ATTACHMENT E

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ADDENDUM to GEOTECHNICAL SITE EVALUATION REPORT– Commercial Development
Bandon Beach Motel,
1090 Portland Ave. SW
Bandon, Oregon 97411

CGS Project No: 17050

Mr. Robert S. Miller III,
Attorney at Law
BANDON PROFESSIONAL CENTER
1010 First Street S.E., Suite 210
Bandon, Oregon 97411

Cascadia Geoservices, Inc. (CGS) is pleased to submit this Addendum to our Geotechnical Site Evaluation Report dated July 31, 2017 for the Bandon Beach Motel site located at 1090 Portland Ave. SW, Bandon, Oregon. Our understanding is a based on an email dated October 11, 2018 from you.

We understand that the plans for the new hotel structure have changed and that your client is now proposing to build a two-story structure with a basement. The original plan was to build a three-story building with basement. You indicated in your email to us that this will result in lowering the building from 45 feet to 24 feet. We further understand that there are no other planned changes in siting the building on the subject property and no plans to move the footprint of the structure to the west or south towards the bluff.

Based on these understandings, it is CGS's professional opinion that the recommendations provided in the Geotechnical Site Evaluation Report dated July 31, 2017 regarding, but not limited to, Design and Construction are still valid in preparing and developing the site. At the time that this addendum was written, CGS had not been provided with building documents for the new structure.

In an email from you dated May 3, 2018, we were informed that local complainants raised concerns about the development suitability of the site. They referenced earlier geotechnical site evaluations[1],[2] which were done as part of the design phase of the Coquille Point South Stairway project. Based on a request by you, we reviewed these reports and in an email attachment to you dated May 12, 2018, provided the following response:

> *"After review of our report and of the geotechnical report provided by others, it is still CGS's professional opinion that the site is suitable for the proposed hotel structure. We refer you to our report regarding the scope of our site evaluation and our findings.*
>
> *In summary, we determined that the site is underlain by medium dense to dense native soils and hard bedrock and that these soils and rock are suitable to support the proposed hotel structure. We further determined that the site was geologically stable with no visible landslides, earthflows or other geologic hazards impacting the site. And, we reviewed beach profiles and determined that erosion and bluff retreat do not pose a threat to the proposed development for the life of the structure. We further note that the proposed hotel site is, at the closest point, 45 feet from the break in slope on the sea cliff and meets the requirements for setback as provided under the 2017 IBC."*

The site, which is located in the City of Bandon, is zoned Controlled Development Zone One (CD-1). Under the City's Municipal Code 17.24.040C, the city requires, prior to development, a soils, geology and hydrology report for the subject property. The code further requires that the reports be prepared by a professional geologist and professional engineer currently registered in the state of Oregon. CGS's Geotechnical Site Evaluation Report dated July 31, 2017 meet the requirements of the city's municipal code for the proposed new hotel structure.

LIMITATIONS

Cascadia Geoservices, Inc.'s (CGS) professional services have been performed, findings obtained, and recommendations prepared in accordance with generally

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[1] Report of Geotechnical Engineering Services, Coquille Point Stairway, Bandon, Oregon, April 23, 2015. Prepared for U.S. Fish and Wildlife Service by Hart Crowser

[2] Alder Geotechnical Services (AGS) 1997. *Geotechnical Investigation for Proposed North and South Beach Accesses Oregon Islands National Wildlife Refuge Bandon, Oregon,* October 28, 1997.

accepted principles and practices for geologists and geotechnical engineers. No other warranty, express or implied, is made. The client acknowledges and agrees that:

1. CGS is not responsible for the conclusions, opinions, or recommendations made by others based upon our findings.
2. The scope of our services is intended to evaluate soil and groundwater (ground) conditions within the primary influence or influencing the engineered improvements. Our services do not include an evaluation of potential ground conditions beyond the depth of our explorations. Analyses and recommendations submitted in writing or verbally will be based on the data obtained from our literature review, discussions with knowledgeable persons, observations, and explorations performed at the location indicated. Regardless of the thoroughness of a geologic and geotechnical exploration, there is always a possibility that conditions in areas not specifically observed will be different from specific observations made at our discrete observation location. In addition, the construction process itself may alter soil and groundwater conditions. If any subsurface variations become evident during the course of this project, a re-evaluation of our recommendations will be necessary after Cascadia Geoservices, Inc. has had an opportunity to observe the conditions encountered.
3. Recommendations provided herein are based in part upon project information provided to CGS. Our work will apply only to the specific project and subject site. If the project information is incorrect or if additional information becomes available, the correct or additional information should be immediately conveyed to CGS for review. Cascadia Geoservices, Inc. recommends that we be retained to provide Construction Observation Services (COS) based upon our familiarity with the project, the subsurface conditions, and the geotechnical recommendations and design criteria provided.
4. The scope of services does not include evaluations regarding the presence or absence of contaminated soils or wetlands.
5. The Pacific Northwest region is subject to intense subduction zone earthquakes, tsunamis, and other less extraordinary geologic hazards, including shallow fault earthquakes, deep earthquakes, landslides, debris flows, and flooding. As such, we cannot predict nor preclude the possibility of such natural occurrences,

whose magnitude cannot be anticipated or provided against by the exercise of ordinary care. By necessity, the current and future owners of this property must assume the risks associated with any such natural occurrences, and release and hold harmless Cascadia Geoservices, Inc., its owners, agents, and representatives from any liability for damages resulting therefrom.

Cascadia Geoservices, Inc. recommends that upon completion of our work, we be retained to provide review of geotechnical items in the final design documents and Construction Observation Services (COS) once construction begins.

PROFESSIONAL QUALIFICATIONS

Please refer to our website, www.cascadiageoservices.com, to review our qualifications.

Sincerely,

Cascadia Geoservices, Inc.

ERIC T. OBERBECK
1332
Eric Oberbeck

#12,910
MAY 23 1985
FREDERICK G. THRALL

Eric Oberbeck, RG, CEG
Expires June 1, 2019

Frederick G. Thrall, PE, GE
Expires June 30, 2020

XC: Garrett Harabedian
Sent via e-mail: GHarabedian@nwks.com

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May 12, 2018

Robert S. Miller III, Attorney at Law
BANDON PROFESSIONAL CENTER
1010 First Street S.E., Suite 2
Bandon, Oregon 97411

GEOTECHNICAL SITE EVALUATION – Commercial Development
Bandon Beach Hotel,
1090 Portland Ave. SW
Bandon, Oregon 97411

CGS Project No.: 16084

Dear Mr. Miller,

Based on your email to us dated May 3, 2018, Cascadia Geoservices, Inc. (CGS) has reviewed our Geotechnical Site Evaluation Report[1] dated July, 31 2017 for the above property. We understand that local complainants have raised concerns about development suitability of the site and have referenced an earlier geotechnical report[2] provided by others for the Coquille Point Stairway project. We further understand that you are asking CGS to review the reports and to provide you with a one-page opinion as to whether CGS finds it necessary to modify our conclusions and recommendations provided in the 2017 report.

After review of our report and of the geotechnical report provided by others[2], it is still CGS's professional opinion that the site is suitable for the proposed hotel structure. We refer you to our report regarding the scope of our site evaluation and our findings. In summary, we determined that the site is underlain by medium dense to dense native

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[1] Geotechnical Site Evaluation – Commercial Development, Bandon Beach Motel, July, 31 2017. Prepared for NORTHWORKS Architects + Planners by Cascadia Geoservices, Inc.

[2] Report of Geotechnical Engineering Services, Coquille Point Stairway, Bandon, Oregon, April 23, 2015. Prepared for U.S. Fish and Wildlife Service by Hart Crowser

sands and hard bedrock and that these soils and rock are suitable to support the proposed hotel structure. We further determined that the site was geologically stable with no landslides, earthflows or other geologic hazards impacting the site. And, we reviewed beach profiles and determined that erosion and bluff retreat do not pose a threat to the proposed development for the life of the structure. We further note that the proposed hotel site is, at the closest point, 45 feet from the break in slope on the sea cliff and meets the requirements for setback as provided under the 2017 IBC.

LIMITATIONS

Cascadia Geoservices, Inc.'s (CGS) professional services have been performed, findings obtained, and recommendations prepared in accordance with generally accepted principles and practices for geologists and geotechnical engineers. No other warranty, express or implied, is made. The client acknowledges and agrees that:

1. CGS is not responsible for the conclusions, opinions, or recommendations made by others based upon our findings.
2. The scope of our services is intended to evaluate soil and groundwater (ground) conditions within the primary influence or influencing the engineered improvements. Our services do not include an evaluation of potential ground conditions beyond the depth of our explorations. Analyses and recommendations submitted in writing or verbally will be based on the data obtained from our literature review, discussions with knowledgeable persons, observations, and explorations performed at the location indicated. Regardless of the thoroughness of a geologic and geotechnical exploration, there is always a possibility that conditions in areas not specifically observed will be different from specific observations made at our discrete observation location. In addition, the construction process itself may alter soil and groundwater conditions. If any subsurface variations become evident during the course of this project, a re-evaluation of our recommendations will be necessary after Cascadia Geoservices, Inc. has had an opportunity to observe the conditions encountered.
3. Recommendations provided herein are based in part upon project information provided to CGS. Our work will apply only to the specific project and subject site. If the project information is incorrect or if additional information becomes available, the correct or additional information should be immediately

conveyed to CGS for review. Cascadia Geoservices, Inc. recommends that we be retained to provide Construction Observation Services (COS) based upon our familiarity with the project, the subsurface conditions, and the geotechnical recommendations and design criteria provided.

4. The scope of services does not include evaluations regarding the presence or absence of contaminated soils or wetlands.
5. The Pacific Northwest region is subject to intense subduction zone earthquakes, tsunamis, and other less extraordinary geologic hazards, including shallow fault earthquakes, deep earthquakes, landslides, debris flows, and flooding. As such, we cannot predict nor preclude the possibility of such natural occurrences, whose magnitude cannot be anticipated or provided against by the exercise of ordinary care. By necessity, the current and future owners of this property must assume the risks associated with any such natural occurrences, and release and hold harmless Cascadia Geoservices, Inc., its owners, agents, and representatives from any liability for damages resulting therefrom.

Sincerely,

Cascadia Geoservices, Inc.

ERIC T. OBERBECK
Eric Oberbeck
1332

12,910
MAY 23 1985
FREDERICK G. THRALL

Eric Oberbeck, RG, CEG
Expires June 1, 2018

Frederick G. Thrall, PE, GE
Expires June 30, 2018

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GEOTECHNICAL SITE EVALUATION – Commercial Development

Bandon Beach Motel, 1090 Portland Ave. SW
Bandon, Oregon 97411

Prepared for:	**Prepared by:**
Garrett Harabedian, RA, NCARB, LEED AP Project Architect NORTHWORKS Architects + Planners 1512 North Throop St., Chicago, Illinois 60642 Sent via e-mail: GHarabedian@nwks.com	Cascadia Geoservices, Inc. 190 6th Street PO Box 1026 Port Orford, Oregon 97465
CGS Project No.: 17050	**Date:** July, 31 2017

Table of Contents

INTRODUCTION

Cascadia Geoservices, Inc. (CGS) is pleased to submit this Geotechnical Site Evaluation Report for the site located at 1090 Portland Ave. SW, Bandon, Oregon (Figure 1, Site Location Map). The site proposed for development (subject property or site) is currently occupied by a two-story wood-frame structure (Bandon Beach Motel). We understand that you are proposing to remove the existing structure and to replace it with a new three-story, 34,000 sq. ft. hotel and restaurant with an occupiable basement level and adjacent surface parking. The site, which is located in the city of Bandon, Oregon, is zoned Controlled Development Zone One (CD-1). Under the city's municipal code, a soils, geology, and hydrology report for the subject property is required. This document constitutes that required report and summarizes our project understanding, site investigation, and subsurface explorations, and provides our conclusions and recommendations for constructing on the site.

PROJECT DESCRIPTION AND UNDERSTANDING

We understand that your client is proposing to build a new three-story, 34,000 sq. ft. hotel and restaurant with an occupiable basement level and adjacent surface parking. We further understand that there is an existing structure on the site which is slated for demolition prior to construction.

Our understanding is based on a phone call with you on May 30, 2017, a Request for Proposal from you dated May 31, 2017, and on preliminary drawings (Progress Packet) dated April 19, 2017 which were sent to us by you on May 31, 2017. And, our understanding is based on four site visits: the first on June 12, 2017 at which time a site reconnaissance of the site and surrounding area was conducted; the second on July 1, 2017 at which time three exploratory borings were completed; the third on July 11, 2017 at which time an open tip piezometer was installed in Boring B-1; and on July 18, 2017 at which time the water level in the piezometer was measured.

We further understand, based on mapping done by others,[1,2] that soils at the site consist of sandy loam (Bullards sandy loam) which are well drained soils derived from mixed

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[1] United States Department of Agriculture (USDA). Natural Resource Conservation Service Web Soil Survey. Retrieved March 14, 2017 from http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. **Note: A portion of this report is included here as Attachment 1. For a copy of the complete report, please contact our office.**

[2] Thomas J. Wiley, et al. (2014). Geologic Map of the Southern Oregon Coast between Port Orford and Bandon, Curry, and Coos Counties, Oregon. Oregon Department of Geology and Mineral Industries (DOGAMI) Open-File Report O-14-0.

eolian and marine deposits. These soils overlay surficial sediments of Quaternary Marine Terrace deposits of semi-consolidated sand, silt, clay, and gravel. Below the terrace sands are Late Mesozoic Mélange Rocks of Sixes River. These are an assemblage of sedimentary, volcanic, and metamorphic rocks which vary dramatically in both composition and degree of metamorphism. The contact between the terrace sands and bedrock is unconformable. Regionally, bedding within bedrock is variable. This assemblage of rocks, which is exposed in the sea cliff west of the site (Photo 1), was subsequently elevated during coastal uplift associated with regional tectonics.

SURFACE DESCRIPTION

The site is located on an elevated coastal marine terrace which is part of a larger, regional landform within the Coast Range Physiographic Region of Southwestern Oregon and which is known locally as the Bandon Bluff. The site sits at an elevation of 81 feet Above Mean Sea Level (AMSL) and is east of the edge of the bluff, a distance of approximately 45 feet at the nearest point.

The site is level and is bordered to the east by residential development, to the south by a city park, and to the north and west by undeveloped, vacant land. The site and structure appeared stable at the time of our site visit with no settlement or ground cracks observed.

SUBSURFACE EXPLORATIONS

CGS drilled three borings during our July 1, 2017 site visit. The borings were drilled to identify and observe surficial fill, native soil, and bedrock. Each of the borings was drilled to bedrock which resulted in refusal to advance the drill bit. The borings were drilled using a trailer-mounted drill rig and advanced using conventional auger drilling techniques. Standard Penetration Tests (SPT) of the soil samples were completed at 2.5-foot intervals for the first 10 feet and 5-foot intervals thereafter. The borings were logged by an Oregon Certified Engineering Geologist from our Port Orford, Oregon office. Summary logs are included here as Attachment 2. The locations of the borings are shown on Figure 2, Site Map.

Soil samples from the borings were collected and stored in sealed plastic bags and transported to our laboratory in Woodland, Washington for analysis.

