PanGEO INCORPORATED
Geotechnical & Earthquake Engineering Consultants

August 16, 2018
File No. 17-014

Mr. Chris Niederman
6800 96th Avenue SE
Mercer Island, WA 98040

Subject: **Additional Surface Exploration and Recommendations**
Niederman Residence Remodel
6800 – 96th Avenue SE, Mercer Island, Washington

Dear Mr. Niederman,

As requested, PanGEO conducted additional subsurface exploration in the garage area at the above site. The intent of the additional exploration exploration was to explore the subsurface conditions at this location, after the existing garage foundations were exposed and poor existing garage foundation conditions were observed. Additionally, it was observed that the existing garage slabs appeared to be sloping from west to east, indicating up to approximately 4 to 5 inches of differential settlement. The following sections summarize results of our additional field exploration, and geotechnical opinions and recommendations:

ADDITIONAL FIELD EXPLORATION

Our additional subsurface exploration consisted of drilling two test borings, PG-3 and PG-4, to about 19 and 16½ feet below the surface, respectively. Boring PG-3 was drilled just east of the eat garage wall and boring PG-4 was drilled in the slab area. The approximate boring locations were located in the field from on-site features, and are shown on Figure 1. Previously drilled borings PG-1 and PG-2 were also shown on the Figure 1.

In general, both PG-3 and PG-4 encountered about 11 feet of very loose to loose, silty to slightly sand, which are interpreted as fill and lake deposits. A layer of very soft peat was encountered between 5½ and 7½ feet in PG-4. Below the fill and lake deposit, both borings encountered stiff to hard, clay that extended to the bottom of the borings at about 19 and 16½ feet below the surface in PG-3 and PG-4, respectively. We interpret this clay layer as Pre-Olympia Fine-Grained Deposit. Perched groundwater was encountered between 5 to 10 feet in PG-3 and between 7½ and 10½ feet in PG-4 during drilling.

The soil samples were described and field classified in general accordance with the symbols and terms outlined in Figure A-1, and the summary boring logs including the previous borings are included as Figures A-2 through A-5.

GEOTECHNICAL OPINIONS AND RECOMMENDATIONS

GARAGE FOUNDATIONS

Based on the very loose and soft soil conditions encountered in the borings and observations of the existing garage foundation conditions, it is our opinion that the existing east garage footing should be reconstructed and be supported by deep foundations, such as pin piles or driven soldier piles. The existing garage foundations in other areas, if subject to additional structural loads, should also be considered to be underpinned to reduce the potential for future foundation settlement.

TEMPORARY EXCAVATIONS AND SHORING

PanGEO attended a site meeting with the design team and the general contractor on August 8, 2018 to review the temporary excavations and shoring design at the site. Based on the review, it was team's agreement that a more stringent shoring system than the ultrablock walls will likely be needed due to a combination of limited space to the property lines, limited space available for excavations/disturbance into the existing asphalt driveway, and site soil conditions exposed at the site. Based on the site access conditions, it is also agreed that the most appropriate shoring system will likely be driven soldier piles walls with timber lagging. The following presents our recommendations for the driven soldier pile wall design.

Design Earth Pressure – We recommend that the design parameters outlined in Figure 2 be used for the soldier pile wall design. Above the bottom of excavation, the recommended active earth pressure should be applied over the full width of the pile spacing. Below the bottom of excavation, the passive resistance should be applied over two times the pile diameter and the active and at-rest pressure applied over one single pile diameter. The recommended passive earth pressure assumes level ground surface at the bottom of the excavation. The soldier piles should have a minimum embedment of 10 feet.

If the soldier piles will be incorporated into the design of permanent walls, a uniform seismic earth pressure indicated in Figure 2 should be included in design calculations. The seismic pressure should be applied to the portion located above the bottom of the excavation.

Surcharge Loads – The shoring walls should be designed to accommodate surcharge pressures if surcharge loads are located within the height dimension of the wall. Depending on the shoring wall location, potential surcharge from the existing buildings to the west and north will need to be considered in the shoring wall design and can be estimated using Figure 2.

It should be noted that heavy point loads located close to the top of the walls, such as outriggers of heavy cranes or pump trucks, should be individually analyzed and incorporated into the wall design.

Vertical Capacity – If soldier piles will be used as a permanent foundation system, the soldier piles should have a minimum embedment of 10 feet into the underlying native soil to achieve adequate axial capacities. Soldier piles incorporated into the permanent load bearing system may be designed using an allowable skin friction value of 1.0 ksf for the portion of the pile below the bottom of the excavation, and an allowable end bearing value of 10 ksf.

