill Site, Seattle, Washington* dated June 19, 2015, prepared by Farallon Consulting, L.L.C. for South Park Property Development, L.L.C. |
| Farallon | Farallon Consulting, L.L.C. |
| HASP | Health and Safety Plan |
| HDPE | high-density polyethylene |
| Interim Action Compliance Monitoring Plan | *Interim Action Compliance Monitoring Plan, Appendix C of the Interim Action Work Plan, South Park Landfill Site, Seattle, Washington* dated February 22, 2013, prepared by Farallon Consulting, L.L.C. for South Park Property Development, L.L.C. |

| | |
|---|---|
| Interim Action Work Plan | *Interim Action Work Plan, South Park Landfill Site, Seattle, Washington* dated February 22, 2013, prepared by Farallon Consulting, L.L.C. for South Park Property Development, L.L.C. |
| Interim Action | a cleanup action mutually agreed upon by potentially liable persons for the South Park Landfill Site and King County that addresses the cleanup of the South Park Property Development, L.L.C. Property and as documented in the Interim Action Work Plan attached to the amended Agreed Order |
| Interim Action Area | the area to which the Interim Action applies, which is a portion of the South Park Landfill Site and includes the approximately 19.4-acre SPPD Property and areas contiguous with the SPPD Property where mixed municipal solid waste from the South Park Landfill operation extends beneath City of Seattle street rights-of-way beneath 5th Avenue South, 2nd Avenue South, and South Sullivan Street |
| LED | light-emitting diode |
| LEL | lower explosive limit (5 percent methane) |
| LFGCCS | landfill gas collection and control system |
| MFS | Minimum Functional Standards for Solid Waste Handling |
| MTCA | Washington State Model Toxics Control Act Cleanup Regulation |
| OMMP | Operation, Maintenance, and Monitoring Plan |
| PSCAA | Puget Sound Clean Air Agency |
| RI/FS Report | *Draft Final South Park Landfill Remedial Investigation/Feasibility Study* dated June 2014, prepared by Floyd\|Snider for the City of Seattle and South Park Property Development, L.L.C. |
| RI/FS Work Plan | *Final Remedial Investigation/Feasiblity Study Work Plan, South Park Landfill Site, Seattle, Washington* dated November 3 2010, prepared by Farallon Consulting, L.L.C. for South Park Property Development, L.L.C. and the City of Seattle |
| scfm | standard cubic feet per minute |
| South Park Landfill Site | the locations where contamination caused by the release of hazardous substances from the South Park Landfill has come to be located |
| SPPD | South Park Property Development, L.L.C. |

| | |
|---|---|
| SPPD Property | a 19.4-acre parcel purchased by South Park Property Development, L.L.C. from King County in 2006 (King County Tax Parcel No. 3224049005) |
| WAC | Washington Administrative Code |

# 1.0 INTRODUCTION

Farallon Consulting, L.L.C. (Farallon) has prepared this Operation, Maintenance, and Monitoring Plan (OMMP) on behalf of South Park Property Development, L.L.C. (SPPD) to provide sufficient information to support the operation of the SPPD-owned landfill gas collection and control system (LFGCCS) at a portion of what is known as the South Park Landfill in the South Park neighborhood, less than 5 miles south of downtown Seattle, Washington (Figure 1). This parcel-specific OMMP is intended to be consistent with plans to be developed for adjacent land parcels comprising the South Park Landfill and with a general plan governing all properties operating landfill gas collection and control systems at the South Park Landfill[1].

The LFGCCS was installed as part of an interim action being conducted under terms of an amendment to Agreed Order No. 6706 (Agreed Order) and the Washington State Model Toxics Control Act Cleanup Regulation (MTCA), as established in Chapter 173-340 of the Washington Administrative Code (WAC 173-340), specifically WAC 173-340-430 (Interim Action). The Agreed Order amendment was executed by Seattle Public Utilities, SPPD, and the Washington State Department of Ecology (Ecology) with an effective date of June 6, 2013. The *Interim Action Work Plan, South Park Landfill Site, Seattle, Washington* dated February 22, 2013, prepared by Farallon for SPPD (2013a) (Interim Action Work Plan) describing the Interim Action is attached to the Agreed Order amendment as its Appendix E, Interim Action Work Plan, and specifies this OMMP as a required deliverable.

The South Park Landfill is an approximately 39-acre area roughly bounded by South Kenyon Street to the north, State Route 99 and 5th Avenue South to the east, South Sullivan Street to the south, and Occidental Avenue South to the west. Figures 1 and 2 show the approximate boundary of the South Park Landfill based on review of aerial photographs, information obtained from numerous subsurface investigations conducted in the area, and data collected during completion of the remedial investigation. The LFGCCS was designed to capture landfill gas generated by mixed municipal solid waste disposed of during the period of approximately 1938 through the 1960s at an approximately 19.4-acre parcel within the South Park Landfill that SPPD purchased from King County in 2006 (King County Tax Parcel No. 3224049005) (SPPD Property). The LFGCCS was installed between June and December 2014 and start-up commenced on December 17, 2014. Figure 2 shows the land parcels encompassed by the South Park Landfill, including the SPPD Property, and the positions of components of the LFGCCS. The detailed design drawings of the LFGCCS and as-built information are provided in Appendix A.

This OMMP has been prepared to meet the requirements of MTCA and specifically WAC 173-340-400[4][c]. This OMMP pertains to the landfill gas control component of the Interim Action, and documents the operation, maintenance, and monitoring concepts for the LFGCCS. The LFGCCS was constructed concurrently with construction of other elements of the Interim Action (landfill cap, surface water controls, institutional controls) and with redevelopment of the SPPD Property, which included grading and paving for tenant equipment parking and options for future build-out of structures to support tenant operations.

[1] Draft Final South Park Landfill Post-Closure Operations, Maintenance, and Monitoring Plan being prepared by Floyd|Snider et al. (pending) for the Potentially Liable Persons for the South Park Landfill.

# 2.0 ORGANIZATION

The OMMP has been organized into the following sections:

**Section 3—Site Background:** Section 3 provides background information for the South Park Landfill Site.

**Section 4—Operational Goals:** Section 4 provides a summary of the operational goals of the LFGCCS.

**Section 5—LFGCCS Description:** Section 5 describes the design elements of the LFGCCS, including landfill gas collectors, monitoring and control assemblies, connector piping, pipe mains, blowers, condensate sumps, control panels, and emissions management.

**Section 6—Personnel Roles and Responsibilities:** Section 6 describes the roles and responsibilities of the supervising Engineer and Operator and provides contact information.

**Section 7—System Operation:** Section 7 describes the system operation and troubleshooting procedures of the LFGCCS.

**Section 8—System Monitoring:** Section 8 describes the system monitoring requirements for the LFGCCS.

**Section 9—System Inspections and Maintenance:** Section 9 describes the system inspections and maintenance requirements for the LFGCCS.

**Section 10—Site Safety:** Section 10 provides detail for site-specific health and safety and procedures for handling any spills or releases.

**Section 11—Reporting:** Section 11 describes the reporting requirements for the operation of the Interim Action LFGCCS.

**Section 12—References**: Section 12 lists the documents cited in this report.

# 3.0 BACKGROUND

In accordance with the provisions of MTCA, the South Park Landfill Site is defined as the locations where contamination caused by the release of hazardous substances from the South Park Landfill has come to be located. The South Park Landfill Site and a range of cleanup alternatives are described in the *Draft Final South Park Landfill Remedial Investigation/Feasibility Study* dated June 2014, prepared for the City of Seattle and SPPD by Floyd|Snider (2014) (RI/FS Report), which was submitted to Ecology on June 27, 2014. The RI/FS Report was prepared on behalf of the Potentially Liable Persons for the South Park Landfill Site, the City of Seattle, and SPPD. The remedial investigation and feasibility study for the South Park Landfill Site was conducted in accordance with the *Final Remedial Investigation/Feasibility Study Work Plan, South Park Landfill Site, Seattle, Washington* dated November 3, 2010, prepared by Farallon (2010) (RI/FS Work Plan). The *Draft Final South Park Landfill Cleanup Action Plan* dated November 2015, prepared for the City of Seattle and SPPD by Floyd|Snider (2015) was submitted to Ecology on November 30, 2015. The RI/FS Work Plan, the Interim Action Work Plan, the RI/FS Report, and the Cleanup Action Plan provide additional details regarding the description of the South Park Landfill Site and background information.

The Interim Action was designed so as to not preclude selection of a cleanup alternative that will be implemented for the South Park Landfill Site as a whole. The Interim Action addresses cleanup of a portion of the South Park Landfill Site to reduce threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to hazardous substances. The area to which the Interim Action applies is a portion of the South Park Landfill Site and includes the SPPD Property and areas contiguous with the SPPD Property where mixed municipal solid waste from the South Park Landfill operation extends beneath City of Seattle street rights-of-way beneath 5$^{th}$ Avenue South, 2$^{nd}$ Avenue South, and South Sullivan Street (Interim Action Area) (Figure 2). The basis for design of the LFGCCS is documented in the *Engineering Design Report, Landfill Gas Collection and Control System, South Park Landfill Site, Seattle, Washington* dated June 19, 2015, prepared for SPPD by Farallon (2015a) (Engineering Design Report), which was submitted to Ecology on June 30, 2015. Documentation of construction of the LFGCCS and other aspects of the Interim Action are presented in the *Interim Action Construction Completion Report, South Park Landfill Site, Seattle, Washington* dated August 14, 2015, prepared for SPPD by Farallon (2015b), which was submitted to Ecology on August 14, 2015.

# 4.0 OPERATIONAL GOAL AND COMPLIANCE MONITORING CRITERIA

As summarized in the Interim Action Work Plan, landfill gas migration criteria are pursuant to WAC 173-304, Minimum Functional Standards for Solid Waste Handling (MFS). MFS are defined in WAC 173-304-460 and King County Board of Health Title 10 regulations. The principal migration criteria per the MFS and relevant to the whole of the South Park Landfill Site include the following:

- Methane concentrations in soil at the boundary of the buried waste must not exceed 5 percent by volume, the lower explosive limit (LEL) for methane;
- Methane concentrations inside buildings and structures on the landfill must not exceed 1.25 percent by volume, or 25 percent of the LEL; and
- Methane concentrations inside buildings and structures off the landfill must not exceed 100 parts per million volume (0.01 percent by volume and 0.2 percent of the LEL).

The LFGCCS is designed to achieve MFS with regards to landfill gas generated on the SPPD Property. The primary operational goal of the LFGCCS is to protect human health and the environment by achieving MFS.

As summarized in the Interim Action Work Plan, the LFGCCS should be adjusted depending on concentrations of residual nitrogen[2] in LFGCCS landfill gas collectors and of methane in perimeter landfill gas monitoring probes at the edge of the Interim Action Area mixed municipal solid waste. Residual nitrogen concentrations tend to rise with increasing LFGCCS extraction rate. The *Interim Action Compliance Monitoring Plan, Appendix C of the Interim Action Work Plan, South Park Landfill Site, Seattle, Washington* dated February 22, 2013, prepared by Farallon for SPPD (2013b) (Interim Action Compliance Monitoring Plan) presents compliance monitoring criteria to be used for "triggers" for LFGCCS mitigation measures. The triggers are standards for landfills that are actively generating large quantities of methane and are therefore conservative for application at the South Park Landfill, which, per the RI/FS Report, is characterized as late Stage 4/early Stage 5 with low methane generation yet still anaerobic:

- Residual nitrogen in landfill gas collection wells or laterals exceeds 20 percent. If residual nitrogen exceeds 30 percent, combustion of mixed municipal solid waste is a risk.

[2] Residual nitrogen level is calculated from concentrations of methane, oxygen, and carbon dioxide measured in landfill gas collectors as follows: Sum concentrations of methane, oxygen, and carbon dioxide. Subtract this sum from 100 to obtain an estimate of total percent nitrogen concentration. Multiply the measured oxygen concentration by 3.76 to estimate the amount of nitrogen associated with oxygen, and subtract the product from the estimated total percent nitrogen concentration. The resulting percent concentration is considered residual nitrogen. Increasing vacuum flow in a collection well/lateral will result in a reduction of methane levels, but residual nitrogen may increase. Experience has shown that 20 percent residual nitrogen is a safe, stable landfill gas control system operational parameter that will not induce aerobic decomposition increasing the risk for accelerated differential settlement of the land surface and/or combustion in buried solid waste. If necessary to control migrating methane, residual nitrogen up to 30 percent can be managed with monitoring.

- Methane exceeds 1.25 percent (25 percent of the LEL) in Perimeter Probes[3]. If methane exceeds the LEL, combustion of landfill gas is a risk, particularly in areas with limited air circulation.

Mitigation measures and notifications that may be triggered by these conditions are described in more detail in Section 4.2.2, Landfill Gas Control Confirmational Monitoring, of the Interim Action Compliance Monitoring Plan. Interpretation of landfill gas compliance monitoring results and appropriate mitigation measures may be implemented by the O&M Professional with consultation with the Project Engineer, as necessary, and as summarized in the Interim Action Compliance Monitoring Plan (see Section 6, Personnel Roles and Responsibilities, for a description of these roles). Mitigation measures may consist of adjusting operation of the LFGCCS by throttling (partially or fully closing) or opening valving on individual landfill gas collectors in appropriate sectors of the system, and monitoring to confirm maintenance of optimal operation and safe conditions.

[3] The Interim Action Compliance Monitoring Plan lists 20 "Perimeter Probes" selected for landfill gas monitoring, which are shown in Figure 2. Some of the Perimeter Probes are completed within mixed municipal solid waste and some are outside the mixed municipal solid waste and better suited for evaluating landfill gas migration from the Interim Action Area as methane is not being generated at the locations of these gas probes.

Since issuing the Interim Action Compliance Monitoring Plan, 11 of the 20 Perimeter Probes were selected as best-suited for comparing methane concentrations to compliance monitoring criteria (Compliance Probes). Listed in counter-clockwise order starting at the northwestern corner of the SPPD Property, these probes are: GP-11, GP-13, GP-03, GP-32, GP-15, GP-31, GP-30, GP-16, GP-29, GP-28, and GP-27. Four of these 11 Compliance Probes are completed within, but near the edge of, mixed municipal solid waste. These probes listed in counter-clockwise order starting along South Sullivan Street south of the SPPD Property are: GP-32, GP-29, GP-28, and GP-27. The occurrence of some mixed municipal solid waste at these locations should be considered when evaluating methane data from Compliance Probes. Compliance monitoring criteria triggers listed above from the Interim Action Compliance Monitoring Plan apply to Compliance Probes.

The other nine of the 20 Perimeter Probes identified in the Interim Action Compliance Monitoring Plan are completed within the interior of the South Park Landfill. Eight of these nine Perimeter Probes are located along the northern boundary of the Interim Action Area and are monitored to collect data from the edge of the Interim Action Area and to inform operation of the LFGCCS. Listed counter-clockwise order starting at the southeastern corner of the SPPD Property, these probes are: GP-17, GP-19, GP-36, GP-20, GP-35, GP-34, GP-21, GP-22, and GP-33. Compliance monitoring criteria triggers listed above from the Interim Action Compliance Monitoring Plan do not apply to these nine Perimeter Probes in the near-term as elevated methane is expected in the interior of the South Park Landfill, distant from structures, and before landfill gas controls are in-place on adjacent land parcels comprising the South Park Landfill Site.

# 5.0 LFGCCS DESCRIPTION

This section provides a description of the LFGCCS and its components, including landfill gas collectors, monitoring and control assemblies, connector piping, pipe mains, blowers, condensate sumps, control panels, and emissions management. Specific design details and construction drawings are provided in Appendix A. Positions of landfill gas collectors, piping, and the equipment compound are shown in Figure 2. Components of the LFGCCS are described in more detail in the Engineering Design Report.

## 5.1 LANDFILL GAS COLLECTORS

Vertical landfill gas collectors (gas collection wells) are the primary mode of landfill gas collection in the medium to deep portions of the SPPD Property where mixed municipal solid waste is up to 20 feet thick and 20 feet deep. The vertical collectors were extended to the bottom of the mixed municipal solid waste to depths between approximately 5 and 23 feet below the redeveloped SPPD Property ground surface. A 4-inch-diameter high-density polyethylene (HDPE) casing was perforated from the well bottom to a point that is approximately 50 percent of the distance from the ground surface to the water table, and was surrounded with highly permeable rock. The vertical collectors are estimated to have as much as a 100-foot radius of influence in the deeper portions of the SPPD Property and a 60-foot radius of influence in the medium to shallow areas.

