April 15, 2024
File No. 04224030.20

Mr. Andrew Smith
Washington State Department of Ecology
Southwest Regional Office
Toxics Cleanup Program
300 Desmond Drive
Lacey, Washington 98503

Subject: Work Plan for Groundwater and Landfill Gas Monitoring Network Modifications, Closed Leichner Landfill, Clark County, Washington

Dear Mr. Smith:

This letter presents a work plan to modify the groundwater and landfill gas (LFG) monitoring networks at the closed Leichner Landfill (Landfill) to accommodate the planned development of the City of Vancouver's operations center on the former Koski property, located adjacent to the south end of the Landfill (Figure 1). The scope of the modifications includes (1) decommissioning groundwater monitoring wells LB-6S, LB-5S, LB-5C and LB-5D (see Figure 1), (2) installing replacement monitoring wells for LB-5S and LB-5D, (3) decommissioning compliance landfill gas (LFG) probes GP-26 and GP-27 (see Figure 2) and (4) installing five new LFG compliance probes along the southern edge of the landfill. SCS Engineers (SCS) in Portland, Oregon, prepared this work plan on behalf of and with approval from Clark County Public Health (CCPH).

The rationale for making the proposed modifications to the groundwater and LFG monitoring networks noted above are as follows:

- The operations facility being planned for the former Koski property includes structures built over the area where the current LB-5 group of wells are located. It is not feasible to have the wells inside the finished building

- LB-6S is located in the northwest corner of the property, near NE 94th Avenue and construction traffic will likely damage the well in its current location. Rather than risk damaging the well, it will be decommissioned just prior to construction.

- Once the operations center is built, wells LB-5S and LB-5D are proposed to be re-installed at a new location (see Figure 1). Replacement wells for LB-6S and LB-5C are not proposed to be re-installed for the reasons presented in this work plan.

- Once the new operations facility is built, five new compliance perimeter LFG gas probes will be installed along the southern landfill boundary. Proposed locations of the new LFG probes are shown in Figure 2. Once the new probes are installed, existing LFG probes GP-26 and GP-27 will be decommissioned, since the perimeter compliance boundary has moved to between the Landfill and the City's operation center.

FIELDWORK ACTIVITIES

Monitoring well and LFG probe decommissioning and replacement activities will be performed in accordance with Washington Administrative Code (WAC) regulation 173-160, Part 2 (General Requirements for Resource Protection Well Construction and Geotechnical Soil Borings). A licensed drilling contractor will decommission and install the monitoring wells and LFG probes, using the appropriate drill rig, with all drill casing and equipment that goes into the borehole decontaminated between borings. The following sections describe the proposed fieldwork methods and procedures.

UTILITY CLEARANCE

Before field activities are performed, SCS will arrange for public utility notification using the Washington utility notification center, as well as a private utility locating contractor, to provide utility clearance in the vicinity of the monitoring wells and LFG probes.

TASK 1 - MONITORING WELL DECOMMISSIONING AND REPLACEMENT

Monitoring well LB-6S, LB-5D, LB-5C and LB-5S (see Figure 1) are monitoring wells proposed for decommissioning since they will be impacted by the construction of the future City of Vancouver Operations facility. Monitoring wells LB-6S, LB-5D and LB-5S are routinely sampled during semiannual monitoring events at the Landfill. Monitoring well LB-5C is not normally monitored and the water level information is not used to construct groundwater potentiometric maps. Construction information for all four wells is summarized below in Table 1. Although boring logs completed by a consultant during installation are included in Attachment 1, there are no well logs on file in the Department of Ecology (Ecology) database.

Table 1. Well Construction Information

Well ID	Installed	Borehole Size (inches)	Surface Elevation (ft amsl)	Total Depth (ft bgs)	Screen Interval (ft bgs)	Screen Elevations (ft amsl)
LB-6S	7/1/1987	10	201.4	44.5	23-38	178.4-193.4
LB-5S	4/24/1987	10	221.2	93.5	32-47	189.2-174.2
LB-5C	8/17/1989	10	221.7	94.5	81-91	130.7-140.7
LB-5D	5/19/1987	6	220.1	135.7	125-135	85.1-95.1
GP-26	7/27/1992	---	---	13	12-13	---
GP-27	7/27/1992	---	---	15	14-15	---

amsl = above mean sea level

Decommissioning

Since boring and well construction logs for these wells cannot be found on file with Ecology, state regulations require them to be decommissioned by over drilling. The three shallow wells will be over-drilled using 10-inch outside diameter casing. The deep well (LB-5D) was installed using telescoping casing, with 12-inch casing at the surface, 8-inch casing down to the top of Troutdale Gravel Aquifer (TGA) and then 6-inch casing through the TGA to total depth. The drilling contractor proposes to obtain a variance from the Washington Department of Ecology (Ecology) to leave the 12-inch and 8-inch casing in the ground and use 6-inch casing for over drilling down to the well's total depth.

Before decommissioning activities are initiated, the wells will be measured to verify the total well depth and depth to water in each well. Each well will be decommissioned by first removing the above-ground well head materials (i.e., concrete surface pad, and any above-ground protective monuments or protective posts). An attempt will be made to pull out as much of the polyvinyl chloride (PVC) well casing as possible before over-drilling the borehole to the total well depth. After reaching total depth, the borehole will be backfilled from the bottom up as the drill string is removed from the hole with hydrated bentonite chips and/or bentonite grout. The surface will be covered with soil.

Installation of Replacement Wells

Once the operations center has been constructed, replacement wells for LB-5S and LB-5D will be installed approximately 200 feet south of their current location, outside of the planned site building (Figure 1). Since LB-5C is not sampled nor used to interpret groundwater flow conditions, a replacement well for LB-5C will not be installed. Additionally, a replacement well for LB-6S is also not being proposed. This is because LB-6S is located along the east side of NE 94th Avenue and downgradient of the landfill where there are four additional shallow groundwater monitoring wells for interpreting groundwater flow conditions and monitoring groundwater quality.

Replacement well LB-5SR will be installed approximately 200 feet south of its current location and screened in approximately the same elevations, 174 feet to 189 feet above mean sea level (amsl). LB-5DR will be located near LB-5SR and screened at approximately the same elevations as the original well, 85-95 feet amsl (Figure 1). The replacement wells will be constructed with 2-inch-diameter, Schedule 40, polyvinyl chloride (PVC), flush threaded solid and slotted (screened) casing with O-ring fitted joints. The 10-foot-long or 15-foot long, screened casing will have 0.010-inch machine-cut slots and be installed at the bottom of the boring. The filter sand pack and bentonite chip seal will be constructed inside the drill casing, which will be incrementally withdrawn as the materials are placed in the annular space between the well casing and drill casing. The filter sand pack will be placed approximately 1 foot below and 2 feet above the top of the well screen. Additional sand will be added if needed to achieve the required depth. Bentonite chips, hydrated with water, will be placed above the filter pack material. A flush mount, lockable, steel protective monument will be secured with concrete over each well casing.

