4. Geotechnical Soil Analysis Report

Exhibit 16 SUB26-1011

Report of Geotechnical Engineering Services

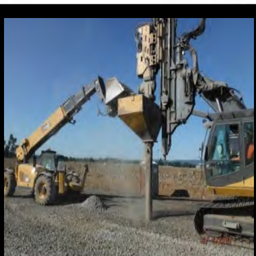
Uhacz Development

Camas, Washington

June 17, 2025

Geotechnical ■ Environmental ■ Special Inspections

Columbia West Engineering, Inc

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June 17, 2025

Romano Development, Inc.
4660 NE 77th Avenue, Suite 200
Vancouver, WA 98662

Attn: Stacey Shields and Dominic Maiello

Re: Report of Geotechnical Engineering Services
Uhacz Development
27429 SE 15th Street
Camas, Washington
CWE Project: Romano-8-01-1

Columbia West Engineering, Inc. (Columbia West) is pleased to present this geotechnical report for the proposed Uhacz Development in Camas, Washington. Our services were conducted in accordance with the Annual Master Services Agreement dated June 16, 2023, and the Work Order for Environmental Services dated May 5, 2025, between Romano Development, Inc. and Columbia West.

We appreciate the opportunity to work on the project. Please contact us if you have any questions regarding this report.

Sincerely,

Nick Paveglio, PE
Principal Engineer

NICHOLAS N. PAVEGLIO
STATE OF WASHINGTON
45872
REGISTERED
PROFESSIONAL ENGINEER

Signed 06/17/2025

NNP:kat
Attachments
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EXECUTIVE SUMMARY

This section provides a summary of the geotechnical considerations associated with the proposed Uhacz Development in Camas, Washington. Our conclusions and recommendations are based on the subsurface information presented in the report and proposed development information provided by the design team. A detailed discussion of the geotechnical considerations summarized herein is presented in respective sections of the report.

- Structures associated with the development can be supported on conventional spread footings bearing on firm, native soil or structural fill overlying firm, native soil.

- Based on the soil and groundwater conditions at the site, seismic settlement and lateral spreading are not design considerations for the project.

- The on-site soil will generally provide poor support for construction equipment during the wet construction season. Subgrade protection during construction will be important. Granular haul roads and working pads should be employed if earthwork occurs during the wet season or when the subgrade is wet of optimum moisture content.

- Moisture conditioning will be required to use the on-site soil as structural fill. Accordingly, extended dry weather will be required to adequately condition and place the silt as structural fill. It will be difficult, if not impossible, to adequately compact the on-site soil during the rainy season or during prolonged periods of rainfall.

- Due to the sloping topography, silty subsurface soil, and perched groundwater encountered in our test pits, perimeter building foundation drains are recommended for all structures at the site.

- Dewatering may be required in portions of the site, particularly in cut areas.

- Based on the soil and groundwater conditions, infiltration systems are not feasible at the site.

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ABBREVIATIONS AND ACRONYMS

AC	asphalt concrete
AOS	apparent opening size
ASCE	American Society of Civil Engineers
ASTM	ASTM International
BGS	below ground surface
CSZ	Cascadia subduction zone
ESAL	equivalent single axle load
g	gravitational acceleration (32.2 feet/second^2)
HMA	hot mix asphalt
H:V	horizontal to vertical
IBC	International Building Code
in/hr	inch(es) per hour
km	kilometers
MCE	maximum considered earthquake
M_W	moment magnitude
NGVD	National Geodetic Vertical Datum
pcf	pounds per cubic foot
pci	pounds per cubic inch
PG	performance grade
psf	pounds per square foot
psi	pounds per square inch
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WSS	Washington Standard Specifications for Road, Bridge, and Municipal Construction (2024)
WWHM	Western Washington Hydrology Model

REPORT OF GEOTECHNICAL ENGINEERING SERVICES
UHACZ DEVELOPMENT
CAMAS, WASHINGTON

1.0 INTRODUCTION

Columbia West is pleased to submit this geotechnical report for the proposed Uhacz Development in Camas, Washington. The approximately 6.8-acre site is located at 27429 SE 15th Street and is currently occupied by a single-family residence and several outbuildings. The site is shown relative to surrounding physical features on Figure 1. Figure 2 shows the existing conditions of the site. Abbreviations and acronyms used herein are defined immediately following the Table of Contents.

Development consists of a residential subdivision with approximately 30 lots. Associated infrastructure, including utilities, private roadways, and stormwater detention, will also be constructed as part of the development. Structures will be of wood-framed construction and lightly loaded. We estimate that column and wall loads will not exceed 20 kips and 4 kips per lineal foot, respectively. Slab loads are not expected to exceed 150 psf.

Based on topography at the site, we anticipate cuts and fills could be moderate and up to 10 feet each and retaining walls may be constructed in portions of the development. Based on our experience in the area and results of testing, infiltration of stormwater will not be feasible due to the fine-grained nature of the near-surface soil.

2.0 PURPOSE AND SCOPE

The purpose of our services was to provide geotechnical engineering recommendations for use in design and construction of the proposed project. Specifically, we completed the following tasks:

- Reviewed information available in Columbia West's files for the site vicinity.
- Coordinated and managed the field exploration program, which included locating utilities, coordinating site access, and scheduling subcontractors and Columbia West field staff.
- Excavated eight test pits to depths between 12 and 13.5 feet BGS.
- Performed infiltration testing in select test pits to evaluate on-site infiltration potential.
- Observed subsurface conditions, maintained continuous logs of the explorations, and collected soil samples at representative intervals.
- Performed a laboratory testing program using select soil samples collected from the explorations, which included the following:
  - Six moisture content determinations in general accordance with ASTM D2216
  - Five particle-size analyses in general accordance with ASTM D1140
  - Two Atterberg limits tests in general accordance with ASTM D4318
- Prepared this geotechnical report that summarizes our explorations, laboratory testing, and analyses and provides geotechnical design criteria and construction recommendations for the development, including information relating to the following:
  - Summary of soil and groundwater conditions at the site
  - Laboratory testing results
  - Settlement potential

- Seismic hazards
- Recommendations for shallow spread footings
- Recommendations for retaining walls, including lateral earth pressures, backfill, compaction, and drainage
- Recommendations for site preparation, including grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork
- Recommendations for managing groundwater conditions that may affect the performance of structures and site improvements
- Recommendations for pavement sections and construction
- Code-based seismic design parameters in accordance with currently accepted design codes

3.0 SITE CONDITIONS

3.1 GEOLOGY

The near-surface geology at the site is mapped as Oligocene-aged basaltic andesite of Elkhorn Mountain. The unit is described as a sequence of lava flows and flow breccia composed of dark gray to brown, porphyritic to seriate to aphyric tholeiitic basaltic andesite and basalt. Individual flows are generally 15 to 25 feet thick and exhibit platy to blocky to columnar jointing. The unit locally includes minor volcaniclastic rocks too thin or poorly exposed to map (Evarts and O'Connor 2008).

The Web Soil Survey indicates that the surficial soil at the site consists of Olympic clay loam and Olympic stony loam generally consisting of 3 to 4 feet of clay loam underlain by gravelly clay loam (USDA 2025).

3.2 SURFACE CONDITIONS

The approximately 6.8-acre site is located at 27429 SE 15th Street in the north portion of Camas, Washington. The property is a "flag" lot with a narrow access road off of SE 15th Street. The property is generally open with the exception of a single-family residence and several outbuildings in the central portion. Vegetation generally consists of grass with occasional mature trees near the residence and along NE Woodburn Drive at the southern site boundary.

Topography at the site slopes downward to the north and south from a topographic high in the middle of the property near the residence. Elevations at the site range between approximately 430 and 460 (NGVD 29 (47)). The slope gradient in the north portion of the site is less than approximately 5 percent while maximum slopes in the south portion of the site approach 20 percent in isolated areas.

3.3 SUBSURFACE CONDITIONS

3.3.1 General

Subsurface conditions at the site were explored by excavating eight test pits (TP-1 through TP-8) to depths between 12 and 13.5 feet BGS. The exploration locations are shown on Figure 2. A description of the field exploration program and the exploration logs are presented in Appendix A. A description of the laboratory testing program and the testing results are presented in Appendix B. A summary of the subsurface conditions is presented below.

3.3.2 Subsurface Conditions

3.3.2.1 Topsoil and Root Zones

A 3- to- 4-inch-thick root zone within an approximately 8- to 12-inch-thick topsoil zone was encountered in all of the test pits completed at the site.

3.3.2.2 Low to Medium Plasticity Silt

Underlying the topsoil at the site is low to medium plasticity silt. The silt is typically medium stiff with some clay and variable proportions of sand. It is orange-brown-gray and moist. The low to medium plasticity silt generally extends to the maximum depths explored of 13.5 feet BGS in the north portion of the site and 7 to 10 feet BGS in the south portion of the site.

Laboratory testing indicates the moisture content of the low to medium plasticity silt ranged between 27 and 50 percent at the time of exploration.

3.3.2.3 High Plasticity Silt

High plasticity silt with is present below the low to medium plasticity silt in the south portion of the site. The silt is generally stiff and sandy with cobbles and boulders and some clay. The silt is orange-brown and moist. We interpret the silt to be highly decomposed Elkhorn Mountain basalt as described in Section 3.1 (Geology). The high plasticity silt extends to the maximum depth explored of up to 13 feet BGS, where encountered.

Laboratory testing indicates the moisture content of the high plasticity silt ranged between 40 and 45 percent at the time of exploration.

3.3.3 Groundwater

Slow to moderate groundwater seepage was encountered in several of the test pits at depths between 7 and 11 feet BGS. We anticipate the observed groundwater is perched and static groundwater will be more than 50 feet BGS.

Perched groundwater levels are subject to seasonal variation and may rise during extended periods of increased precipitation. Perched groundwater may also be present in localized areas and not consistently across the site. Seepage from perched groundwater may become evident during site grading, primarily along slopes or in areas cut below existing grade.

3.4 INFILTRATION TESTING

Infiltration testing was completed in three of the test pits to assist in the evaluation of stormwater management facilities for the project. The infiltration testing was conducted in general accordance with the recommendations for the encased falling head method per the *Clark County Stormwater Manual* (Clark County 2021). Table 1 summarizes our infiltration testing results and fines content determinations. The exploration logs and the laboratory testing results are presented in Appendices A and B, respectively.

