



Bull Run TREATMENT PROJECTS

Technical Memorandum

Subject: Responses to Multnomah County Comments on Geologic Hazards Permit Application, Filtration Pipelines Project

Project #s: **Filtration Pipeline Project**

Date: November 11, 2022

To: Jesse Winterowd, Managing Principal
Winterbrook Planning

From: Brad Phelps, PE / Jacobs Engineering Group
Laura Miles, PE / McMillen Jacobs Associates

Prepared by: Jeff Quinn, PE / McMillen Jacobs Associates
Todd Cotten, PE, GE / Jacobs Engineering Group

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1.0 Introduction

The City of Portland has retained Jacobs Engineering Group (Jacobs) to assist the Portland Water Bureau (Water Bureau) with subsurface exploration, and design and construction support services associated with the Filtration Pipelines Project (FPP) portion of the Bull Run Treatment Program. The FPP consists of new raw water pipelines (RWP), finished water pipelines (FWP), and associated interties. Jacobs has contracted with McMillen Jacobs Associates (MJ) to assist with geotechnical services associated with the RWP section of the pipelines.

In September 2022, MJ and Jacobs submitted their respective Geologic Hazards Permit (GHP) packages to address Multnomah County Code Section 39.5085(C)(3)(c); 38.5515(C)(3)(c), Geologic Hazards Permits. Form A of the GHP package, submitted by Jacobs, addresses the portion of the FWP within the geologic hazard zone. Form B, submitted by MJ, addresses the portion of the RWP within the geologic hazard zone.

The GHP packages were submitted to Jesse Winterowd of Winterbrook Planning, who subsequently submitted them to Multnomah County for review. This memorandum summarizes Multnomah County's comments to the GHP packages and MJ's and Jacobs' responses to these comments.

2.0 MJ & Jacobs' Responses to Multnomah County Comments

Comments to the GHP packages were transmitted via email from Multnomah County to Jesse Winterowd of Winterbrook Planning on October 28, 2022. Project team members representing Winterbrook Planning, Jacobs, and MJ discussed the Multnomah County comments in a conference call on November 1, 2022. A total of ten comments were made by Multnomah County. The project team determined that four of these comments warranted written responses from the engineers, as summarized below. We understand that Jesse Winterowd will discuss the remaining comments with Multnomah County in a future meeting or correspondence.

- **Multnomah County Comment No. 2:** *"Provide location for wash out and cleanup of concrete equipment 39.5085(A)(8)."*
 - There will no concrete wash out or cleanup locations within the geologic hazard zones.
- **Multnomah County Comment No. 3:** *"Include soil information MCC 39.5085 (A)(10) & MCC 39.5085 (C)."*
 - **Project Team Response:** Several geotechnical borings were advanced within the geologic hazard zones of the FWP and RWP alignments. Please see the respective attached site plans, Figure 1 and Figure 2, showing the boring locations within the geologic hazard zones for the FWP and RWP alignments. The respective logs of borings shown in the figures are included in Appendices A and B, respectively.

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- The FWP and RWP alignments within the geologic hazard zones are separated by approximately 1 ¼ miles, with the FWP alignment being northwest of the RWP alignment. Both alignments extend through similar geologic units. The RWP geologic hazard zone extends east from approximately 450 feet upslope of SE Dodge Park Boulevard (elevation [El.] 700 feet) to approximately 450 feet downslope from SE Dodge Park Boulevard (El. 510 feet). The geologic hazard zone along the FWP extends east from approximately 350 feet upslope of SE Lusted Road (elevation [El.] 680 feet) to approximately 340 feet downslope from SE Lusted Road (El. 475 feet). The RWP and FWP geologic hazard zones descend the western wall of the Sandy River Canyon which cuts through several geologic units of Portland Basin terrestrial sediments. These geologic units, from the bottom up, include: Sandy River Mudstone; Troutdale Formation; Boring Lava; Springwater Formation; and alluvial terrace deposits along the Sandy River. Two prominent levels of alluvial terraces are present along both sides of the Sandy River - the higher of these terraces is referred to as the Gresham Formation, which is composed of gravel and mudflow deposits. Within the RWP geologic hazard zone, the Gresham Formation was encountered only in boring LRWP-BH-04, which was advanced within the higher/upper alluvial terrace above the Sandy River. Borings LRWP-BH-05 and BH-06, were advanced at higher elevations through the Springwater Formation terrace and encountered each of the aforementioned geologic units except for the Gresham Formation.
 - The FWP alignment through the geologic hazard area passes through the Springwater Formation, from the top down the sublayers of the formation include Residual Soil of the Springwater Formation, Sensitive Saprolite of the Springwater Formation, and Less Weathered Springwater Formation. The Residual Soil of the Springwater Formation typically consists of elastic silt and lean to fat clay with varying amounts of sand. The Sensitive Saprolite of the Springwater Formation is similar in composition but has lower density and higher plasticity compared to the overlying material. The Less Weathered Springwater Formation consists of poorly graded sands, silty and clayey sands, and silty and clayey gravel (GM, GC) with occasional cobbles.

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- **Multnomah County Comment No. 5:** *“Provide geologic map and cut/fill topographic map MCC 39.5085(3)(a).”*
 - **Project Team Response:** Please see attached geologic map excerpt (Figure 3) showing the RWP and FWP alignments and denoting the approximate segments within the geologic hazard areas. There are no permanent grade changes proposed along the RWP and FWP alignments; only temporary grade changes associated with the open trench section of the FWP that will be backfilled to original grades upon completion of the pipeline installation. Figures showing existing ground surface contours were provided in the original GHP packages. Therefore, a cut/fill topographic map is not relevant.
 - Additional erosion and sediment control requirements for the open cut trench segment of the project within the FWP geologic hazard area are provided on drawing ESC-004, Erosion Control General Notes (Figure 4). Highlighted notes address protection and restoration of vegetation within the FWP geologic hazard area.

 - **Multnomah County Comment No. 10:** *“Include hydrogeologic information or map – show underground water elevations and flow direction, well or monitoring locations, if there are areas of seepage, local drainage basin.”*
 - **McMillen Jacobs’ Response:** The regional groundwater aquifer lies deep within the Troutdale Formation, at an approximate elevation (El.) of 435 feet or lower, based on nearby well logs. This aquifer elevation is significantly deeper than the invert elevation of the tunnels, which ranges from approximately 479 feet to 485 feet within the geologic hazard zone. Therefore, construction of the tunnels will have no influence on the regional aquifer conditions. From a long-term perspective, the tunnels will not affect the groundwater conditions since they will be impervious concrete structures and therefore isolated from the surrounding geology. Therefore, a hydrogeologic study was not completed, nor did we provide hydrogeologic figures as part of our work.
 - **Jacobs’s Response:** Perched groundwater is present at shallow depths ranging from about 6 to 15 feet below the ground surface at the west end of the FWP alignment near the geologic hazard area. The perched groundwater flows to the east in the vicinity of the geologic hazard area, which is consistent with the slope gradient, which dips east towards the Sandy River. A surface seep was observed outside of the geologic hazard area during a site reconnaissance. The seep was observed at the toe of the slope at the east end of the proposed trenchless installation, as shown in the attached Figure 1. The FWP within the geologic hazard area is adjacent to existing pipelines, therefore the installation of the proposed LRDM pipeline is not anticipated to change groundwater conditions.

3.0 Conclusion

MJ and Jacobs have provided responses to Multnomah County's comments to the September 2022 GHP packages for the RWP and FWP alignments. If there are any further questions or comments regarding the responses herein, please contact the undersigned.



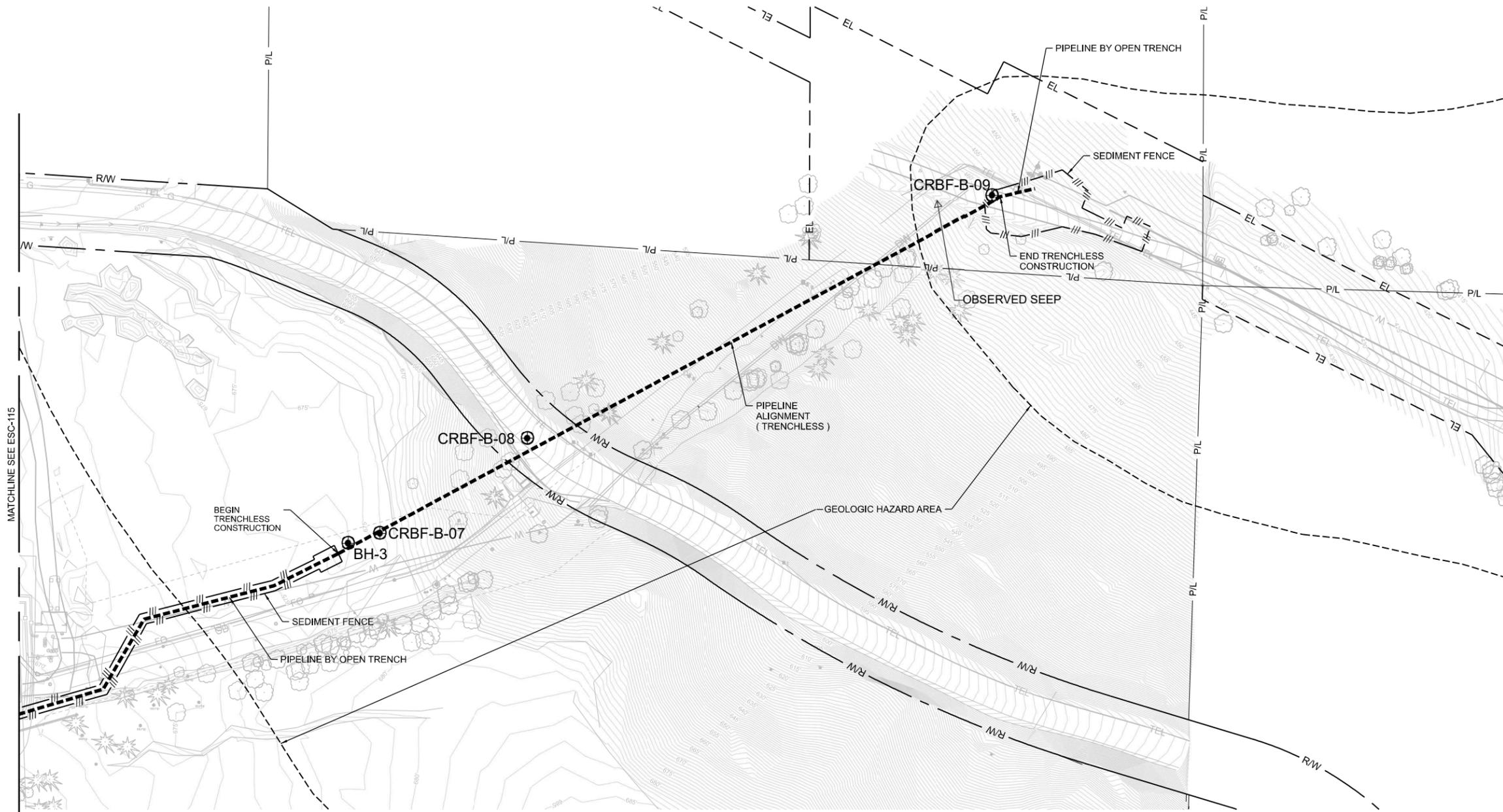
Jeff Quinn/McMillen Jacobs Associates
Stamping for Raw Water Pipeline Information



Todd Cotten/Jacobs Engineering
Stamping for Finished Water Pipeline Information

Figures

FIGURE 1: BORING LOCATIONS WITHIN AND NEAR GEOLOGIC HAZARD ZONE, FWP ALIGNMENT

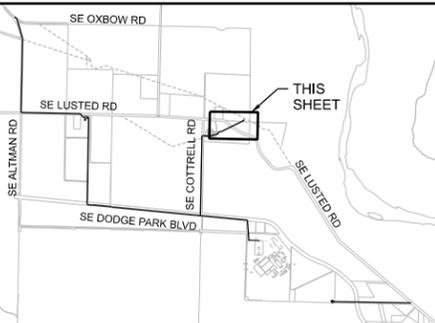
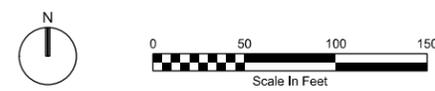


GENERAL SHEET NOTES

1. REFER TO EROSION AND SEDIMENT CONTROLS NOTES, SHEET ESC-004
2. PROTECT ALL EXISTING STRUCTURES AND TREES NOT SHOWN FOR DEMOLITION.
3. LIMITS OF GROUND DISTURBANCE ARE CONCURRENT WITH RIGHT-OF-WAY, PROPERTY LINE, EASEMENT LINE, OR TREE PROTECTION LINES EXCEPT AS INDICATED ON THE DRAWINGS.
4. REMOVE AND REPLACE ROADWAY PAVEMENT WITHIN LIMITS OF DISTURBANCE TO MATCH EXISTING LINE AND GRADE.
5. CONTRACTOR TO RE-GRADE DISTURBANCE AREA FROM PIPELINE CONSTRUCTION TO MATCH EXISTING GRADE, WHERE NOT OTHERWISE SHOWN ON DRAWINGS.
6. ALL DISTURBANCE AREA NOT RECEIVING PAVEMENT OR GRAVEL, UNLESS OTHERWISE SHOWN, SHALL BE RESTORED WITH GRASS SEEDING, SLOPES STEEPER THAN 3:1 SHALL BE RESTORED WITH GRASS SEEDING AND PERMANENT EROSION CONTROL BLANKETS AS SPECIFIED AND PER DETAIL 3125-152, SHEET ESC-201.
7. UPON PROJECT COMPLETION REMOVE GRAVEL SURFACING FROM ALL STAGING AREAS AND RESTORE TOPSOIL AND SEED.
8. SEE ESC-003 FOR TREE REMOVAL.