Well Development

The wells will be allowed to stabilize for a minimum of 24 hours before they are developed. The monitoring wells will be developed using a decontaminated, submersible pump to alternately purge and surge each well. Field water-quality parameters (specific conductance, pH, temperature, and turbidity) will be measured and recorded on a well development field form after each casing volume is removed. The wells will be considered developed when (1) at least ten casing volumes of water have been removed, (2) the field parameters have stabilized to within 5 percent of the previous measurement for at least three successive measurements, and (3) the purged water is at or near sediment free conditions.

TASK 2 - COMPLIANCE LFG PROBES DECOMMISSIONING AND INSTALLATION

LFG probes to be decommissioned are listed in Table 1 and shown in Figure 2. Available information regarding the depth and screen interval are also listed on boring logs included as Attachment 1. The LFG probes are constructed with ¾ inch PVC and backfilled and sealed in borings that are 13 to 15 feet deep (Table 1). As indicated in the available boring logs, a bentonite seal was constructed at the surface of the two LFG probe points in accordance with WAC regulations.

Decommissioning

Each probe will be checked with a tape to verify total depth of the hole before they are decommissioned. The LFG probes will be decommissioned by over-drilling, using 8-inch outside diameter augers to the total depth of the borehole. All above ground well head materials and the PVC well casing material will be removed from the borehole. Each boring will be backfilled with bentonite chips (hydrated with clean tap water) as the drill string is withdrawn from the boring. The surface will be covered with soil.

Installation of New LFG Probes

Five new LFG probes (GP-43 through GP-47) in approximate locations as shown in Figure 2. The probes will be installed following the operations facility construction, along the southern landfill boundary, within the COV facility, between the landfill and the onsite buildings (Figure 2). They will be located just outside the landfill footprint, at the base of the current slope.

The probes will be constructed with 1-inch diameter, Schedule 80, PVC, flush thread solid and slotted (screened) casing with O-ring fitted joints. The screen casing will have 0.020-inch machine-cut slots and be installed from approximately 5 to 15 feet bgs. Solid casings will extend from 5 feet bgs to approximately 0.5 feet below ground surface. The annular gravel pack will be placed from the bottom of the screen to one- foot above the top of the screen through the hollow stem augers used to advance the borehole, as the drilling equipment is incrementally withdrawn from the borehole. The annular space above the pea gravel (from 2 to 4 feet bgs) will be sealed with bentonite chips hydrated with clean tap water. The probes will be capped at the top with a ½ inch ball valve with a barbed fitting. A traffic-rated, flush mount monument will be set in concrete over each of the probe casings.

Monitoring Point Surveying

The two replacement monitoring wells and five new LFG probes will be surveyed by a Washington-registered professional land surveyor. Horizontal coordinates and elevations will be surveyed relative to and consistent with other survey data for the site. The ground surface and top of casing elevations will be surveyed to an accuracy of 0.01 foot.

SCHEDULE AND REPORTING

The four monitoring wells are planned to be decommissioned during the fourth quarter of 2024 or first quarter of 2025, following approval of this work plan by Ecology and before the operations facility construction is scheduled to begin.

Installation of the replacement monitoring well and new LFG probe replacements will be scheduled after the operations facility has been finished, likely sometime in 2027 or 2028. The CCPH will notify Ecology of the well and LFG probe installations and schedule, once established. The two LFG probes will be decommissioned after the new LFG probes are installed.

Within 45 days after the monitoring wells are decommissioned, a report will be submitted to Ecology documenting the work. Following installation of the replacement wells and LFG probes, another report will be submitted to Ecology. Both reports will describe the field methods and procedures and include a site map showing monitoring locations, boring logs and well/probes construction details, and copies of the driller's reports submitted to Ecology.

Sincerely,

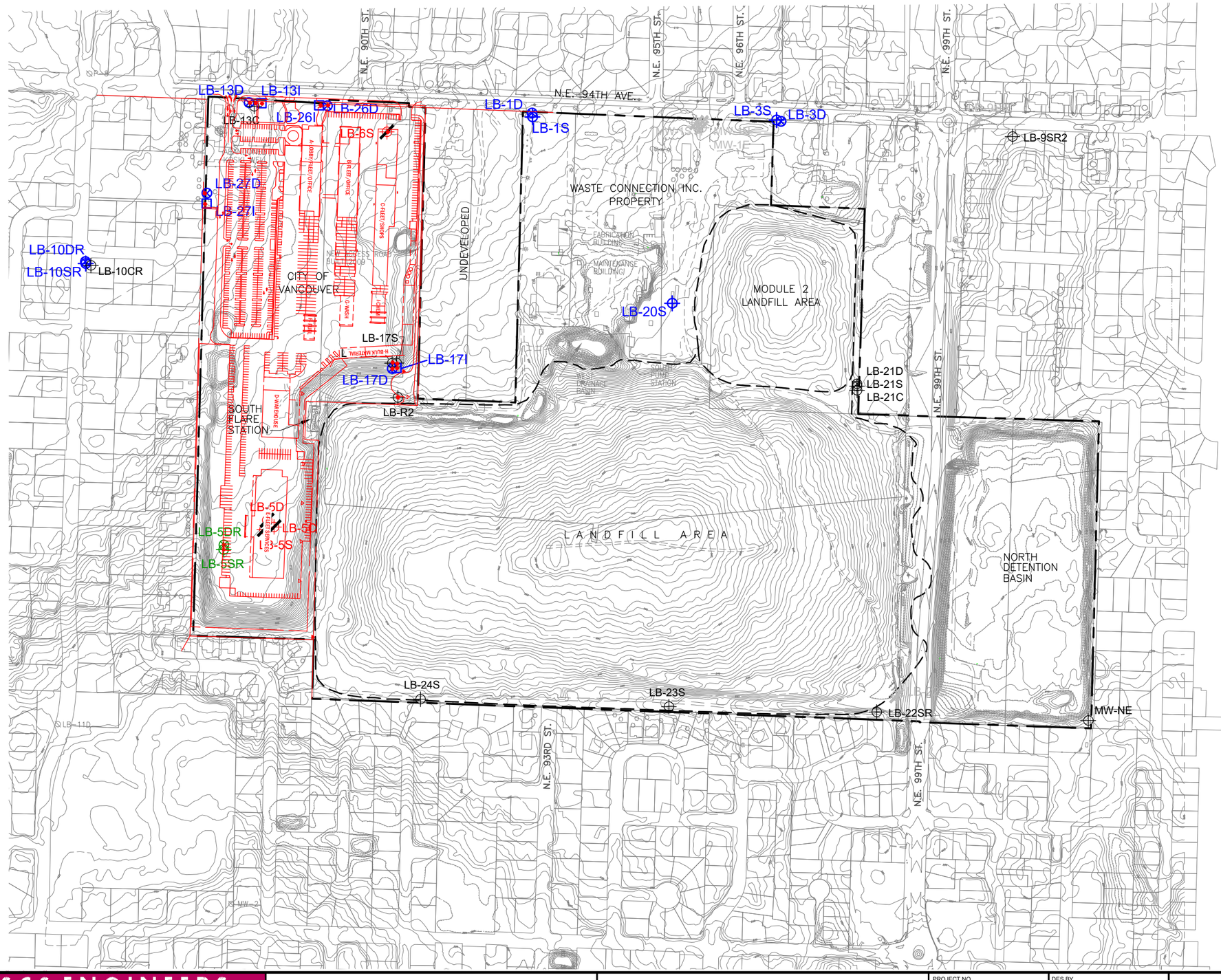
Barbara E. Lary, LG
Project Manager
SCS Engineers