Table 1. Infiltration Testing Results

Location	Depth (feet BGS)	Soil Type	Fines Content[1] (percent)	Unfactored Infiltration Rate (in/hr)
TP-2	4	Silt	85	Negligible
TP-5	4	Silt with sand	73	Negligible
TP-7	4	Sandy Silt	54	Negligible

1. Fines content: percent passing U.S. Standard No. 200 sieve

As indicated in Table 1, near-surface infiltration rates were negligible in the tested locations. Based on review of Table 7-2 of the USDA hydrologic soil group criteria (USDA 2009), Appendix 2-A of the 2021 *Clark County Stormwater Manual*, and the *Clark County WWHM Soil Groupings* memorandum (Otak, Inc. 2010), the near-surface native soil meets the classification criteria for WWHM Soil Group 4. Based on the near-surface soil at the site and the results of testing, on-site infiltration systems are not feasible.

3.5 GEOLOGIC HAZARDS

3.5.1 Seismic Setting

3.5.1.1 Earthquake Sources

Three scenario earthquakes were considered for this study consistent with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

3.5.1.2 Regional Events

The CSZ is the region where the Juan de Fuca Plate is being subducted beneath the North American Plate. This subduction is occurring in the coastal region between Vancouver Island and northern California. Evidence has accumulated suggesting that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock 1991). The fault trace is mapped approximately 50 to 120 km off the Washington Coast.

Two types of subduction zone earthquakes are possible and considered in this study:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a M_W of 9.0+.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a M_W of up to 8.0.

3.5.1.3 *Local Events*

A significant earthquake could occur on a local fault near the site within the design life of the development. Such an event would cause ground shaking at the site that could be more intense than the CSZ events, although the duration would be shorter. Table 2 provides the closest mapped faults to the site.

Table 2. Nearest Mapped Crustal Faults[1]

Source	Closest Mapped Distance (km)	Mapped Length (km)	Slip Rate (mm/yr)
Lacamas Lake fault	1.2	24	<0.02
Grant Butte fault	14.2	10	<0.02

1. Based on mapping by USGS (2025)

3.5.2 Seismic Settlement

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles. Granular soil, which relies on interparticle friction for strength, undergoes a loss of strength until the excess pore pressures dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Silty soil with low plasticity can be susceptible to strain softening under relatively higher levels of ground shaking. Strain-softened soil has volumetric strains much smaller than liquefiable soil due to matrix effects.

Based on the soil and groundwater conditions observed in the explorations and geology mapping, liquefaction and seismic settlement are not design considerations at the site.

3.5.3 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement.

Because liquefiable soil is not present at the site and there is no open face at or adjacent to the site, lateral spreading is not a design consideration at the site.

3.5.4 Fault Rupture

Based on USGS mapping, the nearest mapped fault is approximately 1 km away from the site (USGS 2025). As such, fault rupture is not considered a hazard at the site.

4.0 DESIGN

4.1 *STATIC SETTLEMENT CONSIDERATIONS*

Subsurface conditions at the site consist of silt with varying proportions of sand, clay, cobbles, and boulders. Areal loading from placement of fill can result in settlement that can be detrimental to structural elements at the site. In general, residential structures are constructed at least several months after grading and fill-induced settlement is not a consideration. Roadways and, particularly, utilities are typically constructed shortly after fill placement. If areal fills at the site exceed 10 feet, we should be contacted to review the grading plan to determine if settlement monitoring points should be installed to monitor settlement and determine when it is appropriate to construct settlement-sensitive improvements.

4.2 FOUNDATION SUPPORT

4.2.1 General

Based on the foundation loads in Section 1.0 (Introduction), the proposed buildings can be supported by conventional spread footings bearing on firm, native soil or engineered structural fill underlain by firm, native soil.

Footings should not be supported on topsoil or undocumented fill. All topsoil or undocumented fill should be removed from under footings and replaced with compacted crushed rock. Over excavation should extend 6 inches beyond the margins of the footings for every foot excavated below the base grades of the footings. Crushed rock should consist of imported granular material, as defined in Section 5.5.1 (Structural Fill). Imported granular material should be compacted to not less than 95 percent of maximum dry density as determined by ASTM D1557 or until well-keyed as determined by one of our geotechnical staff. We recommend that a member of our geotechnical staff observe the prepared footing subgrade.

4.2.2 Dimensions and Capacities

Continuous perimeter wall and isolated spread footings should have minimum widths of 16 and 20 inches, respectively. The bases of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The bases of interior footings should bear at least 12 inches below the base of the floor slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,000 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and is typically increased by one-third for transient lateral forces such as seismic or wind.

If footings are constructed after fill-induced settlement is complete, total post-construction consolidation settlement is expected to be less than 1.0 inch, with differential settlement less than 0.5 inch over a 50-foot span.

4.2.3 Resistance to Sliding

Lateral loads on footings can be resisted by passive earth pressure on the sides of structures and by friction on the bases of footings. Our analysis indicates that the available passive earth pressure for footings confined by native soil and structural fill is 300 pcf, modeled as an equivalent fluid pressure. Typically, the movement required to develop the available passive resistance may be relatively large; therefore, we recommend using a reduced passive equivalent fluid pressure of 250 pcf. Adjacent floor slabs, pavement, or the upper 12-inch depth of unpaved areas should not be considered when calculating passive resistance. In addition, in order to rely on passive resistance, a minimum of 5 feet of horizontal clearance must exist between the faces of the footings and any adjacent down slopes.

An allowable coefficient of friction equal to 0.30 can be used for footings supported on native soil. If a minimum of 6 inches of gravel are placed at the base of a footing, the coefficient of friction can be increased to 0.45.

4.2.4 Subgrade Observation and Preparation

All footing subgrade should be evaluated by a representative of Columbia West to confirm suitable bearing conditions. Observations should also confirm that loose or soft material, organic material, unsuitable fill, prior topsoil zones, and softened subgrade (if present) have been removed. Localized deepening of footing excavations may be required to penetrate any deleterious or soft material, particularly during wet weather conditions.

4.2.5 Foundation Drainage

Foundation drains should be installed for structures associated with the development as described in Section 4.7 (Drainage).

4.3 FLOOR SLABS

Floor slabs supporting loading of up to 150 psf can be supported on firm soil, provided the subgrade is prepared as described in Section 4.1 (Static Settlement Considerations) and Section 5.1 (Site Preparation). A modulus of subgrade reaction of 100 pci can be used to design slabs. A minimum 6-inch-thick layer of imported granular material should be placed and compacted over the prepared subgrade to assist as a capillary break. The floor slab base rock should be crushed rock or crushed gravel and sand meeting the requirements outlined in Section 5.5.1 (Structural Fill). The imported granular material should be placed in one lift and compacted to not less than 95 percent of maximum dry density as determined by ASTM D1557. Floor slab base rock contaminated with excessive fines (greater than 5 percent by dry weight passing the U.S. Standard No. 200 sieve) should be replaced.

Flooring manufacturers often require vapor barriers to protect flooring and flooring adhesives. Many flooring manufacturers will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier, if needed, should be based on discussions among members of the design team. We can provide additional information to assist you with your decision.

4.4 SEISMIC DESIGN CRITERIA

The structures will likely be constructed in accordance with the 2021 IBC, which references ASCE 7-16 for design parameters. Based on geologic mapping, our explorations, and review of well logs for the area, the appropriate seismic site class for design is C. Seismic design parameters in accordance with ASCE 7-16 are provided in Table 3.

Table 3. ASCE 7-16 Seismic Design Parameters

Parameter	Short Period (T_s)	1 Second Period (T_1)
MCE spectral response acceleration, S	S_S = 0.787 g	S_1 = 0.345 g
Site class	C	
Site coefficient, F	F_a = 1.2	F_v = 1.5
Adjusted spectral response acceleration, S_M	S_{MS} = 0.945 g	S_{M1} = 0.571 g
Design spectral response acceleration, S_D	S_{DS} = 0.630 g	S_{D1} = 0.345 g

4.5 RETAINING STRUCTURES

4.5.1 Assumptions

Our retaining wall design recommendations are based on the following assumptions: (1) the walls are cantilevered walls, (2) the walls are less than 10 feet in height, (3) drainage is provided behind the walls, (4) the retained soil has a slope flatter than 4H:1V, and (5) the ground surface at the toes of the walls has an inclination of flatter than 5H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

4.5.2 Wall Design Parameters

Permanent retaining structures free to rotate slightly around the base should be designed for active earth pressures using an equivalent fluid unit pressure of 35 pcf. If retaining walls are restrained against rotation during backfilling, they should be designed for an at-rest earth pressure of 55 pcf.

Seismic lateral forces can be calculated using a dynamic force equal to $7H^2$ pounds per linear foot of wall, where H is the wall height. The seismic force should be applied as a distributed load with the centroid located at 0.5H from the wall base. Footings for retaining walls should be designed as recommended for shallow foundations.

The design equivalent fluid pressure should be increased for walls that retain sloping soil. We recommend the above lateral earth pressures be increased using the factors presented in Table 4 when designing walls that retain sloping soil.

Table 4. Lateral Earth Pressure Increase Factors for Sloping Soil

Slope of Retained Soil (degrees)	Lateral Earth Pressure Increase Factor
0	1.00
5	1.06
10	1.12
20	1.33
25	1.52
30	2.27

A vertical live load of 250 psf should be applied where roadways are located within 1H of the backs of the walls, where H is the exposed height of the wall. Figure 3 should be used if other surcharges are located near the backs of the walls.

Foundations for walls can be designed in accordance with Section 4.2 (Foundation Support).

4.5.3 Wall Drainage and Backfill

The above design parameters have been provided assuming drains will be installed behind walls to prevent hydrostatic pressure from developing. If a drainage system is not installed, our office should be contacted for revised design forces.

Backfill placed behind walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of retaining wall select backfill placed and compacted in conformance with Section 5.5.1 (Structural Fill).

A minimum 6-inch-diameter, perforated collector pipe should be placed at the bases of walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of the finished grade. The drain rock and drainage geotextile fabric should meet the specifications in Section 5.5 (Materials). Perforated collector pipes should discharge at an appropriate location away from the bases of walls. Discharge pipes should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the wall's drainage system.

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend construction of flatwork 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.

