- ENGINEERING GEOLOGY REPORT-

REPORT ON SITE GEOLOGY, HYDROGEOLOGY, ENGINEERING GEOLOGY, AND GEOTECHNICAL ENGINEERING ISSUES

TRANE U.S. INC.

CITY OF LYNNWOOD LIFT STATION 8 IMPROVEMENTS

Prepared by RH2 Engineering, Inc.
for Trane U.S. Inc. and the City of Lynnwood

February 2016

This report is based on site investigations conducted on December 21, 2015, and subsequent analysis, interpretation, and evaluation of site geology, hydrogeology, engineering geology, and geotechnical issues specific to the design and constructability of a new sewer lift station.

RH2 Project: TRN 114.050.02.205

RH2 ENGINEERS PLANNERS SCIENTISTS

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Trane U.S. Inc.
City of Lynnwood
Lift Station 8 Improvements
REPORT ON SITE GEOLOGY, HYDROGEOLOGY, ENGINEERING GEOLOGY, AND GEOTECHNICAL ENGINEERING ISSUES

February 2016

Report based on December 21, 2015 Site Investigation and Analysis

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RH2 Engineering, Inc., (RH2) has prepared this report for exclusive use by Trane U.S. Inc. (Trane) and the City of Lynnwood (City) to support the design of a proposed lift station to replace an existing lift station. The project site is at the Edmonds School District #15 Bus Yard at 3009 Alderwood Mall Drive in Lynnwood, Washington (**Figure 1**). Within the limitations of the scope of work, schedule, and budget, RH2 has completed an engineering geology and groundwater investigation to gain information necessary for developing specific recommendations for the proposed sewer lift station.

The geologic services have been conducted in accordance with the locally accepted practices of a licensed engineering geologist and per the elements of Chapter 18.220 of the Revised Code of Washington (RCW) and Chapter 308-15 of the Washington Administrative Code (WAC) that are included in the scope of work. The conclusions and recommendations contained in this report are based upon surface and subsurface geologic exploration of the earth materials and groundwater conditions at the site, and previous studies and maps of the region. Use of this report by others, or for another project, is at the user's sole risk.

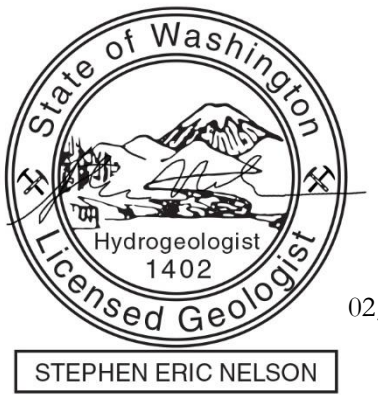
Based on the explorations completed under the scope of work, RH2 predicts that the types of earth materials encountered during excavation and construction of the facility will consist of loose to moderately dense sandy silt with gravel and very dense silty sand with gravel. The lateral and vertical continuity and composition of these layers is often variable. At the time of exploration in December 2015, shallow perched groundwater was at a depth of approximately 2 feet below the project site, and groundwater in deeper layers was at a depth of approximately 7 to 14 feet below the project site. Groundwater conditions will affect design and construction of the lift station.

Site inspection by RH2 during construction is recommended to determine the significance of variations in the geology and hydrogeology. RH2 should be notified when excavation begins and for the inspection of the subgrades prior to the initial placement of the foundations to confirm that the earth materials and groundwater conditions are consistent with those predicted in this report and meets the design requirements. If unsuitable earth materials and/or groundwater conditions are exposed, recommendations for correcting the problems may include additional field investigation. If conditions change due to new construction at or adjacent to the project, RH2 should inspect those changes prior to construction. We look forward to assisting and supporting the City for successful construction of the facility.

Sincerely,

RH2 Engineering, Inc.

Steve Nelson, L.E.G, L.HG.
Licensed Engineering Geologist and Hydrogeologist



02/10/2016

Rick Ballard, P.E.
Director

02/10/2016

This report is a final and complete response to all elements in the Scope of Work and Contract agreement between Trane U.S. Inc. and RH2 Engineering, Inc.

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ENGINEERING GEOLOGY REPORT

INTRODUCTION

Project Description

The City of Lynnwood (City) intends to replace the existing Lift Station 8 at the Edmonds School District #15 Bus Barn at 3009 Alderwood Mall Boulevard in Lynnwood, Washington (**Figure 1 – Proposed Site Plan**). The proposed lift station will be approximately 100 feet to the northwest of the existing lift station. The proposed lift station will provide greater capacity and reliability for the City's sewer system.

Trane U.S. Inc., on behalf of the City, authorized this geologic/hydrogeologic investigation to provide contractors with sufficient information to develop construction and excavation approaches for dewatering and excavation shoring plans to support the installation of the proposed lift station (the project).

The 10-foot by 20-foot wet well for the proposed lift station will be founded on native soil at a depth of approximately 22 feet below ground surface (bgs). A new electrical generator will be placed on a concrete slab founded on subgrade soil at a depth of approximately 18 to 24 inches. A new 24-inch-diameter gravity pipe will connect the existing lift station to the new wet well at depths ranging from 16 to 19 feet bgs. **Appendix A** contains the proposed lift station site plan and profile.

Location and Existing Conditions

The surrounding properties are developed for commercial and residential use. The proposed lift station site is on a vacant portion of the site currently used for vehicle storage. The project site is flat and the ground surface elevation of the project site is approximately 385 feet above mean sea level.

Figure 1 shows the project site, existing site structures, soil boring location for this investigation, and soil boring locations from previous investigations. This information should be used to guide any and all alterations to the site, including excavation for the proposed lift station, and shoring and dewatering during construction.

