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ENGINEERING DESIGN REPORT
LANDFILL GAS COLLECTION AND CONTROL SYSTEM

SOUTH PARK LANDFILL SITE
SEATTLE, WASHINGTON

Submitted by:
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ABBREVIATIONS AND ACRONYMS

AESI	Associated Earth Sciences, Inc.
Agreed Order	Agreed Order No. 6706 executed by South Park Landfill Site Potentially Liable Persons and the Washington State Department of Ecology
ARARs	applicable or relevant and appropriate requirements
CAP	Cleanup Action Plan
Ecology	Washington State Department of Ecology
Farallon	Farallon Consulting, L.L.C.
HDPE	high-density polyethylene
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
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.
LandGEM	U.S. Environmental Protection Agency LandGEM LFG Emissions Model version 3.02
LED	light-emitting diode
LEL	lower explosive limit
LFG	landfill gas
LFGCCS	landfill gas collection and control system
MCA	monitoring and control assembly
MMSW	mixed municipal solid waste

MTCA	Washington State Model Toxics Control Act Cleanup Regulation
OMMP	Operation, Maintenance, and Monitoring Plan
PLP	potentially liable person
PSCAA	Puget Sound Clean Air Agency
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RI/FS Report	*Draft Final South Park Landfill Remedial Investigation/ Feasibility Study* dated June 2014, prepared by Floyd|Snider
scfm	standard cubic feet per minute
South Park Landfill	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 where mixed municipal solid waste was deposited (and some burned) over approximately 30 years from 1938 to 1968
South Park Landfill Site	the "Site" per the provisions of the Washington State Model Toxics Control Act Cleanup Regulation, as established in Chapter 173-340 of the Washington Administrative Code, is defined as 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)
SSRDS	Seattle South Recycling and Disposal Station
WAC	Washington Administrative Code
w.c.	water column in reference to presure, e.g., 1 inch w.c.

1.0 INTRODUCTION

Farallon Consulting, L.L.C. (Farallon) has prepared this Engineering Design Report on behalf of South Park Property Development, L.L.C. (SPPD), to provide sufficient information to support the design of the SPPD-owned and -operated Interim Action 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). An interim action is 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 LFGCCS was installed between June and December 2014 and start-up commenced on December 17, 2014. The LFGCCS was designed to capture landfill gas (LFG) generated by mixed municipal solid waste (MMSW) disposed of during the period of approximately 1938 through the 1950s at an approximately 19.4-acre parcel within the South Park Landfill that SPPD purchased from King County in 2006 (King County tax parcel number 3224049005) (SPPD Property). The detailed design drawings of the LFGCCS are provided in Appendix A.

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. Figure 2 shows 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 (RI). Figure 2 also shows the land parcels encompassed by the South Park Landfill, including the SPPD Property.

This Engineering Design Report has been prepared to meet the requirements of MTCA and specifically WAC 173-340-400[4][a]. This Engineering Design Report pertains to the LFG control component of the Interim Action, and documents the engineering concepts and design primary goal, objectives, and considerations used for development of construction plans and specifications for the LFGCCS issued for construction in July 2014 (Appendix A). The LFGCCS has been constructed concurrently 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. The LFGCCS is designed so as to not preclude other remedies that may be applied in the future on other land parcels composing the South Park Landfill.

2.0 ORGANIZATION

The Engineering Design Report has been organized into the following sections:

- **Section 3—Site Description and Background:** Section 3 provides background information for the South Park Landfill Site, including a Site description, history, and location.
- **Section 4—Operational Goal and Design Objectives:** Section 4 provides a summary of the operational goal and design objectives of the LFGCCS.
- **Section 5—Site-Specific Design Considerations:** Section 5 describes the subsurface conditions pertaining to design of the LFGCCS and the estimated current and future LFG generation rate.
- **Section 6—Design Elements:** Section 6 describes the design elements of the LFGCCS, including LFG collectors, monitoring and control assemblies, connector piping, pipe mains, blowers, condensate sumps, control panels, and emissions management.
- **Section 7—Institutional Controls:** Section 7 describes the institutional controls that will be implemented in the form of an environmental covenant for the Interim Action Area.
- **Section 8—Operation and Monitoring:** Section 8 describes the operation and monitoring requirements following installation and start-up of the LFGCCS
- **Section 9—Schedule:** Section 9 describes the anticipated schedule and duration of the cleanup action.
- **Section 10—References**: Section 10 lists the documents cited in this report.

3.0 SITE DESCRIPTION AND BACKGROUND

This section provides background information for the South Park Landfill Site, including the description, history, and location.

3.1 DESCRIPTION

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. SPPD and the City of Seattle were identified by Ecology as potentially liable persons (PLPs) for the South Park Landfill Site. The Agreed Order requires that the PLPs conduct a remedial investigation/feasibility study (RI/FS) and prepare a draft Cleanup Action Plan (CAP) for the South Park Landfill Site. Although King County also has been identified as a PLP for the South Park Landfill Site, King County is not a signatory to the Agreed Order at this time. The Agreed Order states that the PLPs and King County "intend to mutually amend the [Agreed Order] … to expand the scope of work to include implementation of an Interim Action that meets the requirements of WAC 173-340-430."

3.2 HISTORY

Farallon (2013) prepared the *Interim Action Work Plan, South Park Landfill Site* dated February 22, 2013 (Interim Action Work Plan), which was approved by Ecology, and was attached to the amendment to the Agreed Order. The Interim Action Work Plan provides the rationale, basis for design information, including environmental conditions and applicable or relevant and appropriate requirements (ARARs), and a general summary of the four primary components of the Interim Action, which are:

- LFG control;
- Landfill cap;
- Surface water control; and
- Institutional controls.

While the effectiveness and protectiveness of the LFGCCS is dependent on these four components, this Engineering Design Report addresses only the component related to LFG control which was designed by Farallon engineers. Other components of the Interim Action have been designed by others, per information in the Interim Action Work Plan, as part of the design of the SPPD Property re-development.

The *Draft Final South Park Landfill Remedial Investigation/Feasibility Study* dated June 2014, prepared for the South Park Landfill Site by Floyd|Snider (2014b) (RI/FS Report) was submitted to Ecology on June 27, 2014. The RI/FS was conducted per the *Final Remedial Investigation/Feasibility Study Work Plan, South Park Landfill Site, Seattle, Washington* dated

November 3, 2010, prepared by Farallon (2010). The *Draft Final South Park Landfill Cleanup Action Plan* dated June 2014, prepared for the South Park Landfill Site by Floyd|Snider (2014a) (CAP) was submitted to Ecology on June 27, 2014. The RI/FS Work Plan, the Interim Action Work Plan, the RI/FS Report, and the CAP provide additional details regarding the Site description and background information.

3.3 LOCATION

The Interim Action Area, the area to which the Interim Action applies, 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 MMSW 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 as shown on Figure 2.

4.0 OPERATIONAL GOAL AND DESIGN OBJECTIVES

This section provides a summary of the operational goal and design objectives of the LFGCCS.

4.1 OPERATIONAL GOAL

The operational goal of the LFGCCS is to protect human health and the environment by preventing:

- LFG migration off the SPPD Property resulting in methane exceeding 5 percent by volume the lower explosive limit for methane (LEL);
- LFG in buildings on the SPPD Property exceeding 1.25 percent by volume, or 25 percent of the LEL;
- LFG in buildings off the SPPD Property exceeding 100 parts per million volume (0.01 percent by volume and 0.2 percent of the LEL); and
- LFG surface emissions that would create an explosion, fire hazard, or odors.

4.2 DESIGN OBJECTIVES

Design objectives for the LFGCCS include the following:

- LFG extraction blower(s), piping, and collectors will have sufficient capacity to achieve LFG control and capture at the Interim Action Area;
- LFG collectors will be designed to accommodate variable thicknesses and depths to MMSW and variable depths to groundwater;
- The LFGCCS will enable drainage of condensate to sumps so that condensate does not impact operation of the LFGCCS, does not present adverse exposure to operators at the SPPD Property, and enables appropriate disposal;
- If required by the Puget Sound Clean Air Agency (PSCAA), LFG generated within the Interim Action Area may be captured, filtered through pelletized granular activated charcoal to remove regulated hazardous constituents in air emissions, and discharged to the atmosphere;
- The LFGCCS will not limit planned use of the SPPD Property, and can be constructed as part of redevelopment of the SPPD Property and as part of construction of other elements of the Interim Action;
- Construction and operation of the LFGCCS will not preclude other remedies that may be applied at the South Park Landfill Site per the CAP;

- The LFGCCS is designed as an active system and may be operated in concert with other LFG control systems to be installed in the future on other properties composing the South Park Landfill Site per the CAP;
- Construction and operation of the LFGCCS comply with ARARs and permitting requirements identified in the Interim Action Work Plan; and
- The LFGCCS will be designed to function with a landfill cap system to enhance the influence of the LFGCCS, to limit surface emissions, and to limit the infiltration of rainfall and stormwater.

5.0 SITE-SPECIFIC DESIGN CONSIDERATIONS

This section describes the subsurface conditions pertaining to design of the LFGCCS and the estimated current and future LFG generation rate. The LFGCCS was designed based on design objectives outlined in Section 4.2, and considerations specific to the SPPD Property.

5.1 SUBSURFACE CONDITIONS

Subsurface conditions at the South Park Landfill are documented in previously generated reports. A more-detailed summary of existing subsurface conditions at the SPPD Property is provided in the RI/FS Report.

In general, the thickness of the MMSW ranges from 10 feet or less on the fringe to over 20 feet in the central and south-central portion of the South Park Landfill. At the SPPD Property, on average, the bottom of the MMSW was within about 11 feet of the former ground surface prior to recent re-development of the SPPD Property when approximately 5 feet of imported soil was placed upon the former ground surface. The composition and texture of the MMSW encountered during subsurface investigations conducted at the South Park Landfill Site vary widely among locations. Typical MMSW materials that have been observed include ash, plastic, glass, tires, other anthropogenic materials, and organic material. Other materials such as wood, metal, brick, concrete, and other types of construction-related debris also were noted in some locations at the South Park Landfill Site, but are not necessarily related to disposal activities at the South Park Landfill.

The soil cover layer placed on top of the MMSW across most of the SPPD Property portion of the South Park Landfill prior to SPPD Property re-development and initiation of the Interim Action reached up to 4 feet in thickness, but was absent in some areas of the SPPD Property, according to an assessment conducted by Associated Earth Sciences, Inc. (AESI), et al. (1999). In general, the cover material was composed of sand, silty sand, gravel, and silty gravel.

The RI/FS Report describes a coarse-grained water-bearing alluvial channel deposit occurring in the Duwamish Valley which the RI/FS Report refers to as the Shallow Aquifer. Three general water-bearing strata are described in the RI/FS Report for the South Park Landfill Site.

- The shallowest water-bearing stratum at the South Park Landfill is referred to as the Perched Zone. Groundwater in the Perched Zone is under unconfined conditions prevented from moving downward by an underlying silt over-bank flood deposit comprising a laterally-variable low-permeability aquitard. This aquitard is laterally discontinuous in the Duwamish Valley but at the South Park Landfill is continuous except where penetrated during placement of MMSW at the Kenyon Industrial Park property and in areas along the west and east edges of the South Park Landfill.

MMSW at the Interim Action Area was placed above the silt over-bank flood deposits and within the Perched Zone.

- Beneath the Perched Zone is a 20 to 50-foot-thick sequence of Shallow Aquifer sand and silty sand. According to the RI/FS Report, groundwater levels in some areas below the silt over-bank flood deposits are influenced by changes in barometric pressure, indicative of confined aquifer conditions

- Estuarine deposits comprised of silt and fine sand with shell fragments occur beneath the Shallow Aquifer as shallow as approximately sea level along the western edge of the SPPD Property and dip to the northeast toward the center of the Duwamish Valley, where they occur at much greater depths.

The depth to groundwater at the South Park Landfill Site measured prior to the Interim Action varied by location, season, and screened interval, and has been measured from less than approximately 2 to over 15 feet below ground surface (bgs) in wells completed in either the Perched Zone and/or the Shallow Aquifer. The RI/FS Report presents groundwater hydrograph data indicating seasonal fluctuations in groundwater levels of between 0.5 and 2.5 feet in the vicinity of the South Park Landfill.

Regional groundwater flow in the Shallow Aquifer in the central portion of the Duwamish Valley generally moves from the higher elevations of the uplands (recharge area) to the lower elevations of the Duwamish Waterway (discharge area). Groundwater flow in the Shallow Aquifer in the Interim Action Area is generally to the northeast.

According to the RI/FS Report, there is a consistent downward vertical hydraulic gradient in the Perched Zone across the silt over-bank flood deposit aquitard. However, a consistent vertical hydraulic gradient in the Shallow Aquifer is not apparent from water level elevation data and both slight upward and slight downward gradients have been measured.

5.2 LANDFILL GAS GENERATION

LFG is a complex mixture of gases consisting primarily of methane, carbon dioxide, and oxygen. Methane is the primary chemical of concern in LFG at the South Park Landfill because of its flammability and potentially explosive nature. Methane was not detected in structures over the South Park Landfill, but is measurable within the landfill.

LFG has been monitored periodically for approximately 25 years at the Kenyon Industrial Park property, the former City of Seattle South Recycling and Disposal Station (SSRDS), SPPD Property, and at the perimeter of the landfill. Prior to 2006, King County installed 14 gas probes within the South Park Landfill and along its perimeter. Additional gas probes were installed as part of the completion of the RI. LFG monitoring at 22 gas probes, 5 monitoring wells, 2 bar holes, 2 piezometers, and in buildings in the vicinity of the South Park Landfill was completed prior to the Interim Action as part of the RI with results documented in the RI/FS Report.

Prior to the Interim Action, monitoring for LFG indicated that methane levels exceeded the LEL of 5 percent by volume at some of the gas probes at the South Park Landfill Site, and as high as about 85 percent. Prior to the Interim Action, the highest methane concentration was measured in a gas probe at the Kenyon Industrial Park property, outside the South Park Landfill, and north of the Interim Action Area, and may be partially attributable to natural methane sources in addition to the South Park Landfill. The Kenyon Industrial Park property is paved, potentially trapping methane produced by decomposing solid waste at the property. Other areas where LFG monitoring indicated methane levels exceeding the LEL include locations in the central portion of the South Park Landfill on the SPPD Property and at SSRDS, and at locations on both sides of 5th Avenue South, east of the SPPD Property.

The RI/FS Report described five predictable stages in the evolution of municipal waste landfills such as the South Park Landfill. During the early years (i.e., "Stage 1") when the waste is fresh and still contains putrescible components (primarily food wastes and plant debris), methane is produced at a faster rate than a landfill can naturally vent to the atmosphere, and significant LFG pressure builds up within the landfill. This pressure acts to push the LFG out of the landfill into surrounding areas. As the landfill ages, the rate at which methane is produced falls sharply, and pressure buildup reduces. Rather than pressure, diffusion and barometric pumping become primary mechanisms for LFG migration.

The RI/FS Report indicated that ongoing LFG and groundwater monitoring confirms that the South Park Landfill is in late "Stage 4/early Stage 5," depending on location. Per the RI/FS Report, the South Park Landfill is still producing low levels of methane and remains anaerobic, but the rate of gas production is so low that there was no measureable pressure buildup. The recent addition of about 5 feet of silty soil, and the construction of a cap at the SPPD Property may change this potential for pressure buildup.

Farallon estimated the volume of MMSW within the Interim Action Area based on extent and thickness data documented by AESI (2000) and as documented in the South Park LFG Generation Estimate produced using U.S. Environmental Protection Agency LandGEM LFG Emissions Model version 3.02 (LandGEM) (Appendix B). It was estimated that 372,000 cubic yards of MMSW are in place within the Interim Action Area. Use of the LandGEM model requires conversion of the volume of MMSW to tons of MMSW. A conversion factor of 0.55 tons of MMSW per cubic yard of MMSW was selected based on Farallon engineering experience at other landfills with MMSW density at the time of placement, and also due to settlement and consolidation of the MMSW over the years since original MMSW placement. Applying that conversion factor yields 204,600 tons of MMSW within the Interim Action Area. Use of the LandGEM model also requires reducing the decomposable portion of the MMSW for the loss during the years when it was a "burning landfill." A conservative 20 percent "burning landfill" reduction in total decomposable MMSW was applied, yielding 163,700 tons of decomposable MMSW. It is expected that additional LFG will be collected during operation of the LFGCCS due to extracting LFG from the MMSW deposited on the adjacent portion of the SSRDS and the Kenyon Industrial Park property. Adjacent property MMSW was assumed to contribute an additional 15 percent of MMSW, yielding a total of 188,200 tons of MMSW.

Records indicate that MMSW was placed in the South Park Landfill from approximately 1938 and throughout the 1950s. According to the RI/FS Report, burning of MMSW ceased in 1961 and the South Park Landfill was closed in 1966. For the purposes of estimation of LFG generation, the small amount of MMSW deposited prior to 1950 has been considered of small tonnage and of negligible contribution to present and future LFG flow, especially because of its age. A more-conservative approach that used total estimated tons being considered for estimated LFG generation was used for individual year MMSW deposits through the 1950s. The 188,200 tons of MMSW in-place has been time-distributed annually, with a 12 percent annual tonnage increase, yielding 3,198 tons deposited in 1950, increasing to 21,955 tons deposited in 1958. Inputting the tonnage distribution into the LandGEM model yields an estimated annual average LFG generation for LFGCCS collection of 15.3 standard cubic feet per minute (scfm) in 2014, decreasing continuously to 5.6 scfm in 2034. In the LandGEM model, the potential generation capacity (L_o) used was the Clean Air Act Conventional of 170 cubic meters per milligram, and the methane generation rate (k) used was the Clean Air Act Conventional of 0.05 per year. The resulting annual LFG generation estimates are presented in Appendix B.

A design consideration for the LFGCCS is that methane can be released by sources other than MMSW. Naturally occurring organic material that was covered with fill during development in the vicinity of the Interim Action Area can be generating methane gas. Natural gas pipelines in the vicinity of the Interim Action Area can have leaks that release methane gas. Overlapping areas of release may make it difficult to identify all sources of methane.

6.0 DESIGN ELEMENTS

This section provides a description of the design elements of the LFGCCS, including LFG 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.

6.1 LFG COLLECTORS

Vertical LFG collectors will be the primary mode of LFG collection in the medium to deep portions of the landfill where MMSW is up to 20 feet thick and up to 20 feet deep and within what is referred to as the Perched Zone in Section 5.1, Subsurface Conditions, and above the silt over-bank flood deposit aquitard. The vertical collectors were installed with a hollow-stem drill rig, in 10-inch-diameter boreholes. The vertical collectors were extended to the bottom of the MMSW to depths between approximately 5 and 20 feet below the redeveloped SPPD Property ground surface. A 6-inch-diameter high-density polyethylene (HDPE) casing was perforated from the well bottom to a point that is 50 percent of the distance from the ground surface to the water table, and was surrounded with highly permeable rock. The unperforated casing was surrounded by bentonite seals. Based on Farallon engineering experience designing and operating LFGCCSs at other landfills, the vertical collectors are estimated to have as much as a 100-foot radius of influence in the deeper portions of the landfill (MMSW up to 20 feet deep), and a 60-foot radius of influence in the medium to shallow areas. Positions of vertical LFG collectors were selected based on estimated radii of influence; data regarding the extent, depth, and thickness of MMSW within the Interim Action Area; proximity to property lines within the South Park Landfill; and redevelopment plans for the SPPD Property.

