ADDENDUM NO. 1
TO THE CONTRACT DOCUMENTS FOR

City of Chehalis
Chehalis Pump Station

Project No. W0 11.1003

Project Issued: January 14, 2020
Addendum No. 1 Issued: January 22, 2020
Bid Opening Date: To remain the same (2:00 PM on February 11, 2020)

To: All Holders of Contract Documents

This addendum forms a part of the Contract Documents and modifies the original Contract Documents for which proposals are due as indicated on the date and time above.

Acknowledge receipt of this addendum on "Proposal Form" of the Bid Documents in the Contract Documents. Failure to do so might subject the bidder to disqualification.

This addendum shall modify the Contract Documents as follows:

Item: **1**
Division 00 Procurement and Contracting Documents
00 42 74 Proposal Bond Page 21
Description: **Section 00 42 74 Page 21 is deleted and replaced with the following:**

DEPOSIT OR BID BOND FORM

DEPOSIT STATEMENT

Herewith find deposit in the form of certified check or cashier's check in the amount of $____________________, which amount is not less than **five percent** of the Base Bid Amount.

Sign Here ____

****

BID BOND

KNOWN ALL MEN BY THESE PRESENTS:

That we,____________________________________, as Principal, and___________**,** as Surety, are held firmly bound unto____, Washington, as Obligee, in the penal sum of____Dollars, **(five percent** of the Base Bid Amount) for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally by these presents.

The condition of this obligation is such that if the Obligee shall make any award to the Principal for **THE CHEHALIS PUMP STATION for the CITY OF CHEHALIS** according to the terms of the bid made by the Principal therefore, and the Principal shall duly make and enter into a Contract with the Obligee in accordance with the terms of said bid and award and shall provide Certificate of Insurance And Contract Bond for the faithful performance of the Contract, with Surety or Sureties approved by the Obligee, or if the Principal shall, in case of failure to so do, pay and forfeit to the Obligee the penal amount of the deposit specified in the Call for Bids, then this obligation shall be null and void; otherwise it shall be and remain in full force and effect and the Surety shall forthwith pay and forfeit to the Obligee, as penalty and liquidated damages, the amount of this bond.

SIGNED, SEALED AND DATED THIS DAY OF____________________, 20 .

____
Principal

____
Surety

Received return of deposit in the sum of $__________________________________.

Note: This Bid Form must be completed in its entirety and submitted to bid the work.

Item:	**2**
	Division 00 Procurement and Contracting Documents
	00 43 73 Schedule of Values
Description:	**Section 00 43 73 pages 23 and 24 are deleted and replaced with the following:**

SECTION 00 43 73
SCHEDULE OF VALUES

As part of the overall Base Bid, and any Bid Alternates, the Bidder shall assign lump costs to the line items listed in the following Schedule of Values.

At the end of each month of construction the Contractor will submit an estimated percentage complete for the budget of each line item shown in the Schedule of Values. The Contracting Agency will then review and confirm if the Contractor percentage complete listed on the schedule corresponds to the actual work performed, including materials on hand.

1. Mobilization ________________
2. Clearing, grubbing & Demolition ________________
3. Erosion Control ________________
4. Earthwork (cut & fill) ________________
5. Retaining wall ________________
6. Storm Drainage System ________________
7. Pump House ________________
8. Water main including taps and 23appurtenances ________________
9. Duplex Water Pump System & controller ________________
10. Pump House Electrical, including design ________________
11. Pump House plumbing, complete ________________
12. Water analyzer for pH, NTU and Chlorine complete ________________
13. Electrical hardware and installation ________________
14. Telemetry, including design ________________
15. Cement Concrete slab including reinforcing ________________
16. HMA and gravel Paving ________________

17. Fencing including gates ___________________
18. Topsoil, Seeding Fertilizing and Mulching ____________________
19. Surveying ____________________
20. Clean-Up ____________________
21. System disinfection & testing ____________________
22. System Start-up ____________________
23. As-built drawings ____________________
24. Operation & Maintenance Manual ____________________
25. Incidentals[1] ____________________

Total Base Bid (must match total on Bid Form) ____________________

End of Section

[1] Includes all work not specifically listed above, including all costs for L&I electrical permits & special inspections. Contractor to complete all necessary City applications. However, City will pay all City Application fees directly

Item:	**3**
	Division 00 Procurement and Contracting Documents
	Soil Report Pages 40-70
Description:	**Draft Geotechnical Engineering Report pages 40-70 is deleted in its entirety and replaced with the following Final Geotechnical Engineering Report:**

Geotechnical Engineering Report
Chehalis Pump Station
Chehalis, Washington

January 14, 2020

Prepared for

SCJ Alliance
8730 Tallon Lane NE, Suite 200
Lacey, Washington 98516

Landau Associates
955 Malin Lane SW, Suite B
Tumwater, Washington 98501
(360) 791-3178

Geotechnical Engineering Report
Chehalis Pump Station
Chehalis, Washington

This document was prepared by, or under the direct supervision of, the undersigned, whose seal is affixed below.

Name: Benjamin Ford, PE
Washington No. 56249

Date: January 14, 2020

BENJAMIN JAY FORD
STATE OF WASHINGTON
56249
REGISTERED
PROFESSIONAL ENGINEER
1/14/2020

Document prepared by: ______________________ Benjamin Ford, PE
Project Manager

Document reviewed by: ______________________ Calvin McCaughan, PE
Quality Reviewer

Date: January 14, 2020
Project No.: 1174035.010.011
File path: \\olympia1\PROJECTS\1174\035.010\R\Signature Page.docx
Project Coordinator: MCS

LANDAU ASSOCIATES

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LIST OF ABBREVIATIONS AND ACRONYMS

ASTM	ASTM International
bgs	below ground surface
City	City of Chehalis
CMC	Chehalis Municipal Code
CSBC	Crushed Surfacing Base Course
cy	cubic yards
EHA	erosion hazard area
ft	foot/feet
H:V	horizontal to vertical
LAI	Landau Associates, Inc.
LHA	landslide hazard area
MSR	marine sedimentary rock
pcf	pounds per cubic foot
psf	pounds per square foot
SCJ	SCJ Alliance
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

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1.0 INTRODUCTION

This report summarizes the results of geotechnical engineering services provided by Landau Associates, Inc. (LAI) in support of the Chehalis Pump Station project. The City of Chehalis (City; project owner) proposes to replace a pump station at its water treatment plant, located at 405 Parkhill Drive in Chehalis, Washington; the replacement pump station will be adjacent to the existing pump station (site; Figure 1).

This report has been prepared based on information provided by representatives of SCJ Alliance (SCJ; project civil engineer) and the City, data collected during the field investigation and laboratory testing programs, and LAI's experience with similar projects.

1.1 Project Understanding

The replacement pump station will be located approximately 50 feet (ft) west of the existing pump station, adjacent to a gravel-surfaced access road.