Louis Caruso, LG, LHG
Project Director
SCS Engineers

BEL/JC

cc: Bill Harris and Mike Gallagher, Washington Department of Ecology
Mike Davis and Tina Kendall, CCPH
Alan Melnick and Melissa Sutton, CCPH
Chris Malone and Jean Singer, City of Vancouver

Attachments: Figure 1 - Groundwater Monitoring Well Locations
Figure 2 – Landfill Gas Probe Locations
Attachment 1 – Monitoring Well and LFG Probe Boring Logs/Construction Details



LEGEND:

LB-5SR ⊕	New Monitoring Well Location, Alluvial Water–Bearing Zone
LB-5S ⊕	Monitoring Well Location, Alluvial Water–Bearing Zone
LB-5DR ⊗	New Monitoring Well Location, Troutdale Aquifer
LB-5D ⊗	Monitoring Well Location, Troutdale Aquifer
LB-17I □	Monitoring Well Location, Middle of Alluvial Water–Bearing Zone
LB-22S ⊕	Decommissioned Monitoring Well Location
———	Property Boundary
– – – –	Limit of Landfill Cover and Approximate Edge of Waste

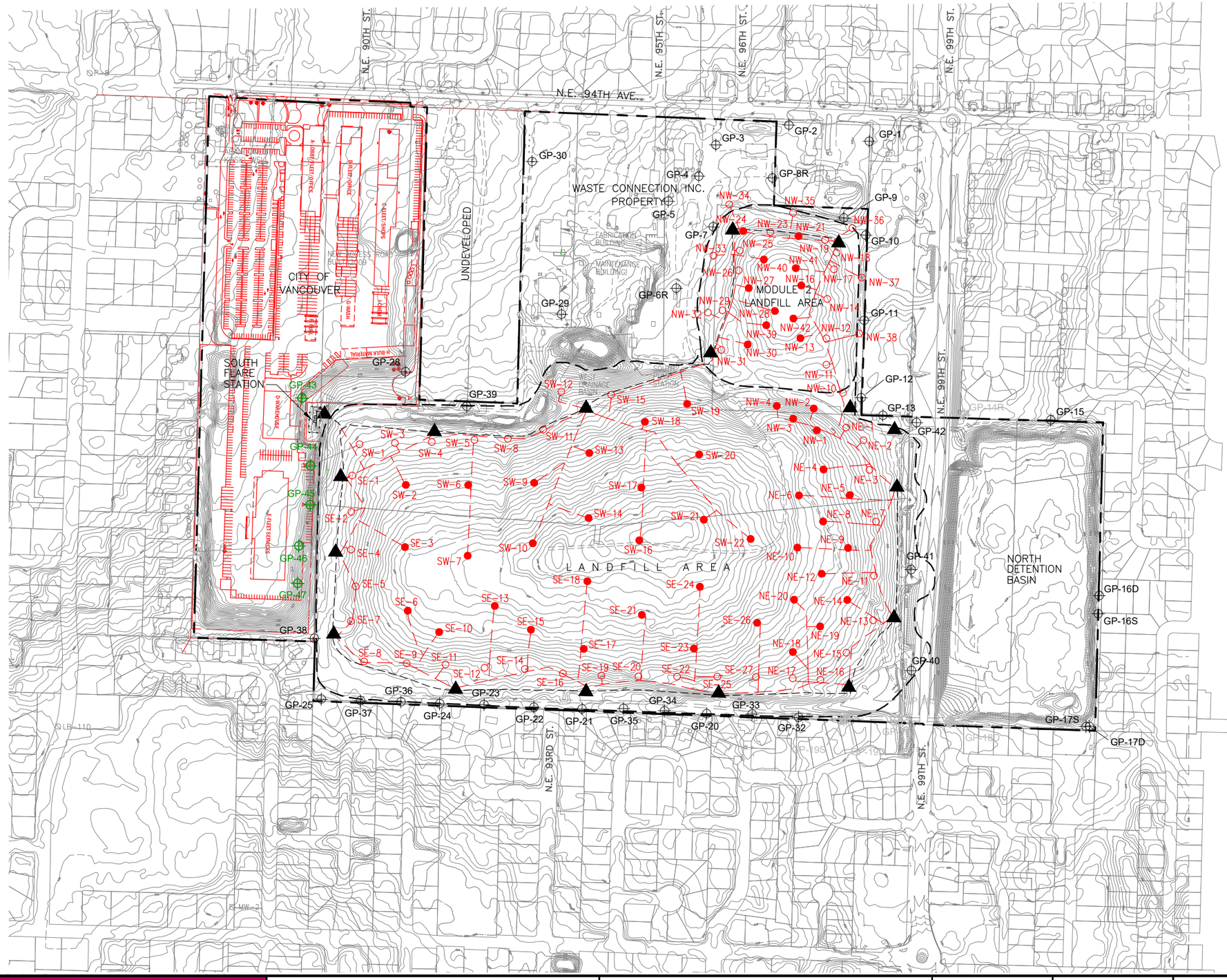
NOTES:

1. Monitoring wells designated by blue color are compliance monitoring wells.
2. Topography taken from Clark County GIS, December 2023.

SCS ENGINEERS
Environmental Consultants and Contractors
15940 S.W. 72nd Avenue
Portland, Oregon 97224
(503) 639-9201 FAX: (503) 684-6948

SCALE
0 400 800 FEET

PROJECT NO. 04223030.20	DES BY B.L.	GROUNDWATER MONITORING WELL LOCATIONS	DATE APRIL 2024
SCALE AS SHOWN	CHK BY B.L.	LEICHNER LANDFILL VANCOUVER, WASHINGTON	FIGURE 1
CAD FILE FIGURE 1	APP BY L.C.		



LEGEND:

- GP-30 — Compliance Landfill Gas Monitoring Probe Location
- GP-47 — New Compliance Landfill Gas Monitoring Probe Location
- GP-31 — Decommission Landfill Gas Monitoring Probe Location
- SW-1 — Vertical Landfill Gas Extraction Well
- SW-2 — Extraction Wells Proposed for Additional Data Collection
- Condensate Sump
- Gas Collection Piping
- Property Boundary
- Limit of Landfill Cover and Approximate Edge of Waste

NOTE:

Topography taken from Clark County GIS, December 2023.

SCALE
0 400 800 FEET

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PROJECT NO. 04223030.20	DES BY B.L.	LANDFILL GAS PROBE AND EXTRACTION WELL LOCATIONS	DATE APRIL 2024
SCALE AS SHOWN	CHK BY B.L.	LEICHNER LANDFILL VANCOUVER, WASHINGTON	FIGURE 2
CAD FILE FIGURE 2	APP BY L.C.		

