CRITICAL AREAS EVALUATION AND GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

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PREPARED FOR:

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RGI PROJECT NO. 2015-046

BERGSMA PROPERTY
SOUTHEAST NEWPORT WAY AND 17TH AVENUE NORTHWEST
ISSAQUAH, WASHINGTON 98027

DECEMBER 7, 2017

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December 7, 2017

Mr. Jim Tosti
Windward Real Estate Services, Inc.
335 Park Place Center, Suite G119
Kirkland, Washington 98033

Subject: **Critical Areas Evaluation and Geotechnical Engineering Report**
Bergsma Property
Southeast Newport Way and 17th Avenue Northwest
Issaquah, Washington 98072
RGI Project No. 2015-046

Dear Mr. Tosti:

As requested, The Riley Group, Inc. (RGI) has prepared this Critical Areas Evaluation and Geotechnical Engineering Report (GER) for the above-referenced site. Critical Areas Evaluation and Preliminary Geotechnical Engineering Report was submitted on April 1, 2015 based on the review a geotechnical study completed by Geotechnical Investigation Group on November 8, 2007.

Per the City of Issaquah's requests, additional exploration was performed from December 2015 to May 2016. *Geotechnical Report Addendum - Additional Exploration and Recommendations* was submitted on January 28, 2016 and *Phase III Geotechnical Exploration and Recommendations* was submitted on June 17, 2016. This report summarizes all the explorations and recommendations and will supersede all previous documents.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

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Executive Summary

This Executive Summary should be used in conjunction with the entire GER for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and this GER must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included a total of 4 test borings to a maximum depth of 60 feet below ground surface (bgs) and 19 test pits to a maximum depth of 14 feet bgs. RGI also reviewed the geotechnical report prepared by Geotechnical Testing Laboratory, Inc. dated December 12, 2007. Based on our subsurface exploration and analysis performed, the site is suitable for development of the proposed project. The following geotechnical considerations were identified.

Soil Conditions: The site is underlain by loose to medium dense deposits of silty sand with varying amounts of gravel, sand with varying amounts of silt and gravel, and sandy gravel with varying amounts of silt, and soft to medium stiff deposits of sandy silt, clayey silt, and silt to depths of 15 to 20 feet. Below 15 to 20 feet, the deposits become very dense silty sand with varying amounts of gravel and silty sandy gravel, and hard clay.

Boring B-201 encountered medium dense to dense silty sand, sand, and sandy gravel with interbedded sandy silt to a depth of 50 feet bgs. Boring B-202 encountered 20 feet of medium dense to dense silty sand and sand, and soft to very stiff sandy silt and silt over very stiff to hard silt and clay to a depth of 60 feet bgs. Test pits TP-201 to TP-209 encountered loose to dense silty sand, sand, and gravel with varying amounts of silt. Test pits TP-210, TP-218, TP-219 encountered 1 to 4 feet of silty sand over 10 feet of medium stiff to hard silt. Test pits TP-211 to TP-217 encountered up to 14 feet of medium dense silty sand with some gravel.

Groundwater: Light to moderate groundwater seepage was encountered from 2.5 feet to 13 feet bgs in four of the test pits (TP-101, TP-103, TP-104, and TP-105) and from 7 feet to 15 feet bgs in two of the test borings (B-201 and B-202) during our subsurface exploration. The groundwater appears to be perched over impermeable soil layers.

Geological Hazard Areas: The site contains steep slopes and potential landslide hazard areas. Based on the findings and analysis, the proposed development can be performed as proposed from a geotechnical point of view. Because of the nature of the native soil and proposed earthwork, there is a potential risk related to this development if it is not carefully designed and constructed. Due to the variability of the subsurface soil and water conditions, some areas of the site will likely have potential for ground movement.

The purpose of this study and the recommendations contained in this report is to limit the potential for sliding and slope movement through design recommendations that will limit exposed temporary cuts and fill areas within the steep slope areas. Additional

recommendations and analysis is expected as the plans are refined through the design process.

Based on our evaluation and slope stability analysis, the existing slopes are in stable condition. The slope buffer can be reduced to 10 feet from the top of the steep slopes. The building setback should be maintained at 15 feet from the slope buffer.

Foundations: Foundations for the proposed residences can be supported on conventional continuous and spread footings bearing on medium dense to dense native soil or new structural fill.

Slab-on-grade: Slab-on-grade floors can be supported on medium dense to dense native soil or new structural fill.

Pavements: The following flexible pavement sections are recommended:

- **Private driveway**: 2 inches of hot mix asphalt (HMA) over 6 inches of Crushed Rock Base (CRB) over compacted subgrade
- **Public roadway**: 3 inches HMA over 9 inches of CRB over compacted subgrade

1.0 Introduction

This Critical Areas Evaluation and Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the proposed Bergsma Property in Issaquah, Washington. The purpose of this evaluation is to assess subsurface conditions and provide geotechnical recommendations for the construction of 57 single-family residences and associated access roadways. Our scope of services included field exploration, laboratory testing, slope stability analysis, meeting discussions with the City of Issaquah, and preparation of this GER.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. RGI should review the proposed site grading and utility plans once they are developed in order to confirm the recommendations provided in this report are appropriate for the development as proposed. In addition, RGI requests to review the final site grading plans and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project Description

The site is located east of Southeast Newport Way north of the intersection with 17th Avenue Northwest in Issaquah, Washington. The approximate location of the site is shown on Figure 1. The site is currently undeveloped.

Based on the preliminary site plan prepared by PACE dated October 23, 2017, RGI understands it is proposed to develop the site into 57 single-family residential lots. RGI expects that grading for the proposed lots will require cut/fill to reach the final grade. Some lots may be terraced for daylight basement structures.

Access to the site will be provided by a new Road A. Road A extends from Newport Way Northwest to Westside Reservoir with a slope gradient of 12 percent. The major earthwork will be widening Newport Way, grading Roads A to C and private driveways, installation of utility vaults, and grading of residential lots. A section of Road A (from Lot 50 to 57) will be close to a previous quarry mine and needs to reconstruct the slopes left by the quarry mine.

Based on our experience with similar construction, RGI anticipates that the proposed residential buildings will be 2- to 3-story, wood-framed structures supported on perimeter walls with bearing loads of 2 to 3 kips per linear foot, and a series of columns with a maximum load up to 100 kips. Slab-on-grade floor loading of 150 pounds per square foot (psf) are expected for garage or basement slabs.

3.0 Field Exploration and Laboratory Testing

On December 30, 2015 and January 12, 2016, RGI observed the excavation of five test pits to a maximum depth of 15 feet and drilling of two borings to approximate depths of 40 feet below existing site grades, respectively. From May 4 to 16, 2016, RGI observed the drilling of two borings (B-201 to B-202) to a maximum depth of 60 feet with a sonic drill rig and excavation of 19 test pits (TP-201 to TP-219) to a maximum depth of 14 feet below existing site grades.

Boring B-201 and test pits TP-201 to TP-204 are located at the entrance of Road A with Northwest Newport Way. Boring B-202 and Test pits TP-210 to TP-212 are located at the south end of the property near the Westside Reservoir. Test pits TP-205 to TP-209 are located along the proposed roadway widening area along Newport Way Northwest.

Test pits TP-213 to TP-219 are scatted in the upper lots to verify the original findings and obtain additional soil information. The approximate exploration locations are shown on Figure 2. The original test pit explorations performed by others in 2008 are also shown on the figure.

During the field exploration, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Selected samples retrieved from the borings were tested for moisture content, grain size analysis, and direct shear tests to aid in soil classification and provide input for the recommendations provided in this report addendum. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 SURFACE

The site is an irregular-shaped property, which includes seven tax parcels totaling approximately 46 acres. The site is bound to the north and west by Cougar Mountain Regional Wildlife Park and undeveloped forest, to the east by Newport Way Northwest, and to the south by the Talus residential development, Harvey Manning Park, and the Westside Reservoir tank owned by the City of Issaquah.

The site slopes generally northeast with approximately 300 feet of elevation change across the property. The site topography is highly variable, with several upper bench areas bisected by numerous ravines with sloped sides.

4.1.1 WESTERN PARCEL

The westernmost parcel, which is approximately 12.5 acres in size, contains predominately steep slopes that descend to a series of intermittent streams. There are no plans to develop this parcel.

The central portion of the property contains three 5-acre parcels that make up most of the proposed development area. This portion of the property contains a generally north-sloping bench that descends approximately 70 to 90 feet over a horizontal distance of approximately 900 to 1000 feet. Slope gradients in the bench area range from less than 5 up to about 25 percent.

Several wetlands are located in the bench area, with the largest extending approximately 250 feet north into the site from the southern property line. The large wetland is drained by a stream that flows generally east-northeast into the neighboring parcel, eventually flowing off-site into Tibbetts Creek. The bench area is bordered to the west, north, and east by slopes with gradients of about 30 to 70 percent.

4.1.2 SOUTHEAST PORTION

The southeastern portion of the property is an 11.3-acre parcel that contains an eastern bench area that is to be included in the development area. The bench area descends generally east with an elevation change of about 60 feet over a horizontal distance of about 300 feet. Slope gradients in the bench area range from about 10 to 20 percent, with localized areas in the range of 30 to 50 percent. The bench is bordered to the east by slopes that descend to Newport Way Northwest at gradients of 30 to 70 percent.

A large wetland is located just below the bench area in the central portion of the parcel that extends approximately 180 feet east down the face of the slope. A stream flows into the site near the southwest corner of the parcel, flowing east-northeast down the slope. The stream exits the site at the eastern property line at Newport Way Northwest, eventually flowing into Tibbetts Creek. Road A will cross the lower portion of this slope.

4.1.3 NORTHEASTERN PORTION

The northeastern portion of the property contains an approximately 6.7-acre parcel and a 0.5-acre parcel. The 0.5-acre triangular-shaped parcel descends northeast about 35 feet in elevation to Newport Way Northwest. The 6.7-acre parcel contains a small eastern bench area that extends approximately 160 feet east from the western property line at a gradient of about 10 to 15 percent. The rest of the parcel contains slopes that descend generally northeast to Newport Way Northwest at gradients of 30 to 70 percent.

The stream draining the wetland in the south-central portion of the property extends east-northeast down the slope through the southern part of this parcel. An approximately 400 foot long section of the toe of the slope has been mined out along Newport Way Northwest in this parcel, leaving vertical soil faces of about 5 to 20 feet in height. Road A is proposed to extend from the bench on this parcel across the stream and into the parcel to the south.

4.2 GEOLOGY

Review of the *Geologic Map of the Issaquah 7.5' Quadrangle, Washington* by Derek B. Booth, etc, (2006) shows a number of geologic environments mapped throughout the site. Much of the site is likely underlain at depth by Tertiary bedrock. In the western portion of the property, several localized outcrops are mapped as Blakeley Formation of Weaver (Map Unit Tb) which is sandstone, conglomerate, and minor siltstone exposed at the surface due to the Seattle Uplift. Bedrock was not encountered during our subsurface explorations.

The upper slopes in the westernmost parcel are mapped as Till (Qvt) which is a compact mixture of gravel, sand, silt, and clay deposited directly by ice during the latest glacial advance. Glacial till was not encountered during exploration. The lower slopes of the westernmost parcel, as well as slopes to the west of the central bench area are mapped as Mass-wastage deposits (Qmw) which is colluvium and landslide debris that is thick enough to obscure the nature of the underlying deposits. Mass-wastage debris mantles much of the site slopes, but is usually relatively thin.

The central bench area that includes most of the proposed development is mapped as ice-contact deposits (Qvi_2) which is poorly sorted, stratified sediments deposited against stagnant ice during recession of the ice sheet. The subscript associates the deposit with Stage 2 recessional outwash deposits (Qvr_2), with the deposit marking the location of the ice tongue necessary to divert meltwater south down Tibbetts Creek to deposit the Stage 2 recessional deposits along the Tibbetts Creek channel. The ice-contact deposits are generally not glacially consolidated. The loose to medium dense and soft to stiff deposits encountered in the exploration locations in the bench areas generally matches the descriptions for ice-contact deposits.

The slope areas to the north and east of the central bench area is mapped as Undifferentiated sedimentary deposits of pre-Fraser glaciation age (Qpf) which is fresh to slightly oxidized silt and clay beds and slightly to moderately oxidized sand and gravel beds. The southwest corner of the southeast parcel is mapped as Fine-grained deposits (Qpf_f) which is predominately silt and clay. These soil units are glacially consolidated. Soils encountered in the slope areas to the east of the central bench match the descriptions for pre-Fraser deposits.

4.3 SOILS

The site is generally underlain by loose to medium dense deposits of silty sand with varying amounts of gravel, sand with varying amounts of silt and gravel, and sandy gravel with varying amounts of silt, and soft to medium stiff deposits of sandy silt, clayey silt,

and silt to depths of 15 to 20 feet. Below 15 to 20 feet, the deposits become very dense silty sand with varying amounts of gravel and silty sandy gravel, and hard clay.

Boring B-201 encountered medium dense to dense silty sand, sand, and sandy gravel with interbedded sandy silt to a depth of 50 feet bgs. Boring B-202 encountered 20 feet of medium dense to dense silty sand and sand, and soft to very stiff sandy silt and silt over very stiff to hard silt and clay to a depth of 60 feet bgs.

Test pits TP-201 to TP-209 encountered loose to dense silty sand, sand, and gravel with varying amounts of silt. Test pits TP-210, TP-218, TP-219 encountered 1 to 4 feet of silty sand over 10 feet of medium stiff to hard silt. Test pits TP-211 to TP-217 encountered up to 14 feet of medium dense silty sand with some gravel. Cross sections through the site were shown on Figures 3a to 3e.

More detailed descriptions of the subsurface conditions encountered are presented in the test pit and boring logs included in Appendix A. Sieve analyses and direct shear tests were performed on several soil samples. Grain size distribution curves and direct shear test results are included in Appendix A.

4.4 GROUNDWATER AND HYDROGEOLOGY

Light to moderate groundwater seepage was encountered from 2.5 feet to 13 feet bgs in four of the test pits (TP-101, TP-103, TP-104, and TP-105) and from 7 feet to 15 feet bgs in two of the test borings (B-201 and B-202) during our subsurface exploration. Monitoring wells were installed in test borings B-201 and B-202 for further groundwater monitoring for the site. The groundwater appears to be perched over the impermeable soil layers.

There are two streams that extend through the project site; the north stream and the south stream. The north stream starts from a wetland in the central portion of the site near Lot 31 and flows generally east-northeast into the neighboring parcel, eventually flowing off-site into Tibbetts Creek.

The south stream flows into the site near the southwest corner of the southeast parcel, flowing east-northeast down the slope and exits the site at the eastern property line at Newport Way Northwest, eventually flowing into Tibbetts Creek. Based on the topography, most of the surface runoff flows into the north stream and associated wetland in the proposed development area. In the southeast parcel, runoff flows to the south stream or the wetland on the slope face.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less

permeable soils following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.5 SEISMIC CONSIDERATIONS

Based on the 2012 International Building Code (IBC), RGI recommends the follow seismic parameters in Table 1 be used for design.

Table 1 IBC Seismic Parameters

2012 IBC Parameter	Value
Site Soil Class[1]	D[2]
Site Latitude	47.54263 N
Site Longitude	122.06845 W
Maximum considered earthquake spectral response acceleration parameters (g)	S_s =1.334, S_1 =0.505
Spectral response acceleration parameters adjusted for site class (g)	S_{ms} =1.334, S_{m1} =0.757
Design spectral response acceleration parameters (g)	S_{ds} =0.889, S_{d1} =0.505

1 Note: In general accordance with the USGS *2012 International Building Code*. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2 Note: The *2012 International Building Code* requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Test borings extended to a maximum depth of 60 feet, and this seismic site class definition considers that hard soil continues below the maximum depth of the subsurface exploration.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus reducing or eliminating the soil's strength.

RGI reviewed the results of the field and laboratory testing and assessed the potential for liquefaction of the site's soil during an earthquake. Since the site is underlain by stiff to dense soil and a deep groundwater table, RGI considers that the possibility of liquefaction during an earthquake is minimal.

4.6 GEOLOGIC HAZARD AREAS

Review of the Issaquah Municipal Code (IMC) Critical Areas Regulations indicates that the portion of the site with high gradient slope meets the criteria for a landslide hazard area (18.10.560) and steep slope hazard area (18.10.580). This portion of the area is subject to severe erosion and potential landslides when slopes are cleared. Based on the previous study and additional explorations and the definition contained in the IMC, RGI believes that the area with greater than 40 percent slope would be considered landslide hazard areas and the rest of the site with low gradient slope should not be consider as landslide hazard area.

4.6.1 SITE RECONNAISSANCE

From December 30, 2015 to January 12, 2016, RGI's geotechnical engineer and geologist performed several site reconnaissance to evaluate the stability of the site slope. During our field observations, we did not observe any signs of slope instability such as tension cracks or exposed slope surface that would indicate previous landslide activities. Several wetland areas are mapped in the central bench area and a large wetland is mapped on the slope face in the southeastern portion of the property. No additional seeps or springs were observed on the slope face.

We observed two fallen trees on the edge of the slope in the middle portion of the site that has caused some ground disturbance. Localized hummocky terrain was observed that may be indicative of past shallow debris flow failures. Numerous trees with curved trunks were observed which is consistent with surficial creep. We also found vertical cuts of approximately 5 to 20 feet in height in the lower slope areas in the northeastern portion of the property near Newport Way Northwest, which were the result of previous sand and gravel mining. The vertical cuts were observed to be actively eroding.

Much of the slope is heavily vegetated with mature trees and undergrowth, reducing the potential of shallow debris flow failures. Based on our observations, the slopes appear to be stable in their current configuration and condition, with the exception of the previous mining activity in the northeastern portion of the site.

4.6.2 LITERATURE REVIEW

As part of this scope of work, RGI has performed a literature review of landslide history in the vicinity of the project area. Three landslides were found within half mile radius in the last three decades and three known landslides were found.

Westside Reservoir Landslide

Based on the city engineer, there was a landslide that occurred during the construction of the Westside Reservoir in 1986. RGI went to the city several times and didn't find related documents. Based on the geology map and our observation, the landslide occurred to the west of the reservoir during construction. The affected area seems to be limited to the cutslope above the bottom elevation of the reservoir. The failure seems to have been

repaired using a gabion wall and horizontal drains. The slide is about 100 feet to the south and west of the property boundary. No additional movement or reactivation was observed or reported.

Goode Place Landslide

The landslide occurred at 1855 Northwest Goode Place in early 1999 during the construction of a single-family residence. The failure occurred to the southeast of a steep slope after a record rainfall event. The landslide was a result of a combination of loose marginally stable surficial soil, saturation of the loose soil mass by record rainfall, and hydrostatic pressures generated by the record amount of water within and beneath the landslide mass. The landslide is about 350 feet to the south of the property boundary and was stabilized. No additional movement was reported.

Talus Lot 9 Landslide

A relatively large landslide occurred to the west of the intersection of Northwest Talus Drive and Shangri La Way in late 2015 during site grading. The affected area is over 400 feet wide and 300 feet long and up to 50 feet deep. The site grading involved fill over 20 feet on the top of a steep slope.

The cause of the landslide is still under investigation. The preliminary conclusions contained in the Terra Associates report indicate the cause of the failure was increased groundwater pressures underlying the slide area. The slide area was significantly modified by the placement of fill near the top of the slide area. The slide plane appears to be within a weak soil layer consisting of completely weathered siltstone bedrock over the sloping surface of the underlying competent bedrock. The landslide is about 1,500 feet to the west of the property boundary and the subsurface soil and groundwater conditions in the slide area are significantly different from the conditions encountered on the proposed Bergsma site. The final repair and stabilization is under design.

4.6.3 SLOPE STABILITY ANALYSIS

RGI performed a slope stability analysis using the computer program *Slide Version 6.0*, developed by rocscience. The slope profile (Figure 3a and 3c Cross Section C-C' and H-H') was produced from the Preliminary Utility Plan (C4.0) prepared by Pace Engineers, Inc. The profile extends east through the Westside Reservoir on the neighboring property to the west, extending into the property through the Tract H (Vault 1), the Road A cul-de-sac, the Tract I lot fills, and down the slope face across the stream in Tract D. Soil parameters were based on direct shear testing by HWA GeoSciences Inc. or estimated from *Geotechnical Properties of Geologic Materials,* by Jon W. Koloski, et al. (1989). The soil profile was created from Boring B-201 and Test Pit TP-210, with the underlying gravels estimated from B-102. The contact between the silt and underlying gravel was placed at an elevation of 200 feet approximately where observed in the Tract D stream channel to the South.

Table 2 Soil Parameters for Slope Stability Analysis

Soils	Unit Weight (pcf)	Cohesion (pcf)	Phi angle (degrees)
Fill	125	100	34
Soft to medium stiff silt	110	100	28
Dense silty sand (wet)	120	100	33
Dense silty sand/ very stiff sandy silt	115	100	33
Lean clay	110	400	22.6
Very dense silty sandy gravel	125	100	38

The analyses were performed for the existing slope static and seismic, construction static during excavations for Vault 1, and post-construction static and seismic. An estimated load of 1,500 PSF was used for the Westside Reservoir, and a load of 440 PSF was used for the temporary retaining wall for the vault excavation. The safety factors for the most critical surfaces are shown in the table below.

Table 3 Result of Slope Stability Analysis

Condition	Section C-C'	Section H=H'	Design Requirements
Existing Slope	Static SF = 1.60 Seismic SF = 1.08	Static SF = 1.57 Seismic SF = 1.10	1.5 1.15
Construction –Vault Cut	Static SF = 1.75		1.25
Post-Construction Fill w/o Retaining Wall Fill With Retaining Wall	Static SF = 1.50 Seismic SF = 1.003 Seismic = 1.15	Static SF = 1.78 Seismic SF = 1.22	1.5 1.15 1.15

NCHRP/FHWA suggests that a minimum safety factor of 1.1 for negligible slope displacement and 1.0 for small displacement (less than two inches). Based on the analysis, the existing slope and post-construction slope in Section H-H' will be stable during seismic event. The slope in section C-C' without retaining wall will experience small displacement of less than two inches.

As part of our preliminary analysis, RGI evaluated the amount of support needed to meet the required safety factor of 1.15 which is slightly higher the value suggested by NCHRP/FHWA in section C-C' area. The analysis indicates that an active support force of 25 kips/foot will be needed on the upper portion of the slope. A soldier pile wall with

tieback anchors can meet this type of design requirement. The retaining wall will only be needed along the edge of the steep slope from Lot 36 to 43 and will be dependent upon the grading and final configuration of these lots.

4.6.4 SLOPE SETBACKS

Based on our observations and review of the slope stability analysis, the existing slopes are stable in their present configuration and condition. Based on section 18.10.580 of the IMC, RGI recommends that the standard 50-foot buffer be reduced to a 10-foot undisturbed buffer with the additional 15-foot building setback for slopes greater than 40 percent. Based on the topography of the site, the proposed development area is located in areas of slopes with inclinations of 10 to 25 percent with the steeper slopes located on the perimeter of the development.

5.0 Discussion and Recommendations

5.1 GEOTECHNICAL CONSIDERATIONS

Based on the findings and analysis in this study, the proposed development can be performed as proposed from a geotechnical point of view. RGI does not expect major landslides affecting multiple lots, major roadway, or deep-seated slope failure like Talus Lot 9 Landslide for this project.

However, the site contains steep slopes and is located in landslide hazard area. Because of the nature of the native soil and proposed earthwork, there is a potential risk related to this development if it is not carefully designed and constructed. Due to the variability of the subsurface soil and water conditions, some areas of the site will likely have potential for ground movement.

The purpose of this study and the recommendations contained in this report is to limit the potential for sliding and slope movement through design recommendations that will limit exposed temporary cuts and fill areas within the steep slope areas. Additional recommendations and analysis is expected as the plans are refined through the design process.

Based on the research of landslides in the area, the landslides typically occurred in wet winter conditions in soils disturbed by grading activities. Therefore, RGI recommends that the mass excavation and grading be performed in the dry season and areas stabilized with erosion control measures prior to October 31. Retaining walls over six feet in height located in or near steep slope areas should use soldier pile walls either cantilever or with tieback anchors.

The grading design should minimize the depth of fill at the top of the slope. The final grading should promote positive drainage to avoid discharge runoff to the slope surface.

For grading on the top of critical areas, stockpiles are allowed at the top of slopes within a distance of at least 50 feet from the top of the steep slope.

RGI recommends that foundations for the proposed building be supported on conventional spread footings bearing on medium dense/stiff native soil or new structural fill. Slab-on-grade floors and pavement section can be similarly supported on medium dense/stiff native soil or structural fill.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 EARTHWORK

Based on the plans provided, significant earthwork will be necessary to achieve building and pavement grades and excavation for utilities including storm, water, sanitary sewer, and other utilities.

Due to moisture sensitive nature of the native soils, RGI recommends earthwork take place in the dryer summer months. We do not expect significant groundwater will be encountered if the construction occurs during the dry season (June through September) but the contractor should be prepared for seepage in excavations if the construction occurs in the winter or spring months.

5.2.1 EROSION AND SEDIMENT CONTROL

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Establishing a quarry spall construction entrance
- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather

- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.2.2 STRIPPING

Stripping efforts should include removal of vegetation, organic materials, and deleterious debris from areas slated for building, pavement, and utility construction. The borings and test pits encountered 6 to 12 inches of topsoil and rootmass. Deeper areas of stripping may be required in forested or heavily vegetated areas of the site.

5.2.3 EXCAVATIONS

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. Temporary excavations in areas within 50 feet of the property boundaries and the steep slope areas should be limited to six feet in height and should be reviewed by RGI prior to and during excavation.

The native soil is classified as Group B soil. Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1H:1V (Horizontal:Vertical). If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered.

For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least 5 feet from the top of the cut

- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized
- Surface water is diverted away from the excavation
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2.4 SITE PREPARATION

RGI anticipates that some areas of loose or soft soil will be exposed upon completion of stripping and grubbing. Proofrolling and subgrade verification should be considered an essential step in site preparation. After stripping, grubbing, and prior to placement of structural fill, RGI recommends proofrolling building and pavement subgrades and areas to receive structural fill. These areas should be proofrolled under the observation of RGI and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Proofrolling and adequate subgrade compaction can only be achieved when the soils are within approximately ± 2 percent moisture content of the optimum moisture content. Soils that appear firm after stripping and grubbing may be proofrolled with a heavy compactor, loaded double-axle dump truck, or other heavy equipment under the observation of an RGI representative. This observer will assess the subgrade conditions prior to filling. The need for or advisability of proofrolling due to soil moisture conditions should be determined at the time of construction. In wet areas it may be necessary to hand probe the exposed subgrades in lieu of proofrolling with mechanical equipment.

If fill is placed in areas of the site where existing slopes are steeper than 5:1 (Horizontal:Vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment, and to allow placement of horizontal lifts of fill. A slope fill detail is shown on Figure 4.

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with

compacted structural fill. In order to maximize utilization of site soils as structural fill, RGI recommends that the earthwork portion of this project be completed during extended periods of warm and dry weather if possible. If earthwork is completed during the wet season (typically November through May) it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond that which would be expected during the drier summer and fall months.

5.2.5 STRUCTURAL FILL

RGI recommends fill below the foundation and floor slab, behind retaining walls, and below pavement and hardscape surfaces be placed in accordance with the following recommendations for structural fill.

The suitability of excavated site soils and import soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the U.S. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve. Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is that moisture that results in the greatest compacted dry density with a specified compactive effort.

Non-organic site soils are only considered suitable for structural fill provided that their moisture content is within about 2 percent of the optimum moisture level as determined by ASTM D1557. Excavated site soils may not be suitable for re-use as structural fill depending on the moisture content and weather conditions at the time of construction. If soils are stockpiled for future reuse and wet weather is anticipated, the stockpile should be protected with plastic sheeting that is securely anchored. Even during dry weather, moisture conditioning (such as, windrowing and drying) of site soils to be reused as structural fill may be required. Even during the summer, delays in grading can occur due to excessively high moisture conditions of the soils or due to precipitation. If wet weather occurs, the upper wetted portion of the site soils may need to be scarified and allowed to dry prior to further earthwork, or may need to be wasted from the site.

Most of the native soil contains a large percentage of fines and is moisture sensitive, it may necessary to import structural fill if the construction occurs in wet weather. The native soils may also require moisture conditioning prior to use as structural fill.