The replacement pump station will measure approximately 12 ft deep by 16 ft wide, and will be built into the steep slope present above and below the site. The rear wall of the pump station will act as a retaining wall and support the slope. New duplex pumps will be installed in the pump house, and new conveyance pipes will tie into the existing pipe network. The approximate locations of the proposed improvements are shown on Figure 2.

1.2 Scope of Services

SCJ retained LAI's services to support design of the project. Geotechnical services were provided in general accordance with the scope outlined in the Subconsultant Agreement for Professional Services, dated May 22, 2019.

2.0 SITE CONDITIONS

The following sections describe the geologic setting of the site and the surface and subsurface conditions observed during LAI's field investigation. Interpretations of site conditions are based on LAI's review of available geologic and geotechnical information, and on the results of the site reconnaissance, subsurface explorations, and laboratory testing.

2.1 Geologic Setting

Geologic information for the site was obtained from the *Geologic Map of the Centralia 1:100,000 Quadrangle, Washington* (Schasse 1987). Near-surface deposits in the vicinity of the site are mapped as Lincoln Creek Formation [OEm(lc)]. At the site, this geologic formation generally consisted of marine sedimentary rock (MSR; tuffaceous siltstone and fine-grained sandstone) and non-marine volcaniclastic rock (basaltic sandstone with interbedded pyroclastic rock).

The subsurface conditions observed in LAI's June 2019 explorations were generally consistent with the mapped geologic conditions for the site, with the exception of undocumented fill encountered in one boring.

2.2 Surface Conditions

The site consists of a gravel-paved access road, pump house, and generator pad, built into a 30 to 50 percent slope. The pump station is located at an elevation 25 ft lower than the nearby water treatment plant. The access road to the plant spans the slope and terminates at the existing pump house.

The site features coniferous and deciduous trees with an understory of vegetation common to the area. Existing site features and topography are shown on Figure 2.

2.3 Subsurface Explorations

On June 18, 2019, LAI explored site subsurface conditions by advancing two hollow-stem auger borings (B-1 and B-2) 31.5 to 40.3 ft below ground surface (bgs). The borings were advanced at the approximate locations shown on Figure 2. LAI personnel collected representative soil samples from the explorations. The samples were transported to LAI's soils laboratory for examination and testing.

The following sections summarize the subsurface soil and groundwater conditions observed in the explorations. More detailed information, including summary exploration logs, is provided in Appendix A. A description of laboratory test procedures and the test results are presented in Appendix B.

2.3.1 Soil Conditions

The soils observed underlying existing surface conditions (i.e., topsoil, gravel surfacing) can be categorized into two general units:

- **Fill:** Observed in boring B-2, this unit consisted of brown silt with gravel in a medium stiff, moist condition. The fill extended 4 ft bgs.
- **Lincoln Creek Formation:** Observed underlying the gravel surfacing in boring B-1 and the fill in boring B-2, this unit consisted of MSR and non-MSR (siltstone). The MSR was weathered and generally consisted of very silty to silty sand (weathered sandstone) or elastic silt with varying sand and gravel content (weathered siltstone) in a medium dense to very dense or stiff to hard condition. The MSR extended 40 ft bgs in boring B-1, and 31.5 ft bgs (the full depth explored) in boring B-2. Medium hard, gray siltstone was observed beneath the MSR in boring B-1. Boring B-1 terminated in the siltstone at 40.3 ft bgs.

2.3.2 Groundwater

During the June 2019 field investigation, groundwater was observed at 19 ft bgs in boring B-1. Groundwater was not observed in boring B-2. LAI interpreted the groundwater to be a perched layer at the contact between the MSR and siltstone. The groundwater conditions reported herein are for the specific locations and date indicated, and may not be indicative of other locations and/or times. Groundwater conditions will vary depending on local subsurface conditions, weather conditions, and other factors. Furthermore, groundwater conditions are expected to fluctuate seasonally, with maximum groundwater levels occurring during late winter and early spring.

3.0 GEOLOGICALLY HAZARDOUS AREA ASSESSMENT

The City proposes to construct the replacement pump station on a steep slope. LAI evaluated the proposed improvements in accordance with Title 17 of the Chehalis Municipal Code (CMC).

3.1 Landslide Hazard Areas

On June 11, 2019, LAI representatives evaluated slopes adjacent to the proposed location of the replacement pump station. LAI did not observe signs of historical or current slope instability or groundwater seepage. LAI discussed the site history with City personnel, who indicated there is no record of historical slope movement at the site. Based on LAI's review of topographic information, the site slope (slope between upper and lower portions of the access road) and the adjacent slope (slope below the lower access road) are inclined at 25 to 50 percent. The average overall slope inclination is approximately 30 to 35 percent.

Per Chapter 17.24.010 of the CMC, 30 percent or greater slopes with a vertical relief of more than 10 ft qualify as sensitive slope areas. Accordingly, the slopes at, and adjacent to, the site should be designated a sensitive slope area. No other landslide hazard characteristics were identified during LAI's slope evaluation. Because the site encompasses a sensitive slope area, the proposed improvements will be made within a landslide hazard area (LHA). Development within an LHA is permitted, provided it complies with the standards in Section 17.24.020(C) of the CMC.

LAI used the software program SLIDE Version 8 (RocScience 2018) to evaluate slope stability in pre- and post-construction static and dynamic conditions. LAI's slope stability analysis was based on the soil conditions encountered in LAI's June 2019 explorations, the proposed development plans, and the minimum seismic horizontal acceleration provided in the 2015 International Building Code (IBC; ICC 2014). The results of the analyses indicate a 5 percent increase in the factor of safety against landsliding for the site slope, and a negligible impact to the adjacent slope. Increased slope stability, post-construction, is attributed to the pump station wall acting as a retaining wall, stronger than the soils being replaced.

Given the negligible impacts indicated by the slope stability model, LAI does not recommend establishing LHA buffers at the site. However, stockpiled material should not be allowed within 10 ft of the top of slope, and all stockpiles should be limited to 10 cubic yards (cy) or less (one truck load). Stockpiles greater than 10 cy should be located within the area shown on Figure 2. All construction activities should be performed within established clearing limits along the existing access road. Encroachment of slopes outside of clearing limits should not be allowed.

Provided the design and construction recommendations within this report are followed, it is LAI's opinion that the proposed project meets the requirements for development within an LHA. The proposed project will not affect development on the subject property or other properties, and will not result in a greater risk or a need for increased buffers on neighboring properties.

3.2 Erosion Hazard Areas

A description of near-surface site soils was obtained from the Natural Resources Conservation Service's Web Soil Survey (NRCS 2018; accessed July 17, 2019). The survey shows two soil units at the site: Buckpeat silt loam 30 to 65 percent slopes and Melbourne loam 15 to 30 percent slopes. Given the severe erosion potential of these soil units, the site should be classified as an erosion hazard area (EHA), per the CMC. Development within an EHA must comply with the standards in Section 17.24.030 of the CMC.

