EXHIBIT F.5

Geotechnical Engineering Report Prepared by GeoResources

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Updated Geotechnical Engineering Report
Proposed Residential Plat
17504 Johnson Road Northwest
Poulsbo, Washington
PN: 252601-2-004-2008
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INTRODUCTION

This geotechnical engineering report summarizes our site observations, subsurface explorations, laboratory testing and engineering analyses, and provides geotechnical recommendations and design criteria for the proposed residential plat to be constructed at 17504 Johnson Road Northeast in Poulsbo, Washington. The general location of the site is shown on the attached Site Location Map, Figure 1.

Our understanding of the project is based on our conversation with you, our review of a *Highest and Best Use Site Plan* prepared by AHBL dated August 3, 2018 and the *Preliminary Site Plan* prepared by CPH Consultants dated July 29, 2019, our review of the letter from the City of Poulsbo Engineering Department dated December 19, 2017 regarding the Johnson Road Extension Project, our understanding of Poulsbo development codes, and our experience in the area. ***This revised report to address comments in the City of Poulsbo Engineering Department Memo dated August 27, 2019 and the third-party Geotechnical Report Review prepared by Aspect Consulting, LLC (Aspect) dated August 30, 2019.***

We understand that you propose to construct a multi-lot residential plat with several retaining walls to accommodate the grade changes at the site. The plat will also include several open space tracts, two stormwater tracts, two roads, and two wetlands with associated buffers. A copy of the proposed site development is attached as our Site and Exploration Plan, Figure 2. Cross sections showing existing and approximate proposed grades for the development are attached as Figures 3a and 3b. We anticipate the proposed residences will be one or two story, wood framed structures founded on conventional shallow foundations.

We also reviewed the Preliminary Geotechnical Investigation: Proposed Residential Development report prepared by N.L. Olson and Associates, Inc dated December 2007. This report included the descriptive log of 15 test pits excavated at across the site.

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions across the site as a basis for providing geotechnical recommendations and design criteria for the proposed development. Specifically, the scope of services for this project included the following:

1. Reviewing the available geologic, hydrogeologic, and geotechnical data for the site area;
2. Exploring surface and subsurface conditions by reconnoitering the site and monitoring the excavation of a series of test pits at select locations across the site;
3. Describing surface and subsurface conditions, including soil type, depth to groundwater, and an estimate of seasonal high groundwater levels;
4. Addressing potential Geological Hazard Areas per City of Poulsbo Municipal Code (CPMC) 16.20.410;
5. Providing geotechnical conclusions and recommendations regarding site grading activities, including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut slopes and drainage and erosion control measures;
6. Providing conclusions regarding shallow foundations and floor slab support and design criteria, including bearing capacity and subgrade modulus as appropriate;
7. Evaluating the global stability at the site by completing slope stability models in SLIDE ***2018*** by RocScience for the existing ***and proposed*** conditions at the site;
8. Providing our opinion about the feasibility of onsite infiltration in accordance with the 2012 Stormwater Management Manual for Western Washington (SWMMWW) with 2014 Amendments, as adopted by the City of Poulsbo under CPMC 12.02.030;
9. Providing recommendations for erosion and sediment control during wet weather grading and construction; and,
10. Preparing a written *Geotechnical Engineering Report* summarizing our site observations and conclusions, and our geotechnical recommendations and design criteria, along with the supporting data.

The above scope of work was summarized in our *Proposal for Geotechnical Engineering* Services dated August 22, 2018. We received written authorization to proceed from Mr. Ken Allen on August 29, 2018.

SITE CONDITIONS

Surface Conditions

The site is located at 17504 Johnson Road Northwest in Poulsbo, Washington within an area of existing residential development. Based on the information provided on the Highest and Best Use Site Plan prepared by AHBL dated August 3, 2018 and the updated Preliminary Site Plan prepared by CPH Consultants in 2019, the site is rectangular in shape, measures 675 feet to 677 feet (north to south) wide by 1346 feet to 1352 feet deep (east to west), and encompasses about 13.74 acres. The site is bounded by a stream to the west, Johnson Road Northwest to the east and northwest, and by undeveloped land to the north and south.

The site generally slopes down in all directions from a localized high point in the center of the site. In general, the site slopes down from the high point at 15 to 25 percent, with localized areas as flat

as 6 to 10 percent and as steep as 40 to 55 percent. Within the proposed area of development, the areas steeper than 40 percent have a vertical height on the order of 20 feet. There is a wetland located in the north-central portion of the site, and the topography in that area is generally flat to gently sloping towards the center of the wetland. A ravine sloping down from north to south crosses the eastern margin of the site, labeled Tract 905 on Site and Exploration Plan, Figure 2. The side walls of the ravine slope down at approximately 45 to 60 percent. The southern portion of the ravine has sidewalls that slope down at about 15 to 35 percent. The vertical height of the side walls is on the order of 60 to 70 feet. The bottom of the ravine slopes down to the south at approximately 12 to 15 percent. The total topographic relief across the site is on the order of 130 feet. The existing site topography for the site and surrounding area is shown on both the Site and Exploration Plan, Figure 2 and Site Vicinity Map, Figure 4.

Vegetation across the site generally consists of various native and invasive grasses, areas of dense blackberry bushes, and moderate stands of coniferous and deciduous trees. No areas of surficial erosion, active slope movement, or surficial seeps, springs, or standing water were observed at the site at the time of our reconnaissance.

Site Soils

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey maps the majority of the site as being underlain by Poulsbo gravelly sandy loam (39, 40, and 41) soils, and the north-central portion of the site as being underlain by McKenna gravelly loam (32) soils. The Poulsbo soils are derived from basal till with volcanic ash and are included in hydrologic soils group B/D. The 39 soils, mapped in the northwest corner of the site, form on slopes of 0 to 6 percent and have a "slight" erosion hazard when exposed. The 40 soils, mapped in the southwest, central, and northeast portions of the site, form on slopes of 6 to 15 percent and have a "moderate" erosion hazard when exposed. The 41 soils, mapped in the east-central and southeast portions of the site, form on slopes of 15 to 30 percent and have a "moderate to severe" erosion hazard when exposed. The McKenna soils are derived from glacial till, form on slopes of 0 to 6 percent, have an erosion hazard of "none," and are included in hydrologic soils group D. A copy of the soils map for this area is provided in Figure 5.

Site Geology

The *Geologic map of the Suquamish 7.5' Quadrangle and part of the Seattle North 7.5' x 15' Quadrangle, Kitsap County, Washington* (Haugerud and Troost, 2011) maps the site as being underlain by glacial till (Qvt) and Esperance sand (Qev), with several, small isolated areas mapped as landslide deposits (Qls). The glacial soils were deposited during the most recent Vashon Stade of the Fraser Glaciation, approximately 12,000 to 15,000 years ago. The glacial till consists of a heterogeneous mixture of clay, silt, sand, and gravel that was deposited at the base of the prehistoric continental glacial ice mass and was subsequently over-ridden. The Esperance sand (an outwash deposit) consist of a poorly sorted lightly stratified mixture of sand that may contain localized deposits of gravel, silt, and clay that were deposited by meltwater streams emanating from the advancing ice mass, and were subsequently overridden. As such, the glacial till and advance outwash are considered over-consolidated and exhibits high strength and low compressibility characteristics.

The mapped landslide deposits typically consist of jumbled mixtures of gravel, sand, silt and clay that are typically in a loose condition. The map describes the landslides as being mapped primarily based on morphology (landforms). The largest landslide area is in the western portion of

the site, in line with the access road on the western side of the parcel. The slide deposit generally lines up with a shallow swale that is at the north of the northwest corner of the parcel, while the portion of the site where the slide debris is located is generally flat with no scarps, hummocks or other geomorphic features common of landslide deposits. There are several smaller deposits within the drainage swale on the east side of the parcel. As stated above, we observed no evidence of landslide activity on the site or in these areas during our site visit. An excerpt of the above referenced map is included as Figure 6.

The Washington State Department of Ecology Coastal Atlas maps the site and site area to be stable. No areas of recent or old (prehistoric slides) are indicated on the parcel or site area by the Coastal Atlas. A copy of the Coastal Atlas slope stability designation map for the site area is attached as Figure 7.

Subsurface Explorations

On September 6, 2018, a field representative from GeoResources, LLC (GeoResources) visited the site and monitored the excavation of 18 test pits to depths of 4.5 to 8 feet below the existing ground surface, logged the subsurface conditions encountered in each test pit, and obtained representative soil samples. The test pits were excavated by a medium sized track-mounted excavator operated by a licensed earthwork contractor working for GeoResources, LLC.

The specific number, locations, and depths of our explorations were selected based on the configuration of the proposed development, and were adjusted in the field based on consideration for underground utilities, existing site conditions, site access limitations and encountered stratigraphy. Representative soil samples obtained from the test pits were placed in sealed plastic bags and then taken to a laboratory for further examination and testing as deemed necessary. The test pits were then backfilled with the excavated soils and bucket tamped, but not otherwise compacted.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun. Based on our experience and extent of prior explorations in the area, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site.

The approximate locations and numbers of our test pits are shown on the attached Site and Exploration Plan, Figure 2. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D: 2488. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our test pits are included as Figures A-2 through A-8.

Subsurface Conditions

The subsurface conditions encountered in our explorations were relatively uniform and differed from the mapped stratigraphy at the site. Our explorations encountered 0.5 to 1.5 feet of duff and rootzone mantling 0.5 to 1.5 feet of tan, lightly iron-oxide stained, silty sand with gravel in a medium dense, moist condition. These soils were underlain by light grey, heavily iron-oxide stained sandy silt with gravel in a medium dense, moist condition that was underlain by grey sandy silty in a stiff to very stiff, moist condition that was encountered to the full depth explored. We interpret these deeper cohesive soils to be consistent with glacial lacustrine deposits, a sub-member of the mapped advance outwash. Therefore, the glacial lacustrine soils should be over-consolidated.

Test pit TP-5, in the northeast corner of the site, encountered grey silty sand with gravel in a very dense, moist condition below the lacustrine. Test pit TP-15 encountered brown silty sand with gravel in a medium dense, moist condition that appears to be consistent with the Esperance sand member mapped at the site.

The soils encountered in our test pits were generally consistent with the subsurface conditions encountered in the N.L. Olson test pits from 2007. However, the N.L. Olson logs generally described the shallow, glacial lacustrine soils to be "lean clay" while the deeper soils were typically described as very stiff to hard silt to elastic silt.

Laboratory Testing

Geotechnical laboratory tests were performed on select samples retrieved from the test pits to determine soil index and engineering properties encountered. Laboratory testing included visual soil classification per ASTM D: 2488, moisture content determinations per ASTM D: 2216, and grain size analyses per ASTM D: 422 standard procedures. The results of the laboratory tests are included in Appendix B.

The N.L. OIson report did perform Atterberg Limit tests on 4 samples of the soils collected from their test pits. The Atterberg limits generally classified the site soils as SILT (ML) with one sample being classified as an elastic silt (MH).

Groundwater Conditions

Groundwater was not observed in any of our test pits explorations at the time of excavation; however, iron oxide staining (mottling) was observed in all of our explorations at 0.5 to 1.5 feet below the existing ground surface. Mottling is often indicative of a seasonal or perched groundwater table that develops when a more permeable soil, such as silty sand, is underlain at depth by a less permeable soil, such as silt. Based on the nature of the near surface soils, we anticipate fluctuations in the local groundwater levels may occur in response to precipitation patterns, off-site construction activities, and site utilization.

ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our data review, site reconnaissance, subsurface explorations and our experience in the area, it is our opinion that the site is suitable for the proposed residential plat. As stated, we understand that you propose to construct several retaining walls to accommodate the grade changes at the site. We anticipate that mass grading with permanent cut and fill slopes will be utilized for the proposed development. Existing grades are shown on cross sections A-A' and B-B' (used in our slope stability to address potential landslide hazards), while both the existing and proposed grades are shown on cross sections C-C' and D-D' to depict proposed cuts and fills across the site. The cross sections are included in Appendix C.

The site soils do contain a significant amount of fines and will be difficult or impossible to reuse as structural fill when wet. Also, the site do have fines that are "plastic" and therefore do not meet Washington State Department of Transportation (WSDOT) standard specification for common borrow. So, the reuse of these soils may not be allowed by the City in public right-of-ways, but it does appear feasible to reuse these soil within the building lot areas provided the moisture content is maintained within 2 percent of optimum and below the plastic limit.

Pertinent conclusions and geotechnical recommendations regarding the design and construction of the proposed development are presented below.

Geologically Hazardous Area Categories per PMC 16.20.410.A.1

In accordance with the Poulsbo Municipal Code (PMC), the following categories shall be used in classifying geologically hazardous areas:

Geologically Hazardous Areas

a. Areas with slopes greater than thirty percent and mapped by the Coastal Zone Atlas or Quaternary Geology and Stratigraphy of Kitsap County as unstable (U), unstable old landslides (UOS) or unstable recent slides (URS).
b. Areas with slopes greater than thirty percent in grade and deemed by a qualified geologist or geotechnical engineer to meet the criteria of U, UOS, or URS.

Areas of Geologic Concern PMC 16.20.410.A.2

a. Areas designated U, UOS, or URS in the Coastal Zone Atlas or Quaternary Geology and Stratigraphy of Kitsap County, with slopes less than thirty percent; or areas found by a qualified geologist to meet the criteria for U, URS, or UOS with slopes less than thirty percent; or
b. Slopes identified as intermediate (I) in the Coastal Zone Atlas or Quaternary Geology and Stratigraphy of Kitsap County, or areas found by a qualified geologist to meet the criteria of I; or
c. Slopes fifteen percent or greater, not classified as I, U, UOS, or URS, with soils classified by the U.S. Department of Agriculture Natural Resources Conservation Service as "highly erodible" or "potentially highly erodible"; or
d. Slopes of fifteen percent or greater with springs or groundwater seepage not identified in subsections (A)(2)(a) through (c) of this section; or
e. Seismic areas subject to liquefaction from earthquakes (seismic hazard areas) such as hydric soils as identified by the Natural Resources Conservation Service, and areas that have been filled to make a site more suitable. Seismic areas may include former wetlands which have been covered with fill; or
f. Areas mapped as "severe" in all development limitations based on mapped soil units of the USDA Soil Conservation Service. These designations are listed in Table 10 of Soil Survey of Kitsap County Area, Washington.

As stated, the western portion of the site is mapped as a landslide deposits (Qls), with several smaller landslide deposits being mapped in the drainage east of the site. However, the Coastal Atlas does not map these areas as recent or historic slides, rather the Coastal Atlas maps the entire site as stable. No evidence of active or ongoing deep seated or other landslide activity was observed at the time of our site visit, therefore, we would tend to agree with the Stable designation provided by the Coastal Atlas.

Slopes steeper than 15 percent are present across the site, however the NRCS soils types in in these areas are listed as having a "moderate" erosion hazard, and these areas did not appear to be unstable at the time of our reconnaissance. The slopes steeper than 15 percent in the east-

central and southeastern portions of the site are mapped as having a "moderate to severe" erosion potential.

Based on the above, the eastern portion of the site meets one of the criteria (slopes steeper than 15 percent with a high erosion potential) of an Area of Geologic Concern. No development is proposed within the portion of the site that meets the definition of an Area of Geologic Concern. Per Title 16.2.420.C, a standard buffer of 25 feet should be applied to the Area of Geologic Concern, unless otherwise specified through a geological report. Based on the proposed *Site Plan* prepared by CPH Consultants, it appears that no development is located within 25 feet the Area of Geologic Concern.

Slope Stability Analysis

We analyzed the global and internal slope stability of the existing slope geometry using subsurface profile A-A', B-B', ***C-C', and D-D'*** as shown on Figure 2. The cross sections were selected as the most critical section given the height and steepness of the slopes. ***Subsurface profiles A-A' and C-C' are oriented along the south-facing, central slope at the site. Subsurface profiles B-B' and D-D' are oriented along the east-facing slope in the eastern portion of the site.***

We used the computer program SLIDE ***2018*** version ***8.029***, from RocScience to perform the slope stability analyses. The computer program SLIDE uses a number of methods to estimate the factor of safety (FS) of the stability of a slope by analyzing the shear and normal forces acting on a series of vertical "slices" that comprise a failure surface. Each vertical slice is treated as a rigid body; therefore, the forces and/or moments acting on each slice are assumed to satisfy static equilibrium (i.e., a limit equilibrium analysis). The FS is defined as the ratio of the forces available to resist movement to the forces of the driving mass. A FS of 1.0 means that the driving and resisting forces are equal; an FS less than 1.0 indicates that the driving forces are greater than the resisting forces (indicating failure). We used the Generalized Limit Equilibrium method using the Morgenstern-Price analysis, which satisfies both moment and force equilibrium, to search for the location of the most critical failure surfaces and their corresponding FS. The most critical surfaces are those with the lowest FS for a given loading condition, and are therefore the most likely to fail.

For the proposed conditions, we modeled the proposed retaining walls as MSE walls with a reinforced soil zone extending 0.7H from the face of the wall, where H is the total height of the wall including embedment based on the current Preliminary Clearing and Grading Plan provided to us by CPH Consultants dated November 22, 2019. Actual wall designs have not been completed at this time, but 0.7H would the on the lower range of the anticipated grid lengths, and would therefore be a conservative model. We anticipate actual grid lengths will be on the range of 0.9 to 1.1H, resulting in a wider reinforced zone and inherently more stable design. Based on our global stability analyses, MSE walls appear to be feasible. We did not perform detailed internal, external, or compound stability analyses of the proposed walls. We recommend the wall designer be required to perform these analyses and to determine the required reinforcing strengths, lengths, and spacing where MSE walls are used. The actual design length of reinforcement may be controlled by internal or external stability considerations and may be greater.

Our analyses included static and seismic conditions. For the seismic condition, a surcharge loading of 0.28g was applied. Based on our analyses, the minimum FS for the ***existing and proposed conditions are summarized in Table 1, below.*** The analyses indicate that the slope is stable in both static and seismic conditions for the existing ***and proposed*** site configuration. The cross section and slope stability results using both static and seismic conditions are included as Appendix C.

TABLE 1:
Slope Stability Analysis Results

Subsurface Profile	***Existing***		***Proposed***	
	Static	***Dynamic***	***Static***	***Dynamic***
A-A' (North-South, West half of site)	***2.7***	***1.4***	***2.0***	***1.3***
B-B' (East-West, NE corner of site)	***1.8***	***1.1***	***1.9***	***1.1***
C-C' (North-South, middle of site)	***2.9***	***1.4***	***1.9***	***1.3***
D-D' (East-West, middle of site)	***2.6***	***1.4***	***2.0***	***1.2***

Recommended Setback from Steep Slopes

The 2015 International Building Code (IBC), Section 1808.7 requires a building setback from slopes that are steeper than 3H:1V (Horizontal: Vertical) or 33 percent with greater than 10 feet in vertical height, unless evaluated and reduced and/or a structural setback is provided by a licensed geotechnical engineer. The setback distance is calculated based on the vertical height of the slope. The typical 2015 IBC setback from the top of the slope equals one third the height of the slope or 40 feet, whichever is less, while a setback from the toe of the slope equals one half the height of the slope or 15 feet, whichever is less.

The slopes in the central portion of the site that slope down at 40 to 55 percent have a vertical height on the order of 20 feet. From the central slope, we recommend a top of slope building setback of 7 feet and a toe of slope setback of 10 feet be applied. Based on our conversations with you, we understand the site will be mass graded for the proposed residential lots. As such, we anticipate that the majority of this slope will be regraded to flatter than 33 percent or to have less than 10 feet of vertical relief in areas steeper than 33 percent. Alternatively, daylight basements may be used to accommodate grade separation across the lots and/or to meet structural setback requirements, discussed below.

A structural setback may be used where the setback from the top of the slope cannot be met. A structural setback is created by deepening the foundation elements so that, when measured horizontally from the font of the foundation to the face of the slope, the top of slope setback discussed above is met. We have provided recommendations for deepened foundations in the "**Foundation Support**" section of this report.

The ravine, which slopes down at 45 to 60 percent in the northern portion of the site and 15 to 35 percent in the southern portion of the site, has a vertical height on the order of 60 to 70 feet. ***Based on the results of our slope stability analysis, we recommend a minimum top of slope building setback of 24 feet from the side slopes of the ravine on the east side of the project site. We understand that the minimum recommended building setback from the ravine will be met by*** the City of Poulsbo prescriptive setback from an Area of Geologic Concern.

Seismic Design

Based on our observations and the subsurface units mapped at the site, we interpret the structural site conditions to correspond to a seismic Site Class "D" in accordance with the 2015 IBC

documents and American Society of Civil Engineers (ASCE) standard 7-10 Chapter 20 Table 20.3-1. This is based on the anticipated range of SPT (Standard Penetration Test) blow counts for the soils types in the site area. These conditions were assumed to be representative for the subsurface conditions for the site in general based on our experience in the vicinity of the site.

The U.S. Geological Survey (USGS) completed probabilistic seismic hazard analyses (PSHA) for the entire country in November 1996, which were updated and republished in 2002 and 2008. The PSHA ground motion results can be obtained from the USGS 2015 IBC design. ***Table 2***, below, summarizes the recommended design parameters.

TABLE 2:
2015 IBC PARAMETERS FOR DESIGN OF SEISMIC STRUCTURES

Spectral Response Acceleration (SRA) and Site Coefficients	Short Period	1 Second Period
Mapped SRA	S_s = 1.319	S_1 = 0.526
Site Coefficients (Site Class D)	F_a = 1.0	F_v = 1.5
Maximum Considered Earthquake SRA	S_{MS} = 1.319	S_{M1} = 0.789
Design SRA	S_{DS} = 0.879	S_{D1} = 0.526

Earthquake-induced geologic hazards may include liquefaction, lateral spreading, slope instability, and ground surface fault rupture. In our opinion, the potential for liquefaction and lateral spreading is not significant because of the soil gradation and the anticipated depth to groundwater. The ground surface at the site slopes down in all directions and steep slopes are located along the eastern portion of the site; however, our slope stability analyses determined the slope should be stable under design-level seismic loading. No evidence of ground fault rupture was observed in the subsurface explorations or out site reconnaissance.

According to the Department of Natural Hazard Map (Geologic Information Portal), the site is located between the east of the Dabob Bay fault zone, southwest of the Whidbey Island fault zone, and north of the Seattle Fault Zone, as shown on Figure 8. Given the distance the mapped fault zones and thickness of young, dense glacial sediments underlying the site, we interpret the potential for ground surface fault rupture is also low.

The third party review indicated that during their review of the LIDAR imagery of the site area, they appeared to observe linear features that could be indicative of faulting. We update Figure 8 to include the LIDAR imagery. The mapped faults are still several miles north and south of the project. Glacial striations and fluvial stream valleys are visible in the area around the site, but we did not observe evidence of features suggestive of past faulting or ground surface rupture.

Foundation Support

Based on the subsurface soil conditions encountered across the site, we recommend that spread footings for the proposed residences be founded on the on the medium dense tan to grey silty sand to sandy silt encountered across the site or on appropriately prepared structural fill that extends to suitable native soils. The soil at the base of the excavations should be disturbed as little as possible. All loose, soft or unsuitable material should be removed or recompacted, as

appropriate. A representative from our firm should observe the foundation excavations to determine if suitable bearing surfaces have been appropriately prepared, particularly in the areas where the foundation will be situated on prepared structural fill material.

All exterior footing elements should be embedded at least 18 inches below grade for frost protection. We recommend a minimum width of 2 feet for isolated footings and at least 16 inches for continuous wall footings. Footings founded as described above may be designed with a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) for combined dead and long-term live loads. The weight of the footing and any overlying backfill may be neglected. The allowable bearing value may be increased by one-third for transient loads such as those induced by seismic events or wind loads.

Lateral loads may be resisted by friction on the base of footings and floor slabs and as passive pressure on the sides of footings. We recommend that an allowable coefficient of friction of 0.35 be used to calculate friction between the concrete and the underlying ***native soils***. Passive pressure may be determined using an allowable equivalent fluid density of 350 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

We estimate that settlements of footings designed and constructed as recommended will be less than 1 inch, for the anticipated load conditions, with differential settlements between comparably loaded footings of ½-inch or less over a span of 50 feet. Most of the settlements should occur essentially as loads are being applied; however, disturbance of the foundation subgrade during construction could result in larger settlements than predicted. We recommend that all foundations be provided with footing drains constructed in accordance with the 2015 IBC Section 1805.4.2.

Floor Slab Support

Slab-on-grade floors, where constructed, should be supported on the native tan to grey silty sand to sandy silt or on structural fill prepared as described above. Any areas of old fill material or glacial lacustrine should be evaluated during grading activity for suitability of structural support. Areas of organic debris should be removed.

We recommend that floor slabs be directly underlain by a minimum 4-inch thick capillary break that consists of clean, granular material, such as pea gravel or clean crushed rock. This layer should be placed in one lift, compacted to an unyielding condition, and should contain less than 2 percent fines.

A synthetic vapor retarder is recommended to control moisture migration through the slabs. This is of particular importance where the foundation elements are ***underlain by silty native soils***, or where moisture migration through the slab is an issue, such as where adhesives are used to anchor carpet or tile to the slab.

A subgrade modulus of 350 kips per cubic foot (kcf) may be used for floor slab design. We estimate that settlement of the floor slabs designed and constructed as recommended, will be ½-inch or less over a span of 50 feet.

Subgrade/Basement Walls

Adequate drainage behind retaining structures is imperative. Positive drainage which controls the development of hydrostatic pressure can be accomplished by placing a zone of drainage behind the walls. Granular drainage material should contain less than 2 percent fines and at least 30 percent greater than the US No. 4 sieve. Assuming properly compacted structural fill is used to

backfill the foundation walls, an allowable active fluid pressure of 35 pcf and an at-rest pressure of 55 pcf should be appropriate for design. A seismic surcharge of 10H should be applied in accordance with applicable building codes.

A minimum 4-inch diameter perforated or slotted PVC pipe should be placed in the drainage zone along the base and behind the wall to provide an outlet for accumulated water and direct accumulated water to an appropriate discharge location. We recommend that a nonwoven geotextile filter fabric be placed between the soil drainage material and the remaining wall backfill to reduce silt migration into the drainage zone. The infiltration of silt into the drainage zone can, with time, reduce the permeability of the granular material. The filter fabric should be placed such that it fully separates the drainage material and the backfill, and should be extended over the top of the drainage zone. Typical wall drainage and backfilling details are shown on Figure 9.

A geocomposite drain mat may also be used instead of free draining soils, provided it is installed in accordance with the manufacturer's instructions. A soil drainage zone should extend horizontally at least 18 inches from the back of the wall. The drainage zone should also extend from the base of the wall to within 1 foot of the top of the wall. The soil drainage zone should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D:1557. Over-compaction should be avoided as this can lead to excessive lateral pressures.

Lateral loads may be resisted by friction on the base of footings and as passive pressure on the sides of footings and the buried portion of the wall, as described in the "**Foundation Support**" section. We recommend that an allowable coefficient of friction of 0.35 be used to calculate friction between the concrete and the underlying soil. Passive pressure may be determined using an allowable equivalent fluid density of 350 pcf (pounds per cubic foot). Factors of safety have been applied to these values.