Permanent Walls – If soldier pile walls will be incorporated into the permanent walls, they should be properly protected against corrosion. This may include proper coatings or upsizing of piles. In addition, it should be noted that timber lagging between soldier piles have limited design life, and the installation of a permanent concrete facing in front of the timber lagging may be considered.

When placing timber lagging, the height of each lift may need to be limited to prevent the un-shored soil from escaping through the base of the timber boards. We recommend that the soil exposed for timber lagging be no more than 4 to 5 feet deep. The actual allowable vertical cut for timber lagging placement should be determined in the field, based on the actual conditions observed.

We appreciate the opportunity to be of service.

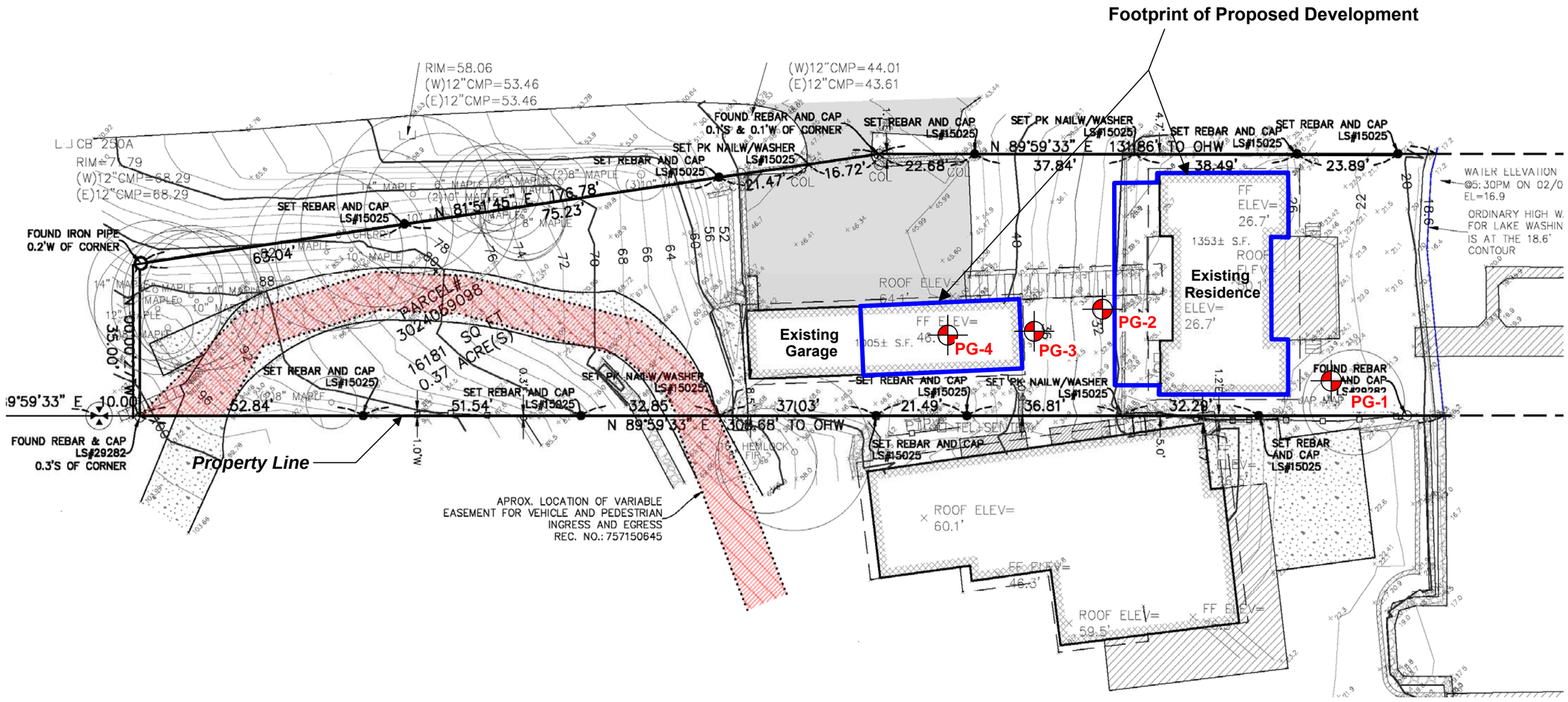
Sincerely,

H. Michael Xue, P.E.
Senior Geotechnical Engineer

Attachment:

Figure 1 Site and Exploration Plan
Figure 2 Design Lateral Pressures, Cantilever Concrete Walls

Appendix A Summary Boring Logs



Approx. Scale
(feet)

1" = 25'