Import structural fill should meet the gradation requirements listed in Table 4 for wet weather conditions. For dry season earthwork, the percent passing the No. 200 may be increased to 10 percent maximum or materials meeting the 2012 Washington State

Department of Transportation (WSDOT) Standard Specifications for Road, Bridge, and Municipal Construction, Section 9-03.14(1) may be used.

Table 4 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
4 inches	100
No. 4 sieve	75 percent
No. 200 sieve	5 percent *

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 5. The soil's maximum density and optimum moisture should be determined by ASTM D1557.

Table 5 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils:	95	+2	-2
General Fill (non-structural areas)	On-site soils or approved imported fill soils:	90	+3	-2
Pavement – Subgrade and Base Course	On-site granular or approved imported fill soils:	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.2.6 CUT AND FILL SLOPES

All permanent cut and fill slopes should be graded with a finished inclination no greater than 2H:1V. Upon completion of construction, the slope face should be trackwalked, compacted and vegetated, or provided with other physical means to guard against erosion.

Final grades at the top of the slopes must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe of the slope. All fill placed for slope construction should meet the structural fill requirements as described in Section 5.2.5.

5.2.7 WET WEATHER CONSTRUCTION CONSIDERATIONS

RGI recommends that preparation for site grading and construction include procedures intended to drain ponded water, control surface water runoff, and to collect shallow subsurface seepage zones in excavations where encountered. It will not be possible to successfully compact the subgrade or utilize on-site soils as structural fill if accumulated water is not drained prior to grading or if drainage is not controlled during construction. Attempting to grade the site without adequate drainage control measures will reduce the amount of on-site soil effectively available for use, increase the amount of select import fill materials required, and ultimately increase the cost of the earthwork phases of the project. Free water should not be allowed to pond on the subgrade soils. RGI anticipates that the use of berms and shallow drainage ditches, with sumps and pumps in utility trenches, will be required for surface water control during wet weather and/or wet site conditions.

5.3 FOUNDATIONS

Following site preparation and grading, the proposed building foundations may be supported on conventional spread footings bearing on medium dense/stiff native soil or structural fill. Where loose soils or other unsuitable soils are encountered in the proposed building footprint, they should be overexcavated and backfilled with structural fill.

Perimeter foundations exposed to weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab. Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings.

Table 6 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf[1]
Friction Coefficient	0.25
Passive pressure (equivalent fluid pressure)	250 pcf[2]
Minimum foundation dimensions	Columns: 24 inches Walls: 16 inches

1 psf = pounds per square foot

2 pcf = pounds per cubic foot

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because it can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.2.5. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

With spread-footing foundations designed in accordance with the recommendations in this section, maximum total and differential post-construction settlements of 1 inch and 1/2 inch, respectively, should be expected.

5.4 SHORING AND RETAINING WALLS

Soldier piles wall can be used in either a cantilevered or a tied-back configuration for temporary shoring and permanent retaining walls where the proposed excavation or fill is over six feet in height. The following geotechnical comments and recommendations are provided concerning soldier piles.

5.4.1 SOLDIER PILE AND TIEBACK SHORING OR PERMANENT WALLS

All soldier piles must have sufficient embedment below the final excavation level to provide adequate kick-out resistance to horizontal loads, as calculated by the design engineer. RGI recommends providing a minimum embedment of 10 feet below the excavation base directly in front of each pile. For cantilevered soldier piles, RGI further recommends that the embedment depth not be less than the exposed wall height.

Our subsurface explorations revealed that the site is underlain by layers of loose to dense sands, dense sand and gravel, stiff to hard silts, and stiff lean clay. These soils can likely be drilled with a conventional auger, but the very dense and hard layers will undoubtedly yield slow drilling rates. Cobbles and boulders were encountered in some locations in the slope face, particularly at the base of the slope along Northwest Newport Way, and

obstructions should be anticipated. Groundwater should be expected in the holes below groundwater level.

Applied Loads

All soldier piles at the subject site should be designed to resist the various lateral loads applied to them. RGI expects that these lateral loads will consist of active or at-rest pressures and possibly traffic surcharge or structural surcharge pressures, depending on the specific wall location. For a shoring wall that has adequate drainage, RGI does not expect that hydrostatic pressures will need to be considered. Our recommended design pressures are presented graphically on Figures 5a to 5g and are discussed in the following paragraphs.

- **Active Earth Pressures**: Cantilevered soldier pile wall can be designed using the pressure diagram in Figure 5a, 5d, 5f. Tied-back walls that have only one row of tiebacks can be designed using active earth pressures shown on Figure 5b, 5d, 5g. Tied-back walls that have two or more rows of tiebacks should be designed using the pressure distribution shown on Figure 5c.
- **Backslope Surcharge Pressures**: Backslope surcharge should be applied to the shoring design or retaining wall with temporary cut slope and natural slope behind.
- **Traffic Surcharge Pressures**: Lateral earth pressures acting on the soldier piles should be increased to account for traffic, construction equipment, material stockpiles, or other temporary loads located within a horizontal distance equal to half the wall height. For light to moderately heavy vehicles, this traffic surcharge can be modeled as a uniform lateral pressure of 75 psf acting over the upper 8 feet of wall; or heavy vehicles, such as concrete trucks, a value of 150 psf would be more appropriate.
- **Hydrostatic Pressures**: If groundwater is allowed to collect behind the temporary shoring wall, a net hydrostatic pressure of 45 pcf would act against the portion of wall above the foreslope level and below the saturation level in Figure 5f and 5g. However, if adequate drainage is provided behind the shoring wall, we expect that hydrostatic pressures will not develop.
- **Resisting Forces**: Lateral resistance can be computed by using an appropriate passive earth pressure acting over the embedded portion of each soldier pile, neglecting the upper 1 to 2 feet. This passive pressure should be applied over a lateral distance equal to the pile spacing or twice the pile diameter, whichever is less. For a level foreslope (measured perpendicular to the wall face), RGI recommends using a maximum allowable passive pressure modeled as an equivalent fluid density of 350 pounds per cubic foot (pcf), based on a safety factor of 1.5 or more.

- **Soldier Pile Bearing and Friction Resistance:** The resistance to vertical loads from tieback may be calculated using an allowable end bearing of 10,000 pound per square foot (psf) and an allowable friction of 1,500 psf in the dense silty sand expected at the base of the piles.
- **Pile Deflections:** Lateral deflections for a soldier pile can be calculated from the horizontal modulus of subgrade reaction, which generally increases with depth. As a reasonable approximation, however, a uniform modulus of 250 kips per cubic foot (kcf) or 145 pounds per cubic inch (pci) can be used.

Lagging

For temporary shoring, either conventional wooden timbers or reinforced shotcrete panels could be utilized as lagging at the site, but the former would likely be much less expensive. For permanent shoring wall applications, RGI typically recommends that all wooden timber lagging be pressure-treated.

Due to soil arching effects, temporary lagging that spans 8 feet or less need be designed for only 50 percent of the lateral earth pressure previously recommended for soldier pile design. Permanent lagging, on the other hand, should be designed for 75 percent of this same lateral earth pressure. In both cases, these values assume that adequate drainage is provided behind the lagging, as discussed below.

RGI recommends that any voids behind the lagging be backfilled with a material sufficiently pervious to allow groundwater flow and prevent a build-up of hydrostatic pressure. For this reason, permeable materials such as granular excavation spoils, clean sand, or pea gravel are suitable as backfill material, whereas silty soils, cement grout, controlled-density fill, or other less-permeable materials are not suitable.

Drainage System

RGI recommends that all lagging backfill material connect to a continuous horizontal drain located in front of the wall. This can be accomplished either by extending gravel under the lagging or by providing gaps between the lagging boards. If concrete or shotcrete walls are to be placed against wooden lagging, prefabricated vertical drainage strips (such as MiraDRAIN 6000®) should be attached to each lagging bay.

Tiebacks

RGI anticipates that tieback anchors might be needed to support any soldier pile walls having an exposed height greater than about 15 feet. Our tieback comments and recommendations are summarized below and are illustrated on the attached Figures 5b, 5c, 5d, 5e, and 5g. For wall retaining new fill, deadman anchors may be used instead of tieback. If deadman anchors are used, the design recommendation are shown in Figure 5d.

Because tiebacks typically extend about 30 to 60 feet behind the excavation face, conflicts with underground utilities and adjacent structures often arise. The project structural engineer should carefully consider the locations of such obstructions when laying out all tiebacks.

All tiebacks should be installed in a manner that minimizes caving and associated ground subsidence. Typically, this involves drilling with a full-length casing or continuous flight auger, as well as pumping grout from the bottom of each tieback hole with a tremie. If desired, the shoring contractor can use secondary pressure-grouting techniques to reduce auger diameters and develop greater adhesion values.

The anchor portion of all tiebacks must be located a sufficient distance behind the retained excavation face in order to develop resistance within a stable soil mass. We specifically recommend that the anchorage be obtained behind a "no-load zone" defined by a plane set back from the wall face a horizontal distance equal to 25 percent of the wall height and projected upward at a 60-degree angle from the excavation base level. This configuration is shown on Figures 5b, 5c, 5d, 5e, and 5f.

The anchor portion of all tiebacks must have sufficient embedment below the backslope surface and behind the no-load zone to provide adequate pull-out resistance to lateral loads, as calculated by the design engineer. RGI recommends providing a minimum anchor depth of 10 feet and a minimum anchor length of 20 feet. To avoid interactions between adjacent tiebacks, RGI further recommends that a clear spacing of at least 5 feet be maintained along the anchor zones.

If properly grouted, RGI tentatively estimates that an allowable concrete/soil adhesion of 1,500 pounds per square foot (psf) can be assumed for the anchor portion of a tieback located within the medium dense silty sand with gravel. The actual design value will depend on the installation method and should be confirmed by load-testing all tiebacks in the field.

Field testing of all tiebacks is necessary to confirm design assumptions, verify the integrity of individual tiebacks, and provide information regarding their short-term creep characteristics. Our recommended tests are described below. After testing, each tieback should be locked off at 100 percent of its design load.

- Performance Tests: A performance test load should be applied to selected production tiebacks at the site. RGI specifically recommends testing at least one tieback on each side of the excavation. The test load should equal 200 percent of the design capacity and the 150 percent load should be held for at least 60 minutes.

- Proof Tests: A proof test load should be applied to every production tieback at the site. The test load should equal 130 percent of the design capacity and be held for at least 10 minutes.
- Permanent Anchors: We recommend permanent anchors be tested for creep with a minimum of a 24 hour test equal to 150 percent of the design load.

For permanent tieback anchors, the tiebacks should properly designed and sealed to against corrosion.

Permanent Wall Facing and Drainage

For permanent retaining wall, the wall design should add seismic load shown in pressure diagrams Figure 5a to 5e. The solider piles and tieback anchors should have proper corrosion protection. City of Issaquah may not allowed a permanent retaining with a wood-lagging face. A concrete wall facing typically consisting 4 to 6 inches of shotcrete should be applied in front wood-lagging. Drainage system should be installed before applying the concrete facing. A typical retaining wall drainage system for walls formed against soldier piles and lagging is shown on Figure 6.

5.4.2 CAST-IN-PLACE WALLS

For basement walls and stormwater detention vaults, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown on Figure 7.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design.

Table 7 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H for restrained walls should be applied to the wall surface. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.3.

5.4.3 SEGMENTAL RETAINING WALLS

For retaining walls less than six feet in height and located in non-steep slope area, RGI recommends that either rockeries, modular block or gabion of type of walls can be used. The advantage of these type walls are free draining and flexible to enough to tolerate some differential settlement. RGI can provide details in the final design stage for these walls once the preliminary plans are approved by the city.

RGI understands that cuts and fills will be used to provide site grades and retaining walls will be necessary in some areas. For fill areas, RGI recommends using segmental retaining walls. A typical segmental retaining wall includes the Keystone wall system which is a proprietary retaining wall system. The system is used to rest lateral earth pressures either as a gravity wall or combined with geogrid reinforced fill. The system includes manufactured segmental block units designed to be connected to each other by fiberglass pins.

For preliminary planning purposes, the detail shown on Figure 8a and geogrid reinforcing schedule shown on Figure 8b may be used. We recommend RGI review the location and potential surcharge loading to segmental walls. These walls typically require a separate building permit. RGI can provide design plans for the permitting and construction of these walls.

5.4.4 ROCKERIES

Rockeries may be used on the site for grade changes, however, rockeries are not retaining walls and do require periodic maintenance. RGI can provide supplemental information for the construction of rockeries once the location and height of the walls has been determined. Generally, we don't recommend rockery more than 6 feet in height to be used. A general rockery section detail is included on Figure 9. Rockeries should be constructed by an experienced rockery contractor in accordance with Associated Rockery Contractors (ARC) guidelines or the City of Issaquah standards.

5.5 SLAB-ON-GRADE CONSTRUCTION

Once site preparation has been completed as described in Section 5.2, suitable support for slab-on-grade construction should be provided. Immediately below the floor slab, RGI recommends placing a 4-inch-thick capillary break layer of clean, free-draining pea gravel, washed rock, or crushed rock that has less than 5 percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter-thick plastic membrane should be placed on a 4-inch-thick layer of clean gravel or rock. For the anticipated floor slab loading, we estimate post-construction floor settlements of ¼- to ½-inch.

5.6 DRAINAGE

Subsurface and subsurface drainage systems will be necessary at the site and special consideration should be taken to ensure the drainage is directed away from the top of the steep slopes on the site. The preliminary plans provided did not include locations for collection and storage of surface or subsurface water. RGI should review the drainage plans once developed to confirm drainage is routed appropriately and storm water collection areas will not have an adverse effect on the steep slope areas.

5.6.1 SURFACE

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 SUBSURFACE

RGI recommends installing perimeter foundation drain as shown on Figure 10. The retaining wall drains, perimeter foundation drain, and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge.

RGI understands that the design team is considering interceptor drains along the top of slope. The interceptor drain will catch the shallow groundwater and discharge to the stream or wetland areas. A typical interceptor drain should consist of a 6-inch diameter perforated pipe wrapped with clean drainage rock with details shown on Figure 11. The interceptor drain can also be used in landscape or roadway areas where shallow seepage is encountered during excavation.

5.6.3 INFILTRATION

At the time of performing this study, RGI does not aware of any infiltration systems are being considered for the on-site disposal of storm water run-off. Based on the soil encountered, the native soil is not suitable for infiltration.

5.7 UTILITIES

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with City of Issaquah specifications. At a minimum, trench backfill should be placed and compacted as

structural fill, as described in Section 5.2.5. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by ASTM D1557. The onsite excavated soil is not suitable for being used as structural fill. Imported structural fill is needed for trench backfill as recommended in Section 5.2.5.

5.8 PAVEMENTS

Pavement subgrades should be prepared as described in Section 5.2 of this GER and as discussed below. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. This condition should be verified by proofrolling with heavy construction equipment or hand probe by inspector.

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for private driveway areas and street paved with flexible asphalt concrete surfacing.

- **For private driveways**: 2 inches of asphalt concrete (AC) over 6 inches of crushed rock base (CRB) over compacted subgrade;
- **For public roadways**: 3 inches of asphalt concrete (AC) over 9 inches of CRB over compacted subgrade or follow the City of Issaquah's special requirement about roadway.

The asphalt paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for Hot Mix Asphalt Class 1/2 inch and CRB surfacing. If concrete driveway is preferred, the following section can be used.

- **For concrete driveways**: 5 inches of concrete over 4 inches of CRB over compacted subgrade

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than 2 percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

5.9 SPECIAL DESIGN RECOMMENDATIONS

5.9.1 NEWPORT WAY WIDENING

Roadway improvement along the south side of Newport Way will require up three areas with excavations up to 14 feet with a total horizontal distance of about 500 feet. RGI recommends that shoring be installed prior to excavating in these areas. RGI expects that a cantilevered soldier pile wall or soldier pile wall with single row of tieback will be

adequate for this wall height. The pressure diagrams in Figure 5a and 5b should be used for the retaining wall design.

Table 8 Newport Way

Start (Station)	End (Station)	Recommendation
15+75	17+75	Permanent Wall Use Figure 5a or 5b
19+00	20+75	Permanent Wall Use Figure 5a
22+50	23+50	Permanent Wall Use Figure 5a

5.9.2 NEW ROADWAYS

Road A will require up cut up approximately 12 feet from the start of the road to Station 23+75, minor cut/fill to Station 25+00, and deep fills up to 22 feet from Station 26+75 to 28+50 to cross the existing stream. Except for the right side from Station 20+50 to Station 23+75 where a 2:1 (Horizontal: Vertical) cutslope will adequate, shoring should be installed before the excavation for the rest of the grading. Permanent retaining walls should be design based on pressure diagrams in Figure 5a and 5b for all cut areas. For new fill area, use the pressure diagrams in Figure 5d and 5e for retaining wall design.

Table 9 Road A

Start	End	Left	Right
20+50	23+75	Wall use Figure 5a or 5b	2:1 (H:V) Cutslope
23+75	25+25	Wall use Figure 5a or 5b	Wall use Figure 5d or 5e
25+25	25+50	2:1 (H:V) Cutslope	Wall use Figure 5d or 5e
25+50	26+00	Wall use Figure 5d or 5e	Wall use Figure 5d or 5e
26+00	27+50	Wall use Figure 5a or 5b	2:1 (H:V) Cutslope
27+50	29+50	Wall use Figure 5a or 5b	Lots 50 to 57
29+50	30+50	Cutslope, no wall needed	Cutslope, no wall needed

Road B is located on the top of the ridge and will require major excavation to reach the finish grade for residential lots to access the road. No retaining walls will be needed.

Road C will require for crossing a wetland or Track H. A culvert and walls will be used to reduce the wetland disturbance. Shallow cuts will be needed for the rest of the road. At end of the road or cul-de-sac, excavation will be needed towards the West Reservoir at the right side and fills up to 10 feet will be needed in the left side.

RGI recommends that the temporary shoring for vault excavation be installed for excavation in the cul-de-sac area. The current grading plan show a permanent cutslope

towards the reservoir at the west of the cul-de-sac. RGI recommends that a permanent retaining wall be installed instead of a cutslope. The retaining wall should be designed using pressure diagrams in Figure 5a or 5b.

5.9.3 STORMWATER VAULTS

At the time of preparing this report, detailed design is not available for the stormwater vaults. Based on our experience of similar projects RGI expects that excavation from 10 to 15 feet will be needed for the excavation. RGI recommends that temporary shoring be installed for the excavations in accordance with the following table. Temporary cut slopes can be used in limited areas away from steep slopes and existing streets.

Table 13 Utility Vaults

Number	Location	Recommendation
1	End of Road C near Westside Reservoir	Temporary cutslope on eastside, shoring use Figure 5f or 5g on three sides
2	All Vaults along Newport Way	Shoring use Figure 5f or 5g on all four sides

Reconnaissance of the stream channels showed fairly deep incisions into dense native deposits with near vertical walls in some areas, while other areas appear to be slope wash/colluvium that is eroding during higher flow rates. The streams do not appear to have significant flows, and may dry up in the summer.

During the design phase, RGI recommends that the discharge rates from the vaults be controlled to match current flow rates and energy dissipaters be installed at three outflow locations. An energy dissipater is typically consisting of a pipe diffuser tee and a splash pad includes two feet of quarry spalls over 6 inches of railroad ballast over geotextile fabric. RGI can provide details during final design phase.

5.9.4 RESIDENTIAL LOTS

The preliminary site grading will require mass excavation up to 30 feet for 25 lots, fill up to 14 feet for 11 lots, cut/fill for 42 lots. Most of the lots don't need retaining walls except Lot 43 to 45 where short retaining walls will be needed. Based on our slope stability analysis, adding fill over the top of steep slope will decrease the safety factors. RGI recommends that the final grading design minimize or eliminate fill for Lots 45, 46, 49, and 50 that are close the steep slope area. RGI also recommends that extend the retaining wall between Road C and Westside Reservoir further south and eliminate the shoring retaining walls in Lot 43 to 45.

Table 14 Residential Lots

Lots	Grading	Recommendation
1-14	Cut	Summer construction, positive drains
50-57	Fill	Follow structural fill requirements
Others	Cut/Fill	Retaining wall from Lot 36 to 43 using Figure 5d or 5e with a support load of 25 kips/foot.

5.10 FURTHER WORK AND ADDITIONAL DEVELOPMENT AREA

At the time of the study was performed, exploration could only be performed in limited areas due to site access. RGI recommends that further exploration be performed during design phase to verify the soil conditions. At least one test boring or test pit be performed every 200 feet along the roadway, one each stormwater vault area, one in each group of lots lot with major excavation or fill placement.

There are several areas to the west of the proposed development area that can potentially be developed in the future. These areas are not steep slopes, but still mapped as landslide hazards or other critical area. We expect that the soil conditions in these are similar to the proposed development area and can potentially be developed with proper geotechnical design and construction techniques in the future.

RGI should also provide geotechnical engineering and construction monitoring services during the construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the grading and utilities plans in order to verify that earthwork and foundation recommendations in this report are appropriate and provide supplemental recommendations as necessary.

RGI should be contracted to provide geotechnical engineering and construction monitoring services during. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. RGI can provide an estimate for these services once the construction plans and schedule have been developed.

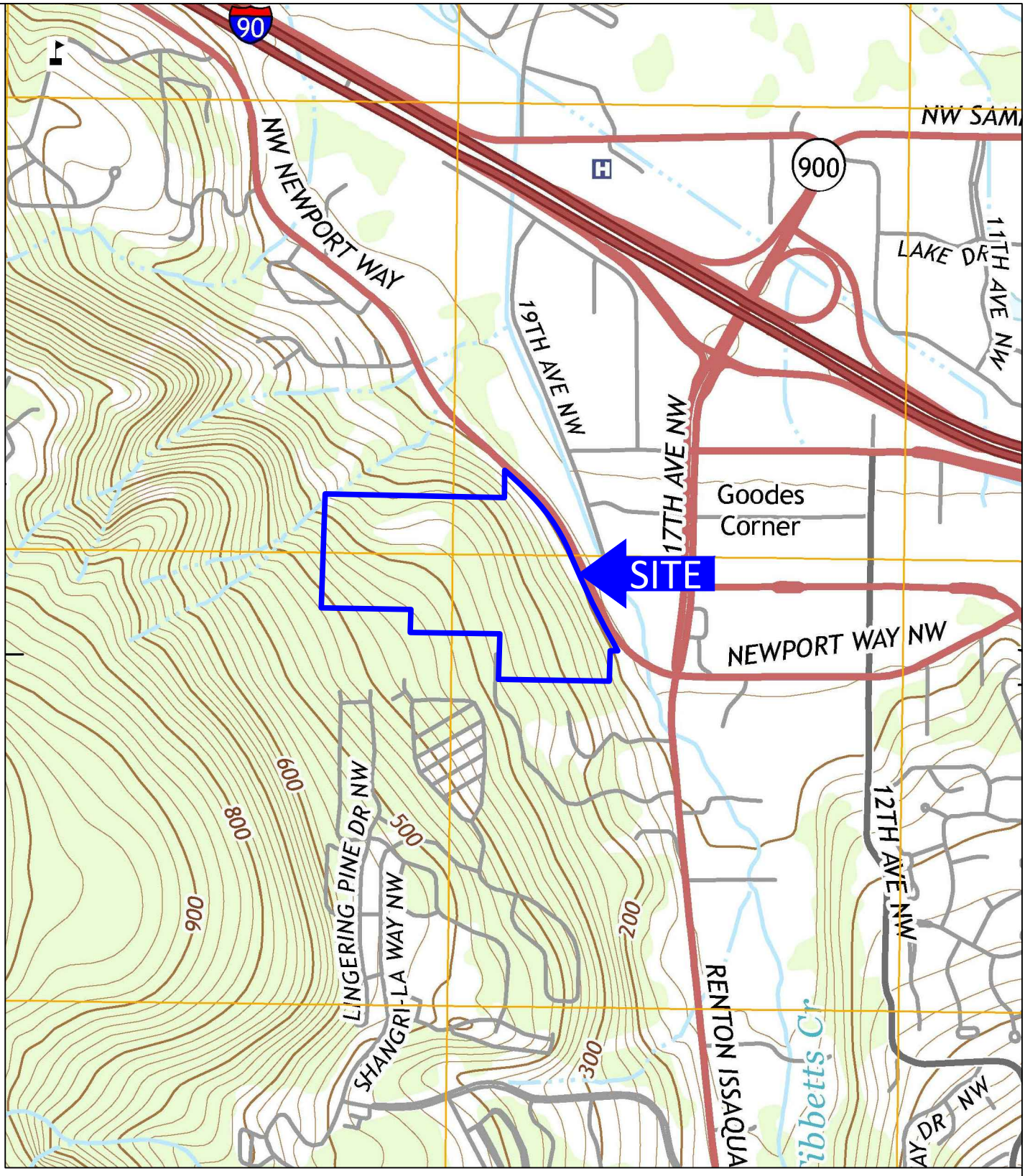
7.0 Limitations

This GER is the property of RGI, Windward Real Estate Services, Inc. and their designated agents. Within the limits of the scope and budget, this GER was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This GER is intended for specific application to the Bergsma Property at the southwest corner of Southeast Newport Way and 17th Avenue Northwest in Issaquah, Washington, and for the exclusive use of Windward Real Estate Services, Inc. and its authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this GER are based upon review of the previous explorations on the site by Geotechnical Investigations Group. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this GER prior to proceeding with construction.

It is client's responsibility to see that all parties to the project, including the designers, contractors, subcontractors, are made aware of this GER in its entirety. The use of information contained in this GER for bidding purposes should be done at the contractor's option and risk.



USGS, 2014, Issaquah, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

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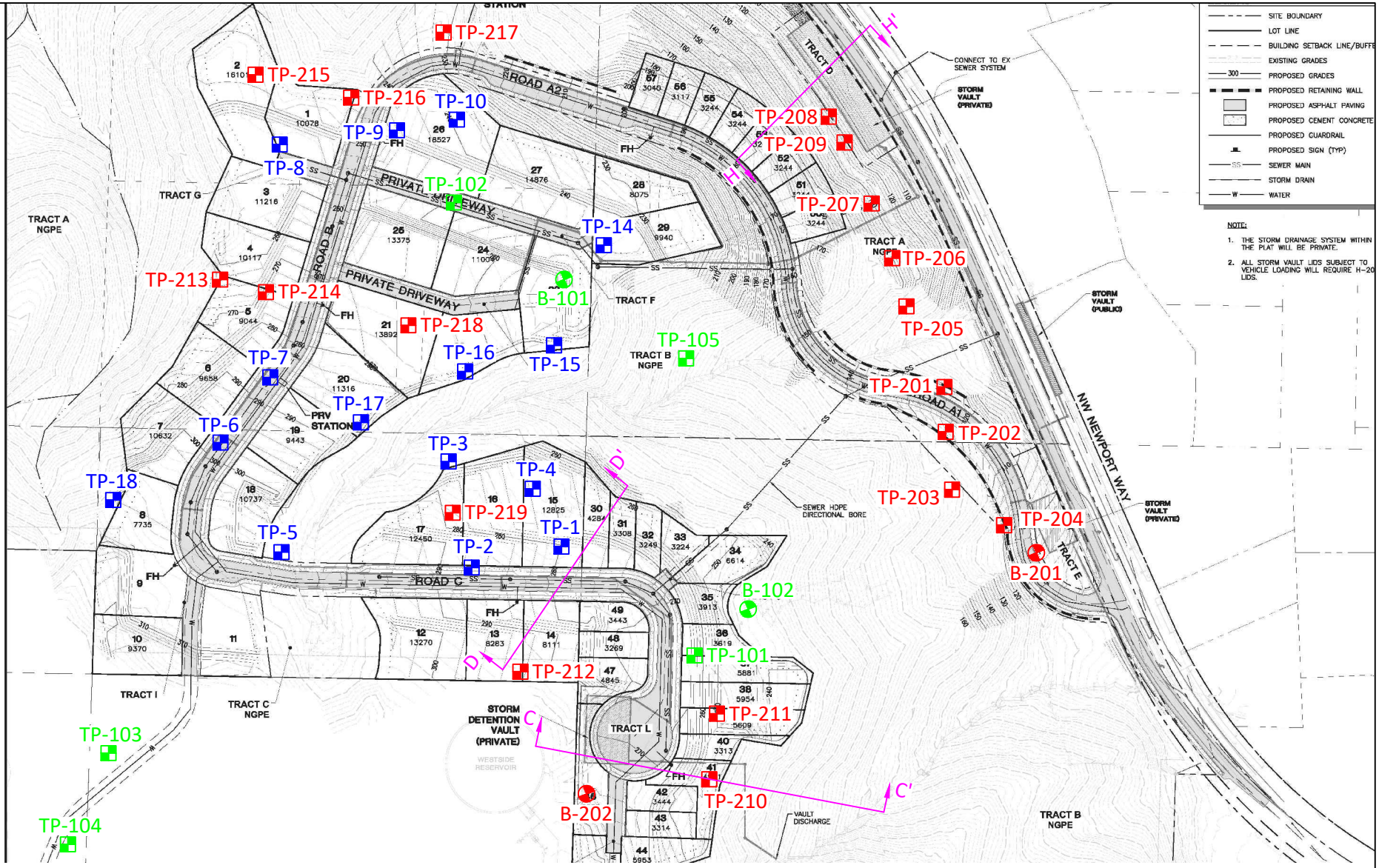
Bergsma Property		Figure 1
RGI Project Number 2015-046	Site Vicinity Map	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



= Boring Location by RGI, 05/2016
= Test Pit Location by RGI, 05/2016
= Boring Location by RGI, 01/12/16
= Test Pit Location by RGI, 12/30/15
= Test Pit Location by Geotechnical Investigations Group
= Cross Section Location

Drawn from Pace, Preliminary Plat, C4.0, 10/23/17.

