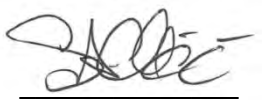
GEOTECHNICAL ENGINEERING STUDY W/INFILTRATION

Proposed Oliver's Terrace Subdivision
1004 SE Everett Road
Camas, WA 98607
(Parcel No. 178221000)

Prepared for:

Kevin Miller
HSR Development
19120 SE 34th St #103
Vancouver, WA 98683

Prepared By:



Seth A. Chandlee
President

Adam Swenson, PE
Project Engineer

Project No. G2352400r
{July 2025}

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Soil and Water Technologies, Inc.
Geotechnical, Monitoring I Materials Testing I Erosion Compliance

HSR Development
19120 SE 34th St. #103
Vancouver, WA 98683
Attn: Kevin Miller

July 23rd 2025
G2352400r

Hello Kevin,

We are pleased to submit our report titled "Geotechnical Engineering Study with Infiltration Testing, for the proposed Oliver's Terrace Subdivision located at 1004 SE Everett Road in Camas, Washington. This report presents the results of our field exploration, laboratory testing, and engineering analyses.

Based on the results of this study, it is our opinion that construction of the proposed residential building lots are feasible from a geotechnical standpoint, provided recommendations presented in this report are included in the project design.

We appreciate the opportunity to have been of service to you and look forward to working with you in the future. Should you have any questions about the content of this report, or if we can be of further assistance, please call (360) 200-8693.

Respectfully Submitted,
Soil and Water Technologies, Inc.

Seth A. Chandlee
President

Adam Swenson, PE
Project Engineer

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Attachments:

INTRODUCTION

General

This report presents the results of the geotechnical engineering study completed by Soil and Water Technologies, Inc. (SWT) for the proposed Oliver's Terrace Subdivision located in Camas, Washington. The general location of the site is shown on the *Vicinity Map, Figure 1.* Our approximate exploratory test pit locations are shown in relation to the site on the *Site Plan, Figure 2.*

The purpose of this study is to explore and evaluate subsurface conditions at the site and provide geotechnical recommendations for the proposed construction based on the conditions encountered. These recommendations include site specific geotechnical parameters for foundation support, earthwork grading, stormwater infiltration, site drainage, erosion control and a seismic hazard evaluation.

Project Description

Based on our review of the preliminary site plan provided, it is our understanding that the west side of the 18.15-acre property, designated Clark County tax parcel 178221000, will consist of the construction of a total of 11 single-family residential building lots. The project will also include associated underground utilities and a paved onsite roadway/shared driveway. A grading plan was not provided at this time; however, we anticipate earthwork grading to consist predominately of minimal cuts/fills ranging from approximately 1 to 3 feet in thickness. However, based on our onsite observations and site topography, thicker structural fills may be feasible at the north side of the site to accommodate an additional building lot north of proposed lots 7 & 8.

Specific structural design loads were also not available, however, based on our experience with similar projects, we anticipate that wall loads will be approximately 700 to 1,500 pounds per lineal foot (plf). Slab-on-grade floor loads will most likely range from one hundred to one hundred and fifty pounds per square foot (100-150 psf).

If any of the above information is incorrect or changes, we should be consulted to review the recommendations contained in this report. In any case, it is recommended that Soil and Water Technologies perform a general review of the final design.

SITE CONDITIONS

General Regional/Local Geology

General information about geologic conditions and soil in the vicinity of the site was obtained by reviewing the USGS Geologic Map of Washington-Southwest Quadrant, WA. State Department of Natural Resources, (Geologic Map GM-34, 1987) and the Geologic Map of the Vancouver Quadrangle, Washington & Oregon, (DLNR), Open File Report 87-10 and the USDA web soil survey.

Regionally, the site is located within Portland-Vancouver Basin/ Willamette Valley/Puget Sound lowland. This area is defined by the coastal range mountains located to the west and the Cascade volcanic mountains to the east.

Locally, the site is located within the Late Pleistocene (17 -13 kya) Cayaclysmic-flood deposit zone. These deposits were created by a series of floods caused by the failure of the ice dam at Glacial Lake

Missoula in western Montana. This dam failure caused the deposition of suspended sediments after the floodwaters became hydraulically dammed north of the confluence of the Columbia and Lewis Rivers. Fine-grained sediments were deposited when the flood waters slowed down and created a series of distinct layers described as unconsolidated Gravels, Sands, Silts, and Clays.

Surface

The project site is located at the west side of the referenced parcel, east of terminated N. 49th Avenue of Lacamas Hills Ph. 2 & 3. The property consists of a relatively level (0-5% slope) circular plateau, that transitions to a both a steep (15-25%) downward slope at the northeast edge of the proposed building lots, and a moderate (10-15%) downward slope across the south/southeast side of the plateau. The maximum total elevation change is approximately 56 feet. The ground surface consisted of grass, weeds and mature deciduous/evergreen trees scattered across the flat plateau and heavily forested across the slope face and surrounding area. A large outcrop of bedrock was observed at the east side of the site, adjacent to N. 49th avenue.

Subsurface

On December 12th, 2024, we excavated a total of 7 test pits, designated TP-1 through TP-6 and I-7, to the maximum explored depth by refusal of 4.5 feet below the existing ground surface (bgs). Native bedrock was encountered at all test pits at depths ranging from 2.0 to 4.5 feet bgs. All exploration locations were selected by the SWT to determine subsurface conditions across the site and for the proposed stormwater treatment/control locations. The approximate locations are shown on the *Site Plan, Figure 2.*

All soil was classified in general accordance with the *Unified Soil Classification System (USCS).* Soil samples obtained from the test pits were returned to our office for additional evaluation and laboratory testing. Descriptions of field and laboratory procedures are included in Appendices A and B, respectively.

The following is a generalized description of the subsurface units encountered.

TOPSOIL:	Surface materials encountered at each test pit consisted of approximately 6 to 8 inches of grass and organic topsoil.
SILTY GRAVEL W/SAND	Native silty Gravel (GM) with sand was encountered below the Surface Materials at test pits TP-1 through TP-4, TP-6 and I-7 to depths ranging from 2.0 to 2.5 feet bgs. The silty Gravel (GM) with sand was red/brown, moist, and in a dense condition. The moisture content of this layer ranged from 22.1% to 34.9, with a fines content ranging from 13.6% to 40.8%.
GRAVEL W/SAND & SILT	Native Gravel (GP-GM) with sand and silt was encountered below the Surface Materials at test pit TP-5 to the maximum explored depth/refusal to 2.0 feet bgs. The Gravel (GP-GM) with sand and silt was red/brown, dense, and in a moist condition. The moisture content of this layer was 24.4% with a fines content of 9.7%.

GRAVEL W/SILT Native Gravel (GP-GM) with silt was encountered below the silty Gravel (GM) with sand at test pit TP-4 to depths ranging from 2.0 feet to the maximum explored depth/refusal at 4.5 feet bgs. The Gravel (GP-GM) with silt was dense, red/brown, and moist. The moisture content of this layer was 20.1% with a fines content of 5.6%.

BEDROCK Native Bedrock, consisting weathered and solid basaltic-andesite was encountered at all test pits TP-1 through TP-6 & I-7 to depths ranging from 2.0 to 2.5 feet bgs. The bedrock was easily fractured during test pit excavation in the upper ~8-12 inches underlain by solid rock. According to the *Geologic Map of the Camas Quadrangle, Clark County Washington and Multnomah County, US Geologic Survey,* Scientific Investigations Map 3017, indicates bedrock within this area to consist largely of "basalt and basaltic andesite flows during the late Oligocene time".

Infiltration Testing

Infiltration testing was performed at test pit I-7 at 0.5 feet bgs. The approximate location of the infiltration test is shown on the *Site Plan, Figure 2.* The purpose of performing this test was to determine if onsite subgrade soils are suitable for infiltration of stormwater and provide stormwater treatment and control for all onsite impervious surfaces after construction at proposed Tract 'B'. Infiltration testing methods were performed in general accordance with 2021 Clark County Stormwater Manual requirements. Each infiltration test was advanced to the desired depth and a 6-inch diameter PVC pipe was embedded at the base. Following the minimum pre-saturation period, the pipe was filled with water and timed as the head dropped. The test results were averaged and recorded in inches per hour (iph).

All soil was classified following the *Unified Soil Classification System* (USCS) and the *AASHTO Soil Classification System (M145).* The following table provides the field infiltration test results and associated laboratory testing:

Location	USCS Soil Type	Approx. depth to static groundwater	WWHM	Depth (ft.)	% Passing #200 sieve	Moisture content	Field Coefficient of Permeability (k)
I-7	**GM**	**Not encountered to 2.5 ft. bgs**	**SG-4**	**0.5**	**20.3**	**23.9**	**4.0 iph**

(USCS) Unified Soil Classification System | (GM) silty Gravel with sand
(WWHM) Western Washington Hydrology Model | Soil Group 4 (poorly drained soils)

Groundwater

Groundwater was not encountered in our test pits, which extended to the maximum explored depth/refusal of 2.5 feet bgs. Our review of Clark County MapsOnline indicates a static groundwater level exceeding 30 feet. Historical well data from the Department of Ecology Well Log Database indicates a static groundwater level of 70 feet below the ground surface within the vicinity of the site.

It is important to note that groundwater conditions are not static; fluctuations may be expected in the level and seepage of flow depending on the season, amount of rainfall, surface water runoff, and other

factors. Generally, the groundwater level is higher and seepage rate is greater in the wetter winter months (typically October through May).