LEGEND

- PIPE
- 500' ----- CONTOUR
- ☀ CONIFEROUS TREE
- ⊙ DECIDUOUS TREE
- P/L — PROPERTY LINE
- R/W — RIGHT-OF-WAY
- E/L — EXISTING EASEMENT LINE
- TEL — TELEPHONE LINE
- FO — FIBER OPTIC LINE
- W — WATER LINE
- G — GAS LINE
- ▭ EXISTING BUILDINGS
- ||| SEDIMENT FENCE
- GEOHAZARD AREA
- ⊕ BORING LOCATION AND NUMBER



KEYPLAN

FIGURE 1

No	Date	Description	Appd
Revisions			
Survey			

**PRELIMINARY
NOT FOR
CONSTRUCTION**

Designed By	RG	Program Mgr	XXX
Drawn By	JSL	Const Mgr	XXX
Checked By	RG	Const Supvr	XXX
Project Mgr		Date	6/30/22

WARNING
0 1"
If this bar does not measure 1" then the drawing is not to scale



XXX XXX _____ Date
XXX XXX _____ Date



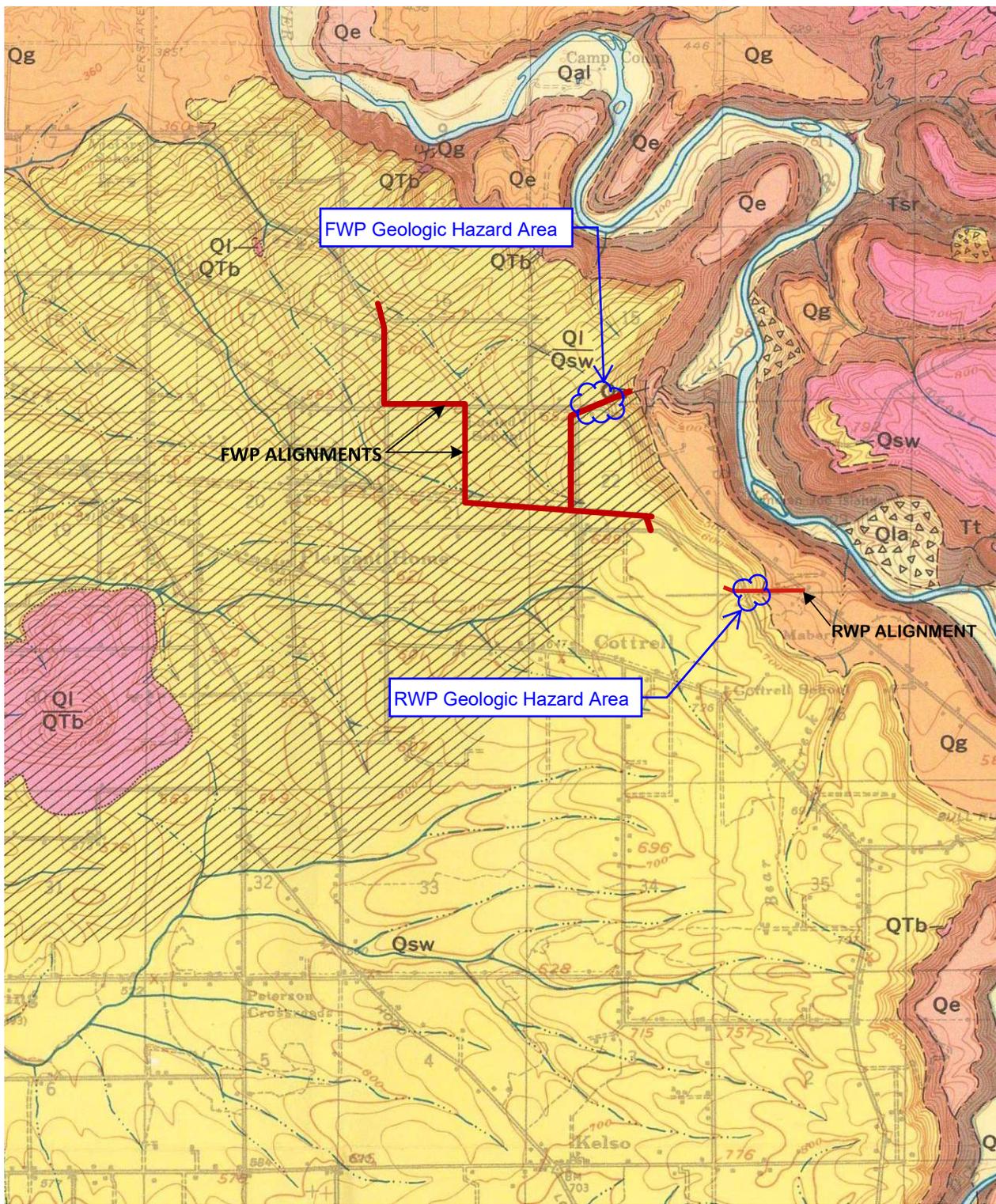
**Bull Run Filtration Pipelines
FINISHED WATER PIPELINE
EROSION CONTROL
GRID 16**

SAP Project No
W02563
1/4 Section
3765
Sheet No
GH-06

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Qal
Alluvium

Qla
Landslide
Deposits

Qe
Estacada
Formation

Qg
Gresham
Formation

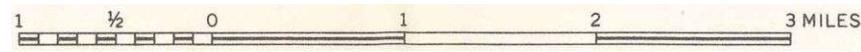
Ql
Loess

Qsw
Springwater
Formation

QTb
Boring Lava

Tt
Troutdale
Formation

Tsr
Sandy River
Mudstone



Scale (approximate)

Jacobs

GEOTECHNICAL DATA REPORT
GEOLOGIC VICINITY MAP

PORTLAND WATER BUREAU

FILTRATION PIPELINES PROJECT - FINISHED WATER PIPELINE

FIGURE 3

JUNE 2022

Source: Trimble, D. E., (1963). *Geologic Map and Diagrammatic Section of Portland, Oregon and Adjacent Areas*; Geological Survey Bulletin, 1119. USGS.

EROSION AND SEDIMENT CONTROL NOTES

- THE CONTRACTOR WILL MAINTAIN A LIST OF ALL PERSONNEL (BY NAME AND POSITION) THAT ARE RESPONSIBLE FOR THE INSTALLATION AND MAINTENANCE OF STORMWATER CONTROL MEASURES, AS WELL AS THEIR INDIVIDUAL RESPONSIBILITIES.
- VISUAL MONITORING INSPECTION REPORTS WILL BE MADE IN ACCORDANCE WITH DEQ 1200-C PERMIT REQUIREMENTS TO INSPECT ON THE INITIAL DATE THAT LAND DISTURBING ACTIVITIES COMMENCE, WITHIN 24 HOURS OF ANY STORM EVENT, AND AT LEAST ONCE EVERY 14 DAYS REGARDLESS OF WHETHER STORMWATER RUNOFF IS OCCURRING.
- INSPECTION LOGS WILL BE KEPT IN ACCORDANCE WITH DEQ'S 1200-C PERMIT REQUIREMENTS USING DEQ FORM 1 AND 2. CONSTRUCTION SITE BUMP INSPECTION REPORT & CHECKLIST FOR COMPLIANCE WITH OREGON NPDES 1200-C GENERAL PERMIT. INSPECTION FORMS WILL DOCUMENT OBSERVATIONS, THE IMPLEMENTATION AND PRESENCE OF EROSION AND SEDIMENT CONTROLS, APPARENT DISCHARGES, AND CONSTRUCTION ACTIVITIES PERTINENT TO EROSION AND SEDIMENT CONTROL INCLUDING BUT NOT LIMITED TO INGRESS, EGRESS, AND STOCKPILING.
- A COPY OF THE ESCP AND ALL REVISIONS WILL BE RETAINED ON SITE AND AVAILABLE ON REQUEST TO DEQ, AGENT, OR THE LOCAL MUNICIPALITY.
- CLEARING AND GRADING WILL BE SEQUENCED TO PREVENT EXPOSED INACTIVE AREAS FROM BECOMING A SOURCE OF EROSION TO THE MAXIMUM EXTENT POSSIBLE BY PROVIDING TEMPORARY STABILIZATION AS DESCRIBED BELOW AND PER EROSION AND SEDIMENT CONTROL CONSTRUCTION DETAILS ON SHEETS ESC-201 AND ESC-202.
- CRITICAL RIPARIAN AREAS AND VEGETATION INCLUDING PROTECTED TREES AND ASSOCIATED ROOTING ZONES, AND VEGETATION AREAS TO BE PRESERVED ARE IDENTIFIED, MARKED, AND PROTECTED (BY CONSTRUCTION FENCING) AS SHOWN ON SHEETS ESC-101 THROUGH ESC-117 PER DETAIL ON ESC-202. VEGETATIVE BUFFER ZONES BETWEEN THE SITE AND SENSITIVE AREAS, AND OTHER AREAS TO BE PRESERVED ARE SHOWN ON SHEETS ESC-101, -102, -103, -105, -109, -113, AND -117.
- PRESERVE EXISTING VEGETATION OUTSIDE OF PROJECT LIMITS AS DELINEATED BY TREE PROTECTION FENCING AND SEDIMENT FENCING AND RE-VEGETATE ALL UNPAVED AREAS WITHIN THE PROJECT LIMITS. TEMPORARY RE-VEGETATION IS REQUIRED DURING CONSTRUCTION AS INDICATED BELOW AND PERMANENT RE-VEGETATION IS REQUIRED FOLLOWING COMPLETION OF CONSTRUCTION. PROPOSED VEGETATIVE SEED MIX IS IDENTIFIED ON SHEET ESC-004.
- A NATURAL BUFFER OF 100 FEET WILL BE MAINTAINED AROUND BEAVER CREEK AS SHOWN ON SHEET ESC-105.
- INSTALL PERIMETER SEDIMENT CONTROL, INCLUDING STORM DRAIN INLET PROTECTION AND SEDIMENT BARRIERS PER THE DETAILS ON SHEETS ESCS-201 AND ESC-202 PRIOR TO LAND DISTURBANCE.
- CONTROL OF STORMWATER RUNOFF DURING CONSTRUCTION WILL BE BY DISPERSION THROUGH WATTLES AND SEDIMENT BARRIERS ADJACENT TO CONSTRUCTION ACTIVITIES. EROSION AT OUTLETS AND CHANNELS WILL BE MINIMIZED THROUGH FILTER SOCKS OR WATTLES. REFER TO DETAILS ON SHEETS ESC-201 AND ESC-202 AND TO THE STORMWATER REPORTS INCLUDED SEPARATELY IN THIS APPLICATION.
- SEDIMENT ALONG THE PERIMETER OF THE PROJECT LIMITS AND AT ALL OPERATIONAL INTERNAL STORM DRAIN INLETS WILL BE CONTROLLED AT ALL TIMES DURING CONSTRUCTION WITH SEDIMENT BARRIER INSTALLED ALONG THE COMPLETE UNPAVED PERIMETER OF THE PROJECT LIMITS.
- ESTABLISH CONCRETE TRUCK AND OTHER CONCRETE EQUIPMENT WASHOUT AREAS BEFORE BEGINNING CONCRETE WORK AS SHOWN ON SHEETS ESC-101 AND ESC-117.
- APPLY TEMPORARY AND PERMANENT SOIL STABILIZATION MEASURES IMMEDIATELY ON ALL DISTURBED AREAS AS GRADING PROGRESSES, PER DETAILS ON ESC-201 AND ESC-202.
- MATERIAL AND WASTE STORAGE AREAS OUTSIDE OF RIGHTS-OF-WAY WILL BE ESTABLISHED BY THE CONTRACTOR AND EROSION CONTROL MEASURES TO PROTECT MATERIAL AND WASTE STORAGE AREAS WILL COMPLY WITH THE EROSION CONTROL CONSTRUCTION DETAILS ON ESC-201 AND ESC-202 MATERIAL WILL NOT BE STOCKPILED WITHIN THE RIGHT-OF-WAY EXCEPT FOR ACTIVE CONSTRUCTION ACTIVITIES.
- WASTE CONTAINER LIDS WILL BE KEPT CLOSED OR COVERED TO PREVENT EXPOSURE TO PRECIPITATION WHEN NOT IN USE. CONTRACTOR WILL TRANSPORT WASTE MATERIALS OFFSITE TO STAGING YARDS FOR COLLECTION PRIOR TO DISPOSAL. WASTE MATERIALS WILL NOT BE STORED WITHIN THE RIGHT-OF-WAY.
- CONSTRUCTION ENTRANCES WITH TIRE WASHES ON SE LUSTED ROAD AT THE MULTNOMAH CONNECTION (SEE SHEET ESC-101) AND ON SE LUSTED ROAD AT THE FINISHED WATER INTERTIE (SEE SHEET ESC-117) WILL BE PROVIDED TO PREVENT TRACKING OF SEDIMENT ONTO PUBLIC ROADS. PUBLIC ROADS WILL BE SWEEPED DAILY. PRIVATE FARM ROADS UTILIZED DURING CONSTRUCTION WILL BE IMPROVED WITH GRAVEL PRIOR TO LAND DISTURBING ACTIVITIES. THESE BMPs MUST BE IN PLACE PRIOR TO LAND-DISTURBING ACTIVITIES.
- CONCRETE WASH-OUTS WILL BE PROVIDED AT THE CONSTRUCTION ENTRANCE ON SE LUSTED ROAD AT THE MULTNOMAH CONNECTION (SEE SHEET ESC-101) AND AT THE CONSTRUCTION ENTRANCE ON SE LUSTED ROAD AT THE FINISHED WATER INTERTIE (SEE SHEET ESC-117) TO PREVENT CONCRETE DISCHARGES FROM LEAVING THE CONSTRUCTION SITE.
- STEEP SLOPE AREAS WHERE CONSTRUCTION ACTIVITIES ARE NOT OCCURRING WILL BE DELINEATED BY SEDIMENT FENCE TO PREVENT DISTURBANCE.
- PERMANENT RESTORATION OF UNPAVED AREAS WITHIN RIGHTS-OF-WAY WILL INCLUDE SOIL AMENDMENT FOR FILTER STRIPS FOR STORMWATER DISPERSION, AND PERMANENT RESTORATION OF AGRICULTURAL SOILS ON PRIVATE PROPERTY WILL BE REQUIRED TO MEET SPECIFIC COMPACTION REQUIREMENTS. POST-CONSTRUCTION TESTING AND INSPECTION WILL BE PERFORMED TO IDENTIFY RESTORATION AREAS WHICH HAVE BEEN DISTURBED, AND A CORRECTION NOTICE WILL BE ISSUED TO THE CONTRACTOR.
- CONTRACTOR BEST MANAGEMENT PRACTICES INCLUDING SECONDARY CONTAINMENT WILL BE USED TO PREVENT OR MINIMIZE STORMWATER EXPOSURE TO POLLUTANTS FROM SPILLS; VEHICLE AND EQUIPMENT FUELING, MAINTENANCE, AND STORAGE; OTHER CLEANING AND MAINTENANCE ACTIVITIES; AND WASTE HANDLING ACTIVITIES. THESE POLLUTANTS INCLUDE FUEL, HYDRAULIC FLUID, AND OTHER OILS FROM VEHICLES AND MACHINERY, AS WELL AS DEBRIS, FERTILIZER, PESTICIDES AND HERBICIDES, PAINTS, SOLVENTS, CURING COMPOUNDS AND ADHESIVES FROM CONSTRUCTION OPERATIONS. A WRITTEN SPILL PREVENTION PLAN WILL BE PREPARED AND SUBMITTED BY THE CONTRACTOR ADDRESSING RESPONSE PROCEDURES, EMPLOYEE TRAINING ON SPILL PREVENTION AND PROPER DISPOSAL PROCEDURES, SPILL KITS IN ALL VEHICLES, REGULAR MAINTENANCE SCHEDULE FOR VEHICLES AND MACHINERY, MATERIAL DELIVERY AND STORAGE CONTROLS, TRAINING AND SIGNAGE, AND COVERED STORAGE AREAS FOR WASTE AND SUPPLIES.
- ENGINEERED SOILS USING SOIL AMENDMENTS SUCH AS FLY-ASH OR PORTLAND CEMENT WILL NOT BE USED.
- A DEWATERING PLAN WILL BE PREPARED AND SUBMITTED BY THE CONTRACTOR FOR ACCUMULATED WATER FROM PRECIPITATION AND UNCONTAMINATED GROUNDWATER SEEPAGE IN EXCAVATIONS. DEWATERING SYSTEMS WILL BE REQUIRED TO FILTER THE DISCHARGE THROUGH AT LEAST TWO SEDIMENT BARRIERS INCLUDING A FILTER BAG AND SEDIMENT FENCE. DEWATERING SYSTEMS WILL BE REQUIRED TO LIMIT DISCHARGE QUANTITY AS SPECIFIED FOR EACH STORMWATER BASIN.
 - NORTH FORK BEAVER CREEK DISCHARGE LIMIT: 200 GALLONS PER MINUTE
 - MIDDLE FORK BEAVER CREEK DISCHARGE LIMIT: 200 GALLONS PER MINUTE
- DUST CONTROL WILL BE ADDRESSED BY WATER SPRAYING AND COVERING OF SOIL PILES TO MITIGATE WIND-BLOWN SOIL.
- THE APPLICATION RATE OF ORGANIC FERTILIZERS USED TO REESTABLISH VEGETATION MUST FOLLOW PROJECT SPECIFICATIONS AND MANUFACTURER'S RECOMMENDATIONS TO MINIMIZE NUTRIENT RELEASES TO SURFACE WATERS. ABIDE BY ANY SETBACKS ON PRODUCT LABELS AND USE IN SUCH A WAY THAT THE PRODUCT DOES NOT CAUSE OR CONTRIBUTE TO AN EXCEEDANCE OF APPLICABLE WATER QUALITY STANDARDS.

