Exhibit L

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July 6, 2021

Ashlee Sorber
American Pacific International Capital
Via Email: asorber@apicincus.com

RE: **GEOTECHNICAL EVALUATION OF GROUNDWATER HYDRAULICS**
FLORENCE HOUSING DEVELOPMENT – SITE A
RHODODENDRON DRIVE AND 35TH STREET
FLORENCE, OREGON
BRANCH ENGINEERING INC. PROJECT NO. 19-510

Pursuant to your request, Branch Engineering Inc. (BEI) geotechnical engineering staff has collected information regarding the historic surface and subsurface flow of stormwater on and in the vicinity of the subject site (Site). The information contained herein is based on our geologic knowledge of the area, discussions with a long-time local excavation contractor, review of the December 2018 Stormwater Master Plan Update for the City of Florence, and discussions with City of Florence Public Works staff.

The Site, formerly a KOA campground prior to the year 2000, lies on the southern end of a north to south drainage path that begins in the open dune area north of Heceta Beach Road creating a series of shallow lakes between these open dunes and those located behind the Fred Meyer store on the north end of the Sand Pines Golf Course at which point the flow of water bends west towards the Siusalw River with various surface water outlets to the river and groundwater flow atop a cemented sand lense near low tide river level. It is our understanding the lakes within the golf course are lined manmade reservoirs.

Findings

Historically, several areas of Florence have experienced extended periods of standing surface water during times of heavily, sustained rainfall as is evidenced by conditions documented in 1996/1997 and 2016/2017. Continued improvements over the years by the City of Florence and developers have mitigated some of the high-water conditions, but it is our understanding that Federal agency oversight has limited the number of direct outfalls and flow volumes to the Siuslaw River requiring the implementation of detention/retention and infiltration systems to be employed.

Recent stormwater system improvements in the vicinity of the Site include:

- Construction of retention facilities in the Mariners Village development north of the Site;
- Installation of detention and flow control structures for stormwater in the Fairway Estates subdivision directly north of the Site; and

- Construction of the Siano Ditch and enhancement of Bud's Ravine on the south end of the Site to mitigate surface water that was directed onto the Site by development of the Sand Pines and Sand Pines West subdivision.

Our geotechnical site investigation in December 2019 did not encounter any groundwater the test pits that were excavated to a maximum depth of 10-feet below the surface grade nor was there oxidation staining of the sand that would indicate a fluctuating water level observed. No flowing surface water was present, although surface soil on the east side of the site, adjacent to the Sand Pines development, had a noticeably elevated moisture content and is believed to be yard and roof drain runoff from the adjacent houses.

The Site is currently forested with some remaining remnants of the former campground; since it appears that a majority of the surface water that had originally been diverted towards the Site has been mitigated, and the amount of precipitation falling on the Site cannot be controlled, we researched factors that may contribute to the pre- and post-development stormwater conditions. These factors include changes in vegetation cover and concentrated infiltration of stormwater from impervious surface areas. A United States Department of Agriculture[1] (USDA) study indicates tree canopies detain an average of 20% to 30% of the rainfall and that vegetation provides a reduction in water through transpiration. Modeling by the United States Geological Survey[2] (USGS) of groundwater mounding effects from concentrated infiltration basins indicates that mounding is most sensitive to the vertical hydraulic conductivity of the soil. Higher rates of infiltration show less mounding of groundwater levels in aquifers but increased lateral spread of the mounding effect.

In our initial July 24, 2020 report, the groundwater mounding was estimated using a hypothetical stormwater infiltration basin for a 10-acre site, for which the USGS had conducted numerous simulations using the finite difference model MODFLOW. The results of this modeling effort were presented in accordance with Reference 2, from which BEI chose the model simulation results with conditions of 40% impervious cover, a design storm of 1.25-inches, basin depth of 2-feet, with a square basin area of 9,075 square feet, aquifer thickness of 20-feet, and soil permeability of 5-inches/hour and a specific yield of 8.5%. This model simulation produced a maximum mounding height of 1.85-feet with a maximum extent of 185 feet for a mounding of 0.25-feet. For comparison, a simulation was run using the Hantush spreadsheet analysis provided as a link in Reference 2 with the similar input parameters as used in the MODFLOW model with an unrealistic mounding effect.

BEI has subsequently used the Hantush analysis using the following input parameters provided by 3J Consulting and BEI's site specific research:

Infiltration rate (ft/day)	12
Specific Yield	0.3
Hydraulic Conductivity (ft/Day)	12 (conservative est.)
Half basin length (ft)	2
Half basin width (ft)	87.5
Duration of Infiltration Period (day)	1
Aquifer thickness (ft)	50

The attached results show a mounding of 1.9-feet at the source with an attenuation to 0.25 at 80-feet away and 0.06-feet at 120-feet from the source. These results are comparable to our initial results presented from the USGS MODFLOW analysis.

In addition to above considerations associated with groundwater, in the unlikely event where groundwater extends all the way to the surface, mounding would be non-existent, and all infiltration facilities will surcharge. Similarly, during an intense rainfall event that produces surface water flow, the water will be conveyed to the designated flow path routes that includes driveways, alleys and roads where stormwater catch basins and inlets reside. Should the site stormwater system become overloaded, the alleys and roads will become the conveyance routes to Bud's Ravine, which is identified as the conveyance path to the Siuslaw River.

Conclusions

Based on our research of the hydraulics of the Site and general vicinity we conclude the following:

- Recent stormwater improvements in the area of the Site have reduced the flow of surface water onto the site.
- Groundwater mounding may occur as a result of concentrated infiltration of stormwater; however, the degree of mounding is expected to be negligible.

The proposed design for infiltration of Site stormwater is consistent with the area and local regulations, and does not appear it will have an adverse impact on the current subsurface flow of water on, or offsite, of the property.

Sincerely,
Branch Engineering Inc.

Ronald J. Derrick, P.E., G.E.
Principal Geotechnical Engineer

1: USDA Forest Service 1146, Urban Forest Systems and Green Stormwater Infrastructure, February 2020.

2: USGS, Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins, Scientific Investigations Report 2010-5102.

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

Input Values		use consistent units (e.g. feet & days **or** inches & hours)
12.0000	*R*	**Recharge (infiltration) rate (feet/day)**
0.300	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
12.00	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
2.000	x	**1/2 length of basin (x direction, in feet)**
87.500	y	**1/2 width of basin (y direction, in feet)**
1.000	t	**duration of infiltration period (days)**
50.000	hi(0)	**initial thickness of saturated zone (feet)**

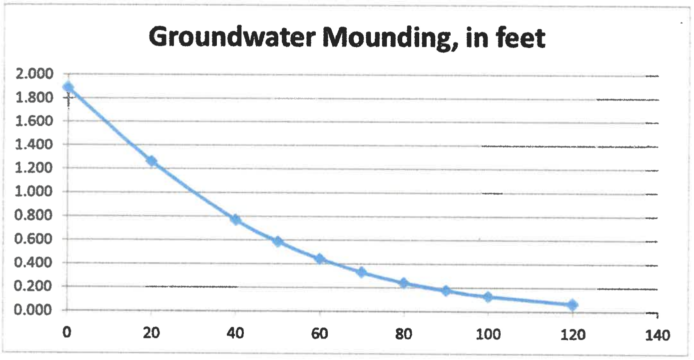
Conversion Table	
inch/hour	**feet/day**
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

51.885	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.885	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
1.885	**0**
1.259	**20**
0.768	**40**
0.586	**50**
0.440	**60**
0.326	**70**
0.238	**80**
0.172	**90**
0.123	**100**
0.063	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Exhibit L1

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January 28, 2020

Ashlee Sorber
American Pacific International Capital
Via Email: asorber@apicincus.com

RE: **GEOTECHNICAL ENGINEERING RECOMMENDATIONS AND SITE EVALUATION**
FLORENCE HOUSING DEVELOPMENT – SITE A
RHODODENDRON DRIVE AND 35TH STREET
FLORENCE, OREGON
BRANCH ENGINEERING INC. PROJECT NO. 19-510

Pursuant to your authorization Branch Engineering Inc. (BEI) performed a geotechnical engineering investigation at the subject site for the proposed development of a multi-family residential apartment complex.

On December 17, 2019 ten (10) exploratory test pits were advanced using a metal tracked excavator to a maximum depth of 10-feet below ground surface (BGS). The subsurface soil conditions in the test pits were logged in accordance the USCS (Unified Soil Classification System) ASTM D2488 and field tests consisting of portable dynamic cone penetrometer (DCP) tests, and falling head infiltration tests were performed. The accompanying report presents the results of our site research, field exploration and testing, data analysis, our conclusions and geotechnical engineering recommendations for the project. The site is suitable for the planned development, provided the recommendations of this report are implemented in the design and construction of the project.

Sincerely,
Branch Engineering Inc.