3.3 Seismic Hazard Areas

Data from the Washington State Department of Natural Resources' Geologic Information Portal (2010; accessed July 18, 2019) indicate that the site is not susceptible to liquefaction. Additionally, LAI's slope stability analysis indicates that the site is not susceptible to seismic instability. Site conditions do not constitute a seismic hazard area.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of LAI's field investigation, laboratory testing, and engineering analyses, site subsurface conditions are suitable for the proposed improvements, provided the recommendations contained herein are incorporated into the project design:

- The site is located within an LHA and an EHA. Development plans should limit the project footprint, and all clearing limits should be marked in the field before beginning earthwork activities. Vegetation outside of the project footprint should not be disturbed.
- To mitigate potential impacts to the LHA, the proposed pump station will be built into the site slope, and the foundation walls/rear wall of the structure should be designed to resist earth pressures imparted by sloping ground.
- Moisture-sensitive soils (noted as ML, MH, or SM on the boring logs in Appendix A) will be exposed within excavations and at the subgrade elevation for shallow foundations. LAI recommends placing a 6-inch-thick bearing pad below shallow foundations and on-grade slabs to limit disturbance of moisture-sensitive soils and provide a firm working surface. Site soils are not considered suitable for reuse as structural fill.

4.1 Pump Station Design

Geotechnical design recommendations for the proposed pump station are provided in the following sections.

4.1.1 Seismic Conditions

LAI understands that seismic design will be performed in accordance with the 2015 IBC standards (ICC 2014). The parameters in Table 1 can be used to compute seismic base shear forces.

Table 1. 2015 International Building Code Seismic Design Parameters

Spectral response acceleration at short periods (S_s) = 1.15g
Spectral response acceleration at 1-second periods (S_1) = 0.499g
Site class = C
Site coefficient (F_a) = 1.000
Site coefficient (F_v) = 1.301

g = force of gravity

Geologic material at the site generally consists of medium stiff to hard sedimentary rock deposits. In LAI's opinion, the site has a low risk for seismically-induced soil liquefaction or lateral spreading. Considering the location of the site with respect to the nearest known active crustal faults and the presence of a thick layer of marine deposits, the risk of ground rupture due to surface faulting is low.

4.1.2 Foundation Support

The shallow foundation support parameters in Table 2 should be used in conjunction with the complete recommendations in this report.

Table 2. Summary of Design Parameters

Allowable soil bearing pressure = 3,000 psf
Minimum foundation width = 18 inches

psf = pounds per square foot

When calculating design parameters, LAI assumed foundations would be established on firm, unyielding subgrade or import structural fill extending to such soils. The allowable soil bearing pressure applies to long-term dead and live loads, exclusive of the weight of the footing and any overlying backfill. The allowable soil bearing pressure can be increased by one-third for total loads, including transient loads, such as those induced by wind and seismic forces.

LAI recommends a minimum width of 18 inches for footings. For frost protection, exterior footings should be embedded at least 12 inches below the nearest adjacent grade. Assuming construction is completed as recommended, LAI estimates that spread footings will settle 1 inch or less, with differential settlement between similarly loaded foundation elements limited to ½ inch or less.

4.1.3 Foundation Wall Design

The foundation wall design parameters in Table 3 should be used in conjunction with the complete recommendations provided in this report.

Table 3. Foundation Wall Design Parameters

Parameter	Value	
	2.5H:1V Backslope	Level Backslope
Passive earth pressure (pcf)	230	230
Active earth pressure (pcf)	60	40
Seismic earth pressure (psf)	25*H	11*H
Ultimate coefficient of sliding	0.35	

H = height of wall
pcf = pounds per cubic foot
psf = pounds per square foot

LAI has assumed that walls will be free to yield, and active earth pressures can be used for design. For seismic loading conditions, the rectangular earth pressure (dependent on the wall height) should be added to the active earth pressure. Foundation walls may be supported on shallow foundations designed in accordance with the parameters in Table 2. LAI has assumed that the rear wall will support a 2.5 horizontal to 1 vertical (2.5H:1V) slope, and the sidewalls will have level backslope conditions.

An allowable coefficient of sliding resistance of 0.35, applied to the vertical dead loads only, can be used to compute the frictional resistance acting on the base of footings. The allowable coefficient of sliding resistance includes a factor of safety of 1.5 on the calculated ultimate value. The value for the foundation passive earth pressure has been reduced by a factor of 1.5 to limit deflections to less than 2 percent of the embedded depth. The passive earth pressure and friction components can be combined, provided the passive component does not exceed two-thirds of the total; the top foot of soil should be excluded from the calculation, unless the foundation perimeter is covered by a slab-on-grade or pavement.

4.1.3.1 Wall/Perimeter Drainage

Drainage systems should be constructed to collect water and prevent buildup of hydrostatic pressure against retaining walls. A zone of free-draining backfill, at least 18 inches wide, should be included against the back of all foundation walls. Free-draining backfill should meet the requirements for Gravel Backfill for Walls in Section 9-03.12(2) of the Washington State Department of Transportation's 2018 *Standard Specifications for Roadway, Bridge, and Municipal Construction* (*2018 WSDOT Standard Specifications*). The free-draining backfill zone should extend to within 1 ft of the top of the wall. A perforated, rigid, smooth-walled drain pipe with a minimum diameter of 4 inches should be placed along the base of foundation walls within the free-draining backfill, and should extend the length of the wall. The perforated pipe should be connected to a tightline conveyance pipe that discharges to an approved location (not on sloping ground). LAI is available to discuss pipe discharge or drywell locations during final design.

4.1.4 Slab-On-Grade

Slabs-on-grade should be established on a subgrade that consists of uniformly firm, unyielding native soil or structural fill extending to such soil. Subgrades should be prepared as described in Section 4.2.

A modulus of vertical subgrade reaction (subgrade modulus) can be used to design the slabs-on-grade. The subgrade modulus will vary depending on the dimensions of the slab and the magnitude of applied loads on the slab surface; slabs with larger dimensions and loads are influenced by soils at a greater depth. LAI recommends using a subgrade modulus of 175 pounds per cubic inch for design of on-grade floor slabs. This subgrade modulus is for a 1-ft by 1-ft square plate, and is not the overall modulus of a larger area.

Slabs-on-grade in interior spaces should be underlain by a minimum 4-inch-thick capillary break layer to reduce the potential for moisture migration into the slab. The capillary break material should consist of well-graded sand and gravel containing less than 5 percent fines based on the fraction passing the ¾-inch sieve.