- TEMPORARILY STABILIZE SOILS WITH BLOWN STRAW AND A TACKIFIER, LOOSE STRAW, OR AN ADEQUATE COVERING OF COMPOST MULCH AT THE END OF THE SHIFT BEFORE HOLIDAYS AND WEEKENDS, IF NEEDED. THE CONTRACTOR IS RESPONSIBLE FOR ENSURING THAT SOILS ARE STABLE DURING RAIN EVENTS AT ALL TIMES OF THE YEAR.
- AS NEEDED BASED ON WEATHER CONDITIONS, AT THE END OF EACH WORKDAY SOIL STOCKPILES WILL BE STABILIZED OR COVERED, OR OTHER BMPs WILL BE IMPLEMENTED TO PREVENT DISCHARGES TO SURFACE WATERS OR CONVEYANCE SYSTEMS LEADING TO SURFACE WATERS.
- SEDIMENT FENCE: REMOVE TRAPPED SEDIMENT BEFORE IT REACHES ONE THIRD OF THE ABOVE GROUND FENCE HEIGHT AND BEFORE FENCE REMOVAL. SEDIMENT FENCES ARE SHOWN ON SHEETS ESC-101 THROUGH ESC-117, DETAILS ON SHEET ESC-201.
- OTHER SEDIMENT BARRIERS (SUCH AS BIOBAGS): REMOVE SEDIMENT BEFORE IT REACHES TWO INCHES DEPTH ABOVE GROUND HEIGHT AND BEFORE BMP REMOVAL. OTHER SEDIMENT BARRIERS ARE SHOWN ON DETAILS ON SHEET ESC-201 AND ESC-202.
- CATCH BASINS: CLEAN BEFORE RETENTION CAPACITY HAS BEEN REDUCED BY FIFTY PERCENT. SEDIMENT BASINS AND SEDIMENT TRAPS: REMOVE TRAPPED SEDIMENTS BEFORE DESIGN CAPACITY HAS BEEN REDUCED BY FIFTY PERCENT AND AT COMPLETION OF PROJECT. CATCH BASINS, SEDIMENT BASINS AND SEDIMENT TRAPS ARE SHOWN ON DETAILS ON SHEET ESC-201 AND ESC-202.
- WITHIN 24 HOURS, SIGNIFICANT SEDIMENT THAT HAS LEFT THE CONSTRUCTION SITE, MUST BE REMEDIATED. INVESTIGATE THE CAUSE OF THE SEDIMENT RELEASE AND IMPLEMENT STEPS TO PREVENT A RECURRENCE OF THE DISCHARGE WITHIN THE SAME 24 HOURS. ANY IN-STREAM CLEAN-UP OF SEDIMENT SHALL BE PERFORMED ACCORDING TO THE OREGON DEPARTMENT OF STATE LANDS REQUIRED TIMEFRAME.
- NO INTENTIONAL WASHING OF SEDIMENT INTO STORM SEWERS OR DRAINAGE WAYS IS PROPOSED. VACUUMING OR DRY SWEEPING AND MATERIAL PICKUP WILL BE USED TO CLEANUP RELEASED SEDIMENTS.
- IDENTIFY ON EROSION CONTROL INSPECTION FORMS ANY PORTION(S) OF THE SITE WHERE LAND DISTURBING ACTIVITIES HAVE PERMANENTLY CEASED OR WILL BE TEMPORARILY INACTIVE FOR 14 OR MORE CALENDAR DAYS.
- PROVIDE TEMPORARY STABILIZATION FOR ANY PORTION OF THE SITE WHERE CONSTRUCTION ACTIVITIES CEASE FOR 14 DAYS OR LONGER WITH A COVERING OF BLOWN STRAW AND A TACKIFIER, LOOSE STRAW, OR AN ADEQUATE COVERING OF COMPOST MULCH UNTIL WORK RESUMES ON THAT PORTION OF THE SITE. APPLY TEMPORARY SEEDING OF STERILE WHEAT GRASS- REGREEN, QUICKGUARD, OR APPROVED EQUAL AT A RATE OF 50 POUNDS PER ACRE, OR HORDEUM VULGARE VAR. POCO -POCO BARLEY AT A RATE OF 60 POUNDS PER ACRE.
- DO NOT REMOVE TEMPORARY SEDIMENT CONTROL PRACTICES UNTIL PERMANENT VEGETATION OR OTHER COVER OF EXPOSED AREAS IS ESTABLISHED. ONCE CONSTRUCTION IS COMPLETE AND THE SITE IS STABILIZED, ALL TEMPORARY EROSION CONTROLS AND RETAINED SOILS WILL BE REMOVED AND DISPOSED OF PROPERLY, UNLESS NEEDED FOR LONG TERM USE FOLLOWING TERMINATION OF PERMIT COVERAGE.

SITE CONDITION	MINIMUM INSPECTION FREQUENCY
1. ACTIVE PERIOD	ON INITIAL DATE THAT LAND DISTURBANCE ACTIVITIES COMMENCE. WITHIN 24 HOURS OF ANY STORM EVENT, INCLUDING RUNOFF FROM SNOW MELT, THAT RESULTS IN DISCHARGE FROM THE SITE. AT LEAST ONCE EVERY 14 DAYS, REGARDLESS OF WHETHER STORMWATER RUNOFF IS OCCURRING.
2. INACTIVE PERIODS GREATER THAN 14 CONSECUTIVE CALENDAR DAYS	THE INSPECTOR MAY REDUCE THE FREQUENCY OF INSPECTIONS IN ANY AREA OF THE SITE WHERE THE STABILIZATION STEPS IN SECTION 2.2.20 HAVE BEEN COMPLETED TO TWICE PER MONTH FOR THE FIRST MONTH, NO LESS THAN 14 CALENDAR DAYS APART, THAN ONCE PER MONTH.
3. PERIODS DURING WHICH THE SITE IS INACCESSIBLE DUE TO INCLEMENT WEATHER	IF SAFE, ACCESSIBLE AND PRACTICAL, INSPECTIONS MUST OCCUR DAILY AT A RELEVANT DISCHARGE POINT, OR DOWNSTREAM LOCATION OF THE RECEIVING WATERBODY.
4. PERIODS DURING WHICH CONSTRUCTION ACTIVITIES ARE SUSPENDED AND RUNOFF IS UNLIKELY DUE TO FROZEN CONDITIONS.	VISUAL MONITORING INSPECTIONS MAY BE TEMPORARILY SUSPENDED. IMMEDIATELY RESUME MONITORING UPON THAWING, OR WHEN WEATHER CONDITIONS MAKE DISCHARGES LIKELY.
5. PERIODS DURING WHICH CONSTRUCTION ACTIVITIES ARE CONDUCTED AND RUNOFF IS UNLIKELY DURING FROZEN CONDITIONS.	VISUAL MONITORING INSPECTIONS MAY BE REDUCED TO ONCE A MONTH. IMMEDIATELY RESUME MOITORING UPON THAWING, OR WHEN WEATHER CONDITIONS MAKE DISCHARGES LIKELY.