REGISTERED PROFESSIONAL ENGINEER
#16,170
OREGON
SEPT 15, 1992
RONALD J. DERRICK
EXPIRES: 12/31/2021

Ronald J. Derrick, P.E., G.E.
Principal Geotechnical Engineer

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1.0 INTRODUCTION

The subject site is located along and east of Rhododendron Drive in Florence, Oregon at latitude 44.000000˚ north and longitude 124.118365˚ west. The site consists of vacant land with 7 separate parcels totaling approximately 9.2-acres in size.

This report presents the results and findings of Branch Engineering, Inc. (BEI) field observations, testing, and research for the subject site. Our investigation included the evaluation of the subsurface conditions at the site to provide geotechnical recommendations for the design and construction of proposed residential buildings and site improvements for access and parking.

1.1 Project and Site Description

Our understanding of the project is a residential development consisting of multi-unit and detached housing units with associated site improvements such as utility installation, paved access roads, and parking is proposed. Access to the site is expected to be taken from Rhododendron Drive.

The site is surrounded by single-family residential development with Rhododendron Drive running roughly north-south along the western perimeter of the site and the Florence Golf Links golf course present behind adjacent single-family residences.

At the time of our visit, the site surface was covered with vegetation consisting of scattered shore pines, manzanita, salal, rhododendrons, and other vegetation typical of the Oregon Coast dune ecology. Several partially overgrown former driveways, or pathways were used to access the interior of the site. Review of historical photos available from Google Earth ™ indicate that in the 1990's the site was used as an RV park/campground. During our site visit we observed several areas of debris indicating the site had been used for dumping household waste items, and in other areas trash from unauthorized camp sites was observed. Water and wastewater pipes from the former RV park were observed in various locations on the site and there is potential for slabs or septic tanks to remain buried on the property. Areas of undocumented sand fill are also likely to be encountered during site clearing activities.

The site topography is relatively flat, with elevations ranging from 58-feet to 67-feet above sea level. Several swales, or drainage ditches were observed on the southeastern portion of the site and the northwestern portion of the site, north of an existing driveway from Rhododendron Drive. The southeastern drainage features appear to be part of an existing surface drainage pattern transporting surface runoff from the adjacent Wisteria at Sandpines development across the southern portion of the site to a recently (2015 +/-) constructed drainage swale and box culvert crossing Rhododendron Drive to the west.

1.2 Scope of Work

Our scope of work included a site reconnaissance and subsurface investigation on December 17, 2019. Ten (10) exploratory test pits were advanced at the locations shown on the attached Figure-1 Site Exploration Map with the observed soil stratigraphy classified in accordance with the American Society of Testing and Materials (ASTM) Method D-2488.

A portable dynamic cone penetrometer which consists of graduated steel rods driven into the soil by dropping a 35-lb slide hammer a vertical distance of 18-inches was used to assess the consistency of the site soil at select locations and depths in the test pits.

In addition to the exploratory test pits, three (3) Falling Head Infiltration Tests were performed at the locations shown on the attached Figure-1 with results summarized below and field data attached.

Field log summaries of the site exploratory test pits, including field test results, are presented in Appendix A. Also included in Appendix A are copies of nearby well logs from the Oregon Department of Water Resources on-line database, and the soil survey mapping of the site. Field and laboratory test results are summarized on the test pit log summaries.

1.3 Site Information Resources

The following site investigation activities were performed and literature resources were reviewed for pertinent site information:

- Review of the United States Department of the Interior Geological Survey (USGS) 2017 Mercer Lake, Oregon Quadrangle Map and the 2017 Florence, OR Quadrangle Map.
- Ten exploratory test pits were advanced to a maximum depth of 10-feet below ground surface (BGS), and three Falling Head Infiltration Tests were performed on the site at the approximate locations shown on Figure-1.
- Review of the Lane County area Web Soil Survey, United States Department of Agricultural (USDA) Natural Resources Conservation Service (NRCS), see Appendix A.
- Review of the USGS Geologic Map of Oregon, (USGS 1991, Walker & MacLeod).
- Review of Oregon Department of Water Resources Well Logs from nearby locations, see Appendix A.
- Review of DOGAMI online hazard view for the subject site vicinity.

2.0 SITE SUBSURFACE CONDITIONS

The analyses, conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume the exploratory test pit excavations, presented in Appendix A, are representative of the subsurface conditions throughout the site. If, during construction, subsurface conditions differ from those encountered in the exploratory test pits; BEI requests that we be informed to review the site conditions and adjust our recommendations, if necessary.

2.1 Site Soils

The NRCS Web Soil Survey maps two soil units across the site area; Waldport fine sand, 0 to 12 percent slopes and Waldport fine sand is mapped across the majority of the site area with Yaquina loamy fine sand mapped across the northeast portion of the site. Both soil units are described as well drained fine grain eolian sand.

In the exploratory test pits, medium dense, tan, moist, fine grain sand was observed underlying existing topsoil, or root zones. In several test pits, clayey gravel fill was observed near the ground surface which we attribute to previous development on the site. Sidewall caving was observed as excavation depths increased below approximately 3-feet to 5-feet BGS.

Blow counts recorded during DCP testing at depths from 3-feet to 4-feet BGS indicate a loose consistency of the sand which becomes medium dense with depth.

2.2 Ground Water

No groundwater was observed in the exploratory test pits which were advanced to a maximum of 10-feet BGS or to about a bottom elevation of 50-feet (mean sea level) MSL. Well logs from nearby sites were obtained from the Oregon Water Resources Department and list static water levels at 6.2-feet and 21-feet BGS, see attached logs. Variations in the depth to water is typical in stabilized dune environments with raised dunal areas and deflation zones with water closer to the surface. Historically the subject site had received more surface and near surface water flow before up slope development to the north and west have collected and diverted stormwater away from the site. Ponds remain on the golf course property that also retain water.

We expect that ground water levels (from the regional water table or perched lenses) will fluctuate with the seasons and should be expected to be highest during the late winter and spring months when rainstorms are more intense and frequent, and soils are near saturation. Due to the presence of relatively clean sand on the site, it is likely well drained with remnants of surface water channels in the southeast are of the site.

The presence of ground water is not expected to impact the proposed development, provided the recommendations of this report are implemented in the design and construction of the project. Perched lenses of water may be encountered but impacts can be mitigated by the recommendations within this report. If excavations do encounter the static water table dewatering measures will be required for work such as utility installation below the water table elevation.

3.0 GEOLOGIC SETTING

The 1991 Geologic map of Oregon by Walker and MacLeod maps the site geology as dune sand. The subject site is located near the northern extent of the longest coastal strip of dunes on the Oregon Coast. The dunes in the area were likely formed post ice-age during the Holocene epoch by eolian processes associated with the activity of wind. The typical pattern seen in the area is transverse dunes (running parallel to the ocean) caused by the varying on, and off shore winds. The area is mapped as sedimentary deposits of the Holocene and or Pleistocene, unconsolidated to poorly consolidated eolian sands. The subject site is underlain by Holocene-aged sedimentary deposits of unconsolidated to poorly consolidated fine-grained sands.

The site is located on the Oregon Coast, the entire Oregon Coast is located near the Cascadia Subduction Zone, which is a zone of converging tectonic plates that historically produces major earthquake events, a depiction of the historical Subduction Zone earthquake events is shown below.

Occurrence and Relative Size of Cascadia Subduction Zone Megathrust Earthquakes

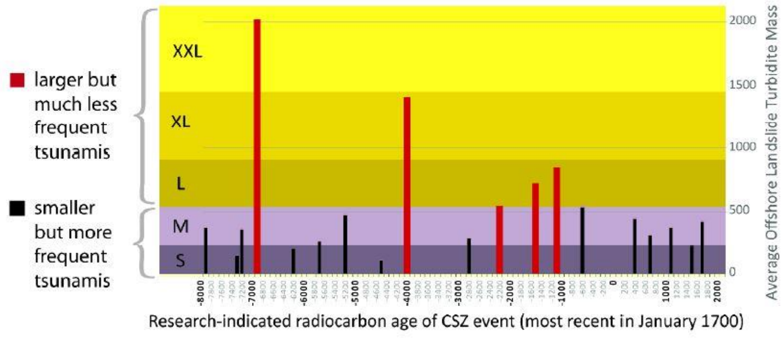


Figure 3: This chart depicts the timing, frequency, and magnitude of the last 19 great Cascadia Subduction Zone events over the past 10,000 years. The most recent event occurred on January 26, 1700. The 1700 event is considered to be a "medium sized" event. The data used to create this chart came from research that examined the many submarine landslides, known as "turbidites," that are triggered only by these great earthquakes (Witter and others, 2011). The loose correlation is "the bigger the turbidite, the bigger the earthquake."

3.1 Seismic Site Classification

Based on the soil properties encountered in our site pits and on-site well log information, Site Class D (Table 20.1-1 ASCE 7) is recommended for the medium dense sand encountered in the test pits. Pursuant to the 2019 Oregon Structural Specialty Code the following potential geologic and seismic hazards are addressed.