4.2 Construction Considerations

The following construction considerations should be reviewed during design and development of project specifications:

- **Site soils:** The fine-grained site soils have an above-optimum moisture content and should not be considered for reuse as structural fill. Because site soils are highly moisture sensitive, earthwork should be avoided during heavy and/or extended precipitation events.
- **Clearing and stripping:** Clearing and stripping activities should be minimized to the extent possible. Clearing limits should be indicated on the plans and marked in the field before beginning earthwork activities.
- **Erosion control:** All temporary and permanent slopes should be stabilized using appropriate best management practices. All disturbed areas should be revegetated to provide long-term erosion control.
- **Subgrade preparation:** Following stripping and excavating to the proposed subgrade elevation for structures and utilities, the subgrade should be evaluated by a qualified civil or geotechnical engineer, who is familiar with the project. If subgrades are not in a firm, unyielding condition following excavation, unsuitable soils should be overexcavated and replaced with structural fill. Soil overexcavation and replacement should be performed under the supervision of a geotechnical engineer.
- **Foundation bearing pads:** Moisture-sensitive soils are anticipated at the base of shallow foundations and on-grade slabs. To provide a firm working surface, LAI recommends overexcavating at least 6 inches of soil and replacing it with Crushed Surfacing Base Course (CSBC; bearing pad). CSBC should conform to the requirements in Section 9-03.9(3) of the *2018 WSDOT Standard Specifications.* The bearing pad should extend within the limits of the excavation.
- **Utility trench excavation:** LAI anticipates utility trenches will be excavated primarily within stiff to hard silt or dense to very dense sand. A heavy-duty hydraulic excavator should be able to excavate trenches to the expected depths. Upon reaching the trench bottom, a smooth-bladed bucket should be used to remove any loose and/or disturbed soil. The final trench bottom should be firm and free of roots, topsoil, lumps of silt and clay, and organic and inorganic debris. Trench boxes should provide adequate support for shallow excavations, provided the trench is properly dewatered and settlement-sensitive structures or utilities are not adjacent to the excavation. Trench boxes should meet the requirements in Safety Standards for Construction Work, Part N (Washington Administrative Code [WAC] Chapter 296-155).
- **Construction dewatering:** The low-permeability site soil does not readily transmit groundwater. Significant groundwater occurrence is not anticipated during excavation. However, perched groundwater zones may be encountered where excavations cross existing utility trenches. If perched groundwater zones are encountered, conventional sumps and pumps within the excavations should provide a dry, stable work area. The contractor should be responsible for design and implementation of dewatering systems.
- **Permanent slopes:** Alteration of existing grades should be avoided. Where required, permanent cut-or-fill slopes should be no steeper than 2H:1V. Permanent slopes should be protected from erosion and reseeded or revegetated as soon as practical.

- **Structural fill:** Imported structural fill should meet the requirements for Gravel Borrow in Section 9-03.14(1) of the *2018 WSDOT Standard Specifications.* If wet weather construction is anticipated, the amount of fines should be less than 5 percent by weight, based on the minus ¾-inch fraction.
- **Fill placement and compaction:** Structural fill should be placed on an approved subgrade that consists of uniformly firm, unyielding, inorganic native soils or compacted structural fill extending to such soils. Structural fill should be placed and compacted in accordance with Section 2-03.3(14)C, Method C of the *2018 WSDOT Standard Specifications.* Method A of the *2018 WSDOT Standard Specifications* is appropriate for non-structural areas, such as landscaping. Each layer of structural fill should be compacted to at least 95 percent of the maximum dry density as determined by the compaction control tests described in Section 2-03.3(14)D of the *2018 WSDOT Standard Specifications* or by ASTM International standard test method D1557.
- **Temporary excavations:** To limit the project footprint within the LHA, LAI recommends using a trench shoring system to install utilities where excavation depth exceeds 4 ft. Open-cut excavations may be allowed for construction of structures, but they should not extend beyond the clearing limits.

  LAI recommends that temporary excavations be completed in accordance with the guidelines set forth in Section 2-09 of the *2018 WSDOT Standard Specifications.* Actual excavation trench configurations and the maintenance of safe working conditions, including temporary excavation stability, are the responsibility of the contractor. Temporary excavations in excess of 4 ft should be shored in accordance with the requirements outlined in Safety Standards for Construction Work, Part N (Washington State Department of Labor and Industries, WAC Chapter 296-155). The material likely to be exposed in the structural excavations should be considered Type C soil with a maximum allowable excavation inclination of 1.5H:1V. The parameters provided in Table 4 should be used to design engineered shoring systems.

Table 4. Recommended Soil Parameters for Design of Temporary Shoring

Soil Unit	Moist Unit Weight (pcf)	Submerged Unit Weight (pcf)	Cohesion (psf)	Internal Angle of Friction (degrees)
Fill	125	63	0	34
Lincoln Creek Formation	125	63	50	32

pcf = pounds per cubic foot
psf = pounds per square foot

5.0 USE OF THIS REPORT

Landau Associates, Inc. (LAI) prepared this report for the exclusive use of SCJ Alliance and the City of Chehalis for the proposed Chehalis Pump Station project in Chehalis, Washington. Within the limitations of scope, schedule, and budget, LAI's services have been conducted in accordance with generally accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

The conclusions and recommendations contained in this report are based on the conditions observed during the field investigation. There may be some variation in subsurface soil and groundwater conditions, and the nature and extent of the variation may not become evident until construction. Accordingly, a contingency for unanticipated conditions should be included in the construction budget and schedule.

If variations in subsurface conditions are encountered during construction, LAI should be asked to review the recommendations in this report and revise as necessary. If there is a substantial lapse of time between the submission of this report and the start of construction, LAI should review the applicability of the conclusions and recommendations contained herein.

6.0 REFERENCES

ASTM. 2012. D1557-12e1: Standard Test Methods for Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)). West Conshohocken, PA: ASTM International.

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ICC. 2014. *2015 International Building Code.* International Code Council. May 30.

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USDA NRCS. Web Soil Survey. U.S. Department of Agriculture Natural Resources Conservation Service. Accessed July 17, 2019. Available online at: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Washington State Department of Labor and Industries. 2016. Construction Work. Chapter 296-155 WAC; Part N. Excavation, Trenching, and Shoring. Washington State Department of Labor and Industries. May 20.

WSDOT. 2017. *M 41-10: Standard Specifications for Road, Bridge, and Municipal Construction 2018.* Washington State Department of Transportation. December 1.