ATTACHMENT 1

MONITORING WELL AND LFG PROBE BORING LOGS WITH CONSTRUCTION DETAILS

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BORING LOG

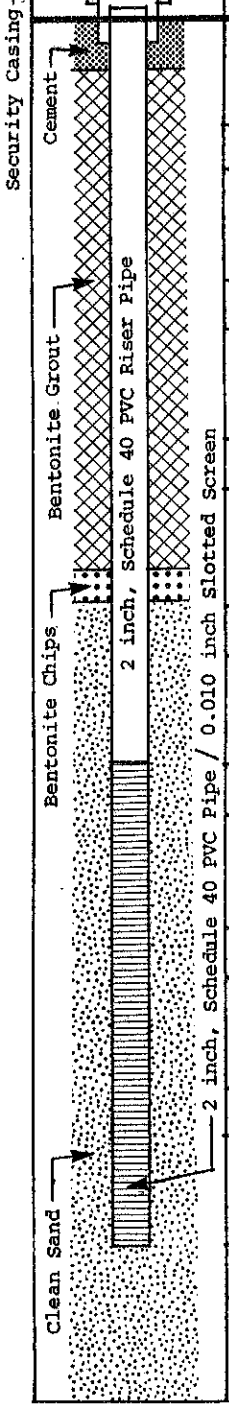
PROJECT Leichner Brothers Landfill, Shallow Monitoring Wells **Page** 1 **of** 2

Location Far west side of Koski field **Boring No.** LB-6S

Surface Elevation 201.4 ft. **Drilling Method** Hollow Stem Auger

Total Depth 44.5 ft. **Drilled By** Soil Sampling Service

Date Completed 7/1/87 **Logged By** Craig Rankine



PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
	0					GRAVELLY SAND, nonplastic, 10% fine gravel, 20% coarse sand, 20% medium sand, 50% fines, dark brown, dry, moderately dense, massive (SW).	
6-18-14		1	SS				
	5					GRAVELLY SAND, nonplastic, 10% fine gravel, 20% coarse sand, 30% medium sand, 40% fine sand, brown, dry, moderately dense, massive, iron oxide coating on BASALT gravel (SW).	
9-16-14		2	SS				
	10					GRAVELLY SAND, barely cohesive, 1 coarse gravel clast, 20% coarse gravel, 6% fine gravel, 50% medium sand, 24% fine sand, gray brown, damp, moderately dense, massive, yellow palagonitic and red iron oxide color grains (SW).	
9-11-12		3	SS				
	15					SAND, barely cohesive, 85% medium sand, 15% fine sand, gray, damp, moderately dense, mottled thin bedding-less than 0.4 ft. thick palagonitic and iron oxide stained grains (SW).	
9-13-12		4	SS				
	20					GRAVELLY SAND, barely cohesive, 4% fine gravel, 26% coarse sand, 50% medium sand, 20% fines, red brown, damp, dense, mottled thin bedding, less than 0.4 ft. thick, palagonitic and iron oxide color grains (SW).	WATER SAMPLE 25.3-26' Temperature 18.1°C pH 5.90 Specific Conductivity 440 µS
12-13-18		5	SS				
	25					GRAVELLY SAND, nonplastic, 2% coarse gravel, 10% fine gravel, 30% coarse sand, 40% medium sand, 18% fine sand, brown gray, wet, moderately dense, mottled thin bedding-less than 0.06 ft. thick, palagonitic and iron oxide colored BASALT gravel (SW).	
7-16-13		6	SS				
	30						
9-10-12		7	SS				
	35					Bottom 0.3': MEDIUM SAND, brown, gray, wet, moderately dense, mottled thin bedding-less than 0.06 ft. thick (SP). Top 0.6': SAND, 30% coarse sand, 70% medium sand.	
10-12-14		8	SS				
	40					SAND, barely cohesive, 85% medium sand, 15% fine sand, light brown, wet, moderately dense, mottled thin bedding, palagonitic and micaceous (SP).	

SEA-300-02a

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BORING LOG

PROJECT Leichner Brothers Landfill, Shallow Monitoring Wells

Boring No. LB-6S

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Clean Sand		40					SAND, barely cohesive, 85% medium sand, 15% fine sand, light brown, wet, moderately dense, mottled thin bedding, palagonitic and micaceous (SP).	
	9-15-20		9	SS				
		45					1) Water encountered at 25.32'. 2) Drilled using 6-in hollow stem auger to bottom of hole. 3) Geologic Unit is "Pleistocene Alluvium" (Missoula Flood Sediment). 4) SS = Split Spoon Sample	

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BORING LOG

PROJECT Leichner Brothers Landfill, Shallow Monitoring Wells **Page** 1 **of** 5

Location East Side Koski Field **Boring No.** LB-5S

Surface Elevation 221.2 ft. **Drilling Method** Hollow Stem Auger

Total Depth 93.5 ft. **Drilled By** Soil Sampling Service

Date Completed 4/24/87 **Logged By** Craig Rankine

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Security Casing; Cement/Bentonite Grout; 2 inch, Schedule 40 PVC Riser Pipe; Fine Gravel		5						
	17-17-32		1	SS			SANDY GRAVEL, nonplastic, 40% coarse gravel (BASALT), 30% fine gravel, 30% sand and fines, brown, damp, dense, massive, gravelly soil (GS) (SW).	
		10						
	7-8-10		2	SS			GRAVELLY SAND, 1 coarse gravel clast, 5% fine gravel, 80% coarse sand, 15% medium sand, trace fine sand, gray brown, damp, medium density, massive, BASALT and QUARTZITE gravels (SP).	
		15						
	12-12-15		3	SS			GRAVELLY SAND, nonplastic, trace coarse gravel, 30% fine gravel, 50% coarse sand, 20% medium sand, trace fine sand, gray brown, damp, medium density, massive, BASALT and QUARTZITE gravel (SP).	
		20						

SEA-300-02a

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BORING LOG

PROJECT Leichner Brothers Landfill

Boring No. LB-5S

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Cement/Bentonite Grout; Fine Gravel; 2 inch Schedule 40 PVC Riser Pipe; Bentonite Pellets; Clean Sand; 2 inch, Schedule 40 PVC Pipe, 0.010 inch Slotted Screen		20						
	15-20-30		4	SS			Same as sample immediately above (SP).	
		25						
	11-17-28		5	SS			Same as sample immediately above (SP).	
		30						
	8-9-10		6	SS			SAND, nonplastic, 40% coarse sand, 60% medium sand, trace fine sand, brown gray with medium density, massive (SP).	
		35						WATER SAMPLE 31-32 ft. Temperature 17.6° C pH 6.16 Specific Conductivity 175
		40						