Horizontal LFG collectors are used for three conditions where vertical collectors would not be as effective:

- Where the MMSW 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;
- Under new buildings on the SPPD Landfill; and
- Where more laterally continuous LFG control is desired (e.g., along 5^{th} Avenue South).

The horizontal collectors were constructed of 4-inch-diameter perforated HDPE surrounded with highly permeable rock. Some areas of the landfill may require stronger horizontal collector vacuum applications for LFG control. Other areas may produce high LFG flows at slight vacuums in horizontal collectors. Segmented horizontal collector installation allows segment operation adjustments to match the LFG flow characteristics of the particular area served. The horizontal collectors were installed in approximately 150-foot-long segments.

In addition to collecting LFG, it is anticipated that the LFGCCS may collect large volumes of air. There will be significant air short-circuiting through the various landfill cover materials, including the gravel in the landfill cap, and through soil and through the upper layers of MMSW. This air collection may be necessary to establish in-waste vacuums strong enough to collect the generated methane and prevent off-site migration and/or building intrusion. It is anticipated that the total LFG-air mixture collected may be up to 15 times the LFG generation rate alone. The horizontal collectors may be especially prone to collection of large volumes of air. There is no practical method to seal subsurface soil to prevent air short-circuiting, which will be especially prevalent in areas peripheral to the Interim Action Area. As the asphaltic concrete cap ages, settles, and cracks, and if not not properly maintained, air may start to short-circuit through cap systems over time.

6.2 MONITORING AND CONTROL ASSEMBLIES

Each LFG collector has an associated monitoring and control assembly (MCA) housed in an 18-inch-minimum-diameter flush-mounted traffic-rated vault. The MCA includes a 1-inch-diameter polyvinyl chloride pipe with a monitoring port to facilitate measurement of LFG velocity, methane, oxygen, carbon dioxide, 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 MCA is located at the high point in the connector, between the collector and the LFG main.

The 1-inch-diameter pipe and valve have been selected because they will allow monitoring and control of LFG flow and vacuum at flows as low as 0.1 scfm. At the upper anticipated flow of 5.0 scfm per collector, the friction losses through the MCA are expected to be less than 1 inch water column (w.c.). Even if an unexpected flow of 10 scfm was to occur, the friction losses would be less than 3 inches w.c., which is accommodated by the LFGCCS blower vacuum.

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 MCA 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.

An MCA at each collector enables considerable adjustment in applied vacuum and flow. MCAs 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 LFG control systems installed by others on adjacent properties.

6.3 CONNECTOR PIPING

The connector pipes between the collectors and the mains are 6-inch-diameter HDPE. The friction loss in the connector piping is expected to be less than 0.1 inch w.c. Six-inch-diameter piping is the minimum acceptable to provide condensate drainage considering anticipated differential settlement of the MMSW and resulting pipe grade variations. Connector piping design requires minimum 2 percent sloping for condensate to drain to condensate sumps.

6.4 PIPE MAINS

The LFG pipe mains are 8-inch-diameter HDPE. The longest continuous length of LFG main is approximately 1,870 feet, with a calculated total friction loss of 1.03 inches w.c. summed from calculations for three sections:

- Length 1: 500 feet closest to the blower; estimated flow: 260 scfm; calculated friction loss: 0.65 inch w. c.
- Length 2: 900 feet; estimated flow: 130 scfm; calculated friction loss: 0.35 inch w.c.
- Length 3: 470 feet farthest from the blower; estimated flow: 45 scfm; calculated friction loss: 0.03 inch w.c.

Pipe main design requires minimum 2 percent sloping for condensate to drain to condensate sumps.

6.5 BLOWERS

The LFGCCS has two blowers, one running at a time, with the other for backup. The 6-inch-diameter HDPE blower piping array, fittings, and blower intake-discharge reducers will add about 3.6 inch w.c. friction losses to the system. The blower is 10 horsepower and capable of a 45-inch w.c. pressure rise at 270 scfm. The blower vacuum intake likely will operate at 23 to 32 inches w.c., which will supply 13 to 22 inches w.c. available as applied well vacuum, assuming about 10 inches w.c. of piping system friction losses. The blower discharge likely will operate at 7 inches w.c. pressure, which includes about 2 inches w.c. for friction losses, and about 5 inches w.c. back-pressure from a carbon filtration system and vent stack. A New York model 2606A or similar will be capable of the above requirements, with additional capacity for higher flows or applied vacuum if determined necessary during start-up and operation. Performance specifications for New York model 2606A at motor speeds of 3,500 and 3,150 revolutions per minute are provided in Appendix C.

6.6 CONDENSATE SUMPS

Operation of the LFGCCS results in generation of LFG condensate, which is collected in sumps and discharged to the sanitary sewer. LFG condensate is mostly water that develops as a result of cooling in the LFG collection and piping system, but can contain concentrations of constituents occurring in MMSW disposed of at the South Park Landfill. Condensate is captured in one of two condensate sumps, as shown in plan and in detail in Appendix A (drawings EN-3 and EN-4). One condensate sump is located just prior to the LFG blower in the northwestern portion of the SPPD Property; the other is installed at a low elevation area in the LFG pipe main at 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 LFG stream and gravity-drains into the sump collection points. LFG condensate is pumped from the condensate sumps by pumps operated in alternating duplex operation. The LFGCCS design assumes that approximately 20 gallons per day of condensate will be collected and discharged. The exact amount of condensate generated will be highly variable based on operating conditions.

The condensate pumps are operated by a 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. The LFG condensate is pumped through a totalizing meter and eventually discharged to the sanitary sewer per discharge permit requirements.

6.7 CONTROL PANELS

The LFGCCS is operated with a main LFG blower and condensate sump pump control panel located at the main equipment compound in the vicinity of the LFG 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 at the northeastern corner of the SPPD Property proximate to the condensate sump.

The main control panel includes a power disconnect switch that can shut off power to the control panel and operating equipment. The main control panel has hand/off/auto switches for each of the two LFG 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 remote LFG condensate sump control panel at the northeastern corner of the Property includes a power disconnect switch that will shut off power to the panel and associated equipment. The remote LFG condensate control panel includes a hand/off/auto switch for each LFG 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.

6.8 EMISSIONS MANAGEMENT

The LFG-air mixture from the LFGCCS will contain a small percentage of methane, less than the LEL, and will not support combustion. A LFG flare therefore cannot be used 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 PSCAA. The pelletized activated carbon filters will not remove methane from the LFGCCS flow.

If emissions treatment is required, it is anticipated that two 2,000-pound filters will be used in series. The back-pressure is expected to be about 2.5 inches w.c. each at up to 300 scfm, for a total filter back-pressure of about 5 inches w.c.

The LFG emissions will be piped to a 6-inch-diameter polyvinyl chloride vent stack that will extend at least 12 feet into the air. The pipe will be stabilized with wire secured to anchors. The top 1 foot of the vent pipe will have a 45-degree angle to the north, and the pipe tip will be cut vertically to keep rain out of the pipe as the flow velocity diminishes with time. LFG emissions are expected to contain methane significantly less than the LEL and to not be flammable or explosive.

7.0 INSTITUTIONAL CONTROLS

This section describes the institutional controls that will be implemented in the form of an environmental covenant for the Interim Action Area.

Per the Interim Action Work Plan, institutional controls will be implemented in accordance with WAC 173-340-440 to limit or prohibit activities that may diminish the integrity of the Interim Action or potentially result in exposure to hazardous substances at the SPPD Property. These institutional controls will include recording an environmental covenant on the property title restricting the use of groundwater in the Interim Action Area, requiring that the cap be maintained in the future, requiring mitigation measures to prohibit potential exposure to hazardous substances if the cap is damaged in the future, and stipulating procedures in the case that the landfill cap is penetrated either accidentally or as part of a future construction plan.

It is anticipated that institutional controls will include requirements for repair of penetrations of on-site building slabs, the asphaltic concrete cap, and the low-permeability membrane cap, and requirements for repairs to LFGCCS components if a need for repair is identified during future maintenance or construction activity.

8.0 OPERATION AND MONITORING

This section describes the operation and monitoring requirements following installation and start-up of the LFGCCS.

LFGCCS design allowed for phased start-up as sectors of the system were constructed and the landfill cap was installed. However, actual start-up of the LFGCCS occurred full-scale after construction of the LFGCCS and most of the landfill cap was completed. Operation, maintenance, and monitoring procedures to be employed after system start-up and the system has been optimized and balanced will be detailed in an Operation, Maintenance, and Monitoring Plan (OMMP). Key elements of the OMMP for the LFGCCs are summarized below.

Operation of the LFGCCS entails achieving the general operational goals identified in Section 4, Operational Goal and Design Objectives. The Interim Action Work Plan indicated the following supplemental operational objectives for safe operation of the LFGCCS:

- Methane less than 1.25 percent (25 percent of the LEL) in Perimeter Probes[1]. If methane exceeds the LEL, combustion of LFG is a risk, especially in areas having limited air circulation.
- Residual nitrogen[2] in LFG collectors less than 20 percent. If residual nitrogen exceeds 30 percent, combustion of buried solid waste is a risk.

A Landtec Gem 2000 LFG monitoring instrument is used to measure standard monitoring parameters at MCAs during start-up and at the direction of the supervising Engineer, including methane, carbon dioxide, oxygen, barometric pressure, and 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 MCAs at direction of the supervising Engineer include carbon monoxide and a direct reading of flow.

Optimal, safe, and steady-state operation will be achieved by adjusting vacuum flow valving at the blower for control to the whole system, and by adjusting valving at each of the MCAs. Interim Action activities, such as re-grading and placement of cap systems, or construction

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[1] See Figure 2 for perimeter probes to be monitored for the LFGCCS.

[2] Residual nitrogen is calculated from measured concentrations of methane, oxygen, and carbon dioxide as follows:
Concentrations of methane, oxygen, and carbon dioxide are summed.
This sum is subtracted from 100 to obtain an estimate of total percent nitrogen concentration.
The measured oxygen concentration is multiplied by 3.76 to estimate the amount of nitrogen associated with oxygen, and subtracted from the estimated total percent nitrogen concentration.
The resulting percent concentration is considered "residual nitrogen." Increasing flow in a collection well/lateral will result in a reduction of methane levels, although residual nitrogen will increase. Experience has shown that 20 percent residual nitrogen is a safe stable LFG control system operational parameter that will not start fires in buried solid waste. If necessary to control migrating methane in a Perimeter Probe, residual nitrogen up to 30 percent can be managed with more-frequent monitoring.

activities on adjacent properties, including operation of other LFG-control systems, likely will have some effect on subsurface methane concentrations at the SPPD Property. Monitoring at MCAs and the landfill perimeter probes will be performed to check for changes in methane concentrations and consideration of mitigation action by the supervising Engineer. If perimeter probe methane concentrations rise, adjacent LFG collector flows may be increased to attempt to reduce the concentration of methane in those perimeter probes to less than the 25 percent of the LEL operational objective while also monitoring for residual nitrogen. Effectiveness of the LFGCCS at reducing methane levels in perimeter probes off the SPPD Property will be evaluated as part of start-up testing.

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

Operation of the LFGCCS will result in condensate being collected and discharged to the sanitary sewer, necessitating a King County Industrial Waste Discharge Authorization. Condensate discharge will be tested as required for the discharge authorization, and volumes will be measured and recorded.

It is anticipated that a notice of construction permit from PSCAA may be required for the LFGCCS discharge, which will be monitored as required by PSCAA. If volatile organic compounds in system emissions are found to exceed limits set by PSCAA, emissions will be treated using a granular activated carbon filtration system. These filtration systems require periodic monitoring for breakthrough and to inform the system operator when the filtration system requires servicing.

Periodic inspections and maintenance of the condensate pumps and LFG blowers will be made in accordance with manufacturer instructions. Periodic inspections and maintenance of the asphalt concrete pavement and membrane cap to assess and maintain integrity also will be conducted, as breaches in the cap system have the potential to affect LFGCCS operations.

9.0 SCHEDULE

This section describes the anticipated schedule and duration of the cleanup action.

Grading work pertaining to re-development of the SPPD Property began in 2012. Construction of the cap, stormwater, and LFGCCS components of the Interim Action commenced in June 2014. Construction of the cap and stormwater system components of the Interim Action was completed in April 2015. Start-up of the LFGCCS began in December 2014, with optimal and balanced steady-state operation anticipated later in 2015.

Operation and monitoring of the LFGCCS is expected to occur for the indefinite future in accordance with a schedule described in the OMMP. At some point, monitoring likely will indicate a reduction in methane production, and that methane migration off the SPPD Property portion of the South Park Landfill is no longer a risk. Reduced operation will be considered at that time.

10.0 REFERENCES

Associated Earth Sciences, Inc. (AESI) et al. 1999. *South Park Custodial Landfill Cover Soils Investigation.* Prepared for King County Solid Waste Division, King County Department of Natural Resources. March 22.

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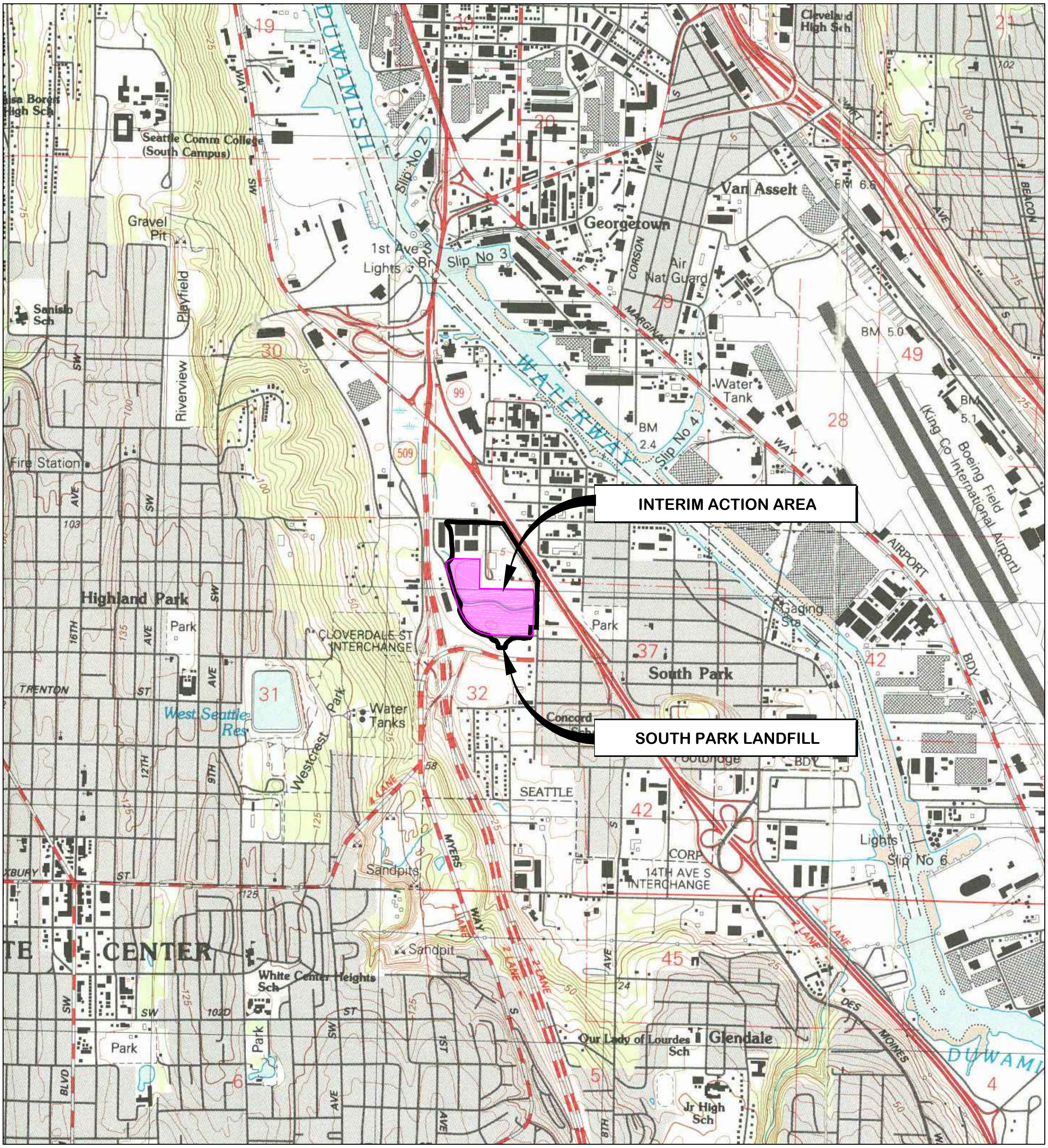
———. 2014b. *Draft Final South Park Landfill Remedial Investigation/Feasibility Study.* June.