4.6 PAVEMENT

4.6.1 General

New private roadways will be installed as part of the project. All pavement should be installed on subgrade prepared in conformance with Section 5.1 (Site Preparation) and Section 5.5 (Materials). Our pavement design recommendations are based on the following assumptions:

- The top 12 inches of soil subgrade are compacted to at least 92 percent of maximum dry density as determined by ASTM D1557 or until proof rolling with heavy equipment indicates that is it firm and unyielding.
- Resilient moduli of 4,500 psi and 20,000 psi were assumed for the subgrade soil and aggregate base, respectively.
- The design manual provided for the project specifies pavement recommendations based on a design life of 20 years.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.45.
- Fire access will consist of an imposed fire apparatus load of 75,000 pounds on an infrequent basis.
- No growth.

If any of our assumptions are incorrect, we should be contacted to provide alternative recommendations.

4.6.2 Traffic Loading Assumptions

We anticipate vehicle traffic will primarily consist of passenger cars and up to five semi-trucks per day. If any of these assumptions are incorrect, our office should be contacted with the appropriate information so that the pavement designs can be revised.

4.6.3 AC Pavement Design

Our AC pavement design recommendations are presented in Table 5.

Table 5. Recommended AC Pavement Sections Constructed over Native Soil or Engineered Fill

Traffic	ESALs	AC Thickness (inches)	Aggregate Base Thickness[1] (inches)
Drive aisles with limited trucks (up to five trucks per day)	25,000	3	10
Automobile parking (no trucks)	5,000	2.5	8

1. Aggregate base thickness can be decreased to 4 inches if the subgrade is cement amended to a minimum depth of 12 inches with a minimum unconfined compressive strength of 100 psi.

4.6.4 Construction Considerations

All thicknesses are intended to be the minimum acceptable. Design of the recommended sections assumes that construction will be completed during an extended period of dry weather. Wet weather construction could require an increased thickness of aggregate base.

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

If cement amendment is completed, the amendment subgrade should be allowed to cure for at least four days prior to construction traffic or placing the base rock to avoid strength loss. Lastly, the amended subgrade should be protected with a minimum of 4 inches of base rock prior to construction traffic access.

The aggregate base thicknesses do not account for construction traffic, and haul roads and staging areas should be used as described in Section 5.2 (Construction Traffic and Staging).

4.7 DRAINAGE

4.7.1 Temporary

During work at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface. During rough and finished grading of the site, the contractor should keep all pads and subgrade free of ponding water.

4.7.2 Surface

The ground surface at finished pads should be sloped away from their edges at a minimum 2 percent gradient for a distance of at least 5 feet. Roof drainage from buildings should be directed into solid, smooth-walled drainage pipes that carry the collected water to the storm drain system.

4.7.3 Subsurface

Based on the soil and groundwater conditions at the site and sloping topography at the site, we recommend perimeter footing drains for structures in the proposed development. Perimeter foundation drains should consist of a filter fabric-wrapped, drain rock-filled trench that extends at least 12 inches below the lowest adjacent grade (i.e., slab subgrade elevation). A perforated pipe should be placed at the base to collect water that gathers in the drain rock. The drain rock and filter fabric should meet specifications in Section 5.5 (Materials). Discharge for footing drains should not be tied directly into the stormwater drainage system, unless mechanisms are installed to prevent backflow.

4.7.4 Stormwater Infiltration Systems

Based on the measured rates in Table 1 and discussion in Section 3.4 (Infiltration Testing), the near-surface native soil meets the classification criteria for WWHM Soil Group 4 and on-site infiltration systems are not viable at the site.

4.8 PERMANENT SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Slopes that will be maintained by mowing should not be constructed steeper than 3H:1V. Access roads and pavement should be located at least 5 feet from the top of cut and fill slopes. The horizontal setback should be increased to 10 feet for buildings. Note that the setback recommendations pertain to engineered cut and fill slopes only.

Concentrated drainage or water flow over the faces of slopes should be prohibited as described in this report and adequate protection against erosion is required. Fill slopes should be overbuilt, compacted, and trimmed at least 2 feet horizontally to provide adequate compaction of the outer slope face.

5.0 CONSTRUCTION

5.1 SITE PREPARATION

5.1.1 General

Site grading activities should be performed in accordance with the requirements specified in the 2021 IBC, Chapter 18 and Appendix J, with exceptions noted in this report. Site preparation should be observed and documented by Columbia West.

5.1.2 Demolition
Demolition includes removal of structural features that may be at the site. Abandoned foundations and utilities will need to be removed and the resulting excavations backfilled. Utility lines should be completely removed or, with prior approval, grouted full if left in place. Excavations left from demolition and removal of existing structures should be backfilled with compacted structural fill in accordance with the recommendations in Section 5.5 (Materials).

5.1.3 Stripping and Grubbing
Where encountered, existing root and topsoil zones should be stripped and removed from all areas to receive new structural improvements. Based on test pit explorations at the site, we anticipate average stripping depths will range between 8 and 12 inches. Deeper stripping depths 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 offsite for disposal or used in landscaped areas.

Trees and shrubs should be removed from fill 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 root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

5.1.4 Undocumented Fill
5.1.4.1 General
Undocumented fill was not observed at the site; however, isolated areas of fill may be present at the site, particularly near existing structures. Due to the variable composition of fill and the unknown methods of placement and compaction, reliable strength properties for undocumented fill are difficult to predict.

5.1.4.2 Foundation Areas
Undocumented fill should be removed from under new building foundations and footings supported on crushed rock as discussed in the Section 4.2 (Foundation Support) and Section 5.5 (Materials).

5.1.4.3 Pavement Areas
There is a small risk for poor performance of pavement established directly over undocumented fill. If undocumented fill is present after site grading, removal and replacement of undocumented fill would eliminate all risk. Pavement can be constructed on fill, provided a small risk of distress is accepted and it is evaluated as described in Section 5.1.5 (Subgrade Evaluation).

5.1.5 Subgrade Evaluation
Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully loaded dump truck or similar heavy, rubber-tired construction equipment. When the subgrade is too wet for proof rolling, a foundation probe may be used to identify areas of soft, loose, or unsuitable

soil. Subgrade evaluation should be performed by Columbia West. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over excavated and backfilled with compacted imported granular fill.

5.2 CONSTRUCTION TRAFFIC AND STAGING

The near-surface soil at the site contains silt and is easily disturbed. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during or extends into the wet season or if the moisture content of the surficial soil is more than a couple percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy season or when the moisture content of the surficial soil is more than a few percentage points above optimum. The aggregate base thickness for pavement areas is intended to support post-construction design traffic loads and is not designed to support construction traffic. Moreover, if construction is planned for periods when the subgrade soil is wet, staging and haul roads with increased thicknesses of base rock will be required. The amount of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and type/frequency of construction equipment and should, therefore, be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material are generally required in staging areas and between 18 and 24 inches in haul road areas. The contractor should also be responsible for selecting the type of material for construction of haul roads and staging areas. A geotextile fabric can be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic to help prevent silt migration into the base rock. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in Section 5.5 (Materials).

As an alternative to thickened crushed rock sections, haul roads and utility work zones may be constructed using cement-amended subgrade overlain by a crushed rock wearing surface. If this approach is used, the thickness of granular material in staging areas and along haul roads can typically be reduced to between 6 and 9 inches. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and should be the contractor's responsibility. Cement amendment is discussed in Section 5.5 (Materials).

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

5.3 EXCAVATION

Excavations will be required for the installation of foundations, utilities, and other earthwork activities. Conventional earthmoving equipment in proper working condition should be capable of making the necessary excavations.

Temporary excavation sidewalls should stand vertical to a depth of approximately 4 feet, provided groundwater seepage does not occur in the sidewalls. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet BGS, provided the walls of the excavation are cut at a slope of 1H:1V or flatter and groundwater seepage does not occur. Excavations should be flattened to 1.5H:1V or flatter if excessive sloughing occurs.

Given the relatively shallow groundwater, temporary shoring and dewatering will likely be required. Use of approved temporary shoring is recommended where the slopes cannot be cut back, within the influence area of structural elements, and for cuts below the water table. The influence area can be defined as a 1H:1V slope extending down from a 5-foot setback from the edge of a foundation element. A wide variety of shoring and dewatering systems are available. Consequently, we recommend the contractor be responsible for selecting the appropriate shoring and dewatering systems.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If excavations are left open for extended periods of time, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation

5.4 CONSTRUCTION DEWATERING

5.4.1 General

Perched groundwater was generally observed between depths of 7 and 11 feet BGS in the test pits at the site. Based on experience in the area, perched groundwater could be present within a few feet of the ground surface during the wet season. Groundwater should be expected in excavations during mass grading and temporary dewatering systems may be required, particularly in cut slope areas.

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater as necessary to prevent standing water and/or erosion at the working surface. Because of the instability of saturated soil, sloughing and "running" conditions can occur if excavations extend below groundwater seepage levels. Positive control of groundwater will be required to maintain stable trench sides and base. The proposed dewatering plan should be capable of maintaining groundwater levels at least 2 feet below the base of the trench excavation (including the depth required for trench bedding and stabilization material). In addition to safety considerations, running soil, caving, or other loss of ground will increase backfill volumes and can result in damage to adjacent structures or utilities.

Flow rates for dewatering are likely to vary depending on location, soil type, and the season in which excavation occurs. Dewatering systems should be capable of adapting to variable flows. Because of the tendency of saturated, low plasticity silt with sand to "run," we recommend dewatering wells or well points be considered if trench excavations extend below groundwater levels. Tight-joint driven sheets in conjunction with a scaled-down dewatering program can also be an effective way to control groundwater seepage, provided the sheets are driven deep enough to control heaving conditions at the base of the excavation.

Trench dewatering will be required to maintain dry working conditions if the invert elevations of the proposed utilities encounter groundwater. Pumping from sumps located within the trench may result in excessive sloughing, caving, or running conditions, and dewatering by well points may be required. If groundwater is present at the base of utility excavations, we recommend placing 1.5 to 2 feet of stabilization material at the base of the excavation. The use of a subgrade geotextile fabric may reduce the amount of stabilization material required. The actual thickness should be based on field observations during construction. Trench stabilization material and the subgrade geotextile fabric should meet the requirements described in Section 5.5 (Materials). Trench stabilization material should be placed in one lift and compacted until well keyed.