Horizontal landfill gas collectors (gas collection trenches) were used for three conditions where vertical collectors would not be as effective:

- Where the mixed municipal solid waste depth is less than 6 feet;
- At the top of steep slopes at the junction between asphaltic concrete cap and low-permeability membrane cap sections; and
- Where more laterally continuous landfill gas control is desired (e.g., along the western side of 5$^{th}$ Avenue South).

Horizontal collectors may also be used under future buildings developed on the SPPD Property.

The horizontal collectors were constructed of 6-inch-diameter perforated HDPE surrounded with highly permeable rock. Segmented horizontal collector installation allows segment operation adjustments to match the landfill gas flow characteristics of the particular area served. The horizontal collectors were installed in approximately 150-foot-long segments.

In addition to collecting landfill gas, the LFGCCS may collect large volumes of air. There may be significant air short-circuiting through the various landfill cover materials, including gravel below the landfill cap, and through soil and the upper layers of mixed municipal solid waste. This air collection may be necessary to establish in-waste vacuums strong enough to collect the methane generated by mixed municipal solid waste at the SPPD Property and prevent migration out of the Interim Action Area and/or building intrusion. It is anticipated that the total landfill gas-air mixture collected may be up to 5 times the landfill gas generation rate alone. The horizontal collectors may be particularly prone to collecting large volumes of air. There is no practical method to seal

subsurface soil to prevent air short-circuiting, which will be prevalent in areas peripheral to the Interim Action Area. As the asphaltic concrete cap ages, settles, and cracks, and if not properly maintained, air may start to short-circuit through cap systems over time.

## 5.2 MONITORING AND CONTROL ASSEMBLIES

Each landfill gas collector has an associated monitoring and control assembly housed in an 18-inch-minimum-diameter flush-mounted traffic-rated vault. Each monitoring and control assembly includes a 1-inch-diameter polyvinyl chloride pipe with a monitoring port to facilitate measurement of landfill gas velocity, methane, oxygen, carbon dioxide, carbon monoxide, vacuum, and temperature. A 1-inch-diameter gate valve controls vacuum and flow to the collector. To prevent accumulation of condensate at the control valve, the monitoring and control assembly is located at the high point in the connector, between the collector and the landfill gas main.

The 1-inch-diameter pipe and valve are attached to reducer bushings to match the larger collector pipes and the 6-inch-diameter HDPE connectors. The bushings are close-connected to the larger pipes with rubber connectors. The monitoring and control assembly 1-inch-diameter pipe can be readily replaced with a larger or smaller pipe and valve, if desired, for exceptional flows or to enhance flow and vacuum control.

A monitoring and control assembly at each collector enables considerable adjustment in applied vacuum and flow. Monitoring and control assemblies allow the vacuum and flow at each collector to be finely adjusted to optimize and balance LFGCCS operations during the Interim Action and to re-balance and coordinate operations in the event of future landfill gas control systems installed by others on adjacent properties.

## 5.3 CONNECTOR PIPING

The connector pipes between the collectors and the mains are 6-inch-diameter HDPE. Six-inch-diameter piping is the minimum acceptable to provide condensate drainage considering anticipated differential settlement of the mixed municipal solid waste and resulting pipe grade variations. The connector piping design required minimum 2 percent sloping for condensate to drain to condensate sumps.

## 5.4 PIPE MAINS

The landfill gas pipe mains are 8-inch-diameter HDPE. The longest continuous length of landfill gas main is approximately 1,870 feet. Pipe mains have been sloped a minimum 2 percent to facilitate condensate drainage to condensate sumps.

## 5.5 BLOWERS

The LFGCCS has two blowers, one running at a time, with the other for backup. The blower system includes a 6-inch-diameter HDPE blower piping array, fittings, and blower intake-discharge reducers. Blowers are New York Blower size 2606A10 pressure blowers with belt-driven, aluminum, radial-bladed wheels driven by Baldor model EM3771T, 10 horsepower, 460

volt, 3 phase, totally enclosed fan-cooled motors. The blowers are capable of a 45-inch water column pressure rise at 270 standard cubic feet per minute (scfm). The blower fan belt sheaves on one of the two blowers have been modified to reduce operational speed of the blower to approximately 1,018 revolutions per minute, and reduce the vacuum to a 4-inch water column. The blowers can be operated with an adjustable operational timer located in the blower control panel to allow greater operational flexibility. The operational timer can be adjusted to operate under several different scenarios. The timer also logs total system run-time. Blower manufacture specifications are provided in Appendix B.

## 5.6 CONDENSATE SUMPS

Operation of the LFGCCS results in generation of landfill gas condensate, which is collected in sumps and discharged to the sanitary sewer. Landfill gas condensate is primarily water that develops as a result of cooling in the landfill gas collection and piping system, but can contain concentrations of constituents occurring in mixed municipal solid waste disposed at the SPPD Property. Condensate is captured in one of two condensate sumps, as shown in plan and in detail in Appendix A (design and as-built drawings EN-3 and EN-4). One condensate sump is located just prior to the landfill gas blower on the northwestern portion of the SPPD Property; the other is installed at a low elevation area in the landfill gas pipe main on the northeastern corner of the SPPD Property. The condensate sumps consist of a 12-inch-diameter HDPE moisture-separator knockout system in which condensate drops out of the landfill gas stream and gravity-drains into the sump collection points. Landfill gas condensate is pumped from the condensate sumps by pumps operated in alternating duplex operation. The exact amount of condensate generated will be highly variable based on operating conditions.

The condensate pumps are the Grundfos Redi-Flo3 10-gallon-per-minute pump model no. 10 Redi-Flo3-1-40 with a 1/2 horsepower, 230 volt, 1 phase motor; and are operated by a Warrick Series 3G pump controller and condensate level control rods. The condensate level control rods are used for pump off, lead pump on, lag pump on, and a high-level alarm. Additional technical information regarding the condensate sump system is provided in Appendix B. The condensate is pumped through a totalizing meter and eventually discharged to the sanitary sewer per the No Control Document Required to Discharge determination issued by the King County Industrial Waste Program per reference No. 400185-01, effective April 1, 2015 (Discharge Authorization). Regulatory permit documentation is presented in Appendix C.

## 5.7 CONTROL PANELS

The LFGCCS is operated with a main landfill gas blower and condensate sump pump control panel located at the main equipment compound in the vicinity of the landfill gas blowers situated on a fenced concrete pad on the northwestern portion of the SPPD Property. A second remote condensate sump pump control panel is located on the northeastern corner of the SPPD Property proximate to the condensate sump. Panel manufacture specifications are provided in Appendix B.

The main control panel includes a power disconnect switch that will shut off power to the control panel and operating equipment. The main control panel has hand/off/auto switches for each of the two landfill gas blowers and for each pump in the main equipment compound condensate sump.

An auto-dialer alarm callout system with a telephone line will dial out to a programmed operator telephone number(s) in the event of system alarms. The auto-dialer will activate in the event of a blower shutdown, including a power outage or an overload condition, and for a high condensate level in either of the two condensate sumps. The control panel includes green indicator light-emitting diode (LED) lights for normal operating conditions, and red indicator LED lights for alarm conditions. The main control panel includes two digital displays that show the run time for each blower, as measured in hours operated. The button adjacent to each display will reset the runtime measurement, and should only be operated after consulting with the Project Engineer. Inside the main control panel are blower timers for each blower. These timers can be adjusted to operate blowers intermittently. Adjustment of these timers should only be performed after consulting with the Project Engineer, reviewing timer manufacturer instructions, and following the shut-down procedure described in Section 7.3.

The remote LFGCCS condensate sump control panel on the northeastern corner of the SPPD Property includes a power disconnect switch that will shut off power to the panel and associated equipment. The remote LFGCCS condensate control panel includes hand/off/auto switches for each LFGCCS condensate sump pump, a normal operation green indicator LED light for the condensate sump pumps, and a red indicator LED light for high-condensate-level alarms.

## 5.8 EMISSIONS MANAGEMENT

The landfill gas-air mixture from the LFGCCS contains a small percentage of methane and will not support use of a landfill gas flare for discharge control. The LFGCCS design allows for emissions treatment using pelletized activated carbon filters for removal of volatile organic compounds such as vinyl chloride, methylene chloride, and benzene, if present in hazardous concentrations and if determined necessary by the Puget Sound Clean Air Agency (PSCAA). The pelletized activated carbon filters will not remove methane from the LFGCCS flow.

Based on pre-construction landfill gas probe data collected through 2014, PSCAA did not anticipate the need for treating emissions from the LFGCCS. Samples of LFGCCS emissions have since been tested, analyzed, and evaluated under steady-state operational conditions and, based on the results of this evaluation, a PSCAA Notice of Construction Application is not necessary. PSCAA has not yet concurred with this evaluation. The results of the LFGCCS emission testing and evaluation are summarized in a Technical Memorandum regarding Landfill Gas Control System Emissions Sampling, SPPD Property, South Park Landfill Site, Seattle, Washington dated January 20, 2016, prepared by Farallon and included in Appendix C. However, the LFGCCS design allows for emissions treatment using pelletized activated carbon filters for removal of volatile organic compounds if determined necessary by PSCAA based on results of future emissions testing. If emissions treatment is required, it is anticipated that two 2,000-pound filters will be used in series. The landfill gas emissions are piped to a 6-inch-diameter polyvinyl chloride vent stack, which discharges to the atmosphere.

# 6.0 PERSONNEL ROLES AND RESPONSIBILITIES

This section describes the personnel roles and responsibilities associated with the operation, maintenance, and monitoring of the LFGCCS. The SPPD Property owner is to employ or designate personnel to fulfill the responsibilities of three roles: Project Coordinator, Project Engineer, and O&M Professional.

## 6.1 PROJECT COORDINATOR

The responsibility of the Project Coordinator is to work under the direction of the owner of the SPPD Property to:

- Implement this OMMP;
- Be familiar with conditions at the SPPD Property and the components of the Interim Action;
- Evaluate work orders for LFGCCS repairs, upgrades, or retrofits;
- Oversee implementation of LFGCCS repairs, upgrades, or retrofits;
- Serve as the primary contact for events and documentation regarding the LFGCCS, including receiving and submitting notices, comments, documents, reports, approvals, decisions, and other communications relevant to the LFGCCS; and
- Ensure that issues pertaining to the operation, maintenance, and monitoring of the LFGCCS are brought to the attention of the owner of the SPPD Property.

As of the date of this OMMP, the individual assigned to the Project Coordinator role is:

Mr. Robert Howie
Managing Partner
South Park Property Development, L.L.C.
c/o SEACON, L.L.C.
165 Northeast Juniper Street, Suite 100
Issaquah, Washington 98027
Email: rhowie@seaconllc.com
Direct: (425) 837-9720
Mobile: (425) 652-2550

## 6.2 PROJECT ENGINEER

The Project Engineer will be a licensed Professional Civil or Environmental Engineer in the State of Washington, and will be a competent person to make decisions in the operation of the LFGCCS based on field data collected from the SPPD Property. The Project Engineer will work under the direction of the Project Coordinator to provide technical guidance pertaining to the operation, maintenance, and monitoring of the LFGCCS as well as system retrofits and repairs.

As of the date of this OMMP, the individual assigned to the Project Engineer role is:

Mr. Thaddeus (Tad) Cline, P.E., L.G., L.H.G.
Principal Civil Engineer/Hydrogeologist
Farallon Consulting, L.L.C.
975 5th Avenue Northwest
Issaquah, Washington 98027
Email: tcline@farallonconsulting.com
Direct: (425) 295-0849

## 6.3 O&M PROFESSIONAL

The O&M Professional will be a competent person able to operate and monitor the LFGCCS in a safe manner, within the constraints of the OMMP and the Interim Action Compliance Monitoring Plan, and under the direction of the Project Coordinator to:

- Conduct periodic routine and emergency LFGCCS maintenance, monitoring, and operational adjustments;
- Perform compliance monitoring per the Interim Action Compliance Monitoring Plan; and
- Provide recommendations for repairs, upgrades, or retrofits to the LFGCCS and system adjustments.

As of the date of this OMMP, the individual assigned to the O&M Professional role is:

Mr. Robert de la Llata
South Park Property Development, L.L.C.
c/o SEACON, L.L.C.
165 Northeast Juniper Street, Suite 100
Issaquah, Washington 98027
Email: rdelallata@seaconllc.com
Direct: (425) 837-9720
Mobile: (425) 652-2637

# 7.0 SYSTEM OPERATION

Standard operation will occur after initial system start-up achieves balanced and steady-state operation over the course of a few to several months. Long-term balanced and steady-state standard operations may entail continuous or pulsed operations in order to achieve the operational goal and compliance monitoring criteria per the Interim Action Compliance Monitoring Plan. Results from periodic LFGCCS and Perimeter Probe monitoring will be used to inform the O&M Professional, with consultation with the Project Engineer as necessary, if LFGCCS adjustments are needed to further balance LFGCCS operation and/or to comply with the MFS operational goal described in Section 4, Operational Goal and Compliance Monitoring Criteria.

## 7.1 SYSTEM DISCHARGES

Standard operation of the LFGCCS will result in condensate being collected and discharged from the condensate sumps to the sanitary sewer and landfill gas being collected and discharged to the atmosphere through the LFGCCS discharge stack. At this time, there are no regulatory discharge monitoring requirements for landfill gas condensate or landfill gas air emissions according to the King County Discharge Authorization and correspondence with PSCAA. It is anticipated that a Notice of Construction permit from PSCAA is not required for the LFGCCS air emissions, as documented in the Farallon correspondence to PSCAA included in Appendix C.

## 7.2 SYSTEM ADJUSTMENTS

LFGCCS adjustments will be achieved by opening or throttling vacuum flow valving at the blower for control to the whole system, and at each of the monitoring and control assemblies for control of individual landfill gas collectors. LFGCCS adjustments may be made to increase methane collection in particular areas, to reduce the concentration of methane in Compliance Probes, to reduce the level of residual nitrogen, and/or for mitigation measures per the Interim Action Compliance Monitoring Plan.

Following a period of LFGCCS operation, the relative performance of system components, including landfill gas collectors, may change. System performance can change over time as a result of changes in soil moisture, contaminant concentrations, and establishment of preferential landfill gas vapor pathways; and with substantive changes in ground conditions on adjacent properties. The O&M Professional, with consultation with the Project Engineer as necessary, will periodically review LFGCCS operational data to evaluate overall system performance and the need for system adjustments. If a reduction in vacuum flow is necessary and the O&M Professional cannot reduce the vacuum flow to the whole system using only valves at the blower manifold, it may be necessary to operate the blower intermittently using the blower timer. Prior to timer adjustment, the O&M Professional should consult with the Project Engineer, review timer manufacturer instructions, and follow the shut-down procedure described in Section 7.3.

## 7.3 SHUT-DOWN PROCEDURE

The following procedure applies to normal system shut-down. Contact with live wires or electrical components can lead to serious injury or death, and motor control and electrical service panels should be opened only by an electrician or other personnel with the specific training and knowledge to safely operate and service this equipment.

1. **Power Down the Blower—**Turn the blower switch to the "off" position. The blower motor should stop operation.
2. **Power Down the Condensate Pump—**Turn the condensate pump switch to the "off" position.
3. **Power Off**—If complete power shutoff is needed, turn the main power disconnect switch to the "off" position.

## 7.4 PROCEDURE FOR START-UP AFTER TEMPORARY SHUT-DOWN

The following procedure applies to start-up of the LFGCCS:

1. **Power On**—Check the control panel to ensure that the main power disconnect switch is in the "on" position.
2. **Condensate Pump On**—Check the control panel to ensure that the condensate pump #1 switch is set to "auto" (this setting will result in the pump cycle being controlled by condensate level control rods).
3. **Check Warning Lights**—Ensure that the "high-condensate-level" warning light is not illuminated. If the light is illuminated, refer to Section 7.5.1, High-Condensate-Level Shut-Down, for troubleshooting.
4. **Blower On**—On the control panel, turn the active blower switch to "auto." At the time of preparation of this OMMP, the active blower is Blower No. 2. Operation in "auto" mode will ensure that the blower operates with the design fault protection.