SUBSURFACE CONDITIONS ENCOUNTERED

Our analysis of the subsurface conditions on the site is based on the soils and rock encountered in our borings and is summarized as follows:

> **Fill:** We encountered fill in all three of the borings. The fill was minimal and ranged from 2.5 to 5.0 feet thick. In Boring B-1, the fill consisted of brown, medium-dense silty sand with some gravel which overlays medium-dense 3/4-inch road base gravel. In Boring B-3, drilled near the southeast side of the existing structure, we encountered loose brown organic silt. We infer that this was placed during landscaping of the site.
>
> **Surficial Deposits (Quaternary Marine Coastal Deposits):** Beginning at a depth of 2.5 to 5.0 feet bgs in all three borings, we encountered medium-dense to dense tan and tan-brown fine sand. We infer that this is part of the Quaternary Marine Coastal Deposits as identified by others.[2] The sand was observed to have thin interlayers of stiff to very stiff gray clay at 5.0 feet bgs in Boring B-2 and at 7.5 and 15.0 feet bgs in Boring B-3. The fine sand becomes coarse, rounded sand near the bottom of the unit at 10.0 feet bgs in Boring B-1 and 15.0 feet bgs in Boring B-2. We infer that coarse sand is also present near the base of the unit at 32.5 feet bgs in Boring B-3. A basal coarse sand layer has been noted in other places within the Quaternary Marine Coastal Deposits and typically contains groundwater as it does in our borings.
>
> **Bedrock (Late Mesozoic Mélange Rock of Sixes River):** We encountered bedrock in all three borings. In Boring B-1, we encountered soft (R-1) gray-green sandstone, intensely weathered at 15.4 feet bgs. In Borings B-2 and B-3, we encountered hard (R-4) green-tan chert at 21.9 and 32.0 feet bgs, respectively. Bedrock resulted in much harder drilling and refusal to advance the auger.

Figure 2, Site Map, shows the location of the borings. It should be noted that the contact with bedrock becomes significantly deeper to the southeast. We infer from this that the site may border an ancient drainage swale to the south.

GROUNDWATER

Groundwater was encountered in all three borings, ranging in depth from 13 to 15 feet bgs. In the two western borings (B-1 and B-2), groundwater occurs within the sands near the base of the Quaternary Marine Coastal Deposits but appears at the same elevation in Boring B-3. This indicates that groundwater is independent of the terrace sands-bedrock contact. We infer that groundwater follows topography and that the hydraulic gradient is to the west.

In order to monitor groundwater, an open tip piezometer was installed on July 1, 2017 in Boring B-1 at a depth of 13.3 feet bgs. The depth of installation was restricted due to flowing sands and caving of the bore hole.

The bottom of the piezometer, which includes the groundwater intake zone, was bedded in sand. The sand intake zone was capped with bentonite and bentonite-cement grout (see completion diagram, Boring B-1 Log). An initial water level reading in the piezometer was measured using a Solinst Groundwater Meter on July 18, 2017. The static water level in Boring B-1 was measured at 13.3 feet bgs. This corresponds with water observed in the samples collected in Boring B-1 on July 1, 2017 and further agrees with groundwater elevations in Borings B-2 and B-3 of 15.0 feet and 13.0 feet bgs, respectively, as determined by moisture content of the samples.

It should be noted that the porous sands within the lower part of the surficial deposits (Quaternary Marine Coastal Deposits) is the primary aquifer locally but that the terrace sands do develop zones of shallow, perched groundwater. It should be further noted that the elevation of these perched aquifers will rise during periods of surface recharge due to seasonal rainfall. Because of this, we recommend that groundwater on the site be monitored through the winter months in order to determine seasonal elevations of the water table or the design should anticipate shallower groundwater, particularly for the proposed occupied below-grade portion of the structure.

LABORATORY ANALYSIS

Select samples were packaged in moisture-tight bags and shipped to our laboratory in Woodland, Washington where they were classified in general accordance with the Unified Soil Classification System, Visual-Manual Procedure. In addition, Moisture Content (ASTM 2216), Percent Fines (ASTM D114), and Atterberg Limits (ASTM D431) were determined for selected samples. The results are summarized below in Table 1. The Lab Analysis Reports for the samples are provided as Attachment 3.

Table 1: Laboratory Testing Results

Sample ID	Boring Depth (feet)	Type of Soil	Moisture Content (%)	% Fines (Silts and Clays)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	USCS Symbol
SS-2	B-1 (5)	Clayey Sand	18.9					SC
SS-4	B-1 (10)	Sand	10.9	13.0				SP
SS-7	B-2 (5)	Clay	21.0		20	19	1	CL
SS-9	B-2 (10)	Sand	10.4	8.2				SP
SS-14	B-3 (7.5)	Sandy Clay	29.8		28	25	3	CL
SS-15	B-3 (10)	Sand	16.4	17.3				SP
SS-17	B-3 (20)	Sand	18.6					SP

Moisture content, as determined in the lab, indicates that residual water content in the clay layers is high. We infer that this is due to surface saturation and to the clays' intrinsic water-holding capacity. The clay encountered within shallow layers within the sand in B-1 and B-2, was determined to be low plasticity. Based on our experience with these soils, which are derived from weathering of sedimentary rocks, and on our lab analysis, these clay soils are determined to be non-swelling.

GEOLOGIC HAZARDS

Oregon's Department of Geology and Mineral Industries (DOGAMI), in concert with others,[3] has begun monitoring rates of erosion along parts of the Oregon coastline. They have identified chronic coastal hazards such as mass wasting of sea cliffs and recession of coastal bluffs caused by wave attack and geologic instability. This process is termed bluff retreat.

As indicated by the presence of storm debris along the base of the sea cliff (Photo 2), wave-sea cliff interaction is occurring along the base of the sea cliff to the southwest of the subject property (Figure 3, Aerial Photograph). Beach profiles conducted by others[3] using Real Time Kinematic Differential Global Positioning Systems (RTK-DGPS) provide a

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[3] Washington Department of Ecology (WA beaches), Oregon Department of Geology and Mineral Industries (OR beaches), and at Oregon State University (OR/WA near shore bathymetry) accessed July 5, 2015 The Northwest Association of Networked Ocean Observing Systems (NANOOS) website at http://www.nanoos.org/.

measure of the response of the beach to variations in the offshore wave energy, which is reflected in accretion of sediments on the beach during the summer and erosion of sediments in winter. A beach profile (Bandon09, Figure 4) taken 180 feet southwest of the site during various times during the summer and winter beginning in 2002, and most recently surveyed in February 2009, indicates that 18 feet of erosion has occurred along the base of the sea cliff beginning in September 2002 until February 2009. This indicates a rate of over two (2) feet of beach erosion per year. The profile indicates that deposition occurred along the beach for the period from April 1998 until September 2002.

It is our opinion that bluff retreat does not pose a threat to this property over the anticipated life of the proposed structure. We base our opinion on the hard, resistant bedrock encountered in Borings B-2 and B-3 and exposed at the base of the bluff.

DISCUSSION AND RECOMMENDATIONS

Feasibility

Based on our investigation and experience with similar soils, it is CGS's opinion that the site is geologically suitable for the proposed structure and that the structure can be supported on conventional spread footings provided the site is prepared in accordance with our recommendations. We base this on our work experience involving similar structures in similar settings.

As we note in the **Groundwater** section of this report, it has been our experience that shallow, perched water tables will develop in the surficial deposits during periods of sustained seasonal rainfall. Because of this, we recommend that either groundwater be monitored during the winter months or that near-surface, shallow groundwater elevations be anticipated for purposes of design.

The site, which is located in the city of Bandon, is zoned Controlled Development Zone One (CD-1). Under the city's municipal code, a soils, geology, and hydrology report for the subject property is required prior to development. It is our professional opinion that this geotechnical report meets that standard and provides information, conclusions, and recommendations as they pertain to the soils, geology, and hydrology of the site. The authors of this report are an Oregon Certified Engineering Geologist and a Licensed Oregon Geotechnical Engineer.

DESIGN

Spread Footing Design Recommendations

Our analysis and recommendations are based on the following physical properties of the soil and rock encountered:

Depth below Surface (feet)	Type of Soil	Blow Counts, N[4]	Effective Unit Weight (pcf)	Drained Friction Angle, φ' (degrees)	Drained Cohesion, c' (psf)
0 – 2.5	Variable fill (Silt)	2-3 (est.)	70-100	34	0
2.5 -5.0	Gravel	8	120	0	500
2.5 – 32.0	Fine to coarse sand with interlayered clay	11 to 31	125	25-28	0
15.5 – 32.0	Soft sandstone, hard chert	50+	130 (?)	0	5,000

All footings should be designed for an allowable bearing pressure of 2,000 pounds per square foot (psf) for building column and perimeter foundation loads, assuming the loadings are less than 75 kips for columns and 3 kips per linear foot for strip footings. If greater loads are anticipated, we will need to evaluate the specific load scenario individually. The native soils at the site will likely have a variable consistency. Soft areas should be over-excavated to a firm layer and replaced with structural fill. All surfaces with building foundations should be prepared in accordance with the **Site Preparation** section of this report. The building foundations may be installed on firm native subgrade. Continuous wall and isolated spread footings should be at least 2 and 3 feet wide, respectively. The bottom of exterior footings should be at least 18 inches below the lowest adjacent exterior grade. The bottom of interior footings should be established at least 12 inches below the base of the floor slab.

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[4] Standard Penetration Testing (SPT, ASTM D 1586) involves advancing an 18-inch-long by 2-inch (outer diameter) split spoon sampler with a 140-pound hammer falling 30 inches. The blow counts (hammer strikes) required to advance the sampler for each 6-inch interval are counted and recorded. The number of blows for the final 12 inches is recorded as the N-value. The N-value provides correlation of relative density for granular (coarse-grained) soils, or the consistency of cohesive (fine-grained) soil.

As discussed, footings bearing on firm native subgrade should be sized for an allowable bearing capacity of 2,000 psf. This is a net bearing pressure. The weight of the footing and overlying backfill can be disregarded in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term-live loads, and this bearing pressure may be doubled for short-term loads, such as those resulting from wind or seismic forces.

Based on CGS's estimates and provided that the subgrade is prepared in accordance with CGS's recommendation, total post-construction settlement is estimated to be less than 1 inch, with post-construction differential settlement of less than 0.5 inch over a 50-foot span for maximum column and perimeter footing loads of less than 75 kips and 3 kips per linear foot, respectively.

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structures and by friction at the base of the footings. An allowable passive earth pressure of 250 pounds per cubic foot (pcf) may be used for footings confined by native soils and new structural fills. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent unpaved areas should not be considered when calculating passive resistance. For footings in contact with native soils, use a coefficient of friction equal to 0.35 when calculating resistance to sliding.

CGS should confirm suitable bearing conditions and evaluate all footing subgrades. Observations should also confirm that loose or soft material, construction and demolition debris, organics, unsuitable fill, and old topsoil zones are removed. Localized deepening of footing excavations may be required to penetrate any deleterious materials.

If construction occurs during wet weather, we recommend that a thin layer of compacted crushed rock be placed over the footing subgrades to help protect them from disturbance due to foot traffic and the elements.

The footings should be founded below a line projected at a 1H:1V slope from the base of any adjacent, near parallel, open, or backfill excavations such as utility trenches. Any footings placed adjacent to any slopes must be embedded so that a minimum of 10 feet of horizontal distance is between the face of the footings and any adjacent parallel slope.

Floor Slabs

Satisfactory subgrade support for building floor slabs can be obtained from the native subgrade prepared in accordance with our **Site Preparation** recommendations. Once prepared, an 8-inch-thick layer of imported granular material should be placed and compacted over the prepared subgrade. Imported granular material should be crushed rock or crushed gravel that is fairly well graded between coarse and fine, contains no deleterious materials, has a maximum particle size of one (1) inch, and has less than 5 percent by weight passing the U.S. Standard No. 200 Sieve. Material recommendations are included in **Attachment 5 – General Construction Recommendations** at the end of this report.

Retaining Structures

CGS's retaining wall design recommendations are based on the following assumptions: 1) the walls are conventional, cantilevered retaining walls; 2) the walls are 8 feet or less in height; 3) the backfill is drained; and 4) the backfill has a backslope flatter than 4H:1V.

Evaluation of our recommendations will be required if the retaining wall design criteria for the project vary from these assumptions. Unrestrained site walls that retain native soils or structural fill should be designed to resist equivalent fluid pressures of 35 pcf where back slopes are flatter than 4H:1V. If retaining walls are restrained from rotation prior to being backfilled, the equivalent fluid pressure should be increased to 55 pcf. For embedded building walls, a superimposed seismic lateral force should be calculated based on a dynamic force of $6H^2$ pounds per lineal foot of wall (where H is the height of the wall in feet), and applied at 0.6H from the base of the wall. If other surcharges (e.g., slopes steeper than 4H:1V, foundations, vehicles, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, then additional pressures will need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based upon actual magnitude and configuration of the applied loads.

The wall footings should be designed in accordance with the guidelines provided in the **Spread Footing Design Recommendations** section of this report. These design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls. If a drainage system is not installed, then our office should be contacted for revised design forces.

The backfill material placed behind the walls and extending a horizontal distance equal to at least half of the height of the retaining wall should consist of granular retaining wall backfill as specified in the **Structural Fill** section of this report. A minimum 12-inch-wide zone of drain rock extending from the base of the wall to within 6 inches of finished grade should be placed against the back of all retaining walls. Perforated collector pipes should be embedded at the base of the drain rock.

The drain rock should meet the requirements provided in the **Structural Fill** section of this report. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into storm water drain systems, unless measures are taken to prevent backflow into the wall's drainage system.

Settlements of up to one (1) percent of the wall height commonly occur in the backfill immediately adjacent to the wall, as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flat work adjacent to retaining walls be postponed at least four weeks after backfilling of the wall, unless survey data indicates that settlement is complete prior to that time.

DRAINAGE

Surface and Groundwater Drain

In order to mitigate potential surface runoff and groundwater along the eastern side of the building, we recommend that an enhanced drain be installed at the base of the excavated retaining wall foundation. The surface drain should be sized based on runoff calculations for 8 inches in one 24-hour period rain event, on the subsurface conditions encountered the building. and on the extent of the surface area drained. All pavement and driveway subgrades should be appropriately graded to prevent ponding and to provide positive drainage away from the building.

On-Site Storm Water Infiltration

In the event that city storm drain services are not available for the site, on-site infiltration of groundwater will be required. This will require that an infiltration study be conducted to determine the infiltration rates of the soils and to determine the size of the infiltration system needed. CGS can provide you with infiltration testing under a separate proposal.

Erosion and Storm Water Runoff

It is our opinion that erosion of the subject property and storm water runoff can be controlled by initiating an Erosion and Sediment Control Plan (ESCP), as required by the National Pollutant Discharge Elimination System (NPDES) 1200-C Stormwater Permit Program. Regulation of this permit in Oregon is by the Oregon DEQ. The ESCP should be designed based on DEQ's Best Management Practices as outlined in their Construction Stormwater Erosion and Sediment Control Manual. Both DEQ and Coos County will require submission of the plan and issue a permit. Prior to construction permits being issued, the ESCP will need to be developed and the 1200-C permit issued. CGS can provide you with an ESCP and can assist you with obtaining a 1200-C Stormwater Permit.

Seismic Design Criteria

The subject property is located in an area that is highly influenced by regional seismicity due to the proximity to the Cascadia Subduction Zone (CSZ). Recent studies[5] indicate that the southern portion of the CSZ has generated maximum credible earthquakes with a Moment Magnitude (Mm) of 8.7 or greater every 200 to 300 years. Studies conducted in 2010[6] indicate that Time Dependent Probabilities currently range up to 40% in 50 years for a CSZ rupture. The seismic design criteria for this project are based on the 2015 National Earthquake Hazard Reduction Program (NEHRP) and are taken from the USGS Design Maps Summary Report[7] (included here as Attachment 4). The seismic design criteria, in accordance with the IBC, are summarized in Table 2 below.

