THE GALLI GROUP
Engineering Consulting

GEOTECHNICAL INVESTIGATION AND DEWATERING STUDY WEBSTER PUMP STATION GRANTS PASS, OREGON

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02-5115-01
October 14, 2015

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GEOTECHNICAL INVESTIGATION AND DEWATERING WEBSTER PUMP STATION GRANTS PASS, OREGON

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1.0 INTRODUCTION

In accordance with your authorization, we have completed the subsurface investigation and pump testing for the Webster Pump Station in the Reinhart Sports Park, Grants Pass, Oregon. This report provides a description of our field and office studies and provides 1) geotechnical recommendations for shoring design and pump station construction and 2) groundwater evaluation with general recommendations regarding dewatering for the project.

2.0 SITE AND PROJECT DESCRIPTION

2.1 SITE DESCRIPTION

The subject site is a moderately narrow, grass-covered roadside area within this sports park. It is surrounded by Webster Avenue on the south, AC parking on the east and west and concrete walkways on the north. It is approximately 40 feet X 50 feet in size. The site is level and mostly grass covered with several large trees on the east side.

This general area is typically underlain by silty Sand with gravels and cobbles at 10 feet. Then denser gravels and cobbles are usually encountered. Water is usually at a depth of about 8 feet.

2.2 PROJECT DESCRIPTION

The subject project consists of constructing/installing a new pump station to a depth of approximately 20 feet below ground surface. This pump station will be an approximate 8 foot diameter, pre cast unit that is placed in the prepared excavation and connected to the required piping. Due to the tight confines of the site and possible high groundwater level, it is likely shoring will be required to construct the pump station.

3.0 SITE INVESTIGATION

On September 21, 2015 we accomplished two borings utilizing a hollow-stem auger drill rig provided by Subsurface Exploration of Banks, Oregon. The first boring was to a depth of 31 ½ feet and near the center of the site. This boring had a 3-inch diameter casing installed in the 7-inch diameter hole. The second boring was approximately 9 feet away and was drilled to verify the consistency of the upper 10 feet of soil (due to the possibility B-1 was within a gravel and cobble backfill zone). B-2 was backfilled with hole plug. On September 25, 2015, a third boring was drilled approximately 9 feet away from B-1 to help with the pump test. This boring also had a 3-inch diameter slotted casing to a depth of 28 feet. The bottom 2 feet were filled with small gravels to help hold the casing in place as the auger was withdrawn.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL

The three borings encountered very similar soils conditions. The surface layer was 2 to 2 ½ feet of silty Sand. This was underlain by approximately 5 feet of gravelly Sand. Beneath this all borings encountered dense to very dense, sandy Gravels with Cobbles. These were silty between 10 and 21 feet and very silty below that.

Please see Appendix A for the formal Boring Logs.

4.2 WATER

All three borings encountered water at a depth of approximately 7 ½ feet. We have found this area to have water levels between 8 and 9 feet on several projects throughout the year.

It is likely this water level could rise a foot or more during the wet winter months. We also feel this site will be influenced by the moderate sized lake/pond located across Webster to the southwest. We measured the water surface in the pond to be about 6½ feet below the ground surface at the pump station site.

5.0 GEOTECHNICAL RECOMMENDATIONS

The challenge for this site will be excavating 12 to 13 feet or more below the groundwater level in these granular soils. Dewatering to below the depth of excavation will be critical to maintaining a stable subgrade for the structure. Uplift resistance will then be very important for long term stability after dewatering pumps are removed.

5.1 FOOTING SUPPORT

Footings or base of the unit will be at a depth of approximately 20 feet. This will be within the dense, silty, sandy Gravels and Cobbles unit. Support to be as follows:

1. Excavate "in the dry" to the required depth and overexcavate 6 inches below final subgrade elevation. The area should be dewatered to <u>at least</u> 3 or 4 feet below the

level of excavation at any given time during the excavation process. **Note:** These soils will likely excavate with a rough raveled gravelly bottom.

2. Place 6 inches of 4-inch minus crushed rock on the base and compact until the base is dense and unyielding. Alternate would be to pour a "rat" slab of 4 inches of 3 sack concrete over a redensified subgrade. This will help achieve uniform support on the bottom.
3. Allowable Bearing Pressure will be 3,500 pounds per square foot.