## 7.5 TROUBLESHOOTING PROCEDURES

This section provides detailed troubleshooting procedures to be followed in the event of an automatic shut-down of the LFGCCS for a high-condensate-level alarm and/or motor fault.

### 7.5.1 High-Condensate-Level Shut-Down

High-condensate-level switches are installed in each of the two condensate sumps to prevent damage to the blower. When the condensate level in a sump reaches approximately half-full, an intermediate-level ("pump on") switch will trigger on the condensate pump, which will discharge the condensate in the sump until the condensate level reaches a low level ("pump off") switch, which will shut the pump off. If a condensate sump pump is not functioning correctly and condensate continues to rise above the "pump on" switch level, a high-condensate-level switch will shut down the system, including the landfill gas blower, and trigger an alarm callout via the auto-dialer.

Following a high-condensate-level shut-down, a manual restart of the condensate pumps and landfill gas blower is required, using the following procedures:

1. Verify the condensate level in the sump. If the condensate level is below the "pump on" switch level, press the "alarm reset" button on the control cabinet to reset the alarm. The high-condensate-level warning light should turn off.
2. If the condensate level is above the "pump on" switch level, turn the condensate pump switch to the "manual" switch mode. This will turn the condensate pump on and will pump down the condensate level in the sump. Once the condensate level reaches the "pump off" switch level, turn the condensate pump switch back to "auto" switch mode. Press the "alarm reset" button on the control cabinet to reset the alarm.
3. If the "high-condensate-level" warning light remains illuminated, repeat step 1.
4. Restart the system using the standard start-up procedure described in Section 7.4, Procedure for Start-Up After Temporary Shut-Down.

To troubleshoot the condensate pump further, refer to the manufacturer-specific instructions in the pump manual (Appendix B). If the pump is clogged or fouled in any way, the pump will need to be disassembled and cleaned by a trained technician.

### 7.5.2 Motor Overload Fault Shut-Down

Motor overload fault can occur for several reasons, causing the blower motor to shut down. If a motor overload fault occurs, attempts to restart the system should be made by a qualified person using the following procedures:

1. Open the control panel door to access the internal components of the control panel;
2. Press the "reset" button on the motor starter contactor;
3. Start the system using the standard system start-up procedure described in Section 7.4; and
4. If the blower does not restart and run under normal operational conditions, motor amperage drawn under operation conditions should be cross-checked with operational amperage indicated on the motor name plate. If required, contact the local technical representative for further assistance

# 8.0 SYSTEM MONITORING

During balanced steady-state long-term operations, periodic monitoring of components of the LFGCCS and the Perimeter Probes will be performed to verify that the LFGCCS is achieving the operational goal and compliance monitoring criteria per Section 4, Operational Goal and Compliance Monitoring Criteria, and the Interim Action Compliance Monitoring Plan. Results from periodic LFGCCS and Perimeter Probe monitoring will be used to inform the O&M Professional, with consultation with the Project Engineer as necessary, if LFGCCS adjustments are needed to further balance LFGCCS operation and/or to comply with the MFS operational goals per Section 4, Operational Goal and Compliance Monitoring Criteria.

Routine system and compliance monitoring events will be performed approximately monthly during the first year of operation and until balanced steady-state long-term operation is achieved, after which the monitoring period may be lengthened to quarterly at the direction of the Project Engineer. Access to the monitoring and control assemblies and Perimeter Probes should be maintained to facilitate routine monitoring and maintenance.

The Interim Action Compliance Monitoring Plan describes protection and performance monitoring during the period of Interim Action construction and confirmational monitoring, after completion of Interim Action construction and after start-up of the LFGCCS, and prior to preparation and implementation of a compliance monitoring plan for the South Park Landfill Site as a whole.

## 8.1 MONITORING EQUIPMENT

The suggested equipment needed to perform routine monitoring and maintenance includes the following:

- Landtec GEM 2000 Plus landfill gas monitoring instrument;
- Dwyer DS-300 pitot tube for 1-inch, 4-inch, and 6-inch pipes or a TSI Velicicalc® Model 9535-A Velocity Meter (or equivalent);
- Dwyer digital manometer model 477A (or equivalent);
- 1/4-inch male pipe thread by hose barb connector for connection hose to the piping system;
- 1/8-inch-diameter Teflon hose for connection from the hose barb to the Landtec GEM 2000 Plus;
- Cordless screw gun;
- Standard hand tools;
- Electrical meter to measure voltage and amperage; and
- Personal protective equipment to include at a minimum: gloves, hard hat, safety glasses, steel toe boots, hearing protection, and traffic rated safety vest.

## 8.2 LFGCCS MONITORING

A Landtec Gem 2000 Plus landfill gas monitoring instrument is used to measure standard monitoring parameters for the LFGCCS, including methane, carbon dioxide, oxygen, barometric pressure, and carbon monoxide. A Dwyer digital manometer is used to measure static pressure in the system. These standard monitoring parameters enable calculation of flow, water vapor, nitrogen, and residual nitrogen. Other parameters that may be measured at the monitoring and control assemblies at direction of the Project Engineer include hydrogen sulfide, temperature, and a direct reading of flow.

Each LFGCCS monitoring event will include measuring the following monitoring parameters and recording the data on a field form provided in Appendix D:

1. Northwestern equipment area:
    - Condensate discharge meter reading[4];
    - Ambient air temperature;
    - Barometric pressure;
    - System vacuum upstream of the dilution air inlet and directly upstream of the blower;
    - Air flow temperature;
    - System discharge pressure immediately downstream of the blower;
    - System air flow differential pressure[5] for the air flow from the LFGCCS, dilution air, and discharge stack;
    - System monitoring of methane, carbon dioxide, oxygen, and carbon monoxide in the system influent and blower effluent;
    - Condensate pump operating amperage when pump is running;
    - Blower operating amperage; and
    - Blower total operation hours.

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[4] The total gallons of condensate pumped to the King County sanitary sewer by the condensate collection system will be recorded. The water meter is a Master Meter Model 3G and is calibrated in gallons.

[5] Install a Dwyer Instruments DS-300 averaging pitot tube in the monitoring port located upstream of the blower and the dilution air inlet, in the dilution air inlet, and in the effluent discharge stack. Use a Dwyer digital manometer model 477A or a TSI model 8386 air velocity meter (or equivalent) with the appropriate operating range to measure static vacuum and pressure differential. The current operation differential pressure ranges from a 0.01-inch water column to 13.2-inch water column in the system monitoring ports.

Convert the pressure differential to flow rate. The flow rate can be calculated by entering the collected field data into the monitoring data Excel spreadsheet or by using the following calculation: $SCFM = (128.8 \times K \times D^2) \times \sqrt{((P \times \Delta P)/(T + 460))}$ where K = flow coefficient, D = inside diameter of pipe in inches, P = static line pressure, $\Delta P$ = differential pressure, and T = temperature. See Dwyer Series DS-300 Flow Sensor Installation and Operating Instructions Flow Calculations in Appendix B.

2. Monitoring and control assemblies:

    - Barometric pressure measured by the GEM 20000 Plus;
    - Monitoring and control assembly vacuum from the monitoring port;
    - Air flow temperature from the monitoring port (at the direction of the Project Engineer);
    - Monitoring and control assembly air flow differential pressure[3] for the air flow from monitoring port (at the direction of the Project Engineer); and
    - Monitoring and control assembly monitoring of methane, carbon dioxide, oxygen, and carbon monoxide from the monitoring port.

Additional measurements should be made following any landfill gas system or monitoring and control assembly adjustments, including:

3. Northwestern equipment area:

    - System vacuum upstream of the dilution air inlet and directly upstream of the blower;
    - Air flow temperature;
    - System discharge pressure;
    - System air flow differential pressure for the air flow from the landfill gas collectors, dilution air, and discharge stack; and
    - System monitoring of methane, carbon dioxide, oxygen, and carbon monoxide in the system influent and blower effluent.

## 8.3 PERIMETER PROBE MONITORING

A Landtec Gem 2000 Plus landfill gas monitoring instrument is used to measure standard monitoring parameters for the Perimeter Probes, including methane, carbon dioxide, oxygen, and barometric pressure. A Dwyer digital manometer is used to measure static pressure. Other parameters that may be measured at the Perimeter Probes at direction of the Project Engineer include carbon monoxide, hydrogen sulfide, and temperature. Perimeter Probe monitoring data will be recorded on a field form provided in Appendix D.

# 9.0 SYSTEM INSPECTIONS AND MAINTENANCE

During system monitoring events, components of the LFGCCS should be inspected. Standard inspections should include observing all aboveground system plumbing and components, including the blowers and motors, for deficiencies, cracks, breaks, or malfunctions. The panels should be inspected to verify that there are no un-realized alarm conditions or automatic shut-offs. Components found to be deficient should be immediately repaired or replaced.

Standard maintenance tasks will include but are not limited to:

- Lubricating motor bearings after every 3,600 hours of operation with Polyrex EM grease; and
- Checking and cleaning debris from the dilution air inlet hardware cloth filter as needed.

Operation and monitoring of the LFGCCS is expected to occur for the indefinite future. At some point, monitoring may indicate a reduction in methane production, and that methane migration off the SPPD Property is no longer a risk. Reduced operation will be considered at that time.

The effectiveness and performance of the LFGCCS is partly dependent on the integrity of the landfill cap component of the Interim Action. Therefore, operation and maintenance procedures and repairs to the landfill cap should be conducted per the *Operation and Maintenance Plan Landfill Cap, South Park Landfill Site, Seattle, Washington* dated August 24, 2015, prepared by Farallon for SPPD (2015c).

# 10.0 HEALTH AND SAFETY

Farallon has prepared a Health and Safety Plan (HASP), for use by Farallon employees only, for work at the SPPD Property. The Farallon HASP is provided in Appendix E. Any Farallon employee performing work at the SPPD Property should read and be familiar with the Farallon HASP, updated as necessary as the project progresses and new information becomes available. Other companies performing work at the SPPD Property should prepare their own HASP. At a minimum, personal protective equipment, including earplugs, eye protection, and steel-toed boots, should be worn at all times when work is performed.

# 11.0 REPORTING

Reporting for this OMMP will be per progress reporting specifications indicated in the Interim Action Compliance Monitoring Plan. Reporting documenting LFGCCS operation, maintenance, and monitoring will be submitted annually to Ecology by the end of March for the previous calendar year. Annual progress reporting will summarize operation and maintenance activities and mitigation measures occurring for the prior calendar year. Requirements for SPPD Property LFGCCS monitoring and progress reporting may be modified when the compliance monitoring plan for the South Park Landfill Site comes into effect and landfill gas monitoring occurs for the entire South Park Landfill Site. No reporting is presently required for discharge of condensate to the sanitary sewer or LFGCCS emissions to the atmosphere.

# 12.0 REFERENCES


Farallon Consulting, L.L.C. (Farallon). 2010. *Final Remedial Investigation/Feasibility Study Work Plan, South Park Landfill Site, Seattle, Washington.* Prepared for South Park Property Development, L.L.C. and City of Seattle, Seattle Public Utilities. November 3.

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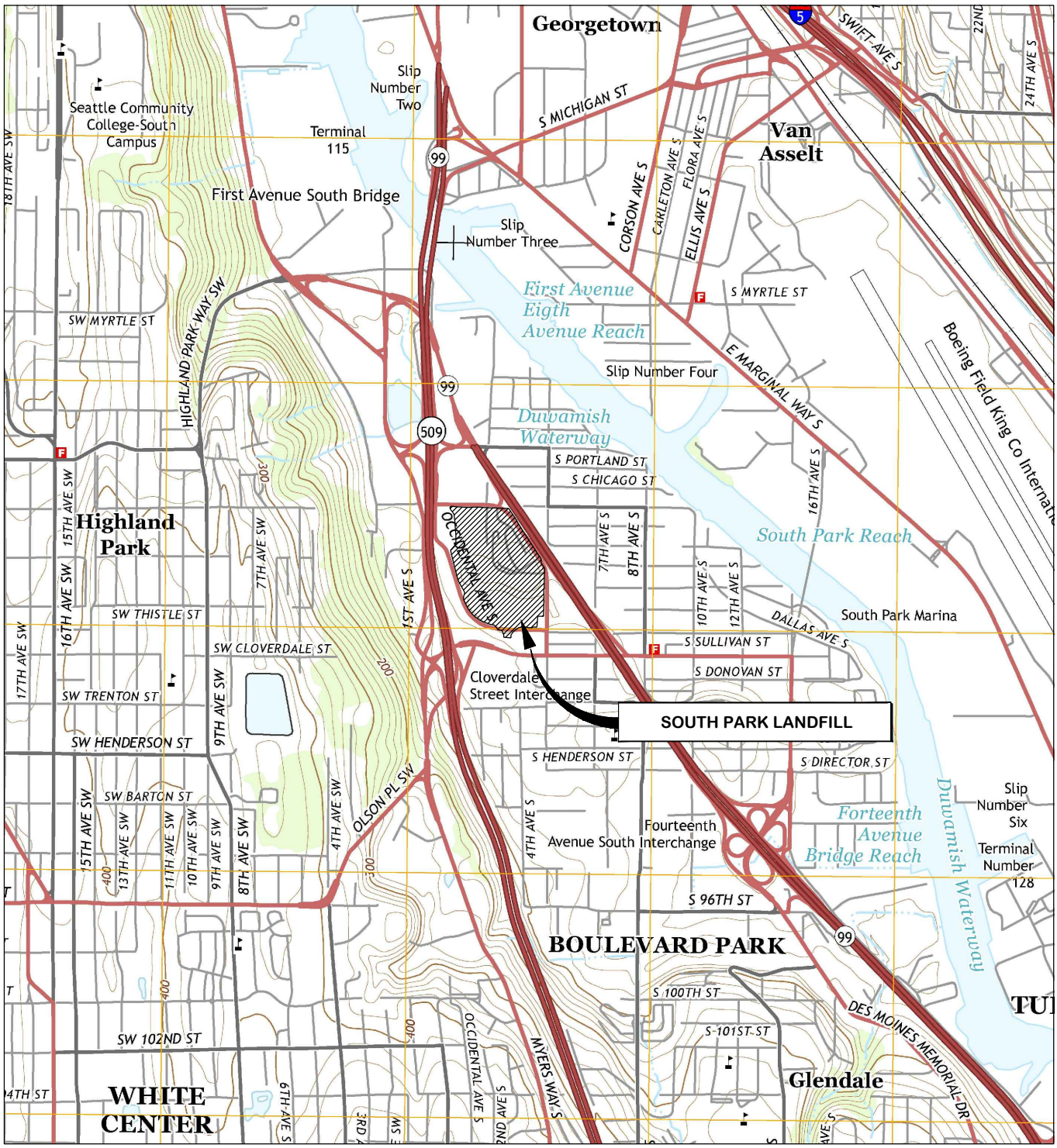
Floyd|Snider. 2014. *Draft Final South Park Landfill Remedial Investigation/Feasibility Study.* June.

———. 2015. *Draft Final South Park Landfill Cleanup Action Plan.* November.