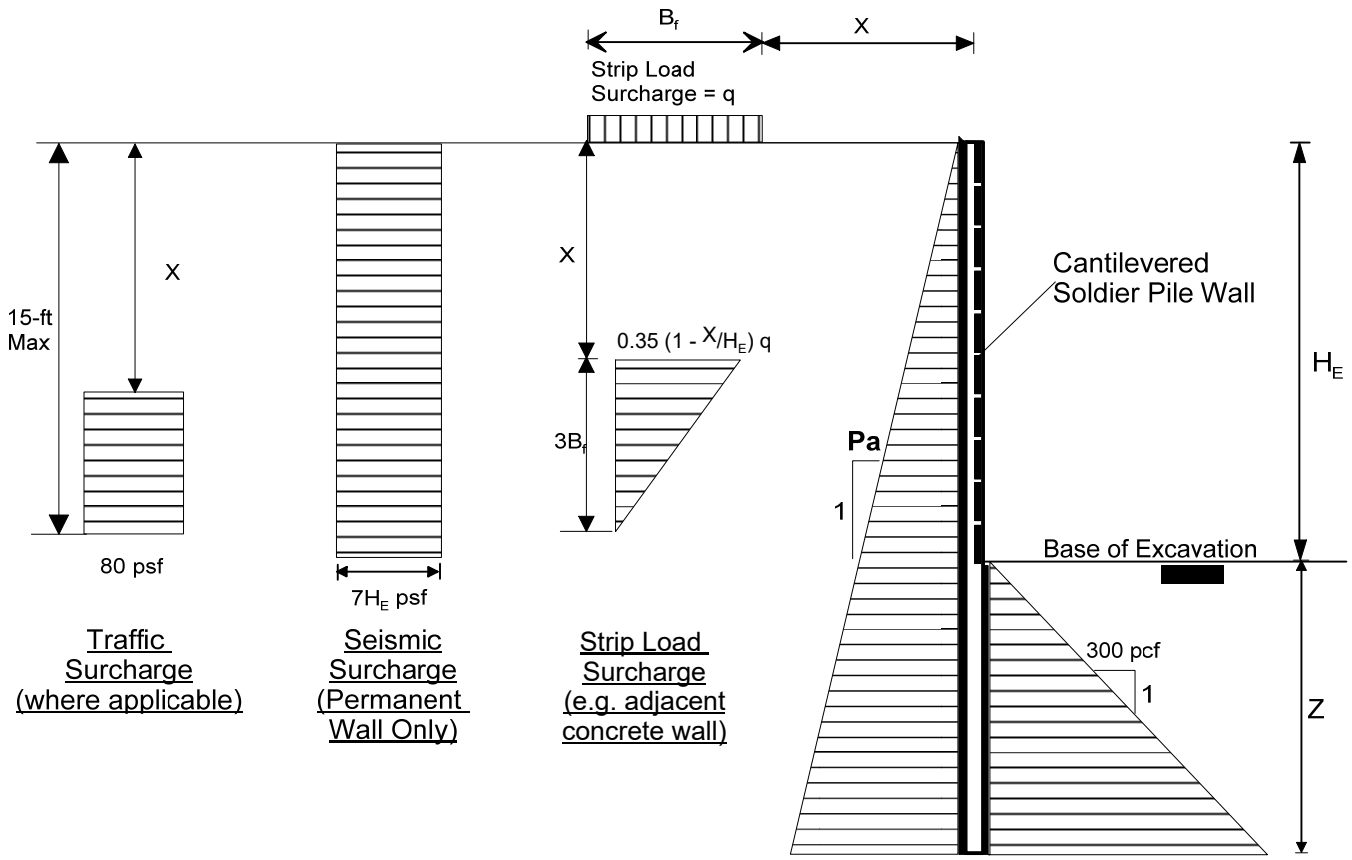
Legend:

PG-1 Approx. Boring Location

Note: Site plan modified from topographic survey by Terrane, provided by the client, dated September 13, 2016.

PanGEO INCORPORATED	**Niederman Residence Remodel** **6800 - 96th Avenue SE** **Mercer Island, WA**	**SITE AND EXPLORATION PLAN**	
		Project No. **17-014**	Figure No. **1**

17-014_Fig 2 Site & Exploration Plan.grf 8/16/18 NER



Pa* = 40 pcf (level backslope)
50 pcf (1H:1V backslope, 6' Max.)

LEGEND

H_E = Height of Excavation (ft)

Z = Embedment Depth (min. 10 ft)

Notes:
1. Minumum embedment should be at least 10 feet below bottom of excavation.
2. A factor of safety of 1.5 has been applied to the recommended passive earth pressure value. No factor of safety has been applied to the recommended active or surcharge earth pressure values.
3. Active and surcharge pressures should be applied over the full width of the pile spacing above the base of the excavation, and over one pile diameter below the base of the excavation.
4. Seismic pressures should be applied over the full width of the pile spacing for permanent walls.
5. Passive pressure should be applied to two times the diameter of the soldier piles.
6 .Use 50% of the active and surcharge pressures for lagging design with soldier piles spaced at 8' or less.
7. Refer to report text for additional discussions.