5.2 UPLIFT RESISTANCE

The pump station will be embedded approximately 13 feet below the groundwater table (perhaps 15 feet during winter months). Therefore, uplift will be a concern. Resistance to uplift may be computed utilizing the following:

1. Weight of the Pump Station.
2. Weight of soil vertically above outside lip around base of unit. Soil unit weight will be 130 pounds per cubic foot above the water table. Soil unit weight will be 68 pounds per cubic foot for soil below the water table.
3. Frictional resistance along a shear plane vertically above the outside edge of the bottom lip may also be used. Use frictional coefficient of 0.40 along the shear zone. Must be multiplied by normal force at each depth, reduced by buoyancy of water below water level. We computed the following frictional resistance along the vertical plane.

0 to 6 feet	40 psf (average)
6 to 12 feet	120 psf (average)
12 to 20 feet	160 psf (average)

4. Hold down force of any form of anchor or concrete deadman placed adjacent to or above and attached to the pump station unit may also be used.

We recommend a minimum factor of safety of at least 1.5 be used when designing for uplift.

5.3 EXCAVATIONS

The pump station will likely require an excavation that is 20+ feet deep and at least 20 to 25 feet in diameter. Open excavations in the silty, sandy gravels with cobbles encountered will not stand at steep inclinations, especially below the water table. The upper 6 feet, when above the water table, will be reasonably stable at 1 1/4H to 1 1/2H:1V. Below the water table the gravels will likely have to be excavated as flat as 2H:1V when seepage is not emerging from the face. Excavations with pumping from open sumps with water flow coming through the excavation slopes are likely to collapse and are not recommended.

A totally dry excavation may be reasonably stable at 1 1/2H:1V slopes. However, with a bottom width of 15 feet, a 20 foot deep excavation would still have a top width of 75 feet. The dewatering (discussed later in this report) must keep the localized water levels at least 3 to 4 feet below the level of deepest excavation at all times and at 15 feet beyond the shored slopes. If this is not accomplished, severe disturbance of the subgrade and possible slope failure is likely.

5.4 SHORING DESIGN PARAMETERS

Shoring will be required to excavate for this pump station unless a wide excavation can be tolerated. Soil pressures to use in design for areas above the water table would be:

Active Equivalent Fluid Pressure	40 pcf
At-Rest Equivalent Fluid Pressure	65 pcf
Passive Equivalent Fluid Pressure	350 pcf

C = O; Ø = 30°; Unit Wt. = 130 pcf

If the area is dewatered to below the bottom of the excavation the values above can be used full depth down to the base of the excavation if the cone of depression for dewatering extends back far enough to encompass the entire active soil wedge plus 5 feet laterally. Below the base of the excavation or for all shoring that is not dewatered, use the following values:

Buoyant Active E.F.P. + Water	85 pcf
Buoyant At-Rest E.F.P. + Water	95 pcf
Buoyant Passive E.F.P. + Water	200 pcf

Arching factor for kickout resistance of individual embedded piles or piers driven into the dense gravels would be 1.5.

All shoring must be designed for a factor of safety of at least 2.0.

Note: If full dewatering of the site is not achieved, the excavation bottom will become unstable below the achieved localized water table. This can present a significant risk to any workmen that enter the excavation as blow out of the bottom is possible. Such excavation below the partially depressed water table is not recommended.

5.5 DEWATERING

5.5.1 General

During drilling the water table was found to be at approximately 7 feet below the ground surface. This was measured to be approximately 1 foot below the water surface in the pond located to the southwest of the pump station site. The subject sands and gravels many times are assumed to have a reasonably high hydraulic conductivity. However, the amount of fine sand and silt can and usually does reduce this value. Clean gravel zones also are usually discontinuous lenses rather than continuous layers.

5.5.2 Pump Test

We conducted pump tests at the site utilizing the 3 inch diameter slotted casing installed into the 7 inch diameter auger holes. The holes into these gravel soils were allowed to collapse and settle in around the casing (likely loosened silty, sandy Gravel in annulus). As discussed earlier, three holes were drilled, with two having the casing installed. The casing was slotted with wide slots for a 10 foot length in one hole and for a 20 foot length in the other.