Geologic Hazards

Clark County *Code Section 40.430.010* provides guidelines for the conduct of a geological hazard review of construction projects requiring permits. The code applies to properties in or within 100 feet of a geological hazard area. Geological hazards include steep slopes, landslide hazards, seismic hazards, and volcanic hazards. The purpose of this investigation was to determine if geologic hazards are present on the site, and if so, to provide recommendations to mitigate their impacts on development. The geologic hazard review is based on our site reconnaissance, subsurface explorations, laboratory analysis of representative soil samples collected in the field, and a review of publicly available published literature and maps.

Steep Slope Hazards and Observations:

As mentioned above, the proposed building area consists predominately of a flat (0-5%) circular plateau that transitions to a steep (15-40%) downward slope along the outside northeast edge. The steep slope transitions to a predominately moderate (~10-15%) slope across the south/southeast edge. See the attached site plan for areas of steep to moderate slopes. The total elevation change, as measured from the slope toe to crest, ranges from about 24 to 26 feet. During the time of our reconnaissance, the existing slope face was heavily forested with mature deciduous/evergreen trees and thick understory vegetation. No visible signs of erosion, surface slumping, tension cracks, or tilted trees were observed across the entire slope face.

Primary factors that will adversely affect slope stability include: the placement of un-retained fill on or at the top of slopes, excavation of steep un-retained cuts at the toe of slopes, and uncontrolled top of slope surface water runoff. At this time, and to the best of our knowledge, non of these are planned for the development of this property**.**

Based on the dense soil conditions encountered in our test pits, weathered bedrock encountered at depths of 2.0 to 4.5 feet bgs, and the heavily forested slope face, steep slope hazards **should not be considered.**

Building Set-backs from Top-of-Slope

- Lots 1 - 4: No set-back. Buildings may be constructed with bench-type excavations across the entire gentle to moderate slope face consisting predominantly of bedrock.

- Lots 5, 6 and east half of 7: A 10' foot horizontal foundation set-back is recommended from top-of-slope.

- Lots 8 - 11: No set-back requirement.

Landslide Hazards:

According to the "Landslide Hazard" layer on the Clark County MapsOnline, the site is not located within an active or historical landslide area. In addition, the entire site consists of bedrock at a depth of 2.0 to 4.5 feet bgs. Landslide hazard **should not be considered a hazard** for this site.

Erosion Hazards:

According to the "Erosion hazard" layer on Clark County MapsOnline, the site is not located within an area of erosion. Due to flat topography across the plateau and heavily vegetated surface, erosion **should not be considered a hazard**.

However, erosion control measures should be considered during construction to limit soil disturbance and degradation to the upper subsurface soil horizon that is considered highly moisture sensitive. As required, Best Management Practices (BMP's) should be followed per State and Local jurisdictions and approved engineering plans.

Volcanic Hazards:

Volcanic hazards include different phenomena of volcanic activity from the 5 stratovolcanoes located in Washington that include: alteration, blast, debris avalanche, lahar, surges, and regional lava flows. The site is located within a historic volcanic hazard area of regional lava flows between both Mt. St. Helens and Mt. Adams and is verified by the underlying bedrock across the site. However, due to vast distance (40-60 miles) from the historically active volcanoes (Mt. Adams and Mt. St. Helens) **volcanic hazards should not be considered** for the site.

Seismic Hazards:

Liquefaction Hazards:

Structures are subject to damage from earthquakes due to direct and indirect action. Shaking represents direct action. Indirect action is represented by foundation failures and is typified by liquefaction. Liquefaction occurs when soil loses all shear strength for short periods of time during an earthquake. Ground shaking of sufficient duration then results in the loss of grain-to-grain contact as well as a rapid increase in pore water pressure. This causes the soil to assume the physical properties of a fluid. To have potential for liquefaction a soil must be loose, cohesion-less (generally sands and silts), below the groundwater table, and must be subjected to sufficient magnitude and duration of ground shaking.

According to the "Liquefaction Susceptibility" layer of Clark County MapsOnline, the site is mapped as having "Bedrock – lowest risk" liquefaction susceptibility. Based on native bedrock encountered at a depth of 2.0 to 4.5 feet bgs and the absence of near surface static groundwater within the upper soil horizon, it is our professional opinion that soil liquefaction and induced differential settlement will not occur at the subject site during a moderate to strong seismic event and that a "very low" susceptibility is adequate for the site.

Ground Motion Amplification

According to the "Site Class Map layer on the Washington Geologic Information Portal, the site is designated as a seismic Site Class of "B – Bedrock". Based on our subsurface explorations and laboratory test results, it is our opinion that a Site Class "B-C – Bedrock/dense soil" is appropriate for the predominantly dense soil encountered in the upper 2.0 to 4.5 feet across the site. This

designation indicates that some/minor amplification of seismic activity may occur during a seismic event based on the subsurface soil conditions encountered.

Seismic Design Criteria:

As stated above, the supportive foundation soils encountered at the site are classified as a type "D". For more detail regarding soil conditions refer to the soil logs in Appendix A of this report.

The seismic design criteria for this project found herein is based on the American Society of Civil Engineers (ASCE7-22), and ASCE7Hazardtool.online. A summary of the seismic design criterion is below.

Table 1. ASCE 7-22 Seismic Design Parameters

Location (45.615395, -122.406824)	Short Period	1-Second
Maximum Credible Earthquake Spectral Acceleration	S_s = 0.81	S_1 = 0.30
Soil Site Class / Risk Category	B-C / II	
Adjusted Spectral Acceleration	S_{MS} = 0.73	S_{M1} = 0.3
Design Spectral Response Acceleration Parameters	S_{DS} = 0.49	S_{D1} = 0.20

g – acceleration due to gravity

Using the information provided, the structural engineer can select/calculate the appropriate site coefficient values (F_a and F_v) from Tables 1613.5.3(1) and 16135.3(2) of the IBC for determining an earthquake spectral response acceleration for the reference site. Please *Appendix C* for ASCE7-22 Seismic Summary for the site.

GEOTECHNICAL DESIGN RECOMMENDATIONS

General

Based on the results of our study, it is our opinion the proposed residential buildings can be constructed as planned, provided the geotechnical recommendations contained in this report are incorporated into the final design. The following sections present detailed recommendations and parameters pertaining to the geotechnical engineering design for this project.

Foundations

Based on the encountered subsurface soil conditions, preliminary building design criteria, and assuming compliance with the preceding *Site Earthwork and Grading* section, the proposed residential building foundations may be supported on conventional shallow spread footings bearing on undisturbed native dense silty Gravel (GM) with sand, native bedrock, or compacted engineered structural fill.

Individual spread footings or continuous wall footings providing support for the proposed buildings may be designed for a maximum allowable bearing value of 1,500 pounds per square foot (psf). Footings for one level structures should be at least 12 inches in width. Footings for two level structures should be at least 15 inches in width. Footings for three level structures should be at least 18 inches in width. All footings should extend to a depth of at least twelve (12) inches below the lowest adjacent finished subgrade.

These basic allowable bearing values are for dead plus live loads and may be increased one-third for combined dead, live, wind, and seismic forces. Lateral loads can be resisted by friction between the foundation and the supporting sub grade or by passive earth pressure acting on the buried portions of the foundation. For the latter, the foundations must be poured "neat" against the existing soil or back filled with a compacted fill meeting the requirements of structural fill.

- Passive Pressure = 250 pcf (equivalent fluid weight)
- Coefficient of Friction = 0.35

Slab on Grade

If concrete floor slabs are desired, then any disturbed soils must be re-compacted prior to pouring concrete. Satisfactory subgrade support for lightly loaded building floor slabs can be obtained on the undisturbed native soil or on competent engineered structural fill. Unsuitable fill material shall be removed and replaced with approved structural fill. We recommend a minimum 6-inch thick layer of compacted crushed rock beneath the slab to provide a homogeneous support surface for the slab. A subgrade modulus of 125 pounds per cubic inch (pcf) may be used to design floor slabs.

A minimum 6-inch-thick layer of free draining fill should be placed and compacted over the prepared subgrade to assist as a capillary break and blanket drain. It is also suggested that nominal reinforcement such as "6x6-10/10" welded wire mesh be employed, near midpoint, in new concrete slabs. In areas where slab moisture is undesirable, a vapor barrier such as a 6-mil plastic membrane should be placed beneath the slab.

Exterior concrete slabs that are subject to vehicle traffic loads should be at least 4 inches in thickness. It is also suggested that nominal reinforcement such as "6x6-10/10" welded wire mesh be installed, near midpoint, in new exterior concrete slabs and paving. Fiber mesh concrete may be used in lieu of welded wire mesh.

Site Drainage

The site should be graded so that surface water is directed off the site and not be allowed to stand in any area where buildings or foundations are to be constructed. Loose surfaces should be sealed at the end of each workday by compacting the surface to reduce the potential of moisture infiltrating into the soils. Final site grades should allow for positive drainage away from the building foundations.

The ground should be sloped at a gradient of 3% for a distance of at least 10 feet away from the buildings. We suggest that a foundation footing drain be installed around the perimeter of the buildings. The drain should consist of a 4-inch diameter perforated pipe with holes facing down and installed in an envelope of clean drain rock or pea gravel wrapped with free draining filter fabric. The drain should be a minimum of 1-foot-wide and 1-foot-deep with sufficient gradient to initiate flow. The drain should be routed to a suitable discharge area. Details for the footing drain have been included as *Figure 3, Typical Footing Subdrain Detail.*

Under no circumstances should the roof down spouts be connected to the perimeter building drain. We suggest that clean outs be installed at several accessible locations to allow for the periodic maintenance of the drain system.