PanGEO INCORPORATED	**Niederman Residence Remodel** **6800 - 96th Avenue SE** **Seattle, Washington**	**DESIGN LATERAL EARTH PRESSURES** **CANTILEVERED SOLDIER PILE WALL**	
		Project No. **17-014**	Figure No. **2**

APPENDIX A

SUMMARY BORING LOGS

RELATIVE DENSITY / CONSISTENCY

SAND / GRAVEL			SILT / CLAY		
Density	SPT N-values	Approx. Relative Density (%)	Consistency	SPT N-values	Approx. Undrained Shear Strength (psf)
Very Loose	<4	<15	Very Soft	<2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Med. Dense	10 to 30	35 - 65	Med. Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	>50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	>30	>4000

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		GROUP DESCRIPTIONS	
Gravel 50% or more of the coarse fraction retained on the #4 sieve. Use dual symbols (eg. GP-GM) for 5% to 12% fines.	GRAVEL (<5% fines)	GW	Well-graded GRAVEL
		GP	Poorly-graded GRAVEL
	GRAVEL (>12% fines)	GM	Silty GRAVEL
		GC	Clayey GRAVEL
Sand 50% or more of the coarse fraction passing the #4 sieve. Use dual symbols (eg. SP-SM) for 5% to 12% fines.	SAND (<5% fines)	SW	Well-graded SAND
		SP	Poorly-graded SAND
	SAND (>12% fines)	SM	Silty SAND
		SC	Clayey SAND
Silt and Clay 50%or more passing #200 sieve	Liquid Limit < 50	ML	SILT
		CL	Lean CLAY
		OL	Organic SILT or CLAY
	Liquid Limit > 50	MH	Elastic SILT
		CH	Fat CLAY
		OH	Organic SILT or CLAY
Highly Organic Soils		PT	PEAT

Notes: 1. Soil exploration logs contain material descriptions based on visual observation and field tests using a system modified from the Uniform Soil Classification System (USCS). Where necessary laboratory tests have been conducted (as noted in the "Other Tests" column), unit descriptions may include a classification. Please refer to the discussions in the report text for a more complete description of the subsurface conditions.

2. The graphic symbols given above are not inclusive of all symbols that may appear on the borehole logs. Other symbols may be used where field observations indicated mixed soil constituents or dual constituent materials.

DESCRIPTIONS OF SOIL STRUCTURES

Layered: Units of material distinguished by color and/or composition from material units above and below

Laminated: Layers of soil typically 0.05 to 1mm thick, max. 1 cm

Lens: Layer of soil that pinches out laterally

Interlayered: Alternating layers of differing soil material

Pocket: Erratic, discontinuous deposit of limited extent

Homogeneous: Soil with uniform color and composition throughout

Fissured: Breaks along defined planes

Slickensided: Fracture planes that are polished or glossy

Blocky: Angular soil lumps that resist breakdown

Disrupted: Soil that is broken and mixed

Scattered: Less than one per foot

Numerous: More than one per foot

BCN: Angle between bedding plane and a plane normal to core axis

COMPONENT DEFINITIONS

COMPONENT	SIZE / SIEVE RANGE	COMPONENT	SIZE / SIEVE RANGE
Boulder:	> 12 inches	Sand	
Cobbles:	3 to 12 inches	Coarse Sand:	#4 to #10 sieve (4.5 to 2.0 mm)
Gravel		Medium Sand:	#10 to #40 sieve (2.0 to 0.42 mm)
Coarse Gravel:	3 to 3/4 inches	Fine Sand:	#40 to #200 sieve (0.42 to 0.074 mm)
Fine Gravel:	3/4 inches to #4 sieve	Silt	0.074 to 0.002 mm
		Clay	<0.002 mm

TEST SYMBOLS

for In Situ and Laboratory Tests listed in "Other Tests" column.

ATT	Atterberg Limit Test
Comp	Compaction Tests
Con	Consolidation
DD	Dry Density
DS	Direct Shear
%F	Fines Content
GS	Grain Size
Perm	Permeability
PP	Pocket Penetrometer
R	R-value
SG	Specific Gravity
TV	Torvane
TXC	Triaxial Compression
UCC	Unconfined Compression

SYMBOLS

Sample/In Situ test types and intervals

- 2-inch OD Split Spoon, SPT (140-lb. hammer, 30" drop)
- 3.25-inch OD Spilt Spoon (300-lb hammer, 30" drop)
- Non-standard penetration test (see boring log for details)
- Thin wall (Shelby) tube
- Grab
- Rock core
- Vane Shear

