HARTCROWSER
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MEMORANDUM

DATE: November 23, 2020

TO: CJ Dens Lacamas I, LLC
Attention: Mr. Carl Lawson

FROM: Daniel J. Trisler, PE
Russell Rosenberg, GIT

RE: **Geotechnical Report Addendum #1 - Supplemental Design Support**
CJ Dens East Subdivision – Leadbetter Road
Camas, Washington
15948-02

CC: AKS Engineering & Forestry – John Meier, PE

Hart Crowser, a division of Haley & Aldrich, Inc., is pleased to submit this addendum to CJ Dens Lacamas I, LLC (CJ Dens) summarizing our updated geotechnical findings and recommendations, as applicable, for the CJ Dens East Subdivision in Camas, Washington. This memorandum and all attachments supersede or should be considered supplemental to our geotechnical report titled "Report of Geotechnical Engineering Services, CJ Dens Subdivision, Camas, Washington," dated July 6, 2016 (Geotechnical Report).

Our specific scope of work for the addendum was detailed in our contract change agreement with you, dated August 24, 2020, and generally included reviewing the updated development (grading) plans, reviewing our past reports, reviewing supplemental test pit explorations completed in November 2017, conducting limited geotechnical analysis to evaluate rock slope stability, and preparing this addendum summarizing our findings and any updated recommendations.

Amended or updated sections from the Geotechnical Report are shown with the relevant section numbers. The header titles for new sections are numbered and underlined.

We updated figures from the Geotechnical Report and added a new figure showing the depth to rock across the site. These updated figures are attached. We have also updated Attachment A-1 providing logs of explorations completed in 2015 and Attachment A-2 providing logs of explorations completed on the site since 2016. Attachment A-2 includes new explorations (TP-43 to TP-114) not included in the Geotechnical Report. All supplemental explorations in Attachment A-2 were completed using the procedures outline in Appendix A of the Geotechnical Report for TP-1 to TP-22.

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We note that this update does not address the portion of the original development that was designated Phase II and was generally located in the northern and western portions of the site. The area was addressed in a geotechnical report titled "Report of Geotechnical Engineering Services, CJ Dens Subdivision (Phase II), Camas, Washington," dated July 31, 2017.

2.0 Project Description

We understand that since the Geotechnical Report was prepared, the northwest portion of the original property, or the former "Phase II" area of the project has been sold and is no longer part of the project, as shown on Figure 1. Therefore, we understand the currently proposed development to consist of approximately 200 lots on the remaining eastern portion of original property.

As stated in our original report, we understand that conventional one- to three-story, single-family residences supported on shallow foundations will be constructed on each lot. We anticipate the buildings will be constructed with wood frames and will be relatively lightly loaded with strip loads up to 2.5 kips per lineal foot and column loads of 75 kips.

Infrastructure, such as roadways and utilities, will also be constructed. We understand that mass cuts and fills of up to approximately 20 feet deep will be required for site grading. Finished cut and fill slopes up to approximately 40 feet tall will be created by this mass earthwork. Figure 3 shows preliminary mass grading for the development.

4.1 Geologic and Soils Mapping

In additional to the geologic and soils mapping described in *Section 4.1* of the Geotechnical Report, we further reviewed the available geologic mapping (Evarts and O'Connor 2008) for orientation measurements of the basaltic andesite and/or volcaniclastic rocks. No orientation data were available within the project area; however, rock attitude measurements in the basaltic andesite closer to the Washougal River indicate a generally 15- to 30-degree dip to the southeast within the basaltic andesite to the southeast of the site.

4.3 Subsurface Conditions

The following material completely replaces *Section 4.3* of the Geotechnical Report.

4.3.1 General

Soil and rock conditions interpreted from geologic maps and our explorations, in conjunction with soil and rock properties inferred from field observations and laboratory tests, formed the basis for the conclusions and recommendations in this report. Test pit locations relative to the existing and proposed site plans are shown on Figures 2 and 3, and the depth to bedrock encountered in each test pit is shown

on Figure 4. Appendix A describes our field exploration procedures and presents field data and logs. Appendix B (not replicated herein) describes our laboratory soil testing procedures and results.

We completed exploration of the site by observing the advancement of 102 test pits to depths ranging from approximately zero feet bgs (refusal on strong bedrock at the surface) to 15 feet bgs. Nine test pits, designated TP-1a through TP-9a were completed on November 23, 2015, 22 test pits, designated TP-1 through TP-22, were completed on May 27, 2016, and 71 tests pits, designated TP-43 to TP-114 were completed between October 26 and 30, 2017. Additional test pit and hand auger explorations were completed within the former Phase II area of the project in 2016 and 2017; however, we do not discuss them further or include logs of these explorations in this memorandum.

The project area is typically mantled with colluvium and residual soil overlying moderately weathered to fresh basaltic andesite and slightly weathered to highly weathered volcaniclastic breccia to the maximum depths explored. Soil thickness (or depth to bedrock in feet bgs) ranged from approximately 0 to 13 feet. The average soil thickness for the site was approximately 2.6 feet. Most of the site consists of upland and mild hillslope areas, which typically had thin soil thicknesses of approximately 0 to 4 feet, with occasional areas of up to approximately 6 feet of soil and up to approximately 7.8 feet of soil at TP-1. Soil thickness within drainages and on, or at the base, of taller slopes was greater and typically ranged from approximately 4 to 9 feet and was up to 13 feet. The most consistent areas of thicker soil cover were encountered in northeast and southern portions of the property. Descriptions of the soil and rock units encountered are provided below.

4.3.2 Soil and Rock Conditions

4.3.2.1 Colluvium

Colluvium was encountered on or at the bottom of hillslopes at the site and is interpreted as slope wash deposits. The colluvium consisted of silty sand, sandy silt, silt with sand, elastic silt and lean clay with sand with varying percentages of fine, subrounded to subangular gravel. Colluvium up to 12 feet thick was encountered in test pit TP-8, but typically ranged from approximately 1 to 5 feet thick and was thicker at the bottom of slopes. The colluvium was typically covered with approximately 6 to 12 inches of rooted topsoil. Based on the backhoe action and pocket penetrometer tests in the sidewalls of the excavations, we estimate the consistency of the fine-grained colluvium to be soft to medium stiff and the relative density of the coarse-grained colluvium to be loose to medium dense.

Moisture contents in the colluvium varied from approximately 25 to 42 percent based on 12 tests. Atterberg limit testing was conducted on two samples of fine-grained colluvium yielding liquid limits of 43 to 48 and plastic limits of 23 to 34 indicating silt to lean clay soil classifications.

4.3.2.2 Residual Soil

Materials interpreted as residual soil consisting of silty sand, sandy silt, and lean clay with varying percentages of sand and fine gravel was encountered at the surface or underlying colluvium at the site. Residual soils are completely weathered and decomposed in-place bedrock that has experienced minimal transport by water or other means. Residual soil was encountered at the ground surface in most of our explorations but was encountered underlying colluvium at depths ranging from approximately 4 to 12 feet bgs in test pits TP-1a, TP-5a, TP-6a, TP-8, and TP-14. The residual soil extends to the maximum depths explored in test pit TP-8 (13 feet bgs), TP-83 (11 feet bgs), TP-84 (10 feet bgs), TP-85 (10 feet bgs), and TP-108 (10 feet bgs). Based on the backhoe action during test pit excavation, we estimate the consistency of the fine-grained residual soil is soft to very stiff and the relative density of the coarse-grained residual soil is loose to dense.

Moisture contents in the residual soil varied from 20 to 38 percent based on six tests. Atterberg limits testing was conducted on two samples of fine-grained residual soil yielding liquid limits of 46 to 49 and plastic limits of 26 to 31 indicating a soil classification of silt.

4.3.2.3 Oligocene Basaltic Andesite of Elkhorn Mountain

Bedrock interpreted as Oligocene-age Basaltic Andesite of Elkhorn Mountain was observed in numerous outcrops across the site and was encountered in most of our test pits either near the surface or at depths of up to approximately 8 feet bgs. The basaltic andesite varied from fresh to highly weathered, moderately weak to strong (R2-R4), with closely to moderately spaced fractures. The basaltic andesite was typically rippable with a toothed bucket to between 1 to 2 feet below top of rock with moderate effort; however, in approximately 40 test pits less than approximately 0.5 feet from the top of the basaltic andesite was rippable. Moisture contents in the basaltic andesite varied 9.0 to 9.4 percent based on two tests.

4.3.2.4 Oligocene Volcaniclastic Sedimentary Rock

Volcaniclastic breccia, interpreted as Oligocene-age Volcaniclastic Sedimentary Rock, was encountered at depths ranging from approximately 3 to 13 feet bgs in test pits TP-1a through TP-6a, TP-9a, TP-6, TP-7, TP-19, and TP-20. Volcaniclastic breccia was encountered in the northwest and southern limits of our explorations and stratigraphically underlies the basaltic andesite; no outcrops of volcaniclastic breccia were observed at the surface during our explorations. The breccia consists of angular, medium sand to coarse gravel-sized fragments of igneous rocks in a weakly-cemented, fine-grained matrix. The breccia was typically moderately to highly weathered, thin-bedded, gray-brown to red-brown, and very weak to moderately weak (R1-R2), with closely spaced fractures. The breccia was typically rippable to at least 1 foot below top of rock with minimal effort.

We did not directly observe the contact between the basaltic andesite and the volcaniclastic rocks during our explorations and reconnaissance and were therefore unable to measure the orientation directly. However, based on the elevations where we encountered the top of the volcaniclastic rock, we anticipate the contact between the overlying basaltic andesite to be either relatively flat lying or up to approximately 5 to 6 degrees (approximately 10 percent) with a south to southeast dip direction.

4.3.3 Groundwater

Subsurface water seepage was encountered in test pit TP-1 at a depth of approximately 7.5 feet bgs, and in TP-52 at approximately 6.4 feet bgs. No other test pits encountered seepage during our explorations. Based on local well logs that are primarily screened in the basaltic andesite and volcaniclastic breccia, we anticipate regional groundwater levels to be approximately 50 to 100 feet bgs at the site. We anticipate shallowly infiltrating precipitation and surface runoff can become perched within the upper soils at the site during the wetter months of the year and may approach the ground surface during periods of heavy rain.

4.3.4 Limitations

The subsurface information used for this study represents conditions at discrete locations within the project site. Actual conditions in other areas could vary. The nature and extent of any variations in subsurface conditions may not become evident until construction begins. If significant variations are observed at that time, we may need to modify our conclusions and recommendations accordingly to reflect actual site conditions.

7.4 Retaining Structures

In addition to the wall systems discussed in the Geotechnical Report , we understand that gabion baskets/cribbing may be used as facing for MSE walls. In this case, the design recommendations from *Section 7.4.2 MSE Wall Design Parameters* of the Geotechnical Report remain valid.

Gabion facing should meet the specifications provided in Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction (WSS) WSS 8-24.3(3) – Gabion Cribbing and be filled with stone meeting the specifications provided in WSS 9-27.3(6) - Stone or alternative materials as discussed below in *Gabion Fill and Construction.*

8.0 Earthwork Recommendations

The following presents supplemental recommendations in addition to those described in *Section 8.0* of the Geotechnical Report.

8.3.1 Rock Excavations and Cuts

In addition to the general earthwork and excavation recommendations provided in *Sections 8.0* and *8.3* of the Geotechnical Report, the following specific considerations may be necessary for excavations and cuts into bedrock. We note that the two bedrock materials encountered at the site, basaltic andesite, that are pervasive throughout most of the site and volcaniclastic sedimentary rock that is in the southern and far northern portion of the site will behave very differently from one another. The basaltic andesite will typical be represented by a hard basalt bedrock; whereas, the volcaniclastic sedimentary rock will act more like a stiff soil. The following discussion primarily relates to the basaltic andesite, except where specifically noted.

8.3.1.1 Rock Excavation

The basaltic andesite bedrock is hard and expected to be very difficult to excavate. During excavation of test pits TP-43 to TP-114 with a relatively large excavator (roughly 45,000-pound Komatsu PC-200), the excavator could only rip 0.5 to 2 feet into the rock. We anticipate the rock will not be easily excavated beyond this upper surface, and that large dozers with rippers, rock hammers and blasting will be required to excavate the rock below those depths.

The volcaniclastic rocks are generally very weak and are expected to be minimally to moderately difficult to excavate. During excavation of test pits TP-1a to TP-9a with a medium-sized, steel-track excavator, the excavator encountered refusal at some, but not all, of the test pit sites after ripping approximately 0.5 to 3 feet into the rock. However, minimal effort was required in other test pits. We anticipate that in some locations, large dozers with rippers may be required to excavate this unit below several feet.

8.3.1.2 Permanent Rock Cuts

Based on our understanding of the subsurface conditions and review of the preliminary grading plans, which shows cuts at a 2 horizontal to 1 vertical (2H:1V) inclination, proposed permanent cuts into bedrock at that inclination will be globally stable and will be suitable for construction according to the proposed plans and the recommendations in this report. We also anticipate that steeper permanent cuts into basaltic andesite bedrock, up to near vertical, may be globally stable. However, steeper cuts should be evaluated on a case-by-case basis to verify their global stability, but also to evaluate local stability (e.g., rockfall hazard). Furthermore, non-geotechnical considerations, such as trip-and-fall hazards, maintenance access, etc. should also be evaluated by the project team in concert with Hart Crowser.

For planning purposes, it is reasonable to assume that from a geotechnical perspective permanent cuts up to 1H:1V are globally stable when excavated into basaltic andesite bedrock. However, permanent cuts into bedrock that are steeper than 2H:1V may locally expose areas of lower quality rock, which could require additional reinforcement, such as rock bolting, and should be evaluated on a case-by-case basis. Additionally, refer to *Section 8.3.1.4 Volcaniclastic Sedimentary Rock Excavations* for discussion regarding cuts in the southeast portion of the site (near Lots #149 to #153), where the basaltic andesite bedrock may not be encountered.

8.3.1.3 Temporary Rock Cuts

Temporary cuts into basaltic andesite bedrock that will be permanently buttressed by retaining walls (e.g., houses with daylight basements) are likely to be stable at inclinations ranging from 1H:1V to near vertical. However, the stability of such cuts should be evaluated on a case-by-case basis during construction.

For planning purposes, it is reasonable to assume that from a geotechnical perspective temporary cuts up to 1/2H:1V are globally stable when excavated into basaltic andesite bedrock.

8.3.1.4 Volcaniclastic Sedimentary Rock Excavations

If mass grading exposes the contact between the basaltic andesite and the underlying volcaniclastic rocks at an adverse (out of slope) orientation, then these cuts may have the potential for global instability and should be further evaluated by Hart Crowser. Based on our subsurface explorations and review of the most recent proposed grading plan (Figure 3), most of the project area is unlikely to encounter this condition; however, as outlined above in our addendum to *Section 4.3.2.4 Oligocene Volcaniclastic Sedimentary Rock*, we anticipate the contact between the basaltic andesite and the underlying volcaniclastic rocks to be either relatively flat lying or up to approximately 5 to 6 degrees (approximately 10 percent) with a south to southeast dip direction, which has the potential to create adverse orientations within large cut slopes.

Specifically, we anticipate the potential for cuts to expose this stratigraphic condition near the south to southeast portion of the project area near lots #149 to #153 in cuts proposed to be generally 5 to 10 feet, but up to approximately 13 feet tall. Based on our explorations, the stratigraphic contact between the two geologic units also has the potential to be exposed near the north end of the (approximately lot #38 and northward); however, if exposed, we do not anticipate an adverse orientation in this location.

For planning purposes, we recommend permanent cuts in this area be kept at a 2H:1V inclination.

8.4.1 On-Site Soils and Bedrock Spoils

8.4.1.1 On-Site Soils

In general, the overburden native materials in the project area consist of fine-grained materials. During periods of dry weather, the native soils may be used as fill, provided they are properly moisture conditioned and oversized materials (greater than 6 inches) are removed.

We note that the *in situ* moisture contents of the site soils (colluvium and residual soil) varied from approximately 20 to 42 percent. The Atterberg limits of these same materials indicated liquid limits of 43 to 49 and plastic limits of 23 to 34. Some of the natural moisture contents were near the liquid limits, which would indicate the soil was too wet to place as fill, as it would tend to pump and rut. Therefore, regardless of the weather it may be necessary to dry the site soils prior to placing as fill. Also, during periods of wet weather, it will likely be infeasible to use the native soil as a structural fill. The earthwork contractor should plan accordingly.

8.4.1.2 On-Site Soils and Bedrock Spoils

Bedrock spoils from excavations may be used as structural fill, provided they are processed/crushed to a gradation appropriate for their planned use, per the WSS. We note that depending upon usage some changes to the WSS gradational tolerances may potentially be feasible if the design of the project element is adjusted to account for any changes. For example, if crushed rock larger than typically allowed for MSE backfill is used, then increased geogrid reinforcement strength may be required to account for greater installation damage. These sorts of the design changes based on the actual material gradations produced in the field will need to be evaluated on a case-by-case basis.

For use as general fill, bedrock materials should generally be processed to a well-graded crushed material with nominal sizes between 1 and 6 inches, and/or meeting the gradations of the materials described in S*ection 8.4.2 Imported Select Structural Fill* of the Geotechnical Report.

8.4.8 Gabion Fill and Construction

Gabion baskets for MSE wall facings should be constructed to meet the specifications of WSS 8-24.3(3) – Gabion Cribbing and should be filled with stone with a degradation factor of at least 30, a minimum fracture percentage of 75 percent and meet the gradation specifications provided in WSS 9-27.3(6) – Stone. The material should have nominal sizes between 4 and 8 inches. Additionally, the gabion baskets should be filled in lifts not exceeding 14 inches thick and following the general recommendations of *Section 8.5 Fill Placement and Compaction* of our original report. The unit weight of the filled gabion baskets must be at least 100 pounds per cubic foot (pcf) as described in WSS 8-24.3(3)F.

Other gradations of gabion rock may be acceptable provided that they meet the minimum unit weight noted above and are approved by our office. Special measures, such as separation fabrics, may be required to prevent the migration of fines, and sand- and gravel-sized particle.

Limitations

We have prepared this addendum for the exclusive use of CJ Dens Lacamas I, LLC and their authorized agents for the CJ Dens East Subdivision in Camas, Washington. This memorandum is intended to summarize our updated geotechnical findings and recommendations for the proposed subdivision based on additional explorations and analysis following our original report. However, conditions can vary between exploration locations and our conclusions should not be construed as a warranty or guarantee of subsurface conditions.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this memorandum was prepared. No warranty, express or implied, should be understood.

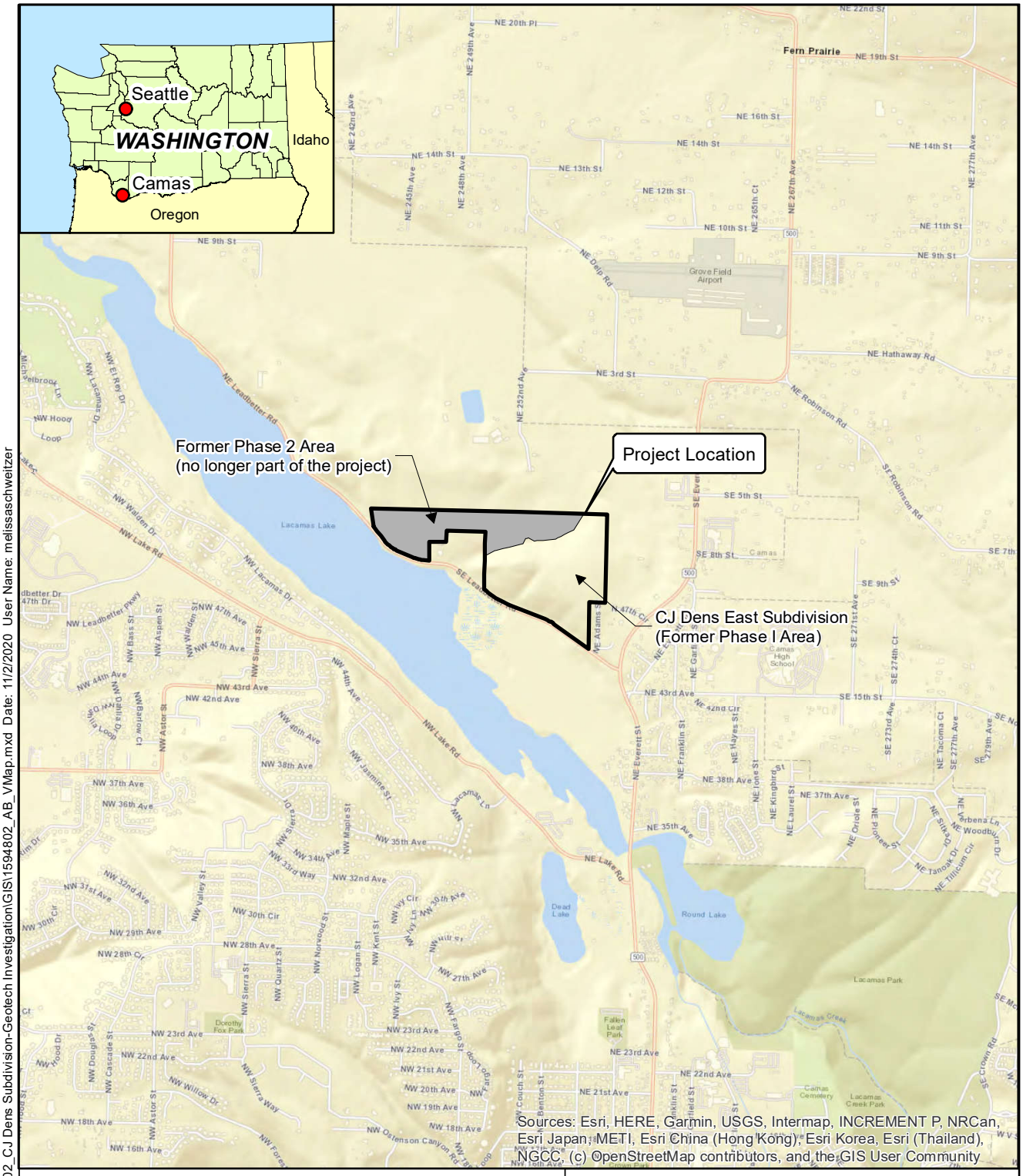
Any electronic form, facsimile, or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by Hart Crowser and will serve as the official document of record.

Attachments:
Figure 1 – Vicinity Map
Figure 2 – Existing Site Plan
Figure 3 – Proposed Site Plan
Figure 4 – Depth to Rock
Figure 5 – Generalized Subsurface Conditions Cross Section A-A’
Figure 6 – Generalized Subsurface Conditions Cross Section B-B’
Figure 7 – Generalized Subsurface Conditions Cross Section C-C’
Figure 8 – Typical Cut and Fill Slope Cross Section
Attachment A-1 – 2015 Field Explorations
Attachment A-2 – 2016 and later Field Explorations

References

Evarts, R.C. and J.E. O'Connor 2008. Geologic map of the Camas quadrangle, Clark County, Washington, and Multnomah County, Oregon: U.S. Geological Survey Scientific Investigations Map 3017, 31 p., 1:24,000 scale.

Washington State Department of Transportation (WSDOT) 2020. *Standard Specifications for Road, Bridge, and Municipal Construction*, Publication M 41-10.



0 1,000 2,000 4,000 Feet

N

CJ Dens East Subdivision
Camas, Washington

Vicinity Map

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Figure
1

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LEGEND
Test Pit (October 2017)
Test Pit (May 2016)
Test Pit (November 2015)
Phase 2 Hand Auger Boring
Phase 2 Test Pit
Cross Section
Former Phase II Area (No Longer Included in Project)
Bedrock Outcrop and Talus
Existing Contour
0 150 300 600 Feet
N
Note: Feature locations are approximate.
Source: Aerial photograph provided by Hexagon Imagery Program Data.
Lacamas Lake
CJ Dens East Subdivision
Camas, Washington
Existing Site Plan
11/20
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Figure
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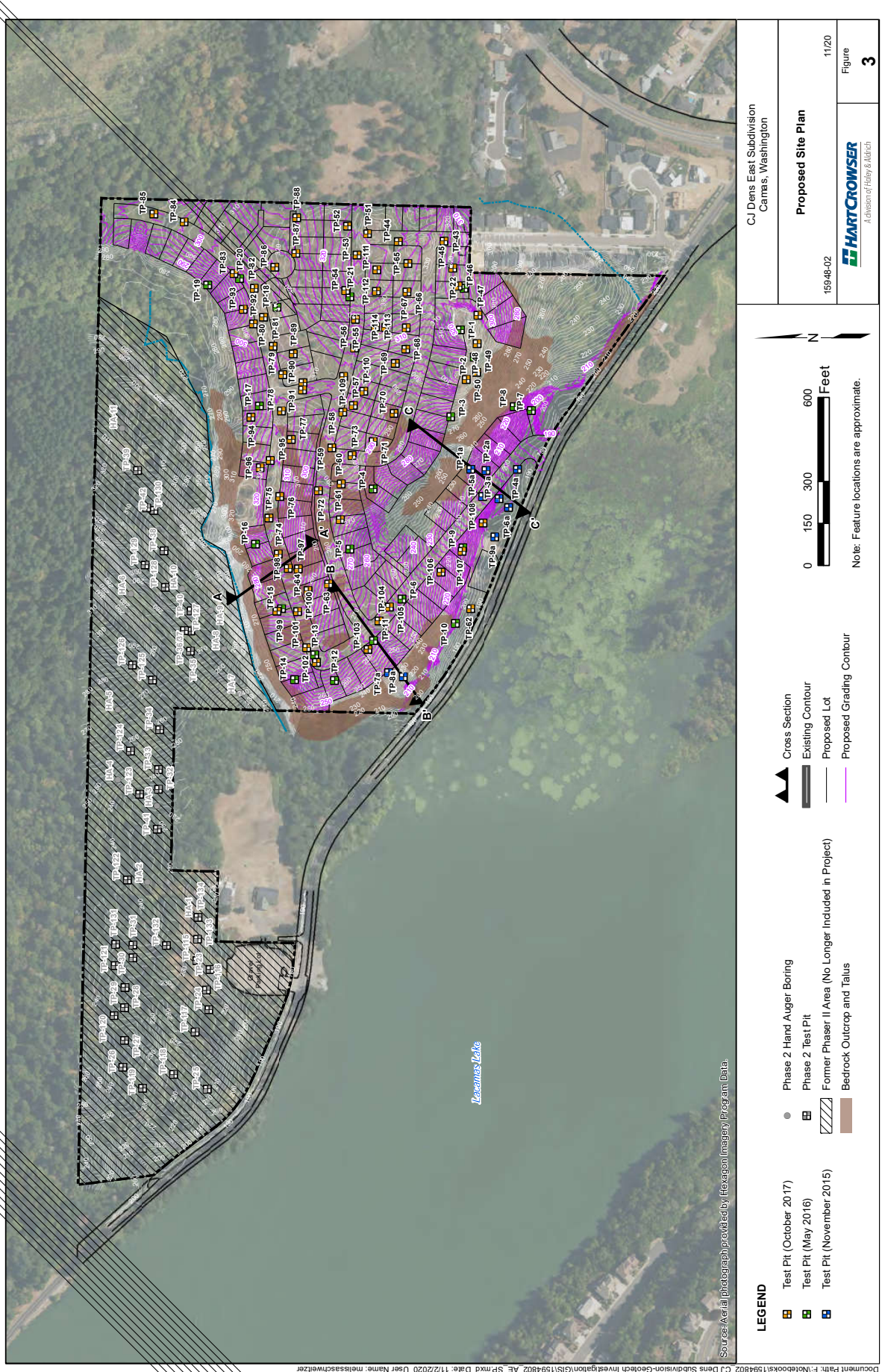
LEGEND
Test Pit (October 2017)
Test Pit (May 2016)
Test Pit (November 2015)
Phase 2 Hand Auger Boring
Phase 2 Test Pit
Former Phaser II Area (No Longer Included in Project)
Bedrock Outcrop and Talus
Cross Section
Existing Contour
Proposed Lot
Proposed Grading Contour
0 150 300 600 Feet
N
Note: Feature locations are approximate.
Source: Aerial photograph provided by Hexagon Imagery Program Data.
Lacamas Lake
CJ Dens East Subdivision
Camas, Washington
Proposed Site Plan
11/20
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Figure
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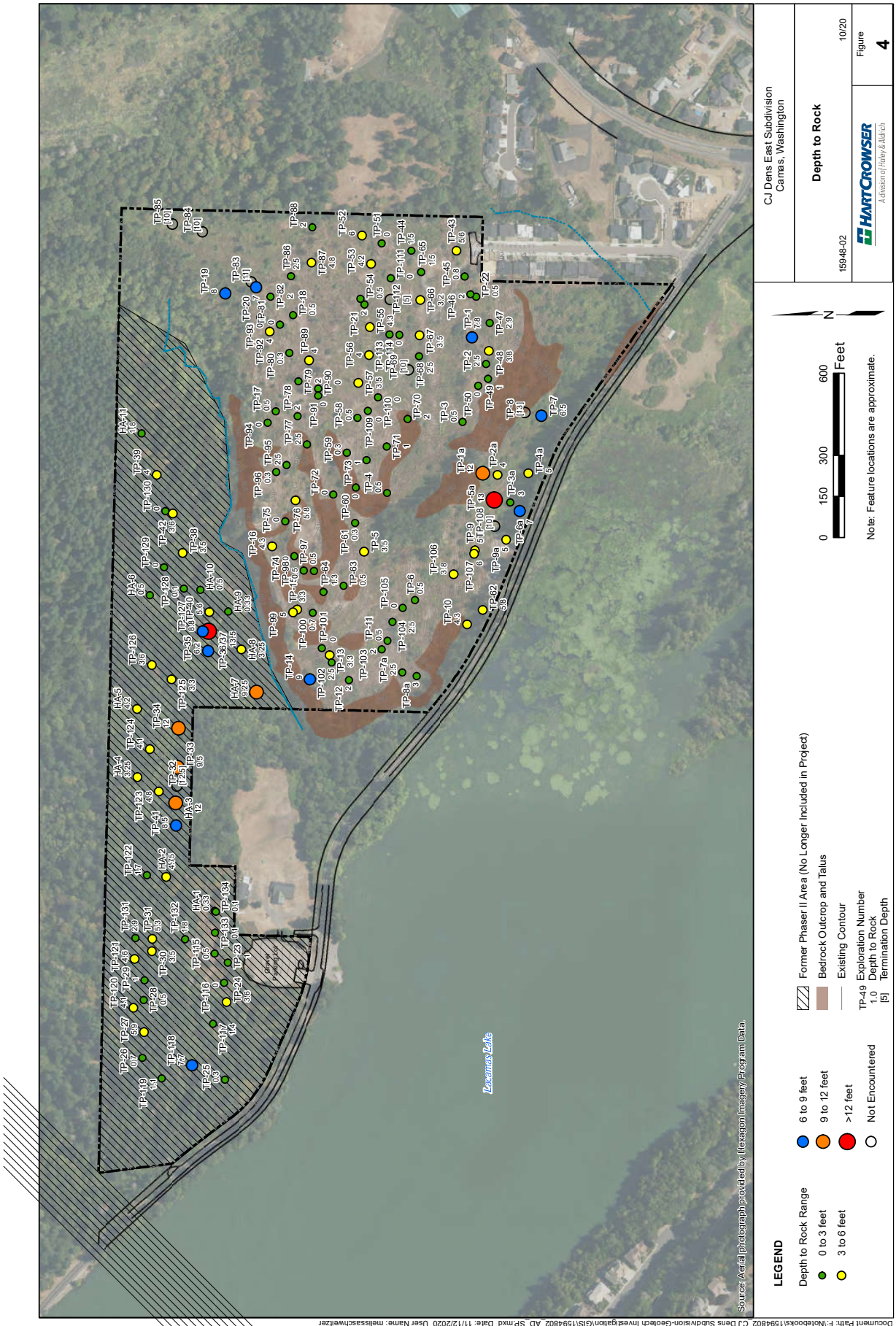
LEGEND
Depth to Rock Range
0 to 3 feet
3 to 6 feet
6 to 9 feet
9 to 12 feet
>12 feet
Not Encountered
Former Phaser II Area (No Longer Included in Project)
Bedrock Outcrop and Talus
Existing Contour
TP-49 Exploration Number
1.0 Depth to Rock
[5] Termination Depth
Lacamas Lake
Source: Aerial photograph provided by Hexagon Imagery Program Data.
0 150 300 600 Feet
N
Note: Feature locations are approximate.
CJ Dens East Subdivision
Camas, Washington
Depth to Rock
15948-02
10/20
HARTCROWSER
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Figure
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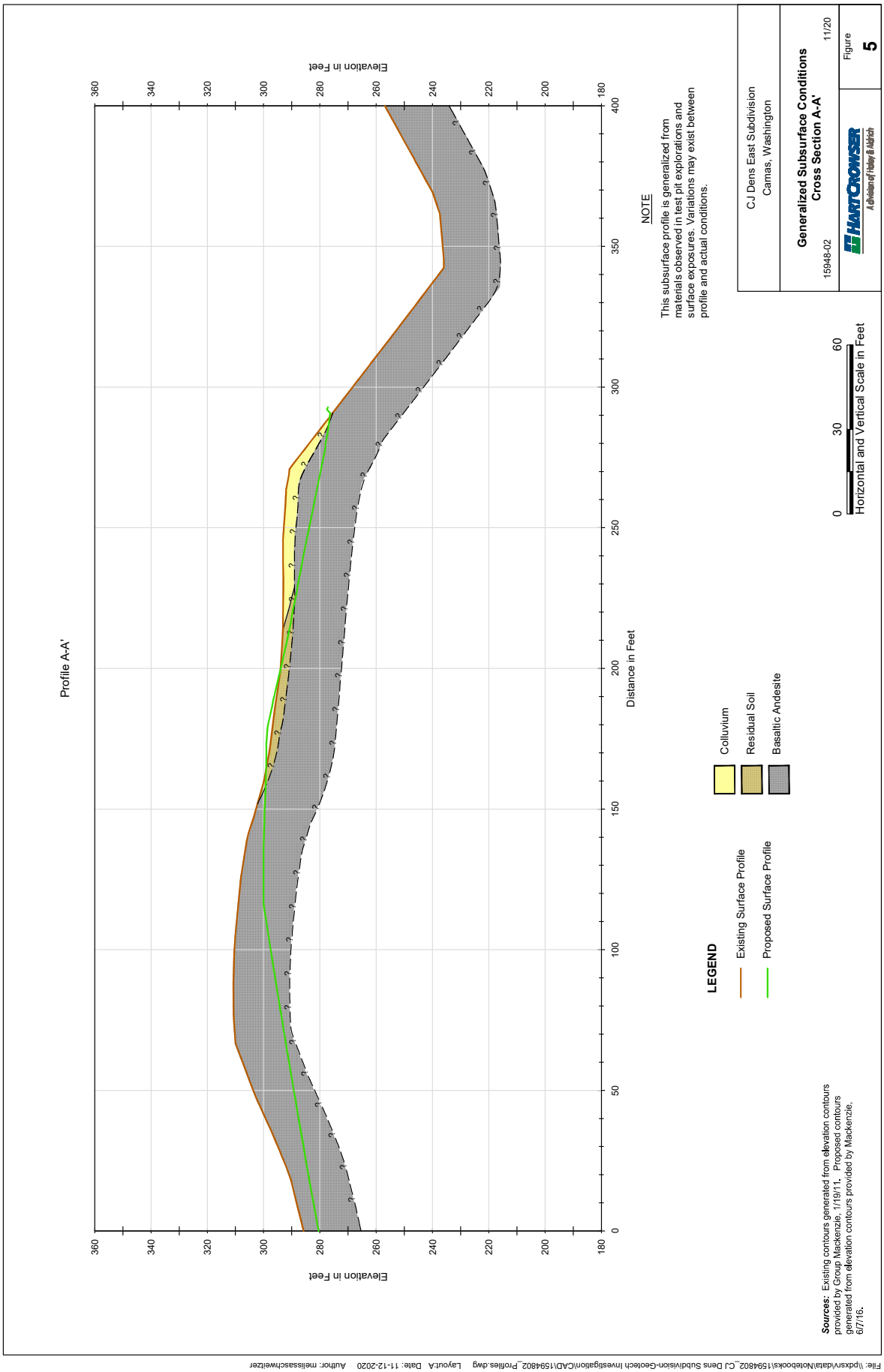
Profile A-A'
Elevation in Feet
Distance in Feet
LEGEND
Existing Surface Profile
Proposed Surface Profile
Colluvium
Residual Soil
Basaltic Andesite
NOTE
This subsurface profile is generalized from materials observed in test pit explorations and surface exposures. Variations may exist between profile and actual conditions.
Horizontal and Vertical Scale in Feet
0
30
60
CJ Dens East Subdivision
Camas, Washington
Generalized Subsurface Conditions
Cross Section A-A'
15948-02
11/20
HartCrowser
Figure
5
Sources: Existing contours generated from elevation contours provided by Group Mackenzie, 1/19/11. Proposed contours generated from elevation contours provided by Mackenzie, 6/7/16.
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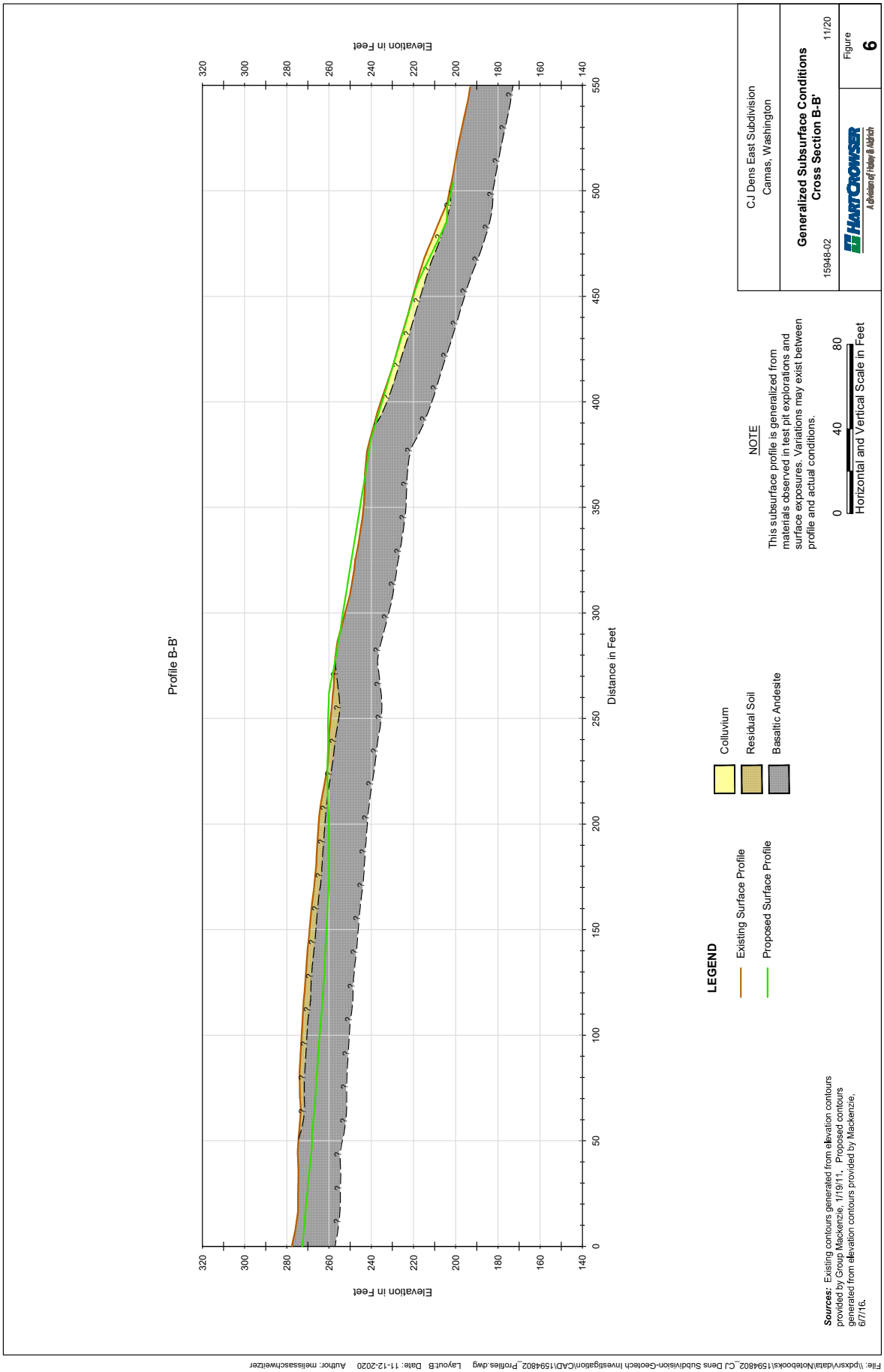
Profile B-B'
Elevation in Feet
Distance in Feet
LEGEND
Existing Surface Profile
Proposed Surface Profile
Colluvium
Residual Soil
Basaltic Andesite
NOTE
This subsurface profile is generalized from materials observed in test pit explorations and surface exposures. Variations may exist between profile and actual conditions.
0 40 80
Horizontal and Vertical Scale in Feet
CJ Dens East Subdivision
Camas, Washington
Generalized Subsurface Conditions
Cross Section B-B'
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Figure
6
Sources: Existing contours generated from elevation contours provided by Group Mackenzie, 1/19/11. Proposed contours generated from elevation contours provided by Mackenzie, 6/7/16.
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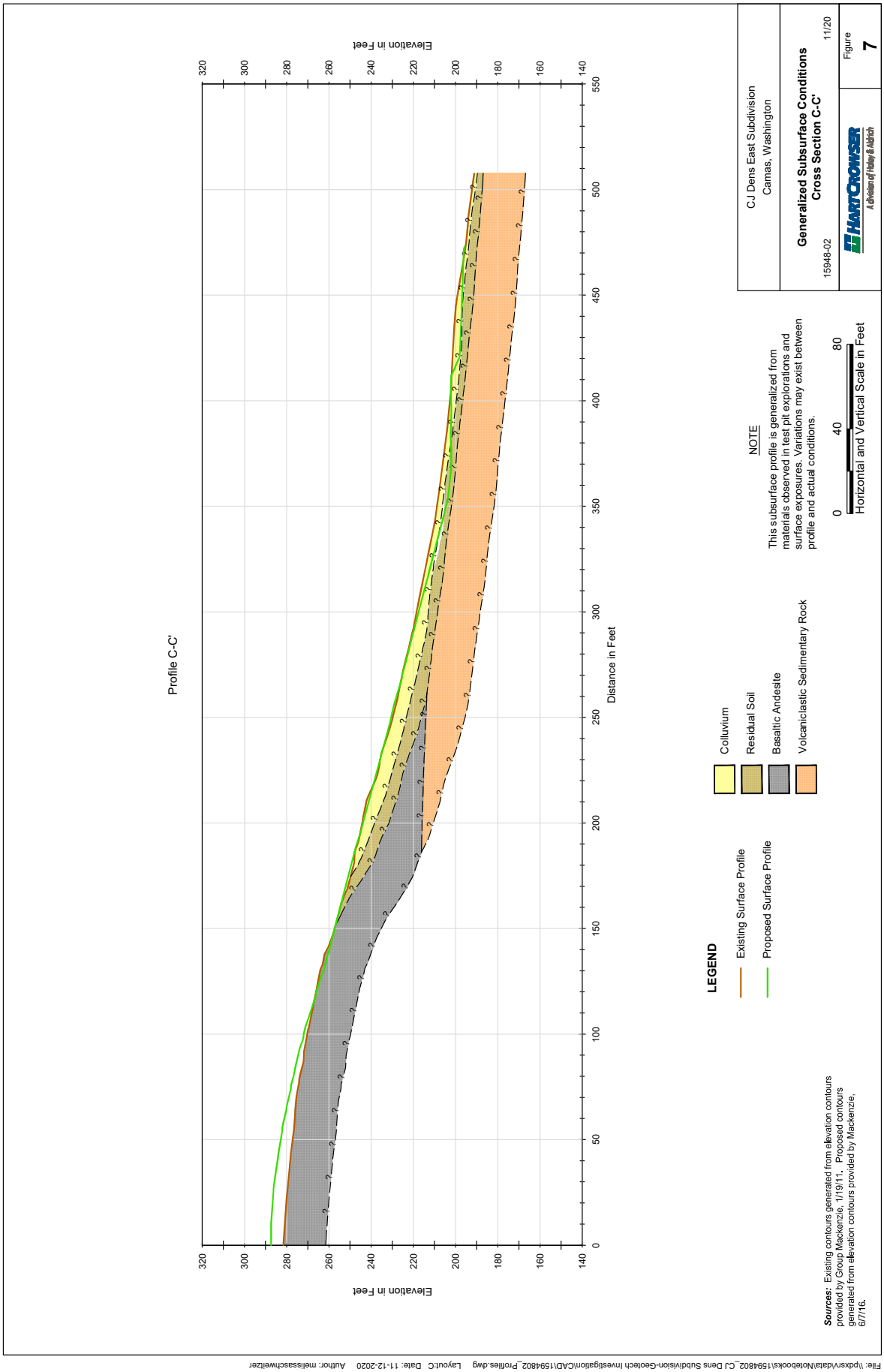
Profile C-C'
Elevation in Feet
Distance in Feet
LEGEND
Existing Surface Profile
Proposed Surface Profile
Colluvium
Residual Soil
Basaltic Andesite
Volcaniclastic Sedimentary Rock
NOTE
This subsurface profile is generalized from materials observed in test pit explorations and surface exposures. Variations may exist between profile and actual conditions.
0
40
80
Horizontal and Vertical Scale in Feet
CJ Dens East Subdivision
Camas, Washington
Generalized Subsurface Conditions
Cross Section C-C'
15948-02
11/20
HartCrowser
Figure
7
Sources: Existing contours generated from elevation contours provided by Group Mackenzie, 1/19/11. Proposed contours generated from elevation contours provided by Mackenzie, 6/7/16.
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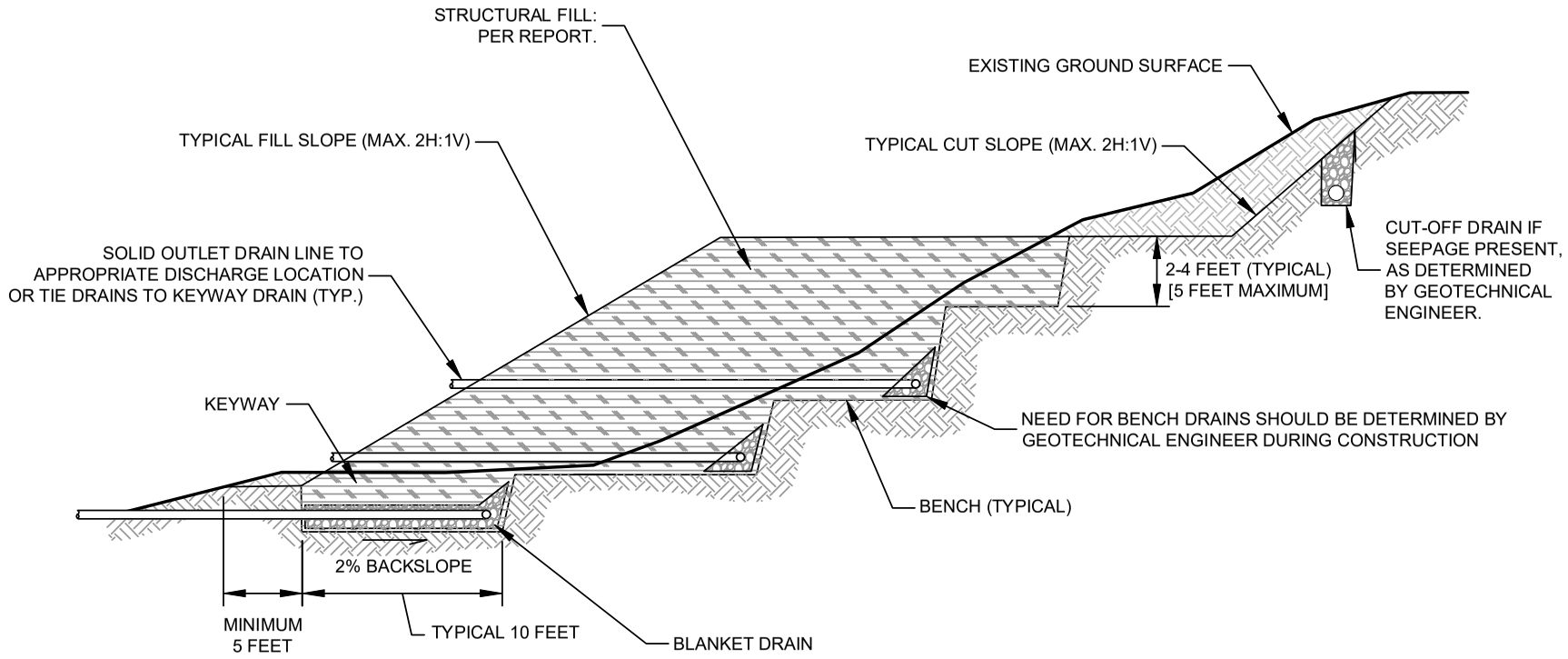
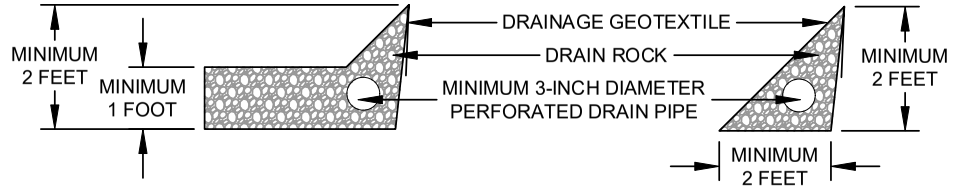


NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE SCHEMATIC.
3. DRAWING REPRESENTS TYPICAL FILL AND CUT SLOPE SECTION, AND IS NOT SITE-SPECIFIC.

TYPICAL DRAIN SECTION DETAIL



CJ Dens East Subdivision
Camas, Washington

Typical Cut and Fill Slope Cross-Section

15948-02 11/20

HARTCROWSER
A division of Haley & Aldrich

Figure
8

ATTACHMENT A-1
2015 Field Explorations

KEY TO EXPLORATION LOGS

HARTCROWSER

SOIL CLASSIFICATION CHART

MATERIAL TYPES	MAJOR DIVISIONS		GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	GW	WELL-GRADED GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES, >12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	SW	WELL-GRADED SAND
			SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	CL	LEAN CLAY
			ML	SILT
		ORGANIC	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	CH	FAT CLAY
			MH	ELASTIC SILT
		ORGANIC	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS			PT	PEAT

Note: Multiple symbols are used to indicate borderline or dual classifications

OTHER MATERIAL SYMBOLS

- Concrete
- Asphalt
- Topsoil

MOISTURE MODIFIERS

- Dry - Absence of moisture, dusty, dry to the touch
- Moist - Damp, but no visible water
- Wet - Visible free water or saturated, usually soil is obtained from below the water table

SEEPAGE MODIFIERS

- None -
- Slow - < 1 gpm
- Moderate - 1-3 gpm
- Heavy - > 3 gpm

CAVING MODIFIERS

- None -
- Minor - isolated
- Moderate - frequent
- Severe - general

MINOR CONSTITUENTS

- Trace - < 5% (silt/clay)
- Occasional - < 15% (sand/gravel)
- With - 5-15% (silt/clay) in sand or gravel
  15-30% (sand/gravel) in silt or clay

SAMPLE TYPES

- Dames & Moore
- Standard Penetration Test (SPT)
- Shelby Tube
- Bulk or Grab

LABORATORY/ FIELD TESTS

- ATT - Atterberg Limits
- CP - Laboratory Compaction Test
- CA - Chemical Analysis (Corrosivity)
- CN - Consolidation
- DD - Dry Density
- DS - Direct Shear
- HA - Hydrometer Analysis
- OC - Organic Content
- PP - Pocket Penetrometer (TSF)
- P200 - Percent Passing No. 200 Sieve
- SA - Sieve Analysis
- SW - Swell Test
- TV - Torvane Shear
- UC - Unconfined Compression

GROUNDWATER SYMBOLS

- Water Level (at time of drilling)
- Water Level (at end of drilling)
- Water Level (after drilling)

STRATIGRAPHIC CONTACT

- Distinct contact between soil strata or geologic units
- Gradual or approximate change between soil strata or geologic units

Notes:

Blowcount (N) is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted) per ASTM D-1586. See exploration log for hammer weight and drop.

When the Dames & Moore (D&M) sampler was driven with a 140-pound hammer (denoted on logs as D+M 140), the field blow counts (N-value) shown on the logs have been reduced by 50% to approximate SPT N-values.

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

Refer to the report text and exploration logs for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the exploration locations at the time the explorations were made. The logs are not warranted to be representative of the subsurface conditoins at other locations or times.

KEY TO EXPLORATION LOGS - F:\GINT\OREGON_LIBRARY.GLB - 6/15/16 15:48 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS.GPJ

Figure A-1

KEY TO BEDROCK TERMS (1 of 2)
(WSDOT, 2014)

HARTCROWSER
8910 SW Gemini Drive
Beaverton, Oregon 97008

Weathered State of Rock

Term	Description	Grade
Fresh	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering, and may be somewhat weaker externally than in its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength
R0	Extremely Weak	Indented by thumbnail.	0.04 to 0.15 ksi
R1	Very Weak	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	0.15 to 3.6 ksi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3.6 to 7.3 ksi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	7.3 to 15 ksi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15 to 29 ksi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 29 ksi

Discontinuities

Discontinuity Spacing		Discontinuity Condition	
Description	**Spacing**	**Condition**	**Description**
Very Widely Spaced	Greater than 10 feet.	Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall.
Widely Spaced	3 to 10 feet.	Good Condition	Slightly rough surfaces, separation less than 0.05 inches, hard discontinuity wall.
Moderately Spaced	1 to 3 feet.	Fair Condition	Slightly rough surface, separation greater than 0.05 inches, soft discontinuity wall.
Closely Spaced	2 to 12 inches	Poor Condition	Slickensided surfaces, or soft gouge less than 0.2 inches thick, or open discontinuities 0.05 to 0.2 inches.
Very Closely Spaced	Less than 2 inches	Very Poor Condition	Soft gouge greater than 0.2 inches, or open discontinuities greater than 0.2 inches.

Figure A-2

KEY TO BEDROCK TERMS (2 of 2)
(WSDOT, 2014)

HARTCROWSER
8910 SW Gemini Drive
Beaverton, Oregon 97008

Grain Size

Grain Size	Description	Criteria
Less than 0.04 inches	Fine grained	Few crystal boundaries/ grains distinguishable in the field or with a hand lens.
0.04 to 0.2 inches	Medium grained	Most crystal boundaries/ grains distinguishable with the aid of a hand lens.
Greater than 0.2 inches	Coarse grained	Most crystal boundaries/ grains distinguishable with the naked eye.

Igneous Rock Textures

Texture	Grain Size
Pegmatitic	Very large; diameters greater than 0.8 in.
Phaneritic	Can be seen with the naked eye
Porphyritic	Grained of two widely different sizes
Aphanitic	Cannot be seen with the naked eye
Glassy	No grains present

Pyroclastic Rocks

Rock Name	Characteristics
Pyroclastic Breccia	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which *angular* pyroclasts predominate.
Agglomerate	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which *rounded* pyroclasts predominate.
Lapilli Tuff	Pyroclastic rock whose average pyroclast size is 0.08 to 2.5 inches.
Ash Tuff	Pyroclastic rock whose average pyroclast size is less than 0.08 inches.

Degree of Vesicularity

Designation	Percentage of Cavities (by volume) of Total Sample
Slightly Vesicular	5 to 10 Percent
Moderately Vesicular	10 to 25 Percent
Highly Vesicular	25 to 50 Percent
Scoriaceous	Greater than 50 Percent

OTHER TERMS:

Core Recover (CR) = the ratio of core recovered to the core run length expressed as a percentage.

Rock Quality Designation (RQD) = the percentage of rock core recovered in intact pieces of 4 inches or more in length in the length of a core run. Does not include mechanical breaks caused by drilling.

Fracture Frequency (FF) = the number of natural fractures per foot in the length of core recovered.

REFERENCE:

Washington State Department of Transportation (WSDOT), 2014. *Geotechnical Design Manual*, Publication M 46-03.02, August, 2014.