# FIGURES

SPPD PROPERTY LANDFILL GAS COLLECTION AND CONTROL SYSTEM
OPERATION, MAINTENANCE, AND MONITORING PLAN
South Park Landfill Site
Seattle, Washington

Farallon PN: 408-002




REFERENCE: 7.5 MINUTE USGS QUADRANGLE SEATTLE SOUTH, WASHINGTON. DATED 2014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Oregon
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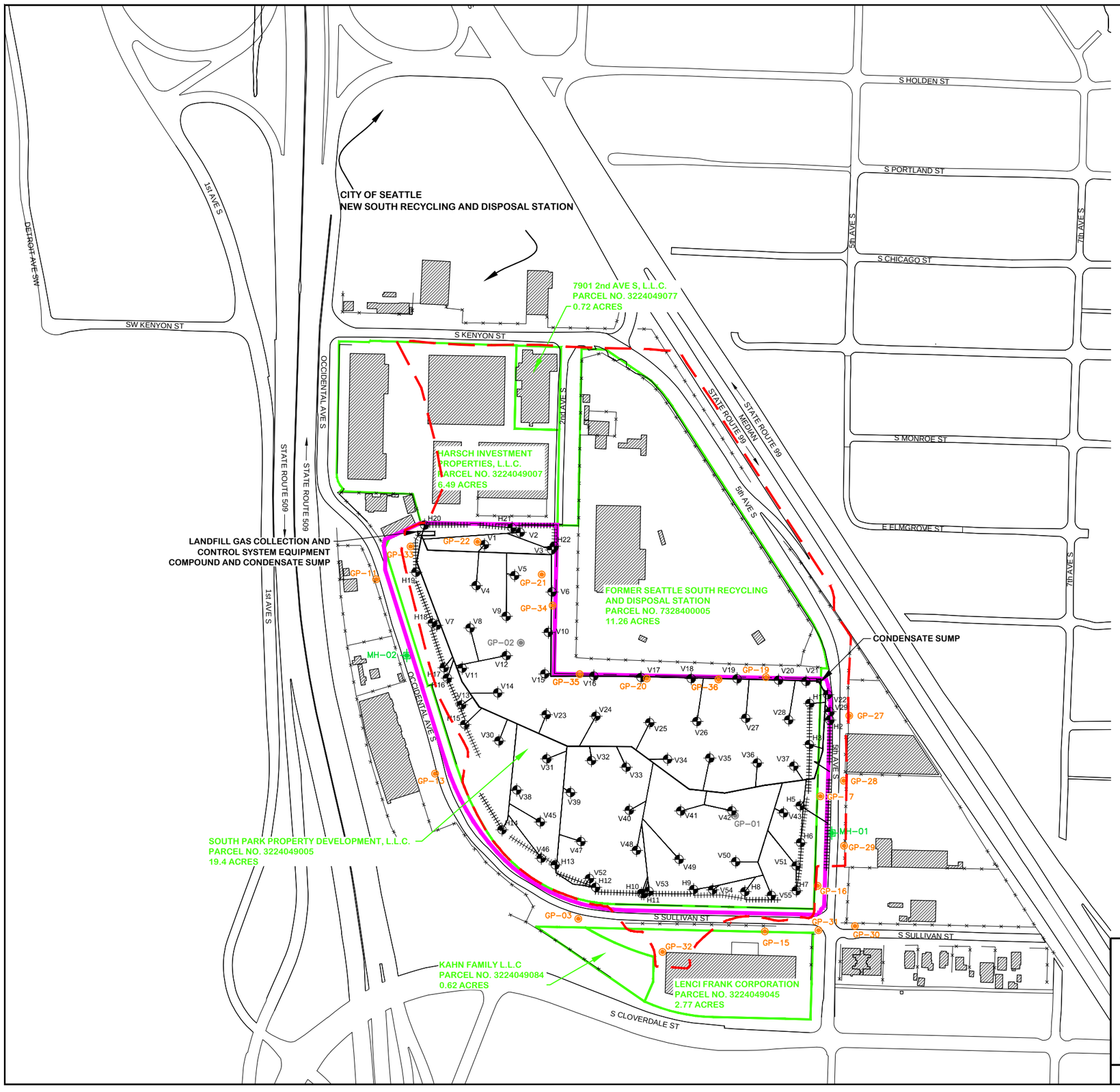
California
Oakland | Sacramento | Irvine

# FIGURE 1

VICINITY MAP
SPPD PROPERTY, SOUTH PARK LANDFILL SITE
SEATTLE, WASHINGTON

FARALLON PN: 408-002

Drawn By: DEW | Checked By: TC | Date: 03/17/2016 | Disk Reference: BASEMAPb




LEGEND

- SOUTH PARK LANDFILL BOUNDARY
- KING COUNTY TAX PARCEL BOUNDARY
- INTERIM ACTION AREA
- FENCE
- EXISTING BUILDING
- LANDFILL GAS PROBE MONITORING LOCATIONS
- FORMER LANDFILL GAS PROBE MONITORING LOCATIONS
- GAS PROBE LOCATIONS NOT INCLUDED IN THE INTERIM ACTION COMPLIANCE MONITORING PROGRAM
- SEWER MANHOLE MONITORING LOCATIONS
- V35 — LANDFILL GAS COLLECTION VERTICAL WELL
- H3 — LANDFILL GAS COLLECTION HORIZONTAL TRENCH

NOTES:

1. FIGURE INCLUDES INFORMATION PRESENTED IN COLOR. PHOTOCOPIES MAY NOT DEPICT ALL INTENDED INFORMATION ON THE ORIGINAL DRAWING.
2. ALL LOCATIONS ARE APPROXIMATE

N

0 300

APPROXIMATE SCALE IN FEET

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Oregon
Portland | Bend | Baker City

California
Oakland | Sacramento | Irvine

# FIGURE 2

PROPERTY MAP
SPPD PROPERTY, SOUTH PARK LANDFILL SITE
SEATTLE, WASHINGTON

FARALLON PN: 408-002

Drawn By: DEW Checked By: CS Date: 03/23/2016 Disk Reference: BASEMAPb

# APPENDIX A
# ENGINEERING DESIGN AND AS-BUILT DRAWINGS

SPPD PROPERTY LANDFILL GAS COLLECTION AND CONTROL SYSTEM
OPERATION, MAINTENANCE, AND MONITORING PLAN
South Park Landfill Site
Seattle, Washington

Farallon PN: 408-002

## ELECTRICAL ABBREVIATIONS

| | |
|---|---|
| A/AMP | AMP |
| AC | ALTERNATING CURRENT |
| BD | BUS DUCT |
| C | CURRENT |
| CB | CIRCUIT BREAKER |
| CLG | CEILING |
| DC | DIRECT CURRENT |
| DIS | DISCONNECT |
| DP | DOUBLE POLE |
| DT | DOUBLE THROW |
| EG | ENCLOSED AND GASKETED |
| E(OH) | ELECTRICAL (OVERHEAD) |
| E(UG) | ELECTRICAL (UNDERGROUND) |
| EMER | EMERGENCY |
| EPO | EMERGENCY POWER OFF |
| EMT | ELECTRICAL METALLIC TUBING |
| EXP | EXPOSED |
| FBO | FURNISHED BY OTHERS |
| FLEX | FLEXIBLE METAL CONDUIT |
| FRN | DUAL ELEMENT FUSE |
| GEN | GENERATOR |
| GFIC | GROUND FAULT INTERRUPTER |
| GND | GROUND |
| GRC | GALVANIZED RIGID CONDUIT |
| HOA | HAND-OFF-AUTO SWITCH |
| IRD | INFRARED DETECTOR |
| HP | HORSE POWER |
| HZ | CYCLES PER SECOND |
| JB | JUNCTION BOX |
| LFMC | LIQUID TIGHT FLEXIBLE METAL CONDUIT |
| M | MOTOR/MOTOR STARTER COIL |
| MCC | MOTOR CONTROL CENTER |
| MCP | MOTOR CIRCUIT PROTECTOR |
| NC | NORMALLY CLOSED |
| NEC | NATIONAL ELECTRIC CODE |
| NEMA | NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION |
| NF | NON-FUSED |
| NO | NORMALLY OPEN |
| OL | OVERLOADS |
| PBS | PUSHBUTTON |
| PF | POWER FACTOR |
| PL | PILOT LIGHT |
| PLC | PROGRAMMABLE LOGIC CONTROLLER |
| RC | RIGID CONDUIT |
| RCPT | RECEPTACLE |
| SN | SOLID NEUTRAL |
| SP | SINGLE POLE |
| ST | SINGLE THROW |
| SW | SWITCH |
| TF/TRAN | TRANSFORMER |
| UF | UNDERFLOOR |
| UG | UNDERGROUND |
| V | VOLTS |
| VFD | VARIABLE FREQUENCY DRIVE |
| VP | VAPOR PROOF |
| WHT | WHITE |
| WP | WEATHER PROOF |
| XP | EXPLOSION PROOF |

## STANDARD ABBREVIATIONS

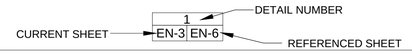
| | |
|---|---|
| AF | AIR FILTER |
| AB | AGGREGATE BASE |
| AC | ASPHALTIC CONCRETE |
| APPROX | APPROXIMATELY |
| AF | AIR FILTER |
| AS | AIR SPARGE |
| BF | BLIND FLANGE |
| B.G.S. | BELOW GROUND SURFACE |
| BLDG | BUILDING |
| BOP | BOTTOM OF PIPE |
| BV | BALL VALVE |
| CONC | CONCRETE |
| CPLG | COUPLING |
| ℄ /CL | CENTERLINE |
| CV | CONTROL VALVE/CHECK VALVE |
| DC | DOUBLE CONTAINED |
| /DIA | DIAMETER |
| DWG | DRAWING |
| DP | DUAL PHASE |
| DPI | DIFFERENTIAL PRESSURE INDICATOR |
| EF | EACH FACE |
| EL/ELEV | ELEVATION |
| ELEC | ELECTRICAL |
| ELB | ELBOW |
| EPDM | ETHYLENE PROPYLENE RUBBER |
| EXIST/(E) | EXISTING |
| EXP | EXPANSION |
| EW | EACH WAY |
| EA | EACH |
| FC | FAIL CLOSE |
| FO | FAIL OPEN |
| FLXC | FLEXIBLE CONNECTION |
| FM | FLOW METER |
| FL | FLOW LINE |
| FT | FOOT |
| FUT | FUTURE |
| FIN GR | FINISHED GRADE |
| FE | FLANGED END |
| FNPT | FEMALE NATIONAL PIPE THREAD |
| GA | GAUGE |
| GAC | GRANULAR ACTIVATED CARBON |
| GALV | GALVANIZED |
| GI | GALVANIZED IRON |
| GPM | GALLONS PER MINUTE |
| GR | GRADE |
| GND | GROUND |
| GSKT | GASKET |
| GW | GROUNDWATER |
| GV | GATE VALVE |
| HDPE | HIGH DENSITY POLYETHYLENE |
| HORIZ | HORIZONTAL |
| HP | HORSEPOWER/HIGH PRESSURE |
| HR | HOUR |
| HS | HOSE |
| HYD | HYDRANT |
| HOA | HAND OFF AUTOMATIC |
| ID | INSIDE DIAMETER |
| IN | INCHES |
| INV | INVERT |
| IPS | IRON PIPE SIZE |
| JT | JOINT |
| JB | JUNCTION BOX |
| KO | KNOCK OUT |
| LSHH | LEVEL SWITCH |
| M | MOTOR |
| MAX | MAXIMUM |
| MH | MANHOLE |
| MJ | MECHANICAL JOINT |
| MIN | MINUTE/MINIMUM |
| MISC | MISCELLANEOUS |
| MNPT | MALE NATIONAL PIPE THREAD |
| MP | METER PUMP |
| MON.PORT | MONITORING PORT |
| MW | MONITORING WELL |
| NC | NORMALLY CLOSED |
| NIC | NOT IN CONTRACT |
| NO | NORMALLY OPEN |
| NO. | NUMBER |
| N | NEW |
| NTS | NOT TO SCALE |
| NPDES | NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM |
| OC | ON CENTER |
| OD | OUTSIDE DIAMETER |
| OSHA | OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION |
| OVHD | OVERHEAD |
| #/LB | POUND |
| PB | PULL BOX |
| PBF | PROVIDED BY FARALLON |
| PC | PORTLAND CEMENT |
| PCC | PORTLAND CEMENT CONCRETE |
| PG | PRESSURE GAS |
| PL | PROPERTY LINE/PIPE LINE |
| PO | PUMP OUT |
| P | PRESSURE |
| PRV | PRESSURE RELEASE VALVE |
| PSI | POUNDS PER SQUARE INCH |
| PSIA | POUNDS PER SQUARE INCH, ABSOLUTE |
| PSIG | POUNDS PER SQUARE INCH, GAUGE |
| PTW | PRESSURE TREATMENT |
| PVC | POLYVINYL CHLORIDE |
| PV | PROCESS VARIABLE |
| PR | PAIR |
| PUE | PUBLIC UTILITY EASEMENT |
| R | RADIUS/RISER |
| RC | REINFORCED CONCRETE |
| REQ | REQUIRED |
| REF | REFERENCE |
| SCH | SCHEDULE |
| SDR | STANDARD DIMENSION RATIO |
| SECT | SECTION |
| SHT | SHEET |
| SPEC | SPECIFICATION |
| SQ | SQUARE |
| STA | STATION |
| STD | STANDARD |
| STL | STEEL |
| SBO | SUPPLIED BY OWNER |
| ST | SAMPLE TAP |
| STR | STRAINER |
| SS | STAINLESS STEEL |
| STL | STEEL |
| SVE | SOIL VAPOR EXTRACTION |
| SW | SWITCH |
| TYP | TYPICAL |
| TOC | TOP OF CASING/CURB |
| TOS | TOP OF STEEL |
| TOW | TOP OF WALL |
| UBC | UNIFORM BUILDING CODE |
| UGPS | UNDERGROUND PULL SECTION |
| UTIL | UTILITY |
| V | VALVE/VENT/VOLTS |
| VAC | VACUUM |
| VAR | VARIES/VARIABLE |
| VERT | VERTICAL |
| VP | VAPOR |
| VRV | VACUUM RELIEF VALVE |
| W/ | WITH |
| W/O | WITHOUT |
| WS | WATER SURFACE/WATER STOP |

## INSTRUMENTATION ABBREVIATIONS AND SYMBOLS

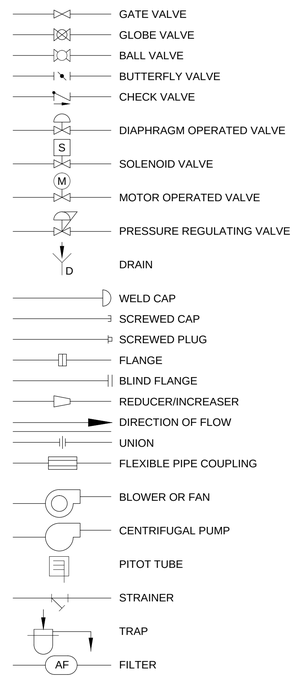
### INSTRUMENT LEGEND

| FIRST LETTER INITIATING VARIABLE | | SUCCEEDING LETTERS OUTPUT FUNCTIONS |
|---|---|---|
| A | ANALYSIS | ALARM |
| B | BURNER | |
| C | CONDUCTIVITY | CONTROL |
| D | DENSITY | DIFFERENTIAL |
| E | POTENTIAL (VOLTS) | PRIMARY ELEMENT |
| F | FLOW RATE | RATIO (FRACTION) |
| G | FIRE ALARM | GLASS (SIGHT GAUGE) |
| H | HAND (MANUALLY) | HIGH |
| I | CURRENT (AMPERES) | INDICATE |
| J | POWER | |
| K | TIME | |
| L | LEVEL | LEAK, LOW |
| M | MOISTURE/HUMIDITY | LIGHT (PILOT) |
| N | EQUIPMENT STATUS | |
| P | PRESSURE/VACUUM | POINT (TEST CONNECTION) |
| Q | QUANTITY | INTEGRATE (TOTALIZE) |
| R | | RECORD/PRINT |
| S | SPEED | SWITCH |
| T | TEMPERATURE | TRANSMIT |
| U | MULTIVARIABLE | MULTIFUNCTION |
| V | VIBRATION/VOLUME | VALVE/DAMPER |
| W | WEIGHT/FORCE/TORQUE | |
| X | UNCLASSIFIED | UNCLASSIFIED |
| Y | | RELAY/COMPUTE |
| Z | POSITION | DRIVE/ACTUATE |

### STANDARD SYMBOLS




## PIPING, ELECTRICAL AND EQUIPMENT SYMBOLS




## GENERAL NOTES

1. A COPY OF THE PROJECT DESIGN DRAWINGS SHALL BE MAINTAINED ON THE JOB SITE AT ALL TIMES.
2. COPIES OF ALL PERMITS SHALL BE MAINTAINED ON THE JOB SITE AT ALL TIMES. THE CONTRACTOR SHALL COMPLY WITH ALL PERMIT REQUIREMENTS.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL DIMENSIONS.
4. BURIED UTILITIES SHOWN ON THE DRAWINGS ARE FOR GENERAL INFORMATION ONLY. UTILITY LOCATIONS ARE APPROXIMATE AND MAY NOT BE INCLUSIVE OF ALL UTILITIES THAT EXIST ON THE PROPERTY.
5. THE CONTRACTOR SHALL HAVE A PRIVATE UTILITY LOCATE SERVICE VERIFY ALL UTILITIES AND MARK THEIR LOCATIONS ON THE GROUND PRIOR TO STARTING CONSTRUCTION. FARALLON SHALL BE CONTACTED IMMEDIATELY IF A CONFLICT IS FOUND BETWEEN EXISTING UTILITIES AND THE PROJECT DESIGN.
6. FARALLON SHALL BE NOTIFIED OF DISCREPANCIES BETWEEN CONTRACT DRAWINGS AND ACTUAL SITE CONDITIONS.
7. THE CONTRACTOR SHALL ASSUME RESPONSIBILITY FOR THE JOB SITE CONDITIONS AND ENSURE THE SAFETY OF ALL PERSONS AND PROPERTY FOR THE DURATION OF ON SITE PROJECT WORK. THE CONTRACTOR SHALL PROTECT STRUCTURES, UTILITIES, AND PAVING FROM DAMAGE, DIRECT OR INDIRECT, RESULTING FROM THE WORK. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY OVER THE DURATION OF ON SITE ACTIVITIES AND NOT BE LIMITED TO NORMAL WORKING HOURS.
8. ALL EXCAVATIONS SHALL BE PERFORMED IN STRICT ACCORDANCE WITH APPLICABLE U.S. DEPARTMENT OF LABOR OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND THE WASHINGTON INDUSTRIAL SAFETY AND HEALTH ACT (WISHA) REGULATIONS. THE CONTRACTOR ASSUMES FULL RESPONSIBILITY FOR THE SAFETY OF ALL CONSTRUCTION OPERATIONS.
9. NO TRENCHES SHALL BE LEFT OPEN WHEN WORK IS NOT IN PROGRESS. ALL OPEN EXCAVATIONS SHALL BE FENCED.