N

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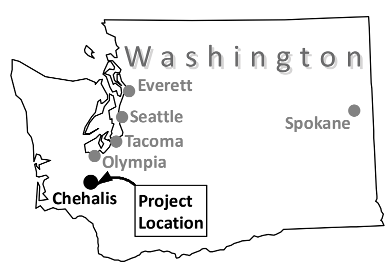
Miles

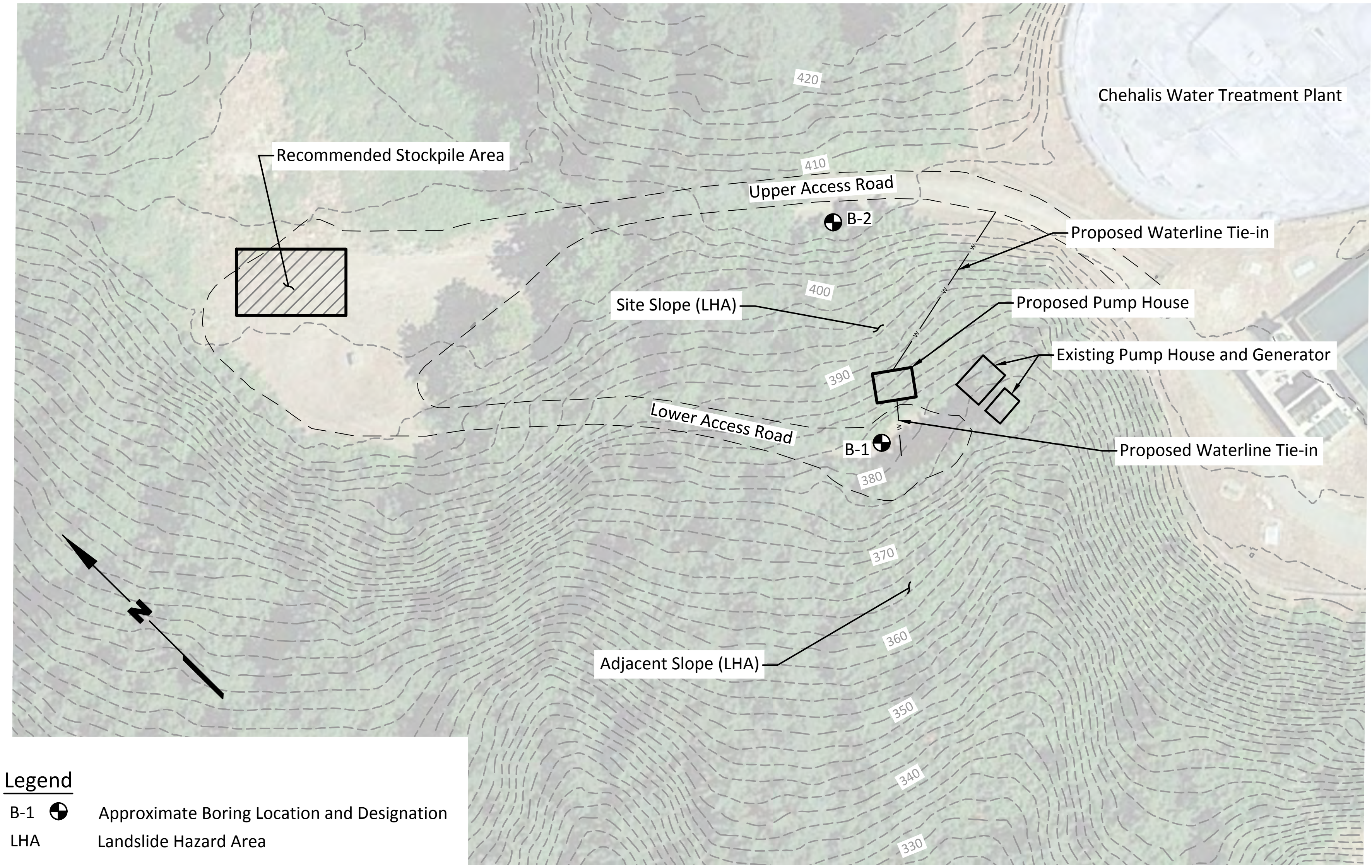


Data Source: Esri 2012

G:\Projects\1174\035\010\011\F01 VicinityMap.mxd 6/27/2019

Landau Associates

City of Chehalis Chehalis Pump Station Chehalis, Washington	**Vicinity Map**	Figure 1



Legend

B-1 ⊕ Approximate Boring Location and Designation

LHA Landslide Hazard Area

Image Source: Google Earth 2019

0 60 120

Scale in Feet

LANDAU ASSOCIATES

City of Chehalis
Chehalis Pump Station
Chehalis, Washington

Site and Exploration Plan

Figure
2

APPENDIX A

Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Site subsurface conditions were explored on June 18, 2019 by advancing and sampling two hollow-stem auger borings (B-1 and B-2) at the approximate locations shown on Figure 2. Holocene Drilling, Inc., subcontracted by Landau Associates, Inc. (LAI), advanced boring B-1 approximately 40.3 feet (ft) below ground surface (bgs), and boring B-2 approximately 31.5 ft bgs.

The field investigation was coordinated and monitored by LAI personnel, who also obtained representative soil samples, maintained a detailed record of the subsurface soil and groundwater conditions observed, and described the soil by visual and textural examination. Each representative soil type was described using the soil classification system shown on Figures A-1 and A-2, in general accordance with ASTM International standard test method D2488, *Standard Recommended Practice for Description of Soils (Visual-Manual Procedure).* The summary logs on Figures A-3 and A-4 represent LAI's interpretation of the subsurface conditions identified during the field explorations. The stratigraphic contacts shown on the logs represent the approximate boundaries between soil types; actual transitions may be more gradual.

Disturbed soil samples were obtained from the borings at frequent intervals using a 1.5-inch inside-diameter, standard penetration test, split-spoon sampler. The sampler was driven 18 inches (or a portion thereof) into the undisturbed soil ahead of the auger bit with a 140-pound automatic hammer falling a distance of approximately 30 inches. The number of blows required to drive the sampler for the final 12 inches (or a portion thereof) of soil penetration is noted on the boring logs, adjacent to the appropriate sample notation. Samples were transported to LAI's soils laboratory for further examination and testing.

Upon completion of drilling and sampling, the boreholes were decommissioned in general accordance with the requirements of Washington Administrative Code 173-160.

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL(1)	TYPICAL DESCRIPTIONS (2)(3)
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		**GW**	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		**GM**	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		**SW**	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		**SM**	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			**ML**	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			**MH**	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			**PT**	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		**AC** or **PC**	Asphalt concrete pavement or Portland cement pavement
ROCK		**RK**	Rock (See Rock Classification)
WOOD		**WD**	Wood, lumber, wood chips
DEBRIS		**DB**	Construction debris, garbage

Notes:
1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent:	> 50%	- "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents:	> 30% and ≤ 50%	- "very gravelly," "very sandy," "very silty," etc.
	> 15% and ≤ 30%	- "gravelly," "sandy," "silty," etc.
Additional Constituents:	> 5% and ≤ 15%	- "with gravel," "with sand," "with silt," etc.
	≤ 5%	- "with trace gravel," "with trace sand," "with trace silt," etc., or not noted.