MONITORING WELL

- Groundwater Level at time of drilling (ATD)
- Static Groundwater Level
- Cement / Concrete Seal
- Bentonite grout / seal
- Silica sand backfill
- Slotted tip
- Slough
- Bottom of Boring

MOISTURE CONTENT

Dry	Dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

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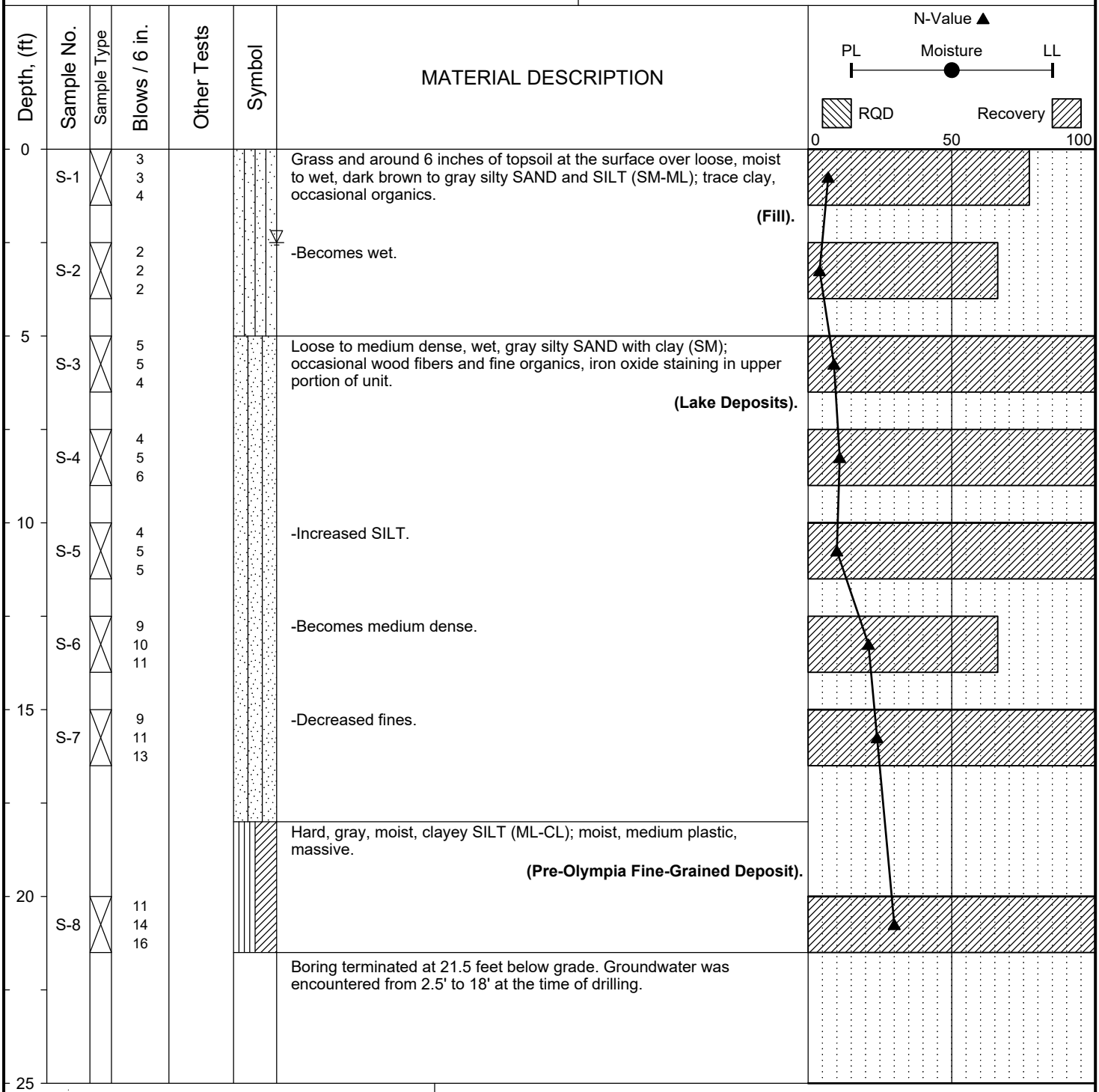
Terms and Symbols for Boring and Test Pit Logs

Figure A-1

Project:	6800 - 96th Ave SE	Surface Elevation:	23.0ft
Job Number:	17-014	Top of Casing Elev.:	
Location:	6800 - 96th Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	21.5ft
Date Borehole Started:	2/9/17
Date Borehole Completed:	2/9/17
Logged By:	Nels R.
Drilling Company:	CN Drilling