Approximate Scale: 1"=120'

0 60 120 240

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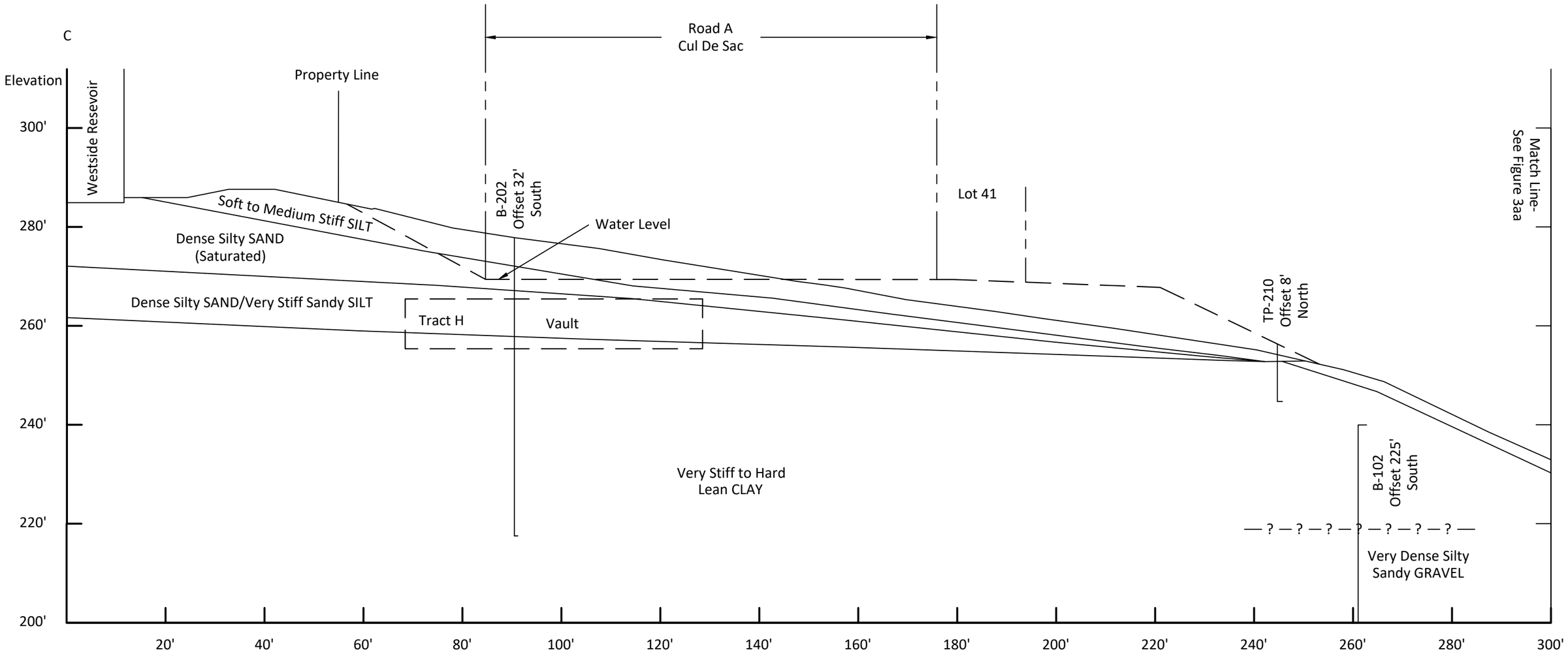
Bergsma Property		Figure 2
RGI Project Number 2015-046	Geotechnical Exploration Paln	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



Approximate Scale: 1"=20'

0 10 20 40

N

= Existing Ground Surface

= Proposed Ground Surface

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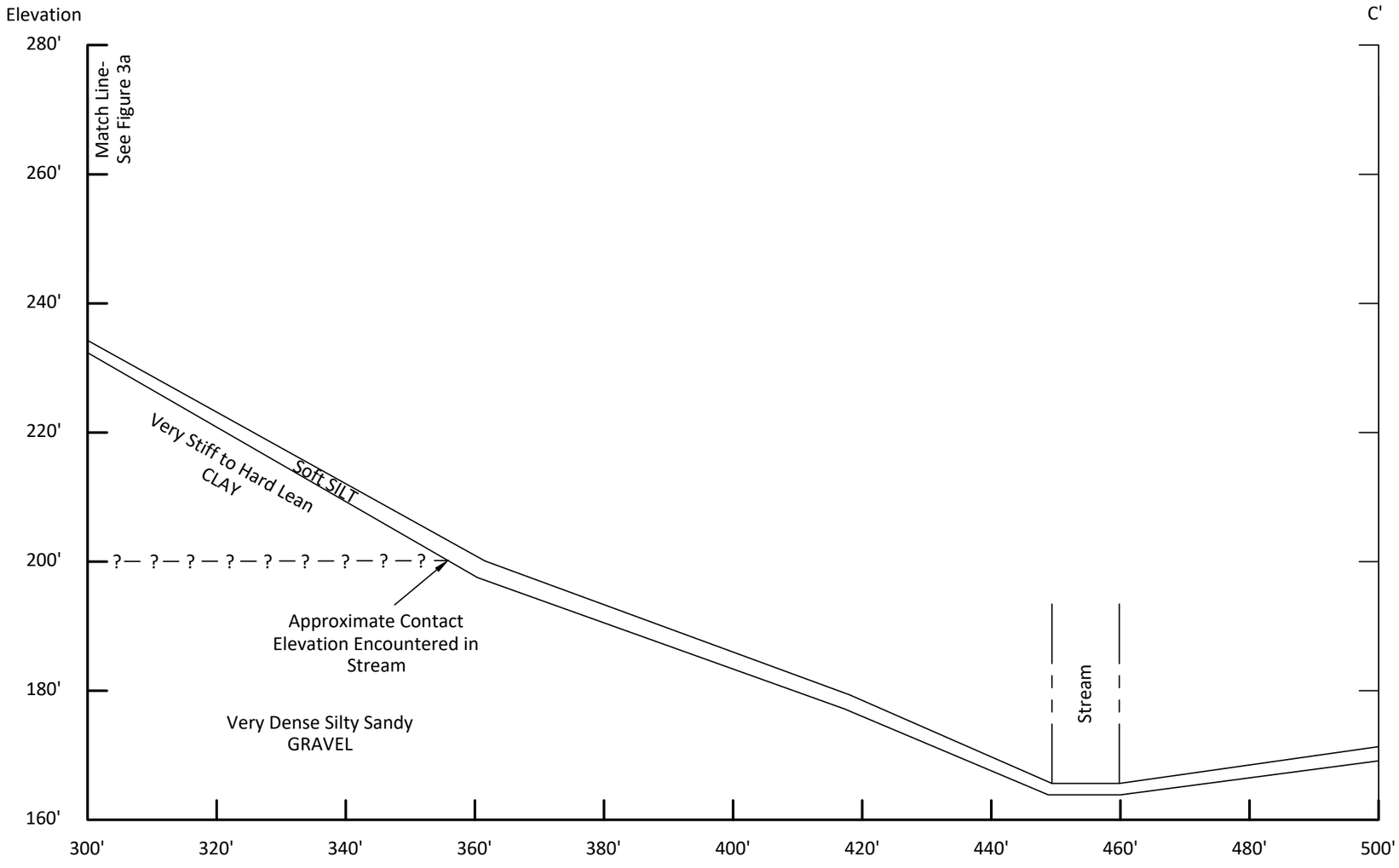
Bergsma Property		Figure 3a
RGI Project Number 2015-046	Cross Section C-C'	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



Approximate Scale: 1"=20'

0 10 20 40

N

= Existing Ground Surface

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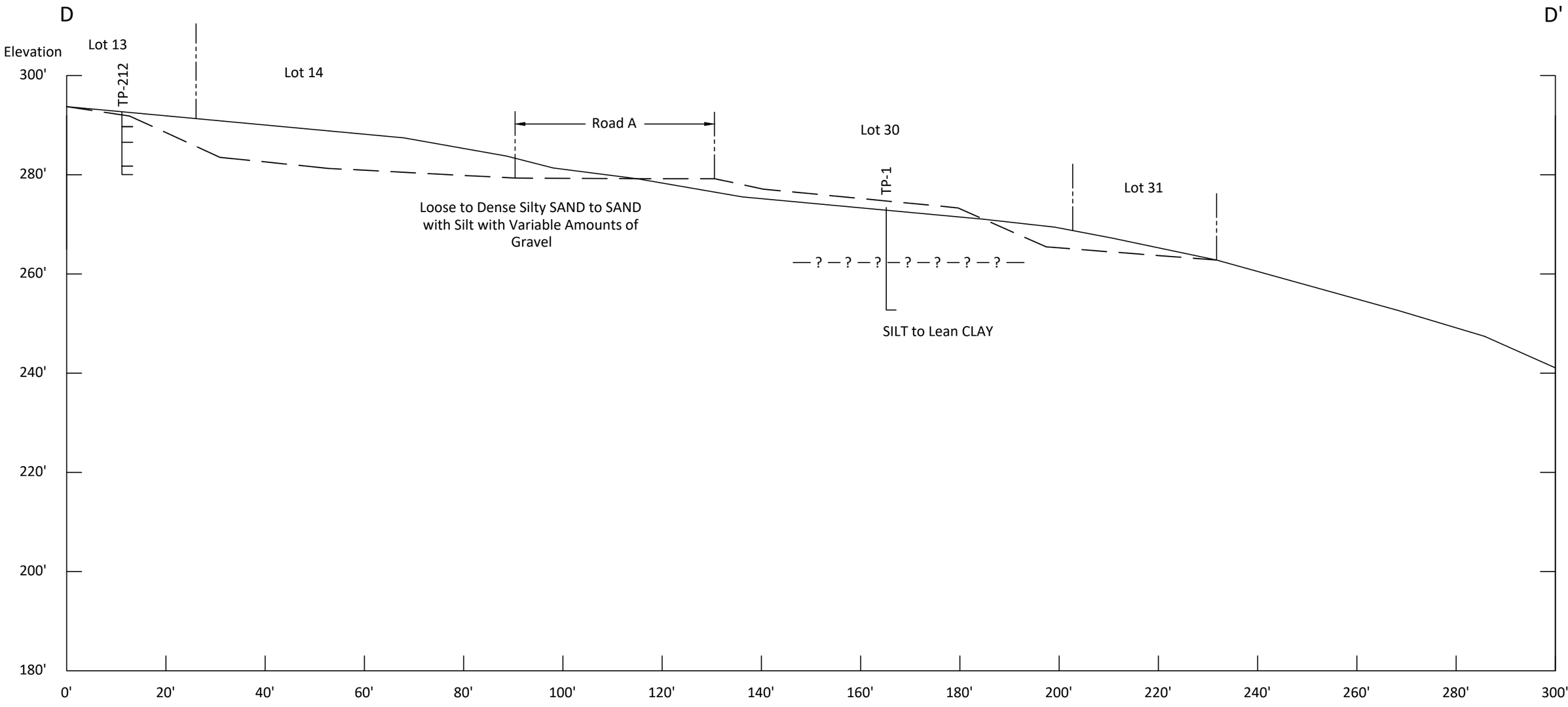
Bergsma Property		Figure 3aa
RGI Project Number 2015-046	Cross Section C-C' Continued	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



Approximate Scale: 1"=20'

0 10 20 40

N

———— = Existing Ground Surface

— — — — — = Proposed Ground Surface

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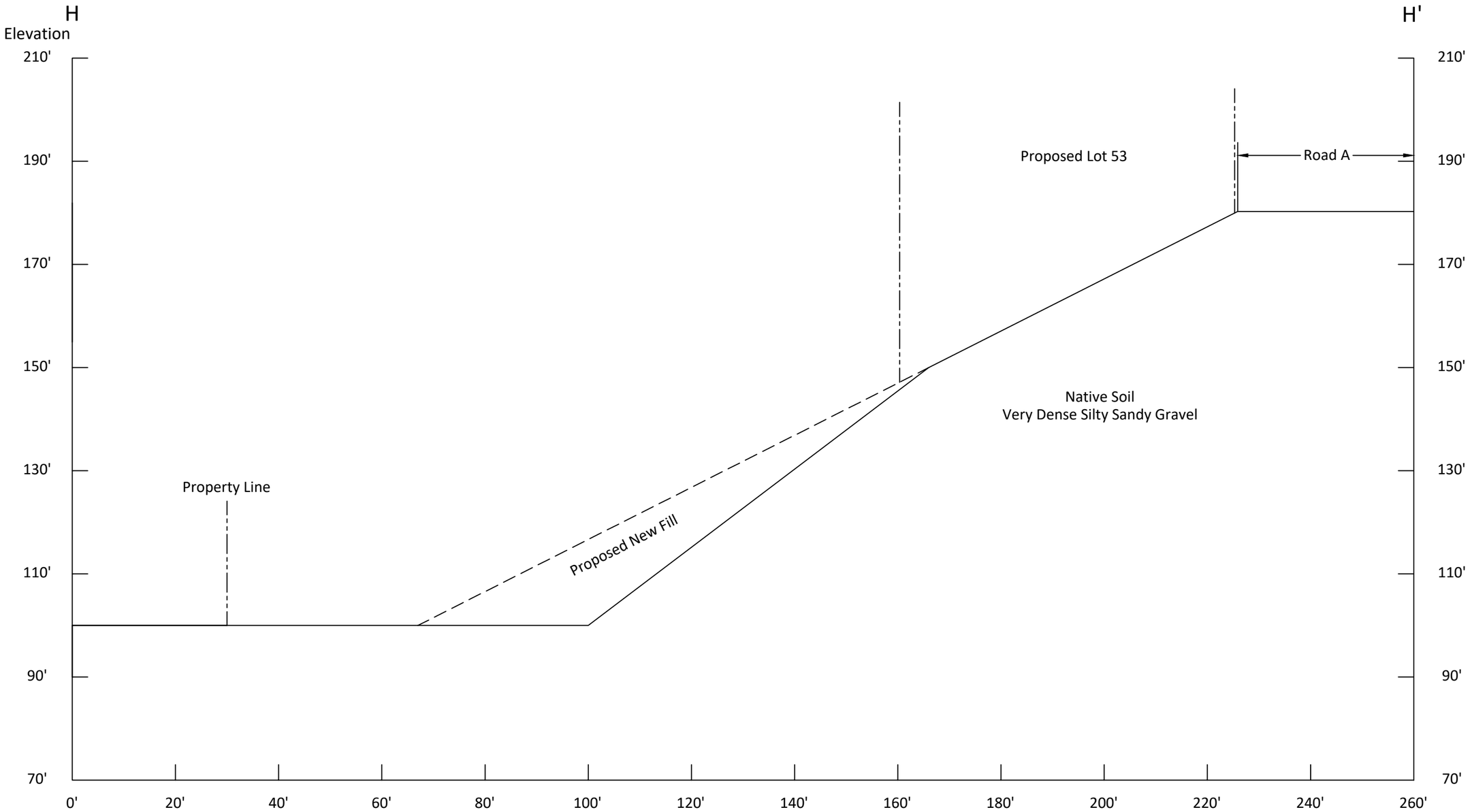
Bergsma Property		Figure 3b
RGI Project Number 2015-046	Cross Section D-D'	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



Approximate Scale: 1"=20'

0 10 20 40

N

= Existing Ground Surface

= Proposed Ground Surface

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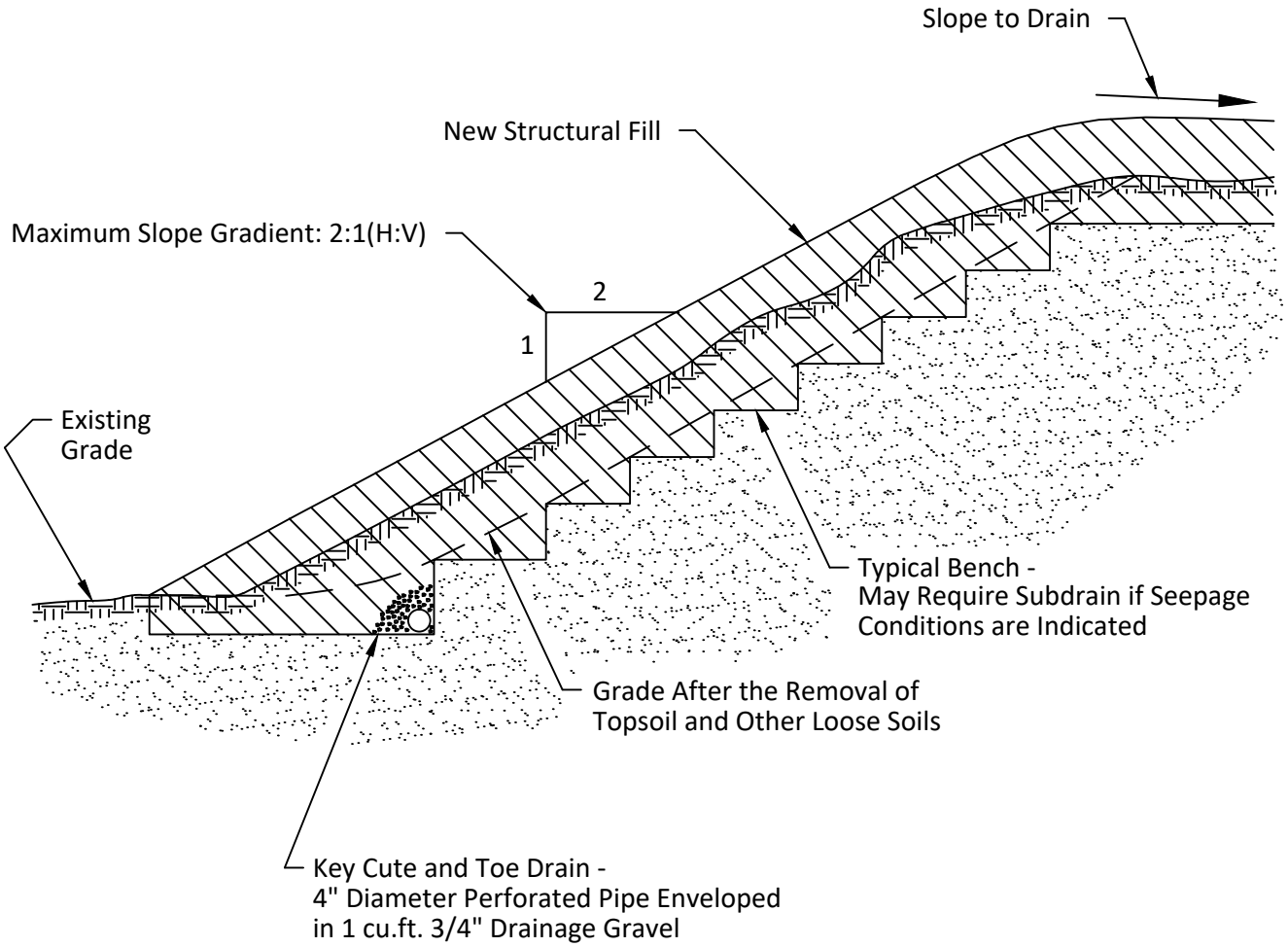
Bergsma Property		Figure 3c
RGI Project Number 2015-046	Cross Section H-H'	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



Notes

1. Slope should be stripped of topsoil and unsuitable soils prior to placing any fill.
2. "Benches" should be a minimum of 6 feet wide.
3. "Key" should be minimum 2 feet deep and 6 feet wide, extending the full length of the slope face.
4. Final slope face should be densified by compaction.
5. Plant or hydroseed slope face to reduce erosion potential.
6. All structural fill should be compacted to 95% of soils maximum dry density per ASTM D-1557 (modified proctor).

Not to Scale

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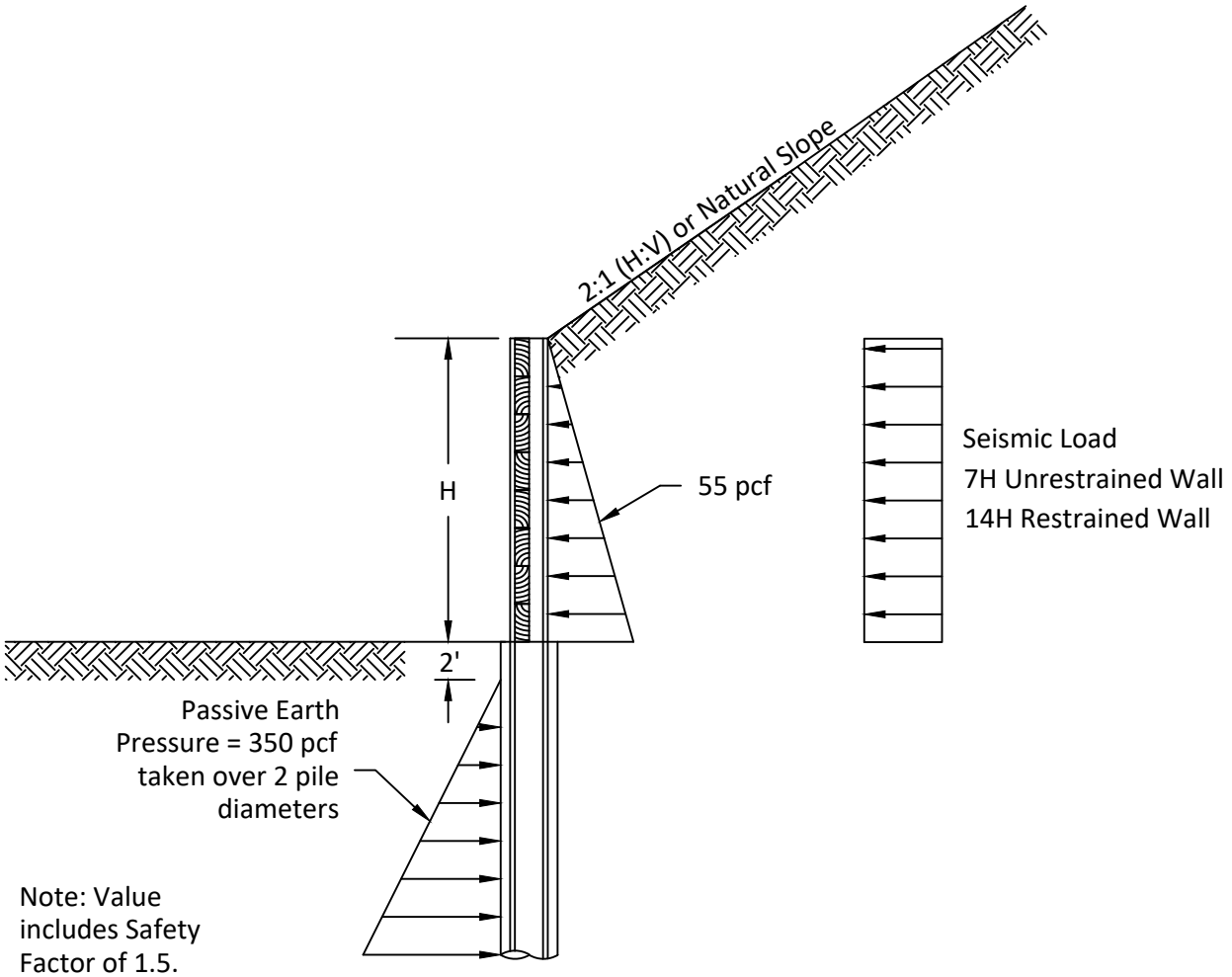
Bergsma Property		Figure 4
RGI Project Number 2015-046	General Slope Fill Detail	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

EARTH PRESSURE DESIGN PARAMETERS FOR CANTILEVERED SOLDIER PILE WALL WITH SLOPED CUT



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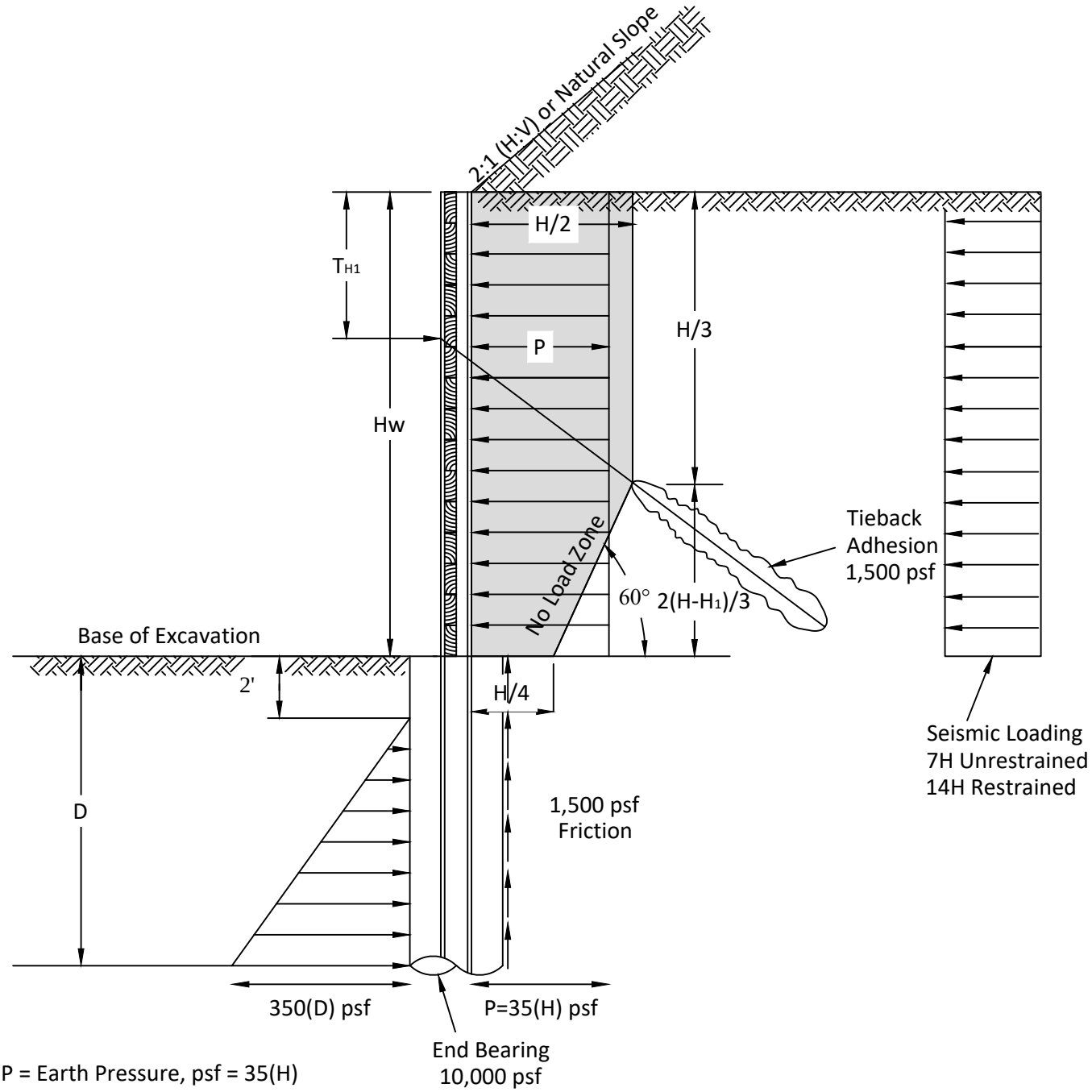
Bergsma Property		Figure 5a
RGI Project Number 2015-046	Soldier Pile Pressure Diagram For Cut	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