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SEATTLE, WA

First Student

SYMBOLS AND ABBREVIATIONS

CLYDE N. MOORE — STATE OF WASHINGTON — 14087 — REGISTERED PROFESSIONAL ENGINEER

9-23-13

DRAWN: DEW / CM
CHECKED: CLYDE MOORE
DATE: 9/18/13
SCALE: AS NOTED
JOB NUMBER: 408-002

EN-1

Appendix A:  Design Drawings


LEGEND

- SOUTH PARK LANDFILL BOUNDARY
- INTERIM ACTION AREA
- PROPERTY LINE
- 32 PROPOSED CONTOUR
- RETAINING WAL
- SAW CUT LINE
- x FENCE LINE
- APPROXIMATE EXTENT OF ASPHALT COVER (SEE SOILS REPORT)
- APPROXIMATE EXTENT OF GEOMEMBRANE LINER (SEE SOILS REPORT)

| | |
|---|---|
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CAP SITE PLAN

CLYDE N. MOORE
STATE OF WASHINGTON
14087
REGISTERED
PROFESSIONAL ENGINEER
9-23-13

| | |
|---|---|
| DRAWN | DEW / CM |
| CHECKED | CLYDE MOORE |
| DATE | 9/18/13 |
| SCALE | AS NOTED |
| JOB NUMBER | 408-002 |

EN-2

LANDFILL GAS VACUUM BLOWER AND CARBON TREATMENT COMPOUND — 1 / EN-3 | EN-4
2 - 5 HP BLOWERS (PRIMARY AND BACKUP)
1 - WATER KNOCKOUT
2 - WATER PUMPS (PRIMARY AND BACKUP)
1 - FORCE MAIN TO SANITARY SEWER IN OCCIDENTAL AVE. SOUTH
2 - 2000 LB ACTIVATED CARBON FILTERS IN SERIES

4" FORCE MAIN SIDE SEWER CONNECTION

289 L.F. 5.5' WIDE BIOSWALE @ 1.5%

APPROXIMATE I.E. 11.82

APPROXIMATE I.E. 9.83

6" MAIN PIPE SECTION — 3 / EN-3 | EN-4

4 / EN-3 | EN-4 — 4" CONNECTOR PIPE SECTION

295 L.F. 11' WIDE (W/ 1' SWALE) @ 0.75%

SEE NOTE 2

FUTURE BUILDING PAD FF=26.5

FUTURE BUILDING PAD (BY OTHERS)

CONDENSATE DRAINAGE HIGH POINT 8"Φ I.E. 27.83'

SLOPE TO DRAIN

SLOPE TO DRAIN

GAS COLLECTION WELL — 2 / EN-3 | EN-5

2 / EN-3 | EN-4 — LANDFILL GAS CONDENSATE PUMP STATION
2 - WATER PUMPS (PRIMARY AND BACKUP)
1 - FORCE MAIN TO SANITARY SEWER IN 5TH AVE SOUTH
4" SDR 17 HDPE WITH CLEANOUTS AT ANGLE POINTS

APPROXIMATE I.E. 18.20

APPROXIMATE I.E. 15.33

1 / EN-3 | EN-6 — TOP OF SLOPE GAS COLLECTION WELL/TRENCH CONNECTOR

4" FORCE MAIN SIDE SEWER CONNECTION

2 / EN-3 | EN-6 — GAS COLLECTION WELL CONNECTION

1 / EN-3 | EN-6 — TOP OF SLOPE GAS COLLECTION WELL/TRENCH CONNECTOR

3 / EN-3 | EN-6 — GAS COLLECTION TRENCH CONNECTION PIPE

1 / EN-3 | EN-6 — TOP OF SLOPE GAS COLLECTION WELL/TRENCH CONNECTOR

8"Φ 1 1/2 MIN SLOPE

CONDENSATE DRAINAGE HIGH POINT 8"Φ I.E. 27.83'

SLOPE TO DRAIN

SLOPE TO DRAIN

8"Φ 1 1/2 MIN SLOPE

3 / EN-3 | EN-6 — GAS COLLECTION TRENCH CONNECTION PIPE

FF=33.50

SSCO

FF=35.5

FUTURE BUILDING PAD (BY OTHERS)

FUTURE BUILDING PAD FF=35.5

1 / EN-3 | EN-6 — TOP OF SLOPE GAS COLLECTION WELL/TRENCH CONNECTOR

SEE NOTE 2

1 / EN-3 | EN-5 — LANDFILL CAP AND GAS COLLECTION TRENCH

LEGEND

- 8"Φ SDR 21 HDPE LANDFILL GAS MAIN
- 6"Φ GAS COLLECTION TRENCH — 1 / EN-3 | EN-5
- 6"Φ HDPE LANDFILL GAS CONNECTION PIPE
- GAS COLLECTION WELLS — 2 / EN-3 | EN-5
- CONNECTION POINT — 4 / EN-3 | EN-5
- 32 — CONTOUR AFTER SITE REGRADING

NOTES:

1. PERFORATED HORIZONTAL COLLECTION TRENCHES TO BE INSTALLED PRIOR TO SITE RE-GRADING. SITE RE-GRADING BY OTHERS.
2. BUILDING SUB-SLAB HORIZONTAL COLLECTION TRENCHES TO BE INSTALLED DURING BUILDING CONSTRUCTION AT FUTURE DATE.
3. LANDFILL GAS MAINS TO BE INSTALLED AT COMPLETION OF SITE RE-GRADING.
4. LANDFILL GAS COLLECTION PIPES MAY BE INSTALLED BEFORE OR AFTER RE-GRADING AT CONTRACTOR OPTION.
5. VERTICAL LANDFILL GAS WELLS MAY BE INSTALLED BEFORE OR AFTER RE-GRADING AT CONTRACTOR OPTION.
6. LANDFILL GAS MAIN SLOPE TO DRAIN WITH MINIMUM 1 1/2% SLOPE.
7. ALL LANDFILL GAS CONNECTION PIPES SHALL BE INSTALLED AT A MINIMUM 2% SLOPE TO LANDFILL GAS MAIN.

0 60
APPROXIMATE SCALE IN FEET

N

A

7/23/14 | REVISION A — ISSUED FOR CONSTRUCTION

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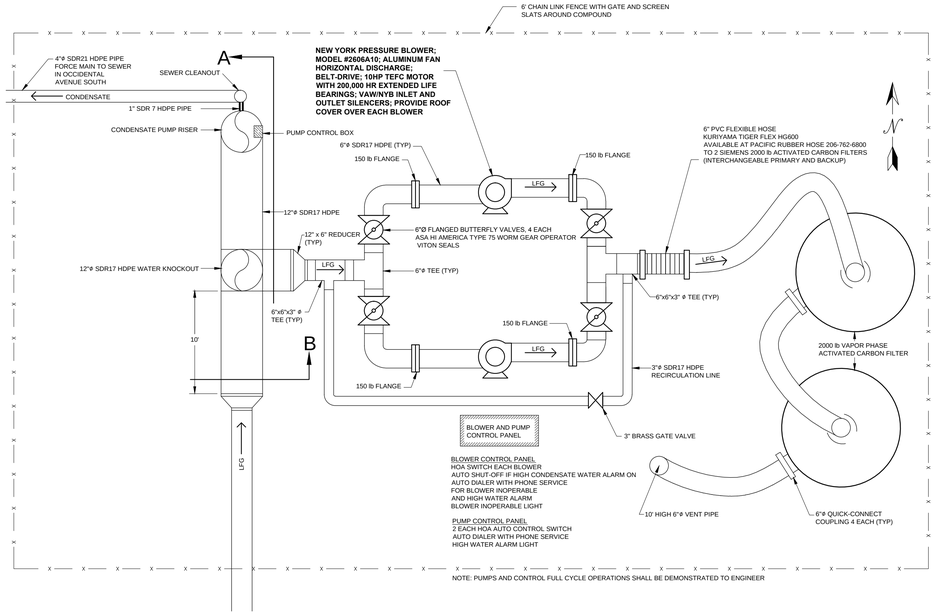
# LFG SYSTEM PLAN

CLYDE E. MOORE — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER
7-23-14

| | |
|---|---|
| DRAWN | DEJ / DEW |
| CHECKED | CLYDE MOORE |
| DATE | 7/22/14 |
| SCALE | AS NOTED |
| JOB NUMBER | 408–002rev7 |

EN-3




1 | EN-4 | EN-3

## LANDFILL GAS VACUUM BLOWER AND CARBON CLEANUP COMPOUND DETAIL

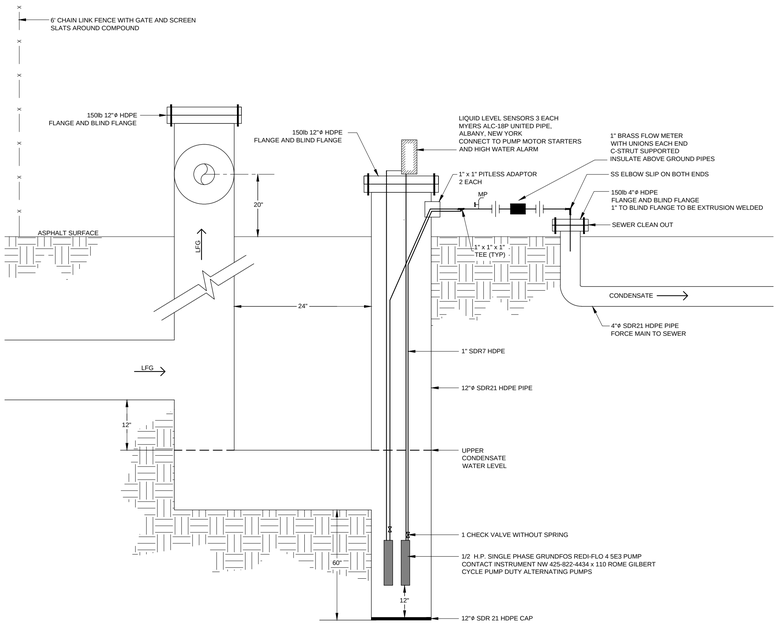
NOT TO SCALE




2 | EN-4 | EN-3

## LANDFILL GAS CONDENSATE PUMP STATION DETAIL

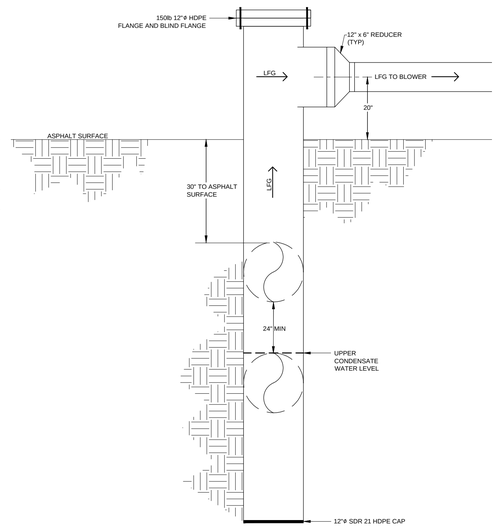
NOT TO SCALE




A | EN-4 | EN-4

## DETAIL A

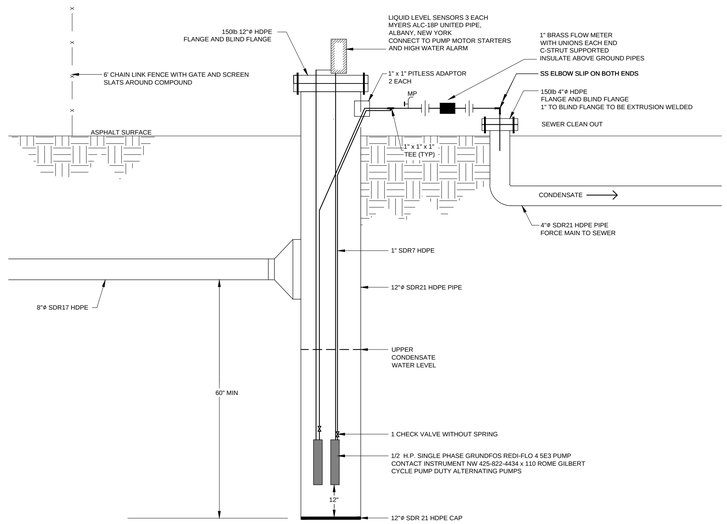
NOT TO SCALE




B | EN-4 | EN-4

## DETAIL B

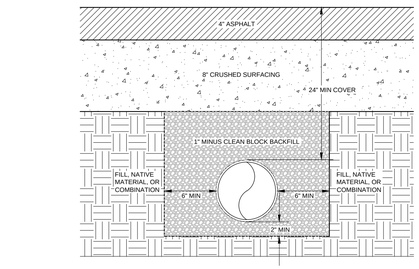
NOT TO SCALE




C | EN-4 | EN-4

## DETAIL C

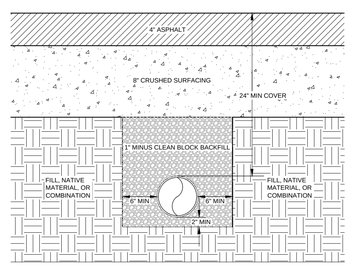
NOT TO SCALE




3 | EN-4 | EN-3

## TYPICAL 8" MAIN PIPE SECTION

NOT TO SCALE




4 | EN-4 | EN-3

## TYPICAL 6" CONNECTOR PIPE SECTION

NOT TO SCALE

| | |
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# DETAILS

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9-23-13

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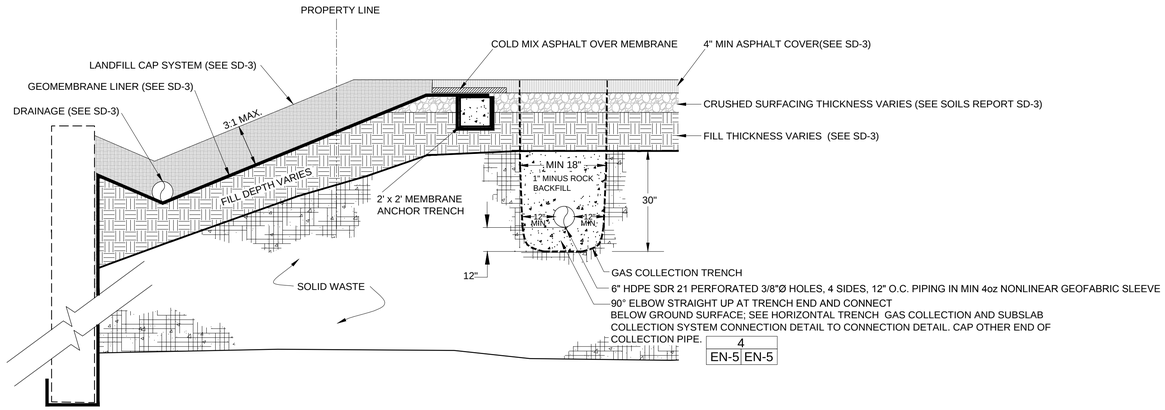
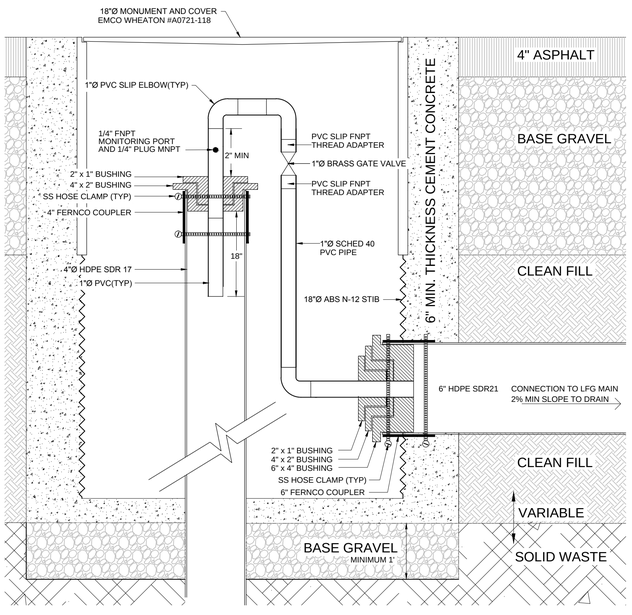
CHECKED: CLYDE MOORE
DATE: 9/18/13
SCALE: AS NOTED
JOB NUMBER: 408–002