Figure A-2

Test Pit Log TP-1a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil	0				
ML		(Soft), moist, brown to dark brown, sandy SILT, roots. (Colluvium/Disturbed Soil)		S-1			
MH		(Soft), moist, brown, ELASTIC SILT, some roots, disturbed texture.	5	S-2			
SM		(Loose), moist, brown, silty SAND with occasional gravel-sized clasts of subangular to subrounded volcaniclastic fragments, relict rock texture. (Residual Soil)	10				
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-3			
		Bottom of Test Pit at 15.0 Feet. Started 11/23/15. Completed 11/23/15. Completed due to refusal.	15				

Test Pit Log TP-2a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil, roots.	0				
SM		(Medium dense), moist, gray to brown, silty SAND with weathered gravel-sized subangular volcaniclastic fragments. (Colluvium/Disturbed Soil)		S-1			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)	5	S-2			
		Bottom of Test Pit at 6.5 Feet. Started 11/23/15. Completed 11/23/15.	10				
			15				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

15948-02 12/15

Figure A-3

Test Pit Log TP-3a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil, roots.	0				
ML		(Stiff), moist, brown, SILT with sand, disturbed texture. (Colluvium/Disturbed Soil)		S-1			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)	5	S-2			
		Bottom of Test Pit at 5.5 Feet. Started 11/23/15. Completed 11/23/15.	10				
			15				

Test Pit Log TP-4a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil	0				
ML		(Stiff), moist, brown, SILT with sand, roots, disturbed texture. (Colluvium/Disturbed Soil)		S-1			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)	5	S-2			
		Bottom of Test Pit at 6.5 Feet. Started 11/23/15. Completed 11/23/15.	10				
			15				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

15948-02 12/15

Figure A-4

Test Pit Log TP-5a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil, roots, dark brown.	0				
SM		(Loose), moist, brown to dark brown, silty SAND, roots, weathered residual soil fragments in fine-grained matrix. (Colluvium/Disturbed Soil)					
CL		(Medium stiff), moist, brown, LEAN CLAY with sand.		S-1			
			5				
SM		(Loose), moist, brown, silty SAND with hard gravel-sized clasts of subangular to subrounded volcaniclastic fragments, relict rock texture. (Residual Soil)		S-2			
			10				
				S-3			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-4			
		Bottom of Test Pit at 13.5 Feet.	15				
		Started 11/23/15.					
		Completed 11/23/15.					
		Completed due to refusal.					

Test Pit Log TP-6a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM/ML		(Loose to medium stiff), dark brown, moist, silty SAND to sandy SILT, roots.	0				
ML		(Medium stiff), moist, brown, SILT with sand, small roots, disturbed texture. (Colluvium/Disturbed Soil)					
		Abundant roots and rootlets from 3.0 to 4.0 feet.		S-1			
SM		(Medium dense to dense), moist, light brown to brown, silty SAND, relict rock texture. (Residual Soil)	5				
				S-2			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-3			
		Bottom of Test Pit at 9.5 Feet.	10				
		Started 11/23/15.					
		Completed 11/23/15.					
		Completed due to refusal.					
			15				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

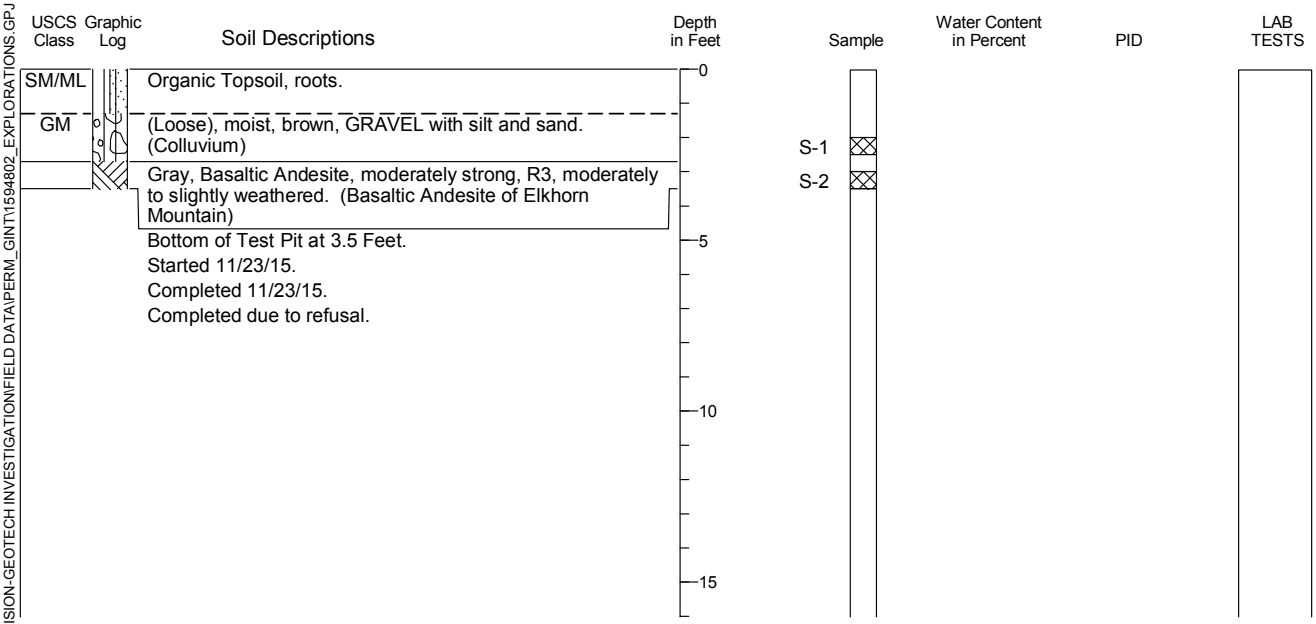
15948-02 12/15

Figure A-5

Test Pit Log TP-7a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

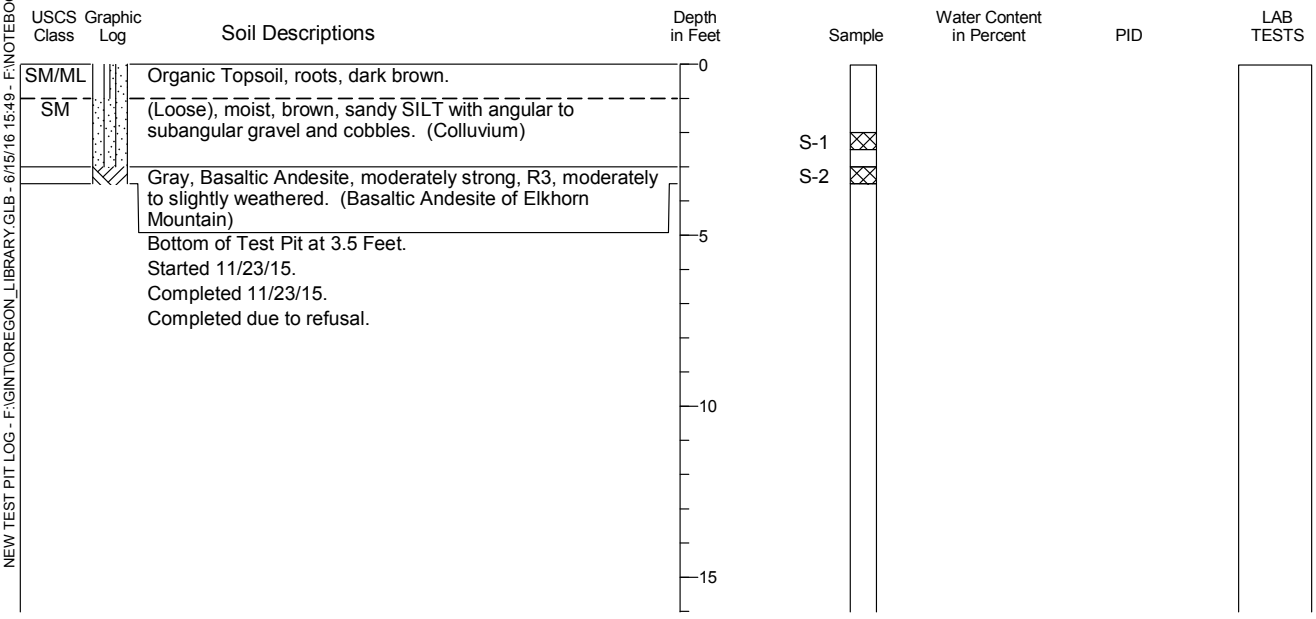
Horizontal Datum: N/A
Vertical Datum: N/A



Test Pit Log TP-8a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

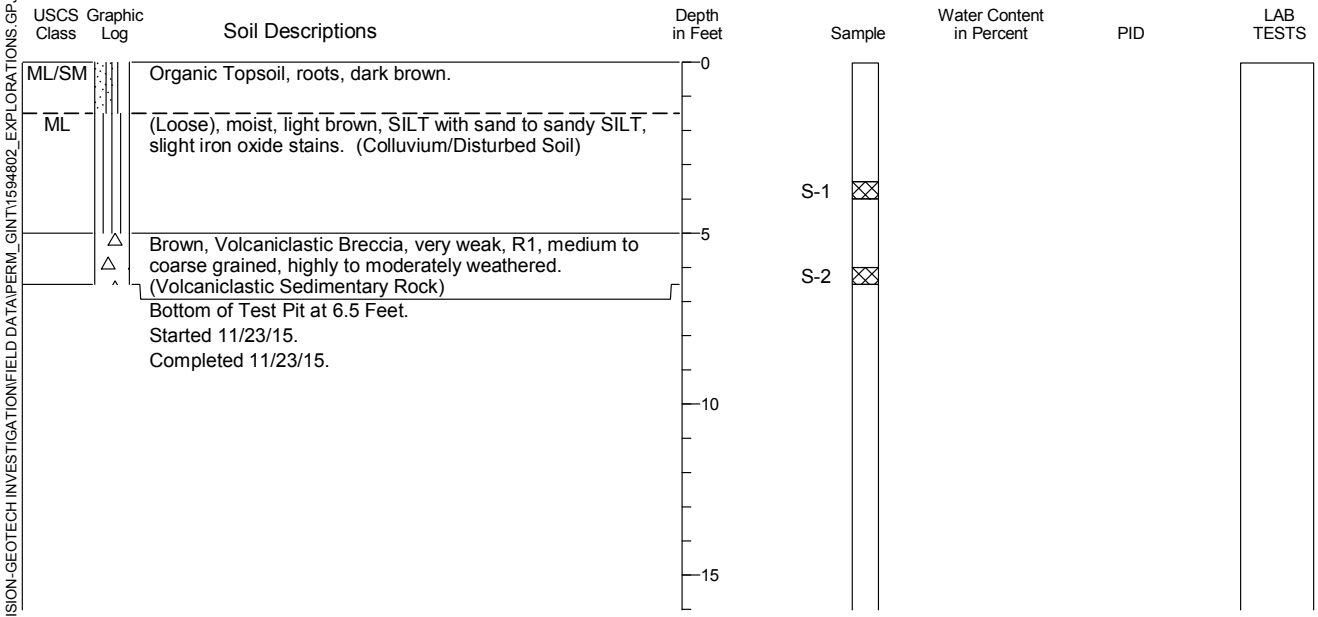
15948-02 12/15

Figure A-6

Test Pit Log TP-9a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



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1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

15948-02 *12/15*

Figure A-7

ATTACHMENT A-2
2016 and later Field Explorations

Sample Description

Identification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. ASTM D 2488 visual-manual identification methods were used as a guide. Where laboratory testing confirmed visual-manual identifications, then ASTM D 2487 was used to classify the soils.

Relative Density/Consistency

Soil density/consistency in borings is related primarily to the standard penetration resistance (N). Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Relative Density	N (Blows/Foot)	SILT or CLAY Consistency	N (Blows/Foot)
Very loose	0 to 4	Very soft	0 to 1
Loose	5 to 10	Soft	2 to 4
Medium dense	11 to 30	Medium stiff	5 to 8
Dense	31 to 50	Stiff	9 to 15
Very dense	>50	Very stiff	16 to 30
		Hard	>30

Moisture

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

USCS Soil Classification Chart (ASTM D 2487)

Major Divisions			Symbols Graph	Symbols USCS	Typical Descriptions
Coarse Grained Soils: More than 50% of Material Retained on No. 200 Sieve	Gravel and Gravelly Soils: More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels (<5% fines)		GW	Well-Graded Gravel; Well-Graded Gravel with Sand
				GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Gravels (5-12% fines)		GW-GM	Well-Graded Gravel with Silt; Well-Graded Gravel with Silt and Sand
				GW-GC	Well-Graded Gravel with Clay; Well-Graded Gravel with Clay and Sand
				GP-GM	Poorly Graded Gravel with Silt; Poorly Graded Gravel with Silt and Sand
				GP-GC	Poorly Graded Gravel with Clay; Poorly Graded Gravel with Clay and Sand
		Gravels with Fines (>12% fines)		GM	Silty Gravel; Silty Gravel with Sand
				GC	Clayey Gravel; Clayey Gravel with Sand
	Sand and Sandy Soils: More than 50% of Coarse Fraction Passing No. 4 Sieve	Sands with few Fines (<5% fines)		SW	Well-Graded Sand; Well-Graded Sand with Gravel
				SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Sands (5-12% fines)		SW-SM	Well-Graded Sand with Silt Well-Graded Sand with Silt and Gravel
				SW-SC	Well-Graded Sand with Clay; Well-Graded Sand with Clay and Gravel
				SP-SM	Poorly Graded Sand with Silt; Poorly Graded Sand with Silt and Gravel
				SP-SC	Poorly Graded Sand with Clay; Poorly Graded Sand with Clay and Gravel
		Sands with Fines (>12% fines)		SM	Silty Sand; Silty Sand with Gravel
				SC	Clayey Sand; Clayey Sand with Gravel
Fine Grained Soils: More than 50% of Material Passing No. 200 Sieve	Silts			ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
				MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
	Silty Clay (based on Atterberg Limits)			CL-ML	Silty Clay; Silty Clay with Sand or Gravel; Gravelly or Sandy Silty Clay
	Clays			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
				CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
	Organics			OL/OH	Organic Soil; Organic Soil with Sand or Gravel; Sandy or Gravelly Organic Soil
Highly Organic (>50% organic material)				PT	Peat - Decomposing Vegetation - Fibrous to Amorphous Texture

Minor Constituents

	Estimated Percentage
Sand, Gravel	
Trace	<5
Few	5 - 15
Cobbles, Boulders	
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45

Soil Test Symbols

%F	Percent Passing No. 200 Sieve
AL	Atterberg Limits (%)
	Liquid Limit (LL)
	Water Content (WC)
	Plastic Limit (PL)
CA	Chemical Analysis
CAUC	Consolidated Anisotropic Undrained Compression
CAUE	Consolidated Anisotropic Undrained Extension
CBR	California Bearing Ratio
CIDC	Consolidated Drained Isotropic Triaxial Compression
CIUC	Consolidated Isotropic Undrained Compression
CK0DC	Consolidated Drained k0 Triaxial Compression
CK0DSS	Consolidated k0 Undrained Direct Simple Shear
CK0UC	Consolidated k0 Undrained Compression
CK0UE	Consolidated k0 Undrained Extension
CRSCN	Constant Rate of Strain Consolidation
DS	Direct Shear
DSS	Direct Simple Shear
DT	In Situ Density
GS	Grain Size Classification
HYD	Hydrometer
ILCN	Incremental Load Consolidation
K0CN	k0 Consolidation
kc	Constant Head Permeability
kf	Falling Head Permeability
MD	Moisture Density Relationship
OC	Organic Content
OT	Tests by Others
P	Pressuremeter
PID	Photoionization Detector Reading
PP	Pocket Penetrometer
SG	Specific Gravity
TRS	Torsional Ring Shear
TV	Torvane
UC	Unconfined Compression
UUC	Unconsolidated Undrained Triaxial Compression
VS	Vane Shear
WC	Water Content (%)

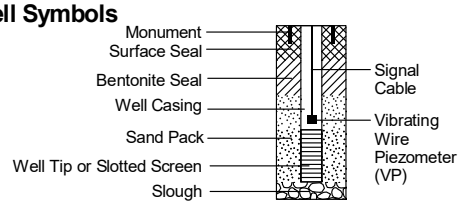
Groundwater Indicators

- Groundwater Level on Date or At Time of Drilling (ATD)
- Groundwater Level on Date Measured in Piezometer
- Groundwater Seepage (Test Pits)

Sample Symbols

- 1.5" I.D. Split Spoon
- 3.25" O.D. Split Spoon
- Modified California Sampler
- Rock Core Run
- Sonic Core
- Thin-walled Sampler
- Grab
- Cuttings
- Push Probe

Well Symbols



KEY TO EXP LOGS (SOIL ONLY) - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:32 - F:\NOTEBOOKS\1594802_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Key to Exploration Logs

Figure **A-8**
Sheet **1 of 1**

Weathered State of Rock

Term	Description	Grade
Fresh	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering, and may be somwhat weaker externally than in its fresh condition	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength
R0	Extremely Weak	Indented by thumbnail.	0.04 to 0.15 ksi
R1	Very Weak	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	0.15 to 3.6 ksi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3.6 to 7.3 ksi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	7.3 to 15 ksi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15 to 29 ksi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 29 ksi

Discontinuities

Discontinuity Spacing		Discontinuity Condition	
Description	**Spacing**	**Condition**	**Description**
Very Widely Spaced	Greater than 10 feet	Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall.
Widely Spaced	3 to 10 feet	Good Condition	Slightly rough surfaces, separation less than 0.05 inches, hard discontinuity wall.
Moderately Spaced	1 to 3 feet	Fair Condition	Slightly rough surface, separation greater than 0.05 inches, soft discontinuity wall.
Closely Spaced	2 to 12 inches	Poor Condition	Slickensided surfaces, or soft gouge less than 0.2 inches thick, or open discontinuities 0.05 to 0.2 inches.
Very Closely Spaced	Less than 2 inches	Very Poor Condition	Soft gouge greater than 0.2 inches, or open discontinuities greater than 0.2 inches.

Grain Size

Grain Size	Description	Criteria
Less than 0.04 inches	Fine grained	Few crystal boundaries/grains distinguishable in the field or with a hand lens.
0.04 to 0.2 inches	Medium grained	Most crystal boundaries/ grains distinguishable with the aid of a hand lens.
Greater than 0.2 inches	Coarse grained	Most crystal boundaries/ grains distinguishable with the naked eye.

Igneous Rock Textures

Texture	Grain Size
Pegmatitic	Very large; diameters greater than 0.8 in.
Phaneritic	Can be seen with the naked eye
Porphyritic	Grained of two widely different sizes
Aphanitic	Cannot be seen with the naked eye
Glassy	No grains present

Pyroclastic Rocks

Rock Name	Characteristics
Pyroclastic Breccia	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which angular pyroclasts predominate.
Agglomerate	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which rounded pyroclasts predominate.
Lapilli Tuff	Pyroclastic rock whose average pyroclast size is 0.08 to 2.5 inches.
Ash Tuff	Pyroclastic rock whose average pyroclast size is less than 0.08 inches.

Degree of Vesicularity

Designation	Percentage of Cavities (by volume) of Total Sample
Slightly Vesicular	5 to 10 Percent
Moderately Vesicular	10 to 25 Percent
Highly Vesicular	25 to 50 Percent
Scoriaceous	Greater than 50 Percent

Other Terms:

Core Recover (CR) = the ratio of core recovered to the core run length expressed as a percentage.

Rock Quality Designation (RQD) = the percentage of rock core recovered in intact pieces of 4 inches or more in length in the length of a core run. Does not include mechanical breaks caused by drilling.

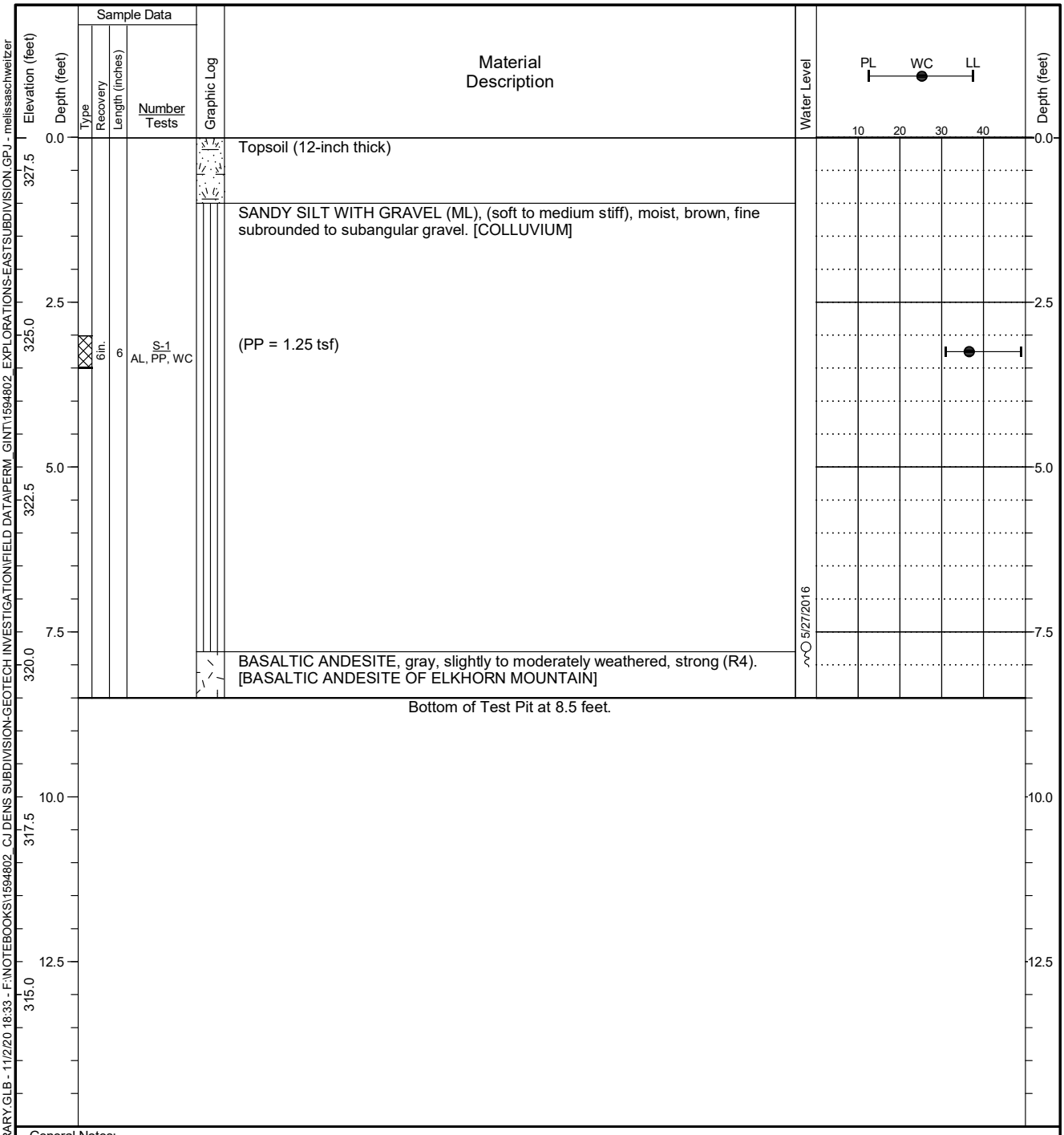
Fracture Frequency (FF) = the number of natural fractures per foot in the length of core recovered.

Reference:

Washington State Department of Transportation (WSDOT), 2014. *Geotechnical Design Manual*, Publication M 46-03.10, August, 2014.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	**Key to Exploration Logs**	Figure **A-8** Sheet **3 of 3**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614371 Long: -122.410712 (WGS 84) Total Depth: 8.5 feet Depth to Seepage: 7.8 feet
Ground Surface Elevation: 328 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-1

Figure **A-9**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614228 Long: -122.411086 (WGS 84) Total Depth: 2.8 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 306 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
305.0	0.0		SANDY SILT (ML), (soft), wet, brown, with angular gravel. [RESIDUAL SOIL]	0.0
302.5	2.5		BASALTIC ANDESITE, gray, slightly to moderately weathered, strong (R4). [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
			Bottom of Test Pit at 2.8 feet.	
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0			10.0
292.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-2

Figure **A-10**
Sheet **1 of 1**

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Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614445 Long: -122.411925 (WGS 84) Total Depth: 3 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 280 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description	WC (10 20 30 40)	Depth (feet)
280.0	0.0						Topsoil (6-inch thick)		0.0
							BASALTIC ANDESITE, gray, slightly to moderately weathered, strong (R4), closely spaced discontinuities, highly fractured from 0.5 to 1.0 feet. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]		
277.5	2.5	6in.	6		S-1 WC			●	2.5
							Bottom of Test Pit at 3.0 feet.		
275.0	5.0								5.0
272.5	7.5								7.5
270.0	10.0								10.0
267.5	12.5								12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-3

Figure **A-11**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615186 Long: -122.412964 (WGS 84) Total Depth: 2.6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 282 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
282.0	0.0		Topsoil (6-inch thick)	0.0
280.0	2.5		BASALTIC ANDESITE, gray, slightly to moderately weathered, strong (R4), moderately spaced discontinuities, highly fractured from 0.5 to 1.0 feet. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
			Bottom of Test Pit at 2.6 feet.	
277.5	5.0			5.0
275.0	7.5			7.5
272.5	10.0			10.0
270.0	12.5			12.5
267.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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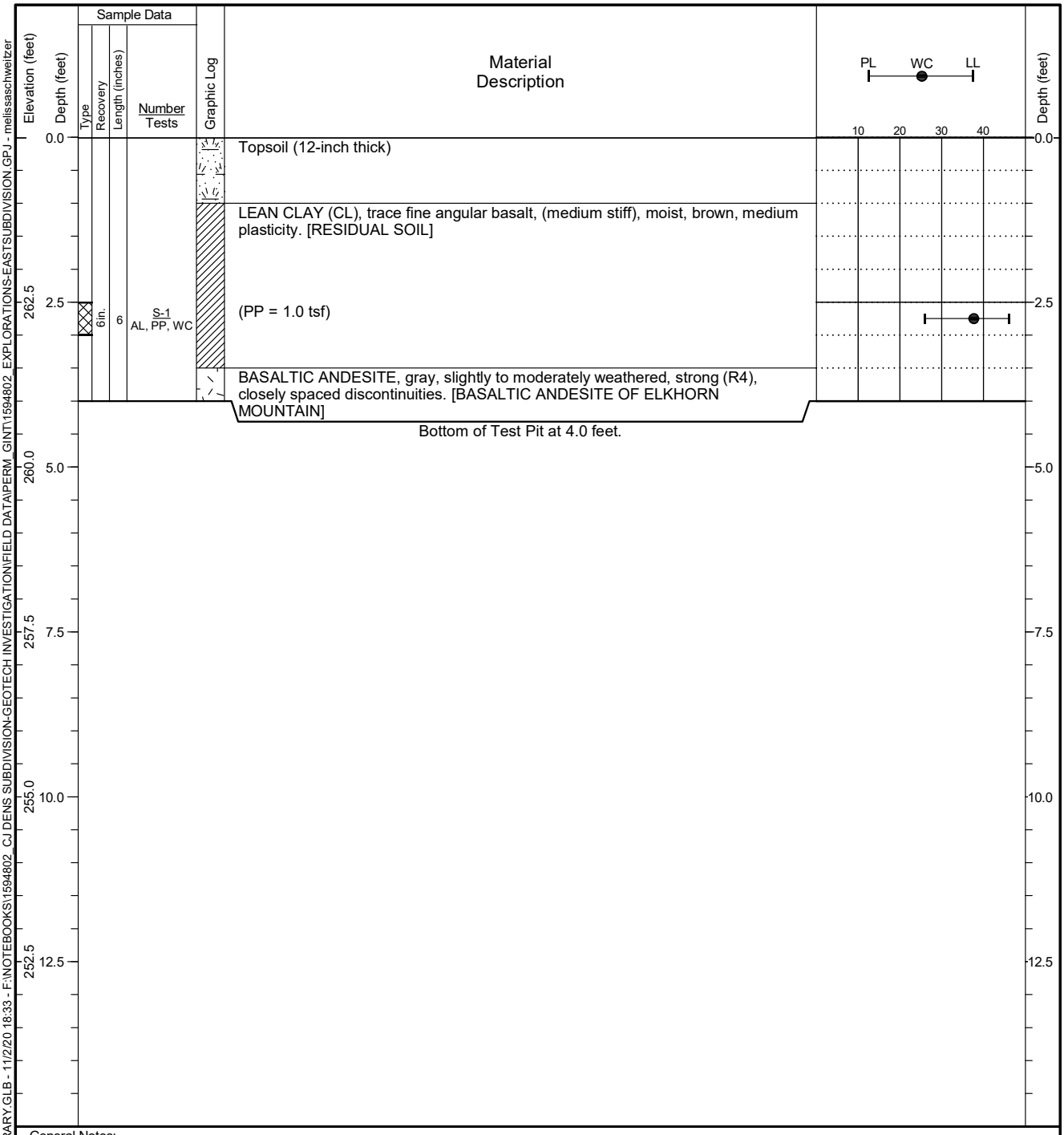
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-4

Figure **A-12**
Sheet **1 of 1**

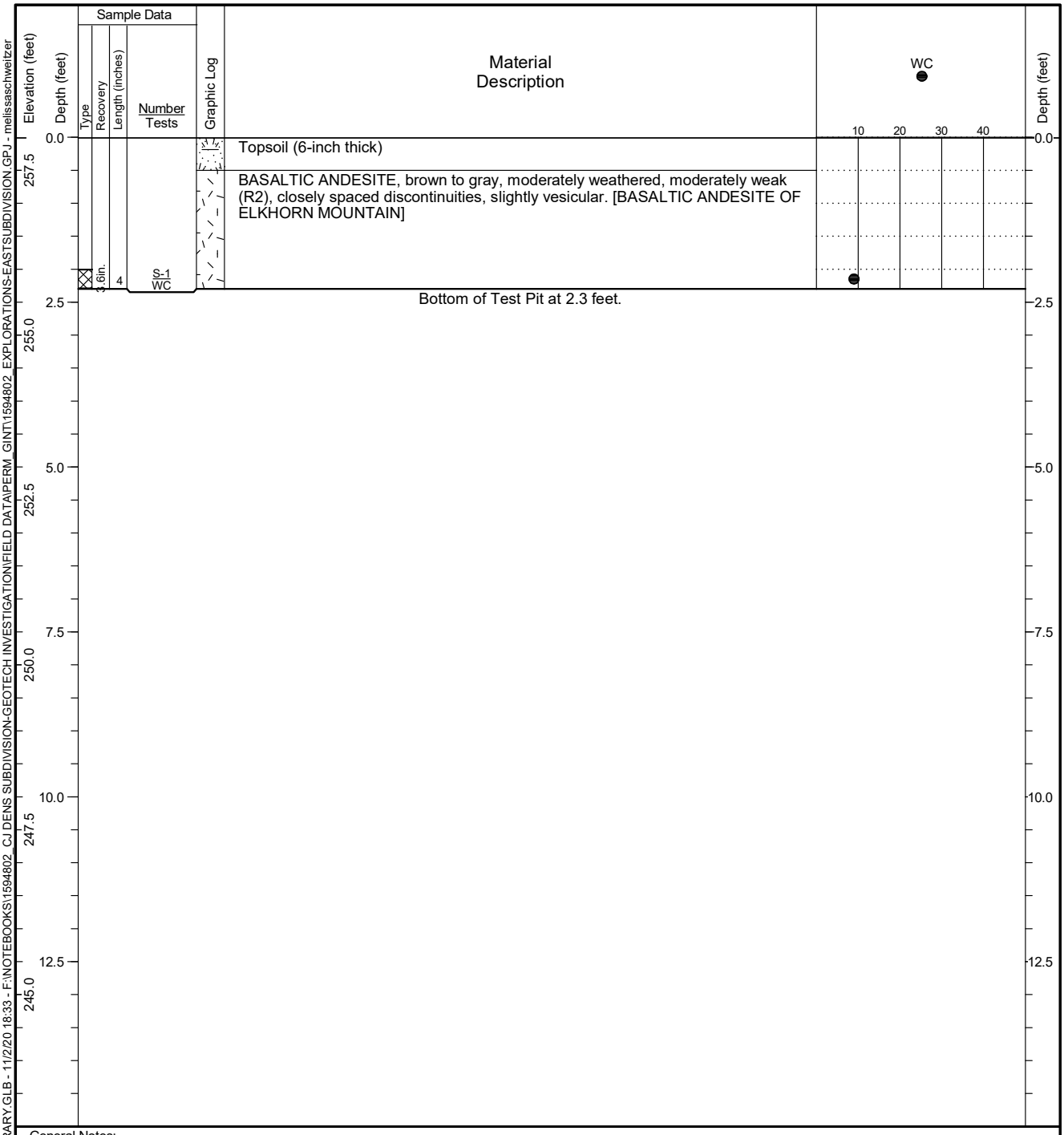
Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615400 Long: -122.413806 (WGS 84) Total Depth: 4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 265 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-5**	Figure **A-13** Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614879 Long: -122.414485 (WGS 84) Total Depth: 2.3 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 258 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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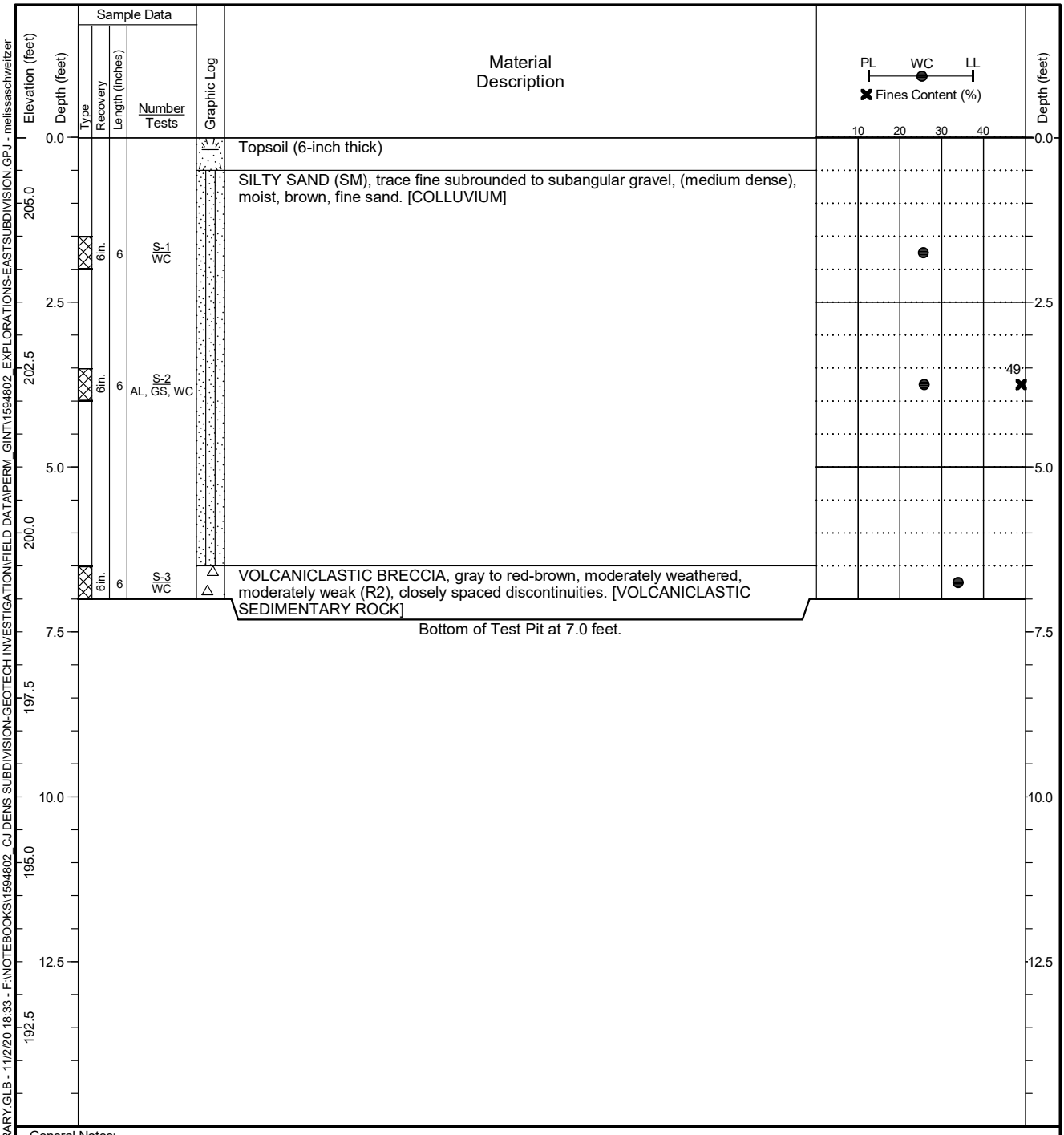
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-6

Figure **A-14**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.613657 Long: -122.411810 (WGS 84) Total Depth: 7 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 206 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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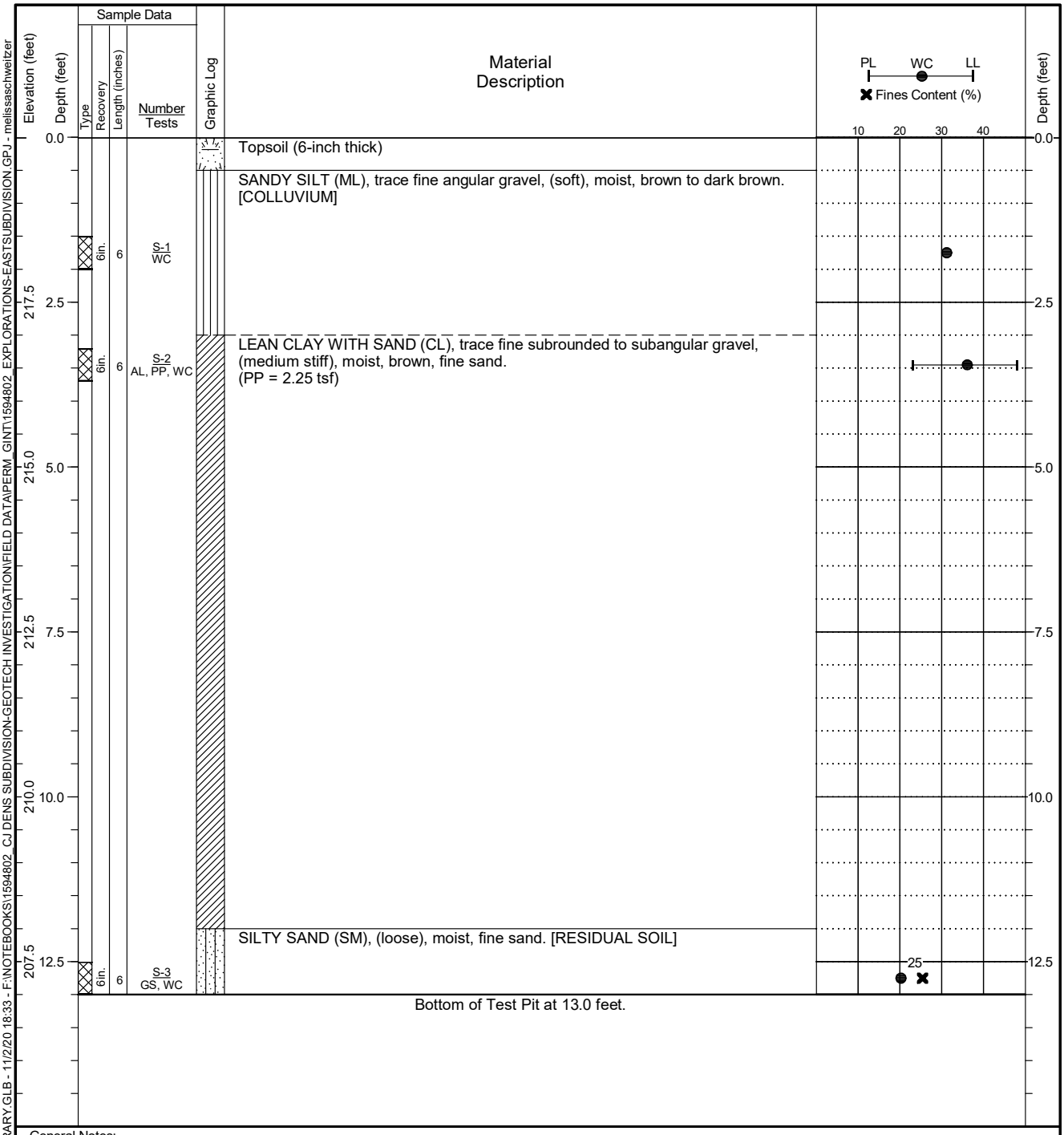
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-7

Figure **A-15**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.613824 Long: -122.411764 (WGS 84) Total Depth: 13 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 220 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-8

Figure **A-16**
Sheet **1 of 1**

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Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614293 Long: -122.413752 (WGS 84) Total Depth: 7 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 204 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description	WC (10 20 30 40)	Depth (feet)
204.0	0.0						Topsoil (6-inch thick)		0.0
							SILT WITH SAND (ML), trace angular gravel, (soft), moist, brown, fine sand, low plasticity. [COLLUVIUM]		
202.5	2.5								2.5
200.0			6in.	6	S-1 WC			●	
197.5	5.0		6in.	6	S-2		BASALTIC ANDESITE, gray to brown, moderately weathered, moderately weak (R2), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]		5.0
							Bottom of Test Pit at 7.0 feet.		
	7.5								7.5
195.0									
	10.0								10.0
192.5									
	12.5								12.5
190.0									

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-9

Figure **A-17**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614351 Long: -122.414811 (WGS 84) Total Depth: 4.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 202 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
202.0	0.0		Topsoil (6-inch thick)	0.0
			SANDY SILT (ML), trace angular gravel, (soft), moist, brown. [COLLUVIUM]	
200.0	2.5			2.5
197.5	5.0		BASALT, gray, slightly weathered to fresh, strong (R4), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	5.0
			Bottom of Test Pit at 4.5 feet.	
195.0	7.5			7.5
192.5	10.0			10.0
190.0	12.5			12.5
187.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-10

Figure **A-18**
Sheet **1 of 1**

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Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615146 Long: -122.415074 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 258 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
257.5	0.0		Topsoil (6-inch thick)	0.0
			BASALTIC ANDESITE, gray, fresh to slightly weathered, strong (R4), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	
			Bottom of Test Pit at 2.0 feet.	
255.0	2.5			2.5
252.5	5.0			5.0
250.0	7.5			7.5
247.5	10.0			10.0
245.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-11

Figure **A-19**
Sheet **1 of 1**

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Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615521 Long: -122.415646 (WGS 84) Total Depth: 2.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 264 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number	Graphic Log	Material Description	Depth (feet)
264.0	0.0						Topsoil (6-inch thick)	0.0
							SILTY GRAVEL WITH SAND (GM), (dense), moist. [RESIDUAL SOIL]	
262.5	2.5	6in.	6		S-1		BASALTIC ANDESITE, gray, slightly weathered to fresh, strong (R4), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
							Bottom of Test Pit at 2.5 feet.	
260.0	5.0							5.0
257.5	7.5							7.5
255.0	10.0							10.0
252.5	12.5							12.5
250.0								

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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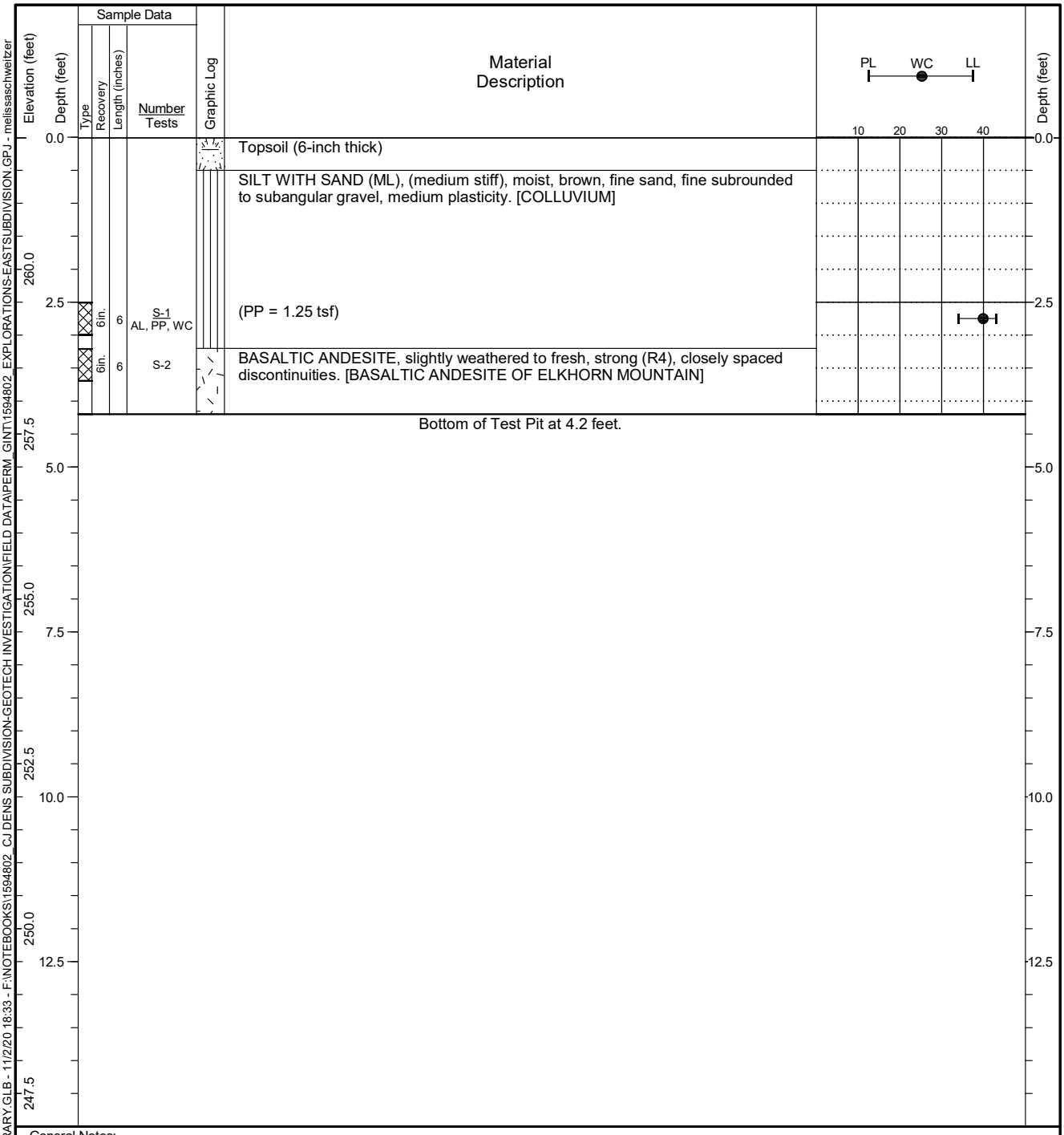
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-12

Figure **A-20**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615721 Long: -122.415296 (WGS 84) Total Depth: 4.2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 262 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

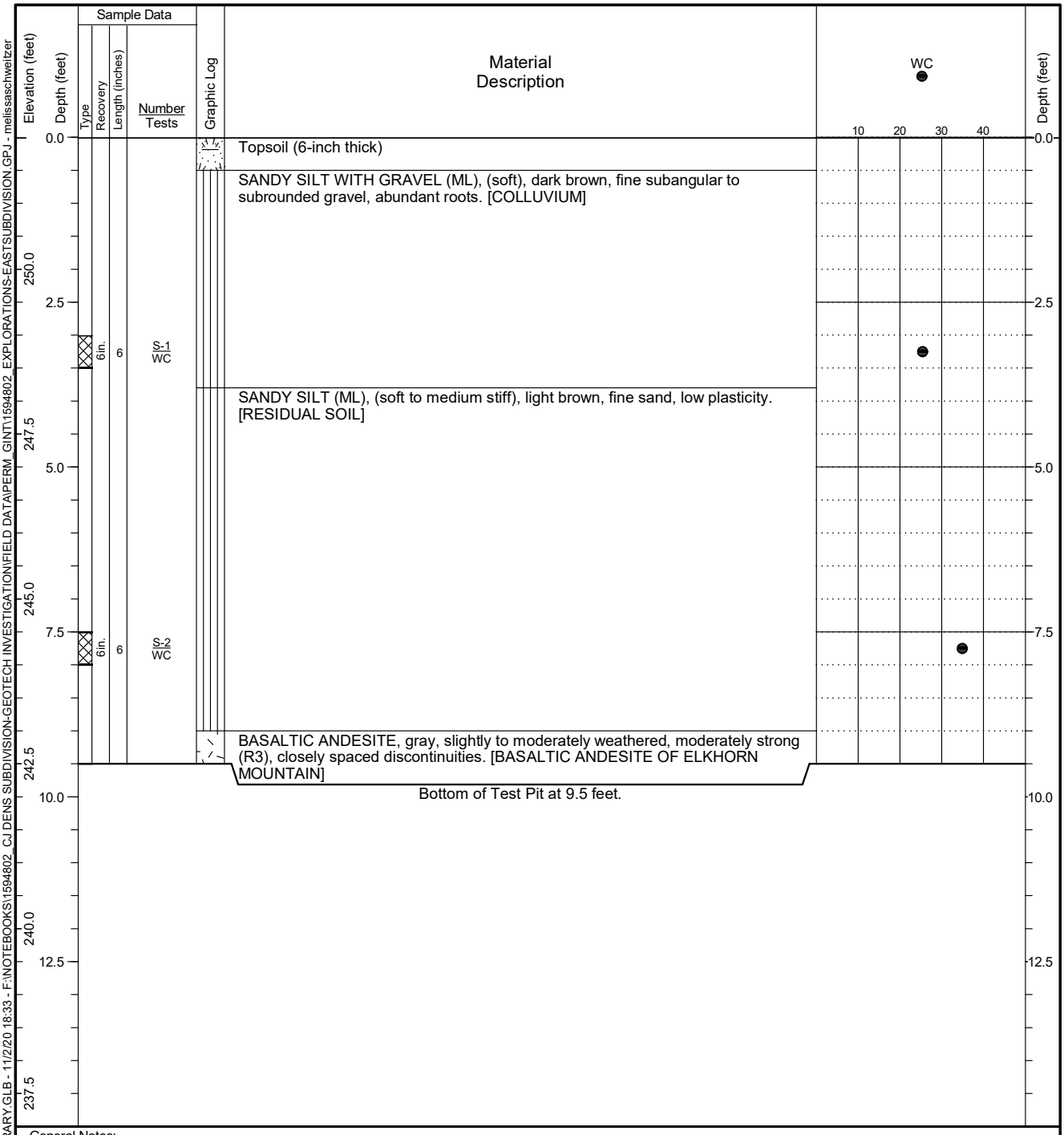
Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-13

Figure **A-21**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\15948002_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615912 Long: -122.415649 (WGS 84) Total Depth: 9.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 252 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-14**	Figure **A-22** Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616057 Long: -122.414660 (WGS 84) Total Depth: 4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 285 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description	WC (10 20 30 40)	Depth (feet)
285.0	0.0						Topsoil (6-inch thick)		0.0
							SANDY SILT (ML), trace fine subangular to subrounded gravel, (soft), moist, brown. [COLLUVIUM]		
282.5	2.5		6in.	6	S-1 / WC			•	2.5
			6in.	6	S-2		BASALTIC ANDESITE, gray, fresh to slightly weathered, moderately strong (R3), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]		
							Bottom of Test Pit at 4.0 feet.		
280.0	5.0								5.0
277.5	7.5								7.5
275.0	10.0								10.0
272.5	12.5								12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-15

Figure **A-23**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616324 Long: -122.413767 (WGS 84) Total Depth: 6.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 298 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description	WC (10 20 30 40)	Depth (feet)
297.5	0.0						Topsoil (6-inch thick)		0.0
							SILTY SAND WITH GRAVEL (SM), (loose), moist, brown, fine subrounded to subangular gravel. [COLLUVIUM]		
295.0	2.5		6in.	6	S-1 / WC			•	2.5
							BASALTIC ANDESITE, gray, slightly to moderately weathered, moderately strong (R3), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]		
292.5	5.0		6in.	6	S-2				5.0
							Bottom of Test Pit at 6.5 feet.		
290.0	7.5								7.5
287.5	10.0								10.0
285.0	12.5								12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-16

Figure **A-24**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\15948002_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616322 Long: -122.411837 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 302 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
300.0	0.0		Topsoil (6-inch thick)	0.0
			BASALTIC ANDESITE, gray, fresh to slightly weathered, strong (R4), moderately spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	
			Bottom of Test Pit at 2.0 feet.	
297.5	2.5			2.5
295.0	5.0			5.0
292.5	7.5			7.5
290.0	10.0			10.0
287.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-17

Figure **A-25**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616170 Long: -122.410459 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 310 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
	0.0		Topsoil (6-inch thick)	0.0
			BASALTIC ANDESITE, gray, fresh to slightly weathered, strong (R4), closely spaced discontinuities. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	
			Bottom of Test Pit at 2.0 feet.	
307.5	2.5			2.5
305.0	5.0			5.0
302.5	7.5			7.5
300.0	10.0			10.0
297.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-18

Figure **A-26**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\15948002_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616855 Long: -122.410170 (WGS 84) Total Depth: 9 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 310 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description	WC (10 20 30 40)	Depth (feet)
310.0	0.0						Topsoil (6-inch thick)		0.0
							SANDY SILT (ML), (soft), moist, dark brown. [COLLUVIUM]		
		6in.	6		S-1 WC			●	
307.5	2.5						SANDY SILT WITH GRAVEL (ML), (medium stiff), moist, light brown, fine subangular to subrounded gravel.		2.5
		6in.	6		S-2 WC			●	
305.0	5.0								5.0
302.5	7.5						VOLCANICLASTIC BRECCIA, brown to gray, moderately to highly weathered, very weak (R1), closely spaced discontinuities. [VOLCANICLASTIC SEDIMENTARY ROCK]		7.5
		6in.	6		S-3				
							Bottom of Test Pit at 9.0 feet.		
300.0	10.0								10.0
297.5	12.5								12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-19

Figure **A-27**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\15948802_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616546 Long: -122.410071 (WGS 84) Total Depth: 8 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 306 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number / Tests	Graphic Log	Material Description	WC / Fines Content (%)	Depth (feet)
306.0	0.0						Topsoil (6-inch thick)		0.0
305.0							SILTY SAND (SM), trace angular to subangular gravel, (loose), moist, brown. [RESIDUAL SOIL]		
302.5	2.5		6in.	6	S-1 GS, WC			24	2.5
300.0	5.0								5.0
	7.5						VOLCANICLASTIC BRECCIA, brown to gray, moderately to highly weathered, very weak (R1), closely spaced discontinuities. [VOLCANICLASTIC SEDIMENTARY ROCK]		7.5
297.5							Bottom of Test Pit at 8.0 feet.		
295.0	10.0								10.0
292.5	12.5								12.5