Earth Pressure Diagram Parameters for Single Tieback Wall



P = Earth Pressure, psf = 35(H)

H_1 = Distance from top of wall to tieback

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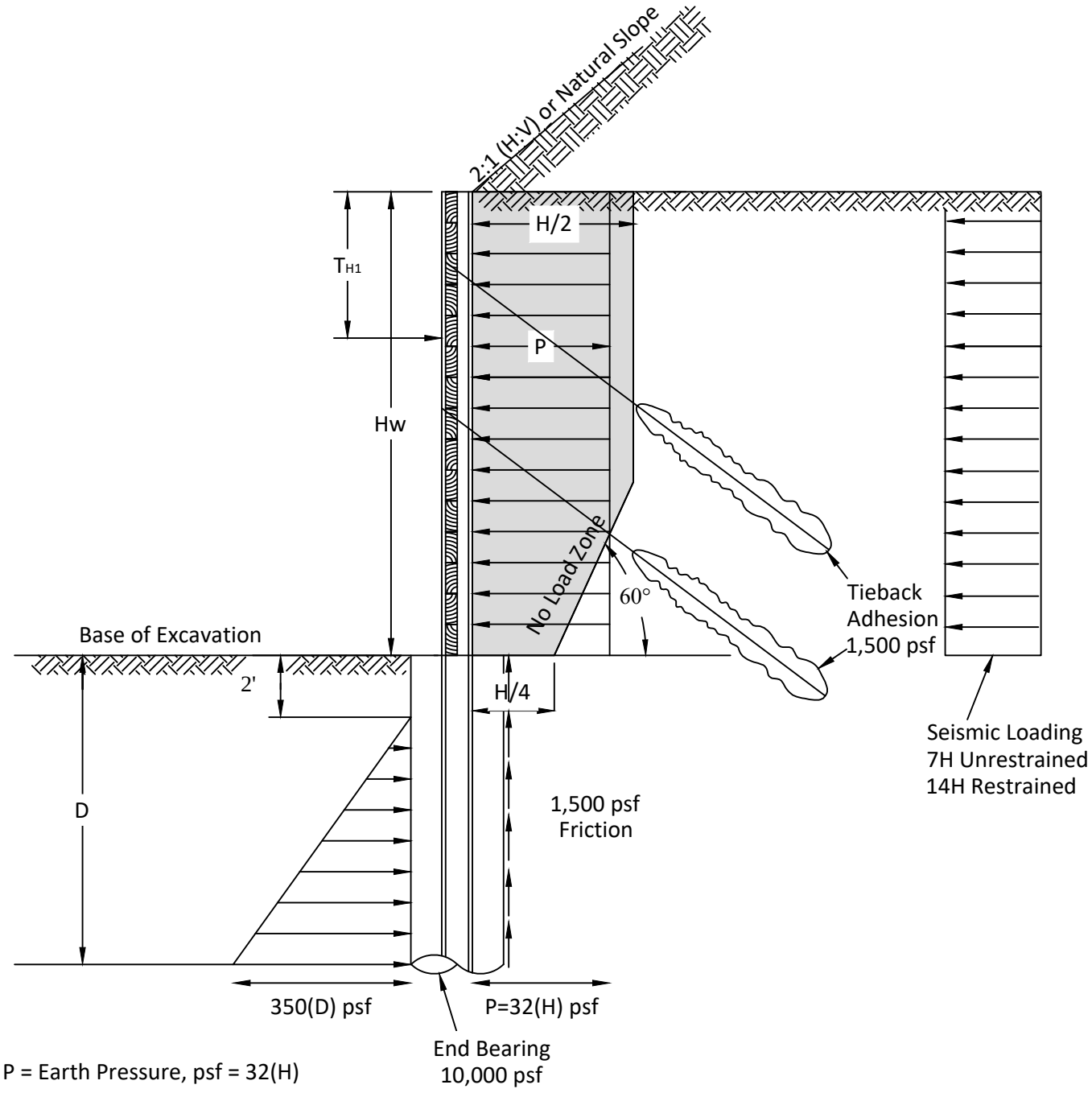
Bergsma Property		Figure 5b
RGI Project Number 2015-046	Earth Pressure - Single Tieback For Cut	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

Earth Pressure Diagram Parameters for Multiple Tieback Wall



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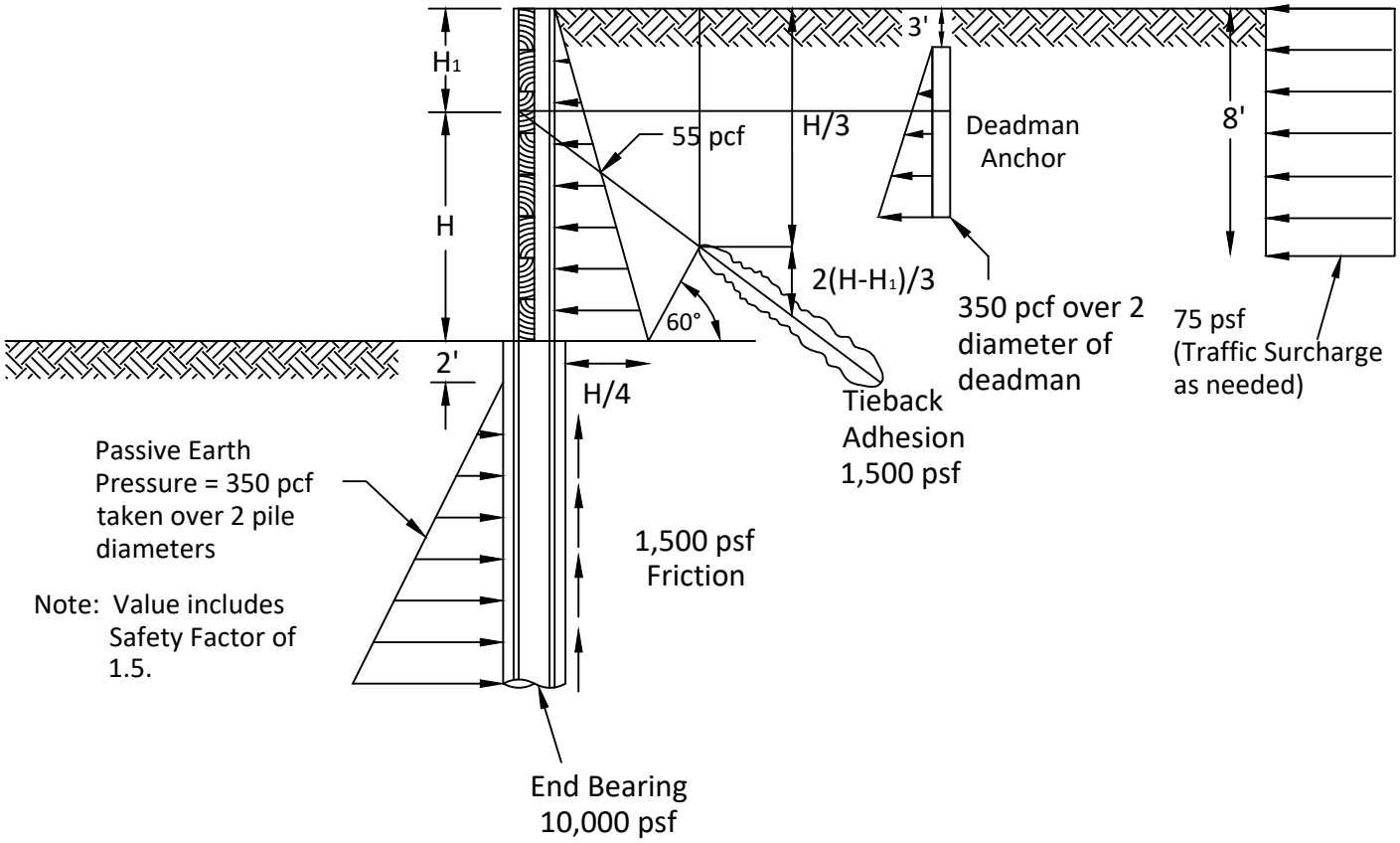
Bergsma Property		Figure 5c
RGI Project Number 2015-046	Earth Pressure - Multiple Tieback For Cut	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

Earth Pressure Design Parameters
for Soldier Pile Cantilever or Single Tieback Wall- For Fill



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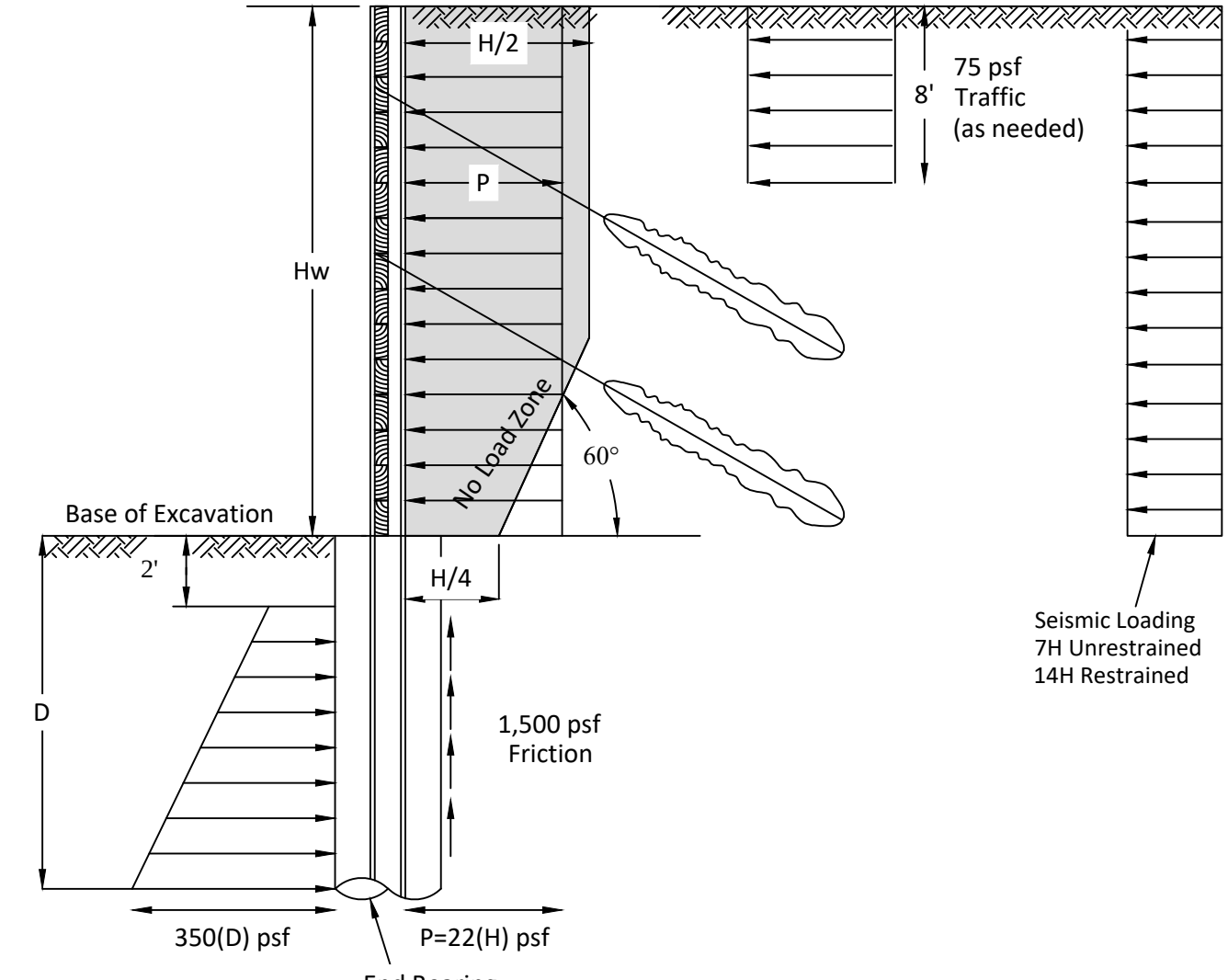
Bergsma Property		Figure 5d
RGI Project Number 2015-046	Soldier Pile Pressure Diagram For Fill	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

Earth Pressure Diagram Parameters
for Multiple Levels of Tiebacks - For Fill



P = Earth Pressure, psf = 22(H)

H = Hw

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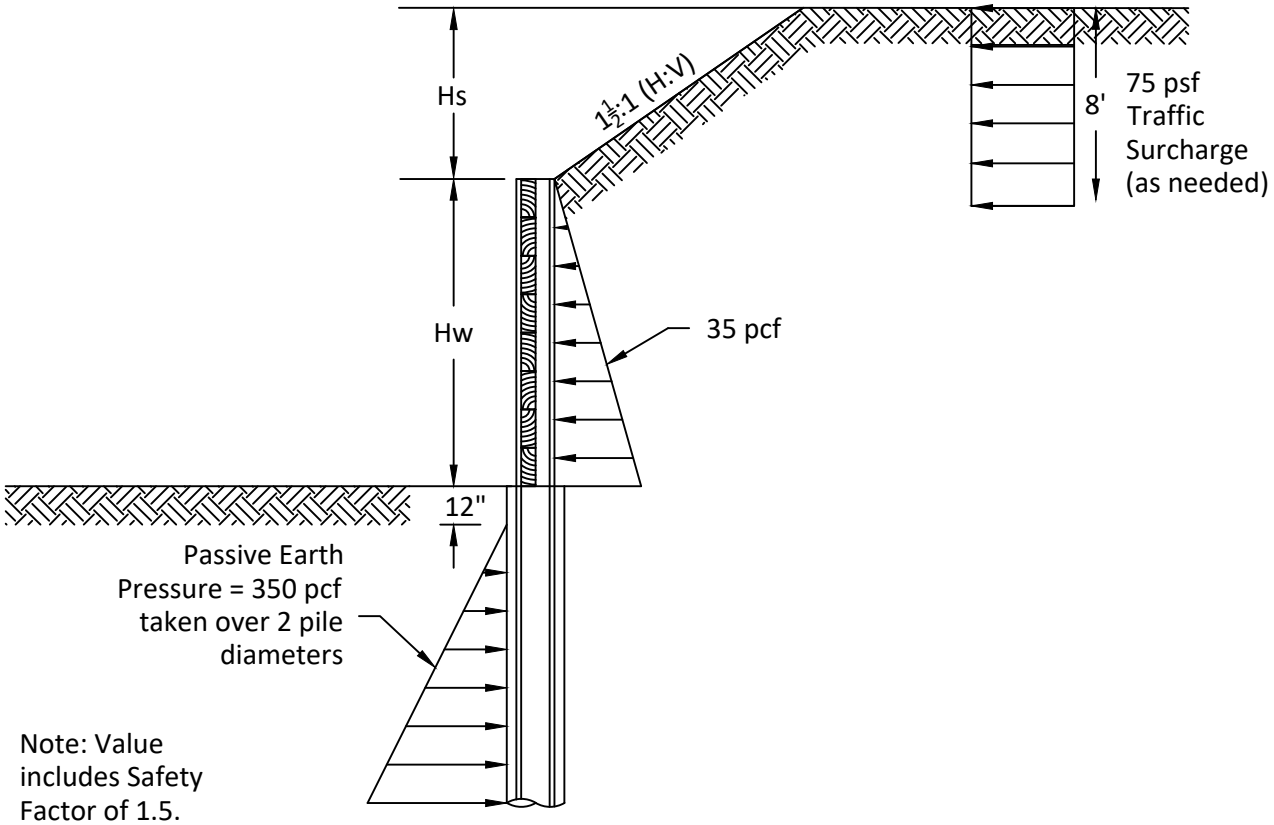
Bergsma Property		Figure 5e
RGI Project Number 2015-046	Earth Pressure - Multiple Tieback for Fill	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

EARTH PRESSURE DESIGN PARAMETERS FOR CANTILEVERED SOLDIER PILE WALL WITH SLOPED CUT



Total Height $H = Hw + \frac{Hs}{2}$

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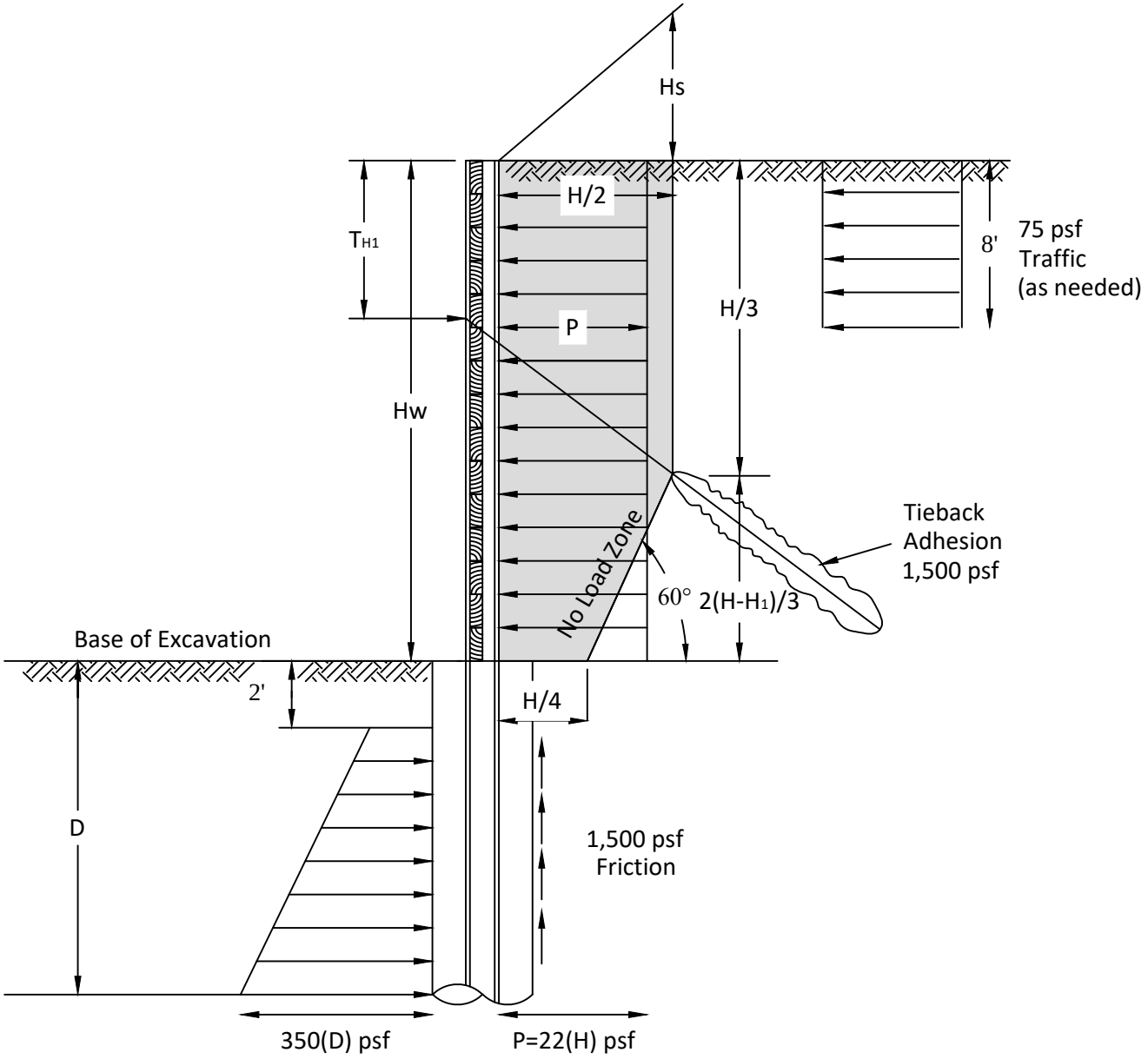
Bergsma Property		Figure 5f
RGI Project Number 2015-046	Soldier Pile Pressure Diagram - Temporary	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

Earth Pressure Diagram Parameters for Single Tieback Wall - Temporary



P = Earth Pressure, psf = 22(H)

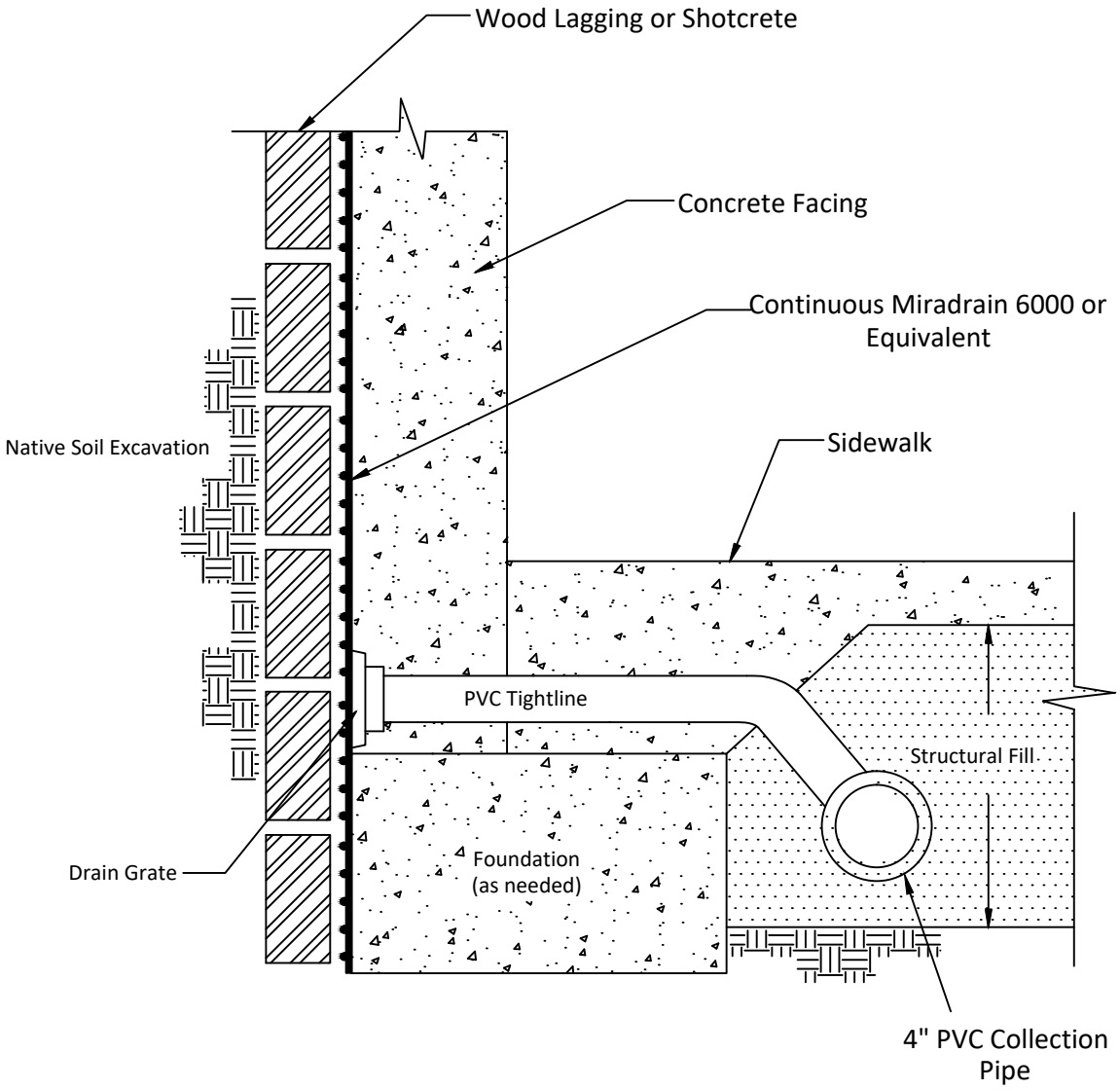
H = Hw + ½ Hs

H_1 = Distance from top of wall to tieback

H_5 ≤ 5 Feet

Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	Bergsma Property	Figure 5g
	RGI Project Number 2015-046	Soldier Pile Pressure Diagram - Temporary Date Drawn: 12/2017
	Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072	

Basement Wall Drainage Against Shoring



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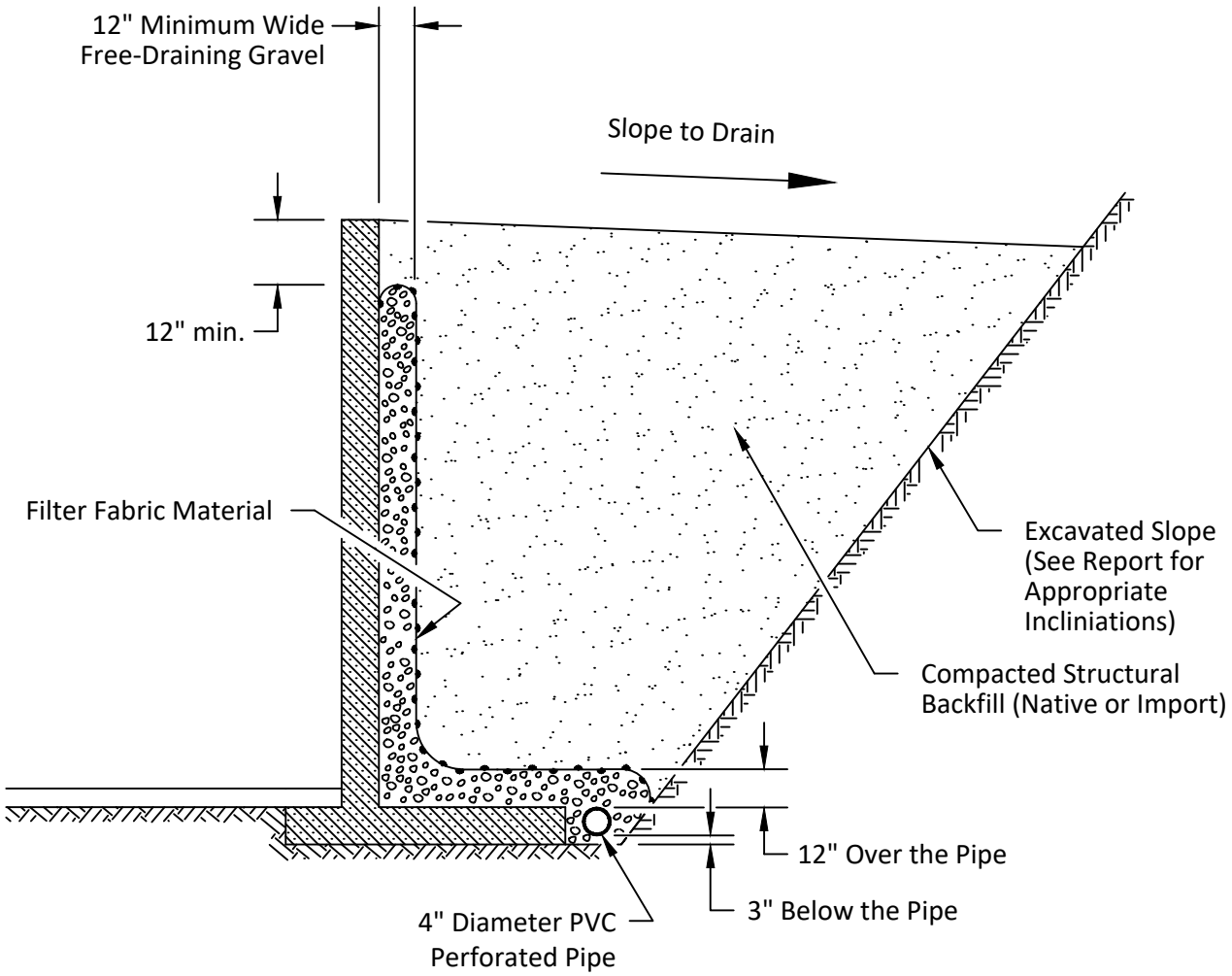
Bergsma Property		Figure 6
RGI Project Number 2015-046	Retaining Wall Drainage Detalil	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



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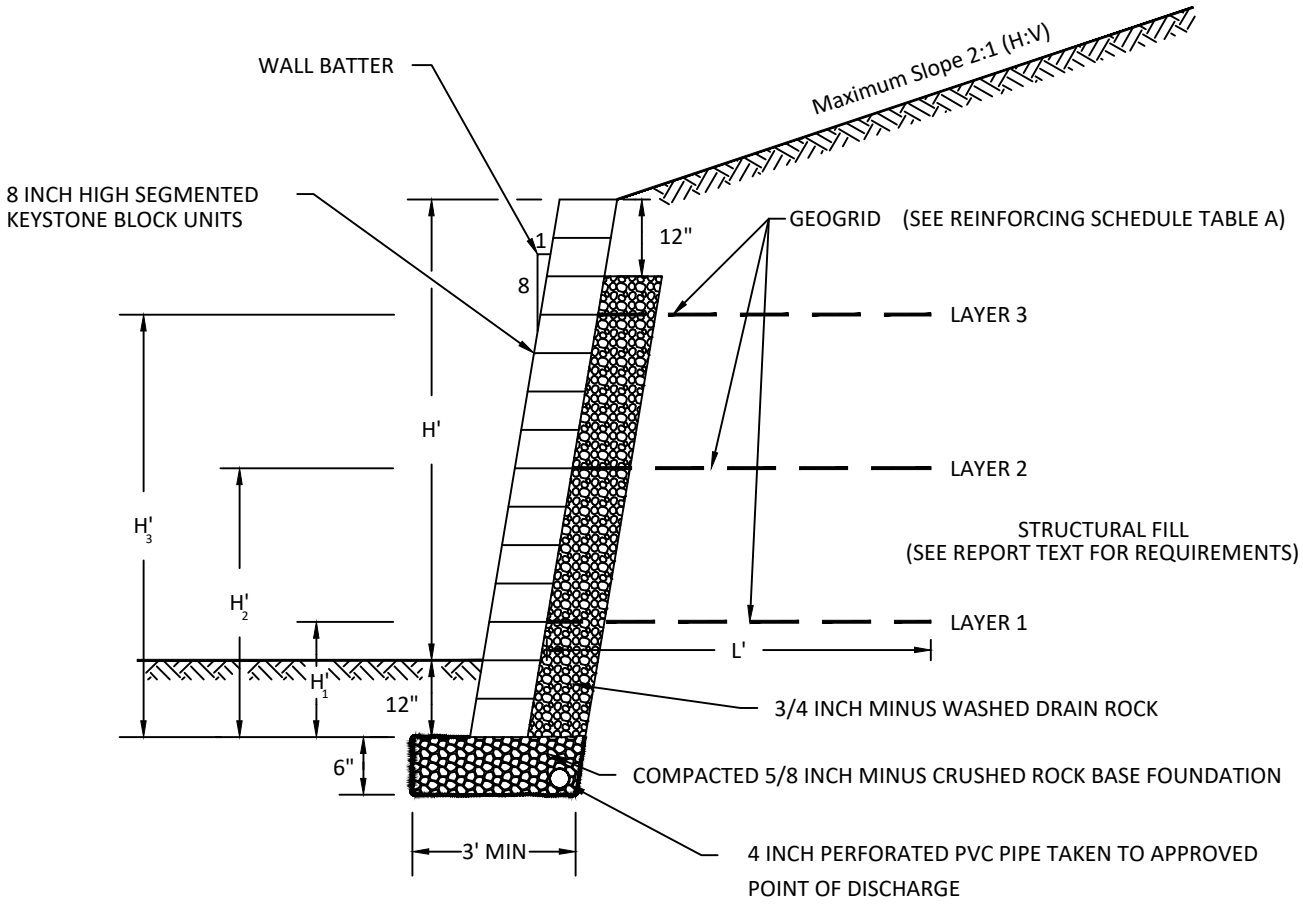
Bergsma Property		Figure 7
RGI Project Number 2015-046	Retaining Wall Drainage Detail	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



NOTES:

1. ALL GEOGRID LAYER HEIGHTS ARE MEASURED FROM TOP OF CRUSHED ROCK BASE FOUNDATION.
2. KEYSTONE BLOCK CONSTRUCTION AND CONNECTION OF GEOGRID TO WALL TO BE COMPLETED PER MANUFACTURERS SPECIFICATIONS.
3. MAXIMUM ALLOWABLE HEIGHT OF SLOPE BEHIND WALL : 5 FEET.