- Slope Instability: The site topography is relatively flat with isolated high and low areas typical of stabilized dune topography. Our review of the online Department of Geologic and Mining Industries (DOGAMI) hazard viewer does not map any areas of high landslide hazard risk, or existing landslides in the vicinity of the site, or in a location that may affect the site. Provided the earthwork recommendations in this report are incorporated into design and construction of the project the risk of landslides impacting the site is low.

- Liquefaction: Near surface sands are loose and susceptible to liquefaction and settlement if saturated at the time of a seismic event; however, based on our investigation findings and review of area well logs, it appears that the high ground water level is at least 10-feet below most areas of the site, at or below an elevation of 50-feet MSL. The sand at this depth becomes a medium dense consistency. Based on an anticipated lateral acceleration of 0.4g in the event of CSZ earthquake resulting in a cyclic stress ratio of 0.26 the sands within 20-feet BGS, liquefaction may occur (Boulanger & Idriss, University of California, Davis 2014) in saturated conditions; however, the risk of ground surface effects due to liquefaction are considered to be low. The potential from tsunami and ground shaking at the site in the event of a CSZ earthquake are considered to be the primary potential site impacts.

- There are no known active faults on the site, other normal faults are mapped in the hills in the site vicinity, however, these faults are not known to be active. The risk of surface rupture is low.

- There are no abrupt changes in ground elevation on or near the site that would present a potential for lateral spreading to occur during a seismic event; the risk for lateral spread on the site is low, provided any embanked fill on the site is constructed per the recommendations in this report.

4.0 CONCLUSIONS

Based on our field observations, subsurface explorations, and data analyses, we conclude that the site is geologic and geotechnically suitable for the proposed development provided that the recommendations of this report are incorporated into the design and construction of the project. Our investigation did not reveal any specific site features or subsurface conditions that would impede the proposed design and construction of the project. We conclude that no further geotechnical analysis is required on the subject site for the proposed site improvements.

5.0 RECOMMENDATIONS

The following sections present site-specific recommendations and design parameters for site preparation, drainage, foundations, utility excavations, and slab/pavement design. General material and construction specifications for the items discussed herein are provided in Appendix B.

The subsurface conditions observed in our site investigation are consistent; however, our field explorations only represent a very small portion of the site. Should loose or unsuitable soils extend to a depth greater than that described herein, or areas of distinct soil variation be discovered, this office shall be notified to perform site observation and additional excavation may be required.

5.1 Site Preparation and Foundation Subgrade Requirements

The following recommendations are for earthwork in the building foundation areas, roadways, and parking areas. Earthwork shall be performed in general accordance with the standard of practice as described in Appendix J of the 2019 Oregon Structural Specialty Code and as specified in this report.

All areas intended to directly or laterally support structures or roadways shall be stripped of vegetation, organic soil, unsuitable fill, and/or other deleterious material. These stripping’s shall be removed from the site or reserved for use in landscaping or non-structural areas. Once subgrade is exposed, expected to be loose to medium dense sand, the recommended subgrade preparation is as follows:

Foundation Subgrade Preparation
In areas of foundation footings, organic topsoil and loose sand shall be removed to consistently medium dense sand either for the placement of foundation forms or structural fill. Upon excavation to suitable subgrade, the subgrade shall be wetted and rolled with a vibratory smooth drum roller until no additional visual settlement of the subgrade is detected. Conventional strip and spread footings may be used for the foundation system of the proposed structures.

Foundation footings shall be placed at least 5-feet from the competent face of downward slopes below footings.

If footings are not constructed immediately upon subgrade preparation, we recommend that the subgrade be covered with a minimum of 3-inches of compacted aggregate to mitigate wind and water erosion. After construction of footings, the perimeter of the footings shall be protected from erosion to mitigate undermining of footings. If structural fill is required to raise subgrade elevations, the fill shall conform to the recommendations in Sections 5.2 below.

Pavement Subgrade Preparation

In areas of pavement for vehicle access or parking, we recommend that the existing vegetation, topsoil, and areas of loose soil be removed to consistent subgrade material as described above. The expected depth of excavation to the subgrade material described above is approximately 10- to 16-inches. Upon excavation to suitable subgrade, the subgrade shall be wetted and rolled with a vibratory smooth drum roller until no additional visual settlement of the subgrade is detected. Fill placed to raise pavement subgrade elevations shall be placed on suitable subgrade, and conform to the recommendations below. We recommend that a minimum of 6-inches of compacted aggregate be placed on the subgrade in light vehicle pavement areas. Heavy construction traffic will require additional aggregate thickness, a minimum of 12-inches, to mitigate rutting of the subgrade.

During subgrade excavation in foundation and pavement areas we recommend the Geotechnical Engineer of Record, or designated representative visit the site to observe the subgrade material prior to placement of structural fill or aggregate.

5.2 Engineered Fill Recommendations

All engineered fill placed on the site shall consist of homogenous material and shall meet the following recommendations. Clean, native sand is suitable for use as structural fill material.

- Areas of structural fill placement shall be stripped of organic material, loose soil, and subgrade approved by the Geotechnical Engineer prior to the placement of fill materials. Sloped areas in excess of 20% shall be properly keyed and benched horizontally into competent material as the fill height progresses. Proof-rolling or hand-probing of the subgrade may be required to assess competence.

- Prior to placement, fill material shall be approved by the Geotechnical Engineer. Acceptable fill shall be free of organics or other deleterious materials. The sand present on the site is acceptable for use as engineered fill upon removal of any organic material.

- The fill shall be moisture conditioned within 2% +/- of optimum moisture content and compacted in lifts with loose lift thickness not exceeding 8- inches with appropriate equipment for the fill material.

- Periodic visits to the site to verify lift thickness, source material, and compaction efforts shall be conducted by the Geotechnical Engineer or designated representative and documented.

- The recommended compaction level for engineered fill is 90% of ASHTO T-180/ASTM 1557-D (modified Proctor) unless otherwise specified. Compaction shall be measured by testing with nuclear densometer ASTM D-6938, or D-1556 sand cone method. If compaction testing by nuclear densometer is not possible due to the nature of the approved fill material, proof rolling with a fully loaded 10 CY dump truck observed by the Geotechnical Engineer or designated representative shall be conducted.

5.3 Cut/Fill Slopes

Fill slopes may be constructed up to a slope of 2:1 (H:V) and should be protected from erosion. See the attached Figure 2, Fill Slope Detail, for benching and drainage details. Fill shall be placed on subgrade consisting of level benches excavated through near surface topsoil or other unsuitable subgrade materials. All fill slopes in excess of 5 feet in height shall contain a keyway as shown on Figure 2. Temporary cut slopes may be excavated up to 1.5:1 (H:V) in steepness. but permanent slopes shall not exceed 2:1. All slopes shall be protected from erosion by timely placement of vegetation, or other means, and runoff should not be allowed to flow down the face of slopes.

Cut and/or fill slopes shall be no steeper than 2:1 and shall be compacted to their outer edge by either back rolling or being over built and cut to grade. All slopes shall be protected with erosion control measures and surface water shall not be allowed to drain over the top of a slope. Foundations shall be placed such that there is at least 5 lateral feet from the face of slope or outside a 1:1 plane projected from the toe of slope; whichever is greater.

5.4 Lateral Earth Pressures and Friction Coefficient

The following equivalent fluid pressure parameters can be used for design of site retaining structures that are free draining with no hydrostatic pressures.

Table-1 Lateral Earth Pressures

Material	Passive Earth Pressure (Kp)*1	Active Earth Pressure (Ka)*3	At-Rest Earth Pressure (Ko)*2
Sand (Level Backfill)	250 pcf	30 pcf	45 pcf
Sand (2:1 Backfill Slope)	250 pcf	40 pcf	55 pcf

*1 – Neglect upper foot of material unless covered by footing or pavement.
*2 – For walls restrained at the top from movement
*3 – For seismic design increase Ka by 0.7 of the peak ground acceleration (PGA) and apply at 0.4H above the base of the wall, where H is the wall height.

The coefficient of friction for concrete poured neat against undisturbed or compacted sand subgrade is 0.45 and 0.5 may be used for concrete poured on a minimum of 12-inches of compacted aggregate.

5.5 Drainage & Infiltration Testing

An on-site storm drainage system is expected to be engineered for this project. Three encased falling head infiltration tests were performed on December 17, 2019. Infiltration tests were conducted with 6-inch diameter pipes set and sealed in native soil. Infiltration test locations are shown on the attached Figures 1. The recorded field test measurements are provided in Appendix A. No factor of safety has been applied to the measured rates of vertical hydraulic conductivity.

Test Location	***Test Depth (Inches)***	***Measured Hydraulic Conductivity, k (in/hr)***
IT-1	54	92
IT-2	54	49
IT-3	56	80

Alteration of existing grades for this project will likely change drainage patterns but should not adversely affect adjacent properties. We recommend that areas of structural fill be evaluated to ensure proper drainage away from structures is maintained. Accumulation of drainage near structural fills may result in saturation and softening of material. Final perimeter landscape grades shall slope away from the foundation and surface water shall not be allowed to pond adjacent to foundations.