WC ● Fines Content (%) ✖ 10 20 30 40

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

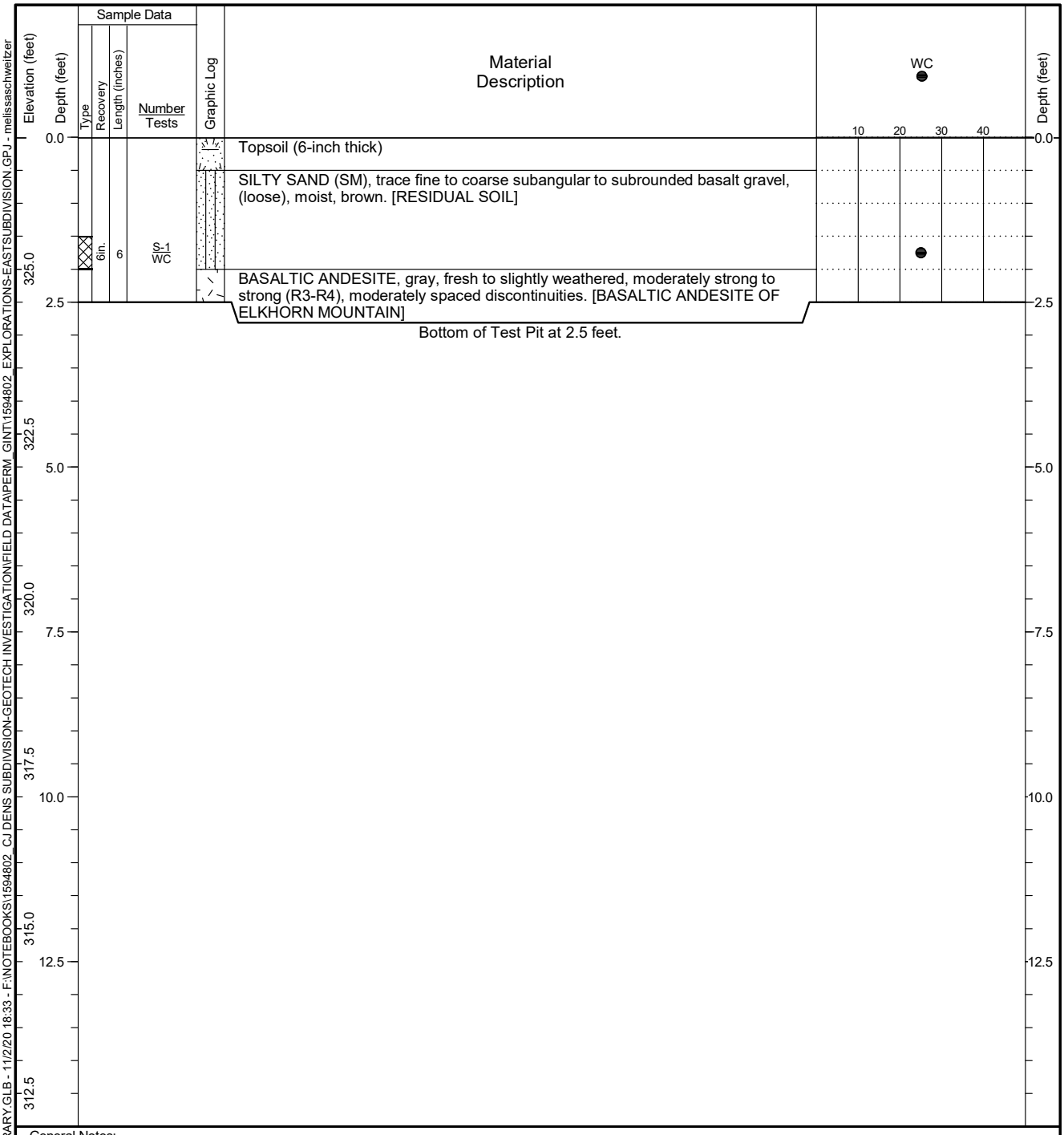
Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-20

Figure **A-28**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\15948002_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615457 Long: -122.410283 (WGS 84) Total Depth: 2.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 327 feet (NAVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-21**	Figure **A-29** Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\1594802_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 5/27/16 Date Completed: 5/27/16 Contractor/Crew: Tapani, Inc.
Logged by: A. Jones Checked by: A. Pyrch Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614343 Long: -122.410129 (WGS 84) Total Depth: 2.6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 312 feet (NAVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
312.0	0.0		Topsoil (6-inch thick)	0.0
310.0	2.5		BASALTIC ANDESITE, gray, fresh to slightly weathered, strong (R4), closely spaced discontinuities, highly fractured and moderately weathered from 0.5 to 1.0 feet. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
			Bottom of Test Pit at 2.6 feet.	
307.5	5.0			5.0
305.0	7.5			7.5
302.5	10.0			10.0
300.0	12.5			12.5
297.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

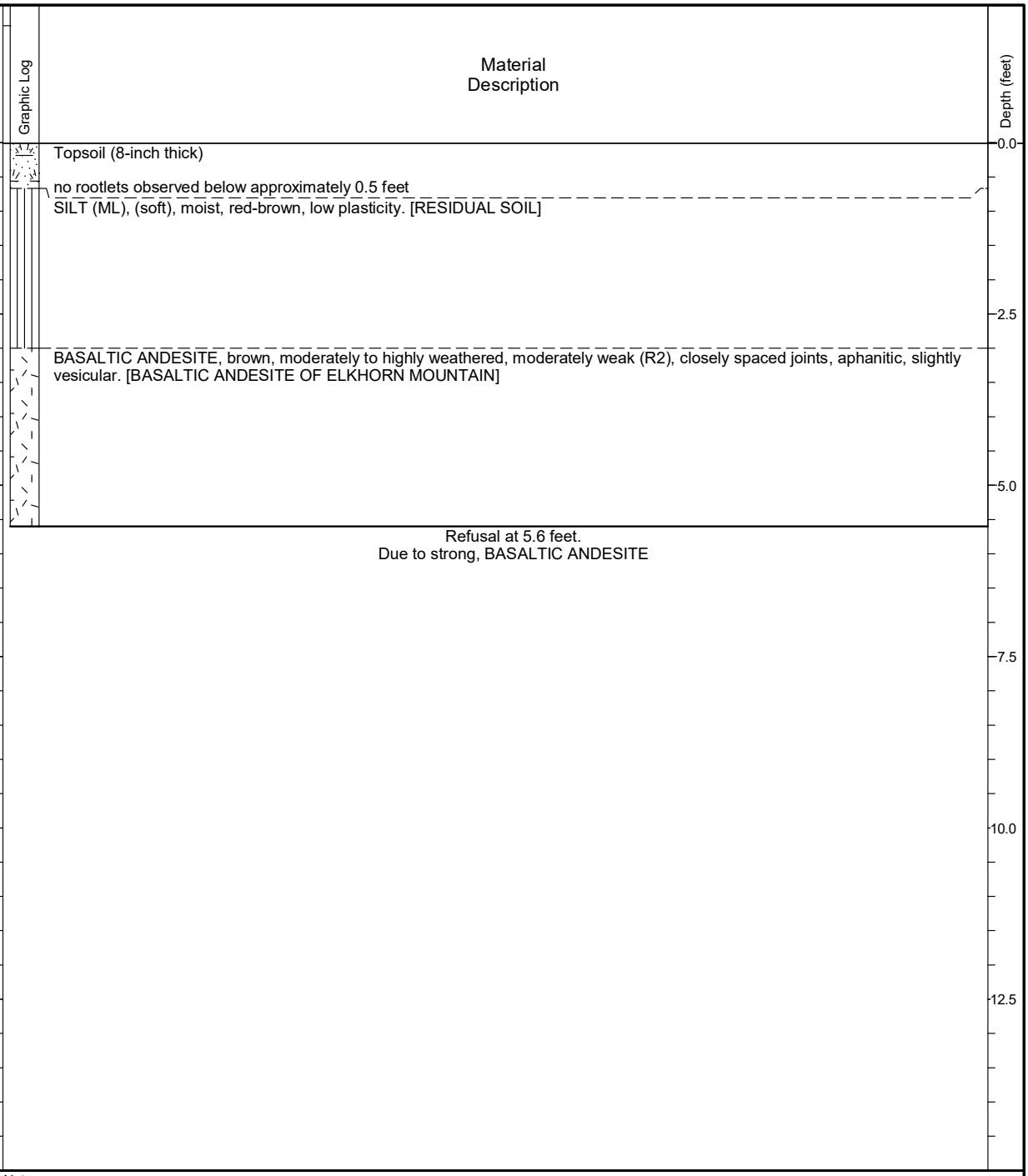
Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-22

Figure **A-30**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:33 - F:\NOTEBOOKS\1594802_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614550 Long: -122.409480 (WGS 84) Total Depth: 5.6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 323.57 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-43**	Figure **A-31** Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615000 Long: -122.409500 (WGS 84) Total Depth: 3.6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 328.65 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
328.65	0.0		Topsoil (6-inch thick)	0.0
327.5			SILT (ML), (soft), moist, red-brown, low plasticity. [RESIDUAL SOIL] no rootlets observed below approximately 0.67 feet	
	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
325.0			Refusal at 3.6 feet. Due to strong, BASALTIC ANDESITE	
	5.0			5.0
322.5				
	7.5			7.5
320.0				
	10.0			10.0
317.5				
	12.5			12.5
315.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-44

Figure **A-32**
Sheet **1 of 1**

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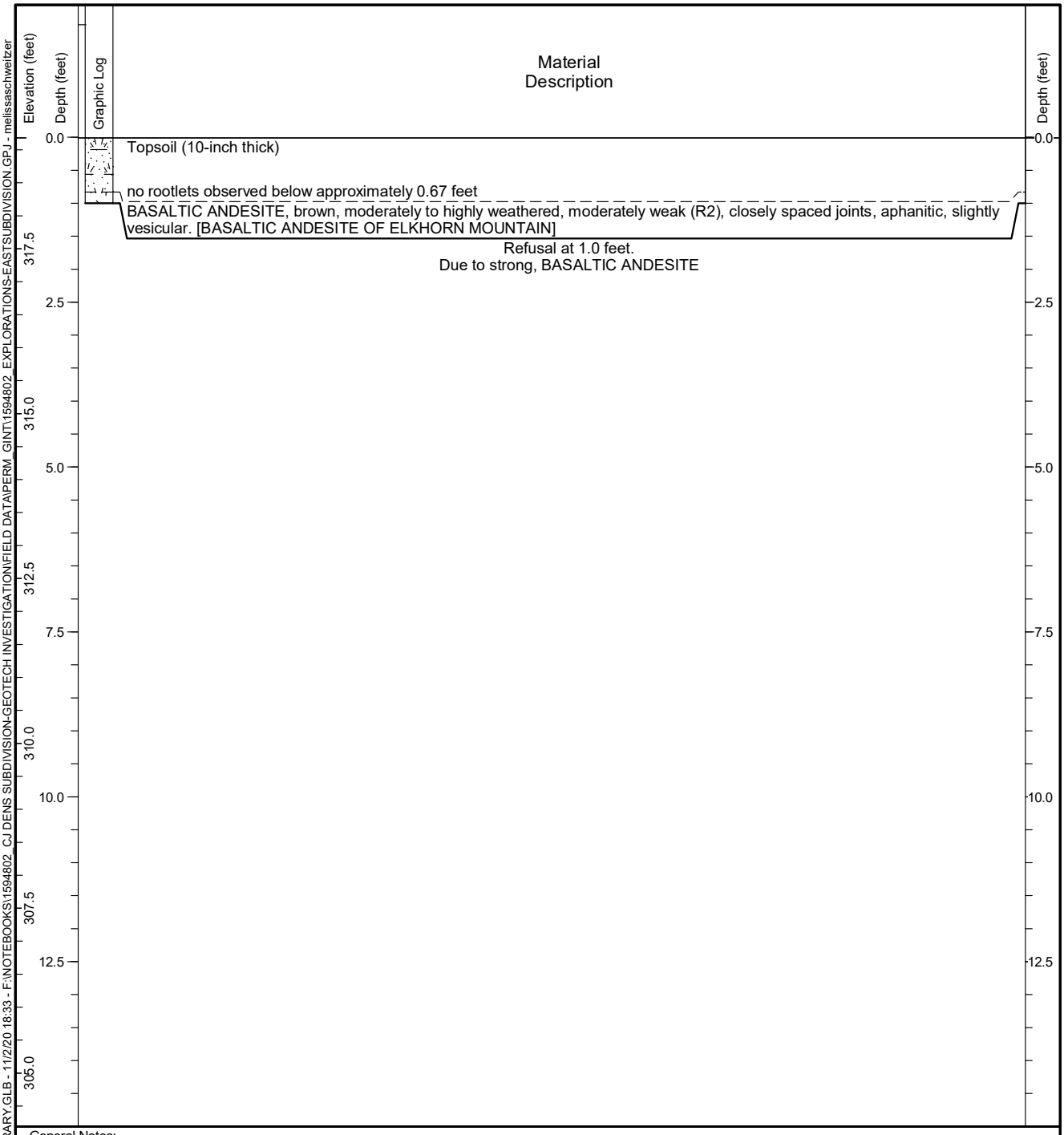
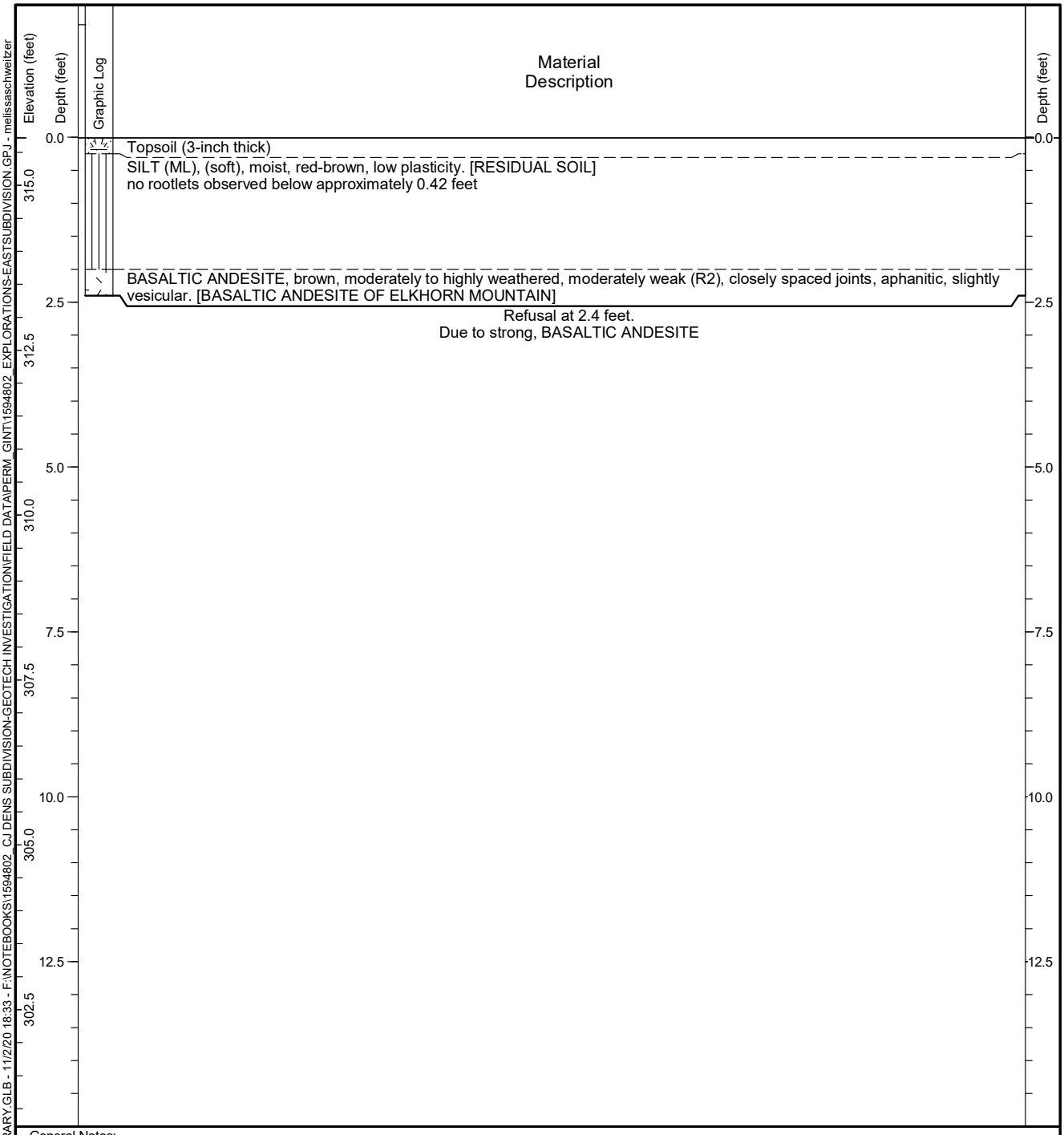
Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614460 Long: -122.409850 (WGS 84) Total Depth: 1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 319.19 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-45**	Figure **A-33** Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614400 Long: -122.410100 (WGS 84) Total Depth: 2.4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 315.73 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-46**	Figure **A-34** Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614200 Long: -122.410500 (WGS 84) Total Depth: 3 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 310.06 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
	0.0		Topsoil (4-inch thick)	0.0
307.5	2.5		SILTY GRAVEL (GM), (loose), moist, red-brown, coarse angular gravel, low plasticity fines. [RESIDUAL SOIL] no rootlets observed below approximately 0.5 feet	2.5
305.0	5.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN] Refusal at 3.0 feet. Due to strong, BASALTIC ANDESITE	5.0
302.5	7.5			7.5
300.0	10.0			10.0
297.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-47

Figure **A-35**
Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614200 Long: -122.410900 (WGS 84) Total Depth: 6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 312.97 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
312.5	0.0		Topsoil (6-inch thick)	0.0
			SILT (ML), (soft), moist, red-brown, low plasticity. [RESIDUAL SOIL]	
310.0	2.5		no rootlets observed below approximately 2.5 feet	2.5
			BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	
307.5	5.0		Refusal at 6.0 feet. Due to strong, BASALTIC ANDESITE	5.0
305.0	7.5			7.5
302.5	10.0			10.0
300.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-48

Figure **A-36**
Sheet **1 of 1**

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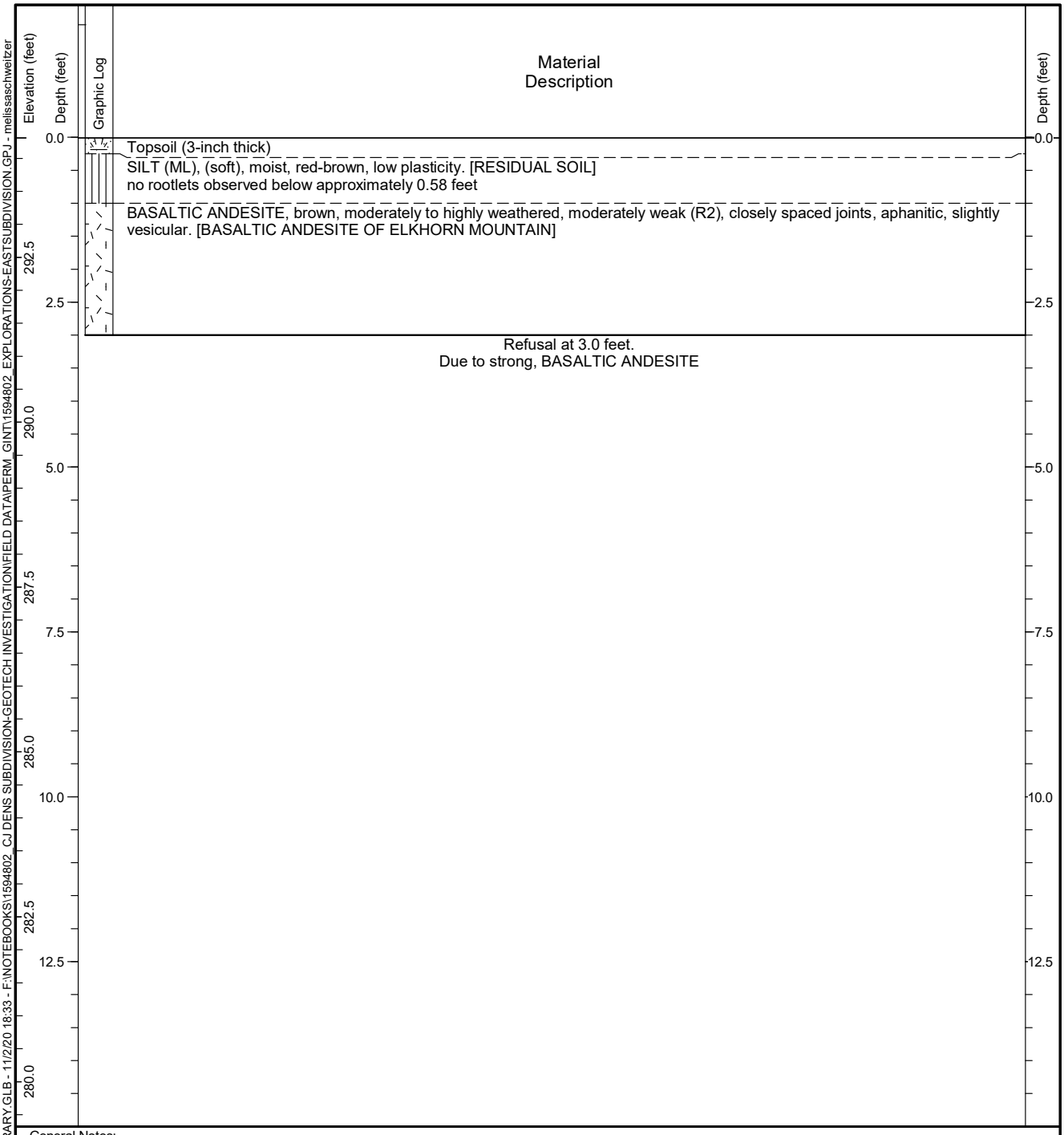
Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614200 Long: -122.411300 (WGS 84) Total Depth: 3 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 294.32 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-49**	Figure **A-37** Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614300 Long: -122.411400 (WGS 84) Total Depth: 0.1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 303.33 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
303.3	0.0		BASALTIC ANDESITE, brown, slightly weathered, moderately strong (R3), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
			Refusal at 0.1 feet. Due to strong, BASALTIC ANDESITE	
302.5	2.5			2.5
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0			10.0
292.5	12.5			12.5
290.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-50

Figure **A-38**
Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615300 Long: -122.409400 (WGS 84) Total Depth: 0.1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 333.90 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
333.9	0.0		BASALTIC ANDESITE, brown, slightly weathered, moderately strong (R3), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
			Refusal at 0.1 feet. Due to strong, BASALTIC ANDESITE	
332.5	2.5			2.5
330.0	5.0			5.0
327.5	7.5			7.5
325.0	10.0			10.0
322.5	12.5			12.5
320.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-51

Figure **A-39**
Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615500 Long: -122.409300 (WGS 84) Total Depth: 6.5 feet Depth to Seepage: 6.4 feet
Ground Surface Elevation: 326.12 feet (NGVD 88)
Comments:

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-52**	Figure **A-40** Sheet **1 of 1**

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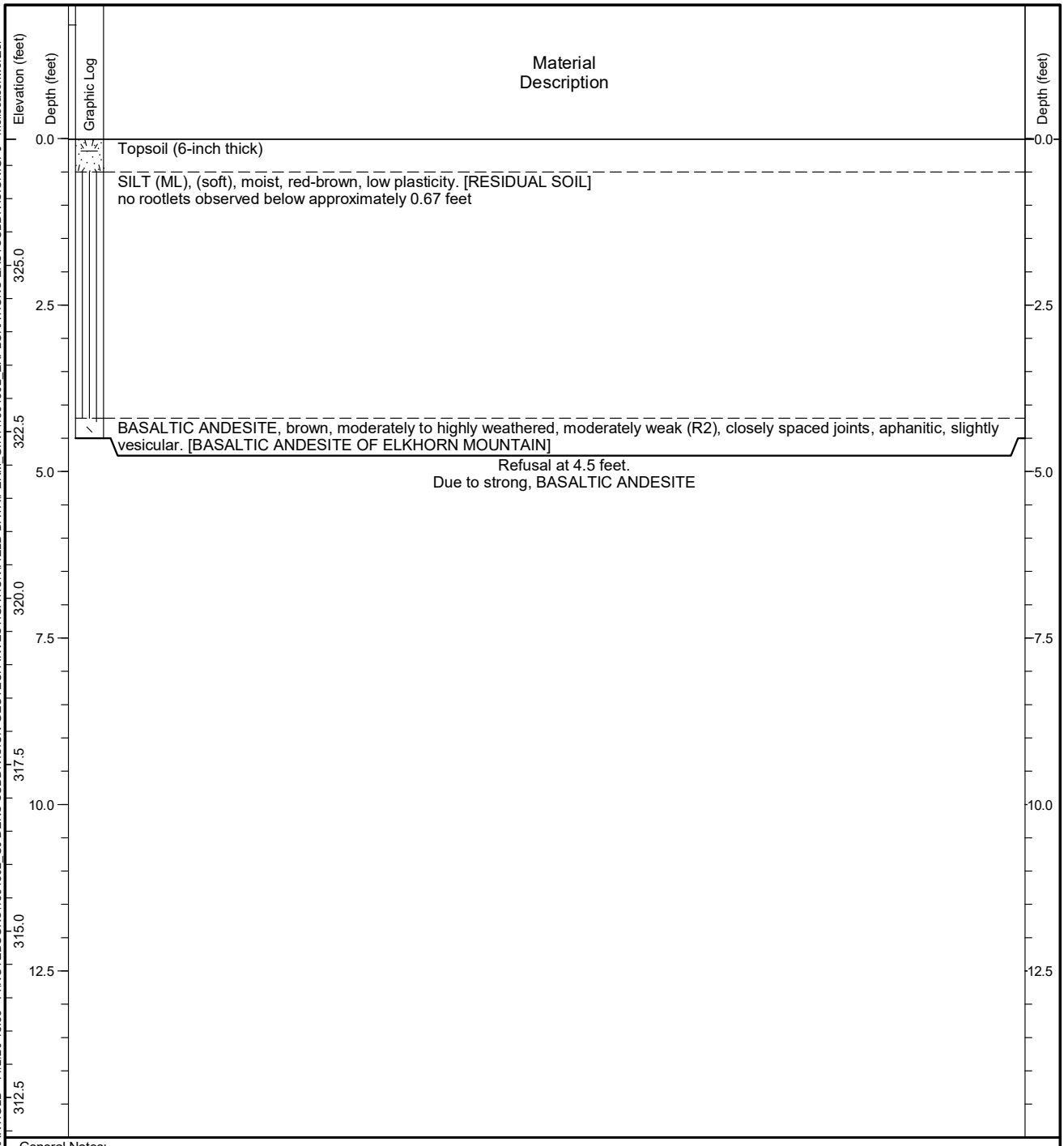
Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615400 Long: -122.409700 (WGS 84) Total Depth: 4.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 326.90 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-53**	Figure **A-41** Sheet **1 of 1**

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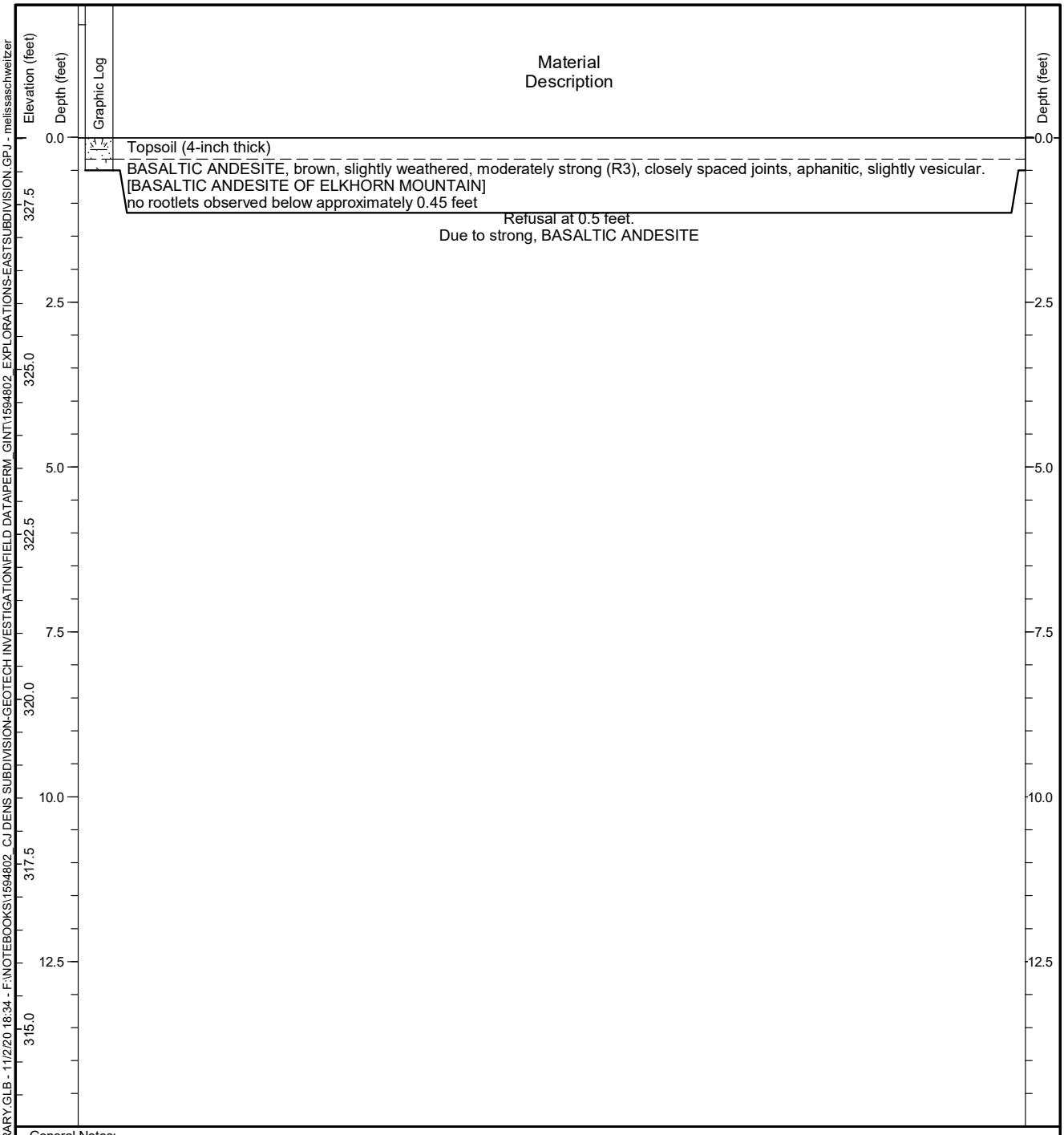
Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615500 Long: -122.410200 (WGS 84) Total Depth: 0.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 328.52 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-54**	Figure **A-42** Sheet **1 of 1**

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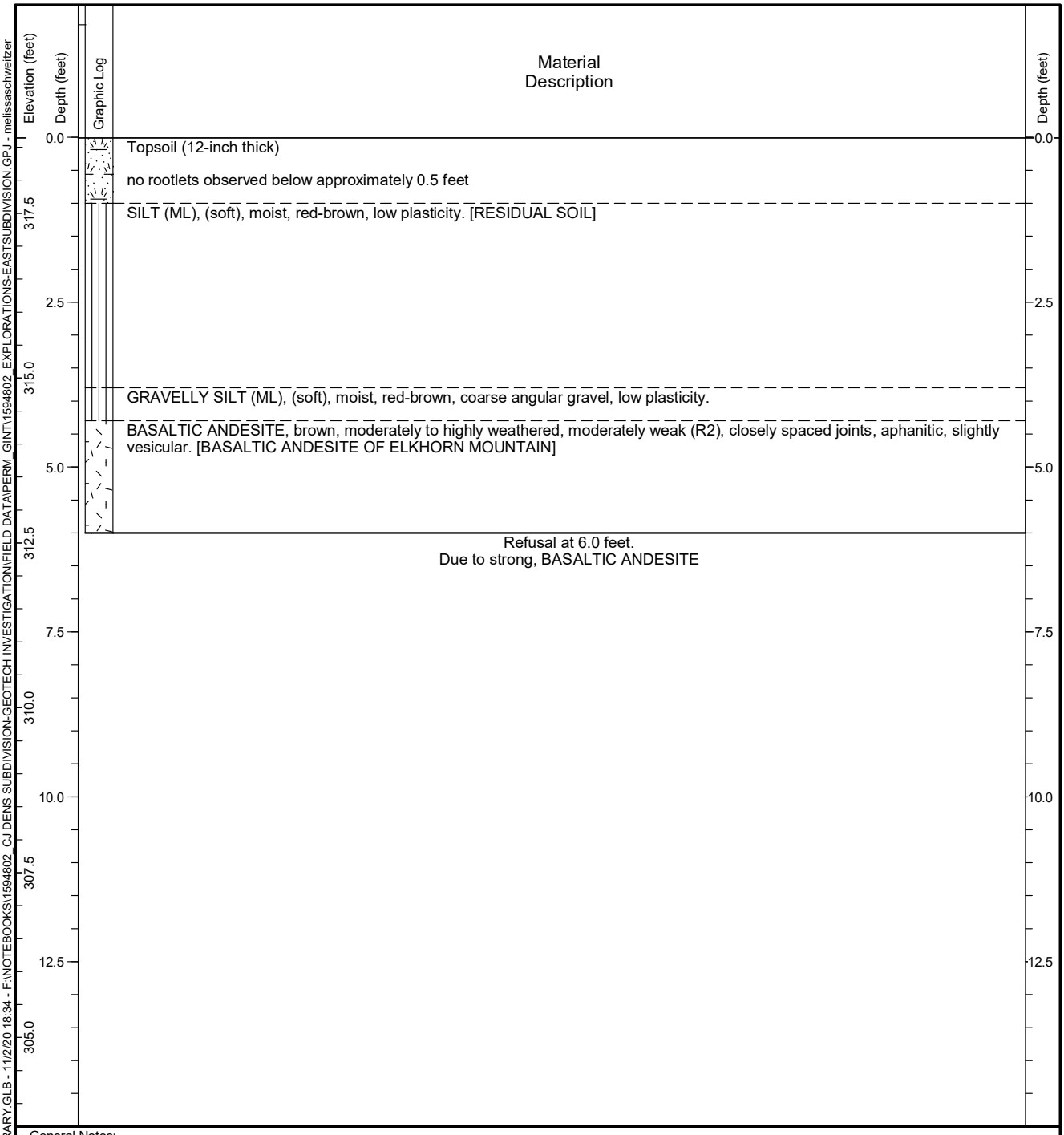
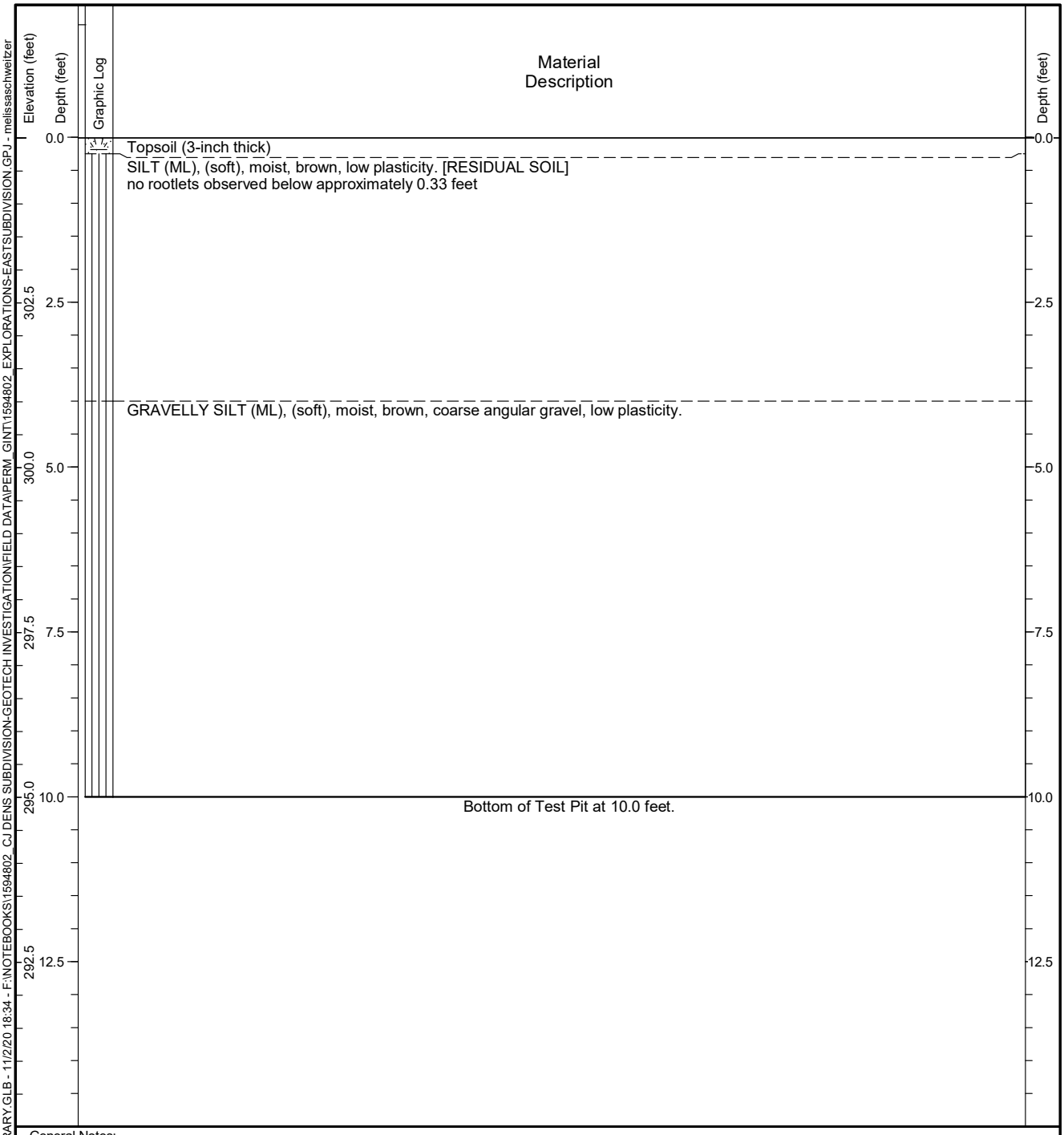
Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615400 Long: -122.410600 (WGS 84) Total Depth: 6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 318.65 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-55**	Figure **A-43** Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615400 Long: -122.411000 (WGS 84) Total Depth: 10 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 305.01 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-56**	Figure **A-44** Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615500 Long: -122.411400 (WGS 84) Total Depth: 3.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 307.45 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
307.5	0.0		Topsoil (6-inch thick)	0.0
			SILT (ML), (soft), moist, brown, low plasticity. [RESIDUAL SOIL]	
			no rootlets observed below approximately 1.5 feet	
305.0	2.5			2.5
			Refusal at 3.5 feet. Due to strong, BASALTIC ANDESITE	
302.5	5.0			5.0
300.0	7.5			7.5
297.5	10.0			10.0
295.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-57

Figure **A-45**
Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615500 Long: -122.411900 (WGS 84) Total Depth: 2.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 310.00 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
	0.0		Topsoil (6-inch thick)	0.0
			no rootlets observed below approximately 0.5 feet	
307.5	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
			Refusal at 2.5 feet. Due to strong, BASALTIC ANDESITE	
305.0	5.0			5.0
302.5	7.5			7.5
300.0	10.0			10.0
297.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-58

Figure **A-46**
Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615600 Long: -122.412400 (WGS 84) Total Depth: 0.25 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 308.91 feet (NGVD 88)
Comments:

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-59**	Figure **A-47** Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615500 Long: -122.412900 (WGS 84) Total Depth: 3.1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 297.15 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
295.0	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
			no rootlets observed below approximately 1.2 feet	
292.5	2.5			2.5
			Refusal at 3.1 feet. Due to strong, BASALTIC ANDESITE	
290.0	5.0			5.0
287.5	7.5			7.5
285.0	10.0			10.0
282.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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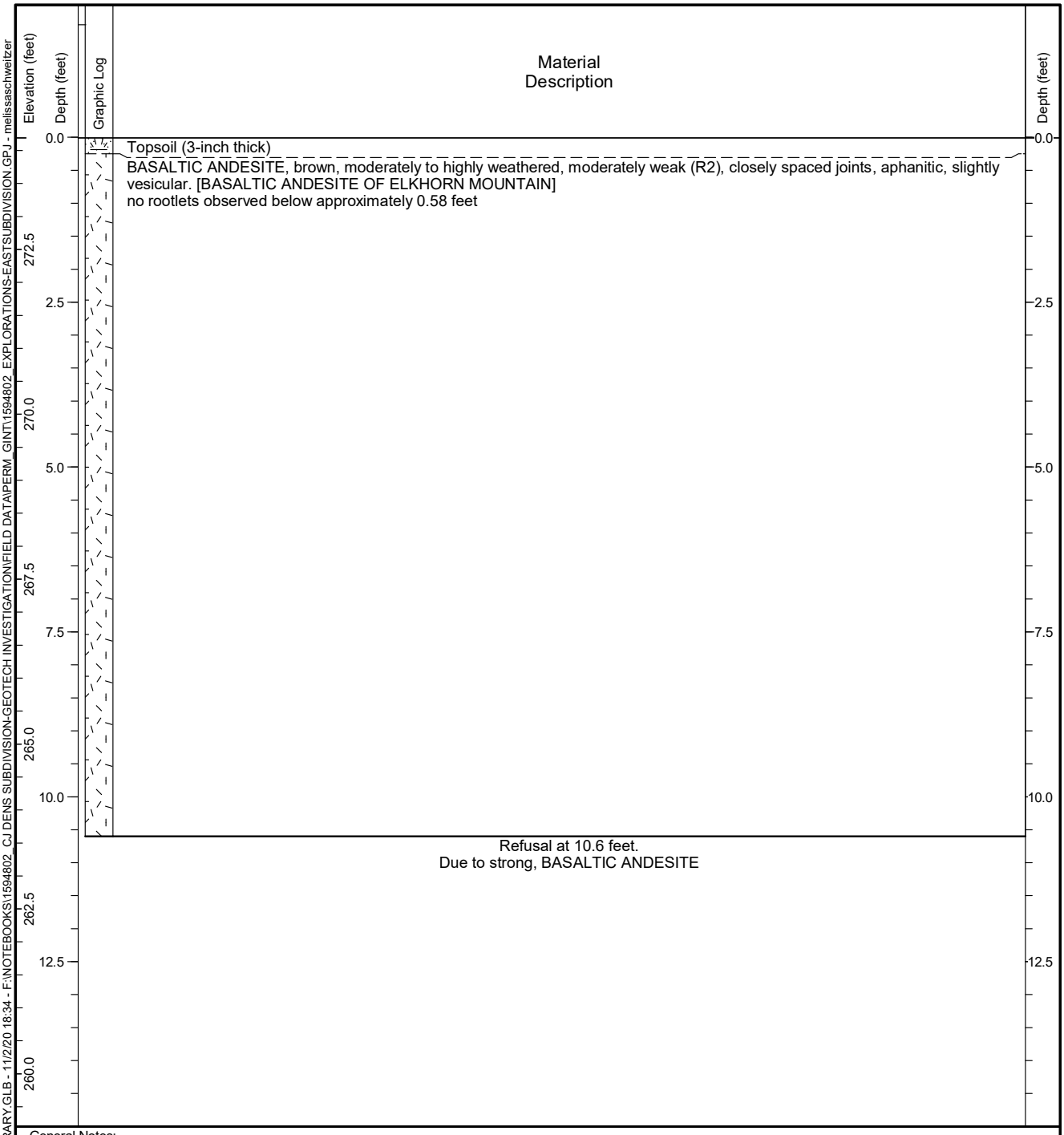
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-60

Figure **A-48**
Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615500 Long: -122.413400 (WGS 84) Total Depth: 10.6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 274.20 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-61**	Figure **A-49** Sheet **1 of 1**

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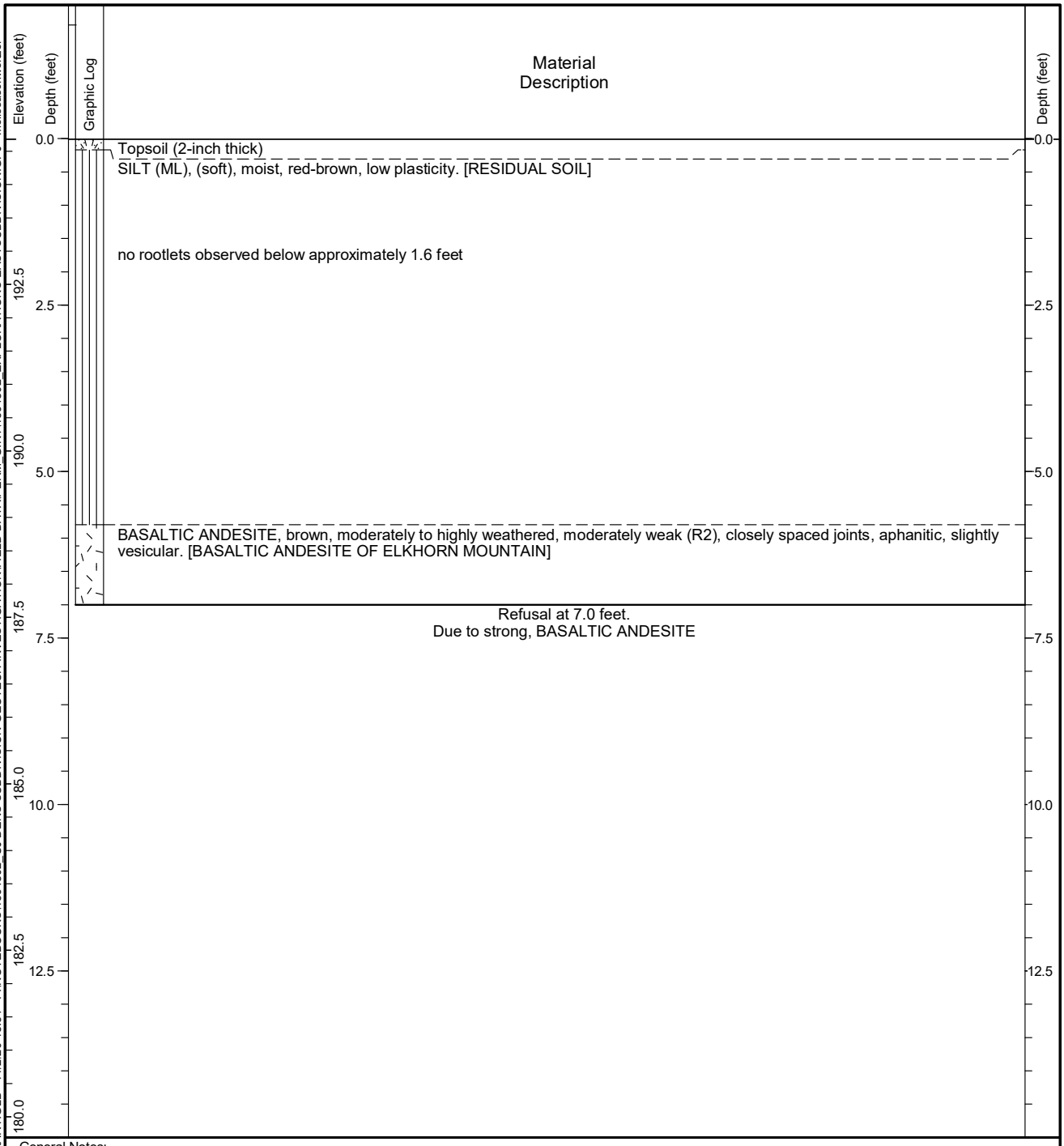
Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614200 Long: -122.414600 (WGS 84) Total Depth: 7 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 194.69 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-62**	Figure **A-50** Sheet **1 of 1**

Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615600 Long: -122.414300 (WGS 84) Total Depth: 0.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 279.38 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
	0.0		Topsoil (6-inch thick) no rootlets observed below approximately 0.5 feet	0.0
			Refusal at 0.5 feet. Due to strong, BASALTIC ANDESITE	
277.5	2.5			2.5
275.0	5.0			5.0
272.5	7.5			7.5
270.0	10.0			10.0
267.5	12.5			12.5
265.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-63

Figure **A-51**
Sheet **1 of 1**

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Date Started: 10/26/17 Date Completed: 10/26/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615800 Long: -122.414400 (WGS 84) Total Depth: 2.75 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 288.09 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
287.5	0.0		Topsoil (6-inch thick)	0.0
			SILT (ML), (soft), moist, red-brown, low plasticity. [RESIDUAL SOIL] no rootlets observed below approximately 0.67 feet	
			BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	
285.0	2.5		Refusal at 2.8 feet. Due to strong, BASALTIC ANDESITE	2.5
282.5	5.0			5.0
280.0	7.5			7.5
277.5	10.0			10.0
275.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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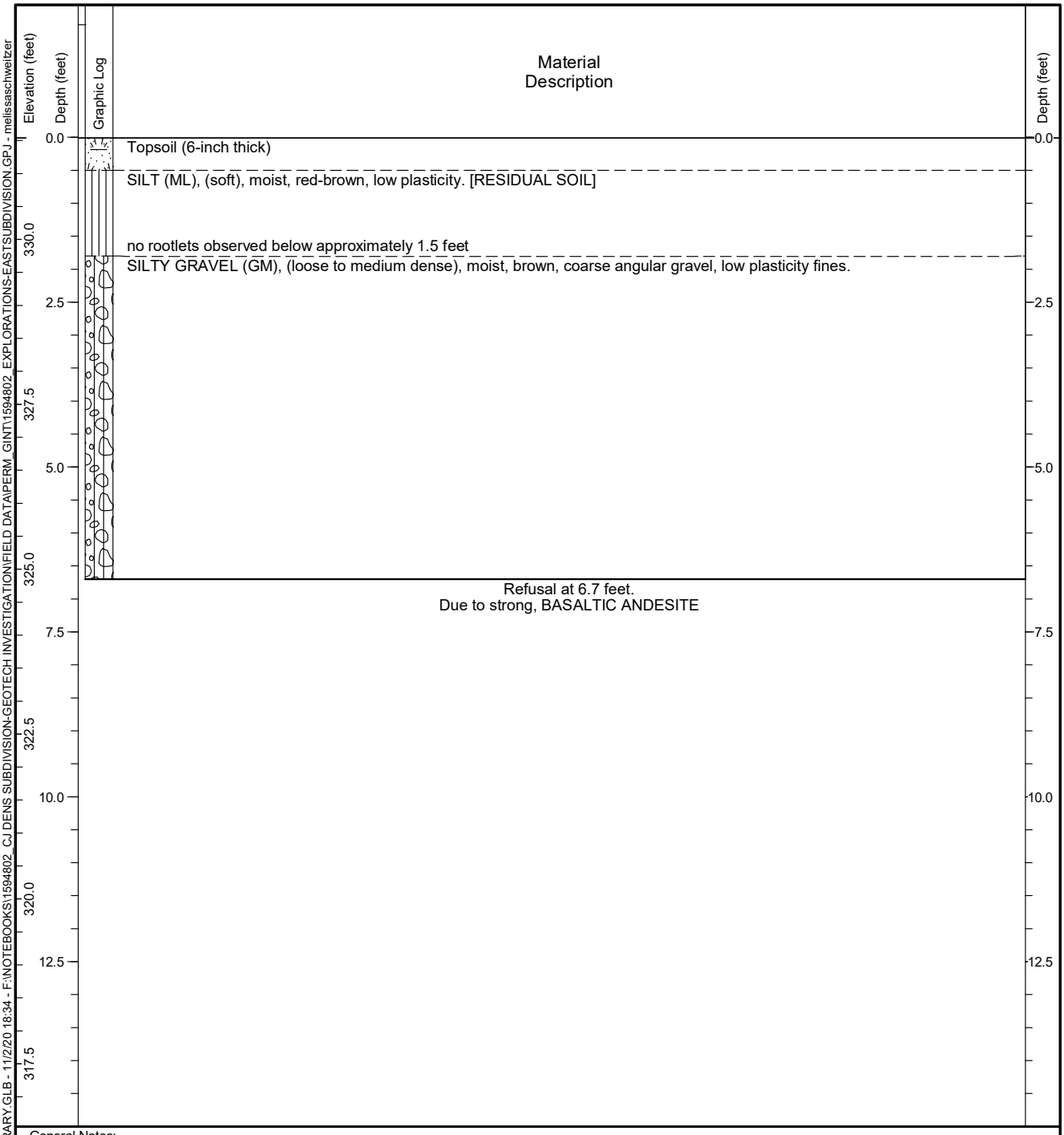
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-64

Figure **A-52**
Sheet **1 of 1**

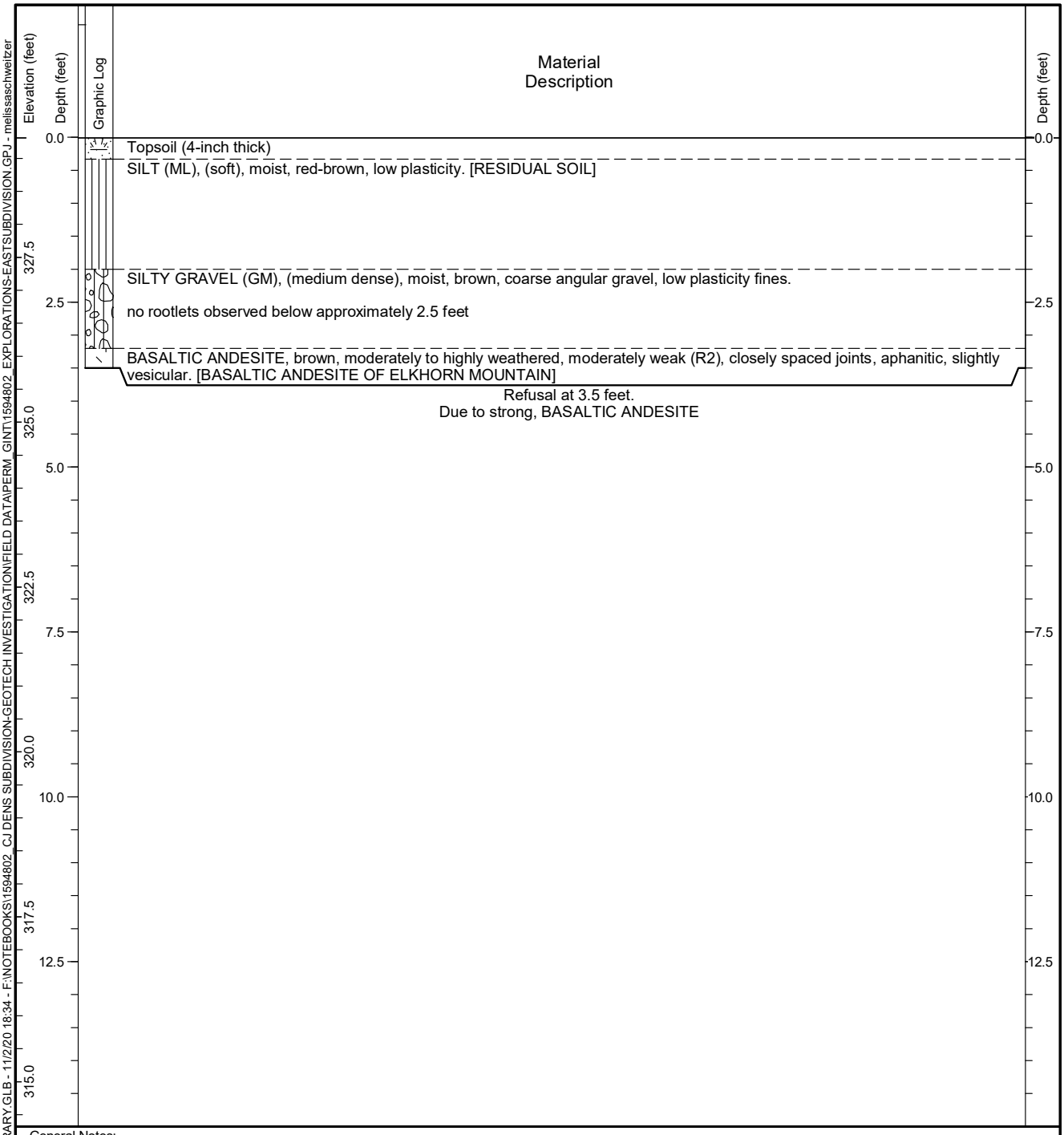
Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614900 Long: -122.409800 (WGS 84) Total Depth: 6.7 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 331.55 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-65**	Figure **A-53** Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614900 Long: -122.410200 (WGS 84) Total Depth: 3.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 329.32 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-66**	Figure **A-54** Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614900 Long: -122.410700 (WGS 84) Total Depth: 6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 316.79 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description
315.0	0.0		Topsoil (4-inch thick)
			SILT (ML), (soft), moist, red-brown, low plasticity. [RESIDUAL SOIL]
312.5	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]
			no rootlets observed below approximately 4 feet
310.0	5.0		Refusal at 6.0 feet. Due to strong, BASALTIC ANDESITE
307.5	7.5		
305.0	10.0		
302.5	12.5		

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-67

Figure **A-55**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614900 Long: -122.411000 (WGS 84) Total Depth: 5.1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 307.00 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
307.0	0.0		Topsoil (30-inch thick)	0.0
			no rootlets observed below approximately 1.08 feet	
305.0	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
302.5	5.0		Refusal at 5.1 feet. Due to strong, BASALTIC ANDESITE	5.0
300.0	7.5			7.5
297.5	10.0			10.0
295.0	12.5			12.5
292.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