EN-4



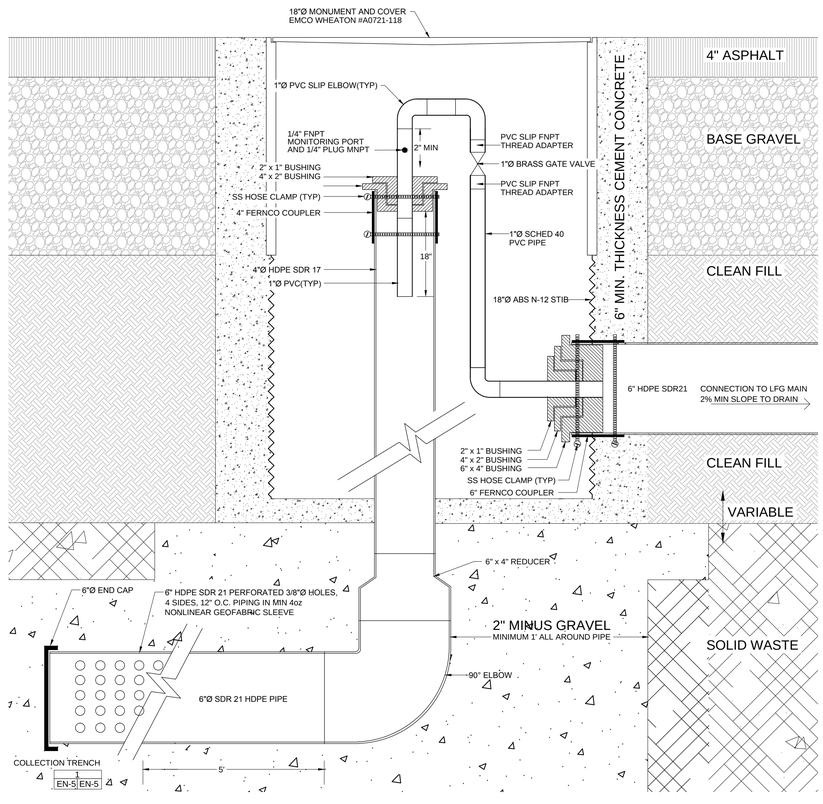

1
EN-5 EN-3 GAS COLLECTION TRENCH DETAIL

NOT TO SCALE



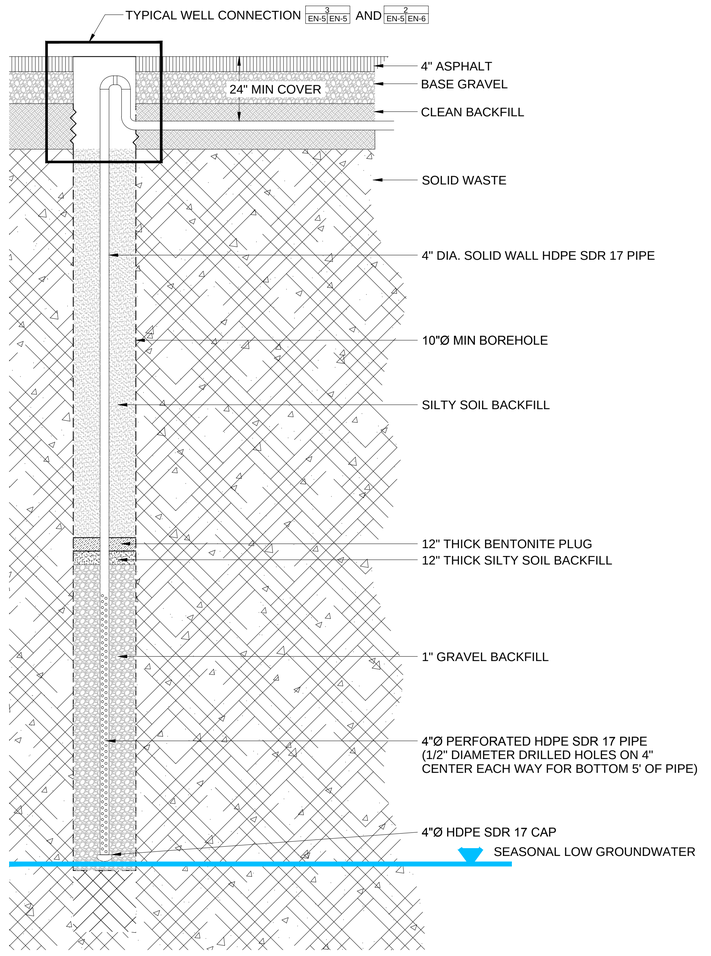

3
EN-5 EN-5 GAS COLLECTION WELL CONNECTION DETAIL FOR CONNECTOR SLOPES AWAY FROM WELL

NOT TO SCALE




4
EN-5 EN-3 GAS COLLECTION TRENCH AND CONNECTION PIPE DETAIL FOR CONNECTOR SLOPES AWAY FROM TRENCH

NOT TO SCALE




2
EN-5 EN-3 GAS COLLECTION WELL DETAIL

NOT TO SCALE

**REFER TO WELL SCHEDULE IN EN-7 FOR WELL COMPLETION DETAILS**

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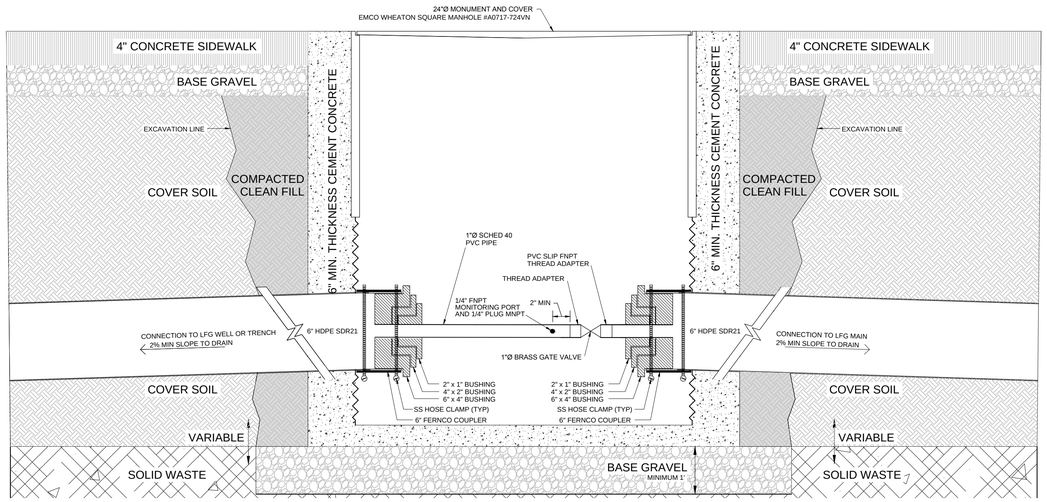
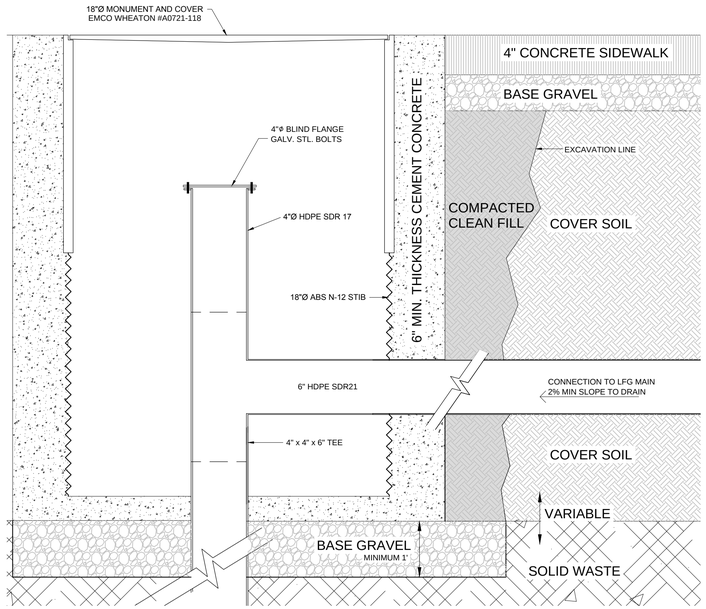
EN-5