5.6 Soil Bearing Capacity

Based on our site observations and review of proposed building plans, conventional spread footings or continuous strip footings are suitable for the proposed site development provided the building pad area preparation is in conformance with the recommendations described above in Section 5.1. The allowable bearing capacity for foundation elements placed on undisturbed sand subgrade or prepared structural fill is 1,500 psf. The allowable bearing capacity may be increased by 1/3 for short-term loading such as wind and seismic.

Additionally, structural fill should extend laterally, from all foundation edges, a minimum distance or 5-feet or within a 1:1 plane from at least 1-foot outside the edge of footing. Perimeter landscape grades shall be sloped away from all foundations and water should not be allowed to pond within 10-feet of footings.

The following recommendations shall be implemented in the design and construction of the project. Periodic site observations by a geotechnical representative of Branch Engineering, Inc. are recommended during the construction of the project. The specific phases of construction that should be observed are:

Table 3:

Recommended Construction Phases to be Observed by the Geotechnical Engineer	
Phase	*Observation*
At completion of street excavation	Subgrade observation by the geotechnical engineer before fabric and aggregate placement.
Imported fill material	Observation of material or information on material type and source.
Placement or compaction of fill material	Observation by geotechnical engineer or test results by qualified testing agency.

5.7 Settlement

The maximum building foundation loads are estimated to be less than 1.5 kip/linear foot for wall loads and/or 3 kips for column loads. Site-specific consolidation testing was not performed; however, based on soil observations and test results in similar soil conditions, the estimated total settlement at the site is not expected to exceed 0.75-inches with a differential settlement up to 0.5-inches over a span of 20 feet. The settlement estimates are based on the building load effects and area expected to occur over a short-term, generally by the time construction is completed. These settlement estimates do not account for seismic induced settlement, which may be as much as 2+ inches, but is expected to be relatively uniform across a building footprint. Foundations should be placed a minimum distance from each other to prevent overlapping of stress distributions defined as a 1:1 (H:V) slope projection from all foundation edges to a minimum depth of two (2) times the foundation width of the largest footing.

5.8 Slabs-On-Grade

After site preparation to expose suitable subgrade prepared in accordance with Section 5.1, load bearing concrete slabs shall be underlain by a compacted sand subgrade or leveling course of compacted, crushed aggregate, if necessary. A modulus of subgrade reaction of 150 pci may be used for design of slabs on approved native subgrade material or structural fill. Non-load bearing slabs or pavements do not require geotechnical design criteria; however, BEI recommends a stable subgrade to mitigate un-controlled cracks. The edges of slabs shall be protected from erosion and undermining of the slab; a vapor barrier system shall be selected by the project architect and may be dependent on slab cover materials.

5.9 Pavement Design Recommendations

The estimated California Bearing Raito (CBR) for the near surface loose sand is 3 based on blow count correlations; however, once the pavement section subgrade is exposed and compacted, the consistency of the sand can typically be increased to at least medium dense to depths of at least 3-feet thereby increasing the CBR of 8, which is a “Fair” classification. Our recommendations used the guidance of the 1993 AASHTO Guide for Design of Pavement Structures, the 2003 revised Asphalt Pavement Design Guide, published by the Asphalt Pavement Association of Oregon, and the 2019 ODOT Pavement Design Guide as well as results from engineered structural pavement sections developed for sites with similar soils and anticipated traffic loads. Based on an estimated equivalent 18-kip single axle loading (ESAL) of 50,000 over 20-years, a subgrade resilient modulus of 5000 psi, and 90% reliability, a Structural Number of 3.0 has been used for design of the pavement sections for the driveway portions of the site. Pavement may consist of 4-inches of Asphalt Concrete (AC) over 12-inches of base aggregate. The above section is recommended for areas of anticipated heavy traffic, including refuse, delivery, and furniture moving trucks. In areas that will be restricted to light passenger vehicle travel or parking, the recommended pavement section can be reduced to 3-inches of AC pavement over 8-inches of base aggregate. A geotextile separation fabric is recommended in wet areas where pumping of the sand may cause intrusion into the base aggregate.

A bi-axial geogrid system may be used to reduce base aggregate thicknesses, if necessary, for design grades. The surface must then be smooth and free of obstructions, depressions, and debris. Geogrid placement must be in accordance with 2018 ODOT Standard Specifications 00331.41. The aggregate size atop the geogrid shall not exceed 1.5-inches.

The above recommended structural pavement sections are designed for the type of vehicle use on the site after construction completion, not for construction vehicle traffic which is generally heavier, occurs over a short time, and impacts the site before full pavement sections are constructed. The construction traffic may cause subgrade failures and the site contractor should consider over-building designated haul routes through the site to mitigate soft areas at the time of final paving.

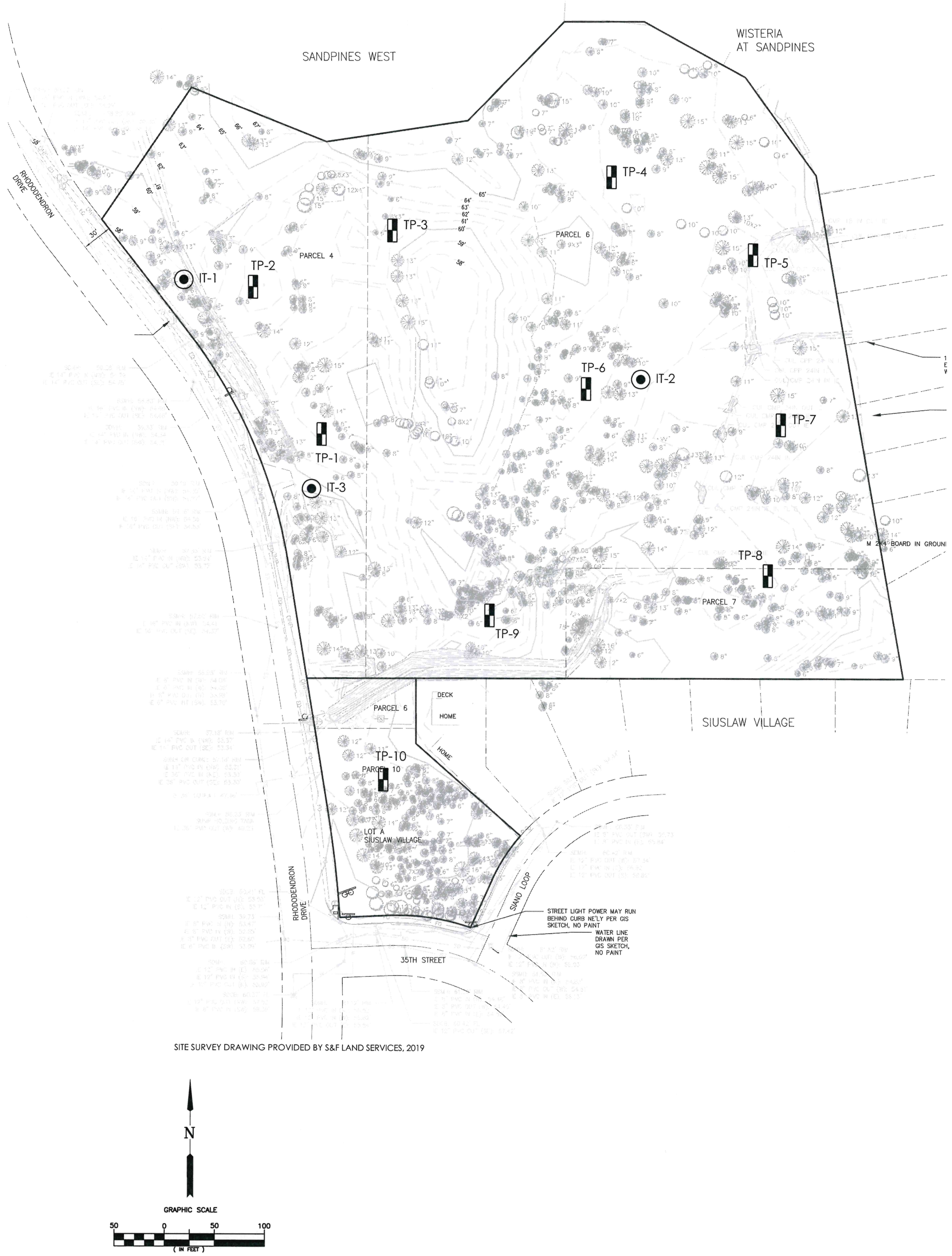
5.10 Wet Weather/Dry Weather Construction Practices

The site material is sand to depths over 70-feet and is relatively free-draining. Precipitation will not adversely impact site earthwork; however, high groundwater levels during the wet season may impact site trenching activities and cause "pumping" of the subgrade with repeated heavy vehicle traffic. Dewatering and/or shoring of excavation sidewalls may be required during construction. Construction traffic routes should have a minimum of 12-inches of aggregate, with preferably 3-inch minus angular aggregate in the lower 8-inches of the temporary road section to mitigate subgrade degradation during wet weather conditions. Final design pavement sections and foundation subgrade recommendations do not account for repeated heavy truck traffic associated with construction.