While we have described certain approaches to excavation dewatering, it is the contractor's responsibility to select the dewatering methods.

5.4.2 Cut Slopes

Subdrains should also be considered if portions of the site are cut below surrounding grades. Shallow groundwater, springs, or seeps should be conveyed via drainage channels or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and subsurface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail and cut and fill slope cross sections are provided on Figures 4 and 5.

Drains should be closely monitored after construction to assess their effectiveness. If additional surface or shallow subsurface seeps become evident, the drainage provisions may require modification or additional drains. Columbia West should be consulted to provide appropriate recommendations.

5.5 MATERIALS

5.5.1 Structural Fill

5.5.1.1 General

Areas proposed for fill placement should be appropriately prepared as described in Section 5.1 (Site Preparation). Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by proof rolling or nuclear gauge field compaction testing performed in accordance with ASTM D6938. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet the specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory testing and approval by Columbia West prior to placement. All structural fill should be free of organic material and have a particle size of less than 6 inches.

5.5.1.2 On-Site Soil

The on-site soil is suitable for use as general fill, provided it is free of particles over 6 inches in diameter. Based on laboratory testing, the moisture content of the on-site soil will be above the optimum moisture content required to meet compaction requirements and drying of the soil will be necessary. Accordingly, extended dry weather will be required to adequately condition and place the soil as structural fill. It will be difficult, if not impossible, to adequately compact on-site silt during the rainy season or during prolonged periods of rainfall. In addition, the soil at the site will be "blocky" and will need to be broken up or pulverized to adequate dry it.

On-site soil used as structural fill should be placed in loose lifts not exceeding 8 inches in thickness and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 92 percent of maximum dry density as determined by ASTM D1557.

On-site soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this study. We can provide site-specific factors upon request.

5.5.1.3 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand. Imported granular material should be placed in loose lifts not exceeding 12 inches in thickness and compacted to at least 95 percent of maximum dry density as determined by ASTM D1557. During wet weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

5.5.1.4 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organic material and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-grained soil. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and the stabilization material.

5.5.1.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of durable, well-graded granular material with a maximum particle size of 1½ inches, should have less than 7 percent fines by dry weight, and should have at least two mechanically fractured faces. The pipe zone backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557 or as required by the pipe manufacturer or local building department.

Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of durable, well-graded granular material with a maximum particle size of 2½ inches, should have less than 7 percent fines by dry weight, and should have at least two mechanically fractured faces. This material should be compacted to at least 92 percent of maximum dry density as determined by ASTM D1557 or as required by the pipe manufacturer or local building department. The upper 3 feet of the trench backfill should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

5.5.1.6 Retaining Wall Backfill

Backfill placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of imported granular material as described above and should have less than 7 percent fines by dry weight. We recommend the wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

The wall backfill should be compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D1557. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of maximum dry density as determined by ASTM D1557. 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 compactor). If flatwork (sidewalks or pavement) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of maximum dry density as determined by ASTM D1557.

5.5.1.7 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of ¾- or 1¼-inch-minus crushed rock and should have less than 7 percent fines by dry weight. The leveling pad material should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

5.5.1.8 Floor Slab and Pavement Aggregate Base

Imported granular material used as base rock for building floor slabs and pavement should consist of ¾- or 1½-inch-minus material (depending on the application). In addition, the aggregate should have less than 5 percent fines by dry weight and have at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of maximum dry density as determined by ASTM D1557.

5.5.1.9 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches. The material should be free of roots, organic material, and other unsuitable material; should have less than 2 percent fines by dry weight; and should have at least two mechanically fractured faces. Drain rock should be compacted to a well-keyed, firm condition.

5.5.1.10 Existing AC and Aggregate Base Material
The existing crushed aggregate base course material may be reused for engineered structural fill, provided it is well graded, clean, and free from deleterious material; has a maximum particle size of 3 inches; and is evaluated by Columbia West during construction when conditions are exposed. In addition, the existing AC pavement may be pulverized and blended into engineered structural fill in accordance with the requirements outlined in WSS 9-03.21 – Recycled Material. The specification for reuse of recycled material requires pulverized asphalt to be completely blended and mixed into the source material and places limits on the maximum amount of recycled asphalt (by weight) that can be added.

5.5.2 Geotextile Fabric
5.5.2.1 Subgrade Geotextile
A geotextile separation fabric will be required at the interface of the existing soil and imported granular material beneath proposed walls. In addition, geotextile fabric may be required where soft subgrade is encountered. The separation fabric should meet the specifications provided in WSS 9-33.2(1) – Geotextile Properties (Table 3) for soil separation. The geotextile should be installed in conformance with the specifications provided in WSS 2-12 – Construction Geosynthetic.

5.5.2.2 Drainage Geotextile
Subgrade geotextile should meet the specifications in WSS 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties. The AOS should be between U.S. Standard No. 70 and No. 100 sieves. The water permittivity should be greater than 1.5/sec. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

5.5.3 Pavement
5.5.3.1 AC
The AC should conform to the specifications provided in WSS 5-04 – Hot Mix Asphalt and WSS 9-03.8 – Aggregates for Hot Mix Asphalt. The asphalt cement binder should be PG 58-22 Performance Grade Asphalt Cement meeting WSS 9-02.1(4) – Performance Graded (PG) Asphalt Binder. The AC should be ½-inch HMA. The lift thicknesses should be 2 to 3 inches. The AC should be compacted to 91 percent of maximum specific gravity of the mix as determined by ASTM D2041.

5.5.3.2 Cold Weather Paving Considerations
In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress.

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Washington, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2 and 2.5 inches.

If AC paving activities must take place during cold weather construction as defined above, the contractor and design team should discuss options for minimizing risk of pavement serviceability.

5.5.4 Soil Amendment with Cement

5.5.4.1 General

The on-site soil can be amended with portland cement to obtain suitable properties for use as wet weather structural fill, subbase for pavement, or to limit potential expansion of the near-surface soil. The effectiveness of soil amendment is highly dependent on proper mixing techniques, soil moisture conditioning, and the quantity of cement. The quantity of cement applied during amendment should be based on an assumed dry unit weight of 100 pcf for site soil.

Due to the plasticity of the near-surface soil, two passes with the tiller may be required for the project.

5.5.4.2 Subbase Stabilization

Specific recommendations based on exposed site conditions for soil amendment can be provided if necessary. However, for preliminary design purposes, we recommend a target strength for cement-amended subgrade for building and pavement subbase (below aggregate base) soil of 100 psi. The amount of cement used to achieve this target generally varies with moisture content and soil type. It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. In general, 5 percent cement by weight of dry soil can be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 25 to 35 percent, 6 to 8 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content. We recommend assuming a minimum cement ratio of 6 percent by dry weight; however, the cement amendment contractor should be responsible for selecting the cement content. If the soil moistures are in excess of 30 percent, a cement ratio of 7 percent may be needed.

We recommend cement amendment equipment be equipped with balloon tires to reduce rutting and disturbance of the fine-grained soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction of the fine-grained soil without the use of vibratory action. A smooth-drum roller with a minimum applied linear force of 700 pounds per inch should be used for final compaction. The amended soil should be compacted to at least 92 percent of maximum dry density as determined by ASTM D1557.

A minimum curing time of four days is required between amendment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-amended surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

Amendment depths for subgrade beneath buildings and pavement, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated traffic, as well as the contractor's means and methods and, accordingly, should be the contractor's responsibility.

Cement amendment should not be attempted when the air temperature is below 40 degrees Fahrenheit or during moderate to heavy precipitation. Cement should not be placed when the ground surface is saturated or standing water exists.

5.5.4.3 Cement-Amended Structural Fill

On-site soil that would not otherwise be suitable for structural fill may be amended and placed as fill over a subgrade prepared in conformance with Section 5.1 (Site Preparation). The cement ratio for general cement-amended fill can generally be reduced by 1 percent (by dry weight). Typically, a minimum curing time of four days is required between amendment and construction traffic access. Consecutive lifts of fill may be amended immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect.

5.5.4.4 Other Considerations

Portland cement-amended soil is hard and has low permeability. This soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Moreover, cement amending soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands.

5.5.4.5 Specific Recommendations

We recommend the following comments be included in the specifications for the project:

- In general, cement amendment is not recommended during the cold weather (temperatures less than 40 degrees Fahrenheit) or during steady rainfall.
- Mixing Equipment
  - Use a pulverizer/mixer capable of uniformly mixing the cement into the soil to the design depth. Blade mixing will not be allowed.
  - Pulverize the soil-cement mixture such that 100 percent by dry weight passes a 1-inch sieve and a minimum of 70 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. If water is required, the pulverizer should be equipped to inject water to a tolerance of ¼ gallon per square foot of surface area.
  - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the pulverizer/mixer vehicle. If subgrade is disturbed, the tilling/amendment depth shall extend the full depth of the disturbance.
  - Multiple passes of the tiller will likely be required to adequately blend the cement and soil mixture, particularly if a high frequency of cobbles and boulders are encountered.

- Spreading Equipment
  - Use a spreader capable of distributing the cement uniformly on the ground to within 5 percent variance of the specified application rate.
  - Use machinery that will not disturb the subgrade, such as using low-pressure balloon tires on the spreader vehicle. If subgrade is disturbed, the tilling/amendment depth shall extend the full depth of the disturbance.
- Compaction Equipment
  - Use a static, sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds for initial compaction of fine-grained soil (silt and clay) or an alternate approved by the geotechnical engineer.

5.6 EROSION CONTROL

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed before construction begins. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

6.0 OBSERVATION OF CONSTRUCTION

Satisfactory pavement, earthwork, and foundation performance depends to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Columbia West should be retained to observe subgrade preparation, fill placement, foundation excavations, drainage system installation, and pavement placement and to review laboratory compaction and field moisture-density information.

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.

7.0 LIMITATIONS

We have prepared this report for use by the addressee and members of the design and construction team for the proposed project. This report is subject to the limitations expressed in Appendix C.