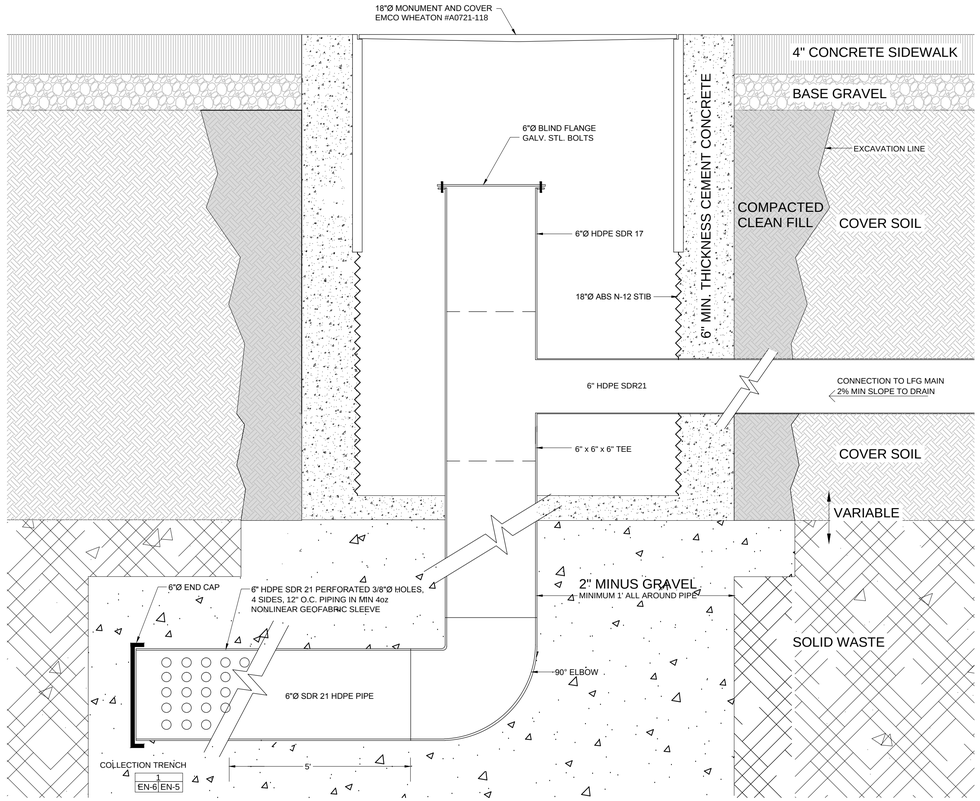

1 | EN-6 EN-3 — TOP OF SLOPE WELL / TRENCH CONNECTOR MONITORING / CONTROL ASSEMBLY

NOT TO SCALE




2 | EN-6 EN-3 — GAS COLLECTION WELL CONNECTION DETAIL FOR CONNECTOR SLOPES TO WELL

NOT TO SCALE




3 | EN-6 EN-3 — GAS COLLECTION TRENCH AND CONNECTION PIPE DETAIL FOR CONNECTOR SLOPES TO TRENCH

NOT TO SCALE

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AS NOTED
JOB NUMBER
408-002

EN-6

| Well No. | Approximate Elevation (feet) | | Approximate Groundwater Depth (feet) | Approximate Waste Depth (feet) | Estimated Well Bore Depth (feet) | Pipe Length (feet) | | Thickness of Gravel (feet) | Depth to Gravel (feet) | Accumulated Bore Depth (feet) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Surface Elevation | Groundwater Elevation | | | | Perf | Solid Wall | | | |
| 1 | 22.6 | 8.5 | 16.1 | 7.0 | 8.0 | 4.0 | 3.0 | 5.0 | 3.0 | 8.0 |
| 2 | 21.6 | 8.2 | 15.4 | 10.0 | 11.0 | 5.5 | 4.5 | 6.5 | 4.5 | 19.0 |
| 3 | 22.5 | 8.2 | 16.3 | 12.5 | 13.5 | 6.8 | 5.8 | 7.8 | 5.8 | 32.5 |
| 4 | 24.6 | 8.8 | 17.8 | 9.0 | 10.0 | 5.0 | 4.0 | 6.0 | 4.0 | 42.5 |
| 5 | 24.6 | 8.5 | 18.1 | 12.0 | 13.0 | 6.5 | 5.5 | 7.5 | 5.5 | 55.5 |
| 6 | 24.5 | 8.3 | 18.2 | 15.0 | 16.0 | 8.0 | 7.0 | 9.0 | 7.0 | 71.5 |
| 7 | 24.3 | 9.3 | 17.0 | 5.5 | 6.5 | 3.3 | 2.3 | 4.3 | 2.3 | 78.0 |
| 8 | 25.1 | 9.1 | 18.0 | 11.5 | 12.5 | 6.3 | 5.3 | 7.3 | 5.3 | 90.5 |
| 9 | 25.4 | 8.8 | 18.6 | 16.5 | 17.5 | 8.8 | 7.8 | 9.8 | 7.8 | 108.0 |
| 10 | 25.4 | 8.5 | 18.9 | 19.0 | 20.0 | 10.0 | 9.0 | 11.0 | 9.0 | 128.0 |
| 11 | 25.2 | 9.6 | 17.6 | 8.5 | 9.5 | 4.8 | 3.8 | 5.8 | 3.8 | 137.5 |
| 12 | 25.8 | 8.9 | 18.9 | 19.0 | 20.0 | 10.0 | 9.0 | 11.0 | 9.0 | 157.5 |
| 13 | 25.0 | 9.5 | 17.5 | 6.0 | 7.0 | 3.5 | 2.5 | 4.5 | 2.5 | 164.5 |
| 14 | 26.1 | 9.3 | 18.8 | 12.5 | 13.5 | 6.8 | 5.8 | 7.8 | 5.8 | 178.0 |
| 15 | 26.5 | 8.8 | 19.7 | 19.0 | 20.0 | 10.0 | 9.0 | 11.0 | 9.0 | 198.0 |
| 16 | 27.5 | 8.4 | 21.1 | 17.5 | 18.5 | 9.3 | 8.3 | 10.3 | 8.3 | 216.5 |
| 17 | 27.0 | 8.1 | 20.9 | 17.0 | 18.0 | 9.0 | 8.0 | 10.0 | 8.0 | 234.5 |
| 18 | 22.5 | 7.7 | 16.8 | 15.5 | 16.5 | 8.3 | 7.3 | 9.3 | 7.3 | 251.0 |
| 19 | 19.5 | 7.5 | 14.0 | 14.5 | 15.5 | 7.8 | 6.8 | 8.8 | 6.8 | 266.5 |
| 20 | 24.4 | 7.1 | 19.3 | 14.2 | 15.2 | 7.6 | 6.6 | 8.6 | 6.6 | 281.7 |
| 21 | 22.0 | 6.8 | 17.2 | 10.0 | 11.0 | 5.5 | 4.5 | 6.5 | 4.5 | 292.7 |
| 22 | 19.0 | 6.7 | 14.3 | 13.0 | 14.0 | 7.0 | 6.0 | 8.0 | 6.0 | 306.7 |
| 23 | 27.1 | 8.8 | 20.3 | 15.5 | 16.5 | 8.3 | 7.3 | 9.3 | 7.3 | 323.2 |
| 24 | 27.8 | 8.5 | 21.3 | 16.7 | 17.7 | 8.9 | 7.9 | 9.9 | 7.9 | 340.9 |
| 25 | 28.4 | 8.2 | 22.2 | 15.7 | 16.7 | 8.4 | 7.4 | 9.4 | 7.4 | 357.6 |
| 26 | 29.4 | 7.5 | 23.9 | 16.8 | 17.8 | 8.9 | 7.9 | 9.9 | 7.9 | 375.4 |
| 27 | 30.1 | 7.4 | 24.7 | 13.2 | 14.2 | 7.1 | 6.1 | 8.1 | 6.1 | 389.6 |
| 28 | 30.7 | 7.2 | 25.5 | 8.5 | 9.5 | 4.8 | 3.8 | 5.8 | 3.8 | 399.1 |
| 29 | 19.5 | 6.8 | 14.7 | 4.0 | 5.0 | 2.5 | 1.5 | 3.5 | 1.5 | 404.1 |
| 30 | 25.1 | 9.4 | 17.7 | 7.8 | 8.8 | 4.4 | 3.4 | 5.4 | 3.4 | 412.9 |
| 31 | 27.5 | 9.1 | 20.4 | 11.5 | 12.5 | 6.3 | 5.3 | 7.3 | 5.3 | 425.4 |
| 32 | 28.8 | 8.8 | 22.0 | 14.3 | 15.3 | 7.7 | 6.7 | 8.7 | 6.7 | 440.7 |
| 33 | 29.3 | 8.7 | 22.6 | 15.2 | 16.2 | 8.1 | 7.1 | 9.1 | 7.1 | 456.9 |
| 34 | 28.8 | 8.0 | 22.8 | 16.5 | 17.5 | 8.8 | 7.8 | 9.8 | 7.8 | 474.4 |
| 35 | 29.5 | 8.0 | 23.5 | 15.4 | 16.4 | 8.2 | 7.2 | 9.2 | 7.2 | 490.8 |
| 36 | 29.5 | 7.6 | 23.9 | 6.7 | 7.7 | 3.9 | 2.9 | 4.9 | 2.9 | 498.5 |
| 37 | 29.2 | 7.5 | 23.7 | 4.0 | 5.0 | 2.5 | 1.5 | 3.5 | 1.5 | 503.5 |
| 38 | 28.3 | 9.3 | 21.0 | 6.0 | 7.0 | 3.5 | 2.5 | 4.5 | 2.5 | 510.5 |
| 39 | 31.2 | 9.2 | 24.0 | 10.3 | 11.3 | 5.7 | 4.7 | 6.7 | 4.7 | 521.8 |
| 40 | 33.0 | 9.0 | 26.0 | 14.3 | 15.3 | 7.7 | 6.7 | 8.7 | 6.7 | 537.1 |
| 41 | 32.5 | 8.6 | 25.9 | 18.0 | 19.0 | 9.5 | 8.5 | 10.5 | 8.5 | 556.1 |
| 42 | 30.3 | 8.0 | 24.3 | 16.0 | 17.0 | 8.5 | 7.5 | 9.5 | 7.5 | 573.1 |
| 43 | 28.1 | 7.6 | 22.5 | 7.6 | 8.6 | 4.3 | 3.3 | 5.3 | 3.3 | 581.7 |
| 44 | 28.5 | 11.0 | 19.5 | 3.0 | 4.0 | 2.0 | 1.0 | 3.0 | 1.0 | 585.7 |
| 45 | 31.6 | 10.0 | 23.6 | 7.0 | 8.0 | 4.0 | 3.0 | 5.0 | 3.0 | 593.7 |
| 46 | 32.8 | 10.7 | 24.1 | 4.3 | 5.3 | 2.7 | 1.7 | 3.7 | 1.7 | 599.0 |
| 47 | 34.8 | 10.2 | 26.6 | 9.0 | 10.0 | 5.0 | 4.0 | 6.0 | 4.0 | 609.0 |
| 48 | 35.3 | 9.6 | 27.7 | 16.5 | 17.5 | 8.8 | 7.8 | 9.8 | 7.8 | 626.5 |
| 49 | 34.4 | 9.3 | 27.1 | 19.0 | 20.0 | 10.0 | 9.0 | 11.0 | 9.0 | 646.5 |
| 50 | 31.8 | 8.4 | 25.4 | 15.0 | 16.0 | 8.0 | 7.0 | 9.0 | 7.0 | 662.5 |
| 51 | 30.0 | 7.6 | 24.4 | 6.7 | 7.7 | 3.9 | 2.9 | 4.9 | 2.9 | 670.2 |
| 52 | 34.5 | 10.6 | 25.9 | 6.5 | 7.5 | 3.8 | 2.8 | 4.8 | 2.8 | 677.7 |
| 53 | 35.0 | 9.7 | 27.3 | 16.0 | 17.0 | 8.5 | 7.5 | 9.5 | 7.5 | 694.7 |
| 54 | 33.5 | 9.0 | 26.5 | 16.0 | 17.0 | 8.5 | 7.5 | 9.5 | 7.5 | 711.7 |
| 55 | 31.1 | 8.3 | 24.8 | 8.3 | 9.3 | 4.7 | 3.7 | 5.7 | 3.7 | 721.0 |

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SEATTLE, WA

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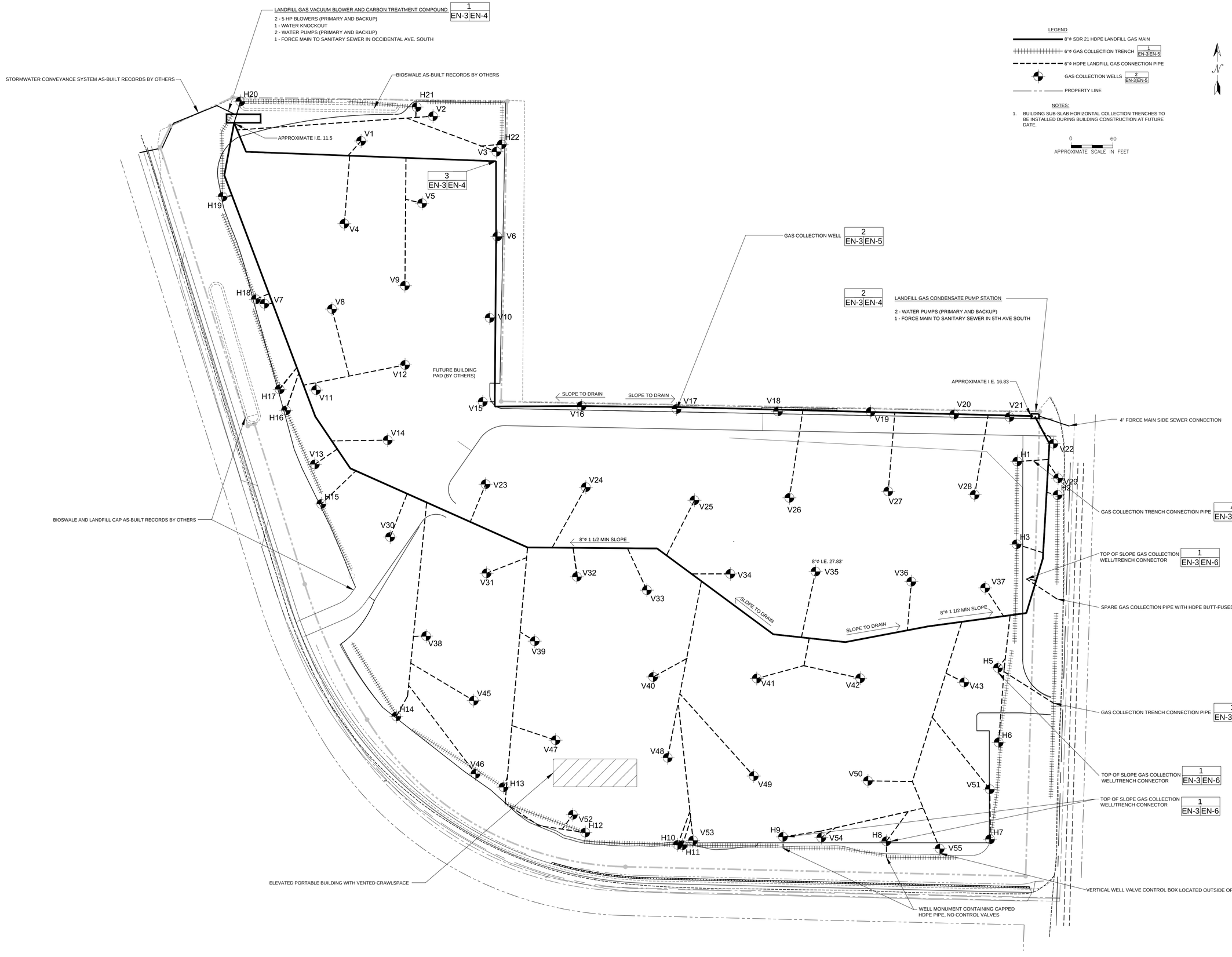
# WELL SCHEDULE

CLYDE N. MOORE
STATE OF WASHINGTON
14087
REGISTERED
PROFESSIONAL ENGINEER
9-23-13

DRAWN
DEW / CM
CHECKED
CLYDE MOORE
DATE
9/18/13
SCALE
AS NOTED
JOB NUMBER
408-002

EN-7

Appendix A:  As-Built Drawings




| | |
|---|---|
| 6/23/15 | AS-BUILT |

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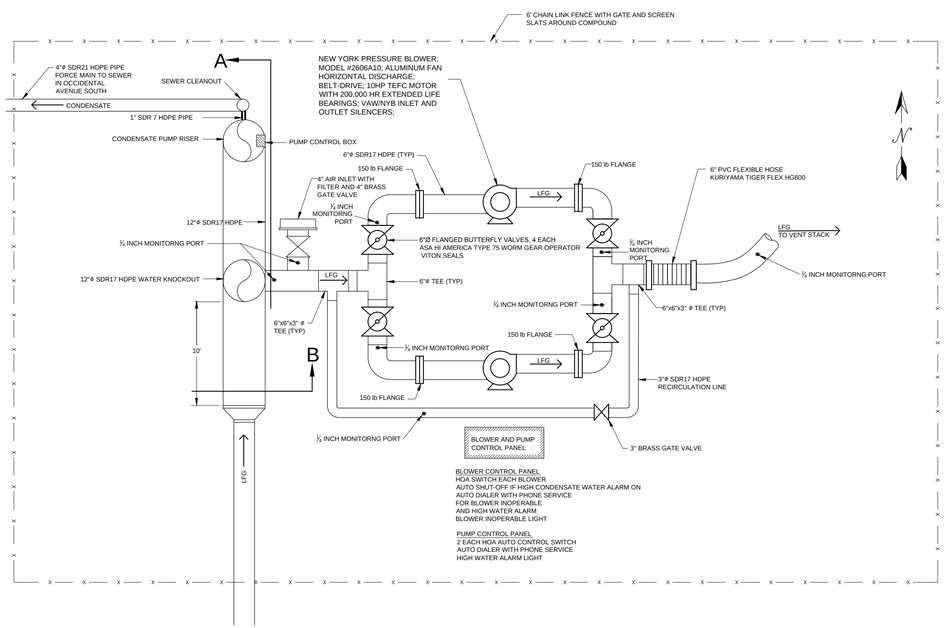
PROPERTY DEVELOPMENT
8249 5TH AVENUE SOUTH
SEATTLE, WA

First Student

# LFG SYSTEM PLAN

| | |
|---|---|
| DRAWN | AEV / DW |
| CHECKED | DAVID E. JOHNSON |
| DATE | 6/23/15 |
| SCALE | AS NOTED |
| JOB NUMBER | 408-002 |

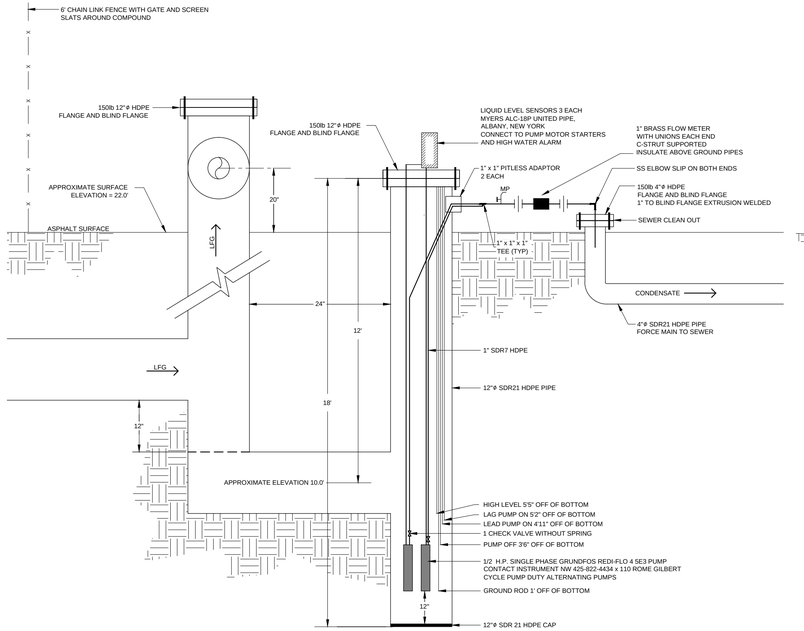
EN-3




1 | EN-4 | EN-3

## LANDFILL GAS VACUUM BLOWER AND CARBON CLEANUP COMPOUND DETAIL

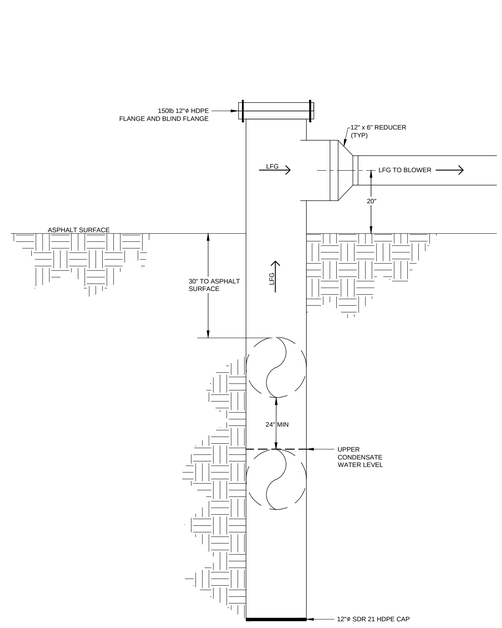
NOT TO SCALE




A | EN-4 | EN-4

## DETAIL A

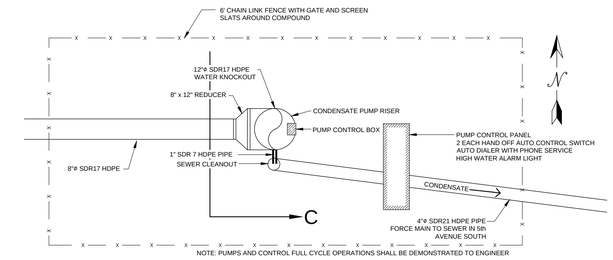
NOT TO SCALE




B | EN-4 | EN-4

## DETAIL B

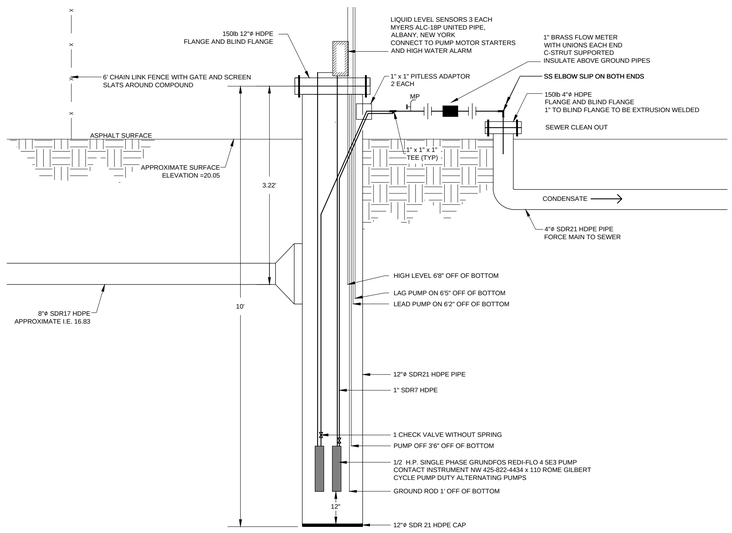
NOT TO SCALE




2 | EN-4 | EN-3

## LANDFILL GAS CONDENSATE PUMP STATION DETAIL

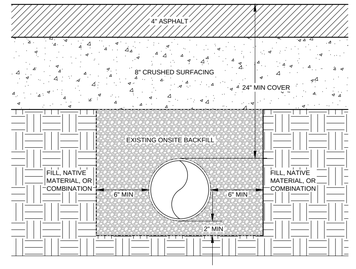
NOT TO SCALE




C | EN-4 | EN-4

## DETAIL C

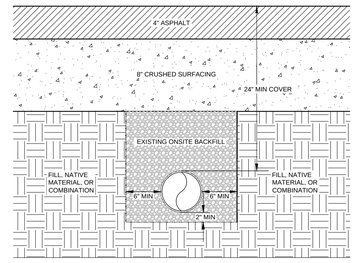
NOT TO SCALE




3 | EN-4 | EN-3

## TYPICAL 8" MAIN PIPE SECTION

NOT TO SCALE




4 | EN-4 | EN-3

## TYPICAL 6" CONNECTOR PIPE SECTION

NOT TO SCALE

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DETAILS

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DATE: 6/23/15
SCALE: AS NOTED
JOB NUMBER: 408-002