FIGURES

ENGINEERING DESIGN REPORT
LANDFILL GAS COLLECTION AND CONTROL SYSTEM
South Park Landfill Site
Seattle, Washington

Farallon PN: 408-002



REFERENCE: 7.5 MINUTE USGS QUADRANGLE SEATTLE SOUTH, WASHINGTON. DATED 1953 AND PHOTOREVISED 1981

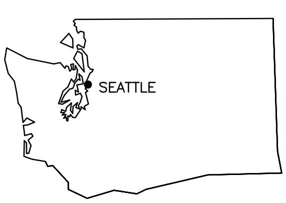


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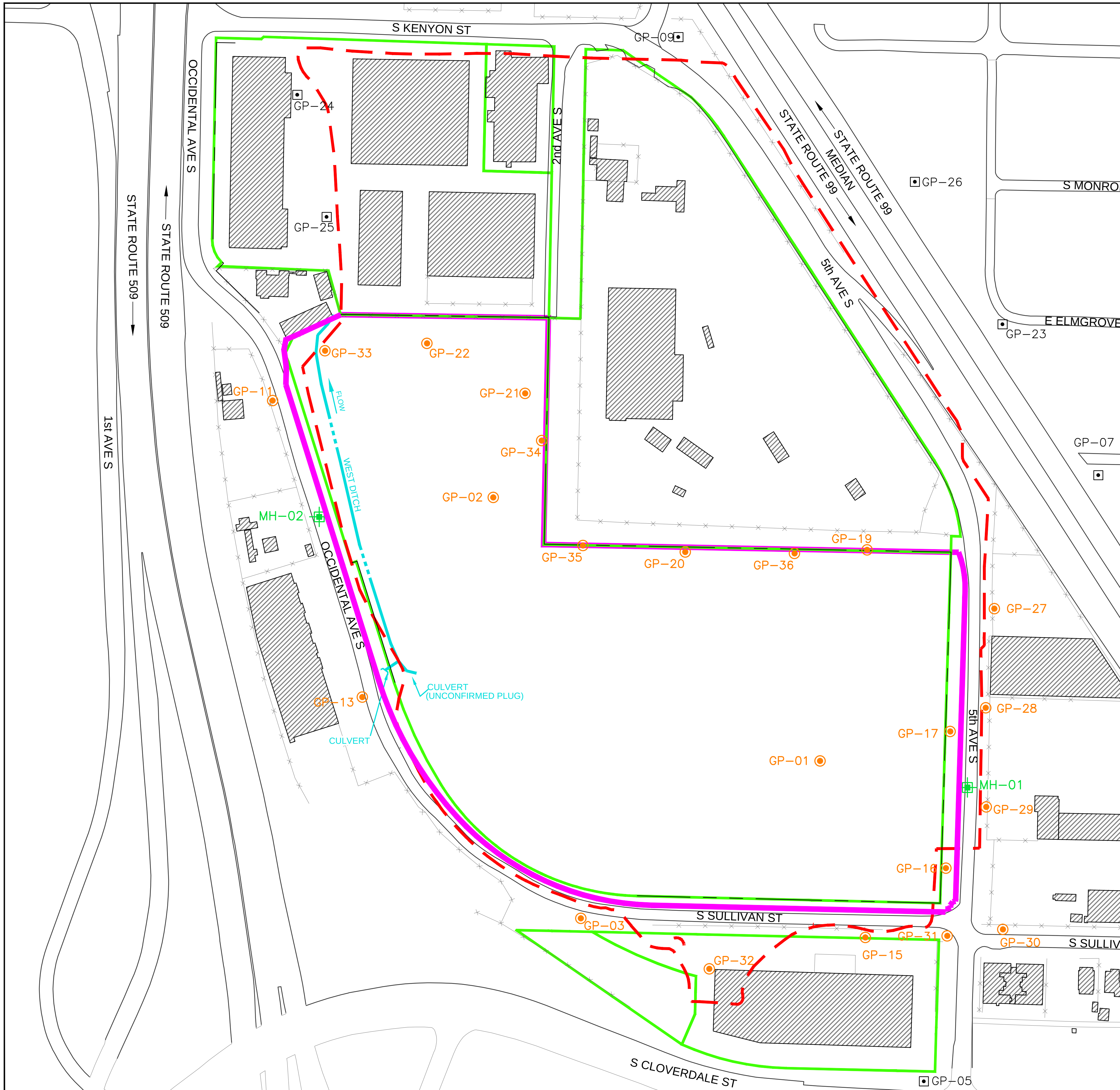
FIGURE 1

VICINITY MAP
SOUTH PARK LANDFILL SITE
SEATTLE, WASHINGTON

FARALLON PN: 408-002

Drawn By: DEW | Checked By: TC | Date: 3/6/2015 | Disk Reference: BASEMAPb



LEGEND

- SOUTH PARK LANDFILL BOUNDARY
- KING COUNTY TAX PARCEL BOUNDARY
- INTERIM ACTION AREA
- FENCE
- DITCH OR CHANNEL
- EXISTING BUILDING
- LANDFILL GAS PROBE MONITORING LOCATIONS
- GAS PROBE LOCATIONS NOT INCLUDED IN THE INTERIM ACTION COMPLIANCE MONITORING PROGRAM
- SEWER MANHOLE MONITORING LOCATIONS

NOTES:

1. FIGURE INCLUDES INFORMATION PRESENTED IN COLOR. PHOTOCOPIES MAY NOT DEPICT ALL INTENDED INFORMATION ON THE ORIGINAL DRAWING.
2. GROUNDWATER MONITORING WILL BE PREFORMED BY POTENTIALLY LIABLE PERSONS FOR SOUTH PARK LANDFILL SITE AS PART OF INTERIM SITE-WIDE GROUNDWATER MONITORING PROGRAM
3. ALL LOCATIONS ARE APPROXIMATE

N

0 300
APPROXIMATE SCALE IN FEET

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FIGURE 2

INTERIM ACTION COMPLIANCE MONITORING LOCATIONS
INTERIM ACTION AREA
SOUTH PARK LANDFILL SITE
SEATTLE, WASHINGTON

FARALLON PN: 408-002

Drawn By: DEW | Checked By: CS | Date: 3/6/2015 | Disk Reference: BASEMAPb

APPENDIX A
ENGINEERING DESIGN DRAWINGS

ENGINEERING DESIGN REPORT
LANDFILL GAS COLLECTION AND CONTROL SYSTEM
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

PIPING, ELECTRICAL AND EQUIPMENT SYMBOLS

GATE VALVE
GLOBE VALVE
BALL VALVE
BUTTERFLY VALVE
CHECK VALVE
DIAPHRAGM OPERATED VALVE
SOLENOID VALVE
MOTOR OPERATED VALVE
PRESSURE REGULATING VALVE
DRAIN
WELD CAP
SCREWED CAP
SCREWED PLUG
FLANGE
BLIND FLANGE
REDUCER/INCREASER
DIRECTION OF FLOW
UNION
FLEXIBLE PIPE COUPLING
BLOWER OR FAN
CENTRIFUGAL PUMP
PITOT TUBE
STRAINER
TRAP
AF FILTER
DIAMETER

FEMALE ADAPTER
S SILENCER
NEEDLE VALVE
FLOW METER
HOSE BIB
SAMPLE TAP/MONITORING PORT
HEAT EXCHANGER
PRESSURE RELIEF OR AIR RELIEF
VACUUM RELIEF
NO NORMALLY OPEN
NC NORMALLY CLOSED
MAGNETIC STARTER
DUPLEX RECEPTACLE, 15A; WP-WEATHER PROOF
ETM ELAPSED TIME METER
FUSE
FUSED DISCONNECT
CAMLOCK CONNECTION
VERTICAL PIPERUN

GROUND
GROUND ROD (3/4" COPPER WELD)
HEATER STRIP
J JUNCTION BOX, PB-PULLBOX
KWH KILOWATT HOUR METER
M MOTOR
MOTOR OVERLOAD
NON-FUSABLE DISCONNECT SWITCH
PILOT LIGHT, R=RED, W=WHITE, G=GREEN
SELECTOR SWITCH AO=AUTO OFF, HOA=HAND OFF AUTO
SWITCH, 120-277V, 2-2POLE, 20A
T THERMOSTAT
TD TIME DELAY RELAY, CR=CONTROL RELAY
TRANSFORMER
UNDERGROUND PULLBOX
W.P. WEATHER PROTECTED
120/208V PANEL
277/480V PANEL
*HIGH LIGHT STANDARD
X REVISION TO PLANS

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

CURRENT SHEET — 1 — EN-3 EN-6 — DETAIL NUMBER — REFERENCED SHEET

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.

9/18/13 ISSUED FOR CONSTRUCTION

FARALLON CONSULTING
975 5th Avenue Northwest
Issaquah, WA 98027

SOUTH PARK DEVELOPMENT
PROPERTY DEVELOPMENT
8249 5TH AVENUE SOUTH
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

9/18/13 ISSUED FOR CONSTRUCTION

SOUTH PARK DEVELOPMENT
PROPERTY DEVELOPMENT
8249 5TH AVENUE SOUTH
SEATTLE, WA

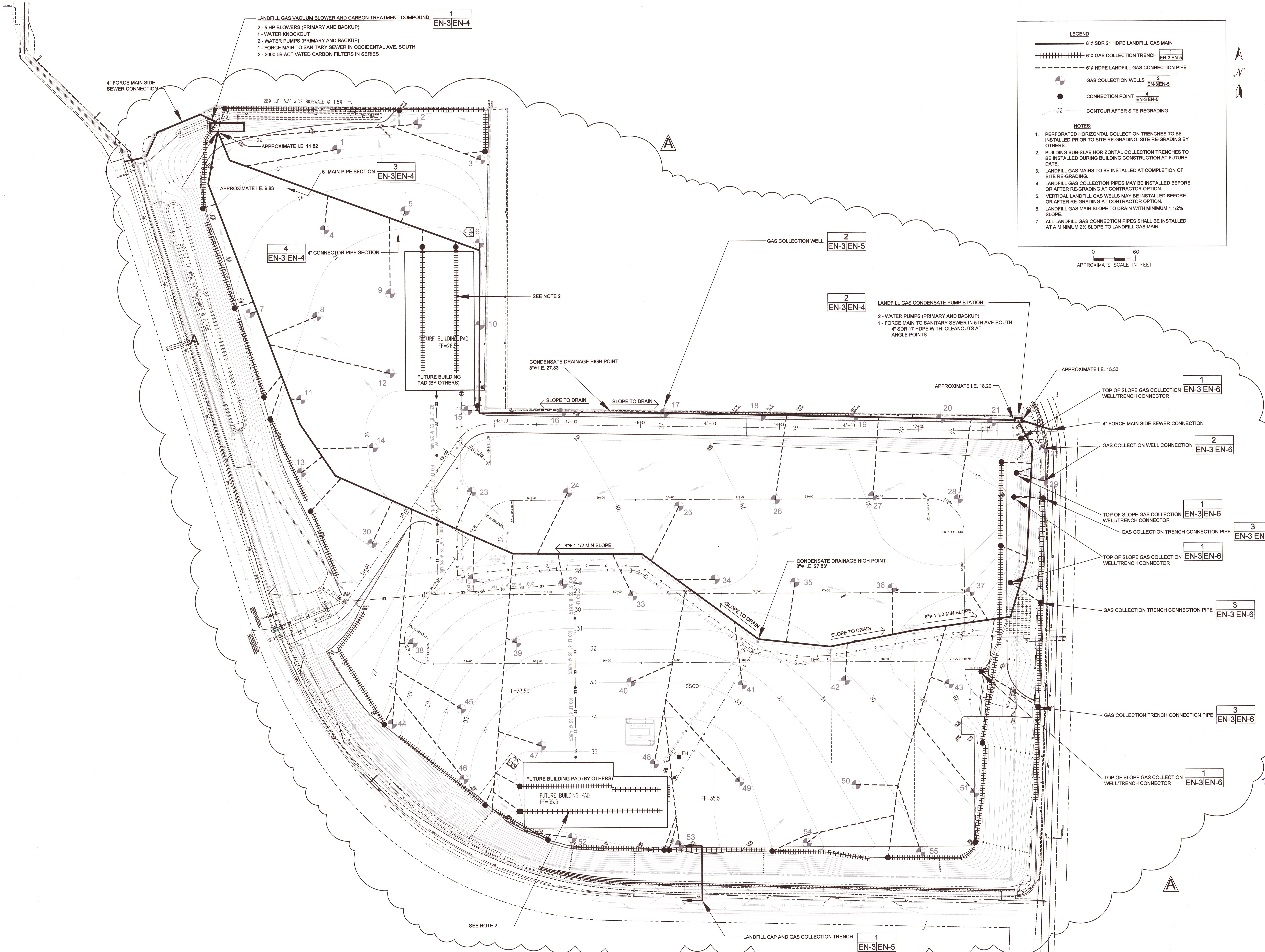
First Student

CAP SITE PLAN

CLYDE N. MOORE
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



LEGEND

- 8"ø SDR 21 HDPE LANDFILL GAS MAIN
- 6"ø GAS COLLECTION TRENCH (1, EN-3 EN-5)
- 6"ø 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