SITE INFORMATION

- TYPE OF DEVELOPMENT: CAPITAL IMPROVEMENT
- CONSTRUCTION ACTIVITY WILL CONSIST OF:
 - CLEARING AND GRUBBING
 - MASS GRADING AND EXCAVATION
 - UTILITY INSTALLATION
 - STREET CONSTRUCTION
 - FINAL STABILIZATION
- PROJECT TIMELINE:

BEGINNING DATE:	2024
COMPLETION DATE:	2027
- PROJECT SITE WITHIN R/W AREAS:

-TOTAL AREA:	21.0 AC
-DISTURBED AREA:	20.3 AC
-PERCENT OF SITE DISTURBED:	96.7%
- OUTSIDE OF R/W IMPROVEMENT AREAS:

-TOTAL AREA:	15.7 AC
-DISTURBED AREA:	9.5 AC
-PERCENT OF AREA DISTURBED:	60.5%
- ONSITE SOIL TYPES:
 - CAZADERO SILTY CLAY LOAM
 - MERSHON SILT LOAM
 - WOLLENT SILT LOAM
 - CORNELIUS SILT LOAM
 - POWELL SILT LOAM
- CUT AND FILL DATA: FWI SITE

-CUT:	272 CY
-FILL:	0 CY
-NET ADJUSTED:	-272 CY

BMP MATRIX FOR CONSTRUCTION PHASE

1200-C PHASES	PHASE 1					PHASE 2					PHASE 3					PHASE 4													
	BMP					CLEARING					MASS GRADING					UTILITY CONSTRUCTION					VERTICAL CONSTRUCTION					FINAL STABILIZATION			
EROSION PREVENTION																													
GROUND COVER					X	X	X	X	X																				
PLASTIC SHEETING					X	X	X	X	X																				
DUST CONTROL					X	X	X	X	X						X														
TEMPORARY STABILIZATION (STRAW MULCH/HYDROSEED)																													
PERMANENT STABILIZATION					X	X	X	X	X						X														
BUFFER ZONE (FROM RAVINE)																													
					X	X	X	X	X						X														
SEDIMENT CONTROL																													
SEDIMENT FENCE (PERIMETER)					X	X	X	X	X						X														
SEDIMENT FENCE (INTERIOR)					X	X	X	X	X						X														
STRAW WATTLES					X	X	X	X	X						X														
INLET PROTECTION					X	X	X	X	X						X														
DEWATERING						X	X	X	X																				
RUN OFF CONTROL																													
CONSTRUCTION ENTRANCE					X	X	X	X	X						X														
EXISTING OUTLET PROTECTION					X	X	X	X	X						X														
NEW OUTLET PROTECTION						X	X	X	X						X														
EXISTING CURB INLET CHECK DAMS					X	X	X	X	X						X														
POLLUTION PREVENTION																													
HAZARD WASTE MANAGEMENT																				X									
SPILL KIT ONSITE					X	X	X	X	X						X					X									
CONCRETE WASHOUT AREA					X	X	X	X	X						X					X									

OWNER/DEVELOPER _____ SURVEYOR _____ SITE CONTRACTOR _____

DESIGN ENGINEER _____ BMP INSTALLER/MAINTAINER: _____ CESCL: _____

GEOTECHNICAL ENGINEER _____ ESCP PREPARER: _____ RAIN GUAGE: _____

10/28/2022 11:24:51 AM W02563_ESC-004.dgn

No	Date	Description	Appd
Revision			
Survey			

PRELIMINARY
NOT FOR
CONSTRUCTION

Designed By	Program Mgr	XXX
Drawn By	Const Mgr	XXX
Checked By	Const Supvr	XXX
Project Mgr	Date	12/22/22

WARNING

0 1"

If this bar does not measure 1" then the drawing is not to scale



XXX XXX

Date



Bull Run Filtration Pipelines
EROSION CONTROL
GENERAL NOTES

FIGURE 4
SAP Project No
W02563
1/4 Section
Sheet No
ESC-004

Appendix A: Boring Logs, FWP Alignment



PROJECT NUMBER: D3460500	BORING NUMBER: CRBF-B-07	SHEET 1 OF 6
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664496.98 N, 7740359.62 E)
 ELEVATION : 673.22 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/15/22 09:20 END : 8/15/22 16:28 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/NUMBER					6"-6"-6" (N)
2.5						Start advancing borehole with 4-7/8" spade/drag bit	
4.0	1.50	1-SS	1-3-5 (8)		LEAN CLAY (CL) Orangish-brown, moist, firm, low to medium plasticity, ±10% fine to coarse sand, trace organics roots, trace black Mn nodules, trace reddish-brown iron oxide staining	PP = 0, 0, 0.25 tsf 4'-5': 400 psi 5'-6': 700 psi	
5.0		2-ST					
6.0							
7.5	1.50	3-SS	4-6-7 (13)		LEAN CLAY (CL) Similar to above, trace gray mottling, stiff, ±5% fine to coarse sand, trace subangular to subrounded gravel	PP = 0.5, 1.75, 0.5 tsf 7.5'-8.5': 500 psi 8.5'-9.5': 800 psi	
9.3		4-ST					
10.0							
11.5	1.50	5-SS	4-6-9 (15)		ELASTIC SILT WITH SAND (MH) Brown with trace gray mottling, moist, stiff, medium to high plasticity, ±5-15% fine to coarse sand, trace subangular to subrounded gravel, trace black Mn nodules, trace iron oxide staining	PP = 2.5, 2.5, 2 tsf	
12.5							
14.0	1.50	6-SS	6-8-10 (18)		ELASTIC SILT WITH SAND (MH) Similar to above, very stiff, persistent gray mottling, ±5-10%, fine to coarse sand	PP = 1.75, 1.25, 1.5 tsf	
15.0		7-ST				14'-15': 650 psi 15'-15.5': 800 psi	
15.5							
17.0	1.50	8-SS	4-5-8 (13)		FAT CLAY (CH) Orangish-brown, mottled gray, moist, stiff, medium to high plasticity, ±10% fine to coarse sand, trace subangular to subrounded gravel, black spots of sand and gravel, trace black Mn nodules, trace reddish-brown iron oxide staining	PP = 1.5, 0.5, 1.5 tsf Short clay collars retrieved from borehole	
20.0							



PROJECT NUMBER: D3460500	BORING NUMBER: CRBF-B-07	SHEET 2 OF 6
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664496.98 N, 7740359.62 E)

ELEVATION : 673.22 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/15/22 09:20 END : 8/15/22 16:28 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)			PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/ NUMBER	6"-6"-6" (N)				
20.0	1.50	9-SS	4-5-8 (13)		FAT CLAY (CH) Similar to above, trace red mottling in gray parts, ±5 sand	PP = 1, 1.75, 1.75 tsf	
21.5							
25.0	1.50	10-SS	2-3-5 (8)		FAT CLAY WITH SAND (CH) Gray and brown parts, moist, firm, medium to high plasticity, ±15% fine to coarse sand, trace subangular to subrounded gravel, trace black Mn nodules, trace reddish-brown iron oxide staining	PR = 0, 0, 0 tsf (<0.25 tsf)	
26.5							
30.0	1.50	11-SS	3-6-10 (16)		SANDY SILT WITH GRAVEL (ML) Gray, trace white and orange spots, moist, very stiff, ±35% fine to coarse sand, ±15% fine to coarse subangular to subrounded gravel <1.5" dia, trace iron oxide staining	PP = 0, 0, 0 tsf (<0.25 tsf)	
31.5							
35.0	0.20	12-SS	50/1 (50/1")		POORLY GRADED GRAVEL (GP) Subangular gravel < 1" dia recovered two broken gravel pieces	Switch to 4-7/8" tricone bit Very slow drill rig progress. Drill rig chatter	
35.2							
40.0							



PROJECT NUMBER: D3460500	BORING NUMBER: CRBF-B-07	SHEET 3 OF 6
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664496.98 N, 7740359.62 E)

ELEVATION : 673.22 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/15/22 09:20 END : 8/15/22 16:28 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)			PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/ NUMBER	6"-6"-6" (N)			SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION
40.0 40.8	0.80	13-SS	19-50/4 (50/4")		SILTY SAND WITH GRAVEL (SM) Gray, moist, very dense, fine to coarse sand, lightly cemented, disintegrated with finger pressure, ±15% fines, ±20% fine to coarse subangular to subrounded gravel less than 2.0" diameter		
45.0 45.4	0.40	14-SS	50/5 (50/5")				
50.0 51.5	1.50	15-SS	9-12-18 (30)		FAT CLAY (CH) Gray mottled orangish brown, moist, very stiff, medium to high plasticity, trace fine to coarse sand, trace reddish-brown iron oxide staining	Switch to 4-7/8" drag bit PP = 2.75, 1.75, 2.25 tsf	
55.0 56.5	1.50	16-SS	13-16-23 (39)				
60.0					SANDY FAT CLAY (CH) Gray with rare pink and brown spots, hard, medium to high plasticity, ±40% fine to coarse sand, trace fine to coarse subangular to subrounded gravel <1" diameter	Switch to 4-7/8" tricone bit Start drill rig chatter (likely start of SM recovered in SS-18)	



PROJECT NUMBER: D3460500	BORING NUMBER: CRBF-B-07	SHEET 4 OF 6
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664496.98 N, 7740359.62 E)

ELEVATION : 673.22 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/15/22 09:20 END : 8/15/22 16:28 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)			PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/ NUMBER	SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY			DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION	
60.0	0.00	17-SS	50/0.5 (50/0.5")				
65.0							
65.4	0.40	18-SS	50/5 (50/5")		SILTY SAND (SM) Gray, moist, very dense, fine to coarse sand, very light cementation, easily disintegrated with finger pressure, ±40% fines, ±5% subangular to subrounded gravel, reddish brown iron-oxide staining		
70.0							
		19-SS	50/0.2 (50/0.2")			Hammer bouncing off gravel/cobble	
75.0							
76.5	1.50	20-SS	19-30-29 (59)		SILTY SAND WITH GRAVEL (SM) Grayish brown, moist, very dense, lightly cemented, disintegrated with finger pressure, ±15% subangular to subrounded gravel <1" diameter, reddish brown iron-oxide staining		
80.0							



PROJECT NUMBER: D3460500	BORING NUMBER: CRBF-B-07	SHEET 5 OF 6
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664496.98 N, 7740359.62 E)

ELEVATION : 673.22 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/15/22 09:20 END : 8/15/22 16:28 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)			PENETRATION TEST RESULTS 6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/NUMBER					
80.0	0.70	21-SS	27-21-19 (40)		SILTY SAND (SM) Gray, moist, dense, lightly cemented sand, disintegrated with finger pressure, trace subangular to subrounded gravel <1.5" diameter, ±30-35% fines	Heavy drill rig chatter	
81.5							
85.0	0.90	22-SS	10-50/4 (50/4")		SILTY SAND (SM) Similar to above, ±10% fine to coarse subangular to subrounded gravel <2.5" diameter very dense	Heavy drill rig chatter	
85.9							
90.0	1.50	23-SS	18-24-24 (48)		SILTY SAND (SM) WITH GRAVEL Similar to above (SS-21), ±10-15% subangular to subrounded gravel <1.5" diameter very dense	Heavy drill rig chatter	
91.5							
95.0	0.60	24-SS	13-50/1 (50/1")		SILTY SAND (SM) WITH GRAVEL Similar to above, very dense		
95.6							
100							

DRAFT



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 1 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/NUMBER					6"-6"-6" (N)
0.0					6 in: ASPHALT CONCRETE PAVEMENT		
					GRAVEL BASE		
	4.00	S-1			LEAN CLAY (CL) Brown, moist, soft, low to medium plasticity, trace fine to coarse sand, black Mn nodules, trace organics roots, trace iron-oxide staining		
5	5.0						
	0.80	SS-2	1-1-1 (2)		LEAN CLAY (CL) Similar to above		
	6.5						
	5.00	S-3					
	9.0						
	1.00	GS-4			LEAN CLAY (CL) Brown, moist, stiff, low plasticity, trace fine to coarse sand, trace fine to coarse subrounded to subangular gravel < 2" diameter, black Mn nodules, trace organics roots, trace iron-oxide staining		
10	10.0						
	0.10	SS-5	8-5-8 (13)		ELASTIC SILT (MH) TO LEAN CLAY WITH GRAVEL (CL) Gray with orange mottling, moist, stiff, low to medium plasticity, trace fine to coarse sand, ±15% fine to coarse subrounded to subrounded gravel <3" to 5" diameter, basalt cobble at 12.5 feet, black Mn nodules, trace iron-oxide staining	SS-3 poor recovery; description is from the sonic sample	
	11.5						
	5.00	S-6					
	14.0						
	1.00	GS-7					
15	15.0						
	1.50	SS-8	6-24-48 (72)		SANDY LEAN CLAY WITH GRAVEL (CL) Gray to brown, moist, hard, low plasticity, ±30-40% fine to coarse sand, ±15% fine to coarse subrounded to subangular gravel < 2" diameter, trace iron-oxide staining	Sonic 15'-20': similar description to SS-8 sample	
	16.5						
	5.00	S-9					
	18.0						
	1.00	GS-10					
	19.0						
20	20.0						