Pavement Areas

Asphaltic Cement (AC) and Crushed Rock Base (CRB) materials should conform to WSDOT specifications. All pavement area subgrades should be compacted to at least 95% of the ASTM D1557 modified proctor laboratory test standard. Based on our laboratory testing of the upper soil horizon, visual observations and local knowledge of soil types in the area, the subgrade soils from 0.5 to 2.5 feet is an AASHTO soil type A-2. Therefore, we recommend that a minimum of 3 inches of AC underlain by 8 inches of compacted CRB be applied at all light vehicle loading areas and a minimum of 4 inches of AC underlain by 12 inches of compacted CRB at all public right-of-way road improvement areas.

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements have the potential to saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be scarified 12 inches in depth, re-compacted to 95% percent (modified proctor ASTM D1557) and graded to provide positive drainage within the granular base section.

The subgrade and the pavement surface should have a minimum ¼ inch per foot slope to promote drainage. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the base layer.

CONSTRUCTION RECOMMENDATIONS

Site Preparation and Grading

Clearing and Grubbing:

Prior to grading, the project area should be cleared of all rubble, trash, debris, etc, if necessary. Any buried organic debris, undocumented fill or other unsuitable material encountered during subsequent excavation and grading work should also be removed. Excavations for removal of any existing footings, slabs, walls, utility lines, tanks, and any other subterranean structures should be processed and backfilled in the following manner:

- Clear the excavation bottom and side cuts of all loose and/or disturbed material.
- Once the organic topsoil has been adequately removed (6 to 8 inches), the subgrade shall be scarified to 12 inches in depth and re-compacted to 95% (ASTM D1557 – Modified proctor). Density testing shall be performed prior to placement of additional fill.
- If basement demolition and backfill apply, after footing/basement removal, the excavation bottom should be moisture conditioned to within 2 percent of the optimum moisture content and compacted to at least 95% of the ASTM D1557 laboratory test standard.

  Backfill should be placed, moisture conditioned (i.e., watered and/or aerated as required and thoroughly mixed to a uniform, near optimum moisture content), and compacted by mechanical means in loose lifts not exceeding 12 inches. The degree of compaction obtained should be at least 95 % of the ASTM D-1557 laboratory test standard, as applicable.

Engineered Structural Fill

- All fill material shall be placed above a prepared subgrade in loose lifts not exceeding 12 inches, within 2-3% of its optimum moisture, and compacted to a dense condition by adequate equipment.
- Compaction of structural fill shall meet a minimum 95% of the maximum dry density determined AASHTO T-180. Engineered structural fill shall be verified by a nuclear density gauge for every vertical foot placed. The processes and procedures of earthwork grading should be observed and monitored by a field technician from SWT during construction.
- All import soils should be sampled, tested, and approved by SWT prior to arrival on site. Imported soils shall consist of clean soils (EI of 20 or less) free from vegetation, debris, or rocks larger than 3 inches in maximum dimension.
- After clearing and grading the site, it is possible that some localized areas of soft, wet or unstable subgrade may still exist. Before placement of any base aggregate, the subgrade should be scarified 8 inches in depth and compacted with suitable compaction equipment. Yielding areas that are identified should be excavated to medium dense/stiff material and replaced with compacted 2-inch-minus clean crushed aggregate. All building and pavement areas should be compacted to a dense non-yielding condition with suitable compaction equipment. This phase of earthwork compaction shall be performed prior to the placement of any structural fill, at the bottom of all foundation excavations and along the roadway subgrade, before the placement of base aggregate.

Wet Weather Construction & Moisture Sensitive Soils

Field observations and laboratory testing indicates that the subsurface soils to a depth ranging from 0.5 to 2.5 feet consist predominately of native silty Gravel (GM) with sand and is a moisture sensitive material. As such, in an exposed condition, moisture sensitive soil can become disturbed during normal construction activity, especially when in a wet or in a saturated condition. Once disturbed, these wet soils will be unsuitable for support of foundations, floor slabs, and roadways.

Therefore, where soil is exposed and will support new construction, care must be taken not to disturb its condition. If disturbed soil conditions develop, the affected soil must be removed and replaced with suitable structural fill. The depth of removal will be dependent on the depth of disturbance developed during construction. Covering the excavated area with plastic and refraining from excavation activities during rainfall will minimize the disturbance and decrease the potential degradation of supportive soils.

Utility Trench Excavation and Backfill

Excavation of utility trenches within the proposed roadway/caul-de-sac will be significantly impacted by the presence of shallow bedrock. As mentioned above and shown on the *Site Plan*, a large, exposed bedrock outcrop was observed within the proposed roadway and encountered at a shallow depth of 2.0 to 2.5 feet bgs at test pits TP-1 and TP-2. Special consideration, including the use of rock removal techniques with specialized equipment or tools, will be required for utility excavation along the proposed roadway/caul-de-sac at the central portion of the site. If bedrock cannot be excavated with a track hoe hydraulic rock breaker attachment, blasting may be an option. If so, SWT recommends a

blasting contractor review the information is this report to create a blasting plan that adheres to City of Camas specifications.

Based on the conditions encountered, the soil/bedrock to be exposed by utility trenches should provide adequate support for utilities. Utility trench backfill is a concern in reducing the potential for settlement along utility alignments, particularly in pavement areas. It is also important that each section of utility line be adequately supported in the bedding material. The backfill material should be hand tamped to ensure support is provided around the pipe haunches.

Fill should be carefully placed and hand tamped to about 12 inches above the crown of the pipe before any compaction equipment is used. The remainder of the trench back fill should be placed in lifts having a loose thickness of eight inches.

A typical trench backfill section and compaction requirements for load supporting and non-load supporting areas is presented on *Figure 4, Utility Trench Backfill Detail*.

Temporary Excavations

The following information is provided solely as a service to our client. Under no circumstances should this information be interpreted to mean that SWT is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred. In no case should excavation slopes be greater than the limits specified in local, state and federal safety regulations.

Based on the information obtained from our field exploration and laboratory testing, the onsite soils expected to be encountered in excavations consist predominately of dense silty Gravel (GM) with sand and stable bedrock. The upper subsurface soil horizon (~2 to 4 feet) encountered is classified as a type "B" soil and should be sloped at an inclination no steeper 1:1 (horizontal to vertical). The remainder of the trench will be stable bedrock and can excavated with vertical sides and remain intact.

If slopes of this inclination, or flatter, cannot be constructed, or if excavations greater than 4 feet in depth are required, temporary shoring may be necessary. This shoring would help protect against slope or excavation collapse and would provide protection to workmen in the excavation. If temporary shoring is required, we will be available to provide shoring design criteria, if requested.

LIMITATIONS

Our recommendations and conclusions are based on the site materials observed, selective laboratory testing, engineering analyses and other design information provided to Soil and Water Technologies as well as our experience and engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty is expressed or implied.

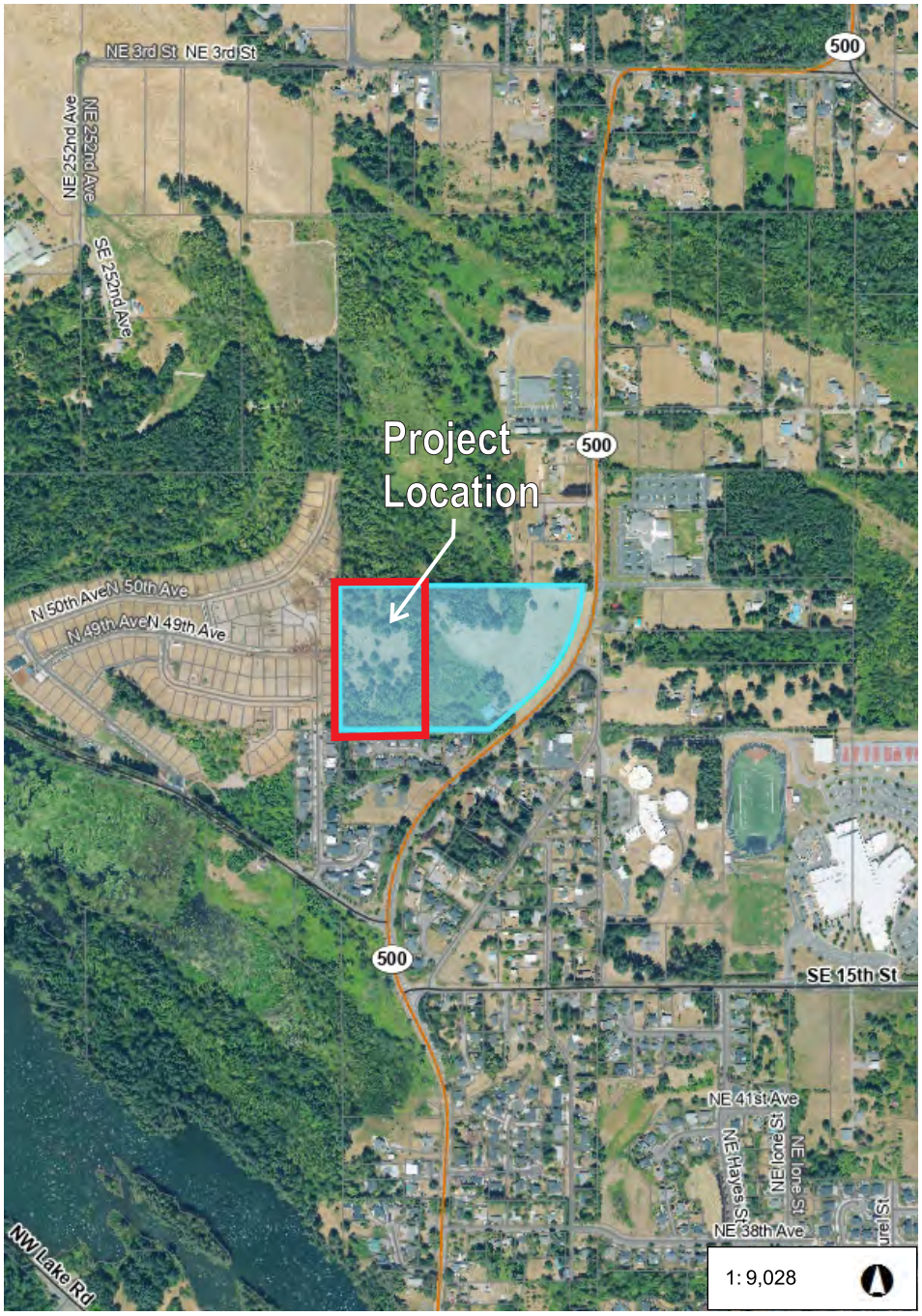
The recommendations submitted in this report are based upon the data obtained from the test pits. Soil and groundwater conditions between the test pits may vary from those encountered. The nature and extent of variations may not become evident until construction.