Retaining Structures

We anticipate retaining walls will likely be required to support cuts and fills in portions of the project area. General conclusions regarding suitable types of retaining walls and soil design parameters for the walls to be designed by others are described below. We understand wall sections up to 12 feet in exposed height are currently proposed, with some areas of tiered wall configurations that provide up to 32 feet of grade separation. Based on our global stability analyses, as described in the "Slope Stability Analysis" section above, the proposed tiered wall configurations appear feasible if constructed as mechanically stabilized earth (MSE) walls. Where the proposed residential access roadway will be within 1H:1V from the base of the proposed retaining walls, we also recommend a live load surcharge of 250 psf be applied to model traffic loading.

We recommend the following geotechnical design parameters be used for the design of retaining walls:

TABLE 3:
RECOMMENDED SOIL PROPERTIES OF ON-SITE SOILS FOR WALL DESIGN

Soil Type	*Dry Unit Weight (pcf)*	*Cohesion[1] (psf)*	*Phi (degrees)*
Native glacial lacustrine	***115***	***500***	***28***
Structural Fill (Common Borrow)	***130***	***0***	***35***
[1]Cohesion should only be used to model foundation soil, not retained soil			

Mechanically Stabilized Earth Walls

MSE walls are constructed using compacted soil with layers of reinforcing material, such as geosynthetics or steel strips, that extend behind the wall face to create a reinforced soil mass. Detailed wall design should be performed by the wall designer, including internal and external stability, sliding resistance, and required reinforcement layout and properties. Wall backfill should consist of structural fill and should be compacted to 95% of the maximum dry density (MDD) as determined by the Modified Proctor (ASTM D: 1557). The soil drainage zone within 12- to 18-inches of the wall should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D: 1557.

Typical facings for MSE walls with geogrid or geotextile reinforcement are small modular concrete blocks (such as Cornerstone, Keystone, Allan Block, Basalite and others) or large modular concrete blocks (such as Redi-rock, StoneTerra, and others). As stated above, rockeries may be considered for use as a decorative facing in front of wrapped face geosynthetic MSE walls. In our opinion, MSE walls with steel reinforcement (or gabion style wall) such as the Hilfiker or SierraScape wall systems, would also be feasible from a geotechnical perspective. A typical MSE Wall detail is attached as Figure 10.

Rockeries

Rockeries should not be used unless the retained material would be stable without the rock facing. Rockeries are considered to act principally as erosion protection and they are not considered to provide strength to the slope unless designed as a buttress using limit equilibrium slope stability methods. Based on our review of the subsurface explorations and the proposed plans, it is our opinion that cuts in the native glacial soils could be stable with rockery facings at minimal heights of no more than 6 feet. We do not recommend rockeries be constructed in front of fill with more than 3 feet of exposed height, unless constructed as a wrapped-face MSE wall with rockery facing.

We recommend tiered rockeries be separated by level terraces at least equal to the height of the lower rockery, so that the upper rockery does not place a surcharge load on the lower rockery. Proposed rockeries should be constructed in accordance with the ARC Rock Wall Construction Guidelines. A typical rockery detail is attached as Figure 11.

Wall Drainage

Adequate drainage behind retaining structures is imperative. Positive drainage which controls the development of hydrostatic pressure can be accomplished by placing a zone of drainage behind the walls. Granular drainage material should contain less than 2 percent fines

and at least 30 percent greater than the US No. 4 sieve. Typical wall drainage and backfill is shown on Figure 8.

A minimum 4-inch diameter perforated or slotted PVC pipe should be placed in the drainage zone along the base and behind the wall to provide an outlet for accumulated water and direct accumulated water to an appropriate discharge location. We recommend that a nonwoven geotextile filter fabric be placed between the soil drainage material and the remaining wall backfill or cut slope to reduce silt migration into the drainage zone. The infiltration of silt into the drainage zone can, with time, reduce the permeability of the granular material. The filter fabric should be placed such that it fully separates the drainage material and the backfill, and should be extended over the top of the drainage zone.

A soil drainage zone should extend horizontally at least 12 inches from the back of the wall. The drainage zone should also extend from the base of the wall to within 1 foot of the top of the wall. The soil drainage zone should be compacted to approximately 90 percent of the maximum dry density (MDD), as determined in accordance with ASTM D: 1557. Over-compaction should be avoided as this can lead to excessive lateral pressures. A geocomposite drain mat may also be used instead of free draining soils, provided it is installed in accordance with the manufacturer's instructions.

Temporary Excavations

All job site safety issues and precautions are the responsibility of the contractor providing services/work. The following cut/fill slope guidelines are provided for planning purposes only. Temporary cut slopes will likely be necessary during grading operations or utility installation. All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements. Based on current Washington State Safety and Health Administration (WSHA) regulations, the soils on the site would be classified as Type C soils.

According to WSHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1½H:1V (Horizontal: Vertical) or flatter from the toe to the crest of the slope. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the slope crest.

Where it is not feasible to slope the site soils back at these inclinations, a retaining structure should be considered. Where retaining structures are greater than 4-feet in height (bottom of footing to top of structure) or have slopes of greater than 15 percent above them, they should be engineered per Washington Administrative Code (WAC 51-16-080 item 5). This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Permanent Cut and Fill Slopes

Fill slopes constructed on grades that are steeper than 5H:1V should be constructed in accordance with Appendix J of the 2015 IBC and should utilize proper keying and benching methods,

as shown on the attached IBC Appendix J Detail, Figure 12. The cut slopes in the upper silty sand soils encountered at the site should be no steeper than 2H:1V. We recommend the cut slopes in the sandy silt, glacial lacustrine soils encountered at the site be sloped no steeper than 4H:1V per the Washington State Department of Transportation Geotechnical Design Manual, Chapter 10, Section 10.3.1.

All slopes should be protected from erosion. Typical erosion control Best Management Practices (BMPs) per the Stormwater Management Manual for Western Washington (SWMMWW) should be sufficient for proposed site grading activities. Additionally, permanent slopes should be planted with a mulch, hardy vegetative groundcover or armored with quarry spalls as soon as feasible after grading is completed.

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped away from the structures. Surface water runoff should be controlled by a system of curbs, berms, drainage swales, and or catch basins, and conveyed to an appropriate discharge point.

We recommend that footing drains are installed for the residence in accordance with the 2015 IBC, Section 1807.4.2, and basement walls (if utilized) have a wall drain as describe above. The roof drain should not be connected to the footing drain.

Stormwater Infiltration

Based on our subsurface explorations, onsite infiltration into the native glacial lacustrine deposits is not feasible per the ***2014 Stormwater Management Manual for Western Washington as adopted by the City of Poulsbo in the Poulsbo Municipal Code (PMC 12.02.030.A).***

Per the 2012 SWMMWW, Volume III, Section 3.3.7, SSC-5, a minimum vertical separation of 5 feet is required between the bottom of an infiltration facility and the top of bedrock, hardpan (glacial till), a water table (seasonal, perched, or regional), or an impermeable layer. Evidence of seasonal perched groundwater (mottling) was encountered at 6 to 18 inches below the existing ground surface, generally atop the sandy silt encountered at depth across the majority of the site.

We recommend that alternative stormwater BMPs be considered for the proposed project. The minimum vertical separation and horizontal setback criteria should be considered prior to the selection of a stormwater facility. All BMPs should be designed and constructed in accordance with the 2012 SWMMWW.

EARTHWORK RECOMMENDATIONS

Site Preparation

All structural areas on the site to be graded should be stripped of vegetation, organic surface soils, and other deleterious materials including existing structures, foundations or abandoned utility lines. Organic topsoil is not suitable for use as structural fill, but may be used for limited depths in non-structural areas. Based on our subsurface exploration, we anticipate that stripping depth will likely range from about 6 to 18 inches. Areas of thicker topsoil or organic debris may be encountered in areas of heavy vegetation or depressions.

Where placement of fill material is required, the stripped/exposed subgrade areas should be compacted to a firm and unyielding surface prior to placement of new fill. Excavations for debris

removal should be backfilled with structural fill compacted to the densities described in the "**Structural Fill**" section of this report.

We recommend that a member of our staff evaluate the exposed subgrade conditions after removal of vegetation and topsoil stripping is completed and prior to placement of structural fill. The exposed subgrade soil should be proof-rolled with heavy rubber-tired equipment during dry weather or probed with a ½-inch diameter steel T-probe during wet weather conditions.

Soft, loose or otherwise unsuitable areas delineated during proof-rolling or probing should be recompacted, if practical, or over-excavated and replaced with structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction. The areas of old fill material should be evaluated during grading operations to determine if they need mitigation, recompaction, or removal.

Structural Fill

All material placed as fill associated with mass grading, as utility trench backfill, under building areas, or under roadways should be placed as structural fill. The structural fill should be placed in horizontal lifts of appropriate thickness to allow adequate and uniform compaction of each lift. Structural fill should be compacted to at least 95 percent of the MDD as determined in accordance with ASTM D: 1557.

The appropriate lift thickness will depend on the structural fill characteristics and compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction. We recommend that our representative be present during site grading activities to observe the work and perform field density tests.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing US No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult to achieve. During wet weather, we recommend a material such as well-graded sand and gravel with less than 5 percent (by weight) passing the US No. 200 sieve based on that fraction passing the ¾-inch sieve, such as *Gravel Backfill for Walls* (WSDOT 9-03.12(2)). If prolonged dry weather prevails during the earthwork and foundation installation phase of construction, higher fines content (up to 10 to 12 percent) may be acceptable.

Material placed for structural fill should be free of debris, organic matter, trash, and cobbles greater than 6-inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Suitability of On-Site Materials as Fill

During dry weather construction, any non-organic onsite soil may be considered for use as structural fill, provided it meets the criteria described above in the "**Structural Fill"** section and can be compacted as recommended. If the soil material is over optimum moisture at the time of excavation, it will be necessary to aerate or dry the soil prior to placement as structural fill. We generally did not observe the site soils to be excessively moist at the time of our subsurface explorations.

The glacial lacustrine soils generally encountered in our explorations generally consisted of high fines and silt, and based on laboratory results contained in the previous N.L. Olson report, have a plasticity index of 5 to 8. Because of the high fines content and plasticity, we do <u>not</u> recommend that these soils are used for structural fill, as these soils are highly moisture sensitive and are likely

to be difficult or impossible to adequately compact during periods of wet weather or if they become saturated. These lower, silty soils may be used as fill in non-structural areas.

We recommend that completed graded-areas be restricted from traffic or protected prior to wet weather conditions. The graded areas may be protected by paving, placing asphalt-treated base, a layer of free-draining material such as pit run sand and gravel or clean crushed rock material containing less than 5 percent fines, or some combination of the above.

Erosion Control and Wet Weather Considerations

Weathering, erosion and the resulting surficial sloughing and shallow land sliding are natural processes. As noted, no evidence of surficial raveling or sloughing was observed at the site. To manage and reduce the potential for these natural processes, we recommend erosion protection measures will need to be in place prior to grading activity on the site. Erosion hazards can be mitigated by applying BMPs outlined in the 2012 SWMMWW.

In the Puget Sound area, the Washington State Department of Ecology generally defines the wet season as beginning October 1st and continuing through about April 30th, although rainy periods could occur at any time of year. ***Nearly all of the soil at the site contains sufficient silt and fines to produce an unstable mixture when wet. Such soil is susceptible to changes in water content, and tends to become unstable and difficult or impossible to compact if their moisture content significantly exceeds the optimum. If earthwork at the site continues into the wet season, or if wet conditions are encountered, we recommend the following:***

1. ***The ground surface in and surrounding the construction area should be sloped to promote runoff of precipitation away from work areas and to prevent ponding of water.***
2. ***Work areas should be covered with plastic. The use of sloping, ditching, sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work.***
3. ***Earthwork should be accomplished in small sections to minimize exposure to wet conditions. That is, each section should be small enough so that the removal of unsuitable soil and placement and compaction of clean structural fill can be accomplished on the same day. The size of construction equipment may have to be limited to prevent soil disturbance. It may be necessary to excavate soils with an track-mounted excavator situated so that equipment does not need to cross over the excavated area.***
4. ***A subgrade stabilization geogrid is recommended for this site where heavy equipment will traverse areas of the site that do not already contain gravel-based access roads.***
5. ***Fill material should consist of gravel borrow, WSDOT 9-03.14(1), with not more than 7 percent fines by dry weight passes the No. 200 mesh sieve, based on wet-sieving the fraction passing the ¾-inch mesh sieve.***
6. ***No soil should be left uncompacted and exposed to moisture. A smooth-drum vibratory roller, or equivalent, should roll the surface to seal out as much water as possible. Soil stockpiles should be covered.***
7. ***In-place soil or fill soil that become wet and unstable and/or too wet to suitably compact should be removed and replaced with clean, granular soil described above in item 5.***
8. ***Excavation and placement of structural fill material should be observed on a full-time basis by a geotechnical engineer (or representative) experienced in earthwork to determine that all work is being accomplished in accordance with the project specifications and our recommendations.***

9. Grading and earthwork should not be accomplished during periods of heavy, continuous rainfall.

Therefore, it is strongly encouraged that earthwork be scheduled during the dry weather months. Most of the soil at the site does contain sufficient fines to produce an unstable mixture when wet. Soils with high fines contents are highly susceptible to changes in water content and tends to become unstable and impossible to proof-roll and compact if the moisture content exceeds the optimum.

In addition, during wet weather months, the groundwater levels could increase, resulting in seepage into site excavations. Performing earthwork during dry weather would reduce these problems and costs associated with rainwater, construction traffic, and handling of wet soil.

LIMITATIONS

We have prepared this report for use by Schwabe, Williamson & Wyatt, CPH Consulting, and other members of the design team, for use in the design of a portion of this project. The data used in preparing this report and this report should be provided to prospective contractors for their bidding or estimating purposes only. Our report, conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated the opportunity to be of service to you on this project. If you have any questions or comments, please do not hesitate to call at your earliest convenience.

Respectfully submitted,
GeoResources, LLC

Neil A. Ferguson, PE
Project Engineer

State of Washington
Engineering Geologist
925
Licensed Geologist
KEITH SCOTT SCHEMBS
11/25/2019

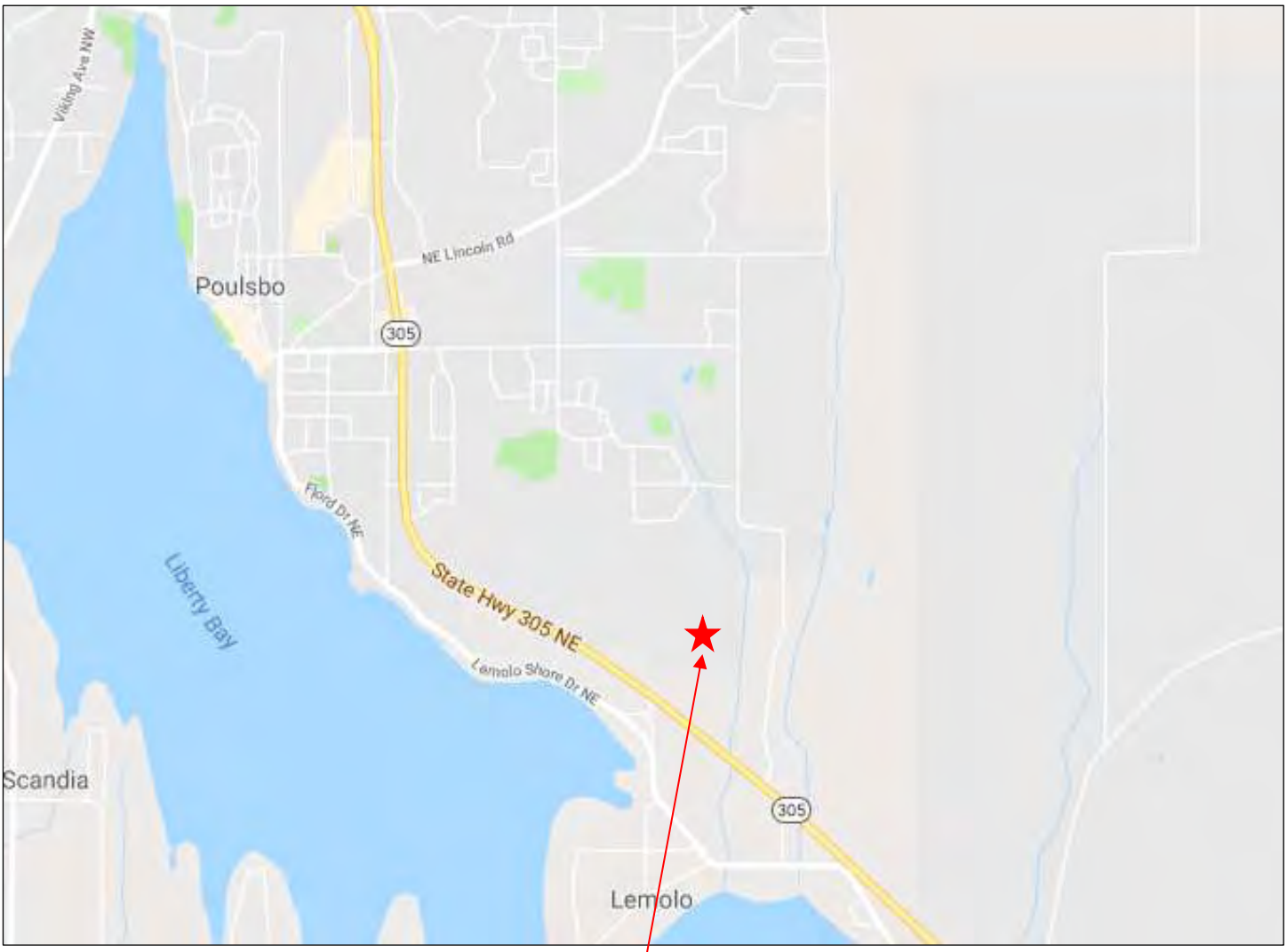
Keith S. Schembs, LEG
Principal

STATE OF WASHINGTON
DANA CHRISTOPHER BIGGERSTAFF
50040
REGISTERED
PROFESSIONAL ENGINEER
11/25/2019

Dana C. Biggerstaff, PE
Senior Geotechnical Engineer

NAF:KSS:DCB/kss
DocID: SWW.JohnsonRoadNW.RG.rev03
Attachments:
Figure 1: Site Location Map
Figure 2: Site & Exploration Plan
Figure 3a: Cross Section C-C'
Figure 3b: Cross Section D-D'
Figure 4: Site Vicinity Map
Figure 5: NRCS Soils Map
Figure 6: USGS Geological Map
Figure 7: Coastal Zone Map
Figure 8: DNR Fault Zone Hazard Map
Figure 9: Typical Drainage and Backfill Detail
Figure 10: Typical MSE Wall Detail
Figure 11: Typical Rockery Detail
Figure 12: IBC Key and Bench Detail
Appendix A - Subsurface Explorations
Appendix B - Laboratory Test Results
Appendix C – Slope Stability Results

Cc: CPH Consultants
11431 Willows Road NE, Suite 120
Redmond, WA 98052
(425) 285-2390
Attn: Mr. Matt Hough



Approximate Site Location

Map created from Google Maps (https://www.google.com/maps)

Not to Scale

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Site Location Map

Proposed Residential Plat
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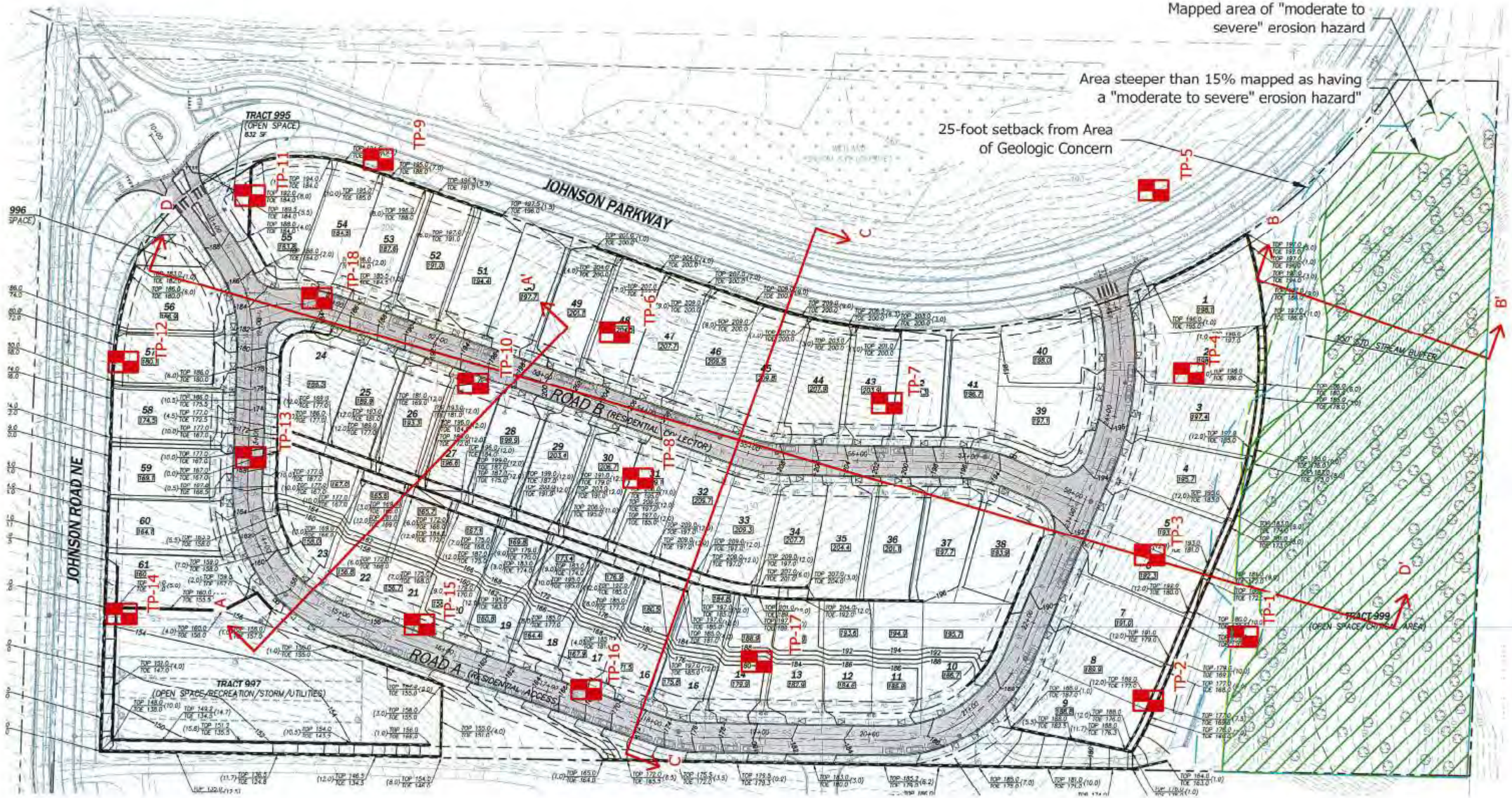
Poulsbo, Washington
PN: 25260120042008

DocID: SWW.JohnsonRdNW.F	July 2019	Figure 1



Notes:
Plan based on Preliminary Clearing and Grading Plan prepared by CPH Consulting, dated 11/22/2019

TP-1 Approximate Test Pit Location

Cross Section

Scale:
1" = 100'

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***Updated* Site & Exploration Plan**
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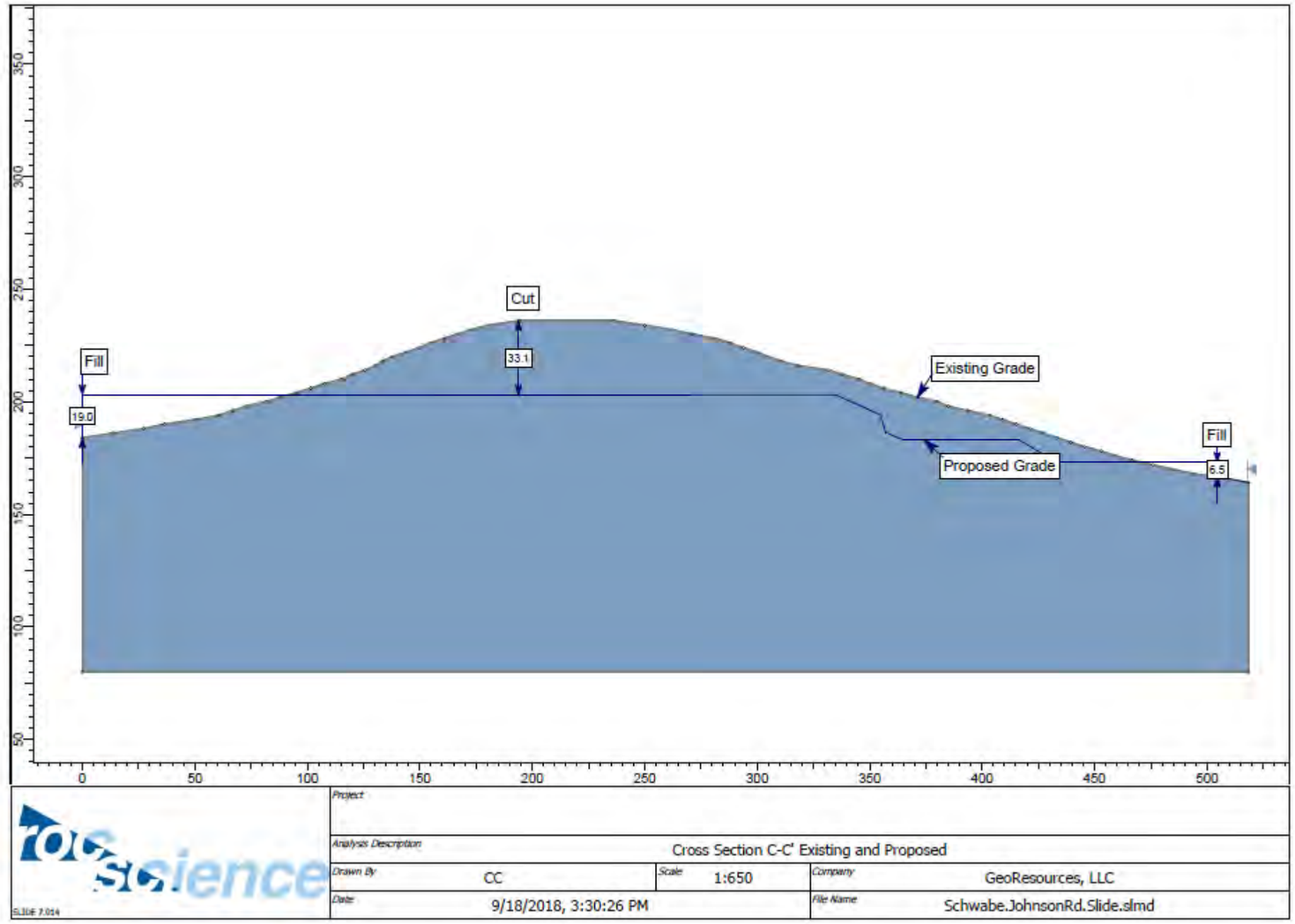
PN: 25260120042008