Table 2: National Earthquake Hazard Reduction Program Seismic Design Parameters

Seismic Design Parameters	**Short Period**	**1 Second**
Maximum Credible Earthquake Spectral Acceleration	S_s = 2.042 g	S_1 = 0.973 g
Site Class	D = Stiff Soil	

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[5] Goldfinger, C., et al. (2012). Turbidite Event History—Methods and Implications for Holocene Paleoseismicity of the Cascadia Subduction Zone. U.S. Geologic Survey (USGS), Professional Paper: 1661-F.

[6] Oregon State University. "Odds are about 1-in-3 that mega-earthquake will hit Pacific Northwest in next 50 years, scientists say." Science Daily. Science Daily, 25 May 2010. Reviewed at www.sciencedaily.com/releases/2010/05/100524121250.htm

[7] USGS Design Maps Summary Report, accessed from their website at https://earthquake.usgs.gov/designmaps/beta/us/ in July, 2017

Site Coefficient	F_a = 1.0	F_v = 1.7
Adjusted Spectral Acceleration	S_{MS} = 2.042 g	S_{M1} = 1.653 g
Design Spectral Response Acceleration Parameters	S_{DS} = 1.361 g	S_{D1} = 1.102 g
Peak Ground Acceleration	PGA = 1.1 g	

There is now a consensus among earth scientists that much of the western US coastline, including the entire southern Oregon coast, is in an area which has been seismically active in the recent geologic past. Our understanding of these forces is evolving and has been heightened by witnessing geologically recent earthquakes and tsunamis in similar tectonic settings in Northern Indonesia (2005) and in Northern Japan (2011). In order to protect people living in seismically active areas within the state, the state has recently updated their 2014 Oregon Structural Specialty Code.[8] It is our opinion that new commercial developments such as you are proposing should adopt these updated standards.

Based on recent mapping and modeling done by the State of Oregon,[9] the site is within the Tsunami Inundation Zone. Based on this modeling, the subject property and surrounding area will be inundated by a tsunami wave generated by a CSZ Moment Magnitude (Mm) Earthquake of 9.0 or greater. Because of this, we strongly recommend that the occupants of the new structure check with the City of Bandon and with the State of Oregon's Department of Mineral Industries (DOGAMI) Tsunami Resource Center for current information regarding tsunami preparedness and emergency procedures.

Liquefaction

Liquefaction potential was assessed based on the information obtained from our borings and using the parameters suggested in the 2013 ODOT Geotechnical Design Manual. According to our seismic analysis, the site will experience a Peak Ground Acceleration (PGA) during a design seismic event of 1.1. Further, groundwater appears to be near and above the bedrock surface, probably rising only occasionally during storm events. As indicated by the relatively shallow depth to bedrock, the increased stiffness and increased fines content at the proposed depth of the excavation, we

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[8] Oregon Structural Specialty Code, 2014, State of Oregon, viewed on July, 2017 at http://www.oregon.gov/bcd/codes-stand/Pages/adopted-codes.aspx

[9] Local Source (Cascadia Subduction Zone) Tsunami Inundation Map, Bandon, Oregon. 2012. State of Oregon Department of Geology and Mineral Industries.

believe the liquefaction potential at the site is moderate. A further consideration is lateral spread due to the exposed face on the ocean side. Again, lateral spread depends on the occurrence of widespread regional liquefaction, which we believe is unlikely at this site.

Pavement Design

Our pavement design recommendations are based on the following assumptions:

- Pavements – on reconstituted medium-stiff fill
- Parking Lots – less than 10,000 ESALs
- Driveways – less than 50,000 ESALs

Minimum Pavement Sections

Traffic Loading (ESALs)	AC (inches)	Base Rock (inches)
10,000	**3.0**	**8**
50,000	**4.0**	**12**

The thicknesses shown in the table are intended to be minimum acceptable values. The pavement subgrade should be prepared in accordance with the **Site Preparation** and **Structural Fill** sections of this report, except that only the surface soils and minimum upper 12 inches of fill should be removed. The subgrade should then be moisturized and rolled with a minimum of 4 passes of a 30,000-lb. tamping foot roller. No vibration should be applied to the subgrade. The surface should be proofrolled and any soft or loose areas repaired with granular structural fill.

Construction traffic should be limited to non-building, unpaved portions of the project site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made.

CONSTRUCTION

Site Preparation

The existing near-surface soils and fill should be stripped and removed from the project site in all proposed building and fill areas, and for a 5-foot margin around such areas. Pavement areas should be prepared as indicated above. The actual stripping depth should be based on field observations at the time of construction. Demolition should include removal of existing improvements throughout the project site including any remnant foundation elements. Underground utility lines, vaults, basement walls, or tanks should also be removed or grouted full if left in place. The voids resulting from removal of footings, buried tanks, etc., or loose soil in utility lines should be backfilled with compacted structural fill. The base of these excavations should be excavated to firm subgrade before filling, with sides sloped at a minimum of 1H:1V to allow for uniform compaction.

Materials generated during demolition of existing improvements should be transported off site or stockpiled in areas designated by the owner.

Probing

Following stripping, excavation, and site preparation, and prior to placing structural fills or concrete, the exposed excavated surface and the footing or slab subgrade should be evaluated by probing. A member of our geotechnical staff should carry out the probing. Soft or loose zones identified during the field evaluation should be compacted to an unyielding condition or be excavated and replaced with structural fill.

Wet-Weather/Wet-Soil Conditions

As indicated, the non-cohesive site soils are susceptible to disturbance and potential flowing during the wet season. Trafficability or grading operations within the exposed soils may be difficult during or after extended wet periods or when the moisture content of the surface soil is more than a few percentage points above optimum. Soils disturbed during site-preparation activities, or soft or loose zones identified during probing, should be removed and replaced with compacted structural fill.

Excavation

Subsurface conditions at the project site show medium-dense-to-dense, fine-to-coarse sand interlayered with stiff clay. Excavations in these soils may be readily accomplished with conventional earthwork equipment.

Trench cuts in native materials should stand vertical to a depth of approximately 4 feet, provided no groundwater seepage is present in the trench walls. Open excavation may be used to excavate trenches with depths between 2 and 4 feet with the walls of the excavation cut at a slope of 1H:1V, provided groundwater seepage is not present and with the understanding that some sloughing may occur. The trenches should be flattened to 1.5H:1V if excessive sloughing occurs or seepage is present.

Groundwater was encountered at from 13.0 to 15.0 feet bgs during our site exploration. However, during the wet months of the year, some shallow perched groundwater may be expected. If shallow groundwater is observed during construction, use of a trench shield (or other approved temporary shoring) is recommended for cuts that extend below groundwater seepage or if vertical walls are desired for cuts deeper than 4 feet. If shoring or dewatering is used, CGS recommends that the type and design of the shoring and dewatering systems be the responsibility of the contractor, who is in the best position to choose systems that fit the overall plan of operation. These excavations should be made in accordance with applicable Occupational Safety and Health Administration and State regulations.

Final Grading

As indicated, the footing backfill should be graded to drain away from the structure and all pavement and driveway subgrades should be appropriately graded to prevent ponding and inappropriate drainage of surface water.

Building Codes

We recommend that the structure be designed to adhere to all local building codes as set forth in the recently revised 2014 Oregon Residential Specialty Code[9].

MATERIALS

Fills should be placed over subgrade that has been prepared in conformance with the **Site Preparation** section. A wide range of material may be used as structural fill; however, all material used should be free of organic matter or other unsuitable materials and should meet the specifications provided in the 2015 Oregon Standard Specifications for Construction, Oregon Department of Transportation (ODOT, SS 2015)[10], depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

Native Soils

The native soils are suitable for use as general fill, provided they are properly moisture conditioned and meet the requirements of ODOT SS 00330.12 – Borrow Material. In order to adequately compact the soil, it may be necessary to moisture condition the soil to within 2 to 3 percentage points of the optimum moisture content. When used as structural fill, native soils should be placed in lifts with a maximum uncompacted

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[10] http://www.oregon.gov/ODOT/Business/Documents/2015_STANDARD_SPECIFICATIONS.pdf

thickness of 6 to 8 inches, and compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557.

Imported Granular Material

Imported granular material used during periods of wet weather or for haul roads, building pad subgrades, staging areas, etc., should be pit or quarry run rock, crushed rock, or crushed gravel and sand, and should meet the specifications provided in ODOT SS 00330.12 – Borrow Material, and ODOT SS 00330.13 – Selected General Backfill. However, the imported granular material should also be fairly well graded between coarse and fine material and have less than 5 percent by weight passing the U.S. Standard No. 200 Sieve.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 8 to 12 inches, and be compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D 1557. During the wet season or when wet subgrade conditions exist, the initial lift should be approximately 18 inches in uncompacted thickness, and should be compacted by rolling with a smooth-drum roller without using vibratory action.

Where imported granular material is placed over soft-soil subgrades, we recommend a geotextile be placed as a barrier between the subgrade and imported granular material. Depending on site conditions, the geotextile should meet ODOT SS 02320.10 – Geosynthetics, Acceptance, for soil separation or stabilization. The geotextile should be installed in conformance with ODOT SS 00350.40 – Geosynthetic Construction, General Requirements.

Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 2 feet above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1.5 inches and less than 10 percent by weight passing the U.S. Standard No. 200 Sieve, and should meet the standards prescribed by ODOT SS 00405.12 – Pipe Zone Bedding. The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.

Within roadway alignments or beneath building pads, the remainder of the trench backfill should consist of well-graded granular material with a maximum particle size of

2.5 inches, less than 10 percent by weight passing the U.S. Standard No. 200 Sieve, and should meet standards prescribed by ODOT SS 00405.14 – Trench Backfill, Class A or B. This material should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department. The upper 2 feet of the trench backfill should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill materials that are free of organics and materials over 6 inches in diameter, and meet the standards prescribed by ODOT SS 00330.12 – Borrow Material, and ODOT SS 00405.14 – Trench Backfill, Class C, D, or E. This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.

Stabilization Material

Stabilization rock should consist of imported granular material that is well graded, angular crushed rock consisting of 4- or 6-inch-minus material with less than 2 percent passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material.

Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of 0.5H, where H is the height of the retaining wall, should consist of select granular material meeting the requirements of ODOT SS 00510.12 – Granular Wall Backfill. We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric which meets the requirements provided in ODOT SS 02320.10 – Geosynthetics, Acceptance. The geotextile should be installed in conformance with ODOT SS 00350.40 – Geosynthetic Construction, General Requirements.

The wall backfill should be compacted to a minimum of 92 percent of the maximum dry density, as determined by ASTM D 1557. However, backfill located within a horizontal distance of 3 feet from the retaining walls should only be lightly compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D 1557, to prevent damage to the wall. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactors).

If flat work (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 92 percent of the maximum dry density, as determined by ASTM D 1557.

Trench and Retaining Wall Drain Backfill

Backfill in a 2-foot zone against the back of retaining walls and for subsurface trench drains should consist of drain rock meeting the specifications provided in ODOT SS 00430.11 – Granular Drain Backfill Material. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in ODOT SS 02320.10 – Geosynthetics, Acceptance, for soil separation and/or stabilization. The geotextile should be installed in conformance with ODOT SS 00350.40 – Geosynthetic Construction, General Requirements.

Footing Base

Imported granular material placed at the base of retaining wall footings should be clean crushed rock or crushed gravel, and sand that is fairly well graded between coarse and fine. The granular materials should contain no deleterious materials, have a maximum particle size of 1.5 inches, and meet the requirements of ODOT SS 00330.14 – Selected Granular Backfill. The imported granular material should be placed on one lift and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D 1557.

Floor Slab Base Aggregate

Base aggregate for floor slabs should be clean crushed rock or crushed gravel. The base aggregate should contain no deleterious materials, meet specifications provided in ODOT SS 00330.14 – Selected Granular Backfill, and have less than 5 percent by weight passing the U.S. Standard No. 200 Sieve. The imported granular material should be placed in one lift and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557.

CONSTRUCTION OBSERVATIONS

Satisfactory pavement and earthwork performance depends on the quality of construction. Sufficient monitoring of the contractor’s activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. We recommend that a representative from CGS be retained to observe general excavation, stripping, fill placement, footing subgrades, and subgrades and base rock for floor slabs and pavements.

Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

LIMITATIONS

Cascadia Geoservices, Inc.'s (CGS) professional services have been performed, findings obtained, and recommendations prepared in accordance with generally accepted principles and practices for geologists and geotechnical engineers. No other warranty, express or implied, is made. The client acknowledges and agrees that:

1. CGS is not responsible for the conclusions, opinions, or recommendations made by others based upon our findings.
2. The scope of our services is intended to evaluate soil and groundwater (ground) conditions within the primary influence or influencing the engineered improvements. Our services do not include an evaluation of potential ground conditions beyond the depth of our explorations. Analyses and recommendations submitted in writing or verbally will be based on the data obtained from our literature review, discussions with knowledgeable persons, observations, and explorations performed at the location indicated. Regardless of the thoroughness of a geologic and geotechnical exploration, there is always a possibility that conditions in areas not specifically observed will be different from specific observations made at our discrete observation location. In addition, the construction process itself may alter soil and groundwater conditions. If any subsurface variations become evident during the course of this project, a re-evaluation of our recommendations will be necessary after Cascadia Geoservices, Inc. has had an opportunity to observe the conditions encountered.
3. Recommendations provided herein are based in part upon project information provided to CGS. Our work will apply only to the specific project and subject site. If the project information is incorrect or if additional information becomes

available, the correct or additional information should be immediately conveyed to CGS for review. Cascadia Geoservices, Inc. recommends that we be retained to provide Construction Observation Services (COS) based upon our familiarity with the project, the subsurface conditions, and the geotechnical recommendations and design criteria provided.

4. The scope of services does not include evaluations regarding the presence or absence of contaminated soils or wetlands.
5. The Pacific Northwest region is subject to intense subduction zone earthquakes, tsunamis, and other less extraordinary geologic hazards, including shallow fault earthquakes, deep earthquakes, landslides, debris flows, and flooding. As such, we cannot predict nor preclude the possibility of such natural occurrences, whose magnitude cannot be anticipated or provided against by the exercise of ordinary care. By necessity, the current and future owners of this property must assume the risks associated with any such natural occurrences, and release and hold harmless Cascadia Geoservices, Inc., its owners, agents, and representatives from any liability for damages resulting therefrom.

Cascadia Geoservices, Inc. recommends that upon completion of our work, we be retained to provide review of geotechnical items in the final design documents and Construction Observation Services (COS) once construction begins.

PROFESSIONAL QUALIFICATIONS

Please refer to our website, www.cascadiageoservices.com, to review our qualifications.

Sincerely,
Cascadia Geoservices, Inc.