Remarks: Borings drilled using an Acker hand portable drill rig. Standard penetration test (SPT) sampler driven with a 140 lb hammer operated with a rope and cathead mechanism. Boring elevation estimated from a topographic survey provided to PanGEO

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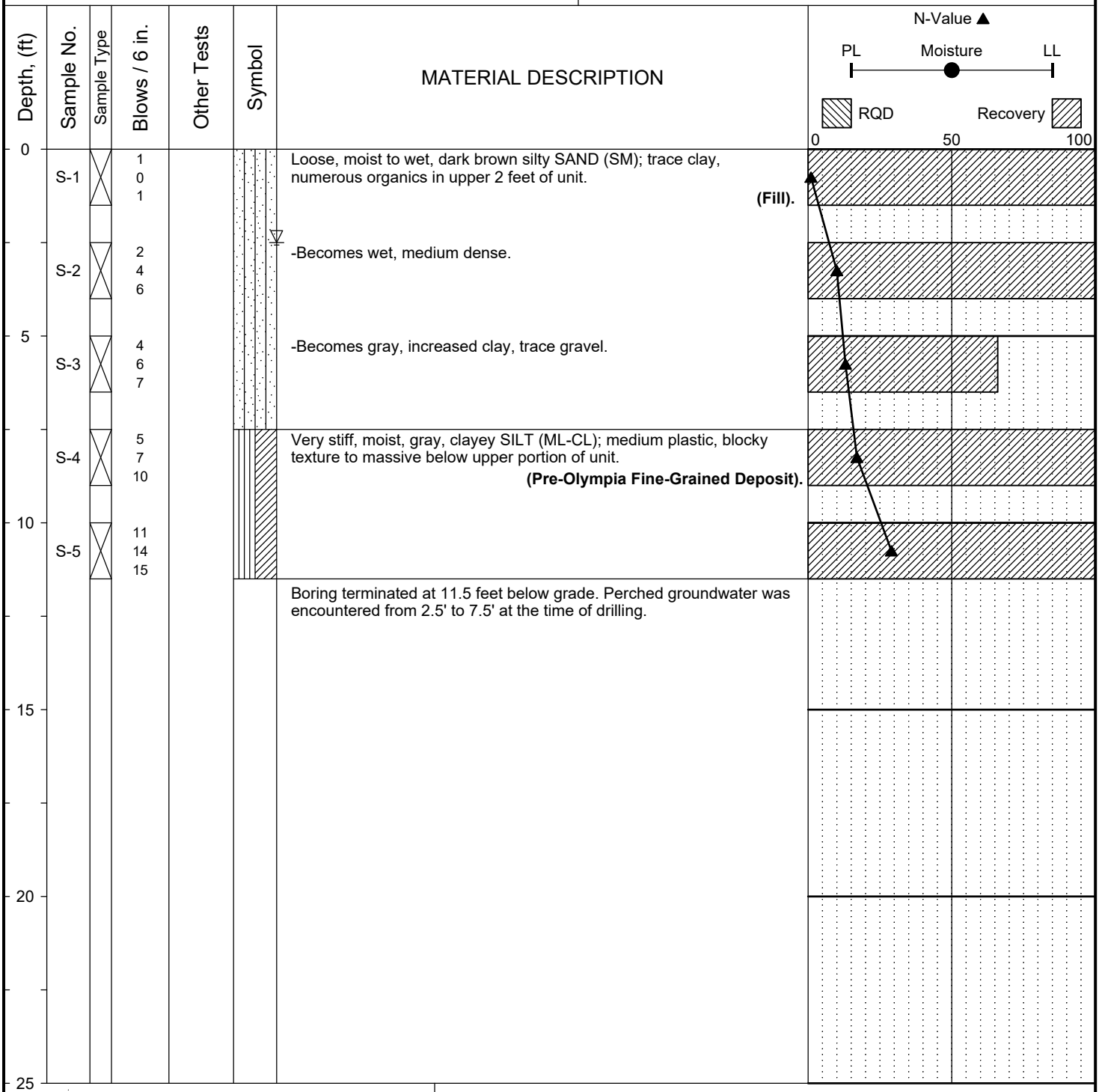
LOG OF TEST BORING PG-1

Figure A-2

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	6800 - 96th Ave SE	Surface Elevation:	31.0ft
Job Number:	17-014	Top of Casing Elev.:	
Location:	6800 - 96th Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	11.5ft
Date Borehole Started:	2/9/17
Date Borehole Completed:	2/9/17
Logged By:	Nels R.
Drilling Company:	CN Drilling

Remarks: Borings drilled using an Acker hand portable drill rig. Standard penetration test (SPT) sampler driven with a 140 lb hammer operated with a rope and cathead mechanism. Boring elevation estimated from a topographic survey provided to PanGEO