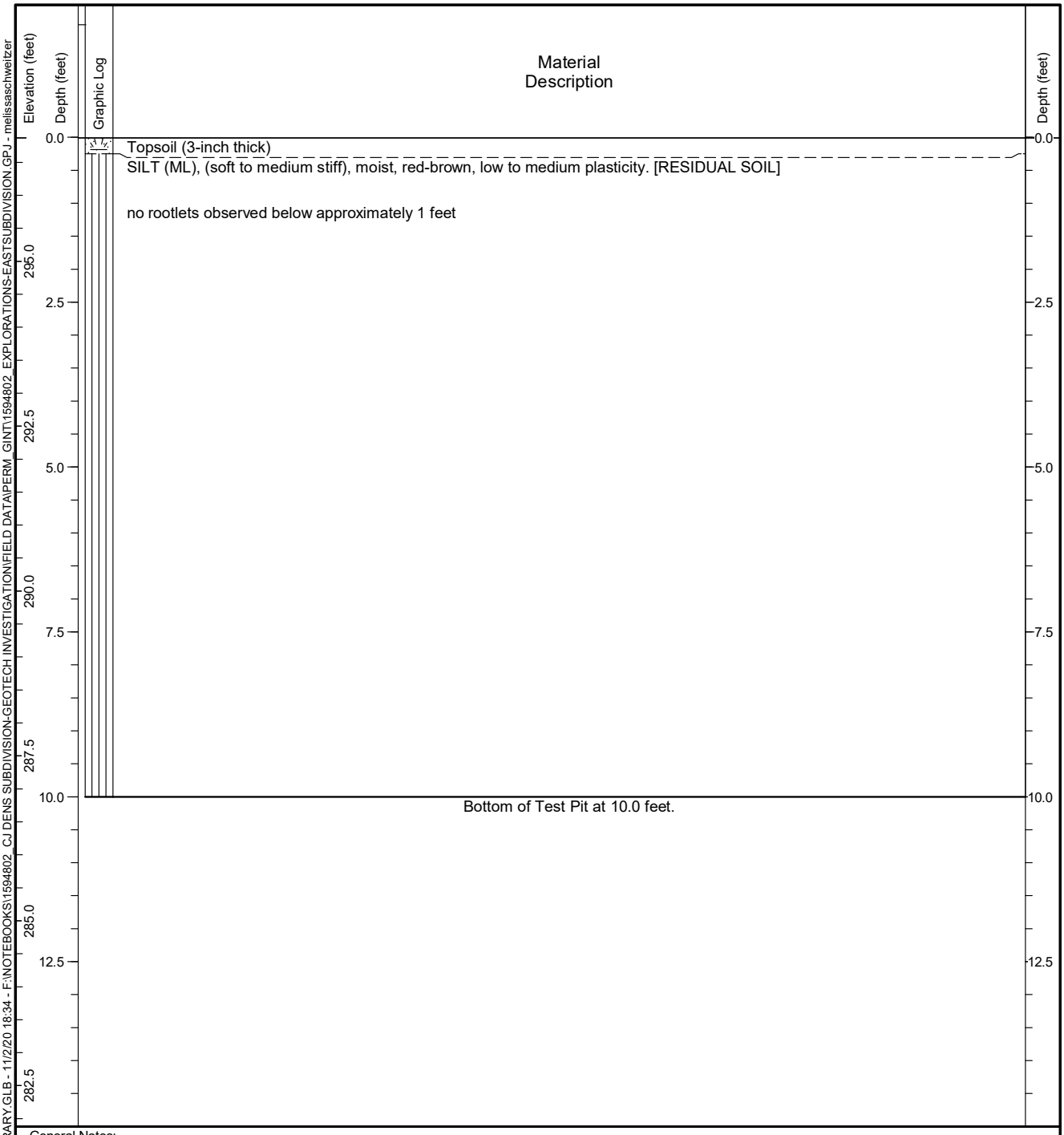
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-68

Figure **A-56**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615000 Long: -122.411200 (WGS 84) Total Depth: 10 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 296.88 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-69**	Figure **A-57** Sheet **1 of 1**

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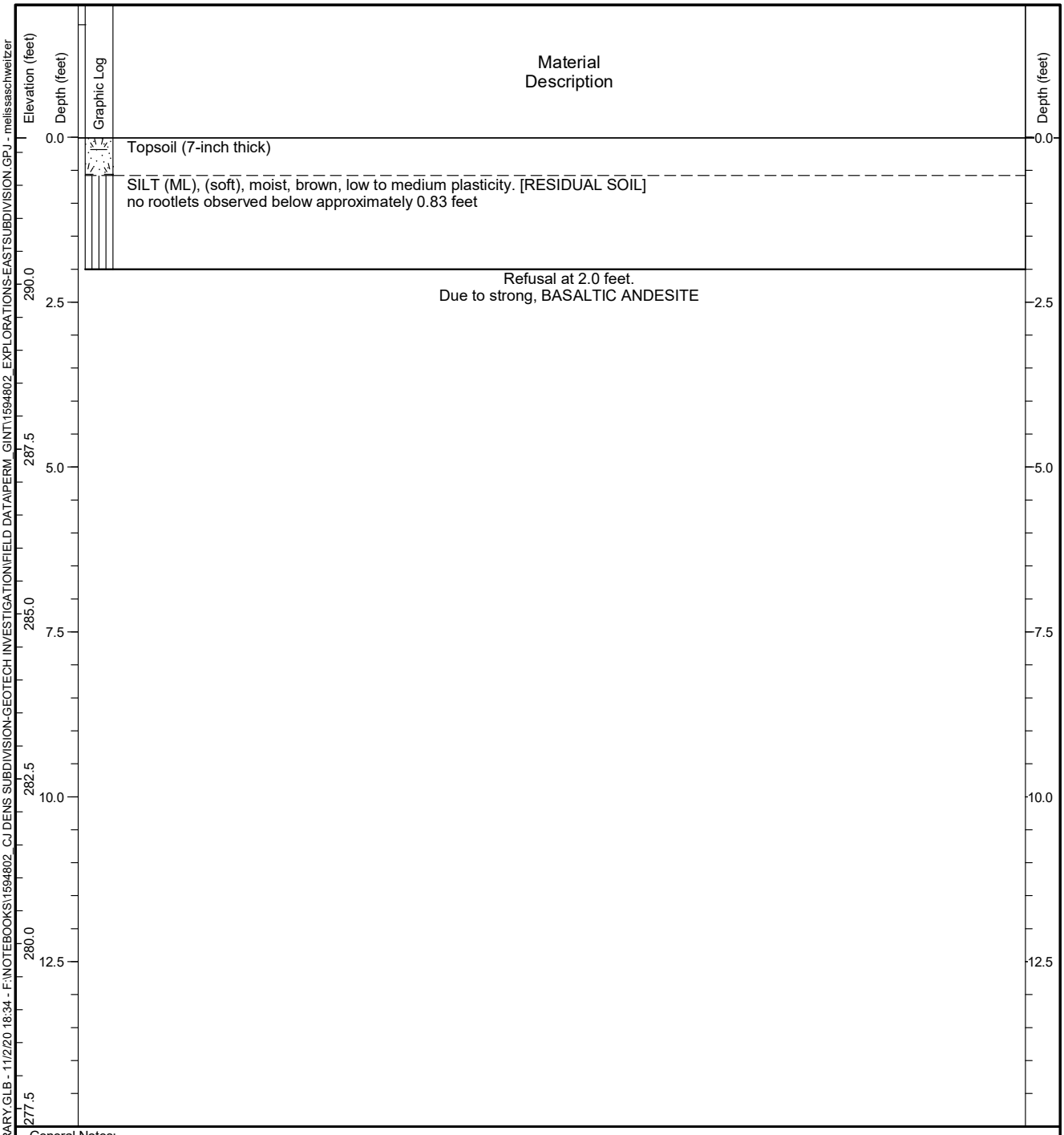
Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615000 Long: -122.411900 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 292.23 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-70**	Figure **A-58** Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615200 Long: -122.412300 (WGS 84) Total Depth: 3.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 299.25 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
299.25	0.0		Topsoil (12-inch thick)	0.0
297.5	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN] no rootlets observed below approximately 1.17 feet	2.5
			Refusal at 3.5 feet. Due to strong, BASALTIC ANDESITE	
295.0	5.0			5.0
292.5	7.5			7.5
290.0	10.0			10.0
287.5	12.5			12.5
285.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-71

Figure **A-59**
Sheet **1 of 1**

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Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615723 Long: -122.413005 (WGS 84) Total Depth: 3.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 283.30 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
282.5	0.0		Topsoil (6-inch thick)	0.0
			SILT (ML), (soft), moist, red-brown, low plasticity. [RESIDUAL SOIL]	
			no rootlets observed below approximately 1 feet	
280.0	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
			Refusal at 3.5 feet. Due to strong, BASALTIC ANDESITE	
277.5	5.0			5.0
275.0	7.5			7.5
272.5	10.0			10.0
270.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-72

Figure **A-60**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615400 Long: -122.412500 (WGS 84) Total Depth: 0 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 300.14 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
300.0	0.0		Refusal at 0.0 feet. Due to strong, BASALTIC ANDESITE	0.0
297.5	2.5			2.5
295.0	5.0			5.0
292.5	7.5			7.5
290.0	10.0			10.0
287.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-73

Figure **A-61**
Sheet **1 of 1**

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Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616100 Long: -122.413900 (WGS 84) Total Depth: 0 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 309.08 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
307.5	0.0		Refusal at 0.0 feet. Due to strong, BASALTIC ANDESITE	0.0
305.0	2.5			2.5
302.5	5.0			5.0
300.0	7.5			7.5
297.5	10.0			10.0
295.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-74

Figure **A-62**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616200 Long: -122.413400 (WGS 84) Total Depth: 5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 311.84 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
310.0	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
	2.5		no rootlets observed below approximately 3.5 feet	2.5
307.5	5.0		Refusal at 5.0 feet. Due to strong, BASALTIC ANDESITE	5.0
305.0	7.5			7.5
302.5	10.0			10.0
300.0	12.5			12.5
297.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-75

Figure **A-63**
Sheet **1 of 1**

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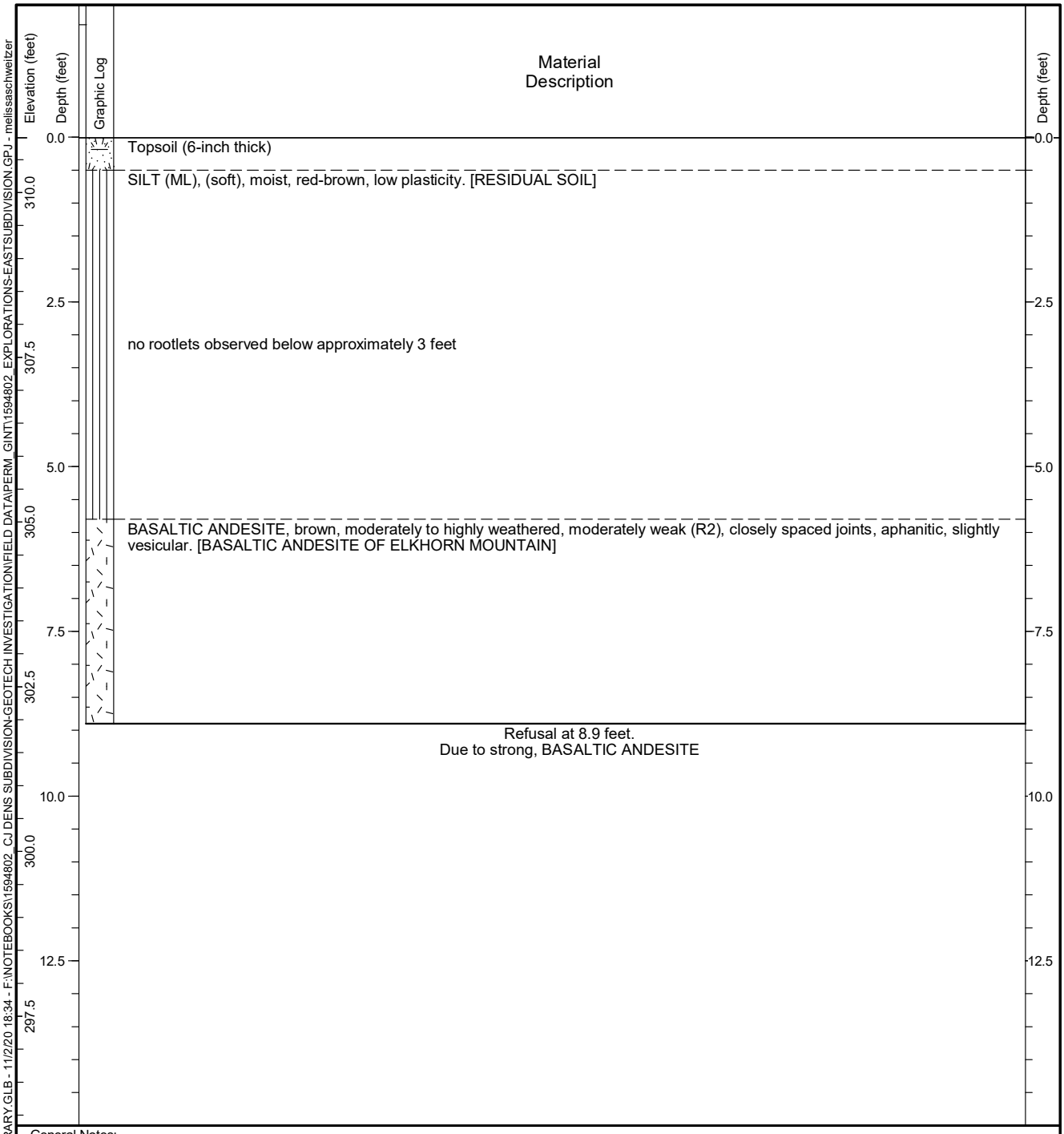
Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616100 Long: -122.413100 (WGS 84) Total Depth: 8.9 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 310.84 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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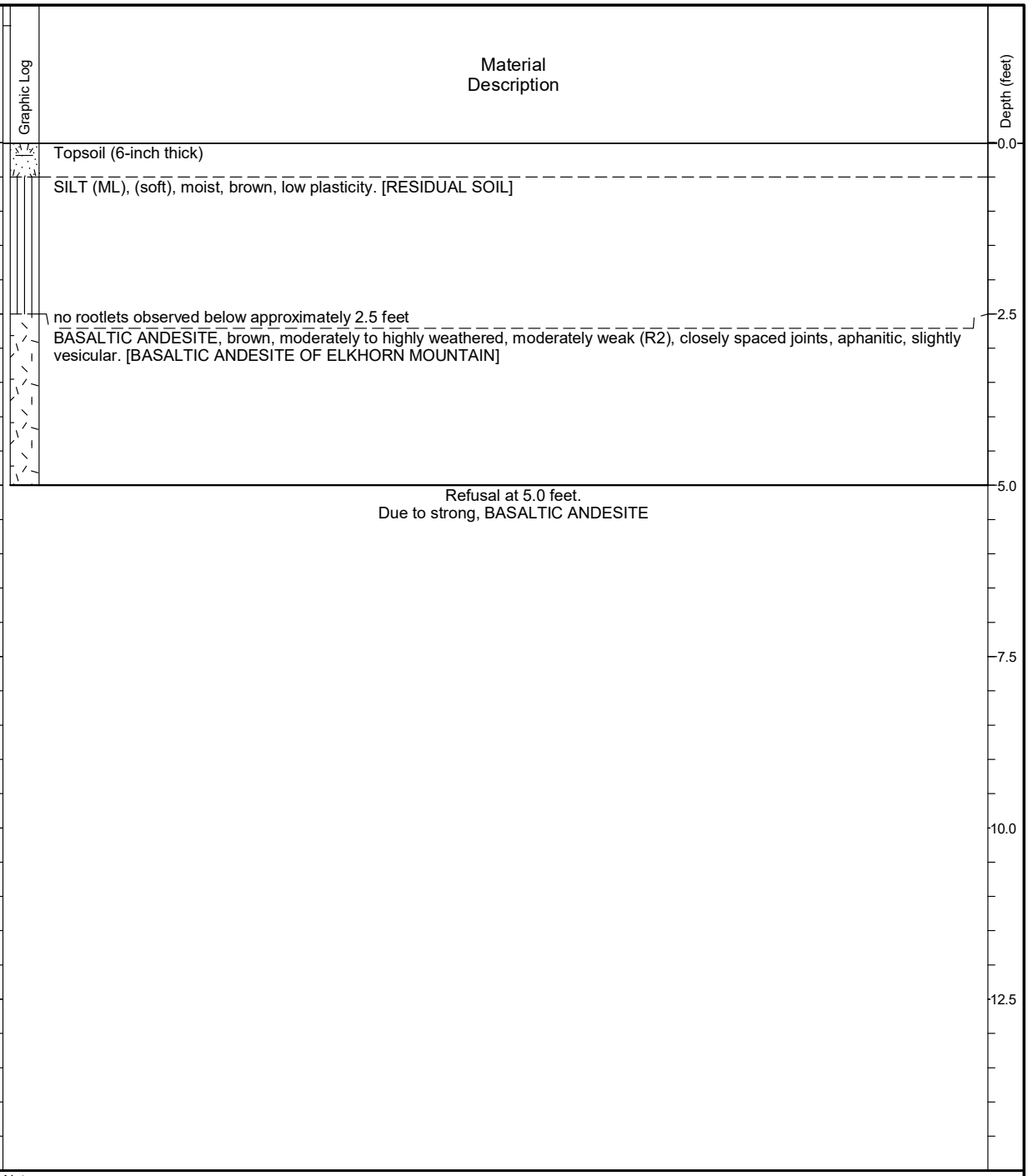
HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-76**	Figure **A-64** Sheet **1 of 1**

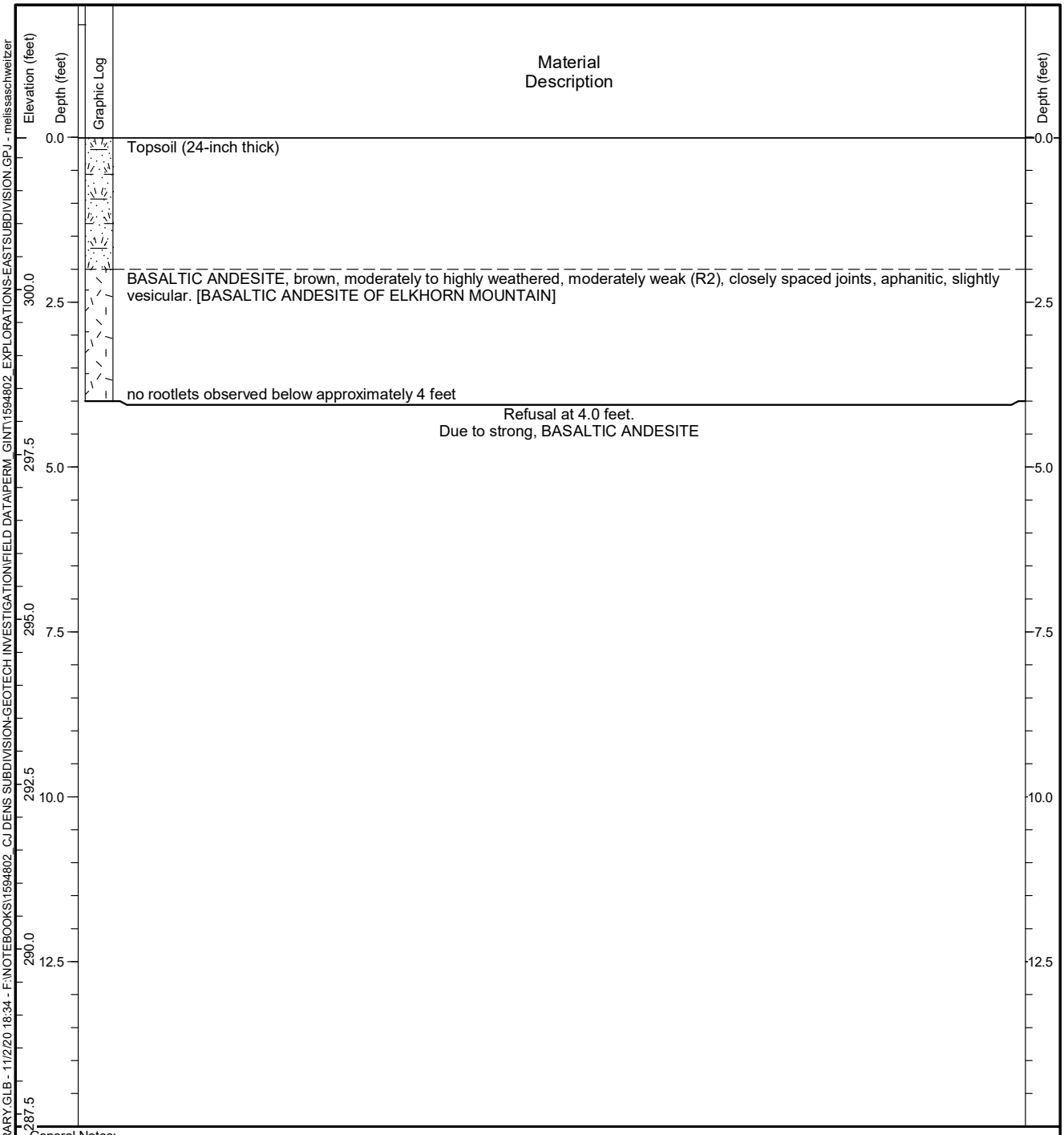
Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616000 Long: -122.412300 (WGS 84) Total Depth: 5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 298.63 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-77**	Figure **A-65** Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616100 Long: -122.411900 (WGS 84) Total Depth: 4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 302.31 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-78**	Figure **A-66** Sheet **1 of 1**

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Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616100 Long: -122.411400 (WGS 84) Total Depth: 9.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 314.66 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
312.5	0.0		Topsoil (6-inch thick)	0.0
			SILT (ML), (soft), moist, brown, low plasticity. [RESIDUAL SOIL]	
	2.5		SILTY GRAVEL (GM), (loose to medium dense), moist, red-brown, coarse angular gravel, low plasticity fines.	2.5
310.0			no rootlets observed below approximately 3.5 feet	
	5.0			5.0
307.5				
	7.5			7.5
305.0			Refusal at 9.5 feet. Due to strong, BASALTIC ANDESITE	
	10.0			10.0
302.5				
	12.5			12.5
300.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-79

Figure **A-67**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616200 Long: -122.411000 (WGS 84) Total Depth: 1.4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 305.96 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
305.0	0.0		Topsoil (3-inch thick) no rootlets observed below approximately 0.25 feet BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
			Refusal at 1.4 feet. Due to strong, BASALTIC ANDESITE	
302.5	2.5			2.5
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0			10.0
292.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-80

Figure **A-68**
Sheet **1 of 1**

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Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616300 Long: -122.410600 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 304.20 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
304.2	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
302.5	2.5		Refusal at 2.0 feet. Due to strong, BASALTIC ANDESITE	2.5
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0			10.0
292.5	12.5			12.5
290.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-81

Figure **A-69**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616400 Long: -122.410200 (WGS 84) Total Depth: 10.1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 305.84 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
305.0	0.0		Topsoil (24-inch thick)	0.0
			no rootlets observed below approximately 2 feet	
302.5	2.5		POORLY GRADED GRAVEL WITH SAND (GP), (loose to medium dense), moist, brown, medium sand, coarse angular gravel. [RESIDUAL SOIL]	2.5
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0		Refusal at 10.1 feet. Due to strong, BASALTIC ANDESITE	10.0
292.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-82

Figure **A-70**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616600 Long: -122.410000 (WGS 84) Total Depth: 11 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 305.54 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
305.0	0.0		Topsoil (6-inch thick)	0.0
			SILTY SAND (SM), (medium dense), moist, brown, medium to coarse sand. [RESIDUAL SOIL] no rootlets observed below approximately 0.67 feet	
302.5	2.5			2.5
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0			10.0
			Bottom of Test Pit at 11.0 feet.	
292.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-83

Figure **A-71**
Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.617100 Long: -122.409300 (WGS 84) Total Depth: 10 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 302.15 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
300.0	0.0		Topsoil (12-inch thick)	0.0
			SILTY SAND (SM), (medium dense), moist, brown, medium to coarse sand. [RESIDUAL SOIL]	
	2.5		no rootlets observed below approximately 3 feet	2.5
297.5	5.0			5.0
295.0	7.5			7.5
292.5	10.0		Bottom of Test Pit at 10.0 feet.	10.0
290.0	12.5			12.5
287.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-84

Figure **A-72**
Sheet **1 of 1**

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Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.617400 Long: -122.409200 (WGS 84) Total Depth: 10 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 296.32 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
296.0	0.0		Topsoil (30-inch thick)	0.0
			no rootlets observed below approximately 1.2 feet	
295.0	2.5		SILTY SAND (SM), (medium dense), moist, brown, medium to coarse sand. [RESIDUAL SOIL]	2.5
292.5	5.0			5.0
290.0	7.5			7.5
287.5	10.0		Bottom of Test Pit at 10.0 feet.	10.0
285.0	12.5			12.5
282.5				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-85

Figure **A-73**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616200 Long: -122.409900 (WGS 84) Total Depth: 3.1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 318.72 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
318.5	0.0		Topsoil (12-inch thick)	0.0
317.5			SILT (ML), (soft), moist, brown, low plasticity. [RESIDUAL SOIL]	
			no rootlets observed below approximately 2 feet	
316.2	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
315.6	3.1		Refusal at 3.1 feet. Due to strong, BASALTIC ANDESITE	
315.0	5.0			5.0
312.5	7.5			7.5
310.0	10.0			10.0
307.5	12.5			12.5
305.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-86

Figure **A-74**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616000 Long: -122.409700 (WGS 84) Total Depth: 5.8 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 325.10 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
325.0	0.0		Topsoil (12-inch thick)	0.0
			SILT WITH SAND (ML), (soft), moist, brown, fine to medium sand, low plasticity. [RESIDUAL SOIL]	
322.5	2.5		no rootlets observed below approximately 3.3 feet	2.5
320.0	5.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	5.0
			Refusal at 5.8 feet. Due to strong, BASALTIC ANDESITE	
317.5	7.5			7.5
315.0	10.0			10.0
312.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-87

Figure **A-75**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616000 Long: -122.409200 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 318.65 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
	0.0		Topsoil (24-inch thick)	0.0
317.5			no rootlets observed below approximately 1.5 feet	
	2.5		Refusal at 2.0 feet. Due to strong, BASALTIC ANDESITE	2.5
315.0				
	5.0			5.0
312.5				
	7.5			7.5
310.0				
	10.0			10.0
307.5				
	12.5			12.5
305.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-88

Figure **A-76**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616000 Long: -122.411100 (WGS 84) Total Depth: 5.2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 309.66 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
309.66	0.0		Topsoil (48-inch thick)	0.0
307.5	2.5		no rootlets observed below approximately 4 feet BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
305.0	5.0		Refusal at 5.2 feet. Due to strong, BASALTIC ANDESITE	5.0
302.5	7.5			7.5
300.0	10.0			10.0
297.5	12.5			12.5
295.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-89

Figure **A-77**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615900 Long: -122.411500 (WGS 84) Total Depth: 0 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 315.01 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
315.0	0.0		Refusal at 0.0 feet. Due to strong, BASALTIC ANDESITE	0.0
312.5	2.5			2.5
310.0	5.0			5.0
307.5	7.5			7.5
305.0	10.0			10.0
302.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-90

Figure **A-78**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:34 - F:\NOTEBOOKS\15948O2_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615900 Long: -122.411600 (WGS 84) Total Depth: 0 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 309.83 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
309.8	0.0		Refusal at 0.0 feet. Due to strong, BASALTIC ANDESITE	0.0
307.5	2.5			2.5
305.0	5.0			5.0
302.5	7.5			7.5
300.0	10.0			10.0
297.5	12.5			12.5
295.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

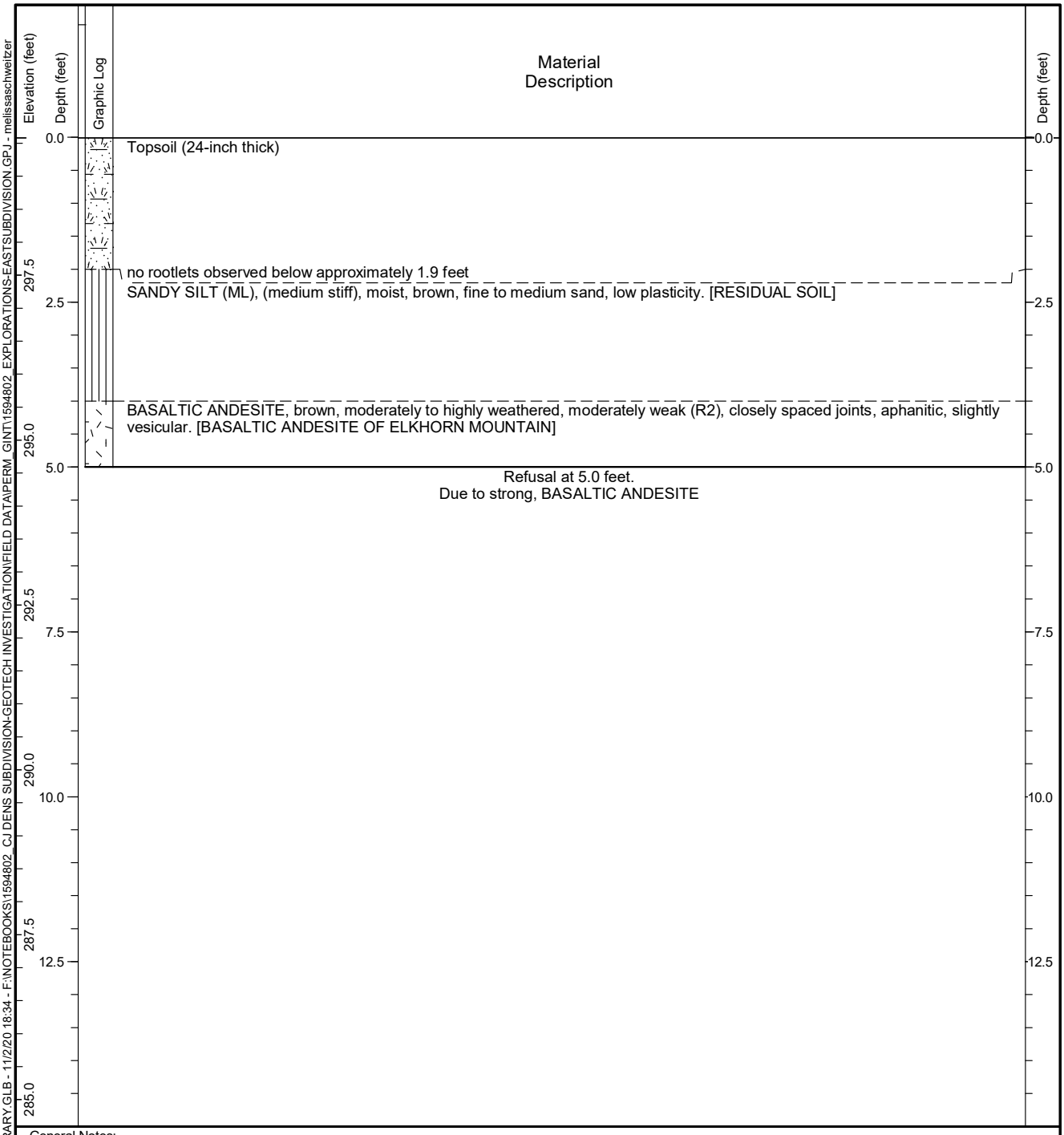
Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-91

Figure **A-79**
Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:34 - F:\NOTEBOOKS\1594802_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616400 Long: -122.410700 (WGS 84) Total Depth: 5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 299.59 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-92**	Figure **A-80** Sheet **1 of 1**

Date Started: 10/27/17 Date Completed: 10/27/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616500 Long: -122.410500 (WGS 84) Total Depth: 4.9 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 299.64 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
299.64	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
297.5	2.5		Organic rich soil observed within discontinuities from approximately 2 to 4 feet	2.5
295.0	5.0		Refusal at 4.9 feet. Due to strong, BASALTIC ANDESITE	5.0
292.5	7.5			7.5
290.0	10.0			10.0
287.5	12.5			12.5
285.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-93

Figure **A-81**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616400 Long: -122.412000 (WGS 84) Total Depth: 0 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 299.27 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
297.5	0.0		Refusal at 0.0 feet. Due to strong, BASALTIC ANDESITE	0.0
295.0	2.5			2.5
292.5	5.0			5.0
290.0	7.5			7.5
287.5	10.0			10.0
285.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-94

Figure **A-82**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616200 Long: -122.412600 (WGS 84) Total Depth: 2.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 317.41 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
315.0	0.0		Topsoil (7-inch thick)	0.0
			SILT WITH SAND (ML), (soft), moist, brown, fine to medium sand, low plasticity. [RESIDUAL SOIL]	
			no rootlets observed below approximately 0.92 feet	
312.5	2.5		Refusal at 2.5 feet. Due to strong, BASALTIC ANDESITE	2.5
310.0	5.0			5.0
307.5	7.5			7.5
305.0	10.0			10.0
302.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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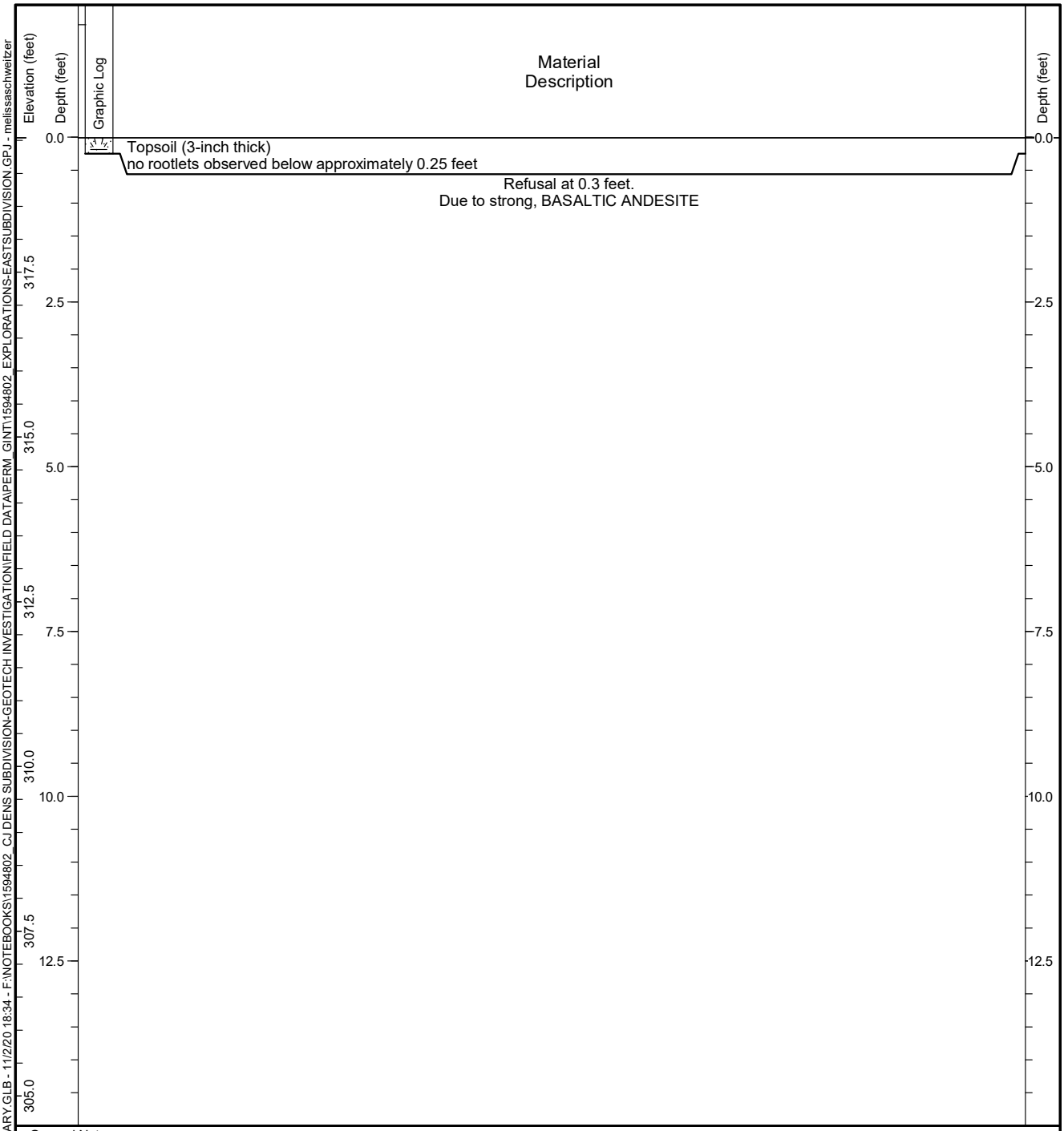
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-95

Figure **A-83**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616300 Long: -122.412700 (WGS 84) Total Depth: 0.25 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 319.55 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-96**	Figure **A-84** Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615900 Long: -122.414100 (WGS 84) Total Depth: 0.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 305.41 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
305.0	0.0		Topsoil (6-inch thick) no rootlets observed below approximately 0.5 feet	0.0
			Refusal at 0.5 feet. Due to strong, BASALTIC ANDESITE	
302.5	2.5			2.5
300.0	5.0			5.0
297.5	7.5			7.5
295.0	10.0			10.0
292.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-97

Figure **A-85**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616000 Long: -122.414100 (WGS 84) Total Depth: 0.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 302.41 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
300.0	0.0		Topsoil (6-inch thick) no rootlets observed below approximately 0.5 feet	0.0
			Refusal at 0.5 feet. Due to strong, BASALTIC ANDESITE	
297.5	2.5			2.5
295.0	5.0			5.0
292.5	7.5			7.5
290.0	10.0			10.0
287.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-98

Figure **A-86**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.616100 Long: -122.414700 (WGS 84) Total Depth: 5.4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 285.68 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
285.0	0.0		Topsoil (9-inch thick)	0.0
			SILT (ML), (soft), moist, brown, low plasticity. [RESIDUAL SOIL]	
282.5	2.5		no rootlets observed below approximately 4 feet	2.5
280.0	5.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	5.0
			Refusal at 5.4 feet. Due to strong, BASALTIC ANDESITE	
277.5	7.5			7.5
275.0	10.0			10.0
272.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-99

Figure **A-87**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615900 Long: -122.414700 (WGS 84) Total Depth: 2.25 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 286.04 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
285.0	0.0		Topsoil (8-inch thick)	0.0
			no rootlets observed below approximately 0.67 feet	
			BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	
282.5	2.5		Refusal at 2.3 feet. Due to strong, BASALTIC ANDESITE	2.5
280.0	5.0			5.0
277.5	7.5			7.5
275.0	10.0			10.0
272.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-100

Figure **A-88**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615800 Long: -122.415200 (WGS 84) Total Depth: 1 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 267.76 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
267.5	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
			Refusal at 1.0 feet. Due to strong, BASALTIC ANDESITE	
265.0	2.5			2.5
262.5	5.0			5.0
260.0	7.5			7.5
257.5	10.0			10.0
255.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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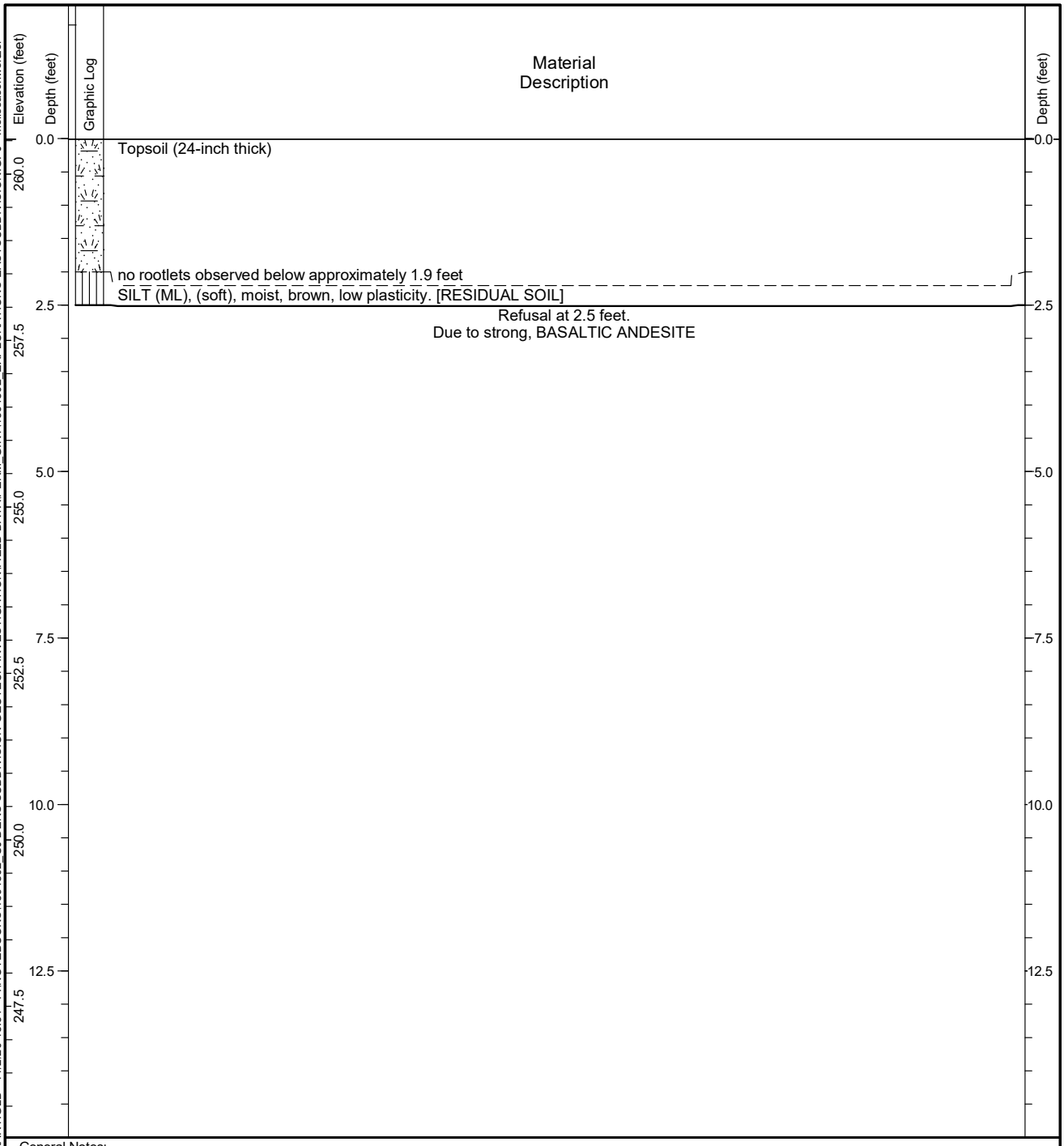
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-101

Figure **A-89**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615700 Long: -122.415400 (WGS 84) Total Depth: 2.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 260.53 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-102**	Figure **A-90** Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615200 Long: -122.415200 (WGS 84) Total Depth: 4.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 261.19 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
260.0	0.0		Topsoil (24-inch thick)	0.0
			no rootlets observed below approximately 1.9 feet	
257.5	2.5		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	2.5
			Refusal at 4.5 feet. Due to strong, BASALTIC ANDESITE	
255.0	5.0			5.0
252.5	7.5			7.5
250.0	10.0			10.0
247.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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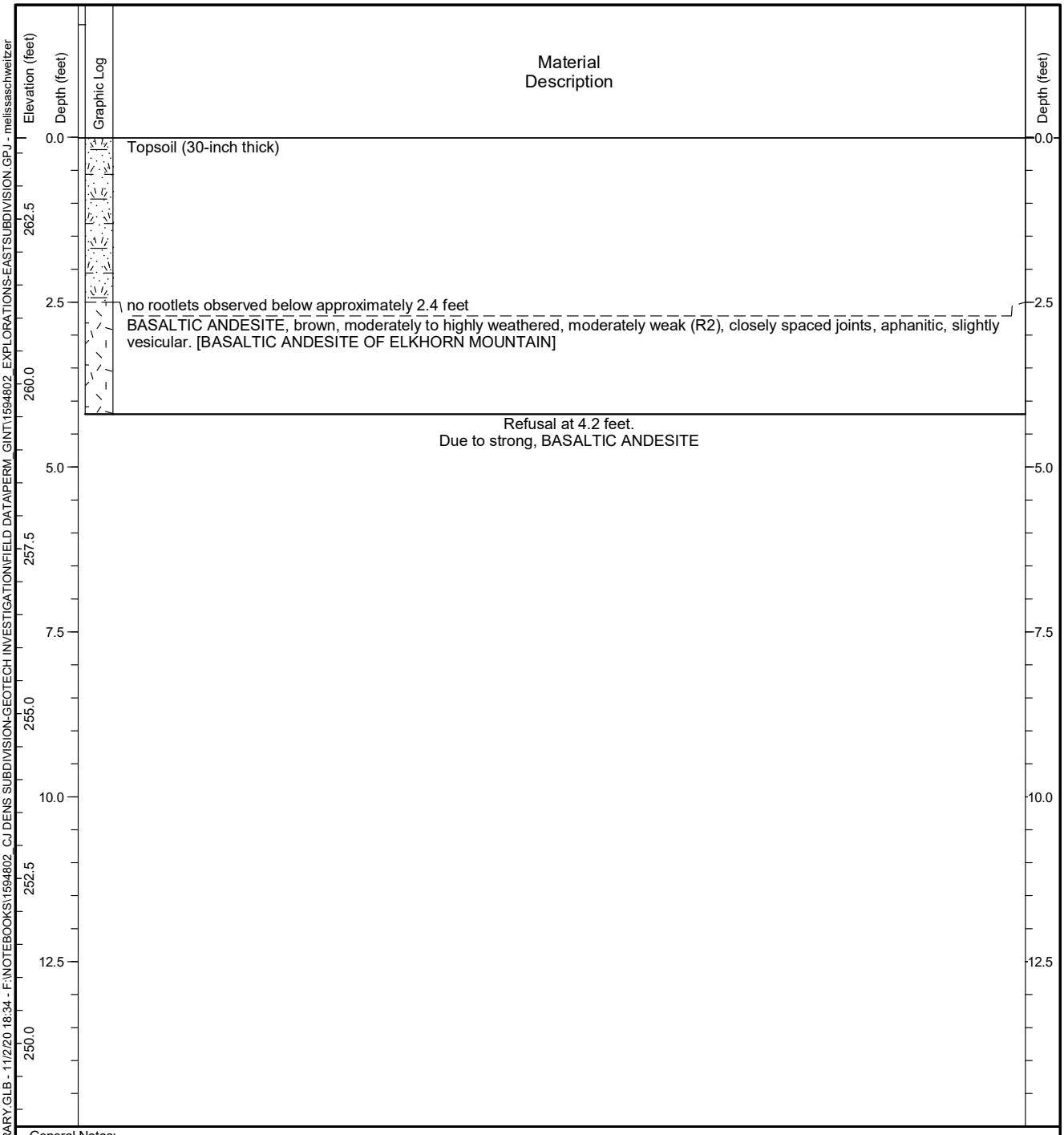
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-103

Figure **A-91**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615100 Long: -122.414800 (WGS 84) Total Depth: 4.2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 263.74 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-104**	Figure **A-92** Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615000 Long: -122.414600 (WGS 84) Total Depth: 3 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 264.12 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
262.5	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
	2.5			2.5
			Refusal at 3.0 feet. Due to strong, BASALTIC ANDESITE	
260.0	5.0			5.0
257.5	7.5			7.5
255.0	10.0			10.0
252.5	12.5			12.5
250.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

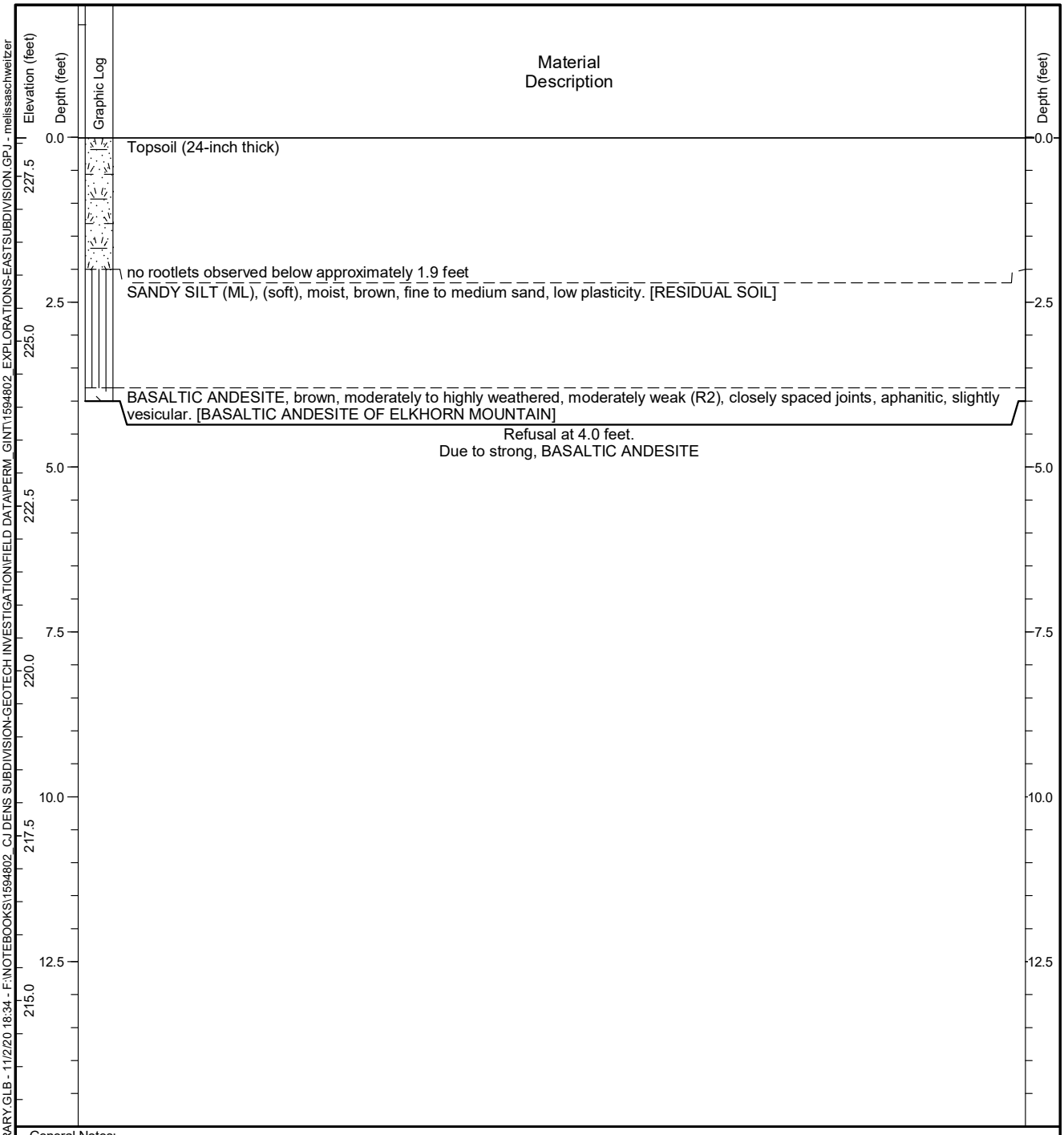
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-105

Figure **A-93**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614500 Long: -122.414100 (WGS 84) Total Depth: 4 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 228.09 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-106

Figure **A-94**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614300 Long: -122.413800 (WGS 84) Total Depth: 6.6 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 204.17 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
202.5	0.0		Topsoil (24-inch thick)	0.0
	2.5		SILT (ML), (soft), moist, brown, low plasticity. [COLLUVIUM] no rootlets observed below approximately 2.5 feet	2.5
200.0	5.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	5.0
197.5	7.5		Refusal at 6.6 feet. Due to strong, BASALTIC ANDESITE	7.5
195.0	10.0			10.0
192.5	12.5			12.5
190.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-107

Figure **A-95**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.614100 Long: -122.413400 (WGS 84) Total Depth: 10 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 195.83 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
195.0	0.0		Topsoil (2-inch thick)	0.0
			SILTY SAND (SM), (loose), moist, brown, fine to medium sand, low plasticity fines. [RESIDUAL SOIL]	
			no rootlets observed below approximately 0.5 feet	
192.5	2.5			2.5
190.0	5.0			5.0
187.5	7.5			7.5
185.0	10.0		Bottom of Test Pit at 10.0 feet.	10.0
182.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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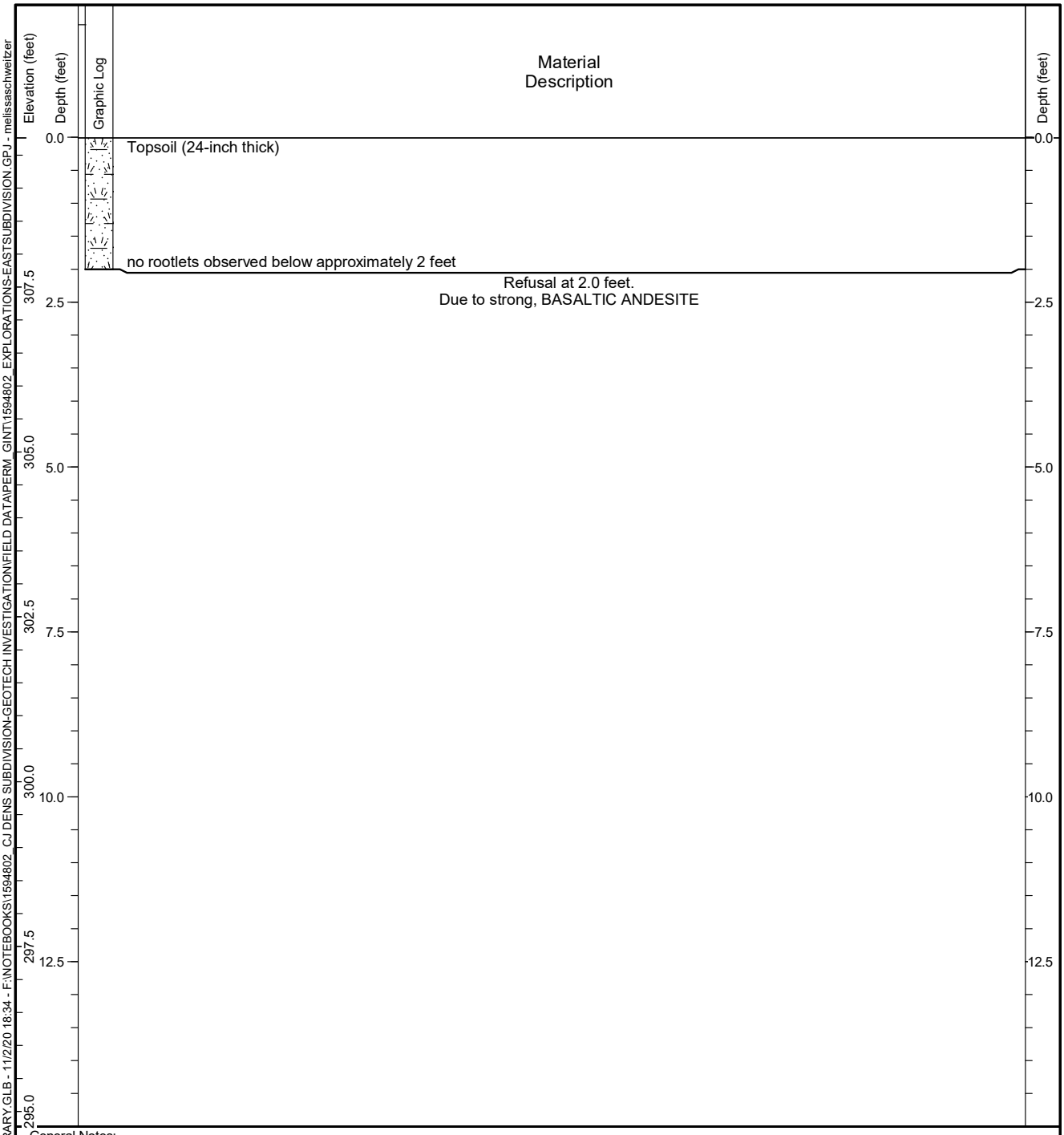
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-108

Figure **A-96**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615400 Long: -122.411800 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 309.77 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-109**	Figure **A-97** Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615300 Long: -122.411600 (WGS 84) Total Depth: 2.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 304.37 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
302.5	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
			no rootlets observed below approximately 2.5 feet	
300.0	2.5		Refusal at 2.5 feet. Due to strong, BASALTIC ANDESITE	2.5
297.5	5.0			5.0
295.0	7.5			7.5
292.5	10.0			10.0
290.0	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-110

Figure **A-98**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615200 Long: -122.409900 (WGS 84) Total Depth: 2 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 336.05 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
336.0	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN]	0.0
335.0			no rootlets observed below approximately 2 feet	
			Refusal at 2.0 feet. Due to strong, BASALTIC ANDESITE	
332.5	2.5			2.5
330.0	5.0			5.0
327.5	7.5			7.5
325.0	10.0			10.0
322.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

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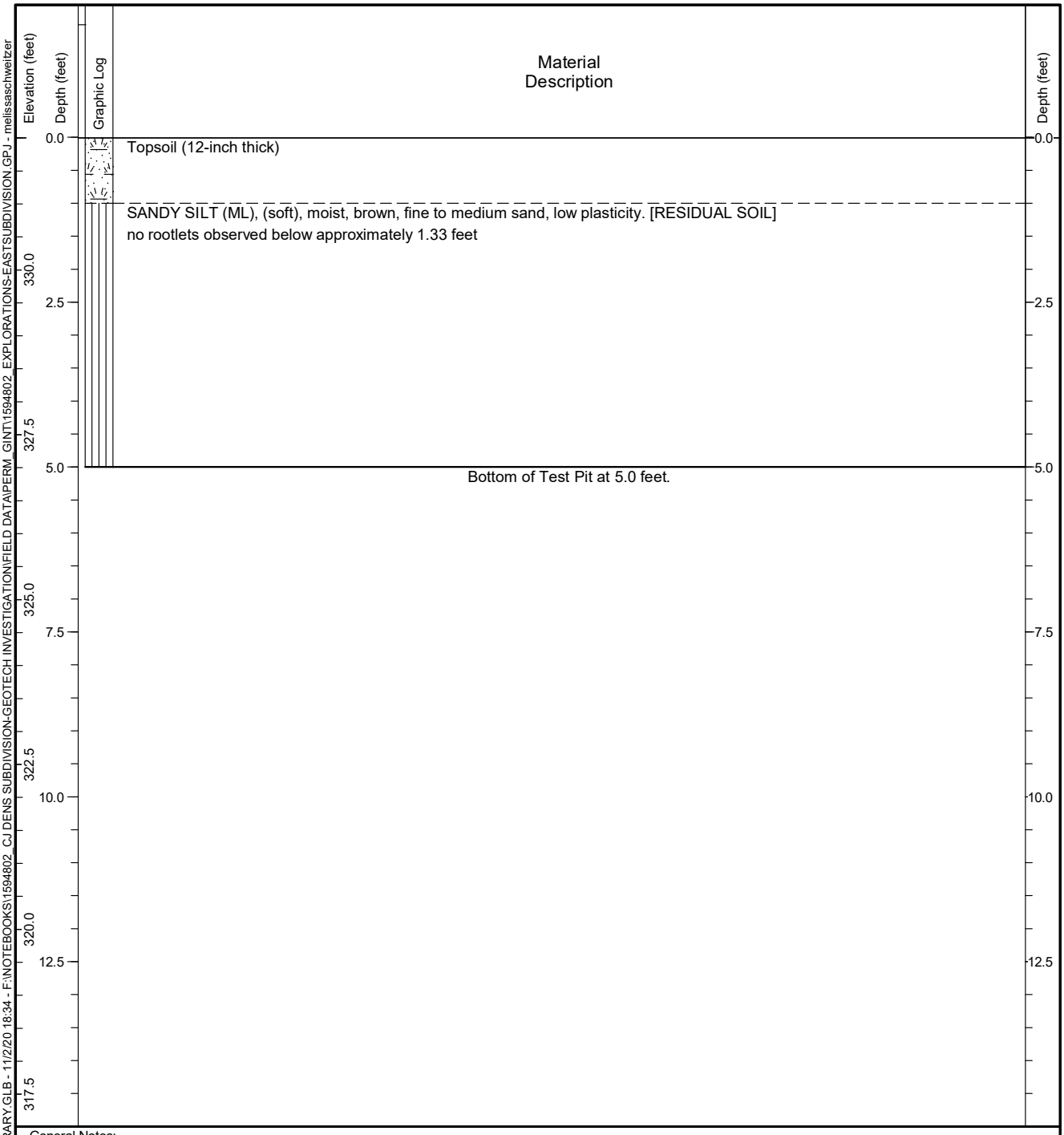
HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-111

Figure **A-99**
Sheet **1 of 1**

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615200 Long: -122.410200 (WGS 84) Total Depth: 5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 332.01 feet (NGVD 88)
Comments:



General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich	Project: CJ Dens East Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-112**	Figure **A-100** Sheet **1 of 1**

HC TEST PIT - F:\GINT\HC_LIBRARY.GLB - 11/2/20 18:34 - F:\NOTEBOOKS\1594802_CJ DENS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-EASTSUBDIVISION.GPJ - melissaschweitzer

Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615200 Long: -122.410700 (WGS 84) Total Depth: 0.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 325.17 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
325.0	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN] no rootlets observed below approximately 0.5 feet	0.0
			Refusal at 0.5 feet. Due to strong, BASALTIC ANDESITE	
322.5	2.5			2.5
320.0	5.0			5.0
317.5	7.5			7.5
315.0	10.0			10.0
312.5	12.5			12.5

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HARTCROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-113

Figure **A-101**
Sheet **1 of 1**

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Date Started: 10/30/17 Date Completed: 10/30/17 Contractor/Crew: Tapani, Inc.
Logged by: J. Robinson Checked by: R. Rosenberg Rig Model/Type: Komatsu PC-200
Location: Lat: 45.615100 Long: -122.410700 (WGS 84) Total Depth: 0.5 feet Depth to Seepage: Not Encountered
Ground Surface Elevation: 323.50 feet (NGVD 88)
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
323.5	0.0		BASALTIC ANDESITE, brown, moderately to highly weathered, moderately weak (R2), closely spaced joints, aphanitic, slightly vesicular. [BASALTIC ANDESITE OF ELKHORN MOUNTAIN] no rootlets observed below approximately 0.5 feet	0.0
322.5	1.0		Refusal at 0.5 feet. Due to strong, BASALTIC ANDESITE	
320.0	2.5			2.5
	5.0			5.0
317.5	7.5			7.5
315.0	10.0			10.0
312.5	12.5			12.5
310.0				

General Notes:
1. Refer to Figure A-8 for explanation of descriptions and symbols.
2. Material stratum lines are interpretive and actual changes may be gradual. Solid lines indicate distinct contacts and dashed lines indicate gradual or approximate contacts.
3. USCS designations are based on visual-manual identification (ASTM D 2488), unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.
5. Location and ground surface elevations are approximate.