If variations do appear, Soil and Water Technologies should be requested to reevaluate the recommendations contained in this report and to modify or verify them in writing prior to proceeding with the proposed construction.

Temporary construction excavation and site safety are the sole responsibility of the construction contractor who also is solely responsible for the means, methods, and sequencing of construction operations. We are providing the following information only as a service to our client for planning purposes by their design team. Under no circumstances should the information provided herein be interpreted to mean that SWT is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

VICINITY MAP

Olivers Terrace Subdivision



Legend

- Taxlots
- All Roads
  - Interstate
  - State Route
  - Arterial
  - Forest Arterial
  - Minor Collector
  - Forest Collector
  - Private or Other
- All Roads
  - Interstate or State Route
  - Arterial
  - Collector
  - Private or Other

Notes:

Parcel No. 178221000

1,504.7 0 752,33 1,504.7 Feet

WGS_1984_Web_Mercator_Auxiliary_Sphere
Clark County, WA. GIS - http://gis.clark.wa.gov

This map was generated by Clark County's "MapsOnline" website. Clark County does not warrant the accuracy, reliability or timeliness of any information on this map, and shall not be held liable for losses caused by using this information. Taxlot (i.e., parcel) boundaries cannot be used to determine the location of property lines on the ground.

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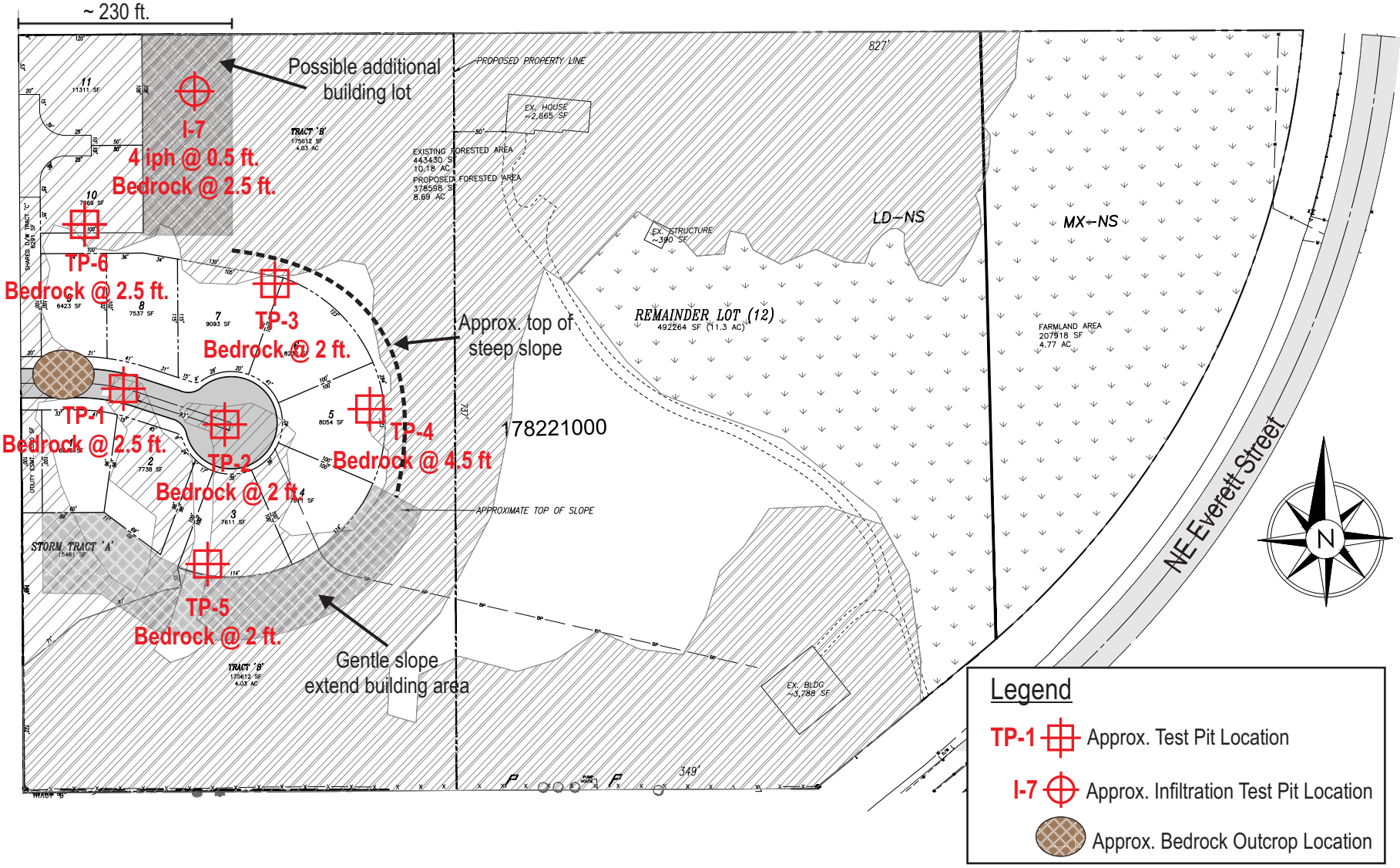
CLIENT:	HSR Development	*DRAWN:*	RN
PROJECT:	Oliver Terrace Subdivision 1004 NE Everett Street Camas, WA 98607	*DATE:*	1/11/2025
		FIGURE:	1
		PRO. #:	G2352400

SITE PIAN



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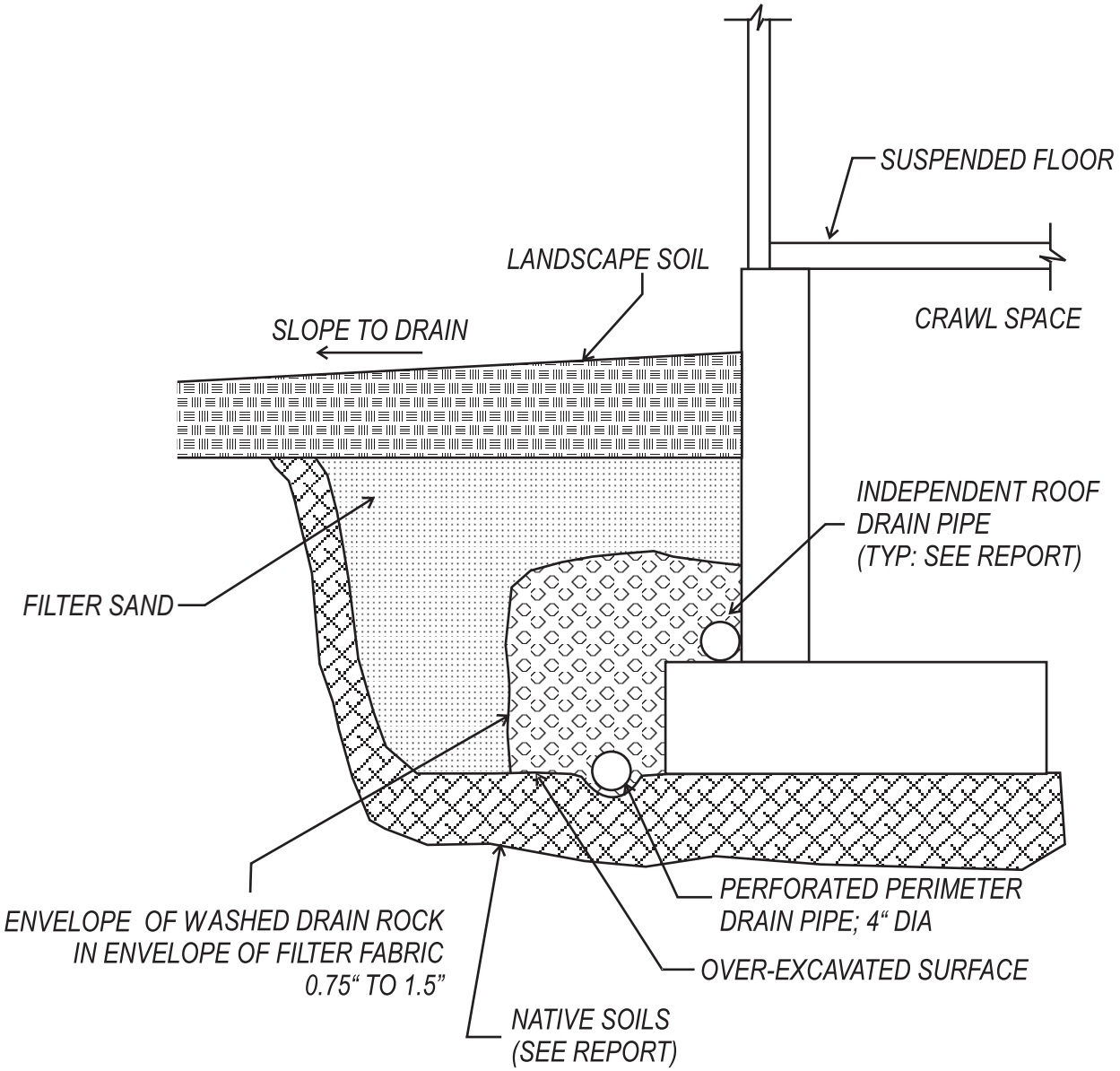
CLIENT:	HSR Development	*DRAWN:*	RN
PROJECT:	Oliver Terrace Subdivision 1004 NE Everett Street Camas, WA 98607	*DATE:*	12/19/2024
		FIGURE:	2
		PRO. #:	G2352400