7/23/14 REVISION A -- ISSUED FOR CONSTRUCTION

SOUTH PARK DEVELOPMENT
PROPERTY DEVELOPMENT
8249 5TH AVENUE SOUTH
SEATTLE, WA

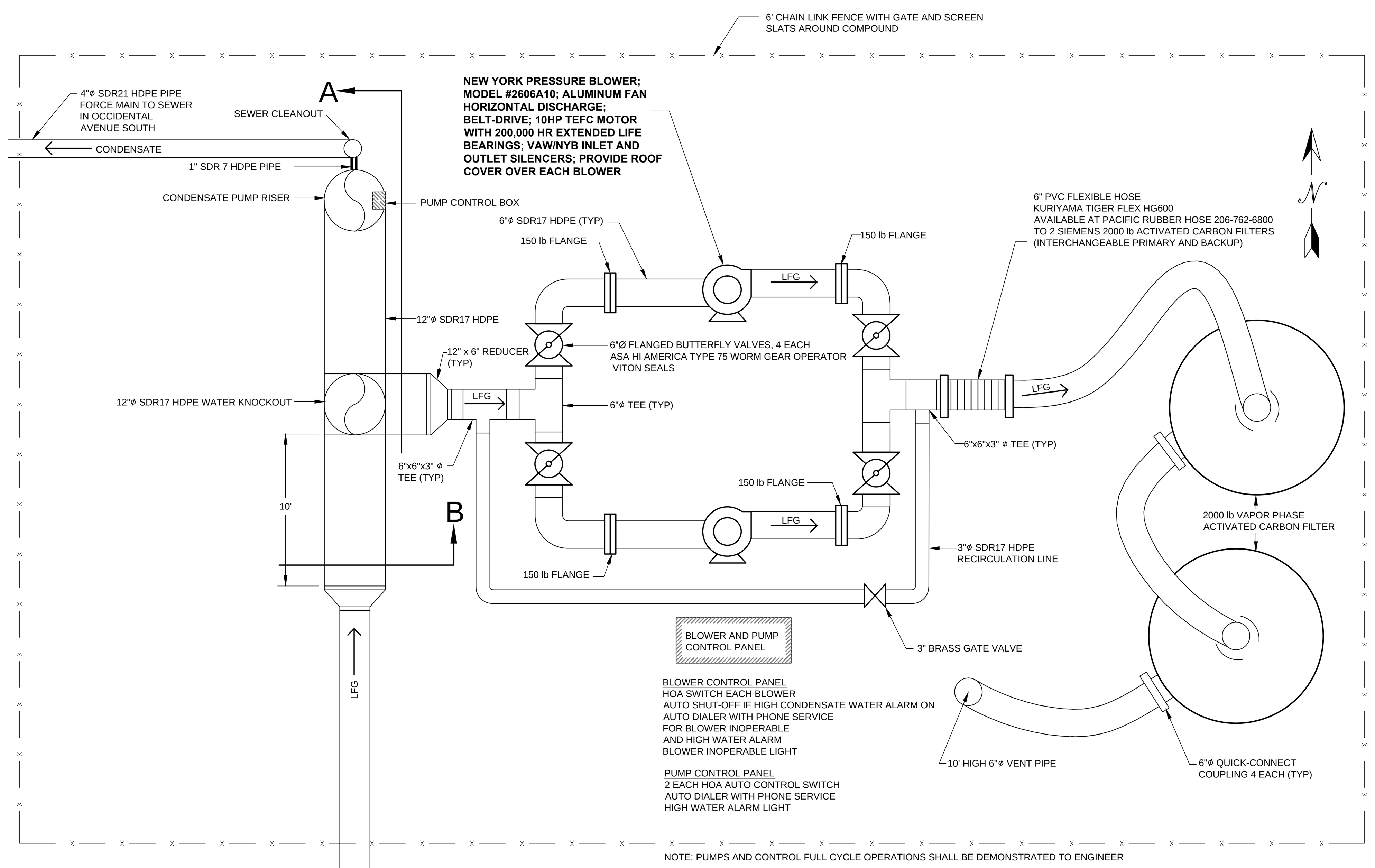
First Student

LFG SYSTEM PLAN

CLYDE N. MOORE, STATE OF WASHINGTON, 14007, REGISTERED PROFESSIONAL ENGINEER
Clyde Moore 7-23-14

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

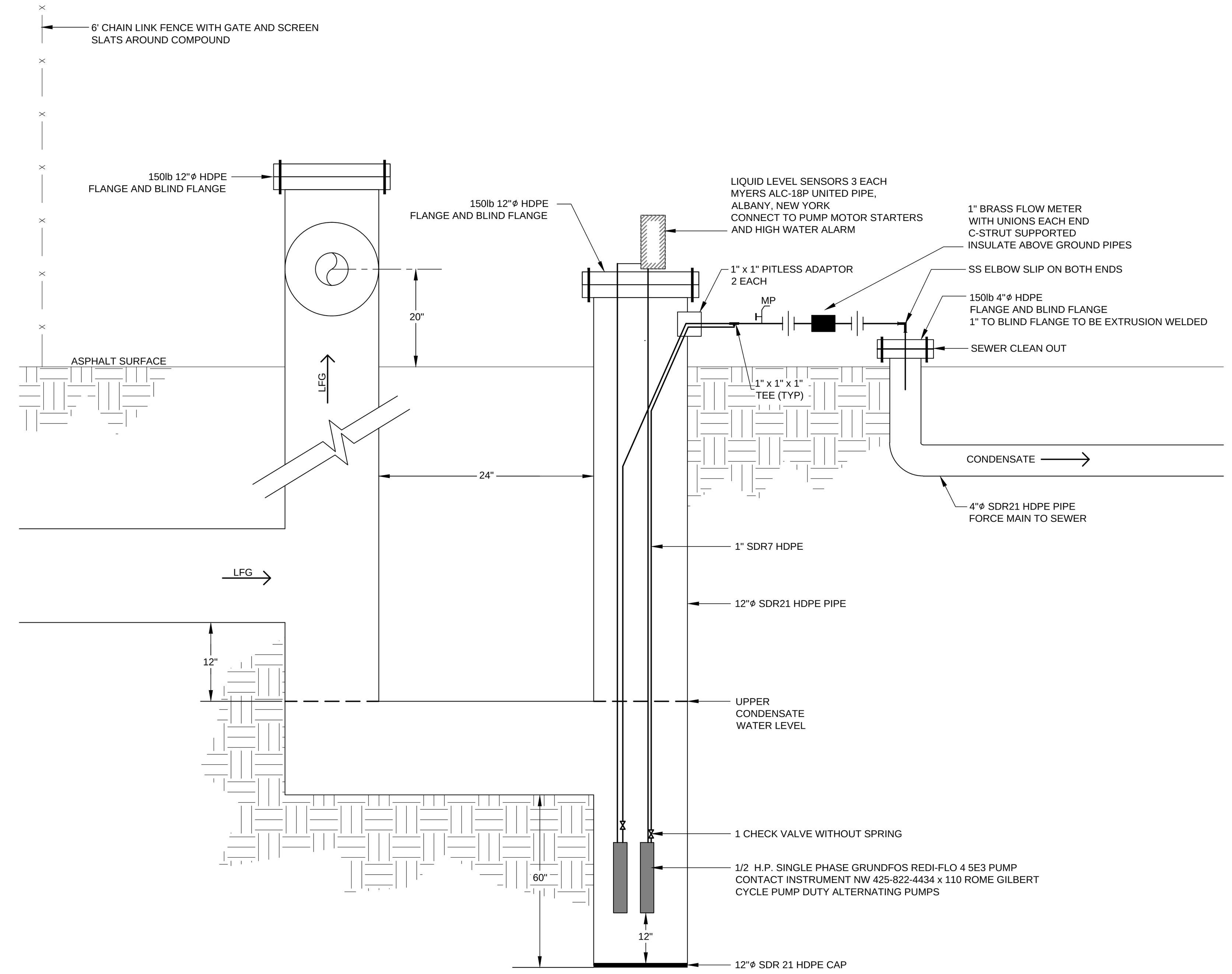
EN-3



1	
EN-4	EN-3

LANDFILL GAS VACUUM BLOWER AND CARBON CLEANUP COMPOUND DETAIL

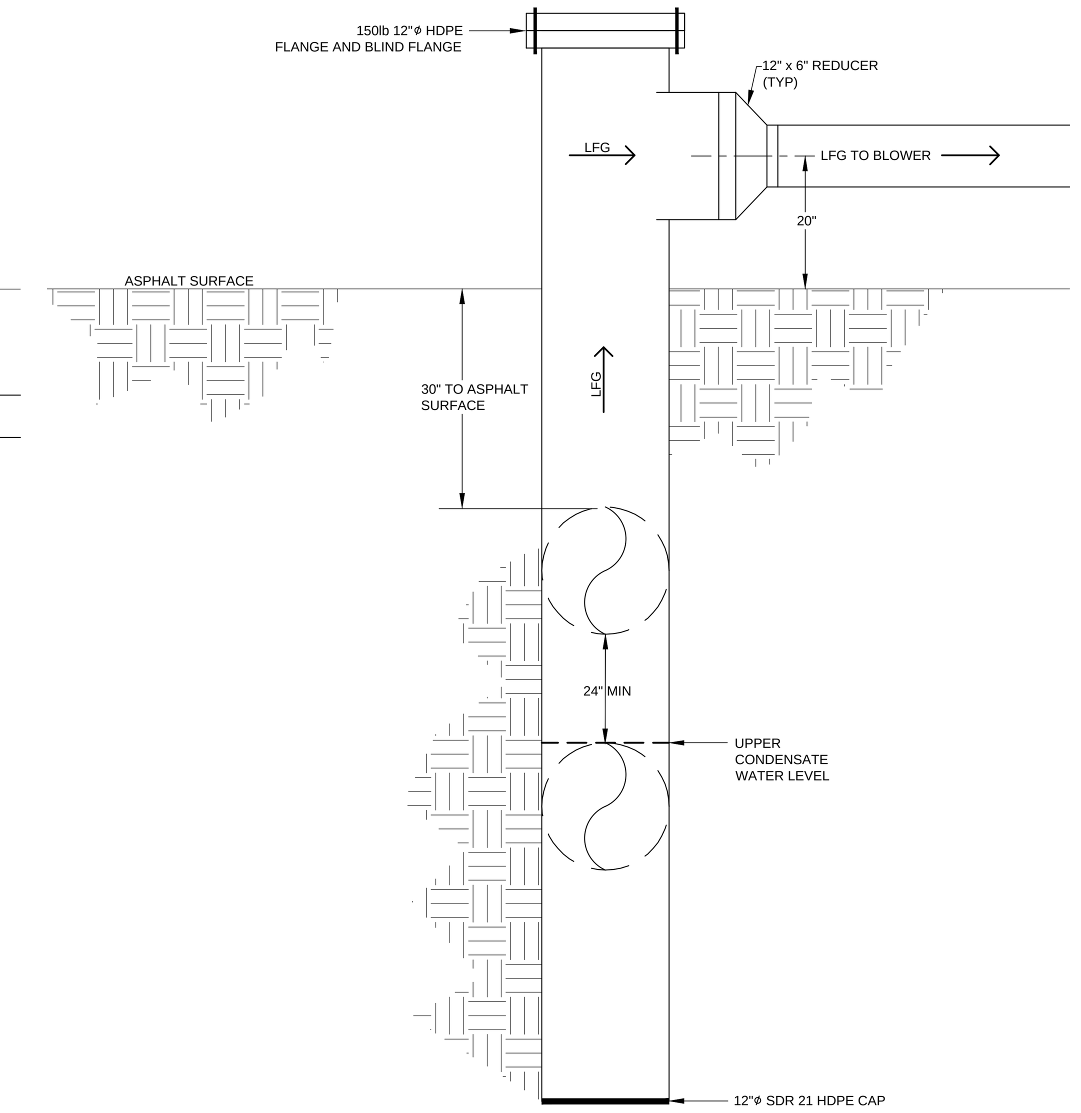
NOT TO SCALE



A	
EN-4	EN-4

DETAIL A

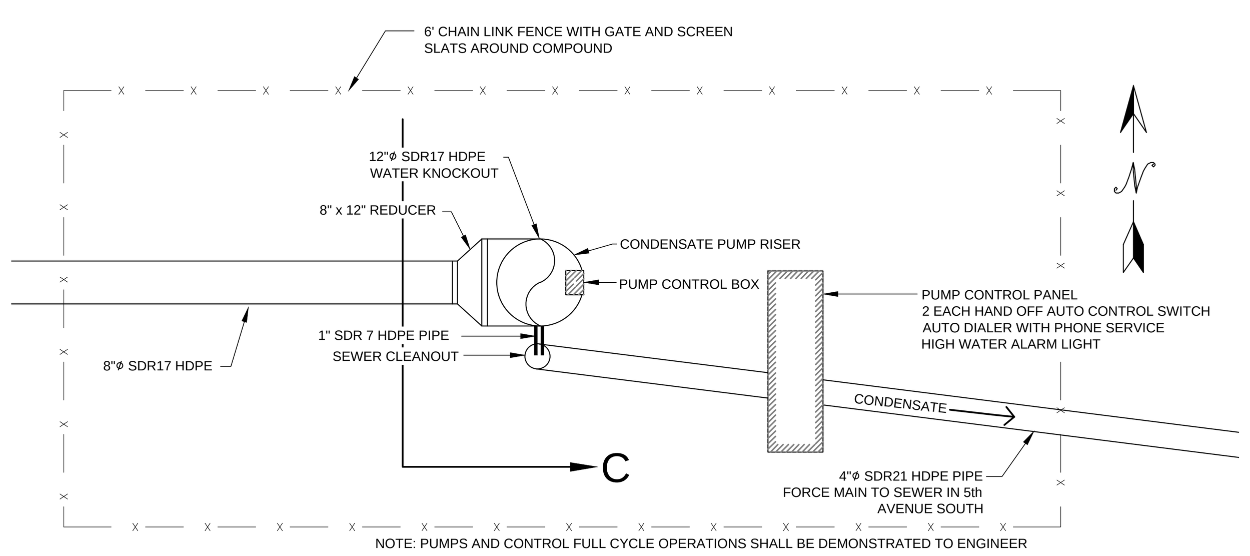
NOT TO SCALE



B	
EN-4	EN-4

DETAIL B

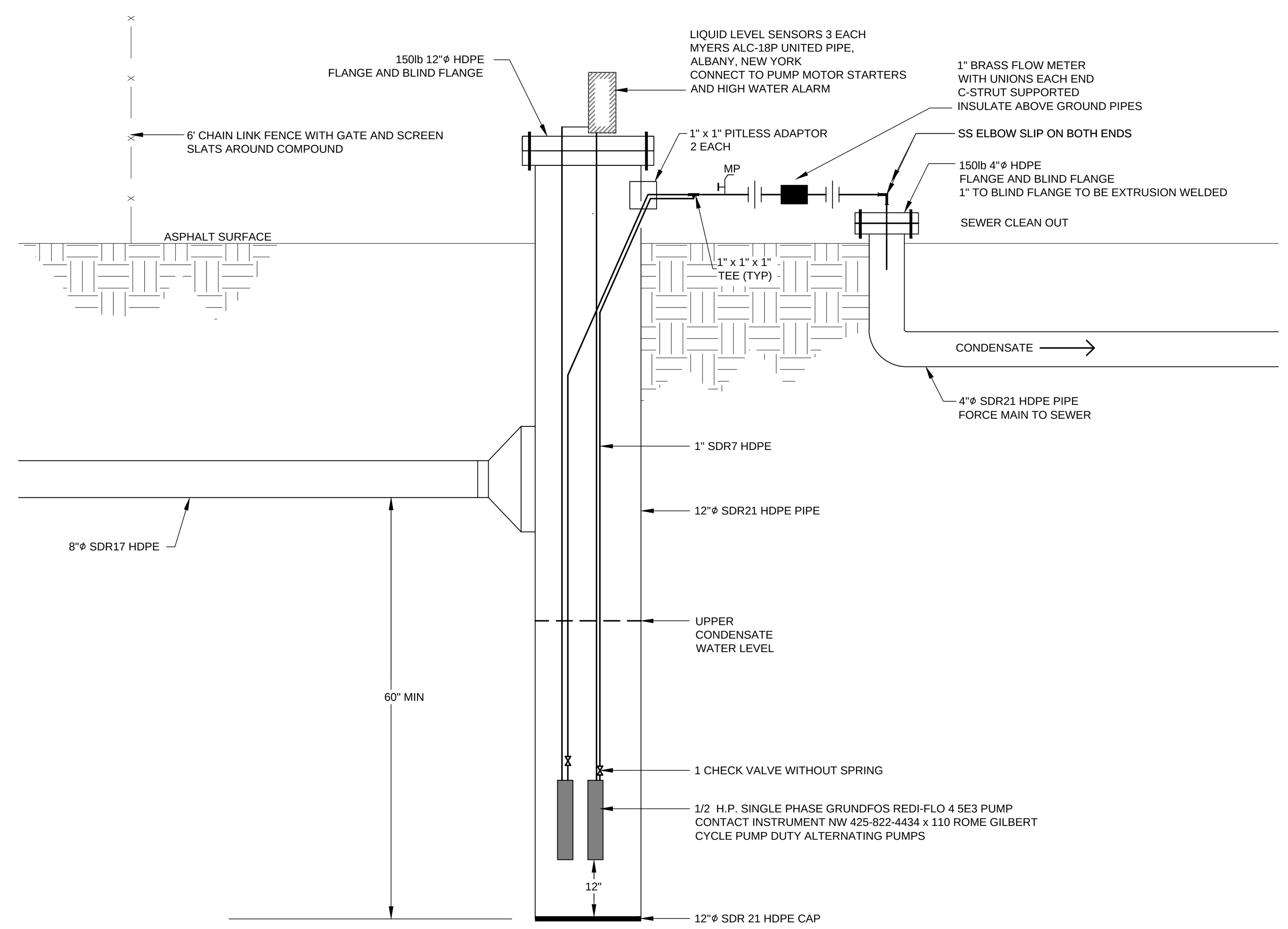
NOT TO SCALE



2	
EN-4	EN-3

LANDFILL GAS CONDENSATE PUMP STATION DETAIL

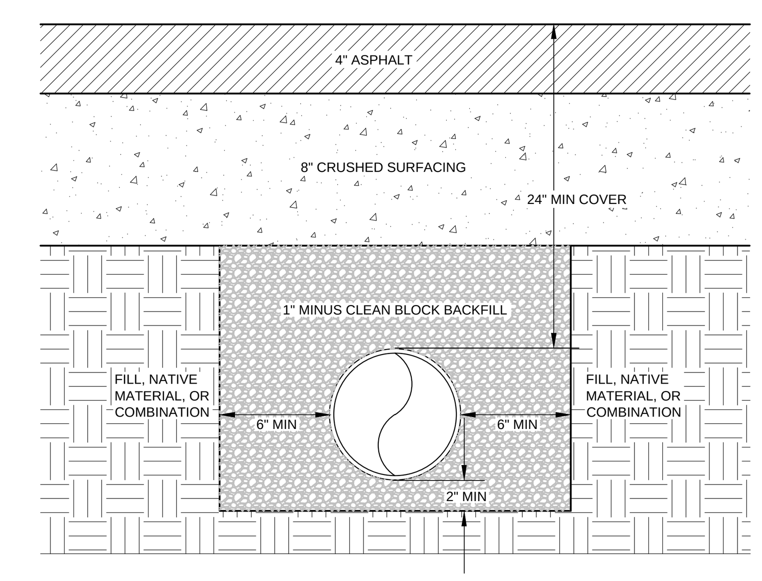
NOT TO SCALE



C	
EN-4	EN-4

DETAIL C

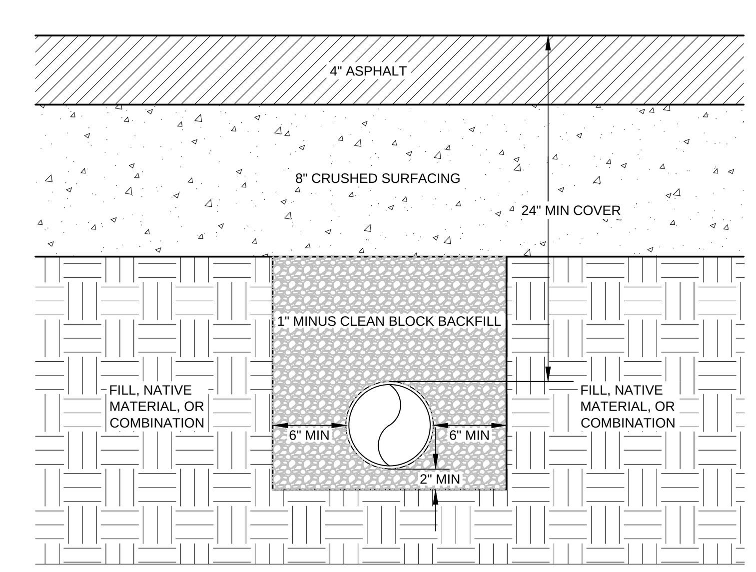
NOT TO SCALE



3	
EN-4	EN-3

TYPICAL 8" MAIN PIPE SECTION