HART CROWSER A division of Haley & Aldrich

Project: CJ Dens East Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-114

Figure **A-102**
Sheet **1 of 1**

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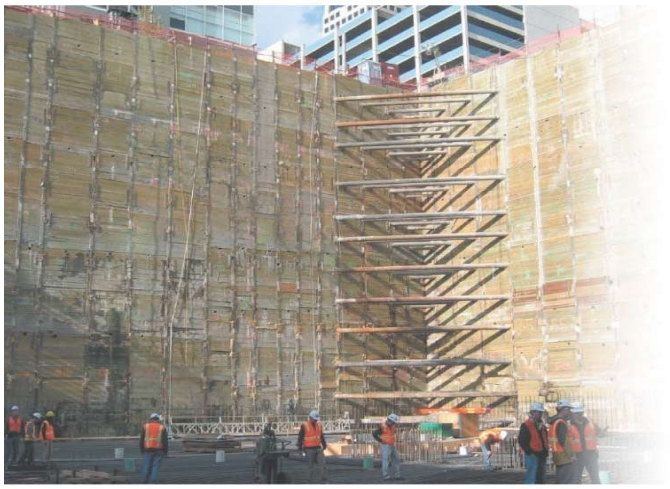

Report of Geotechnical Engineering Services

CJ Dens Subdivision

Camas, Washington

Prepared for

CJ Dens Lacamas I, LLC

July 6, 2016
15948-02

HARTCROWSER

HARTCROWSER www.hartcrowser.com

Report of Geotechnical Engineering Services

CJ Dens Subdivision

Camas, Washington

Prepared for

CJ Dens Lacamas I, LLC

July 6, 2016
15948-02

Prepared by

Hart Crowser, Inc.

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Contents

1.0 INTRODUCTION 1

2.0 PROJECT DESCRIPTION 1

3.0 SCOPE OF SERVICES 2

4.0 SITE CONDITIONS 3
4.1 Geologic and Soil Mapping 3
4.2 Surface Conditions 3
4.3 Subsurface Conditions 4
4.3.1 General 4
4.3.2 Soil Conditions 4
4.3.3 Groundwater 6

5.0 GEOLOGIC AND SEISMIC HAZARDS 6
5.1 Seismic Shaking 6
5.2 Ground Motion Amplification (Site Class) 7
5.3 Liquefaction 7
5.4 Earthquake-Induced Landsliding 7
5.5 Ground Fault Rupture 7
5.6 Geologically Hazardous Areas 8
5.7 Severe Erosion Hazard 8

6.0 CONCLUSIONS 8

7.0 STRUCTURAL DESIGN RECOMMENDATIONS 9
7.1 Design Response Spectrum 9
7.2 Foundation Support Recommendations 9
7.2.1 General 9
7.2.2 Dimensions and Design Parameters 10
7.2.3 Foundation Subgrade Preparation 11
7.3 Floor Slabs 11
7.4 Retaining Structures 12
7.4.1 Cantilevered Wall Design Parameters 12
7.4.2 MSE Wall Design Parameters 12
7.4.3 Surcharges 13
7.4.4 Foundations 13
7.4.5 Drainage, Waterproofing, and Backfill 14

8.0 EARTHWORK RECOMMENDATIONS 14
8.1 Site and Subgrade Preparation 15
8.1.1 Stripping and Clearing 15
8.1.2 Subgrade Preparation and Evaluation 15
8.1.3 Bench Preparation for Fill on Slopes 15
8.2 Wet Soil/Wet Weather Construction 16
8.3 Excavation, Shoring, and Dewatering 17
8.4 Structural Fill and Backfill 18
8.4.1 On-Site Soils and Bedrock Spoils 18
8.4.2 Imported Select Structural Fill 18
8.4.3 Aggregate Base 18
8.4.4 Trench Backfill 19
8.4.5 Drain Rock 19
8.4.6 Retaining Wall Select Backfill 19
8.4.7 Stabilization Material 19
8.5 Fill Placement and Compaction 20
8.6 Temporary Drainage 21

9.0 DRAINAGE 21
9.1 Surface Drainage 21
9.2 Subsurface Drainage 22

10.0 PAVEMENT DESIGN AND CONSIDERATIONS 22
10.1 General 22
10.2 Design Criteria 22
10.3 Pavement Sections 23
10.4 Pavement Materials 23

11.0 CONSTRUCTION OBSERVATIONS 24

12.0 LIMITATIONS 24

13.0 REFERENCES 25

TABLES

1 Seismic Design Parameters 9
2 Footing Base Friction Coefficient 10
3 Cantilevered Retaining Wall Earth Pressures 12
4 MSE Wall Design Parameters 13
5 Guidelines for Uncompacted Lift Thickness 20
6 Fill Compaction Criteria 21
7 Pavement Sections 23

FIGURES

1 Vicinity Map
2 Site Plan – Existing
3 Site Plan – Proposed
4 Profile A-A'
5 Profile B-B'
6 Profile C-C'
7 Typical Cut and Fill Slope Cross Section

APPENDIX A

Field Explorations
A1 – Current Test Pits (5/16)
A2 – Prior Test Pits (11/15)

APPENDIX B

Laboratory Testing

Report of Geotechnical Engineering Services

CJ Dens Subdivision

Camas, Washington

1.0 INTRODUCTION

Hart Crowser, Inc. is pleased to present this report to CJ Dens Lacamas I, LLC describing our geotechnical engineering services for the proposed CJ Dense Subdivision off of Leadbetter Road in Camas, Washington. Our work was performed in general accordance with our Contract Change Order dated May 27, 2016.

Hart Crowser has previously completed work at the site. In March 2013, Hart Crowser prepared an update to an existing Critical Areas Report (CAR) (dated 2005) and a Level One Hydrogeologic Assessment for the proposed subdivision. Several potential geologic hazards areas were identified during those studies. In December 2015, Hart Crowser completed an initial site-specific evaluation of two specific hazard areas (identified as A and C). Based on that initial review, it was our opinion that those geohazard areas did not present geologic hazards to the project that could not be reasonably mitigated. Details regarding these studies were provided in the reports listed below.

- Critical Areas Report – Update – Proposed Camas Subdivision – Leadbetter Road, Camas, Washington, HC Project Number 15948-01-01, dated march 19, 2013.
- Level One Hydrogeologic Assessment – Proposed Camas Subdivision – Leadbetter Road, Camas Washington, HC Project Number 15948-01-02, dated March 19, 2013
- Initial Site-Specific Evaluation of Geohazard Areas A and C – Camas Subdivision – Leadbetter Road, Camas, Washington, HC project number 15948-02, dated December 7, 2015.

2.0 PROJECT DESCRIPTION

Hart Crowser understands the overall proposed development will consist of an approximately 300-lot residential subdivision. However, the current work is limited to an initial phase of approximately 200 lots in the southern and eastern portions of the property. The remaining, northwestern portion of the site, is not included in this geotechnical study.

Conventional one- to three-story, single-family residences supported on shallow foundations will be constructed on each lot. We anticipate the buildings will be constructed with wood frames and will be relatively lightly loaded with strip loads up to 2.5 kips per lineal foot and column loads of 75 kips. Infrastructure, such as roadways and utilities, will also be constructed. We understand that mass cuts and fills of up to 20 feet will be required for site grading.

This report contains the results of our analysis and provides recommendations for design and construction of the subdivision. The first section of this report provides an overview of the project information discussed in the text. The main body of the report presents our geotechnical engineering findings and recommendations in detail. Figures are presented at the end of the text. The location of the site is shown on Figure 1, and the existing and proposed site layouts are shown on Figures 2 and 3, respectively. Supporting information is provided in the appendices. Appendix A contains site subsurface exploration logs, and Appendix B contains the results of laboratory testing completed for our analysis.

3.0 SCOPE OF SERVICES

The purpose of our work was to evaluate subsurface conditions at the project site and to provide geotechnical engineering services for design of project elements. Our complete scope of work was described in our Contract Change Order 2 and is summarized below.

- Conducted field explorations with Tapani Underground by excavating 22 test pits to bedrock, maintained a log of the soils and bedrock encountered in the test pits, and collected samples for laboratory testing.

- Conducted a limited program of laboratory testing on select soil and bedrock samples. The scope of testing included moisture content determinations, particle-size analyses, and Atterberg limits tests.

- Conducted engineering analysis to develop geotechnical design recommendations for earthwork, foundations, retaining walls, pavements, and seismic design criteria.

- Prepared this geotechnical report outlining our findings and recommendations, including information related to:
  - Subsurface soil, bedrock, and groundwater conditions;
  - Slope stability and slope stabilization measures;
  - Seismic hazards and design criteria;
  - Site preparation and grading;
  - Foundation design parameters;
  - Retaining wall design parameters; and
  - Pavement design (conventional asphalt and concrete).

- Provided project management and support services, including coordinating staff, conducting telephone consultations and email communications with you and the design team, etc.

4.0 SITE CONDITIONS

4.1 Geologic and Soil Mapping

The geology of the site is mapped in the *Geologic Map of the Vancouver Quadrangle, Oregon and Washington* (Phillips 1987). The geologic mapping of Phillips indicates that the site is predominantly underlain by Oligocene-age "Skamania Volcanics." The mapping of Evarts and O'Connor (2008) supersedes previous work and differentiates "Skamania Volcanics" into two distinct units at the site. Evarts and O'Connor have mapped the eastern hilltop and adjacent upper slopes as underlain by Oligocene "Volcaniclastic sedimentary rock" interbedded with basalt. The remainder of the site is mapped as underlain by Oligocene "Basaltic andesite of Elkhorn Mountain." Evarts and O'Connor (2008) explain that they consider the term "Skamania Volcanics" too broad and poorly defined to be useful; however, given the age they assign to these units and their description, these materials appear equivalent to the "Skamania Volcanics" of Phillips (1987). Our explorations of the site indicate that a majority of the site is underlain by residual and colluvial soils overlying volcanic breccia and basaltic andesite, which is consistent with the geologic mapping.

The near-surface soils at the site are mapped by the U.S. Department of Agriculture (USDA) as found on the Web Soil Survey (USDA 2006) website. The report generated by Web Soil Survey for the site indicates near surface soils in the vicinity of the project consist predominantly of Olympic Clay Loam (OlD) and Olympic Stony Clay Loam (OmE) and Vader Silt Loam (VaB/VaC). The Olympic soils are described as a mountain slope landform derived from residual soil and colluvium consisting of clay loam with varying percentages of gravel content. These soils are considered well drained, with a moderately high permeability ranging from approximately 0.2 to 0.6 inches per hour. The Vader soils are derived from residual soil and colluvium with a sedimentary rock parent material consisting of ashy silt loam over weathered bedrock. They are also considered well drained, with a moderately high to high permeability of approximately 0.6 to 2.0 inches per hour.

4.2 Surface Conditions

The proposed subdivision site is located on the upslope (northeast) side of Leadbetter Road in Camas, Washington. The site is within the NE Quarter of Section 34 and NW Quarter of Section 35, of Township 2 North and Range 3 East of the Willamette Meridian. The property is comprised of four irregularly shaped parcels (178236-000, 178172-000, 177906-000, and 177905-000) that total approximately 85 acres. The southeast corner of the site is approximately 500 feet northwest of the intersection of Leadbetter Road and NE Everett Street. The southern end of Lacamas Lake is located on the opposite (southwest) side of Leadbetter Road. A vicinity map of the project site is presented on Figure 1.

The site consists of two upland areas separated by a northeast to southwest-trending unnamed stream drainage. The site topography is highly variable, ranging from uniform to irregular and nearly level to very steeply sloping. Elevations range from approximately 175 feet along Leadbetter Road to approximately 360 feet along the northern property line. The overall existing site topography is shown on Figure 2.

The portion of the site northwest of the drainage comprises approximately 35 acres. This area is characterized by a series of small hilltops separated by short, moderately steep to gentle slopes. The northern site boundary rises gently to a broad upland plateau off site, while the southwest boundary slopes down moderately steeply to steeply to Leadbetter Road along Lacamas Lake. The internal slopes along the northwest side of the unnamed stream valley slope steeply down to the southeast and east. (This portion of the site in not included in the current study, as development of this area is not yet proposed.)

The approximately 50-acre portion of the site southeast of the drainage, which is included in this study, is dominated by an approximately 1,500-foot-long, broad-topped, west-trending ridge. This area was recently logged in the winter of 2015/2016 and is covered with light brush. The base of the ridge extends off site to the east and descends along steep, 60- to 80-foot-high side slopes down to Leadbetter Road along the southwest property boundary. The steep slopes descending into the unnamed stream canyon range from 40 to 80 feet high. Several short, steep internal slopes bound scattered rocky internal hilltops that rise above the ridge surface.

4.3 Subsurface Conditions

4.3.1 General

Soil conditions interpreted from geologic maps and our explorations, in conjunction with soil properties inferred from field observations and laboratory tests, formed the basis for the conclusions and recommendations in this report. Appendix A describes our field exploration procedures and presents field data and logs. Appendix B describes our laboratory soil testing procedures and results.

We completed explorations at the site by advancing nine test pits, designated TP-1A through TP-9A, to depths ranging from 4 to 14 feet below ground surface (bgs) on November 23, 2015, and an additional 22 test pits, designated TP-1 through TP-22, to depths ranging from approximately 2.5 to 12.5 feet bgs on May 27, 2016. Test pit locations are shown on Figures 2 and 3. The recent test pit logs are included in Appendix A1, while the prior test pit logs are included in Appendix A2.

The project area is typically mantled with residual soil and colluvium to depths ranging from approximately 1 to 12 feet bgs. Soils in the upland and hillslope areas of the site were typically in the range of 0.5 to 4 feet in thickness, while soils in drainages and at the bottom of slopes were thicker. Underlying the residual soil and colluvium is fresh to moderately weathered basaltic andesite and volaniclastic breccia to the maximum depths explored. Descriptions of these units are provided below.

4.3.2 Soil Conditions

4.3.2.1 Colluvium

Colluvium was encountered on or at the bottom of hillslopes at the site and is interpreted as slope wash deposits. The colluvium consisted of silty sand, sandy silt, silt with sand, elastic silt and lean clay with sand with varying percentages of fine, subrounded to subangular gravel. Colluvium up to 12 feet thick was encountered in test pit TP-8, but typically ranged from approximately 1 to 5 feet thick, and was thicker at the bottom of slopes. The colluvium was typically covered with approximately 6 to

12 inches of rooted topsoil. Based on the backhoe action and pocket penetrometer tests in the sidewalls of the excavations, we estimate the relatively density of the fine-grained colluvium to be soft to medium stiff and the coarse-grained colluvium to be loose to medium dense.

Moisture contents in the colluvium varied from approximately 25 to 42 percent based on 12 tests. Atterberg limit testing was conducted on two samples of fine-grained colluvium yielding liquid limits of 43 to 48 and plastic limits of 23 to 34 indicating silt to lean clay soil classifications.

4.3.2.2 Residual Soil

Residual soil consisting of silty sand, sandy silt, and lean clay with varying percentages of sand and fine gravel was encountered at the surface or underlying colluvium at the site. Residual soil is interpreted as completely weathered and decomposed in-place bedrock that has experienced minimal transport by water or other means. Residual soil was encountered at the ground surface in test pits TP-1, TP-2, TP-5, TP-20, and TP-21 and underlying the colluvium at depths ranging from 4 to 12 feet bgs in test pits TP-1a, TP-5a, TP-6a, TP-8, and TP-14. The residual soil extends to the maximum depth explored (13 feet bgs) in test pit TP-8. Based on the backhoe action during test pit excavation, we estimate the relative density of the fine-grained residual soil is soft to very stiff and the coarse-grained residual soil is loose to dense.

Moisture contents in the residual soil varied from 20 to 38 percent based on six tests. Atterberg limits testing was conducted on two samples of fine-grained residual soil yielding liquid limits of 46 to 49 and plastic limits of 26 to 31 indicating a silt soil classification.

4.3.2.3 Oligocene Basaltic Andesite of Elkhorn Mountain

Bedrock interpreted as Oligocene-age Basaltic Andesite of Elkhorn Mountain was observed in numerous outcrops across the site and was encountered near the surface and in test pits TP-3, TP-4, TP-11, TP-17, TP-18, and TP-22. Basaltic andesite was encountered at depths ranging from about 1.5 to 8 feet in test pits TP-1, TP-2, TP-5, TP-9 through TP-16, and TP-21. The basaltic andesite varied from fresh to moderately weathered, moderately weak to strong (R2-R4), with closely to moderately spaced fractures. The basalt was typically rippable with a toothed bucket to at least 1 foot below top of rock with moderate effort. Moisture contents in the basaltic andesite varied 9.0 to 9.4 percent based on two tests.

4.3.2.4 Oligocene Volcaniclastic Sedimentary Rock

Volcaniclastic breccia, interpreted as Oigocene-age Volcaniclastic Sedimentary Rock, was encountered at depths ranging from approximately 3 to 13 feet bgs in test pits TP-1a through TP-6a, TP-6, TP-7, TP-19, and TP-20. Volcaniclastic breccia was encountered in the northwest and southeast limits of our explorations and statigraphically underlies the basaltic andesite; no outcrops of volcaniclastic breccia were observed at the surface during our explorations. The breccia consists of angular, medium sand to coarse-gravel-sized fragments of igneous rocks in a weakly-cemented, fine-grained matrix. The breccia was typically moderately to highly weathered, thin-bedded, brown-gray to red-brown, and very weak to moderately weak (R1-R2), with closely spaced fractures. The breccia was typically rippable to at least 1 foot below top of rock with minimal effort.

4.3.2.5 Limitations

The subsurface information used for this study represents conditions at a discrete location at the project site. Actual conditions in other areas could vary. The nature and extent of any variations in subsurface conditions may not become evident until construction begins. If significant variations are observed at that time, we may need to modify our conclusions and recommendations accordingly to reflect actual site conditions.

4.3.3 Groundwater

Subsurface water seepage was encountered in test pit TP-1 at a depth of approximately 7.5 feet bgs. No other test pits encountered seepage during our explorations. Based on local well logs that are primarily screened in the basaltic andesite and volcaniclastic breccia, we anticipate regional groundwater levels to be approximately 50 to 100 feet bgs at the site. We anticipate shallowly infiltrating precipitation and surface run off can become perched within the upper soils at the site during the wetter months of the year, and may approach the ground surface during periods of heavy rain.

5.0 GEOLOGIC AND SEISMIC HAZARDS

5.1 Seismic Shaking

The site is in a seismically active area. In this section, we describe the seismic setting at the project site, identify the seismic basis of design, and discuss the seismic hazards at the site.

The seismicity of the region is controlled by the Cascadia Subduction Zone. Plate tectonics cause the oceanic Juan de Fuca Plate to subduct beneath the continental North American Plate. Three types of earthquakes are associated with subduction zones: intraslab, interface, and crustal earthquakes. Contributions from each of these sources to the total site seismic hazard was evaluated using the U.S. Geologic Survey (USGS) 2008 Interactive Deaggregations (USGS 2013).

Intraslab and Interface Sources. Subduction zones are characterized by the interaction of the oceanic Juan de Fuca plate and continental North American plates. As the oceanic plate subducts beneath the continental plate, the two plates lock together. As the plates move together, stresses similar to a spring build in the overlying continental plate. This stress acts to unlock the two plates. When the magnitude of the *spring* stresses becomes large enough to overcome the stresses locking the plates together, the plates will suddenly rupture causing an interface earthquake. Interface earthquakes (such as the 2011 magnitude M9.0 Tohoku earthquake in northern Japan) are some of the largest magnitude earthquakes on record.

Intraslab earthquakes originate from a deeper zone of seismicity that is associated with bending and breaking of the subducting Juan de Fuca plate. Intraslab earthquakes (such as the 2001 magnitude M7.0 Nisqually earthquake in west central Washington) occur at depths of 40 to 70 kilometers (km) and can produce earthquakes with magnitudes up to and greater than magnitude M7.0. Our review of the interactive deaggregations indicate interface and intraslab earthquakes contribute approximately 50 percent of the total seismic hazard to the site.

Crustal Sources. Shallow crustal faults are caused by cracking of the continental crust resulting from the stress that builds as the subduction zone plates remain locked together. Numerous crustal faults are mapped in the region and contribute approximately 17 percent of the total seismic hazard to the site. The remainder (approximately 32 percent) of the seismic hazard is "gridded" crustal faults, which represent general hazards, but not hazard associated with a specific fault.

We anticipate seismic design of new structures will be completed in accordance with the Washington State Building Code (Washington State Building Code Council 2013), which is based on the 2012 International Building Code (IBC) (ICC 2012). We evaluated potential seismic shaking at the site using data obtained from the U.S. Seismic Design Maps (USGS 2008). The expected peak bedrock acceleration having a 2 percent probability of exceedance in 50 years (2,475-year return period) is 0.380g. This value represents the peak acceleration on bedrock beneath the site and does not account for ground motion amplification due to site-specific effects. The peak ground acceleration (PGA) is determined by applying a Site Class factor to the peak bedrock acceleration. Refer to *Section 5.2 - Ground Motion Amplification (Site Class)* for a discussion of ground motion amplification.

5.2 Ground Motion Amplification (Site Class)

Thick sequences of unconsolidated, soft sediments typically amplify the shaking of long-period ground motions, such as those associated with subduction zone earthquakes; whereas, areas underlain by shallow soil profiles are not likely to amplify seismic waves.

The "Site Class" is a designation used by the 2012 IBC to quantify ground motion amplification. The classification is based on the stiffness in the upper 100 feet of soil and bedrock materials at a site. At the project site the upper 4 to 15 feet of soil is generally soft to medium stiff overlying shallow bedrock. This information leads us to classify the site as Site Class D.

5.3 Liquefaction

Based on the relatively deep phreatic groundwater elevation and shallow bedrock mantling the project site, a liquefaction hazard is likely not present.

5.4 Earthquake-Induced Landsliding

Based on the relatively thin soils overlying shallow bedrock at the site, in our opinion, the potential for earthquake-induced landsliding is low.

5.5 Ground Fault Rupture

Based on our review of the USGS Fault and Fold Database (Personius 2002) and mapping of Evarts and O'Connor (2008), several active crustal faults are mapped at and near the site. These include the Northeast/Southwest trending Lacamas Lake Fault, which is inferred beneath Lacamas Lake a few hundred feet from the site and the Northeast/Southwest-trending Prune Hill Thrust Fault, which intersects the Lacamas Lake Fault near the site. Additionally, two small unnamed faults, likely coincident with the Lacamas Lake Fault, are mapped within the project site near Leadbetter Road. No

faults were observed during our explorations. Although the age of movement is somewhat poorly constrained on the mapped faults in the area, we consider there to be a moderate risk of ground surface fault rupture at the site.

5.6 Geologically Hazardous Areas

Geologic Hazard Areas were addressed in our Critical Areas Update and Initial Site-Specific Evaluation of Geohazard Areas A and C for the site. As discussed, the majority of the site is mantled with thin layers of colluvium and residual bedrock overlying intact bedrock. In our opinion, the soils do not present a slope stability hazard to the proposed development, if designed in conformance with the recommendations in this report.

5.7 Severe Erosion Hazard

Review of the Clark County Maps Online viewer indicates that portions of the site, generally coincident with sloping areas, are mapped as a severe erosion hazard. A majority of the site was logged in winter 2015/2016 for development; however, few areas of exposed bare soil were noted and the ground surface is lightly vegetated with brambles and low brush. We consider the site in its current state to have a low to moderate erosion hazard around the perimeter and moderate erosion hazard in the interior. Erosion control measures should be implemented during earthwork construction, as recommended by the project civil engineer. With a properly implemented erosion control plan, the impact of erosion on the site during construction should be minimal and easily mitigated.

6.0 CONCLUSIONS

Based on our explorations, testing, and analyses, it is our opinion that the site is suitable for the proposed use, provided the recommendations in this report are included in design and construction. We offer the following general summary of our conclusions.

- The majority of the project site is underlain by shallow bedrock (less than 10 feet bgs). The bedrock will provide excellent support for shallow foundations. The bedrock generally results in a stable hillside, even though the slopes are moderately steep, although typical measures should be followed to prevent shallow landslides to affect site slopes.

- Grading plans indicate that required cuts are likely to encounter bedrock in areas. In general, the upper few feet of rock will likely be rippable with standard excavation equipment; however, the contractor should anticipate the use of a rock hammer or other methods where significant rock excavation is required or excavations extend more than a few feet into bedrock.

- Thick fills are proposed on some sloping portions of the site. Hillside construction techniques, including the installation of keys and benches, should be employed at the site.

- Due to the presence of a fine-grained soil matrix and hard bedrock, we recommend against the use of infiltration systems to dispose of stormwater.

- The native soils are mostly fine-grained with varying percentages of sand and fine gravel. The reuse of these materials as structural fill will be difficult, since the fine-grained soils will be moisture sensitive and susceptible to disturbance when wet.
- Shallow perched groundwater may result in the need for localized trench and excavation dewatering during earthwork activities, depending on the time of construction.
- We developed our conclusions and recommendations based on our current understanding of the project elements, subsurface explorations, local experience, and guidelines in various design references (as listed in the references section of this report and annotated below). The following sections of this report outline our recommendations for design and earthworks.

7.0 STRUCTURAL DESIGN RECOMMENDATIONS

7.1 Design Response Spectrum

We obtained design spectral acceleration parameters from the U.S. Seismic Design Maps (USGS 2008) for Latitude 45.61517 and Longitude -122.41132 with a 2,475-year return period. The parameters provided in Table 1 are appropriate for code-level seismic design.

Table 1 - Seismic Design Parameters

Parameter	Value (IBC)
Spectral Response Acceleration (Short Period), S_s	0.873 g
Spectral Response Acceleration (1-Second Period), S_1	0.371 g
Peak Ground Acceleration (0-second Period), PGA	0.380 g
Site Class	D
Site Coefficient, F_a	1.151
Site Coefficient, F_v	1.658
Spectral Response Acceleration (Short Period), S_{DS}	0.670 g
Spectral Response Acceleration (1-Second Period), S_{D1}	0.410 g

Note: PGA is the mapped MCE_G peak ground acceleration and should not be used to derive the design response spectrum in accordance with ASCE 7-10 (2011) section 11.4.5.

7.2 Foundation Support Recommendations

7.2.1 General

Based on the results of our investigation, it is our opinion the proposed structures can be supported on conventional spread footings bearing on native soil, bedrock, or new structural fill constructed in accordance with the recommendations in this report.

7.2.2 Dimensions and Design Parameters

We recommend a maximum allowable bearing pressure of 5,000 pounds per square foot (psf) for spread footings bearing directly on hard bedrock or a leveling course of aggregate base overlying hard bedrock. We recommend a maximum allowable bearing pressure of 2,500 psf for spread footings bearing directly on colluvium, residual bedrock soil, or new engineered fills. The allowable soil bearing pressures may be increased by up to one-third for short-duration loads, such as wind or seismic forces. The bearing values provided above represent net bearing pressures; the weight of the footings and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be increased by one-third for short-term loads, such as wind or seismic forces.

Isolated spread footings should have a minimum width of 2 feet. Continuous strip footings should have a minimum width of 12 inches or as required by code. The bottoms of all footings should be at least 1 foot below the lowest adjacent finished grade and, in sloping areas, should be embedded such that there is a minimum of 10 feet of "horizontal cover" from the toe of the footing. For example, in areas with a 2 horizontal to 1 vertical (2H:1V) slope gradient, this will require 5 feet of footing embedment.

Lateral loads on footings can be resisted by passive earth pressures on the sides of footings and by friction on the bearing surface. We recommend that passive earth pressures be calculated using an equivalent fluid weight of 300 pounds per cubic foot (pcf). We recommend using a friction coefficient for footings cast directly against the materials shown in Table 2 below. The passive earth pressure and friction components may be combined, provided that the passive component does not exceed two-thirds of the total. The lateral resistance values do not include safety factors.

Table 2 – Footing Base Friction Coefficient

Footing Base Material	Friction Coefficient
Soil	0.3
Compacted Aggregate Base[a]	0.5
Hard Bedrock	0.6

Note a: Aggregate base must be a minimum 8 inches thick if overlying colluvium or residual bedrock.

Because the depth to bedrock varies across the site and grading activities may result in fill placement, it may not be possible to delineate prior to construction which footing excavations will expose intact bedrock and which footings will expose soil. Therefore, the designer can choose to conservatively use the soil design parameters outlined above for all footings and/or provide a footing "schedule" that identifies different foundation configurations, depending upon which materials are exposed in the excavations.

We estimate that total post-construction settlements should be less than 1 inch, with differential settlement of less than 1/2 inch between columns.

7.2.3 Foundation Subgrade Preparation

Foundation subgrades should be evaluated by Hart Crowser to confirm suitable bearing conditions. Observations should also confirm that loose material has been removed and the design bearing soil unit or bedrock are exposed.

The presence of cobbles, boulders or bedrock should be anticipated within the depths of footing excavations. Boulders, cobbles, or bedrock protruding into the depth of excavation should be overexcavated and backfilled with compacted crushed rock. In this regard, it may be advisable to overexcavate foundation excavations 3 to 6 inches and backfill with compacted crushed rock to form a leveling pad.

Water, along with any disturbed soil, should be removed from footing excavations before placement of reinforcing steel. If construction is undertaken during periods of rain, we recommend that imported granular material be placed over the base of footing excavations. The granular material reduces subgrade disturbance from standing water and from foot traffic during forming and tying of reinforcing steel. Typically, 3 to 6 inches of clean granular material that is lightly compacted until well keyed provides sufficient protection from disturbance.

7.3 Floor Slabs

Satisfactory subgrade support for building floor slabs can be obtained, provided the building pad is prepared as described previously. For loading up to 200 psf, we recommend a minimum 6-inch-thick layer of base rock be placed and compacted over the subgrade. The base rock should meet the criteria for aggregate base discussed in *Section 8.4 - Structural Fill and Backfill.*

We recommend that exterior slabs (e.g., patios, walkways, driveways, and interior garage slabs) be structurally independent from the building foundations. Expansion joints should be provided between floor slabs and foundations. This will allow minor movement of the slabs to occur as a result of vehicular loading, tree root growth, seasonal soil shifting, and other factors, while reducing the potential for slab cracking around the perimeter. Interior slabs may be tied to the building's foundation system.

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 recommend that Hart Crowser observe slab subgrade preparation before placement of aggregate base to determine if the subgrade has been adequately prepared and that the soil conditions are consistent with those observed during our explorations. We should also evaluate the compacted aggregate base to verify required compaction levels have been achieved.

7.4 Retaining Structures

We anticipate that various site and/or building retaining walls will be required throughout the project. If walls are greater than 8 feet tall, or are located on or within 20 feet of downward sloping areas with gradients steeper than 4H:1V, then our office should be contacted to complete a wall-specific stability evaluation. If walls are 8 feet or less in height and located in areas with gradients 4H:1V or flatter, then the design recommendations in the following sections can be used. (We have provided recommendations for both cantilevered, cast-in-place concrete walls and mechanically stabilized earth [MSE] walls.)

7.4.1 Cantilevered Wall Design Parameters

Cantilevered retaining walls supporting new engineered fill or native cuts should be designed to resist earth pressures as shown in Table 3. We anticipate the wall backslopes will vary between flat and up to 2H:1V. The values in Table 3 vary according to the indicated slope angle. Earth pressures for intermediate slope angles can be linearly interpolated.

Table 3 – Cantilevered Retaining Wall Earth Pressures

Wall Type/Loading Condition Static Forces	Slope Angle	Equivalent Fluid Pressure (pcf)
Unrestrained from Rotation (active condition)	Flat	33
	2H:1V	55
Restrained from Rotation (at rest condition)	Flat	56
	2H:1V	82
Dynamic (Seismic) Forces	**Slope Angle**	**Dynamic Surcharge Force (plf)**
Unrestrained from Rotation (active condition)	Flat	5 H^2
	2H:1V	23 H^2
Restrained from Rotation (at-rest condition)	Flat	8 H^2
	2H:1V	33 H^2

Notes: plf = Pounds per linear foot of wall • H = the height of wall in feet

For seismic loading on retaining structures, a superimposed seismic lateral force should be calculated based on the dynamic force surcharges shown in Table 3. The force is applied 0.6H from the base of the wall.

If cuts for retaining walls expose large zones of stable bedrock, then reduced earth pressures may be appropriate for design and some zones of rock may be able to be left structurally unsupported. However, the appropriateness of these options will need to be evaluated in the field when the rock exposures are visible.

7.4.2 MSE Wall Design Parameters

MSE retaining walls supporting new engineered fills or native cuts should be designed to using the soil and rock parameters shown in Table 4.

Table 4 – MSE Wall Design Parameters

Material	Unit Weight, γ (pcf)	Friction Angle, ϕ (degrees)	Cohesion, c (psf)
Reinforced Zone Fill	130	38	0
Retained Material (Soil)	120	32	0
Retained Material (Bedrock)	135	45	500
Foundation Material (Soil)	120	32	50
Foundation Material (Bedrock)	135	45	500

For seismic design of MSE walls, the appropriate seismic parameters are listed in Table 1. The designer may assume an allowable displacement of 3 inches during seismic shaking. Also, the vertical acceleration coefficient, k_V, may be assumed to be 0.

The "reinforced zone fill" shall include the entire zone with geogrid reinforcement and that material should meet the specifications provided in Washington State Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction (WSS) WSS 9-03.14(4) – Gravel Borrow for Geosynthetic Retaining Wall, as discussed in *Section 8.4 – Structural Fill and Backfill* (WSDOT 2016).

Most MSE wall systems are proprietary and all materials for MSE walls should also meet the manufacturer's recommendations for their specific wall. If conflicts exist between the specifications, they should be resolved by the engineer of record for the wall before construction.

7.4.3 Surcharges

If surcharges (e.g., foundations, terraced walls, stored materials, traffic loads, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, then additional pressures may need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads.

Where traffic loads are located within a horizontal distance from the top of the wall equal to one-half the wall height, the lateral earth pressure shall be increased by a surcharge load equal to 2 feet of soil (assuming a soil density of 125 pcf). For overturning and sliding analysis, this surcharge should only be applied behind the reinforced soil zone.

7.4.4 Foundations

The base of the excavation for the wall footings (or first row of MSE blocks) should extend a minimum of 18 inches below lowest adjacent grade. The excavation should be lined with a minimum 6-inch-thick layer of compacted, imported granular material. In addition, the toe of footings/first row of MSE blocks should be embedded such that a minimum of 10 feet of horizontal coverage is present between the face of the footing/block toe and any adjacent downward slope.

The wall footings should be designed in accordance with the guidelines provided in *Section 7.1 – Foundation Support Recommendations*.

All wall subgrades should be evaluated by a qualified geotechnical engineer or their representative to confirm suitable bearing conditions. Observations should also confirm that loose or soft material, organics, unsuitable fill, prior topsoil zones, and softened subgrades (if present) have been removed. Localized deepening of footing excavations may be required to penetrate deleterious materials.

7.4.5 Drainage, Waterproofing, and Backfill

The above design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls. If a drainage system is not installed, then our office should be contacted for revised design forces.

A minimum 12-inch-wide zone of drain rock, extending from the base of the wall to within 6 inches of finished grade, should be placed against the back of all retaining walls. Alternatively, prefabricated drainage panels with a pocket of drain rock at the base of the wall may be used. Perforated collector pipes should be embedded at the base of the drain rock. The drain rock should meet the requirements provided in *Section 8.4 - Fill and Backfill* of this report. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the wall's drainage system.

We recommend that retaining walls that abut living space should be waterproofed to reduce the potential for efflorescence growth or water seepage through the wall. Additionally, care should be taken to assure that the drainage system and perforated collector pipes are located below any habitable areas or crawlspace subgrades. We recommend that waterproofing of all habitable living spaces be the responsibility of the architect/building designer.

The backfill for MSE walls should meet the requirements of and be compacted in conformance with the specifications provided in WSS 6-13 – Structural Earth Walls. The reinforcing geotextile should be installed in conformance with the specifications provided in WSS 2 12 – Construction Geotextile.

Settlements of up to 1 percent of the wall height commonly occur immediately adjacent to the wall, as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of improvements (such as pavements, sidewalks, or structures) adjacent to retaining walls be postponed at least 4 weeks after backfilling of the wall, unless survey data indicate that settlement is complete prior to that time.

8.0 EARTHWORK RECOMMENDATIONS

Based on available information, we estimate mass grading will be relatively substantial consisting of cuts and fills up to 20 feet tall/deep. Localized trench excavations that extend below the base of mass excavation will be required for installation of utilities and foundations. Hillside construction techniques should be employed at the project.

All earthwork should be conducted in accordance with the City of Camas Municipal Code and the WSS (WSDOT 2016) where applicable. Specific recommendations for earthwork are provided in the following sections.

8.1 Site and Subgrade Preparation

8.1.1 Stripping and Clearing

Initial site preparation and earthwork operations will include clearing and stripping of surficial organic materials. Based on our explorations, the anticipated depth of stripping is approximately 8 to 24 inches with an average of 12 inches. Actual stripping depths should be evaluated based on observations during the stripping operation. The prepared subgrade should be observed and approved by a representative of Hart Crowser. Generally, visible organic material (sod, humus, roots larger than 1/4-inch diameter, and/or other decaying plant material), debris, and other unsuitable materials should be removed from the subgrade areas.

Trees and their root balls should be grubbed out to the depth of the roots, which could exceed 3 feet bgs. Depending upon the methods used to remove the root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with compacted structural fill, as described in *Section 8.4 - Structural Fill and Backfill* of this report.

8.1.2 Subgrade Preparation and Evaluation

Following completion of site stripping, clearing, and any mass excavation, and prior to the placement of any fill or aggregate base, the suitability of the subgrade should be evaluated by proofrolling with a fully loaded dump truck or similar heavy rubber-tired construction equipment to identify any remaining soft, loose, or unsuitable areas. The proofroll should be conducted prior to placing any fill. The proofrolling should be observed by Hart Crowser who will evaluate the suitability of the subgrade and identify areas of yielding that are indicative of soft or loose soil. If soft or loose zones are identified during evaluation, these areas should be excavated to the extent indicated by the engineer and replaced with compacted engineered fill in conformance with the specifications provided in WSS 2-03.3(3) – Excavation Below Subgrade, WSS 2-03.3(14)E – Unsuitable Foundation Excavation, and WSS 2-03.3(14)G – Backfilling. During wet weather conditions the subgrade should be evaluated per *Section 8.2 – Wet Soil/Wet Weather Construction*.

8.1.3 Bench Preparation for Fill on Slopes

Fill placed on slopes steeper than 5H:1V (20 percent gradient) will need to be constructed on a series of benches cut into the native slope. The benches shall be level or have an outward gradient of 0.5 percent or less, and have a maximum of height of approximately 5 feet. However, the lowest bench, also known as the keyway, shall be a minimum of 10 feet wide or one and one-half times the width of the compaction equipment, whichever is wider. The keyway shall slope back into the hillside at a 2 percent gradient.

A gravel subdrain should be constructed at the back of the keyway and any benches where seepage is observed in the field. The subdrain should consist of a minimum of a 2-foot-wide by 2-foot-tall "wedge" of drain rock placed at the back of the keyway. The drain rock should be completely wrapped with a geotextile drainage fabric. A perforated pipe should be installed at the base of the gravel to collect water seepage. The collector pipe should "daylight" at an appropriate location near the base of the slope. If seepage, or signs of seepage are present in the field, then a 1-foot-thick blanket drain may also be required along the base of the keyway.

Refer to Figure 7 for a schematic depiction of a keyway and benches.

8.2 Wet Soil/Wet Weather Construction

The site is mantled with soils containing a significant percentage of fine-grained soil that will be susceptible to moisture-related disturbance. Disturbance to subgrades containing these soils should be expected if site preparation and earthwork are conducted during periods of excessive wet weather and/or when the moisture content of the fine grained subgrade soil exceeds optimum. Wet soil construction practices may be necessary during extensive portions of the year, particularly during periods of wet weather. Wet soil construction practices include using equipment, such as smooth excavator buckets and tracked equipment, to limit subgrade disturbance.

During wet weather or when the exposed subgrade is wet or unsuitable for proofrolling, the prepared subgrade should be evaluated by observing excavation activity and probing with a steel foundation probe. Observations and probing should be performed by Hart Crowser.

During wet weather or when adequate moisture control is not possible, it may be necessary to install a granular working blanket to support construction equipment and to provide a firm base on which to place subsequent fill and pavement. Commonly, the working blanket consists of bank run gravel or pit run quarry rock (6-inch maximum size with no more than 5 percent by weight passing a No. 200 sieve).

Based on our experience, between 12 and 18 inches of imported granular material is generally required to provide stable staging and haul road areas. However, the actual thickness will depend on the contractor's means and methods, and accordingly, should be the contractor's responsibility. Additionally, a geotextile fabric should generally be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material and the geotextile fabric should meet the specifications in *Section 8.4 - Structural Fill and Backfill* of this report.

Portions of the site used as haul routes for heavy construction equipment may require a thicker working blanket to protect the fine-grained subgrade. If particularly soft/wet areas are encountered, a heavy grade, nonwoven geotextile fabric installed on the fine-grained subgrade may be helpful in preventing silt from contaminating and pumping into the granular working blanket. The geotextile should meet the specifications provided in WSS 9-33.2(1) Table 3 – Geotextile for Separation or Soil Stabilization.

8.3 Excavation, Shoring, and Dewatering

All excavations, shoring, and dewatering should be completed in accordance with the specifications provided in WSS 2-03 – Roadway Excavation and Embankment and WSS 2-09 – Structure Excavation, and the requirements of Washington Administrative Code (WAC) section 292-155.

The colluvium and residual bedrock soils within expected excavation depths typically range from soft to stiff. Vertical trench excavations into these materials will have a low to moderate tendency to run or slough. On average, the site colluvium and residual bedrock soils should be considered Soil Type C, as defined by Part N of the WAC 296-155. However, the deeper intact bedrock can be classified as "Stable Rock." The presence of cobbles and boulders may cause excavation sidewalls to cave or slough, resulting in greater than anticipated backfill quantities.

Because of the variables involved, actual slope angles required for stability in temporary cut areas can only be estimated before construction. We recommend that stability of the temporary slopes used for construction be the responsibility of the contractor, since the contractor is in control of the construction operation and is continuously at the site to observe the nature and condition of the subsurface. All temporary soil cuts associated with site excavations (greater than 4 feet in depth) should be adequately sloped back to prevent sloughing and collapse, in accordance with Department of Occupational Safety and Health (DOSH) Chapter 296-155 WAC Part N Excavation, Trenching and Shoring Occupational Safety and Health Administration (OSHA) guidelines.

Explorations completed at the site identified relatively shallow bedrock. Earthwork construction will require equipment capable of excavation in this hard material. In our experience, rippers equipped to a large bulldozer can be effective in breaking up hard bedrock to a few or several feet deep to facilitate excavation. However, it is acknowledged that ripping the bedrock may not be completely effective, particularly with increasing depths, and rock hammers or blasting may be necessary to completely remove bedrock encountered within cut areas.

The earthwork contractor should be responsible for providing equipment and following procedures as needed to safely excavate the site soils as described in this report.

If temporary sloping is not feasible, based on site spatial constraints, excavations could be supported by internally braced shoring systems, such as a trench box or other temporary shoring. There are a variety of options available. We recommend that the contractor be responsible for selecting the type of shoring system to apply.

We do not expect that the regional groundwater table will be encountered during construction. However, we encountered perched groundwater in one location at the site, and localized zones of perched water may be encountered during construction, particularly atop the site bedrock during the wet season. The contractor should be prepared to control perched water and water that may seep into trenches and through excavation faces.

8.4 Structural Fill and Backfill

Structural fill includes embankments, slab, and pavement support, such as aggregate base and other fill within the influence zone of structures adjacent to the improvement area. Fill should only be placed over a subgrade that has been prepared in accordance with *Section 8.1 - Site and Subgrade Preparation* of this report. A variety of soils may be used as structural fill, provided they are free of debris, clay balls, roots, organic matter, frozen soil, man-made contaminants, particles exceeding 4 inches in size, and other deleterious materials. Structural fill should meet the appropriate specification provided in WSS 9-03 – Aggregates.

Fill and backfill materials should be placed and compacted in lifts with maximum uncompacted thicknesses and relative densities as recommended in *Section 8.5 - Fill Placement and Compaction* of this report.

In areas where fill is to be placed on soft or fine-grained subgrade soils, then use of a subgrade geotextile per WSS 9-33.2(1) Table 3 – Geotextile for Separation or Soil Stabilization will be required.

8.4.1 On-Site Soils and Bedrock Spoils

In general, the overburden native materials in the project area consist of fine-grained materials. During periods of dry weather, the native soils may be used as fill, provided they are properly moisture conditioned and oversized materials (greater than 6 inches) are removed. During periods of wet weather, the fine-grained component of the native soil will likely make the use of the native soil as a structural fill infeasible. The earthwork contractor should plan accordingly.

Bedrock spoils from excavations may be used as structural fill, provided they are processed/crushed to remove oversized materials. Bedrock materials should generally be processed to a well-graded crushed material with nominal sizes between 1 and 6 inches, and/or meeting the gradations of the materials described in S*ection 8.4.2 - Imported Select Structural Fill.*

8.4.2 Imported Select Structural Fill

Imported granular material used as structural fill during periods of wet weather should be pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in WSS 9-03.9(1) – Ballast, WSS 9-03.14(1) – Gravel Borrow, or WSS-9 03.14(2) – Select Borrow. The imported granular material should also be angular, fairly well graded between coarse and fine material, have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve, and have at least two mechanically fractured faces.

8.4.3 Aggregate Base

Imported granular material used as aggregate base (base rock) beneath pavements or the building should be clean, crushed rock or crushed gravel and sand that is fairly well graded between coarse and fine. The base aggregate should meet the specifications provided in WSS 9 03.9 – Aggregates for Ballast and Crushed Surfacing, depending upon application, with the exception that the aggregate have less than 5 percent by dry weight passing a U.S. Standard No. 200 Sieve and have at least two

mechanically fractured faces. The aggregate base should have a maximum particle size of 1.5 inches for use beneath pavements or footings and a maximum particle size of 0.75 or 1 inch for use beneath floor slabs, sidewalks, or patio slabs.

Refer to *Section 10.0 - Pavement Design and Considerations* for additional discussion regarding base materials for paved areas.

8.4.4 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should meet the WSS requirements and consist of well-graded granular material with a maximum particle size of 3/4 inch and less than 10 percent by dry weight passing the U.S. Standard No. 200 Sieve. The trench backfill should meet the specifications provided in WSS 9 03.12(3) – Gravel Backfill for Pipe Zone Bedding.

Within pavement and slab subgrades the remainder of the trench backfill up to the subgrade elevation shall consist of granular material meeting the specifications provided in WSS 9 03.19 – Bank Run Gravel for Trench Backfill, or other material approved by the City of Camas.

Outside of structural improvement areas, trench backfill placed above the pipe zone may consist of general fill materials that are free of organics and materials over 6 inches in diameter and meet the specifications provided in WSS 9 03.14(3) – Common Borrow and WSS 9 03.15 – Native Material for Trench Backfill, as appropriate.

8.4.5 Drain Rock

Drain rock used for back-of-wall, footing, and keyway drains should meet the specifications provided in WSS 9 03.12(4) – Gravel Backfill for Drains. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in WSS 9 33.2 for drainage geotextiles. The geotextile should be installed in conformance with the specifications provided in WSS 2 12 – Construction Geosynthetic.

8.4.6 Retaining Wall Select Backfill

Granular wall backfill used as reinforced fill for MSE walls should consist of select granular material meeting the specifications of WSS 9 03.14(4) – Gravel Borrow for Geosynthetic Retaining Wall. The select granular material should also meet the gradations specified in WSS 9 03.14 (1) – Gravel Borrow or WSS 9 03.14 (2) – Select Borrow.

8.4.7 Stabilization Material

If imported granular material is used to create haul roads for construction traffic, we recommend that material consist of pit or quarry run rock, or crushed rock. The material should generally be sized between 2 and 6 inches, have less than 5 percent by dry weight passing the U.S. Standard No. 4 Sieve, and have at least two mechanically fractured faces. The material should be free of organic matter and other deleterious material. Material meeting the gradations of WSS 9-03.9(2) - Permeable Ballast, WSS 9-03.12(5) – Gravel Backfill for Drywells, or WSS 9-13.6 – Quarry Spalls is generally acceptable for use.

Stabilization material should be separated from the base of soft or fine-grained subgrades with a layer of subgrade geotextile that meets the specifications provided in WSDOT SS 9-33.2(1) Table 3 – Geotextile for Separation or Soil Stabilization. The geotextile should be installed in conformance with the specifications provided in WSS 2-12 – Construction Geosynthetic.

Stabilization material should be placed atop the geotextile in lifts between 12 and 18 inches thick and be compacted to a well-keyed condition with appropriate compaction equipment without using vibratory action. In trench excavations, a walk behind segmented pad roller or a pinwheel on an excavator typically can provide adequate compaction if carefully used.

8.5 Fill Placement and Compaction

Structural fill should be placed and compacted in accordance with WSS (2016) and the following guidelines.

In locations where fill is to be placed on slopes steeper than 5H:1V, benches should be cut in accordance with WSS 2-03.3(14) – Embankment Construction and *Section 8.1.3 - Bench Preparation for Fills on Slopes*. Fill slopes should be overbuilt by at least 12 inches and then trimmed back to the required slope to maintain a firm face.

- Place fill and backfill on a prepared subgrade that consists of firm, inorganic native soils or approved structural fill.
- Place fill or backfill in uniform horizontal lifts with a thickness appropriate for the material type and compaction equipment. Table 5 provides general guidance for uncompacted lift thicknesses.