6.0 REPORT LIMITATIONS

This report has presented BEI's site observations and research, subsurface explorations, geotechnical engineering analyses, and recommendations for the proposed site development. The conclusions in this report are based on the conditions described in this report and are intended for the exclusive use of American Pacific International Capital and their representatives for use in design and construction of the development described herein. The analysis and recommendations may not be suitable for other structures or purposes.

Services performed by the geotechnical engineer for this project have been conducted with the level of care and skill exercised by other current geotechnical professionals in this area. No warranty is herein expressed or implied. The conclusions in this report are based on the site conditions as they currently exist and it is assumed that the limited site locations that were physically investigated generally represent the subsurface conditions at the site. Should site development or site conditions change, or if a substantial amount of time goes by between our site investigation and site development, we reserve the right to review this report for its applicability. If you have any questions regarding the contents of this report please contact our office.



SITE SURVEY DRAWING PROVIDED BY S&F LAND SERVICES, 2019

LEGEND

▚ TP-4 INDICATES APPROXIMATE LOCATION OF EXPLORATORY TEST PIT EXCAVATION

◉ IT-1 INDICATES APPROXIMATE LOCATION OF INFILTRATION TEST

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SCALE: 1:100 (11"x17")

SITE EXPLORATION MAP - APIC - FLORENCE SITE A

FLORENCE, OREGON

FIGURE-1

12-17-2019

310 5th Street, Springfield, Oregon 97477 | p: 541.746.0637 | www.branchengineering.com

PROJECT NO. 19-510

APPENDIX A:

- TEST PIT SUMMARIES
- DCP TEST LOGS
- INFILTRATION TESTING RESULTS
- OWRD WELL LOGS
- USDA SOIL SURVEY

RELATIVE DENSITY - COARSE GRAINED SOILS

RELATIVE DENSITY	SPT N-VALUE	D&M SAMPLER (140 lbs hammer)	D&M SAMPLER (300 lbs hammer)
VERY LOOSE	< 4	< 11	< 4
LOOSE	4 - 10	11 - 26	4 - 10
MEDIUM DENSE	10 - 30	26 - 74	10 - 30
DENSE	30 - 50	74 - 120	30 - 47
VERY DENSE	> 50	> 120	> 47

USCS GRAIN SIZE

FINES		< #200 (.075 mm)
SAND	Fine	#200 - #40 (.425 mm)
	Medium	#40 - #10 (2 mm)
	Coarse	#10 - #4 (4.75 mm)
GRAVEL	Fine	#4 - 0.75 inch
	Coarse	0.75 - 3 inch
COBBLES		3 - 12 inches

CONSISTENCY - FINE GRAINED SOILS

CONSISTENCY	SPT N-VALUE	D&M SAMPLER (140 lbs hammer)	D&M SAMPLER (300 lbs hammer)	POCKET PEN. / UNCONFINED (TSF)	MANUAL PENETRATION TEST
VERY SOFT	< 2	< 3	< 2	< 0.25	Easy several inches by fist
SOFT	2 - 4	3 - 6	2 - 5	0.25 - 0.50	Easy several inches by thumb
MEDIUM STIFF	4 - 8	6 - 12	5 - 9	0.50 - 1.00	Moderate several inches by thumb
STIFF	8 - 15	12 - 25	9 - 19	1.00 - 2.00	Readily indented by thumb
VERY STIFF	15 - 30	25 - 65	19 - 31	2.00 - 4.00	Readily indented by thumbnail
HARD	> 30	> 65	> 31	> 4.00	Difficult by thumbnail

UNIFIED SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GROUP SYMBOLS AND TYPICAL NAMES	
COARSE-GRAINED SOILS: More than 50% retained on No. 200 sieve	GRAVELS: 50% or more *retained* on the No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines.
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS: 50% or more *passing* the No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines.
			SP	Poorly-graded sands and gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS: Less than 50% retained on No. 200 sieve	SILT AND CLAY	LIQUID LIMIT LESS THAN 50	ML	Inorganic silts, rock flour, clayey silts.
			CL	Inorganic clays of low to medium plasticity, lean clays.
			OL	Organic silt and organic silty clays of low plasticity.
		LIQUID LIMIT 50 OR GREATER	MH	Inorganic silts, clayey silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS			PT	Peat, muck, and other highly organic soil.

MOISTURE CONTENT

DRY: Absence of moisture, dusty, dry to the touch
DAMP: Some moisture but leaves no moisture on hand
MOIST: Leaves moisture on hand
WET: Visble free water, usually saturated

	PLASTICITY	DRY STRENGTH	DILATANCY	TOUGHNESS
ML	Non to Low	Non to Low	Slow to Rapid	Low, can't roll
CL	Low to Med.	Med. to High	None to Slow	Medium
MH	Med. to High	Low to Med.	None to Slow	Low to Med.
CH	Med. to High	High to V.High	None	High

STRUCTURE

STRATIFIED: Alternating layers of material or color > 6mm thick.
LAMINATED: Alternating layers < 6mm thick.
FISSURED: Breaks along definate fracture planes.
SLICKENSIDED: Striated, polished, or glossy fracture planes.
BLOCKY: Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
LENSES: Has small pockets of different soils, note thickness.
HOMOGENEOUS: Same color and appearance throughout.

LIST OF ABBREVIATION & EXPLANATIONS

SPT	Standard Penetration Test split barrel sampler
D&M	Dames and Moore sampler
LL	Atterberg Liquid Limit
PL	Atterberg Plastic Limit
PP	Pocket Penetrometer
VS	Vane Shear
G	Grab sample
MC	Moisture Content
MD	Moisture Density
UC	Unconfined Compressive Strength

TABLE A-1

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GEOTECHNICAL SITE INVESTIGATION   EXPLORATORY KEY

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Borehole ID: TP-1

Sheet 1 of 1

Client: American Pacific International Capital
Project Name: Florence Housing Development - Site A
Project Number: 19-510
Project Location: 35th Street and Rhododendron Drive, Florence, Oregon
Date Started: Dec 17 2019 **Completed:** Dec 17 2019
Logged By: RJD **Checked By:** RJD
Drilling Contractor: Ray Wells Inc.
Latitude: **Longitude:** **Elevation:**
Drilling Method: Test Pit Excavation
Ground Water Levels
Equipment: Metal Tracked Excavator
Hammer Type:
Notes:

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
		(Fill) Loose, light brown, Sand with fine roots, slightly moist					
1							
2		(Fill) Dark brown, Clayey Gravel, former road bed					
3		(SW) Medium dense, slightly moist, light tan, fine grain Sand, laminated structure, former dune					
4							
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Borehole ID: TP-2

Sheet 1 of 1

Client: American Pacific International Capital

Project Name: Florence Housing Development - Site A

Project Number: 19-510

Project Location: 35th Street and Rhododendron Drive, Florence, Oregon

Date Started: Dec 17 2019 **Completed:** Dec 17 2019

Logged By: RJD **Checked By:** RJD

Drilling Contractor: Ray Wells Inc.

Latitude: **Longitude:** **Elevation:**

Drilling Method: Test Pit Excavation

Ground Water Levels

Equipment: Metal Tracked Excavator ▽

Hammer Type: 35 lb Slide Hammer ▼

Notes: ▽

Depth	**Graphic**	**Material Description**	**Sample**	**Recovery % RQD**	**Blow Counts (N Value)**	**Pocket Pen. (tsf)**	**SPT N-Value PL MC LL Fines Content** 10 20 30 40 50 60 70 80 90
		(Fill) Compacted clayey crushed rock Aggregate over organic soil					
1		(SW) Tan, slightly moist, medium dense fine grain Sand, some sidewall caving					
2							
3							
4							
5			BAG	0			
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Borehole ID: TP-3

Sheet 1 of 1

Client: American Pacific International Capital

Project Name: Florence Housing Development - Site A

Project Number: 19-510

Project Location: 35th Street and Rhododendron Drive, Florence, Oregon

Date Started: Dec 17 2019 **Completed:** Dec 17 2019

Logged By: RJD **Checked By:** RJD

Drilling Contractor: Ray Wells Inc.