Not to Scale

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Bergsma Property		Figure 8a
RGI Project Number 2015-046	Keystone Wall Retaining Wall Section	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

Wall Height - 4 feet (Mirafi 5T or equivalent)

Layer No.	Length (L) (feet)	Height (H) (feet)
1	4.0	2.0

Wall Height - 6 feet (Mirafi 5T or equivalent)

Layer No.	Length (L) (feet)	Height (H) (feet)
1	4.5	2.0
2	4.5	4.0

Wall Height - 8 feet (Mirafi 7T or equivalent)

Layer No.	Length (L) (feet)	Height (H) (feet)
1	6.0	2.0
2	6.0	4.0
3	6.0	6.0

Wall Height - 10 feet (Mirafi 7T or equivalent)

Layer No.	Length (L) (feet)	Height (H) (feet)
1	7.5	2.0
2	7.5	4.0
3	7.5	6.0
4	7.5	8.0

Wall Height - 12 feet (Mirafi 7T or equivalent)

Layer No.	Length (L) (feet)	Height (H) (feet)
1	9.0	2.0
2	9.0	4.0
3	9.0	6.0
4	9.0	8.0
5	9.0	10.0

Wall Height - 14 feet (Mirafi 7T or equivalent)

Layer No.	Length (L) (feet)	Height (H) (feet)
1	11.0	2.0
2	11.0	4.0
3	11.0	6.0
4	11.0	8.0
5	11.0	10.0
6	11.0	12.0

Notes:
1. Grid length (L) measured from back of block unit;
2. Grid height (H) measured from top of crushed rock pad foundation.

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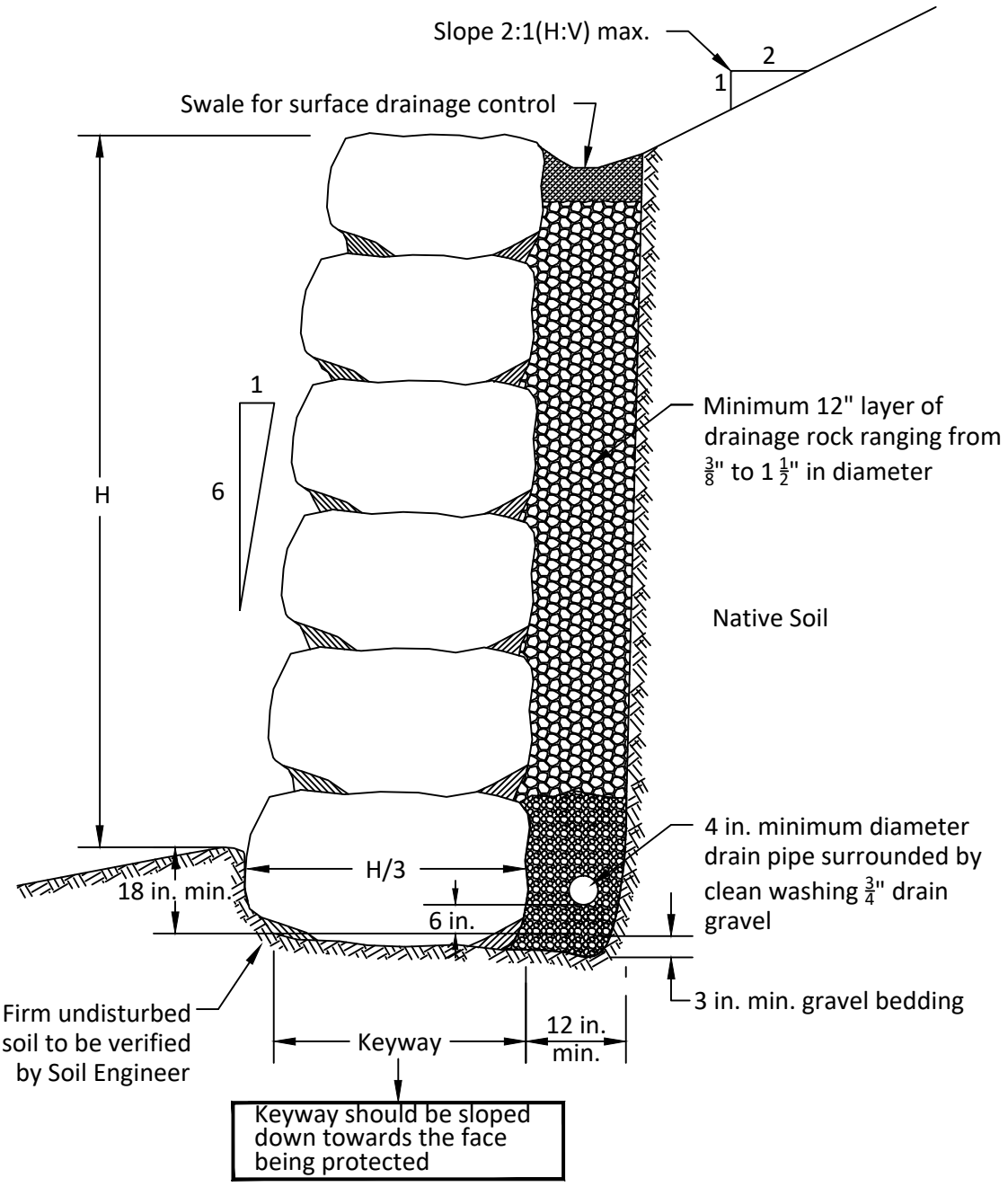
Bergsma Property		Figure 8b
RGI Project Number 2015-046	Geogrid Reinforcing Schedule	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



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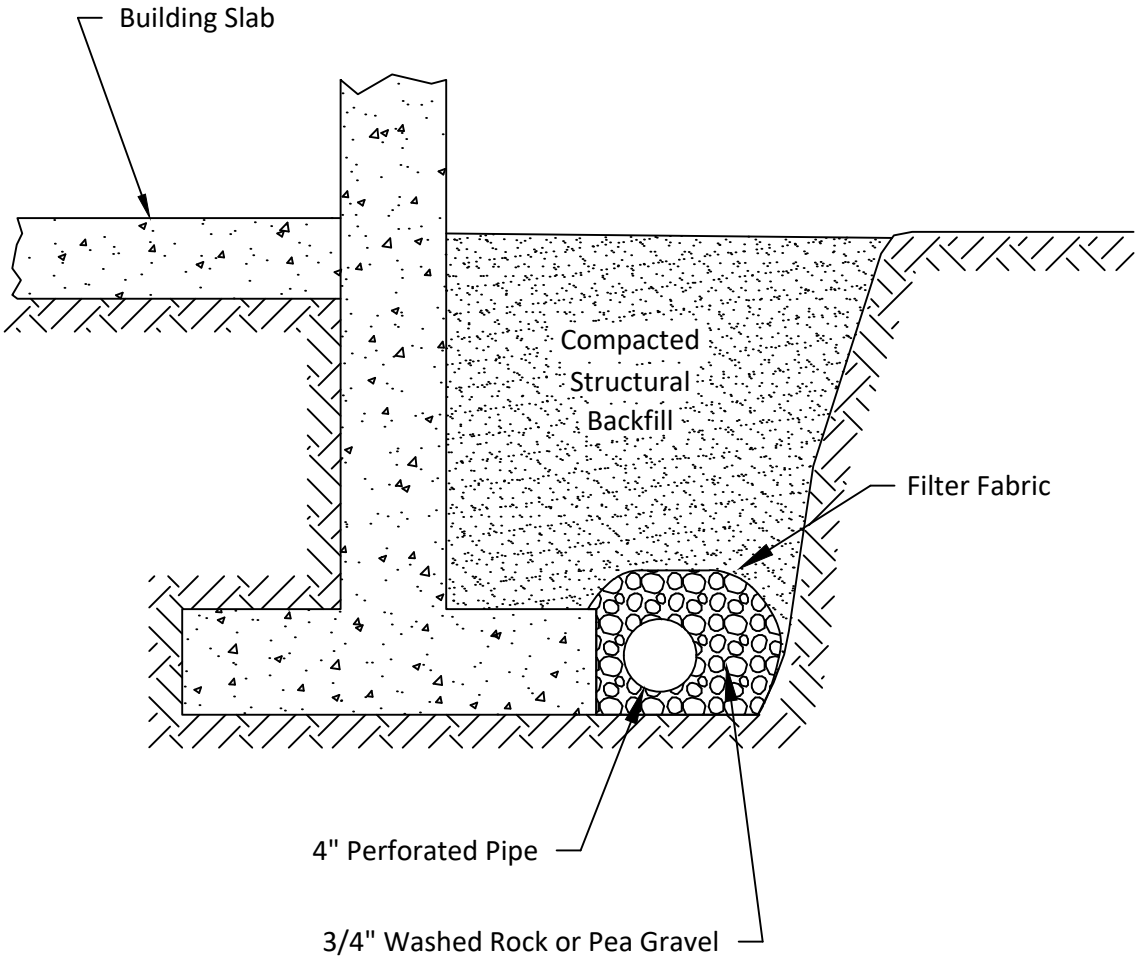
Bergsma Property		Figure 9
RGI Project Number 2015-046	Rockery Section Detail	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



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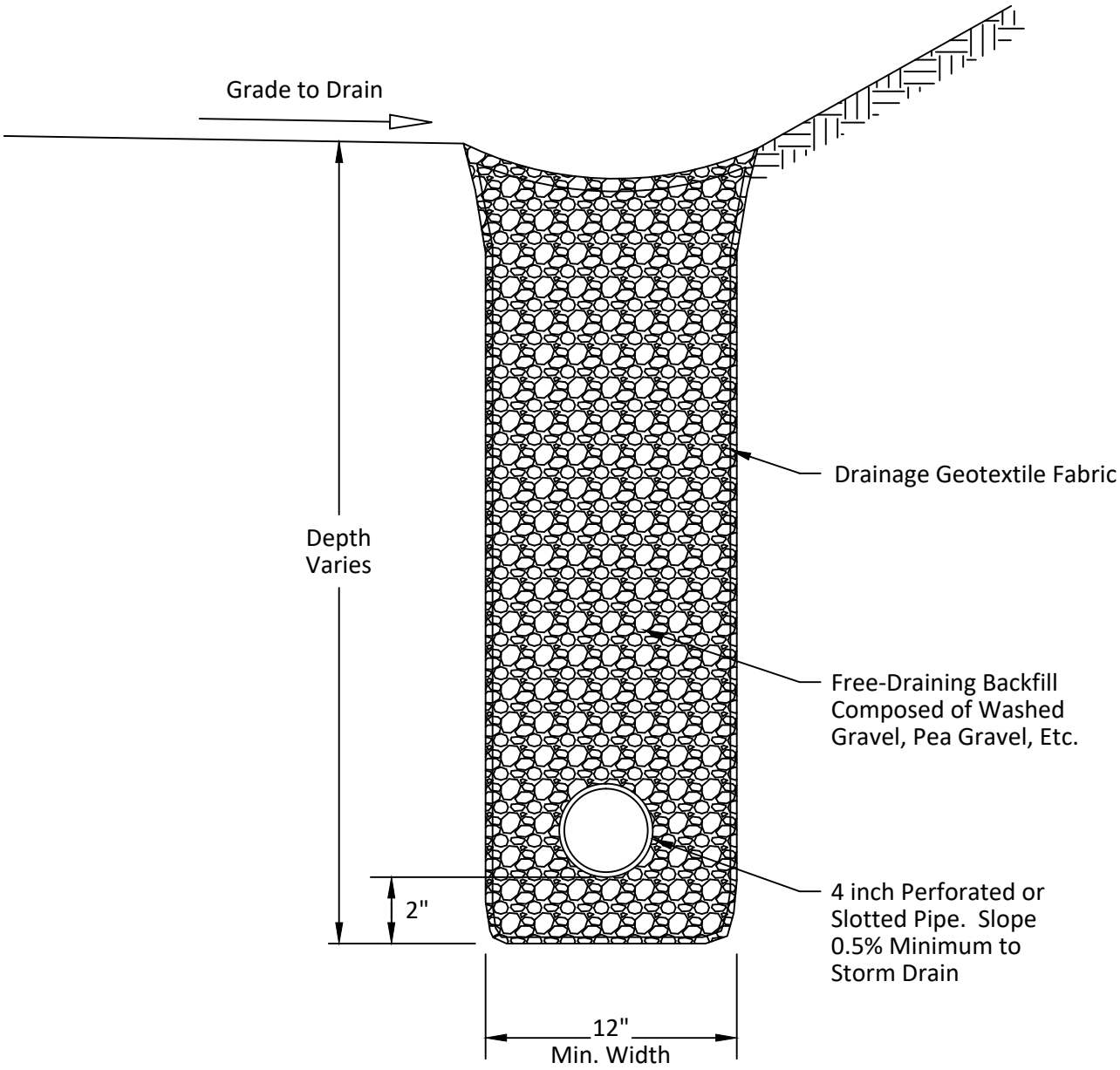
Bergsma Property		Figure 10
RGI Project Number 2015-046	Typical Footing Drain Detail	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		



Note:

Method of Drain Installation and Trench Sidewall Stability Should be Assessed by the Contractor.

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Bergsma Property		Figure 11
RGI Project Number 2015-046	Interceptor Drain Detail	Date Drawn: 12/2017
Address: Southeast Newport Way and 17th Avenue Northwest, Issaquah, Washington 98072		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On December 30, 2015 and January 12, 2016, RGI performed additional field explorations using an excavator and a track-mounted drill rig. The exploration includes five test pits to a maximum depth of 15 feet and drilling of two borings to a maximum depth of 40 feet below existing grade. From May 4 to 16, 2016, RGI performed additional field explorations using an excavator and a track-mounted sonic drill rig including 19 test pits to a maximum depth of 14 feet and drilling of two borings to a maximum depth of 60 feet below existing grade. The test pit and boring locations are shown on Figure 2.

A geologist from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each test exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in-house laboratory based on visual observation, texture, plasticity, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with ASTM D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical samples were measured and is reported on the test pit and boring logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses was determined using D6913-04(2009) Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913) on four of the samples.

Direct Shear

Three direct shear tests were performed on samples from B-202 at 9-9.5 feet, 24.5-25 feet, and 29.5-30 feet. The test was performed using Standard Test Method for Direct Shear Test of Soils under Consolidated Drained Conditions (ASTM D3080). The tests were performed by HWA GeoSciences, Inc. and the results are attached.

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

RILEYGROUP

Boring No.: **B-101**
Sheet 1 of 2

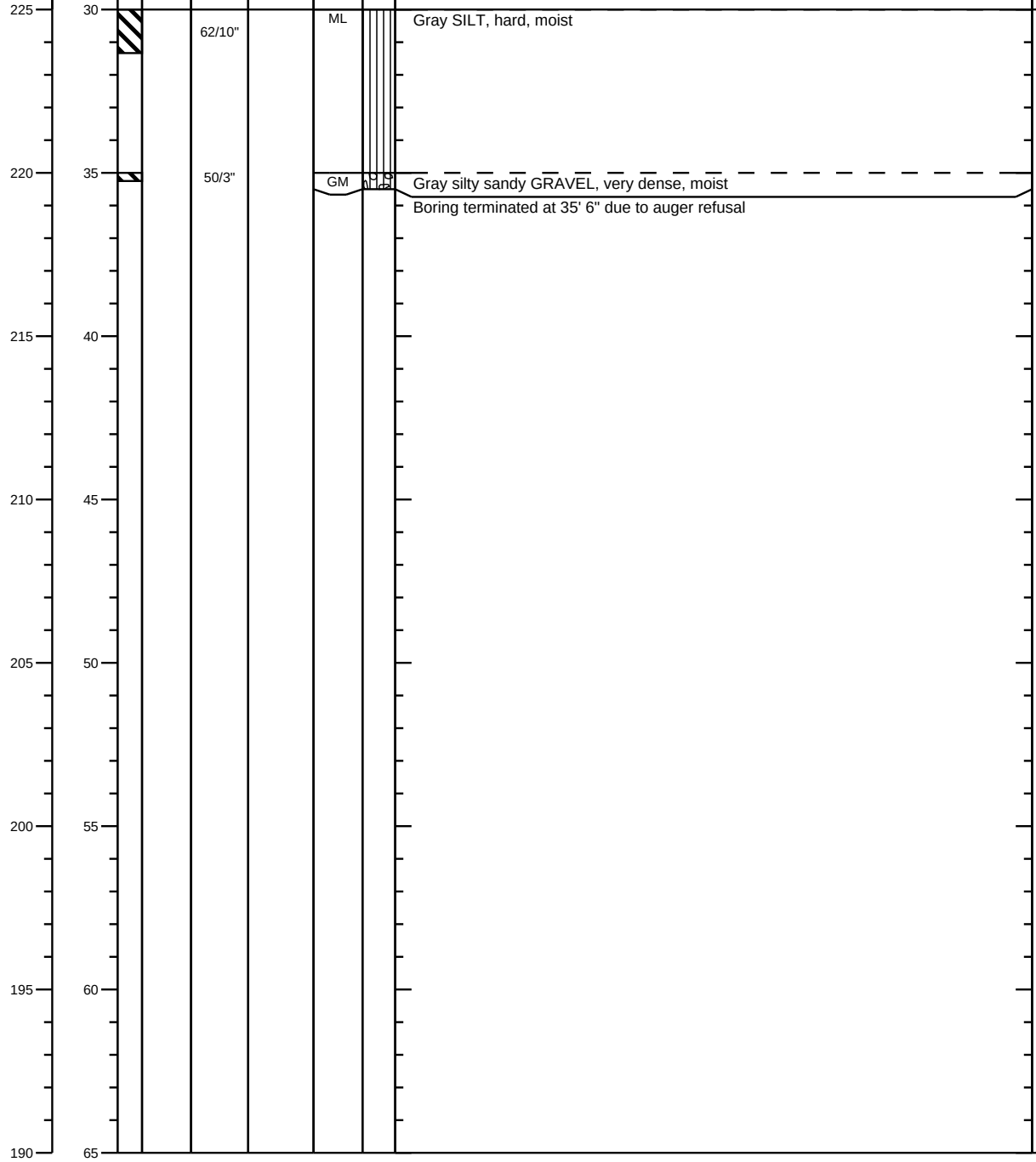
Date(s) Drilled: **1/12/2016**	Logged By: **ELW**	Surface Conditions: **Ferns**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6" auger**	Total Depth of Borehole: **35.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **255**
Groundwater Level: **Not Encountered**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
255	0							Topsoil	
						ML		Brown sandy SILT, soft, wet	
						SM		Brown silty SAND with some gravel, medium dense, moist to wet	
250	5			21					22
245	10			27					13
240	15			32		ML		Gray SILT with trace sand, hard, moist Contains thin sandy silt beds with iron oxide staining	13
235	20			89/9"		SM		Tan to gray silty SAND with trace gravel, very dense, moist	10
230	25			50/6"					7
225	30								

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

RILEYGROUP

Boring No.: **B-101**
Sheet 2 of 2



The Riley Group, Inc.
17522 Bothell Way NE, Bothell, WA 98011

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

RILEYGROUP

Boring No.: **B-201**
Sheet 1 of 2

Date(s) Drilled: **5/9/2016**	Logged By: **ELW**	Surface Conditions: **Mixed Brush**
Drilling Method(s): **Sonic**	Drill Bit Size/Type: **N/A**	Total Depth of Borehole: **50 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Cascade Drilling**	Approximate Surface Elevation: **96**
Groundwater Level: **15.93**	Sampling Method(s): **Grab**	Hammer Data : **N/A**
Borehole Backfill: **Bentonite Chips**	Location: **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
96	0							Black Topsoil	
						ML		Gray gravelly sandy SILT, soft, moist to wet	
						GM		Gray silty sandy GRAVEL, medium dense, moist	7
91	5					GW-GM		Gray sandy GRAVEL with some silt, dense, moist to wet 7% fines	5 6
86	10								7
81	15					GM		Gray silty sandy GRAVEL, dense, moist to wet 13% fines	7 6
						SP-SM		Gray gravelly SAND with some silt, dense, wet	14
76	20					SP-SM		Gray SAND with some silt, dense, water bearing	
71	25								30
						SP-SM		Gray gravelly SAND with some silt, dense, water bearing 5% fines	10
						SM		Gray silty SAND, dense, wet	19
66	30								

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

RILEYGROUP

Boring No.: **B-201**
Sheet 2 of 2

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
66	30					SM		Gray silty SAND, dense, wet	
						SM		Gray gravelly silty SAND, dense, saturated	7
						SM		Gray silty SAND, dense, water bearing	
61	35								
						SP-SM		Gray SAND with some silt, dense, water bearing	19
56	40					ML		Gray sandy SILT, hard, wet	26
						SP-SM		Gray SAND with some silt, dense, water bearing	
									20
51	45								
						ML		Gray sandy SILT, hard, wet	34
								Contains 4" organic layer, wood debris	
						SP-SM		Gray SAND with some silt, dense, water bearing	
									17
46	50							Boring terminated at 50'	
41	55								
36	60								
31	65								

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

RILEYGROUP

Boring No.: **B-202**
Sheet 1 of 2

Date(s) Drilled: **5/10/2016**	Logged By: **ELW**	Surface Conditions: **Mixed Brush**
Drilling Method(s): **Sonic**	Drill Bit Size/Type: **N/A**	Total Depth of Borehole: **60 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Cascade Drilling**	Approximate Surface Elevation: **278**
Groundwater Level: **7.18**	Sampling Method(s): **Grab**	Hammer Data : **N/A**
Borehole Backfill: **Bentonite Chips**	Location: **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	USCS Symbol	MATERIAL DESCRIPTION	Moisture (%)
278	0		Black Topsoil	
		ML	Tan mottled SILT, soft to medium stiff, moist	24
273	5	ML	Tan mottled SILT with some sand, soft to medium stiff, moist to wet	32
				29
		SM	Gray silty gravelly SAND, medium dense, moist to wet	16
		ML	Gray sandy SILT with some gravel, very stiff, moist	
268	10			
				14
263	15	SP-SM	Gray SAND with some silt and gravel, dense, moist	12
				10
258	20	ML	Gray sandy SILT with trace gravel, hard, moist	25
		CL	Gray lean CLAY , very stiff to hard, moist	41
			3.75 TSF	
253	25			
			3.75 TSF	
				31
248	30			

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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Boring No.: **B-202**
Sheet 2 of 2

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
248	30					CL		Gray lean CLAY, very stiff to hard, moist	
								Dry, shattered, trouble drilling and removing sample, high heat sample	13
								>5.0 TSF, may be high due to heat from drilling	
243	35							Trace gravel	
								No gravel	13
								2.5 TSF	
238	40							Becomes moist	26
								3.25 TSF	
									27
								3.75 TSF	
233	45								
								3.75 TSF	
228	50					ML		Gray SILT with trace sand, hard, moist	28
								Contains occasional thin fine sand bed	
								Occasional thin fine sand bed	
223	55								
								4.25 TSF	
218	60							Boring terminated at 60'	23
213	65								

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Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	Boring No.: **B-102** **Sheet 1 of 2**

Date(s) Drilled: **1/12/2016**	Logged By: **ELW**	Surface Conditions: **Blackberries**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6" auger**	Total Depth of Borehole: **40.17 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **238**
Groundwater Level: **Not Encountered**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
238	0							Topsoil	
						ML		Tan sandy SILT with some gravel, soft, wet to saturated	
233	5			11		SM		Tan silty SAND, medium dense, moist to wet	42
228	10			23		ML		Brown SILT, very stiff, moist Iron oxide staining Becomes gray, contains occasional thin fine sand bed	27
223	15			20		ML		Gray SILT, very stiff, moist	28
218	20			50/5"		GM		Gray silty sandy GRAVEL, very dense, moist Trace iron oxide staining	11
213	25			50/5"					13
208	30								

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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Boring No.: **B-102**
Sheet 2 of 2

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
208	30			50/3"		GM		Gray silty sandy GRAVEL, very dense, moist	6
203	35			50/3"					6
198	40			50/2"				Boring terminated at 40' 2"	7
193	45								
188	50								
183	55								
178	60								
173	65								

Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

Key to Log of Boring

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1. Elevation (feet): Elevation (MSL, feet).
2. Depth (feet): Depth in feet below the ground surface.
3. Sample Type: Type of soil sample collected at the depth interval shown.
4. Sample ID: Sample identification number.
5. Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6. Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7. USCS Symbol: USCS symbol of the subsurface material.
8. Graphic Log: Graphic depiction of the subsurface material encountered.
9. MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10. Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
SILT, SILT w/SAND, SANDY SILT (ML)
Silty GRAVEL (GM)
Silty SAND (SM)
Well graded GRAVEL with Silt (GW-GM)
Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
CME Sampler
Pitcher Sample
Bulk Sample
Grab Sample
2-inch-OD unlined split spoon (SPT)
3-inch-OD California w/ brass rings
2.5-inch-OD Modified California w/ brass liners
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