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 2 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/NUMBER					6"-6"-6" (N)
20.0	1.30	SS-11	3-29-50 (79)		CLAYEY SAND WITH GRAVEL (SC) Gray to brown, moist, very dense, fine to coarse sand, ±30-40% fines, ±15% fine to coarse subangular to subrounded gravel <2" diameter, trace iron-oxide staining, trace yellow spots	Sonic 20'-25': similar description to SS-11 sample	
21.5							
22.0							
23.0	1.00	GS-12					
25.0							
25.0	0.90	SS-13	37-50/5 (50/5")		CLAYEY SAND WITH GRAVEL (SC) Similar to above, gray, 20-30% fine to coarse subangular to subrounded gravel < 3" diameter	Sonic 25'-30': similar description to SS-13 sample, long basalt cobble, fresh, fine grained, very lightly cemented, disintegrated with finger pressure, very low water content	
25.9							
27.0							
28.0	1.00	GS-15					
28.0							
30.0	0.60	SS-16	14-50/5 (50/5")		CLAYEY SAND WITH GRAVEL (SC) Similar to above, brown, some gray parts, ±20% fines, ±15% fine to coarse subangular to subrounded gravel < 2" diameter, some parts are lightly cemented, disintegrated with finger pressure, trace iron-oxide staining	Sonic 30'-35': similar description to SS-16	
30.0							
30.6							
35.0	5.00	S-17					
35.0							
35.9							
35.0	0.90	SS-18	4-50/5 (50/5")		CLAYEY SAND WITH GRAVEL (SC) Similar to above, gray, ±30% fines, ±10% fine to coarse subangular to subrounded gravel < 1.5" diameter, lightly cemented, disintegrated with finger pressure	Sonic 35'-40': clayey to silty sand with gravel (SC-SM), 6" diameter cobble, rest of the description is similar to SS-18	
35.0							
35.9							
40.0	5.00	S-19					



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 3 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/NUMBER					
40.0	0.00	SS-20	50/5 (50/5")		CLAYEY SAND WITH GRAVEL (SC) Gray, moist, very dense, ±30% fines, lightly cemented sand, disintegrated easily with finger pressure, ±15% gravel, subrounded to subangular <2" diameter, trace iron-oxide staining	SS-20 poor recovery; description is from the sonic sample	
40.0-40.5	1.00	GS-22					
41.5							
	4.80	S-21					
45							
45.0							
45.0-46.0	1.00	GS-24	3-9-17 (26)				
46.0	0.00	SS-23					
46.5							
	5.00	S-25					
50					CLAYEY TO SILTY SAND (SC-SM) Gray, trace spots of pink, yellow, moist, very dense, fine to coarse lightly cemented sand, disintegrated with finger pressure, ±30% fines, ±5% fine to coarse subangular to subrounded gravel <1" diameter	Sonic 50'-55': similar to SS-26	
50.0-51.5	1.50	SS-26	14-32-44 (76)				
51.5							
	5.00	S-27					
53.0							
54.0	1.00	GS-28					
55							
55.0-55.5	0.50	SS-29	50/5 (50/5")				
55.5							
56.0							
	1.00	GS-31					
57.0					CLAYEY SAND WITH GRAVEL (SC) Similar to above, gray, ±15% fines, ±15% fine to coarse subangular to subrounded gravel < 2.5" diameter, putty knife and hammer required to break	Sonic 55'-60': similar to SS-30	
57.0-58.0	5.00	S-30					
58.0							
59.0	1.00	GS-32					
60							
60.0							

DRAFT

Stop at 55 ft bgs on 8/17 at 3:55 PM. Out of water. Start on 8/18 at 9:05 AM



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 4 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/NUMBER					6"-6"-6" (N)
60.0 60.3 60.6 61.0	0.50	SS-33	5-50/5 (50/5")		CLAYEY SAND WITH GRAVEL (SC) Similar to above	Sonic 60'-65': similar to SS-33	
62.0	1.00	GS-34					
	5.00	S-35					
65 65.0 65.0	1.50	SS-36	9-18-32 (50)		CLAYEY TO SILTY SAND WITH GRAVEL (SC-SM) Gray, moist, dense, ±20-30% fines, fine to coarse sand, ±10-15% fine to coarse subangular to subrounded gravel <1" diameter, trace iron-oxide, trace organics consists of roots	Sonic 65'-70': Clayey Sand with Gravel (SC), brownish gray, rest of the description is similar to SS-36	
66.5 67.0							
	1.00 5.00	GS-38 S-37					
70 70.0 70.0 70.7	0.70	SS-39	14-50/4 (50/4")		CLAYEY TO SILTY SAND WITH GRAVEL (SC-SM) Similar to above, ±25% gravel < 1.5" diameter	Sonic 70'-75': similar to SS-39	
72.0							
	1.00 5.00	GS-41 S-40			FAT CLAY (CH) Dark green, moist, hard, medium to high plasticity, ±10% fine to coarse sand, trace fine to coarse subrounded to subangular gravel, trace iron-oxide staining		
75 75.0 75.0	1.50	SS-42	14-21-31 (52)		FAT CLAY (CH) Similar to above, gray to dark green	Sonic 75'-80': Similar to SS-42, requires putty knife and hammer to break the sonic sample	
76.5							
	5.00	S-43					
78.0							
	1.00	GS-44					
79.0							
80 80.0							



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 5 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/NUMBER					
80.0						CLAYEY GRAVEL WITH SAND (GC) Greenish gray, moist, very dense, ±15% fines, ±15% fine to coarse sand, fine to coarse subangular to subrounded gravel <1.5" diameter	Sonic 80'-85': similar to S-43 from 80'-81', 6" basalt cobble at 80' 81'-84': clayey gravel with sand (GC) or clayey sand with gravel (SC), similar to SS-45
80.0 80.6	1.00	GS-47	14-40-50/3				
80.6 81.3	0.40	SS-45	(90/9")				
	5.00	S-46					
84.0							
	1.00	GS-48					
85							
85.0							
85.0 85.5	0.50	SS-49	50/5.5	(50/5.5")			
	5.00	S-50					
88.0							
	1.00	GS-51					
89.0							
90							
90.0							
90.4	0.40	SS-52	50/5	(50/5")			
91.0							
	1.00	GS-53					
92.0							
95							
95.0							
95.0 95.5	0.50	SS-54	50/0.5	(50/0.5")			
	5.00	S-55					
100							

DRAFT

Sonic 85'-90': similar to SS-49

Sonic 90'-95': similar to S-50 except increase in the amount of cobbles; 90'-90.5': 4" cobbles

SS-54 no recovery; description is from the sonic sample



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 6 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/NUMBER					6"-6"-6" (N)
100.0	0.40	SS-56	22-50/4 (50/4")		<p>CLAYEY GRAVEL WITH SAND (GC) Grayish brown to gray, moist, very dense, ±15% fines, ±20% fine to coarse sand, fine to coarse subangular to subrounded gravel <1.5" diameter</p> <p>CLAYEY GRAVEL WITH SAND (GC) Similar to above, gray, brown, fine to coarse subangular to subrounded gravel <3.0" diameter</p> <p>CLAYEY GRAVEL WITH SAND (GC) Similar to above, gray, brown, dry to moist, ±20% sand, fine to coarse subangular to subrounded gravel <3.0" diameter, 3-7" cobbles, basalt cobbles, trace reddish brown iron-oxide staining</p>	<p>Stop on 8/18/22 at 4:25 PM; Start on 8/19/22 at 8:40 AM</p> <p>SS-62 low recovery; description is from the sonic sample</p>	
100.0 100.8							
102.0	1.00	GS-57					
	5.00	S-58					
105							
105.0							
106.0							
107.0	1.00	GS-60					
	5.00	S-59					
109.0							
110	1.00	GS-61					
110.0	0.30	SS-62	50/4 (50/4")				
111.0							
112.0	1.00	GS-64					
115							
	10.00	S-63					
118.0							
	1.00	GS-65					
119.0							
120							
120.0							



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 7 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)

ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/NUMBER					
120.0	0.90	SS-66	26-50/1 (50/1")	[Diagonal hatching pattern]	CLAYEY GRAVEL WITH SAND (GC) Similar to above, gray, brown, rare red parts, ±20% fine to coarse sand, ±15% fines, fine to coarse subangular to subrounded gravel <3.0" diameter, trace reddish brown iron-oxide staining	Sonic 120'-130': similar to SS-66; the sand/clayey sand is cemented, disintegrated with putty knife	
120.0							
120.9							
122.0	1.00	GS-68					
123.0							
125	10.00	S-67					
128.0							
129.0							
128.0	1.00	GS-68					
129.0							
130	1.00	GS-71	Low recovery, broken gravel pieces in shoe	[Diagonal hatching pattern]		Sonic 130'-140': similar to S-67 except ~25% fines	
130.0							
130.0							
131.0							
131.0	0.10	SS-69					
131.5							
135	10.00	S-70					
138.0							
139.0							
138.0	1.00	GS-72					
139.0							
140	140.0						



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 8 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotosonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)			PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/NUMBER	6"-6"-6" (N)				
140.0 140.0	0.10	SS-73	50/3 (50/3")			<p>Stop at 140' bgs on 8/19/22 at 4:05 PM Start on 8/22/22 at 9:55 AM</p> <p>Sonic 150'-160': core bit stuck at 150' bgs. Driller noted that borehole is advanced with water - this will wash away the fines and sand around the basalt pieces</p>	
142.0							
143.0	1.00	GS-75					
145	10.00	S-74					
148.0							
149.0	1.00	GS-76					
150							
150.0 150.0	0.10	SS-77	50/2 (50/2")				
153.0							
154.0	1.00	GS-79					
155	10.00	S-78					
160	160.0				BASALT		



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-08	SHEET 9 OF 9
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664596.96 N, 7740458.17 E)
 ELEVATION : 631.89 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : GeoProbe 8150LS, Rotasonic, SV5 Sonic Head, Track #13, 4" I.D. core barrel, 6" casing, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/17/22 09:10 END : 8/23/22 10:00 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/ NUMBER					6"-6"-6" (N)
160.0							
165	10.00	S-80					
170	170.0						
175							
180							

DRAFT



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-09	SHEET 1 OF 3
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664782.30 N, 7740890.30 E)

ELEVATION : 454.59 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/16/22 09:33 END : 8/16/22 11:48 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/ NUMBER				
2.5					6 in: GRAVEL PAVEMENT AND GRAVEL BASE	Start advancing borehole with 4-7/8" tricone bit
4.0	1.00	SS-1	2-2-2 (4)		LEAN CLAY (CL) Brown, moist, soft, low to medium plasticity, ±5-10% fine to coarse sand, trace fine to coarse subangular gravel < 1.5" diameter	PP = 0, 0, 0.5 tsf
5.0	2.00	ST-2				ST-2: 4'-5': 300 psi 5'-6': 350 psi
6.0					LEAN CLAY (CL) Similar to above, firm, no gravel, trace fine to coarse sand	PP = 1.75, 0.75, 0.75 tsf
7.5	1.30	SS-3	2-3-4 (7)			
9.0	0.30	SS-4	3-3-5 (8)			
10.0	2.00	ST-5				ST-5: 4'-5': 400 psi 5'-6': 550 psi
11.0					ELASTIC SILT (MH) Brown with red mottling, moist, stiff, medium to high plasticity, trace fine to coarse sand, trace organics consists of fine roots, trace subangular to subrounded gravel, trace black Mn nodules	PP = 3, 0.75, 1.25 tsf
12.5	1.50	SS-6	3-5-6 (11)			
15.0					FAT CLAY (CH) TO ELASTIC SILT (MH) Brown with red mottling, moist, firm, medium to high plasticity, ±5% fine to coarse sand, ±5% subangular to subrounded gravel < 0.5" diameter, black Mn nodules, trace iron-oxide staining	PP = 0.25, 0.5, 0.75 tsf
16.5	1.50	SS-7	2-3-4 (7)			
18.0						
19.9	0.90	ST-8				ST-8: 18'-19': 300 psi 19'-19' 11": 800 psi



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-09	SHEET 2 OF 3
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664782.30 N, 7740890.30 E)
 ELEVATION : 454.59 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.
 DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer
 WATER DEPTH : Not recorded START : 8/16/22 09:33 END : 8/16/22 11:48 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS	
	RECOVERY (ft)	TYPE/ NUMBER					6"-6"-6" (N)
20.0	1.50	SS-9	6-6-5 (11)		FAT CLAY (CH) TO ELASTIC SILT (MH) Similar to above, stiff, ±5-10% fine to sand	PP = 1.75, 2, 0.5 tsf	
21.5							
25.0	1.50	SS-10	1-1-2 (3)		ELASTIC SILT (MH) TO FAT CLAY (CH) Gray, moist, soft, medium to high plasticity, trace fine sand, trace subangular to subrounded gravel, trace iron-oxide staining	PR = 0, 0, 0.25 ST-11: 26.5'-28.5": 300 psi	
26.5							
28.5	2.00	ST-11					
30.0	1.50	SS-12	2-5-4 (9)		ELASTIC SILT (MH) Gray with rare pink spots, green spots, moist, stiff, medium to high plasticity, ±5-10% fine to coarse sand, ±5% fine subangular to subrounded gravel <1.0" diameter, trace black Mn nodules, trace reddish brown iron-oxide staining	PP = 0.5, 2.5, 3.5	
31.5							
35.0	1.50	SS-13	1-1-5 (6)		ELASTIC SILT (MH) Gray, moist, firm, medium to high plasticity, trace fine to coarse sand	PP = 0, 0.5, 0 tsf	
36.5							
40.0							



PROJECT NUMBER: D3460500	BORING NUMBER: CBRF-B-09	SHEET 3 OF 3
SOIL BORING LOG		

PROJECT : Bull Run Filtration Pipelines Project - Finished Water Pipeline LOCATION : Gresham, OR (664782.30 N, 7740890.30 E)

ELEVATION : 454.59 ft DRILLING CONTRACTOR : Western States Soil Conservation Inc.