DocID: SWW.JohnsonRdNW.F	***November 2019***	Figure 2a



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Cross Section C-C'
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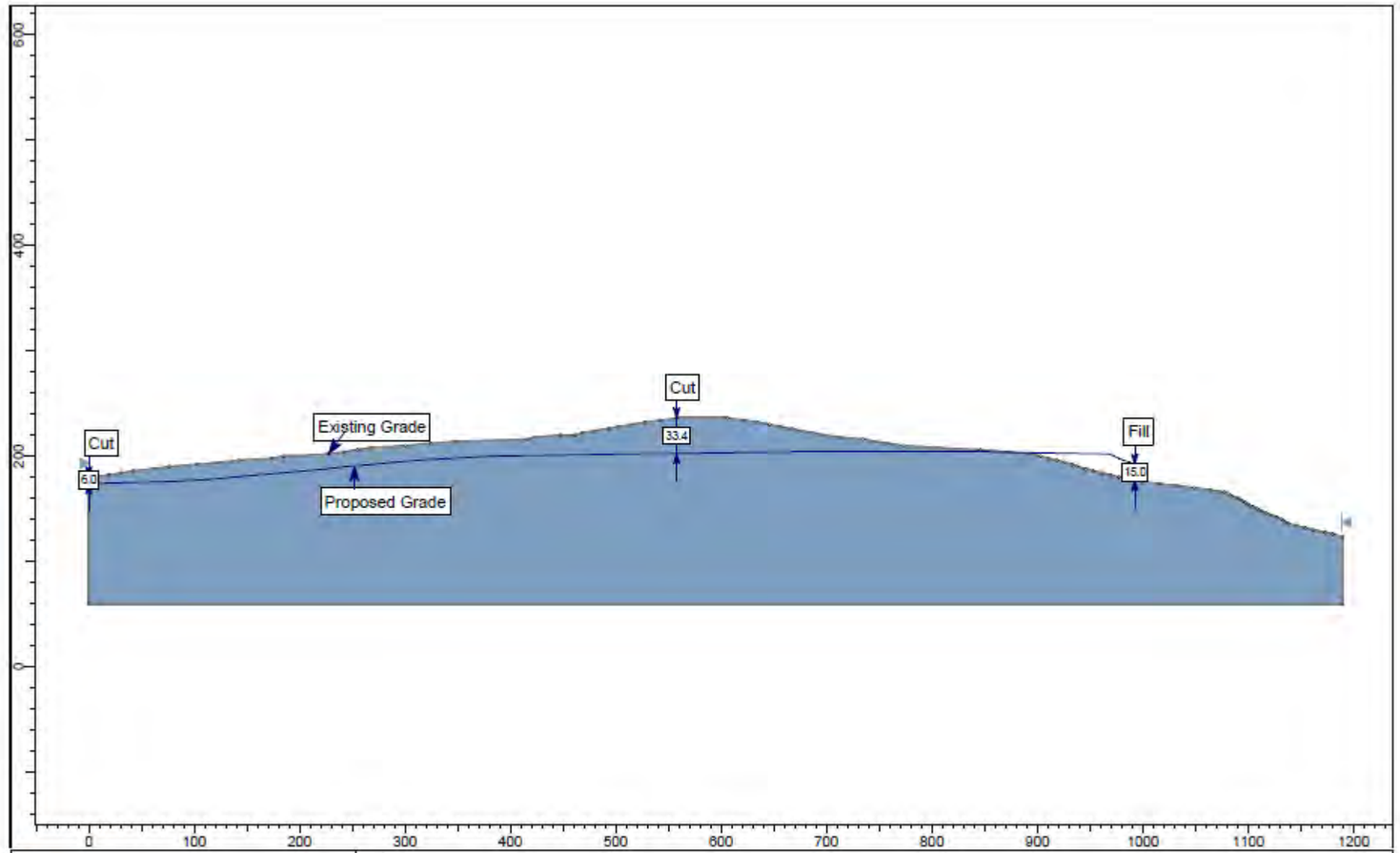
PN: 252601-2-004-2008

Doc ID: SWW.JohnsonRoadNW.F2	July 2019	Figure 3a



rocscience SLIDE 7.014	Project		
	Analysis Description	Cross Section D-D' Existing and Proposed	
	Drawn By: CC	Scale: 1:1500	Company: GeoResources, LLC
	Date: 9/18/2018, 3:30:26 PM		File Name: Schwabe.JohnsonRd.Slide.slmd

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Cross Section D-d'
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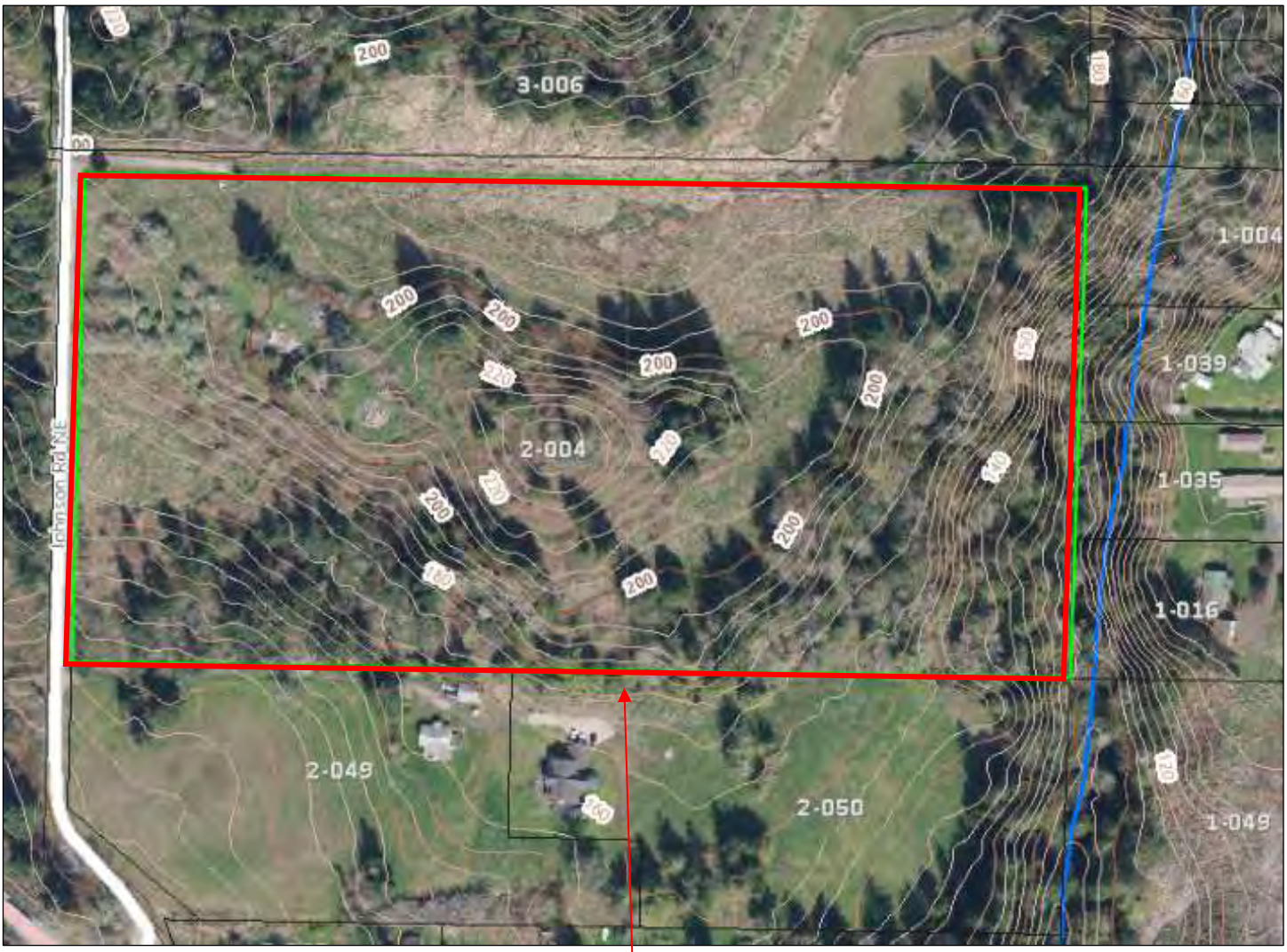
PN: 252601-2-004-2008

Doc ID: SWW.JohnsonRoadNW.F2	July 2019	Figure 3b



Approximate Site Location

Map created from Google Maps (https://www.google.com/maps)

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Site Vicinity Map

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Approximate Site Location

Map created from Web Soil Survey (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

Soil Type	Soil Name	Parent Material	Slopes	Erosion Hazard	Hydrologic Soils Group
32	McKenna gravelly loam	Glacial till	0 to 6	None	D
39	Poulsbo gravelly sandy loam	Basal till with volcanic ash in the upper part	0 to 6	Slight	B/D
40			6 to 15	Moderate	B/D
41			15 to 30	Moderate to severe	B/D

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NRCS Soils Map

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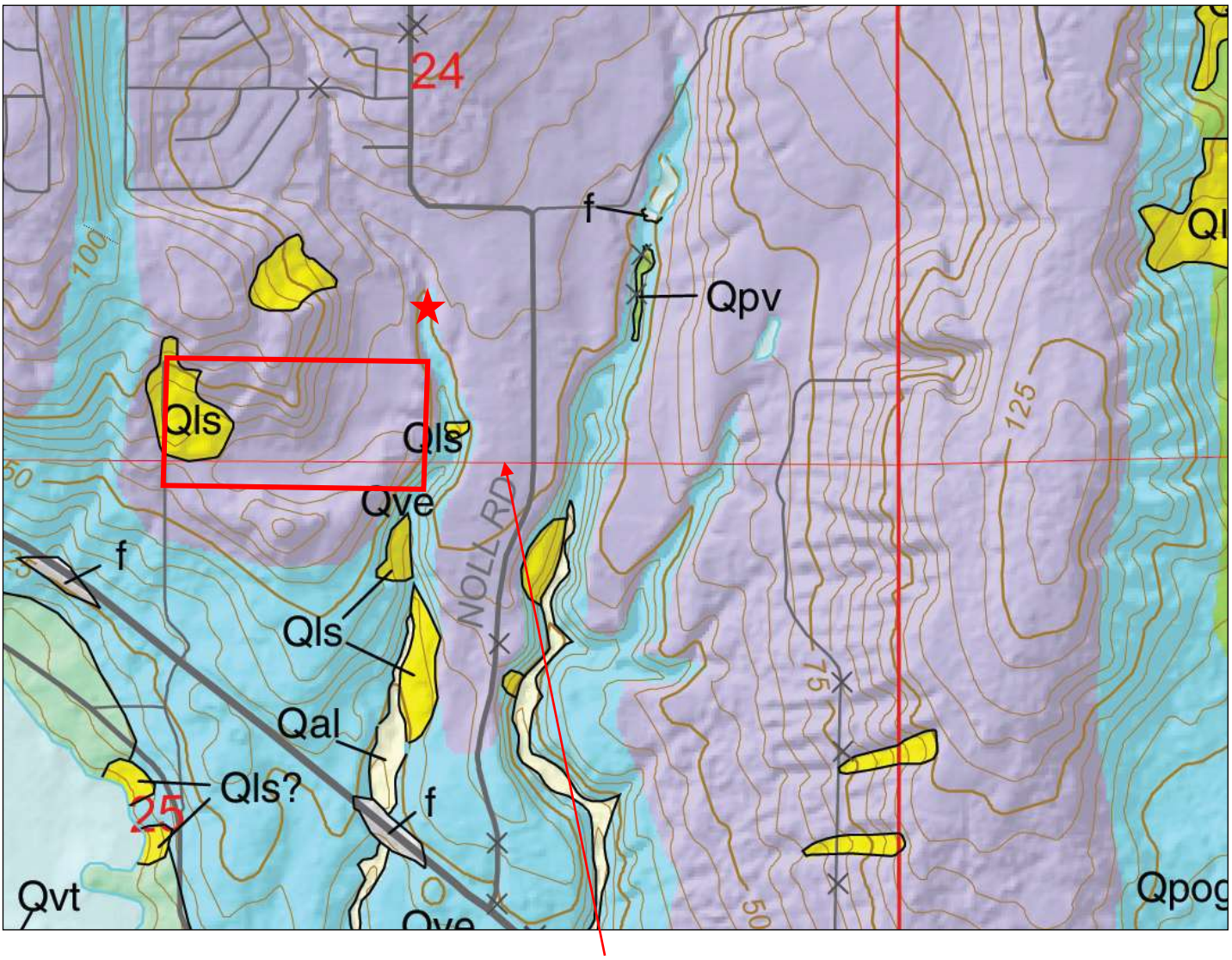
DocID: SWW.JohnsonRdNW.F	July 2019	Figure 5



Approximate Site Location

Excerpt from the *Geologic Map of the Suquamish 7.5' Quadrangle and part of the Seattle North 7.5' x 15' Quandrangle, Kitsap County, Washington*

by Ralph A. Haugerud and Kathy Goetz Troost (2011)

Qal	Alluvium (Holocene)
Qls	Landslide deposits (Holocene and Pleistocene?)
Qvt	Vashon till
Qve	Esperance Sand Member

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USGS Geologic Map

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Approximate Site Location

Map created on the Washington State Department of Ecology Coastal Atlas Website (https://fortress.wa.gov/ecy/coastalatlas/tools/Map.aspx)

Legend:

Slope stability

- Stable
- Intermediate
- Modified
- Unstable
- Unstable (old slide)
- Unstable (recent slide)

Not to Scale

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Coastal Atlas

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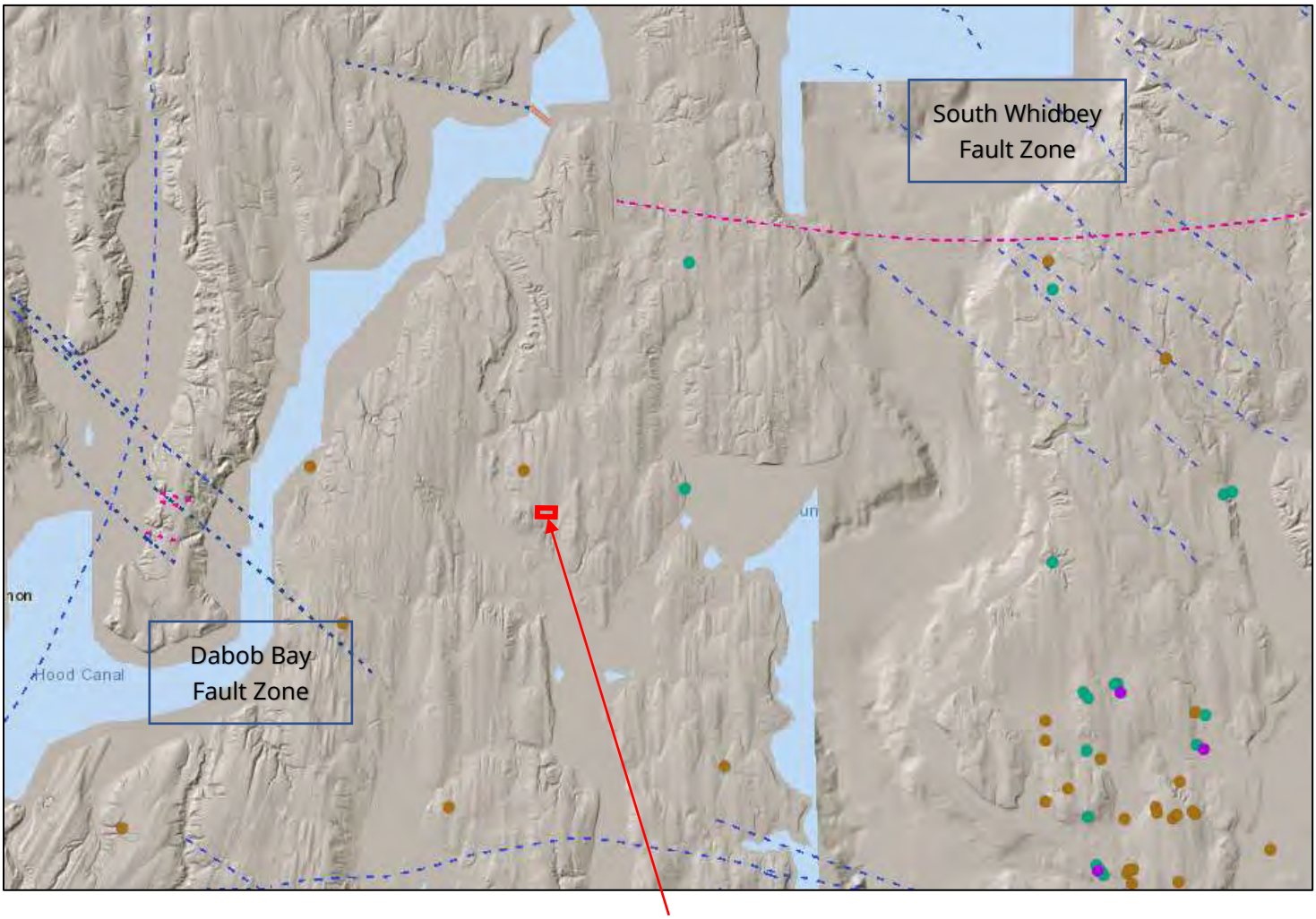

Approximate Site Location

Map created on the Washington State Department of Natural Resources
Washington Geologic Information Portal Website
(https://geologyportal.dnr.wa.gov/#natural_hazards)

Not to Scale

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DNR Earthquake Hazard Maps

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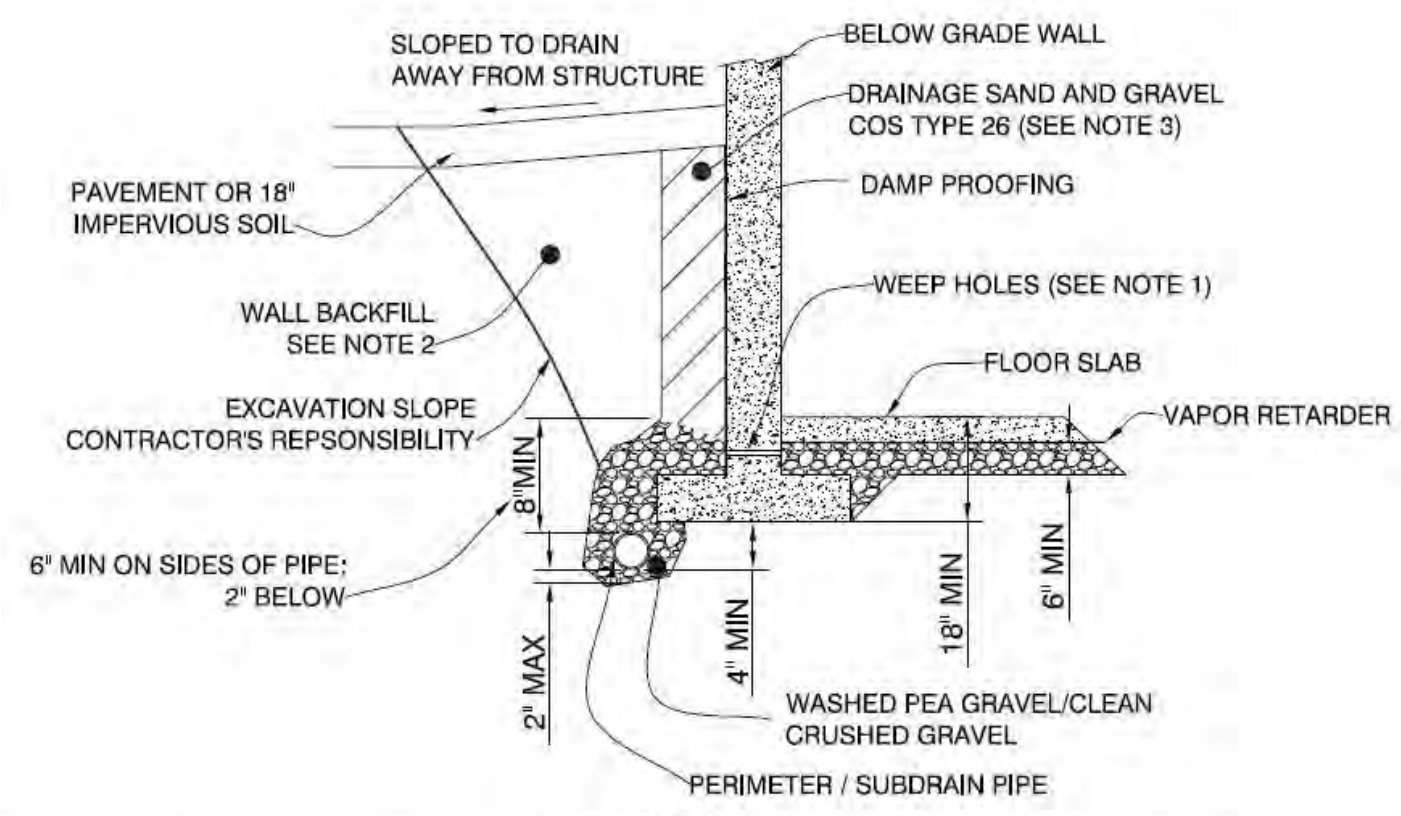
Seattle Fault



Notes

1. Washed pea gravel/crushed rock beneath floor slab could be hydraulically connected to perimeter/subdrain pipe. Use of 1" diameter weep holes as shown is one applicable method. Crushed gravel should consist of 3/4" minus. Washed pea gravel should consist of 3/8" to No. 8 standard sieve.

2. Wall backfill should meet WSDOT Gravel Backfill for walls Specification 9-03-12(2).

3. Drainage sand and gravel backfill within 18" of wall should be compacted with hand-operated equipment. Heavy equipment should not be used for backfill, as such equipment operated near the wall could increase lateral earth pressures and possibly damage the wall. The table below presents the drainage sand and gravel gradation.

4. All wall back fill should be placed in layers not exceeding 4" loose thickness for light equipment and 8" for heavy equipment and should be densely compacted. Beneath paved or sidewalk areas, compact to at least 95% Modified Proctor maximum density (ASTM: 01557-70 Method C). In landscaping areas, compact to 90% minimum.

5. Drainage sand and gravel may be replaced with a geocomposite core sheet drain placed against the wall and connected to the subdrain pipe. The geocomposite core sheet should have a minimum transmissivity of 3.0 gallons/minute/foot when tested under a gradient of 1.0 according to ASTM 04716.

6. The subdrain should consist of 4" diameter (minimum), slotted or perforated plastic pipe meeting the requirements of AASHTO M 304; 1/8-inch maximum slot width; 3/16- to 3/8-inch perforated pipe holes in the lower half of pipe, with lower third segment unperforated for water flow; tight joints; sloped at a minimum of 6"/100' to drain; cleanouts to be provided at regular intervals.

7. Surround subdrain pipe with 8 inches (minimum) of washed pea gravel (2" below pipe" or 5/8" minus clean crushed gravel. Washed pea gravel to be graded from 3/8-inch to No.8 standard sieve.

8. See text for floor slab subgrade preparation.

Materials

Drainage Sand and Gravel

Sieve Size	% Passing by Weight
¾"	100
No 4	28 – 56
No 8	20 – 50
No 50	3 – 12
No 100	0 – 2

¾" Minus Crushed Gravel

Sieve Size	% Passing by Weight
¾"	100
½"	75 – 100
¼"	0 – 25
No 100	0 – 2
(by wet sieving)	(non-plastic)

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Typical Wall Drainage and Backfill Detail

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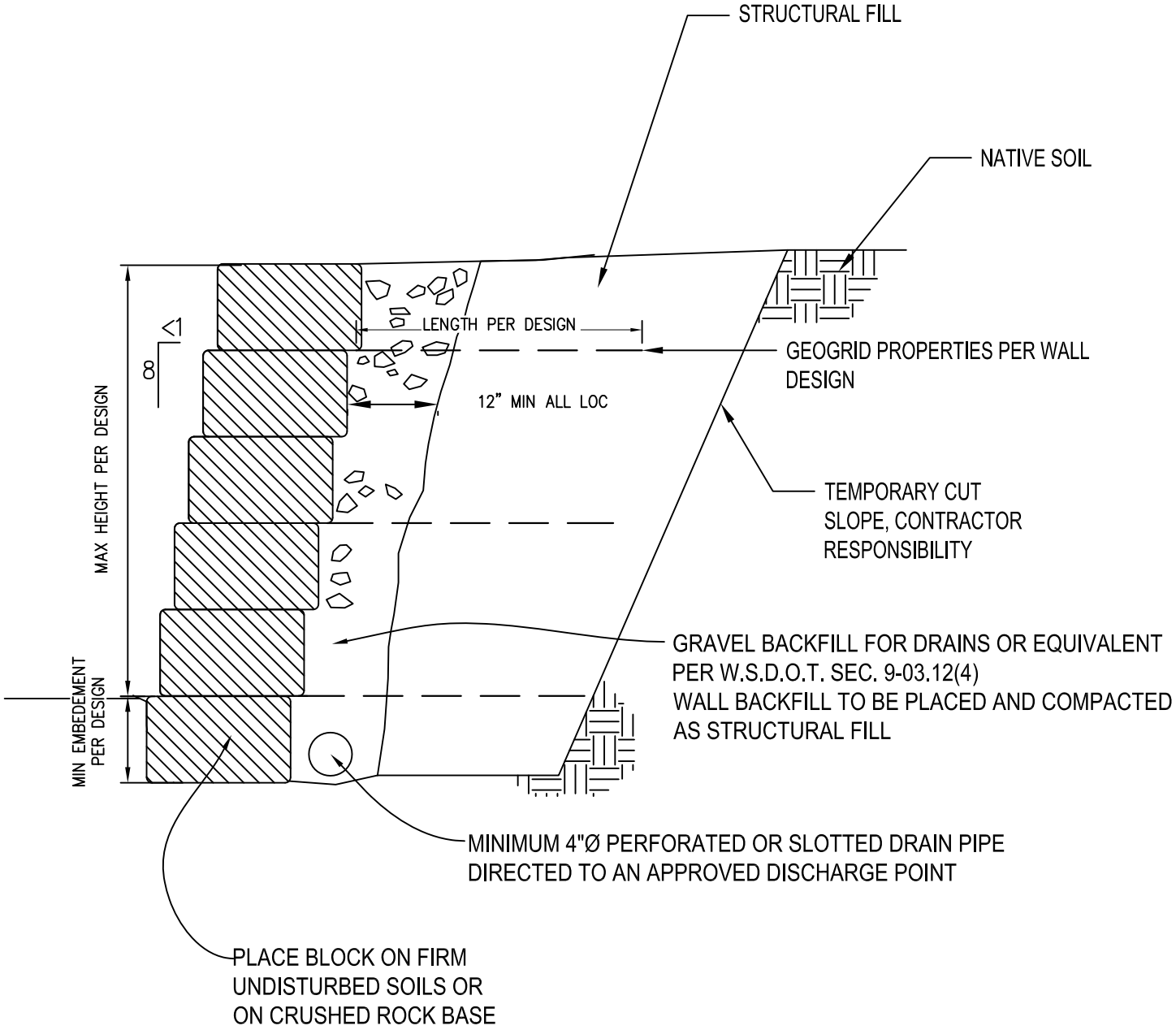