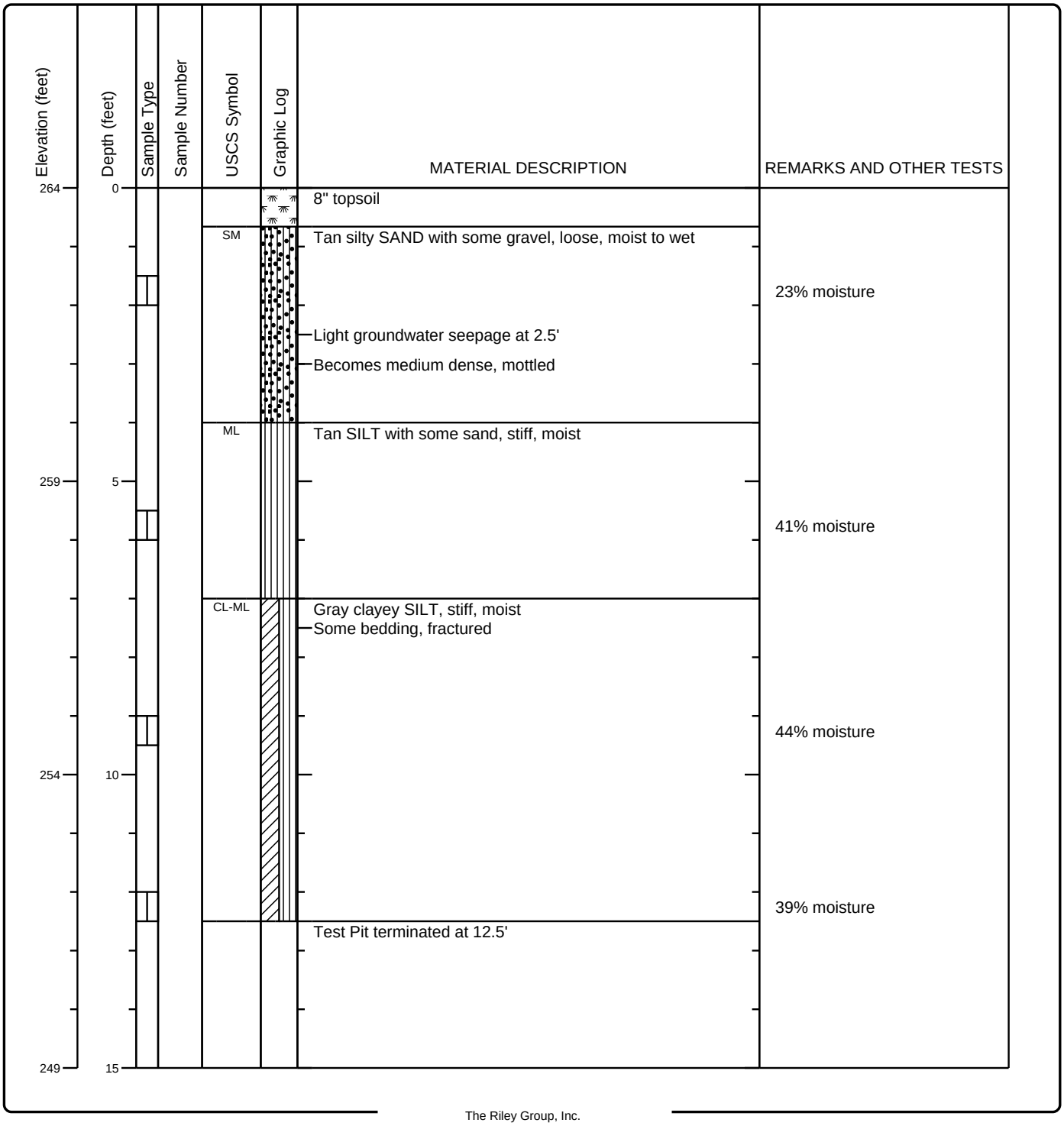
Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP **Test Pit No.: TP-101** **Sheet 1 of 1**

Date(s) Excavated: **12/30/2015**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **264**
Groundwater Level: **Seepage at 2.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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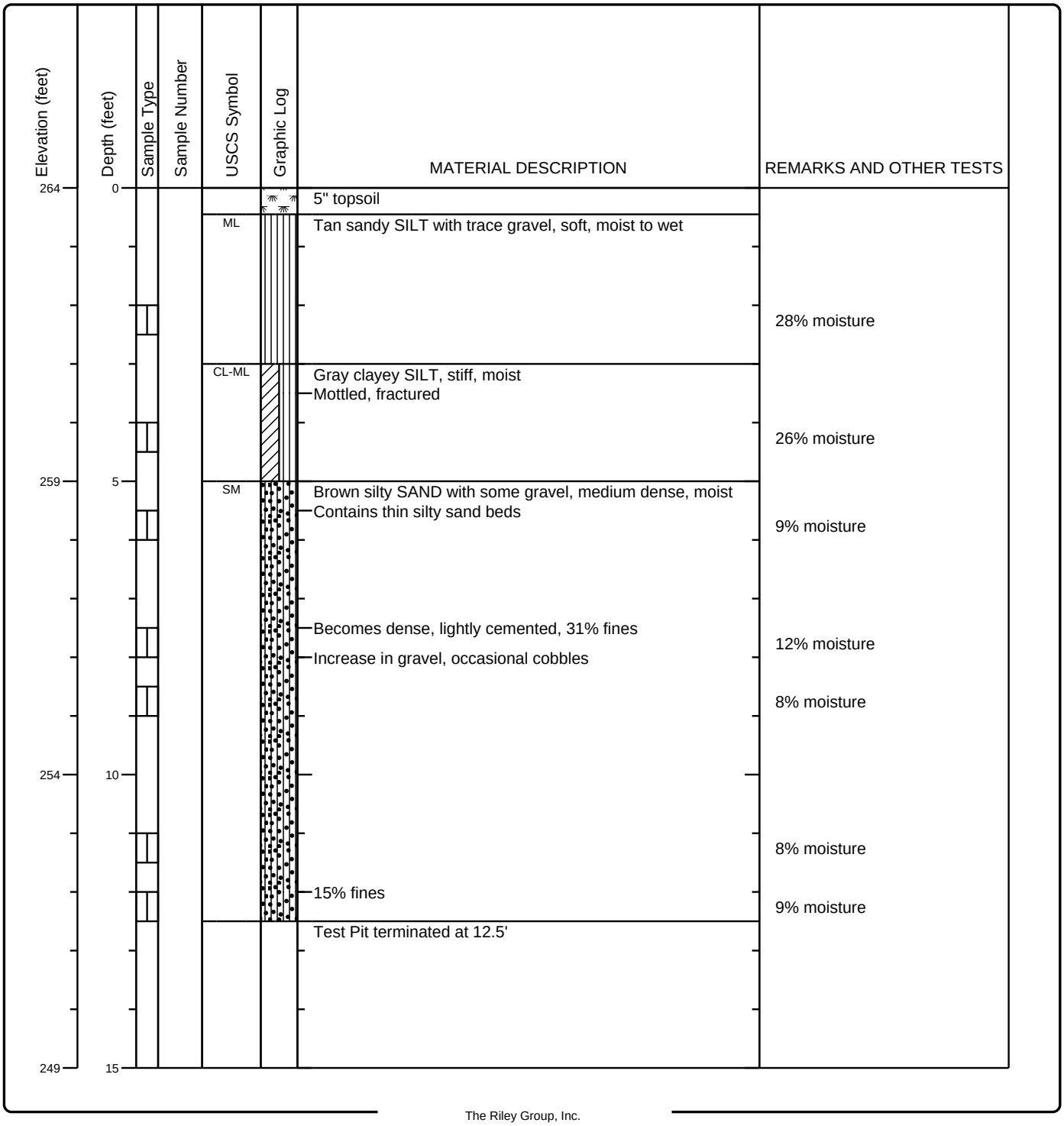
Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

RILEYGROUP

Test Pit No.: TP-102

Sheet 1 of 1

Date(s) Excavated: **12/30/2015**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **264**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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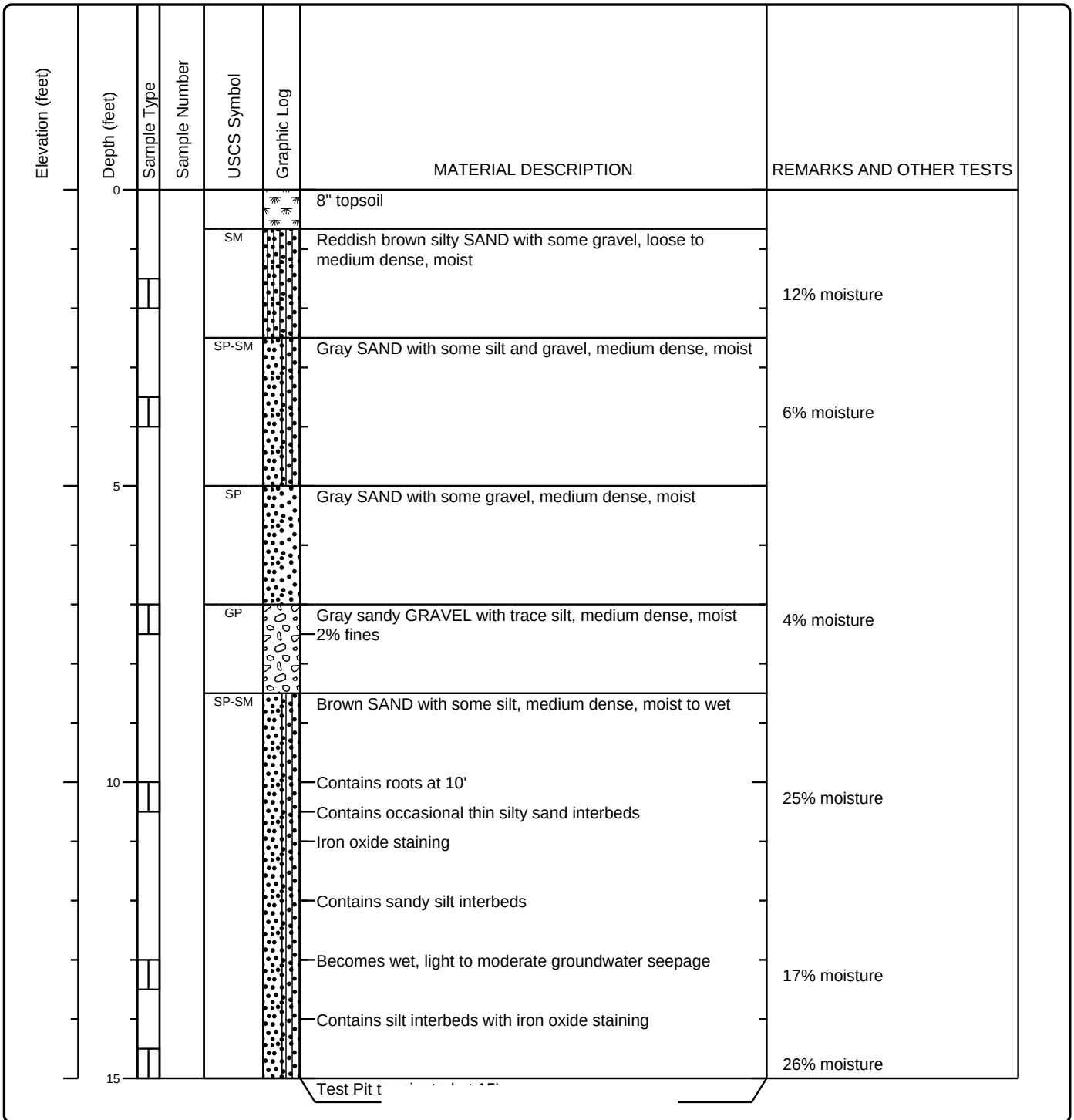
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-103 **Sheet 1 of 1**

Date(s) Excavated: **12/30/2015**	Logged By **ELW**	Surface Conditions: **Ferns**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **15 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Seepage at 13'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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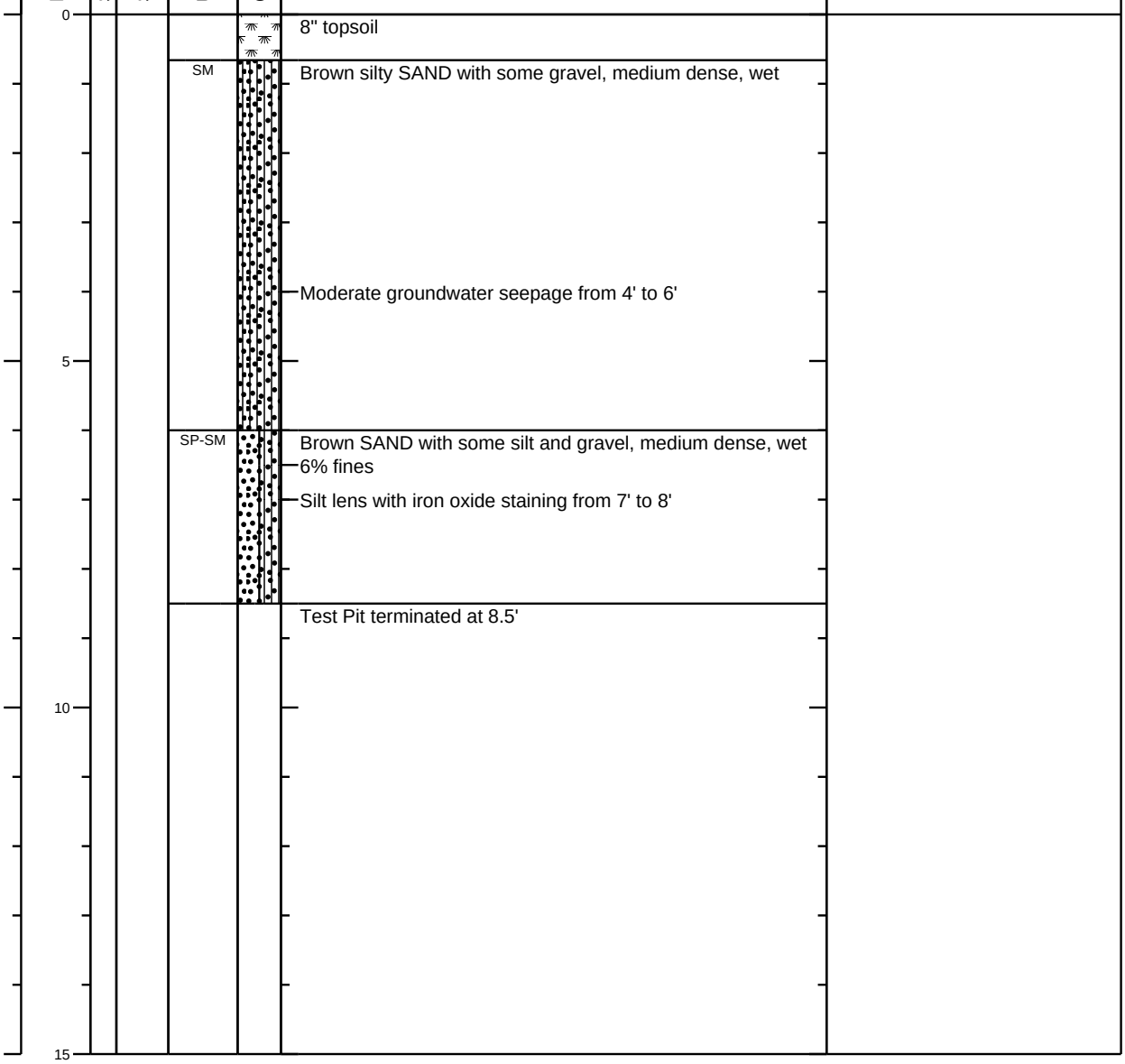
Test Pit No.: TP-104

Sheet 1 of 1

Date(s) Excavated: **12/30/2015**	Logged By **ELW**	Surface Conditions: **Blackberries**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **8.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **N/A**
Groundwater Level: **Seepage from 4' to 6'**	Sampling Method(s)	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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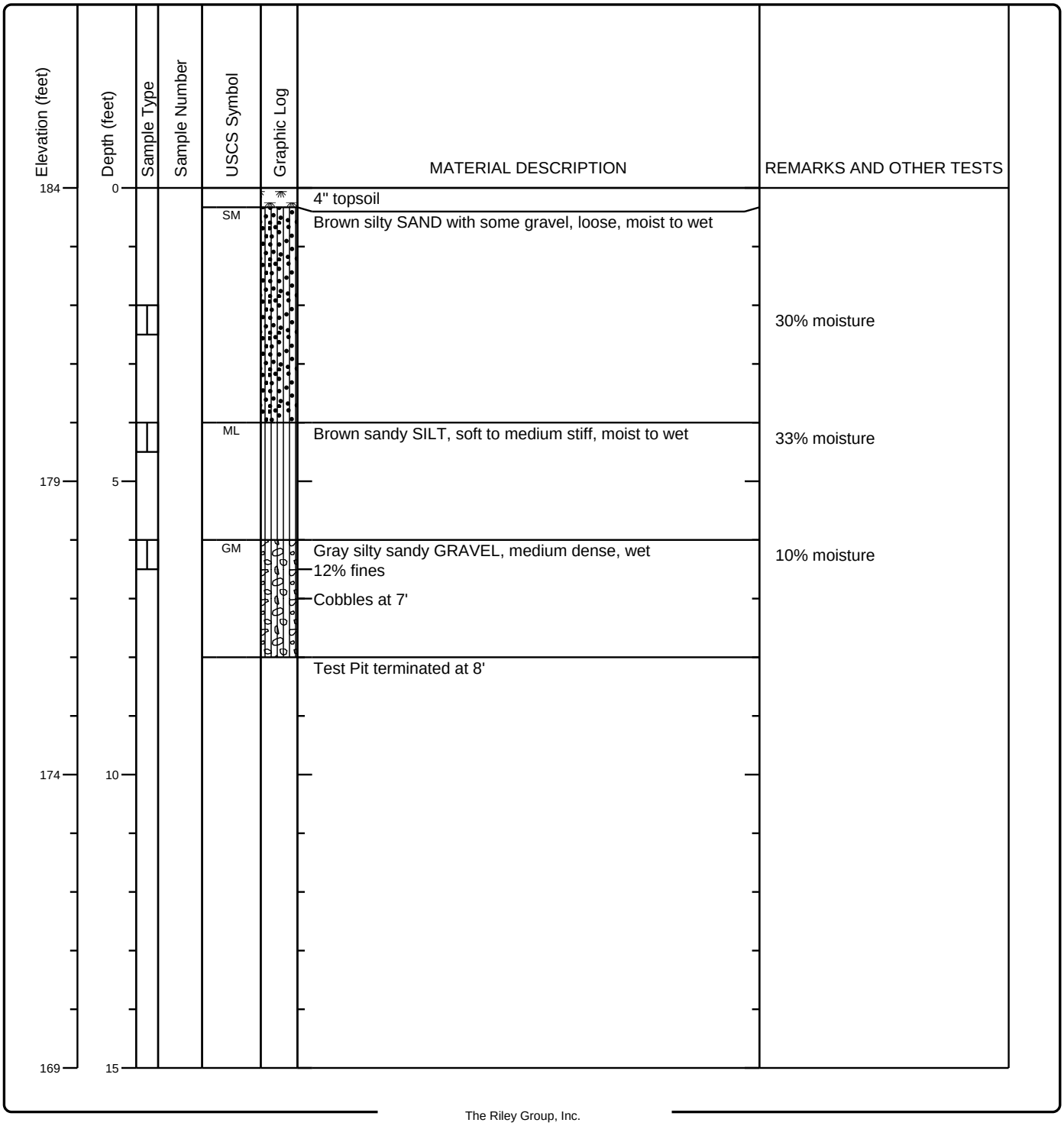
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP **Test Pit No.: TP-105** **Sheet 1 of 1**

Date(s) Excavated: **12/30/2015**	Logged By **ELW**	Surface Conditions: **Ferns**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **8 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **184**
Groundwater Level: **Seepage from 4' to 6'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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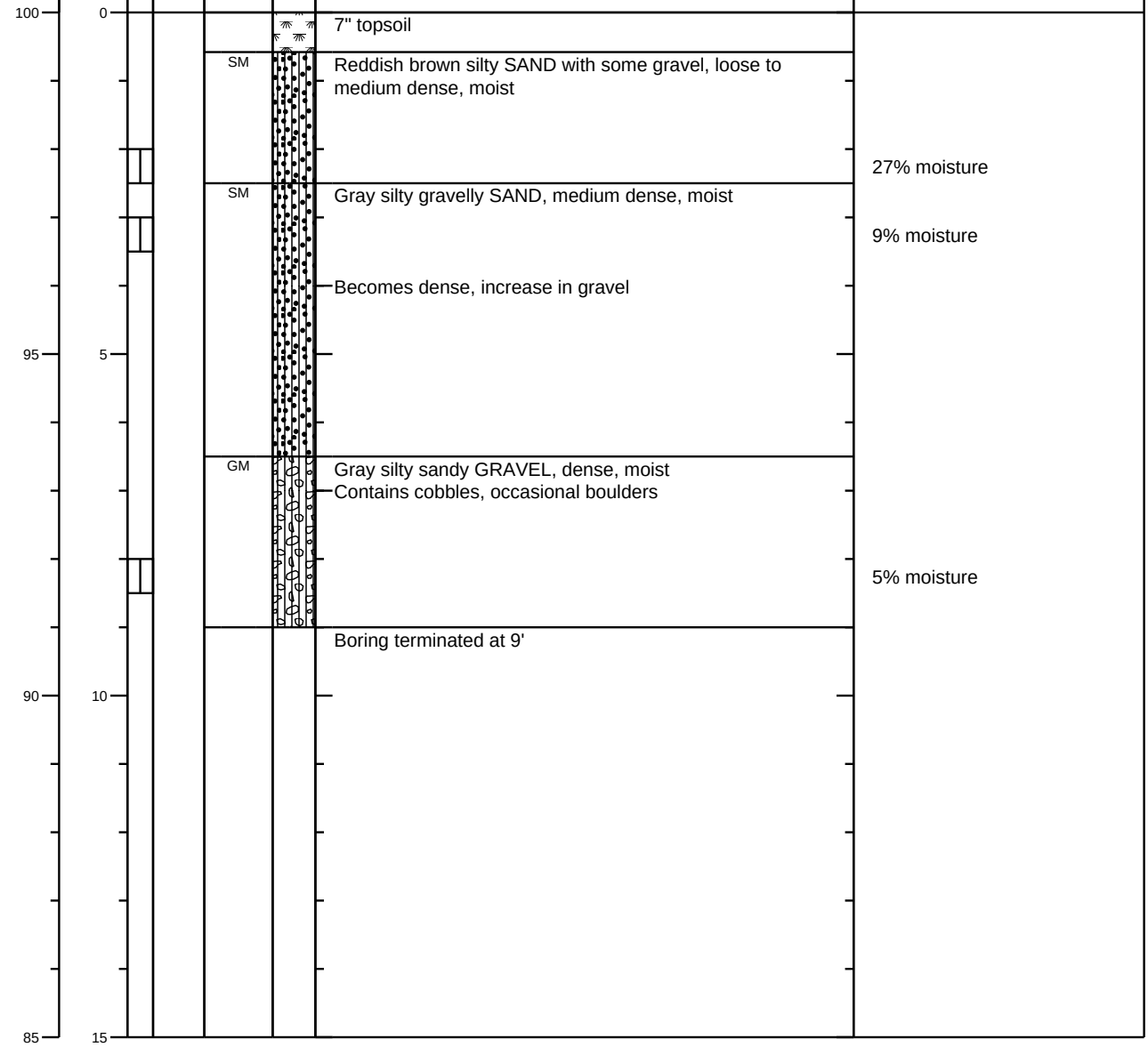
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-201 **Sheet 1 of 1**

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **9 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **100**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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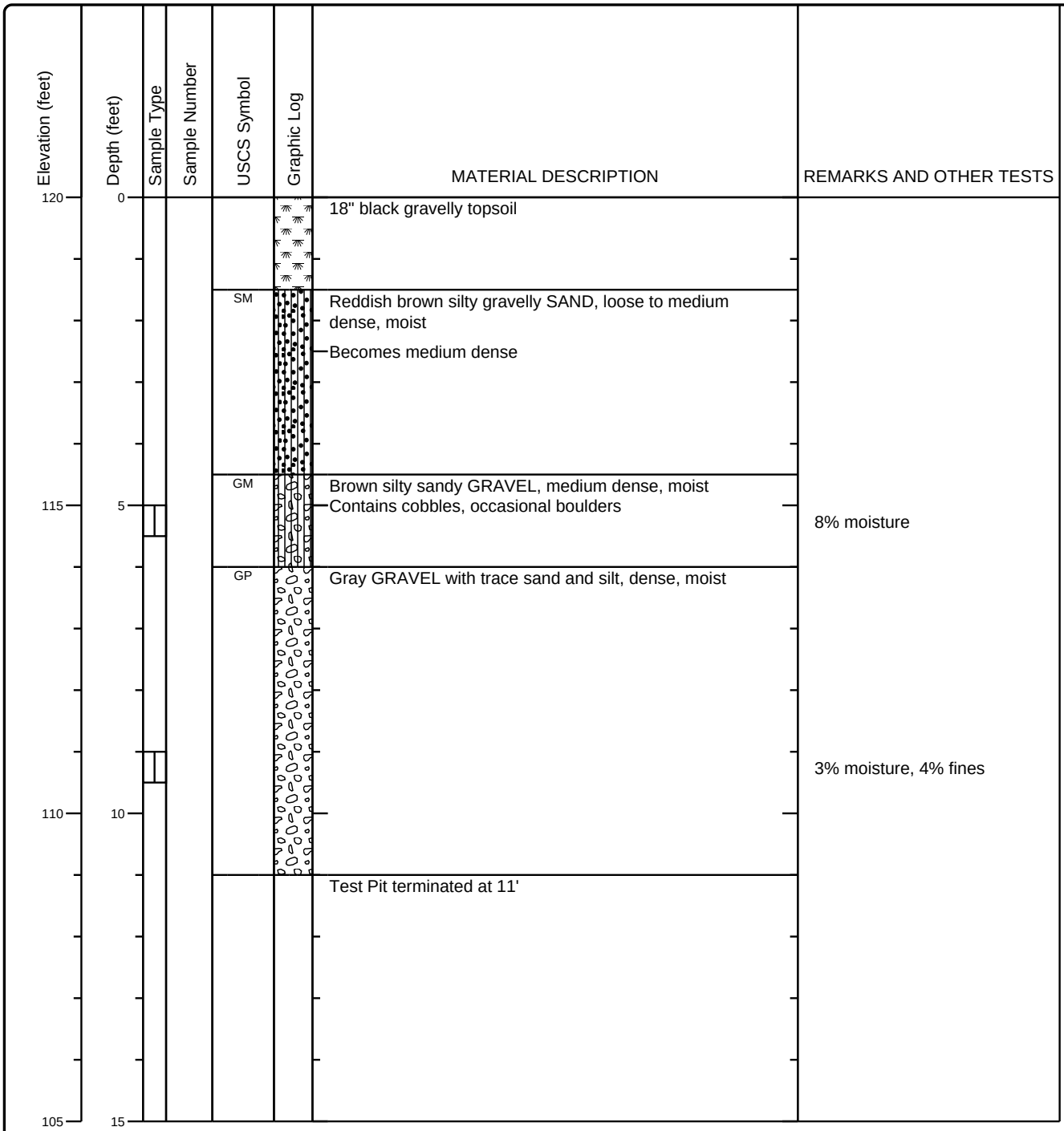
Test Pit No.: TP-202