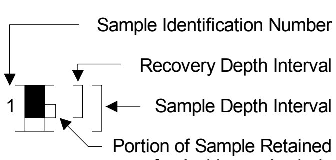
4. Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

Drilling and Sampling Key

SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Single-Tube Core Barrel
f	Double-Tube Core Barrel
g	2.50-inch O.D., 2.00-inch I.D. WSDOT
h	3.00-inch O.D., 2.375-inch I.D. Mod. California
i	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Vibrocore (Rotosonic/Geoprobe)
5	Other - See text if applicable

SAMPLE NUMBER & INTERVAL



Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

Groundwater

▽ Approximate water level at time of drilling (ATD)

▼ Approximate water level at time after drilling/excavation/well

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Soil Classification System and Key

Figure A-1

Rock Classification System

Primary Rock Types

Sedimentary	Clastic	Conglomerate
		Sandstone/ Sedimentary Quartzite
		Siltstone/Graywacke
		Claystone/Mudstone
		Shale
		Coal
	Crystalline	Limestone/Dolomite
		Gypsum/Halite/ Anhydride
		Chert
Metamorphic	Foliated	Gneiss/Schist
		Schist/Talc
		Phyllite
		Slate
		Mylonite
	Massive	Marble
		Quartzite
		Hornfels
		Serpentine/Soapstone/ Greenstone
Igneous	Phaneritic (Individual crystals distinguishable with unaided eye.)	Granite
		Monzonite/ Quartz Monzonite
		Granodiorite/ Diorite Quartz Diorite
		Gabbro
		Diabase/Perioite
	Aphanitic (Crystals not distinguishable or visible crystals in a fine-grained groundmass.)	Rhyolite
		Latite/Quartz Latite
		Dacite/Andesite
		Basalt
	Glassy	Obsidian/ Pumice/Scoria
Pyroclastic		Agglomerate/ Breccia/Tuff
		Bombs/Blocks/ Cinders/Ash

Relative Hardness

Term	Designation	Approx. Unconfined Compressive Strength	Field Identification
Extremely Soft	R0	< 100 psi	Moldable or friable with finger pressure.
Very Soft	R1	100 - 1,000 psi	Peeled by knife with ease. Crumbles under firm blows with point of a geology pick.
Soft	R2	1,000 - 4,000 psi	Peeled by knife with difficulty. Shallow indentation made by firm blow of geology pick.
Medium Hard	R3	4,000 - 8,000 psi	Scratched by knife with ease. Fractured with a single firm blow of hammer/geology pick.
Hard	R4	8,000 - 16,000 psi	Scratched by knife with difficulty. Several hard hammer blows required to fracture.
Very Hard	R5	> 16,000 psi	Cannot be scratched with knife. Many hard hammer blows required to fracture or chip.

Relative Weathering

Fresh	Crystals are bright; no discoloration in rock fabric
Slightly Weathered	Some discoloration in rock fabric; decomposition extends up to 1 inch
Moderately Weathered	Rock mass is decomposed 50 % or less
Predominately Decomposed	Rock mass is more than 50 % decomposed; can be excavated with pick
Decomposed	Completely decomposed; can be reduced to soil with hand pressure

Structural Descriptions

Spacing (in)	Bedding/Foliation	Joint/Shear/Fracture	Attitude and Angle
< 2	Very Thin	Very Close	Horizontal (0-5°)
2 - 12	Thin	Close	Shallow or Low Angle (5-35°)
12 - 36	Medium	Moderately Close	Moderately Dipping (35-55°)
36 - 120	Thick	Wide	Steep or High Angle (55-85°)
> 120	Very Thick	Very Wide	Vertical (85-90°)

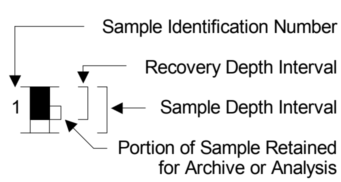
Core Recovery and Rock Quality Designation

$$\text{Core Recovery} = \frac{\textit{length of core recovered}}{\textit{total length of core run}} \times 100$$

$$\text{RQD} = \frac{\textit{total length of all pieces 4 inches or greater}}{\textit{total length of core run}} \times 100$$

Coring and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
e	Other - See text if applicable
f	Single Tube Core Barrel
g	Double Tube Core Barrel
4	Other - See text if applicable
5	Air Rotary
6	Wash Rotary
7	Rotosonic

Field and Lab Test Data

Code	Description
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
CS = 1.0	Compressive Strength, tsf
TS = 0.5	Tensile Strength, tsf
GT	Other Geotechnical Testing
CA	Chemical Analysis

Groundwater

▽ ATD — Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

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Rock Classification System and Key

Figure A-2

B-1

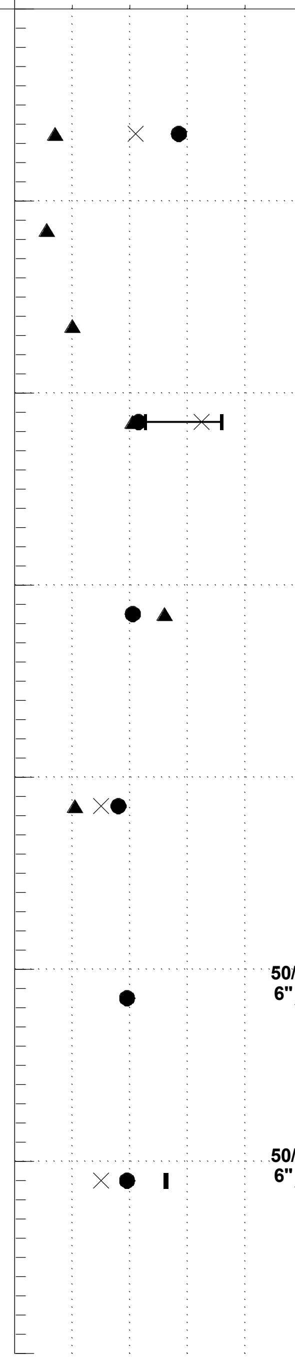
LAI Project No: 1174035.010

SAMPLE DATA / SOIL PROFILE

Drilling Method: Hollow-Stem Auger
Ground Elevation (ft): 381.0
Drilled By: Holocene Drilling Inc.
Logged By: DAR Date: 06/18/19

Moisture Content (%) (Plastic Limit – Liquid Limit) 20 40 60 80
▲ SPT N-Value ▲ (△ Non-Standard N-Value △) 20 40 60 80
× Fines Content (%) × 20 40 60 80

Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
0						GP-GM	Gray, angular, fine to coarse GRAVEL with sand and silt (medium dense, moist) **(GRAVEL SURFACING)**
	380					SM	Brown, very silty, fine to coarse SAND (medium dense, moist) **(LINCOLN CREEK FORMATION)**
		S-1	b2	14	W = 57 -200 = 42		
5	375	S-2	b2	11			
		S-3	b2	20		MH	Mottled orange/brown, very sandy SILT (very stiff, moist)
10	370	S-4	b2	41	W = 43 -200 = 65 AL		-Grades to hard
15	365	S-5	b2	52	W = 41		
						SM	Reddish-brown, very silty, fine to coarse SAND (medium dense, moist)
20	360	S-6	b2	21	W = 36 -200 = 30		
25	355	S-7	b2	50/ 6"	W = 39		-Grades to gray and very dense
30	350	S-8	b2	50/ 6"	W = 39 -200 = 30 AL		
						MH	Gray SILT (hard, moist)
35							



Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

1174035.01 1/14/20 C:\USERS\MSKINNER\DESKTOP\1174035.010.011.GPJ SOIL BORING LOG WITH GRAPH

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Log of Boring B-1

Figure A-3 (1 of 2)

B-1

LAI Project No: 1174035.010

SAMPLE DATA / SOIL PROFILE

Drilling Method: Hollow-Stem Auger
Ground Elevation (ft): 381.0
Drilled By: Holocene Drilling Inc.
Logged By: DAR Date: 06/18/19

Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description	Groundwater	SPT N-Value
35	345	S-9	b2	50/ 6"		MH	Gray SILT (hard, moist) -Grades to without sand -Grades to wet	38.0 ft Perched	50/ 6"
40		S-10	b2	50/ 3"		SLS	Gray SILTSTONE; medium hard (R3); includes sand; (volcaniclastic sedimentary rock)		50/ 3"

Moisture Content (%): Plastic Limit — Liquid Limit; 20 40 60 80
▲ SPT N-Value ▲ / △ Non-Standard N-Value △; 20 40 60 80
× Fines Content (%) ×; 20 40 60 80

Depth scale (ft): 35, 40, 45, 50, 55, 60, 65, 70

Boring Completed 06/18/19
Total Depth of Boring = 40.3 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Log of Boring B-1

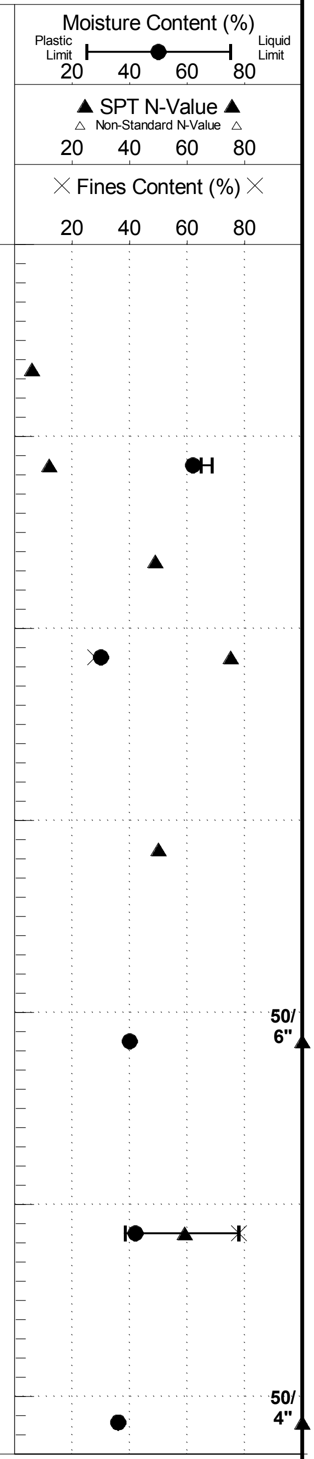
Figure A-3 (2 of 2)

B-2

LAI Project No: 1174035.010

Drilling Method: Hollow-Stem Auger
Ground Elevation (ft): 408.0
Drilled By: Holocene Drilling Inc.
Logged By: DAR Date: 06/18/19

Depth (ft)	Elevation (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Profile	Groundwater
0						ML / ML	2 inches of sod over 3 inches of dark brown, sandy SILT with organics (soft, moist) **(TOPSOIL)**	Groundwater Not Encountered
	405	S-1	b2	6			Brown SILT with gravel (medium stiff, moist) **(FILL)**	
5		S-2	b2	12	W = 62 AL	MH	Brown elastic SILT (stiff, moist) **(LINCOLN CREEK FORMATION)**	
	400	S-3	b2	49		SM	Brown, silty, fine to coarse SAND (dense, moist)	
10		S-4	b2	75	W = 30 GS		-Grades to very dense	
	395							
15		S-5	b2	50			-Grades to dense	
	390					MH	Mottled orange/gray, very sandy elastic SILT (hard, moist)	
20		S-6	b2	50/ 6"	W = 40			
	385							
25		S-7	b2	59	W = 42 GS AL			
	380							
30		S-8	b2	50/ 4"	W = 36		-Grades to gray	
35								



Boring Completed 06/18/19
Total Depth of Boring = 31.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

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Log of Boring B-2

Figure A-4

APPENDIX B

Laboratory Testing

APPENDIX B
LABORATORY TESTING

To facilitate soil classification, natural moisture content determinations, Atterberg limit determinations, U.S. No. 200 wash tests, and grain size analyses were performed on select samples obtained from the borings. Laboratory testing was performed in accordance with the ASTM International (ASTM) standard test methods described below. The samples were checked against the field log descriptions, which were updated where appropriate in general accordance with ASTM standard test method D2487.

Natural Moisture Content

Natural moisture content determinations were performed in accordance with ASTM standard test method D2216. The natural moisture content is shown as W = xx (i.e., percent of dry weight) at the respective sample depth in the column labeled "Test Data" on the summary boring logs in Appendix A.