♦ ♦ ♦

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

Nick Paveglio, PE
Principal Engineer

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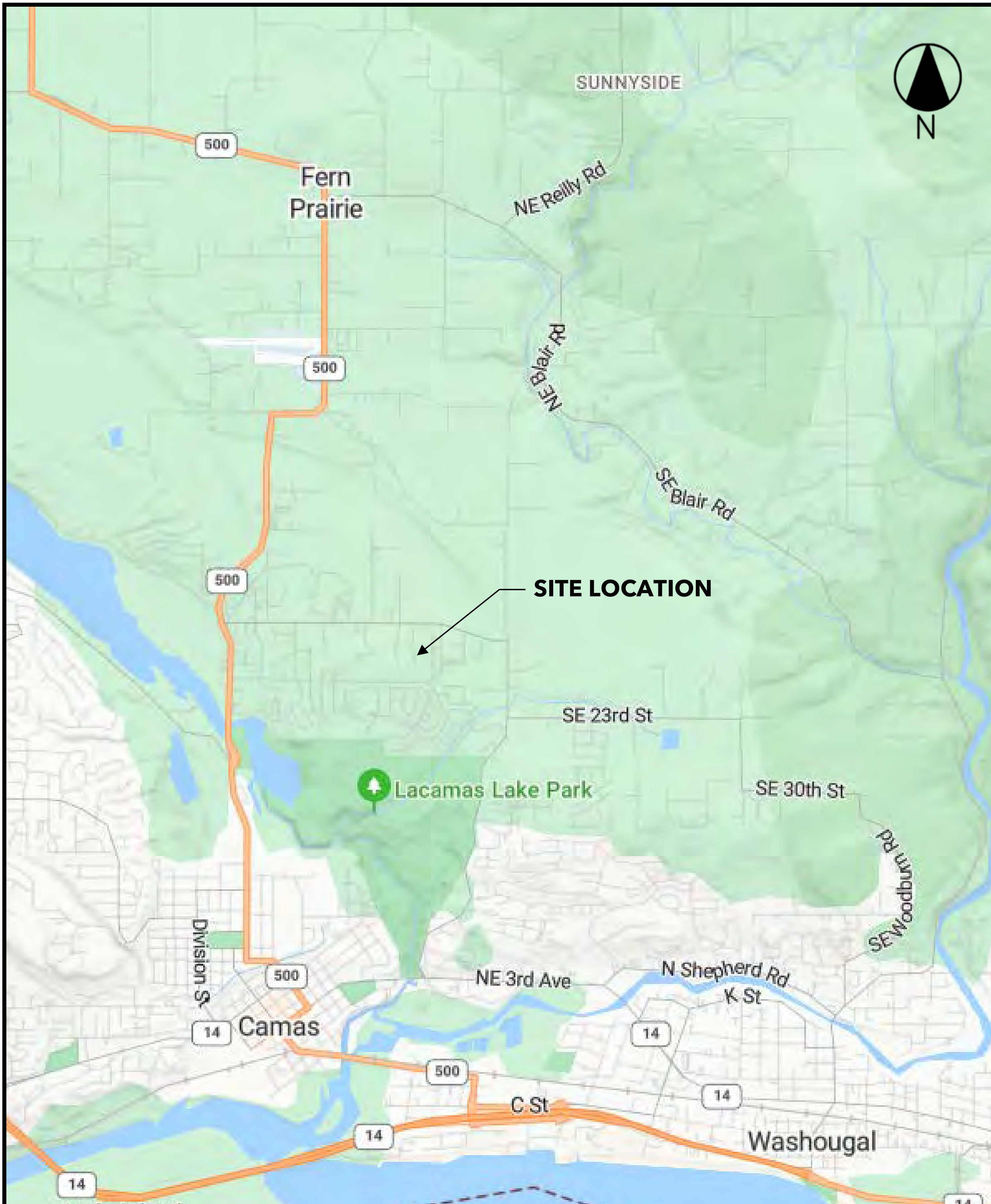
FIGURES



Columbia West Engineering, Inc
Geotechnical ▪ Environmental ▪ Special Inspections

PROJECT NO.: ROMANO-8-01-1

JUNE 2025

VICINITY MAP
UHACZ DEVELOPMENT
CAMAS, WASHINGTON

FIGURE 1

LEGEND

SITE BOUNDAR

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NOTES:
1. AERIAL PHOTO SOURCED FROM GOOGLE EARTH.
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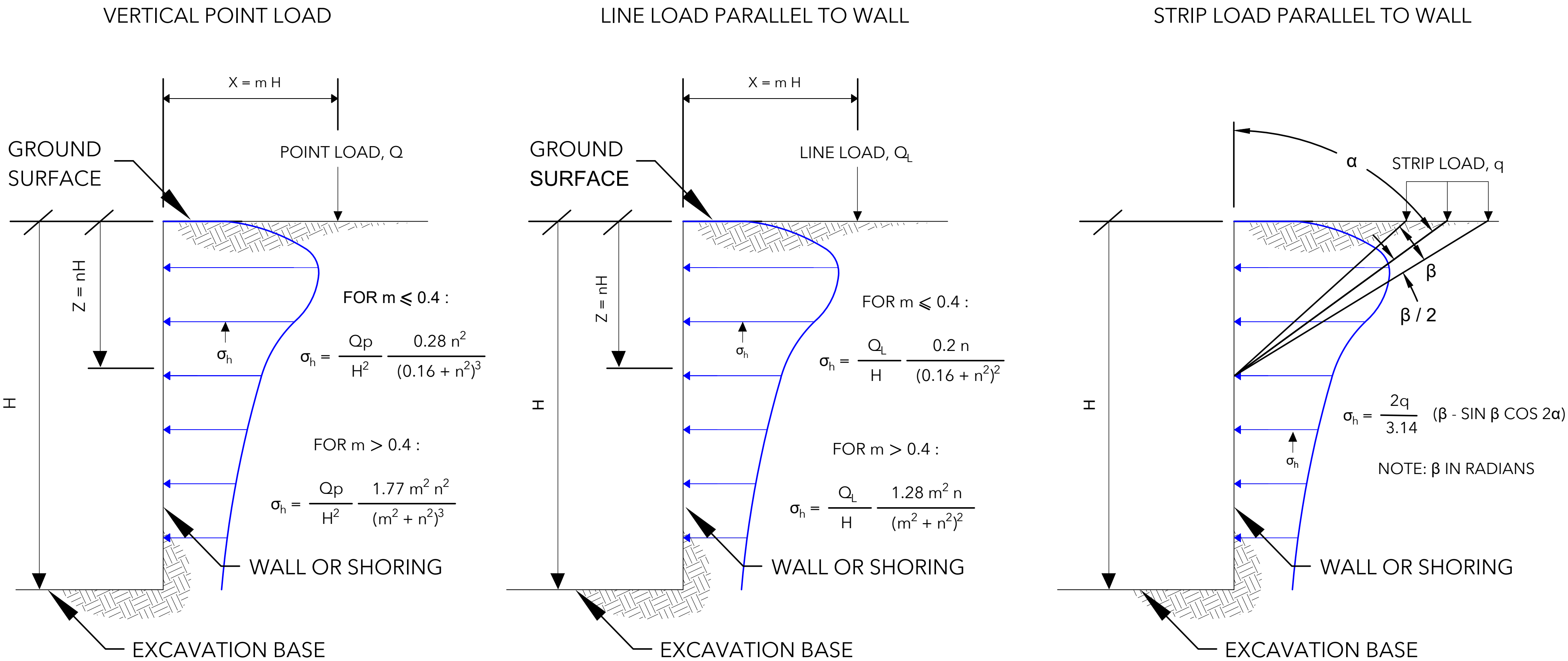

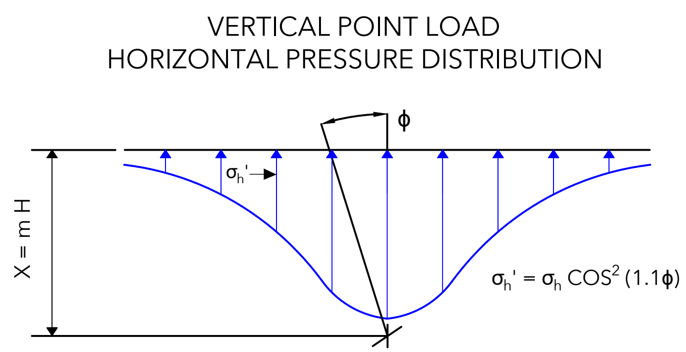

NOTES:

