

# King County Department of Natural Resources and Parks Solid Waste Division

Phase 1 – Vashon Island Closed Landfill  
CONTRACT NO. E00102E08  
Task No. 310.1.7.6 - D310.1.7.6.1

## Landfill Gas Extraction Well Installation Work Plan Addendum

Prepared by  
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**King County**

Department of  
Natural Resources and Parks  
**Solid Waste Division**

<i>Waste</i> <b>Prevention</b>	<i>Resource</i> <b>Recovery</b>	<i>Waste</i> <b>Disposal</b>
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[www.kingcounty.gov/solidwaste](http://www.kingcounty.gov/solidwaste)

June 12, 2018  
FINAL





**VASHON ISLAND CLOSED LANDFILL**  
**Landfill Gas Extraction Well**  
**Installation Work Plan Addendum**  
Prepared for: King County Solid Waste Division

Project No. 090057-310.1.7.6 • June 12, 2018 Final

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# 1 Introduction

This Work Plan Addendum (Addendum) presents the details of field procedures for installation of two new landfill gas (LFG) extraction wells, GW-10 and GW-11, at the Vashon Island Closed Landfill (Site; Figure 1). This Addendum was prepared under Task 310.1.7.6 of Contract No. E00102E08 with Aspect Consulting, LLC (Aspect).

The two new extraction wells GW-10 and GW-11 will expand the LFG collection system (see Figure 2) in order to capture landfill gas south of the main closure area. Proposed installation locations are based on the findings of Task 310.1.7.7, investigations to evaluate the extent of refuse and LFG, and Task 310.1.6.4, influence testing of LFG extraction well GW-9.

This Addendum consists of the following sections:

- New well locations and predrilling activities
- Drilling methods and monitoring
- Extraction well installation

The original Work Plan (Aspect, 2016a) addressed erosion control and Site restoration, handling investigation-derived waste, and decontamination procedures. The details for these elements of well installation have not changed and therefore are not included in this Addendum.

The new wells GW-10 and GW-11 are scheduled to be installed in the third quarter of 2018. A technical memorandum documenting installation (Task D310.1.7.6.3) will be provided concurrent with an influence testing work plan for GW-10 and GW-11 (Task D.310.1.6.4.3).

## 2 New Well Locations and Predrilling Activities

The need for and placement of two new LFG extraction wells (GW-10 and GW-11) are based on current understanding of the extent and thickness of refuse in the area, LFG generation and potential vertical LFG migration to groundwater, and findings from influence testing at GW-9 (Aspect, 2017).

LFG extraction well GW-10 will be installed between existing temporary gas probes VTP-4S and VTP-5S, and LFG extraction well GW-11 will be installed between existing temporary gas probes VTP-5D and VTP-7. The locations for the proposed LFG extraction wells are shown relative to GW-9 and other site features on Figure 3.

For context, an alternate location for GW-10 was considered, primarily because of the extent of refuse in the south slope area. A deeper well completed below the refuse was

also considered. However, the location for GW-10 was selected for the following reasons:

- Less likely to experience atmospheric air intrusion from a well located further from slope face than closer to slope.
- Likely to collect more landfill gas from well with perforation interval within refuse than from soils below refuse.
- More likely to collect landfill gas potentially generated by waste beneath the Phase 2 landfill underliner with well closer to main closure area than well closer to slope.
- Logistically easier to install and connect well located closer to EF-1 than from location further away.

Drilling locations will be field-staked prior to field work during a site walk with project representatives from King County Solid Waste Division (KCSWD), Aspect, and the drilling contractor, Holt Services (Holt). A public and private utility locate will be conducted prior to drilling.

## 3 Drilling Methods and Monitoring

Similar to installation of GW-9, new wells GW-10 and GW-11 will be installed using a dual-casing roto-sonic drilling system that allows the collection of continuous-core soil samples. Landfill gases will be monitored to protect worker health and safety. Field observations will be communicated regularly by Aspect to keep KCSWD personnel informed of progress. Additional details of drilling methods and monitoring are provided below.

### 3.1 Soil Logging and Potential Conditions

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During drilling, soil samples will be collected for soil classification. Field screening will be performed continuously at 5- to 20-foot lengths using a 4.75-inch-diameter inner core barrel and an 8-inch-diameter outer casing. Soil samples will be collected from the inner core barrel during sonic drilling, which provides a near-continuous section of cored soil. The recovered sonic core will be carefully extruded from the inner core barrel into a plastic wrap at ground surface to preserve sample moisture content.