NOTES:

1. FILTER SAND - FINE AGGREGATE FOR PORTLAND CEMENT; SECTION 9=03.1(2)
2. PERFORATED OR SLOTTED RIGID PVC PIPE WITH A POSITIVE DRAINAGE GRADIENT
3. FOOTINGS INSTALLED ABOVE COMPACTED NATIVE SOIL OR BEDROCK

TYPICAL SUSPENDED FOOTING DETAIL

Not to Scale

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Vancouver, WA 98661
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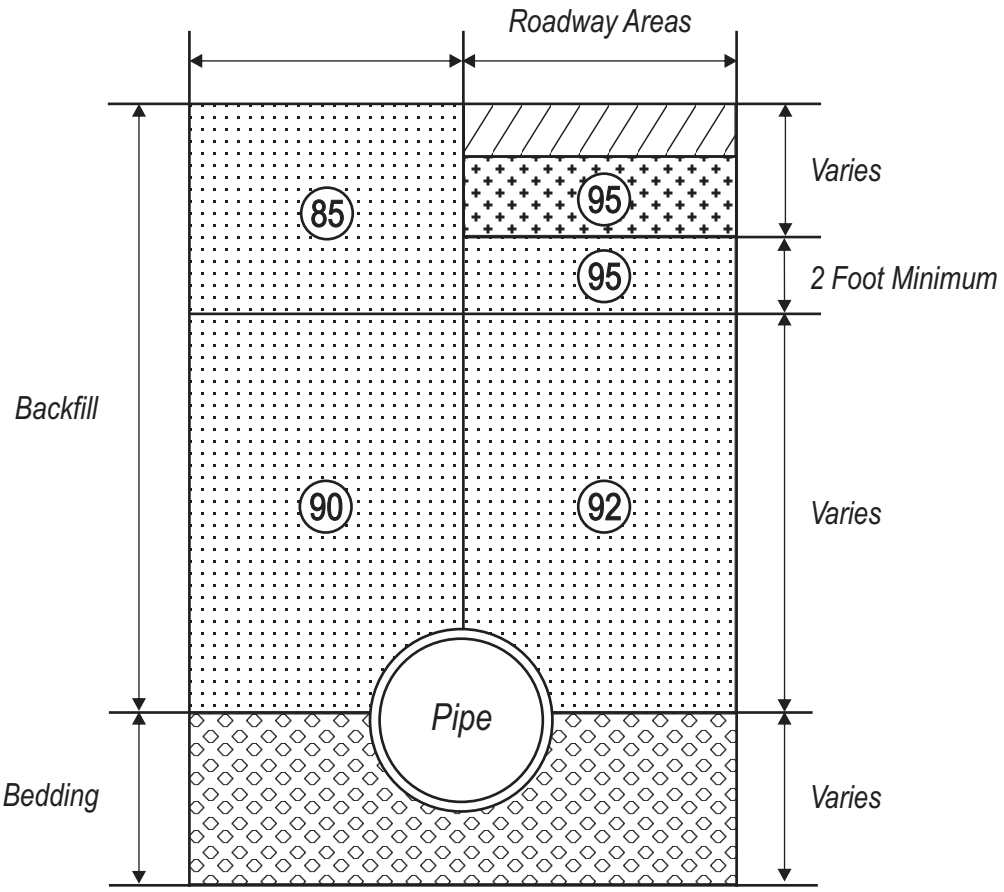
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Oliver Terrace Subdivision 1004 NE Everett Street Camas, WA 98607	DATE:	12/17/2024
		FIGURE:	3
		PRO. #:	G2352400



LEGEND

Asphalt or Concrete Pavement

Roadway Base Material or Base Rock

Backfill: Compacted on-site soil or imported select fill material as described in the site preparation of the general Earthwork Section of the attached report text.

95 — Minimum percentage of maximum Laboratory Dry Density as determined by ASTM Test method D1557 (Modified Proctor),unless otherwise specified in the attached report text.

Bedding Material: Material type depends on type of pipe and laying conditions. Bedding should conform to the manufacturer's recommendations for the type of pipe selected.

UTILITY TRENCH BACKFILL DETAIL

Not to Scale

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PH: (360) 200-8693
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CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Oliver Terrace Subdivision 1004 NE Everett Street Camas, WA 98607	DATE:	1/5/2025
		FIGURE:	4
		PRO. #:	G2352400

APPENDIX A

(FIELD EXPLORATION)

FIELD EXPLORATION

Our field exploration was performed on December 12th, 2024. Subsurface conditions were explored by excavating a total of 7 test pits (TP-1 through TP-6 & I-7) to the maximum explored depth by refusal of 4.5 feet below the existing ground surface. Bedrock refusal was encountered at each test pit at depths ranging from 2.0 to 4.5 feet bgs.

Test pit locations was determined by Soil and Water Technologies, Inc. (SWT) by pacing from existing site features and a measuring wheel. These approximate locations are shown on the *Site Plan, Figure 2.*

The field exploration was monitored by several SWT representatives who classified the soil encountered and maintained a log of each test pit, obtained representative samples, and observed pertinent site features. Representative soil samples were collected at each defined soil horizon, placed in sealed plastic bags, and returned to the laboratory for further examination and testing.

All samples were visually classified in accordance with the Unified Soil Classification System (USCS), which is presented on *Plate A1*. Logs of each test pits is presented in *Appendix A*. The final logs represent our interpretations of the field logs and the results of the laboratory tests on field samples. The stratification lines on the logs represent the approximate boundaries between soil types. However, the transitions may be more gradual.

UNIFIED SOIL CLASSIFICATION SYSTEM
LEGEND

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils	Gravel and Gravelly Soils More Than 50% Coarse Fraction Retained on No 4 Sieve	Clean Gravels (little or no fines)		GW gw	Well-Graded Gravels, Gravel-Sand Mixtures Little or no Fines
				GP gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines (appreciable amount of fines)		GM gm	Silty Gravels, Gravel-Sand-Silt Mixtures
				GC gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
More Than 50% Material Larger Than No 200 Sieve Size	Sand and Sandy Soils More Than 50% Coarse Fraction Passing No 4 Sieve	Clean Sand (little or no fines)		SW sw	Well-graded Sands, Gravelly Sands Little or no Fines
				SP sp	Poorly-Graded Sands, Gravelly Sands Little or no Fines
		Sands with Fines (appreciable amount of fines)		SM sm	Silty Sands, Sand-Silt Mixtures
				SC sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils	Silts and Clays	Liquid Limit Less than 50		ML ml	Inorganic Silts and Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ slight Plasticity
				CL cl	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
				OL ol	Organic Silts and Organic Silty Clays of Low Plasticity
More Than 50% Material Smaller Than No 200 Sieve Size	Silts and Clays	Liquid Limit Greater than 50		MH mh	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
				CH ch	Inorganic Clays of High Plasticity, Fat Clays
				OH oh	Organic Clays of Medium to High Plasticity, Organic Silts
Highly Organic Soils				PT pt	Peat, Humus, Swamp Soils with High Organic Contents

Topsoil		Humus and Duff Layer
Fill		Highly Variable Constituents

SAMPLING DESCRIPTIONS

- Grab Sample
- SPT Drive Sampler (ASTM D1586)
- Shelby Tube Push Sampler (ASTM D1587)
- Dames and Moore Drive Sampler (ASTM D3550)

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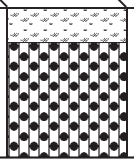
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Oliver Terrace Subdivision 1004 NE Everett Street Camas, WA 98607	DATE:	1/5/2025
		PLATE:	A1
		PRO. #:	G2352400

LOG OF TEST PIT — TP-1

ELEVATION: **+/- 324 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1 2	●	*red/brown, dense* *silty **Gravel** (GM) with sand* *moist* (native)		29.1	22.2	*6-8" Organic topsoil* *{a-1-b}* *{roots to 2 feet bgs}*

Refusal/bedrock at 2.5 feet below existing ground surface (bgs).
Static groundwater not encountered.

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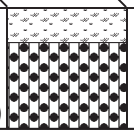
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A2
		PRO. #:	G2352400

LOG OF TEST PIT — TP-2

ELEVATION: **+/- 322 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1 – 2	●	*red/brown, dense* **silty Gravel (GM)** *with sand moist* (native)		23.5	13.6	*6-8" Organic topsoil*

Refusal/bedrock at 2.0 feet below existing ground surface (bgs).
Static groundwater not encountered.

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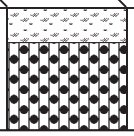
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A3
		PRO. #:	G2352400

LOG OF TEST PIT — TP-3

ELEVATION: **+/- 323 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1 – 2	•	*red/brown, dense* *silty **Gravel** (GM) with sand* *moist* (native)		22.1	15.4	*6-8" Organic topsoil*

Refusal/bedrock at 2.0 feet below existing ground surface (bgs).
Static groundwater not encountered.