Atterberg Limit Determination

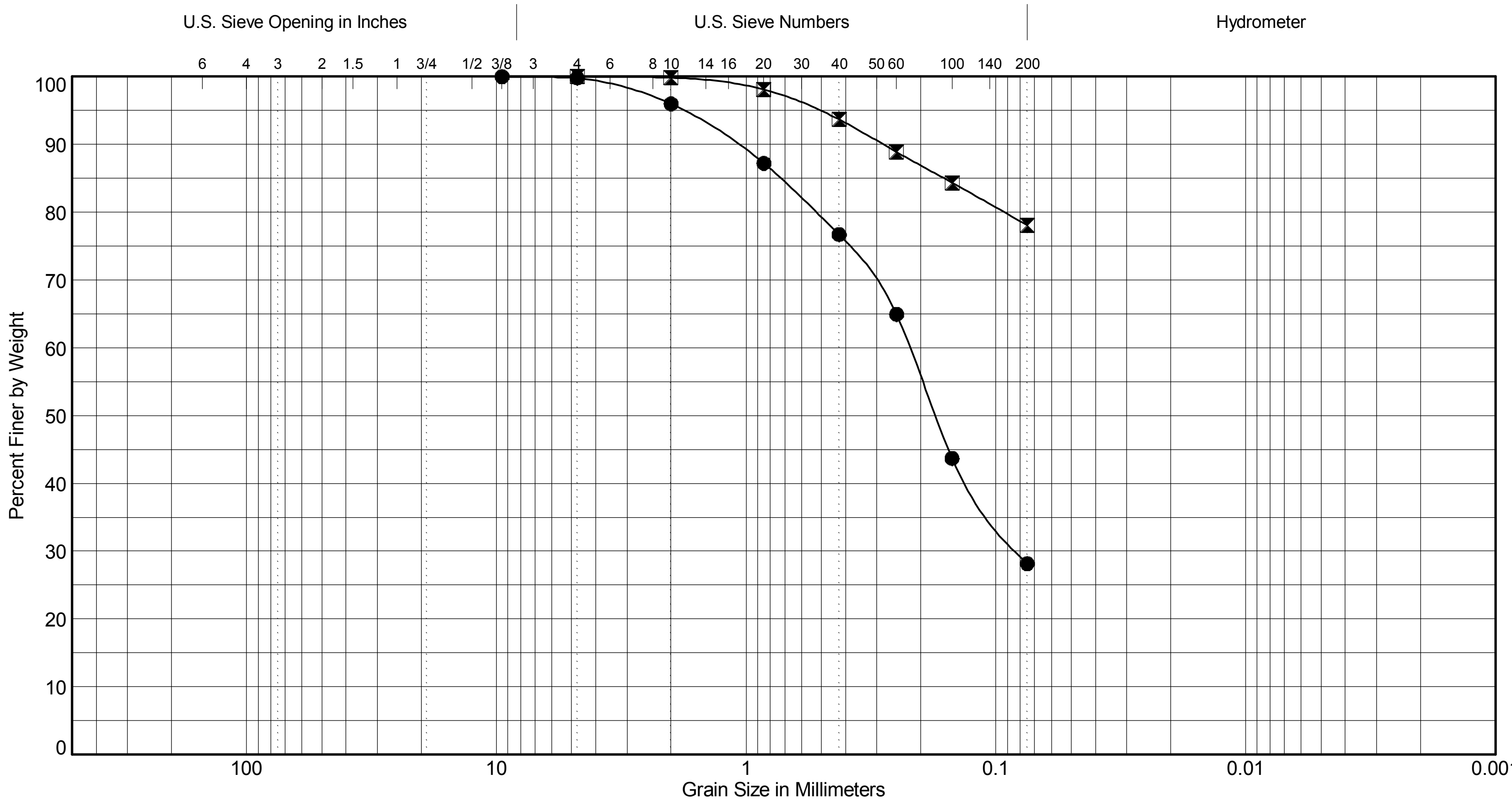
The liquid limit (LL), plastic limit (PL), and plasticity index (PI) were determined in accordance with ASTM standard test method D4318. The tests were conducted on fine-grained soil samples to estimate engineering properties of the soil. Test results are summarized on Figure B-2.

U.S. No. 200 Wash

To provide an indication of the amount of fines present, select soil samples were washed over a U.S. No. 200 sieve in accordance with ASTM standard test method C117. Samples selected for U.S. No. 200 wash are designated with a "-200 = xx" in the column labeled "Test Data" on the summary boring logs in Appendix A.

Grain Size Analysis

To provide an indication of the grain size distribution of site soil, sieve analyses were conducted in accordance with ASTM standard test method D422. Samples selected for grain size analyses are designated with a "GS" in the column labeled "Test Data" on the summary boring logs in Appendix A. Results of the grain size analyses are presented in the form of grain size distribution curves on Figure B-1.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-2	S-4	10.0	30	Silty, fine to coarse SAND	SM
⧗	B-2	S-7	25.0	42	Sandy elastic SILT	MH

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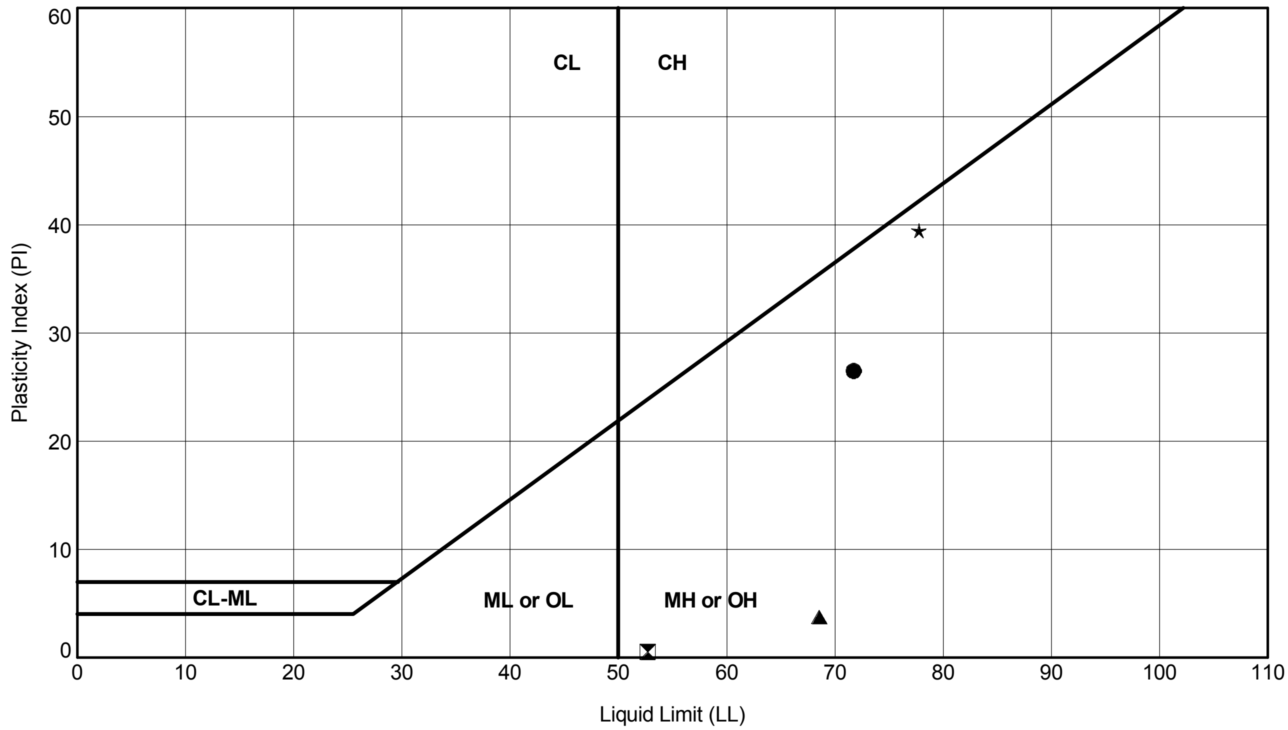
Grain Size Distribution

Figure
B-1



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-1	S-4	10.0	72	45	27	43	Elastic SILT	MH
⧗	B-1	S-8	30.0	53	52	1	39	Very silty SAND	SM
▲	B-2	S-2	5.0	69	65	4	62	Elastic SILT	MH
★	B-2	S-7	25.0	78	38	40	42	Very sandy elastic SILT	MH

ASTM D 4318 Test Method

*****END OF ADDENDUM NO. 1*****