The recovered core will be laid out onto the sample collection and logging area. The plastic wrap will be cut open, and the resulting core segment logged by the Aspect field geologist onsite. Sample descriptions will be made in general accordance with ASTM International (ASTM) Method D2488, Standard Practice for Description and Identification of Soils (Visual/Manual Procedure). All information pertaining to the borings will be recorded on field boring logs. The core will be subsampled at 5-foot intervals and at lithologic changes and then placed in chip trays for archiving. Cores and associated plastic will be disposed of after the geologic log is finalized and project representatives have been given an opportunity to review the core. Core samples and chip

trays will be photographed. Soil cuttings will be stored in dedicated drums or roll-off containers and managed as described in Section 8.0 of the Work Plan, Investigative-Derived Waste (Aspect, 2016a).

The LFG extraction wells will be completed above the groundwater table. Although considered unlikely, if water is encountered in the borehole, the driller will be instructed to stop drilling. Sufficient time (up to 30 minutes) will be allowed for the water level to equilibrate. The water level will be measured through the drill string and referenced to ground-surface elevation. A grab sample will be collected with a bailer to measure field parameters (including specific conductance, temperature, dissolved oxygen, pH, and oxidation-reduction potential). These groundwater quality field parameters will be measured only if water is not added during drilling. Drilling will resume after the water level has been measured, and a water sample has been collected.

### **3.2 Monitoring for Worker Health and Safety**

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Soil samples and cuttings will be field-screened for the presence of volatile organic vapors using a MiniRae 3000 photoionization detector (PID). The PID is designed to detect and measure volatile organic compound (VOC) vapors in air, but it does not detect methane. The VOC concentrations will be used to monitor worker health and safety during drilling, and to indicate if VOCs appear to be present in the soil encountered during drilling (measurements will indicate a potential for contamination that may be investigated further).

In addition, a LandTec GEM 5000 LFG meter will be used to monitor LFG—methane, carbon dioxide, and oxygen concentrations (percent by volume), as well as hydrogen sulfide (H<sub>2</sub>S) concentrations (ppm)—during drilling. LFG measurements will be taken from the top of the drill casing after each sample run, and periodic ambient air measurements will be recorded as part of the Health and Safety Plan.

In the case of elevated LFG concentrations, drilling will cease and a brush fan provided by Holt will be used to clear the immediate area of landfill gasses. Drilling will resume after mitigation plans approved by Aspect's Health and Safety officer are put into place to ensure safe drilling operations. See the Health and Safety Plan in Work Plan for more details.

### **3.3 Communicating Field Observations**

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Field calibration of equipment will be recorded by the Aspect field representative in the field notes. Pertinent subsurface conditions and well installation details, PID measurements, and LFG readings will be recorded on soil boring and extraction well installation log (Appendix B). Daily reports and LFG monitoring logs will be generated to document activity performed each day. Email updates will be prepared and transmitted to KCSWD the following morning.

To ensure targeted depths of new locations are achieved during drilling, an experienced Aspect field geologist will be onsite collecting soil samples, logging cores, and interpreting the depths to the top and bottom of refuse. These interpretations will be

compared to information observed in previously-completed nearby borings and confirmed with Aspect's field manager prior to specifying the well perforation interval.

### 3.4 Decontamination Procedures

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To minimize the distribution of contaminants offsite, all personnel shall be decontaminated before leaving the Site. Personnel decontamination shall be required prior to breaks and when transferring tools, equipment, or materials within the site, or following any other activities where the potential exists for contamination transfer.

All equipment shall be cleaned and decontaminated prior to use onsite, between well sites, and prior to leaving the Site. All equipment shall be washed and cleaned under the appropriate level requirements as specified by the Aspect field manager prior to the initiation of work at the Site. This includes the drill rig, casing, pipe, pumps, tremie pipe, cables, augers, drill bits, drill stem, rods, samplers, well materials, sounding devices, and any tools used during drilling. This is especially important to prevent cross-contamination between wells by equipment being placed down the well or borehole. In the event refuse is encountered, sampling tools shall be decontaminated as approved by Aspect between sample intervals. Between each well, all drilling and driving equipment used in the boreholes or wells shall be decontaminated as approved by Aspect.