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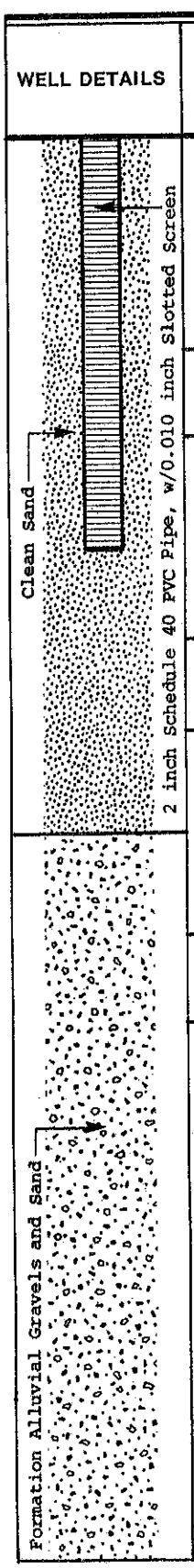
BORING LOG

PROJECT Leichner Brothers Landfill

Boring No. LB-5S



PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
	40						
15-8-15		7	SS			Top 0.6 ft.: SAND, nonplastic, 20% coarse sand, 80% medium sand, trace fine sand, brown gray, wet, moderate density, massive (SP). Bottom 0.6 ft.: SILTY FINE SAND, cohesive, 25% medium sand, 50% fine-very fine sand in a 25% fines matrix, brown, very moist, massive (SP).	
	45						
10-16-19		8	SS			SAND, barely cohesive, 85% medium sand, 15% fine-very fine sand, trace fines, brown gray, wet, density massive (SP).	
	50						
7-24-38		9	SS			Top 0.3 ft.: FINE SAND, nonplastic, brown, very moist, medium density, massive, micaceous (SP). Bottom 0.7 ft.: SILTY SAND, cohesive, 55% medium sand, 30% fine-very fine sand, 15% fines, brown gray, very moist, dense, mottled thin laminae (SP).	
	55						
	60						

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BORING LOG

PROJECT Leichner Brothers Landfill

Boring No. LB-5S

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Alluvial Gravels and Sand		60						
	40-28-30		10	SS			Same as bottom sample portion immediately above (SP).	
		65						
		70						
	17-38-43		11	SS			SAND, nonplastic, 45% medium sand, 55% fine sand, trace very fine sand, brown gray, very moist, very dense, massive, micaceous (SP).	
		75						
		80						

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BORING LOG

PROJECT Leichner Brothers Landfill

Boring No. LB-5S

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Alluvial Gravels and Sand		80						
	9-16-25		12	SS			Top 0.2 ft.: Same as sample immediately above (SP). Bottom 1.4 ft.: SAND, barely cohesive, 80% fine sand, 15% very fine sand, gray brown, very moist, dense, massive, very micaceous (SP).	
		85					"PLEISTOCENE ALLUVIUM" (Missoula Flood Sediments)	
	24-50/3 in.		13	SS			TROUTDALE FORMATION Top 0.6 ft.: Same as bottom, sample portion immediately above (SP). Next 0.3 ft.: VERY FINE SAND, brown, moderately moist, dense, massive, very micaceous (SP). Bottom 0.6 ft.: SAND, non-plastic, 2% fine gravel, 60% coarse sand, 30% medium sand, 5% fine-very fine sand, 3% fines, gray brown, moderately moist, distinct thin beds of micaceous silt, less than 0.01 inch thick, mottled thin bedding 0 red iron oxide and pale yellow tuff grain lenses (Pleistocene Alluvium) (SW).	
		90						
	55/6 in.		14	SS			SANDY GRAVEL, nonplastic, 50% coarse gravel, 30% fine gravel, 15% coarse sand, 5% medium-fine sand, brown gray, wet, very dense, (Troutdale Formation) (GW).	
		95					1) Water encountered at 31.2 ft. 2) Drilled using 4 inch I.D hollow stem auger (h.s.a.) to top of Troutdale Formation, redrill with 6 inch h.s.a. to install monitoring wells. 3) Geologic units are "Pleistocene Alluvium" (Missoula Flood Sediments) and top of Troutdale Formation. 4) SS = Split- Spoon Sample	

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BORING LOG

PROJECT Leichner Brothers Landfill, Deep Monitoring Well **Page** 1 **of** 4

Location East Side Koski Field

Boring No. LB-5D

Surface Elevation 220.10 ft.

Drilling Method Telescoping Air Rotary

Total Depth 135.7 ft.

Drilled By McGhee Drilling

Date Completed 5/19/87

Logged By C. Rankine

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Security Cap; Cement; 12 inch and 8 inch Casing Annular Space; 2 inch Schedule 40 PVC Riser Pipe; Bentonite Grout; 8 inch Casing		5, 10, 15, 20, 25, 30, 35					See "Leichner Brothers Landfill, Shallow Monitoring Well, logs for lithologic descriptions for 0-98.8' depth.	

SEA-300-02a

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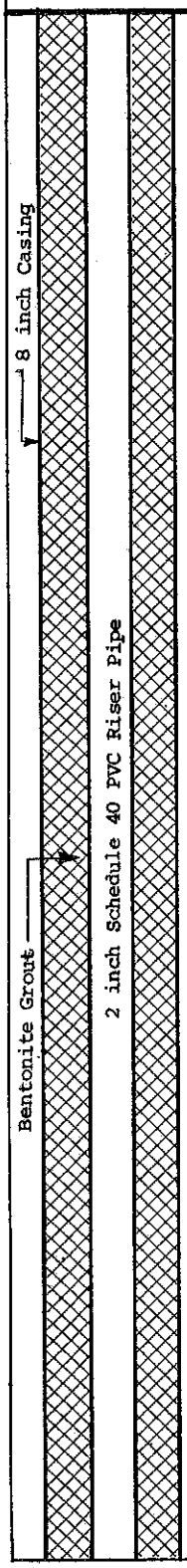
BORING LOG

PROJECT Leichner Brothers Landfill, Deep Monitoring Well

Boring No. LB-5D

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35 40 45 50 55 60 65 70					See "Leichner Brothers Landfill, Shallow Monitoring Well, logs for lithologic descriptions for 0-98.8' depth.	

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BORING LOG

PROJECT Leichner Brothers Landfill, Deep Monitoring Well **Page** 3 **of** 4

Boring No. LB-5D

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
8 inch casing; 2 inch Schedule 40 PVC Riser Pipe; Bentonite Slurry		70, 75, 80, 85, 90, 95, 100, 105	1	CATCH			"PLEISTOCENE ALLUVIUM" (Missoula Flood Sediments) TROUTDALE FORMATION 98-99': Water Sample Specific Conductivity (WSC) 672 uS, GRAVELLY SAND, slightly weathered BASALT with oxidized cemented sand coating, fresh BASALT, QUARTIZITE, PORPHYRITIC VOLCANICS, META SEDIMENTS, WELDED TUFF (SP). 103-104': WSC 893 uS, GRAVELLY SAND 35% fine gravel, 55% coarse sand, 10% medium sand, rock types as above (SP).	