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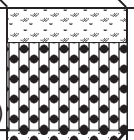
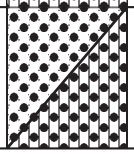
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A4
		PRO. #:	G2352400

LOG OF TEST PIT — TP-4

ELEVATION: **+/- 325 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1	●	red/brown, dense silty **Gravel (GM)** with sand moist (native)		34.9	40.8	6-8" Organic topsoil {A-2 | LL-37 | PL-29 | PI-8}
2						
3	●	red/brown, dense **Gravel (GP-GM)** with silt moist		20.1	5.6	{poorly-graded - A-1-b}
4						

Refusal/bedrock at 4.5 feet below existing ground surface (bgs).
Static groundwater not encountered.

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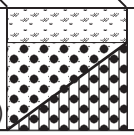
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A5
		PRO. #:	G2352400

LOG OF TEST PIT — TP-5

ELEVATION: **+/- 325 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1 – 2	•	*red/brown, dense* **Gravel (GP-GM)** *with sand and silt moist* (native)		24.4	9.7	*6-8" Organic topsoil* *{roots to 2 ft. bgs}*

Refusal/bedrock at 2.0 feet below existing ground surface (bgs).
Static groundwater not encountered.

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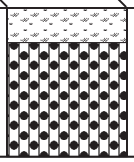
CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A6
		PRO. #:	G2352400

LOG OF TEST PIT — TP-6

ELEVATION: **+/- 325 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1 2		*red/brown, dense* *silty **Gravel** (GM) with sand* *moist* (native)		-	-	*6-8" Organic topsoil*

Refusal/bedrock at 2.5 feet below existing ground surface (bgs).
Static groundwater not encountered.

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CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A7
		PRO. #:	G2352400

LOG OF TEST PIT — I-7

ELEVATION: **+/- 308 feet**
EXPLORATORY EQUIPMENT: **Track Hoe**
DATE: **12/12/2024**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200	NOTES
1 2		*red/brown, dense* *silty **Gravel** (GM) with sand* *moist* (native)		23.9	20.3	6" Organic topsoil Coefficient Infiltration test @ 4 iph @ 0.5 ft.

Refusal/bedrock at 2.5 feet below existing ground surface (bgs).
Static groundwater not encountered.

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CLIENT:	HSR Development	DRAWN:	RN
PROJECT:	Olivers Terrace 1004 NE Everett Street Camas, WA 98607	DATE:	1/6/2025
		FIGURE:	A8
		PRO. #:	G2352400

APPENDIX B

(LABORATORY TESTING)

LABORATORY TESTING

Laboratory tests were conducted on representative soil samples to verify or modify field soil classifications, and to evaluate the general physical properties and engineering characteristics of the soils encountered.

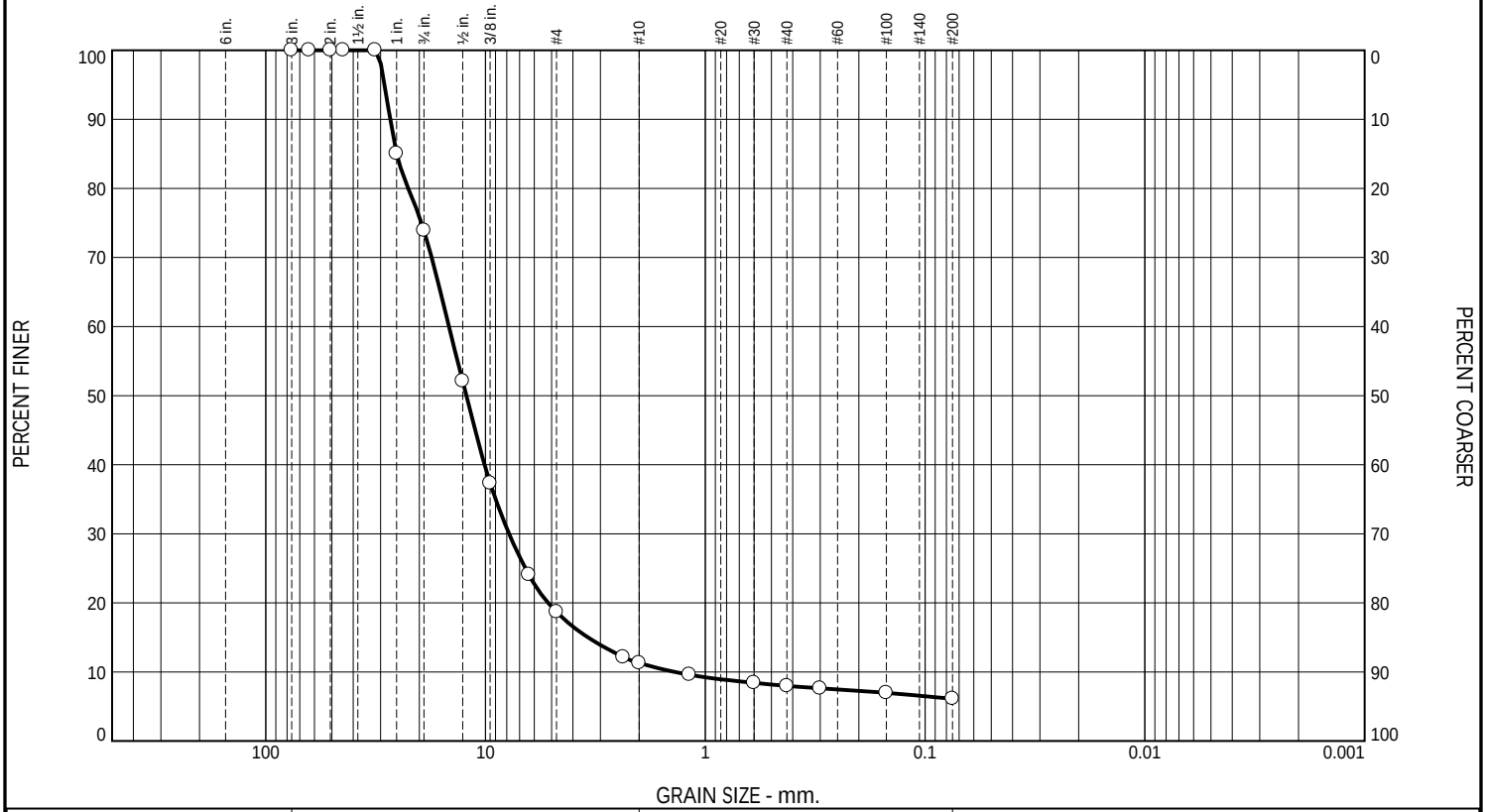
The following provides information about the testing procedures performed on representative soil samples:

- Moisture Content Tests (ASTM D2216) were performed on representative samples encountered in each soil horizon.
- Sieve Analysis - No. 200 wash (ASTM C117) was performed on representative samples encountered at each test pit.
- Atterberg Limits Testing (ASTM D4318) was performed on a representative sample collected at test pit TP-4 to determine the "water-plasticity" ratio of the upper soil horizon. This test also provides an indication of relative soil strength as well as the potential for soil volume changes with variation in moisture content.

The results of laboratory tests performed on specific samples are provided at the appropriate sample depth on the individual test pits logs. However, it is important to note that some variation of subsurface conditions may exist. Our geotechnical recommendations are based on our interpretation of these test results.

Particle Size Distribution Report

AASHTO T 27 & T 11



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	88.7	3.3	1.9	6.1	

Test Results (AASHTO T 27 & T 11)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3"	100.0			
2 1/2"	100.0			
2"	100.0			
1 3/4"	100.0			
1 1/4"	100.0			
1"	85.1			
3/4"	73.9			
1/2"	52.1			
3/8"	37.3			
1/4"	24.1			
#4	18.7			
#8	12.1			
#10	11.3			
#16	9.6			
#30	8.4			
#40	8.0			
#50	7.6			
#100	7.0			
#200	6.1			

* (no specification provided)