NOT TO SCALE



4	
EN-4	EN-3

TYPICAL 6" CONNECTOR PIPE SECTION

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PROPERTY DEVELOPMENT
8249 5TH AVENUE SOUTH
SEATTLE, WA

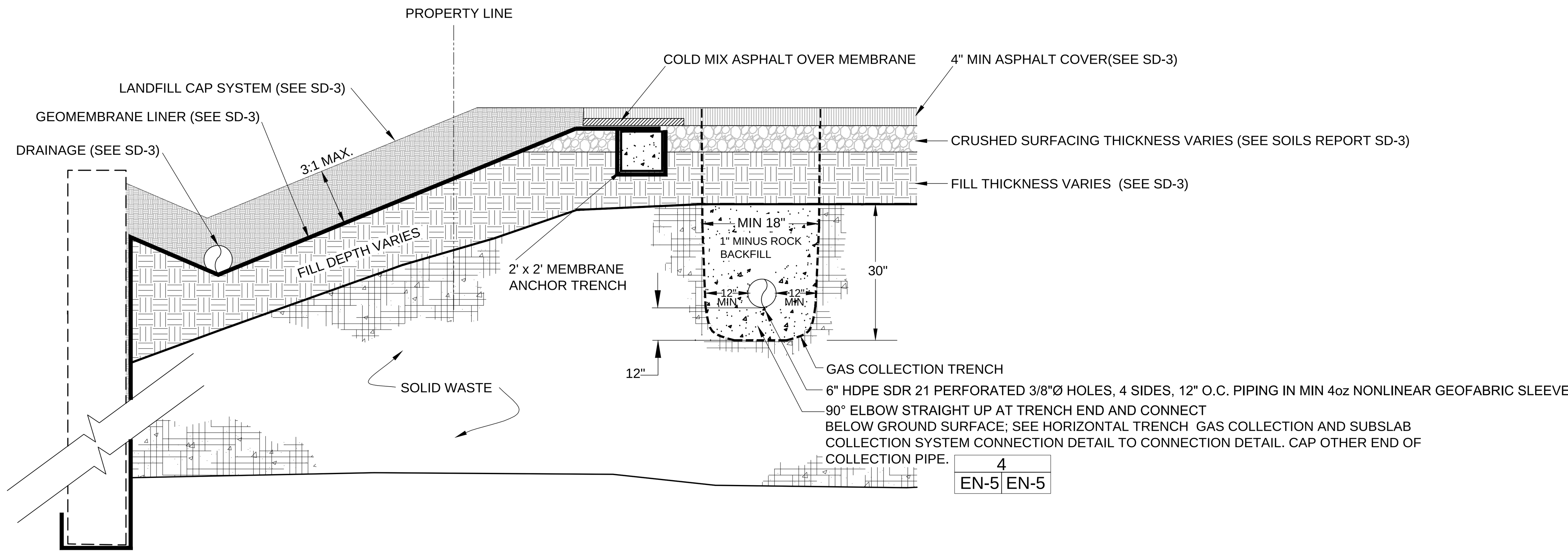
First Student

DETAILS

CLYDE N. MOORE
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-4



1 EN-5 EN-3 GAS COLLECTION TRENCH DETAIL

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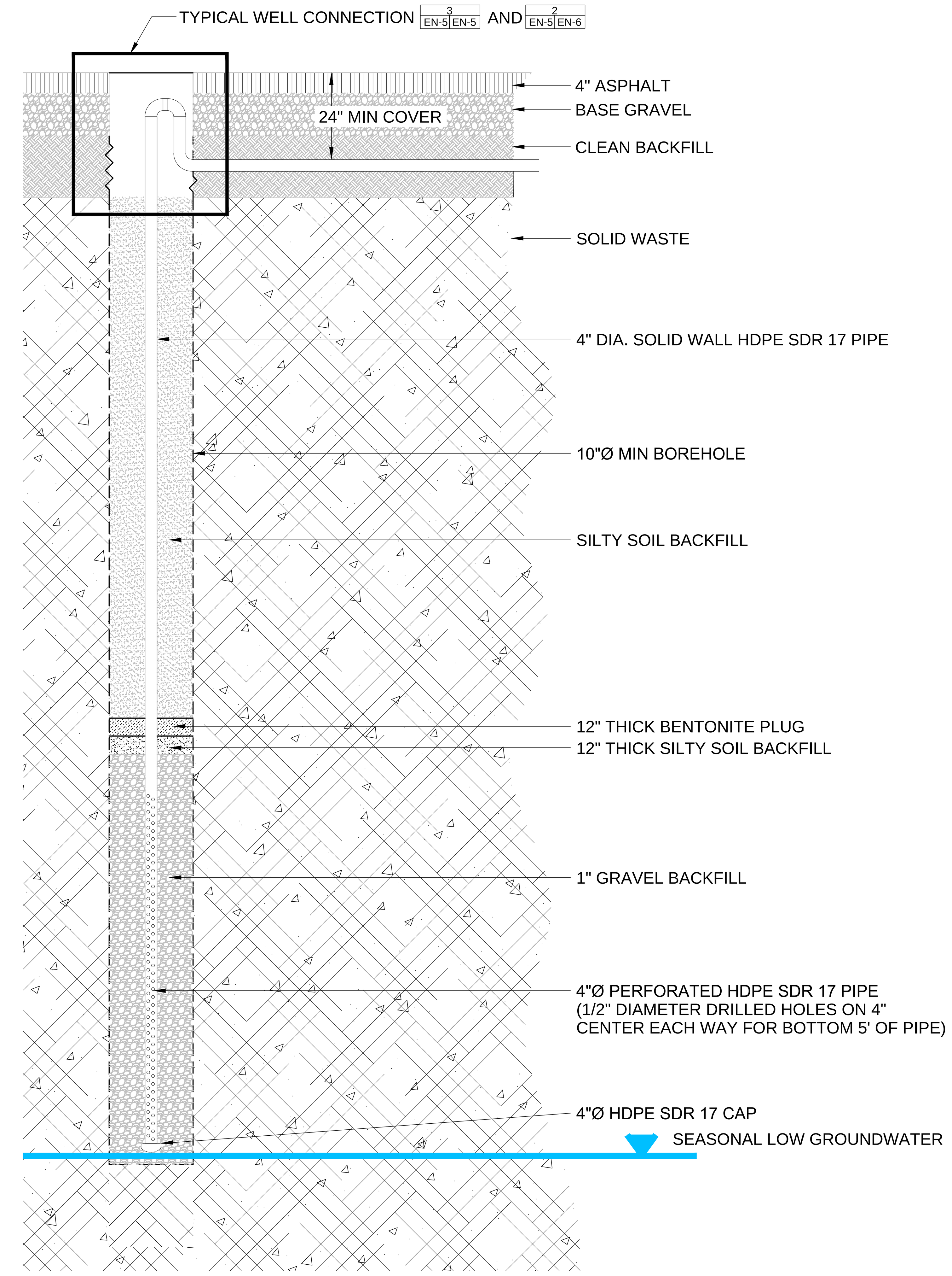
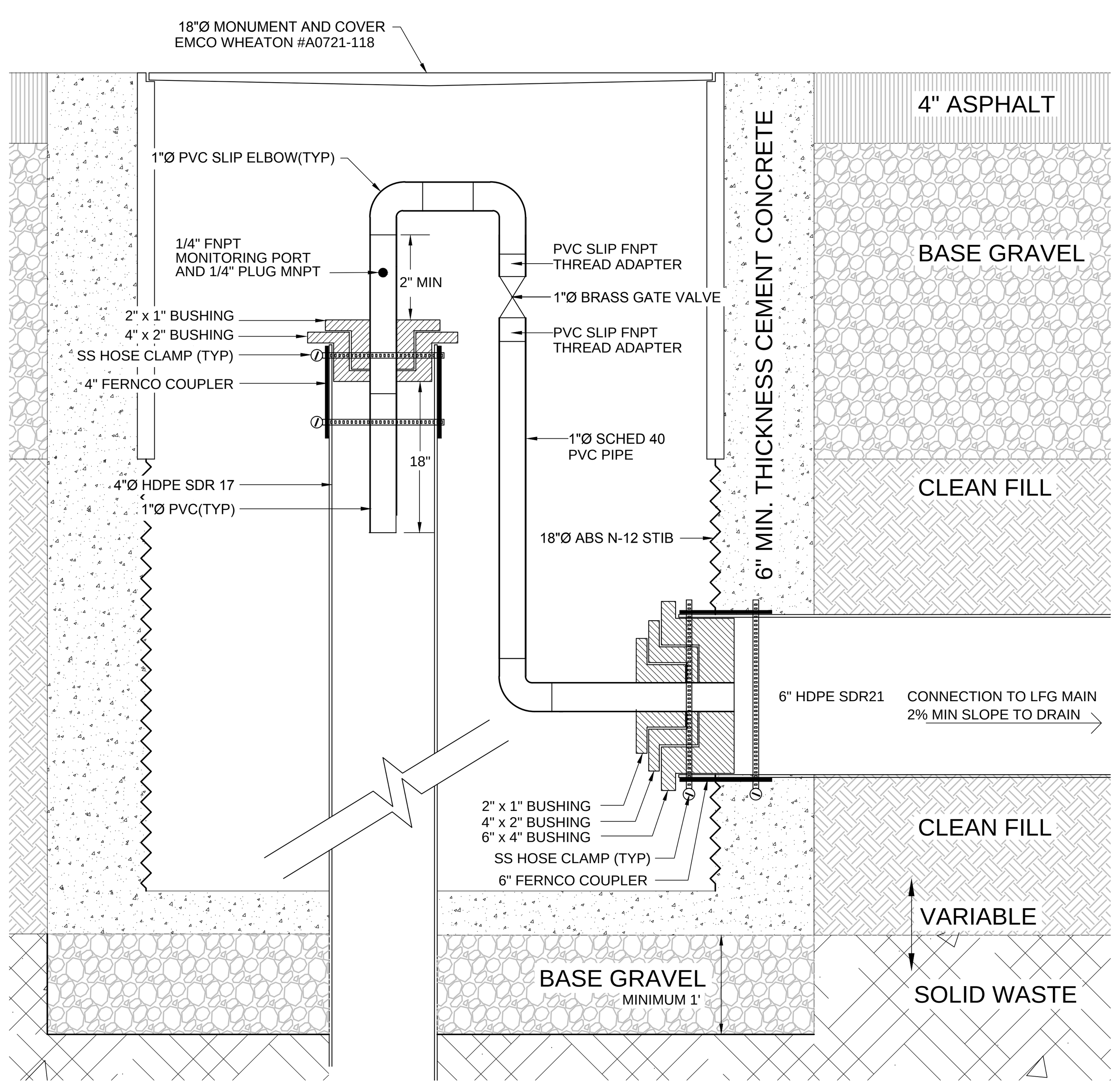


2 EN-5 EN-3 GAS COLLECTION WELL DETAIL

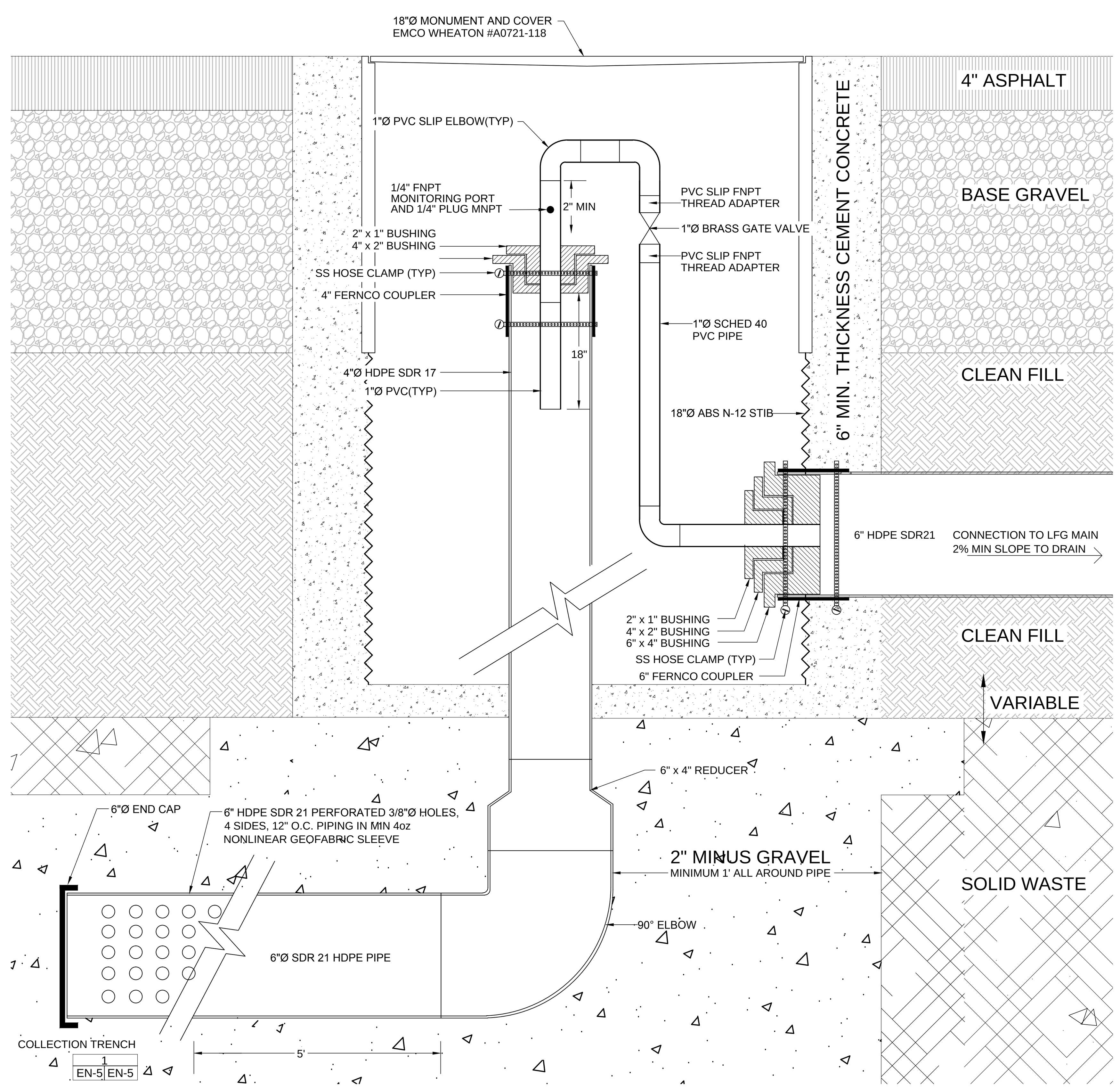
NOT TO SCALE

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



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

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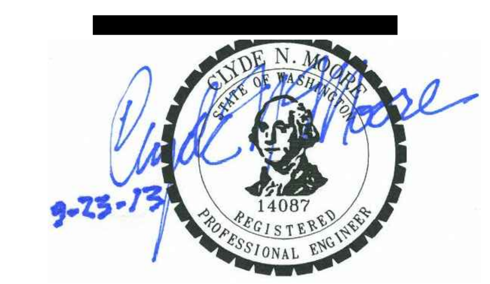

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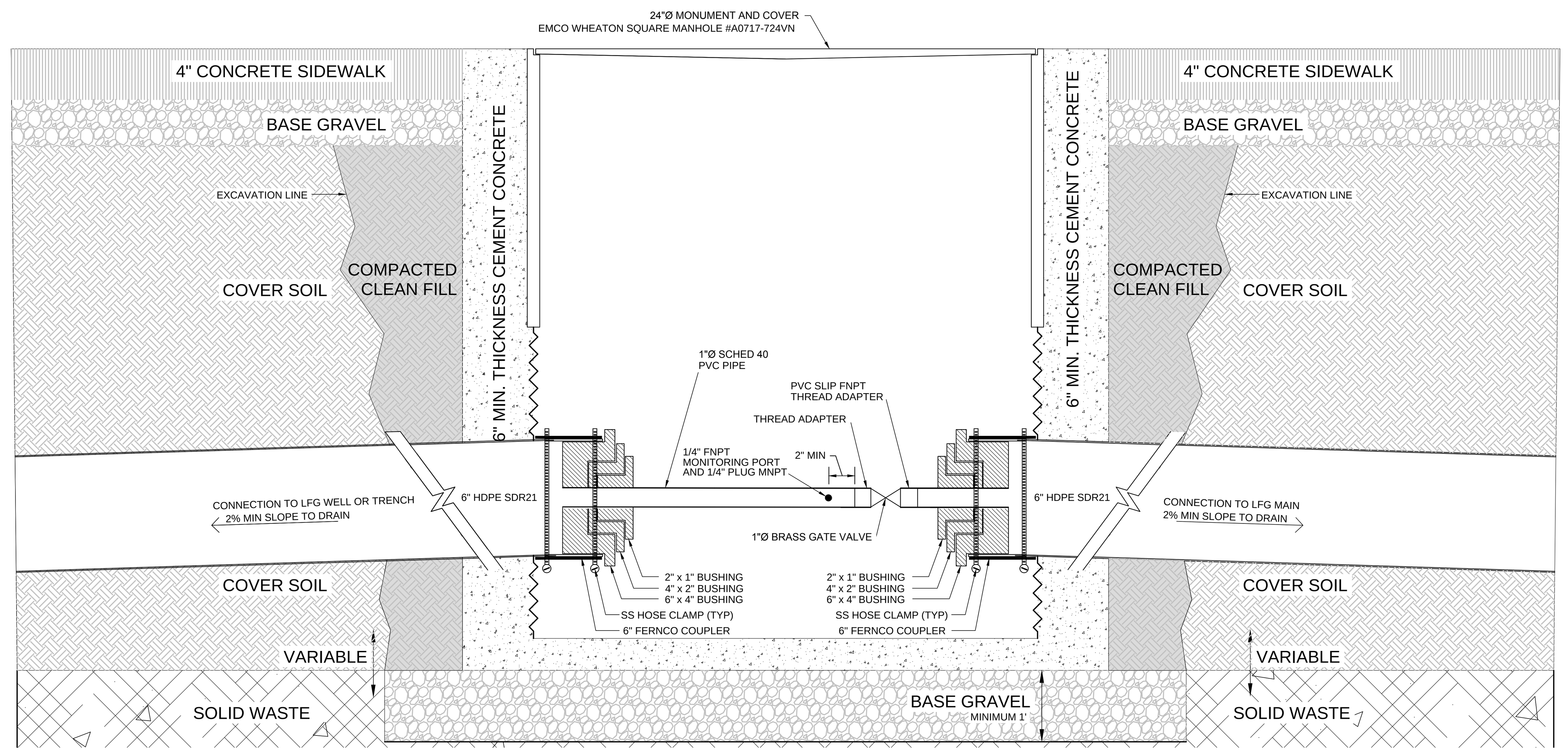
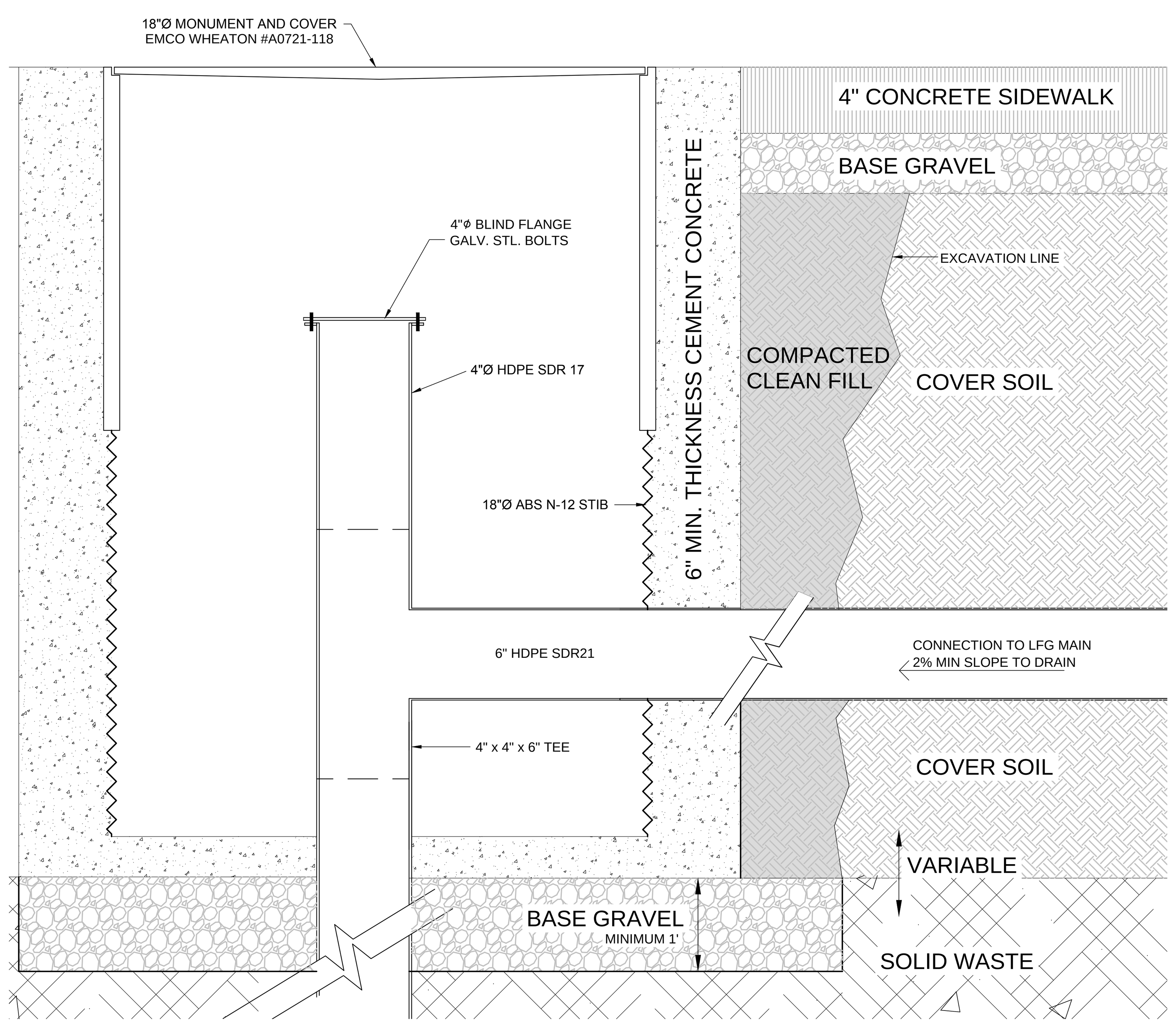
EN-5