CERTIFIED OREGON ENGINEERING GEOLOGIST
ERIC T. OBERBECK
1332
Eric Oberbeck

REGISTERED PROFESSIONAL ENGINEER
12,910
OREGON
MAY 23 1985
FREDERICK G. THRALL

Eric Oberbeck, RG, CEG
Expires June 1, 2018

Frederick G. Thrall, PE, GE
Expires June 30, 2018

Photos

FIGURES AND ATTACHMENTS

Figure 1 –Site Location Map
Figure 2 – Site Map
Figure 3 – Aerial Photograph
Figure 4 – Beach Profile

Attachment 1 – USDA Soils Report (Partial)
Attachment 2 – Bore Logs
Attachment 3 – Lab Analysis Reports
Attachment 4 – Seismic Design Report (Partial)
Attachment 5 – General Construction Recommendations

Photo No: 1

Direction Photo is Taken: East

Photo Description:

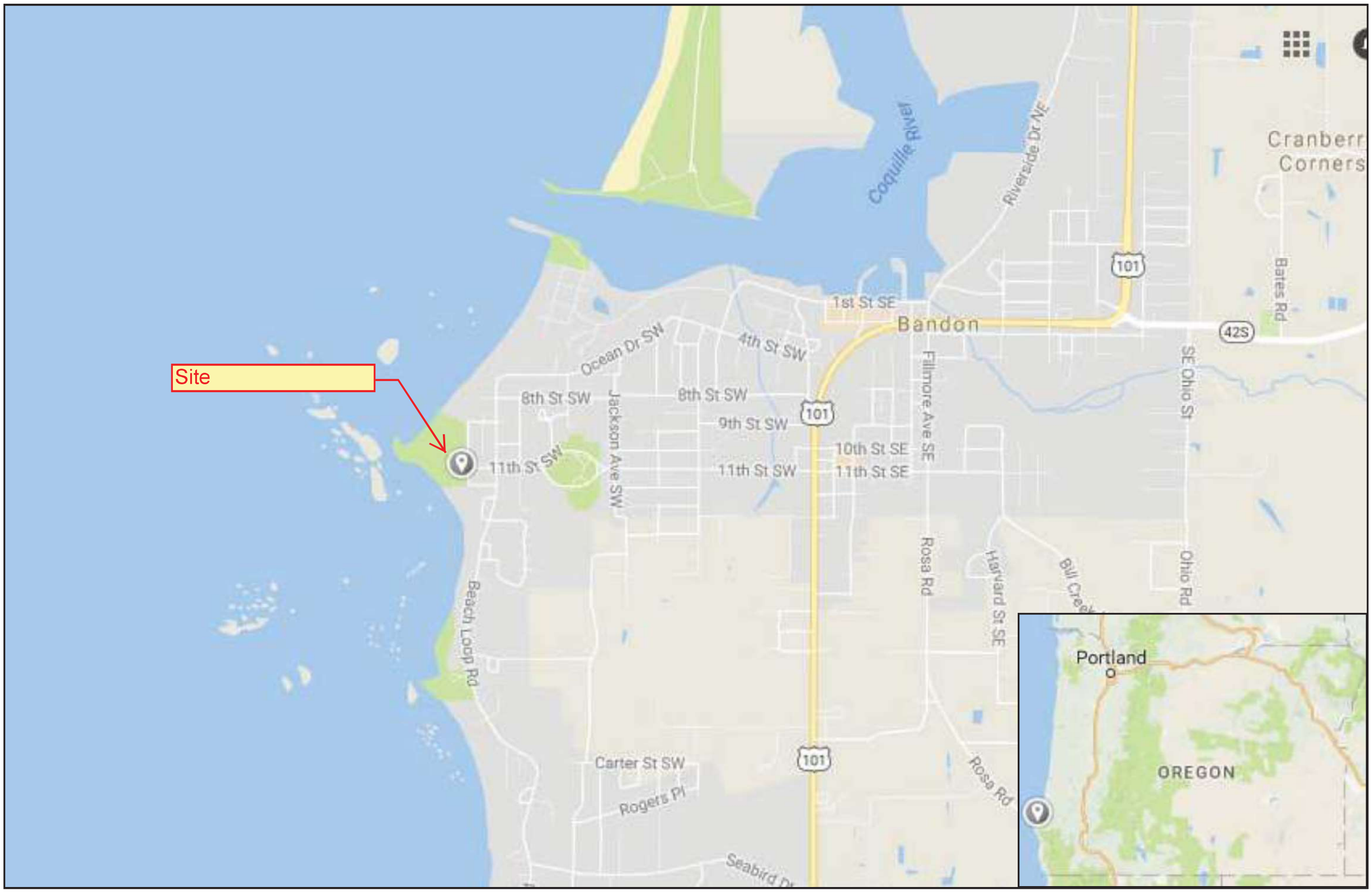
Surficial deposits which overlay bedrock exposed in the bluff west of site

Photo No: 13

Direction Photo is Taken:

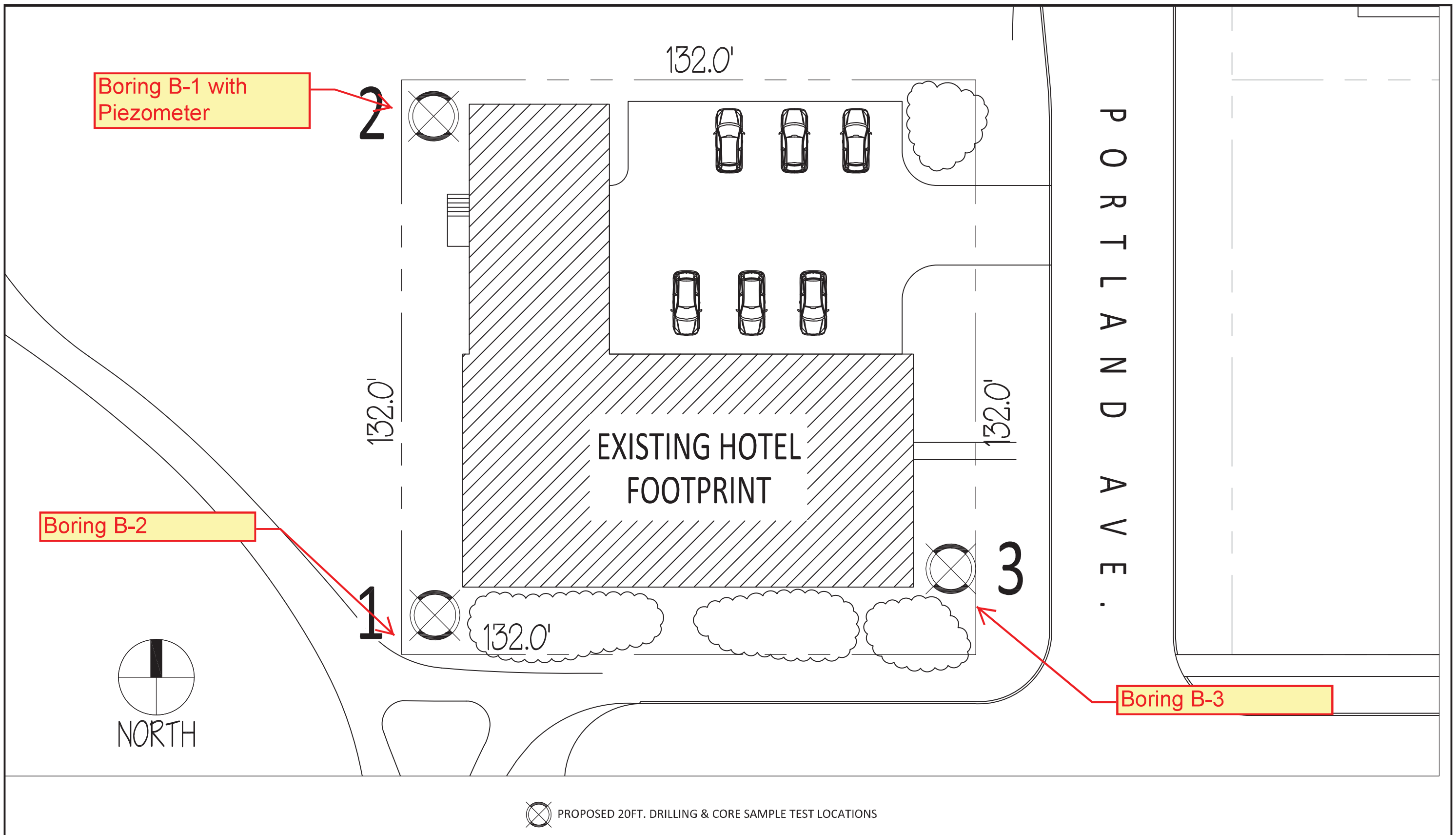
Photo Description:

Storm debris along the base of the sea cliff



Prepared for NORTHWORKS Architects + Planners

CASCADIA Geoservices Geologists and Engineers	Project: 17050 July 2017	**SITE LOCATION MAP** Bandon Beach Hotel 1090 Portland Ave SW Bandon, Oregon 97411	**Figure 1**



BANDON BEACH HOTEL

GEOTECHNICAL DRILLING LOCATIONS

NORTHWORKS

1" = 20'-0"

05.13.2017

Prepared for NORTHWORKS Architects + Planners

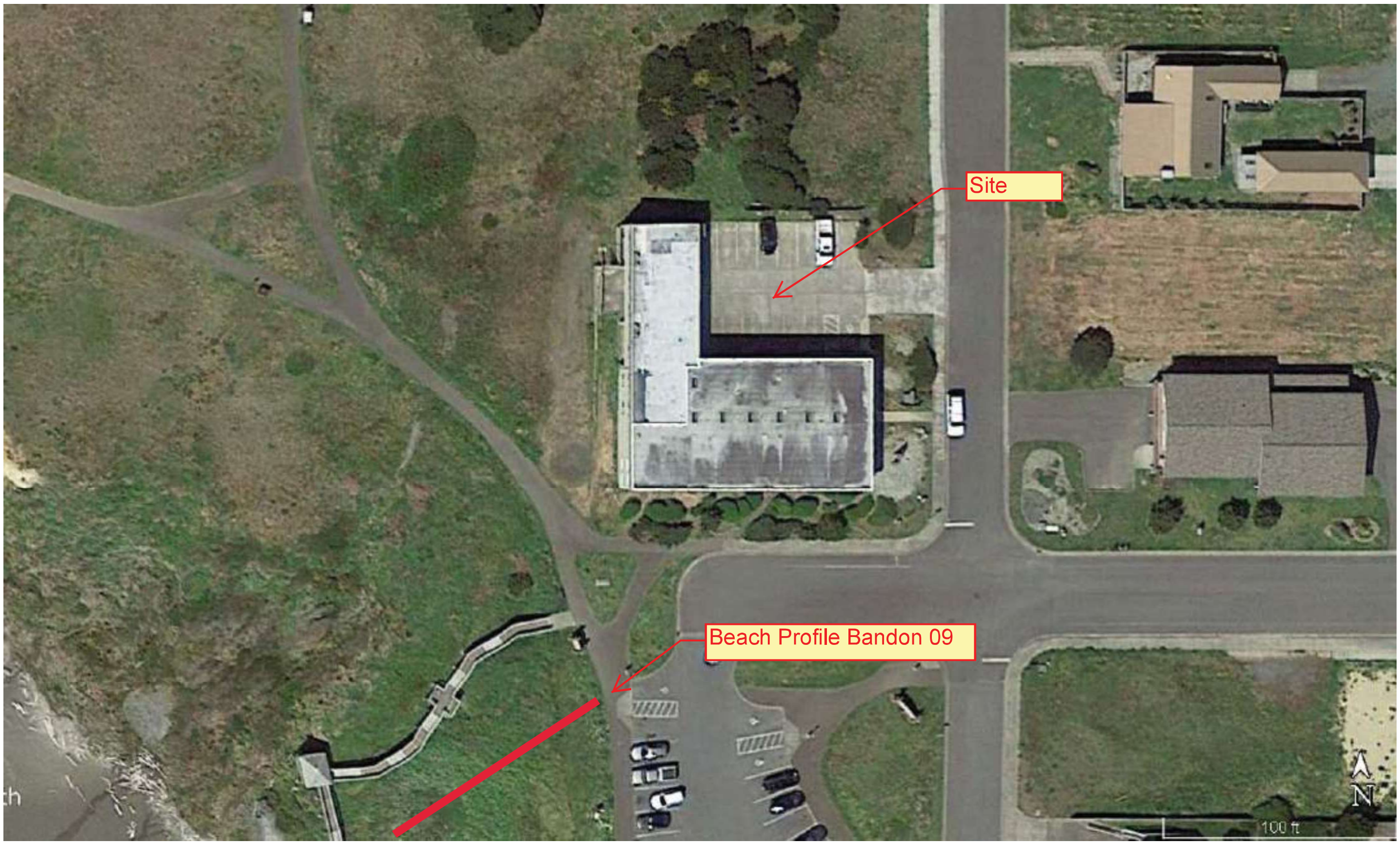
CASCADIA Geoservices
Geologists and Engineers

Project: 17050

July 2017

SITE MAP
Bandon Beach Hotel
1090 Portland Ave SW
Bandon, Oregon 97411

Figure 2



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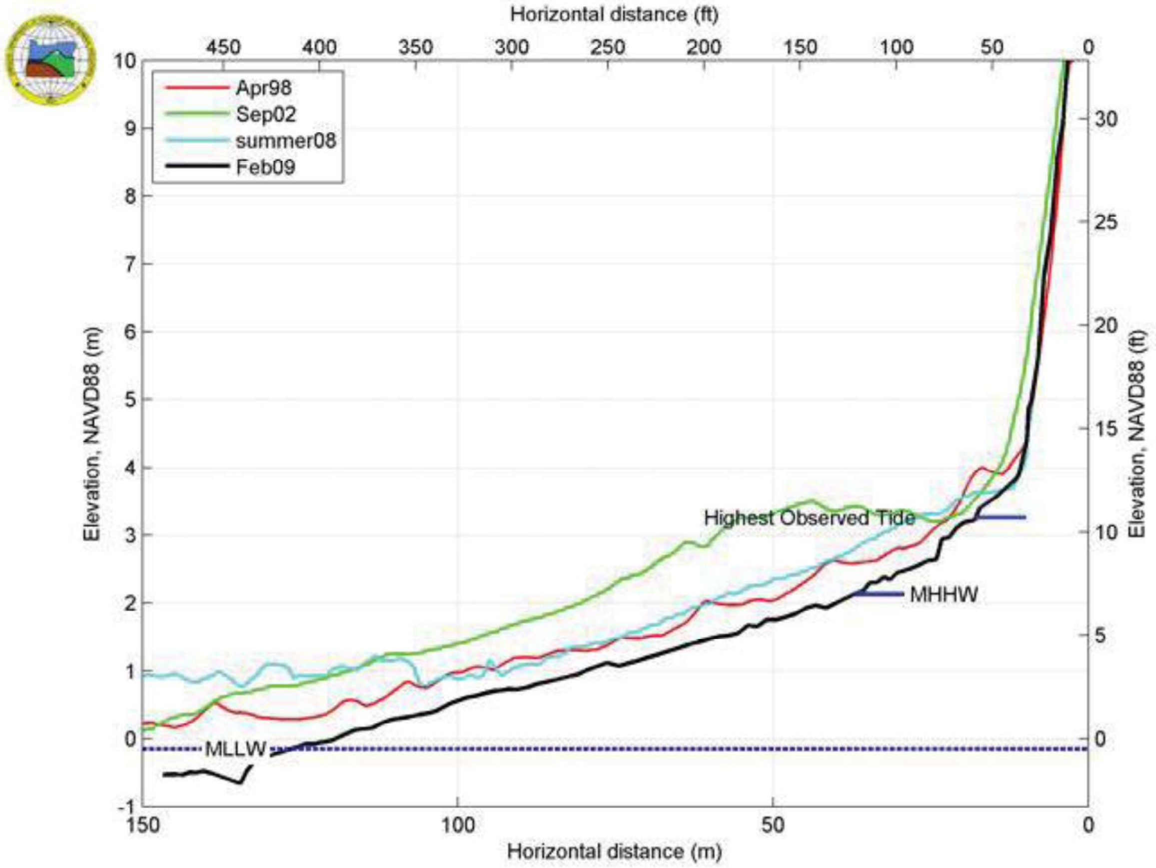
CASCADIA Geoservices
Geologists and Engineers

Project: 17050

July 2017

AERIAL PHOTOGRAPH
Bandon Beach Hotel
1090 Portland Ave SW
Bandon, Oregon 97411

Figure 3



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CASCADIA Geoservices
Geologists and Engineers