1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

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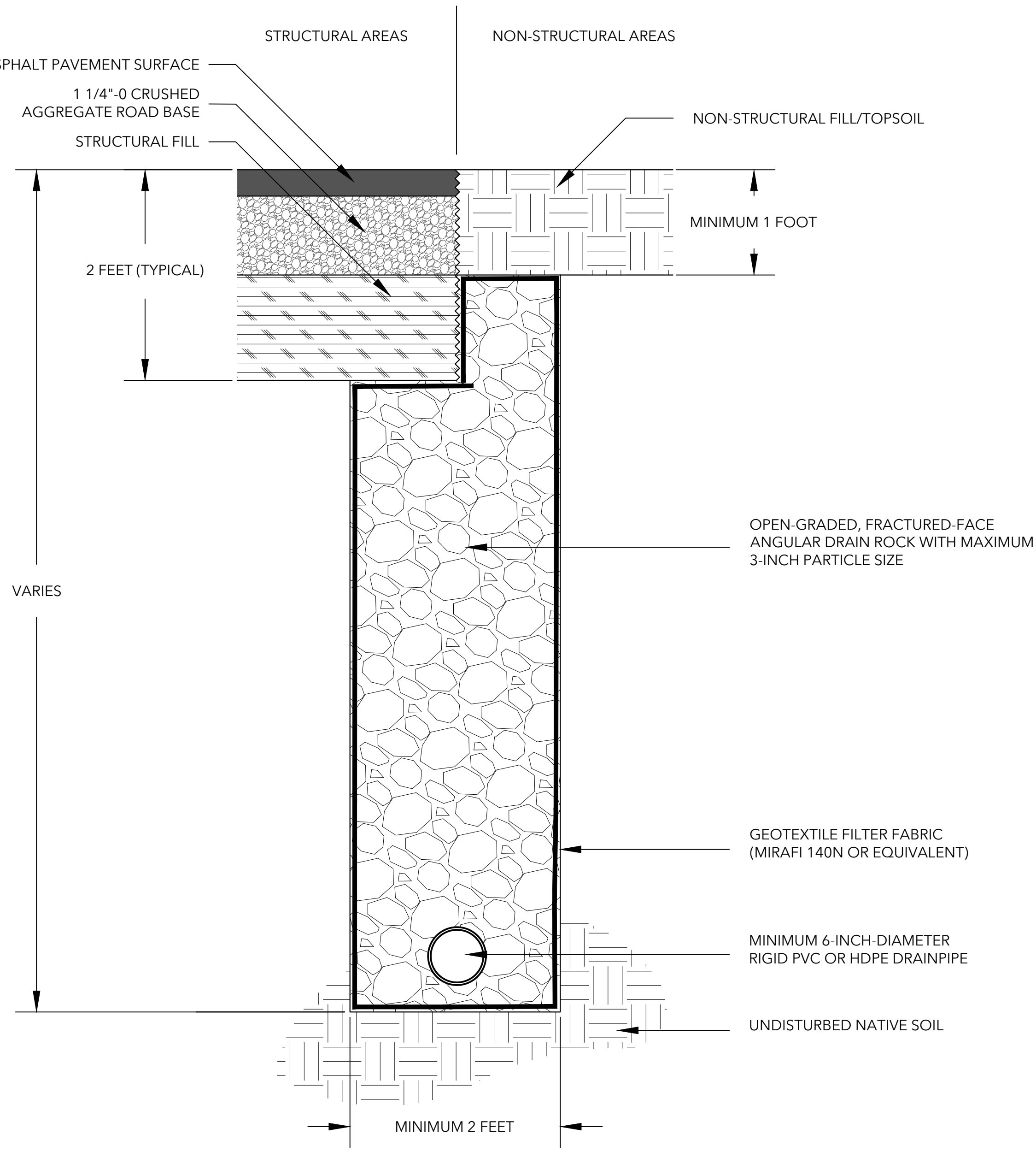
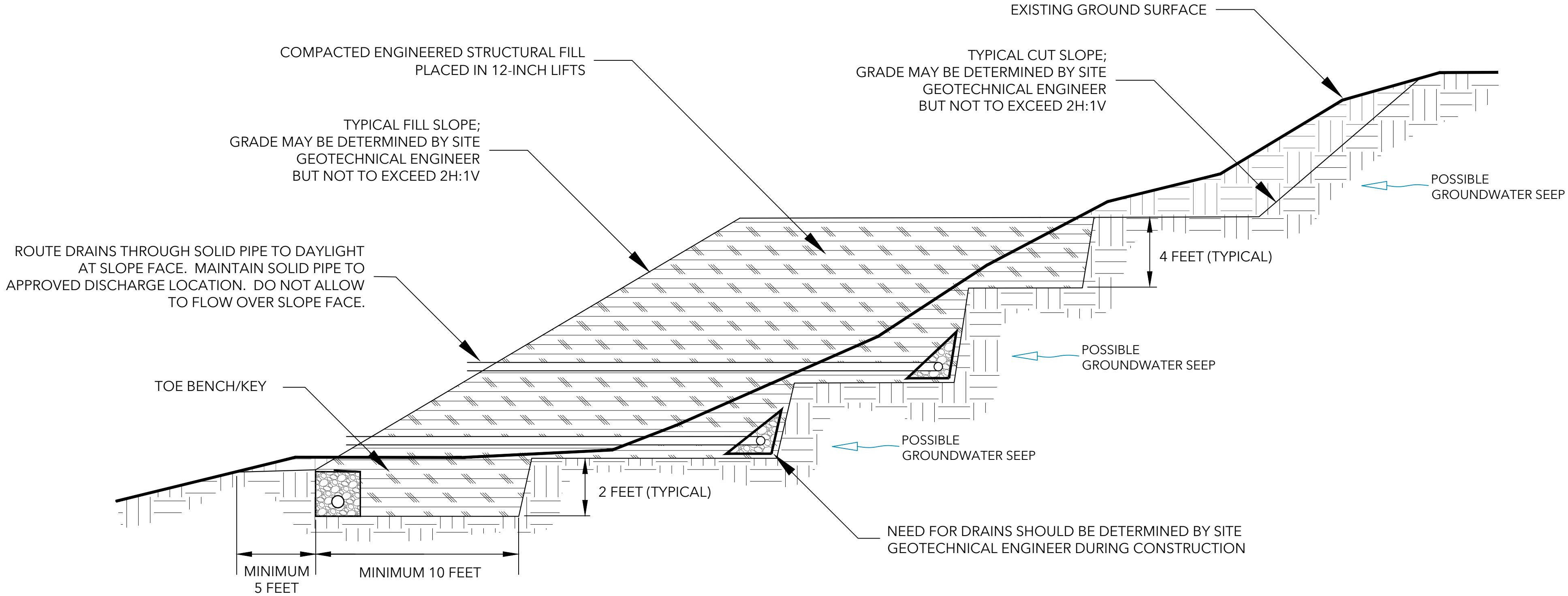
SURCHARGE-INDUCED LATERAL EARTH PRESSURES

FIGURE 3

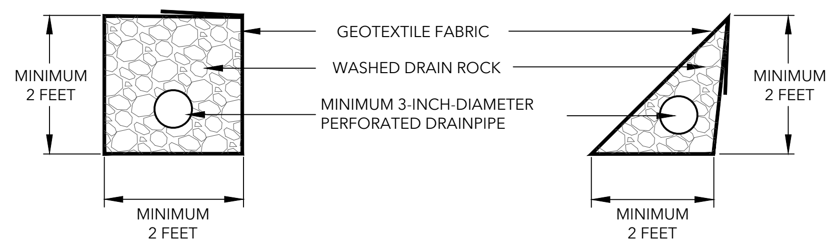


NOTE: LOCATION, INVERT ELEVATION, DEPTH OF TRENCH, AND EXTENT OF PERFORATED PIPE REQUIRED MAY BE MODIFIED BY THE SITE GEOTECHNICAL ENGINEER DURING CONSTRUCTION BASED UPON FIELD OBSERVATION AND SITE-SPECIFIC SOIL CONDITIONS.

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL	NOTES: 1. DRAWING IS NOT TO SCALE. 2. DRAWING REPRESENTS TYPICAL PERFORATED DRAINPIPE TRENCH DETAIL AND MAY NOT BE SITE-SPECIFIC.	FIGURE 4



TYPICAL DRAIN SECTION DETAIL



DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT WITH AOS BETWEEN U.S. STANDARD NO. 70 AND NO. 100 SIEVES.

WASHED DRAIN ROCK SHALL BE OPEN-GRADED ANGULAR DRAIN ROCK WITH LESS THAN 2 PERCENT PASSING THE U.S. STANDARD NO. 200 SIEVE AND A MAXIMUM PARTICLE SIZE OF 3 INCHES.

Geotechnical ▪ Environmental ▪ Special Inspections Columbia West Engineering, Inc	TYPICAL CUT AND FILL SLOPE CROSS SECTION	NOTES: 1. DRAWING IS NOT TO SCALE. 2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE-SPECIFIC.	FIGURE 5

APPENDIX A

APPENDIX A
FIELD EXPLORATIONS

GENERAL
Subsurface conditions at the site were explored by excavating eight test pits (TP-1 through TP-8) to depths between 12 and 13.5 feet BGS. Excavation services were completed by L&S Contracting LLC of Yacolt, Washington. The exploration logs are presented in this appendix.

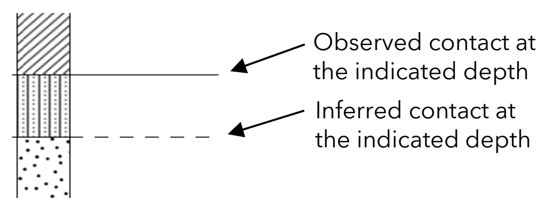
The exploration locations are shown on Figure 2. The exploration locations were determined in the field by pacing or measuring from existing site features. This information should be considered accurate only to the degree implied by the methods used.

SOIL SAMPLING
Representative grab samples of the soil observed in the test pits were collected from the walls and/or base of the test pits using the excavator bucket.

SOIL CLASSIFICATION
The soil samples were classified in the field in accordance with the "Exploration Legend" and "Soil Classification System," which are presented in this appendix. The exploration logs indicate the depths at which the soil characteristics change, although the change could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

EXPLORATION LEGEND

SAMPLER TYPE	DESCRIPTION
SPT	Sample collected from the indicated depth in general accordance with ASTM D1586, *Standard Test Method Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils,* using an SPT sampler and 140-pound hammer
SH	Sample collected from the indicated depth in general accordance with ASTM D1587, *Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes,* using a thin-walled Shelby tube, or in general accordance with ASTM D6519, *Standard Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler,* using a thin-walled tube
D&M	Sample collected from the indicated depth in general accordance with ASTM D3550, *Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils,* using a Dames & Moore sampler and 140-pound hammer or pushed
CSS	Sample collected from the indicated depth in general accordance with ASTM D3550, *Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils,* using a 3-inch-outside diameter California split-spoon sampler and 140-pound hammer
DP	Sample collected from the indicated depth in general accordance with ASTM D6282, *Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations,* using a direct-push soil sampler
GRAB	Grab sample collected from the indicated depth
CORE	Pavement or rock core interval at the indicated depth



GEOTECHNICAL ABBREVIATIONS			
ATT	Atterberg limits	PP	Pocket penetrometer
CBR	California bearing ratio	P200	Percent passing No. 200 sieve
CON	Consolidation test	RES	Resilient modulus
DD	Dry density	SIEV	Sieve analysis
DS	Direct shear	TS	Torvane shear
HYD	Hydrometer	tsf	Tons per square foot
MC	Moisture content	UC	Unconfined compressive strength
MD	Moisture-density relationship	UU	Unconsolidated undrained triaxial test
NP	Non-plastic	VS	Vane shear
OC	Organic content	WD	Wet density

ENVIRONMENTAL ABBREVIATIONS			
CA	Sample submitted for chemical analysis	ND	Not detected
		NS	No sheen
PID	Photoionization detector headspace analysis	SS	Slight sheen
		MS	Moderate sheen
ppm	Parts per million	HS	Heavy sheen