Decontamination water shall be placed in DOT-approved 55-gallon drums, and temporarily stored in a location identified by Aspect and KCSWD. A decontamination pad will be used to collect all decontamination water, which will be directed to the drums. Aspect will notify KCSWD personnel to arrange for disposal of decontamination water.

## 4 Extraction Well Installation

New LFG extraction wells GW-10 and GW-11 will be constructed consistent with regulatory requirements provided by WAC 173-160 using methods and materials similar to existing well GW-9.

### 4.1 New Well Construction

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The proposed LFG extraction wells will be completed within the refuse. The estimated well construction dimensions for GW-10 and GW-11 are presented in Table 1, alongside information for existing well GW-9. Based on the observed refuse depth and thickness in nearby borings, the refuse layer is anticipated between 15 and 36 feet below ground surface (21 feet thick) at GW-10, and between 8 and 18 feet below ground surface (10 feet thick) at GW-11 (Table 1). The wells will be drilled until native material is identified in the core samples.

Any overdrilled section below the bottom of refuse (minimum) will be backfilled and sealed with hydrated bentonite chips or pellets to a minimum of 2 feet above the bottom of refuse. This bentonite thickness between the bottom of refuse and the gravel pack is recommended to prevent the flow of water from the well to refuse or the underlying



native soils. A 1-foot-thick layer of 0.75- to 1-inch gravel will be placed on top of the bentonite to provide a firm base for the well.

Each LFG extraction well will be constructed of 4-inch-diameter HDPE well casing with a welded end cap. The HDPE casing will be perforated from a minimum of 3 feet above the bottom of refuse to a minimum of 3 feet below the top of refuse. Perforations will be made with four 0.5-inch-diameter drilled holes surrounding the circumference of the casing for every 6 inches of screen length (Photograph 1 shows the perforated section below being welded to blank casing above for GW-9). The well annulus will be backfilled with 0.75- to 1-inch gravel to a minimum of 1 foot above the top of perforations, corresponding with 2 feet below the top of refuse. A 2-foot-thick bentonite seal between the top of refuse and the gravel pack is recommended to prevent atmospheric air intrusion through the well annulus.

A minimum 3-foot-thick bentonite seal will be placed above the gravel pack, and the remainder of the annular space will be backfilled with either bentonite chips or pellets to fill the annular space around the extraction well casing to within approximately 2 to 3 feet below ground surface. As the chips are placed, they will be continuously sounded to ensure bridging is not occurring. Water used for hydrating chips will be provided by Holt from a potable water source.

## 4.2 Wellhead Completion

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A LFG extraction wellhead assembly will be constructed aboveground for each well (see Figure 4). The wellhead will be temporarily capped to prevent unintended discharge to atmosphere (Photograph 2 shows the temporary wellhead completion at GW-9). KCSWD will connect the wellhead to the existing LFG extraction system header, similar to the connection provided for GW-9 (Herrera, 2016).

## 4.3 Surveying and Lateral Connection

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Following installation, KCSWD will survey final horizontal positions and elevations for the ground surface and top of casing of the new extraction wells using the Site coordinate system and datums.

Similar to GW-9, KCSWD will connect the wellheads at GW-10 and GW-11 to the existing LFG collection system using aboveground laterals. New laterals and valved monitoring assemblies will be connected to the header near EF-1, similar to the setup for GW-9 (Herrera, 2016). Photograph 3 shows the GW-9 lateral connection at EF-1, including a 2-inch-diameter Flo-Wing assembly. Photograph 4 shows the lateral connection at GW-9, with a GasClam assembly to the right of the wellhead.

## References

- ASTM International (ASTM), 2018, 2018 Annual Book of ASTM Standards, West Conshohocken, Pennsylvania.
- Aspect Consulting, LLC (Aspect), 2016a, Vashon Landfill – Landfill Gas Extraction Well and Temporary Probe Installation Work Plan, Task D310.1.7.6.1, Prepared for King County Solid Waste Division, July 8, 2016.
- Aspect Consulting, LLC (Aspect), 2016b, Vashon Landfill – Gas Extraction Well and Temporary Probe Installation Technical Memorandum, Task D310.1.7.6.2, Prepared for King County Solid Waste Division, September 23, 2016.
- Aspect Consulting, LLC (Aspect), 2017, Vashon Landfill – Influence Testing Summary Report, Task D310.1.6.4.2, Prepared for King County Solid Waste Division, June 7, 2017.
- Herrera Environmental Consultants (Herrera), 2016, Vashon Island Landfill, Landfill Gas Extraction Well and Influence Testing, Site Plan, Draft Preliminary Design Drawing Nos. C-1 and C-2, July 2016.