Table 5 – Guidelines for Uncompacted Lift Thickness

Compaction Equipment	Guidelines for Uncompacted Lift Thickness (inches)		
	Fine-Grained Soil	Granular Soil and Crushed Rock (Maximum Size ≤ 1½ inch	Crushed Rock (Maximum Size > 1½ inch
Plate Compactors and Jumping Jacks	4 – 8	4 – 8	Not Recommended
Rubber-Tire Equipment	6 – 8	10 – 12	6 – 8
Light Roller	8 – 10	10 – 12	8 – 10
Heavy Roller	10 – 12	12 – 18	12 – 16
Hoe Pack Equipment	12 – 16	18 – 24	12 – 16

Note: The above table is based on our experience and is intended to serve as a guideline. The information provided in this table should not be included in the project specifications.

- Do not place fill and backfill until the required tests and evaluation of the underlying materials have been made and the appropriate approvals have been obtained.
- Limit the maximum particle size within the fill to two-thirds of the loose lift thickness.

- Control the moisture content of the fill to within 3 percent of the optimum moisture content based on laboratory Proctor tests. The optimum moisture content corresponds to the maximum attainable Proctor dry density.
- Perform a representative number of in-place density tests on structural fill in the field, to verify adequate compaction.
- Compact fill soils to the percentages of maximum dry density as shown in Table 6.

Table 6 – Fill Compaction Criteria

Fill Type	Percent of Maximum Dry Density Determined in Accordance with ASTM D 1557		
	0 – 2 Feet Below Subgrade	>2 Feet Below Subgrade	Pipe Bedding and Pipe Zone
Structural Fill	95	92	-----
Aggregate Base	95	95	-----
Trench Backfill	95	92	90
Nonstructural Trench Backfill	88	88	-----
Nonstructural Zones	88	88	-----

Note: Structural fill with more than 30 percent retained on the 3/4-inch sieve should be compacted to a well-keyed dense state within 3 percent of optimum moisture content. Compaction should be verified by Hart Crowser staff through performance testing, such as a proofroll.

8.6 Temporary Drainage

The contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion of the working surface during grading. During rough and finished grading of the roadway alignment the contractor should keep subgrades free of water.

9.0 DRAINAGE

As noted previously, the site lies on slopes up to 2H:1V, is mantled with a matrix of fine-grained soils, and is underlain by relatively shallow bedrock. These conditions will tend to perch, as opposed to infiltrate, stormwater; therefore, we recommend against the use of stormwater infiltration facilities at the site.

9.1 Surface Drainage

The finished ground surface around buildings should be sloped away from their foundations at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the building without providing means for positive drainage (i.e., swales or catch basins).

9.2 Subsurface Drainage

We recommend the installation of perimeter footing drains along the uphill sides of buildings and crawlspace areas at a minimum. Where retaining walls are incorporated into building foundation systems, the back-of-wall drain can serve as the footing drainage. Where used, the footing 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., crawlspace or 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 outlined in *Section 8.4 - Structural Fill and Backfill* of this report. The discharge for the footing drain should not be tied directly into the stormwater drainage system, unless mechanisms are installed to prevent backflow.

10.0 PAVEMENT DESIGN AND CONSIDERATIONS

10.1 General

Our pavement design recommendations include options for flexible hot mixed asphaltic concrete (HMAC) pavement and Portland cement concrete (PCC). We were not provided specific traffic counts for the project, so we assumed some traffic loading criteria based on our experience with similar projects. If these and other assumptions in the following section are not valid, please contact our office so that updated recommendations can be developed.

10.2 Design Criteria

The pavement design criteria were based on guidelines found in the WSDOT Pavement Policy (WSDOT 2015) and American Association of State Highway and Transportation Officials (AASHTO*) Guide for Design of Pavement Structures* (AASHTO 1993), and our communications with the traffic engineer (Mackenzie). The following assumptions and criteria were used:

- Average daily traffic (ADT) ranging from approximately 500 to 1,500 vehicles per day with approximately 3 percent heavy truck traffic (e.g. buses, trash trucks, delivery trucks, etc.)
- No annual traffic growth due to lack of through streets
- Average resilient modulus of 6,000 pounds per square inch (psi) for *in situ* soil and fill subgrade
- A resilient modulus of 30,000 psi for aggregate base
- Initial and terminal serviceability indices of 4.5 and 2.0, respectively
- Reliability and standard deviation of 85 percent and 0.45, respectively for AC pavements and 95 percent and 0.35, respectively for PCC pavements
- PCC compressive strength of 4,000 psi and a modulus of rupture of 500 psi
- Structural coefficients of 0.45 and 0.12 for the HMAC and aggregate base layers, respectively

If these parameters and assumptions are incorrect, then we should be contacted to re-evaluate our recommendations.

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

10.3 Pavement Sections

The City standard pavement section for a typical residential street is 3 inches of HMAC over 9 to 12 inches of crushed surfacing (e.g., aggregate base). The results of our project-specific analyses for different ADT values indicates that somewhat different sections are feasible. Our recommended minimum pavement sections are summarized in Table 7.

Table 7 –Pavement Sections

Pavement Type/Location	Roadway Classification	Pavement Thickness (inches)	Aggregate Base Thickness (inches)
HMAC	Driveways	2.5	4.5
	ADT = 500	3.0	7.0
	ADT = 1000	3.0	9.0
	ADT = 1500	3.5	8.5
PCC	Driveways	3.5	4.0
	ADT = 500	4.0	6.0
	ADT = 1000	4.5	6.0
	ADT = 1500	5.0	6.0

We note that the aggregate base thicknesses are intended to support post-construction design traffic loads and should not be used to support construction traffic. Additional thickness of crushed surfacing may be necessary if excessive construction traffic is planned in the new pavement areas.

10.4 Pavement Materials

The HMAC should consist of a Level 2, 1/2-inch dense-graded, PG 64-22 material meeting the specifications of WSS 5-04 – Hot Mix Asphalt. The HMAC should be placed in lifts with minimum and maximum thickness of 1.5 and 3.5 inches, respectively, and be compacted in accordance with WSS 5-04.3(10) – Compaction to 91 percent of Rice Density of the mix, as determined in accordance with American Society for Testing and Materials (ASTM) D 2041.

The PCC should conform to the specifications provided in WSS 5-05 – Cement Concrete Pavement. The PCC should have a minimum modulus of rupture of 650 psi and a modulus of elasticity of approximately 3,500,000 psi. The PCC should be constructed with a maximum joint spacing of 12 feet. The slabs shall be interlocked at joints. However, if the designer wishes to utilize doweled joints then thinner PCC sections may be possible. We should be contacted for additional recommendations, if desired.

Imported granular material used as base aggregate (base rock) should meet the criteria specified in *Section 8.4 - Structural Fill and Backfill* of this report. The base aggregate should be compacted to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

11.0 CONSTRUCTION OBSERVATIONS

Satisfactory pavement and earthwork performance depends to a large degree on quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during subsurface explorations. Recognition of changed conditions often requires experience; therefore, Hart Crowser or their representative should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

We recommend that Hart Crowser be retained to monitor construction at the site to confirm that subsurface conditions are consistent with the site explorations and to confirm that the intent of project plans and specifications relating to earthwork and foundation construction are being met. In particular, we recommend that stripping and subgrade preparation, key and bench preparation, subsurface drainage system installation, placement and compaction of structural fill and backfill, aggregate bases, and asphalt pavements be observed and/or tested by Hart Crowser.

12.0 LIMITATIONS

We have prepared this report for the exclusive use of CJ Dens Lacamas I, LLC and their authorized agents for the proposed CJ Dens subdivision project in Camas, Washington, in accordance with our Agreement for Geotechnical Engineering Services and subsequent change orders. Our report is intended to provide our opinion of geotechnical parameters for design and construction of the proposed project based on exploration locations that are believed to be representative of site conditions. However, conditions can vary significantly between exploration locations and our conclusions should not be construed as a warranty or guarantee of subsurface conditions or future site performance.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty, express or implied, should be understood.

Any electronic form, facsimile, or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by Hart Crowser and will serve as the official document of record.

13.0 REFERENCES

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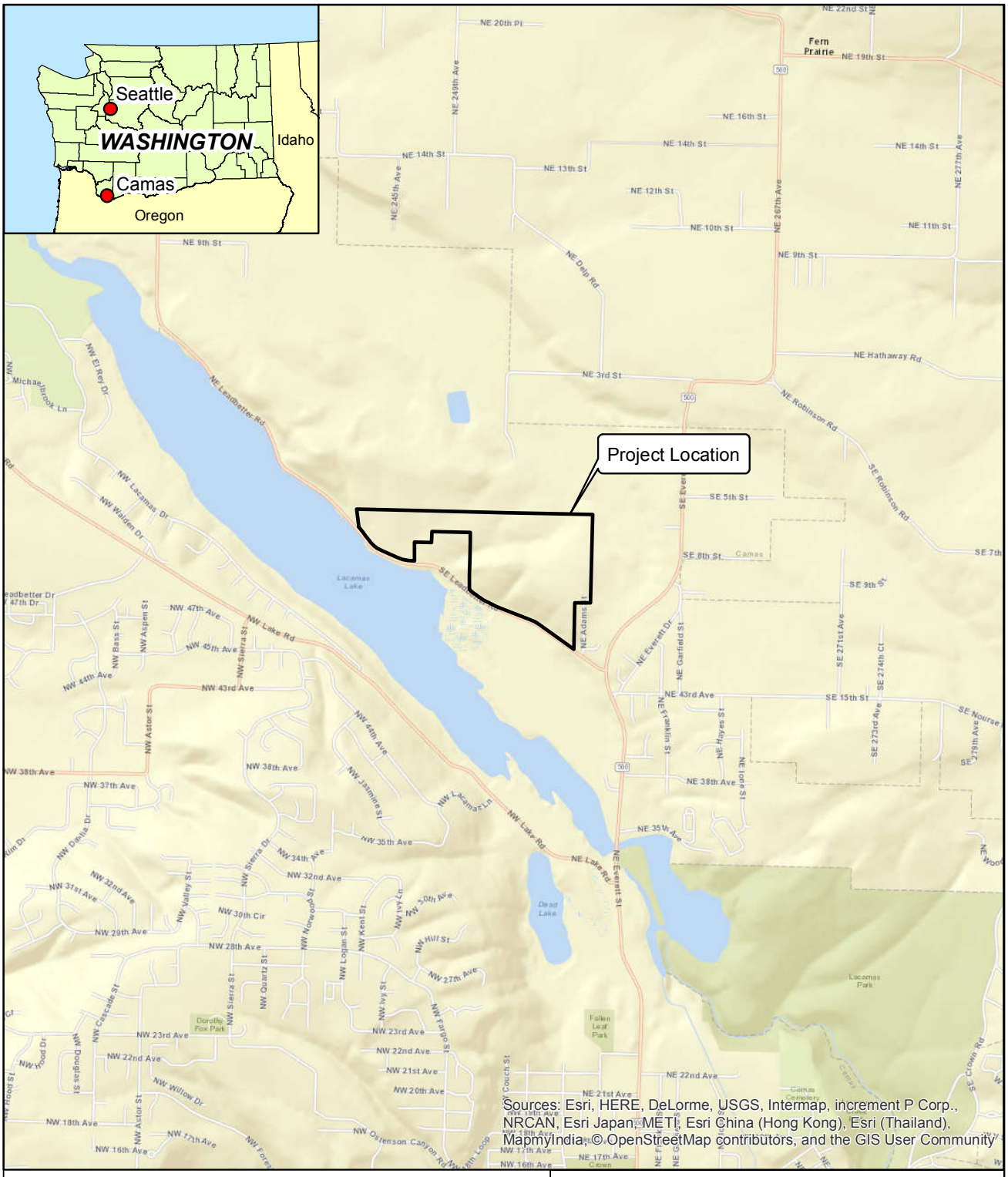

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CJ Dens Subdivision
Camas, Washington

Vicinity Map

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HARTCROWSER

Figure 1

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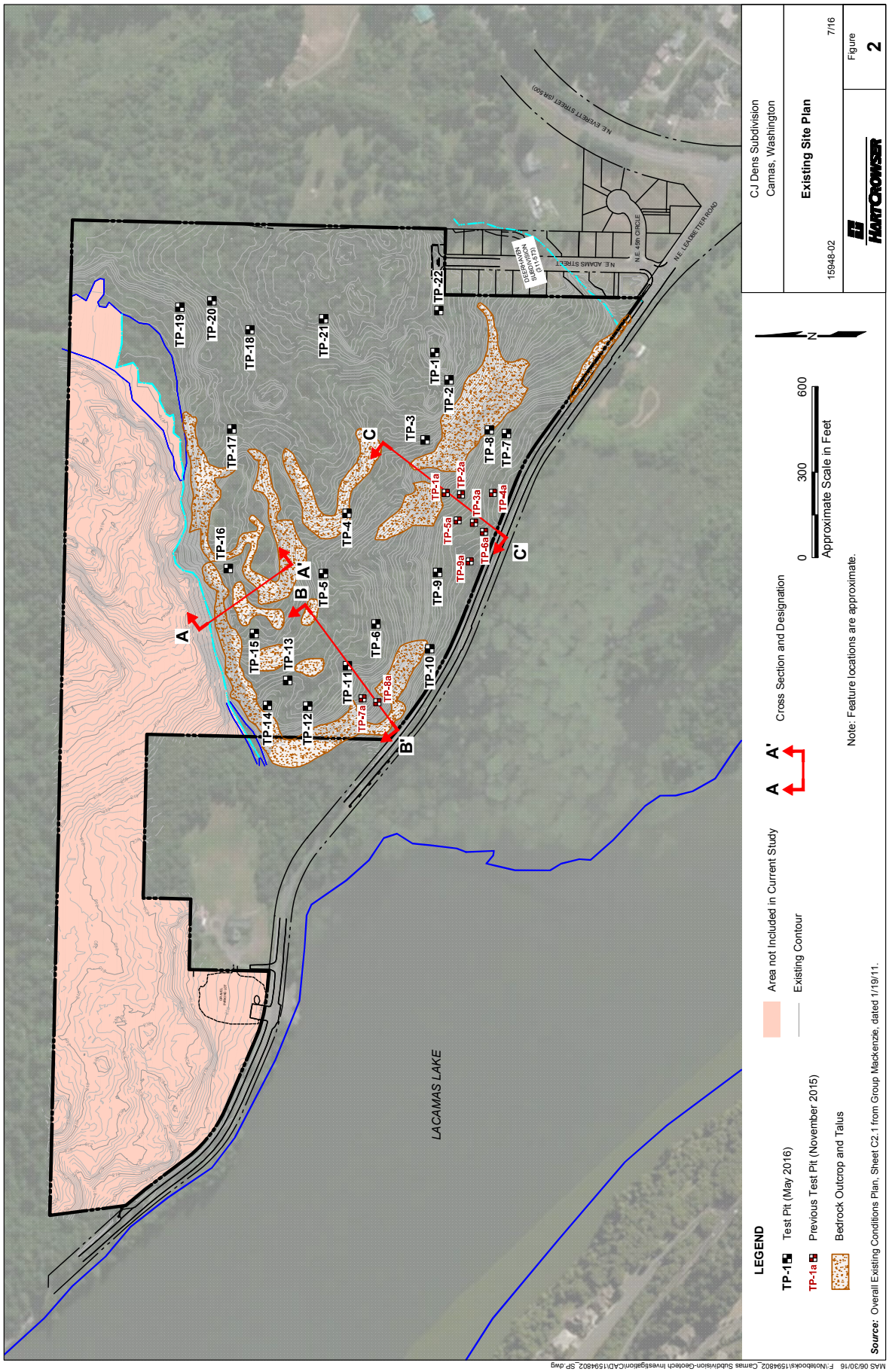
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N.E. 4th CIRCLE
N.E. LEXOBETTER ROAD
N.E. EVERETT STREET (SR-500)
LEGEND
Test Pit (May 2016)
Previous Test Pit (November 2015)
Bedrock Outcrop and Talus
Area not Included in Current Study
Existing Contour
Cross Section and Designation
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Note: Feature locations are approximate.
Source: Overall Existing Conditions Plan, Sheet C2.1 from Group Mackenzie, dated 1/19/11.
CJ Dens Subdivision
Camas, Washington
Existing Site Plan
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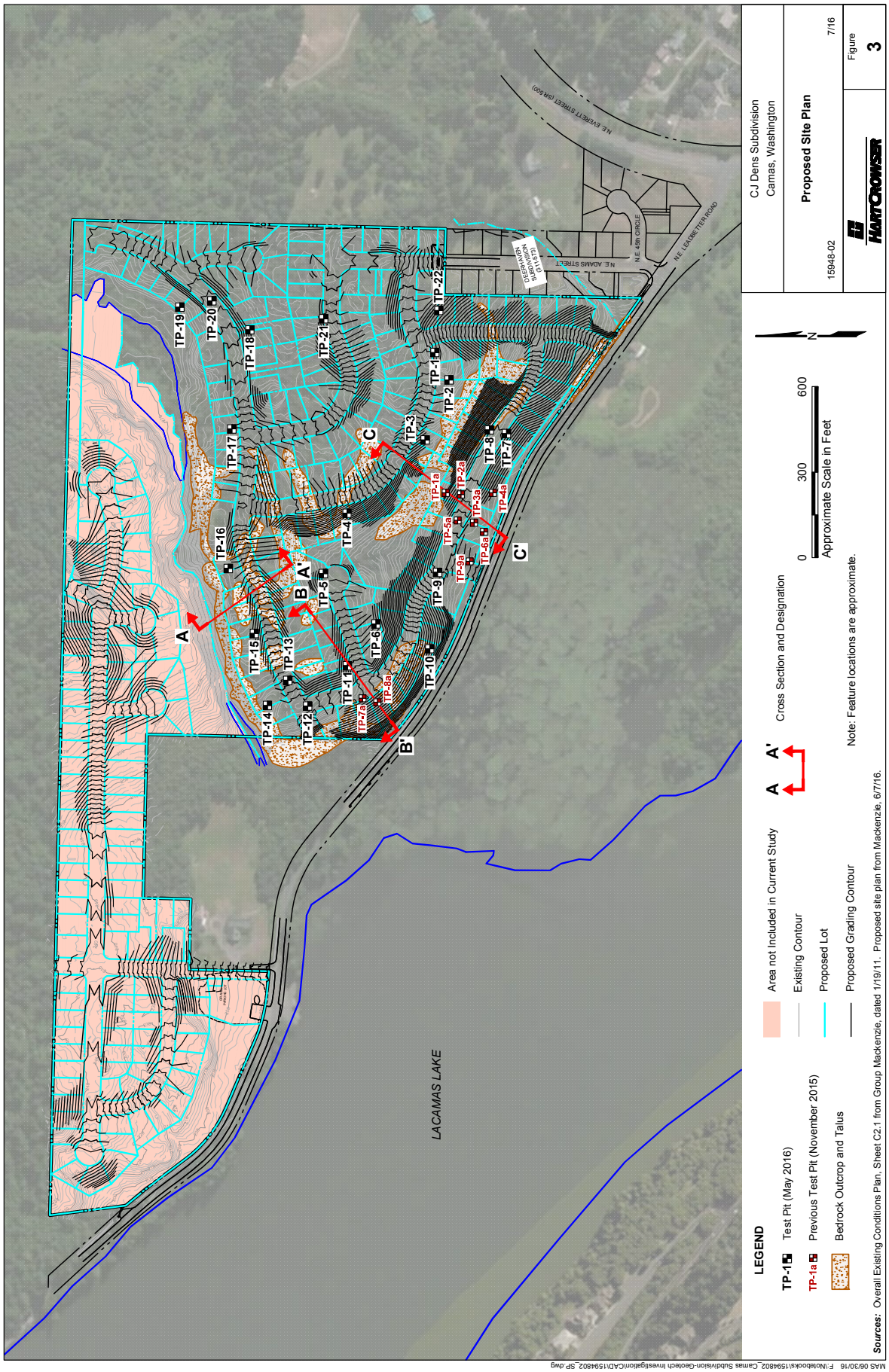
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N.E. 4th CIRCLE
N.E. LEADBETTER ROAD
N.E. EVERETT STREET (SR-500)
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LEGEND
TP-1 Test Pit (May 2016)
TP-1a Previous Test Pit (November 2015)
Bedrock Outcrop and Talus
Area not Included in Current Study
Existing Contour
Proposed Lot
Proposed Grading Contour
Cross Section and Designation
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Approximate Scale in Feet
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Note: Feature locations are approximate.
Sources: Overall Existing Conditions Plan. Sheet C2.1 from Group Mackenzie, dated 1/19/11. Proposed site plan from Mackenzie, 6/7/16.
CJ Dens Subdivision
Camas, Washington
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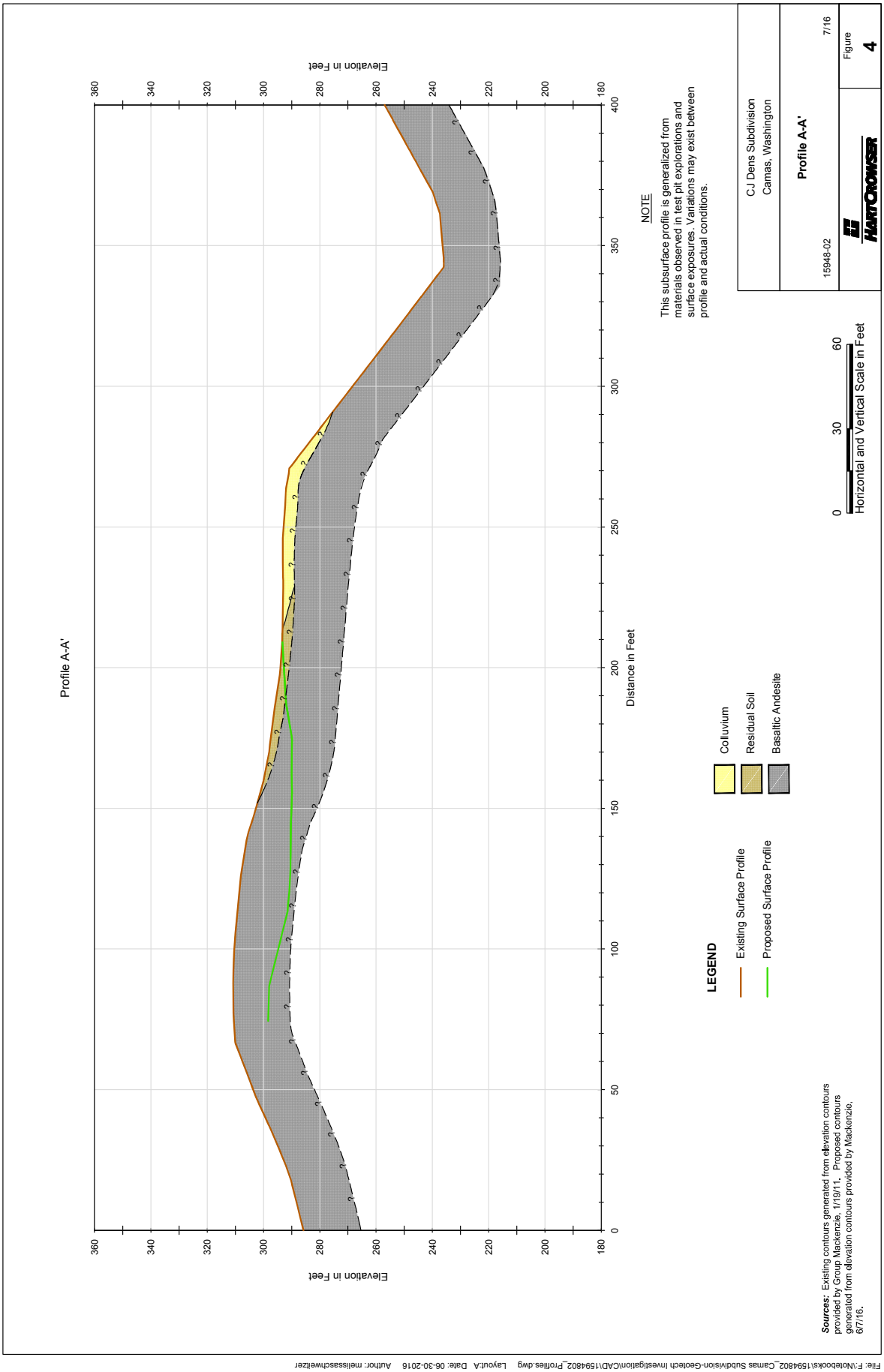
Profile A-A'
Elevation in Feet
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LEGEND
Existing Surface Profile
Proposed Surface Profile
Colluvium
Residual Soil
Basaltic Andesite
NOTE
This subsurface profile is generalized from materials observed in test pit explorations and surface exposures. Variations may exist between profile and actual conditions.
Horizontal and Vertical Scale in Feet
CJ Dens Subdivision
Camas, Washington
Profile A-A'
15948-02
7/16
Figure 4
Sources: Existing contours generated from elevation contours provided by Group Mackenzie, 1/19/11. Proposed contours generated from elevation contours provided by Mackenzie, 6/7/16.
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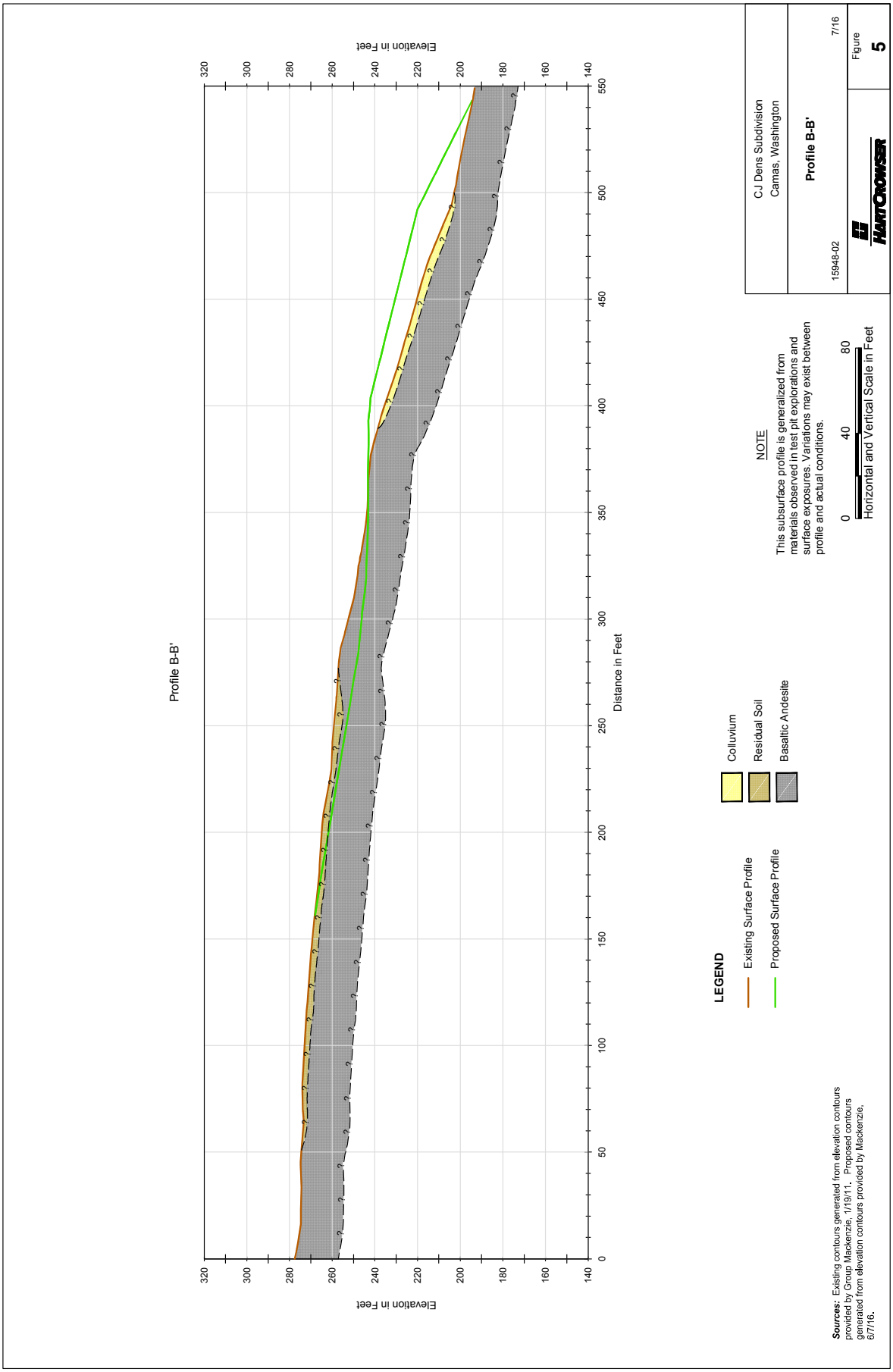
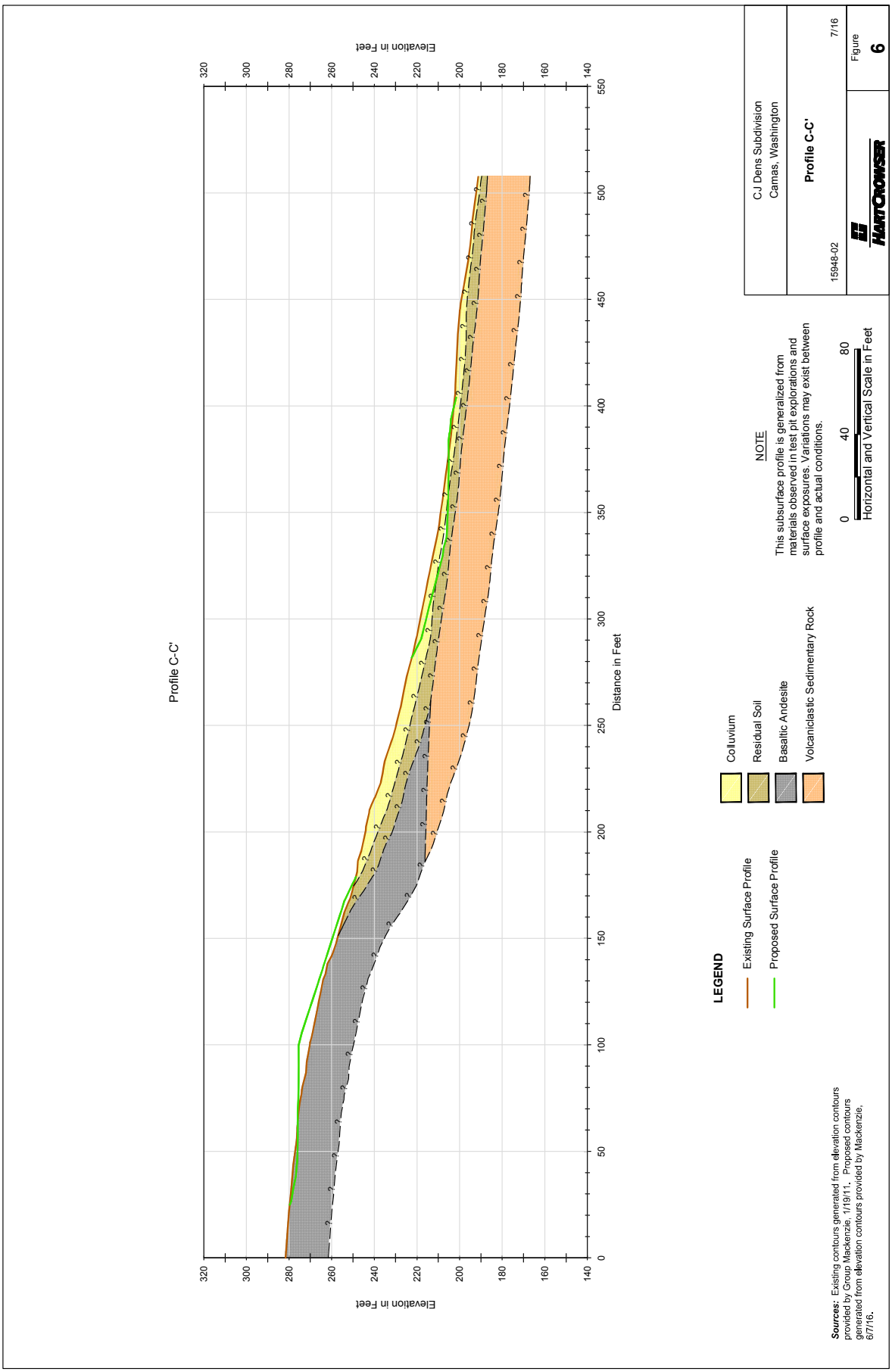
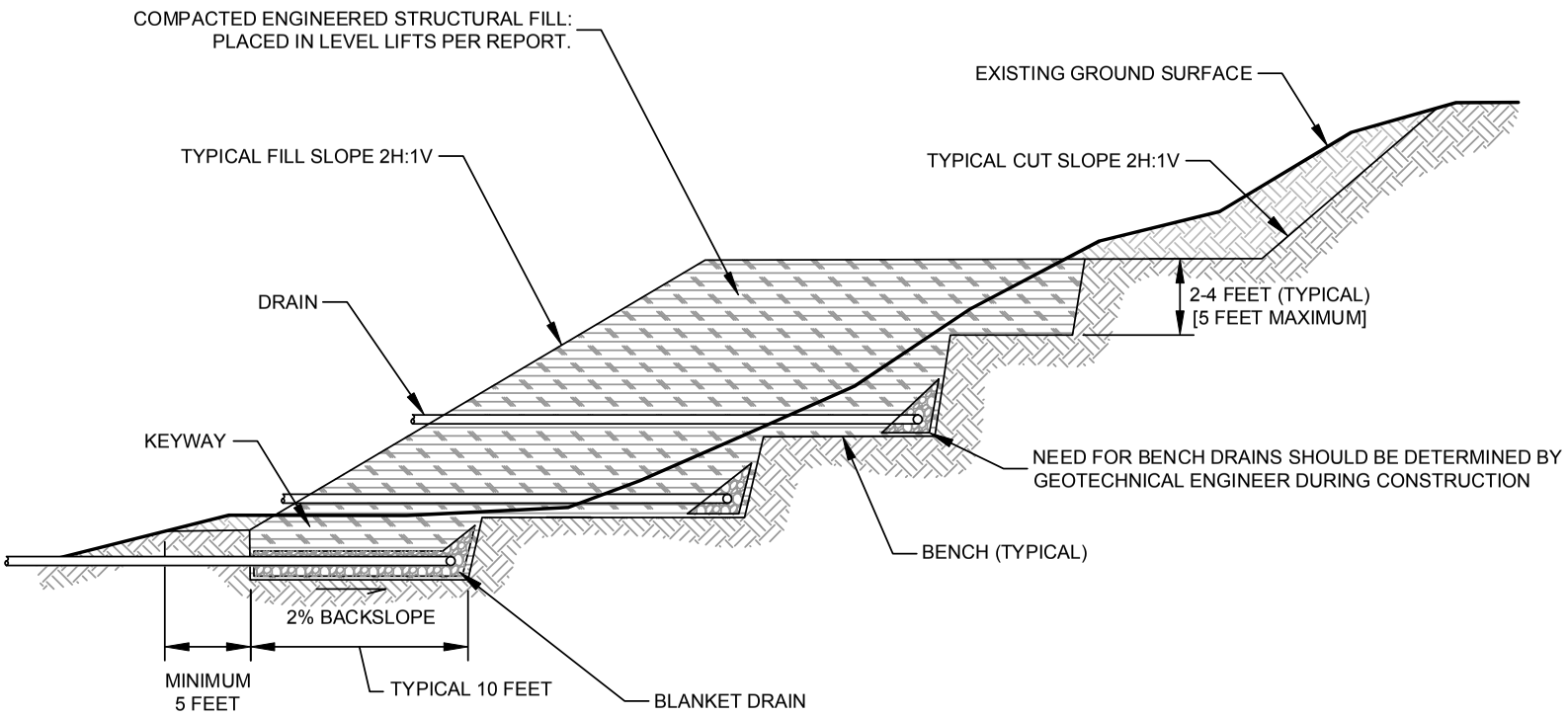
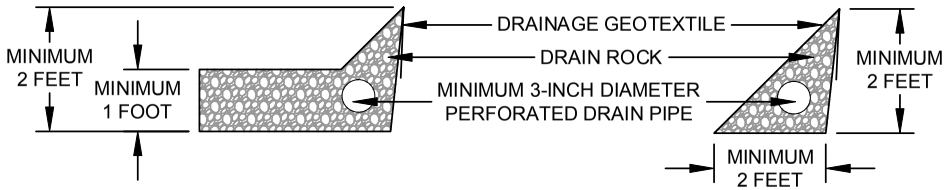

Profile B-B'
Elevation in Feet
320
300
280
260
240
220
200
180
160
140
0
50
100
150
200
250
300
350
400
450
500
550
Distance in Feet
LEGEND
Existing Surface Profile
Proposed Surface Profile
Colluvium
Residual Soil
Basaltic Andesite
NOTE
This subsurface profile is generalized from materials observed in test pit explorations and surface exposures. Variations may exist between profile and actual conditions.
0
40
80
Horizontal and Vertical Scale in Feet
Sources: Existing contours generated from elevation contours provided by Group Mackenzie, 1/19/11. Proposed contours generated from elevation contours provided by Mackenzie, 6/7/16.
CJ Dens Subdivision
Camas, Washington
Profile B-B'
15948-02
7/16
HartCrowser
Figure
5
File: F:\Notebooks\15948O2_Camas Subdivision-Geotech Investigation\CAD\15948O2_Profiles.dwg Layout:B Date: 06-30-2016 Author: melissaschweitzer


Profile C-C'
Elevation in Feet
Distance in Feet
320
300
280
260
240
220
200
180
160
140
0
50
100
150
200
250
300
350
400
450
500
550
LEGEND
Existing Surface Profile
Proposed Surface Profile
Colluvium
Residual Soil
Basaltic Andesite
Volcaniclastic Sedimentary Rock
NOTE
This subsurface profile is generalized from materials observed in test pit explorations and surface exposures. Variations may exist between profile and actual conditions.
0
40
80
Horizontal and Vertical Scale in Feet
Sources: Existing contours generated from elevation contours provided by Group Mackenzie, 1/19/11. Proposed contours generated from elevation contours provided by Mackenzie, 6/7/16.
CJ Dens Subdivision
Camas, Washington
Profile C-C'
15948-02
7/16
Figure
6
HartCrowser
File: F:\Notebooks\15948O2_Camas Subdivision-Geotech Investigation\CAD\15948O2_Profiles.dwg Layout:C Date: 06-30-2016 Author: melissaschweitzer



NOTES:
1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE SCHEMATIC.
3. DRAWING REPRESENTS TYPICAL FILL AND CUT SLOPE SECTION, AND MAY NOT BE SITE-SPECIFIC.

TYPICAL DRAIN SECTION DETAIL



CJ Dens Subdivision
Camas, Washington

Typical Cut and Fill Slope Cross-Section

15948-02 7/16

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Figure
7

APPENDIX A
Field Explorations

APPENDIX A

Field Explorations

This appendix documents the processes Hart Crowser used to determine the nature (and quality) of the soil and groundwater underlying the project site addressed by this report. The discussion includes information on the following subjects:

- Explorations and Their Locations,
- Test Pits, and
- Sampling Procedures.

Explorations and Their Locations

A member of our engineering staff observed subsurface explorations for this project that included test pits TP-1a through TP-9a completed November 23, 2015 and TP-1 through TP-22, completed May 27, 2016. The exploration logs in this appendix show our interpretation of the explorations, sampling, and testing data. The logs indicate the depths where the soils change. Note that soil changes may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on the *Key to Exploration Logs*. This key also provides a legend explaining the symbols and abbreviations used in the logs.

Figures 2 and 3 of the report show the locations of explorations. Exploration locations were estimated using GPS coordinate data.

Test Pits

Nine test pits, TP-1a through TP-9a, were excavated by a medium-sized, steel-track excavator subcontracted by CJ Dens Lacamas I, LLC. An additional 22 test pits, TP-1 through TP-22, were excavated with a Komatsu PC-200, steel-track excavator. The test pits were continuously observed by a geotechnical staff member from Hart Crowser and detailed field logs of the test pits were prepared. The logs are presented at the end of this appendix.

Sampling Procedures

Representative “grab” samples of the soil observed in the test pit explorations were obtained from the test pit walls by hand and/or the test pit base using the excavator bucket. All soil samples were placed into watertight bags and delivered to Hart Crowser's laboratory for further testing.

KEY TO EXPLORATION LOGS

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SOIL CLASSIFICATION CHART

MATERIAL TYPES	MAJOR DIVISIONS		GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	GW	WELL-GRADED GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES, >12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	SW	WELL-GRADED SAND
			SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	CL	LEAN CLAY
			ML	SILT
		ORGANIC	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	CH	FAT CLAY
			MH	ELASTIC SILT
		ORGANIC	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS			PT	PEAT

Note: Multiple symbols are used to indicate borderline or dual classifications

OTHER MATERIAL SYMBOLS

- Concrete
- Asphalt
- Topsoil

MOISTURE MODIFIERS

- Dry - Absence of moisture, dusty, dry to the touch
- Moist - Damp, but no visible water
- Wet - Visible free water or saturated, usually soil is obtained from below the water table

SEEPAGE MODIFIERS

- None -
- Slow - < 1 gpm
- Moderate - 1-3 gpm
- Heavy - > 3 gpm

CAVING MODIFIERS

- None -
- Minor - isolated
- Moderate - frequent
- Severe - general

MINOR CONSTITUENTS

- Trace - < 5% (silt/clay)
- Occasional - < 15% (sand/gravel)
- With - 5-15% (silt/clay) in sand or gravel
  15-30% (sand/gravel) in silt or clay

SAMPLE TYPES

- Dames & Moore
- Standard Penetration Test (SPT)
- Shelby Tube
- Bulk or Grab

LABORATORY/ FIELD TESTS

- ATT - Atterberg Limits
- CP - Laboratory Compaction Test
- CA - Chemical Analysis (Corrosivity)
- CN - Consolidation
- DD - Dry Density
- DS - Direct Shear
- HA - Hydrometer Analysis
- OC - Organic Content
- PP - Pocket Penetrometer (TSF)
- P200 - Percent Passing No. 200 Sieve
- SA - Sieve Analysis
- SW - Swell Test
- TV - Torvane Shear
- UC - Unconfined Compression

GROUNDWATER SYMBOLS

- Water Level (at time of drilling)
- Water Level (at end of drilling)
- Water Level (after drilling)

STRATIGRAPHIC CONTACT

- Distinct contact between soil strata or geologic units
- Gradual or approximate change between soil strata or geologic units

Notes:

Blowcount (N) is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted) per ASTM D-1586. See exploration log for hammer weight and drop.

When the Dames & Moore (D&M) sampler was driven with a 140-pound hammer (denoted on logs as D+M 140), the field blow counts (N-value) shown on the logs have been reduced by 50% to approximate SPT N-values.

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

Refer to the report text and exploration logs for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the exploration locations at the time the explorations were made. The logs are not warranted to be representative of the subsurface conditoins at other locations or times.

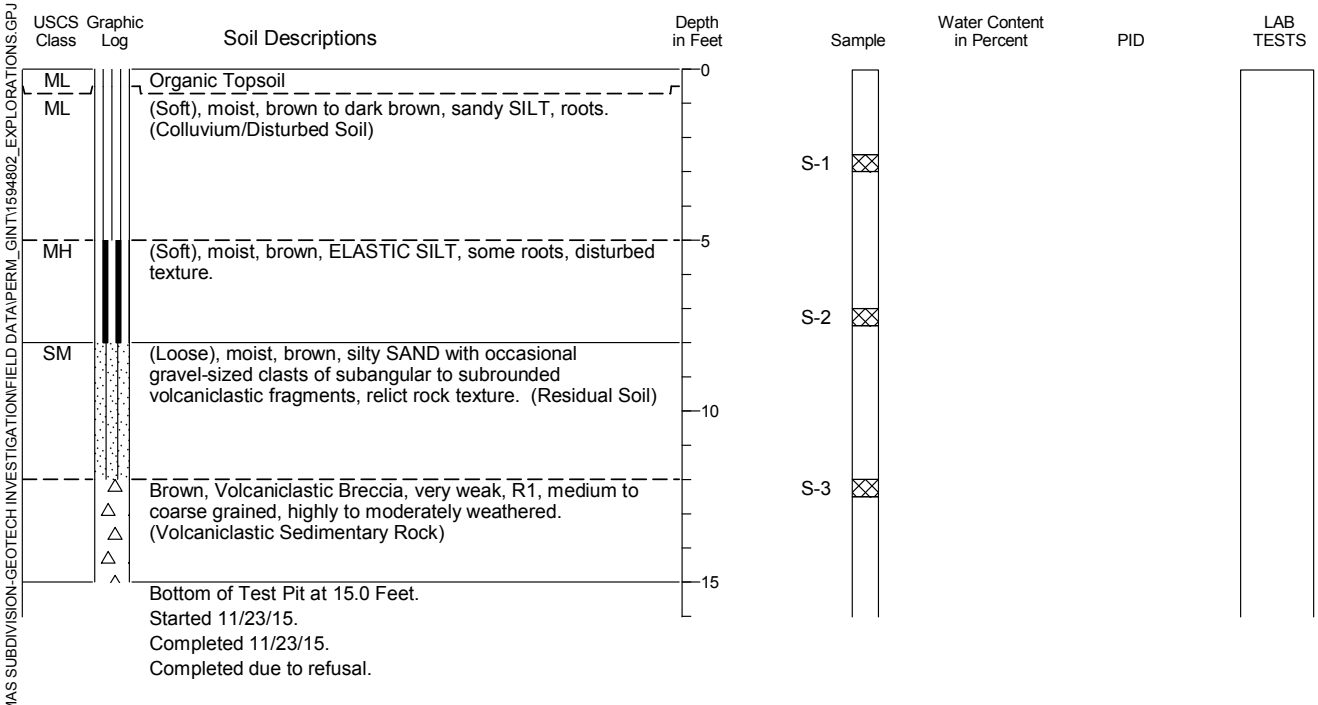
KEY TO EXPLORATION LOGS - F:\GINT\OREGON_LIBRARY.GLB - 6/15/16 15:48 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS.GPJ

Figure A-1

Test Pit Log TP-1a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

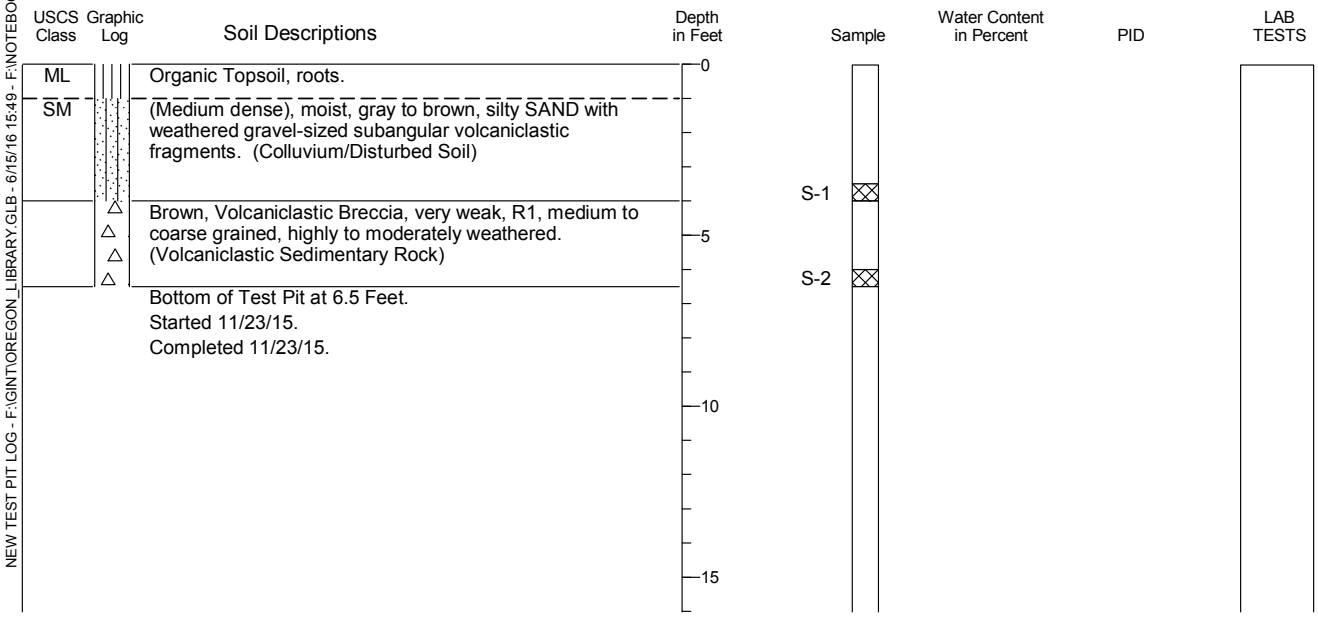
Horizontal Datum: N/A
Vertical Datum: N/A



Test Pit Log TP-2a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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15948-02 *12/15*

Figure A-3

Test Pit Log TP-3a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil, roots.	0				
ML		(Stiff), moist, brown, SILT with sand, disturbed texture. (Colluvium/Disturbed Soil)		S-1			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)	5	S-2			
		Bottom of Test Pit at 5.5 Feet. Started 11/23/15. Completed 11/23/15.	10				
			15				

Test Pit Log TP-4a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil	0				
ML		(Stiff), moist, brown, SILT with sand, roots, disturbed texture. (Colluvium/Disturbed Soil)		S-1			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)	5	S-2			
		Bottom of Test Pit at 6.5 Feet. Started 11/23/15. Completed 11/23/15.	10				
			15				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

15948-02 12/15

Figure A-4

Test Pit Log TP-5a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil, roots, dark brown.	0				
SM		(Loose), moist, brown to dark brown, silty SAND, roots, weathered residual soil fragments in fine-grained matrix. (Colluvium/Disturbed Soil)					
CL		(Medium stiff), moist, brown, LEAN CLAY with sand.		S-1			
			5				
SM		(Loose), moist, brown, silty SAND with hard gravel-sized clasts of subangular to subrounded volcaniclastic fragments, relict rock texture. (Residual Soil)		S-2			
			10				
				S-3			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-4			
		Bottom of Test Pit at 13.5 Feet.	15				
		Started 11/23/15.					
		Completed 11/23/15.					
		Completed due to refusal.					

Test Pit Log TP-6a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM/ML		(Loose to medium stiff), dark brown, moist, silty SAND to sandy SILT, roots.	0				
ML		(Medium stiff), moist, brown, SILT with sand, small roots, disturbed texture. (Colluvium/Disturbed Soil)					
		Abundant roots and rootlets from 3.0 to 4.0 feet.		S-1			
SM		(Medium dense to dense), moist, light brown to brown, silty SAND, relict rock texture. (Residual Soil)	5				
				S-2			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-3			
		Bottom of Test Pit at 9.5 Feet.	10				
		Started 11/23/15.					
		Completed 11/23/15.					
		Completed due to refusal.					
			15				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

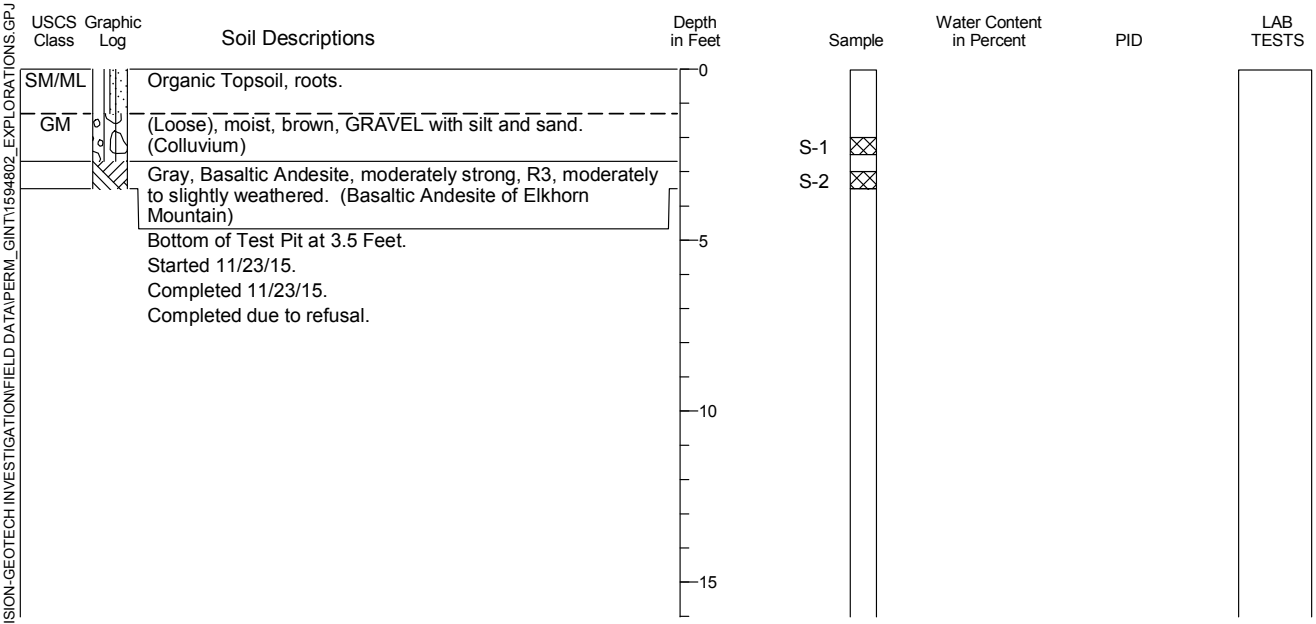
15948-02 12/15

Figure A-5

Test Pit Log TP-7a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

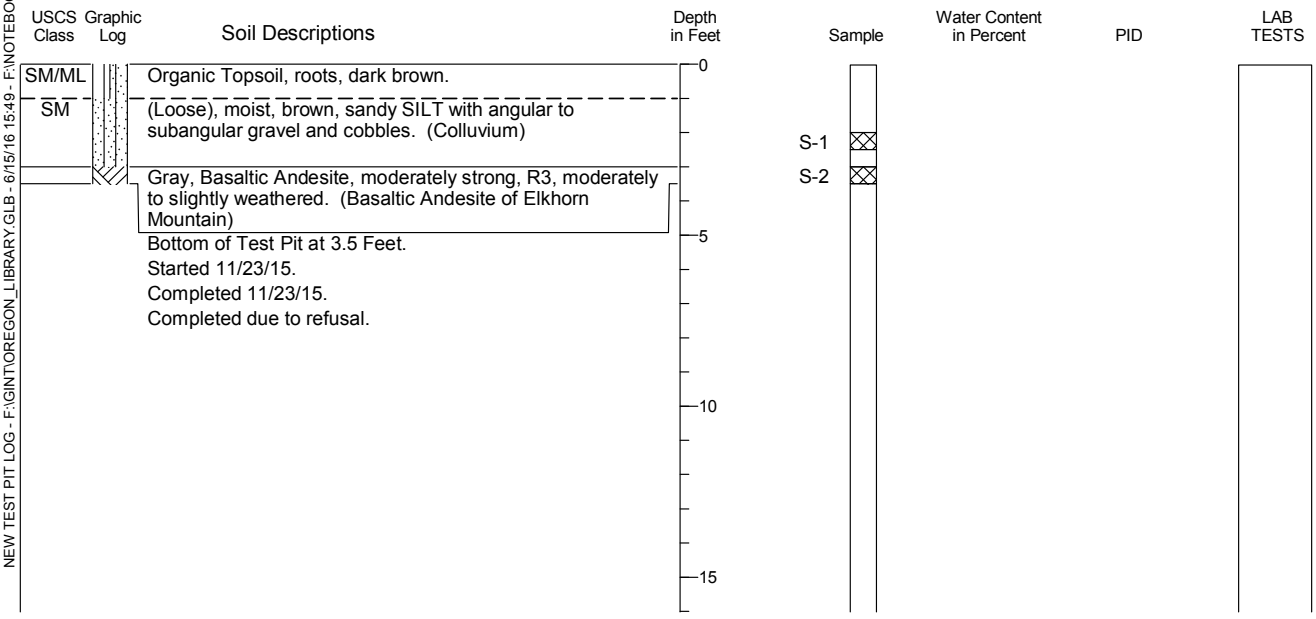
Horizontal Datum: N/A
Vertical Datum: N/A



Test Pit Log TP-8a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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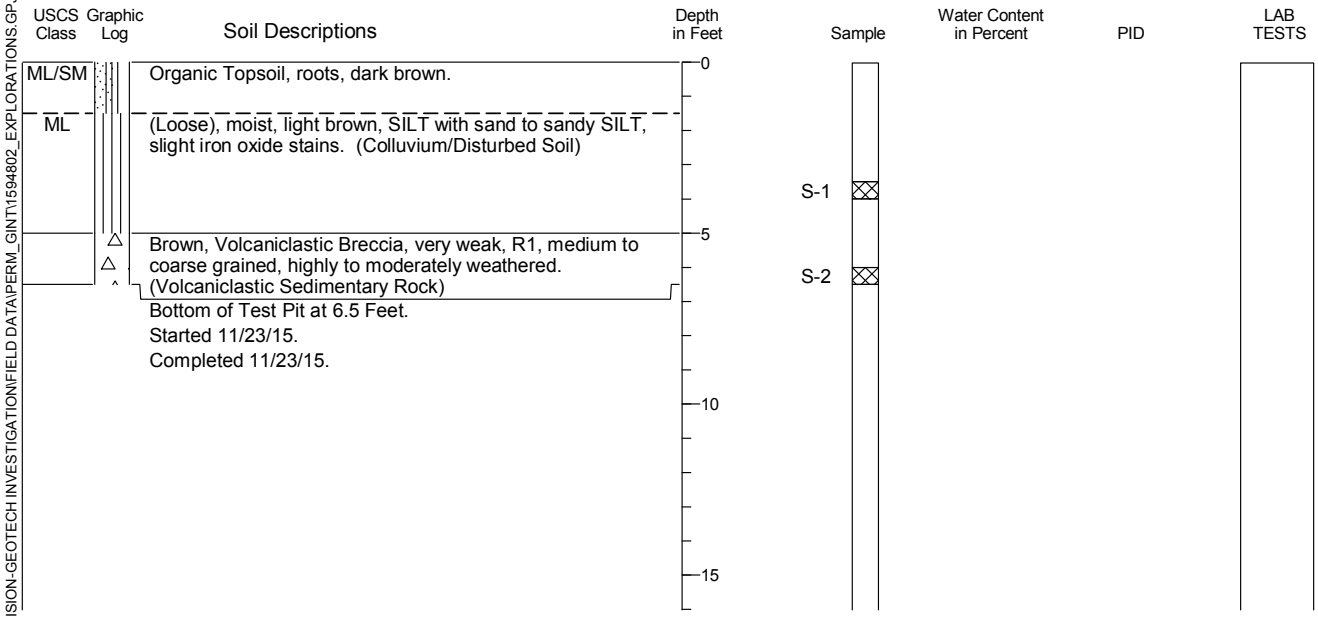
15948-02 12/15

Figure A-6

Test Pit Log TP-9a

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



NEW TEST PIT LOG - F:\GINT\OREGON_LIBRARY.GLB - 6/15/16 15:49 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS.GPJ

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

15948-02 *12/15*

Figure A-7

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. ASTM D 2488 visual-manual identification methods were used as a guide. Major divisions are not necessarily an indicator of soil behavior, which is a function of fines content activity and loading rate.