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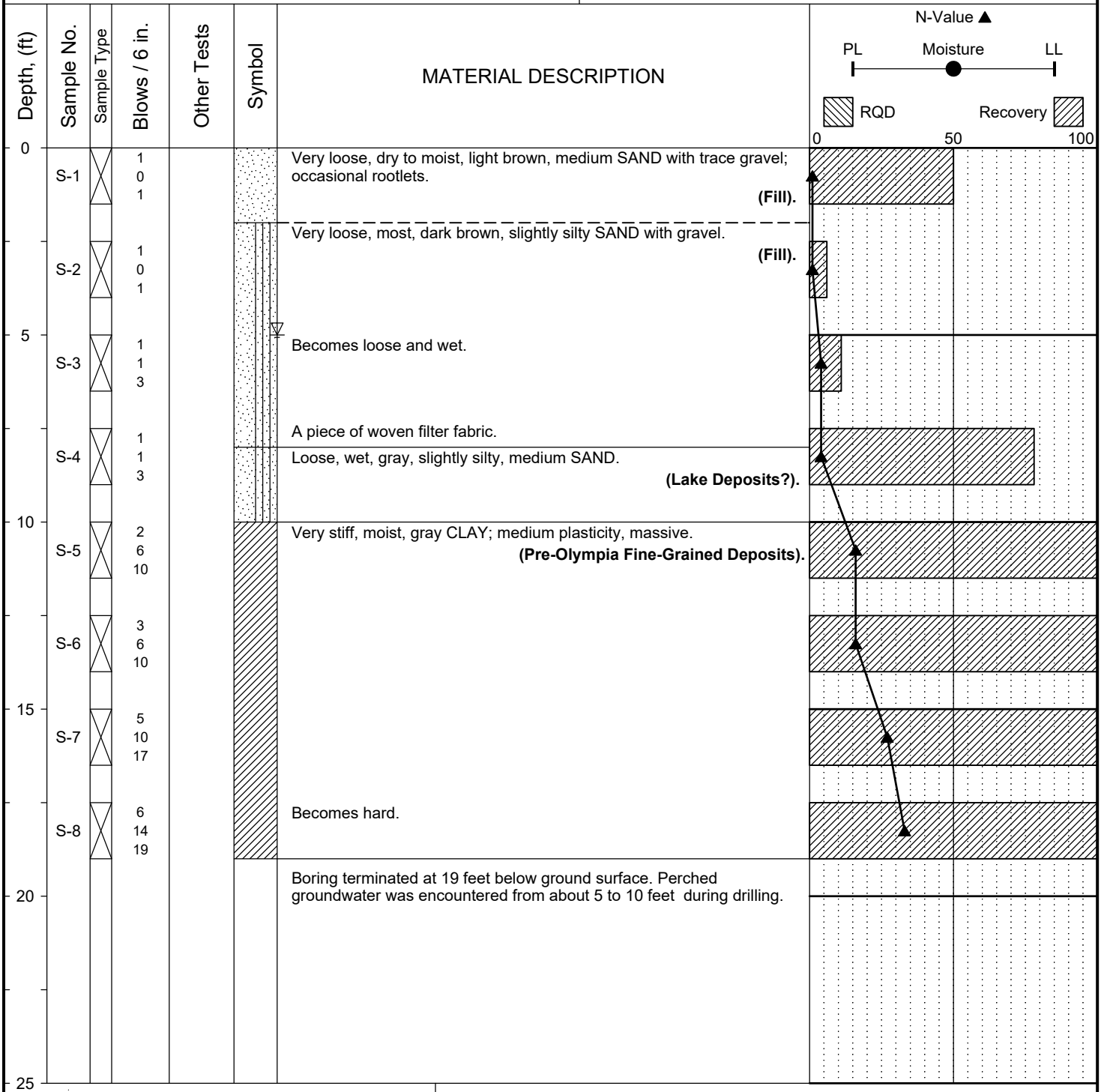
LOG OF TEST BORING PG-2

Figure A-3

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	6800 - 96th Ave SE	Surface Elevation:	37.0ft
Job Number:	17-014	Top of Casing Elev.:	N/A
Location:	6800 - 96th Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	21.5ft
Date Borehole Started:	7/27/18
Date Borehole Completed:	7/27/18
Logged By:	John M.
Drilling Company:	CN Drilling

Remarks: Borings drilled using an Acker hand portable drill rig. Standard penetration test (SPT) sampler driven with a 140 lb hammer operated with a rope and cathead mechanism. Boring elevation estimated from a topographic survey provided to PanGEO