Latitude: **Longitude:** **Elevation:**

Drilling Method: Test Pit Excavation

Ground Water Levels

Equipment: Metal Tracked Excavator

▽

Hammer Type:

▼

Notes:

▽

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
		(OL-SC) Organic Topsoil with roots to 3' below surface					
1		(SW) Light reddish brown, slightly moist, medium dense, fine grain Sand					
2							
3							
4							
5		(SW) Fine grain Sand grades to tan color with sidewall caving					
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Borehole ID: TP-4

Sheet 1 of 1

Client: American Pacific International Capital
Project Name: Florence Housing Development - Site A
Project Number: 19-510
Project Location: 35th Street and Rhododendron Drive, Florence, Oregon
Date Started: Dec 17 2019 **Completed:** Dec 17 2019
Logged By: RJD **Checked By:** RJD
Drilling Contractor: Ray Wells Inc.
Latitude: **Longitude:** **Elevation:**
Drilling Method: Test Pit Excavation
Ground Water Levels
Equipment: Metal Tracked Excavator
Hammer Type: 35 lb Slide Hammer
Notes:

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
1		(Fill) Dark Brown Silt and crushed rock Aggregate					
2		(Fill) Reddish brown, Silty Clay and crushed rock Aggregate					
3		(SW) Tan, slightly moist, medium dense, fine grain Sand, root zone at 48"					
4							
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7							
8							
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Borehole ID: TP-5

Sheet 1 of 1

Client: American Pacific International Capital
Project Name: Florence Housing Development - Site A
Project Number: 19-510
Project Location: 35th Street and Rhododendron Drive, Florence, Oregon
Date Started: Dec 17 2019 **Completed:** Dec 17 2019
Logged By: RJD **Checked By:** RJD
Drilling Contractor: Ray Wells Inc.
Latitude: **Longitude:** **Elevation:**
Drilling Method: Test Pit Excavation
Ground Water Levels
Equipment: Metal Tracked Excavator
▽
Hammer Type:
▼
Notes:
▽

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
		(Fill) Silty Clay with crushed rock Aggregate and roots					
1		(OL/OH Significant root zone					
2		(SW) Tan, slightly moist, medium dense, fine grain Sand					
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Borehole ID: TP-6

Sheet 1 of 1

Client: American Pacific International Capital

Project Name: Florence Housing Development - Site A

Project Number: 19-510

Project Location: 35th Street and Rhododendron Drive, Florence, Oregon

Date Started: Dec 17 2019 **Completed:** Dec 17 2019

Logged By: RJD **Checked By:** RJD

Drilling Contractor: Ray Wells Inc.

Latitude: **Longitude:** **Elevation:**

Drilling Method: Test Pit Excavation

Ground Water Levels

Equipment: Metal Tracked Excavator

Hammer Type:

Notes:

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
0–1		(OL-OH) Organic duff and leaf litter					
1–10		(SW) Reddish brown to tan, slightly moist, medium dense, fine grain Sand, roots extending to 24" below surface					

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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Borehole ID: TP-7

Sheet 1 of 1

Client: American Pacific International Capital
Project Name: Florence Housing Development - Site A
Project Number: 19-510
Project Location: 35th Street and Rhododendron Drive, Florence, Oregon
Date Started: Dec 17 2019 **Completed:** Dec 17 2019
Logged By: RJD **Checked By:** RJD
Drilling Contractor: Ray Wells Inc.
Latitude: **Longitude:** **Elevation:**
Drilling Method: Test Pit Excavation
Ground Water Levels
Equipment: Metal Tracked Excavator
▽
Hammer Type:
▼
Notes:
▼

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
		(Fill) Dark brown Silty Clay and crushed rock Aggregate, trace roots					
1		(SW) Tan, slightly moist, medium dense, fine grain Sand, caving sidewalls at 24"					
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Borehole ID: TP-8

Sheet 1 of 1

Client: American Pacific International Capital
Project Name: Florence Housing Development - Site A
Project Number: 19-510
Project Location: 35th Street and Rhododendron Drive, Florence, Oregon
Date Started: Dec 17 2019 **Completed:** Dec 17 2019
Logged By: RJD **Checked By:** RJD
Drilling Contractor: Ray Wells Inc.
Latitude: **Longitude:** **Elevation:**
Drilling Method: Test Pit Excavation
Ground Water Levels
Equipment: Metal Tracked Excavator
Hammer Type:
Notes:

Depth	**Graphic**	**Material Description**	**Sample**	**Recovery % RQD**	**Blow Counts (N Value)**	**Pocket Pen. (tsf)**	**SPT N-Value PL MC LL Fines Content** 10 20 30 40 50 60 70 80 90
		(Ol-OH) Organic duff and leaf litter					
1		(SW) Tan, slightly moist, medium dense, fine grain Sand, sidewall caving at 24" and roots to 48"					
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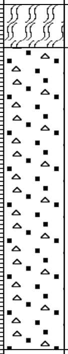
Borehole ID: TP-9

Sheet 1 of 1

Client: American Pacific International Capital
Project Name: Florence Housing Development - Site A
Project Number: 19-510
Project Location: 35th Street and Rhododendron Drive, Florence, Oregon
Date Started: Dec 17 2019 **Completed:** Dec 17 2019
Logged By: RJD **Checked By:** RJD
Drilling Contractor: Ray Wells Inc.
Latitude: **Longitude:** **Elevation:**
Drilling Method: Test Pit Excavation
Ground Water Levels
Equipment: Metal Tracked Excavator
Hammer Type:
Notes:



Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
		(OL-OH) Organic duff and roots					
1		(SW) Tan, slightly moist, medium dense, fine grain Sand, roots to 24" below surface					
2							
3							
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5			BAG	0			
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Borehole ID: TP-10

Sheet 1 of 1

Client: American Pacific International Capital

Project Name: Florence Housing Development - Site A

Project Number: 19-510

Project Location: 35th Street and Rhododendron Drive, Florence, Oregon

Date Started: Dec 17 2019 **Completed:** Dec 17 2019

Logged By: RJD **Checked By:** RJD

Drilling Contractor: Ray Wells Inc.

Latitude: **Longitude:** **Elevation:**

Drilling Method: Test Pit Excavation

Ground Water Levels

Equipment: Metal Tracked Excavator

Hammer Type:

Notes:

Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content 10 20 30 40 50 60 70 80 90
		(OL-OH) Topsoil and roots					
1		(SW) Light brown, slightly moist, loose, fine grain Sand					
2		(SW) Tan, slightly moist, medium dense, fine grain Sand					
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DYNAMIC CONE LOG

PROJECT NUMBER: 19-510
DATE STARTED: 12-17-2019
DATE COMPLETED: 12-17-2019

HOLE #: TP-2
CREW: RJD
PROJECT: APIC Florence Site A
ADDRESS: Rhododendron Drive
LOCATION: Florence, Oregon

SURFACE ELEVATION: 64'
WATER ON COMPLETION: No
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

	BLOWS	RESISTANCE	GRAPH OF CONE RESISTANCE		TESTED CONSISTENCY	
DEPTH	PER 10 cm	Kg/cm²	0 50 100 150	N'	NON-COHESIVE	COHESIVE
-						
-						
- 1 ft						
-						
-						
- 2 ft						
-						
-						
- 3 ft	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
- 1 m	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
- 4 ft	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

C:\My Documents\Wildcat\WC_XL97.XLS

DYNAMIC CONE LOG

PROJECT NUMBER: 19-510
DATE STARTED: 12-17-2019
DATE COMPLETED: 12-17-2019

HOLE #: TP-4
CREW: RJD
PROJECT: APIC Florence Site A
ADDRESS: Rhododendron Drive
LOCATION: Florence, Oregon

SURFACE ELEVATION: 63'
WATER ON COMPLETION: No
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY	
					NON-COHESIVE	COHESIVE
-						
-						
- 1 ft						
-						
-						
- 2 ft						
-						
-						
- 3 ft						
- 1 m	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
-	5	19.3	•••••	5	LOOSE	MEDIUM STIFF
- 4 ft	6	23.2	••••••	6	LOOSE	MEDIUM STIFF
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

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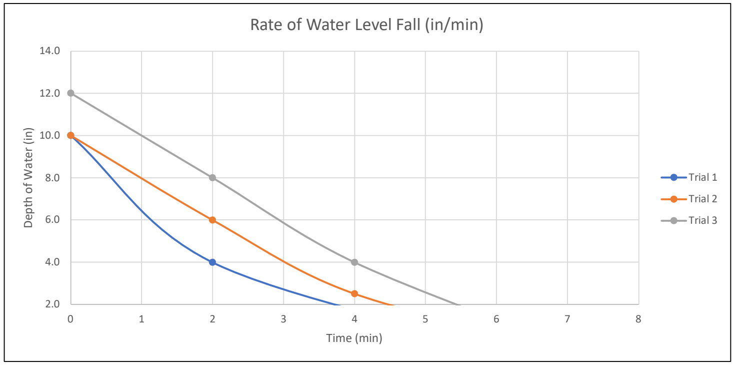
Infiltration Test Results