Project: 17050

July 2017

BEACH PROFILE Bandon09
Bandon, Oregon 97411

Figure 4

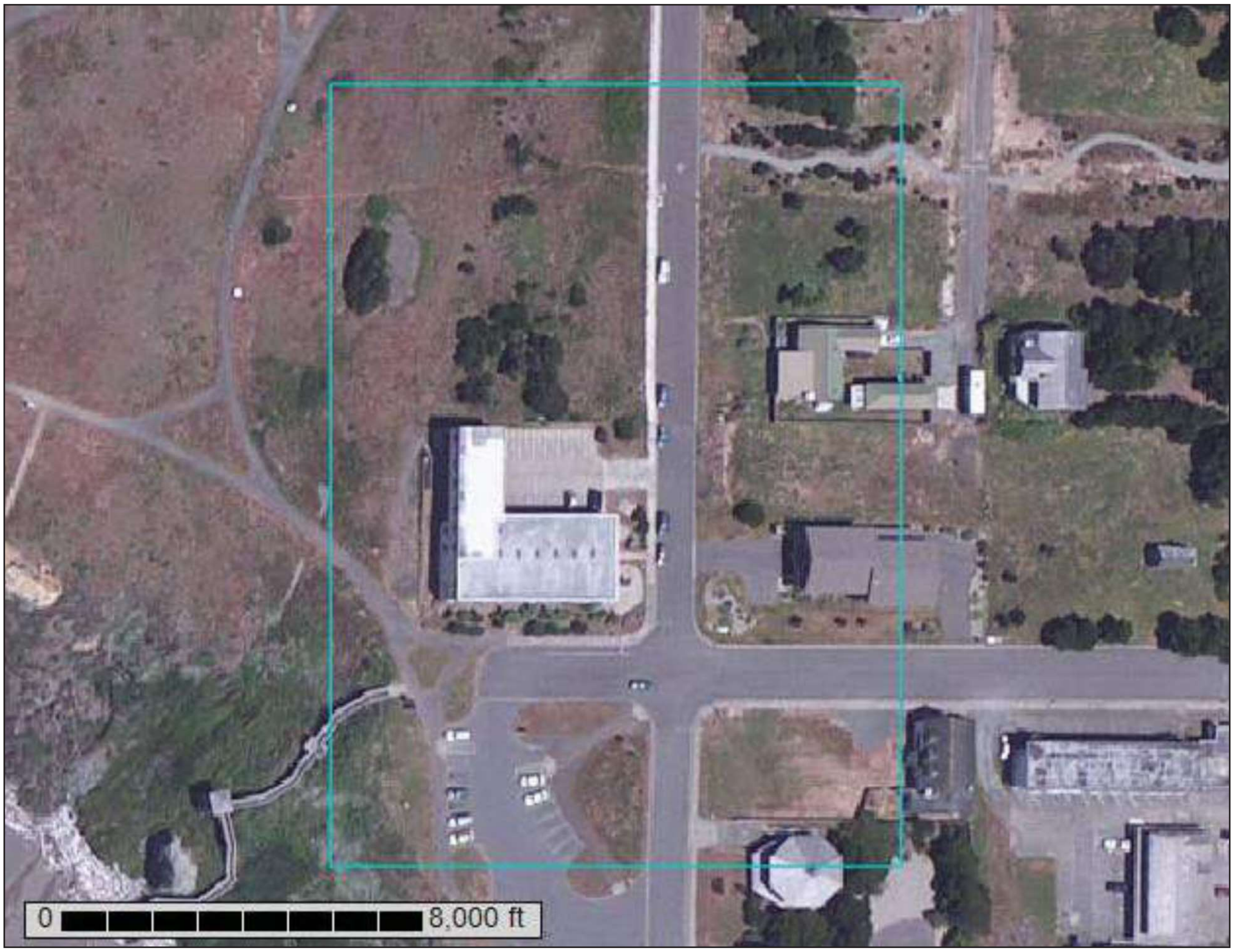
Attachment 1-USDA Soils Report (Partial)

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

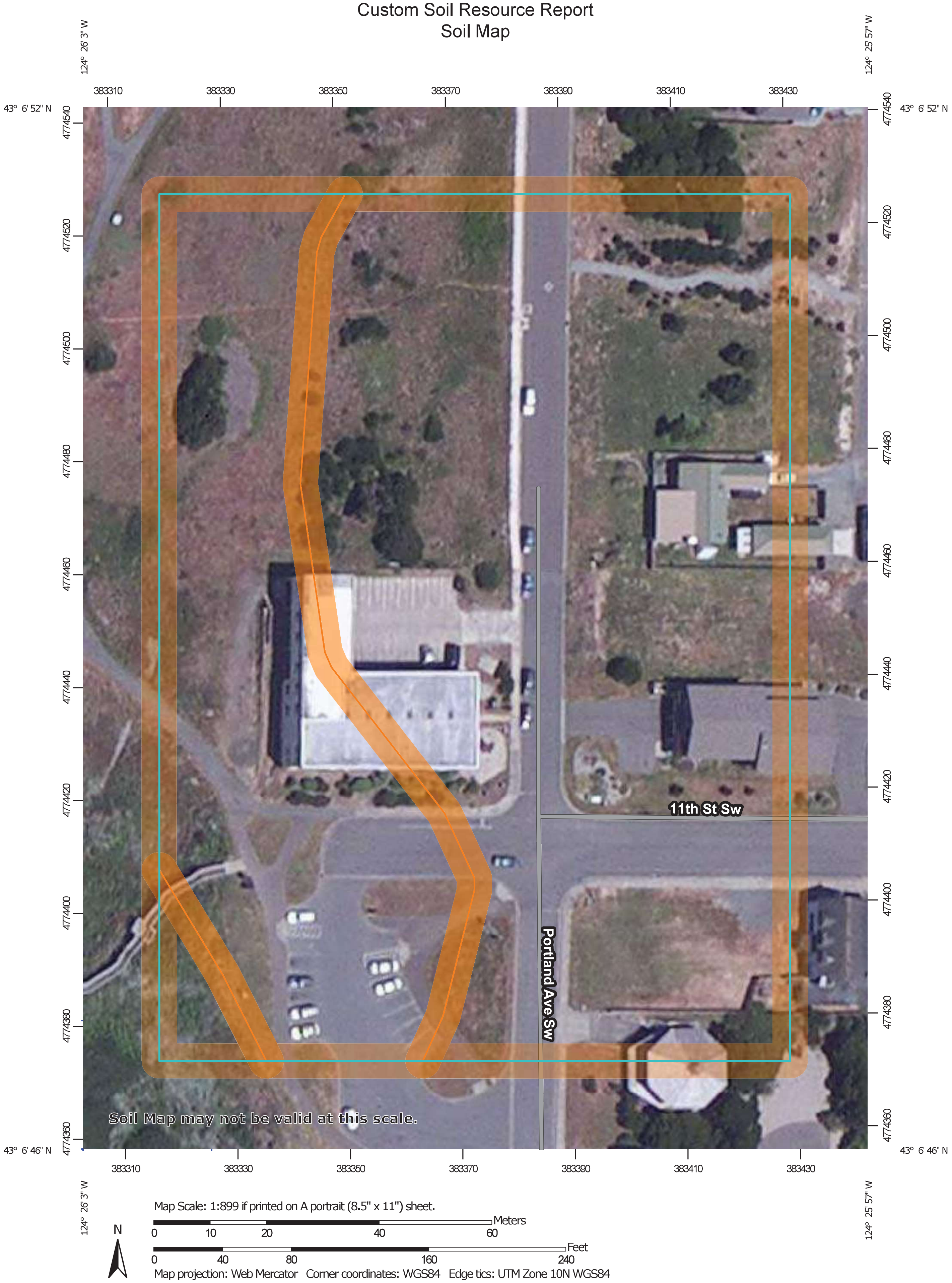
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Coos County, Oregon



June 26, 2017

Custom Soil Resource Report
Soil Map



Map Scale: 1:899 if printed on A portrait (8.5" x 11") 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
- 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: Coos County, Oregon
Survey Area Data: Version 11, Sep 16, 2016

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

Date(s) aerial images were photographed: Jul 6, 2010—Jul 13, 2010

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

Coos County, Oregon (OR011)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
8B	Bullards sandy loam, 0 to 7 percent slopes	2.9	67.2%
8E	Bullards sandy loam, 30 to 50 percent slopes	0.1	2.0%
57	Udorthents, level	1.3	30.9%
Totals for Area of Interest		**4.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Coos County, Oregon

8B—Bullards sandy loam, 0 to 7 percent slopes

Map Unit Setting

National map unit symbol: 21rc
Elevation: 30 to 600 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Bullards and similar soils: 75 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bullards

Setting

Landform: Marine terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian and marine deposits

Typical profile

Oi - 0 to 3 inches: slightly decomposed plant material
H1 - 3 to 10 inches: sandy loam
H2 - 10 to 44 inches: gravelly sandy loam
H3 - 44 to 63 inches: sand

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 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 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: Well Drained <15% Slopes (G004AY014OR)
Hydric soil rating: No

Minor Components

Blacklock

Percent of map unit: 9 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

8E—Bullards sandy loam, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: 21rg
Elevation: 50 to 600 feet
Mean annual precipitation: 55 to 75 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Bullards and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bullards

Setting

Landform: Marine terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed eolian and marine deposits

Typical profile

Oi - 0 to 3 inches: slightly decomposed plant material
H1 - 3 to 10 inches: sandy loam
H2 - 10 to 44 inches: gravelly sandy loam
H3 - 44 to 63 inches: sand

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 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 5.9 inches)

Interpretive groups

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

57—Udorthents, level

Map Unit Composition

Udorthents and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform: Flood plains, marshes, tidal flats
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium, dredging spoil, dune sand, and wood chips

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Attachment 2 -Bore Logs

TABLE 1
FIELD CLASSIFICATIONS
SOILS

SOIL DESCRIPTION FORMAT

(1) consistency,
(2) color,
(3) grain size,
(4) classification name [secondary PRIMARY additional];
(5) moisture,
(6) plasticity of fines,
(7) angularity
(8) shape,
(9) structure,
(10) cementation,
(11) reaction to HCL,
(12) odor,
(13) groundwater seepage,
(14) caving,
(15) (unit name and/or origin),

Note: Bolded items are the minimum required elements for a soil description.

1. CONSISTENCY - COARSE-GRAINED

Term	SPT (140-lb. hammer)[1]	D & M Sampler (140-lb. hammer)[1]	Dynamic cone penetrometer penetration rate sampler (DCP)[4,5,6]	Field Test (using ½-inch rebar)
Very loose	0 – 4	0 – 11	0 – 2	Easily penetrated when pushed by hand
Loose	4 – 10	11 – 26	2 – 5	Easily penetrated several inches when pushed by hand
Medium dense	10 – 30	26 – 74	6 – 31	Easily to moderately penetrated when driven by 5 lb. hammer
Dense	30 – 50	74 – 120	32 – 42	Penetrated 1-foot with difficulty when driven by 5 lb. hammer
Very dense	>50	>120	>43	Penetrated only few inches when driven by 5 lb. hammer

1. CONSISTENCY - FINE-GRAINED

Term	SPT (140-lb. hammer)[1]	D & M Sampler (140-lb. hammer)[1]	Dynamic cone penetrometer penetration rate sampler (DCP)[5,6]	Pocket Pen.[2]	Torvane[3]	Field Test
Very soft	<2	<3	<2	<0.25	<0.13	Easily penetrated several inches by fist
Soft	2 – 4	3 – 6	2 – 3	0.25 – 0.5	0.13 – 0.25	Easily penetrated several inches by thumb
Medium stiff	5 – 8	7 – 12	4 – 7	0.50 – 1.0	0.25 – 0.5	Can be penetrated several inches by thumb with moderate effort
Stiff	9 – 15	13 – 25	8 – 16	1.0 – 2.0	0.5 – 1.0	Readily indented by thumb but penetrated only with great effort
Very stiff	16 – 30	26 – 65	17 – 27	2.0 – 4.0	1.0 – 2.0	Readily indented by thumbnail
Hard	>30	>65	>28	>4.0	>2.0	Difficult to indent by thumbnail

[1] Standard penetration resistance (SPT N-value); Dames and Moore (D & M) sampler, number of blows/ft. for last 12" and 30" drop. Unconfined
[2] compressive strength with pocket penetrometer; in tons per square foot (tsf).
[3] Undrained shear strength with torvane (tsf).
[4] Up to maximum medium-size sand grains only.
[5] Dynamic cone penetration resistance; number of blows/inch.
[6] Reference: George F. Sowers et. al. "Dynamic Cone for Shallow In-Situ Penetration Testing of In-Situ Soils, ASTM STP 399, ASTM, , pg. 29. 1966.

2. COLOR

Use common colors. For combinations use hyphens. To describe tint use modifiers: pale, light, and dark. For color variations use adjectives such as "mottled" or "streaked". Soil color charts may be required by client. **Examples:** red-brown; or orange-mottled pale green; or dark brown.

3. GRAIN SIZE

Description		Sieve*	Observed Size
boulders		–	>12"
cobbles		–	3" – 12"
gravel	coarse	¾" – 3"	¾" – 3"
	fine	#4 – ¾"	4.75 mm (0.19") – ¾"
sand	coarse	#10 – #4	2.0 – 4.75 mm
	medium	#40 – #10	0.425 – 2.0 mm
	fine	#200 – #40	0.075 – 0.425 mm
fines		<#200	<0.075 mm

4. CLASSIFICATION NAME

* Use of #200 field sieve encouraged for estimating percentage of fines.

	Name and Modifier Terms	Constituent Percentage	Constituent Type
Coarse grained	GRAVEL, SAND, COBBLES, BOULDERS	>50%	PRIMARY
	sandy, gravelly, cobbley, bouldery	30 – 50%	secondary
	silty, clayey*	15 – 50%	
	with (gravel, sand, cobbles, boulders)	15 – 30%	additional
	with (silt, clay)*	5 – 15%	
	trace (gravel, sand, cobbles, boulders)		
	trace (silt, clay)*	<5%	
Fine grained	CLAY, SILT*	>50%	PRIMARY
	silty, clayey*	30 – 50%	secondary
	sandy, gravelly		
	with (sand, gravel, cobbles, boulders)	15 – 30%	additional
	with (silt, clay)*		
	trace (sand, gravel, cobbles, boulders)	5 – 15%	
	trace (silt, clay)*		
Organic	PEAT	50 – 100%	PRIMARY
	organic (soil name)	15 – 50%	secondary
	(soil name) with some organics	5 – 15%	additional

* For classification and naming fine-grained soil: dry strength, dilatancy, toughness, and plasticity testing are performed (see Describing Fine-Grained Soil page 2). Confirmation requires laboratory testing (Atterberg limits and hydrometer).

TABLE 1 SOILS
FIELD CLASSIFICATIONS

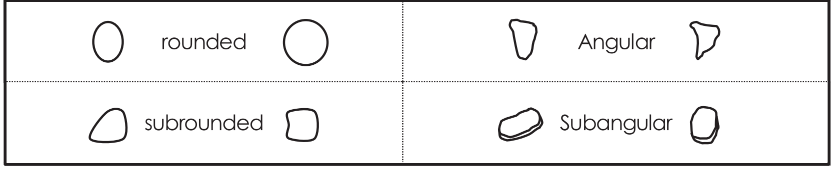
5. MOISTURE

Term	Field Test
dry	absence of moisture, dusty, dry to touch
moist	contains some moisture
wet	visible free water, usually saturated

6. PLASTICITY OF FINES

See "Describing fine-grained Soil" on Page 2.