1
EN-6 / EN-3

TOP OF SLOPE WELL / TRENCH CONNECTOR MONITORING / CONTROL ASSEMBLY

NOT TO SCALE



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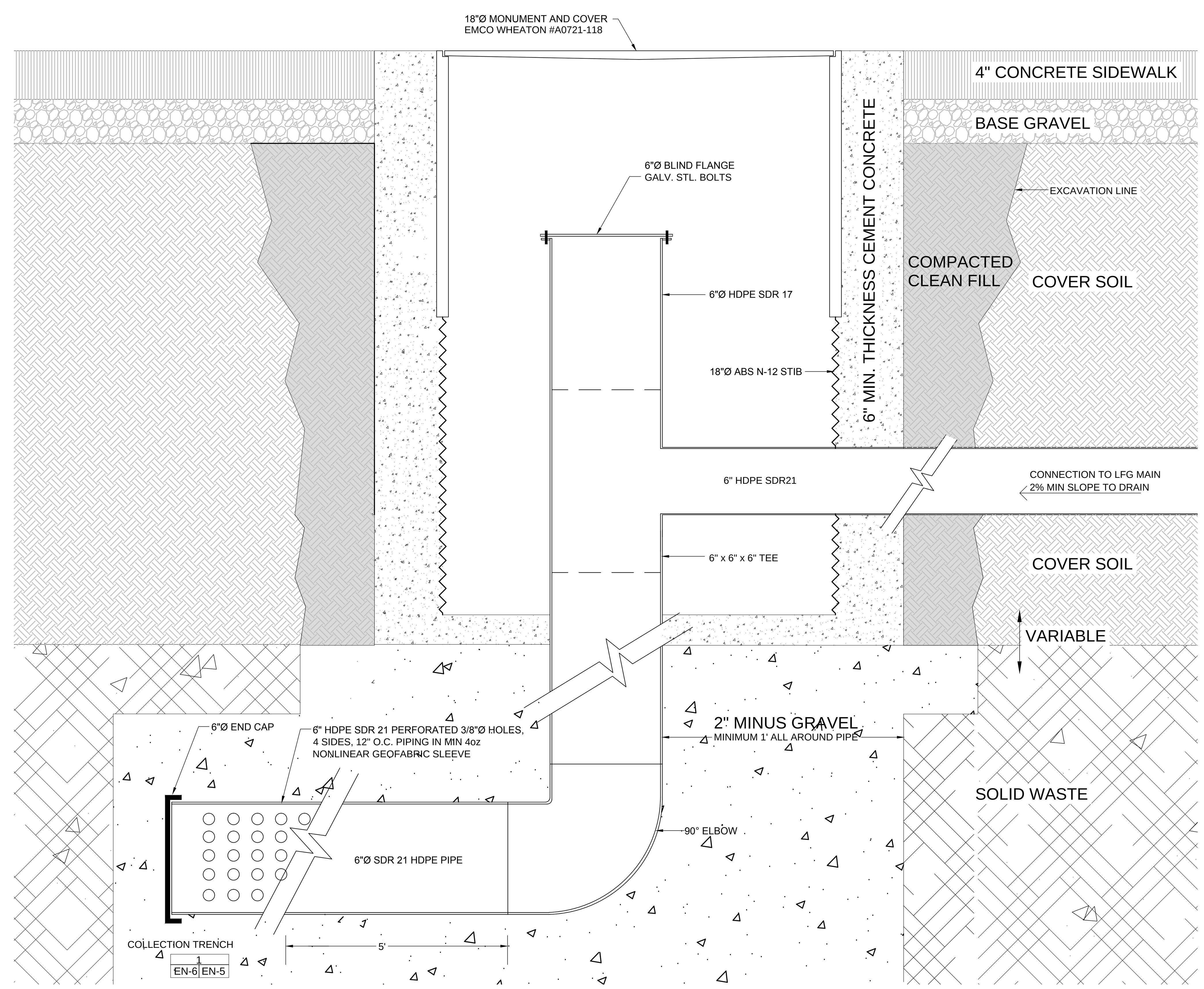
EN-6 / EN-3

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

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CHECKED: CLYDE MOORE
DATE: 9/18/13
SCALE: 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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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
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408-002

EN-7

APPENDIX B
LANDFILL GAS GENERATION ESTIMATE

ENGINEERING DESIGN REPORT
LANDFILL GAS COLLECTION AND CONTROL SYSTEM
South Park Landfill Site
Seattle, Washington

Farallon PN: 408-002

Summary Report

Landfill Name or Identifier: South Park Landfill 1950-1968 CAA Default

Date: Friday, February 13, 2015

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

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

Where,

Q_{CH_4} = annual methane generation in the year of the calculation *(m^3/year)*
i = 1-year time increment
n = (year of the calculation) - (initial year of waste acceptance)
j = 0.1-year time increment
k = methane generation rate *($year^{-1}$)*
L_o = potential methane generation capacity *(m^3/Mg)*

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

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

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

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1950**	
Landfill Closure Year (with 80-year limit)	**1969**	
Actual Closure Year (without limit)	***1969***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**170**	*m^3/Mg*
NMOC Concentration	**4,000**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

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

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1950	2,907	3,198	0	0
1951	3,256	3,581	2,907	3,198
1952	3,646	4,011	6,163	6,779
1953	4,084	4,492	9,809	10,790
1954	4,574	5,032	13,893	15,283
1955	5,123	5,635	18,467	20,314
1956	5,738	6,312	23,590	25,950
1957	6,426	7,069	29,328	32,261
1958	7,198	7,917	35,755	39,330
1959	8,061	8,867	42,952	47,247
1960	9,029	9,931	51,013	56,115
1961	9,029	9,931	60,042	66,046
1962	10,112	11,123	69,071	75,978
1963	11,325	12,458	79,183	87,101
1964	12,684	13,953	90,508	99,559
1965	14,207	15,627	103,192	113,512
1966	15,911	17,503	117,399	129,139
1967	17,821	19,603	133,310	146,642
1968	19,959	21,955	151,131	166,244
1969	0	0	171,091	188,200
1970	0	0	171,091	188,200
1971	0	0	171,091	188,200
1972	0	0	171,091	188,200
1973	0	0	171,091	188,200
1974	0	0	171,091	188,200
1975	0	0	171,091	188,200
1976	0	0	171,091	188,200
1977	0	0	171,091	188,200
1978	0	0	171,091	188,200
1979	0	0	171,091	188,200
1980	0	0	171,091	188,200
1981	0	0	171,091	188,200
1982	0	0	171,091	188,200
1983	0	0	171,091	188,200
1984	0	0	171,091	188,200
1985	0	0	171,091	188,200
1986	0	0	171,091	188,200
1987	0	0	171,091	188,200
1988	0	0	171,091	188,200
1989	0	0	171,091	188,200

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1990	0	0	171,091	188,200
1991	0	0	171,091	188,200
1992	0	0	171,091	188,200
1993	0	0	171,091	188,200
1994	0	0	171,091	188,200
1995	0	0	171,091	188,200
1996	0	0	171,091	188,200
1997	0	0	171,091	188,200
1998	0	0	171,091	188,200
1999	0	0	171,091	188,200
2000	0	0	171,091	188,200
2001	0	0	171,091	188,200
2002	0	0	171,091	188,200
2003	0	0	171,091	188,200
2004	0	0	171,091	188,200
2005	0	0	171,091	188,200
2006	0	0	171,091	188,200
2007	0	0	171,091	188,200
2008	0	0	171,091	188,200
2009	0	0	171,091	188,200
2010	0	0	171,091	188,200
2011	0	0	171,091	188,200
2012	0	0	171,091	188,200
2013	0	0	171,091	188,200
2014	0	0	171,091	188,200
2015	0	0	171,091	188,200
2016	0	0	171,091	188,200
2017	0	0	171,091	188,200
2018	0	0	171,091	188,200
2019	0	0	171,091	188,200
2020	0	0	171,091	188,200
2021	0	0	171,091	188,200
2022	0	0	171,091	188,200
2023	0	0	171,091	188,200
2024	0	0	171,091	188,200
2025	0	0	171,091	188,200
2026	0	0	171,091	188,200
2027	0	0	171,091	188,200
2028	0	0	171,091	188,200
2029	0	0	171,091	188,200

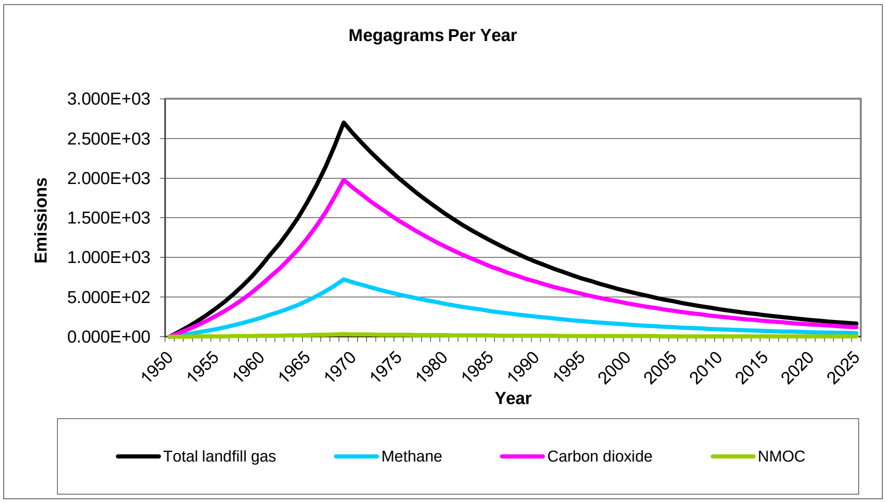
Pollutant Parameters

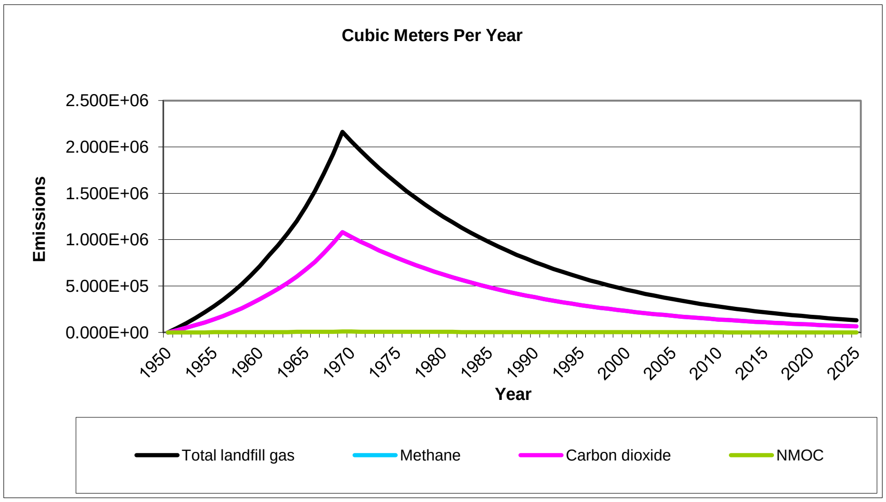
		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl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

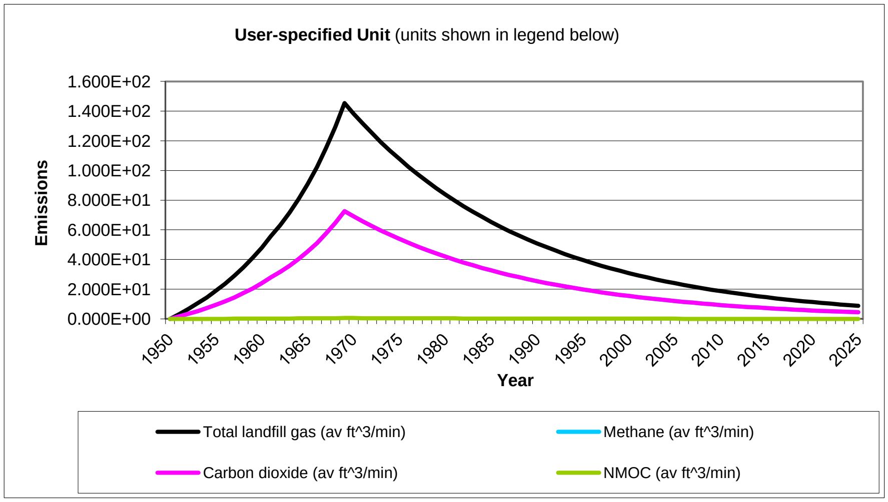
Pollutant Parameters (Continued)

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

Graphs


Megagrams Per Year
Emissions
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
2.500E+06
2.000E+06
1.500E+06
1.000E+06
5.000E+05
0.000E+00
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
1.600E+02
1.400E+02
1.200E+02
1.000E+02
8.000E+01
6.000E+01
4.000E+01
2.000E+01
0.000E+00
1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m³/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m³/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	6.035E+01	4.832E+04	3.247E+00	1.612E+01	2.416E+04	1.623E+00
1952	1.250E+02	1.001E+05	6.725E+00	3.339E+01	5.004E+04	3.363E+00
1953	1.946E+02	1.558E+05	1.047E+01	5.198E+01	7.791E+04	5.235E+00
1954	2.699E+02	2.161E+05	1.452E+01	7.209E+01	1.081E+05	7.260E+00
1955	3.517E+02	2.816E+05	1.892E+01	9.394E+01	1.408E+05	9.461E+00
1956	4.409E+02	3.530E+05	2.372E+01	1.178E+02	1.765E+05	1.186E+01
1957	5.385E+02	4.312E+05	2.897E+01	1.438E+02	2.156E+05	1.449E+01
1958	6.456E+02	5.170E+05	3.474E+01	1.725E+02	2.585E+05	1.737E+01
1959	7.636E+02	6.114E+05	4.108E+01	2.040E+02	3.057E+05	2.054E+01
1960	8.937E+02	7.156E+05	4.808E+01	2.387E+02	3.578E+05	2.404E+01
1961	1.038E+03	8.308E+05	5.582E+01	2.771E+02	4.154E+05	2.791E+01
1962	1.174E+03	9.404E+05	6.318E+01	3.137E+02	4.702E+05	3.159E+01
1963	1.327E+03	1.063E+06	7.140E+01	3.545E+02	5.313E+05	3.570E+01
1964	1.497E+03	1.199E+06	8.056E+01	4.000E+02	5.995E+05	4.028E+01
1965	1.688E+03	1.351E+06	9.080E+01	4.508E+02	6.757E+05	4.540E+01
1966	1.900E+03	1.522E+06	1.022E+02	5.076E+02	7.608E+05	5.112E+01
1967	2.138E+03	1.712E+06	1.150E+02	5.711E+02	8.560E+05	5.751E+01
1968	2.404E+03	1.925E+06	1.293E+02	6.420E+02	9.624E+05	6.466E+01
1969	2.701E+03	2.163E+06	1.453E+02	7.214E+02	1.081E+06	7.265E+01
1970	2.569E+03	2.057E+06	1.382E+02	6.862E+02	1.029E+06	6.911E+01
1971	2.444E+03	1.957E+06	1.315E+02	6.528E+02	9.784E+05	6.574E+01
1972	2.325E+03	1.861E+06	1.251E+02	6.209E+02	9.307E+05	6.253E+01
1973	2.211E+03	1.771E+06	1.190E+02	5.906E+02	8.853E+05	5.948E+01
1974	2.103E+03	1.684E+06	1.132E+02	5.618E+02	8.421E+05	5.658E+01
1975	2.001E+03	1.602E+06	1.076E+02	5.344E+02	8.011E+05	5.382E+01
1976	1.903E+03	1.524E+06	1.024E+02	5.084E+02	7.620E+05	5.120E+01
1977	1.810E+03	1.450E+06	9.740E+01	4.836E+02	7.248E+05	4.870E+01
1978	1.722E+03	1.379E+06	9.265E+01	4.600E+02	6.895E+05	4.633E+01
1979	1.638E+03	1.312E+06	8.813E+01	4.376E+02	6.559E+05	4.407E+01
1980	1.558E+03	1.248E+06	8.384E+01	4.162E+02	6.239E+05	4.192E+01
1981	1.482E+03	1.187E+06	7.975E+01	3.959E+02	5.934E+05	3.987E+01
1982	1.410E+03	1.129E+06	7.586E+01	3.766E+02	5.645E+05	3.793E+01
1983	1.341E+03	1.074E+06	7.216E+01	3.582E+02	5.370E+05	3.608E+01
1984	1.276E+03	1.022E+06	6.864E+01	3.408E+02	5.108E+05	3.432E+01
1985	1.214E+03	9.717E+05	6.529E+01	3.241E+02	4.859E+05	3.265E+01
1986	1.154E+03	9.243E+05	6.211E+01	3.083E+02	4.622E+05	3.105E+01
1987	1.098E+03	8.793E+05	5.908E+01	2.933E+02	4.396E+05	2.954E+01
1988	1.044E+03	8.364E+05	5.620E+01	2.790E+02	4.182E+05	2.810E+01
1989	9.936E+02	7.956E+05	5.346E+01	2.654E+02	3.978E+05	2.673E+01
1990	9.451E+02	7.568E+05	5.085E+01	2.524E+02	3.784E+05	2.542E+01
1991	8.990E+02	7.199E+05	4.837E+01	2.401E+02	3.599E+05	2.418E+01
1992	8.552E+02	6.848E+05	4.601E+01	2.284E+02	3.424E+05	2.300E+01
1993	8.135E+02	6.514E+05	4.377E+01	2.173E+02	3.257E+05	2.188E+01
1994	7.738E+02	6.196E+05	4.163E+01	2.067E+02	3.098E+05	2.082E+01
1995	7.360E+02	5.894E+05	3.960E+01	1.966E+02	2.947E+05	1.980E+01
1996	7.001E+02	5.606E+05	3.767E+01	1.870E+02	2.803E+05	1.883E+01
1997	6.660E+02	5.333E+05	3.583E+01	1.779E+02	2.667E+05	1.792E+01
1998	6.335E+02	5.073E+05	3.408E+01	1.692E+02	2.536E+05	1.704E+01
1999	6.026E+02	4.826E+05	3.242E+01	1.610E+02	2.413E+05	1.621E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2000	5.732E+02	4.590E+05	3.084E+01	1.531E+02	2.295E+05	1.542E+01
2001	5.453E+02	4.366E+05	2.934E+01	1.456E+02	2.183E+05	1.467E+01
2002	5.187E+02	4.153E+05	2.791E+01	1.385E+02	2.077E+05	1.395E+01
2003	4.934E+02	3.951E+05	2.655E+01	1.318E+02	1.975E+05	1.327E+01
2004	4.693E+02	3.758E+05	2.525E+01	1.254E+02	1.879E+05	1.263E+01
2005	4.464E+02	3.575E+05	2.402E+01	1.192E+02	1.787E+05	1.201E+01
2006	4.247E+02	3.400E+05	2.285E+01	1.134E+02	1.700E+05	1.142E+01
2007	4.040E+02	3.235E+05	2.173E+01	1.079E+02	1.617E+05	1.087E+01
2008	3.842E+02	3.077E+05	2.067E+01	1.026E+02	1.538E+05	1.034E+01
2009	3.655E+02	2.927E+05	1.967E+01	9.763E+01	1.463E+05	9.833E+00
2010	3.477E+02	2.784E+05	1.871E+01	9.287E+01	1.392E+05	9.353E+00
2011	3.307E+02	2.648E+05	1.779E+01	8.834E+01	1.324E+05	8.897E+00
2012	3.146E+02	2.519E+05	1.693E+01	8.403E+01	1.260E+05	8.463E+00
2013	2.993E+02	2.396E+05	1.610E+01	7.993E+01	1.198E+05	8.050E+00
2014	2.847E+02	2.279E+05	1.532E+01	7.604E+01	1.140E+05	7.658E+00
2015	2.708E+02	2.168E+05	1.457E+01	7.233E+01	1.084E+05	7.284E+00
2016	2.576E+02	2.063E+05	1.386E+01	6.880E+01	1.031E+05	6.929E+00
2017	2.450E+02	1.962E+05	1.318E+01	6.544E+01	9.810E+04	6.591E+00
2018	2.331E+02	1.866E+05	1.254E+01	6.225E+01	9.331E+04	6.270E+00
2019	2.217E+02	1.775E+05	1.193E+01	5.922E+01	8.876E+04	5.964E+00
2020	2.109E+02	1.689E+05	1.135E+01	5.633E+01	8.443E+04	5.673E+00
2021	2.006E+02	1.606E+05	1.079E+01	5.358E+01	8.031E+04	5.396E+00
2022	1.908E+02	1.528E+05	1.027E+01	5.097E+01	7.640E+04	5.133E+00
2023	1.815E+02	1.453E+05	9.766E+00	4.848E+01	7.267E+04	4.883E+00
2024	1.727E+02	1.383E+05	9.289E+00	4.612E+01	6.913E+04	4.645E+00
2025	1.642E+02	1.315E+05	8.836E+00	4.387E+01	6.576E+04	4.418E+00
2026	1.562E+02	1.251E+05	8.405E+00	4.173E+01	6.255E+04	4.203E+00
2027	1.486E+02	1.190E+05	7.995E+00	3.969E+01	5.950E+04	3.998E+00
2028	1.414E+02	1.132E+05	7.605E+00	3.776E+01	5.660E+04	3.803E+00
2029	1.345E+02	1.077E+05	7.234E+00	3.592E+01	5.384E+04	3.617E+00
2030	1.279E+02	1.024E+05	6.882E+00	3.416E+01	5.121E+04	3.441E+00
2031	1.217E+02	9.743E+04	6.546E+00	3.250E+01	4.871E+04	3.273E+00
2032	1.157E+02	9.267E+04	6.227E+00	3.091E+01	4.634E+04	3.113E+00
2033	1.101E+02	8.815E+04	5.923E+00	2.941E+01	4.408E+04	2.962E+00
2034	1.047E+02	8.386E+04	5.634E+00	2.797E+01	4.193E+04	2.817E+00
2035	9.961E+01	7.977E+04	5.359E+00	2.661E+01	3.988E+04	2.680E+00
2036	9.475E+01	7.588E+04	5.098E+00	2.531E+01	3.794E+04	2.549E+00
2037	9.013E+01	7.217E+04	4.849E+00	2.408E+01	3.609E+04	2.425E+00
2038	8.574E+01	6.865E+04	4.613E+00	2.290E+01	3.433E+04	2.306E+00
2039	8.156E+01	6.531E+04	4.388E+00	2.178E+01	3.265E+04	2.194E+00
2040	7.758E+01	6.212E+04	4.174E+00	2.072E+01	3.106E+04	2.087E+00
2041	7.380E+01	5.909E+04	3.970E+00	1.971E+01	2.955E+04	1.985E+00
2042	7.020E+01	5.621E+04	3.777E+00	1.875E+01	2.810E+04	1.888E+00
2043	6.677E+01	5.347E+04	3.593E+00	1.784E+01	2.673E+04	1.796E+00
2044	6.352E+01	5.086E+04	3.417E+00	1.697E+01	2.543E+04	1.709E+00
2045	6.042E+01	4.838E+04	3.251E+00	1.614E+01	2.419E+04	1.625E+00
2046	5.747E+01	4.602E+04	3.092E+00	1.535E+01	2.301E+04	1.546E+00
2047	5.467E+01	4.378E+04	2.941E+00	1.460E+01	2.189E+04	1.471E+00
2048	5.200E+01	4.164E+04	2.798E+00	1.389E+01	2.082E+04	1.399E+00
2049	4.947E+01	3.961E+04	2.661E+00	1.321E+01	1.981E+04	1.331E+00
2050	4.705E+01	3.768E+04	2.532E+00	1.257E+01	1.884E+04	1.266E+00