DRILLING METHOD AND EQUIPMENT : CME-550 Track #3, Mud Rotary, 4-7/8" Drag Bit, 4-7/8" Tricone Bit, 2" O.D. Split-Barrel Sampler, 140-lb Auto Trip Hammer

WATER DEPTH : Not recorded START : 8/16/22 09:33 END : 8/16/22 11:48 LOGGER : L. Bhaumik

DEPTH BELOW GROUND SURFACE (ft)	INTERVAL (ft)		PENETRATION TEST RESULTS	6"-6"-6" (N)	GRAPHIC LOG	SOIL DESCRIPTION	COMMENTS
	RECOVERY (ft)	TYPE/NUMBER					
40.0	1.50	SS-14	6-9-17 (26)		ELASTIC SILT (MH) Gray with rare red, green and yellow spots, moist, very stiff, low to medium plasticity, trace fine sand, trace subangular to subrounded gravel <1.0" diameter, trace iron-oxide staining	PP = 1.75, 3, 3.5 tsf Backfill with bentonite chips from 0-41.5 feet	
41.5							
45							
50							
55							
60							

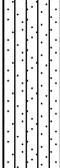
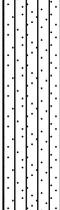
DRAFT

Location: Lusted Hill Facility	Drill Rig: CME 55 Rig	BH-3 SOIL LOG Sheet No. 1 of 3
Northing: 7740328.3 / Easting: 664490.2	Drilling Co.: Western States	
Surface Elevation: 675.00 feet	Logged By: A Herperger, EIT	
Bottom Elevation: 633.50 feet	Prepared By: A Herperger, EIT	
Date Start: 12/12/18 End: 12/12/18	Checked By: J Worthen, PE	
Surface Water: NA	Drilling Type: Mud Rotary	Total Depth: 41.5 feet
		Hole Size: 4 7/8" / 3 7/8" Inclination: 90

Elevation, ft MSL	Depth, ft	Description	USCS	Graphic Log	Method	Sample Number	Blow Counts Per 6 in.	N value	Comments
674	1	Lean CLAY (CL); reddish brown, moist, medium plasticity, stiff, no dilatancy, 100% fines, trace black medium sands.	CL		SPT	1	5	18	Pocket penetrometer = 4-4.5 TSF inside wall of SPT
673	2						7		
672	3						11		
671	4	Lean CLAY (CL); mottled reddish brown and light gray, moist, medium plasticity, stiff, no dilatancy, trace black medium sands.			SPT	2	3	15	
670	5						6		
669	6						9		
668	7	Fat CLAY (CH); beige brown, moist, medium to high plasticity, stiff, no dilatancy.			SPT	3	5	15	
667	8						6		
666	9						9		
665	10	Fat CLAY (CH); reddish brown mottled with gray and blotches of black, moist, medium to high plasticity, stiff, no dilatancy, trace medium sands.			CH		SPT	4	
664	11		5						
663	12		8						
662	13	Shelby tube #1 pushed from 13' - 14.5' 450 psi from 0"-6" 650 psi from 6"-12" 800 psi from 12"-18" Lab: +#4=0% -#200=88%	SH	1					
661	14								
660	15	Fat CLAY (CH); reddish brown mottled with gray and blotches of black, moist, medium to high plasticity, stiff, no dilatancy, trace medium sands.	SPT	5	5	19			
659	16				8				
658	17				11				
657	18								
656	19								

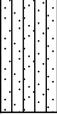


Location: Lusted Hill Facility	Drill Rig: CME 55 Rig	BH-3 SOIL LOG Sheet No. 2 of 3
Northing: 7740328.3 / Easting: 664490.2	Drilling Co.: Western States	
Surface Elevation: 675.00 feet	Logged By: A Herperger, EIT	
Bottom Elevation: 633.50 feet	Prepared By: A Herperger, EIT	
Date Start: 12/12/18 End: 12/12/18	Checked By: J Worthen, PE	
Surface Water: NA	Drilling Type: Mud Rotary	Total Depth: 41.5 feet
		Hole Size: 4 7/8" / 3 7/8" Inclinaton: 90

Elevation, ft MSL	Depth, ft	Description	USCS	Graphic Log	Method	Sample Number	Blow Counts Per 6 in.	N value	Comments
654	21	Fat CLAY (CH); mottled reddish brown with gray, moist, medium plasticity, stiff, no dilatancy.	CH		SPT	6	3	14	Lab: LL=61 PI=35 wc%=33%
	5								
	9								
653	22								
652	23								
651	24								
650	25	Sandy Lean CLAY (CL); mottled dark brown, orange, gray, and black, moist, low plasticity, ~40% sands, ~60% fines, increasing sand content, trace gravels up to 1" diameter. A 1/8" seam of light gray clay at 25'-4".	CL		SPT	7	1	6	Drill rig making more noise
649	26						2		
							4		
648	27								
647	28								
646	29								
645	30	Sandy Lean CLAY (CL); beige, wet, low plasticity, soft-medium stiff, ~10% gravels, ~30% sands, ~60% fines.	CL		SPT	8	1	17	Gravels stuck in shoe of SPT
644	31						5		
							12		
643	32	Changes to soft, rapid dilatancy, loose.							
642	33								
641	34								
640	35	Silty SAND (SM); dark greyish brown, wet, dense, ~10% gravels, ~60% fine to medium sands, ~30% fines, angular gravels up to 1" diameter stuck in shoe of SPT.	SM		SPT	9	22	73	
639	36						51		
638	37								
637	38								
636	39								



Location: Lusted Hill Facility	Drill Rig: CME 55 Rig	BH-3 SOIL LOG Sheet No. 3 of 3
Northing: 7740328.3 / Easting: 664490.2	Drilling Co.: Western States	
Surface Elevation: 675.00 feet	Logged By: A Herperger, EIT	
Bottom Elevation: 633.50 feet	Prepared By: A Herperger, EIT	
Date Start: 12/12/18 End: 12/12/18	Checked By: J Worthen, PE	
Surface Water: NA	Drilling Type: Mud Rotary	Total Depth: 41.5 feet
		Hole Size: 4 7/8" / 3 7/8" Inclination: 90

Elevation, ft MSL	Depth, ft	Description	USCS	Graphic Log	Method	Sample Number	Blow Counts Per 6 in.	N value	Comments
634	41	Silty SAND (SM); dark blueish gray, mottled with some rusty brown, wet, very dense.	SM		SPT	10	17 30 51	81	From 12"-18" of SPT-10: 51 blows/2"
633	42	BOTTOM OF HOLE AT 41.5FT							
632	43								
631	44								
630	45								
629	46								
628	47								
627	48								
626	49								
625	50								
624	51								
623	52								
622	53								
621	54								
620	55								
619	56								
618	57								
617	58								
616	59								



Appendix B: Boring Logs, RWP Alignment

MOISTURE CONTENT

DESCRIPTION	CONDITION
Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp, but no visible water.
Wet	Visible free water, typically below water table.

ABBREVIATIONS

SYMBOL	DEFINITION
H	Atterberg Limits
○	Moisture Content
□	Blows per foot (N)

FINE-GRAINED SOIL CONSISTENCY

RELATIVE CONSISTENCY	N, SPT <i>Blows/foot</i>
Very Soft	0 to 1
Soft	2 to 4
Medium stiff	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	> 30

COARSE-GRAINED SOIL DENSITY

Relative Density	N, SPT <i>Blows/foot</i>
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	> 50

PERCENTAGE RANGE TERMS^{1,2}

DESCRIPTION	RANGE
Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

1. Gravel, Sand and fines are estimated by mass. Other constituents such as organics, cobbles, and boulders are estimated by volume.
2. Percentages per ASTM D2488.

SOIL CONSTITUENCY DEFINITIONS

CONSTITUENT	COARSE-GRAINED	FINE-GRAINED
Major	Less than 50% fines: SAND or GRAVEL	More than 50% fines: SILT, ELASTIC SILT, LEAN CLAY, FAT CLAY, ORGANIC SOIL
Secondary	12% ¹ or more fine-grained: Silty or Clayey	30% or more coarse-grained: Sandy or Gravelly
Minor	5 to 12% ¹ fine-grained: with Silt or with Clay	15 to 30% coarse-grained: with Sand or with Gravel
	15% or more of a second coarse-grained constituent: with Sand or with Gravel	30% or more total coarse-grained and the lesser coarse constituent is 15% or more: with Sand or with Gravel

1. ASTM D2488 specifies more than 15% fines

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE SIZE <i>PER ASTM D2488</i>	
FINES		
	< #200 (0.075 mm)	
SAND	<i>Fine</i>	#200 to #40 (0.075 to 0.4 mm)
	<i>Medium</i>	#40 to #10 (0.4 to 2 mm)
	<i>Coarse</i>	#10 to #4 (0.4 to 4.75 mm)
GRAVEL	<i>Fine</i>	#4 to ¾ in. (4.75 to 19 mm)
	<i>Medium</i>	¾ to 3 in. (19 to 76 mm)
COBBLES		
	3 to 12 in. (76 to 305 mm)	
BOULDERS		
	> 12 in. (305 mm)	

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)¹

MAJOR DIVISIONS		SYMBOL	TYPICAL DESCRIPTION	ALTERNATE DESCRIPTIONS		
COARSE-GRAINED SOILS (50% OR MORE RETAINED BY NO. 200 SIEVE)	GRAVELS (MORE THAN 50% RETAINED ON NO. 4 SIEVE)	CLEAN GRAVELS (≤ 5% FINES)	GW 	WELL-GRADED GRAVEL	WELL-GRADED GRAVEL WITH SAND	
			GP 	POORLY GRADED GRAVEL	POORLY GRADED GRAVEL WITH SAND	
		GRAVELS^{2,4} (5 – 12 % FINES)	GW-GM 	WELL-GRADED GRAVEL WITH SILT	WELL-GRADED GRAVEL WITH SILT AND SAND	
			GW-GC 	WELL-GRADED GRAVEL WITH CLAY	WELL-GRADED GRAVEL WITH CLAY AND SAND	
			GP-GM 	POORLY GRADED GRAVEL WITH SILT	POORLY GRADED GRAVEL WITH SILT AND SAND	
			GP-GC 	POORLY GRADED GRAVEL WITH CLAY	POORLY GRADED GRAVEL WITH CLAY AND SAND	
	GRAVELS WITH FINES² (≥ 12% FINES)	GM 	SILTY GRAVEL	SILTY GRAVEL WITH SAND		
		GC 	CLAYEY GRAVEL	CLAYEY GRAVEL WITH SAND		
	SANDS (LESS THAN 50% RETAINED ON NO. 4 SIEVE)	CLEAN SANDS (≤ 5% FINES)	SW 	WELL-GRADED SAND	WELL-GRADED SAND WITH GRAVEL	
			SP 	POORLY GRADED SAND	POORLY GRADED SAND WITH GRAVEL	
		SANDS^{2,4} (5 – 12 % FINES)	SW-SM 	WELL-GRADED SAND WITH SILT	WELL-GRADED SAND WITH SILT AND GRAVEL	
			SW-SC 	WELL-GRADED SAND WITH CLAY	WELL-GRADED SAND WITH CLAY AND GRAVEL	
			SP-SM 	POORLY GRADED SAND WITH SILT	POORLY GRADED SAND WITH SILT AND GRAVEL	
			SP-SC 	POORLY GRADED SAND WITH CLAY	POORLY GRADED SAND WITH CLAY AND GRAVEL	
		SANDS WITH FINES³ (> 12% FINES)	SM 	SILTY SAND	SILTY SAND WITH GRAVEL	
			SC 	CLAYEY SAND	CLAYEY SAND WITH GRAVEL	
FINE-GRAINED SOILS (50% OR MORE PASSES NO. 200 SIEVE)		SILTS AND CLAYS (LL < 50)	INORGANIC	ML 	SILT	SILT WITH SAND OR GRAVEL; SANDY OR GRAVELLY SILT
				CL 	LEAN CLAY	LEAN CLAY WITH SAND OR GRAVEL; SANDY OR GRAVELLY LEAN CLAY
		ORGANIC	OL 	ORGANIC SOIL	ORGANIC SOIL WITH SAND OR GRAVEL; SANDY OR GRAVELLY ORGANIC SOIL	
	SILTS AND CLAYS (LL ≥ 50)	INORGANIC	MH 	ELASTIC SILT	ELASTIC SILT WITH SAND OR GRAVEL; SANDY OR GRAVELLY ELASTIC SILT	
			CH 	FAT CLAY	FAT CLAY WITH SAND OR GRAVEL; SANDY OR GRAVELLY FAT CLAY	
		ORGANIC	OH 	ORGANIC SOIL	ORGANIC SOIL WITH SAND OR GRAVEL; SANDY OR GRAVELLY ORGANIC SOIL	
	SILT/CLAY²	INORGANIC	CL-ML 	SILTY CLAY	SILTY CLAY WITH SAND OR GRAVEL; SANDY OR GRAVELLY SILTY CLAY	
HIGHLY ORGANIC SOILS	ORGANIC	PT 	PEAT			

NOTES:

1. The USCS described here is based on ASTM standards D2487 & D2488.
2. Dual symbol materials (e.g., SP-SM) are used for soils between 5% and 12% fines or when liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart, (LL: 12 -25, PI: 4-7).
3. ASTM D2488 specifies the use of dual symbol coarse-grained soils between 5% and 15% fines.