Material Description

poorly graded Gravel with silt

Atterberg Limits

PL= NP LL= NV PI= NP

Classification

USCS= GP-GM AASHTO= A-1-a

Test Remarks

Location: TP-4 @ -3'
Sample Number: 240

Sample Date: 12/12/24

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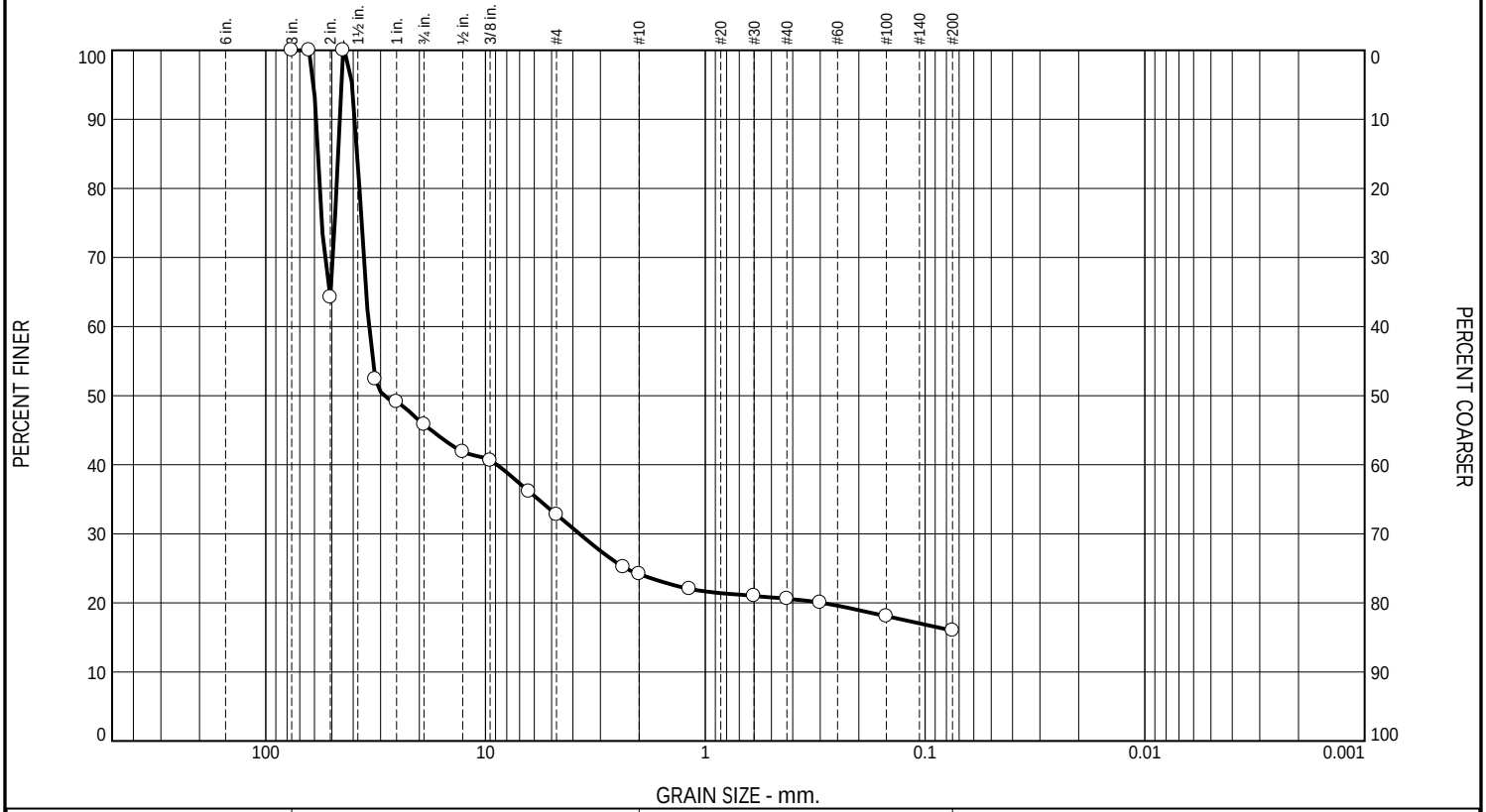
Client: HSR Development
Project: Olivers Terrace

Project No: G2352400 Figure PSD-1

Tested By: KH

Particle Size Distribution Report

ASTM C117 & C136



% +3"	% Gravel	% Sand		% Fines	
		Coarse	Fine	Silt	Clay
0.0	75.8	3.6	4.6	16.0	

Test Results (ASTM C117 & C136)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)	Pct. of Fines
3"	100.0			
2 1/2"	100.0			
2"	64.2			
1 3/4"	100.0			
1 1/4"	52.4			
1"	49.1			
3/4"	45.8			
1/2"	41.9			
3/8"	40.6			
1/4"	36.1			
#4	32.8			
#8	25.2			
#10	24.2			
#16	22.0			
#30	21.0			
#40	20.6			
#50	20.0			
#100	18.1			
#200	16.0			

* (no specification provided)

Material Description
silty Gravel with sand

Atterberg Limits
PL= NP LL= NV PI=

Classification
USCS= GM AASHTO= A-1-b

Test Remarks

Location: TP-1 @ -1.5'
Sample Number: 240

Sample Date: 12/12/24

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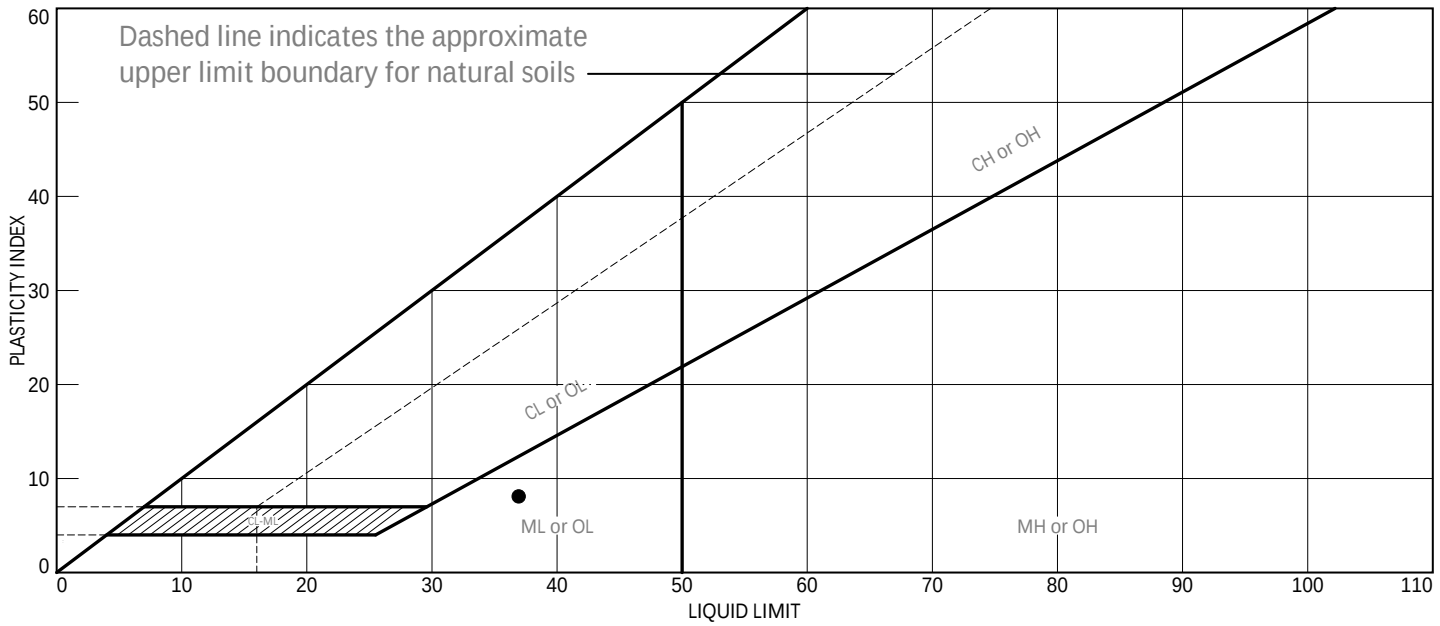
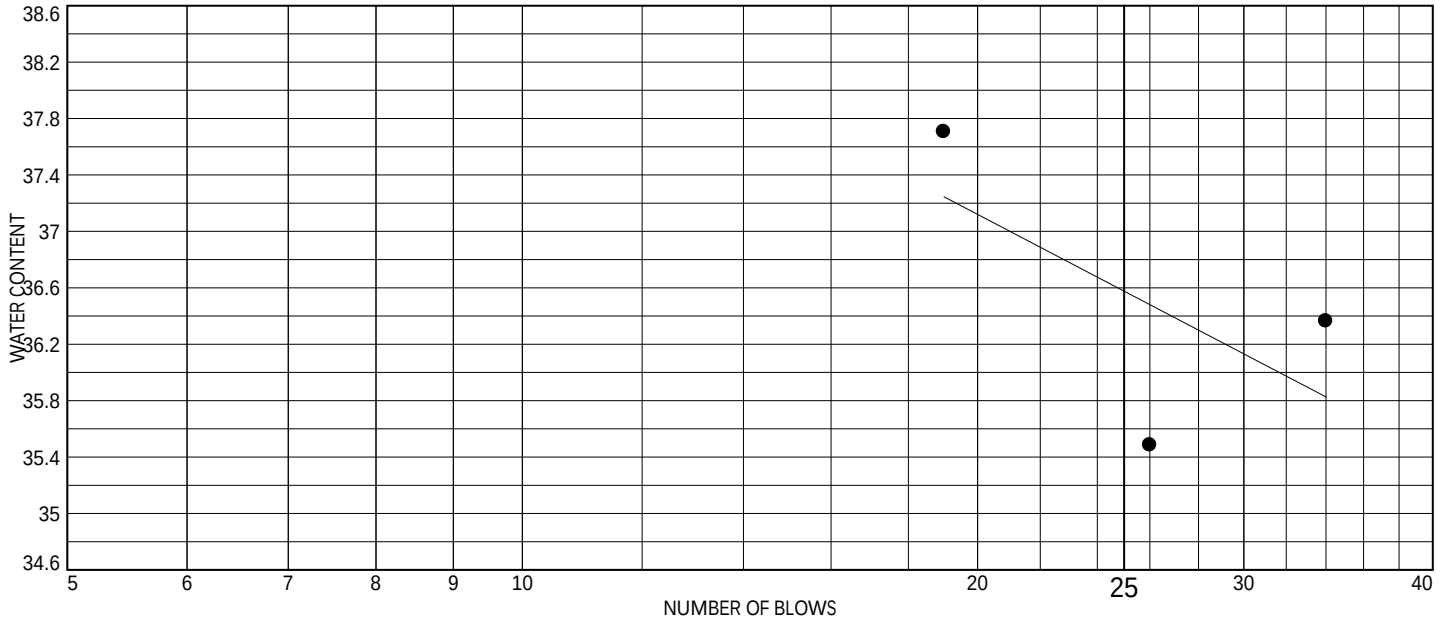
Client: HSR Development
Project: Olivers Terrace

Project No: G2352400 Figure PSD-2

Tested By: KH

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	silty Gravel with sand	37	29	8	20.6	16	GM

Project No. G2352400 Client: HSR Development

Project: Olivers Terrace

Location: TP-4 @ -1'
Sample Number: 240

Remarks:
●AASHTO A-2-4

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Figure: LPL-1

Tested By: KH Checked By: KH

APPENDIX C

(ASCE 7-22 HAZARDS REPORT)