7. ANGULARITY



8. Shape

Term	Observation
flat	particles with width/thickness ratio >3
elongated	particles with length/width ratio >3
flat and elongated	particles meet criteria for both flat and elongated

9. STRUCTURE

Term	Observation
stratified	alternating layers >1 cm thick, describe variation
laminated	alternating layers <1 cm thick, describe variation
fissured	contains shears and partings along planes of weakness
slickensides	partings appear glossy or striated
blocky	breaks into lumps, crumbly
lensed	contains pockets of different soils, describe variation
homogenous	same color and appearance throughout

10. CEMENTATION

Term	Field Test
weak	breaks under light finger pressure
moderate	breaks under hard finger pressure
strong	will not break with finger pressure

11. REACTION TO HCL

Term	Field Test
none	no visible reaction
weak	bubbles form slowly
strong	vigorous reaction

12. ODOR

Describe odor as organic; or potential non-organic*
*Needs further investigation

13. GROUNDWATER SEEPAGE

Describe occurrence (i.e. from soil horizon, fissures with depths) and rate:
slow (<1 gpm); moderate (1-3 gpm); fast (>3 gpm)

14. CAVING

Describe occurrence (depths, soils) and amount with term

Test Pits	minor (<1 ft^3)	moderate (1-3 ft^3)	Severe (>3 ft^3)

15. (UNIT NAME/ORIGIN)

Name of stratigraphic unit (e.g. Willamette Silt), and/or origin of deposit (Topsoil, Alluvium, Colluvium, Decomposed Basalt, Loess, Fill, etc.).

DESCRIBING FINE-GRAINED SOIL

	Field Test			
Name	Plasticity (A below)	Dry Strength (B below)	Dilatancy Reaction (C below)	Toughness of Thread (D below)
SILT	non-plastic, low	none, low	rapid	low
SILT with some clay	low	low, medium	rapid, slow	low, medium
clayey SILT	low, medium	medium	slow	medium
silty CLAY	medium	medium, high	slow, none	medium, high
CLAY with some silt	high	High	none	high
CLAY	high	very high	none	high
organic SILT	non-plastic, low	low, medium	slow	low, medium
organic CLAY	medium, high	medium to very high	none	medium, high

A. PLASTICITY

Term	Observation
non-plastic	A 1/8" (3-mm) thread cannot be rolled at any water content.
low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
high	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

B. DRY STRENGTH

Term	Observation
none	Dry specimen crumbles into powder with mere pressure of handling.
low	Dry specimen crumbles into powder with some finger pressure.
medium	Dry specimen breaks into pieces or crumbles with considerable finger pressure.
high	Dry specimen cannot be broken with finger pressure. Will break into pieces between thumb and a hard surface.
very high	Dry specimen cannot be broken between thumb and a hard surface.

C. DILATANCY REACTION

Term	Observation
none	No visible change in the specimen.
slow	Water appears slowly on surface of specimen during shaking and doesn't disappear or disappears slowly upon squeezing.
rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

D. TOUGHNESS OF THREAD

Term	Observation
low	Only slight hand pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft.
medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and lump have medium stiffness.
high	Considerable hand pressure is required to roll the thread to near the plastic limit. The thread and lump have very high stiffness.

TABLE 2

KEY TO TEST PIT AND BORING LOG SYMBOLS

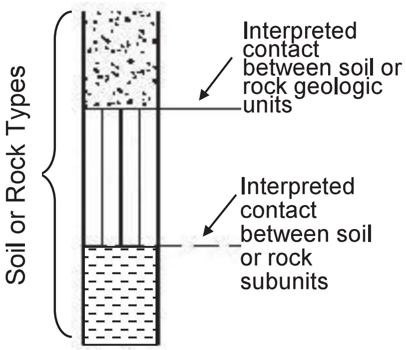
SAMPLE NUMBER ACRONYMS/WATER SYMBOLS

DM - Dames & Moore Sampler
GR - Grab or Bulk Samples
OS - Osterberg (Piston) Sampler
C - Rock Core
SA - Screen Air Sampling
SW - Screen Water Sampling
SS - SPT Standard Penetration Drive Sampler (ASTM D1586)
ST - Shelby Tube Push Sampler (ASTM D1587)

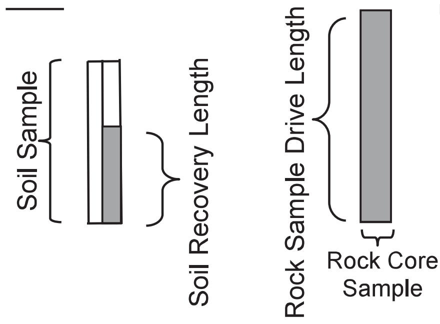
Water Level During Drilling/ Excavation	Water Level on Date Measured
▽	▼

LOG GRAPHICS/INSTALLATIONS

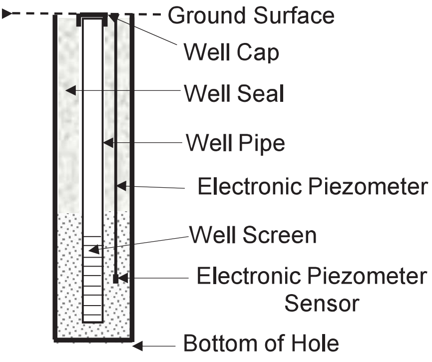
Soil and Rock



Soil and Rock Sampling Symbols



Instrumentation Detail



GEOTECHNICAL FIELD & LABORATORY TESTING/ACRONYM EXPLANATIONS

ATT	Atterberg Limits	OC	Organic Content
AMSL	Above Mean Sea Level	OD	Outside Diameter
BGS	Below ground surface	P200	Percent Passing U.S. Standard No. 200 Sieve
CBR	California Bearing Ratio	PI	Plasticity Index
CON	Consolidation	PL	Plasticity Limit
DCP	Dynamic Cone Penetrometer	PP	Pocket Penetrometer
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SC	Sand Cone
GPS	Global Positioning System	SIEV	Sieve Gradation
HCL	Hydrochloric Acid	SP	Static Penetrometer
HYD	Hydrometer Gradation	TOR	Torvane
kPa	kiloPascal	UC	Unconfined Compressive Strength
LL	Liquid Limit	VS	Vane Shear

ENVIRONMENTAL TESTING/ACRONYM EXPLANATIONS

ATD	At Time of Drilling	ND	Not Detected
BGS	Below ground surface	NS	No Sheen
CA	Sample Submitted for Chemical Analysis	PID	Photoionization Detector Headspace Analysis
HS	High Sheen		
MS	Moderate Sheen	PPM	Parts Per Million

Rev. 10/2015

BORING B-1

BANDON BEACH MOTEL
1090 PORTLAND AVENUE SW
BANDON, OREGON

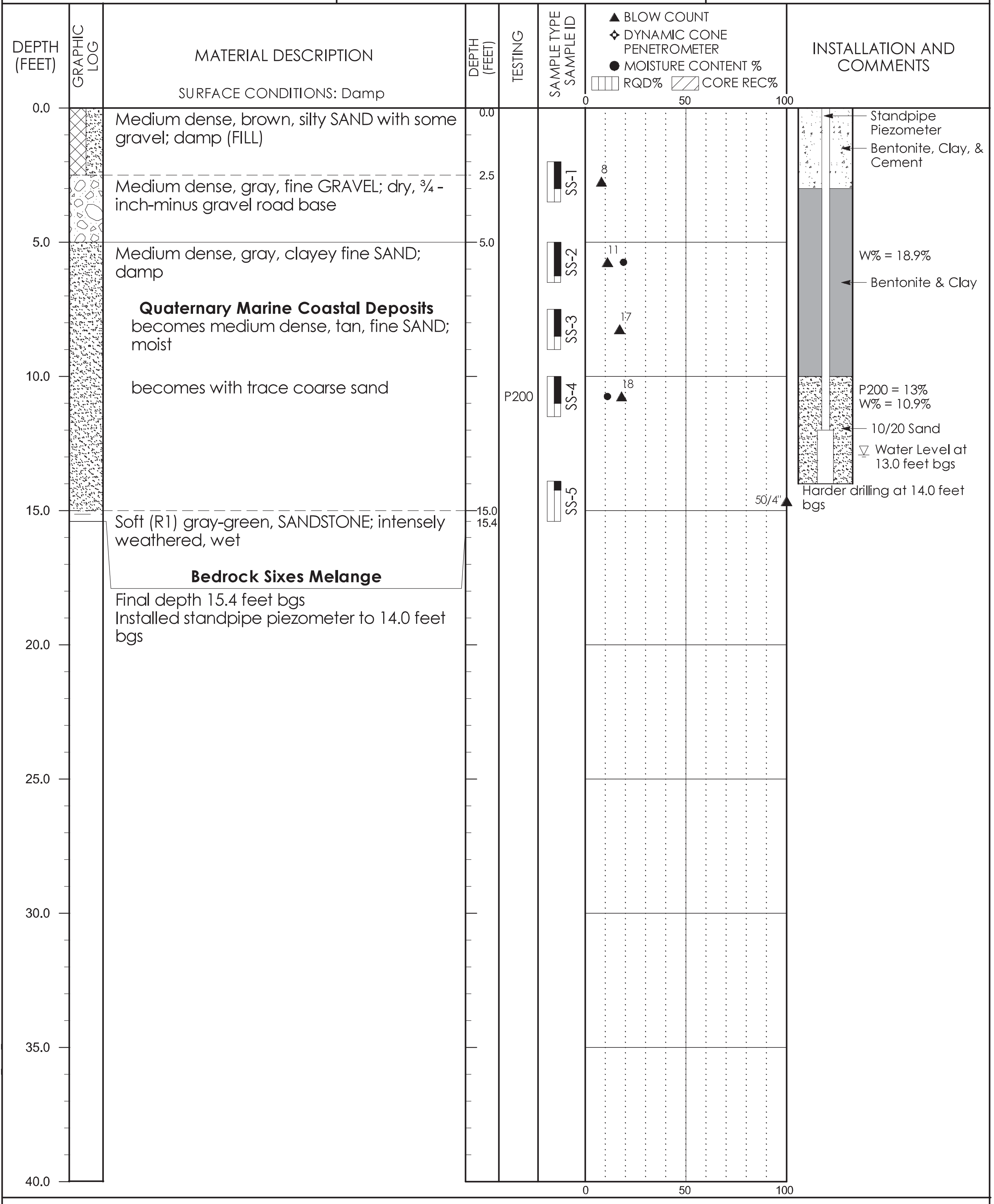
1087 Lewis River Road #309
Woodland, WA 98674
D. 360-225-3945
C. 971-201-7359

190 6th Street
Port Orford, OR 97465
D. 541-332-0433
C. 541-655-0021

CASCADIA Geoservices
Geologists and Engineers

COORDINATES/LOCATION:

CASCADIA GEOSERVICES PROJECT NUMBER:
17050



SURFACE CONDITIONS: Damp

Medium dense, brown, silty SAND with some gravel; damp (FILL)

Medium dense, gray, fine GRAVEL; dry, ¾-inch-minus gravel road base

Medium dense, gray, clayey fine SAND; damp

Quaternary Marine Coastal Deposits

becomes medium dense, tan, fine SAND; moist

becomes with trace coarse sand

Soft (R1) gray-green, SANDSTONE; intensely weathered, wet

Bedrock Sixes Melange

Final depth 15.4 feet bgs
Installed standpipe piezometer to 14.0 feet bgs

DRILLING METHOD: Auger
BIT DIAMETER:

DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: E. Oberbeck

LOGGING COMPLETED: 7/01/17

BORING B-1

BORING B-2

BANDON BEACH MOTEL
1090 PORTLAND AVENUE SW
BANDON, OREGON

1087 Lewis River Road #309
Woodland, WA 98674
D. 360-225-3945
C. 971-201-7359

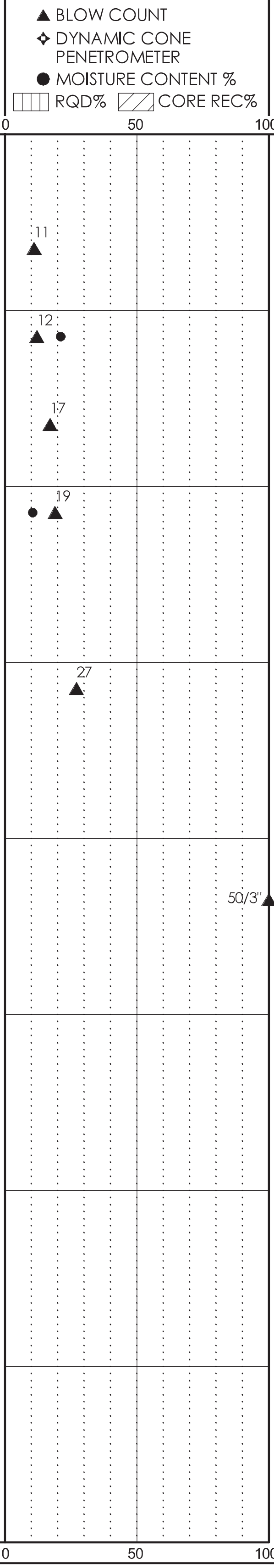
190 6th Street
Port Orford, OR 97465
D. 541-332-0433
C. 541-655-0021

COORDINATES/LOCATION:

CASCADIA GEOSERVICES PROJECT NUMBER:
17050

SURFACE CONDITIONS: Dry

DEPTH (FEET)	MATERIAL DESCRIPTION	DEPTH (FEET)	TESTING	SAMPLE TYPE SAMPLE ID	BLOW COUNT	INSTALLATION AND COMMENTS
0.0	Medium dense, brown, silty fine SAND with some fine gravel; dry (FILL)	0.0				
	Medium dense, tan-brown, fine SAND; damp **Quaternary Marine Coastal Deposits**	2.5		SS-6	11	
5.0	becomes stiff, gray, CLAY; damp, medium plasticity, medium toughness of thread **Quaternary Marine Coastal Deposits**	5.0	ATT	SS-7	12	LL = 19% PL = 18% PI = 19% W% = 21.0% Remarks: Soils liquefied near the Atterberg liquid limit (LL) in sample SS-7
	becomes with fine sand	7.5		SS-8	17	
10.0	becomes medium dense, tan, fine SAND; damp, poorly graded **Quaternary Marine Coastal Deposits**		P200	SS-9	19	P200 = 8% W% = 10.4%
						Very hard drilling at 14.0 feet bgs ▽ Water Level at 15.0 feet bgs
15.0	becomes dense, tan-brown, fine to coarse SAND; wet, rounded to subrounded			SS-10	27	
	becomes flowing wet SAND					Hole caving at 17.5 feet bgs
20.0						No sample collected at 20.0 feet bgs due to hole caving
	Hard (R4), green-tan CHERT; wet **Bedrock Sixes Melange**	21.9 22.0		SS-11	50/3"	
25.0	Final depth at 22.0 feet bgs due to refusal on bedrock Boring backfilled with bentonite chips					
30.0						
35.0						
40.0						



DRILLING METHOD: Auger
BIT DIAMETER:

DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: E. Oberbeck

LOGGING COMPLETED: 7/01/17

BORING B-2

BORING B-3

BANDON BEACH MOTEL
1090 PORTLAND AVENUE SW
BANDON, OREGON

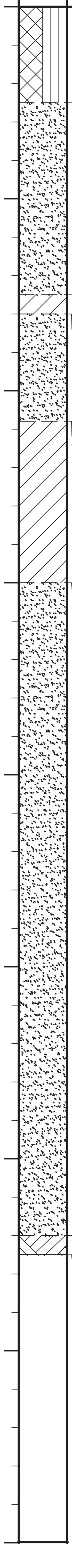
1087 Lewis River Road #309
Woodland, WA 98674
D. 360-225-3945
C. 971-201-7359