## Limitations

Work for this project was performed for the King County Solid Waste Division (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

# **TABLES**

# Table 1 - Expected Drilling Depths

Project No. 090057-310.1.7.6.1, Vashon Island Closed Landfill, King County, Washington

Well ID	Ground Surface Elevation	Approximate Depth of Refuse		Approximate Gravel Pack		Approximate Perforated Interval		Approximate Screen Length
		Top	Bottom	Top	Bottom	Top	Bottom	
	feet	feet bgs	feet bgs	feet bgs	feet bgs	feet bgs	feet bgs	feet
GW-9	358	12	38	15	36	17	35	18
GW-10	360	15	36	17	34	18	33	15
GW-11	360	8	18	10	16	11	15	4

**Notes:**

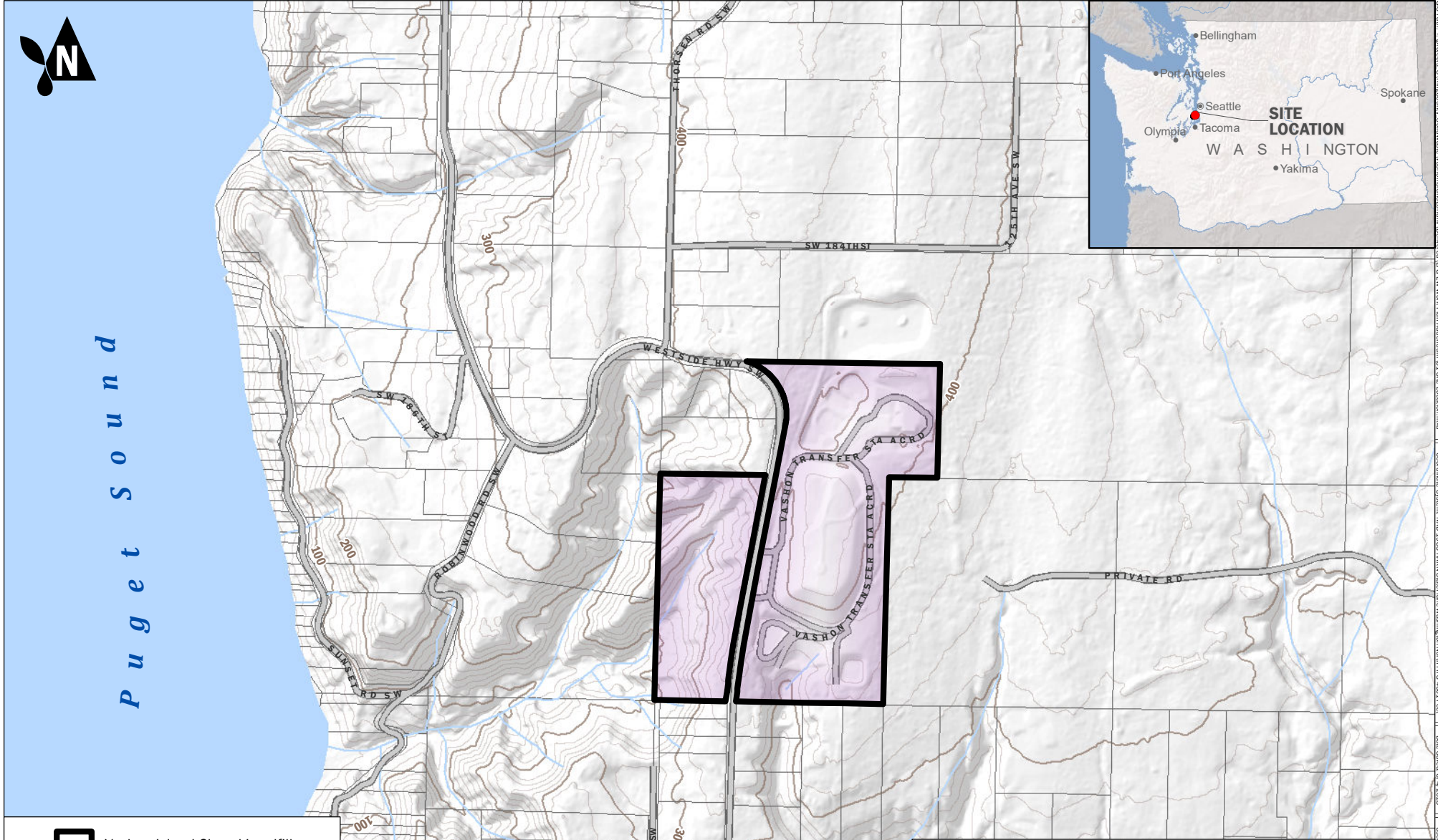
bgs - below ground surface

GW-9 information based on as-built conditions (Aspect, 2016b).

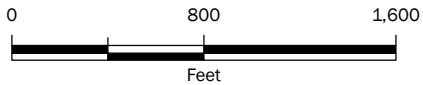
# FIGURES



P u g e t S o u n d



- Vashon Island Closed Landfill
- Stream
- Topographic Contour  
Source: King County LiDAR, 2016
- Road
- King County Tax Parcel



### Site Location Map

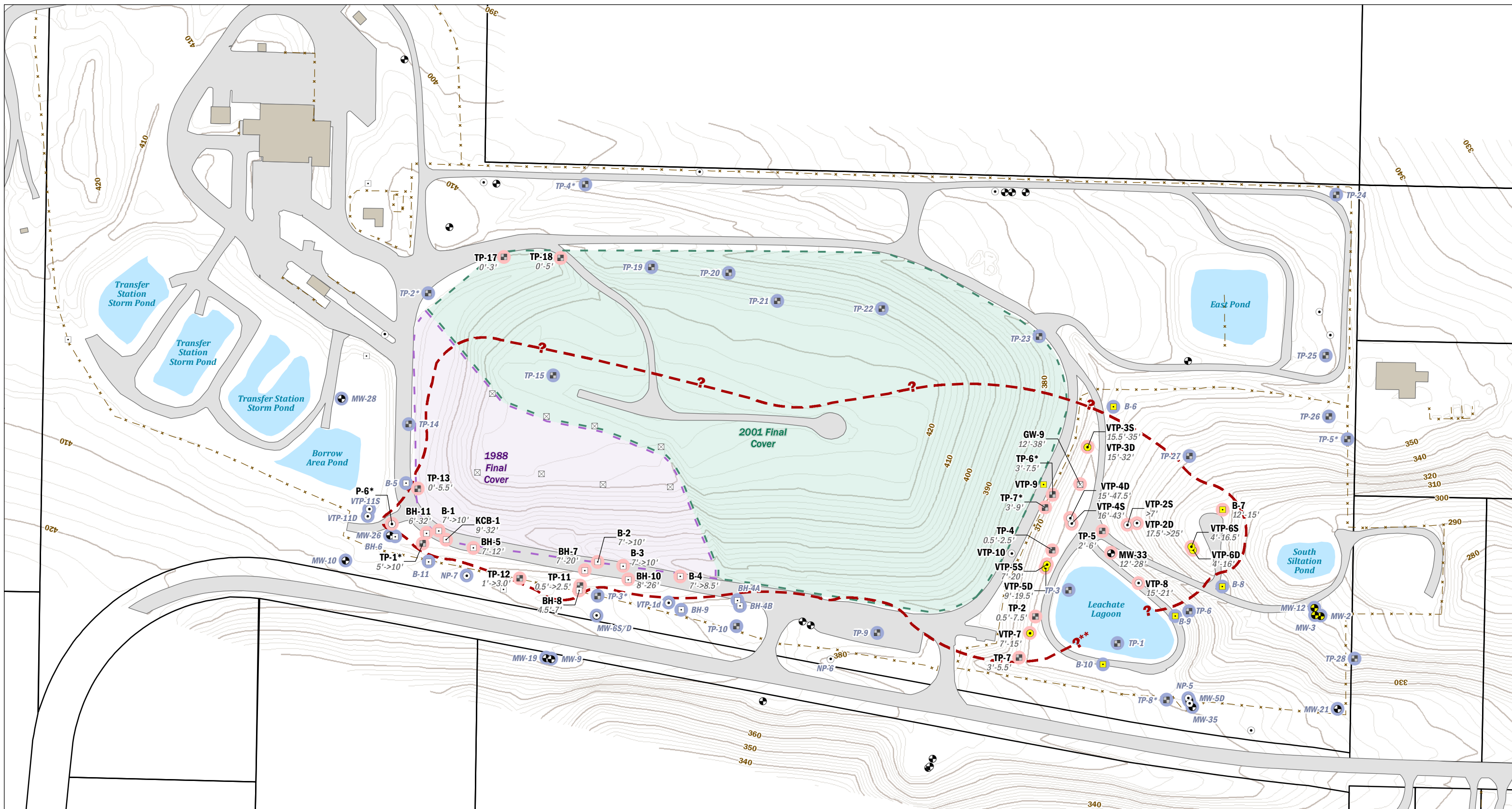
LFG EW Work Plan Addendum  
Vashon Island Closed Landfill  
King County, Washington