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Typical MSE Wall Detail
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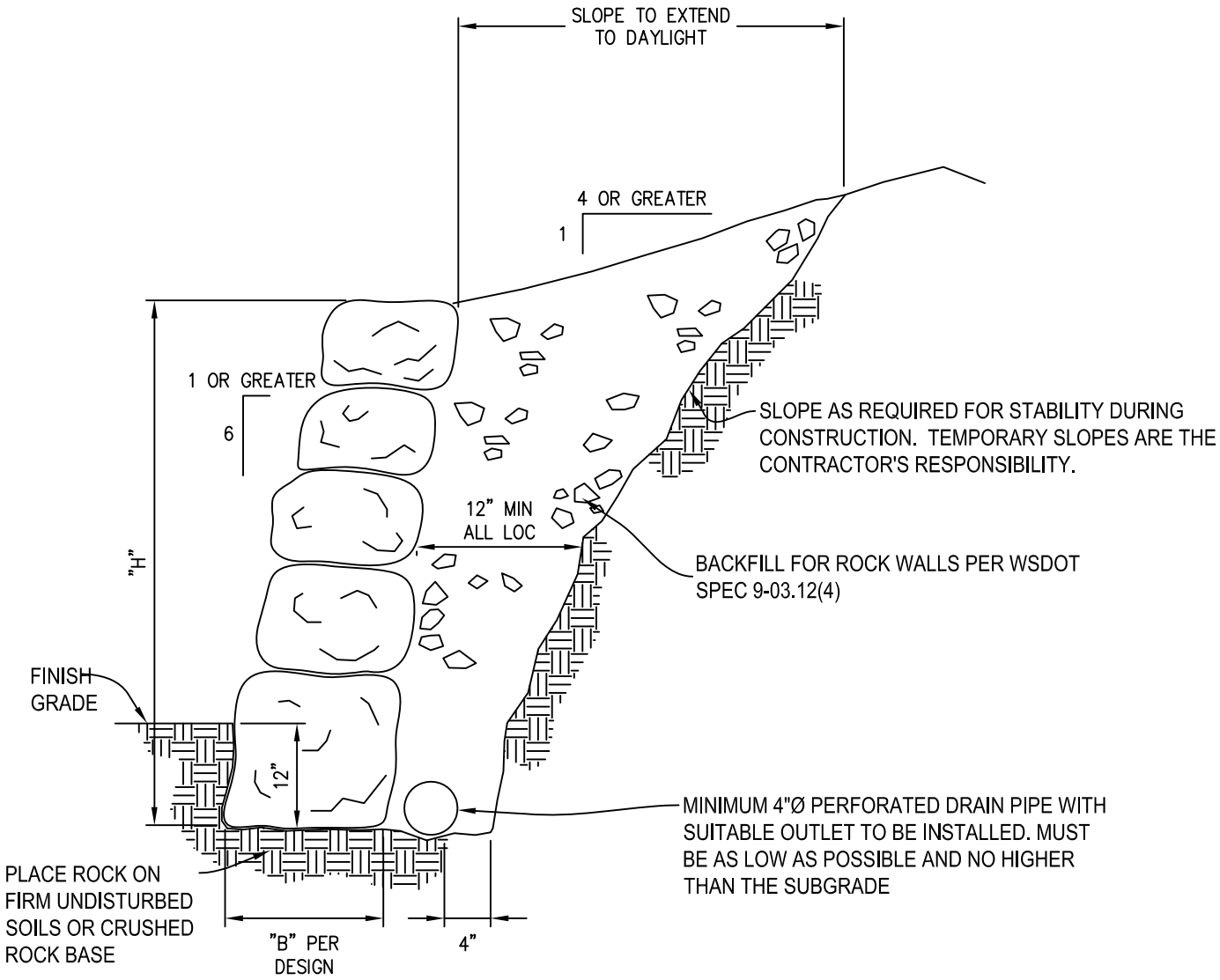
PN: 25260120042008

DocID: SWW.JohnsonRdNW.F	November 2019	Figure 10



NOTES:

1. CONSTRUCT ROCKERIES IN ACCORDANCE WITH A.R.C. GUIDELINES.
2. ENGINEER SHALL VERIFY SUBGRADE CONDITIONS FOR ROCKERIES OVER 4 FEET.
3. ALL ROCKERIES IN FRONT OF FILL WHERE HEIGHT IS GREATER THAN 4 FEET SHALL BE REINFORCED USING MIRAFI GEOGRID PER CALCULATIONS OR APPROVED SUBSTITUTE (SEE SCHEDULE FOR GRID PLACEMENT).
4. EMBED LOWEST COURSE OF ROCKERIY 12 INCHES.
5. NO STRUCTURE SHALL BE LOCATED WITHIN A HORIZONTAL SETBACK EQUAL TO THE ROCKERY HEIGHT FROM THE BACK OF THE UPPER ROCK COURSE.
6. ROCKERY BACKFILL SHALL CONSIST OF STRUCTURAL FILL COMPACTED TO 95% OF MDD PER ASTM D-1557 FOR ROCKERIES IN FRONT OF FILL OR NATIVE, GLACIALLY CONSOLIDATED SOILS IN FRONT OF CUT.
7. SEE RETAINING WALL DESIGN LETTER FOR REQUIRED ROCK SIZES FOR VARIOUS WALL HEIGHTS.

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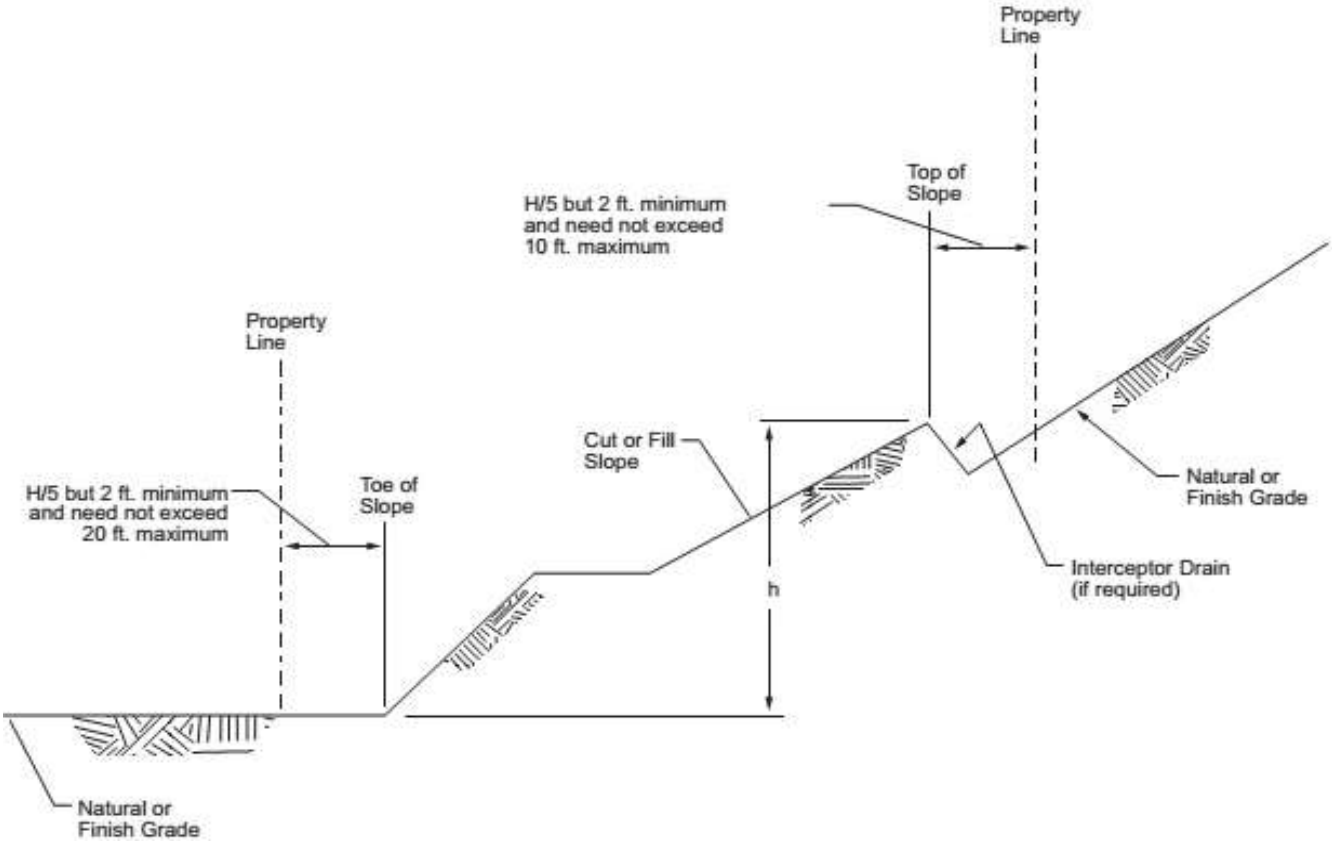
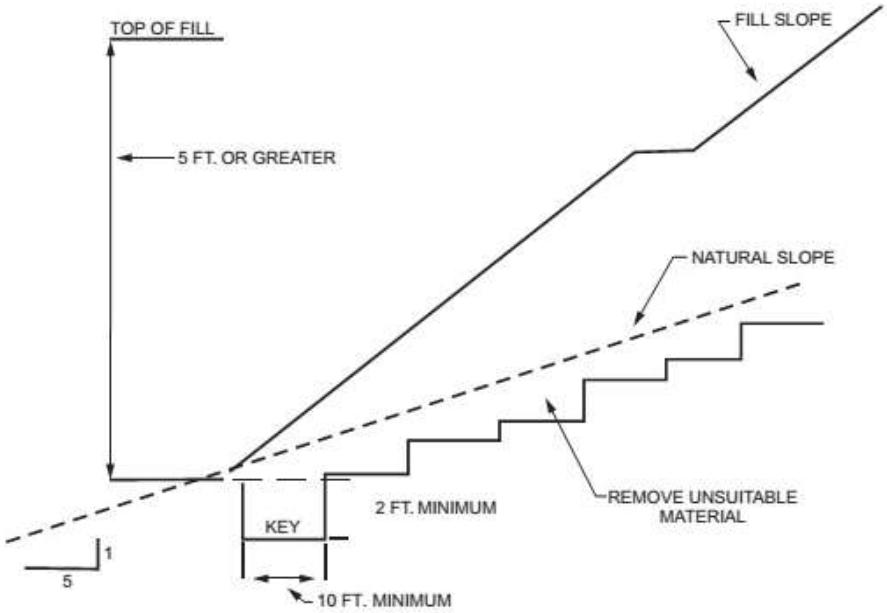
Typical Rockery Detail
Proposed Residential Plat
17504 Johnson Road NE
Poulsbo, Washington
PN: 25260120042008

DocID: SWW.JohnsonRdNW.F	November 2019	Figure 11





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IBC Appendix J Detail

Proposed Residential Plat
17504 Johnson Road NE
Poulsbo, Washington
PN: 25260120042008

DocID: SWW.JohnsonRdNW.F	July 2019	Figure 12

Appendix A

Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Residential Plat
17504 Johnson Road NE
Poulsbo, Washington
PN: 25260120042008

DocID: SWW.JohnsonRdNW.F	July 2019	Figure A-1

Test Pit TP-1

Location: N portion of SE storm tract
Approximate Elevation: 168'

Depth (ft)	Soil Type	Soil Description
0 - 0.7	-	Duff/Root zone
0.7 - 1.75	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
1.75 - 3.25	SM	Light tan and grey, heavily iron oxide stained silty SAND with gravel (medium dense, moist)
3.25 - 7.5	ML	Grey sandy SILT with occasional small gravel, some iron oxide staining to 7' (medium stiff, moist)

Terminated at 7.5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-2

Location: S portion of SE storm tract
Approximate Elevation: 168'

Depth (ft)	Soil Type	Soil Description
0 - 0.8	-	Duff/Root zone
0.8 - 1.25	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
1.25 - 2.0	ML	Light tan and grey, heavily iron oxide stained sandy SILT with some gravel (medium dense, moist)
2.0 - 7.0	ML	Grey SILT (medium stiff, moist)

Terminated at 7 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-3

Location: SE portion of site, near Lots 32/64
Approximate Elevation: 180'

Depth (ft)	Soil Type	Soil Description
0 - 0.7	-	Duff/Root zone
0.7 - 2.25	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
2.25 - 3.0	ML	Light tan and grey, heavily iron oxide stained sandy SILT with some gravel (medium dense, moist)
3.0 - 7.25	ML	Grey sandy SILT with some iron oxide staining to 4' (medium stiff, moist)

Terminated at 7.25 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

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Test Pit Exploration Logs
Proposed Residential Plat
17504 Johnson Road NE
Poulsbo, Washington
PN: 25260120042008

Test Pit TP-4

Location: Intersection of Road B and Road C
Approximate Elevation: 200'

Depth (ft)	Soil Type	Soil Description
0 - 0.5	-	Duff/Root zone
0.5 - 3.0	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
3.0 - 4.0	SM	Grey silty SAND with gravel (medium dense to dense, moist) (glacial till?)
4.0 - 7.0	ML	Grey sandy SILT with occasional small gravel, some iron oxide staining to 7' (medium stiff, moist)

Terminated at 7 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-5

Location: NE portion of site, Lot 31/30
Approximate Elevation: 190'

Depth (ft)	Soil Type	Soil Description
0 - 1.5	-	Duff
1.5 - 2.0	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
2.0 - 3.5	ML	Light tan and grey, heavily iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.5 - 4.5	SM	Medium brown, iron oxide stained silty medium SAND (moist, dense)
4.5 - 5.5	ML	Grey sandy SILT (medium stiff, moist)
5.5 - 7.0	SM	Grey silty SAND with gravel (medium dense to dense, moist) (glacial till?)

Terminated at 7 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

Test Pit TP-6

Location: Central portion of site, Road B
Approximate Elevation: 222'

Depth (ft)	Soil Type	Soil Description
0 - 0.5	-	Duff
0.5 - 1.5	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
1.5 - 2.0	ML	Reddish tan, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
2.0 - 3.0	ML	Light grey, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.0 - 5.5	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 5.5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-7

Location: E-central portion of site, lot 37/36
Approximate Elevation: 220'

Depth (ft)	Soil Type	Soil Description
0 - 0.75	-	Duff
0.75 - 1.5	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
1.5 - 3.0	ML	Light grey, heavily iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.0 - 6.5	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 6.5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-8

Location: Central portion of site, lot 55
Approximate Elevation: 220'

Depth (ft)	Soil Type	Soil Description
0 - 1.5	SM	Root zone/light grey silty sand with gravel (fill)
1.5 - 3.5	SM	Grey silty SAND (very dense, moist) (glacial till?)
3.5 - 4.5	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 4.5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

Test Pit TP-9

Location: NW portion of site, near proposed N access, lot 2
Approximate Elevation: 196'

Depth (ft)	Soil Type	Soil Description
0 - 0.5	-	Duff
0.5 - 1.0	SM	Tan silty SAND with gravel (medium dense, moist)
1.0 - 1.5	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
1.5 - 3.0	ML	Light grey, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.0 - 5.0	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-10

Location: W-central portion of site
Approximate Elevation: 212'

Depth (ft)	Soil Type	Soil Description
0 - 1.0	-	Duff/Root zone
1.0 - 2.5	ML	Light grey, heavily iron oxide stained sandy SILT with some gravel (medium stiff, moist)
2.5 - 5.0	ML	Grey sandy SILT, layers of iron oxide staining throughout (medium stiff, moist)

Terminated at 5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-11

Location: NW portion of site, lots 10/11
Approximate Elevation: 194'

Depth (ft)	Soil Type	Soil Description
0 - 0.5	-	Duff/Root zone
0.5 - 1.0	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
1.0 - 3.0	ML	Light tan and grey, heavily iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.0 - 5.0	ML	Grey sandy SILT with some iron oxide staining to 4' (medium stiff, moist)

Terminated at 5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

Test Pit TP-12

Location: NW corner of SW stormwater tract
Approximate Elevation: 170'

Depth (ft)	Soil Type	Soil Description
0 - 0.75	-	Duff/Root zone
0.75 - 1.0	SM	Tan, lightly iron oxidized silty SAND with occasional cobbles (medium dense, moist)
1.0 - 2.0	ML	Light tan, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
2.0 - 6.0	ML	Grey SILT (medium stiff, moist)

Terminated at 6 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-13

Location: E-central portion of SW stormwater tract
Approximate Elevation: 170'

Depth (ft)	Soil Type	Soil Description
0 - 1.25	-	Duff/Root zone
1.25 - 3.25	SM	Tan, lightly iron oxidized silty SAND with gravel (medium dense, moist)
3.25 - 6.0	SM	Grey silty SAND with gravel (medium dense, moist)

Terminated at 6 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-14

Location: SW corner of SW stormwater tract
Approximate Elevation: 137'

Depth (ft)	Soil Type	Soil Description
0 - 1.0	-	Duff/Root zone
1.0 - 3.0	SM	Tan, lightly iron oxidized silty SAND with occasional cobbles (medium dense, moist)
3.0 - 5.0	ML	Light grey and tan, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
5.0 - 8.0	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 8 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

Test Pit TP-15

Location: SW portion of site, lot 77/Road A
Approximate Elevation: 164'

Depth (ft)	Soil Type	Soil Description
0 - 1.0	-	Duff/Root zone
1.0 - 2.0	SM	Tan, lightly iron oxidized silty SAND with occasional cobbles (medium dense, moist)
2.0 - 3.0	ML	Light grey and tan, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.0 - 5.5	ML	Grey sandy SILT (medium stiff, moist)
5.5 - 7.0	SM	Brown silty SAND with gravel (medium dense, moist)

Terminated at 7 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-16

Location: S-central portion of site, Lot 74
Approximate Elevation: 170'

Depth (ft)	Soil Type	Soil Description
0 - 0.75	-	Duff/Root zone
0.75 - 2.0	SM	Tan, lightly iron oxidized silty SAND with occasional cobbles (medium dense, moist)
2.0 - 3.0	ML	Light grey and tan, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.0 - 5.5	ML	Grey sandy SILT, iron oxide staining from 3 to 5 feet (medium stiff, moist)

Terminated at 5.5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

Test Pit TP-17

Location: S-central portion of site, Lot 71
Approximate Elevation: 205'

Depth (ft)	Soil Type	Soil Description
0 - 1.0	-	Duff/Root zone
1.0 - 2.25	SM	Tan, lightly iron oxidized silty SAND with occasional cobbles (medium dense, moist)
2.25 - 3.5	ML	Light grey and tan, iron oxide stained sandy SILT with some gravel (medium stiff, moist)
3.5 - 6.0	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 6 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Test Pit TP-18

Location: W-central portion of sire, Road B
Approximate Elevation: 200'

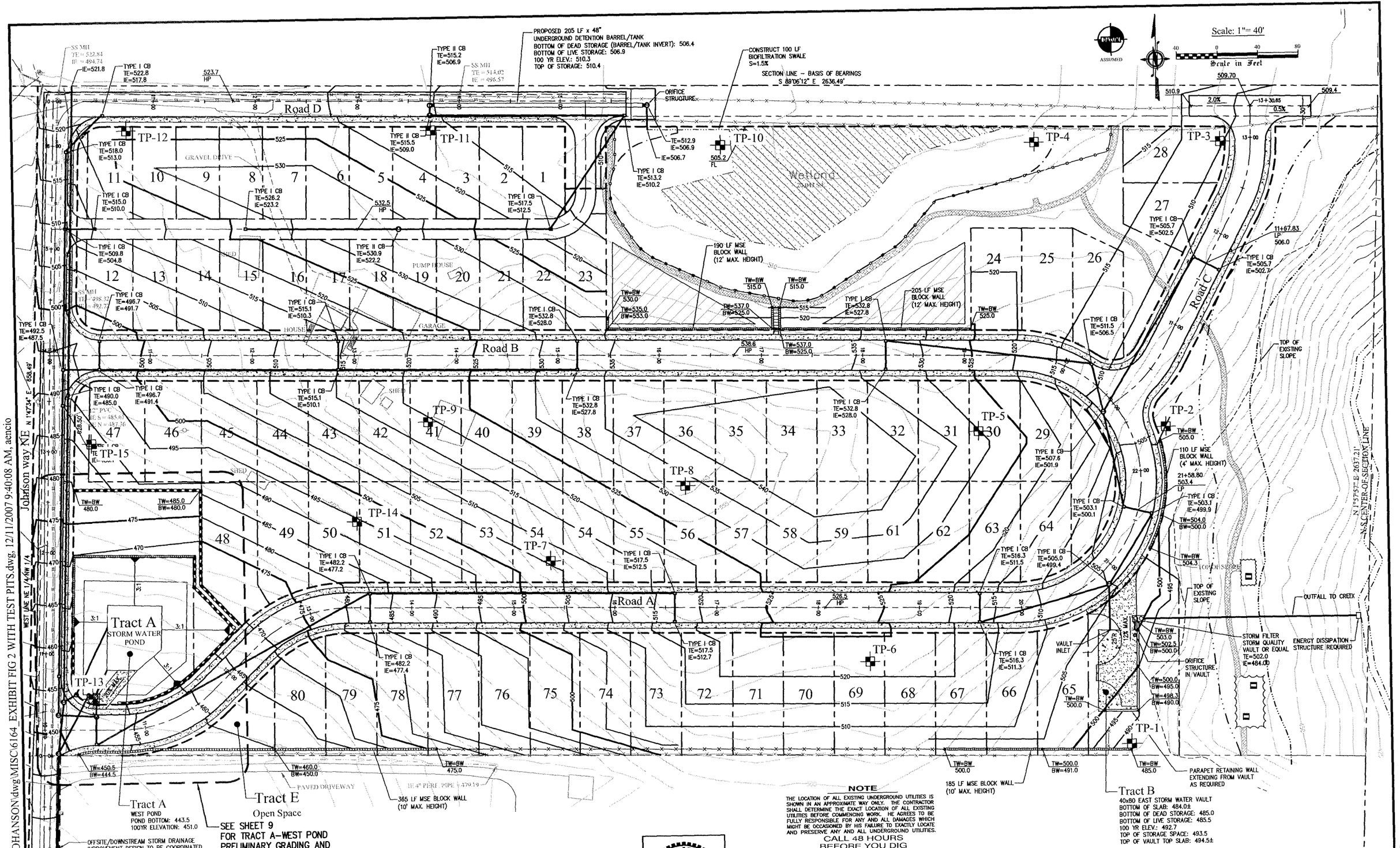
Depth (ft)	Soil Type	Soil Description
0 - 0.5	-	Duff/Root zone
0.5 - 1.5	SM	Tan, iron oxidized silty SAND with occasional cobbles (medium dense, moist)
1.5 - 3.0	ML	Grey, heavily mottles sandy SILT (medium stiff, moist)
3.0 - 5.0	ML	Grey sandy SILT (medium stiff, moist)

Terminated at 5 feet below ground surface.
No caving observed at the time of excavation.
No groundwater seepage observed.

Logged by: VRM **Excavated on: September 6, 2018**

Subsurface Explorations by Others

(N.L. Olson, 2007)



NOTE

THE LOCATION OF ALL EXISTING UNDERGROUND UTILITIES IS SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. HE AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

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REVISIONS			
NO.	DATE	BY	DESCRIPTION

	BY	DATE
DESIGNED	JFK	11/07
DRAWN	AUE	11/07
CHECKED	NLOH	11/07
APPROVED		
ACCEPTED		

N.L.Olson & Associates, Inc.
Engineering, Planning and Surveying
(360) 876–2284
2453 Bethel Avenue, P.O. Box 637, Port Orchard, WA 98366

NORMAN LEE OLSON — STATE OF WASHINGTON — 37919 — REGISTERED PROFESSIONAL ENGINEER — EXPIRES:

PRELIMINARY STORM DRAINGE AND GRADING PLAN

JOHNSON RIDGE - PRELIMINARY PLAT/P.R.D.

17504 JOHNSON WAY NE

PORTION OF THE NORTHEAST QUARTER OF THE NORTHWEST QUARTER SECTION 25, TOWNSHIP 26 NORTH, RANGE 1 EAST, W.M., KITSAP COUNTY, WASHINGTON

FOR: HIGH VALLEY COMMUNITIES, LLC
10106 422nd LANE SE
NORTH BEND, WA. 98045

(425) 888–9830

SCALE: AS SHOWN
DATE: November 30, 2007
DRAWING NUMBER: 056164-XXXXXX
SHEET 1 OF 1

FIGURE 2

APPENDIX A

SUBSURFACE EXPLORATION DISCUSSION

TEST PIT LOGS

LAB RESULTS

The site soil conditions were explored on Nov 29, 2005 and Nov 30, 2005 by excavating fifteen (15) test pits throughout the site. The test pit excavations ranged in depth from 6 to 15 feet below current site grades. Whitworth Excavating performed the excavation work with a Kamatso PC 200 track-hoe. The approximate test pits locations are shown on the attached Site Plan, Figure 2. The test pits soil logs are presented in this Appendix.

Stratification lines designating the interface between soil types in subsurface exploration logs represent approximate boundaries. The transition between materials may be gradual. The depths represented on our test pits logs were referenced to present site grades encountered during our subsurface exploration work.

The subsurface exploration logs and related information depicts conditions only at the specific locations and at the particular time designated on the logs. The passage of time may result in a change of subsurface conditions at these exploration locations. Subsurface conditions at other locations may differ from conditions occurring at the exploration locations. The nature and extent of variations of subsurface conditions between explorations are not known. If variations appear during additional explorations or construction, reevaluation of recommendations in this report may be necessary.