Previous Investigative Work

The site has been investigated by others for the nature and extent of potential soil and groundwater contaminants related to vehicle fueling and maintenance at the bus yard. Boring logs for these investigations were provided by EHS International (EHSI) of Seattle, Washington. The locations of these borings and wells are shown on **Figure 1**. Copies of driller's logs are included in **Appendix B**.

RH2 reviewed the following documents and websites:

United States Geological Survey (USGS) Earthquake Hazards Program, Accessed December 2015. http://earthquake.usgs.gov/hazards/ products/ conterminous/

Washington State Department of Ecology Washington State Well Log Viewer. Accessed December 2015. https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/default.aspx

Washington Department of Natural Resources Washington Interactive Geologic Map. Accessed December 2015. https://fortress.wa.gov/dnr/geology/

Exploration Methods and Strategy

One 30-foot-deep soil boring (EB-20) was used to explore the earth materials (stratigraphy, composition, texture, moisture content, and density) and groundwater conditions (permeability, liquefaction potential, and seepage rate) below the ground surface at the project site. The soil borings provided data on the density of the earth materials using the Standard Penetration Test (SPT), which was used to evaluate soil density and the potential for settlement and liquefaction. Representative soil samples were collected from the soil borings and submitted for laboratory analysis of soil properties. The soil boring was decommissioned after drilling. Nearby borings from work conducted by EHSI encountered geologic and groundwater conditions similar to those at boring EB-20.

Purpose of the Engineering Geology Report

This report is a public document. It is specific to this project and has been prepared to support the planning, permitting, design, and bid documents for this project. This report is intended to support the completion of the project for the City and protect the public interest by safeguarding life, health, property, and the environment, while promoting public welfare in a manner consistent with Chapter 18.220 RCW and Chapter 308.15 WAC, which regulate the licensed practice of Geology.

This report with its appendices, including soil boring and monitoring well construction logs, supports RH2's design of the project.

This report includes recommendations for enhancing the constructability of the project based on site-specific characterizations of the earth materials and groundwater that will likely be encountered during excavation for the project. The purpose of this report is not to dictate any means and methods for construction of the project, but rather it is intended to provide information that will be useful to contractors for preparing bids. Providing this report and appendices will support contractors' cost estimates for excavation, shoring, and managing groundwater activities that are specific to the conditions at the project site. Contractors must independently interpret the findings in this report to select construction methods, safety procedures, equipment, and contingencies for completing the project.

Based on the available geologic, hydrogeologic, and geotechnical engineering data, this site is suitable for construction of the project and associated improvements; therefore, planning, permitting, and design should proceed.

REGIONAL GEOLOGY

RH2 reviewed regional geologic maps of the project area for stratigraphic, tectonic, structural, and geomorphic information relevant to the project. The local stratigraphy consists of Recent fill, alluvial, and weathered glacial till overlying Quaternary Age glacial till. The upper unit is locally extensive and varies in thickness from approximately 5 to 20 feet. The glacial till is locally extensive extends to a depth of 30 to 80 feet in the Lynnwood area, and is underlain by older glacial units to depths of more than 1,000 feet.

Tectonically, the project site lies between an oblique convergent plate boundary and the rising and volcanically active Cascade Mountain Range. An active subduction zone lies deep below Snohomish and King Counties, and the continental crust is being compressed and pushed northward. The site is also located near east-west-trending Seattle and northwest-southeast-trending Southern Whidbey Island fault zones. This tectonic setting results in significant seismic activity and, assuming a 50-year design life for the proposed lift station, USGS Hazards probability mapping predicts a 40-percent probability that the project site will experience an intermediate (Magnitude 6.0) crustal earthquake (like the 2001 Nisqually earthquake) and/or a shallow earthquake that breaks the ground surface (e.g., along the roughly east-west trending Seattle fault zones). USGS hazards mapping predicts a 2-percent probability of exceedance in 50 years of a peak ground acceleration (PGA) of 0.4 to 0.5 g.

The Washington State Department of Natural Resources (WADNR) Interactive Geologic Map, based on the National Earthquake Hazards Reduction Program (NEHRP), identifies the project site as Seismic Site Class C.

The WADNR characterized the project area with very low liquefaction susceptibility.

SITE GEOLOGY

The project site consists of paved or gravel-surfaced developed land used for vehicle parking and maintenance. The project site is bordered by residential and commercial lots and paved roads. The WADNR geologic map identifies the surficial geologic unit as glacial till.

Subsurface Exploration and Investigation

On November 14, 2014, RH2 supervised the drilling, sampling, and testing of one soil boring (EB-20) to explore and characterize the geology and hydrogeology of the site. The boring was decommissioned after drilling.

Soil boring EB-20 was completed at a depth of 30 feet bgs, using a truck-mounted, hollow-stem auger drill rig (CME-75) provided and operated by Holocene Drilling, Inc., of Puyallup, Washington. Soil samples were collected at 5-foot intervals using SPT methods with an auto-hammer. Upon completion of the geological investigation, the boring was decommissioned with hydrated bentonite chips.

Figure 2 shows the location of EB-20 and existing soil borings and monitoring wells. **Appendix C** contains the project hand auger boring log and monitoring well completion log.

Geologic In-situ Tests

In-situ SPTs were performed at regular intervals in the soil boring, and the SPT N-value results (the number of blows in the lower 12 inches of testing) are presented in the boring log in **Appendix B**.

Geologic Laboratory Tests

Grain-size analysis was not performed on soil samples, as the field observations and in-situ testing were adequate to characterize the soil composition and density.

Geologic Units

Three soil/geotechnical units, listed from shallowest to deepest, were found within the site: 1) Gravelly SAND fill; 2) Sandy SILT with Gravel; and 3) Silty SAND with Gravel to Sandy

SILT with Gravel. These units were distinguished based on compositional and textural differences and geotechnical properties.