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	4.476E+01	3.584E+04	2.408E+00	1.196E+01	1.792E+04	1.204E+00
2052	4.258E+01	3.409E+04	2.291E+00	1.137E+01	1.705E+04	1.145E+00
2053	4.050E+01	3.243E+04	2.179E+00	1.082E+01	1.622E+04	1.089E+00
2054	3.852E+01	3.085E+04	2.073E+00	1.029E+01	1.542E+04	1.036E+00
2055	3.665E+01	2.934E+04	1.972E+00	9.788E+00	1.467E+04	9.858E-01
2056	3.486E+01	2.791E+04	1.875E+00	9.311E+00	1.396E+04	9.377E-01
2057	3.316E+01	2.655E+04	1.784E+00	8.857E+00	1.328E+04	8.920E-01
2058	3.154E+01	2.526E+04	1.697E+00	8.425E+00	1.263E+04	8.485E-01
2059	3.000E+01	2.402E+04	1.614E+00	8.014E+00	1.201E+04	8.071E-01
2060	2.854E+01	2.285E+04	1.536E+00	7.623E+00	1.143E+04	7.678E-01
2061	2.715E+01	2.174E+04	1.461E+00	7.251E+00	1.087E+04	7.303E-01
2062	2.582E+01	2.068E+04	1.389E+00	6.898E+00	1.034E+04	6.947E-01
2063	2.456E+01	1.967E+04	1.322E+00	6.561E+00	9.835E+03	6.608E-01
2064	2.337E+01	1.871E+04	1.257E+00	6.241E+00	9.355E+03	6.286E-01
2065	2.223E+01	1.780E+04	1.196E+00	5.937E+00	8.899E+03	5.979E-01
2066	2.114E+01	1.693E+04	1.138E+00	5.647E+00	8.465E+03	5.688E-01
2067	2.011E+01	1.610E+04	1.082E+00	5.372E+00	8.052E+03	5.410E-01
2068	1.913E+01	1.532E+04	1.029E+00	5.110E+00	7.659E+03	5.146E-01
2069	1.820E+01	1.457E+04	9.791E-01	4.861E+00	7.286E+03	4.895E-01
2070	1.731E+01	1.386E+04	9.313E-01	4.624E+00	6.931E+03	4.657E-01
2071	1.647E+01	1.319E+04	8.859E-01	4.398E+00	6.593E+03	4.430E-01
2072	1.566E+01	1.254E+04	8.427E-01	4.184E+00	6.271E+03	4.214E-01
2073	1.490E+01	1.193E+04	8.016E-01	3.980E+00	5.965E+03	4.008E-01
2074	1.417E+01	1.135E+04	7.625E-01	3.786E+00	5.674E+03	3.813E-01
2075	1.348E+01	1.080E+04	7.253E-01	3.601E+00	5.398E+03	3.627E-01
2076	1.282E+01	1.027E+04	6.899E-01	3.425E+00	5.134E+03	3.450E-01
2077	1.220E+01	9.768E+03	6.563E-01	3.258E+00	4.884E+03	3.281E-01
2078	1.160E+01	9.291E+03	6.243E-01	3.099E+00	4.646E+03	3.121E-01
2079	1.104E+01	8.838E+03	5.938E-01	2.948E+00	4.419E+03	2.969E-01
2080	1.050E+01	8.407E+03	5.649E-01	2.804E+00	4.204E+03	2.824E-01
2081	9.987E+00	7.997E+03	5.373E-01	2.668E+00	3.999E+03	2.687E-01
2082	9.500E+00	7.607E+03	5.111E-01	2.538E+00	3.804E+03	2.556E-01
2083	9.037E+00	7.236E+03	4.862E-01	2.414E+00	3.618E+03	2.431E-01
2084	8.596E+00	6.883E+03	4.625E-01	2.296E+00	3.442E+03	2.312E-01
2085	8.177E+00	6.548E+03	4.399E-01	2.184E+00	3.274E+03	2.200E-01
2086	7.778E+00	6.228E+03	4.185E-01	2.078E+00	3.114E+03	2.092E-01
2087	7.399E+00	5.924E+03	3.981E-01	1.976E+00	2.962E+03	1.990E-01
2088	7.038E+00	5.636E+03	3.787E-01	1.880E+00	2.818E+03	1.893E-01
2089	6.695E+00	5.361E+03	3.602E-01	1.788E+00	2.680E+03	1.801E-01
2090	6.368E+00	5.099E+03	3.426E-01	1.701E+00	2.550E+03	1.713E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1950	0	0	0	0	0	0
1951	4.423E+01	2.416E+04	1.623E+00	6.929E-01	1.933E+02	1.299E-02
1952	9.161E+01	5.004E+04	3.363E+00	1.435E+00	4.004E+02	2.690E-02
1953	1.426E+02	7.791E+04	5.235E+00	2.234E+00	6.233E+02	4.188E-02
1954	1.978E+02	1.081E+05	7.260E+00	3.099E+00	8.645E+02	5.808E-02
1955	2.577E+02	1.408E+05	9.461E+00	4.038E+00	1.126E+03	7.569E-02
1956	3.231E+02	1.765E+05	1.186E+01	5.062E+00	1.412E+03	9.488E-02
1957	3.947E+02	2.156E+05	1.449E+01	6.183E+00	1.725E+03	1.159E-01
1958	4.732E+02	2.585E+05	1.737E+01	7.413E+00	2.068E+03	1.390E-01
1959	5.596E+02	3.057E+05	2.054E+01	8.767E+00	2.446E+03	1.643E-01
1960	6.550E+02	3.578E+05	2.404E+01	1.026E+01	2.862E+03	1.923E-01
1961	7.604E+02	4.154E+05	2.791E+01	1.191E+01	3.323E+03	2.233E-01
1962	8.607E+02	4.702E+05	3.159E+01	1.348E+01	3.762E+03	2.527E-01
1963	9.726E+02	5.313E+05	3.570E+01	1.524E+01	4.250E+03	2.856E-01
1964	1.097E+03	5.995E+05	4.028E+01	1.719E+01	4.796E+03	3.223E-01
1965	1.237E+03	6.757E+05	4.540E+01	1.938E+01	5.406E+03	3.632E-01
1966	1.393E+03	7.608E+05	5.112E+01	2.182E+01	6.087E+03	4.090E-01
1967	1.567E+03	8.560E+05	5.751E+01	2.455E+01	6.848E+03	4.601E-01
1968	1.762E+03	9.624E+05	6.466E+01	2.760E+01	7.699E+03	5.173E-01
1969	1.979E+03	1.081E+06	7.265E+01	3.101E+01	8.651E+03	5.812E-01
1970	1.883E+03	1.029E+06	6.911E+01	2.950E+01	8.229E+03	5.529E-01
1971	1.791E+03	9.784E+05	6.574E+01	2.806E+01	7.827E+03	5.259E-01
1972	1.704E+03	9.307E+05	6.253E+01	2.669E+01	7.446E+03	5.003E-01
1973	1.621E+03	8.853E+05	5.948E+01	2.539E+01	7.083E+03	4.759E-01
1974	1.542E+03	8.421E+05	5.658E+01	2.415E+01	6.737E+03	4.527E-01
1975	1.466E+03	8.011E+05	5.382E+01	2.297E+01	6.409E+03	4.306E-01
1976	1.395E+03	7.620E+05	5.120E+01	2.185E+01	6.096E+03	4.096E-01
1977	1.327E+03	7.248E+05	4.870E+01	2.079E+01	5.799E+03	3.896E-01
1978	1.262E+03	6.895E+05	4.633E+01	1.977E+01	5.516E+03	3.706E-01
1979	1.201E+03	6.559E+05	4.407E+01	1.881E+01	5.247E+03	3.525E-01
1980	1.142E+03	6.239E+05	4.192E+01	1.789E+01	4.991E+03	3.353E-01
1981	1.086E+03	5.934E+05	3.987E+01	1.702E+01	4.748E+03	3.190E-01
1982	1.033E+03	5.645E+05	3.793E+01	1.619E+01	4.516E+03	3.034E-01
1983	9.829E+02	5.370E+05	3.608E+01	1.540E+01	4.296E+03	2.886E-01
1984	9.350E+02	5.108E+05	3.432E+01	1.465E+01	4.086E+03	2.746E-01
1985	8.894E+02	4.859E+05	3.265E+01	1.393E+01	3.887E+03	2.612E-01
1986	8.460E+02	4.622E+05	3.105E+01	1.325E+01	3.697E+03	2.484E-01
1987	8.047E+02	4.396E+05	2.954E+01	1.261E+01	3.517E+03	2.363E-01
1988	7.655E+02	4.182E+05	2.810E+01	1.199E+01	3.346E+03	2.248E-01
1989	7.282E+02	3.978E+05	2.673E+01	1.141E+01	3.182E+03	2.138E-01
1990	6.927E+02	3.784E+05	2.542E+01	1.085E+01	3.027E+03	2.034E-01
1991	6.589E+02	3.599E+05	2.418E+01	1.032E+01	2.880E+03	1.935E-01
1992	6.267E+02	3.424E+05	2.300E+01	9.818E+00	2.739E+03	1.840E-01
1993	5.962E+02	3.257E+05	2.188E+01	9.339E+00	2.606E+03	1.751E-01
1994	5.671E+02	3.098E+05	2.082E+01	8.884E+00	2.478E+03	1.665E-01
1995	5.394E+02	2.947E+05	1.980E+01	8.451E+00	2.358E+03	1.584E-01
1996	5.131E+02	2.803E+05	1.883E+01	8.038E+00	2.243E+03	1.507E-01
1997	4.881E+02	2.667E+05	1.792E+01	7.646E+00	2.133E+03	1.433E-01
1998	4.643E+02	2.536E+05	1.704E+01	7.274E+00	2.029E+03	1.363E-01
1999	4.417E+02	2.413E+05	1.621E+01	6.919E+00	1.930E+03	1.297E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2000	4.201E+02	2.295E+05	1.542E+01	6.581E+00	1.836E+03	1.234E-01
2001	3.996E+02	2.183E+05	1.467E+01	6.260E+00	1.747E+03	1.173E-01
2002	3.801E+02	2.077E+05	1.395E+01	5.955E+00	1.661E+03	1.116E-01
2003	3.616E+02	1.975E+05	1.327E+01	5.665E+00	1.580E+03	1.062E-01
2004	3.440E+02	1.879E+05	1.263E+01	5.388E+00	1.503E+03	1.010E-01
2005	3.272E+02	1.787E+05	1.201E+01	5.126E+00	1.430E+03	9.608E-02
2006	3.112E+02	1.700E+05	1.142E+01	4.876E+00	1.360E+03	9.139E-02
2007	2.961E+02	1.617E+05	1.087E+01	4.638E+00	1.294E+03	8.693E-02
2008	2.816E+02	1.538E+05	1.034E+01	4.412E+00	1.231E+03	8.269E-02
2009	2.679E+02	1.463E+05	9.833E+00	4.196E+00	1.171E+03	7.866E-02
2010	2.548E+02	1.392E+05	9.353E+00	3.992E+00	1.114E+03	7.482E-02
2011	2.424E+02	1.324E+05	8.897E+00	3.797E+00	1.059E+03	7.118E-02
2012	2.306E+02	1.260E+05	8.463E+00	3.612E+00	1.008E+03	6.770E-02
2013	2.193E+02	1.198E+05	8.050E+00	3.436E+00	9.585E+02	6.440E-02
2014	2.086E+02	1.140E+05	7.658E+00	3.268E+00	9.118E+02	6.126E-02
2015	1.984E+02	1.084E+05	7.284E+00	3.109E+00	8.673E+02	5.827E-02
2016	1.888E+02	1.031E+05	6.929E+00	2.957E+00	8.250E+02	5.543E-02
2017	1.796E+02	9.810E+04	6.591E+00	2.813E+00	7.848E+02	5.273E-02
2018	1.708E+02	9.331E+04	6.270E+00	2.676E+00	7.465E+02	5.016E-02
2019	1.625E+02	8.876E+04	5.964E+00	2.545E+00	7.101E+02	4.771E-02
2020	1.546E+02	8.443E+04	5.673E+00	2.421E+00	6.755E+02	4.538E-02
2021	1.470E+02	8.031E+04	5.396E+00	2.303E+00	6.425E+02	4.317E-02
2022	1.398E+02	7.640E+04	5.133E+00	2.191E+00	6.112E+02	4.106E-02
2023	1.330E+02	7.267E+04	4.883E+00	2.084E+00	5.814E+02	3.906E-02
2024	1.265E+02	6.913E+04	4.645E+00	1.982E+00	5.530E+02	3.716E-02
2025	1.204E+02	6.576E+04	4.418E+00	1.886E+00	5.260E+02	3.534E-02
2026	1.145E+02	6.255E+04	4.203E+00	1.794E+00	5.004E+02	3.362E-02
2027	1.089E+02	5.950E+04	3.998E+00	1.706E+00	4.760E+02	3.198E-02
2028	1.036E+02	5.660E+04	3.803E+00	1.623E+00	4.528E+02	3.042E-02
2029	9.855E+01	5.384E+04	3.617E+00	1.544E+00	4.307E+02	2.894E-02
2030	9.374E+01	5.121E+04	3.441E+00	1.468E+00	4.097E+02	2.753E-02
2031	8.917E+01	4.871E+04	3.273E+00	1.397E+00	3.897E+02	2.618E-02
2032	8.482E+01	4.634E+04	3.113E+00	1.329E+00	3.707E+02	2.491E-02
2033	8.068E+01	4.408E+04	2.962E+00	1.264E+00	3.526E+02	2.369E-02
2034	7.675E+01	4.193E+04	2.817E+00	1.202E+00	3.354E+02	2.254E-02
2035	7.301E+01	3.988E+04	2.680E+00	1.144E+00	3.191E+02	2.144E-02
2036	6.944E+01	3.794E+04	2.549E+00	1.088E+00	3.035E+02	2.039E-02
2037	6.606E+01	3.609E+04	2.425E+00	1.035E+00	2.887E+02	1.940E-02
2038	6.284E+01	3.433E+04	2.306E+00	9.844E-01	2.746E+02	1.845E-02
2039	5.977E+01	3.265E+04	2.194E+00	9.364E-01	2.612E+02	1.755E-02
2040	5.686E+01	3.106E+04	2.087E+00	8.907E-01	2.485E+02	1.670E-02
2041	5.408E+01	2.955E+04	1.985E+00	8.472E-01	2.364E+02	1.588E-02
2042	5.145E+01	2.810E+04	1.888E+00	8.059E-01	2.248E+02	1.511E-02
2043	4.894E+01	2.673E+04	1.796E+00	7.666E-01	2.139E+02	1.437E-02
2044	4.655E+01	2.543E+04	1.709E+00	7.292E-01	2.034E+02	1.367E-02
2045	4.428E+01	2.419E+04	1.625E+00	6.937E-01	1.935E+02	1.300E-02
2046	4.212E+01	2.301E+04	1.546E+00	6.598E-01	1.841E+02	1.237E-02
2047	4.007E+01	2.189E+04	1.471E+00	6.277E-01	1.751E+02	1.177E-02
2048	3.811E+01	2.082E+04	1.399E+00	5.970E-01	1.666E+02	1.119E-02
2049	3.625E+01	1.981E+04	1.331E+00	5.679E-01	1.584E+02	1.065E-02
2050	3.449E+01	1.884E+04	1.266E+00	5.402E-01	1.507E+02	1.013E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2051	3.280E+01	1.792E+04	1.204E+00	5.139E-01	1.434E+02	9.633E-03
2052	3.120E+01	1.705E+04	1.145E+00	4.888E-01	1.364E+02	9.163E-03
2053	2.968E+01	1.622E+04	1.089E+00	4.650E-01	1.297E+02	8.716E-03
2054	2.823E+01	1.542E+04	1.036E+00	4.423E-01	1.234E+02	8.291E-03
2055	2.686E+01	1.467E+04	9.858E-01	4.207E-01	1.174E+02	7.886E-03
2056	2.555E+01	1.396E+04	9.377E-01	4.002E-01	1.117E+02	7.502E-03
2057	2.430E+01	1.328E+04	8.920E-01	3.807E-01	1.062E+02	7.136E-03
2058	2.312E+01	1.263E+04	8.485E-01	3.621E-01	1.010E+02	6.788E-03
2059	2.199E+01	1.201E+04	8.071E-01	3.445E-01	9.610E+01	6.457E-03
2060	2.092E+01	1.143E+04	7.678E-01	3.277E-01	9.141E+01	6.142E-03
2061	1.990E+01	1.087E+04	7.303E-01	3.117E-01	8.695E+01	5.842E-03
2062	1.893E+01	1.034E+04	6.947E-01	2.965E-01	8.271E+01	5.558E-03
2063	1.800E+01	9.835E+03	6.608E-01	2.820E-01	7.868E+01	5.286E-03
2064	1.712E+01	9.355E+03	6.286E-01	2.683E-01	7.484E+01	5.029E-03
2065	1.629E+01	8.899E+03	5.979E-01	2.552E-01	7.119E+01	4.783E-03
2066	1.550E+01	8.465E+03	5.688E-01	2.427E-01	6.772E+01	4.550E-03
2067	1.474E+01	8.052E+03	5.410E-01	2.309E-01	6.442E+01	4.328E-03
2068	1.402E+01	7.659E+03	5.146E-01	2.196E-01	6.128E+01	4.117E-03
2069	1.334E+01	7.286E+03	4.895E-01	2.089E-01	5.829E+01	3.916E-03
2070	1.269E+01	6.931E+03	4.657E-01	1.987E-01	5.544E+01	3.725E-03
2071	1.207E+01	6.593E+03	4.430E-01	1.890E-01	5.274E+01	3.544E-03
2072	1.148E+01	6.271E+03	4.214E-01	1.798E-01	5.017E+01	3.371E-03
2073	1.092E+01	5.965E+03	4.008E-01	1.711E-01	4.772E+01	3.206E-03
2074	1.039E+01	5.674E+03	3.813E-01	1.627E-01	4.539E+01	3.050E-03
2075	9.880E+00	5.398E+03	3.627E-01	1.548E-01	4.318E+01	2.901E-03
2076	9.398E+00	5.134E+03	3.450E-01	1.472E-01	4.107E+01	2.760E-03
2077	8.940E+00	4.884E+03	3.281E-01	1.400E-01	3.907E+01	2.625E-03
2078	8.504E+00	4.646E+03	3.121E-01	1.332E-01	3.717E+01	2.497E-03
2079	8.089E+00	4.419E+03	2.969E-01	1.267E-01	3.535E+01	2.375E-03
2080	7.695E+00	4.204E+03	2.824E-01	1.205E-01	3.363E+01	2.260E-03
2081	7.319E+00	3.999E+03	2.687E-01	1.147E-01	3.199E+01	2.149E-03
2082	6.962E+00	3.804E+03	2.556E-01	1.091E-01	3.043E+01	2.044E-03
2083	6.623E+00	3.618E+03	2.431E-01	1.038E-01	2.894E+01	1.945E-03
2084	6.300E+00	3.442E+03	2.312E-01	9.869E-02	2.753E+01	1.850E-03
2085	5.993E+00	3.274E+03	2.200E-01	9.388E-02	2.619E+01	1.760E-03
2086	5.700E+00	3.114E+03	2.092E-01	8.930E-02	2.491E+01	1.674E-03
2087	5.422E+00	2.962E+03	1.990E-01	8.494E-02	2.370E+01	1.592E-03
2088	5.158E+00	2.818E+03	1.893E-01	8.080E-02	2.254E+01	1.515E-03
2089	4.906E+00	2.680E+03	1.801E-01	7.686E-02	2.144E+01	1.441E-03
2090	4.667E+00	2.550E+03	1.713E-01	7.311E-02	2.040E+01	1.370E-03