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Engineering, Planning and Surveying
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P.O. BOX 637
PORT ORCHARD, WASHINGTON 98366-0637

Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6164	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	486	TP-1	1 of 1

Surface Conditions: Cedar, Maple, Ferns

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			6 inch layer of topsoil
1 ft (S-1)		SP	1	16.3%	Brown poorly graded SAND, medium dense, moist - Contains gravel - Medium to course grained sand
3 ft (S-2) P.P. =4.5 tsf		CL	2, 3, 4	26.3%	Brown lean CLAY, very stiff to hard, fractured, moist
5 ft (S-3) P.P. = 4.5 tsf		MH	5, 6, 7, 8	14.0%	Brown elastic SILT, very stiff to hard, moist LL=58 PL=53 PI=5
8 ft (S-4)		ML	9, 10	29.3%	Gray SILT, very stiff to hard, moist
10' ft (S-5) P.P. = 4.5 tsf		CL	11, 12	25.9%	Brown lean CLAY, very stiff to hard, fractured, moist
			13, 14, 15, 16, 17, 18		Test Pit terminated at 12 feet. (Ground water not encountered)

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - Komatsu PC 200		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

(Ground water not encountered)

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	507	TP-10	1 of 1

Surface Conditions: Pasture Land

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL	1		1 to 4 inch thick layer of topsoil
		SP	2		silty sand and sand with organics, loose and moist
3.5 ft (S-32)		CL	3	35.7%	Gray Lean CLAY, soft to medium stiff, moist
4-5 ft (S-33)		SP	4	13.3%	Brown/Gray Poorly graded SAND, medium dense, moist
+5 ft (S-34)		ML	5	19.1%	Brown/gray sandy SILT, very stiff, moist
+7 ft (S-35)		SP	6	14.9%	Gray Poorly Graded Sand, medium dense, moist
8-9 ft (S-36)		GP-GM	7	4.3%	Brown poorly graded GRAVEL with silt, medium dense to dense, moist
11 ft (S-37)		ML	8	25.4%	Brown SILT, very stiff, moist - Becomes Gray
			9		
			10		
			11		
			12		Test Pit terminated at 12 feet
			13		
			14		
			15		
			16		
			17		
			18		

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Notes:

(Groundwater encountered 18 to 24 inches bgs)

Hole Completion
- ☐ Monitoring Well
- ☐ Piezometer
- ☒ Abanonded and backfilled
- ☐ Inclinometer
- ☐ _____
- ☐ _____

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 30, 2005	End Date: Nov 30, 2005	515	TP-11	1 of 1

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	Surface Conditions: Pasture Land
1 ft (S-38)		ML	1	15.5%	Fill: Brown SILT, soft to medium stiff, moist - contains cobbles
		TOPSOIL	2		6 to 12 inch thick layer of topsoil
3.6 ft (S-39)		ML	3 4	31.2%	Native: Brown SILT, soft to medium stiff, moist - iron oxide stained - contains cobbles LL=35; PL=25; PI=8
6 ft (S-40)			5 6	24.1%	- Test pit side wall caved below 4 ft - Becomes sandy silt dense
8 ft (S-41)			7 8	23.5%	- becomes very dense
10 ft (S-42)			9 10	22.6%	
11-12 ft (S-43)			11 12	23.4%	Becomes dark gray sandy SILT with gravel dense to very dense at 11 to 12 ft
			13 14 15 16 17 18		Test Pit terminated at 12 ft

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Notes:
(Moderate groundwater seepage midway up test pit)

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 30, 2005	End Date: Nov 30, 2005	518	TP-12	1 of 1

Surface Conditions: Apple Orchard and grass

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	Description
1 ft (S-45)		ML	1	21.4%	Fill: (?) Brown SILT, medium stiff to stiff, moist - Contains Cobbles and Boulders
		TOPSOIL	2		TOPSOIL
2.5 ft (S-46)		SM	3	12.7%	Native: (?) Brown silty SAND with gravel, medium dense to dense, moist
3.6 ft (S-47)		SP		18.7%	Brown/Gray Poorly graded SAND, medium dense, moist - iron oxide stained
5 ft (S-48)		ML	4 5	16.9%	Native: Brown SILT, soft to medium stiff, moist - iron oxide stained - contains cobbles
8 ft (S-49)			6 7 8 9 10 11 12	24.7%	- Becomes sandy silt dense
			13 14 15 16 17 18		Test Pit terminated at 12 ft

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
Notes:			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Appendix A.4

N.L.Olson&Associates,Inc.
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PORT ORCHARD, WASHINGTON 98366-0637

Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 30, 2005	End Date: Nov 30, 2005	452	TP-13	1 of 1

Surface Conditions: Black berry bramble and grassy area

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL	1		TOPSOIL
24 to 40" ft (S-50)		CL	2, 3	24.2%	Gray lean CLAY, medium stiff to stiff, wet
5 ft (S-51)		SM	4, 5, 6	17.6%	Brown silty SAND with gravel, medium dense to dense, moist
8 ft (S-52)		ML	7, 8, 9	31.4%	Brown SILT, medium stiff to stiff, moist - contains fine grained sand
10 ft (S-53)			10, 11, 12	26%	- Becomes light gray at 10 ft - medium stiff to stiff
			13, 14, 15, 16, 17, 18		Test Pit terminated at 12 ft (Groundwater was not encountered)

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

Mottled soil conditions throughout test pit excavation

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 30, 2005	End Date: Nov 30, 2005	498	TP-14	1 of 1

General Notes Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	Surface Conditions: Blackberry and grass
		TOPSOIL	1		TOPSOIL
2 ft		SM	2 3		Gray silty SAND, medium dense to dense, moist - contains fine grained sand
4 ft 11 ft		ML	4 5 6 7 8 9 10 11		Light gray SILT, very stiff to hard, moist - contains fine grained sand
15 ft		MH	12 13 14 15		Dark Gray elastic SILT, stiff to very stiff, moist
			16 17 18		Test Pit terminated at 15 ft

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

Mottled soil conditions throughout test pit excavation

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 30, 2005	End Date: Nov 30, 2005	488	TP-15	1 of 1

General Notes Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	Surface Conditions: Pasture Land
		TOPSOIL	1		TOPSOIL
2 ft		SM	2 3		Gray silty SAND, medium dense to dense, moist - contains fine grained sand
4 ft 6 ft		ML	4 5 6		Light gray SILT, very stiff to hard, moist - contains fine grained sand
			7 8 9 10 11 12 13 14 15 16 17 18		Test Pit terminated at 6 ft (Groundwater was not encountered)

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

Mottled soil conditions throughout test pit excavation

Appendix A.4

N.L.Olson&Associates,Inc.
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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	502	TP-2	1 of 1

General Notes Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	Surface Conditions: Cedar, Tall Grass
		TOPSOIL			6 inch layer of topsoil
		CL	1		Brown lean CLAY, soft to medium stiff, moist
			2		
2.5 ft (S-6)		ML	3	33.4%	Gray SILT, very stiff to hard, moist to wet and weathered LL=33; PL=30; PI=5
			4		
4 ft (S-7) P.P. = 4.5 tsf			5	25.7%	Becomes light gray and very stiff to hard, moist LL=29; PL=24; PI=5
			6		
			7		
			8		
			9		
			10		
			11		
			12		
			13		Test Pit terminated at 12 feet.
			14		(Standing water conditions encountered)
			15		
			16		
			17		
			18		

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Hole Completion
- ☐ Monitoring Well
- ☐ Piezometer
- ☒ Abanonded and backfilled
- ☐ Inclinometer
- ☐ _____
- ☐ _____

Notes:

(Standing water conditions encountered)

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	516	TP-3	1 of 1

Surface Conditions: Brush, Douglas Fir, and Cedar

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			2 to 4 inch layer of topsoil
2.5 ft (S-8)		CL	1, 2, 3	20.4%	Brown lean CLAY, soft to medium stiff, moist Tree roots encountered down 2 to 3 feet
4 ft (S-9) P.P. = 4.5 tsf		ML	4, 5, 6, 7, 8, 9, 10, 11	23.2%, 25.7%	Gray SILT, hard, moist
12 ft (S-10) P.P. = 4.5 tsf			12, 13, 14	26.5%	Becomes light gray
			15, 16, 17, 18		Test Pit terminated at 12 feet. (Standing water conditions encountered)

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

(Standing water conditions encountered)

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	506	TP-4	1 of 1

Surface Conditions: Pasture Land

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL	1		6 to 12 inch layer of topsoil
2 ft (S-11)		CL	2	24.1%	Brown sandy CLAY, loose, fractured, wet
30"-4' (S-12)		SP	3	17.4%	Brown poorly graded SAND, medium dense, moist - Contains gravel - Fine to medium grained sand - Mottled soil conditions and tace cobbles observed upper 4 ft of soil horizon.
4 ft (S-13) P.P. = 4 tsf		ML	4, 5	29.2%	Gray SILT, very stiff to hard, moist
			6, 7, 8, 9, 10		
10-13 ft (S-14) P.P. = 4.0 tsf			11, 12	28.5%	Becomes Dark Gray
			13		
			14, 15, 16, 17, 18		Test Pit terminated at 13 feet. (Light ground water seepage encountered at 4 ft and standing water conditions observed)

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

(Light ground water seepage encountered at 4 ft and standing water conditions observed)

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	534	TP-5	1 of 1

Surface Conditions: Pature land near burn pile

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			2 to 4 inch layer of topsoil
1 ft (S-15)		ML	1	16.5%	Gray SILT, soft, moist to wet and weathered - mottled 32 inches bgs
2.5 ft (S-16)			2, 3	22.4%	- Becomes very stiff at 3 ft
			4, 5	25.4%	- Becomes very stiff to hard at 5 ft
4 ft (S-17)			6, 7, 8, 9		
			10		- Becomes sandy SILT and dense at roughly 10 ft
14 ft (S-18)			11, 12, 13, 14		
			15, 16, 17, 18		Test Pit terminated at 14 feet.

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: see note:	Checked By:	Date
			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Notes:

(Light ground water seepage encountered at 2.5 ft)
upper 2.5 feet of soil horizon disturbed by previous plowing activity

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	521	TP-6	1 of 1

Surface Conditions: Black Berry Bramble

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			2 to 6 inch layer of topsoil
			1		Brown SILT, soft to medium stiff, moist
			2		- mottled 36 inches bgs - upper 3 ft weathered
1-3 ft (S-19)			3	20.6%	
					- Becomes light gray and very stiff at 3 ft
4 ft (S-20)			4	24.3%	
			5		- Becomes very stiff to hard at 5 ft
			6		
		ML	7		
			8		
			9		
			10		- Becomes sandy SILT and dense at roughly 10 ft
			11		
			12		
13.5 ft (S-21)			13	28.5%	
			14		
			15		Test Pit terminated at 14 feet.
			16		
			17		
			18		

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment		Groundwater Elevation	Checked By:	Date
Trackhoe - CAT 311B		not encountered		
Notes:			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	524	TP-7	1 of 1

Surface Conditions: Blackberry and grassland

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			6 inch layer of topsoil
2.5 ft (S-22) 4 ft (S-23)		ML	1 2 3 4 5	13.0% 24.5%	Brown SILT, soft to medium stiff, moist - mottled and weathered upper 36 inches - contains rootlets - contains trace gravel - Becomes light gray and very stiff at 4 ft - Becomes very stiff to hard at 5 ft
7 ft (S-24)		SM	6 7	9.2%	Light Brown silty SAND with gravel, medium dense to dense, moist - Fines content = 24% passing 200 sieve
			8 9 10 11 12 13 14 15 16 17 18		Test Pit terminated at 7 feet.

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
Notes:			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	560	TP-8	1 of 1

Surface Conditions:
Grass land brush and scattered trees

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			6 to 12 inch thick layer of topsoil
0.5 to 1.5 ft (S-25) 2 ft (S-25)		SM	1 2 3 4		Brown silty SAND loose, moist - Fine to medium grained sand - Contains trace gravel - gravel content increases
6 ft (S-27)		SP-SM	5 6		Grayish brown poorly graded SAND with silt and gravel, medium dense to dense, wet - Medium to course grained sand
		SM	7 8		- Becomes fine to medium grained sand.
8.5 ft (S-28)		ML	9 10 11 12		Gray silty SAND with gravel, medium dense to dense, moist - Fine to medium grained sand - Contains Cobbles Brown SILT with gravel and cobbles, hard, moist, - iron oxide stained
			13 14 15 16 17 18		Test Pit terminated at 13 feet

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
Notes:			Revision By:	Date

Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Appendix A.4

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Test Pit Log

PROPOSED RESIDENTIAL DEVELOPMENT
JOHNSON ROAD
POULBO, WA

Job Number:	Logged By:	Subsurface Exploration		Ground Surface Elevation	Test Pit Number	Page
6238	WRJ	Start Date: Nov 29, 2005	End Date: Nov 29, 2005	536	TP-9	1 of 1

Surface Conditions: Lawn area near shop

General Notes: Grab samples taken at following Depths	Graphic Symbol	USCS SYMBOL	Depth (ft)	Moisture Content (%)	
		TOPSOIL			6 inch layer of topsoil
0 to 2.67 ft (S-29)		ML	1, 2	15.0%	Brown SILT with gravel, soft to medium stiff, moist - contains cobbles
4 ft (S-30)		SM	3, 4	12.7%	Light Brown silty SAND with gravel, medium dense, moist - Becomes gray and dense
5 ft (S-31)		ML	5, 6	24%	Gray SILT hard, moist - contains cobbles - Mottled
			7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18		Test Pit terminated at 6 feet.

Contractor	Operators Name	Sampling Method	Drawn By:	Date
Whitworth Excavating	Bob Whitworth	grab	WRJ	November 2, 2005
Equipment: Trackhoe - CAT 311B		Groundwater Elevation: not encountered	Checked By:	Date
Notes:			Revision By:	Date

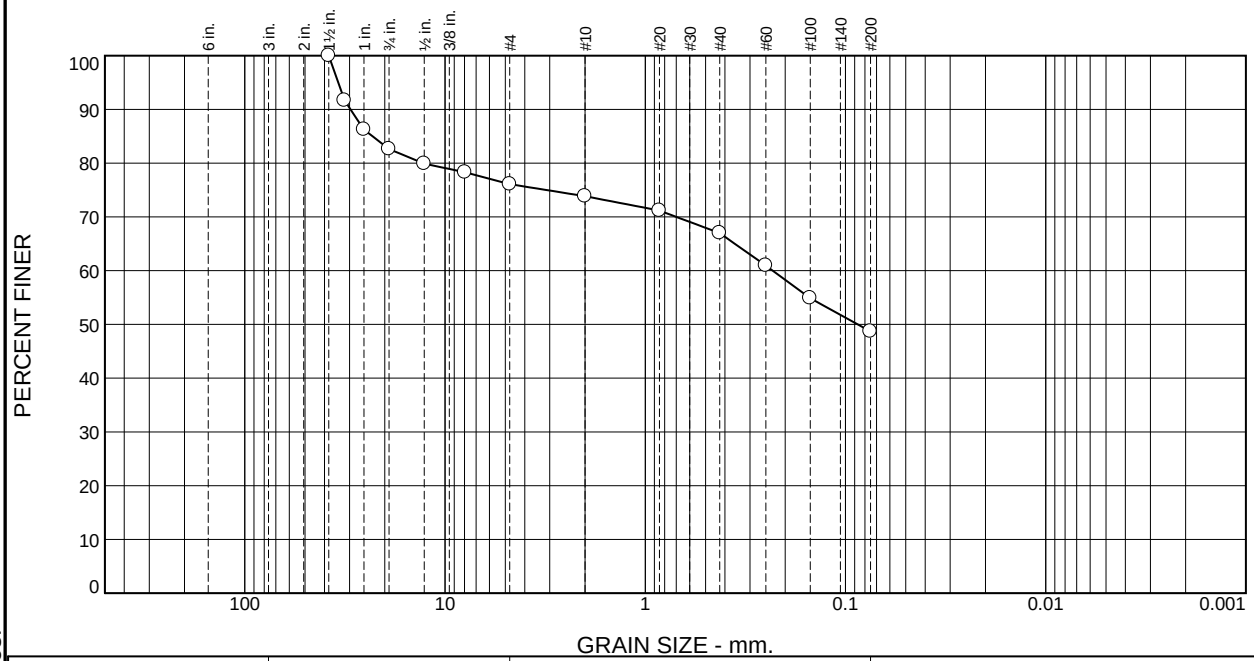
Hole Completion
- [ ] Monitoring Well
- [ ] Piezometer
- [x] Abanonded and backfilled
- [ ] Inclinometer
- [ ] _____
- [ ] _____

Appendix A.4

Appendix B

Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	17.4	6.5	2.2	6.9	18.3	48.7	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1.25	91.7		
1	86.2		
.75	82.6		
.5	79.9		
.3125	78.3		
#4	76.1		
#10	73.9		
#20	71.2		
#40	67.0		
#60	60.9		
#100	54.9		
#200	48.7		

* (no specification provided)

Material Description

Silty sand with gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=** NV

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 29.6434 D_{85}= 23.0175 D_{60}= 0.2310
D_{50}= 0.0867 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 6/7/18 **Date Tested:** 9/7/18
Tested By: JZ
Checked By: KSS
Title: PM

Location: TP-1
Sample Number: 095452 **Depth:** 2.5'
Date Sampled: 9/6/18

GeoResources, LLC

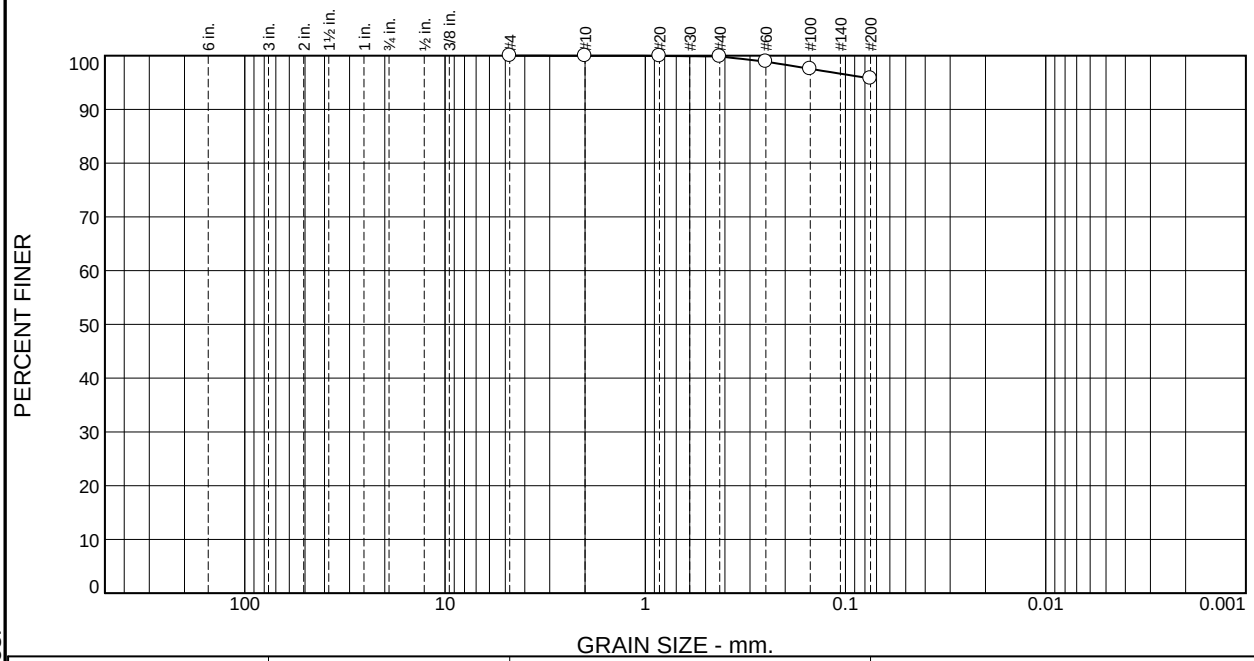
Fife, WA

Client: Schwabe, Williamson, & Wyatt
Project: SWW.JohnsonRdNW
Project No: **Figure**

Tested By: _____ **Checked By:** _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	4.0	95.8	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	98.9		
#100	97.5		
#200	95.8		

* (no specification provided)

Material Description

Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=** NV

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 9/7/18 **Date Tested:** 9/7/18

Tested By: JZ

Checked By: KSS

Title: PM

Location: TP-2
Sample Number: 095453 **Depth:** 7'

Date Sampled: 9/6/18

GeoResources, LLC

Fife, WA

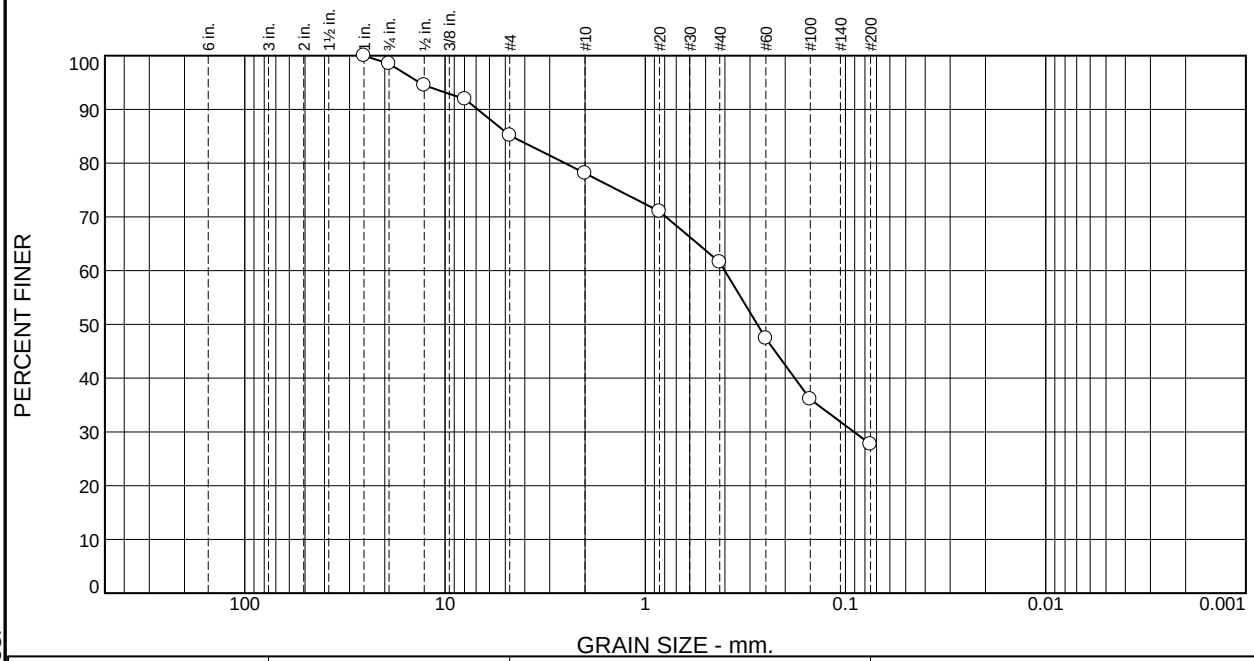
Client: Schwabe, Williamson, & Wyatt
Project: SWW.JohnsonRdNW

Project No: **Figure**

Tested By: _____ **Checked By:** _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	1.5	13.4	7.0	16.5	33.9	27.7	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
.75	98.5		
.5	94.5		
.3125	91.9		
#4	85.1		
#10	78.1		
#20	71.0		
#40	61.6		
#60	47.4		
#100	36.1		
#200	27.7		

* (no specification provided)

Material Description

Silty sand

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NV

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 6.8707 D_{85}= 4.6635 D_{60}= 0.4008
D_{50}= 0.2756 D_{30}= 0.0906 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 9/7/18 **Date Tested:** 9/7/18
Tested By: JZ
Checked By: KSS
Title: PM

Location: TP-8
Sample Number: 095454 **Depth:** 2'
Date Sampled: 9/6/18

GeoResources, LLC

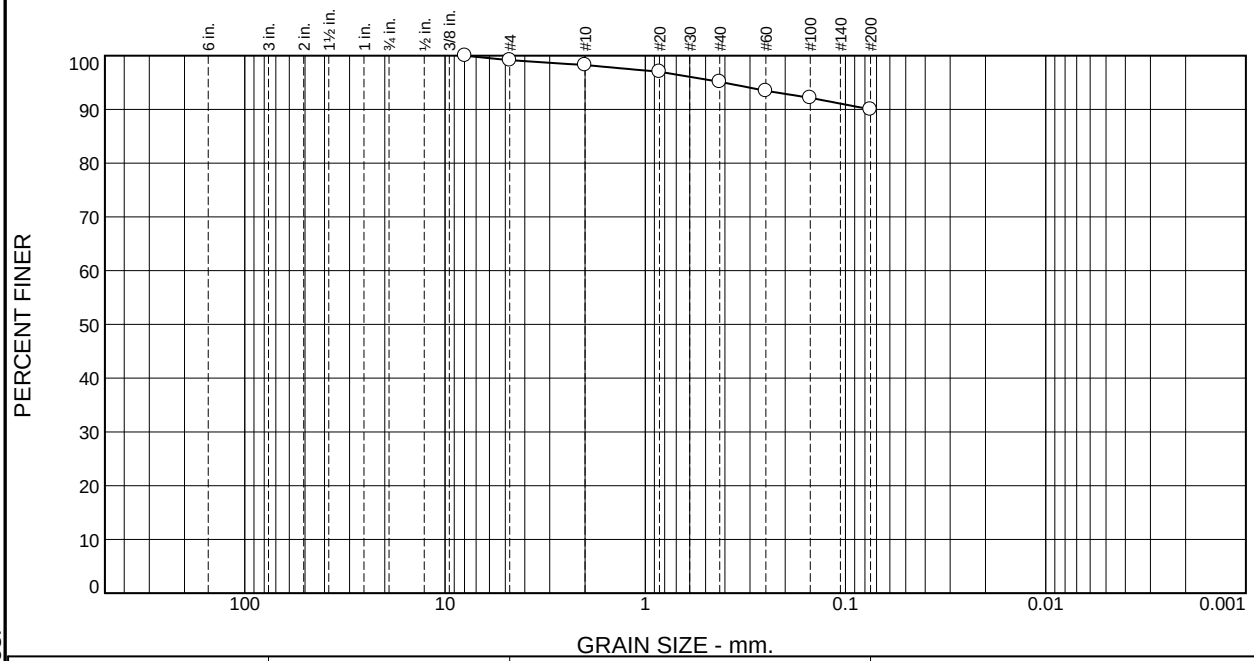
Fife, WA

Client: Schwabe, Williamson, & Wyatt
Project: SWW.JohnsonRdNW
Project No: **Figure**

Tested By: _____ **Checked By:** _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	0.9	3.2	5.1	90.0	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.3125	100.0		
#4	99.2		
#10	98.3		
#20	97.0		
#40	95.1		
#60	93.5		
#100	92.2		
#200	90.0		

* (no specification provided)

Material Description

Silt

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=** NV

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 9/7/18 **Date Tested:** 9/7/18

Tested By: JZ

Checked By: KSS

Title: PM

Location: TP-12
Sample Number: 095455 **Depth:** 4'

Date Sampled: 9/6/18

GeoResources, LLC

Fife, WA

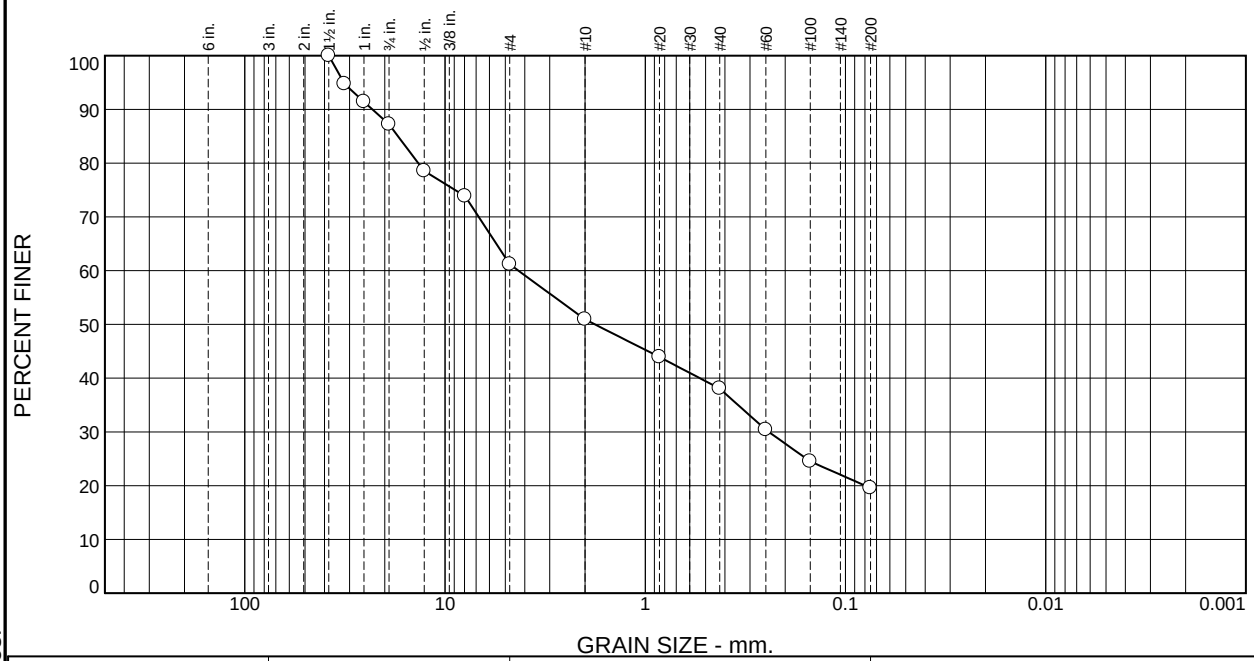
Client: Schwabe, Williamson, & Wyatt
Project: SWW.JohnsonRdNW

Project No: **Figure**

Tested By: _____ **Checked By:** _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.8	26.0	10.3	12.8	18.5	19.6	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1.25	94.7		
1	91.4		
.75	87.2		
.5	78.5		
.3125	73.9		
#4	61.2		
#10	50.9		
#20	43.9		
#40	38.1		
#60	30.4		
#100	24.5		
#200	19.6		