Sheet 1 of 1

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Ferns**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **11 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **120**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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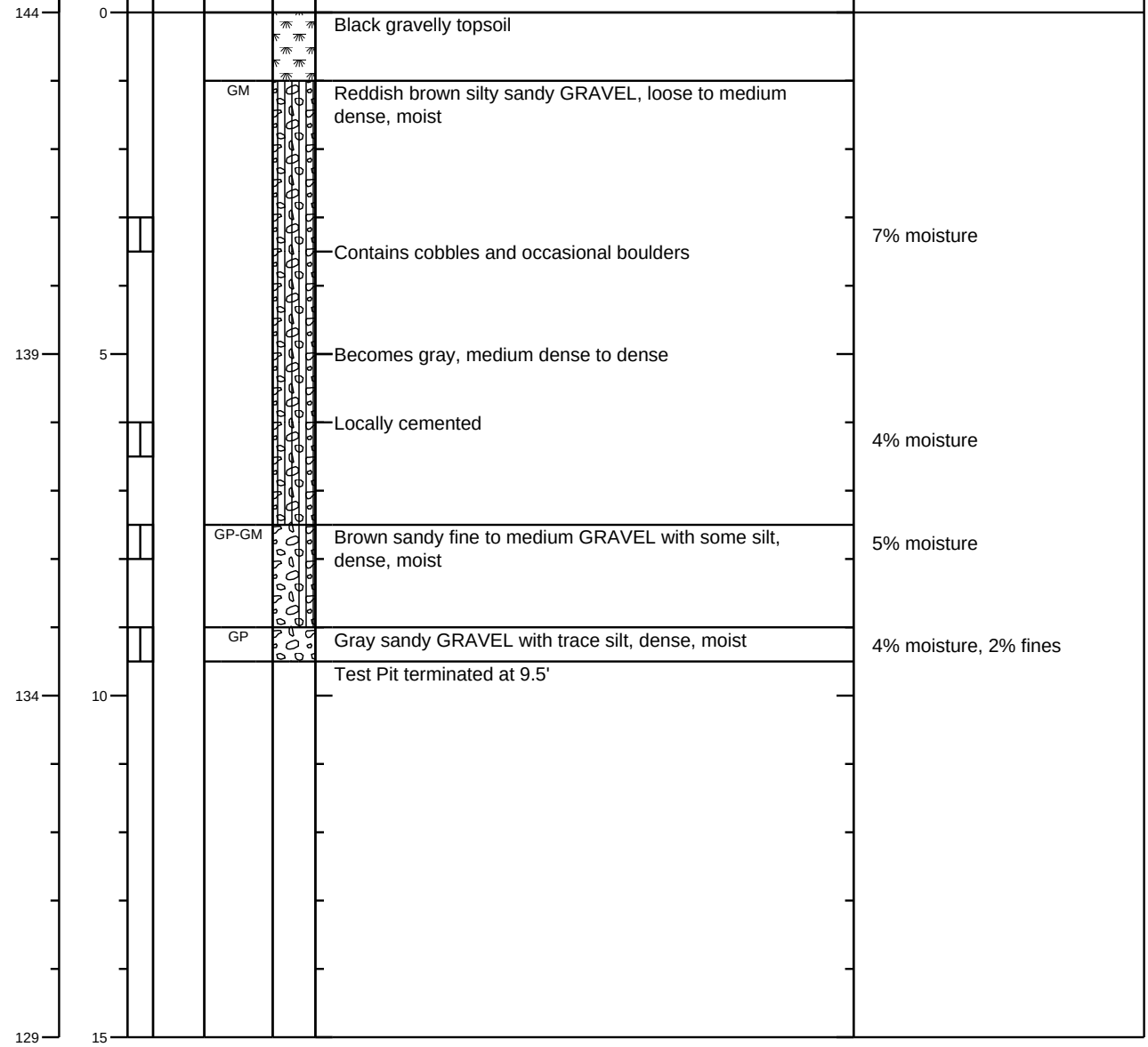
Test Pit No.: TP-203

Sheet 1 of 1

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **9.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **144**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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Test Pit No.: TP-204

Sheet 1 of 1

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **10.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **116**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
116	0					24" black gravelly topsoil	
				SM		Reddish brown silty SAND with some gravel, loose to medium dense, moist	
							10% moisture
111	5						
				SM-ML		Gray sandy SILT/silty SAND with some gravel, hard/dense, moist to wet	
							16% moisture
				GM		Gray silty sandy GRAVEL, dense, moist to wet Contains cobbles and occasional boulders	7% moisture
106	10			GP-GM		Gray GRAVEL with some sand and silt, dense, moist to wet, 6% moisture, 5% fines	6% moisture, 5% fines
						Test Pit terminated at 10.5'	
101	15						

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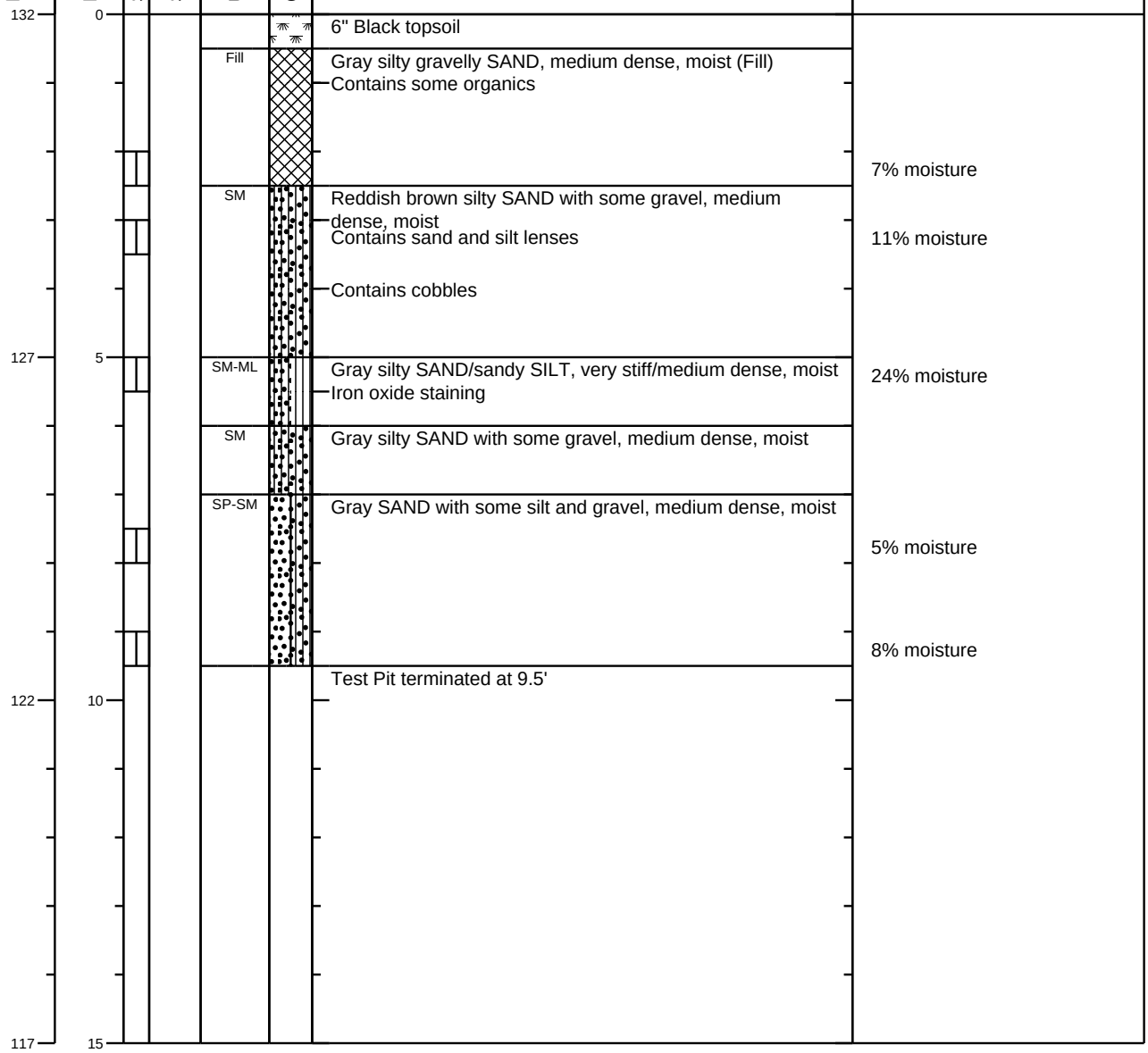
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-205 **Sheet 1 of 1**

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **9.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **132**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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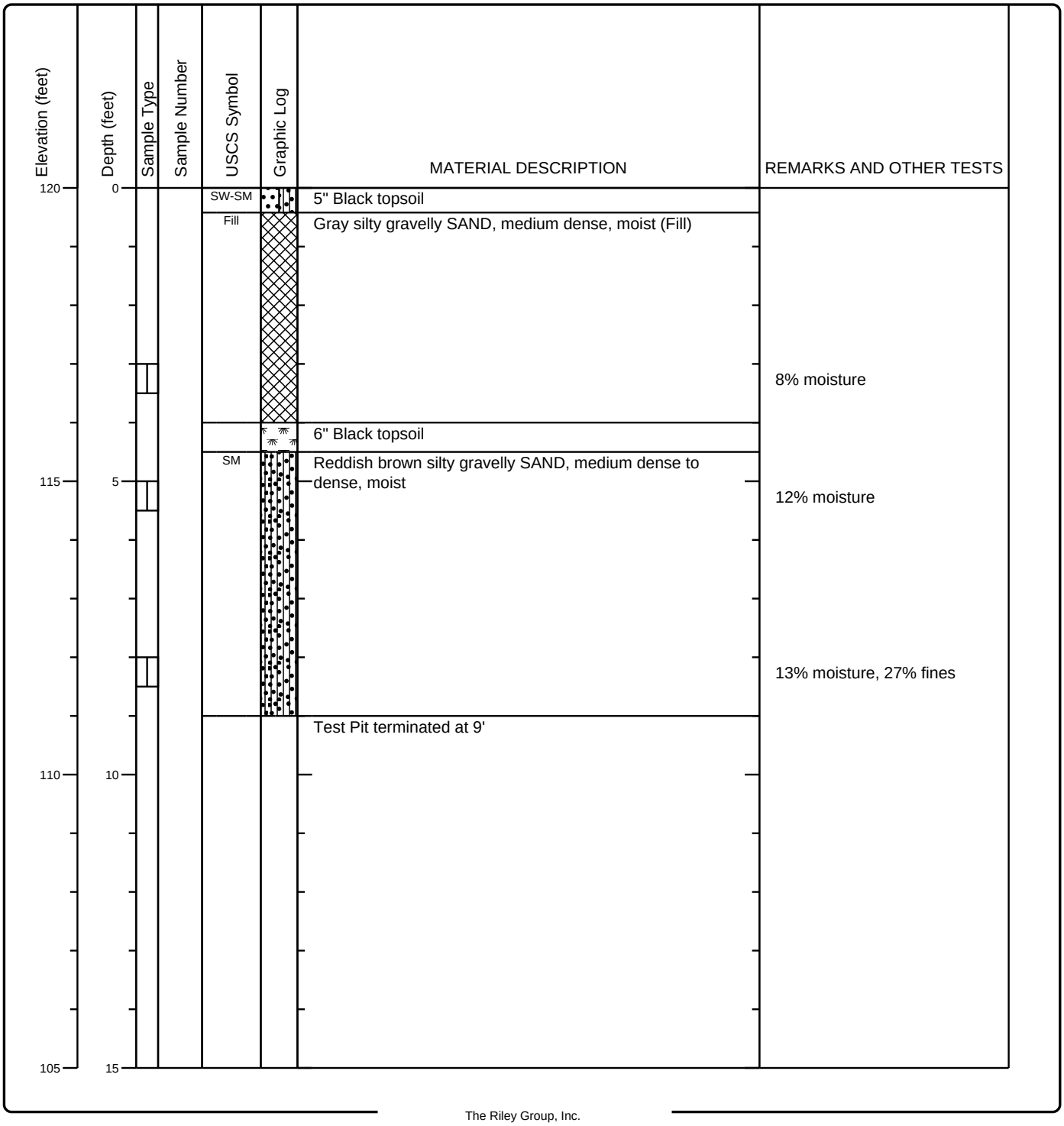
Test Pit No.: TP-206

Sheet 1 of 1

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Ferns**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **9 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **120**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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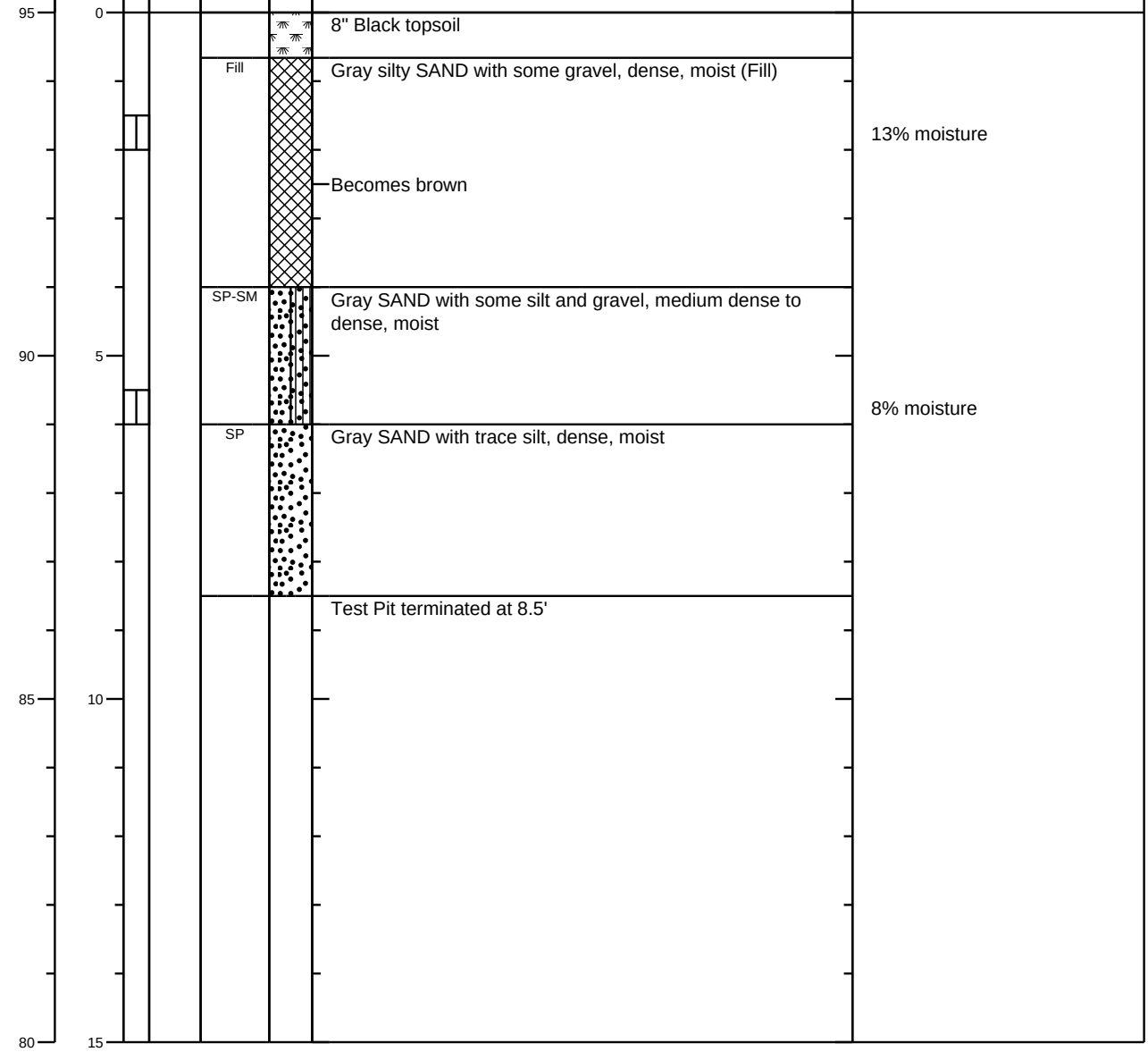
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-207 **Sheet 1 of 1**

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **8.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **95**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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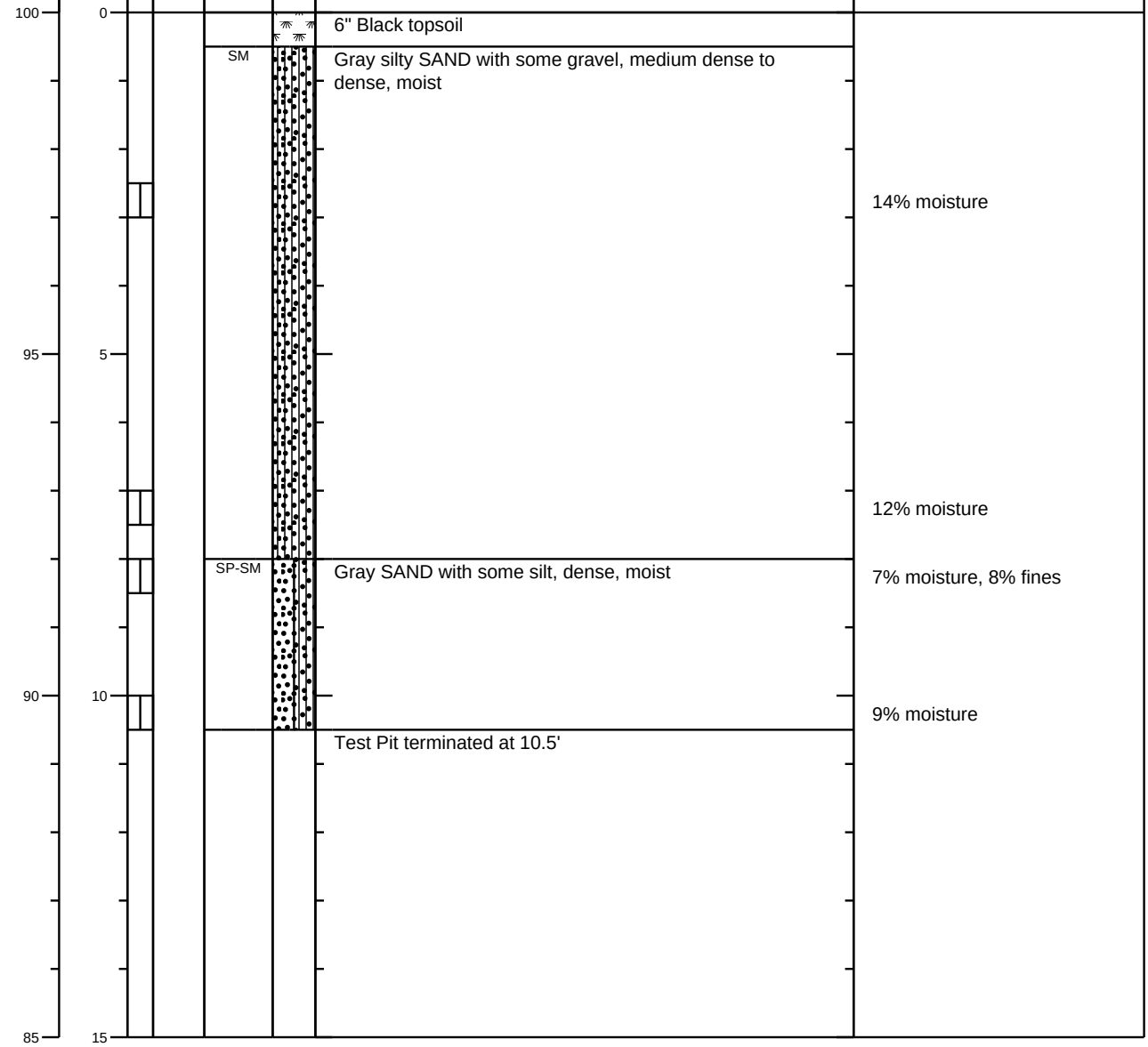
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-208 **Sheet 1 of 1**

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **10.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **100**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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Test Pit No.: TP-209

Sheet 1 of 1

Date(s) Excavated: **5/3/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **10.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **92**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
92	0					8" Black topsoil	
				SP-SM		Gray SAND with some silt, medium dense to dense, moist to wet Iron oxide staining	
				SM		Gray silty gravelly SAND, medium dense to dense, moist Contains cobbles	13% moisture
87	5			SM		Gray silty SAND with some gravel, dense, moist	
				SP-SM		Gray SAND with some silt, dense, moist	11% moisture
82	10						8% moisture
						Test Pit terminated at 10.5'	
77	15						

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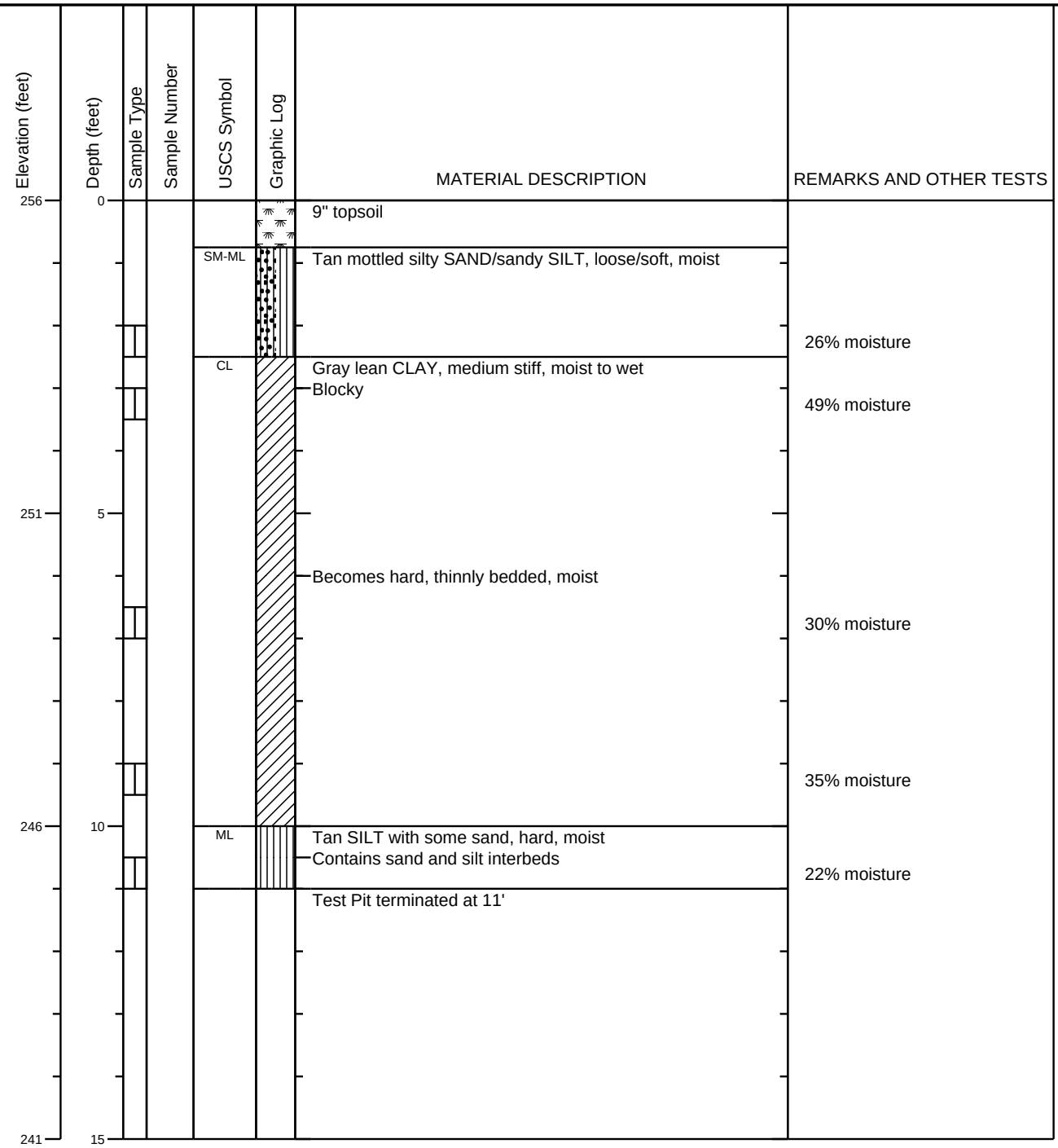
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP **Test Pit No.: TP-210** **Sheet 1 of 1**

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **11 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **256**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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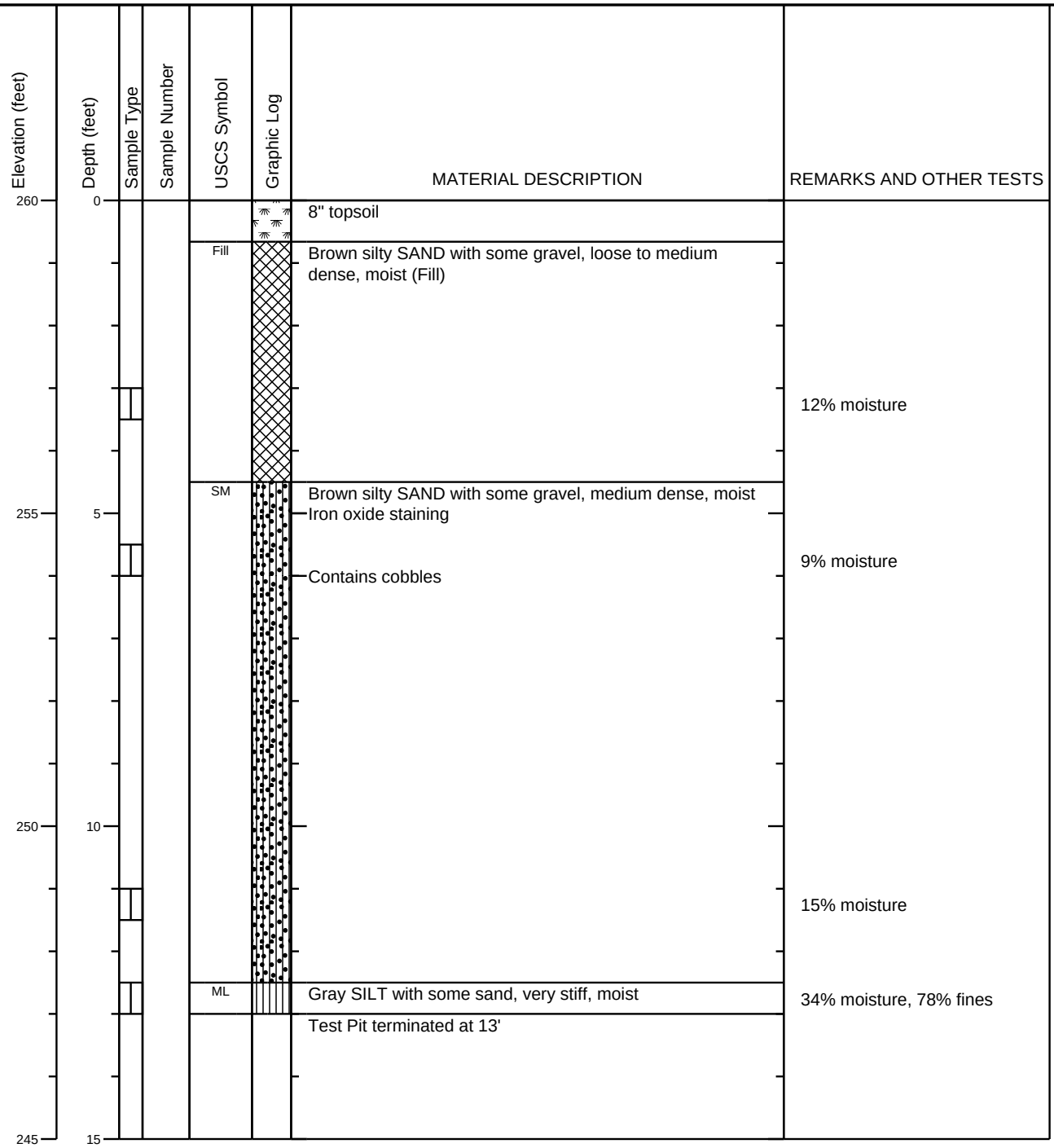
Test Pit No.: TP-211

Sheet 1 of 1

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Grass, Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **13 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **260**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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Test Pit No.: TP-212

Sheet 1 of 1

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **293**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
293	0				8" topsoil	
				SM	Reddish brown silty SAND with trace gravel, loose, moist	
					Becomes tan, medium dense	19% moisture
				SM	Gray silty SAND with some gravel, medium dense to dense, moist Lightly cemented	17% moisture
288	5				Iron oxide staining	12% moisture
				SP-SM	Gray SAND with some silt and gravel, medium dense, moist to wet	12% moisture, 6% fines
283	10					
				SM	Tan silty SAND, medium dense to dense, moist Iron oxide staining Contains sand interbeds	20% moisture
					Test Pit terminated at 12.5'	
278	15					