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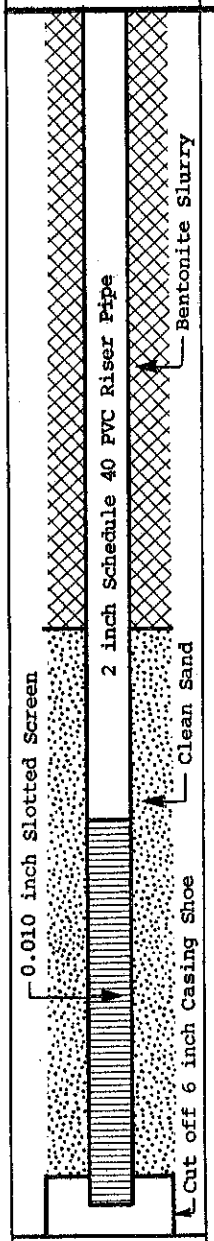
BORING LOG

PROJECT Leichner Brothers Landfill, Deep Monitoring Well **Page** 4 **of** 4

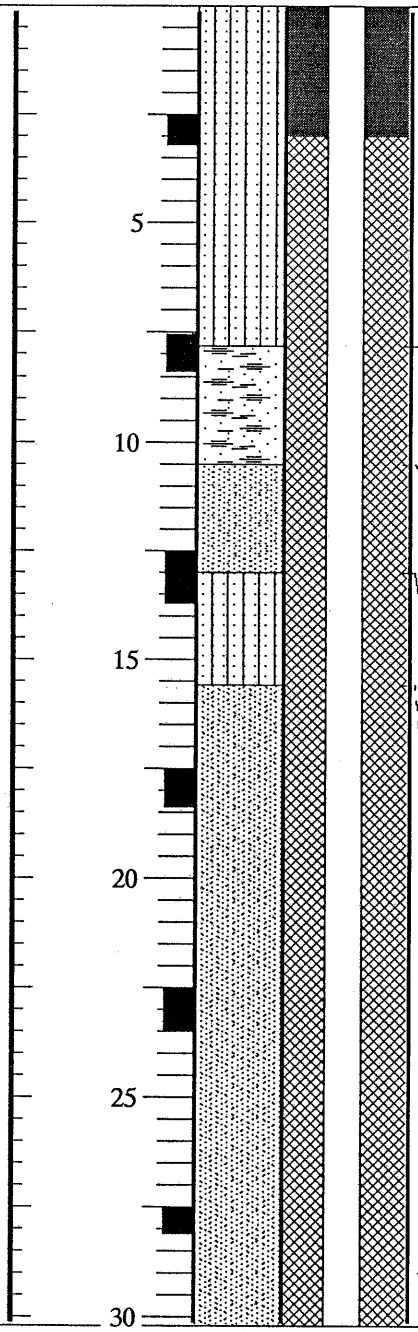
Boring No. LB-5D

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		105						
			2	CATCH			108-109': WSC 841 uS, GRAVELLY SAND, 15% fine gravel, 30% coarse sand, 45% medium sand, 10% fine sand, trace fines, rock types as above (SP).	
		110						
			3	CATCH			113-114': WSC 1046 uS, GRAVELLY SAND, 2% coarse gravel, 33% fine gravel, 60% coarse sand, 5% medium sand, rock types ad above (SP).	
		115						
			4	CATCH			118-119': WSC 952 uS, GRAVELLY SAND, 40% fine gravel, 60% coarse sand, slightly weathered BASALT with oxidized cemented sand coating, fresh BASALT, QUARTZINE, PORPHORITIC VOLCANICS, META SEDIMENTS, WELDED TUFF (SP).	
		120						
			5	CATCH			123-124' WSC 786 uS, GRAVELLY SAND, 25% fine gravel, 60% coarse sand, 10% medium sand, 5% fines, rock types as above (SP).	
		125						
			6	CATCH			128-129' WSC 792 uS, GRAVELLY SAND, 10% fine gravel, 40% coarse sand, 50% medium sand, rock types as above, (SP).	
		130						
			7	CATCH			131-132': WSC 776 uS, GRAVELLY SAND, 1% coarse gravel, 20% fine gravel, 70% coarse sand, 5% medium sand, 4% fines, rock types as above, (SP).	
		135						
			8	CATCH			135-135.7': WSC 664 uS, GRAVELLY SAND, 20% fine gravel, 60% coarse sand, 20% medium sand, rock types as above, (SP).	
		140					1) Drilled, telescoping 12 inch I.D. surface casing, 8 inch I.D. casing into top Troutdale Formation and 6 inch I.D. casing to bottom of hole. 2) Geologic units are "Pleistocene Alluvium" (Missoula Flood Sediments) and the upper portion of the Troutdale Formation.	

LOG OF EXPLORATORY BORING

PROJECT NAME	Leichner Brothers Landfill	BORING NO.	LB- 5C
LOCATION	Vancouver, WA	PAGE	1 OF 4
DRILLED BY	Hokkaido Drilling	REFERENCE ELEV.	221.70'
DRILL METHOD	H.S. Auger	TOTAL DEPTH	94.50'
LOGGED BY	G. Mortyn	DATE COMPLETED	8/17/89

SAMPLE NUMBER	RECOVERY PERCENT	BLOW COUNTS (N COMP)	LITHOLOGIC DESCRIPTION
S-1 (S)	47.0	3-16-23 (39)	**0-7.8' GRAVELLY SILTY SAND**; brown; fine grained; some subrounded gravel to 1-inch; abundant roots; organic odor; stiff; dry; (SM)(TOPSOIL).
S-2 (S)	60.0	7-14-15 (29)	**7.8-10.5' SANDY GRAVEL**; gray; subrounded gravel to 1-inch; medium to coarse sand; iron oxide staining on clast surfaces; (GW)(ALLUVIUM).
S-3 (S)	80.0	10-18-14 (15)	**10.5-13' GRAVELLY SAND**; blue-gray; predominantly coarse grained; some subangular gravel to 1-inch; medium dense; dry-moist; (SW)(ALLUVIUM).
S-4 (S)	60.0	5-11-15 (26)	**13-15.6' GRAVELLY SILTY SAND**; brown-gray; medium-coarse grained; some subangular gravel to 1-inch; some silt; medium dense; moist; (SM)(ALLUVIUM).
S-5 (S)	67.0	10-18-14 (32)	**15.6-35' GRAVELLY SAND**; blue-gray; coarse grained; some subrounded gravel to 2-inch; dense; moist; (SW)(ALLUVIUM).
S-6 (S)	40.0	10-16-24 (40)	



REMARKS

Heavier 3-inch split spoon sampler used for S-10, S-13, S-16, large sampler also used for clearing auger plug prior to well installation, consequently we were able to sample S-20 with it. Total length of fabrication = 92.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	Leichner Brothers Landfill	BORING NO.	LB- 5C
LOCATION	Vancouver, WA	PAGE	2 OF 4
DRILLED BY	Hokkaido Drilling	REFERENCE ELEV.	221.70'
DRILL METHOD	H.S. Auger	TOTAL DEPTH	94.50'
LOGGED BY	G. Mortyn	DATE COMPLETED	8/17/89