BACKFILL, WELL, AND SAMPLE SYMBOLS					
	Bentonite Chips		Grout		2" OD Split Barrel Sampler
	Concrete		Observation Well - Solid		Shelby Tube Sample
	Sand		Observation Well – Screen		Grab Sample
	Asphalt		Vibrating Wire Piezometer		Rock Core Run
	Gravel		Measured Groundwater Level		

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH04

Date(s) Drilled	03/23/2021 - 03/24/2021	Client	Jacobs Engineering Group	Final Depth	70.0 ft bgs
Coordinates	7744469.2 E, 659550.4 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	524.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 21+92	Logged by/Checked by	A. Judy / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
520		5		100	3-3-4 (N=7)	SC-01				ML	Moist, dark brown, SILT (ML); low plasticity. Topsoil		
						Grab 1					Medium stiff, moist, red-brown, Elastic SILT (MH); high plasticity, occasional orange mottles, trace fine subrounded to rounded gravel, medium plasticity. Gresham Formation		
						S-01				MH			
						SC-02							
515		10		100	1-3-3 (N=6)	S-02							
						SC-03					Medium stiff, moist, orange-brown with red-brown mottles, Fat CLAY (CH); high plasticity, trace fine sand.		
510		15		100	2-3-4 (N=7)	S-03							
						Grab 2				CH			
						SC-04							
505		20		100	1-1-2 (N=3)	S-04					Very loose to loose, moist, red-brown Silty GRAVEL with Sand (GM); fine to coarse rounded to subangular gravel, fine to coarse sand, moderately to highly weathered gravel, high plasticity fines. <i>Becomes wet at 18 feet.</i>	Grab 3: 46.5% Fines.	
						SC-05							
500		25		100	1-2-3 (N=5)	Grab 4						Grab 4: 28.4% Fines.	
						S-05							
						SC-06							
495										SC	Loose, to very dense, wet, brown, Clayey SAND; fine to coarse sand, 13% fine rounded gravel, high plasticity fines.	Water level at 26.5 feet bgs on 1/8/2022. Water level at 27.5 feet bgs on 10/24/2021.	



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring

LRWP-BH04

Date(s) Drilled	03/23/2021 - 03/24/2021	Client	Jacobs Engineering Group	Final Depth	70.0 ft bgs
Coordinates	7744469.2 E, 659550.4 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	524.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 21+92	Logged by/Checked by	A. Judy / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
490		35		100	18-31-35 (N=66)	S-06 Grab 5 SC-07				SC	Loose, to very dense, wet, brown, Clayey SAND; fine to coarse sand, 13% fine rounded gravel, high plasticity fines.	Grab 5: 13.0% Gravel, 48.9% Sand, 38.1% Fines.	
485		40		32	50/0" (Refusal)	S-07 SC-08 Grab 6 S-08				GC	Very dense, moist, brown, gray and red, Clayey GRAVEL with Cobbles and Boulders (GC); fine to coarse, subrounded to subangular, moderately to highly weathered gravel, some fine to coarse sand, low plasticity fines. <i>Color becomes brown and gray at 35 feet.</i>	Driller noted material becomes much harder at 31 feet. Driller noted 1-2 foot diameter boulders below 33 feet. Grab 6: 46.8% Gravel, 30.7% Sand, 22.5% Fines.	
480		45		100	7-50/5" (Refusal)	S-09 Grab 7 SC-10				GC	Very dense, moist, dark brown Clayey GRAVEL with Sand (GC); fine to coarse subangular to rounded gravel, occasional cobbles, high plasticity fines.	Driller noted cored rock/boulder at 40 feet. Grab 7: 54.2% Gravel, 31.3% Sand, 14.5% Fines.	
475		50		100	50/6" (Refusal)	S-10 SC-11				GC	<i>Encountered hard, fresh to moderately weathered cobbles from 51.5 to 54 feet.</i>		
470		55		84	50/6" (Refusal)	S-11 Grab 8 SC-12				GC		Grab 8: 54.4% Gravel, 24.4% Sand, 21.2% Fines.	
465													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH04

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH04

Date(s) Drilled	03/23/2021 - 03/24/2021	Client	Jacobs Engineering Group	Final Depth	70.0 ft bgs
Coordinates	7744469.2 E, 659550.4 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	524.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 21+92	Logged by/Checked by	A. Judy / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
460		65		75	14-50/6" (Refusal)	S-12				GC	Very dense, moist, dark brown Clayey GRAVEL with Sand (GC); fine to coarse subangular to rounded gravel, occasional cobbles, high plasticity fines.		
				100	50/6" (Refusal)	S-13				SC	Very dense, moist, dark brown with multicolored clasts, Clayey SAND with Gravel (SC); fine to coarse sand, fine to coarse subrounded gravel., low plasticity fines.		
455		70		100	45-50/2" (Refusal)	S-14							
450		75										Borehole completed at 70 feet below ground surface (bgs).	
445		80											
440		85											
435													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH04

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
610		5				Grab 1				GP	ASPHALT PAVEMENT - 6 inches thick Pavement Section Loose to medium dense, moist, brown, Poorly Graded GRAVEL with Sand (GP); subrounded and subangular fine to coarse gravel, fine to medium sand. Base Aggregate/Fill		
605		10		75		SC-01				CL	Wet, brown, Sandy Lean CLAY with Gravel (CL); low plasticity, fine to coarse subrounded gravel, fine to coarse sand. Residual Soil of the Springwater Formation		
600		15				Grab 2				GP-GC	Moist, brown, Poorly Graded GRAVEL with Sand, Clay, and Cobbles (GP-GC); fine to coarse rounded gravel, fine to coarse sand, low plasticity fines. Less Weathered Springwater Formation	Grab 2: 9.5% Cobbles, 39.1% Gravel, 25.1% Sand, 26.3% Fines.	
595		20				Grab 3				GP-GC	Moist, brown with slight orange mottling, Poorly Graded GRAVEL with Clay, Sand, and Cobbles (GP-GC); fine to coarse sand, fine to coarse subangular to rounded gravel and cobble, low plasticity fines.		
590		25											
585													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
580		35		81		SC-02					Moist, brown with slight orange mottling, Poorly Graded GRAVEL with Clay, Sand, and Cobbles (GP-GC); fine to coarse sand, fine to coarse subangular to rounded gravel and cobble, low plasticity fines.		
575		40				Grab 4	○			GP-GC	Encountered three nested 8-inch cobbles at 40 feet.		
570		45		100		SC-03						Grab 5: 30% Fines.	
565		50				Grab 6	○						
560		55		100		SC-04				CL	Moist, red-brown, Lean CLAY (CL); low plasticity, saprolitic. Residual Soil of Boring Lava		
										CL	Dark brown to slightly red-brown Lean CLAY (CL); low plasticity, scattered, moderately to highly weathered vesicular basalt cobbles.		
555										GC	Light gray-brown, Clayey GRAVEL (GC); fine to coarse gravel, low plasticity fines.		



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH05

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
550		65		100		SC-05				GC	Light gray-brown, Clayey GRAVEL (GC); fine to coarse gravel, low plasticity fines. <i>Encountered 9-inch cobble in brown clay with angular basaltic gravel at 60 feet.</i>		
545		70				Grab 7	○						
540		75		100		SC-06					BASALT; moderately weathered, hard, moderately spaced clay-filled joints. Boring Lava	Unconfined Compressive Strength of sample from 70.1 to 70.8 feet = 13,542 psi.	
535		80									<i>Basalt rock broken in fine to coarse gravel and cobble sizes, angular, vesicular, moderately weathered form 75 to 80 feet.</i>		
530		85		100		SC-07					<i>Moderately to closely spaced clay-filled joints; bright orange oxidized zone at 83 feet. Fragmented, clay-filled zone present between 85 and 86 feet followed by slightly to moderately weathered vesicular basalt.</i>		
525													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
520		95		100		SC-08				USCS	<p>BASALT; moderately weathered, hard, moderately spaced clay-filled joints.</p> <p>Boring Lava</p> <p><i>Slightly to moderately weathered extremely close to closely-spaced joint from 90 to 101 feet.</i></p>		
515		100									<p><i>Becomes dark gray, slight to moderate weathering, closely-spaced clay-filled joints from 100 to 104 feet.</i></p>		
510		105		100		SC-09				GP-GM	<p>Moist, orange-brown, Poorly Graded GRAVEL with Silt, Sand, and Cobbles (GP-GM); fine to medium sand, fine to coarse gravel; subrounded to rounded cobbles, low plasticity fines, weakly cemented.</p> <p>Troutdale Formation</p>	<p>Grab 8: 46.5% Gravel, 30.3% Sand, 23.2% Fines.</p>	
505		110				Grab 8	○						
500		115		100		Grab 9 SC-10	○			SC	<p>Moist, orange-brown, Clayey SAND (SC); fine to medium sand, low plasticity fines, weakly cemented.</p>	<p>Grab 9: 28.5% Fines.</p>	
495													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
						Grab 10				SC	Moist, orange-brown, Clayey SAND (SC); fine to medium sand, low plasticity fines, weakly cemented.		
490		125		100		SC-11				GP-GC	Moist, brown-gray, Poorly Graded GRAVEL with Clay and Cobbles (GP-GC); fine subangular and subrounded gravel, trace fine to coarse sand, low plasticity fines.	Grab 11: 34.1% Fines.	
485		130				Grab 11					Moist, orange-brown grading to gray brown, then back to orange-brown, Clayey SAND (SC); fine to medium sand, low plasticity fines. <i>Encountered some fine rounded gravel and scattered cobbles up to 4-inch particle size below 128 feet.</i>		
						Grab 12							
						Grab 13				SC		Grab 13: 30.8% Fines.	
480		135		100		SC-12							
						Grab 14						Grab 14: 66.1% Sand, 33.9% Fines.	
475		140				Grab 15							
						SC-13				SP	Moist, gray-brown, Poorly Graded SAND (SP); fine to medium sand, low plasticity fines.	Core loss 140 to 145 feet.	
											<i>Becomes orange-brown and becomes weakly cemented with fine to coarse gravel below 147 feet.</i>		
470		145		75									
465													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT				USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20	30	40					
460		155		100		Grab 16	○					Wet, gray, Clayey SAND with Gravel (SC); fine to medium sand, fine subangular and subrounded gravel, low plasticity fines with scattered cobbles. <i>Encountered two 4-inch cobbles at 152 feet.</i> <i>Becomes orange-brown with trace fine to coarse, rounded, weakly cemented gravel. at 153.5 feet.</i>	Grab 16: 16.3% Cobbles/Boulders, 22.8% Gravel, 39.3% Sand, 21.6% Fines.		
455		160				SC-14					SC				
450		165		100		Grab 17	○					Moist, red-brown and gray, Clayey SAND (SC); fine to medium sand,, scattered weakly cemented regions. <i>Becomes red-brown and weakly cemented at 160 feet.</i>	Grab 17: 24.7% Fines.		
445		170				SC-15					SC				
440		175		100		Grab 18	○								
						Grab 19	○					<i>Becomes gray-brown and weakly cemented at 170 feet.</i>	Grab 19: 18.9% Fines.		
						SC-16									
						Grab 20	○								
435															



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH05

Date(s) Drilled	04/13/2021 - 04/15/2021	Client	Jacobs Engineering Group	Final Depth	207.0 ft bgs
Coordinates	7743393.3 E, 659476.3 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	614.4 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 24+80	Logged by/Checked by	K. Elliott, J. Fissel / J. Quinn	Hammer Type	N/A

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
430		185		100		SC-17			[Diagonal Hatching]	SC	Moist, red-brown and gray, Clayey SAND (SC); fine to medium sand,, scattered weakly cemented regions.		
425		190				Grab 21	○		[Diagonal Hatching]	SC	Moist, red-brown and gray, Clayey SAND with Gravel (SC); fine to coarse sand, fine to coarse subrounded gravel, weakly cemented. <i>Encountered 8-inch basalt cobble at 189 feet bgs.</i>	Grab 21: 27.9% Fines.	
420		195				Grab 22	○		[Dotted Pattern]	SP	Moist, red-brown and gray, Poorly Graded SAND with Gravel (SP); medium to coarse sand, coarse subrounded gravel, moderately cemented regions.		
415		200		100		SC-18			[Dotted Pattern]				
410		205											
405												Borehole completed at 207 feet below ground surface (bgs).	