1. Unit 1 consists of granular fill as a surfacing layer for vehicle storage.
2. Unit 2 consists of approximately 8 feet of loose, moist to wet, olive brown to olive gray Sandy SILT with fine subrounded gravel, characteristic of alluvium and weathered till to a depth of approximately 9 feet bgs.
3. Unit 3 consists of at least 21 feet of very dense, moist, olive gray Silty SAND with Gravel and Sandy SILT with fine subrounded gravel to a depth of at least 30 feet. This unit was encountered at all nearby borings at depths ranging from 10 to 15 feet bgs.

Hydrogeology

Soil between 7 and 14 feet bgs was wet and groundwater appeared to be perching on top of underlying low permeability glacial till unit. Soil below 14 feet was moist to slightly moist. These findings are consistent with groundwater observed in nearby monitoring wells, where the static (perched) groundwater level ranges from about 7 to 14 feet bgs. Groundwater levels at the project site likely fluctuate seasonally by a few feet. Constructing the proposed lift station will require site excavation to a depth of approximately 22 feet bgs, approximately 13 feet below the perched groundwater level, measured in December 2015.

PROJECT SUMMARY

Geologic and Groundwater Conditions

The project site from ground surface to approximately 9 feet consists of some fill and mostly native soil identified as loose to medium dense Sandy SILT with Gravel and is underlain by very dense Silty SAND with Gravel to a depth of at least 30 feet.

Groundwater-saturated (perched) soil was encountered from 7 to 14 feet, and soil became moist below 14 feet. The static perched level may fluctuate seasonally by a few feet. Hydraulic conductivity of the groundwater saturated portion of the glacial till unit testing is estimated at 1×10^{-3} to 1×10^{-5} centimeters per second (cm/sec).

Summary of Soil Properties

Based on the findings of the site investigation and laboratory analysis of representative soil samples, design and construction should assume the following soil parameters:

Soil Density (based on SPT N-values)
Sandy SILT with Gravel – loose to medium dense; N = 5 to 9
Silty SAND with Gravel – very dense; N > 50

Soil Unit Weight (based on published values)
Sandy SILT with Gravel – 110 to 115 pounds per cubic foot (pcf)
Silty SAND with Gravel – 110 to 125 pcf

Soil Friction Angle (based on published values)
Sandy SILT with Gravel – 28 to 32 degrees
Silty SAND with Gravel – 28 to 32 degrees

At Rest Earth Pressure (assuming highest values of unit weight and lowest friction angle)
Sandy SILT with Gravel – 54 pcf and 87 pcf submerged
Silty SAND with Gravel – 54 pcf and 87 pcf submerged

Active Earth Pressure
Sandy SILT with Gravel – 35 pcf and 79 pcf submerged
Silty SAND with Gravel – 35 pcf and 79 pcf submerged

Summary of Geologic Risks and Hazards

- Risks from landslides and mass wasting are negligible.
- Risks from flooding are low.
- Risks from groundwater seepage during construction are high and must be mitigated to maintain the integrity and stability of the excavation (refer to the **Recommendations for Design and Construction** section of this report).
- Earthquake and liquefaction risk are very low.

Summary of Construction

The 10-foot by 20-foot wet well will be constructed in an excavation cut to a depth of 22 feet bgs through approximately 9 feet of very loose to medium dense, moist to wet Sandy SILT with Gravel (fill and alluvium) and approximately 13 feet of very dense, wet to moist Silty SAND with Gravel (glacial till). The excavation will encounter a 7- to 10-foot-thick zone of groundwater-saturated (perched) weathered till and alluvium near the upper portion of the glacial till unit. Below this depth, the excavation will likely encounter increasingly denser and drier soil. Refer to the site drawings (**Appendix A**) and site boring log constructed at the proposed wet well (**Appendix B**). The Silty SAND with Gravel (glacial till) unit is considered suitable as a foundation for the wet well for the proposed lift station (refer to the **Recommendations for Design and Construction** section of this report).

RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

The excavation for the new wet well and new gravity pipe will require shoring and groundwater control to stabilize and maintain a dry working condition in the excavation. The method for groundwater control will depend on the timing of construction, the level of perched groundwater, and the type of shoring used for the excavation.

Shoring

The type and method of shoring to stabilize the lift station excavation should be the responsibility of the contractor, and the contractor must submit the shoring designs to the City for review. The project area is constrained by below-ground and above-ground utilities, pavement and fencing, and property lines, and the nearest buildings are on shallow foundations approximately 30 feet from the proposed lift station. The shoring system should minimize movement of soil to protect utilities and structures next to the excavations. Shoring methods should be designed to minimize any disruption of the adjacent pavement and fencing next to the proposed lift station and gravity sewer due to temporary loading next to the excavations,

excessive vibration during construction, and potential settlement related to excavation and dewatering activities.

The selected shoring method and installation approach must consider the density and grain size of the soil, which generally increases with depth below 12 feet.

Shoring should minimize potential for settlement due to dewatering. Groundwater within the perched groundwater zone between approximately 6 to 16 feet bgs should be managed to maintain the integrity of the excavation, maintain a sufficiently dry subgrade for excavation, and minimize the potential for settlement outside the shoring system.

Water-tight shoring could reduce the amount of groundwater withdrawn and the time to achieve dry conditions and could provide greater stability for the excavation sidewall.

- The contractor should install construction stabilization (for example, caisson, slide rail shoring, steel sheets, etc.), as necessary, to protect workers inside excavations and to support excavated vertical slopes. All excavations should comply with all Occupational Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) safety requirements.
- Water-tight shoring for the wet well excavation should extend sufficiently deep below the perched groundwater zone to maintain the stability of the excavation subgrade.
- The shoring system should be designed in coordination with the groundwater control system to minimize conflicts with installation and operation of both systems.