The first casing was slotted between 10 feet and 20 feet where the gravels were found to have less silt. However, when the casing was installed it pulled up about 5 feet as the auger was withdrawn around it. Therefore, the slotted section actually ended up at between 5 and 15 feet below the ground surface. The second casing was slotted from 10 feet to 30 feet. It pulled out 2 feet when the auger was withdrawn. Therefore, the slots ended up between 8 feet and 28 feet below the ground surface.

Pumping was accomplished utilizing a Honda high pressure pump with a 130 gallon per minute (gpm) capacity. The slotted intake pipe was rated at between 90 and 110 gpm.

Before the pump tests were run each hole was surcharged with abundant water to help clean out silt that had accumulated in the slotted casing. After numerous times of surcharging with water and pumping out extremely silty (fine sand also) water, the slotted casings were found to have several feet of fine to medium sand with some fine gravel in the bottom.

Several pump tests were run with the suction point just slightly above 20 feet. The maximum flow rate achieved was 7 gpm. The adjacent well was used to monitor the water levels during the test. The maximum drawdown achieved in this adjacent well was approximately 1 foot. After attempting to gain more drawdown for two hours we opened up the end of the suction pipe in an attempt to clean out the sand in the bottom of the casing. This resulted in a short period of heavy pumping with abundant silt and sand in the water flow (in surges) until fine gravels were sucked up, which caused the pump to seize up. We were unable to restart the pump after that.

6.0 CONCLUSIONS

In our opinion, the silt and fine sand within the formation restricts the flow. However, it is possible there are some cleaner zones that could allow recharge from the pond during full scale pumping.

Based on the results of the pump test it is difficult to determine with confidence what a steady state flow rate would be when dewatering the work area to 5 or 6 feet below the deepest excavation and to at least 10 feet beyond the shoring on all sides. The small amount of drawdown at a relatively close distance from the pumped well (steep cone of depression) would indicate a moderately low hydraulic conductivity. We would normally expect to see the pumping rate decrease when a steady state condition is reached after long term (24 to 48 hours) pumping.

The computed hydraulic conductivity from the pump test data was 2.5×10^{-2} ft/min. This is within the typical range of a slightly silty sand and gravel.

Based on our pump test results, computations indicated that to dewater a 40 foot diameter area to a depth of about 25 feet would require pumping at approximately 375 gallons per minute.

Given the difficulties with silt and sand in the well and geometry of the set up, it appears the actual pumping rate to dewater a 40 foot diameter area to a depth of 25 feet could be between 150 gpm and 350 gpm. To refine these numbers would require establishing a large diameter well (i.e., 48 in. diameter well with sand packing around a 12" diameter slotted casing) at the site and conducting a full scale large diameter well pump test. This was beyond the scope of this study.

For construction, one large diameter well placed close to the excavation and between the excavation and the pond may be adequate to dewater the work area if there are zones of continuous clean gravels. However, this is not likely. Therefore, it is likely that at least three (3) wells spaced around the excavation, would be required. It may take more pumping on the south and SW sections due to the presence of the pond. This is because most of the water replenishment during pumping would likely come from the pond. This could change during the wet winter months when significant recharge from upslope to the north could have an impact.

6.1 CONSTRUCTION CONSIDERATIONS

When the pump station unit is installed it will have to be backfilled to be completed. To prevent infiltration of silt and sand into the backfill, "openwork" rock should not be used. A reasonably well graded 4-inch minus crushed rock with 7% to 12% passing the No. 200 sieve should work well. Smaller rock could be used if needed to help protect portions of the work. However, small crushed rock (such as ¾" minus) can become pumpy and difficult to dewater if it becomes saturated.

The backfill should be placed in 8 to 12 inch lifts and be compacted by several passes with a vibratory "hoe-pak". Densification to at least 95% of the maximum dry density as determined by laboratory procedure ASTM D-698 is recommended.

After backfilling, shoring such as sheet piling could be withdrawn and reused by the contractor.