Relative Density/Consistency

Soil density/consistency in borings is related primarily to the standard penetration resistance (N). Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Relative Density	N (Blows/Foot)	SILT or CLAY Consistency	N (Blows/Foot)
Very loose	0 to 4	Very soft	0 to 2
Loose	4 to 10	Soft	2 to 4
Medium dense	10 to 30	Medium stiff	4 to 8
Dense	30 to 50	Stiff	8 to 15
Very dense	>50	Very stiff	15 to 30
		Hard	>30

Moisture

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

Soil Classification Chart

Major Divisions			Graph	USCS	Typical Descriptions
Coarse Grained Soils: More than 50% of Material Retained on No. 200 Sieve	Gravel and Gravelly Soils: More than 50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels (<5% fines)		GW	Well-Graded Gravel; Well-Graded Gravel with Sand
				GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Gravels (10% fines)		GW-GM	Well-Graded Gravel with Silt; Well-Graded Gravel with Silt and Sand
				GW-GC	Well-Graded Gravel with Clay; Well-Graded Gravel with Clay and Sand
				GP-GM	Poorly Graded Gravel with Silt; Poorly Graded Gravel with Silt and Sand
				GP-GC	Poorly Graded Gravel with Clay; Poorly Graded Gravel with Clay and Sand
		Gravels with Fines (>12% fines)		GM	Silty Gravel; Silty Gravel with Sand
				GC	Clayey Gravel; Clayey Gravel with Sand
	Sand and Sandy Soils: More than 50% of Coarse Fraction Passing No. 4 Sieve	Sands with few Fines (<5% fines)		SW	Well-Graded Sand; Well-Graded Sand with Gravel
				SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Sands (10% fines)		SW-SM	Well-Graded Sand with Silt Well-Graded Sand with Silt and Gravel
				SW-SC	Well-Graded Sand with Clay; Well-Graded Sand with Clay and Gravel
				SP-SM	Poorly Graded Sand with Silt; Poorly Graded Sand with Silt and Gravel
				SP-SC	Poorly Graded Sand with Clay; Poorly Graded Sand with Clay and Gravel
		Sands with Fines (>12% fines)		SM	Silty Sand; Silty Sand with Gravel
				SC	Clayey Sand; Clayey Sand with Gravel
Fine Grained Soils: More than 50% of Material Passing No. 200 Sieve	Silts			ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
				MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
	Clays			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
				CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
	Organics			OL/OH	Organic Soil; Organic Soil with Sand or Gravel; Sandy or Gravelly Organic Soil
Highly Organic				PT	Peat - Decomposing Vegetation - Fibrous to Amorphous Texture

Minor Constituents

	Estimated Percentage
Trace	<5
Few	5 - 10
Little	15 - 25
Some	30 - 45

Soil Test Symbols

%F	Percent Passing No. 200 Sieve
AL	Atterberg Limits
	Water Content in Percent
	Liquid Limit
	Natural
	Plastic Limit
CA	Chemical Analysis
CAUC	Consolidated Anisotropic Undrained Compression
CAUE	Consolidated Anisotropic Undrained Extension
CBR	California Bearing Ratio
CIDC	Consolidated Drained Isotropic Triaxial Compression
CIUC	Consolidated Isotropic Undrained Compression
CK0DC	Consolidated Drained k0 Triaxial Compression
CK0DSS	Consolidated k0 Undrained Direct Simple Shear
CK0UC	Consolidated k0 Undrained Compression
CK0UE	Consolidated k0 Undrained Extension
CRSCN	Constant Rate of Strain Consolidation
DSS	Direct Simple Shear
DT	In Situ Density
GS	Grain Size Classification
HYD	Hydrometer
ILCN	Incremental Load Consolidation
K0CN	k0 Consolidation
kc	Constant Head Permeability
kf	Falling Head Permeability
MD	Moisture Density Relationship
OC	Organic Content
OT	Tests by Others
P	Pressuremeter
PID	Photoionization Detector Reading
PP	Pocket Penetrometer
SG	Specific Gravity
TRS	Torsional Ring Shear
TV	Torvane
UC	Unconfined Compression
UUC	Unconsolidated Undrained Triaxial Compression
VS	Vane Shear
WC	Water Content

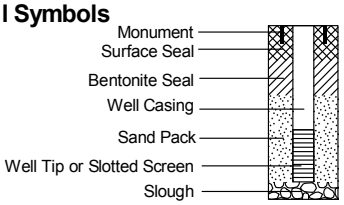
Groundwater Indicators

- Groundwater Level on Date or At Time of Drilling (ATD)
- Groundwater Seepage (Test Pits)

Sample Symbols

- 1.5" I.D. Split Spoon
- 3.0" I.D. Split Spoon
- Modified California Sampler
- Core Run
- Sonic Core
- Thin-walled Sampler
- Grab
- Cuttings

Well Symbols



KEY TO EXPLORATION LOGS (SOIL) - F:\GINT\HC_LIBRARY.GLB - 6/10/16 11:35 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-TPS.GPJ

HARTCROWSER

Project: Camas Subdivision
Location: Camas, Washington
Project No.: 15948-02

Key to Exploration Logs

Figure A-1
Sheet 1 of 1

Weathered State of Rock

Term	Description	Grade
Fresh	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering, and may be somwhat weaker externally than in its fresh condition	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength
R0	Extremely Weak	Indented by thumbnail.	0.04 to 0.15 ksi
R1	Very Weak	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	0.15 to 3.6 ksi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3.6 to 7.3 ksi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	7.3 to 15 ksi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15 to 29 ksi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 29 ksi

Discontinuities

Discontinuity Spacing		Discontinuity Condition	
Description	Spacing	Condition	Description
Very Widely Spaced	Greater than 10 feet	Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall.
Widely Spaced	3 to 10 feet	Good Condition	Slightly rough surfaces, separation less than 0.05 inches, hard discontinuity wall.
Moderately Spaced	1 to 3 feet	Fair Condition	Slightly rough surface, separation greater than 0.05 inches, soft discontinuity wall.
Closely Spaced	2 to 12 inches	Poor Condition	Slickensided surfaces, or soft gouge less than 0.2 inches thick, or open discontinuities 0.05 to 0.2 inches.
Very Closely Spaced	Less than 2 inches	Very Poor Condition	Soft gouge greater than 0.2 inches, or open discontinuities greater than 0.2 inches.

KEY TO BEDROCK TERMS - WSDOT (1 OF 2) - F:\GINT\HC_LIBRARY.GLB - 6/10/16 11:36 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-TPS.GPJ

HARTCROWSER

Project: Camas Subdivision
Location: Camas, Washington
Project No.: 15948-02

Key to WSDOT Bedrock Terms

Figure A-2
Sheet 1 of 2

Grain Size

Grain Size	Description	Criteria
Less than 0.04 inches	Fine grained	Few crystal boundaries/grains distinguishable in the field or with a hand lens.
0.04 to 0.2 inches	Medium grained	Most crystal boundaries/ grains distinguishable with the aid of a hand lens.
Greater than 0.2 inches	Coarse grained	Most crystal boundaries/ grains distinguishable with the naked eye.

Igneous Rock Textures

Texture	Grain Size
Pegmatitic	Very large; diameters greater than 0.8 in.
Phaneritic	Can be seen with the naked eye
Porphyritic	Grained of two widely different sizes
Aphanitic	Cannot be seen with the naked eye
Glassy	No grains present

Pyroclastic Rocks

Rock Name	Characteristics
Pyroclastic Breccia	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which angular pyroclasts predominate.
Agglomerate	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which rounded pyroclasts predominate.
Lapilli Tuff	Pyroclastic rock whose average pyroclast size is 0.08 to 2.5 inches.
Ash Tuff	Pyroclastic rock whose average pyroclast size is less than 0.08 inches.

Degree of Vesicularity

Designation	Percentage of Cavities (by volume) of Total Sample
Slightly Vesicular	5 to 10 Percent
Moderately Vesicular	10 to 25 Percent
Highly Vesicular	25 to 50 Percent
Scoriaceous	Greater than 50 Percent

Other Terms:

Core Recover (CR) = the ratio of core recovered to the core run length expressed as a percentage.

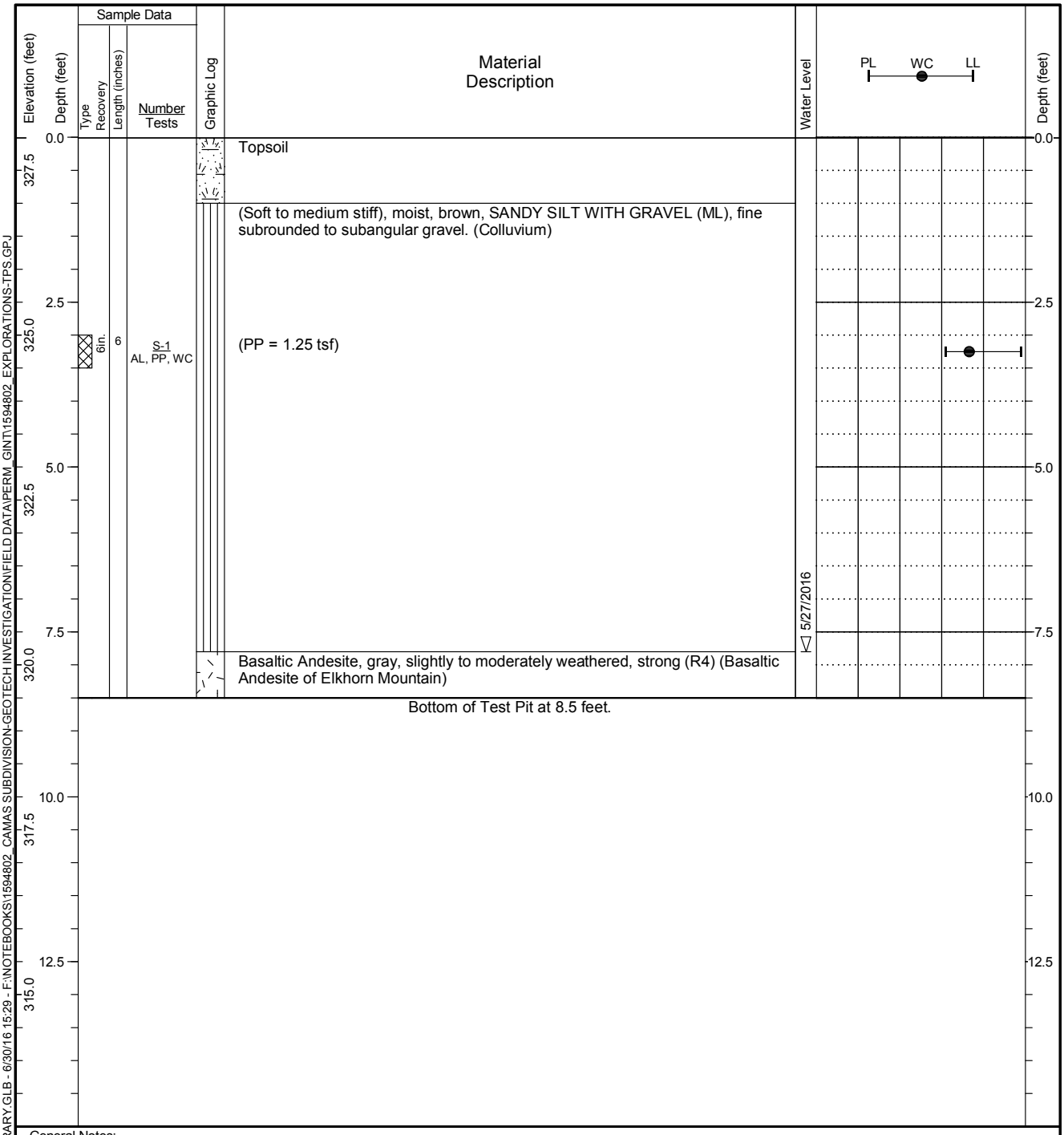
Rock Quality Designation (RQD) = the percentage of rock core recovered in intact pieces of 4 inches or more in length in the length of a core run. Does not include mechanical breaks caused by drilling.

Fracture Frequency (FF) = the number of natural fractures per foot in the length of core recovered.

Reference:

Washington State Department of Transportation (WSDOT), 2014. *Geotechnical Design Manual*, Publication M 46-03.10, August, 2014.

Date Started: 5/27/16	Date Completed: 5/27/16
Logged by: A. Jones	Checked by: A. Pyrch
Location: N: 108,408.99 E: 1,151,478.00	
Ground Surface Elevation: 328 feet	
Horizontal Datum: WA State Plane S, NAD 83, ft.	
Vertical Datum: NAVD88	
Excavation Contractor/Crew: Tapani, Inc.	
Excavation Method: Trackhoe	
Rig Model/Type: Komatsu PC-200	
Total Depth: 8.5 feet	Depth to Ground Water: 7.8 feet
Comments:	



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-1

Figure **A-3**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,359.15 E: 1,151,381.13
Ground Surface Elevation: 306 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2.8 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
305.0	0.0		(Soft), wet, brown, SANDY SILT (ML), with angular gravel. (Residual Soil)	0.0
	2.5		Basaltic Andesite, gray, slightly to moderately weathered, strong (R4) (Basaltic Andesite of Elkhorn Mountain)	2.5
			Bottom of Test Pit at 2.8 feet.	
302.5	5.0			5.0
300.0	7.5			7.5
297.5	10.0			10.0
295.0	12.5			12.5
292.5				

General Notes:
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3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-2

Figure **A-4**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,443.46 E: 1,151,168.38
Ground Surface Elevation: 280 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 3 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type Recovery	Sample Data: Length (inches)	Sample Data: Number Tests	Graphic Log	Material Description	WC	Depth (feet)
280.0	0.0					Topsoil		0.0
						Basaltic Andesite, gray, slightly to moderately weathered, strong (R4), closely spaced discontinuities, highly fractured from 0.5 to 1.0 feet (Basaltic Andesite of Elkhorn Mountain)		
277.5	2.5	6in.	6	S-1 WC			•	2.5
						Bottom of Test Pit at 3.0 feet.		
275.0	5.0							5.0
272.5	7.5							7.5
270.0	10.0							10.0
267.5	12.5							12.5

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-3

Figure **A-5**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,720.06 E: 1,150,909.13
Ground Surface Elevation: 282 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2.6 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
282.0	0.0		Topsoil	0.0
280.0	2.5		Basaltic Andesite, gray, slightly to moderately weathered, strong (R4), moderately spaced discontinuities, highly fractured from 0.5 to 1.0 feet (Basaltic Andesite of Elkhorn Mountain)	2.5
			Bottom of Test Pit at 2.6 feet.	
277.5	5.0			5.0
275.0	7.5			7.5
272.5	10.0			10.0
270.0	12.5			12.5
267.5				

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-4

Figure **A-6**
Sheet **1 of 1**

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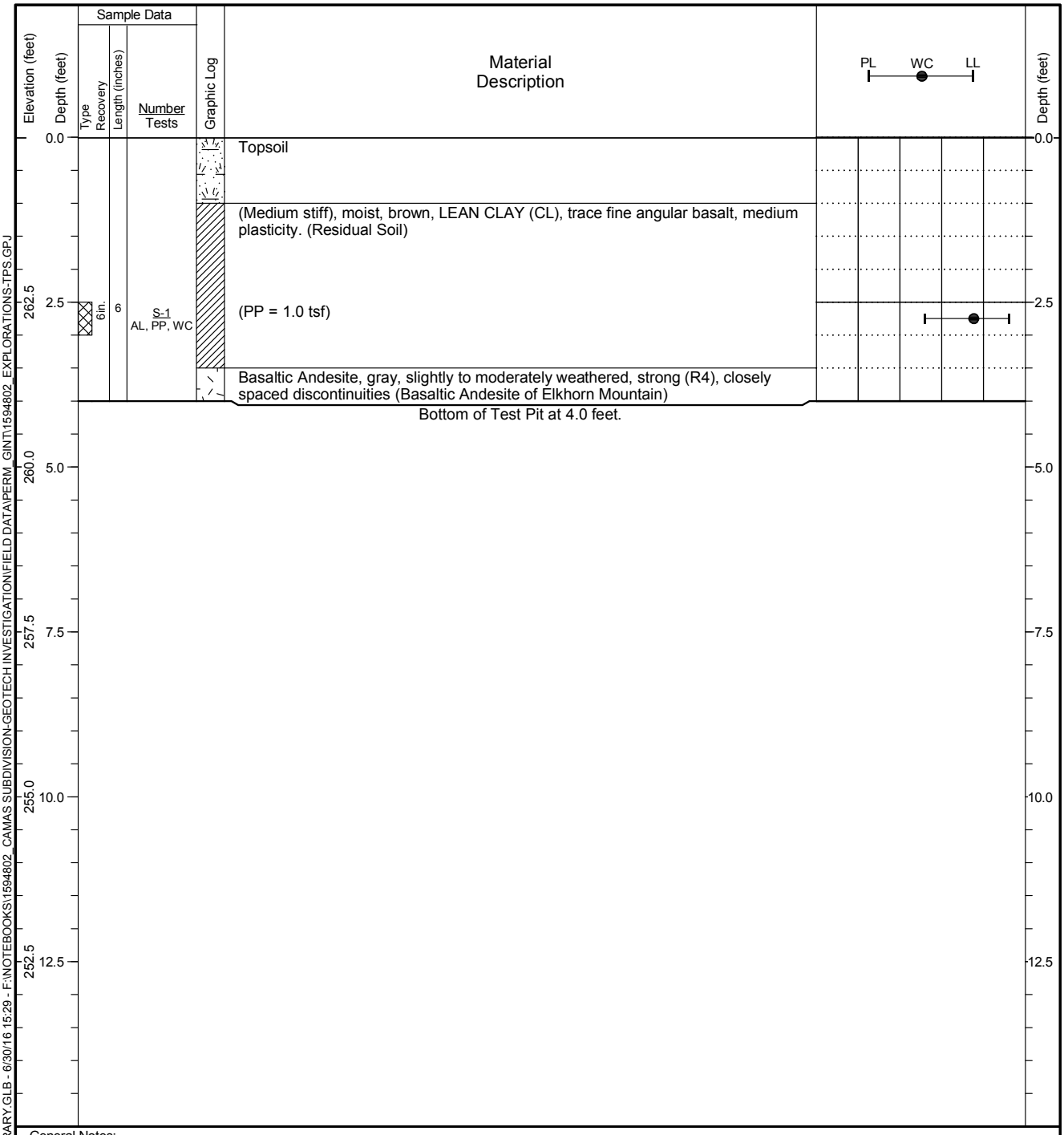
Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,803.30 E: 1,150,695.50
Ground Surface Elevation: 265 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 4 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
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4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-5

Figure **A-7**
Sheet **1 of 1**

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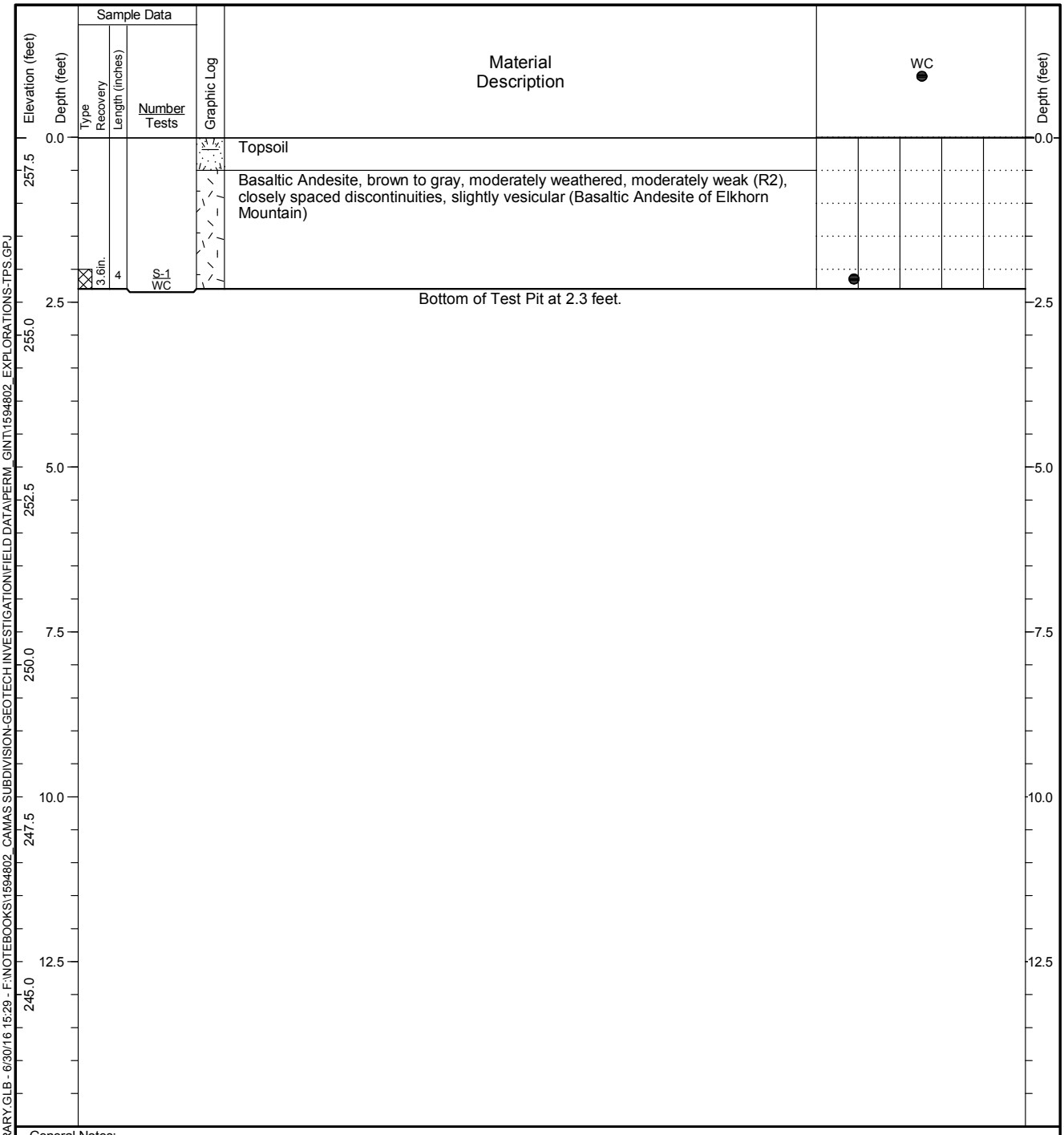
Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,617.58 E: 1,150,517.25
Ground Surface Elevation: 258 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2.3 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
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HARTCROWSER

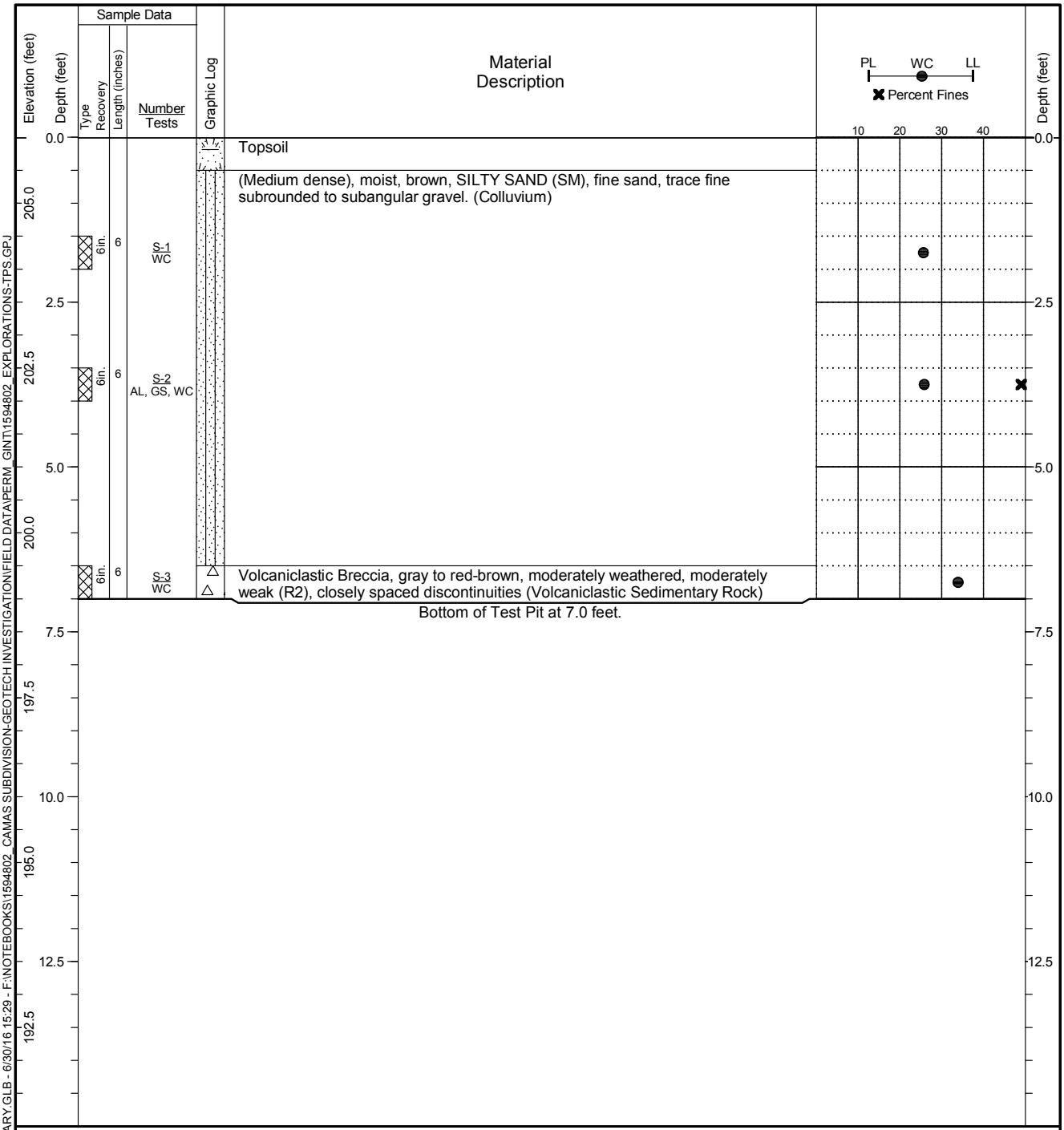
Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-6

Figure **A-8**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,155.49 E: 1,151,190.88
Ground Surface Elevation: 206 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 7 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

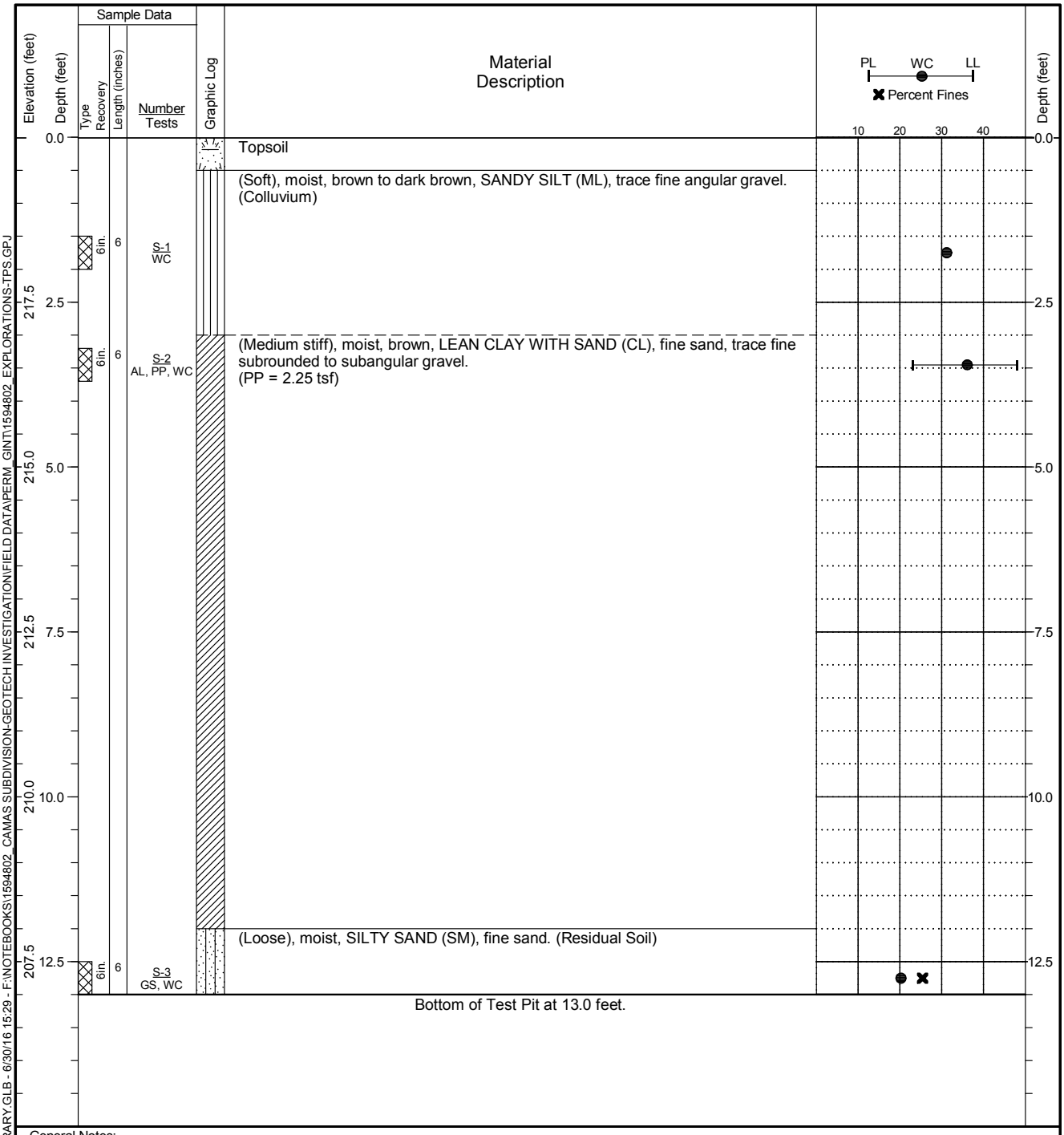
Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-7

Figure **A-9**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,216.10 E: 1,151,204.00
Ground Surface Elevation: 220 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 13 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
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4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-8

Figure **A-10**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,399.40 E: 1,150,699.63
Ground Surface Elevation: 204 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 7 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery Length (inches)	Number Tests	Graphic Log	Material Description	WC	Depth (feet)
204.0	0.0					Topsoil		0.0
						(Soft), moist, brown, SILT WITH SAND (ML), fine sand, trace angular gravel, low plasticity. (Colluvium)		
202.5	2.5							2.5
200.0		6in.	6	S-1 WC			●	
199.0	5.0					Basaltic Andesite, gray to brown, moderately weathered, moderately weak (R2), closely spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)		5.0
197.5		6in.	6	S-2				
						Bottom of Test Pit at 7.0 feet.		
	7.5							7.5
195.0								
	10.0							10.0
192.5								
	12.5							12.5
190.0								

General Notes:
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3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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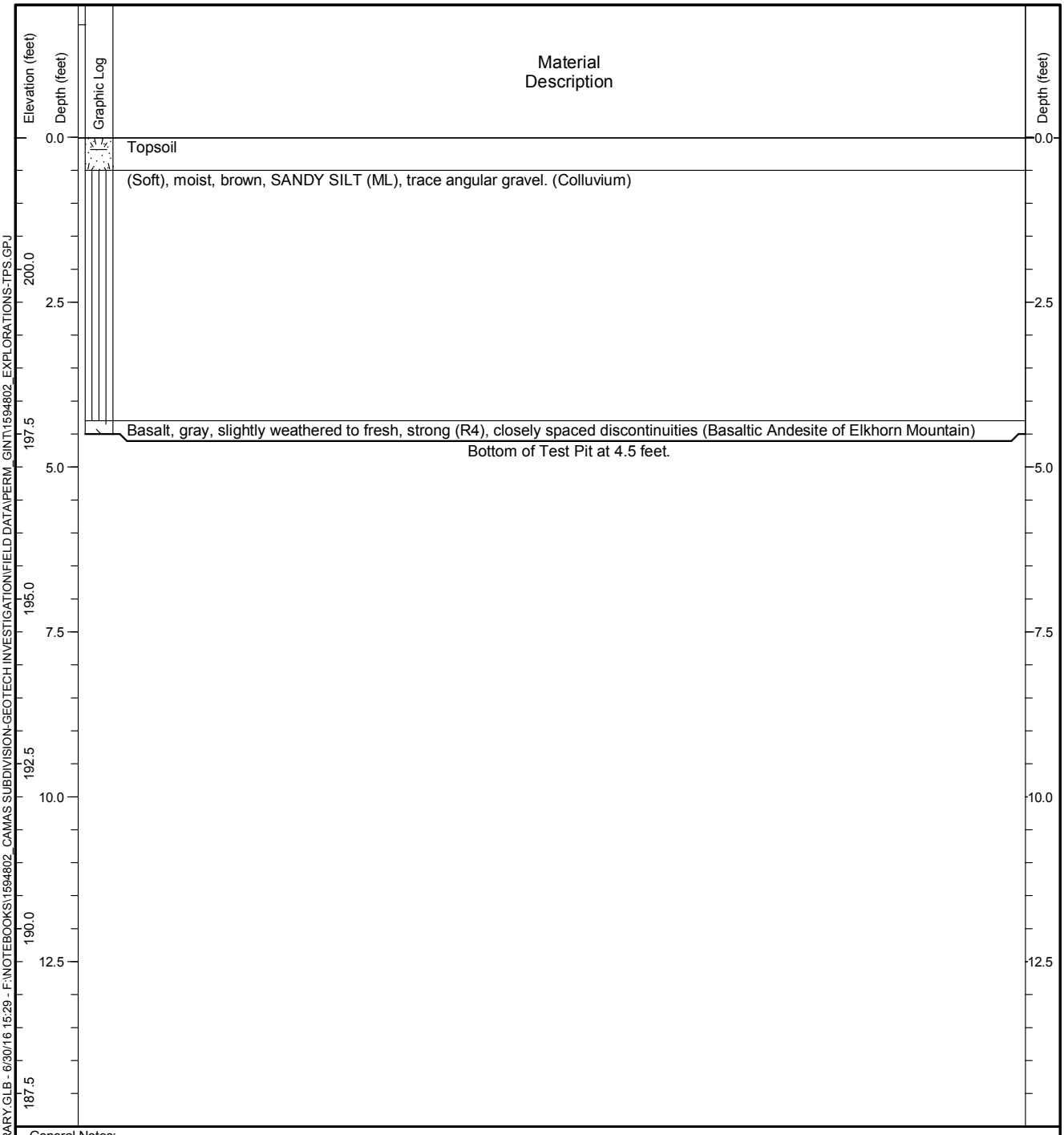
HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-9

Figure **A-11**
Sheet **1 of 1**

Date Started: 5/27/16	Date Completed: 5/27/16	Excavation Contractor/Crew: Tapani, Inc.	
Logged by: A. Jones	Checked by: A. Pyrch	Excavation Method: Trackhoe	
Location: N: 108,427.13 E: 1,150,429.13		Rig Model/Type: Komatsu PC-200	
Ground Surface Elevation: 202 feet		Total Depth: 4.5 feet	Depth to Ground Water: Not Encountered
Horizontal Datum: WA State Plane S, NAD 83, ft.		Comments:	
Vertical Datum: NAVD88			



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER	Project: CJ Dens Subdivision Location: Camas, Washington Project No.: 15948-02	Test Pit Log **TP-10**	Figure **A-12** Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,718.59 E: 1,150,368.88
Ground Surface Elevation: 258 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
257.5	0.0		Topsoil	0.0
			Basaltic Andesite, gray, fresh to slightly weathered, strong (R4), closely spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)	
			Bottom of Test Pit at 2.0 feet.	
255.0	2.5			2.5
252.5	5.0			5.0
250.0	7.5			7.5
247.5	10.0			10.0
245.0	12.5			12.5

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-11

Figure **A-13**
Sheet **1 of 1**

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Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,858.86 E: 1,150,225.88
Ground Surface Elevation: 264 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2.5 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery Length (inches)	Number Tests	Graphic Log	Material Description	Depth (feet)
264.0	0.0					Topsoil	0.0
						(Dense), moist, SILTY GRAVEL WITH SAND (GM). (Residual Soil)	
262.5		6in.	6	S-1		Basaltic Andesite, gray, slightly weathered to fresh, strong (R4), closely spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)	
	2.5					Bottom of Test Pit at 2.5 feet.	2.5
260.0	5.0						5.0
257.5	7.5						7.5
255.0	10.0						10.0
252.5	12.5						12.5
250.0							

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

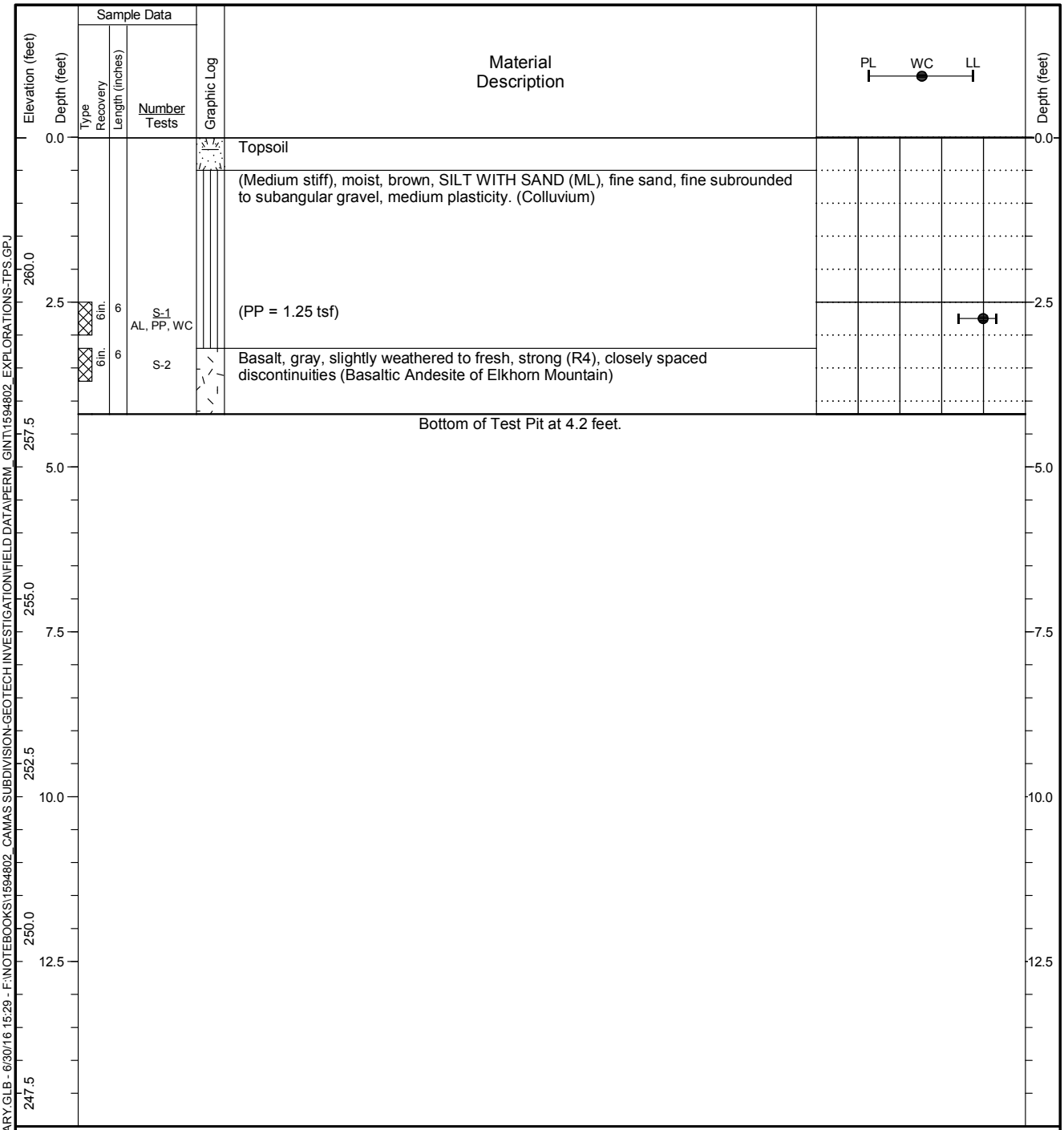
Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-12

Figure **A-14**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,929.59 E: 1,150,317.25
Ground Surface Elevation: 262 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 4.2 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

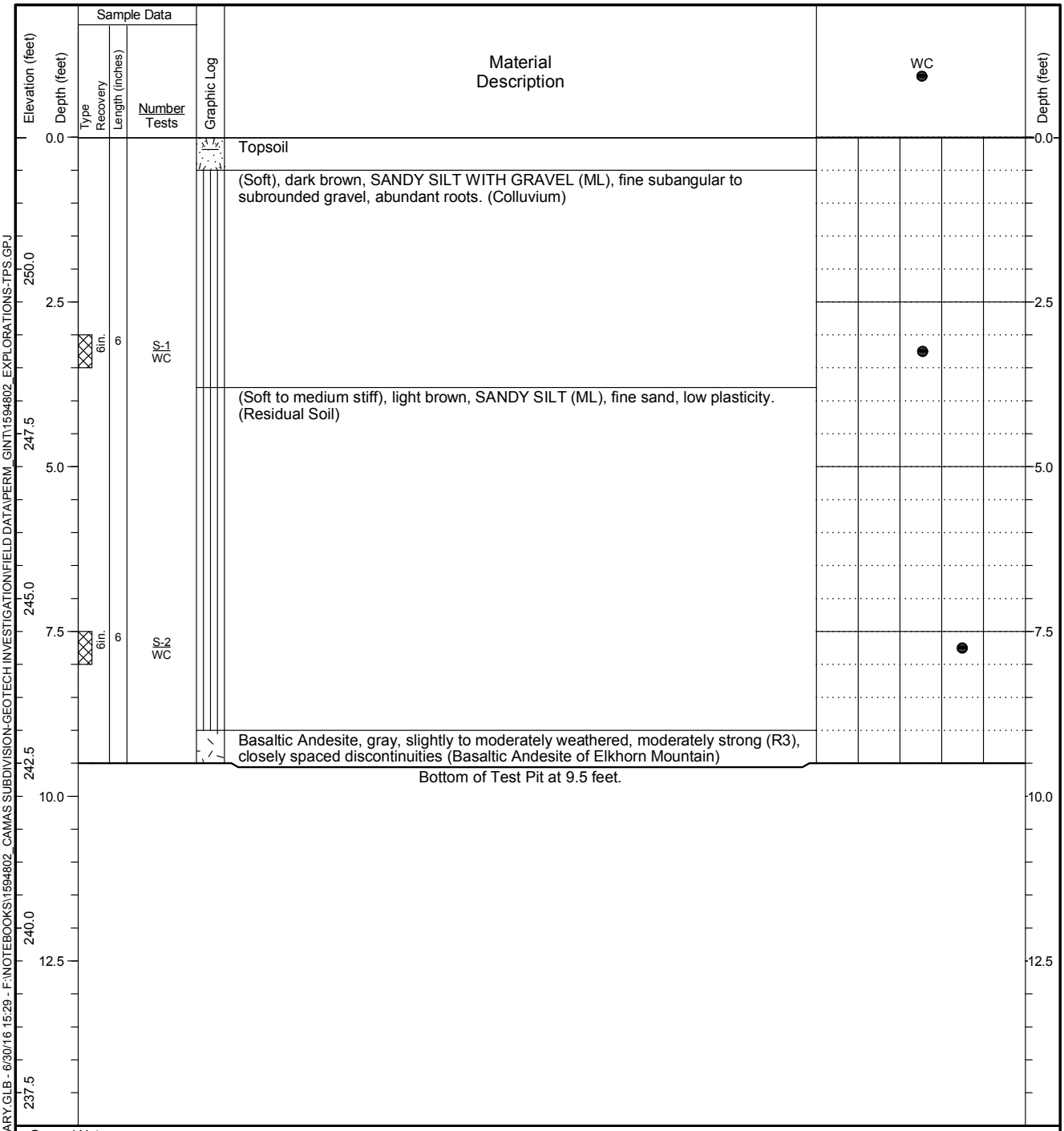
Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-13

Figure **A-15**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,001.39 E: 1,150,228.63
Ground Surface Elevation: 252 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 9.5 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

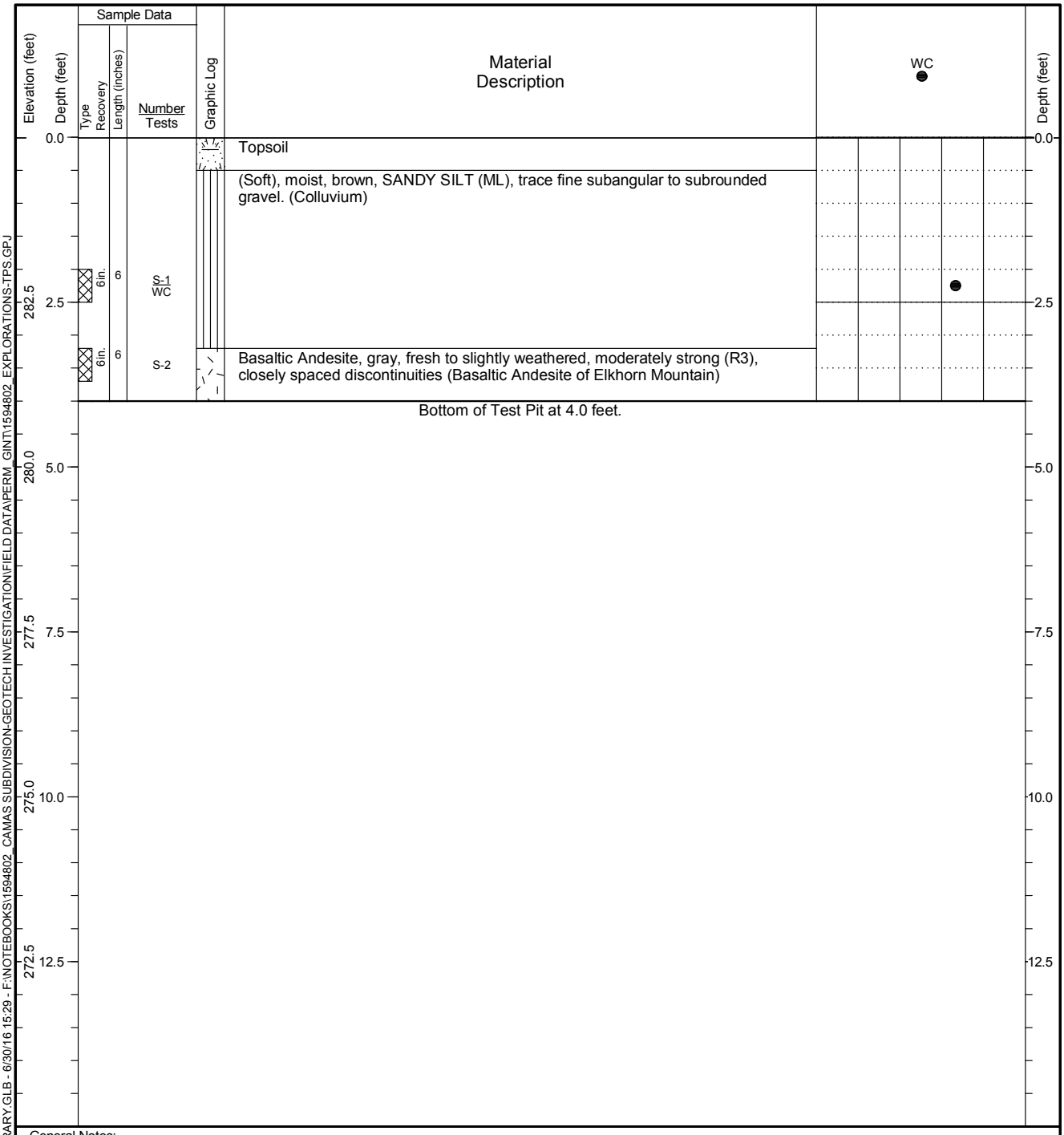
Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-14

Figure **A-16**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,048.11 E: 1,150,482.88
Ground Surface Elevation: 285 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 4 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-15

Figure **A-17**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,139.92 E: 1,150,713.75
Ground Surface Elevation: 298 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 6.5 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery Length (inches)	Number Tests	Graphic Log	Material Description	WC	Depth (feet)
297.5	0.0					Topsoil		0.0
		6in.	6	S-1 WC		(Loose), moist, brown, SILTY SAND WITH GRAVEL (SM), fine subrounded to subangular gravel. (Colluvium)		
295.0	2.5							2.5
292.5	5.0	6in.	6	S-2		Basaltic Andesite, gray, slightly to moderately weathered, moderately strong (R3), closely spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)		5.0
						Bottom of Test Pit at 6.5 feet.		
290.0	7.5							7.5
287.5	10.0							10.0
285.0	12.5							12.5

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-16

Figure **A-18**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,127.21 E: 1,151,207.50
Ground Surface Elevation: 302 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description
302.0	0.0		Topsoil
			Basaltic Andesite, gray, fresh to slightly weathered, strong (R4), moderately spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)
300.0	2.0		Bottom of Test Pit at 2.0 feet.
297.5	5.0		
295.0	7.5		
292.5	10.0		
290.0	12.5		
287.5			

Depth (feet): 0.0, 2.5, 5.0, 7.5, 10.0, 12.5

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-17

Figure **A-19**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,063.24 E: 1,151,558.63
Ground Surface Elevation: 310 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description
	0.0		Topsoil
			Basaltic Andesite, gray, fresh to slightly weathered, strong (R4), closely spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)
307.5	2.5		Bottom of Test Pit at 2.0 feet.
305.0	5.0		
302.5	7.5		
300.0	10.0		
297.5	12.5		

Depth (feet): 0.0, 2.5, 5.0, 7.5, 10.0, 12.5

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

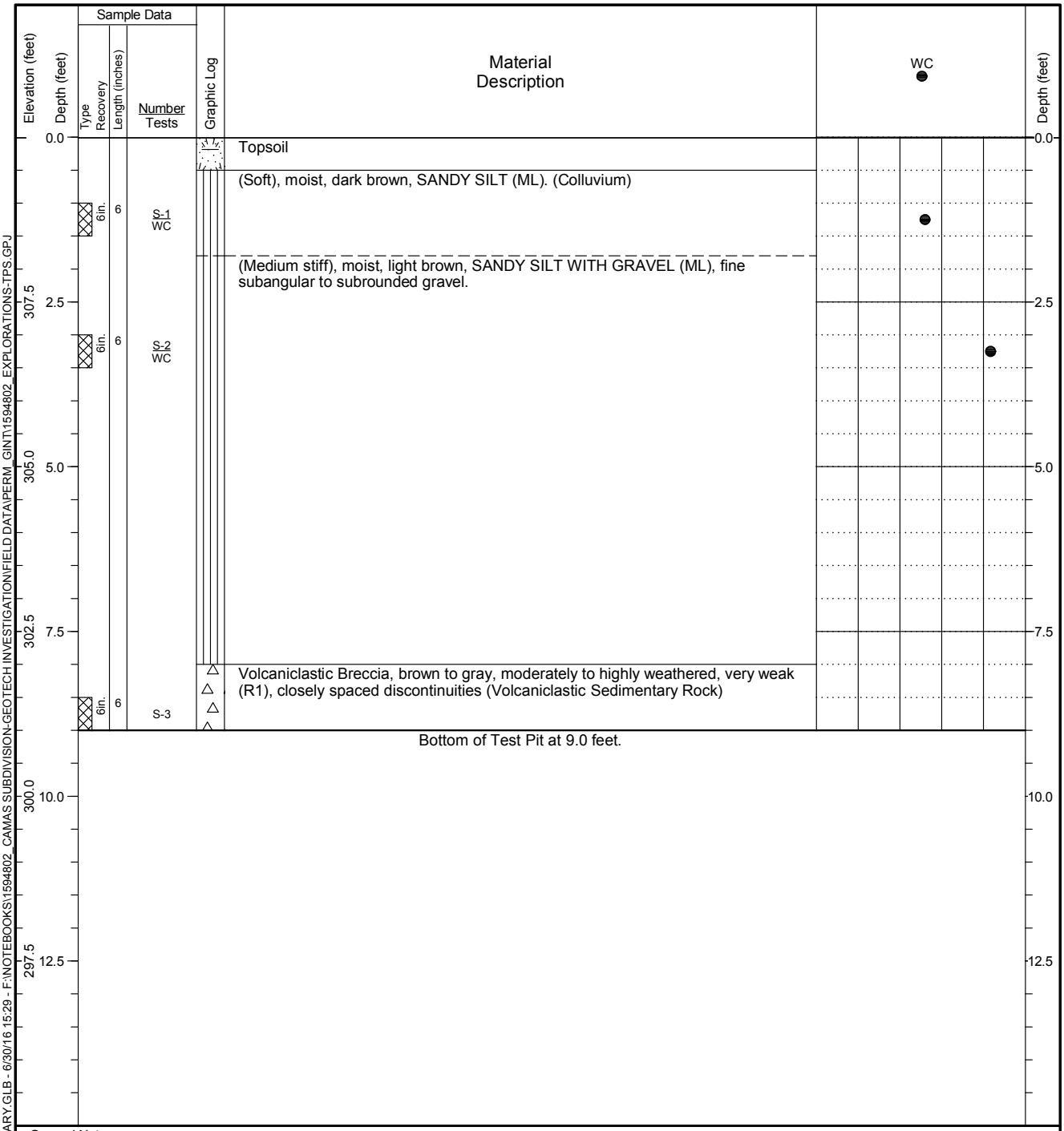
Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-18

Figure **A-20**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,311.19 E: 1,151,638.63
Ground Surface Elevation: 310 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 9 feet Depth to Ground Water: Not Encountered
Comments:



General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-19

Figure **A-21**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 109,197.91 E: 1,151,661.25
Ground Surface Elevation: 306 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 8 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery Length (inches)	Number / Tests	Graphic Log	Material Description
305.0	0.0					Topsoil
						(Loose), moist, brown, SILTY SAND (SM), trace angular to subangular gravel. (Residual Soil)
302.5	2.5	6in.	6	S-1 GS, WC		
300.0	5.0					
	7.5					Volcaniclastic Breccia, brown to gray, moderately to highly weathered, very weak (R1), closely spaced discontinuities (Volcaniclastic Sedimentary Rock)
297.5						Bottom of Test Pit at 8.0 feet.
295.0	10.0					
292.5	12.5					

WC ● Percent Fines ✖ (10, 20, 30, 40)

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-20

Figure **A-22**
Sheet **1 of 1**

Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,802.23 E: 1,151,597.38
Ground Surface Elevation: 327 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2.5 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Sample Data: Type	Recovery	Length (inches)	Number	Tests	Graphic Log	Material Description	WC	Depth (feet)
327.0	0.0							Topsoil		0.0
		6in.		6	S-1	WC		(Loose), moist, brown, SILTY SAND (SM), trace fine to coarse subangular to subrounded basalt gravel. (Residual Soil)	●	
325.0	2.5							Basaltic Andesite, gray, fresh to slightly weathered, moderately strong to strong (R3-R4), moderately spaced discontinuities (Basaltic Andesite of Elkhorn Mountain)		2.5
								Bottom of Test Pit at 2.5 feet.		
322.5	5.0									5.0
320.0	7.5									7.5
317.5	10.0									10.0
315.0	12.5									12.5
312.5										

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
3. USCS designations are based on visual-manual identification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling/excavation (ATD) or for date specified. Level may vary with time.

HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-21

Figure **A-23**
Sheet **1 of 1**

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Date Started: 5/27/16 Date Completed: 5/27/16
Logged by: A. Jones Checked by: A. Pyrch
Location: N: 108,395.14 E: 1,151,627.00
Ground Surface Elevation: 312 feet
Horizontal Datum: WA State Plane S, NAD 83, ft.
Vertical Datum: NAVD88

Excavation Contractor/Crew: Tapani, Inc.
Excavation Method: Trackhoe
Rig Model/Type: Komatsu PC-200
Total Depth: 2.6 feet Depth to Ground Water: Not Encountered
Comments:

Elevation (feet)	Depth (feet)	Graphic Log	Material Description	Depth (feet)
310.0	0.0		Topsoil	0.0
			Basaltic Andesite, gray, fresh to slightly weathered, strong (R4), closely spaced discontinuities, highly fractured and moderately weathered from 0.5 to 1.0 feet (Basaltic Andesite of Elkhorn Mountain)	
307.5	2.5		Bottom of Test Pit at 2.6 feet.	2.5
305.0	5.0			5.0
302.5	7.5			7.5
300.0	10.0			10.0
297.5	12.5			12.5

General Notes:
1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual. Solid stratum lines indicate distinct contact between soil strata or geologic units. Dashed stratum lines indicate gradual or approximate change between soil strata or geologic units.
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HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Test Pit Log
TP-22

Figure **A-24**
Sheet **1 of 1**

APPENDIX B
Laboratory Testing

APPENDIX B

Laboratory Testing

A geotechnical laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. Testing was completed in Hart Crowser's soils laboratory. The tests performed and the procedures followed are outlined below.

Soil Classification

Soil samples were visually classified in our laboratory where the field classifications were verified in a relatively controlled laboratory environment. Classifications were made in general accordance with the Unified Soil Classification System (USCS) and ASTM Test Method D 2487.

Water Content Determinations

Water contents were determined for select samples recovered in the explorations in general accordance with ASTM Test Method D 2216. The test results are shown on the appropriate exploration log included in Appendix A and shown on Figure B-1 in this appendix.

Grain Size Analysis

Sieve analyses were conducted on select samples recovered in the explorations in general accordance with ASTM Test Method D 1140. The test results are shown on the appropriate exploration log included in Appendix A and on Figure B-2 in this appendix.

Atterberg Limits

Atterberg Limits (liquid limit, plastic limit and plasticity index) of select fine-grained soil samples were obtained in general accordance with ASTM Test Method D 4318-02. The test results are shown on Figure B-3 in this appendix.

Exploration	Depth	Class-ification	Water Content (%)	Dry Density (pcf)	Maximum Size (mm)	%<#200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index	Pocket Pen (tsf)	Torvane (tsf)
TP-1	3.0	ML	36.6				49	31	18	1.25	
TP-3	2.5		9.4								
TP-5	2.5	CL	37.7				46	26	20	1.0	
TP-6	2.0		9.0								
TP-7	1.5		25.6								
TP-7	3.5	SM	25.8		0.075	49					
TP-7	6.5		33.9								
TP-8	1.5		31.2								
TP-8	3.2	CL	36.1				48	23	25	2.25	
TP-8	12.5	SM	20.2		0.075	25					
TP-9	4.5		25.6								
TP-13	2.5	ML	39.9				43	34	9	1.25	
TP-14	3.0		25.4								
TP-14	7.5		34.9								
TP-15	2.0		33.3								
TP-16	2.0		25.4								
TP-19	1.0		26.0								
TP-19	3.0		41.7								
TP-20	2.5	SM	22.5		0.075	24					
TP-21	1.5		25.0								

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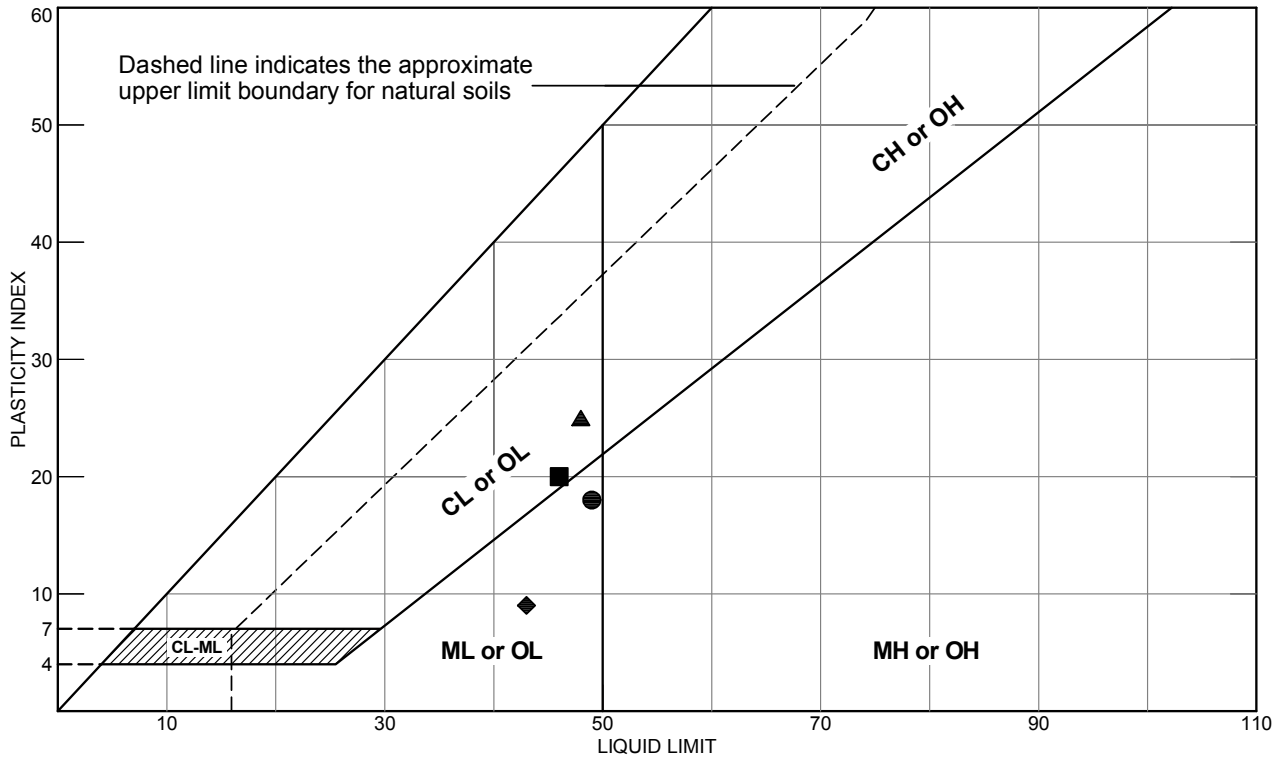
HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Summary of Laboratory Results

Figure **B-1**
Sheet **1 of 1**



Location and Description			LL	PL	PI	#200	MC%	USCS
● **Source:** TP-1 SILT WITH SAND	**Sample No.:** S-1	**Depth:** 3.0 to 3.5 feet	49	31	18	NT	37	ML
■ **Source:** TP-5 LEAN CLAY	**Sample No.:** S-1	**Depth:** 2.5 to 3.0 feet	46	26	20	NT	38	CL
▲ **Source:** TP-8 LEAN CLAY WITH SAND	**Sample No.:** S-2	**Depth:** 3.2 to 3.7 feet	48	23	25	NT	36	CL
◆ **Source:** TP-13 SILT WITH SAND	**Sample No.:** S-1	**Depth:** 2.5 to 3.0 feet	43	34	9	NT	40	ML

Remarks:

● ■ ▲ ◆

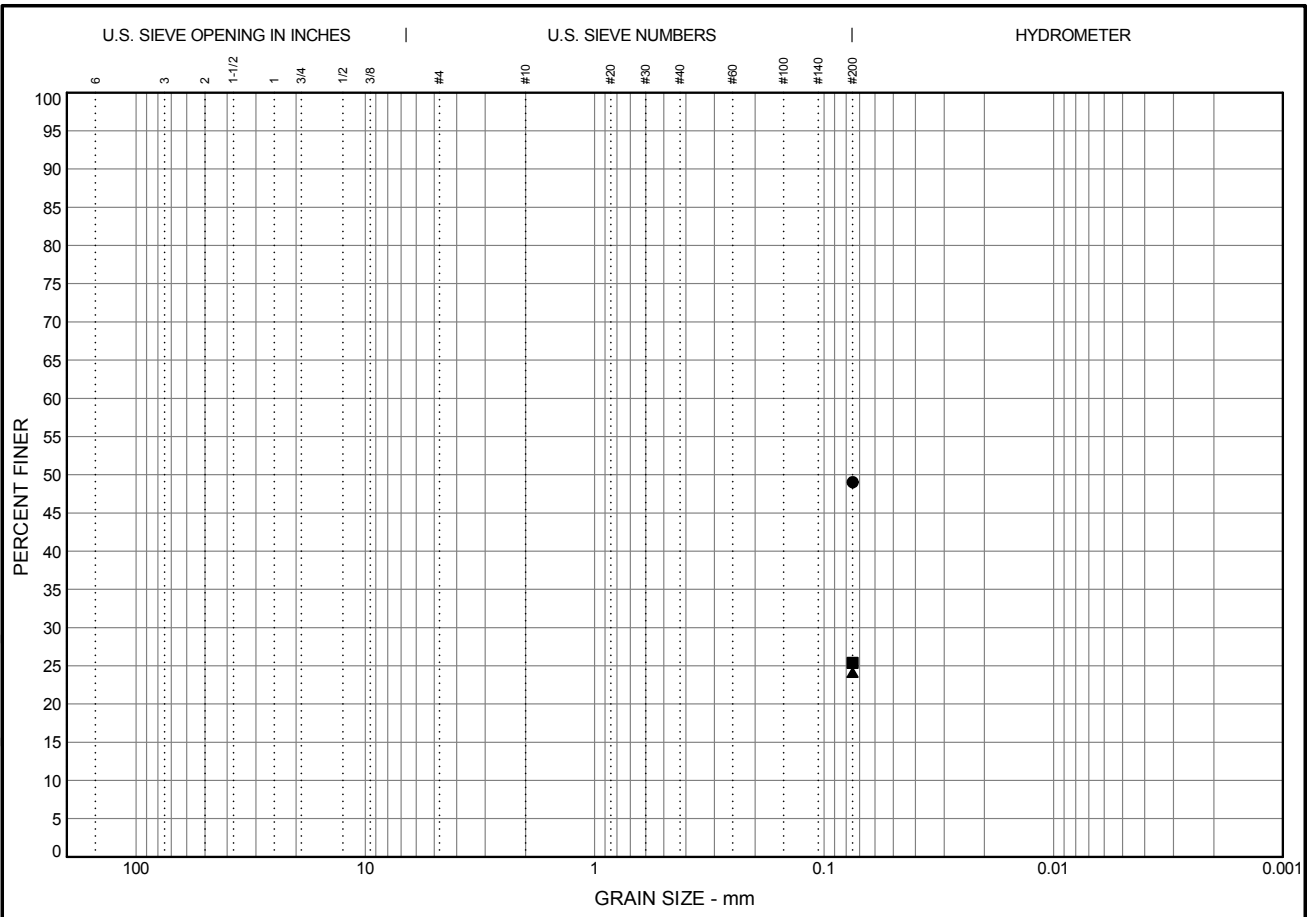
HC ATTERBERG LIMITS - F:\GINT\HC_LIBRARY.GLB - 6/22/16 13:23 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-TPS.GPJ

HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Liquid and Plastic Limits

Figure **B-2**
Sheet **1 of 1**



Location and Description	% Cobbles	% Gravel	% Sand	% Silt	% Clay	MC%	USCS
● **Source:** TP-7 **Sample No.:** S-2 **Depth:** 3.5 to 4.0 SILTY SAND				49.0		26	SM
■ **Source:** TP-8 **Sample No.:** S-3 **Depth:** 12.5 to 13.0 SILTY SAND				25.4		20	SM
▲ **Source:** TP-20 **Sample No.:** S-1 **Depth:** 2.5 to 3.0 SILTY SAND				24.1		23	SM

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●										
■										
▲										

Remarks:

● ■ ▲

HC GRAIN SIZE - F:\GINT\HC_LIBRARY.GLB - 6/22/16 11:21 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS-TPS.GPJ

HARTCROWSER

Project: CJ Dens Subdivision
Location: Camas, Washington
Project No.: 15948-02

Partical Size Distribution

Figure **B-3**
Sheet **1 of 1**

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DANIEL J. TRISLER STATE OF WASHINGTON 38279 REGISTERED PROFESSIONAL ENGINEER

State of Washington Engineering Geologist 3074 Licensed Geologist

Rachel Pirot

MEMORANDUM

DATE: December 7, 2015

TO: CJ Dens Lacamas I, LLC
Attention: Mr. Carl Lawson

FROM: Daniel J. Trisler, PE
Rachel Pirot, LG, LEG

RE: **Initial Site-Specific Evaluation of Geohazard Areas A and C**
Camas Subdivision – Leadbetter Road
Camas, Washington
15948-02

CC: Mackenzie – Brian Hollenback, Todd Johnson
HFI Consultants – Tim Halme-

Introduction

Hart Crowser, Inc. is pleased to submit this memorandum to CJ Dens Lacamas I, LLC, summarizing our evaluation of Geohazard Areas A and C at the proposed subdivision development along Leadbetter Road in Camas, Washington. The proposed subdivision is an undeveloped property on the northeast side of Leadbetter Road, north of Leadbetter Lake, as described in our Critical Areas Report – Update (CAR Update) for the development, dated March 19, 2013.

Two specific geohazard areas were identified and described in the CAR Update that required further site specific-evaluation: Geohazard Areas A and C. The purpose of this evaluation was to gather additional information and provide recommendations to help you assess the general economic feasibility of developing these two areas. Our specific scope of work was detailed in our contract change agreement with you, dated October 14, 2015, and generally included a geologic reconnaissance of the two areas, test pit explorations, an evaluation of the hazards based on our field work, and preparation of this memorandum summarizing our evaluation and recommendations.

The location of the site is shown on Figure 1. The locations of Geohazard Areas A and C and our recent test pit explorations are shown on Figure 2.

300 West 15th Street
Vancouver, Washington 98660-2927
Tel 360.448.4189
Fax 503.620.6918

Site Conditions

We conducted a geotechnical reconnaissance and completed test pits at the two sites on November 23, 2015. Our updated findings from these investigations are described in detail below.

Surface Conditions

Site conditions in the general area of Geohazard Areas A and C consist of a northwest-trending slope abutting the north side of Leadbetter Road with flat slopes on the south side of the road leading to Lacamas Lake. The overall gradient of the northwest-trending slope is moderate, but with locally variable landforms and resulting gradients that are gentle to steep. Elevations range from approximately 190 feet above mean sea level (MSL) at Leadbetter Road to 320 feet MSL at the top of the northwest-trending slope, above both geohazard areas. Although gradients are variable, landforms are generally well-weathered and without abrupt transitions or other features indicative of accelerated erosional processes or earth movement. Prior to current logging activities, the area was forested with a dense mostly coniferous second-growth stand of timber and the ground surface well-vegetated with native understory plants. Conditions at each area specifically are described separately below.

Geohazard Area A

Geohazard Area A consists of an arcuate-shaped landform extending perpendicular to the predominant southwest-facing slope. The feature includes a steeper arcuate upper slope and convex lower toe slope that could be interpreted as the headscarp and toe, respectively, of a landslide.

During our reconnaissance, we observed these and associated features. We noted that the slope of the potential headscarp is only minimally steeper than adjacent slopes and the landform is not well-formed. No exposed soil or ground cracks were observed within it. Slopes in the body of the landform were gentle, approximately 25 to 30 percent. No developed stream channels, seeps or springs were observed within or adjacent to the feature. The area has irregular topography and several trees were observed to have experienced wind throw. The root balls of these trees were exposed and shallow bedrock was observed entangled with the roots. Relatively flat benches cut across the slopes in this area and are interpreted as old logging roads. At the toe of the slope, the cut for Leadbetter Road exposes volcanic rock that holds a vertical face and appears in-place.

The area is heavily vegetated with conifer to approximately 12 to 24 inches in diameter. The conifer trees are straight-trunked except immediately adjacent to Leadbetter Road, where they lean and exhibit bowed trunks. The bowed and leaning conifers continue along Leadbetter Road throughout the area and are not limited to Geohazard Area A.

Geohazard Area C

Geohazard Area C is a complex and irregular landform divided into a lower portion ("Older Debris Flow") and an upper portion ("Recent Debris Flow"). The upper portion is a narrow swale that extends to a distinct break in the southwest-facing slope at about elevation 270 feet MSL. The lower portion is a broader fan with very gentle slopes on both sides of Leadbetter Road.

During our reconnaissance we traversed up the upper portion and found it to consist of a saddle or swale in the otherwise continuous ridgetop. The saddle was slightly arcuate but landforms appeared mature and slopes were 25 to 35 percent. The upper portion of the saddle opened up to flat ground above, and no potential source area for past or future debris flows was observed. The ridgetop was weathered and rounded with gentle slopes and subdued features. The previously mapped geohazard area had a grade of approximately 25 percent in the upper slopes, which flattened to 10 to 20 percent downhill. The lower portion of the slopes were dominated by a wide, relatively flat bench with gentle undulating hummocks. No seeps or springs were observed, and no streams or erosive process at the toe of the slope of deposits were observed. No outcrops exposed bedrock geology directly within Geohazard Area C.

The lower portion of Geohazard Area C was thickly wooded with straight trunked conifers while the upper portion was characterized by a lack of mature conifers and was primarily forested with deciduous trees. Conifer trees where present were predominately straight throughout the area. Timber age and type were generally consistent between Geohazard Area C and other areas of the site.

Subsurface Conditions

Our understanding of the subsurface conditions is based on research and information collected from our field explorations completed for this project. Our explorations consisted of nine test pits and four potholes. (Potholes were test pits that encountered bedrock at very shallow depth, and for which formal test pit logs were not created.) The locations of the explorations are shown on Figure 2. Attachment A presents logs of the test pits. Samples of the soils were collected during the explorations for potential future laboratory testing, though no laboratory testing was conducted as part of this current scope of work.

Soil and Bedrock

Geohazard Area A

The bedrock geology at Geohazard Area A was interpreted to be Basaltic Andesite of Elkhorn Mountain, as discussed in our March 19, 2013 CAR Update. Test pits TP-7 and TP-8 and two additional potholes in this area exposed moderately strong bedrock at 2 to 4 feet below ground surface (bgs). In place jointing of the basaltic andesite was observed in the test pit walls. The overlying material encountered was colluvial gravel, cobbles, and silt. Two additional potholes adjacent to Geohazard Area A encountered a

thin (1 to 3 feet) veneer of colluvium over what appeared to be in-place basaltic andesite. We observed no definitive signs of past landsliding or slope movement within the materials exposed in the test pits and pot holes.

Geohazard Area C

Our test pits in Geohazard Area C encountered fine-grained silty soils over sandy residual soil which transitioned into Volcaniclastic Sedimentary bedrock. The surficial silty soil had a disturbed texture, although we observed no definitive signs of disturbance from landsliding (e.g., slickensides, etc.). In place bedding structures were observed in the residual soil and bedrock. Our test pits in this area encountered bedrock at between 3 and 13 feet bgs.

Groundwater

Groundwater and signs of groundwater (e.g., mottling, etc.) were not encountered in our test pits. Based on the previous Level 1 Hydrogeologic Assessment, dated March 19, 2013, depth to the regional groundwater level is expected to vary from approximately 50 to 100 feet bgs. However, we anticipate that locally perched groundwater will be encountered above the bedrock materials encountered at the site.

Conclusions

Based on our geotechnical reconnaissance and limited subsurface investigation it is our opinion that Geohazard Areas A and C do not present geologic hazards to the project that cannot be reasonably mitigated. We did not observe surface or subsurface signs of active landsliding and the potential for future landsliding in these areas appears low. It is our opinion, based on the observed surface and subsurface conditions, that future development of these areas is feasible with limited mitigation measures, which can be finalized during final design. Therefore, immediate logging of these areas is acceptable, as they can be included within the overall subdivision development.

Slopes across the site and within the previously mapped geohazard areas are gentle with weathered landforms and subdued topographic expression. No significant source areas or geomorphic processes, such as stream erosion or rapid downcutting, were observed that might cause slope movement in either area. Timber age and type are consistent across the site without significant differences within the geohazard areas. Bowed and tilted conifer trees were only observed adjacent the full length of Leadbetter Road, and therefore, suggest the cause of the bowing and tilting is related to the roadway, not slope movement from landsliding.

In Geohazard Area A, shallow bedrock was encountered in the test pits and previously mapped adjacent outcrops also indicate shallow bedrock depths. Bedrock was also exposed in the root balls of wind thrown trees. The hummocky features observed are likely due to wind throw of trees in shallow soils

and grading of old logging roads across the area. It is our opinion, based on the observed features and shallow bedrock encountered in our explorations, that the landform mapped as Geohazard Area A was not formed by a landslide, but the result of bedrock geologic conditions and normal weathering processes. In our opinion Geohazard Area A can henceforth be considered similarly with the rest of the development and specific mitigation for geohazards is not needed in this area. This area is suitable for future development, provided that the recommendations outlined below are followed.

In Geohazard Area C, the disturbed soil and fan morphology observed on site are likely the result of very old debris flows and/or colluvial processes. However, slopes in this area have been extensively modified by weathering since those processes were active. Landforms within the mapped Geohazard Area C exhibit very weathered and rounded topography with gentle slopes. Active driving processes for slope movement, such as streams or erosion at the toe of the deposit, were absent. No obvious source areas were observed for future debris flows. Additionally no discrete failure zone was identifiable in the test pits. Currently conditions to result in debris flows and landsliding appear to be low. This area is suitable for future development, provided that the recommendations outlined below are followed.

Based on our observations and evaluation, it is our opinion that the proposed development is feasible in both Geohazard Areas A and C. Development in these areas in accordance with the *Preliminary Recommendations* section of this memorandum should not adversely affect the stability of the site or neighboring properties. Final design should include additional evaluation and final recommendations related to these areas.

Preliminary Recommendations

As outlined in the CAR Update, general hillside development guidelines should be followed during the design and construction stages. Final geotechnical design recommendations will be developed at the time a full geotechnical investigation is completed. However, a summary of the anticipated general guidelines is provided below.

- Hillside grading methodologies shall be employed for earthwork in all sloping areas, including previously mapped Geohazard Areas A and C. This will likely include keys and benches, installation of sub drains where seepage is encountered, and installation of all material as a compacted structural fill. Limits on fill depths may also be necessary in some areas.
- A detailed erosion and sediment control plan will be required as part of the proposed development.
- In general, we anticipate that homes will be supported by conventional spread footings. However, homes near existing or new steep slopes may require the use of deepened footings, drilled piers, or larger slope setbacks.

- We recommend against the use of infiltration systems for disposal of stormwater from the site. Foundation subdrains may be required around homes to reduce the potential for water seepage in crawlspace areas.

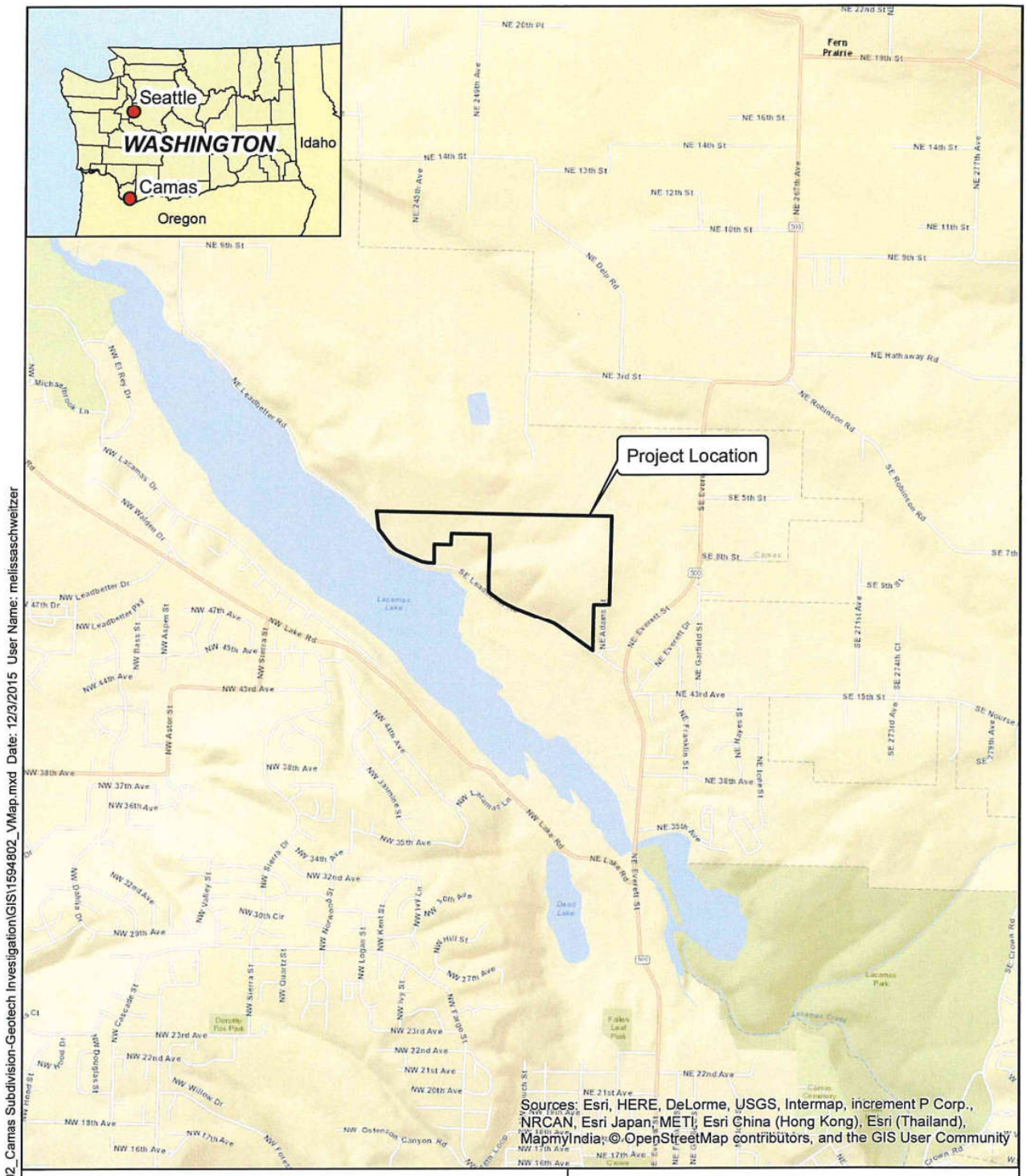
Limitations

We have prepared this memorandum for the exclusive use of CJ Dens Lacamas I, LLC and their authorized agents for this specific site. The scope of our work was in general accordance with our agreement dated October 14, 2015, and is limited to providing the information requested. Our evaluation and conclusions are based on our interpretation of observed site conditions. However, conditions can vary along the slope, and our conclusions should not be construed as a warranty or guarantee of future site performance. This memorandum should not be construed as providing design and construction recommendations for the proposed subdivision. Additional and more detailed geotechnical investigation should be performed before final design-level recommendations may be developed.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this memorandum was prepared. No warranty, express or implied, should be understood. Any electronic form, facsimile, or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by Hart Crowser and will serve as the official document of record.

Attachments:
Figure 1 – Vicinity Map
Figure 2 – Exploration Plan
Test Pit Logs

F:\Notebooks\1594802_Camas Subdivision-Geotech Investigation\Deliverables\Memo-Geohazard Eval 12-07-15\Camas Subdivision Site-Specific Eval.docx



0 1,000 2,000 4,000 Feet

N

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Camas Subdivision
Camas, Washington

Vicinity Map

15948-02 12/15

HARTCROWSER

Figure
1


0
200
400
Approximate Scale in Feet
N
LEGEND
TP-1 Test Pit
Pothole
Gechazard Area
A
TP-7
TP-8
C
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-9
DEERHAVEN SUBDIVISION (311-573)
N.E. ADAMS STREET
N.E. LADDIE LEE ROAD
N.E. 45th
Source: Overall Existing Conditions Plan, Sheet C2.1 from Group Mackenzie, dated 1/19/11.
Camas Subdivision
Camas, Washington
Exploration Plan
15948-02
12/15
HARTCROWSER
Figure
2

KEY TO EXPLORATION LOGS

HARTCROWSER

SOIL CLASSIFICATION CHART

MATERIAL TYPES	MAJOR DIVISIONS		GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	GW	WELL-GRADED GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES, >12% FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	SW	WELL-GRADED SAND
			SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	CL	LEAN CLAY
			ML	SILT
		ORGANIC	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	CH	FAT CLAY
			MH	ELASTIC SILT
		ORGANIC	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS			PT	PEAT

OTHER MATERIAL SYMBOLS

- Concrete
- Asphalt
- Topsoil

Note: Multiple symbols are used to indicate borderline or dual classifications

MOISTURE MODIFIERS

- Dry - Absence of moisture, dusty, dry to the touch
- Moist - Damp, but no visible water
- Wet - Visible free water or saturated, usually soil is obtained from below the water table

SEEPAGE MODIFIERS

- None -
- Slow - < 1 gpm
- Moderate - 1-3 gpm
- Heavy - > 3 gpm

CAVING MODIFIERS

- None -
- Minor - isolated
- Moderate - frequent
- Severe - general

MINOR CONSTITUENTS

- Trace - < 5% (silt/clay)
- Occasional - < 15% (sand/gravel)
- With - 5-15% (silt/clay) in sand or gravel
  15-30% (sand/gravel) in silt or clay

SAMPLE TYPES

- Dames & Moore
- Standard Penetration Test (SPT)
- Shelby Tube
- Bulk or Grab

LABORATORY/ FIELD TESTS

- ATT - Atterberg Limits
- CP - Laboratory Compaction Test
- CA - Chemical Analysis (Corrosivity)
- CN - Consolidation
- DD - Dry Density
- DS - Direct Shear
- HA - Hydrometer Analysis
- OC - Organic Content
- PP - Pocket Penetrometer (TSF)
- P200 - Percent Passing No. 200 Sieve
- SA - Sieve Analysis
- SW - Swell Test
- TV - Torvane Shear
- UC - Unconfined Compression

GROUNDWATER SYMBOLS

- Water Level (at time of drilling)
- Water Level (at end of drilling)
- Water Level (after drilling)

STRATIGRAPHIC CONTACT

- ——— Distinct contact between soil strata or geologic units
- – – – – Gradual or approximate change between soil strata or geologic units

Notes:

Blowcount (N) is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted) per ASTM D-1586. See exploration log for hammer weight and drop.

When the Dames & Moore (D&M) sampler was driven with a 140-pound hammer (denoted on logs as D+M 140), the field blow counts (N-value) shown on the logs have been reduced by 50% to approximate SPT N-values.

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

Refer to the report text and exploration logs for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the exploration locations at the time the explorations were made. The logs are not warranted to be representative of the subsurface conditoins at other locations or times.

KEY TO EXPLORATION LOGS - F:\GINT\OREGON_LIBRARY.GLB - 11/30/15 11:57 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS.GPJ

Figure A-1

KEY TO BEDROCK TERMS (1 of 2)
(WSDOT, 2014)

HARTCROWSER
8910 SW Gemini Drive
Beaverton, Oregon 97008

Weathered State of Rock

Term	Description	Grade
Fresh	No visible signs of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering, and may be somewhat weaker externally than in its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as corestone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength
R0	Extremely Weak	Indented by thumbnail.	0.04 to 0.15 ksi
R1	Very Weak	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	0.15 to 3.6 ksi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3.6 to 7.3 ksi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	7.3 to 15 ksi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15 to 29 ksi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 29 ksi

Discontinuities

Discontinuity Spacing		Discontinuity Condition	
Description	Spacing	Condition	Description
Very Widely Spaced	Greater than 10 feet.	Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall.
Widely Spaced	3 to 10 feet.	Good Condition	Slightly rough surfaces, separation less than 0.05 inches, hard discontinuity wall.
Moderately Spaced	1 to 3 feet.	Fair Condition	Slightly rough surface, separation greater than 0.05 inches, soft discontinuity wall.
Closely Spaced	2 to 12 inches	Poor Condition	Slickensided surfaces, or soft gouge less than 0.2 inches thick, or open discontinuities 0.05 to 0.2 inches.
Very Closely Spaced	Less than 2 inches	Very Poor Condition	Soft gouge greater than 0.2 inches, or open discontinuities greater than 0.2 inches.

Figure A-2

KEY TO BEDROCK TERMS (2 of 2)
(WSDOT, 2014)

HARTCROWSER
8910 SW Gemini Drive
Beaverton, Oregon 97008

Grain Size

Grain Size	Description	Criteria
Less than 0.04 inches	Fine grained	Few crystal boundaries/ grains distinguishable in the field or with a hand lens.
0.04 to 0.2 inches	Medium grained	Most crystal boundaries/ grains distinguishable with the aid of a hand lens.
Greater than 0.2 inches	Coarse grained	Most crystal boundaries/ grains distinguishable with the naked eye.

Igneous Rock Textures

Texture	Grain Size
Pegmatitic	Very large; diameters greater than 0.8 in.
Phaneritic	Can be seen with the naked eye
Porphyritic	Grained of two widely different sizes
Aphanitic	Cannot be seen with the naked eye
Glassy	No grains present

Pyroclastic Rocks

Rock Name	Characteristics
Pyroclastic Breccia	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which *angular* pyroclasts predominate.
Agglomerate	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which *rounded* pyroclasts predominate.
Lapilli Tuff	Pyroclastic rock whose average pyroclast size is 0.08 to 2.5 inches.
Ash Tuff	Pyroclastic rock whose average pyroclast size is less than 0.08 inches.

Degree of Vesicularity

Designation	Percentage of Cavities (by volume) of Total Sample
Slightly Vesicular	5 to 10 Percent
Moderately Vesicular	10 to 25 Percent
Highly Vesicular	25 to 50 Percent
Scoriaceous	Greater than 50 Percent

OTHER TERMS:

Core Recover (CR) = the ratio of core recovered to the core run length expressed as a percentage.

Rock Quality Designation (RQD) = the percentage of rock core recovered in intact pieces of 4 inches or more in length in the length of a core run. Does not include mechanical breaks caused by drilling.

Fracture Frequency (FF) = the number of natural fractures per foot in the length of core recovered.

REFERENCE:

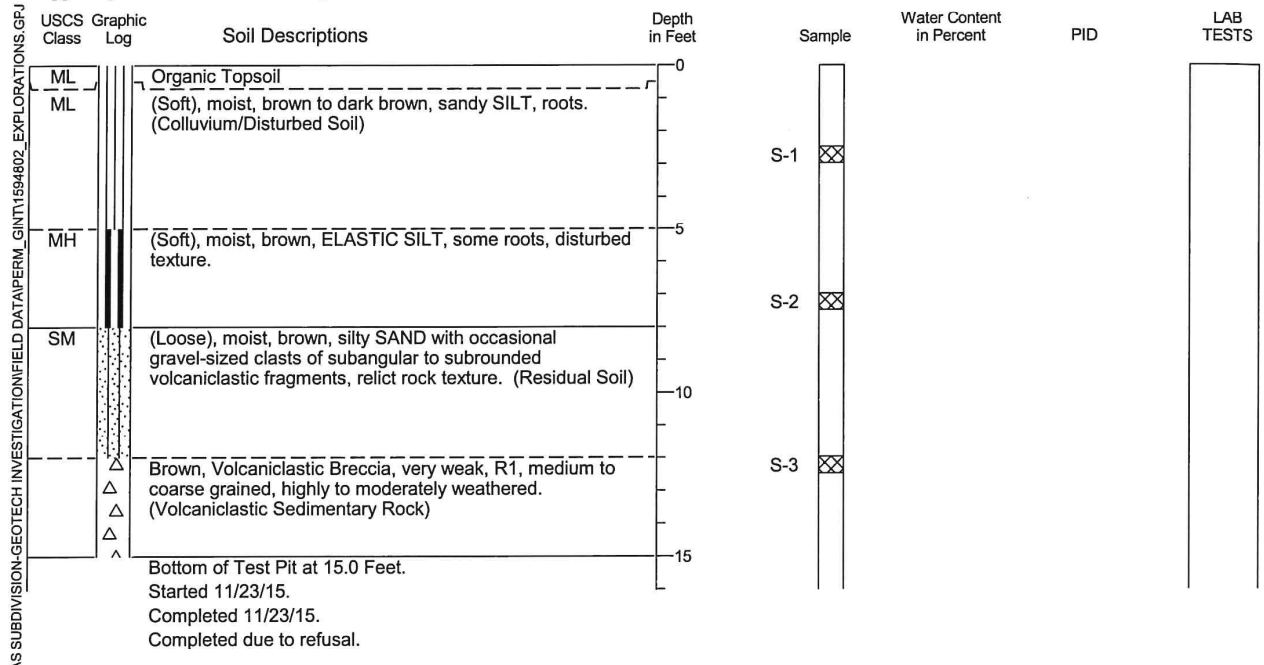
Washington State Department of Transportation (WSDOT), 2014. *Geotechnical Design Manual*, Publication M 46-03.02, August, 2014.

Figure A-2

Test Pit Log TP-1

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

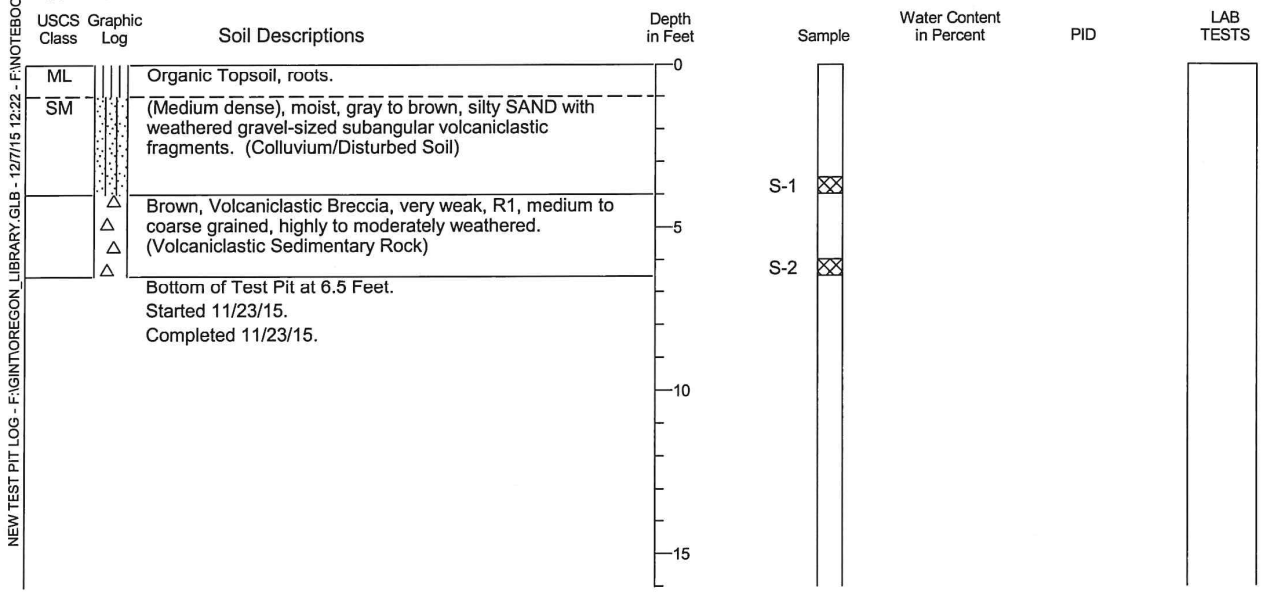
Horizontal Datum: N/A
Vertical Datum: N/A



Test Pit Log TP-2

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

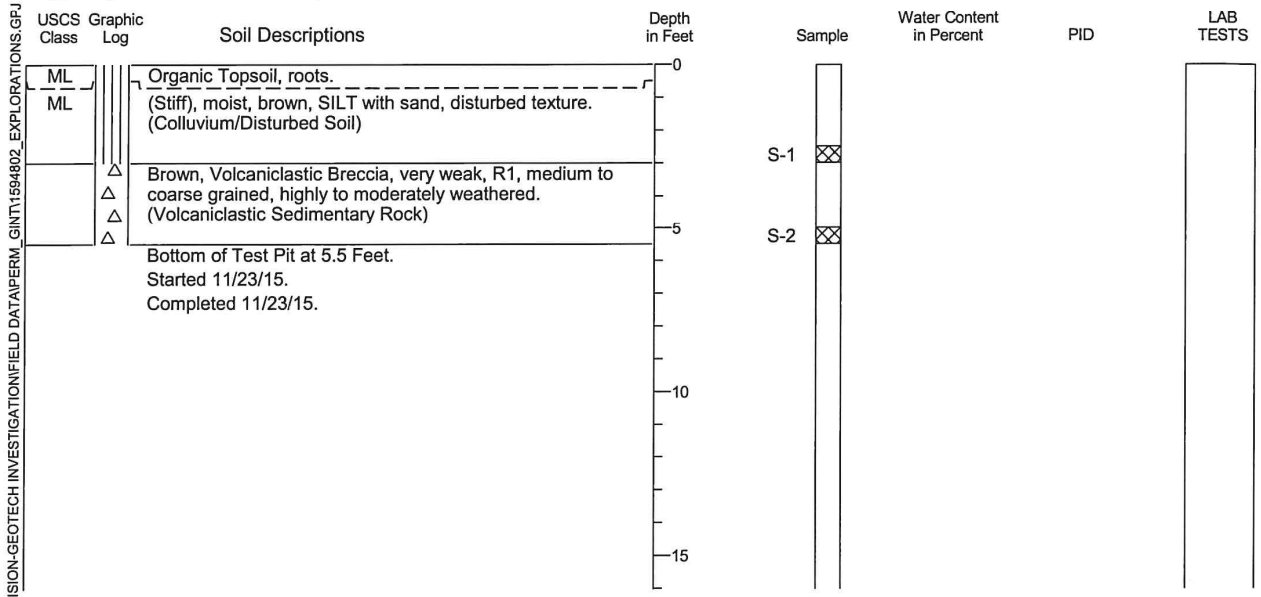
15948-02 12/15

Figure A-3

Test Pit Log TP-3

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

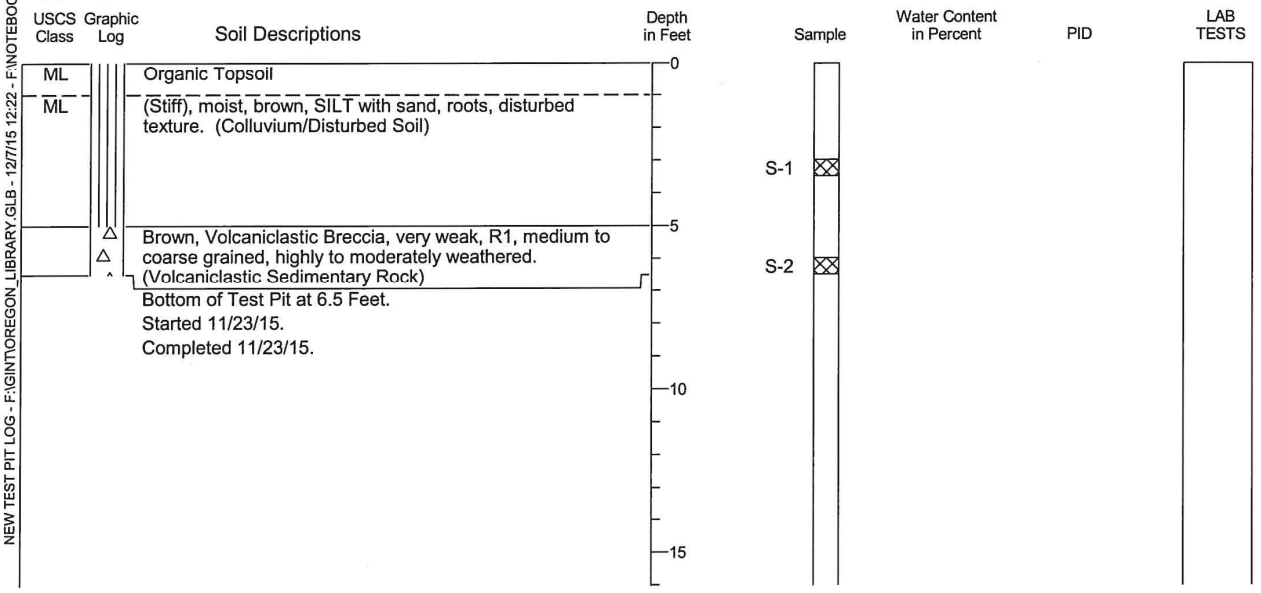
Horizontal Datum: N/A
Vertical Datum: N/A



Test Pit Log TP-4

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

15948-02 12/15

Figure A-4

Test Pit Log TP-5

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
ML		Organic Topsoil, roots, dark brown.	0				
SM		(Loose), moist, brown to dark brown, silty SAND, roots, weathered residual soil fragments in fine-grained matrix. (Colluvium/Disturbed Soil)					
CL		(Medium stiff), moist, brown, LEAN CLAY with sand.		S-1			
			5				
SM		(Loose), moist, brown, silty SAND with hard gravel-sized clasts of subangular to subrounded volcaniclastic fragments, relict rock texture. (Residual Soil)		S-2			
			10	S-3			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-4			
		Bottom of Test Pit at 13.5 Feet.	15				
		Started 11/23/15.					
		Completed 11/23/15.					
		Completed due to refusal.					

Test Pit Log TP-6

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Water Content in Percent	PID	LAB TESTS
SM/ML		(Loose to medium stiff), dark brown, moist, silty SAND to sandy SILT, roots.	0				
ML		(Medium stiff), moist, brown, SILT with sand, small roots, disturbed texture. (Colluvium/Disturbed Soil)					
		Abundant roots and rootlets from 3.0 to 4.0 feet.		S-1			
SM		(Medium dense to dense), moist, light brown to brown, silty SAND, relict rock texture. (Residual Soil)	5				
				S-2			
		Brown, Volcaniclastic Breccia, very weak, R1, medium to coarse grained, highly to moderately weathered. (Volcaniclastic Sedimentary Rock)		S-3			
		Bottom of Test Pit at 9.5 Feet.	10				
		Started 11/23/15.					
		Completed 11/23/15.					
		Completed due to refusal.					
			15				

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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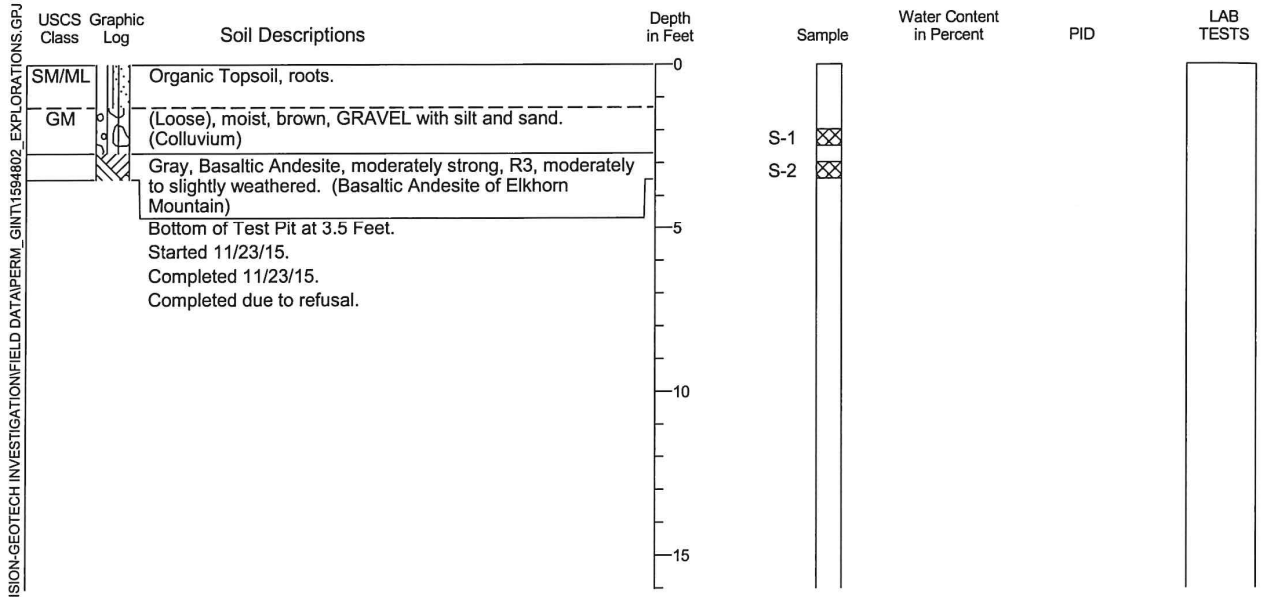
15948-02 12/15

Figure A-5

Test Pit Log TP-7

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

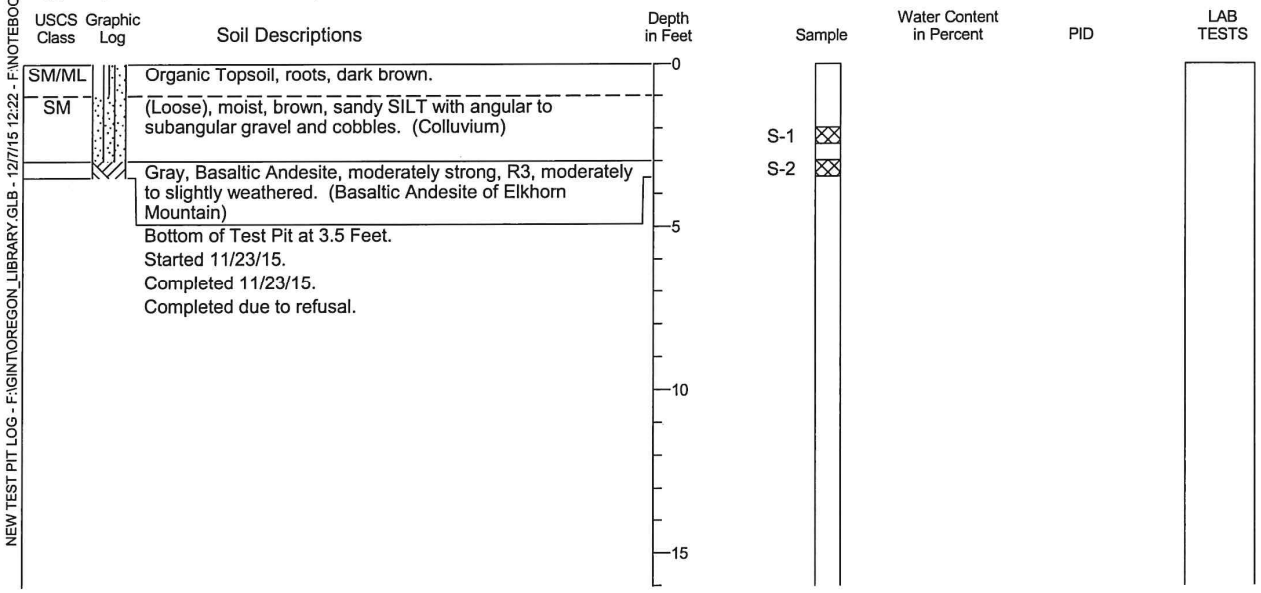
Horizontal Datum: N/A
Vertical Datum: N/A



Test Pit Log TP-8

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



NEW TEST PIT LOG - F:\GINT\OREGON_LIBRARY.GLB - 12/7/15 12:22 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS.GPJ

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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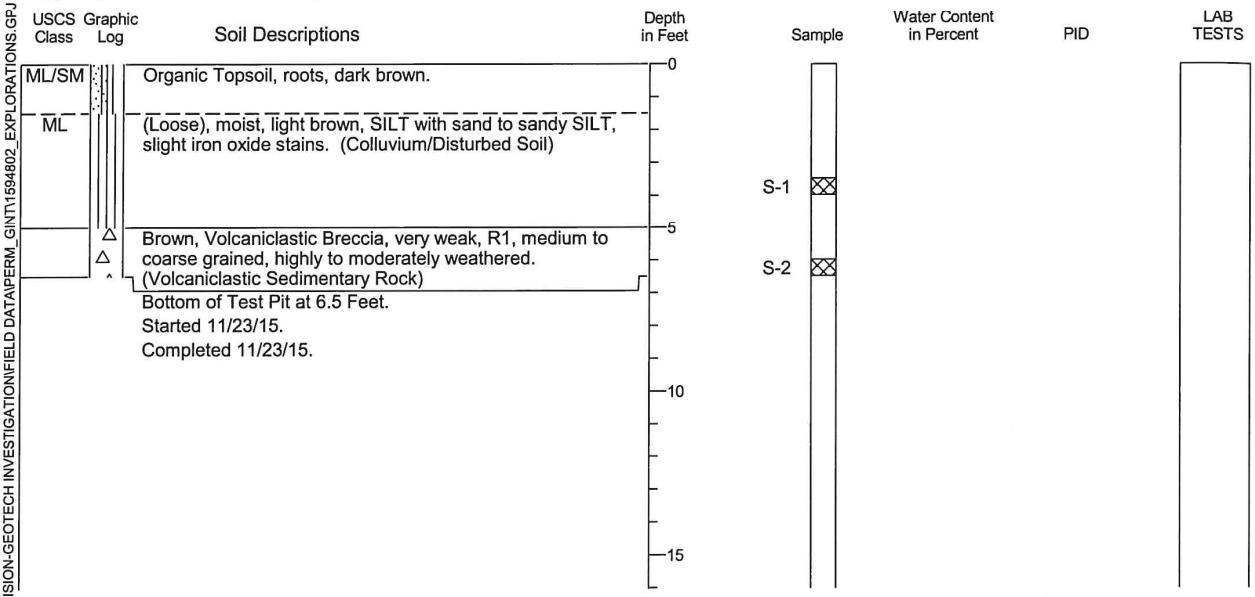
15948-02 12/15

Figure A-6

Test Pit Log TP-9

Location: Camas, Washington
Approximate Ground Surface Elevation (feet): N/A
Logged By: A. Jones Reviewed By: R. Pirot

Horizontal Datum: N/A
Vertical Datum: N/A



NEW TEST PIT LOG - F:\GINTOREGON_LIBRARY.GLB - 12/7/15 12:22 - F:\NOTEBOOKS\1594802_CAMAS SUBDIVISION-GEOTECH INVESTIGATION\FIELD DATA\PERM_GINT\1594802_EXPLORATIONS.GPJ

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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15948-02 12/15

Figure A-7