Groundwater Control

Groundwater control will be required to maintain dry conditions during excavation and the stability of the excavation floor. Groundwater control will be a significant construction issue that should be undertaken by a contractor or subcontractor with relevant experience in construction of similar groundwater and soil conditions. The following summarizes conditions that likely will occur and objectives that should be met to successfully complete the project.

- The excavation will likely encounter moist to wet conditions from 2 to 12 feet and groundwater-saturated conditions below from approximately 6 to 16 feet bgs, depending on the season of construction. Groundwater level at the proposed lift station should be measured at nearby monitoring wells on the site at the time of bidding and prior to construction.
- The contractor is responsible for the design and operation of the dewatering system. The contractor should anticipate and plan for a groundwater control system to maintain a sufficiently dry subgrade to support construction. The contractor should have contingency plans in the event of loss of power, inability to discharge water, and/or settlement of the excavation support.
- The contractor should anticipate and plan on draining the groundwater from the perched groundwater zone during the initial excavation and any groundwater seepage that may enter the excavation from the sides and floor of the excavation.
- The contractor should anticipate initial pumping rates from a groundwater control system completed at the proposed lift station excavation ranging between 20 to

100 gallons per minute (gpm) initially until the shoring system fully extends below the perched groundwater zone. Groundwater seepage likely will reduce to less than 20 gpm once the shoring is fully installed and excavation to the subgrade is complete.

- Groundwater discharge from the dewatering system should be managed through settlement and filtering so that it is free of sediment and does not exceed discharge limits at the point of discharge.
- The contractor should rely upon a specialty groundwater control subcontractor with a Washington State-licensed hydrogeologist with expertise in both vacuum wellpoint and sumping dewatering systems to design and submit a groundwater control plan showing all components, and to operate the groundwater control system.
- The contractor should periodically monitor the quality of water from the groundwater control system for the presence of sediment, odors, and color in the water.
- The contractor should measure groundwater levels at the existing monitoring wells onsite to support groundwater elevation monitoring and to anticipate the requirements of the groundwater control system.
- Any borings or wellpoints used for dewatering must be decommissioned per Chapter 173-160 WAC after project completion.

Excavation to the Subgrade and Excavation Stabilization

- Excavated soil should be exported and not be used for structural fill.
- Excavation for the wet well foundation and the proposed gravity pipe should proceed until a level surface has been cut into the Silty SAND with Gravel unit at or below the design depth.
- Excavation for the emergency generator and supporting slab should be at least 2 feet below the subgrade elevation to allow for sufficient thickness of structural fill.

Inspection and Treatment of In-situ Earth at Excavation Subgrade

- A Licensed Engineering Geologist (LEG) or Professional Engineer with geotechnical experience (PEG) should inspect the excavations and confirm that the native earth materials encountered during excavation are consistent with this report, meet the design requirements, and are favorable for proceeding with the project as planned.
- A LEG or PEG should inspect the in-situ native earth materials at the subgrade elevations before the placement of any imported material.
- A smooth (toothless) backhoe bucket may be necessary to strip off the final layer of earth materials in order to create a level pad at the subgrade. The zone of disturbed earth materials on the level pad should be less than 2 inches thick prior to any compaction.
- After the native subgrade has been inspected and approved, it should be tested for zones or areas of weakness by probing. This testing should be observed and approved by a LEG or PEG.

- Zones of soft soil at the subgrade elevation that are less than 1 foot thick should be over-excavated and backfilled with crushed surfacing base course (CSBC) per the Washington State Department of Transportation (WSDOT) 2014 Specifications 9-03.9(3). CSBC should be placed in lifts that are a maximum of 8 inches thick when loose and then compacted to a firm and unyielding condition.
- Soft soil deeper than 1 foot should be over-excavated by at least 1 foot and backfilled with a base layer of 12 to 24 inches of 8-inch-minus quarry spalls that are pushed into the subgrade and overlain by geotextile fabric to develop a firm working surface; a layer of CSBC should be placed on the geotextile to bring the excavation up to the design subgrade at the direction of the LEG or PEG.

Subgrade Preparation and Compaction

- The wet well should be placed directly on a firm and unyielding surface of quarry spalls or crushed rock that is "free of all loose material," not saturated with water, and undisturbed by construction activity.
- If foundation subgrades are loosened by construction activities, they should be restored to a firm and unyielding condition with hand tampers immediately before placing the structures. In certain situations, a Vactor truck or other suction equipment may effectively remove loose earth materials and groundwater.
- The in-situ subgrade, prepared as recommended in the previous section, will lose strength if it is disturbed or becomes loose or wet. After inspection and approval of the in-situ subgrade by a LEG or PEG, the native subgrade or structural fill should be kept dry and undisturbed until it can be entirely covered by the surfacing layer.
- A layer of CSBC should be placed in two lifts that are not more than 6 inches thick when loosely placed. Each lift should be compacted to a firm and unyielding surface Placement and compaction of the crushed rock should be observed by a LEG or PEG. The crushed rock surface can be the finished subgrade.

Compaction of Structural Fill

- Structural fill, if needed, shall be equivalent to Gravel Borrow, 9-03.14(1) per the WSDOT 2014 Specifications.
- Structural fill should be within plus or minus 2 percent of its optimum moisture content when placed. Structural fill should contain less than 5 percent fines to promote drainage
- Structural fill around the proposed lift station wet well and other subgrade structures should be placed in lifts not to exceed 8 inches in loose thickness and then compacted using methods that will not compromise the structures. The materials should be compacted to a firm and unyielding condition.