* (no specification provided)

Material Description

Silty sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 23.0596 D_{85}= 17.1716 D_{60}= 4.3016
D_{50}= 1.7831 D_{30}= 0.2416 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 9/7/18 **Date Tested:** 9/7/18
Tested By: JZ
Checked By: KSS
Title: PM

Location: TP-13
Sample Number: 095456 **Depth:** 5.5'
Date Sampled: 9/6/18

GeoResources, LLC

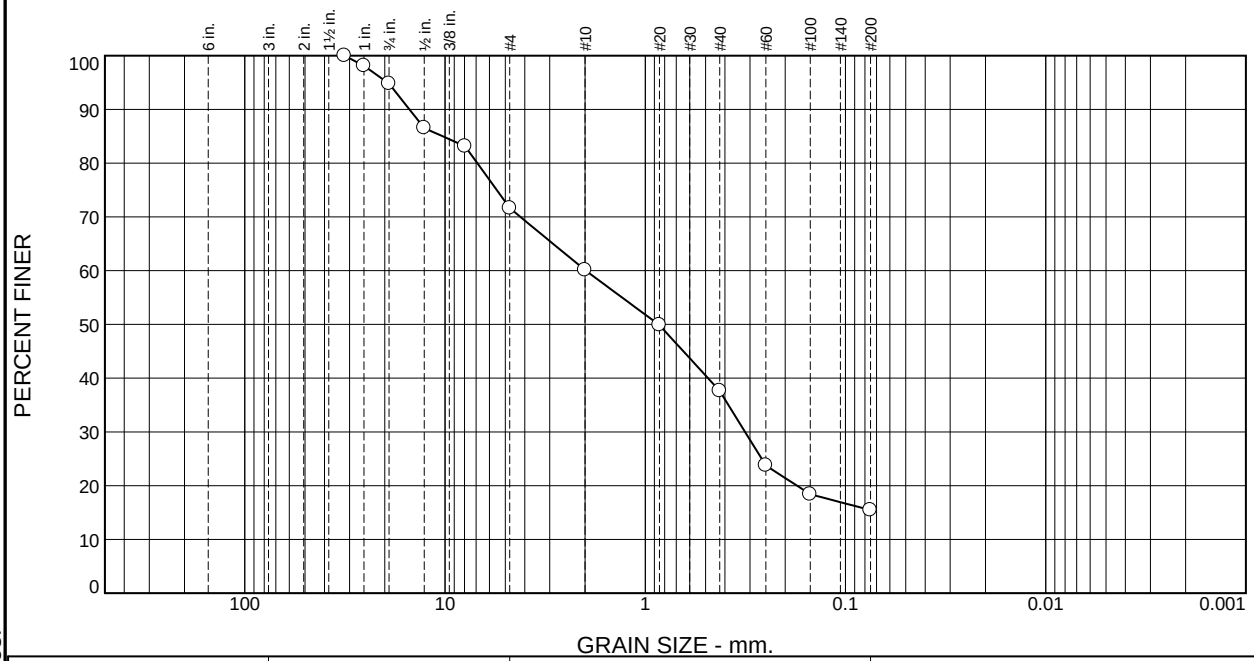
Fife, WA

Client: Schwabe, Williamson, & Wyatt
Project: SWW.JohnsonRdNW
Project No: **Figure**

Tested By: _____ **Checked By:** _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.2	23.2	11.5	22.5	22.1	15.5	

Test Results (ASTM D 422 & ASTM D 1140)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.25	100.0		
1	98.1		
.75	94.8		
.5	86.5		
.3125	83.1		
#4	71.6		
#10	60.1		
#20	49.9		
#40	37.6		
#60	23.8		
#100	18.4		
#200	15.5		

* (no specification provided)

Material Description

Silty sand with gravel

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NV

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 15.0544 D_{85}= 10.2711 D_{60}= 1.9814
D_{50}= 0.8588 D_{30}= 0.3174 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 9/7/18 **Date Tested:** 9/7/18
Tested By: JZ
Checked By: KSS
Title: PM

Location: TP-15
Sample Number: 095457 **Depth:** 6.5'
Date Sampled: 9/6/18

GeoResources, LLC

Fife, WA

Client: Schwabe, Williamson, & Wyatt
Project: SWW.JohnsonRdNW
Project No: **Figure**

Tested By: _____ **Checked By:** _____

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical samples.

Subsurface Explorations by Others

(N.L. Olson, 2007)

Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

January 6, 2006

KA No. 096-05293
Lab Report No. 5

WES JOHNSON
N.L. OLSON & ASSOCIATES, INC.
2453 Bethel Avenue
Port Orchard, Washington 98364

RE: Soil Laboratory Testing
2005 Control Samples
19501 144th Avenue Northeast
Woodinville, Washington

Dear Mr. Johnson,

In accordance with your request and authorization, we have performed laboratory tests for the above referenced project.

Laboratory testing was performed in general accordance with ASTM standards. The results of the laboratory tests are presented on the following pages. If you have any questions or if we can be of further assistance, please do not hesitate to contact our office.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Corbett Mercer
Project Manager
Pacific Northwest Division

CM/ga

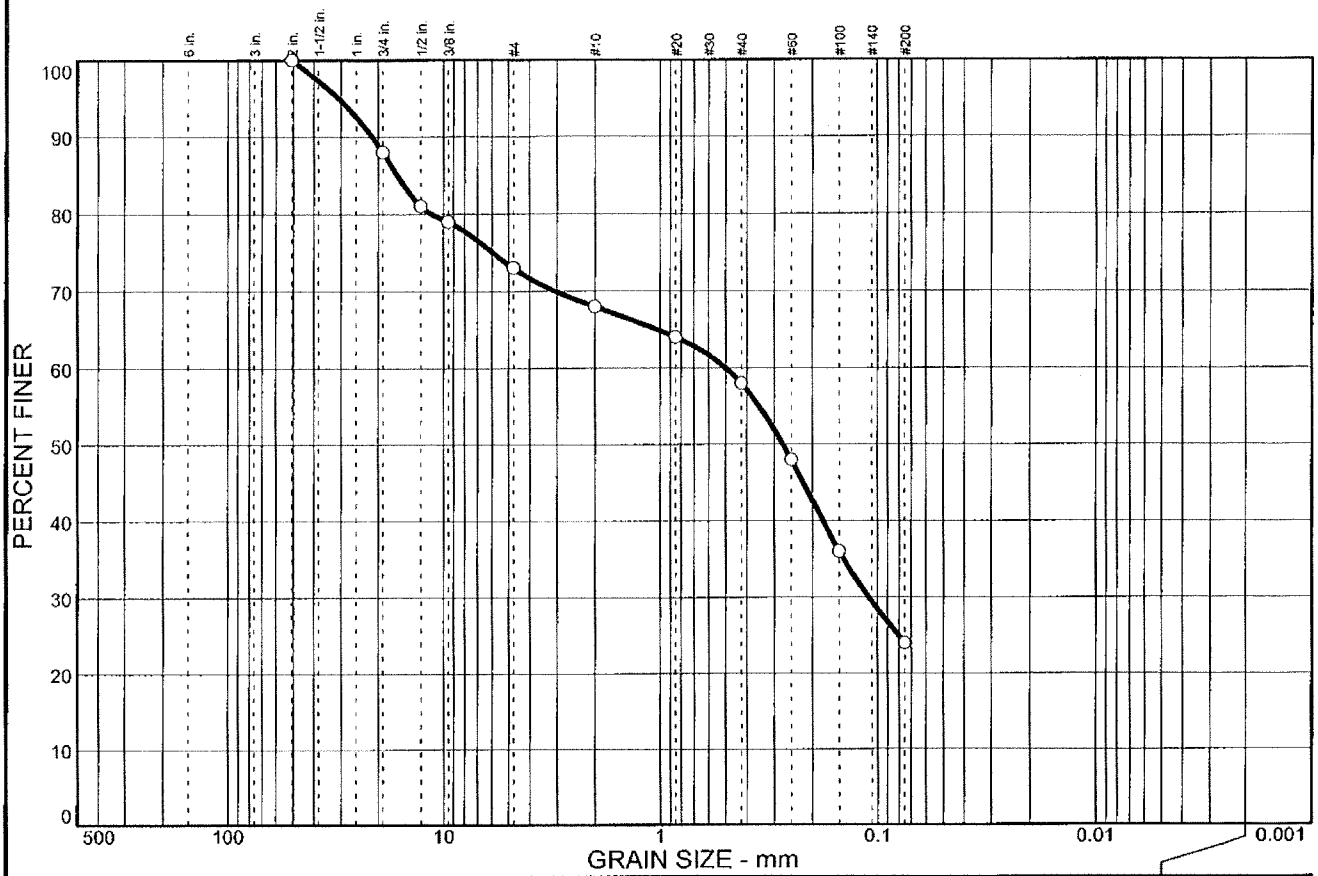
19501 – 144th Avenue NE #F-300 • Woodinville, Washington 98072 • (425) 485-5519 • FAX (425) 485-6837
With Offices Serving the Western United States

Moisture Content

Project No:	09605293	Client:	N.L. Olson and Associcates
Project:	Johnson Road NE	Date:	12/23/05

Sample ID	Bore Hole	Sample No	Depth	Wet & Tare	Dry &Tare	Tare	Results
21499-1	TP-1	S-1	1'	406.4	364.7	108.9	16.3%
21499-2	TP-1	S-2	3'	543.8	454.6	115.3	26.3%
21499-3	TP-1	S-3	5'	578.7	519.8	98.2	14.0%
21499-4	TP-1	S-4	8'	436.5	362.1	107.9	29.3%
21499-5	TP-1	S-5	10'	332.2	283.2	93.9	25.9%
21499-6	TP-2	S-6	2.5'	250.2	215.1	110.1	33.4%
21499-7	TP-2	S-7	4'	282.0	253.3	141.7	25.7%
21499-8	TP-3	S-8	2.5'	527.5	454.9	98.3	20.4%
21499-9	TP-3	S-9	4'	490.6	416.5	97.2	23.2%
21499-10	TP-3	S-10	12'	478.1	397.3	92.3	26.5%
21499-11	TP-4	S-11	2'	482.5	407.7	97.2	24.1%
21499-12	TP-4	S-12	2.5'-4'	662.3	578.1	94.8	17.4%
21499-13	TP-4	S-13	4'	574.4	466.8	97.8	29.2%
21499-14	TP-4	S-14	11'-13'	600.2	487.7	92.4	28.5%
21499-15	TP-5	S-15	1'	483.2	430.5	111.8	16.5%
21499-16	TP-5	S-16	30"	551.1	470.8	112.9	22.4%
21499-17	TP-5	S-17	4'	524.8	440.7	109.6	25.4%
21499-18	TP-5	S-18	14'	576.9	486.3	95.0	23.2%
21499-19	TP-6	S-19	1'-3'	623.8	533.9	97.4	20.6%
21499-20	TP-6	S-20	4'	749.5	625.0	113.5	24.3%
21499-21	TP-6	S-21	13.5'	551.7	454.3	112.1	28.5%
21499-22	TP-7	S-22	2'	514.6	468.2	110.9	13.0%
21499-23	TP-7	S-23	4'	664.2	553.1	99.3	24.5%
21499-24	TP-7	S-24	7'	1304.5	1209.8	177.3	9.2%
21499-25	TP-8	S-25	6"-16"	518.5	469.6	108.4	13.5%
21499-26	TP-8	S-26	2'	330.1	305.4	98.6	11.9%
21499-27	TP-8	S-27	6'	690.3	630.3	109.3	11.5%
21499-28	TP-8	S-28	8.5'	734.6	606.3	113.2	26.0%
21499-29	TP-9	S-29	0'-32"	453.1	406.8	98.8	15.0%
21499-30	TP-9	S-30	4'	851.2	767.8	111.1	12.7%
21499-31	TP-9	S-31	5'	586.5	492.0	97.8	24.0%
21499-32	TP-10	S-32	3.5'	437.7	347.5	94.5	35.7%
21499-33	TP-10	S-33	4'-5'	520.5	470.9	98.2	13.3%
21499-34	TP-10	S-34	5'	562.5	487.8	97.5	19.1%
21499-35	TP-10	S-35	7'	643.4	572.5	97.7	14.9%
21499-36	TP-10	S-36	8'-9'	895.6	863.0	97.1	4.3%
21499-37	TP-10	S-37	11'	652.5	539.6	94.5	25.4%
21499-38	TP-11	S-38	1'	581.3	516.0	94.1	15.5%
21499-39	TP-11	S-39	43"	297.4	260.3	141.5	31.2%
21499-40	TP-11	S-40	6'	629.3	528.9	111.5	24.1%
21499-41	TP-11	S-41	8'	526.0	442.1	85.3	23.5%
21499-42	TP-11	S-42	10'	444.1	377.7	84.3	22.6%
21499-43	TP-11	S-43	11'-12'	569.3	477.3	84.7	23.4%
21499-44	TP-11	S-44	3.5'	SAMPLE	NOT	RECEIVED	W/ BAGS
21499-45	TP-12	S-45	1'	414.3	356.0	83.8	21.4%
21499-46	TP-12	S-46	2.5'	465.7	422.7	84.5	12.7%
21499-47	TP-12	S-47	44"	463.7	404.0	84.6	18.7%
21499-48	TP-12	S-48	5'	782.7	698.8	203.7	16.9%
21499-49	TP-12	S-49	8'	720.2	612.9	179.2	24.7%
21499-50	TP-13	S-50	24"-40"	919.7	770.6	155.0	24.2%
21499-51	TP-13	S-51	5'	738.8	652.8	165.4	17.6%
21499-52	TP-13	S-52	8'	876.3	703.0	151.7	31.4%
21499-53	TP-13	S-53	10'	652.1	554.0	176.0	26.0%

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0	12	15	5	10	34	24	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100		
.75 in.	88		
.5 in.	81		
.375 in.	79		
#4	73		
#10	68		
#20	64		
#40	58		
#60	48		
#100	36		
#200	24		

* (no specification provided)

Soil Description

Light Brown Silty sand with gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 16.3 D_{60}= 0.500 D_{50}= 0.273
D_{30}= 0.110 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

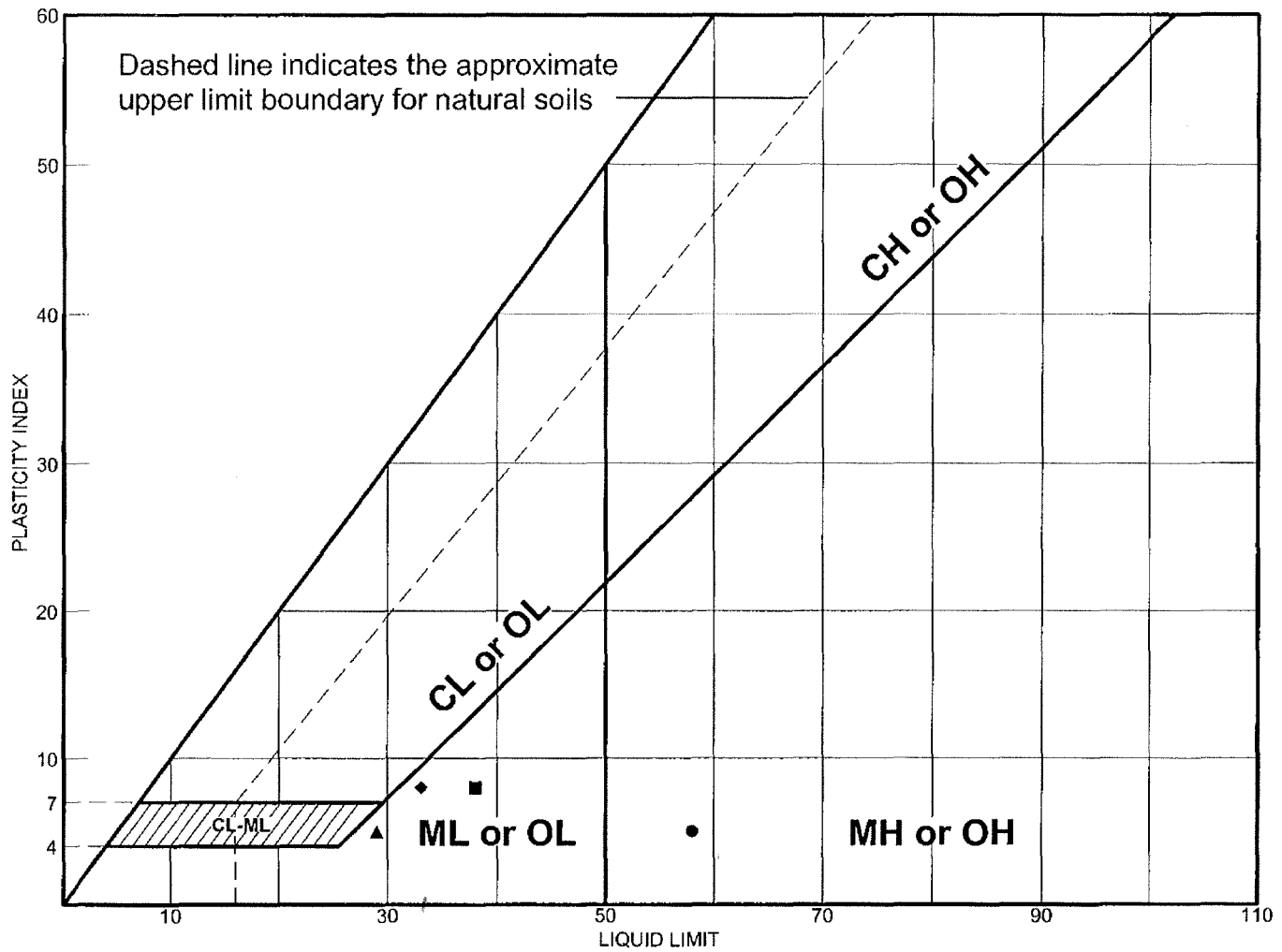
Sample ID: 21499
TP-7/S-24 @ 7'

Sample No.: 21499 **Source of Sample:** Johnson Road NE **Date:** 12-23-05
Location: Test Pit 7, Sample No. 24 **Elev./Depth:** 7'

KRAZAN & ASSOCIATES, INC.

Client: N.L. Olsen & Associates, Inc.
Project: 2005 Control Samples
Project No: 09605293

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light gray silt with clay	58	53	5	100		
■	Light brown silt	38	30	8	100		
▲	Light brown silt with clay	29	24	5	100		
◆	Light brown silt	33	25	8	100		

Project No. 09605293 **Client:** N.L. Olsen & Associates, Inc.

Project: Johnson Road NE-(6164G)

● **Location:** Test Pit 1, Sample No. 5
■ **Location:** Test Pit 2, Sample No. 6
▲ **Location:** Test Pit 2, Sample No. 7
◆ **Location:** Test Pit 11, Sample No. 39

Remarks:
● Sample ID: 21499-A TP-1/S-5 @ 10'
■ Sample ID: 21499-B TP-2/S-6 @ 2.5'
▲ Sample ID: 21499-C TP-2/S-7 @ 4'
◆ Sample ID: 21499-D TP-11/S-39 @ 43"

LIQUID AND PLASTIC LIMITS TEST REPORT

KRAZAN & ASSOCIATES, INC.

Appendix C

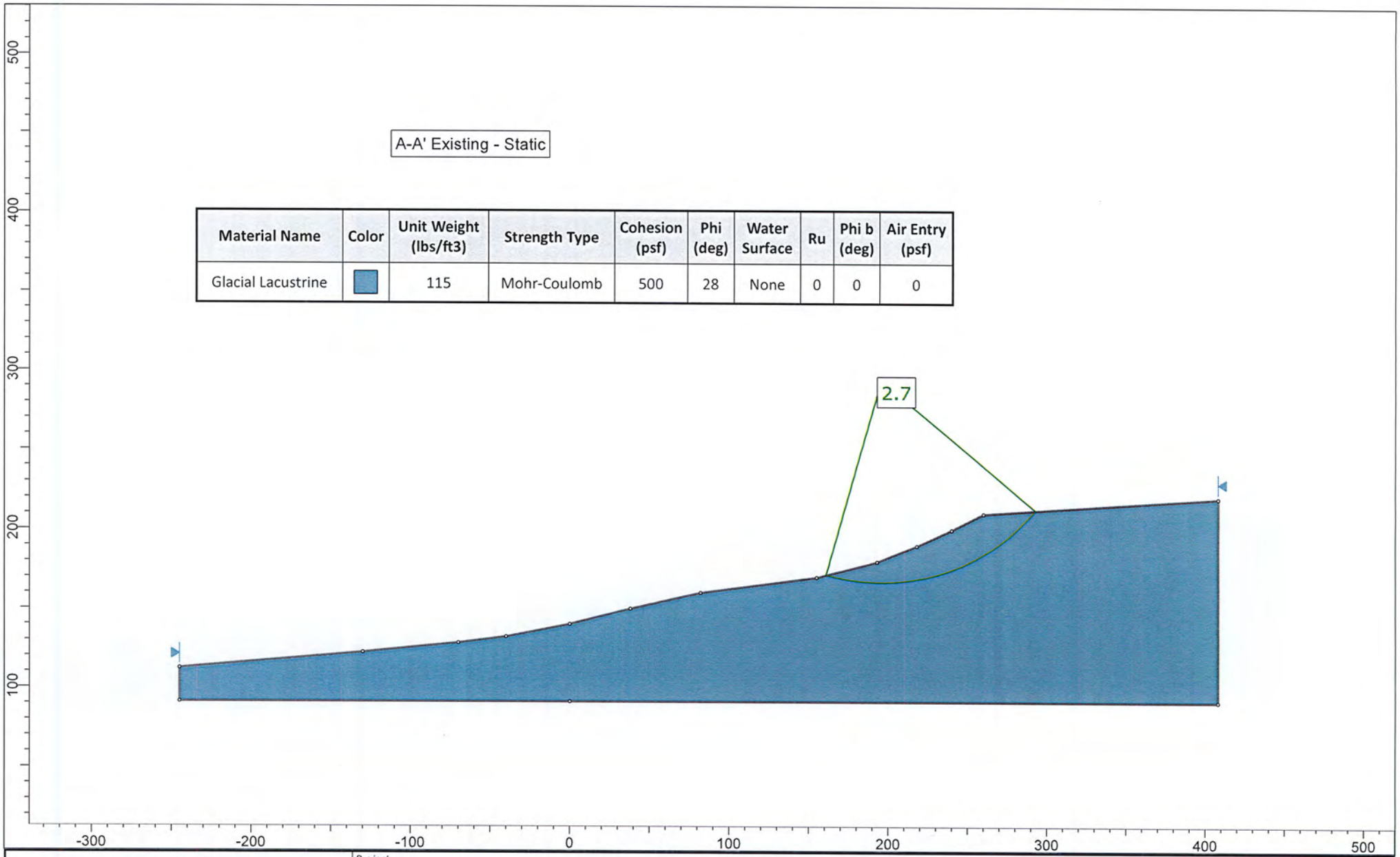
Slope Stability Results

Appendix C

Slope Stability Results

A-A' Existing - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0



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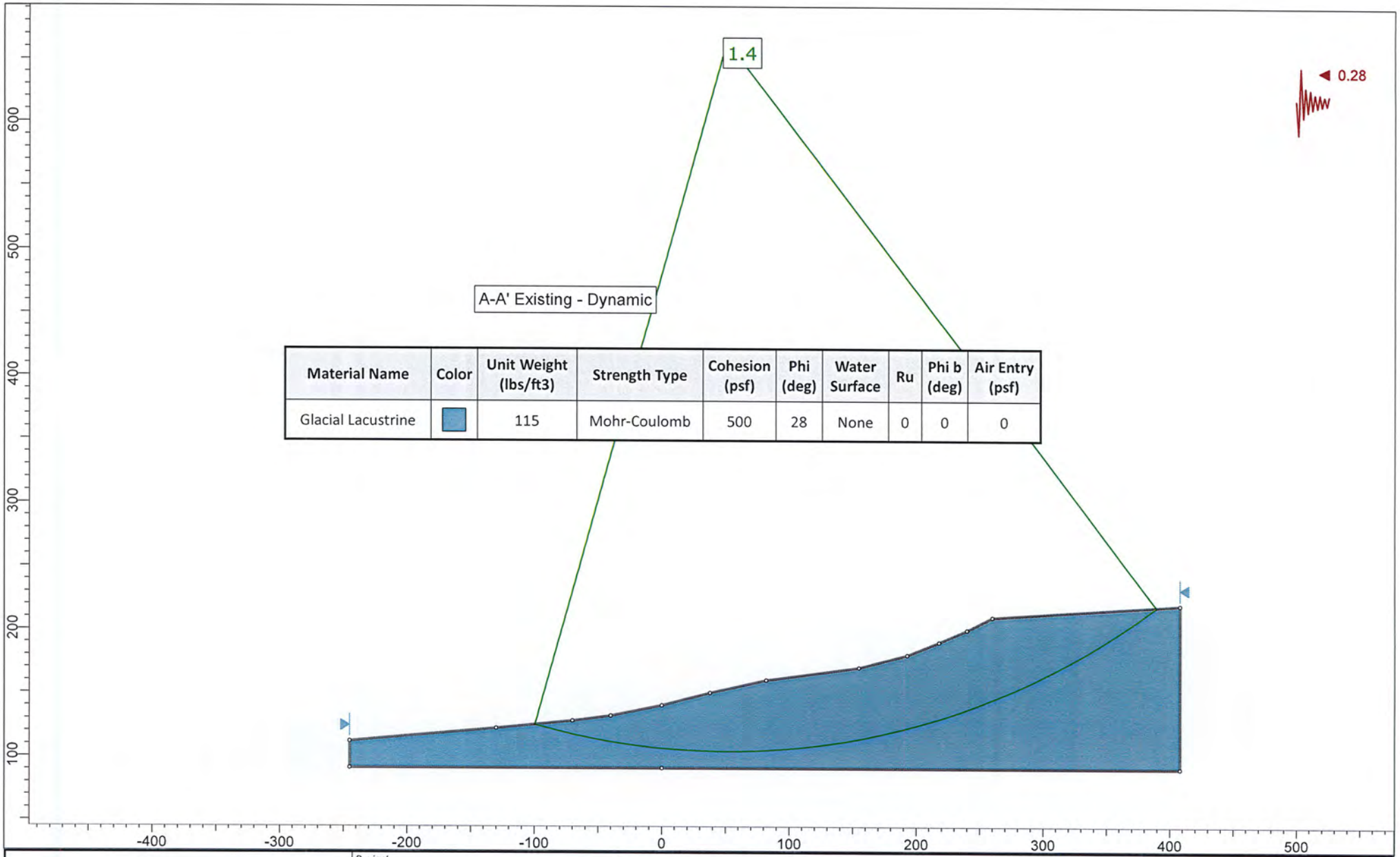
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale 1:1000	Company GeoResources, LLC
Date	9/18/2018, 3:30:26 PM		File Name Schwabe.JohnsonRd.Slide.rev01.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0