SOIL CLASSIFICATION SYSTEM

PARTICLE-SIZE CLASSIFICATION

COMPONENT	ASTM / USCS		AASHTO	
	Size Range	Sieve Size Range	Size Range	Sieve Size Range
Boulders	Greater than 300 mm	Greater than 12 inches	--	--
Cobbles	75 mm to 300 mm	3 inches to 12 inches	Greater than 75 mm	Greater than 3 inches
Gravel	75 mm to 4.75 mm	3 inches to No. 4 sieve	75 mm to 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm to 19.0 mm	3 inches to 3/4-inch sieve	--	--
Fine	19.0 mm to 4.75 mm	3/4-inch to No. 4 sieve	--	--
Sand	4.75 mm to 0.075 mm	No. 4 to No. 200 sieve	2.00 mm to 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm to 2.00 mm	No. 4 to No. 10 sieve	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve	--	--
Fine	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	Less than 0.075 mm	Passing No. 200 sieve	Less than 0.075 mm	Passing No. 200 sieve

CONSISTENCY FOR COHESIVE SOIL

CONSISTENCY	SPT N-VALUE (blows per foot)	D&M N-VALUE (blows per foot)	POCKET PENETROMETER (unconfined compressive strength [tsf])
Very soft	0 to 2	0 to 3	Less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.5
Medium stiff	4 to 8	6 to 12	0.5 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	Greater than 30	Greater than 30	Greater than 4.0

RELATIVE DENSITY FOR GRANULAR SOIL

RELATIVE DENSITY	SPT N-VALUE (blows per foot)	D&M N-VALUE (blows per foot)
Very loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very dense	Greater than 50	Greater than 120

MOISTURE DESIGNATIONS

TERM	FIELD IDENTIFICATION
Dry	Very low moisture, dry to touch
Moist	Damp, color appears darkened, without visible moisture, cohesive soil will clump, sand will bulk
Wet	Visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Percent	SILT AND CLAY IN		Percent	SAND AND GRAVEL IN		Percent	SECONDARY MATERIAL
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil		Organics and Man-Made Debris
< 5	trace	trace	< 5	trace	trace	< 4	trace
5 - 12	minor	with	5 - 15	minor	minor	4 - 12	some
> 12	some	silty/clayey	15 - 30	with	with		
			> 30	sandy/gravelly	with		

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TEST PIT NUMBER: TP-1

PROJECT NAME Uhacz Development
CLIENT Romano Development, Inc.
PROJECT NO. Romano-8-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 05/30/2025
EQUIPMENT CAT 307E2, 5-foot with tooth
TIME STARTED 9:40 AM
LOGGED BY J. Wright
TIME COMPLETED 10:10 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-PI)	REMARKS
0–1.0					Medium stiff, brown SILT, moist (12 inches of topsoil, 4-inch-thick root zone). 1.0				
1.0–13.5			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist. 13.5				
5	Grab	TP1.1						50-30-20	
	Grab	TP1.2							
	Grab	TP1.3							
					Exploration completed at 13.5 feet.				

GROUNDWATER: Slow seepage at 10 feet

CAVING: Not observed

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TEST PIT NUMBER: TP-2

PROJECT NAME Uhacz Development
CLIENT Romano Development, Inc.
PROJECT NO. Romano-8-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 05/30/2025
EQUIPMENT CAT 307E2, 5-foot with tooth
TIME STARTED 9:00 AM
LOGGED BY J. Wright
TIME COMPLETED 9:30 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
0–0.7					Medium stiff, brown SILT, moist (8 inches of topsoil, 3-inch-thick root zone). 0.7				
0.7–12.0			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist. 12.0				
3	Grab	TP2.1							
4									Infiltration test at 4 feet.
5	Grab	TP2.2					29	85	
11	Grab	TP2.3							
					Exploration completed at 12 feet.				

GROUNDWATER: Moderate seepage at 10 feet

CAVING: Not observed

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TEST PIT NUMBER: TP-3

PROJECT NAME Uhacz Development
CLIENT Romano Development, Inc.
PROJECT NO. Romano-8-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 05/30/2025
EQUIPMENT CAT 307E2, 5-foot with tooth
TIME STARTED 10:15 AM
LOGGED BY J. Wright
TIME COMPLETED 10:45 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
0–1.0					Medium stiff, brown SILT, moist (12 inches of topsoil, 4-inch-thick root zone). 1.0			
1.0–13.0			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist. 13.0			
~4	Grab	TP3.1						
5								
10								
~11	Grab	TP3.2						

Exploration completed at 13 feet.

GROUNDWATER: Moderate seepage at 11 feet

CAVING: Not observed

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TEST PIT NUMBER: TP-4

PROJECT NAME Uhacz Development
CLIENT Romano Development, Inc.
PROJECT NO. Romano-8-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 05/30/2025
EQUIPMENT CAT 307E2, 5-foot with tooth
TIME STARTED 11:00 AM
LOGGED BY J. Wright
TIME COMPLETED 11:30 AM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
0–1.0					Medium stiff, brown SILT, moist (12 inches of topsoil, 4-inch-thick root zone). 1.0			
1.0	Grab	TP4.1	ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist.		27	
5	Grab	TP4.2						
10	Grab	TP4.3			13.0			

Exploration completed at 13 feet.

GROUNDWATER: Not observed

CAVING: Not observed

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TEST PIT NUMBER: TP-5

PROJECT NAME	Uhacz Development	**CLIENT**	Romano Development, Inc.
PROJECT NO.	Romano-8-01-1	**PROJECT CITY, STATE**	Camas, Washington
CONTRACTOR	L&S Contractors	**DATE COMPLETED**	05/30/2025
EQUIPMENT	CAT 307E2, 5-foot with tooth	**TIME STARTED**	11:35 AM
LOGGED BY	J. Wright	**TIME COMPLETED**	12:05 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
0.7					Medium stiff, brown SILT, moist (8 inches of topsoil, 4-inch-thick root zone).				
			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist.				
	Grab	TP5.1			With sand at 4 feet.		32	73	Infiltration test at 4 feet.
5									
	Grab	TP5.2			Trace gravel at 7 feet.				
10.0									
			MH		Stiff, orange-brown sandy SILT with cobbles and boulders, some clay, moist.				
12.5	Grab	TP5.3							
					Exploration completed at 12.5 feet.				

GROUNDWATER: Not observed

CAVING: Not observed

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TEST PIT NUMBER: TP-6

PROJECT NAME	Uhacz Development	**CLIENT**	Romano Development, Inc.
PROJECT NO.	Romano-8-01-1	**PROJECT CITY, STATE**	Camas, Washington
CONTRACTOR	L&S Contractors	**DATE COMPLETED**	05/30/2025
EQUIPMENT	CAT 307E2, 5-foot with tooth	**TIME STARTED**	12:15 PM
LOGGED BY	J. Wright	**TIME COMPLETED**	12:45 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
0–1.0					Medium stiff, brown SILT, moist (12 inches of topsoil, 4-inch-thick root zone). 1.0				
1.0–7.0			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist. 7.0				
	Grab	TP6.1							
5									
7.0–13.0	Grab	TP6.2	MH		Stiff, orange-brown sandy SILT with cobbles and boulders, some clay, moist. 13.0				
10	Grab	TP6.3					45	57	

Exploration completed at 13 feet.

GROUNDWATER: Slow seepage at 7 feet

CAVING: Not observed

BoreDM Template: Test Pit Template - New

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TEST PIT NUMBER: TP-7

PROJECT NAME Uhacz Development
CLIENT Romano Development, Inc.
PROJECT NO. Romano-8-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 05/31/2025
EQUIPMENT CAT 307E2, 5-foot with tooth
TIME STARTED 1:00 PM
LOGGED BY J. Wright
TIME COMPLETED 1:30 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-PI)	FINES (%)	REMARKS
0.0–0.7					Medium stiff, brown SILT, moist (8 inches of topsoil, 3-inch-thick root zone). 0.7					
0.7–8.0			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist.					
	Grab	TP7.1								Infiltration test at 4 feet.
5	Grab	TP7.2			Sandy at 5 feet. 8.0		50		54	
8.0–13.0			MH		Stiff, orange-brown sandy SILT with cobbles and boulders, some clay, moist.					
10										
	Grab	TP7.3			13.0			61-48-13		

Exploration completed at 13 feet.

GROUNDWATER: Not observed

CAVING: Not observed

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TEST PIT NUMBER: TP-8

PROJECT NAME Uhacz Development
CLIENT Romano Development, Inc.
PROJECT NO. Romano-8-01-1
PROJECT CITY, STATE Camas, Washington
CONTRACTOR L&S Contractors
DATE COMPLETED 05/31/2025
EQUIPMENT CAT 307E2, 5-foot with tooth
TIME STARTED 1:45 PM
LOGGED BY J. Wright
TIME COMPLETED 2:15 PM

DEPTH (ft)	SAMPLE TYPE	SAMPLE ID	USCS	GRAPHIC LOG	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
0.0–0.7					Medium stiff, brown SILT, moist (8 inches of topsoil, 3-inch-thick root zone). 0.7				
0.7–8.0			ML		Medium stiff, orange-brown SILT, some clay, minor sand, moist. 8.0				
5	Grab	TP8.1							
8.0–13.0			MH		Stiff, orange-brown SILT with cobbles and boulders, some clay, minor sand, moist. 13.0				
8	Grab	TP8.2					40	88	
10									

Exploration completed at 13 feet.

GROUNDWATER: Not observed

CAVING: Not observed

APPENDIX B

APPENDIX B
LABORATORY TESTING

GENERAL
Laboratory testing was conducted on select soil samples to confirm field classifications and determine the index engineering properties and strength characteristics. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications. The locations of the tested samples are shown on the exploration logs. Descriptions of the tests are presented below, and the testing results are presented in this appendix.

ATTERBERG LIMITS TESTING
Atterberg limits (plastic and liquid limits) testing was performed on select soil samples in general accordance with ASTM D4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits.

PARTICLE-SIZE ANALYSIS
Particle-size analyses were completed on select soil samples in general accordance with ASTM D1140 (P200). This test is a quantitative determination of the percent passing the U.S. Standard No. 200 sieve by dry weight.

MOISTURE CONTENT
The natural moisture content of select soil samples was determined in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to dry soil in a test sample and is expressed as a percentage.