JUN-2018  
BY:  
DAC / RAP

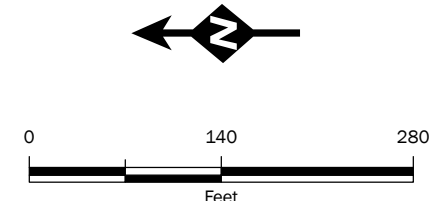
FIGURE NO.  
**1**





- Boring
- Gas Probe
- LFG Extraction Well
- Monitoring Well
- Test Pit
- Estimated Extent of Unlined Refuse
- 1988 Final Cover
- 2001 Final Cover
- Encountered Refuse
- No Refuse, Native Soils Encountered After Fill Unit
- Boring (Till Absent)
- Gas Probe (Till Absent)
- Monitoring Well (Till Absent)
- Pond
- Building
- Road
- Fence
- King County Tax Parcel

Notes:  
 \*Exploration from Golder 1986  
 \*\*TP-1 and TP-3, completed in 1987, indicates refuse does not extend under Leachate Lagoon  
 -For explorations where refuse was not encountered and underlying native soils were not encountered, a blue or red halo was not applied to those explorations. These explorations were likely too shallow to provide data on refuse extent.  
 -Topographic contours from King County Survey, Spring 2017



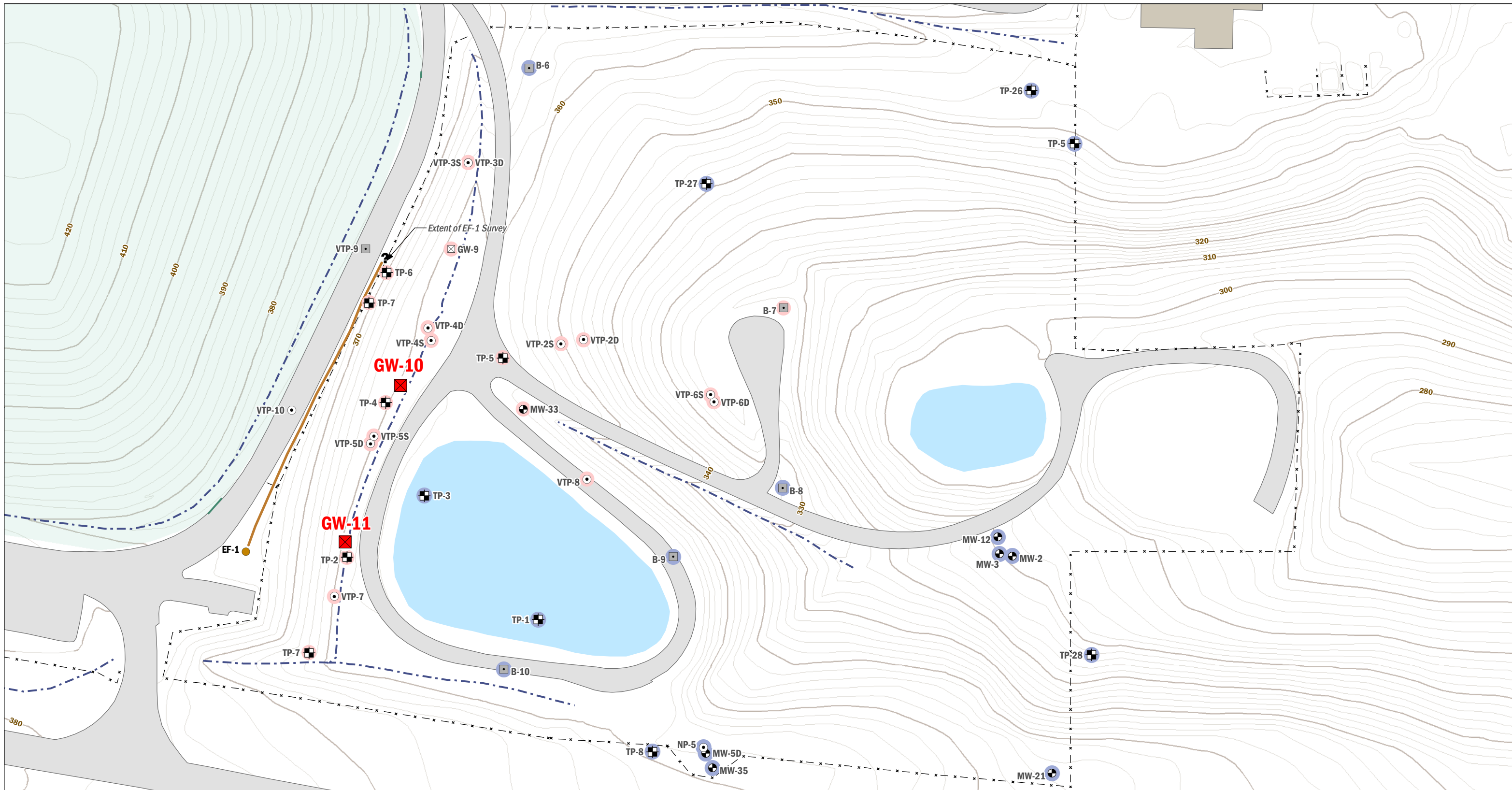
### Site Layout

LFG EW Work Plan Addendum  
 Vashon Island Closed Landfill  
 King County, Washington

		JUN-2018	FIGURE NO. <b>2</b>
		BY: DAC / RAP	

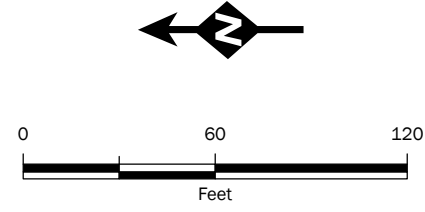
GIS Path: T:\projects\_8\KingCounty\_SolidWaste\WashingtonIsland\landfill\DW\lfg\_ew\_work\_plan\_addendum\02\_Extent of Solid Waste.mxd | Coordinate System: NAD 1983 NAD StatePlane Washington North FIPS 4601 Feet | Date Saved: 6/4/2018 | User: jrgpin | Print Date: 6/4/2018