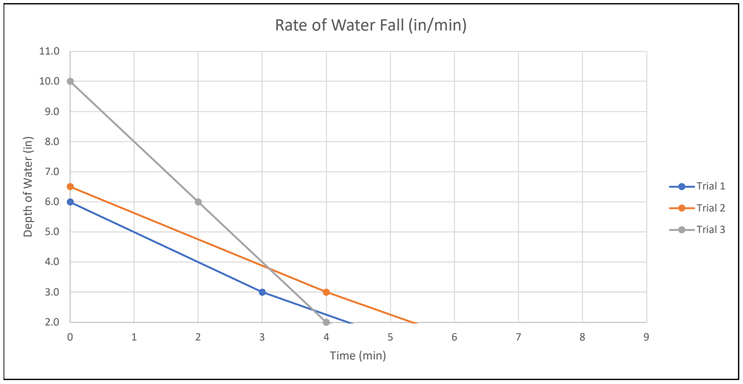
Project: American Pacific International Capital - Florence Site
Testing Date: December 17, 2019
BEI Project Number: 19-510
Test Type: Encased Falling Head Infiltration
Time = 0 at addition of H2O

Infiltration Test 1 Trial 1			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-1 (in/hr)**
Standpipe Diameter (in)	6		0	44.0	10.0			
Standpipe Height AGS (in)	0		2	50.0	4.0	3.00	180.0	
Test Depth BGS (in)	54		6	54.0	0.0	1.00	60.0	120.0
Volume of Water Added (gal)	1							
Clocktime at Start	12:08							
ASTM Soil Type	(SW)							
Infiltration Test 1 Trial 2			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-2 (in/hr)**
Volume of Water Added (gal)	1		0	44.0	10.0			
Clocktime	12:16		2	48.0	6.0	2.00	120.0	
			4	51.5	2.5	1.75	105.0	
			7	54.0	0.0	0.83	50.0	91.7
Infiltration Test 1 Trial 3			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-3 (in/hr)**
Volume of Water Added (gal)	1		0	42.0	12.0			
Clocktime	12:24		2	46.0	8.0	2.00	120.0	
			4	50.0	4.0	2.00	120	
			7	54.0	0.0	1.33	80.0	106.7



Reccomended Rate (in/hr)
92.0

Infiltration Test 2 Trial 1			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-1**
Standpipe Diameter (in)	6		0	48.0	6.0			
Standpipe Height AGS (in)	0		3	51.0	3.0	1.00	60.0	
Test Depth BGS (in)	54		7	54.0	0.0	0.75	45.0	52.5
Volume of Water Added (gal)	1							
Clocktime	13:09							
ASTM Soil Type	(SW)							
Infiltration Test 2 Trial 2			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**AVG Rate of Fall T-2**
Volume of Water Added (gal)	0.75		0	47.5	6.5			
Clocktime	13:17		4	51.0	3.0	0.88	52.5	
			8	54.0	0.0	0.75	45.0	48.8
Infiltration Test 2 Trial 3			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**AVG Rate of Fall T-2**
Volume of Water Added (gal)	1		0	44.0	10.0			
Clocktime	13:33		2	48.0	6.0	2.00	120.0	
			4	52.0	2.0	2.00	120.0	
			7	54.0	0.0	0.67	40.0	120.0



Reccomended Rate (in/hr)
49.0

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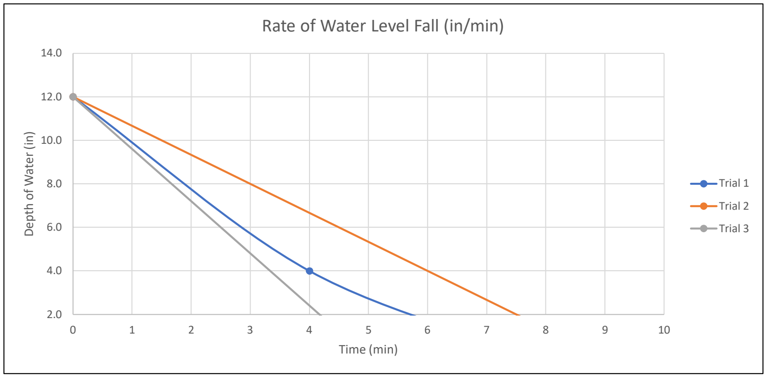
Infiltration Test Results

Project: American Pacific International Capital - Florence Site
Testing Date: December 17, 2019
BEI Project Number: 19-510
Test Type: Encased Falling Head Infiltration
Time = 0 at addition of H2O

Infiltration Test 3 Trial 1			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-1 (in/hr)**
Standpipe Diameter (in)	6		0	44.0	12.0			
Standpipe Height AGS (in)	0		4	52.0	4.0	2.00	120.0	
Test Depth BGS (in)	56		8	56.0	0.0	1.00	60.0	90.0
Volume of Water Added (gal)	1							
Clocktime at Start	13:52							
ASTM Soil Type	(SW)							
Infiltration Test 3 Trial 2			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-2 (in/hr)**
Volume of Water Added (gal)	1		0	44.0	12.0			
Clocktime	14:01		9	56.0	0.0	1.33	80.0	80.0
Infiltration Test 3 Trial 3			**Elapsed Time (min)**	**Depth to Water Surface (in)**	**Depth of Water (in)**	**Rate of Fall (in/min)**	**Rate of Fall (in/hr)**	**Avg Rate of Fall T-3 (in/hr)**
Volume of Water Added (gal)	1		0	44.0	12.0			
Clocktime	14:11		5	56.0	0.0	2.40	144.0	144.0



Reccomended Rate (in/hr)
80.0

Replacement Log

RECEIVED
DEC 11 1995

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

LANE
50937

(START CARD) # 41065

Instructions for completing this report are on the last page of this form.

(1) OWNER:
Well Number 2
Name Florence Resort Community
Address 1050 35th St.
City Florence State OR Zip 97439

(2) TYPE OF WORK
☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☒ Yes ☐ No Depth of Completed Well 105 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
16"	0'	20'	Bentonite	0'	20'	24 sacks
12"	20'	108'				

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	+2'	33'	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	10"	25'	45'	.250	☒	☐	☒	☐
	10"	95'	105'	.250	☒	☐	☒	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☒ Screens Type V-Wire Material Stainless

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
45'	95'	.008		12"	Tele	☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
well output may fluctuate

☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
430	62		10.5 hrs.

Temperature of water 51° Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County Lane Latitude Longitude
Township 18 S N or S Range 12 W E or W. WM.
Section 15 SW 1/4 SE 1/4
Tax Lot 800 Lot Block Subdivision
Street Address of Well (or nearest address) 1050 35th St.
Florence, OR

(10) STATIC WATER LEVEL:
21 ft. below land surface. Date 9/23/92
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found

From	To	Estimated Flow Rate	SWL
21	105	430	21

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
sand brown	0	64	21
sand & blue	64	105	21
sand + blue clay	105	108	21

Date started 5/9/92 Completed 9/22/92

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number
Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 97
Signed Mark Amundsen Date 9/29/92

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

Replacement Log

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

LANE
50936

RE[illegible]
DEC 1 1 1995
WATER [illegible]
SALEM, OREGON

Instructions for completing this report are on the last page of this form.

(START CARD) # 41058

(1) OWNER:
Well Number 1
Name Florence Resort Community
Address 1050 35th St.
City Florence State OR Zip 97439

(2) TYPE OF WORK
☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:
☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger
☐ Other

(4) PROPOSED USE:
☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:
Special Construction approval ☒ Yes ☐ No Depth of Completed Well 70.5 ft.
Explosives used ☐ Yes ☒ No Type Amount

HOLE			SEAL			
Diameter	From	To	Material	From	To	Sacks or pounds
16"	0'	9'	Bentonite	0	9'	12 Sacks
12"	9'	70.5'				

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E
☒ Other
Backfill placed from ft. to ft. Material
Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	12"	+2'	26'	.250	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:	10"	20.5'	25.5'	.250	☒	☐	☒	☐
	10"	65.5'	70.5'	.250	☒	☐	☒	☐

Final location of shoe(s)

(7) PERFORATIONS/SCREENS:
☐ Perforations Method
☒ Screens Type V. Wire Material Stainless

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
25.5	65.5	.008		12"	Tele	☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
well output may fluctuate

☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
175	42'	—	12+ hr.