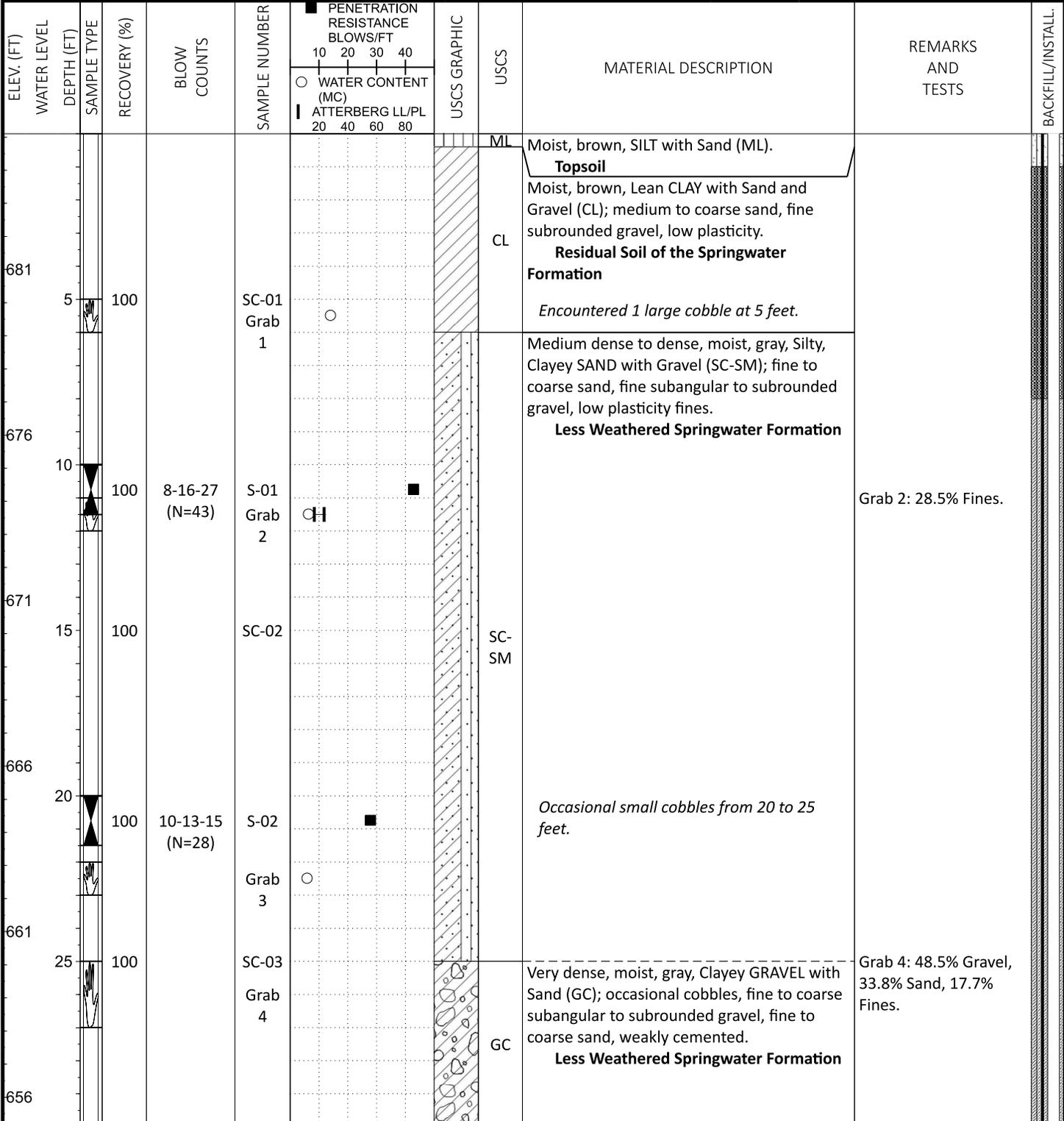
NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH05

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		WATER CONTENT (MC)	ATTERBERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20							
					67	31-50/3" (Refusal)	S-03								
						Grab 5		○							
651		35		100		SC-04									
646		40											Occasional cobbles up to 4-inches from 40 to 50 feet.		
641		45		133		SC-05						GC			
636		50		100		Grab 6		○							
					20-50/3" (Refusal)	SC-06									
						S-04									
						Grab 7								Grab 7: 43.6% Gravel, 40.8% Sand, 15.6% Fines.	
631		55		100		SC-07							5-inch cobble at 55 feet.		
626												GC	Very dense, moist, gray and brown, Clayey GRAVEL with Sand (GC); fine to coarse angular to rounded gravel, medium sand, low plasticity fines. Less Weathered Springwater Formation		



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAV88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH06

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
621		65		100		Grab 8 SC-08				GC	Very dense, moist, gray and brown, Clayey GRAVEL with Sand (GC); fine to coarse angular to rounded gravel, medium sand, low plasticity fines. Less Weathered Springwater Formation <i>Encountered 6-inch cobbles from 61 to 68.5 feet.</i>		
616		70		100	50/3" (Refusal)	S-05				GP-GC	Very dense, moist, gray, Poorly Graded GRAVEL with Clay, Sand, and Cobbles (GP-GC); fine to coarse angular to rounded gravel, fine to coarse sand,. Less Weathered Springwater Formation <i>Encountered 5-inch nested cobbles from 72 to 75 feet.</i>	Grab 9: 34.7% Cobbles, 26.6% Gravel, 27.2% Sand, 11.5% Fines.	
611		75		100		Grab 9 SC-09				GP-GC			
606		80								GC	Very dense, moist, gray, Clayey GRAVEL with Sand (GC); fine to coarse gravel, medium to coarse sand, high plasticity fines. Less Weathered Springwater Formation <i>Encountered 4-inch cobbles in an olive-brown moderately cemented clayey sand matrix from 81 to 88 feet.</i>		
601		85		100		SC-10				GC			
596													



NOTES:
 Location and Elevation Source: 60% Drawings
 Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline
Project Location: Gresham and Boring, OR
Project Number: 6218.0

Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		WATER CONTENT (MC)	ATTERBERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20							
591				100	50/5" (Refusal)	S-06							Very dense, moist, brown and gray, Clayey GRAVEL with Sand and Cobbles (GC); fine to coarse subrounded gravel, fine to coarse sand, high plasticity fines, cobbles up to 5-inch particle size. Less Weathered Springwater Formation	Grab 11: 40.5% Gravel, 27.7% Sand, 31.8% Fines.	
						Grab 10									
		95		100		SC-11									
586						Grab 11									
581						SC-12					GC				
		105		85											
576						S-07						Becomes weakly cemented from 110 to 135 feet.			
		110		100	50/4" (Refusal)										
						SC-13						Occasional cobbles up to 5-inch particle size below 114 feet.			
571															
		115													
566															



NOTES:
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Project Location: Gresham and Boring, OR
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Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
561		125		90		SC-14				GC	Very dense, moist, brown and gray, Clayey GRAVEL with Sand and Cobbles (GC); fine to coarse subrounded gravel, fine to coarse sand, high plasticity fines, cobbles up to 5-inch particle size. Less Weathered Springwater Formation <i>Large nested cobbles from 122 to 128 feet.</i>		
556		130		100	50/4" (Refusal)	Grab 12 S-08				GC		Grab 12: 17.7% Cobbles, 23.8% Gravel, 32.7% Sand, 25.8% Fines.	
551		135		100		SC-15				GM	Very dense, moist, orange-brown grading to brown, Silty GRAVEL (GM); fine to coarse gravel, completely weathered angular vesicular lava. Residual Soil of Boring Lava		
546		140									BASALT: gray, highly weathered, vesicular, closely-spaced joints. Boring Lava		
541		145		100		SC-16							
536													



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Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
				100	50/1" (Refusal)	S-09					BASALT: gray, highly weathered, vesicular, closely-spaced joints. Boring Lava		
531		155		100		SC-17						Unconfined Compressive Strength on sample from 154 to 155 feet = 7,579 psi.	
526		160											
521		165		100		SC-18							
516		170								GC	Very dense, moist, gray and brown, Clayey GRAVEL with Sand (GC); fine to coarse gravel, high plasticity fines, gravel consists of highly weathered vesicular basalt. Weathered Boring Lava		
511		175		100		Grab 13 SC-19				GM	Very dense, moist, gray, brown and yellow-brown, Silty GRAVEL with Sand (GM); coarse subrounded gravel, medium to coarse sand, low plasticity fines, gray vesicular basalt cobbles up to 5-inches in particle size. Troutdale Formation	Grab 13: 14.1% Cobbles, 37.9% Gravel, 23.1% Sand, 24.9% Fines.	
506													



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Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
501				100	50/1" (Refusal)	S-10				GM	Very dense, moist, gray, Silty GRAVEL (GM); some medium sand, high plasticity fines, cobbles of vesicular lava up to 4-inches.	Grab 14: 28.6% Fines. Liquid Limit = 113.	
					Grab 14						Troutdale Formation		
185				100		SC-20				SM	Very dense, moist, light brown and gray, Silty SAND (SM); fine to medium sand., weakly cemented, high plasticity fines, trace subangular gravel.	Grab 15: 19.2% Fines.	
					Grab 15						Troutdale Formation		
496				100	50/6" (Refusal)	S-11				SM	Very dense, moist, gray, Silty SAND with Gravel (SM); fine to coarse sand, fine to coarse subrounded gravel, high plasticity fines, weakly cemented regions.	Grab 16: 33.4% Gravel, 36.8% Sand, 30.1% Fines.	
					Grab 16						Troutdale Formation		
491				90		SC-21					Very dense, moist, red-brown and gray, Silty SAND (SM); trace fine and coarse subrounded gravel, fine to medium sand, high plasticity fines, weakly cemented.	Grab 17: 32.5% Fines.	
					Grab 17						Troutdale Formation		
486				100	16-30-50/6" (Refusal)	S-12				SM	Encountered a 4-inch cobble at 202 feet.		
481				95		SC-22					Large cobble at 207 feet.		
476													



NOTES:
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Log of Boring
LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
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Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		WATER CONTENT (MC)	ATTERBERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20							
471				100	50/5" (Refusal)	S-13							Very dense, moist, red-brown and gray, Silty SAND (SM); trace fine and coarse subrounded gravel, fine to medium sand, high plasticity fines, weakly cemented. Troutdale Formation		
215															
466				65		SC-23						Large cobble or boulder at 220 feet.			
220															
461												SM			
225															
456						Grab 18								Grab 18: 1% Gravel, 70.2% Sand, 28.7% Fines.	
230				100	15-29-50/5" (Refusal)	S-14									
451															
235															
446				75		SC-24									



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Log of Boring

LRWP-BH06

Date(s) Drilled	03/31/2021 - 04/12/2021	Client	Jacobs Engineering Group	Final Depth	250.4 ft bgs
Coordinates	7743845.7 E, 659520.6 N	Geotechnical Consultant	McMillen Jacobs Associates	Method/Rig Type	Sonic Drilling/Track Mounted Geoprobe 8150 LS
Surface Elevation	685.1 ft.	Drilling Contractor	Western States Soil Conservation, Inc.	Hole Diameter	5.00 in
Location	LRWP North Station 27+59	Logged by/Checked by	J. Fissel / K. Elliott	Hammer Type	140 lb / 30 in / Automatic

ELEV. (FT)	WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	PENETRATION RESISTANCE BLOWS/FT		USCS GRAPHIC	USCS	MATERIAL DESCRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
							10	20					
441		245				SC-25				SM	Very dense, moist, red-brown and gray, Silty SAND (SM); trace fine and coarse subrounded gravel, fine to medium sand, high plasticity fines, weakly cemented. Troutdale Formation <i>Encountered >7-inch cobbles from 240 to 245 feet.</i>		
436		250		100	50/5"	S-15							
431		255			(Refusal)							Borehole completed at 250.42 feet below ground surface (bgs).	
426		260											
421		265											
416													



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Boring LRWP-BH06