7.0 LIMITATIONS

The analyses, conclusions and recommendations contained in this report are based on site conditions and development plans as they existed at the time of the study, and assume soils and groundwater conditions exposed and observed in the borings and in the area are representative of soils and groundwater conditions throughout the site. If during construction, subsurface conditions or assumed design information is found to be different, we should be advised at once so that we can review this report and reconsider our recommendations in light of the changed conditions. If there is a significant lapse of time between submission of this report and the start of work at the site, if the pump station has been moved or deepened, or if conditions have changed due to acts of God or construction at or adjacent to the site, it is recommended that this report be reviewed in light of the changed conditions and/or time lapse.

This report was prepared for the use of the owner and his design and construction team in the design and construction of the subject project. It should be made available to others for information and factual data only. This report should not be used for contractual purposes as a warranty of site subsurface conditions. It should also not be used at other sites or for projects other than the one intended.

We have performed these services in accordance with generally accepted geotechnical engineering practices in southern Oregon, at the time the study was accomplished. No other warranties, either expressed or implied are provided.

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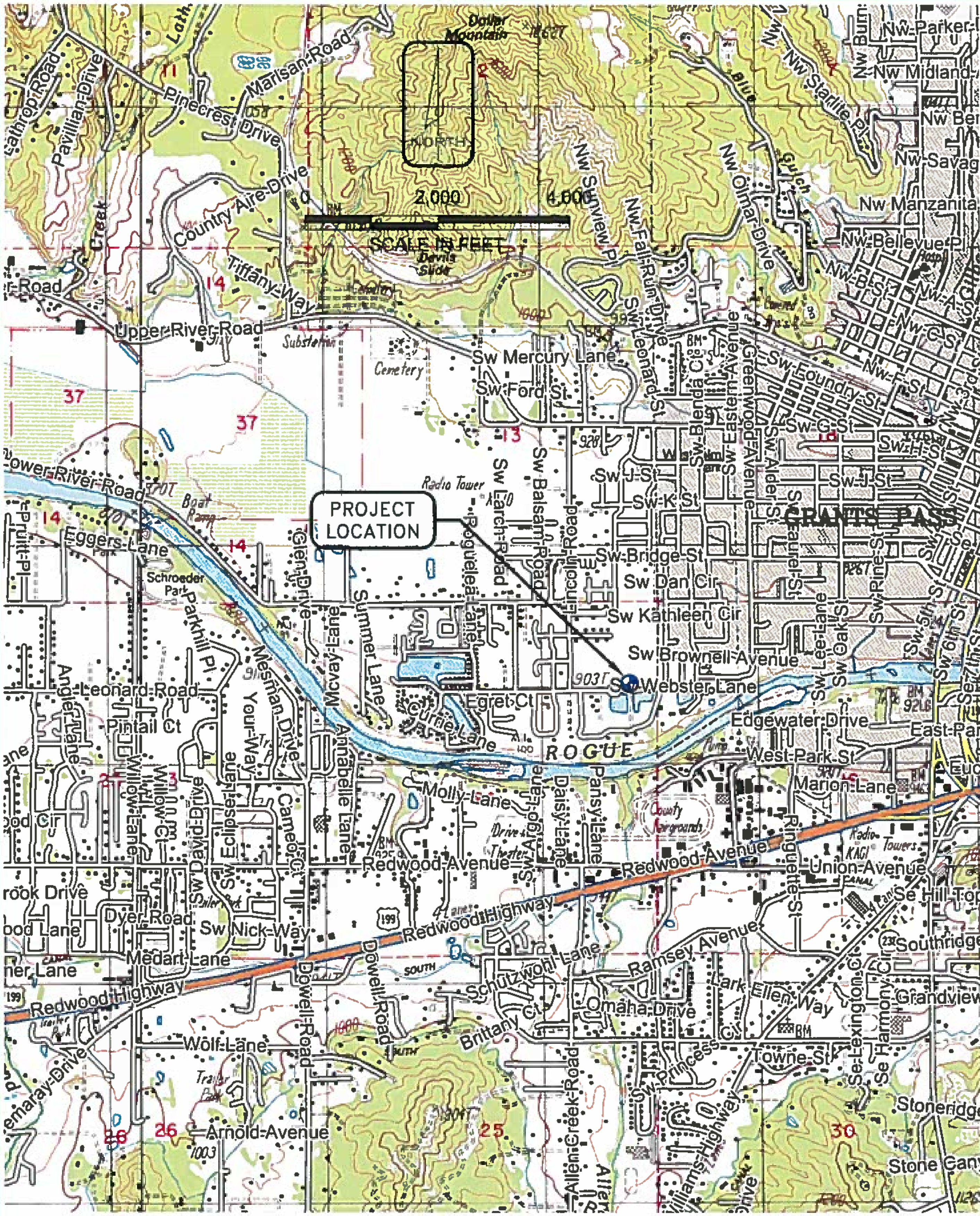
GEOTECHNICAL CONSULTING