Potential Settlement of Adjacent Structures and Utilities

The adjacent ground surrounding the construction may be affected by activities of excavation stabilization and groundwater control due to vibration, excavation, and/or changes in hydrostatic pressure and water elevations. The proximity and potential vulnerability of nearby structures and utilities should be considered when selecting the methods for excavation stabilization and groundwater control. Prior to construction, nearby structures and utilities should be identified and assessed for potential vulnerability, and the allowable changes in position and/or orientation should be predetermined and stated within the construction bid documents.

Settlement Assessment and Monitoring

Structures, pavement, and utilities identified as potentially vulnerable to settling should be surveyed for position and elevation. Tolerances for total and differential settlement of nearby structures, pavement, and utilities should be established in the bid specifications.

During and after construction, selected nearby structures and utilities potentially affected by construction should be monitored for changes in position and/or orientation by optical surveying of settling points that are established prior to construction. Surveyed settling points should be twice the distance of the depth of the excavation (approximately 30 to 40 feet) from the edge of the excavation. Settling points should be surveyed immediately before excavation, daily during dewatering system operation, shoring, and excavation activities, and at 1 week and 2 weeks after dewatering system operation, shoring, and excavation activities are completed.

Existing cracks in structures or pavement should be identified before construction and monitored by installing crack meters before construction, and checked daily for indications and magnitude of displacement during dewatering system operation, shoring, and excavation activities, and at 1 week and 2 weeks after dewatering system operation, shoring, and excavation activities are completed.

Seismic Design

- The lift station should be designed to the 2012 International Building Code (IBC) standards as adopted by the State of Washington, assuming the earthquake frequency summarized above.
- The location of the site is at latitude 47.825 N and longitude 122.274 W.
- The very dense Silty SAND with Gravel that will support the wet well should be considered as a Site Class C, firm soil in the classification system from the 2012 IBC, Table 1613.5.2 Site Class Definitions.
- Liquefaction hazards associated with earthquakes is very low.

Season of Work

- RH2 recommends constructing the project during summer months, at the time of lowest groundwater elevations at the project site.

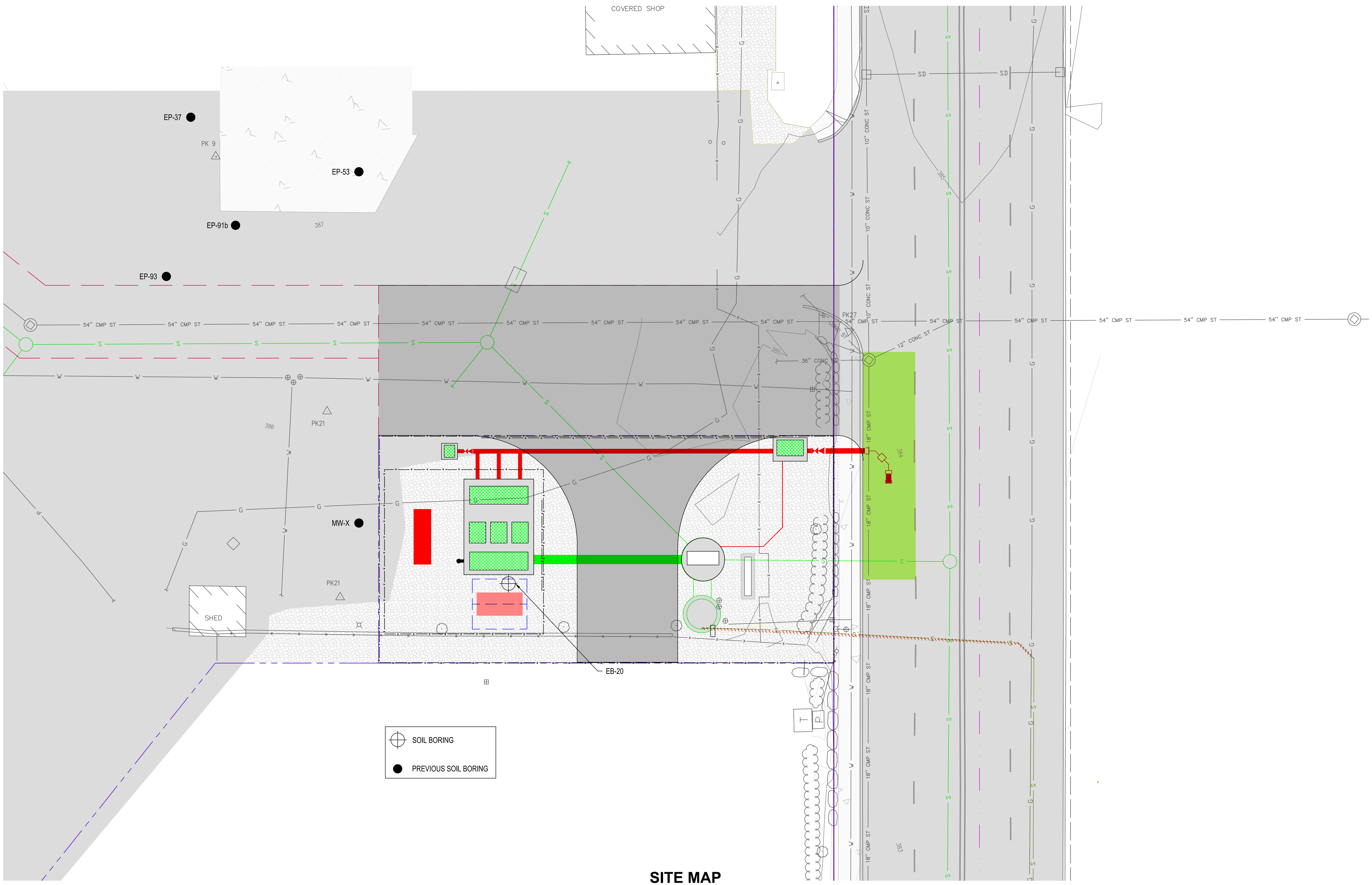
Bid Documents

- This Engineering Geology Report and appendices should be provided to all contractors interested in submitting bids for the work to ensure site specific estimates for excavation, shoring, and construction dewatering.