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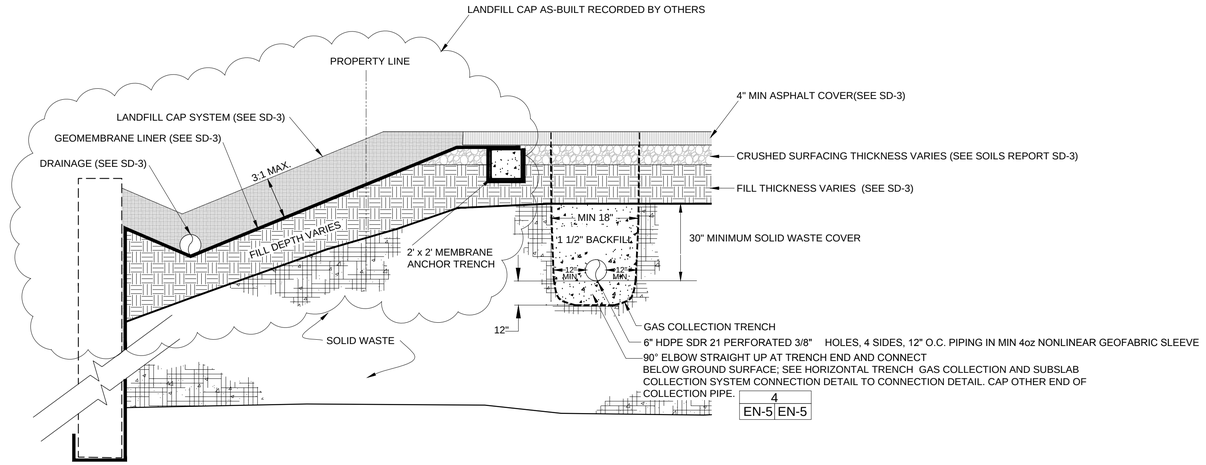
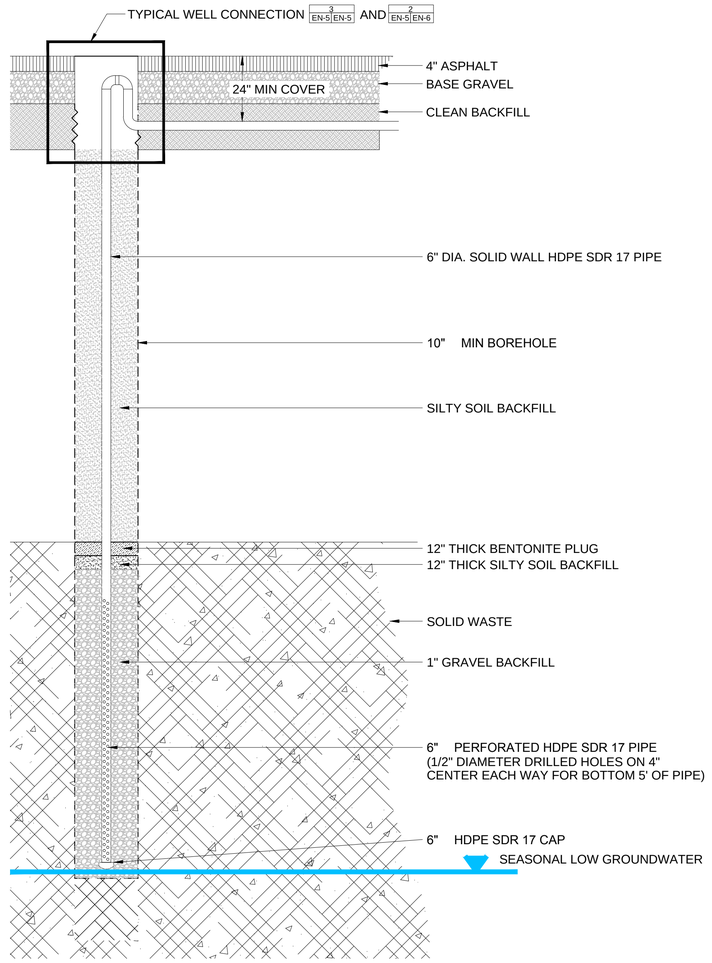
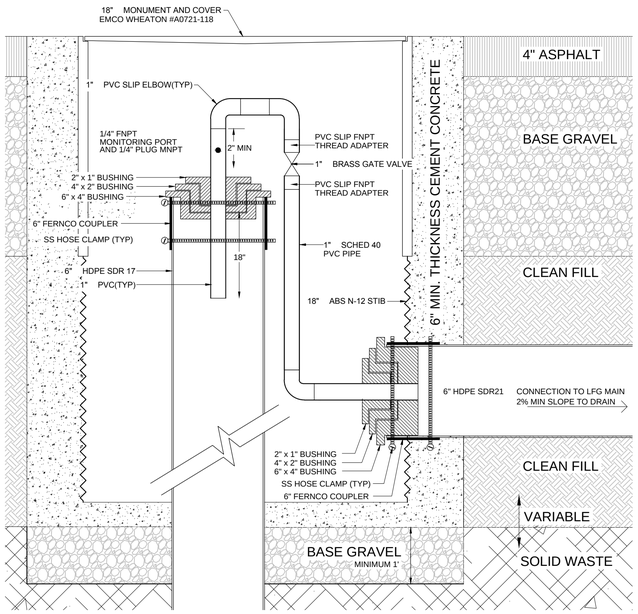



1 GAS COLLECTION TRENCH DETAIL
EN-5 EN-3
NOT TO SCALE

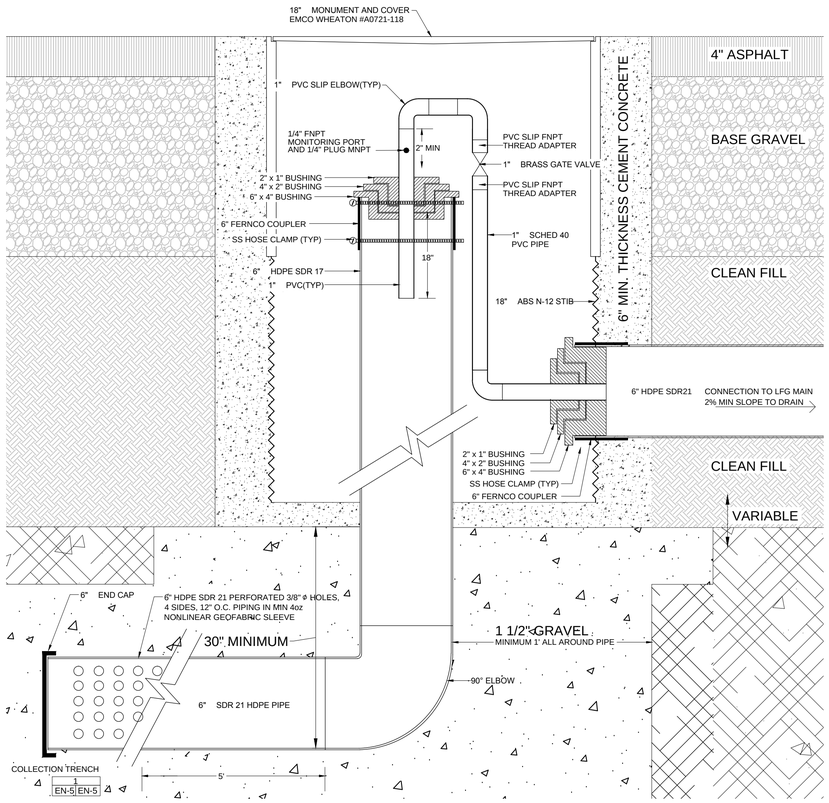



2 GAS COLLECTION WELL DETAIL
EN-5 EN-3
NOT TO SCALE

**REFER TO INTERIM ACTION REPORT TABLE 1 FOR WELL COMPLETION DETAILS**




3 GAS COLLECTION WELL CONNECTION DETAIL FOR CONNECTOR SLOPES AWAY FROM WELL
EN-5 EN-5
NOT TO SCALE




4 GAS COLLECTION TRENCH AND CONNECTION PIPE DETAIL FOR CONNECTOR SLOPES AWAY FROM TRENCH
EN-5 EN-3
NOT TO SCALE

**REFER TO INTERIM ACTION REPORT TABLE 2 FOR TRENCH COMPLETION DETAILS**

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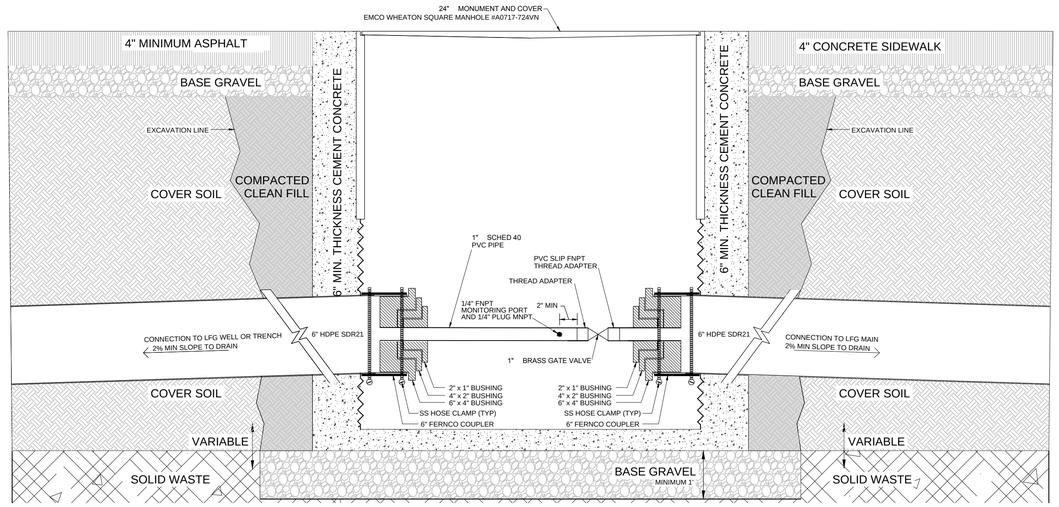
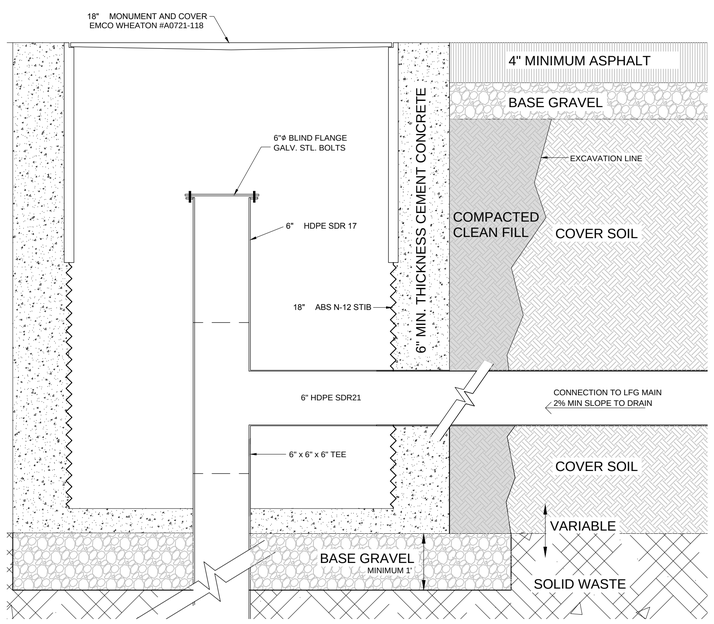
EN-5



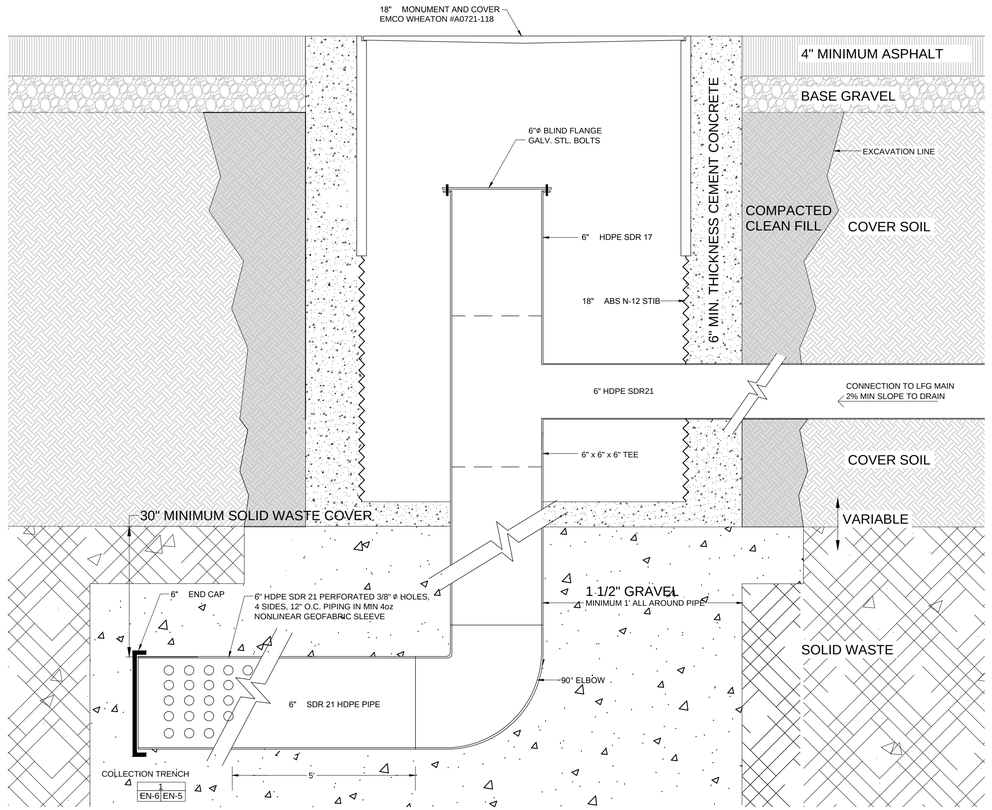

1 / EN-6 EN-3 — TOP OF SLOPE WELL / TRENCH CONNECTOR MONITORING / CONTROL ASSEMBLY

NOT TO SCALE




2 / EN-6 EN-3 — GAS COLLECTION WELL CONNECTION DETAIL FOR CONNECTOR SLOPES TO WELL

NOT TO SCALE




3 / EN-6 EN-3 — GAS COLLECTION TRENCH AND CONNECTION PIPE DETAIL FOR CONNECTOR SLOPES TO TRENCH

NOT TO SCALE

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EN-6