William F. Galli, P.E.
Principal Engineer



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VICINITY MAP

WEBSTER PUMP STATION
GRANTS PASS, OREGON

DATE:	OCTOBER 2015
JOB NO:	02-5115-01
REV:	10/12/2015 10:25 AM
PREPARED BY:	MG3

5115 Webster Pump Sta - 01 - Vicinity dwg

FIGURE: 1

LEGEND

B-1	TEST PIT NUMBER AND APPROXIMATE LOCATION

APPROX NORTH

0 30 60

SCALE IN FEET

AERIAL PROVIDED BY GOOGLE EARTH

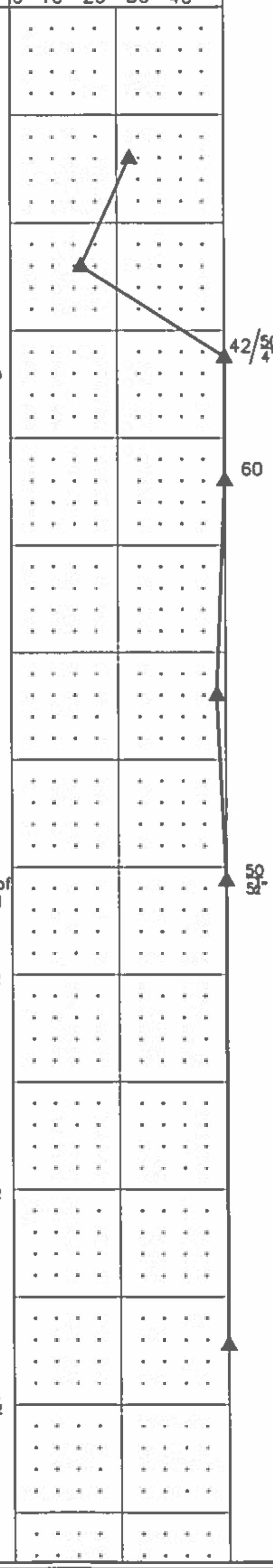
THE GALLI GROUP GEOTECHNICAL CONSULTING 512 NW 3rd Street Grants Pass, OR 97526	SITE PLAN WEBSTER PUMP STATION GRANTS PASS, OREGON	DATE: OCTOBER 2015 JOB NO: 02-5115-01 REV: 10/12/2015 12:11 PM PREPARED BY: MG3 5115 Webster Pump Sta - 02 - Site Plan dwg	FIGURE: 2

APPENDIX A

BORING LOGS

DEPTH IN FEET	MATERIAL DESCRIPTION SURFACE ELEV. (FT.)	SAMPLES NO.	S.P.T.	GROUND WATER DEPTH IN FEET
	Loose, light brown, silty FINE SAND; numerous to scattered fine organics (root hairs), dry. (SP-SM)	S-1		
2	Medium dense, light brown, gravelly SAND; with silt, rounded to subrounded gravels, scattered organics (small roots), dry. (SP)	S-2	28	2½
		S-3	17	5
7	Very dense to dense, light brown & gray, sandy GRAVELS; some silt, scattered cobbles, rounded to subrounded gravels & cobbles, trace organics (small roots < 1"ø), damp to moist. (GP)	S-4	42/50/4	7½ PERCHED 09/21/15
	.. S-5 sample moist at top and wet to saturated at bottom; dense, sandy Gravels become saturated.	S-5	60	10
				12½
		S-6	48	15
				17½
		S-7	50/5"	20 Bottom of Perched Zone (Est.)
21	Very dense, mottled light brown & gray with some white, silty, sandy GRAVELS (to gravelly SAND - varies); trace cobbles, wet to very moist. (GP)			22½
				25
				27½
		S-8	18/50/5	30
31½	Bottom of boring at 31½ feet. Rapid seepage (perched groundwater) zone encountered from approximately 8 feet to 20 feet.			32½
				35