FIGURES

FIGURE 1

SITE MAP



SITE MAP

FIGURE 1

1" = 10'

CITY OF LYNNWOOD

LIFT STATION 8 IMPROVEMENTS

PRELIMINARY

FIGURE 1

RH2 ENGINEERING, INC.
www.rh2.com 1.800.720.8052
BOTHELL, WA
22722 29th Drive SE, Suite 210

LYNNWOOD WASHINGTON

ENGINEER: XXX | SAVE DATE: Jan 28, 2016 | CLIENT: LYNN | JOB NO.: 114-050

REVIEWED: EH | PLOT DATE: Jan 28, 2016 | FILENAME: LS8-P-GEO_BORINGS.DWG

REVISIONS

NO.	DATE	DESCRIPTION	BY	REVIEW

SCALE: SHOWN

0" 1" 2"

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: C02

SHEET NO.: X YY

APPENDICES

APPENDIX A

PROPOSED SITE PLAN AND PROFILE

PROPOSED ASPHALT DRIVEWAY

RIGHT–OF–WAY

33' DRIVEWAY

PROPOSED METER VAULT

PROPOSED FORCE MAIN

FENCE ALTERNATE 1

50' WIDE GATE

POSSIBLE STAGING AREA

PROPOSED POLYPIG VAULT

GAS LINE TO BE RELOCATED AS NECESSARY

FENCE ALTERNATE 2

PROPOSED WETWELL AND VALVE VAULT

PROPOSED GRAVITY PIPE

22'

PROPOSED ELECTRICAL GENERATOR

PROPOSED ELECTRICAL ENCLOSURE

12' SLIDING GATE

EXISTING WETWELL , TO BE MODIFIED

EXISTING LIFT STATION, TO BE ABANDONED

ASPHALT OVERLAY PER CITY OF LYNNWOOD STANDARD DWG. STD3-18C

APPROX. 45 LF OF 14" DI PIPE

PROVIDE:
(2) - 14" DI 45° BENDS (MJxMJ)
(1) - 14" PIPE, LTF

PROVIDE:
(1) - 14" DI PIPE, APPROX. 2' LENGTH
(1) - 14" DI CAP

FUTURE FORCEMAIN BY OTHERS. STUB LOCATION TO BE VERIFIED PRIOR TO CONSTRUCTION.

EXISTING SEWER FORCE MAIN TO BE ABANDONED

APPROX. LOCATION OF EXISTING FORCE MAIN

FLOW

R25'

SHED

PK 9

PK21

PROPOSED SITE PLAN

1" = 10'

L. BALLARD — REGISTERED PROFESSIONAL ENGINEER — STATE OF WASHINGTON

TONY PADDI — REGISTERED PROFESSIONAL ENGINEER — STATE OF WASHINGTON

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CITY OF LYNNWOOD
LIFT STATION 3 IMPROVEMENTS

PRELIMINARY

PROPOSED SITE PLAN

LYNNWOOD WASHINGTON

JOB NO.:	114-050
CLIENT:	LYNN
FILENAME:	LS8-D-CIV02.DWG
SAVE DATE:	Jan 12, 2016
PLOT DATE:	Jan 13, 2016
ENGINEER:	XXX
REVIEWED:	EH