<p><b>Proposed Exploration</b></p> <ul style="list-style-type: none"> <li>☒ LFG Extraction Well</li> </ul>	<p><b>Existing Exploration</b></p> <ul style="list-style-type: none"> <li>■ Boring</li> <li>○ Gas Probe</li> <li>☒ LFG Extraction Well</li> <li>⊕ Monitoring Well</li> <li>⊕ Test Pit</li> </ul>	<ul style="list-style-type: none"> <li>● Encountered Refuse</li> <li>● No Refuse Encountered</li> <li>○ 2001 Final Cover</li> <li>● EF-1</li> <li>— Landfill Gas System Pipe <i>Partial System Shown Query indicates Landfill Gas Pipe Location Beyond Survey Limits Unknown</i></li> </ul>	<ul style="list-style-type: none"> <li>☁ Pond</li> <li>--- Ditch</li> <li>- - - Fence</li> <li>▭ Road</li> <li>▭ Building</li> </ul>
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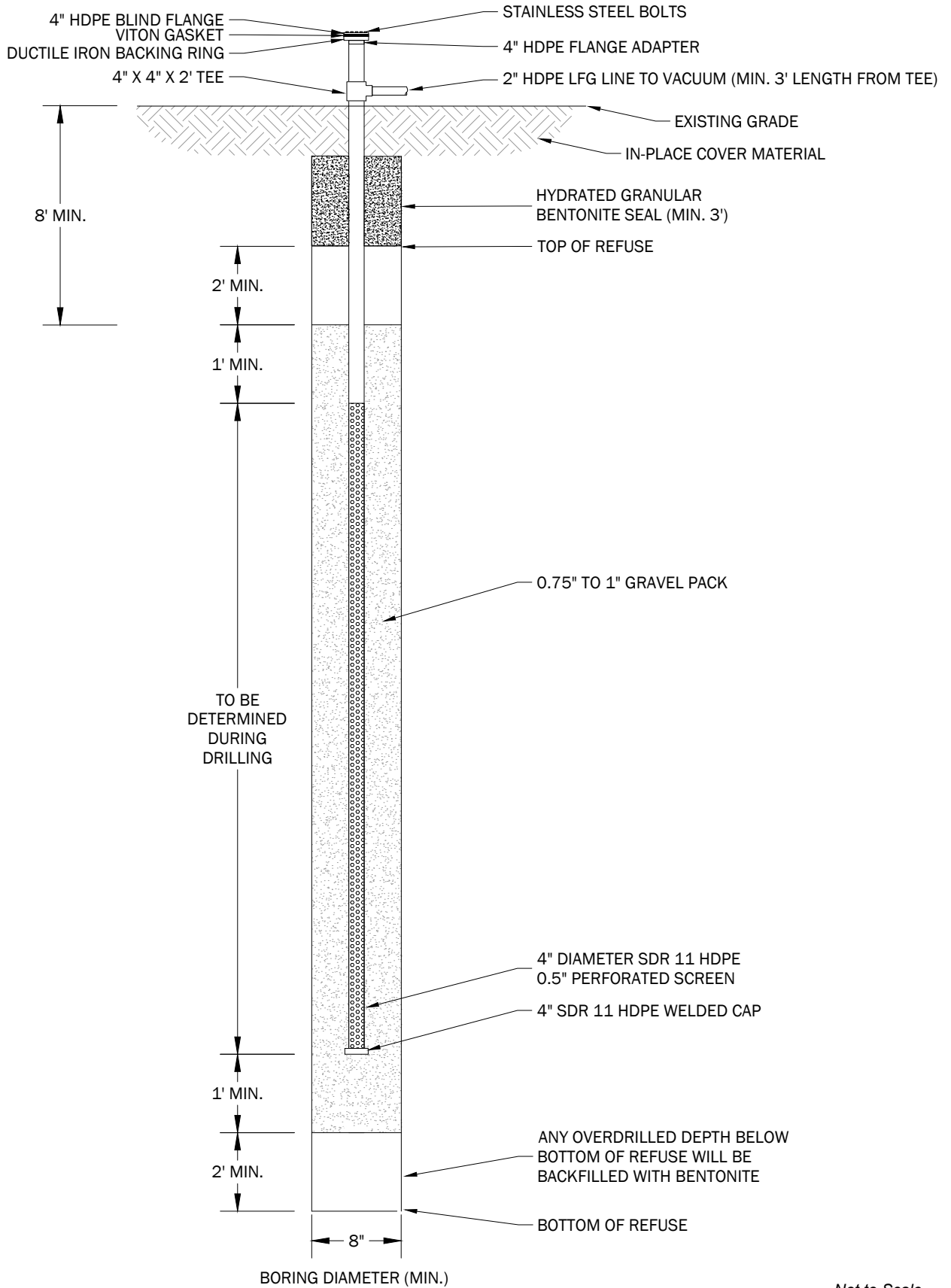
*Approximate proposed explorations locations shown. Exact locations contingent on accessibility.*



**Proposed Gas Extraction Wells**  
LFG EW Work Plan Addendum  
Vashon Island Closed Landfill  
King County, Washington

		JUN-2018	FIGURE NO. <b>3</b>
		BY: PSB / RAP	

GIS Path: T:\projects\_8\KingCounty\_SolidWaste\WashingtonIsland\landfill\Delivered\Work Plan - Eval of Refuse Areas\Proposed Gas Extraction Wells - South Super.mxd | Coordinate System: NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet | Date Saved: 6/4/2018 | User: jpepin | Print Date: 6/4/2018



Not to Scale



### Typical LFG Extraction Well Completion Diagram

Vashon Island Landfill Work Plan  
 Vashon Island Landfill, King County, Washington

DATE	June 2018
DESIGNED BY	ELG
DRAWN BY	SCC
REVISED BY	PSB/SCC

PROJECT NO.	090057
FIGURE NO.	4

# **ATTACHMENT 1**

## **Photographs**



Photograph 1. Perforated section (below) being welded to blank casing (above) for GW-9



Photograph 2. Temporary wellhead completion at GW-9





Photograph 3. GW-9 lateral connection at EF-1



Photograph 4. Lateral connection at GW-9