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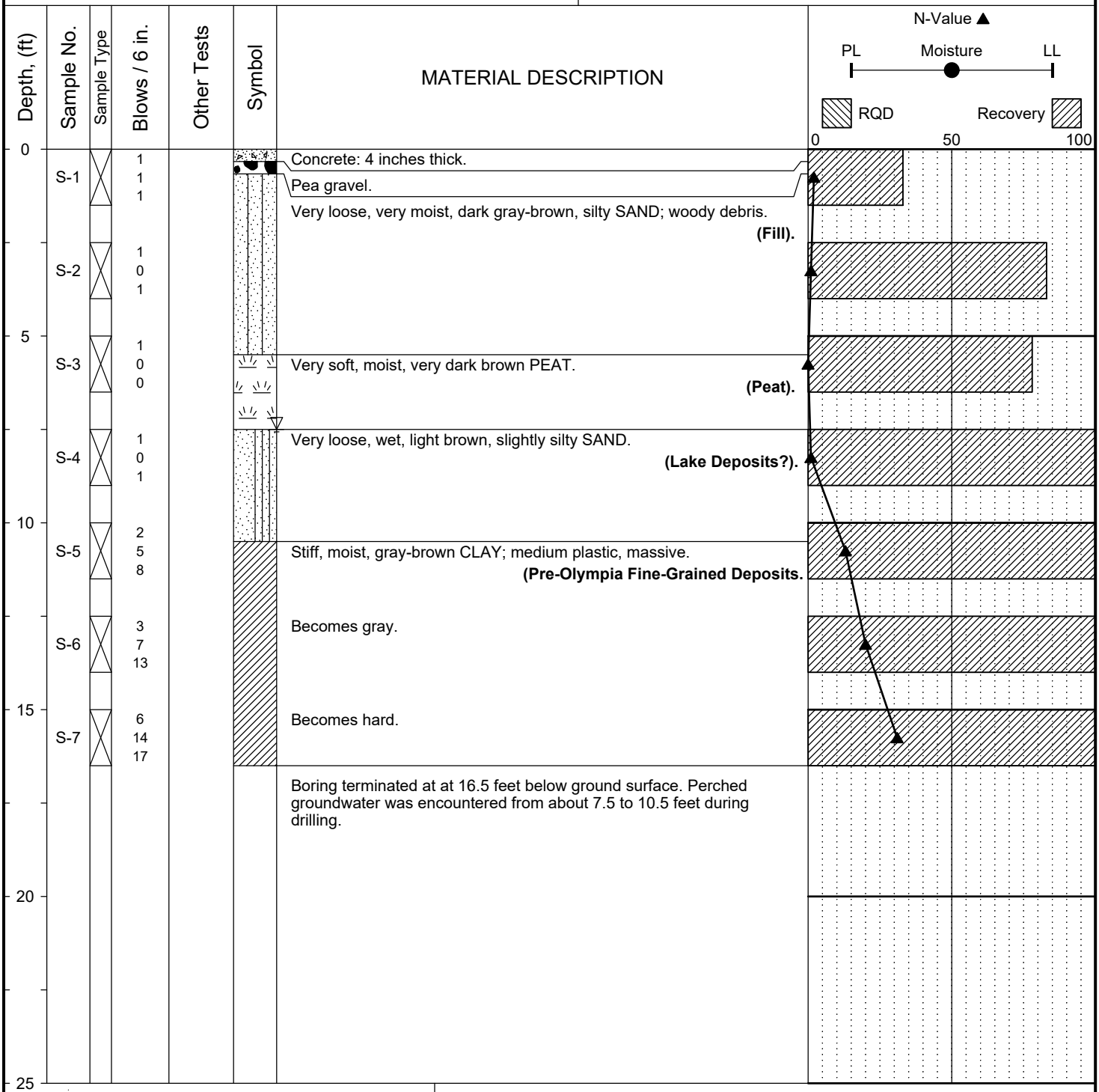
LOG OF TEST BORING PG-3

Figure A-4

The stratification lines represent approximate boundaries. The transition may be gradual.

Project:	6800 - 96th Ave SE	Surface Elevation:	46.0ft
Job Number:	17-014	Top of Casing Elev.:	N/A
Location:	6800 - 96th Ave SE, Mercer Island, WA	Drilling Method:	HSA
Coordinates:	Northing: , Easting:	Sampling Method:	SPT



Completion Depth:	16.5ft
Date Borehole Started:	7/27/18
Date Borehole Completed:	7/27/18
Logged By:	John M.
Drilling Company:	CN Drilling

Remarks: Borings drilled using an Acker hand portable drill rig. Standard penetration test (SPT) sampler driven with a 140 lb hammer operated with a rope and cathead mechanism. Boring elevation estimated from a topographic survey provided to PanGEO

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LOG OF TEST BORING PG-4

Figure A-5

The stratification lines represent approximate boundaries. The transition may be gradual.