REVISIONS

NO.	DATE	DESCRIPTION	BY	REVIEW

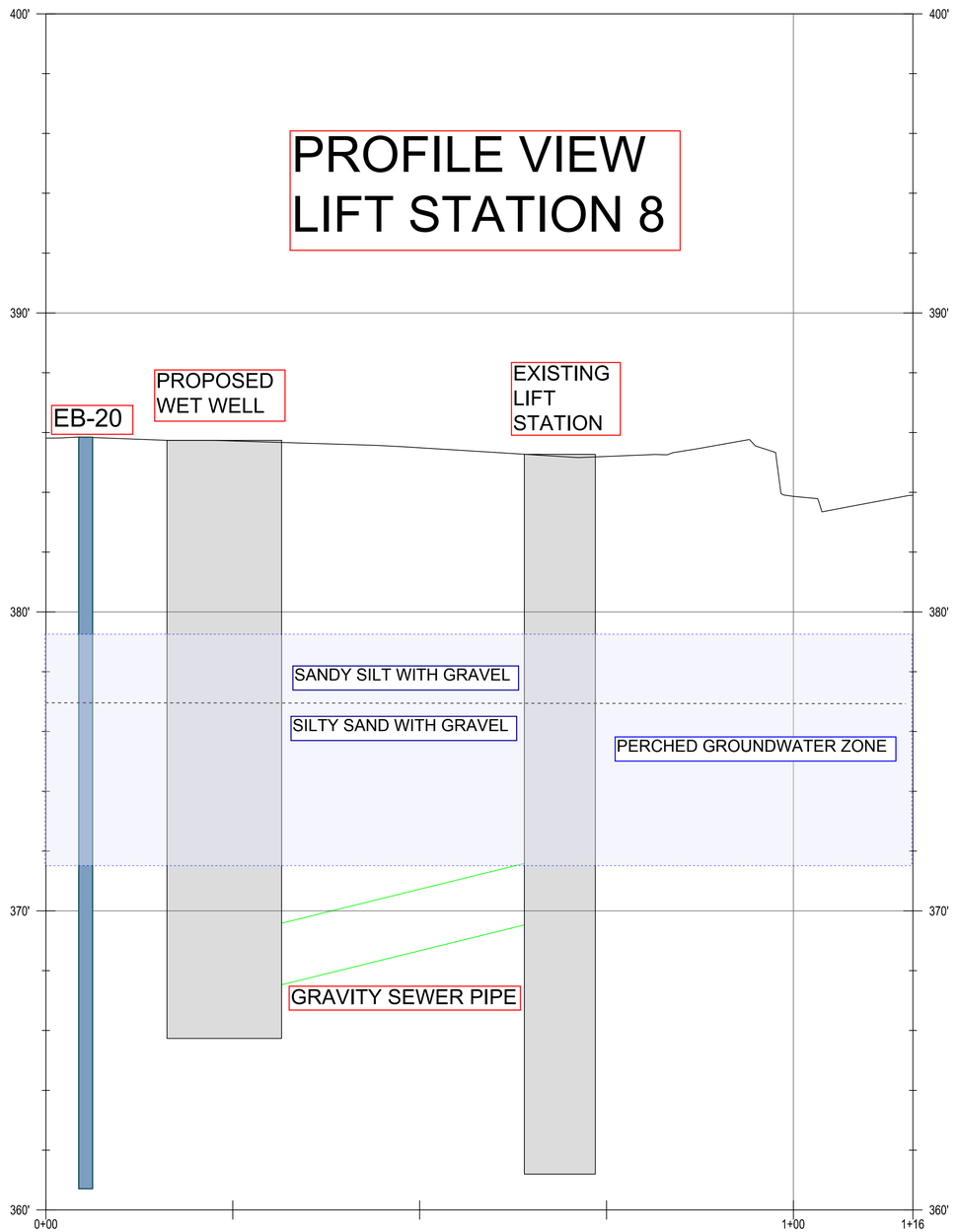
SCALE: SHOWN

0" 1" 2"

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: C02

SHEET NO.: 4 YY



LS8 SITE PROFILE

H: 1" = 10', V: 1" = 2'

.LAYER

\DATA\TRANE\114-050\CAD\LS8-X-SITE

APPENDIX B

SITE VICINITY BORING LOGS

Project Name: Edmonds Bus Barn
Project Number: 107.19a
Client: ESD

Boring No.: EP-37
Sheet 1 of 1

Date(s) Drilled: 11/3/15	Logged By: JSC	Surface Conditions: Asphalt
Drilling Method(s): Probe	Core Size: 2"	Total Depth of Borehole:
Drill Rig Type: AMS	Drilling Contractor: Cascade	Approximate Surface Elevation:
Groundwater Level and Date Measured:	Sampling Method	Hammer Data:
Borehole Backfill:	Location: Former UST Hall	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
					0		
						Med. Sand fill	SP
					5		
				▽		Becomes wet	
						. Rocks	
					10		
						Fine Sand, gray, wet	
					15		
0.0	EP37-17					Fill till	
						Silt, sand & gravel, gray, moist, no odor	GM
						Refusal @ 17' bgs	
					20		

DRAFT

Project Name: Edmonds Bus Barn
Project Number: 107190-01
Client: ESD

Boring No.: EP-53
Sheet 1 of 1

Date(s) Drilled: 11/6/15	Logged By: JSC	Surface Conditions: Concrete
Drilling Method(s): Probe	Core Size: 2"	Total Depth of Borehole: 10
Drill Rig Type: GeoProbe	Drilling Contractor: Cascade	Approximate Surface Elevation:
Groundwater Level and Date Measured:	Sampling Method: Cont.	Hammer Data: N/A
Borehole Backfill: Bentonite	Location: S.E.C. of dispensers	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
					0	Concrete	
0.0						Fine sand, brown, dry	SP
0.0					5	Fine sand, brown, dry, no odor	SP
						Becomes gray & strong gasoline odor	
1465	EP53-8 11:40					Silty sand with gravel, dark gray, moist Very strong gasoline odor	SM
16.4	EP53-10 11:50				10	Silty sand with gravel, brown, dry, hard	SM
						Refusal @ 10' bgs	
					15		
					20		

Project Name: Edmonds Bus Barn
Project Number: 107194-02
Client: ESD

Boring No.: EP-91b
Sheet 1 of 1

Date(s) Drilled: 11/23/15	**Logged By:** JSC	**Surface Conditions:** Asphalt
Drilling Method(s): Probe	**Core Size:** 2"	**Total Depth of Borehole:** 13.5'
Drill Rig Type: Geoprobe	**Drilling Contractor:** Cascade	**Approximate Surface Elevation:**
Groundwater Level and Date Measured:	**Sampling Method** Cont.	**Hammer Data:** N/A
Borehole Backfill:	**Location:** W. of dispenser islands	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
					0	Fine to coarse sand with gravel light gray, dry	SW
					5	Silty fine sand, brown, dry	SM
1.6	EP91b -10 7:35	S		▽	10	Silty fine sand with gravel, light gray very moist, no odor	SM
66.0	EP91b -12 7:45	S				Silty fine sand with gravel, dark gray, wet strong petro. odor	SM
6.4	EP-91b -13.5 7:55	S				Silt, sand, & gravel, light gray, dry	SM GM
					15		
					20	EOB. 13.5' bgs	