SAMPLE NUMBER	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
S-7 (S)	20.0	10-17-20 (37)	▽ 35'	35				**15.6-35' GRAVELLY SAND**; continued from previous page.
S-8 (S)	100.0	6-8-15 (23)		40				**35-53' SAND**; brown-gray; fine to medium grained; thinly bedded from 38.2 to 39 feet; medium dense, loose at 42.5 feet; wet; (SP)(ALLUVIUM).
S-9 (S)	67.0	3-5-4 (9)		45				
S-10(S)	100.0	3-9-15 (24)		50				
S-11(S)	100.0	2-4-5 (9)		55				**53-55.8' SANDY SILT**; yellow-brown; medium plasticity; some fine sand; stiff; wet; (ML)(ALLUVIUM).
S-12(S)	100.0	2-5-8 (13)		60				**55.8-58.2' SAND**; gray; medium to coarse grained; medium dense; wet; (SP)(ALLUVIUM). **58.2-60.8' SILTY SAND**; yellow-orange brown; mottled with black streaks; predominantly fine grained; some silt; medium dense; wet;

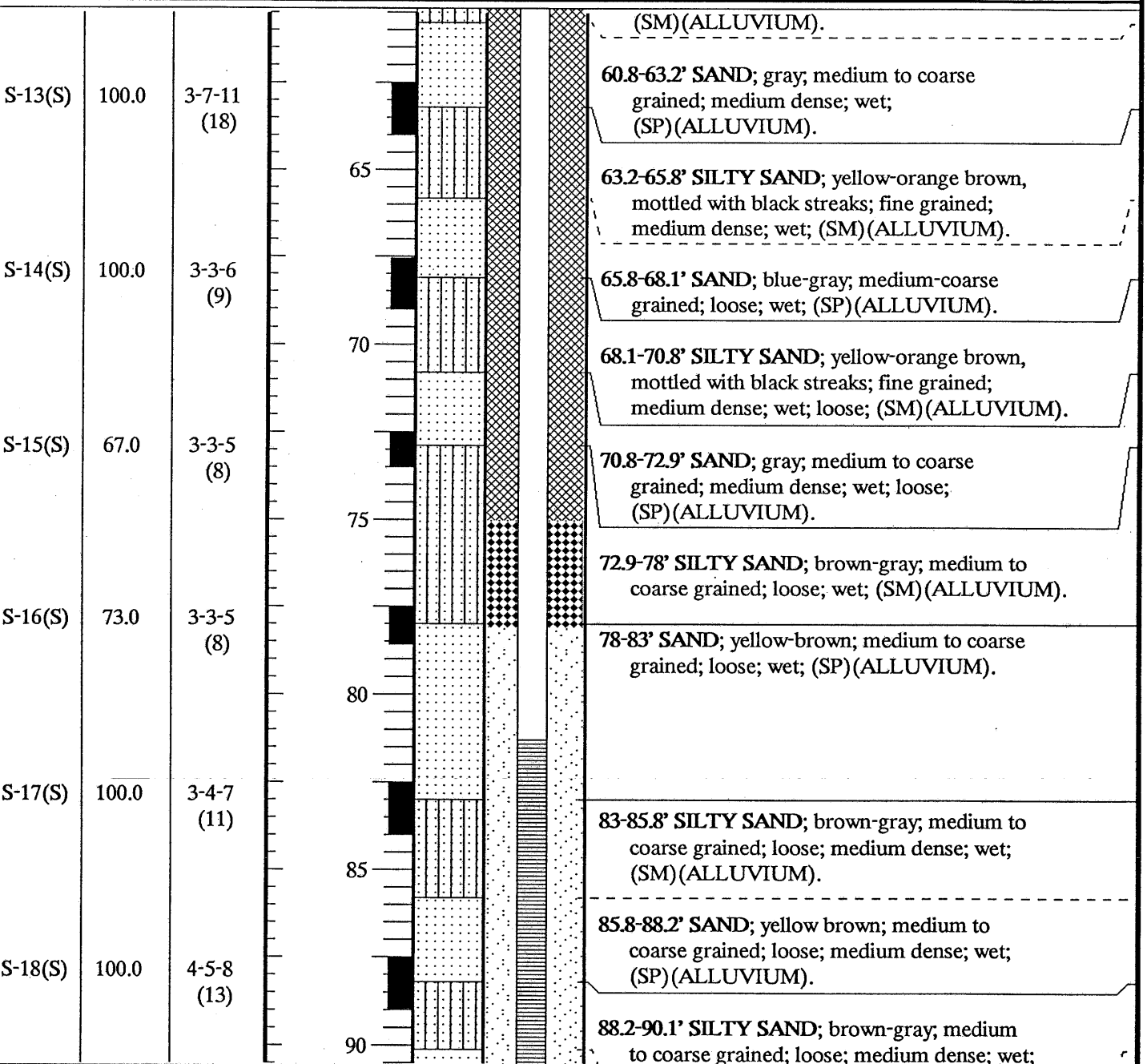
REMARKS

Heavier 3-inch split spoon sampler used for S-10, S-13, S-16, large sampler also used for clearing auger plug prior to well installation, consequently we were able to sample S-20 with it. Total length of fabrication = 92.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	Leichner Brothers Landfill	BORING NO.	LB- 5C
LOCATION	Vancouver, WA	PAGE	3 OF 4
DRILLED BY	Hokkaido Drilling	REFERENCE ELEV.	221.70'
DRILL METHOD	H.S. Auger	TOTAL DEPTH	94.50'
LOGGED BY	G. Mortyn	DATE COMPLETED	8/17/89

SAMPLE NUMBER	RECOVERY PERCENT	BLOW COUNTS (N COMP)	LITHOLOGIC DESCRIPTION
			(SM)(ALLUVIUM).
S-13(S)	100.0	3-7-11 (18)	**60.8-63.2' SAND**; gray; medium to coarse grained; medium dense; wet; (SP)(ALLUVIUM).
			63.2-65.8' SILTY SAND; yellow-orange brown, mottled with black streaks; fine grained; medium dense; wet; (SM)(ALLUVIUM).
S-14(S)	100.0	3-3-6 (9)	**65.8-68.1' SAND**; blue-gray; medium-coarse grained; loose; wet; (SP)(ALLUVIUM).
			68.1-70.8' SILTY SAND; yellow-orange brown, mottled with black streaks; fine grained; medium dense; wet; loose; (SM)(ALLUVIUM).
S-15(S)	67.0	3-3-5 (8)	**70.8-72.9' SAND**; gray; medium to coarse grained; medium dense; wet; loose; (SP)(ALLUVIUM).
			72.9-78' SILTY SAND; brown-gray; medium to coarse grained; loose; wet; (SM)(ALLUVIUM).
S-16(S)	73.0	3-3-5 (8)	**78-83' SAND**; yellow-brown; medium to coarse grained; loose; wet; (SP)(ALLUVIUM).
S-17(S)	100.0	3-4-7 (11)	**83-85.8' SILTY SAND**; brown-gray; medium to coarse grained; loose; medium dense; wet; (SM)(ALLUVIUM).
			85.8-88.2' SAND; yellow brown; medium to coarse grained; loose; medium dense; wet; (SP)(ALLUVIUM).
S-18(S)	100.0	4-5-8 (13)	**88.2-90.1' SILTY SAND**; brown-gray; medium to coarse grained; loose; medium dense; wet;