STANDARD PENETRATION TEST
▲ BLOWS PER FOOT



LEGEND

- 2" S.P.T. SAMPLE
- GRAB SAMPLE
- 3" DAMES & MOORE SAMPLE (140 LB SPT HAMMER)
- * SAMPLE NOT RECOVERED
- ESTIMATED EXTENTS OF PERCHED WATER TABLE
- U 3" THIN WALL SAMPLE
- P PITCHER SAMPLE
- IMPERVIOUS SEAL
- WATER LEVEL
- PIEZOMETER TIP
- LIQUID LIMIT / NATURAL WATER CONTENT / PLASTIC LIMIT
- ● WATER CONTENT IN PERCENT
- USC UNIFIED SOIL CLASSIFICATION

NOTES

1. MATERIAL DESCRIPTIONS AND INTERFACES ARE INTERPRETIVE AND ACTUAL CHANGES MAY BE GRADUAL.
2. GROUNDWATER LEVELS DO RISE AND FALL DUE TO THE SEASONS. GROUNDWATER LEVELS MAY RISE CLOSE TO

DRILLER SUBSURFACE TECHNOLOGIES
DATE START 09/21/15 FINISH 09/21/15
DRILLING TECHNIQUE 8"ø HSA

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SUMMARY BORING LOG
B-1
WEBSTER PUMP STATION
GRANTS PASS, OREGON

DATE SEPT. 2015
JOB NO. 02-5115-01
FIG. A1

DEPTH IN FEET	MATERIAL DESCRIPTION SURFACE ELEV. (FT.)	SAMPLES NO.	S.P.T.	GROUND WATER DEPTH IN FEET	STANDARD PENETRATION TEST ▲ BLOWS PER FOOT 0 10 20 30 40
	Loose, light brown, silty FINE SAND; numerous to scattered fine organics (root hairs), dry. (SP-SM)	S-1			
2	Medium dense, light brown, gravelly SAND; varies somewhat - gravel content increasing with depth, some silt, rounded to subrounded gravels, dry to damp. (SP)			2½	
				5	
		S-2	21		
7	Very dense, light brown & gray, sandy GRAVELS; scattered cobbles, rounded to subrounded gravels & cobbles, moist to wet. (GP-est.)			7½	
	.. S-3 water on sampler: saturated (no sample).	S-3	45/50/5½"	10 PERCHED 09/21/15 ?	45/50/5½"
11	Bottom of boring at 11 feet. Saturated conditions (perched groundwater - est.) encountered at approximately 10 feet.			12½	
				15	
				17½	
				20	
				22½	
				25	
				27½	
				30	
				32½	
				35	

LEGEND

- 2" S.P.T. SAMPLE
- GRAB SAMPLE
- 3" DAMES & MOORE SAMPLE (140 LB SPT HAMMER)
- * SAMPLE NOT RECOVERED
- ESTIMATED EXTENTS OF PERCHED WATER TABLE
- 3" THIN WALL SAMPLE (U)
- PITCHER SAMPLE (P)
- IMPERVIOUS SEAL
- WATER LEVEL
- PIEZOMETER TIP
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DRILLER SUBSURFACE TECHNOLOGIES
DATE START 09/21/15 FINISH 09/21/15
DRILLING TECHNIQUE 8"ø HSA

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612 NW 3rd Street
Grants Pass, OR 97526

SUMMARY BORING LOG B-2

WEBSTER PUMP STATION
GRANTS PASS, OREGON

DATE SEPT. 2015
JOB NO. 02-5115-01
FIG. A2