190 6th Street
Port Orford, OR 97465
D. 541-332-0433
C. 541-655-0021

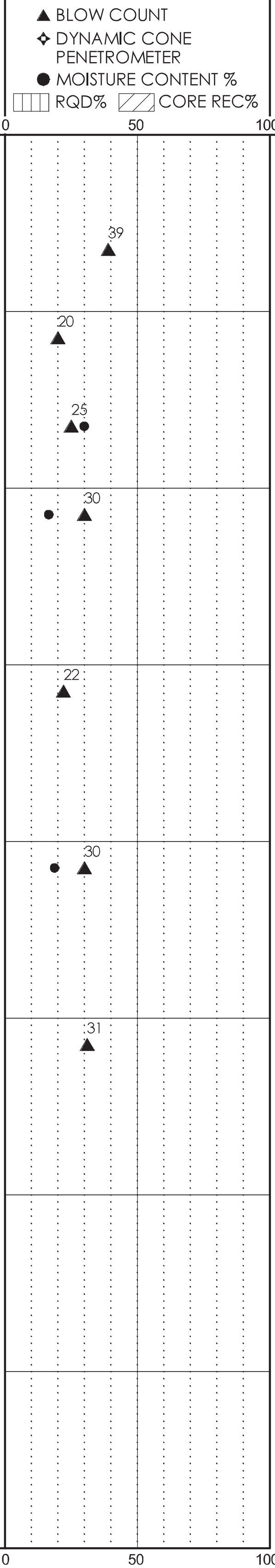
COORDINATES/LOCATION:

CASCADIA GEOSERVICES PROJECT NUMBER: 17050

SURFACE CONDITIONS: Wet



DEPTH (FEET)	MATERIAL DESCRIPTION	TESTING	SAMPLE TYPE SAMPLE ID	INSTALLATION AND COMMENTS
0.0	Loose, brown, organic SILT; damp (FILL)			
2.5	Dense, orange-brown, fine SAND; damp **Quaternary Marine Coastal Deposits**		SS-12	
	becomes medium dense, tan and orange, silty clayey fine SAND; damp		SS-13	
7.5 8.0	becomes very stiff, gray, fine sandy CLAY; damp **Quaternary Marine Coastal Deposits**	ATT	SS-14	Remarks: Sample liquifies at higher moisture content in sample SS-14 LL = 26% PL = 25% PI = 25% W% = 29.8%
10.8	becomes medium dense tan, fine SAND; damp **Quaternary Marine Coastal Deposits** becomes medium dense to dense, gray, fine SAND; damp	P200	SS-15	P200 = 17% W% = 16.4% ▽ Water Level at 13.0 feet bgs
15.0	becomes stiff, gray, silty CLAY; damp **Quaternary Marine Coastal Deposits**		SS-16	Softer drilling at 16.5 feet bgs
	becomes medium dense, tan-brown and orange, fine SAND; wet **Quaternary Marine Coastal Deposits** becomes medium dense to dense, brown-orange fine SAND; wet		SS-17	W% = 18.6%
			SS-18	Hole caving at 25.0 feet bgs
				No sample collected at 30.0 feet bgs due to hole caving
32.0 32.5	Hard (R4), green and tan CHERT **Bedrock Sixes Melange**			
	Final depth 32.5 feet bgs due to refusal Hole backfilled with bentonite chips			



DRILLING METHOD: Auger
BIT DIAMETER:

DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: E. Oberbeck

LOGGING COMPLETED: 7/01/17

BORING B-3

Attachment 3-Lab Analysis

Water Content Determination

ASTM D2216

Project Name: **Bandon Beach Motel**

Project Number: 17050

Recorded By: J Thrall

July 10,2017

Remarks:

Sample Designation	**B1 SS2**	**B1 SS4**	**B2 SS7**	**B2 SS9**	**B3 SS14**
Sample Depth	**5'**	**10'**	**5'**	**10'**	**7.5'**
Pan Number	A	B	C	D	E
Wt. Wet Soil +Pan (g)	87.05	63.79	96.36	66.18	87.34
Wt. Dry Soil +Pan (g)	76.44	59.5	83.11	61.84	71.82
Wt. Water (g)	10.61	4.29	13.25	4.34	15.52
Wt. Pan (g)	20.24	20.12	20.09	19.91	19.82
Wt. Dry Soil (g)	56.2	39.38	63.02	41.93	52
Water Content (%)	18.9	10.9	21.0	10.4	29.8

Sample Designation	B3 SS15	B3 SS17			
Sample Depth	10'	20'			
Pan Number	F	G			
Wt. Wet Soil +Pan (g)	75.94	93.28			
Wt. Dry Soil +Pan (g)	68.12	81.8			
Wt. Water (g)	7.82	11.48			
Wt. Pan (g)	20.33	20.08			
Wt. Dry Soil (g)	47.79	61.72			
Water Content (%)	16.4	18.6			

Sample Designation					
Sample Depth					
Pan Number					
Wt. Wet Soil +Pan (g)					
Wt. Dry Soil +Pan (g)					
Wt. Water (g)					
Wt. Pan (g)					
Wt. Dry Soil (g)					
Water Content (%)					

Percent Fines (-#200)

ASTM D1140

Project Name: Bamdon Beach Motel			**Project Number: 17050**		
Recorded By: J Thrall			**Date: July 10, 2017**		
Remarks: Lots of 1/4' minus gravel in sample B1 SS4					
Sample Designation	**B1 SS4**	**B2 SS9**	**B3 SS15**		
Sample Depth	**10'**	**10'**	**10'**		
Pan Number	**3**	**4**	**5**		
Wt. Wet Soil +Pan (g)	669.13	566.57	703.45		
Wt. Dry Soil +Pan (g)	609.39	526.74	624.24		
Wt. Water (g)	59.74	39.83	79.21		
Wt. Pan (g)	130.97	129.31	130.73		
Wt. Dry Soil (g)	478.42	397.43	493.51		
Water Content (%)	12.5%	10.0%	16.1%		
Test Sample Data					
Wt. Dry Soil (g)	478.42	397.43	493.51		
After Washing Data					
Pan Number	**3**	**4**	**5**		
Wt. Dry Soil +Pan (g)	546.98	494.17	539.06		
Wt. Pan (g)	130.97	129.31	130.73		
Wt. Dry Soil (+200) (g)	416.01	364.86	408.33		
%Fines Calculation					
AW Wt. Dry Soil (g)	416.01	364.86	408.33		
Loss (g) C=A-B	62.41	32.57	85.18		
Fines (%) (C/A)*100	13.0%	8.2%	17.3%		

Atterberg Limits Determination

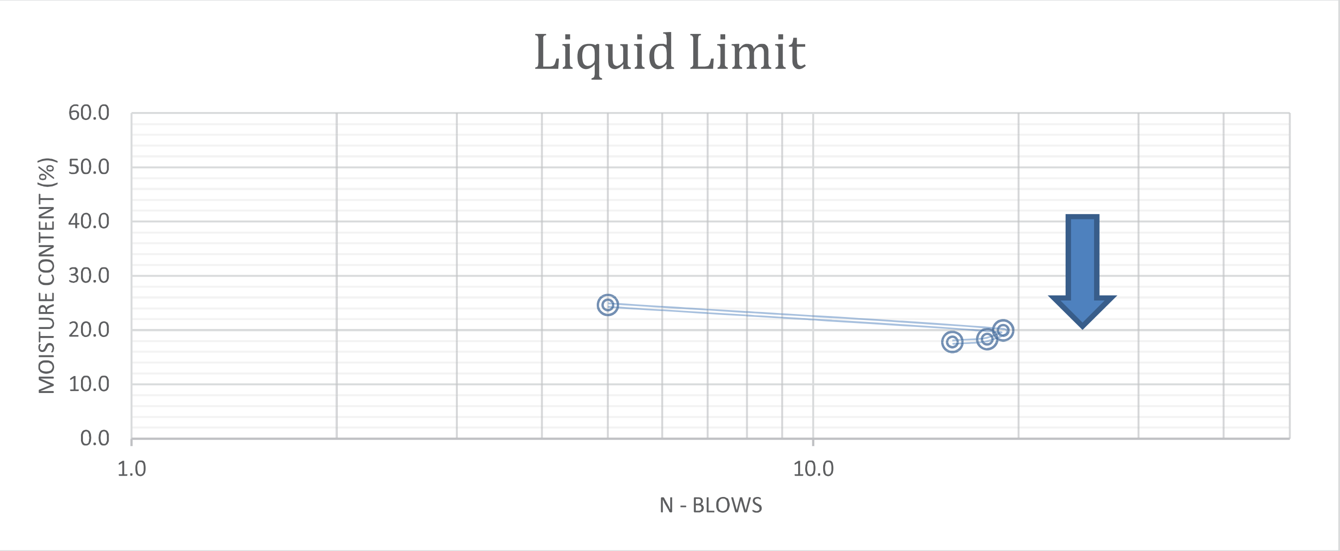
ASTM D4318

Project Name: Bandon Beach Motel	**Project Number: 17050**
Recorded By: J Thrall	**Date: July10, 2017**

Sample Designation: B2 SS7

Remarks: soils liquefied near the liquid limit, interpreted result by rgt

Test Number	**1**	**2**	**3**	**4**
Liquid Limit				
Pan Number	**V**	**W**	**X**	**FF**
Wt. Wet Soil +Pan (g)	72.31	64.43	73.43	75.2
Wt. Dry Soil +Pan (g)	61.95	57.03	65.15	67.55
Wt. Water (g)	10.36	7.4	8.28	7.65
Wt. Pan (g)	19.84	19.83	19.83	24.5
Wt. Dry Soil (g)	42.11	37.2	45.32	43.05
Water Content (%)	24.6	19.9	18.3	17.8
Number of Drops (N)	5.0	19.0	18.0	16.0
Plastic Limit				
	GG	**HH**	**3 FOIL**	
Wt. Wet Soil +Pan (g)	50.3	57.03	33.5	
Wt. Dry Soil +Pan (g)	46.33	52.4	29.52	
Wt. Water (g)	3.97	4.63	3.98	
Wt. Pan (g)	25.05	28.56	8.35	Plastic Limit (%)
Wt. Dry Soil (g)	21.28	23.84	21.17	Average (%)
Water Content (%)	18.7	19.4	18.8	19.0



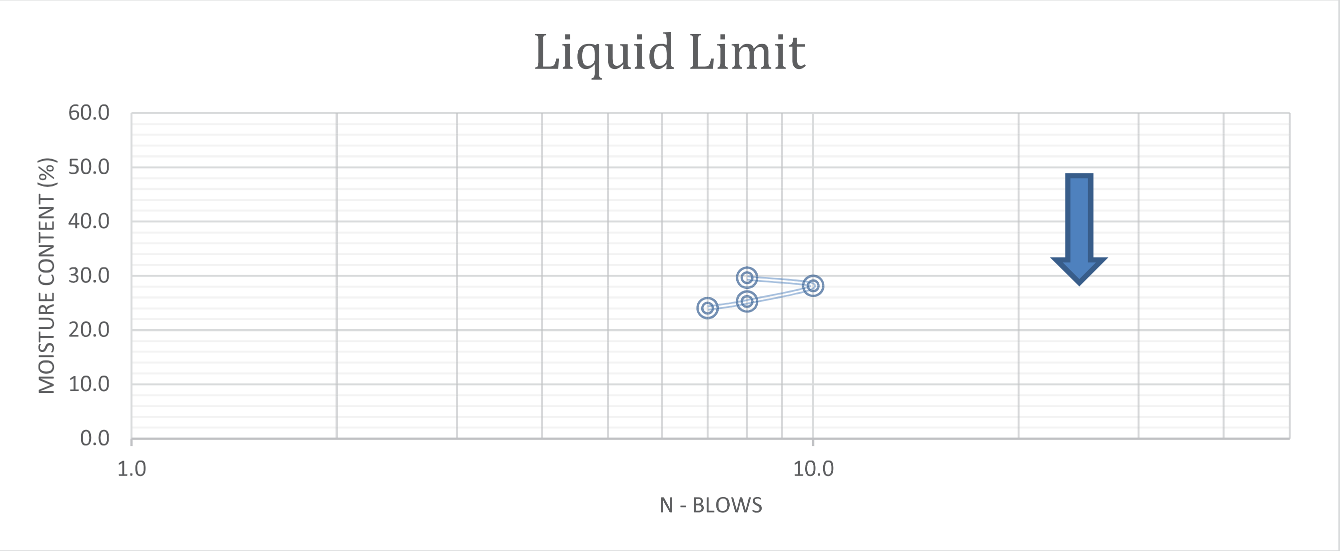
Liquid Limit (%)	20
Plastic Limit (%)	19
Plastic Index (%)	1

Atterberg Limits Determination

ASTM D4318

Project Name: Bandon Beach Motel	**Project Number: 17050**
Recorded By: J Thrall	**11-Jul-17**
Sample Designation: B3 SS14	
Remarks: sample liquifies at higher moisture contents: rgt interpreted result	

Test Number	**1**	**2**	**3**	**4**
Liquid Limit				
Pan Number	**AA**	**BB**	**CC**	**DD**
Wt. Wet Soil +Pan (g)	67.89	60.05	58.84	65.04
Wt. Dry Soil +Pan (g)	57.87	51.96	51.91	57.05
Wt. Water (g)	10.02	8.09	6.93	7.99
Wt. Pan (g)	24.03	23.21	24.41	23.81
Wt. Dry Soil (g)	33.84	28.75	27.5	33.24
Water Content (%)	29.6	28.1	25.2	24.0
Number of Drops (N)	8.0	10.0	8.0	7.0
Plastic Limit				
	EE	**FF**	**GG**	
Wt. Wet Soil +Pan (g)	56.93	52.7	45.57	
Wt. Dry Soil +Pan (g)	50.17	47.07	41.47	
Wt. Water (g)	6.76	5.63	4.1	
Wt. Pan (g)	24.03	24.52	25.03	Plastic Limit (%)
Wt. Dry Soil (g)	26.14	22.55	16.44	Average (%)
Water Content (%)	25.9	25.0	24.9	25.3



Liquid Limit (%)	28
Plastic Limit (%)	25
Plastic Index (%)	3

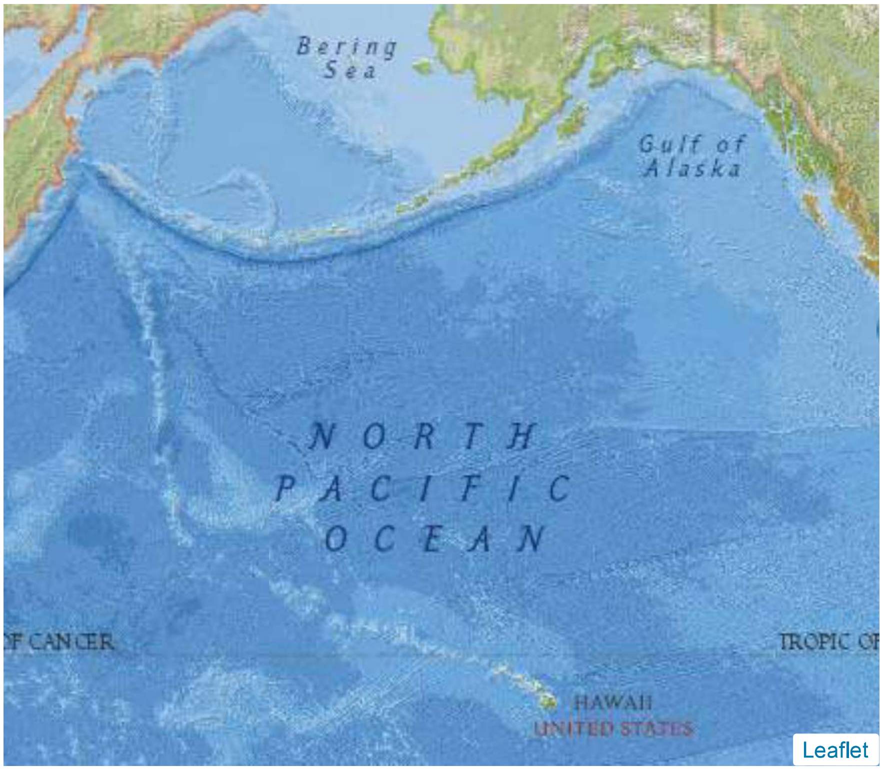
Attachment 4-Seismic Design Report (Partial)

U.S. Geological Survey - Earthquake Hazards Program

Bandon Beach Motel, 1090 Portland Avenue SW, Bandon, OR

Latitude = 43.114°N, Longitude = 124.433°W

Location



Reference Document

2015 NEHRP Provisions

Site Class

D (determined): Stiff Soil

Risk Category

I or II or III

$S_S =$ 2.042 g

$S_{MS} =$ 2.042 g

$S_{DS} =$ 1.361 g

$S_1 =$ 0.973 g

$S_{M1} =$ 1.653 g[1]

$S_{D1} =$ 1.102 g[1]

[1] Since the Site Class is D and $S_1 \geq 0.2$ g, site-specific ground motions might be required. See Section 11.4.7 of the 2015 NEHRP Provisions.

Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site class as Site Class , based on the site soil properties in accordance with Chapter 20.

Table 20.3-1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20 • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		
For SI: 1ft/s = 0.3048 m/s 1lb/ft ^{2} = 0.0479 kN/m ^{2}			

Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Risk-targeted Ground Motion (0.2 s)

$C_{RS}S_{SUH} = 0.857 \times 2.381 = 2.042$ g

Deterministic Ground Motion (0.2 s)

$S_{SD} = 3.287$ g

$S_S \equiv$ “Lesser of $C_{RS}S_{SUH}$ and S_{SD}” = 2.042 g

Risk-targeted Ground Motion (1.0 s)

$C_{R1}S_{1UH} = 0.862 \times 1.128 = 0.973$ g

Deterministic Ground Motion (1.0 s)

$S_{1D} = 1.247$ g

$S_1 \equiv$ “Lesser of $C_{R1}S_{1UH}$ and S_{1D}” = 0.973 g

Table 11.4-1: Site Coefficient F_a

Site Class	Spectral Reponse Acceleration Parameter at Short Period					
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S = 1.25$	$S_S \geq 1.50$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.3	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.2	1.1	1.0	1.0
D (default)	1.6	1.4	1.2	1.2	1.2	1.2
E	2.4	1.7	1.3	1.2[*]	1.2[*]	1.2[*]
F	See Section 11.4.7					

[*] For Site Class E and $S_S \geq 1.0$ g, see the requirements for site-specific ground motions in Section 11.4.7 of the 2015 NEHRP Provisions. Here the exception to those requirements allowing F_a to be taken as equal to that of Site Class C has been invoked.

Note: Use straight-line interpolation for intermediate values of S_S.

Table 11.4-2: Site Coefficient F_v

Site Class	Spectral Response Acceleration Parameter at 1-Second Period					
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 = 0.50$	$S_1 \geq 0.60$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.8	0.8	0.8	0.8	0.8	0.8
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.5	1.5	1.5	1.5	1.5	1.4
D (determined)	2.4	2.2[1]	2.0[1]	1.9[1]	1.8[1]	1.7[1]
D (default)	2.4	2.2[1]	2.0[1]	1.9[1]	1.8[1]	1.7[1]
E	4.2	3.3[1]	2.8[1]	2.4[1]	2.2[1]	2.0[1]
F	See Section 11.4.7					

[1] For Site Class D or E and $S_1 \geq 0.2$ g, site-specific ground motions might be required. See Section 11.4.7 of the 2015 NEHRP Provisions.

Note: Use straight-line interpolation for intermediate values of S_1.

Note: Where Site Class B is selected, but site-specific velocity measurements are not made, the value of F_v shall be taken as 1.0 per Section 11.4.2.

For Site Class = D (determined) and S_1 = 0.973 g, F_v = 1.700

Site-adjusted MCE_R (0.2 s)

$S_{MS} = F_a S_S = 1.000 \times 2.042 = 2.042$ g

Site-adjusted MCE_R (1.0 s)

$S_{M1} = F_v S_1 = 1.700 \times 0.973 = 1.653$ g

Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

Table 11.8-1: Site Coefficient for F_{PGA}

Site Class	Mapped MCE Geometric Mean (MCE_G) Peak Ground Acceleration					
	$PGA \leq 0.10$	$PGA = 0.20$	$PGA = 0.30$	$PGA = 0.40$	$PGA = 0.50$	$PGA \geq 0.60$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.2	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.3	1.2	1.1	1.1
D (default)	1.6	1.4	1.3	1.2	1.2	1.2
E	2.4	1.9	1.6	1.4	1.2	1.1
F	See Section 11.4.7					

Note: Use straight-line interpolation for intermediate values of PGA

Note: Where Site Class D is selected as the default site class per Section 11.4.2, the value of F_{pga} shall not be less than 1.2.

For Site Class = D (determined) and PGA = 1.014 g, F_{PGA} = 1.100

Mapped MCE_G	$PGA = 1.014$ g
Site-adjusted MCE_G	$PGA_M = F_{PGA}PGA = 1.100 \times 1.014 = 1.115$ g

Attachment 5-General Construction Recommendations

GENERAL CONSTRUCTION INFORMATION

1.0 INTRODUCTION

Appendix D outlines Cascadia Geoservices, Inc. specific recommendations for use in the project construction process. This section includes our guidelines for preparing the site, stipulations for structural fill, procedures for sloped conditions, and drainage considerations.

2.0 SITE PREPARATION

Site preparation will include removal of existing buildings not intended as part of future development. Underground utility lines, vaults, basement walls, or tanks associated with these existing buildings should be removed or grouted full if left in place. The voids resulting from removal of footings, buried tanks, etc., or loose soil in utility lines, should be backfilled with compacted structural fill. The base of these excavations should be excavated to firm subgrade before filling with sides sloped at a minimum of 1H:1V to allow for uniform compaction.

Materials generated during demolition of existing improvements should be transported off-site or stockpiled in areas designated by the owner. Asphalt, concrete, and base rock materials may be crushed and recycled for use as general fill. Such recycled materials should meet the criteria described in the "Structural Fill" section of this appendix.

2.1 Stripping and Grubbing

Trees and shrubs should be removed from all pavement and improvement areas. In addition, root balls should be grubbed out to the depth of the roots, which could exceed 3 feet bgs. Depending on the methods used to remove the root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

The existing topsoil zone should be stripped and removed from all proposed structural fill, pavement, and improvement areas and for a 5-foot margin around such areas. Based on our explorations, the average depth of stripping will be approximately 4 to 6 inches, although greater stripping depths may be required to remove localized zones of loose or organic soil. Greater stripping depths (approaching 12 inches) may be anticipated in areas with thicker vegetation and shrubs. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off-site for disposal or used in landscaped areas.

2.2 Proofrolling

Following stripping and prior to placing fill, pavement, or building improvements, the exposed subgrade should be evaluated by proofrolling. The subgrade should be proofrolled with a fully-loaded dump truck or similar heavy rubber-tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe the proofrolling. Soft or loose zones identified during the field evaluation should be compacted to an unyielding condition or be excavated and replaced with structural fill, as discussed in the "Structural Fill" section of this appendix.

2.3 Wet-Weather Conditions

Trafficability on the near-surface soils may be difficult during or after extended wet periods or when the moisture content of the surface soil is more than a few percentage points above optimum. Soils that have been disturbed during site-preparation activities, or soft or loose zones identified during probing or proofrolling, should be removed and replaced with compacted structural fill.

Track-mounted excavating equipment may be required during wet weather. The thickness of the granular material for haul roads and staging areas will depend on the amount and type of construction traffic. A 12- to 18-inch-thick mat of imported granular material is sufficient for light staging areas. The granular mat for haul roads and areas with repeated heavyconstruction traffic typically needs to be increased to between 18 to 24 inches. The actual thickness of haul roads and staging areas should be based on the contractor's approach to site development and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller. Additionally, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic.

As an alternative to placing thick rock sections to support construction traffic, the subgrade can be stabilized using cement amendment. The depth of treatment and percentage of cement required depends on the site conditions at the time of construction. Additional recommendations will be provided during construction, if this approach is used.

3.0 STRUCTURAL FILL

Fills should be placed over subgrade that has been prepared in conformance with the "Site Preparation" and "Wet-Weather/Wet-Soil Considerations" sections of this report. A wide range of material may be used as structural fill; however, all material used should be free of organic matter or other unsuitable materials and should meet the specifications provided in the Oregon Standard Specifications for Construction, Oregon Department of Transportation 2006 (OSSC) depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

3.1 Native Soils

The native soils are suitable for use as general fill, provided they are properly moisture conditioned and meet the requirements of OSSC 00330.12 – Borrow Material. Laboratory testing indicates that the moisture content of the near-surface soils is greater than the soils' optimum moisture content required for satisfactory compaction. In order to adequately compact the soil, it may be necessary to moisture condition the soil to within 2-3 percentage points of the optimum moisture content. Moisture conditioning will be difficult due to the finegrained nature of the soil.

When used as structural fill, native soils should be placed in lifts with a maximum uncompacted thickness of 6 to 8 inches and compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557.

3.2 Imported Granular Material

Imported granular material used during periods of wet weather or for haul roads, building pad subgrades, staging areas, etc., should be pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.12 – Borrow Material, and OSSC 00330.13 – Selected General Backfill. However, the imported granular material should also be fairly well graded between coarse and fine material and have less than 5 percent by weight passing the U.S. Standard No. 200 Sieve.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 8 to 12 inches and be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. During the wet season or when wet subgrade conditions exist, the initial lift should be approximately 18 inches in uncompacted thickness and should be compacted by rolling with a smooth-drum roller without using vibratory action.

Where imported granular material is placed over soft-soil subgrades, we recommend a geotextile be placed as a barrier between the subgrade and imported granular material. Depending on site conditions, the geotextile should meet OSSC 2320.10 for soil separation or stabilization. The geotextile should be installed in conformance with OSSC 0350.40 – Geosynthetic Construction.

3.3 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 2 feet above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 10 percent by weight passing the U.S. Standard No. 200 Sieve, and should meet the standards prescribed by OSSC 405.12 – Pipe Zone Bedding. The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.

Within roadway alignments or beneath building pads, the remainder of the trench backfill should consist of well-graded granular material with a maximum particle size of 2½ inches, less than 10 percent by weight passing the U.S. Standard No. 200 Sieve, and should meet standards prescribed by OSSC 405.14 – Trench Backfill, Class A or B. This material should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department. The upper 2 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill materials that are free of organics and materials over 6 inches in diameter and meet OSSC 00330.12 – Borrow Material and OSSC 405.14 – Trench Backfill, Class C, D, or E. This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.

3.4 Stabilization Material

Stabilization rock should consist of imported granular material that is well-graded, angular, crushed rock consisting of 4- or 6-inch-minus material with less than 2 percent passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material.

3.5 Soil Amendment with Cement

As an alternative to the use of imported granular material for wet-weather structural fill, an experienced contractor may be able to amend the on-site soils with portland cement or with limekiln dust and cement to obtain suitable support properties. Successful use of amendments depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Specific recommendations for soil amending, based upon exposed site conditions, can be provided if necessary.

Portland cement-amended soils are hard and have low permeability. Therefore, these soils do not drain well nor are suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be planned for drainage and planting.

3.6 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of select granular material meeting OSSC 510.12. We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric which meets the requirements provided in OSSC 2320.10. The geotextile should be installed in conformance with OSSC 00350.40 – Geosynthetic Construction.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D 1557. However, backfill located within a horizontal distance of 3 feet from the retaining walls should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D 1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6-inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactors). If flat work (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D 1557.

3.7 Trench and Retaining Wall Drain Backfill

Backfill in a 2-foot zone against the back of retaining walls and for subsurface trench drains should consist of drain rock meeting the specifications provided in OSSC 00430.11 – Granular Drain Backfill Material. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in OSSC 2320.10 for soil separation and/or stabilization. The geotextile should be installed in conformance with OSSC 00350.40 – Geosynthetic Construction.

3.8 Footing Base

Imported granular material placed at the base of retaining wall footings should be clean, crushed rock or crushed gravel, and sand that is fairly well-graded between coarse and fine.

The granular materials should contain no deleterious materials, have a maximum particle size of 1½ inches, and meet OSSC 00330.14 – Select Granular Backfill. The imported granular material should be placed on one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

3.9 Floor Slab Base Aggregate

Base aggregate for floor slabs should be clean, crushed rock or crushed gravel. The base aggregate should contain no deleterious materials, meet specifications provided in OSSC 00330.14 – Select Granular Backfill, and have less than 5 percent weight by passing the U.S. Standard No. 200 Sieve. The imported granular material should be placed in one lift and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557.

3.10 Pavement Base Aggregate

Imported granular material used as base aggregate (base rock) along roadway alignments should be clean, crushed rock or crushed gravel, and sand that is fairly well-graded between coarse and fine. The base aggregate should meet the gradation defined in OSSC 02630.10 – Dense Graded Aggregate 1"-0", depending upon application, with the exception that the aggregate has less than 5 percent passing a U.S. Standard No. 200 Sieve. The base aggregate should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

3.11 Recycled Concrete, Asphalt, and Base Rock

Asphalt pavement, concrete, and base rock from the existing site improvements can be used in general structural fills—provided no particles greater than 6 inches are present. It also must be thoroughly mixed with soil, sand, or gravel such that there are no voids between the fragments. The recycled materials should meet the requirements set forth in OSSC 00744.03 – Reclaimed Asphalt Pavement (RAP) Material.

4.0 PERMANENT SLOPES

Permanent cut and fill slopes up to 15-feet tall may be built to a gradient as steep as 2H:1V. However, cut slopes over 15-feet tall should be limited to a gradient of 2.5H:1V or should be partially retained by a retaining wall. Slopes that will be maintained by mowing should not be constructed steeper than 3H:1V. Newly-constructed fill slopes should be over-built by at least 12 inches and then trimmed back to the required slope to maintain a firm face.

Access roads and pavements should be located at least 5 feet from the top of cut and fill slopes. The setback should be increased to 10 feet for buildings, unless special foundation considerations are implemented. Slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

5.0 DRAINAGE CONSIDERATIONS 5.1 Surface and Subsurface Drainage Requirements

The Contractor shall be made responsible for temporary drainage of surface water and groundwater, as necessary, to prevent standing water and/or erosion at the working surface.

General Construction Information

We recommend removing only the foliage necessary for construction to help minimize erosion.

The ground surface around the structures should be sloped to create a minimum gradient of 2 percent away from the building foundations for a distance of at least 5 feet. Surface water should be directed away from all buildings into drainage swales or into a storm drainage system. “Trapped” planting areas should not be created next to any building without providing means for drainage. The roof downspouts should discharge onto splash blocks or paving that directs water away from the building, or into smooth-walled underground drain lines that carry the water to appropriate discharge locations at least 10 feet away from any buildings.

5.2 Foundation Drains

We recommend foundation drains around the perimeter foundations of all structures, including buildings and tanks. The foundation drains should be at least 12 inches below the base of the slab. The foundation drain should consist of perforated collector pipes embedded in a minimum 2-foot-wide zone of angular drain rock. The drain rock should meet specifications provided in the “Structural Fill” section of this report. The drain rock should be wrapped in a geotextile fabric. The collector pipes should discharge at an appropriate location away from the base of the footings. Unless measures are taken to prevent backflow into the wall’s drainage system, the discharge pipe should not be tied directly into the stormwater drain system.