Temperature of water 51° Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL by legal description:
County Lane Latitude Longitude
Township 18 S N or S Range 12 W E or W. WM.
Section 15 SW 1/4 SE 1/4
Tax Lot 800 Lot Block Subdivision
Street Address of Well (or nearest address) 1050 35th St
Florence, OR

(10) STATIC WATER LEVEL:
62 ft. below land surface. Date 7/30/92
Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:
Depth at which water was first found

From	To	Estimated Flow Rate	SWL
12	70	175	62

(12) WELL LOG:
Ground Elevation

Material	From	To	SWL
Sand	0	41	62
Sand w/ peat	41	47	62
Sand lt blue	47	72	62
Steel plate welded on bottom			

Date started 4/26/92 Completed 9/22/92

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number
Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 97
Signed Date 9/29/92

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

Soil Map—Lane County Area, Oregon

Map Scale: 1:2,300 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- ☐ Area of Interest (AOI)

Soils

- ☐ Soil Map Unit Polygons
- 〰 Soil Map Unit Lines
- 🟧 Soil Map Unit Points

Special Point Features

- ◎ Blowout
- ☒ Borrow Pit
- ✱ Clay Spot
- ◇ Closed Depression
- ✕ Gravel Pit
- ∴ Gravelly Spot
- ● Landfill
- ⋀ Lava Flow
- ⩩ Marsh or swamp
- ⚒ Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- ∨ Rock Outcrop
- ＋ Saline Spot
- ⁘ Sandy Spot
- ⊖ Severely Eroded Spot
- ◈ Sinkhole
- ⅋ Slide or Slip
- ø Sodic Spot
- ≡ Spoil Area
- ◊ Stony Spot
- ◊◊ Very Stony Spot
- ♆ Wet Spot
- △ Other
- ⁃ Special Line Features

Water Features

- ∼ Streams and Canals

Transportation

- ┼┼┼ Rails
- 〰 Interstate Highways
- 〰 US Routes
- 〰 Major Roads
- 〰 Local Roads

Background

- ▨ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lane County Area, Oregon
Survey Area Data: Version 16, Sep 10, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 27, 2007—Sep 15, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
131C	Waldport fine sand, 0 to 12 percent slopes	10.4	92.5%
140	Yaquina loamy fine sand	0.8	7.5%
Totals for Area of Interest		**11.2**	**100.0%**

Lane County Area, Oregon

131C—Waldport fine sand, 0 to 12 percent slopes

Map Unit Setting

National map unit symbol: 234r
Elevation: 0 to 150 feet
Mean annual precipitation: 60 to 100 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 165 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Waldport and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Waldport

Setting

Landform: Dunes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sand of mixed origin

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 3 inches: moderately decomposed plant material
H1 - 3 to 8 inches: fine sand
H2 - 8 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Heceta

Percent of map unit: 4 percent

Landform: Interdunes
Hydric soil rating: Yes

Yaquina

Percent of map unit: 4 percent
Landform: Marine terraces
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Lane County Area, Oregon
Survey Area Data: Version 16, Sep 10, 2019

Lane County Area, Oregon

140—Yaquina loamy fine sand

Map Unit Setting

National map unit symbol: 2359
Elevation: 20 to 130 feet
Mean annual precipitation: 70 to 80 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 180 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Yaquina and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Yaquina

Setting

Landform: Dune slacks
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sand of mixed origin

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
H1 - 1 to 9 inches: loamy fine sand
H2 - 9 to 30 inches: fine sand
H3 - 30 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Somewhat Poorly Drained (G004AY017OR)

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Lane County Area, Oregon
Survey Area Data: Version 16, Sep 10, 2019

APPENDIX B:

Recommended Earthwork Specifications

GEOTECHNICAL SPECIFICATIONS

General Earthwork

1. All areas where structural fills, fill slopes, structures, or roadways are to be constructed shall be stripped of organic topsoil and cleared of surface and subsurface deleterious material, including but limited to vegetation, roots, or other organic material, undocumented fill, construction debris, soft or unsuitable soils as directed by the Geotechnical Engineer of Record. These materials shall be removed from the site or stockpiled in a designated location for reuse in landscape areas if suitable for that purpose. Existing utilities and structures that are not to be used as part of the project design or by neighboring facilities, shall be removed or properly abandoned, and the associated debris removed from the site.
2. Upon completion of site stripping and clearing, the exposed soil and/or rock shall be observed by the Geotechnical Engineer of Record or a designated representative to assess the subgrade condition for the intended overlying use. Pits, depressions, or holes created by the removal of root wads, utilities, structures, or deleterious material shall be properly cleared of loose material, benched and backfilled with fill material approved by the Geotechnical Engineer of Record compacted to the project specifications.
3. In structural fill areas, the subgrade soil shall be scarified to a depth of 4-inches, if soil fill is used, moisture conditioned to within 2% of the materials optimum moisture for compaction, and blended with the first lift of fill material. The fill placement and compaction equipment shall be appropriate for fill material type, required degree of blending, and uncompacted lift thickness. Assuming proper equipment selection, the total uncompacted thickness of the scarified subgrade and first fill lift shall not exceed 8-inches, subsequent lifts of uncompacted fill shall not exceed 8-inches unless otherwise approved by the Geotechnical Engineer of Record. The uncompacted lift thickness shall be assessed based on the type of compaction equipment used and the results of initial compaction testing. Fine-grain soil fill is generally most effectively compacted using a kneading style compactor, such as a sheeps-foot roller; granular materials are more effectively compacted using a smooth, vibratory roller or impact style compactor.
4. All structural soil fill shall be well blended, moisture conditioned to within 2% of the material’s optimum moisture content for compaction and compacted to at least 90% of the material’s maximum dry density as determined by ASTM Method D-1557, or an equivalent method. Soil fill shall not contain more than 10% rock material and no solid material over 3-inches in diameter unless approved by the Geotechnical Engineer of Record. Rocks shall be evenly distributed throughout each lift of fill that they are contained within and shall not be clumped together in such a way that voids can occur.
5. All structural granular fill shall be well blended, moisture conditioned at or up to 3% above of the material’s optimum moisture content for compaction and compacted to at least 90% of the material’s maximum dry density as determined by ASTM Method D-1557, or an equivalent method. 95% relative compaction may be required for pavement base rock or in upper lifts of the granular structural fill where a sufficient thickness of the fill section allows for higher compaction percentages to be achieved. The granular fill shall not contain solid particles over 2-inches in diameter unless special density testing methods or proof-rolling is approved by the Geotechnical Engineer of Record. Granular fill is generally considered to be a crushed aggregate with a fracture surface of at least 70% and a maximum size not exceeding 1.5-inches in diameter, well-graded with less than 10%, by weight, passing the No. 200 Sieve.
6. Structural fill shall be field tested for compliance with project specifications for every 2-feet in vertical rise or 500 cy placed, whichever is less. In-place field density testing shall be performed by a competent individual, trained in the testing and placement of soil and aggregate fill placement, using either ASTM Method D-1556/4959/4944 (Sand Cone), D-6938 (Nuclear Densometer), or D-2937/4959/4944 (Drive Cylinder). Should the fill materials not be suitable for testing by the above methods, then observation of placement, compaction and proof-rolling with a loaded 10 cy dump-truck, or equivalent ground pressure equipment, by a trained individual may be used to assess and document the compliance with structural fill specifications.

Utility Excavations

1. Utility excavations are to be excavated to the design depth for bedding and placement and shall not be over-excavated. Trench widths shall only be of sufficient width to allow placement and proper construction of the utility and backfill of the trench.
2. Backfilling of a utility trench will be dependent on its location, use, depth, and utility line material type. Trenches that are required to meet structural fill specifications, such as those under or near buildings, or within pavement areas, shall have granular material strategically compacted to at least the spring-line of the utility conduit to mitigate pipeline movement and deformation. The initial lift thickness of backfill overlying the pipeline will be dependent on the pipeline material, type of backfill, and the compaction equipment, so as not to cause deflection or deformation of the pipeline. Trench backfill shall conform to the General Earthwork specifications for placement, compaction, and testing of structural fill.

Geotextiles

1. All geotextiles shall be resistant to ultraviolet degradation, and to biological and chemical environments normally found in soils. Geotextiles shall be stored so that they are not in direct sunlight or exposed to chemical products. The use of a geotextile shall be specified and shall meet the following specification for each use.

<u>Subgrade/Aggregate Separation</u>

Woven or nonwoven fabric conforming to the following physical properties:

• Minimum grab tensile strength	ASTM Method D-4632	180 lb
• Minimum puncture strength (CBR)	ASTM Method D-6241	371 lb
• Elongation	ASTM Method D-4632	15%
• Maximum apparent opening size	ASTM Method D-4751	No. 40
• Minimum permittivity	ASTM Method D-4491	0.05 s^{-1}

<u>Drainage Filtration</u>

Woven fabric conforming to the following physical properties:

• Minimum grab tensile strength	ASTM Method D-4632	110 lb
• Minimum puncture strength (CBR)	ASTM Method D-6241	220 lb
• Elongation	ASTM Method D-4632	50%
• Maximum apparent opening size	ASTM Method D-4751	No. 40
• Minimum permittivity	ASTM Method D-4491	0.5 s^{-1}

<u>Geogrid Base Reinforcement</u>

Extruded biaxially or triaxially oriented polypropylene conforming to the following physical properties:

• Peak tensile strength lb/ft	ASTM Method D-6637	925
• Tensile strength at 2% strain lb/ft	ASTM Method D-6637	300
• Tensile strength at 5% strain lb/ft	ASTM Method D-6637	600
• Flexural Rigidity	ASTM Method D-1388	250,000 mg-cm
• Effective Opening Size rock size	ASTM Method D-4751	1.5x