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MOISTURE CONTENT, PERCENT PASSING NO. 200 SIEVE BY WASHING

PROJECT	CLIENT	PROJECT NO.	
Uhacz Property 27429 SE 15th Street Camas, Washington	Romano Development, Inc. 4660 NE 77th Avenue, Ste. 200 Vancouver, WA 98662	Romano-8-01-1	
		ISSUE DATE: 06/11/25	PAGE: 1 of 1
		DATE SAMPLED: 05/30/25	SAMPLED BY: J. Wright

LABORATORY TEST DATA

TEST PROCEDURE
ASTM D2216 - Method A, ASTM D1140

LAB ID	CONTAINER MASS (g)	MOIST MASS + CONTAINER (g)	DRY MASS + CONTAINER (g)	AFTER WASH DRY MASS + CONTAINER (g)	FIELD ID	SAMPLE DEPTH (ft)	PERCENT MOISTURE CONTENT	PERCENT PASSING NO. 200 SIEVE
S25-1158	568.53	831.04	771.37	598.18	TP2.2	5	29%	85%
S25-1159	87.22	287.60	244.70	-	TP4.1	1	27%	-
S25-1160	1,036.42	1,925.04	1,708.91	1,217.17	TP5.1	4	32%	73%
S25-1161	995.65	2,181.21	1,815.90	1,345.58	TP6.3	10	45%	57%
S25-1162	975.04	2,174.30	1,773.48	1,341.90	TP7.2	5	50%	54%
S25-1164	556.31	840.07	759.50	580.12	TP8.2	8	40%	88%

NOTES:	DATE TESTED	TESTED BY
Sample weights received for Lab ID: S25-1160, 1161, and 1162 did not meet the minimum size requirements; entire sample used for analysis.	06/06/25	M. Scherette

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	
Uhacz Property 27429 SE 15th Street Camas, Washington	Romano Development, Inc. 4660 NE 77th Avenue, Ste. 200 Vancouver, WA 98662	Romano-8-01-1	
		ISSUE DATE 06/11/25	PAGE 1 of 1
		LAB ID S25-1157	FIELD ID TP1.1
		DATE SAMPLED 05/30/25	SAMPLED BY J. Wright

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
SILT	Test Pit TP-1 depth = 5 feet	no data provided

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318 - Method A

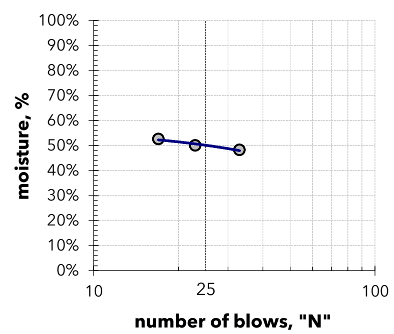
ATTERBERG LIMITS

liquid limit =	50
plastic limit =	30
plasticity index =	20

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	34.69	32.08	31.50	
dry soil + pan weight, g =	30.18	28.19	27.68	
pan weight, g =	20.82	20.42	20.42	
N (blows) =	33	23	17	
moisture, % =	48.2 %	50.1 %	52.6 %	

LIQUID LIMIT



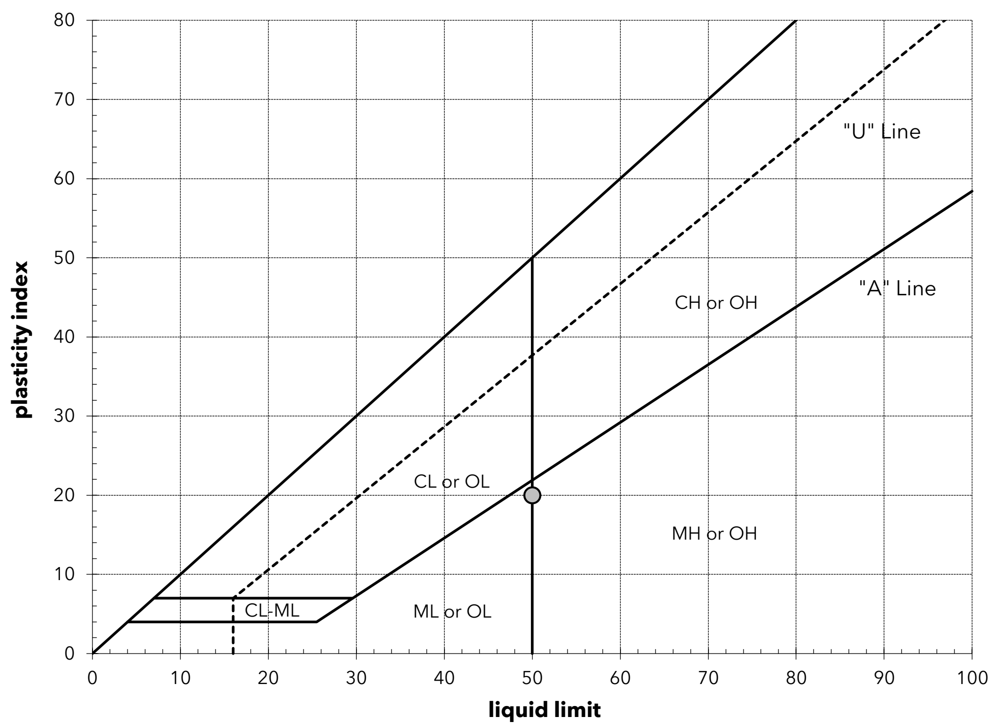
SHRINKAGE

shrinkage limit =	n/a
shrinkage ratio =	n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	28.32	27.66		
dry soil + pan weight, g =	26.61	26.00		
pan weight, g =	20.93	20.41		
moisture, % =	30.1 %	29.7 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel =	n/a
% sand =	n/a
% silt and clay =	n/a
% silt =	n/a
% clay =	n/a
moisture content =	n/a

DATE TESTED	TESTED BY
06/09/25	M. Scherette

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ATTERBERG LIMITS REPORT

PROJECT	CLIENT	PROJECT NO.	
Uhacz Property 27429 SE 15th Street Camas, Washington	Romano Development, Inc. 4660 NE 77th Avenue, Ste. 200 Vancouver, WA 98662	Romano-8-01-1	
		ISSUE DATE: 06/11/25	PAGE: 1 of 1
		LAB ID: S25-1163	FIELD ID: TP7.3
		DATE SAMPLED: 05/30/25	SAMPLED BY: J. Wright

MATERIAL DATA

MATERIAL SAMPLED	MATERIAL SOURCE	USCS SOIL TYPE
SILT	Test Pit TP-7 depth = 11 feet	no data provided

LABORATORY TEST DATA

LABORATORY EQUIPMENT	TEST PROCEDURE
Liquid Limit Machine, Hand Rolled	ASTM D4318 - Method A

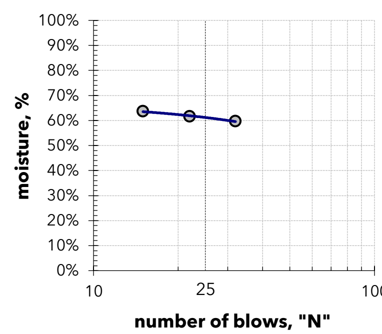
ATTERBERG LIMITS

liquid limit = 61
plastic limit = 48
plasticity index = 13

LIQUID LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	34.40	33.02	33.01	
dry soil + pan weight, g =	29.37	28.26	28.21	
pan weight, g =	20.94	20.54	20.67	
N (blows) =	32	22	15	
moisture, % =	59.7 %	61.7 %	63.7 %	

LIQUID LIMIT



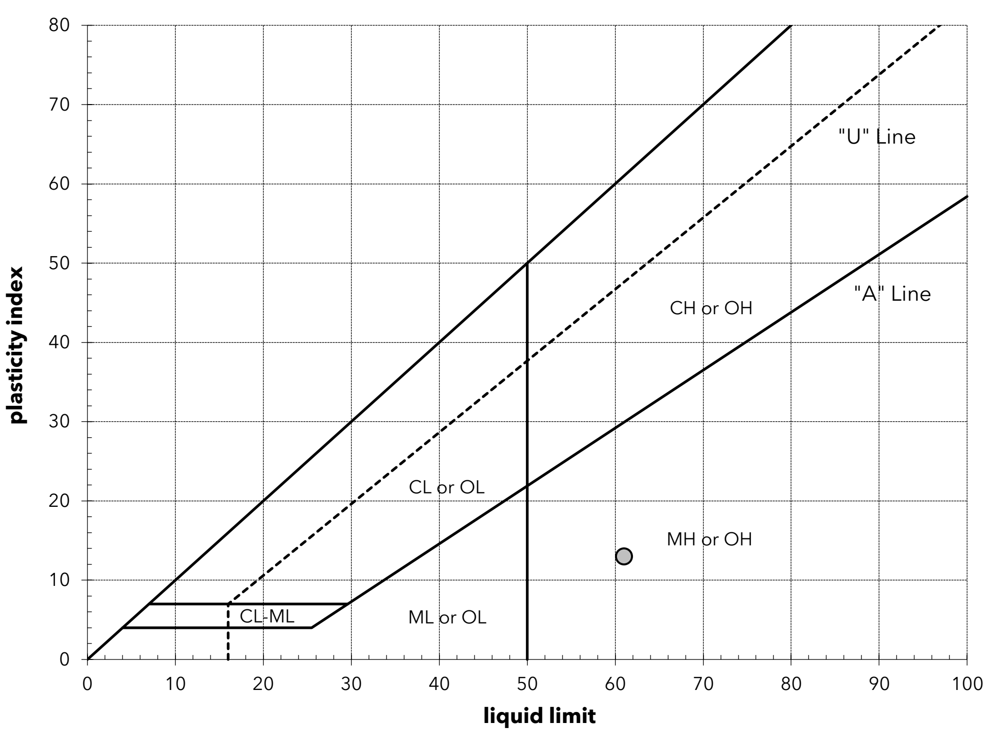
SHRINKAGE

shrinkage limit = n/a
shrinkage ratio = n/a

PLASTIC LIMIT DETERMINATION

	❶	❷	❸	❹
wet soil + pan weight, g =	27.12	27.34		
dry soil + pan weight, g =	25.06	25.26		
pan weight, g =	20.77	20.93		
moisture, % =	48.0 %	48.0 %		

PLASTICITY CHART



ADDITIONAL DATA

% gravel = n/a
% sand = n/a
% silt and clay = n/a
% silt = n/a
% clay = n/a
moisture content = n/a

DATE TESTED	TESTED BY
06/09/25	M. Scherette

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APPENDIX C

APPENDIX C
REPORT LIMITATIONS AND IMPORTANT INFORMATION

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction Observation

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples
Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

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