ASCE Hazards Report

Address:
1004 SE Everett Rd
Camas, Washington
98607

Standard:	ASCE/SEI 7-22	**Latitude:**	45.615395
Risk Category:	II	**Longitude:**	-122.406824
Soil Class:	BC	**Elevation:**	299.06581724399035 ft (NAVD 88)

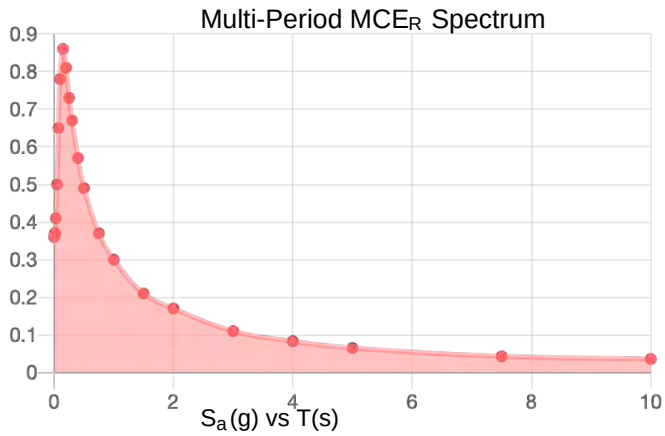
Seismic

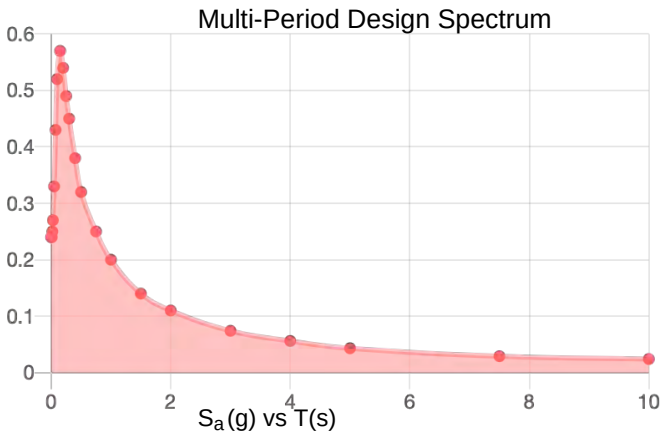
Site Soil Class: BC

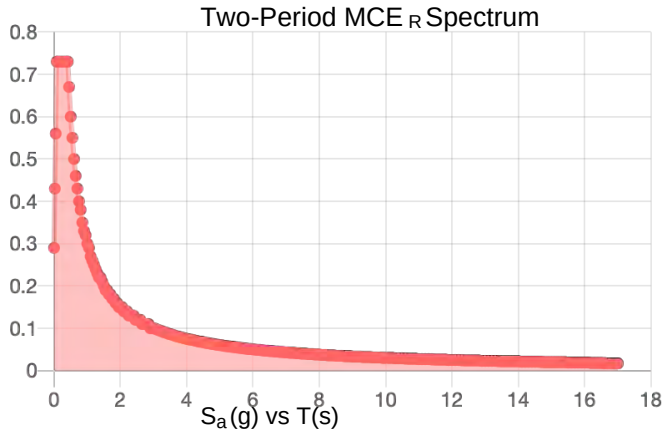
Results:

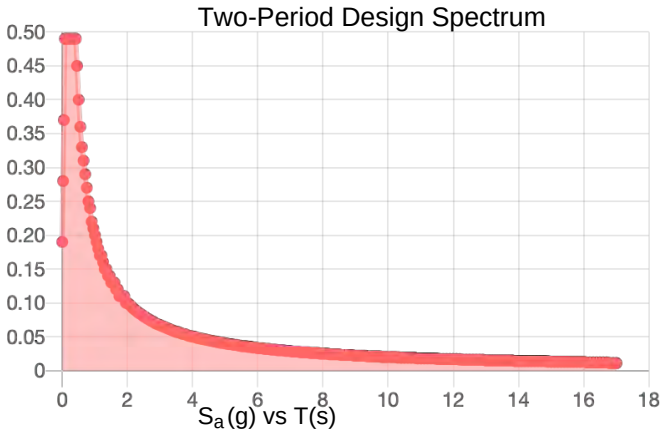
PGA_M :	0.34	T_L :	16
S_{MS} :	0.73	S_S :	0.81
S_{M1} :	0.3	S_1 :	0.3
S_{DS} :	0.49	V_{S30} :	760
S_{D1} :	0.2		

Seismic Design Category: D









MCER Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Fri Feb 14 2025**

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided “as is” and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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ASCE Hazards Report

Address:
1004 SE Everett Rd
Camas, Washington
98607

Standard:	ASCE/SEI 7-22	**Latitude:**	45.615395
Risk Category:	II	**Longitude:**	-122.406824
Soil Class:	BC	**Elevation:**	299.06581724399035 ft (NAVD 88)

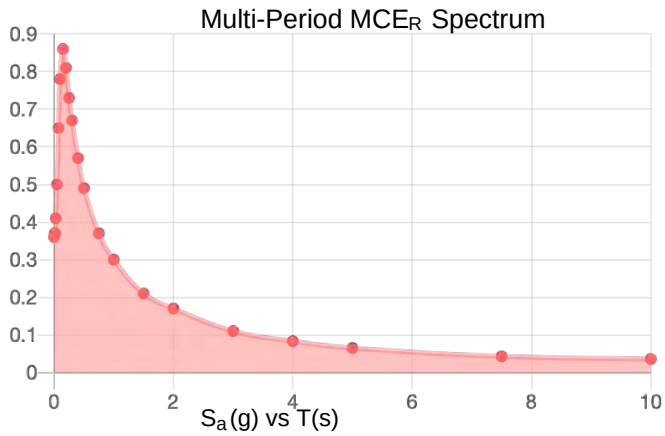
Seismic

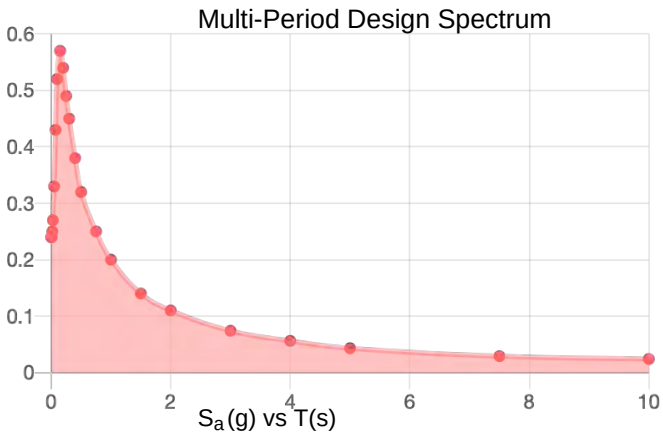
Site Soil Class: BC

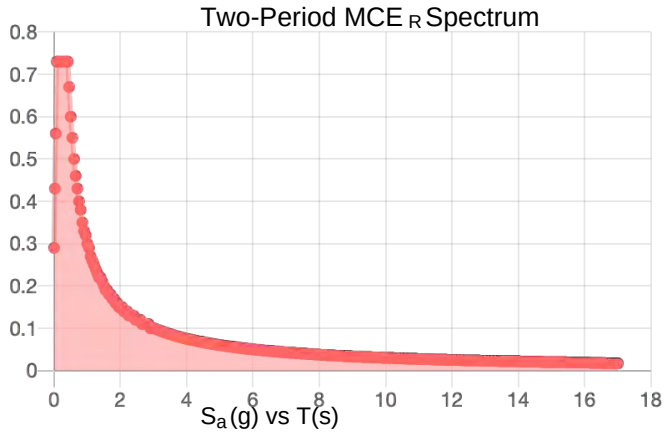
Results:

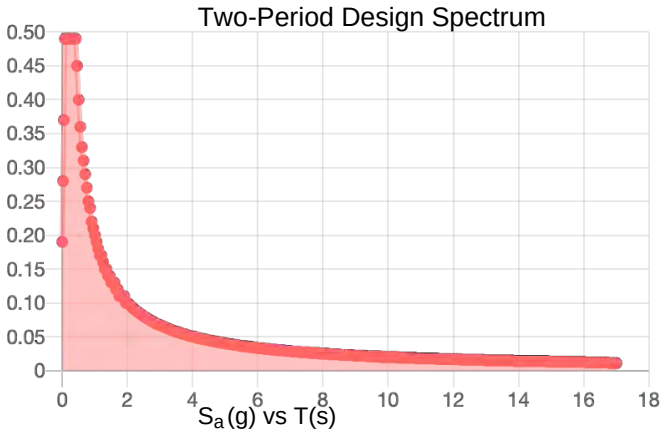
PGA_M :	0.34	T_L :	16
S_{MS} :	0.73	S_S :	0.81
S_{M1} :	0.3	S_1 :	0.3
S_{DS} :	0.49	V_{S30} :	760
S_{D1} :	0.2		

Seismic Design Category: D









MCER Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Design Vertical Response Spectrum

Vertical ground motion data has not yet been made available by USGS.

Data Accessed: **Fri Feb 14 2025**

Date Source:
USGS Seismic Design Maps based on ASCE/SEI 7-22 and ASCE/SEI 7-22 Table 1.5-2. Additional data for site-specific ground motion procedures in accordance with ASCE/SEI 7-22 Ch. 21 are available from USGS.

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APPENDIX D

(Test pits/ Site Photographs)

I-1. Bedrock @ 2.5 ft. bgs

TP-2. Bedrock @ 2.0 ft. bgs

TP-3. Bedrock @ 2.0 ft. bgs

TP-4. Bedrock @ 4.5 ft. bgs

TP-5. Bedrock @ 2.0 ft. bgs

TP-6. Bedrock @ 2.5 ft. bgs

I-7. Bedrock @ 2.5 ft. bgs