REMARKS

Heavier 3-inch split spoon sampler used for S-10, S-13, S-16, large sampler also used for clearing auger plug prior to well installation, consequently we were able to sample S-20 with it. Total length of fabrication = 92.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	Leichner Brothers Landfill	BORING NO.	LB- 5C
LOCATION	Vancouver, WA	PAGE	4 OF 4
DRILLED BY	Hokkaido Drilling	REFERENCE ELEV.	221.70'
DRILL METHOD	H.S. Auger	TOTAL DEPTH	94.50'
LOGGED BY	G. Mortyn	DATE COMPLETED	8/17/89

SAMPLE NUMBER	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
S-19(S)	100.0	11-12-13 (25)		95				(SM)(ALLUVIUM).
S-20(S)	N/A	N/A						**90.1-92.9' SAND**; brown-gray; medium to coarse grained; medium dense; wet; (SP)(ALLUVIUM).
								92.9-94' SILTY SAND; brown; fine to medium grained, medium dense; wet; (SM)(ALLUVIUM).
				100				**94-94.5' SILTY CLAY**; yellow brown; medium-high plasticity; massive; stiff; moist; (CH)(TROUTDALE FORMATION).
				105				Bottom of hole at 94.5 feet.
				110				
				115				
				120				

REMARKS

Heavier 3-inch split spoon sampler used for S-10, S-13, S-16, large sampler also used for clearing auger plug prior to well installation, consequently we were able to sample S-20 with it. Total length of fabrication = 92.8 feet.

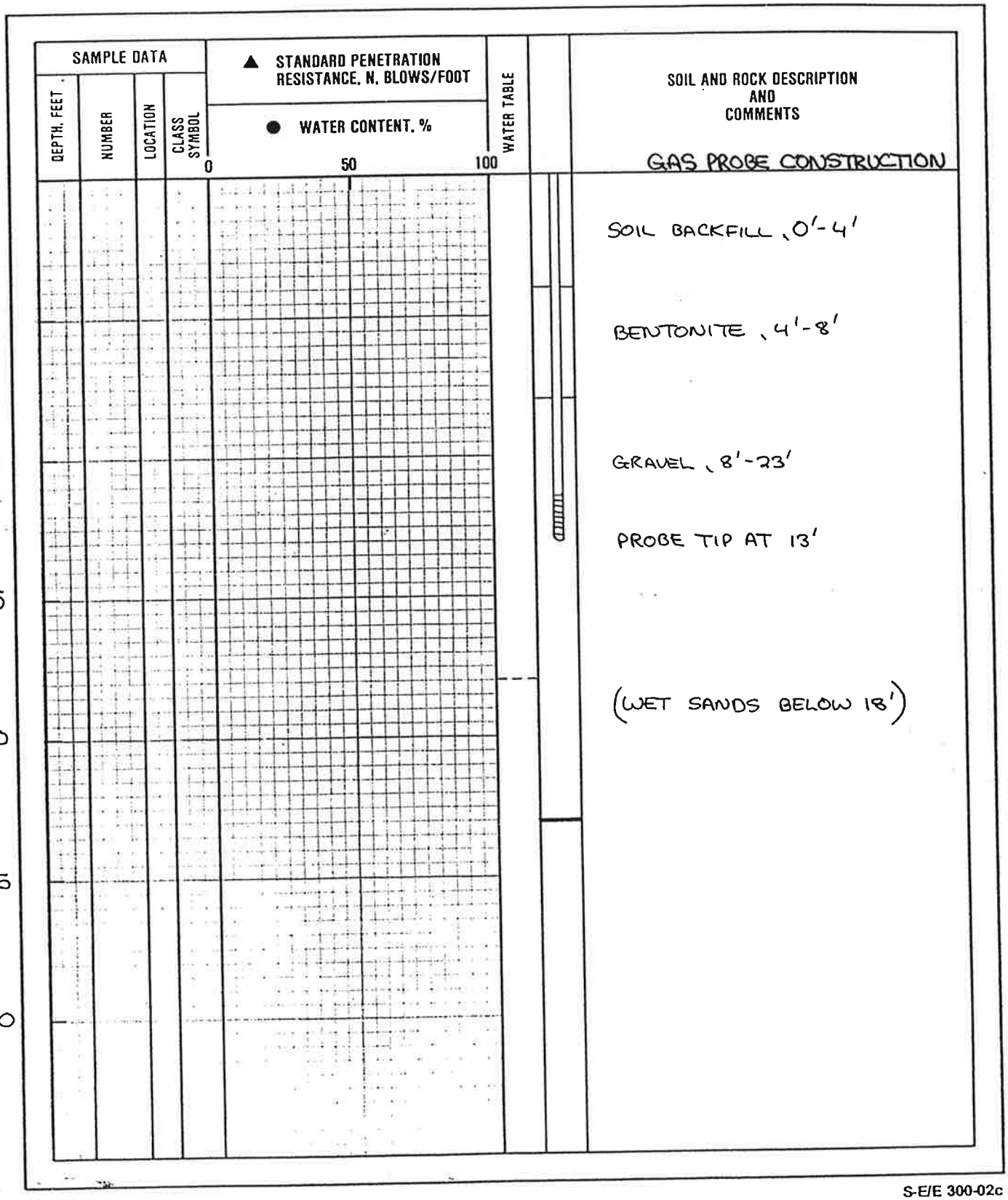
Sweet-Edwards / EMCON, Inc. GAS PROBE **BORING LOG**

PROJECT NAME LEICHNER SOUTH LFG SYSTEM CONSTRUCTION

PROJECT NUMBER S 82-01.43 BORING NUMBER GP-26

DATE OF BORING 7-27-92

GROUND ELEVATION AT BORING WHEN DRILLED 220



S-E/E 300-02c

Sweet-Edwards / EMCON, Inc. GAS PROBE **BORING LOG**

PROJECT NAME LEICHNER SOUTH LFG SYSTEM CONSTRUCTION

PROJECT NUMBER S 82-01.43 BORING NUMBER GP - 27

DATE OF BORING 7-27-92

GROUND ELEVATION AT BORING WHEN DRILLED 205

SAMPLE DATA: DEPTH, FEET	NUMBER	LOCATION	CLASS SYMBOL	▲ STANDARD PENETRATION RESISTANCE, N, BLOWS/FOOT; ● WATER CONTENT, % (0 – 50 – 100)	WATER TABLE	SOIL AND ROCK DESCRIPTION AND COMMENTS
0						GAS PROBE CONSTRUCTION
5						SOIL BACKFILL, 0'-6'
10						BENTONITE, 6'-10'
15						GRAVEL, 10'-23'
20						PROBE TIP AT 15'
25						(WET CLAY, 18'-23')
30						

S-E/E 300-02c