Poor groundwater recharge

Project Name: Edmonds Bus Barn
Project Number: 10719a-02
Client: ESD

Boring No.: EP-93
Sheet 1 of 1

Date(s) Drilled: 11/23/15	Logged By: JSK	Surface Conditions: Asphalt
Drilling Method(s): Probe	Core Size: 2"	Total Depth of Borehole: 13.5'
Drill Rig Type: Geoprobe	Drilling Contractor: Cascade	Approximate Surface Elevation:
Groundwater Level and Date Measured:	Sampling Method: Cont.	Hammer Data: N/A
Borehole Backfill: Bentonite	Location: SW of dispenser islands	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
					0	Asphalt	
						Gravel	
0.0					5	Fine sand, brown, dry	
0.0	EP93-8	S				Silt, sand, and coarse gravel, moist, brown	SM
					10	Silt, sand & gravel, dark gray, hard dry, no odor till	GM
0.0	EP93-13.5	S				" "	GM
					15		
					20	13.5' EOB No groundwater	

Project Name: Edmonds Bus Barn
Project Number: 10719a-01
Client: ESD

Boring No.: EP80/EB-14
Sheet 1 of 1

Date(s) Drilled: 4/13/15	Logged By: JSC	Surface Conditions: Concrete
Drilling Method(s): Probe	Core Size: 2"	Total Depth of Borehole: 12'
Drill Rig Type: AMS	Drilling Contractor: Cascade	Approximate Surface Elevation:
Groundwater Level and Date Measured:	Sampling Method(s): None / Cont.	Hammer Data: N/A
Borehole Backfill: Well	Location: SEC. of S-3 sump	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
			1		0	12" Concrete	
0.0			1 bent.			Silt and sand with gravel, brown very moist	SM GP
2026	EPP-5 14:45		1		5	Silty sand, blue-gray, dry	SM
			sand	▽			
86						Silty sand, dark gray, very moist	SM
					10	Silt, dark gray, very moist	ML
462	EPP-11 15:05			▽		Fine sand, gray, wet	SP
	EPP-11.5 15:30					Silt sand & gravel	GM
	EPP-12 15:17					Refusal @ 12' bgs	
					15		
					20		

Project Name: Edmonds Bus Barn
Project Number: 10719a
Client: ESD

Boring No.: EB-15
Sheet 1 of 2

Date(s) Drilled: 11/16/15	**Logged By:** JSC	**Surface Conditions:** Asphalt
Drilling Method(s): HSA	**Core Size:** ~~2~~ 4"	**Total Depth of Borehole:**
Drill Rig Type:	**Drilling Contractor:** Cascade	**Approximate Surface Elevation:**
Groundwater Level and Date Measured:	**Sampling Method(s):** None	**Hammer Data:** 140 lb.
Borehole Backfill:	**Location:** South of S-1 sump	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
			8		0	Asphalt	
			9				
	EB15 -5 9:35		10			Gravelly	
0.0			11		5	Silty sand, dark gray, soft, moist	SM
			20				
0.0	EB15 -10		24				
			50/6"		10	Silty fine sand & gravel, dark gray, dry	SM GP
			13				
0.0						Fine sand, silt & gravel, dark gray, dry	SM GP
					15		
			50/5"				
	EB15 -20 12:20		50/6"		20		

Part II

Project Name: Edmonds Bus Barn
Project Number: 0719a-03
Client: ESD

Boring No.: EB-15
Sheet 2 **of** 2

Date(s) Drilled: 11/16/15	**Logged By:** JSC	**Surface Conditions:** Asphalt
Drilling Method(s): HSA	**Core Size:** 4"	**Total Depth of Borehole:** 35.5
Drill Rig Type:	**Drilling Contractor:** Cascadia	**Approximate Surface Elevation:**
Groundwater Level and Date Measured:	**Sampling Method(s):** None discrete	**Hammer Data:** 140 lb.
Borehole Backfill: Well to 35.5 bgs	**Location:**	

PID Reading (ppm)	Sample ID	Sample Type	Sampling Resistance (blows/ft)	GW Depth	Depth (feet)	MATERIAL DESCRIPTION	Graphic Log
					20		
					25	Dark gray till	
	EB15 -30 12345			▽	30	Silty sand with gravel, wet, dark gray	SM
					35	Coarse sand & gravel, dark gray, wet	GM
					40		

APPENDIX C

PROJECT BORING LOG

RH2 ENGINEERS PLANNERS SCIENTISTS	**Boring Exploration Log** **EB-20** Exploration Name	**LS8** **Trane & City of Lynnwood** **Trane 114-050** Project	**Edmonds SD Bus Yard** **Lynnwood, WA** Location
Steve Nelson, LHG Inspected by	**December 21, 2015** Date	**CME 75 truck-mounted hollow stem auger - 4-in. ID** **Cascade Drilling** Drilling Equipment and Contractor	

Depth (ft)	Attempt/ Recovery	Blow Counts*	Description	Lithology
			0.0 to 1.0 ft: Gravelly SAND (SW): Gray; fine to coarse; fine to medium subangular gravel; trace fines; moist; dense; (Fill).	
		3-2-3		
5		4-3-3	1.0 to 9.0 ft: Sandy SILT with GRAVEL (ML): olive brown to olive gray; non-plastic, fine to medium sand, fine to medium subrounded gravel; moist to wet below 7 feet; loose; (fill, alluvium, and weathered till).	
		2-2-7	Perched water at 7 to 14 feet 12/21/15	
		8-3-6		
10			9.0 to 30.5 ft: Silty SAND with Gravel to Sandy SILT with Gravel (SM/ML): Olive gray; fine to coarse sand; non-plastic fines; fine to medium subrounded gravel; wet from 9 to 14 feet, moist below 14 feet; very dense; (weathered to fresh glacial till).	
		32-50/6"		
		24-50/6"		
15		38-50/6"	Boring Backfilled with hydrated 3/8-inch bentonite chips.	
		50/5"		
20		50/1"		
		50/4"		
25		50/3"		
		50/2"		
30		50/3"		
35				

SPT, 150# auto hammer	Surface Elevation = 385 feet amsl