APPENDIX C
LANDFILL GAS BLOWER PERFORMANCE SPECIFICATIONS

ENGINEERING DESIGN REPORT
LANDFILL GAS COLLECTION AND CONTROL SYSTEM
South Park Landfill Site
Seattle, Washington

Farallon PN: 408-002

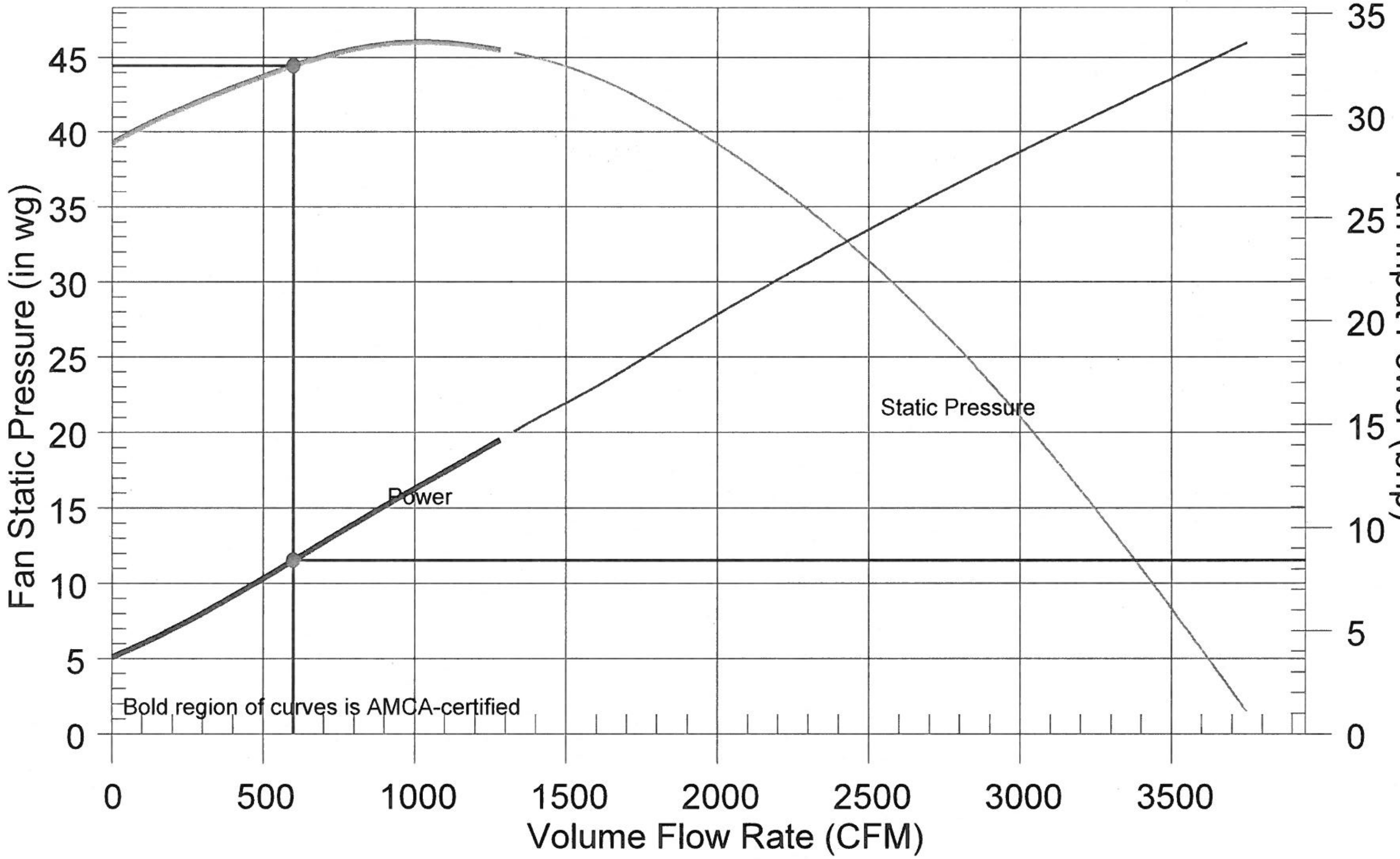
The New York Blower Company

Fan-to-Size

Pressure Blower
2606 Aluminum
Arr.: 1

Volume Flow Rate: 600 CFM
Fan Static Press.: 44.4 in wg
Speed: 3500 rpm
Power: 8.41 bhp

Temp.: 70 Deg F
Altitude: 0 ft
Density: 0.0640 lb/ft3
Outlet Velocity: 3061 ft/min



AMCA Licensed for Air Performance without Appurtenances (Accessories). Power (bhp) excludes drives.
Performance certified is for installation type: B - free inlet, ducted outlet.

Your Sales Representative:
Baxter Air Engineering
Phone: 425-486-6666

[v1.83.300-R --] Date Printed: 7/1/2014

The New York Blower Company
Fan-to-Size
Fan Selection Data

Project:	
Location:	
Contact:	

Fan Design

Product:	Pressure Blower	Arrangement:	1
Size/Model:	2606A	Drive type:	Belt
Wheel Type:	Aluminum		
Wheel Material:	Aluminum		
Wheel Width:	100.0 %	Wheel Diameter:	100.0 %

Operating Conditions

Volume Flow Rate:	600 CFM	Fan Speed:	3500 rpm
Fan Static Pressure:	44.4 in wg	Fan Input Power:	8.41 bhp
Outlet Velocity:	3061 ft/min	VP/SP ratio:	0.0112
Altitude (above mean sea level):	0 ft	Operating Temperature:	70 Deg F
Operating Inlet Airstream Density:	0.0640 lb/ft3		
Static Efficiency:	49.82%	Mechanical Efficiency:	50.38%
Maximum Operating Temperature:	70 Deg F	Maximum Safe Operating Speed:	3800 rpm

Sound Power Level Ratings Levels expressed in dB (power levels reference 10^(-12) watts)

Center Frequency (Hz):	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
Octave Bands:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Overall**
Total Fan Power Levels*:	87.	94.	101.	104.	102.	96.	92.	82.	107.9
Inlet Power Levels**:	84.	91.	98.	101.	99.	93.	89.	79.	104.9
Outlet Power Levels**:	84.	91.	98.	101.	99.	93.	89.	79.	104.9

*As corrected for point of operation (location on fan curve)
**Unsilenced Inlet and Outlet power ratings are 3 dB lower than total fan power levels under the assumption that "half" of the sound power can be attributed to each opening. Silenced power ratings include this 3 dB reduction as well as the silencer attenuation.

Estimated Sound Pressure Levels Expressed in dB (pressure levels reference $2x10^{-7}$ microbar)

Directivity/Reflection Factor (Q) is 1, spherical radiation; Distance is 5 ft.; A-weighting is in use.

The estimated sound pressure level outside the fan due to an open inlet OR outlet is 88.3 dBA at 5.0 feet. The estimated sound pressure level outside the fan when BOTH inlet and outlet are ducted is 76.3 dBA at 5.0 feet (Housing Radiated Noise).

Your Representative:
Baxter Air Engineering
12625 NE Woodinville Dr
Woodinville, WA 98072-8206
USA
Phone: 425-486-6666
Fax: 425-486-8260
E-Mail: da

The New York Blower Company certifies that the Pressure Blower fan is licensed to bear the AMCA Air Performance Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings program.

AMCA Licensed for Air Performance without Appurtenances (Accessories). Power (bhp) excludes drives.

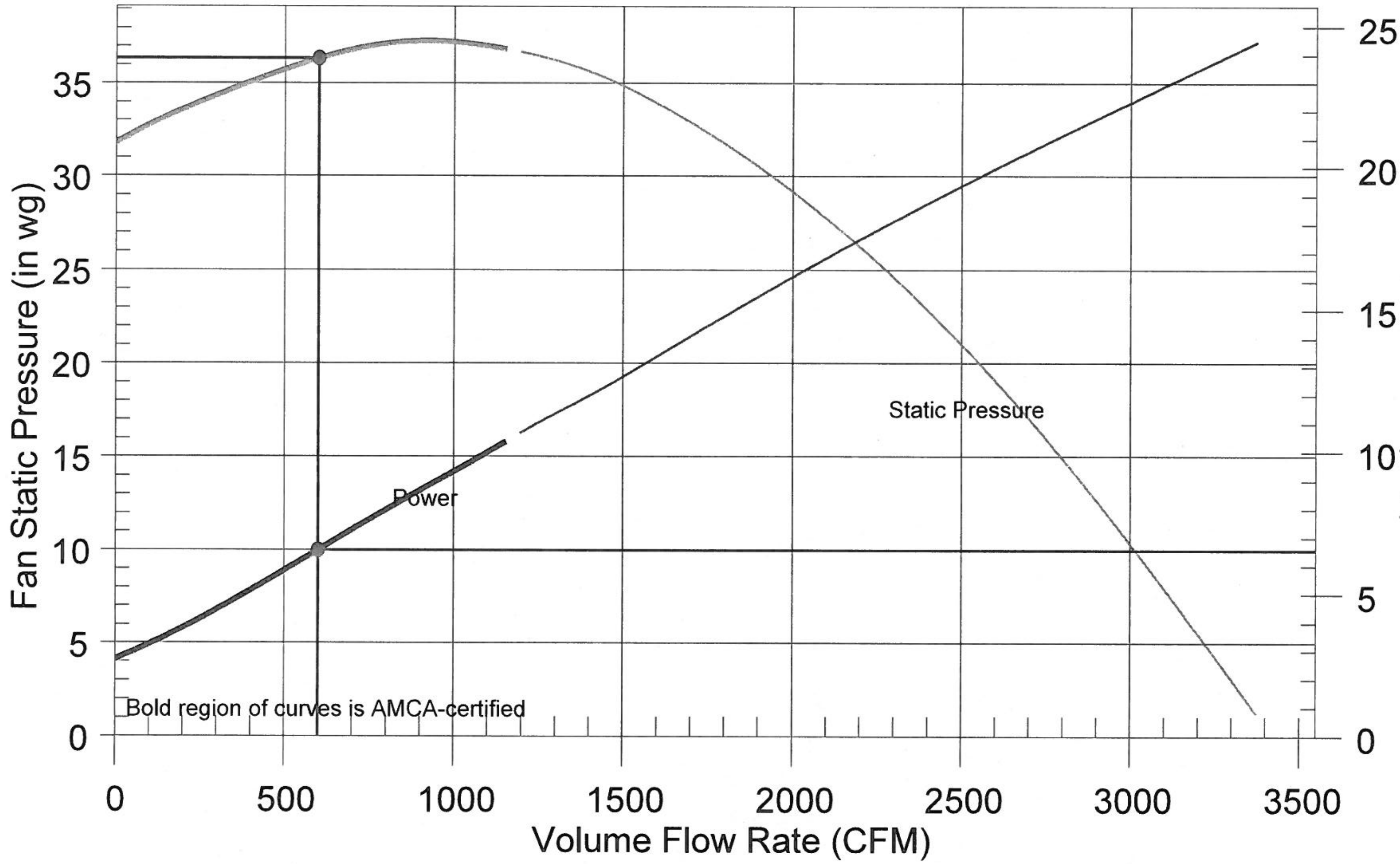
Performance certified is for installation type: B - free inlet, ducted outlet.

The New York Blower Company

Fan-to-Size
Volume Flow Rate: 600 CFM
Fan Static Press.: 36.3 in wg
Speed: 3150 rpm
Power: 6.56 bhp

Pressure Blower
2606 Aluminum
Arr.: 1

Temp.: 70 Deg F
Altitude: 0 ft
Density: 0.0640 lb/ft3
Outlet Velocity: 3061 ft/min



AMCA Licensed for Air Performance without Appurtenances (Accessories). Power (bhp) excludes drives.
Performance certified is for installation type: B - free inlet, ducted outlet.

Your Sales Representative:
Baxter Air Engineering
Phone: 425-486-6666

[v1.83.300-R --] Date Printed: 7/1/2014

The New York Blower Company
Fan-to-Size
Fan Selection Data

Project:	
Location:	
Contact:	

Fan Design

Product:	Pressure Blower	Arrangement:	1
Size/Model:	2606A	Drive type:	Belt
Wheel Type:	Aluminum		
Wheel Material:	Aluminum		
Wheel Width:	100.0 %	Wheel Diameter:	100.0 %

Operating Conditions

Volume Flow Rate:	600 CFM	Fan Speed:	3150 rpm
Fan Static Pressure:	36.3 in wg	Fan Input Power:	6.56 bhp
Outlet Velocity:	3061 ft/min	VP/SP ratio:	0.0137
Altitude (above mean sea level):	0 ft	Operating Temperature:	70 Deg F
Operating Inlet Airstream Density:	0.0640 lb/ft3		
Static Efficiency:	52.21%	Mechanical Efficiency:	52.93%
Maximum Operating Temperature:	70 Deg F	Maximum Safe Operating Speed:	3800 rpm

Sound Power Level Ratings Levels expressed in dB (power levels reference 10^(-12) watts)

Center Frequency (Hz):	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
Octave Bands:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Overall**
Total Fan Power Levels*:	86.4	91.7	98.1	101.7	99.3	93.5	89.7	80.6	105.5
Inlet Power Levels**:	83.4	88.7	95.1	98.7	96.3	90.5	86.7	77.6	102.5
Outlet Power Levels**:	83.4	88.7	95.1	98.7	96.3	90.5	86.7	77.6	102.5

*As corrected for point of operation (location on fan curve)
**Unsilenced Inlet and Outlet power ratings are 3 dB lower than total fan power levels under the assumption that "half" of the sound power can be attributed to each opening. Silenced power ratings include this 3 dB reduction as well as the silencer attenuation.

Estimated Sound Pressure Levels Expressed in dB (pressure levels reference 2x10^{-7} microbar)

Directivity/Reflection Factor (Q) is 1, spherical radiation; Distance is 5 ft.; A-weighting is in use.

The estimated sound pressure level outside the fan due to an open inlet OR outlet is 85.8 dBA at 5.0 feet. The estimated sound pressure level outside the fan when BOTH inlet and outlet are ducted is 73.8 dBA at 5.0 feet (Housing Radiated Noise).

Your Representative:
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Woodinville, WA 98072-8206
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The New York Blower Company certifies that the Pressure Blower fan is licensed to bear the AMCA Air Performance Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings program.

AMCA Licensed for Air Performance without Appurtenances (Accessories). Power (bhp) excludes drives.

Performance certified is for installation type: B - free inlet, ducted outlet.