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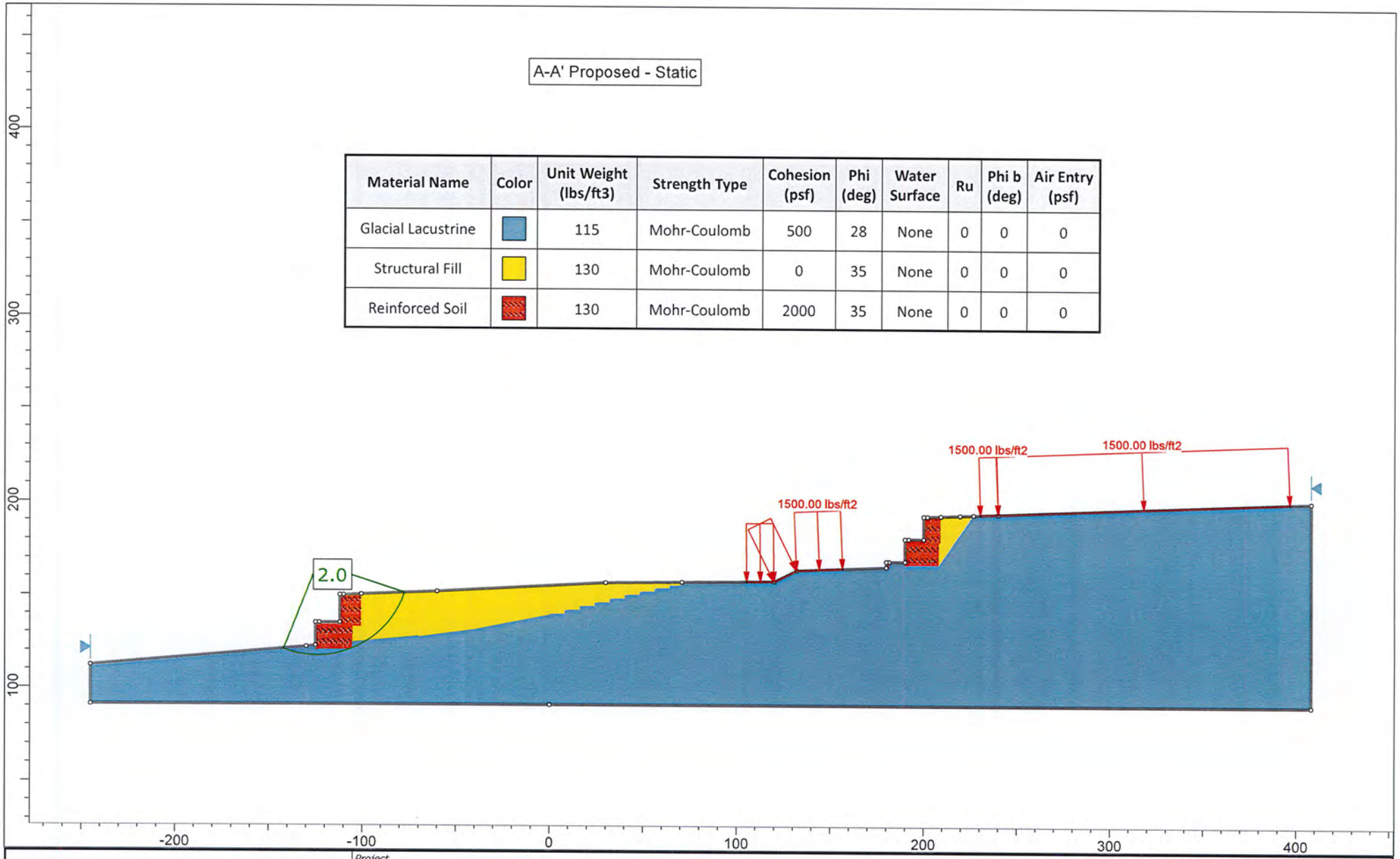
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale 1:1250	Company GeoResources, LLC
Date	9/18/2018, 3:30:26 PM		File Name Schwabe.JohnsonRd.Slide.rev01.slmd

A-A' Proposed - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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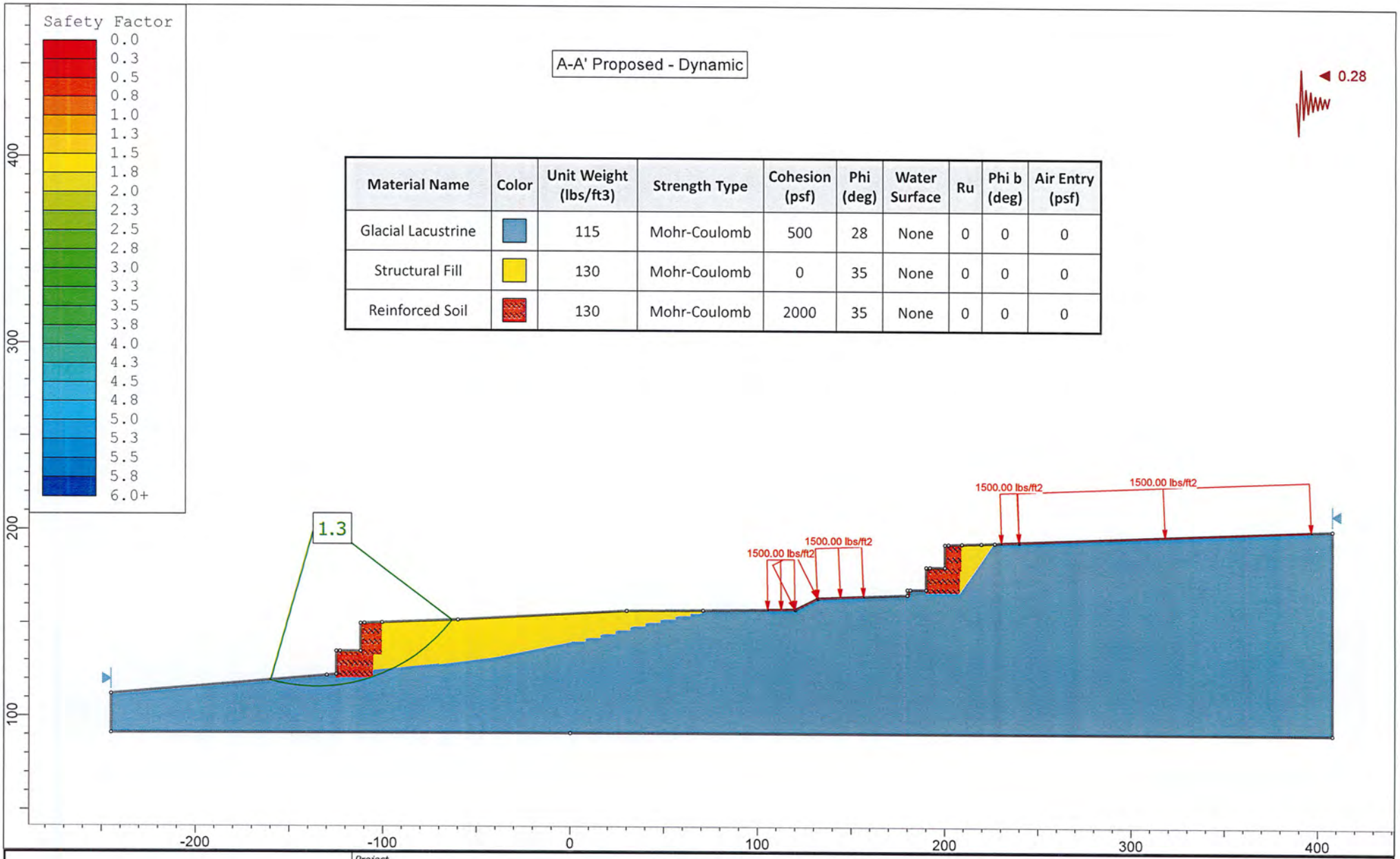
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale 1:850	Company GeoResources, LLC
Date	9/18/2018, 3:30:26 PM		File Name Schwabe.JohnsonRd.Slide.rev01.slmd

A-A' Proposed - Dynamic



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0

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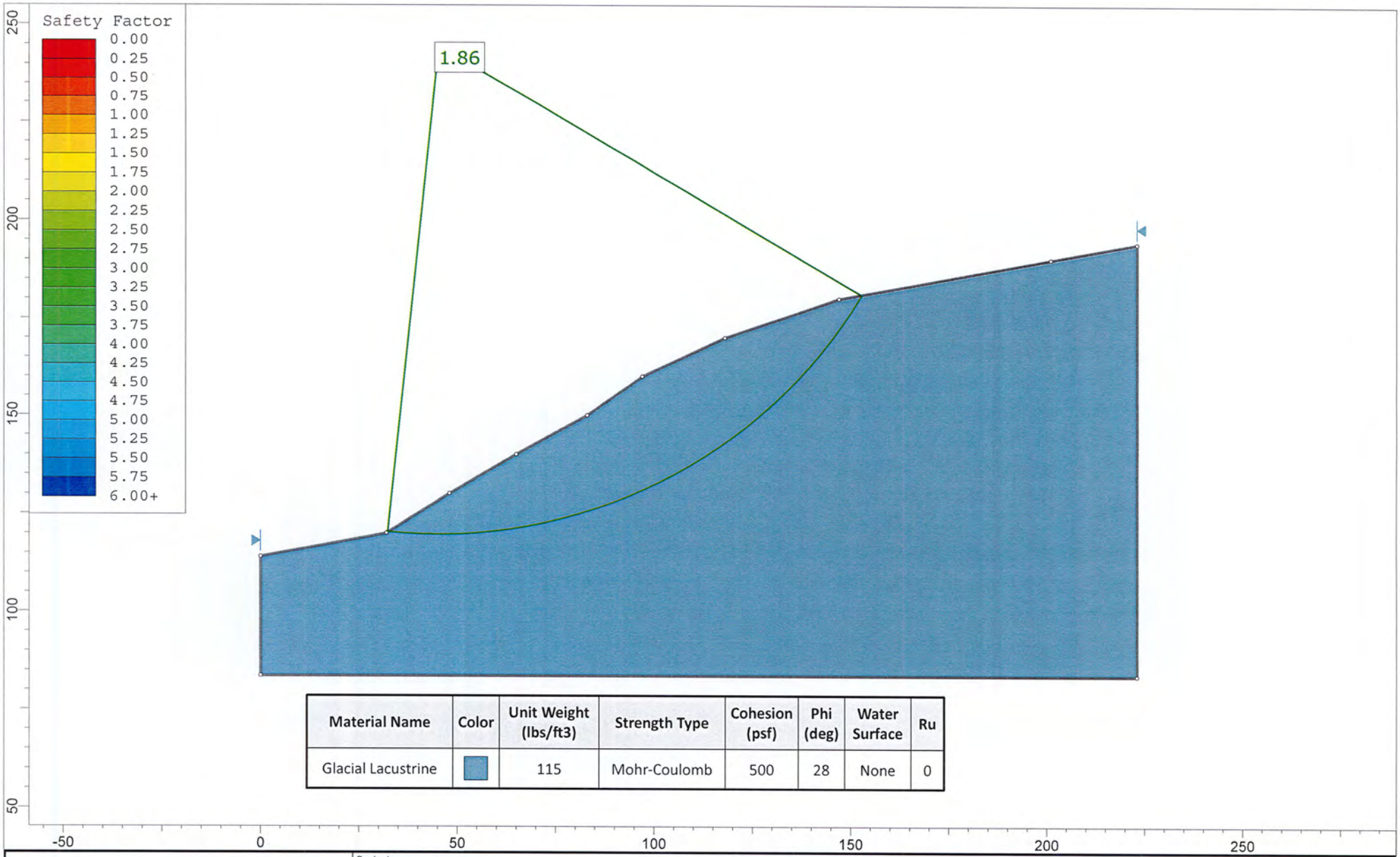
SLIDEINTERPRET 8.029

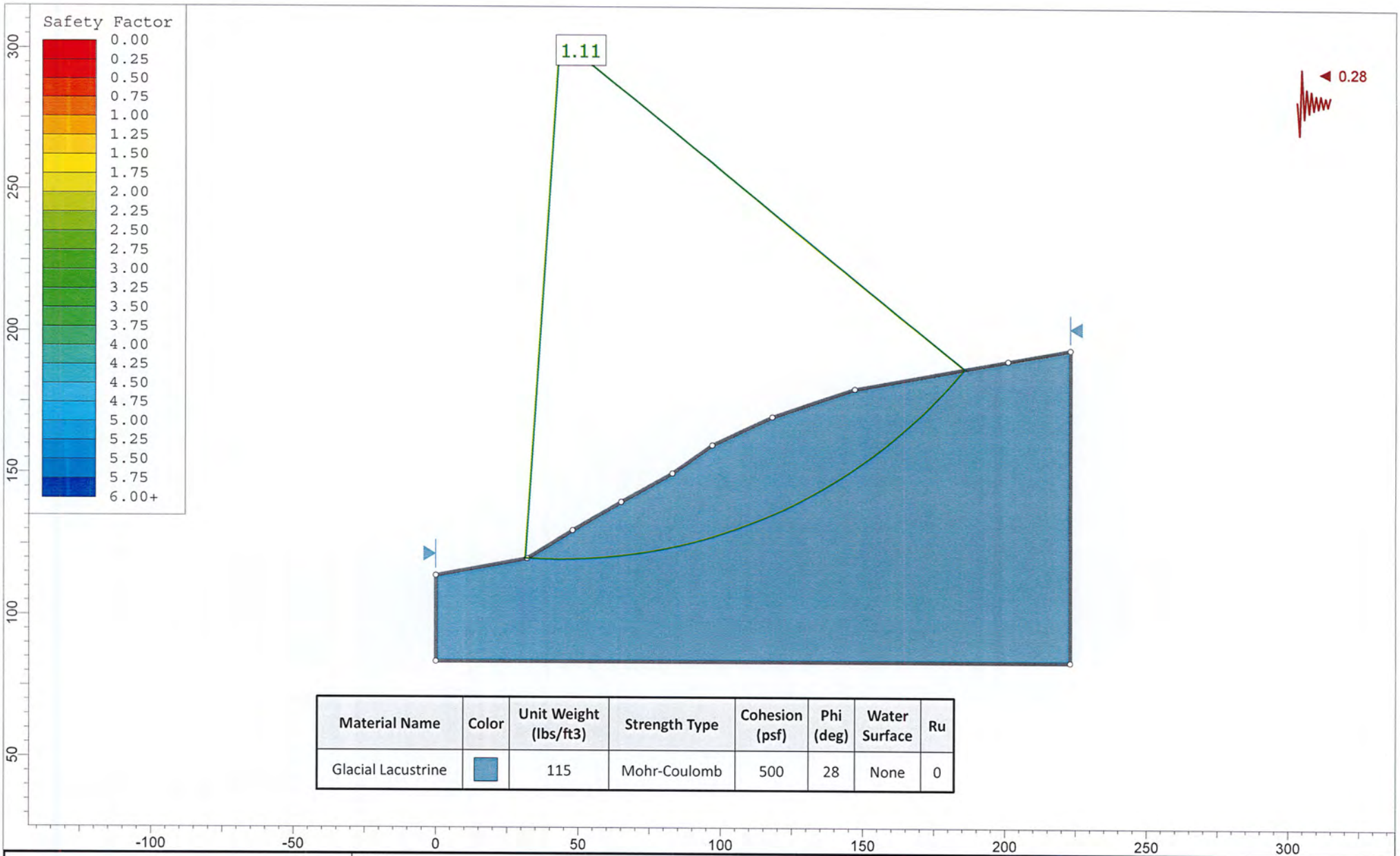
Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:850
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Section B-B': Ravine, Static		
Drawn By: VRM	Scale: 1:405	Company: GeoResources, LLC	
Date: 9/18/2018, 3:30:26 PM		File Name: Schwabe.JohnsonRd.Slide.slmd	

SLIDEINTERPRET 7.018



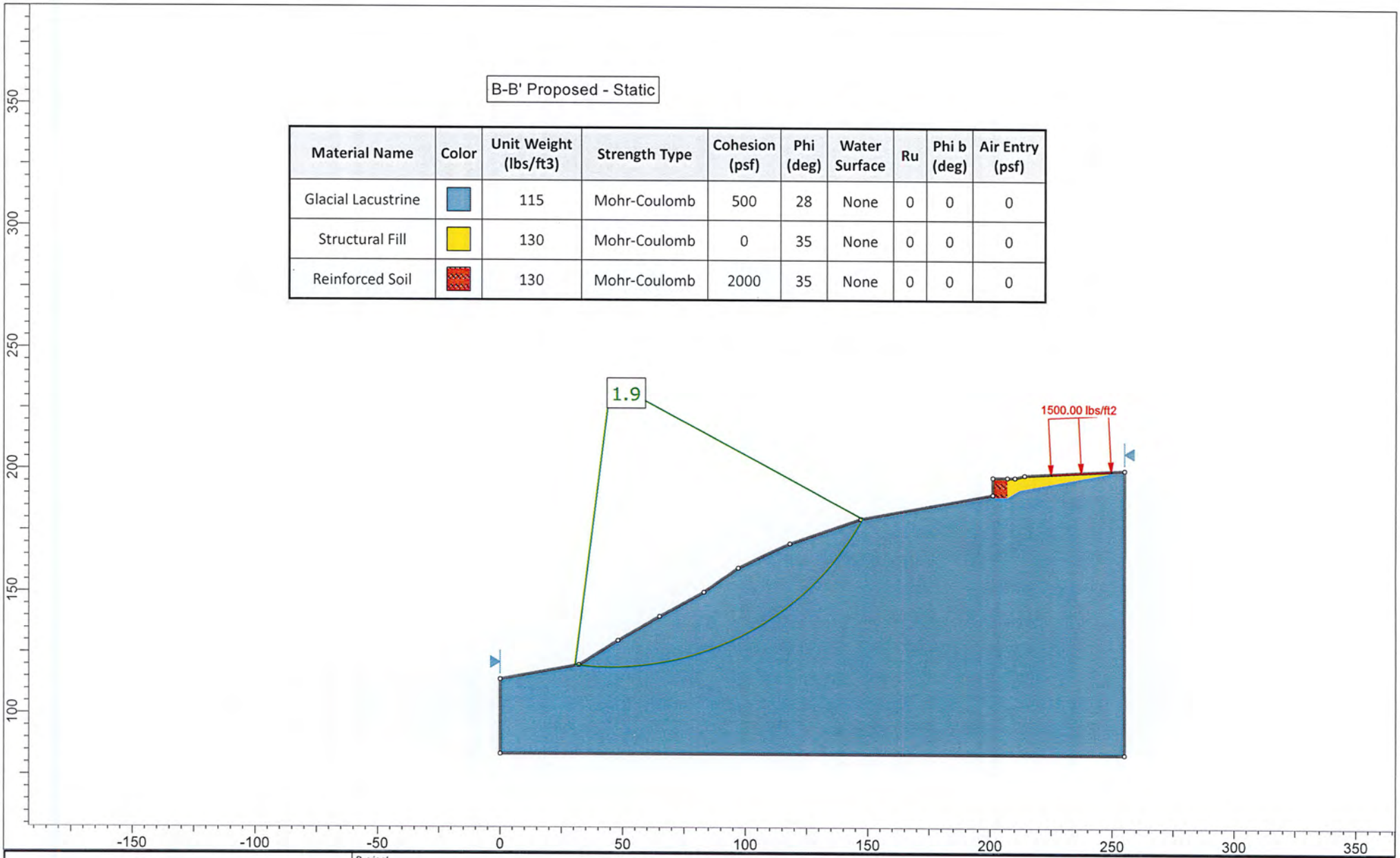
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description	Section B-B': Ravine, Seismic		
Drawn By: VRM	Scale: 1:560	Company: GeoResources, LLC	
Date: 9/18/2018, 3:30:26 PM		File Name: Schwabe.JohnsonRd.Slide.slmd	

SLIDEINTERPRET 7.018

B-B' Proposed - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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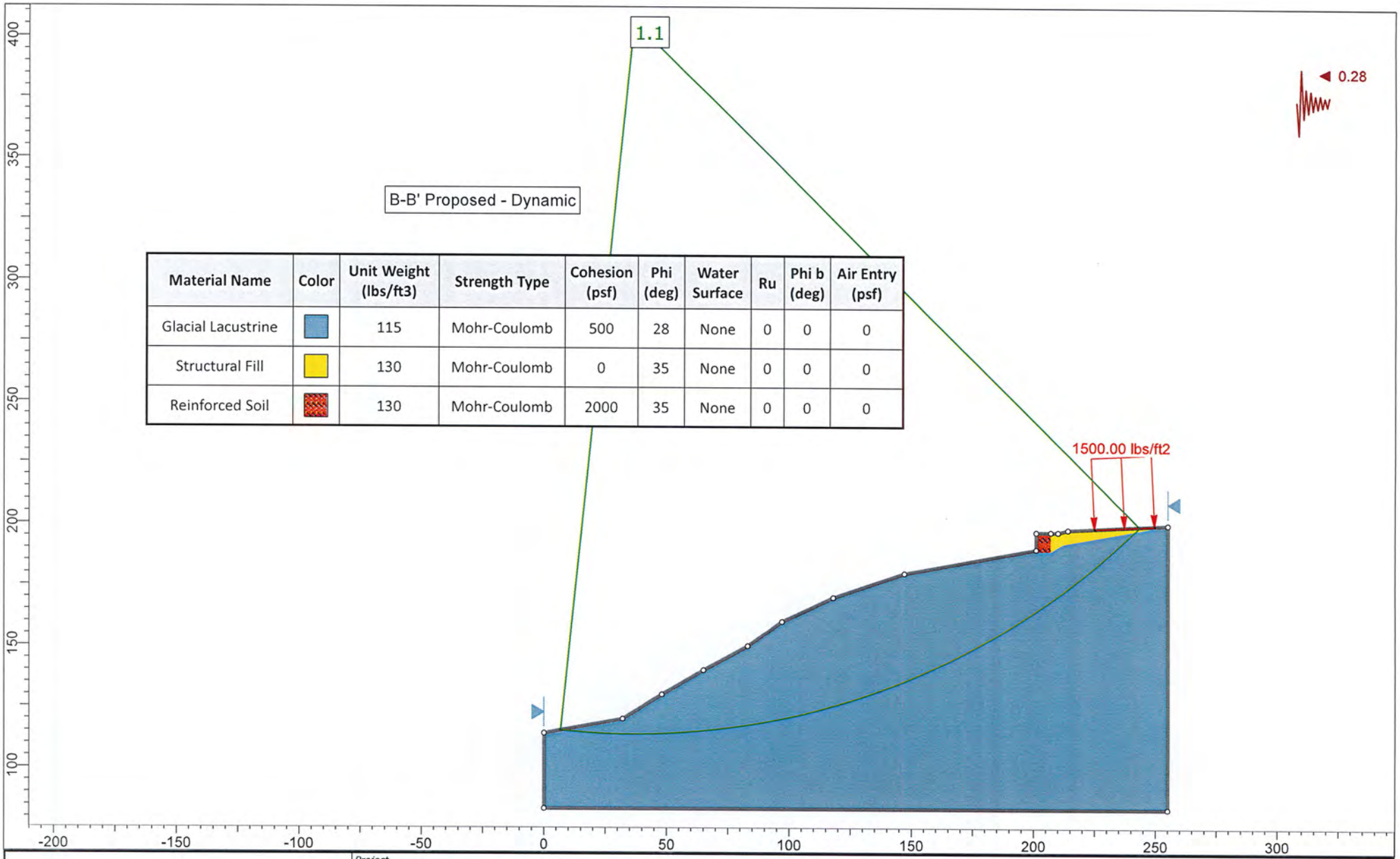
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale 1:650	Company GeoResources, LLC
Date	9/18/2018, 3:30:26 PM		File Name Schwabe.JohnsonRd.Slide.rev01.slmd

B-B' Proposed - Dynamic

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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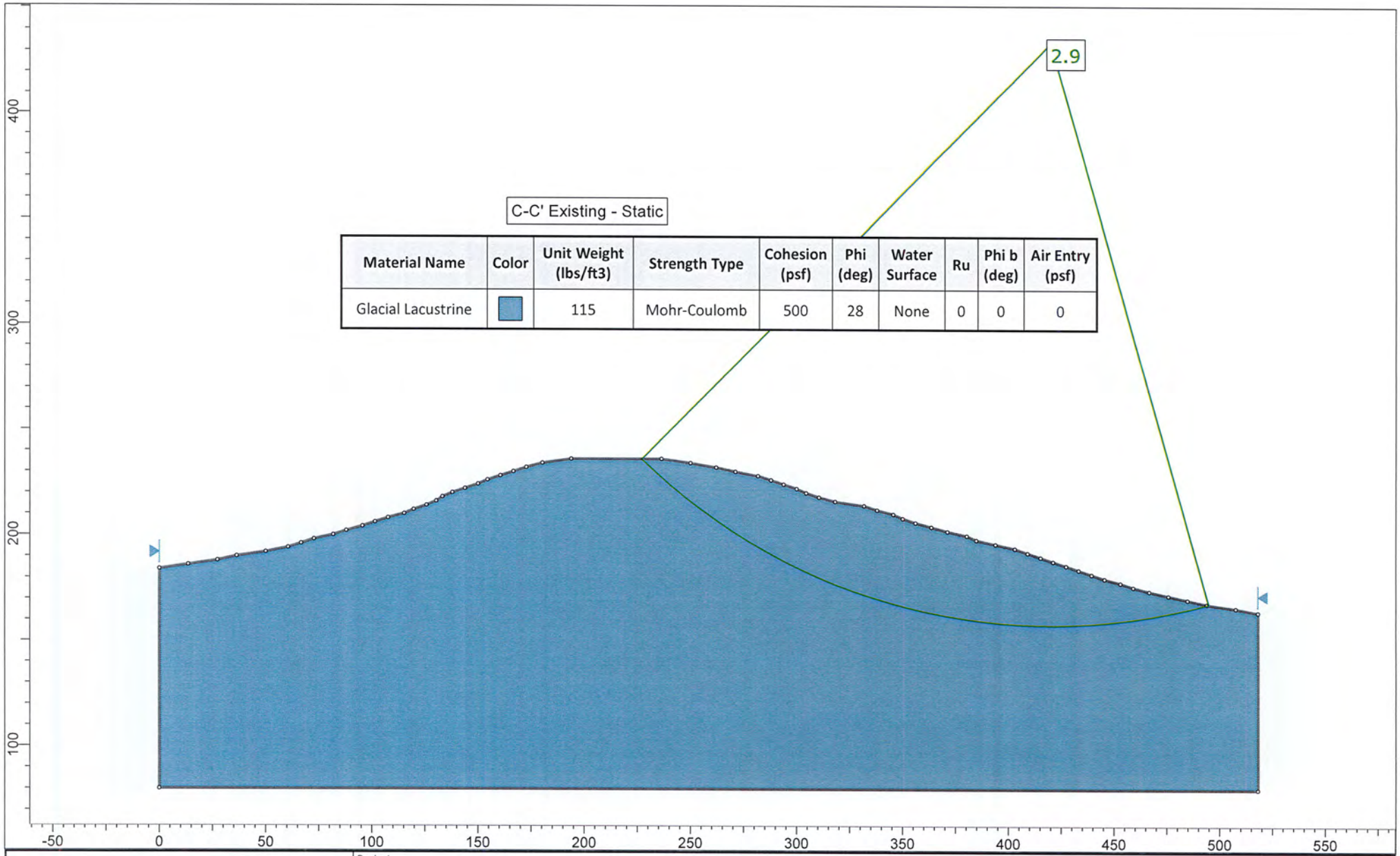
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:650
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd



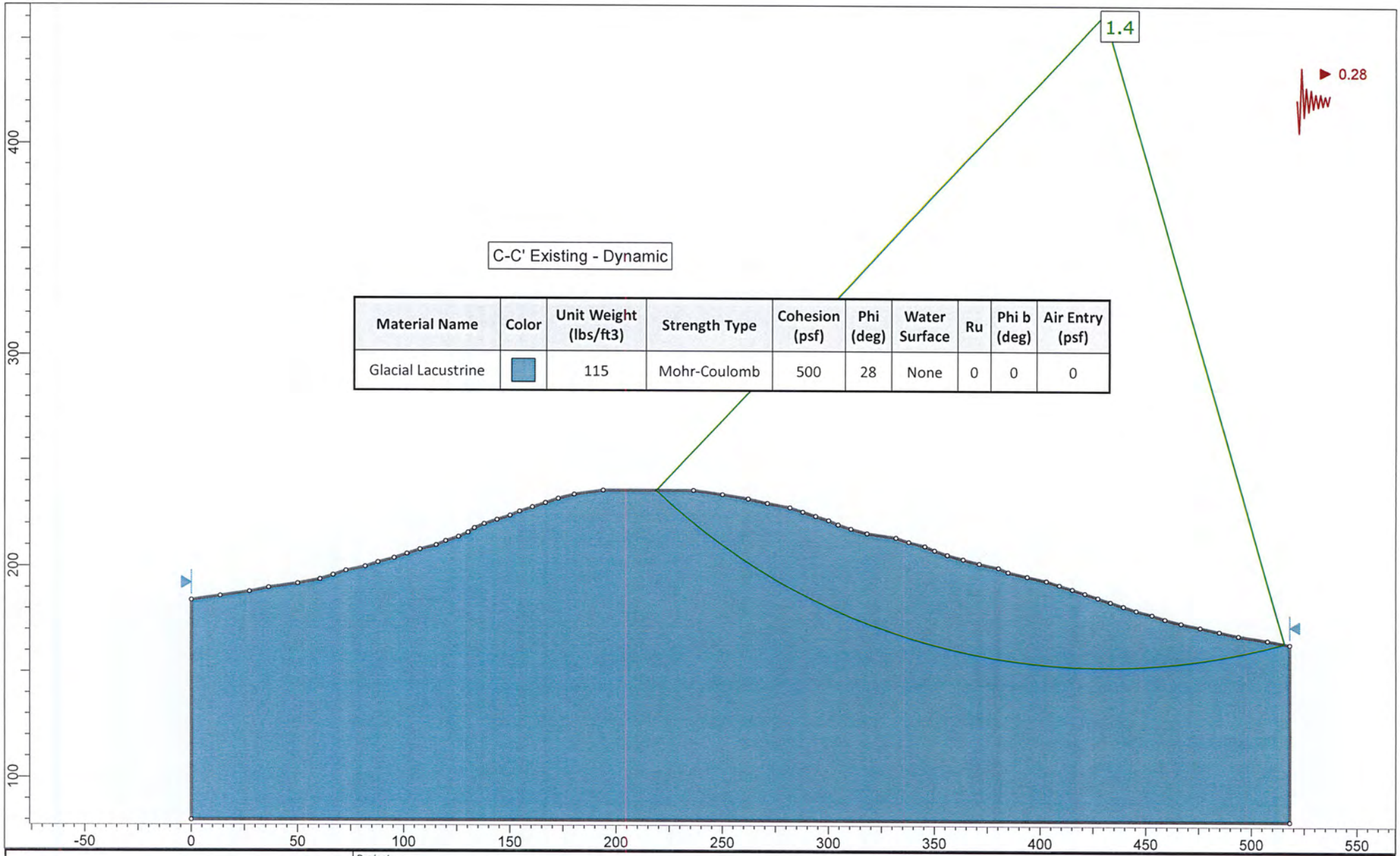
C-C' Existing - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0

rocscience

SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:750
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0

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Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:750
Company	GeoResources, LLC		
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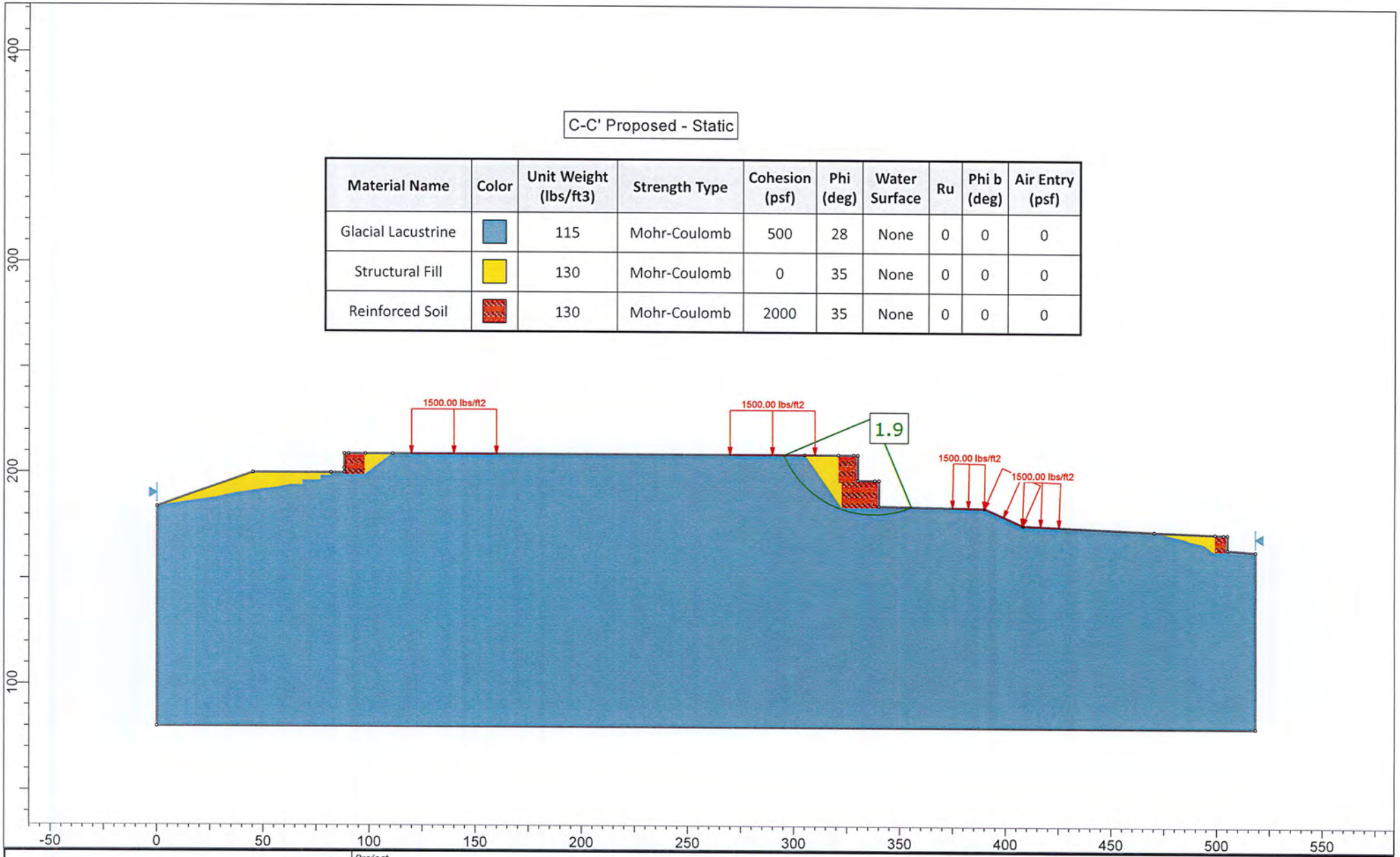
C-C' Proposed - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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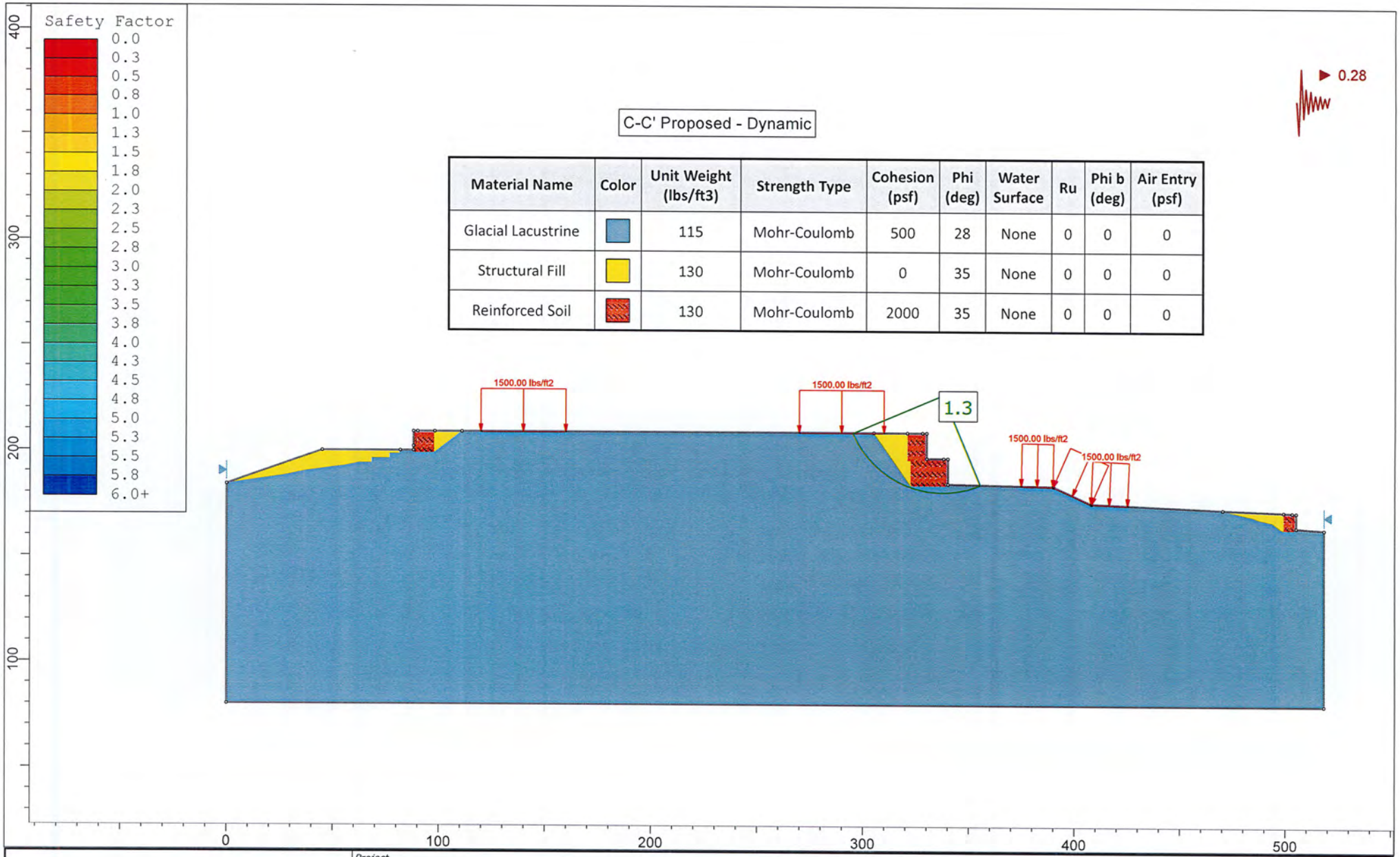
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:750
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd

C-C' Proposed - Dynamic

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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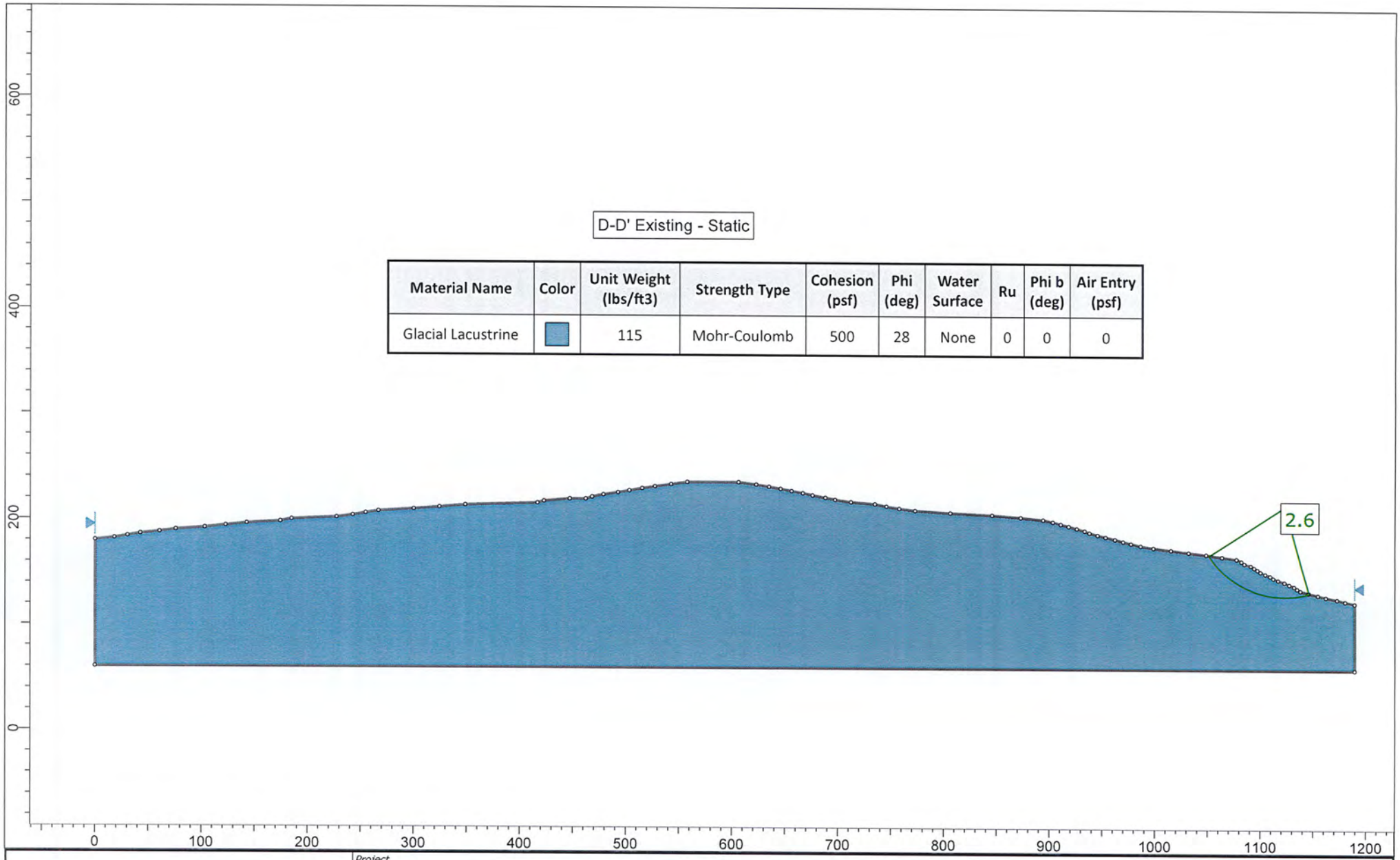
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:750
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd

D-D' Existing - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0



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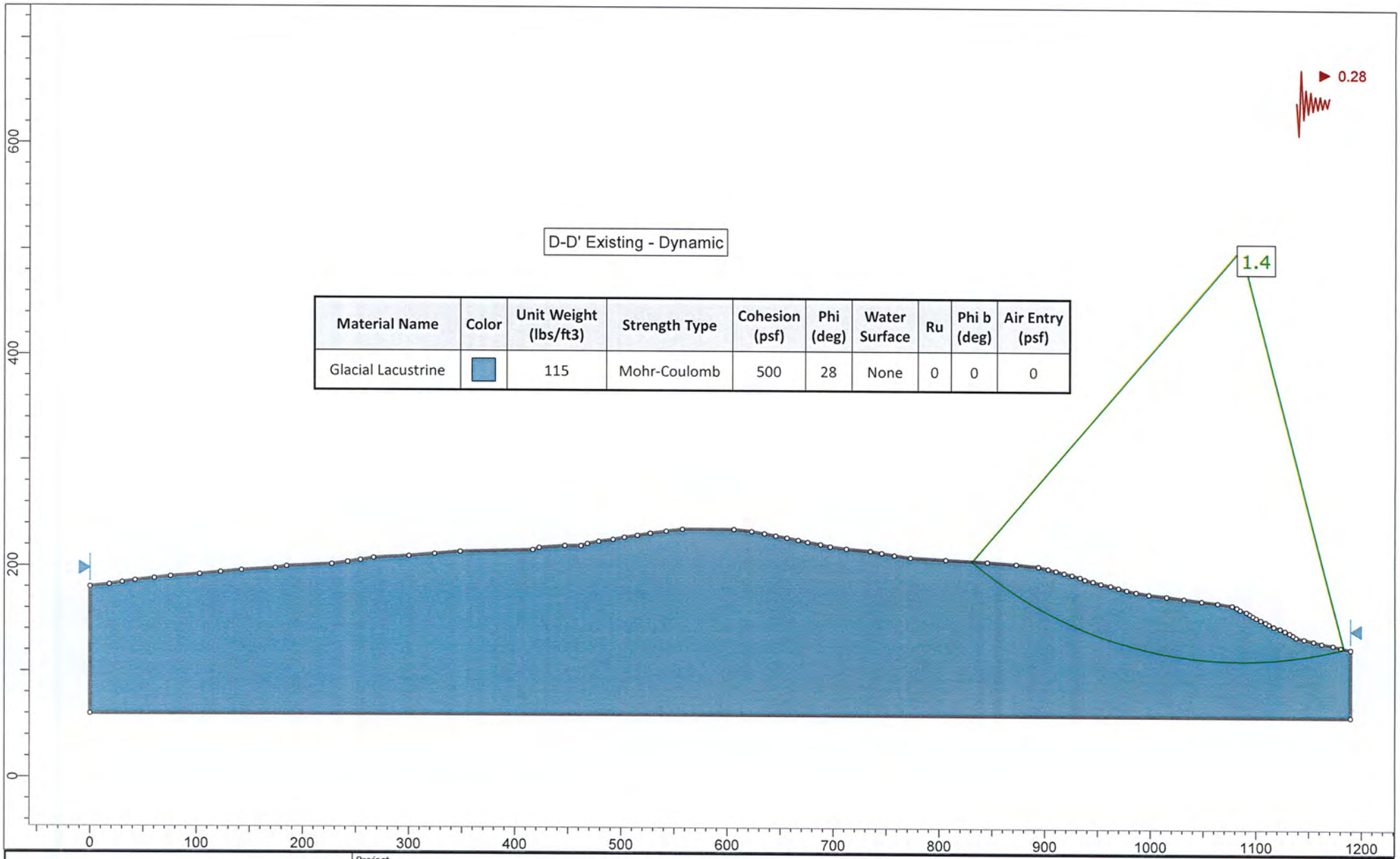
Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale 1:1500	Company GeoResources, LLC
Date	9/18/2018, 3:30:26 PM		File Name Schwabe.JohnsonRd.Slide.rev01.slmd

D-D' Existing - Dynamic

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0



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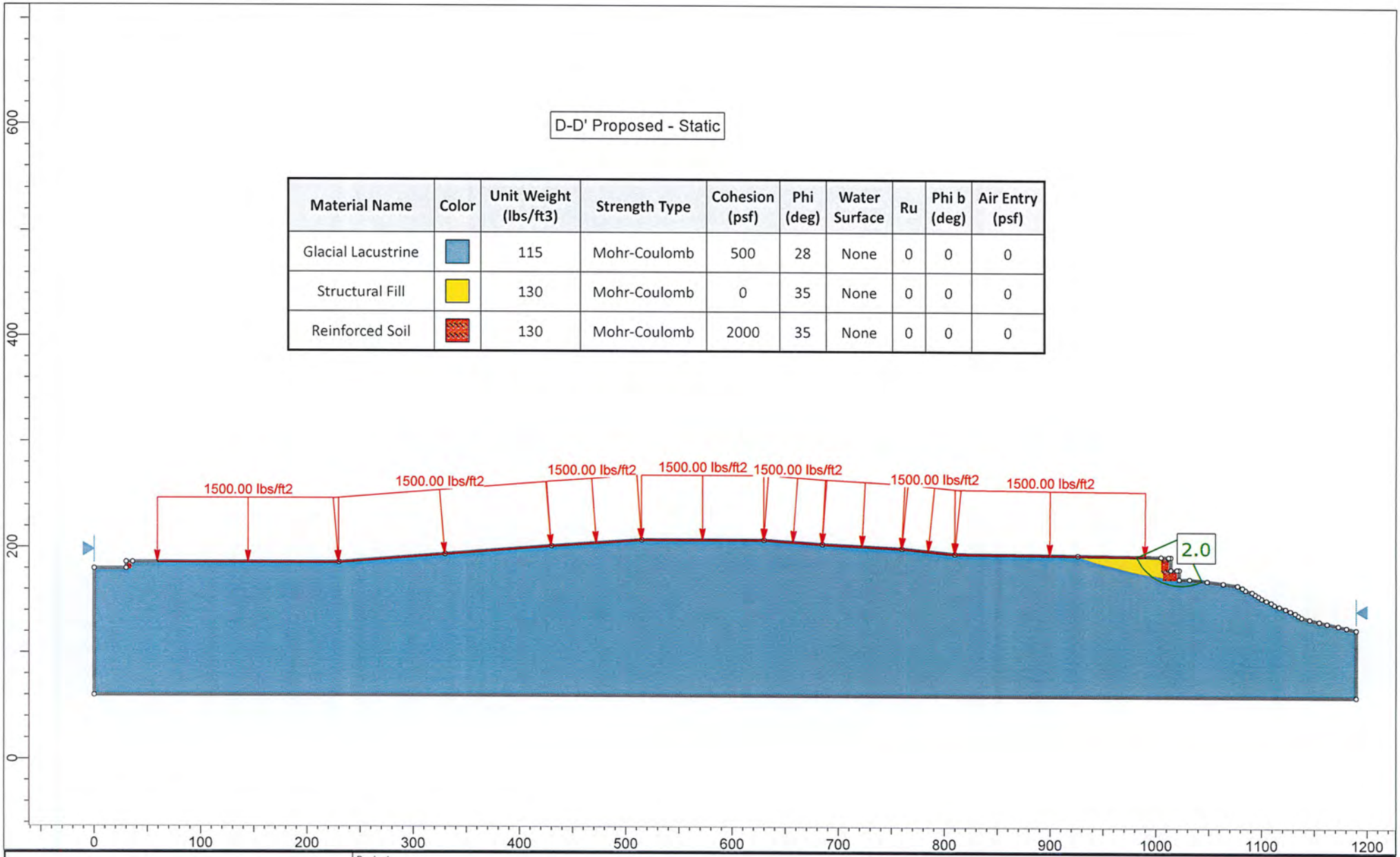
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:1500
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd

D-D' Proposed - Static

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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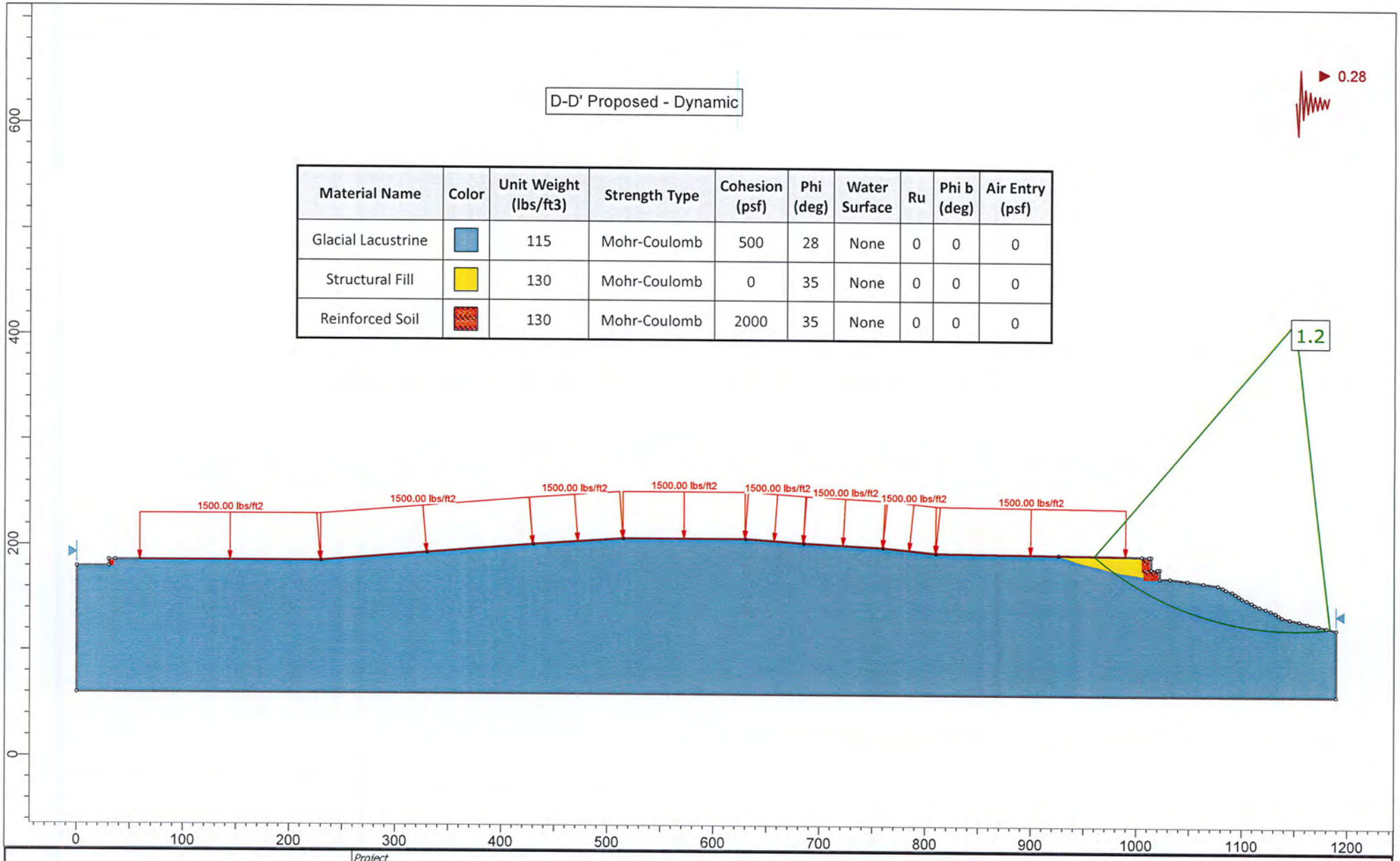
SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program
Analysis Description	
Drawn By	CC
Scale	1:1500
Company	GeoResources, LLC
Date	9/18/2018, 3:30:26 PM
File Name	Schwabe.JohnsonRd.Slide.rev01.slmd

D-D' Proposed - Dynamic

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru	Phi b (deg)	Air Entry (psf)
Glacial Lacustrine		115	Mohr-Coulomb	500	28	None	0	0	0
Structural Fill		130	Mohr-Coulomb	0	35	None	0	0	0
Reinforced Soil		130	Mohr-Coulomb	2000	35	None	0	0	0



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SLIDEINTERPRET 8.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	CC	Scale	1:1500
Company	GeoResources, LLC		
Date	9/18/2018, 3:30:26 PM	File Name	Schwabe.JohnsonRd.Slide.rev01.slmd