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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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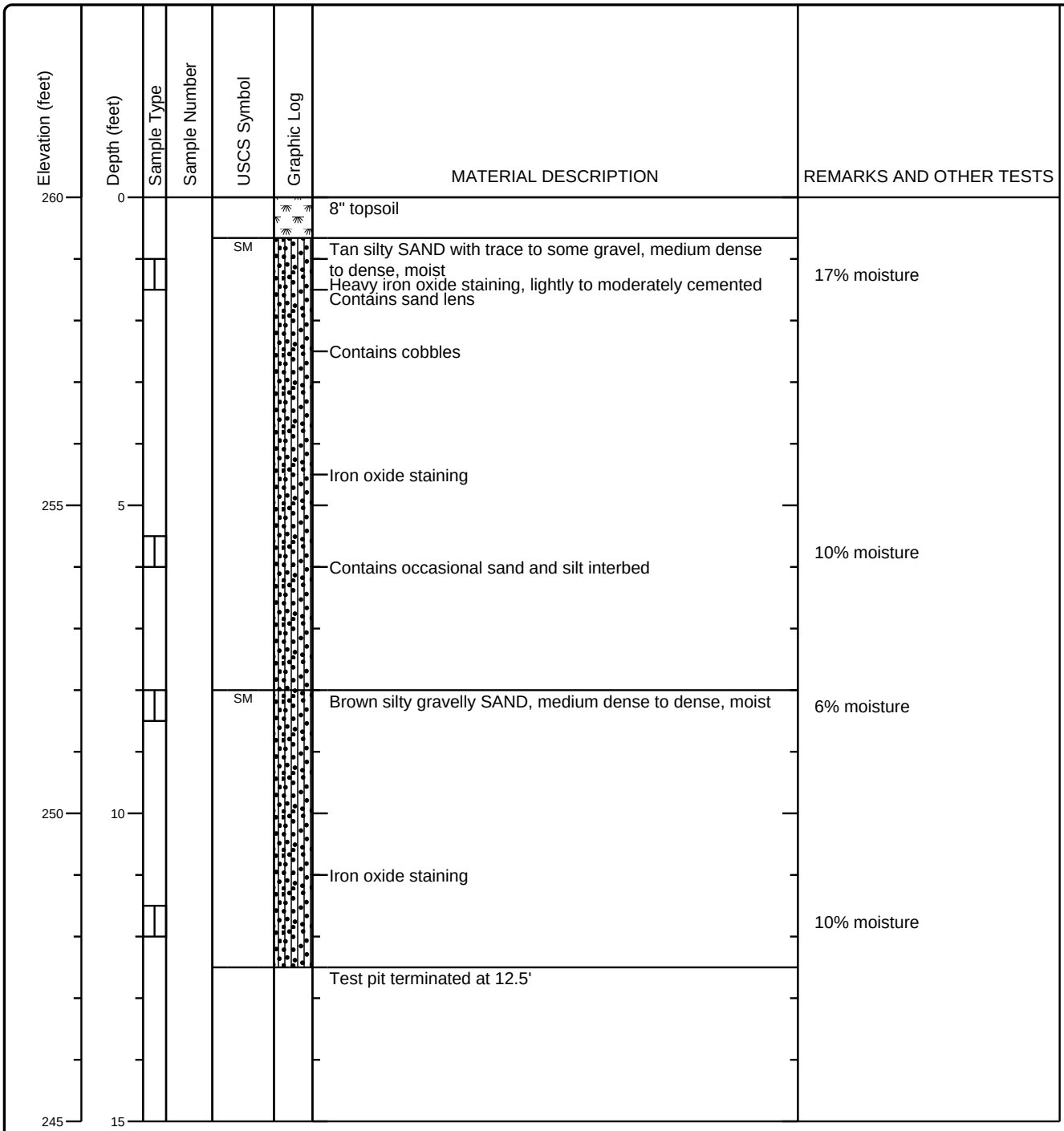
Test Pit No.: TP-213

Sheet 1 of 1

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **260**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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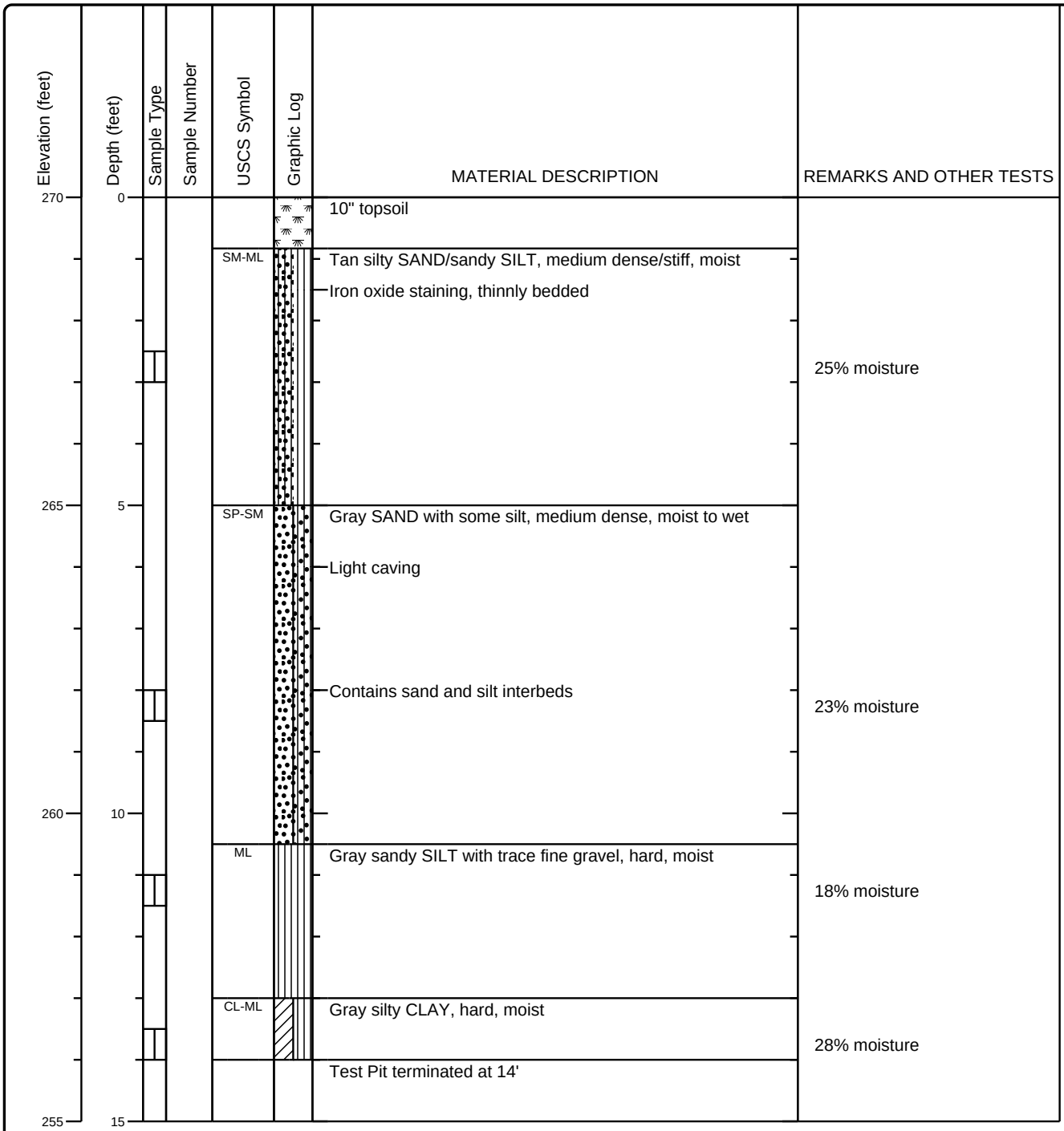
Test Pit No.: TP-214

Sheet 1 of 1

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **14 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **270**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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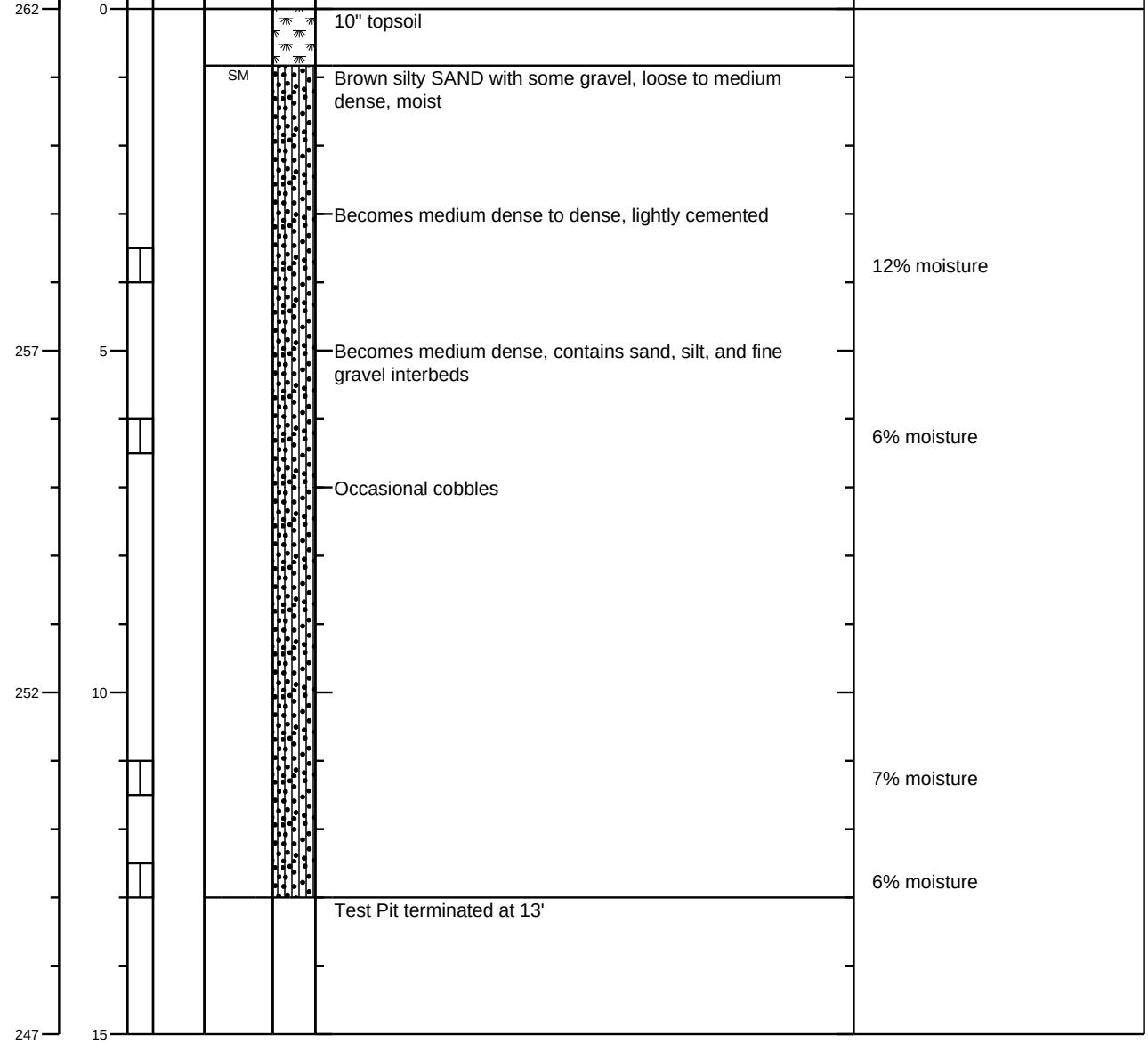
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-215 **Sheet 1 of 1**

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **13 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **262**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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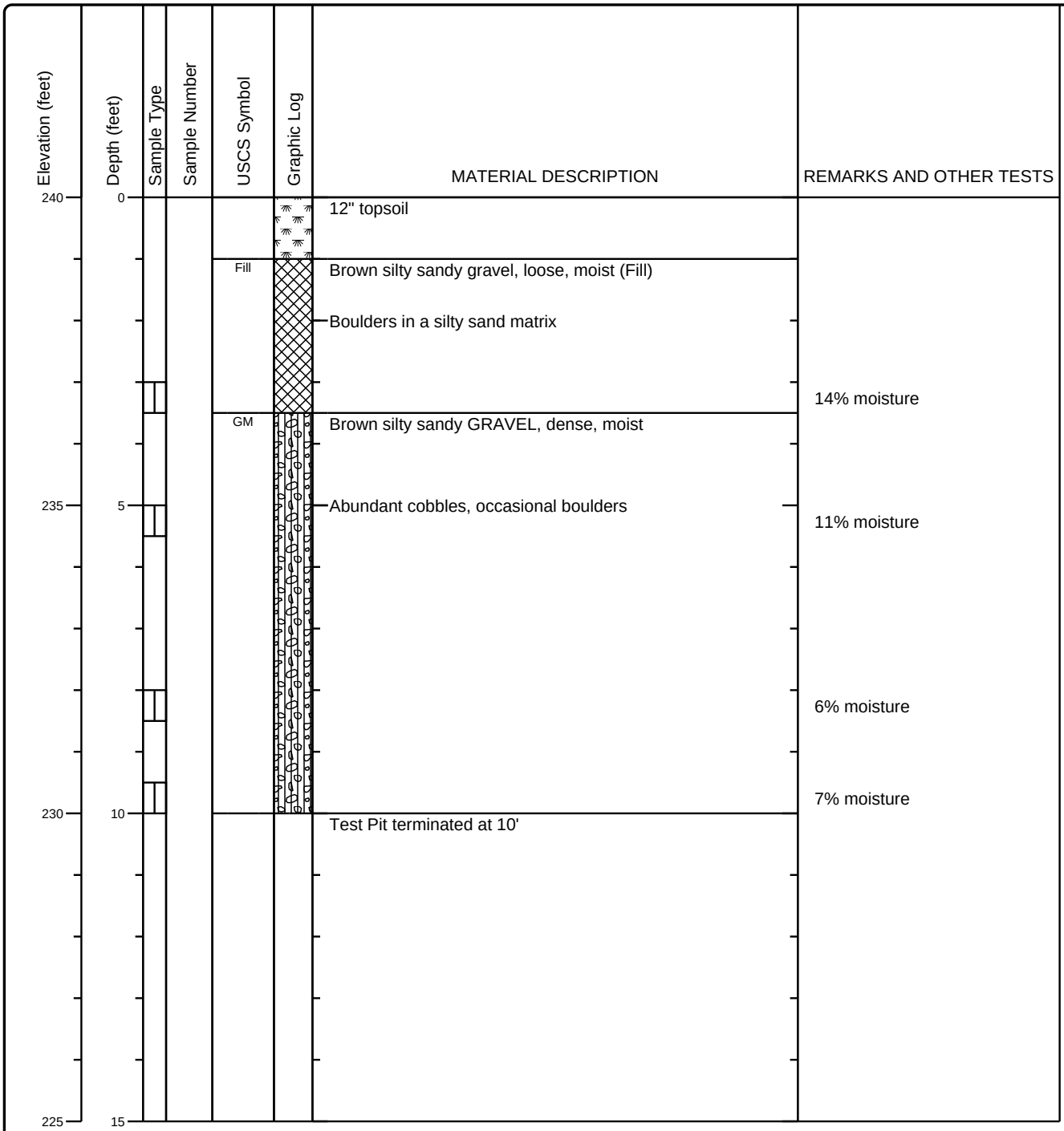
Test Pit No.: TP-216

Sheet 1 of 1

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **10 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **240**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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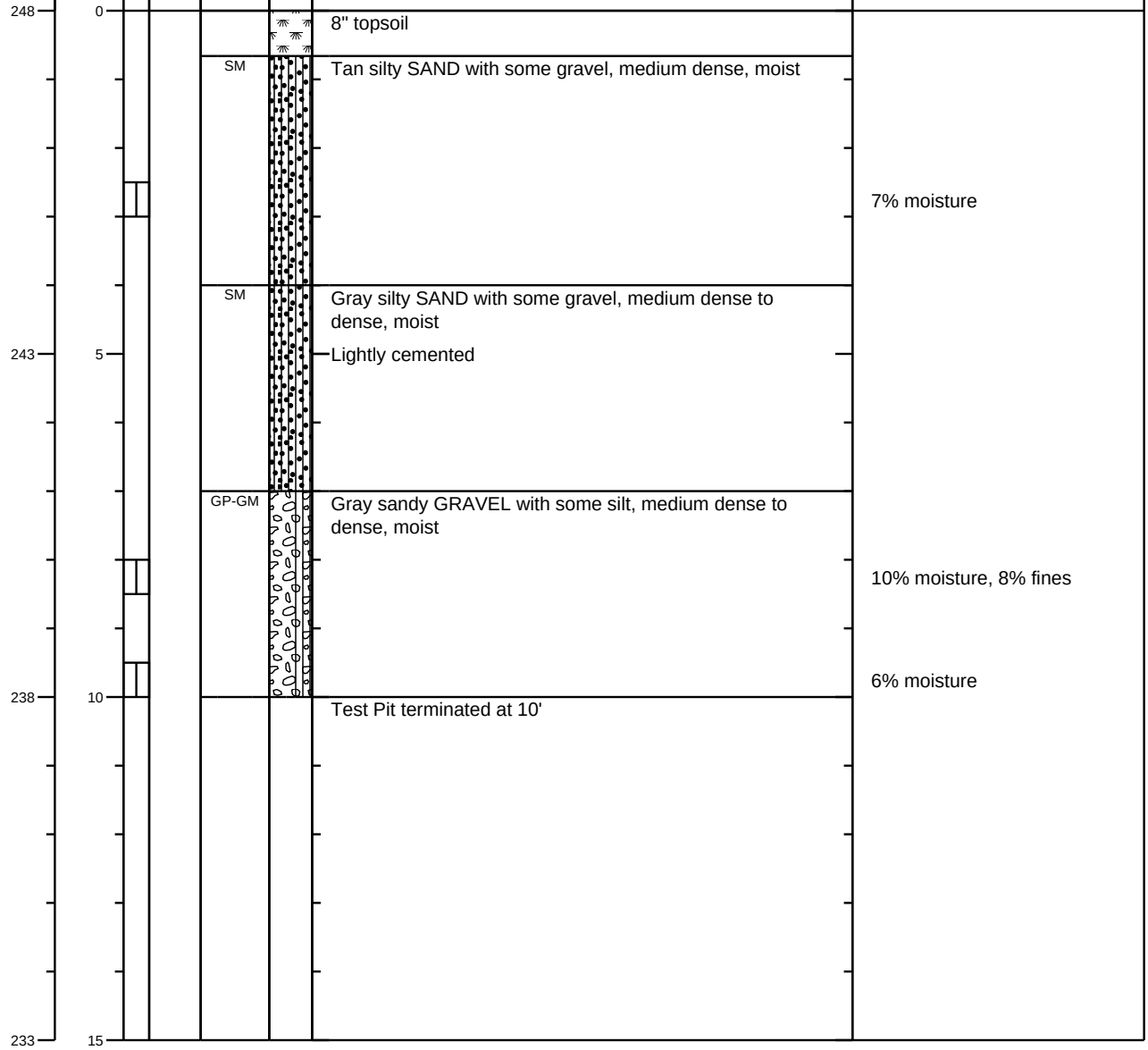
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-217 **Sheet 1 of 1**

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **10 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **248**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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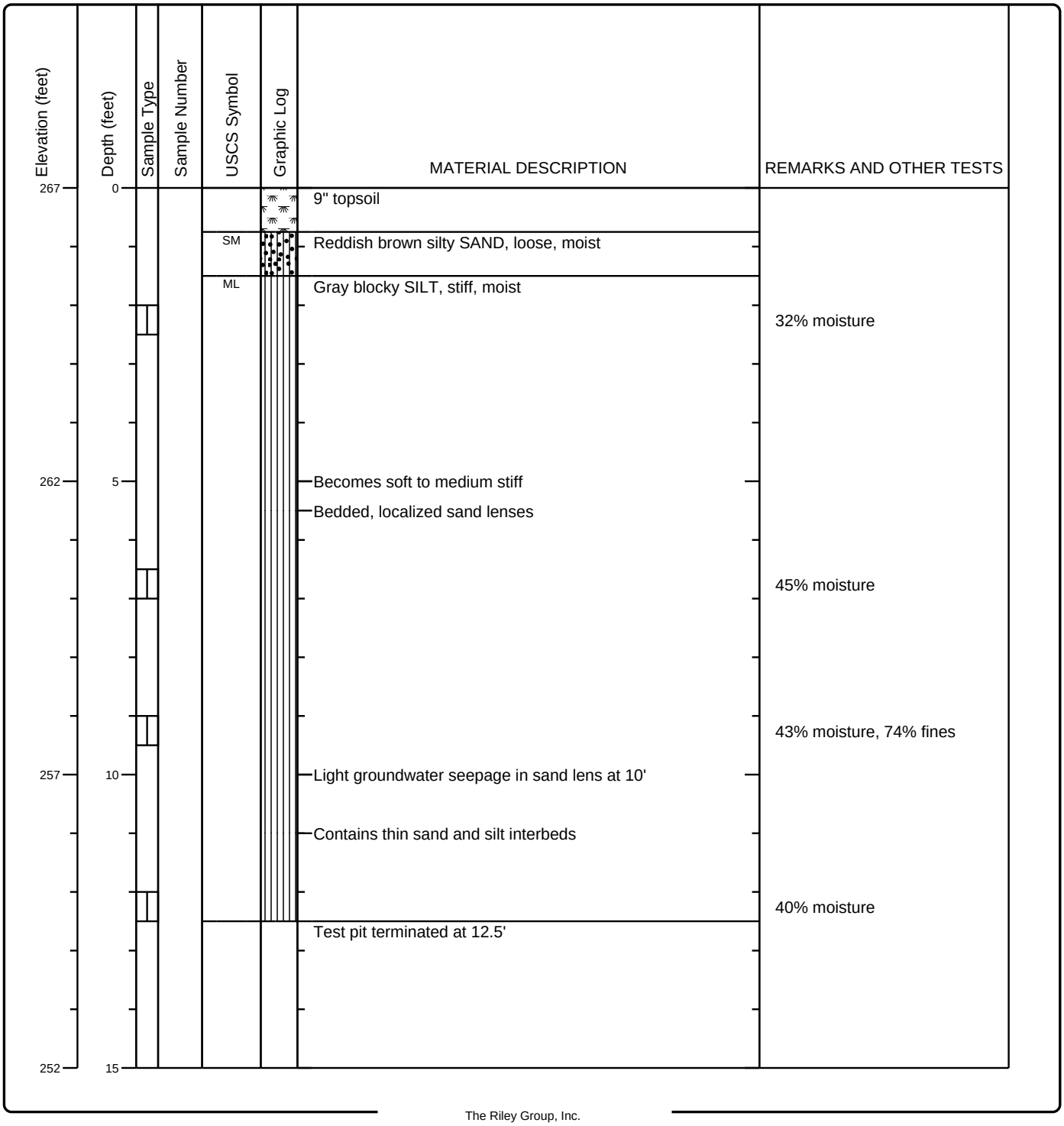
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP **Test Pit No.: TP-218** **Sheet 1 of 1**

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **267**
Groundwater Level: **Seepage at 10'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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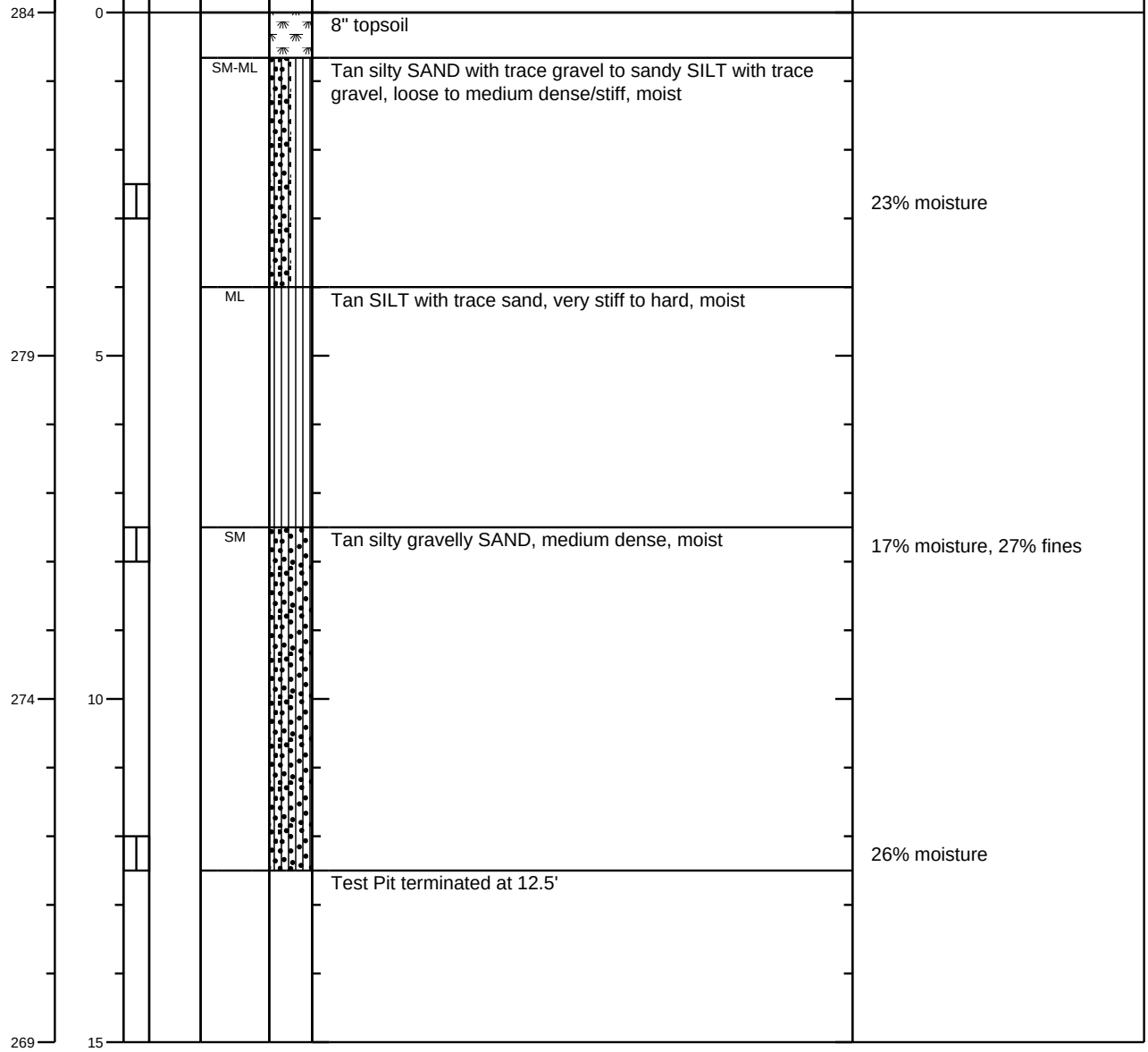
Project Name: **Bergsma Property** Project Number: **2015-046** Client: **Windward Real Estate**	RILEYGROUP Test Pit No.: TP-219 **Sheet 1 of 1**

Date(s) Excavated: **5/16/2016**	Logged By **ELW**	Surface Conditions: **Mixed Brush**
Excavation Method: **Excavator**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Northwest Excavating**	Approximate Surface Elevation **284**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **Southeast Newport Way & 17th Avenue Northwest, Issaquah, Washington**	



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Project Name: **Bergsma Property**
Project Number: **2015-046**
Client: **Windward Real Estate**

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Key to Logs

Sheet 1 of 1

1 Elevation (feet)	2 Depth (feet)	3 Sample Type	4 Sample Number	5 USCS Symbol	6 Graphic Log	7 MATERIAL DESCRIPTION	8 REMARKS AND OTHER TESTS

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample Number: Sample identification number.
5 USCS Symbol: USCS symbol of the subsurface material.
6 Graphic Log: Graphic depiction of the subsurface material encountered.
7 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
SILTY CLAY (CL-ML)
AF
Silty GRAVEL (GM)
Poorly graded GRAVEL (GP)
Poorly graded GRAVEL with Silt (GP-GM)
SILT, SILT w/SAND, SANDY SILT (ML)
Silty SAND (SM)
Silty SAND to Sandy SILT (SM-ML)
Poorly graded SAND (SP)
Poorly graded SAND with Silt (SP-SM)
Well graded SAND with Silt (SW-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

THE RILEY GROUP, INC.
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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	B-201	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	5'	
TECH/TEST DATE	ELW - 5/23/2016		**DATE RECEIVED**	5/9/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	728.8
Wt Dry Soil & Tare (gm)	(w2)	697.0
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	31.8
Weight of Dry Soil (gm)	(w5=w2-w3)	681.4
Moisture Content (%)	(w4/w5)*100	5

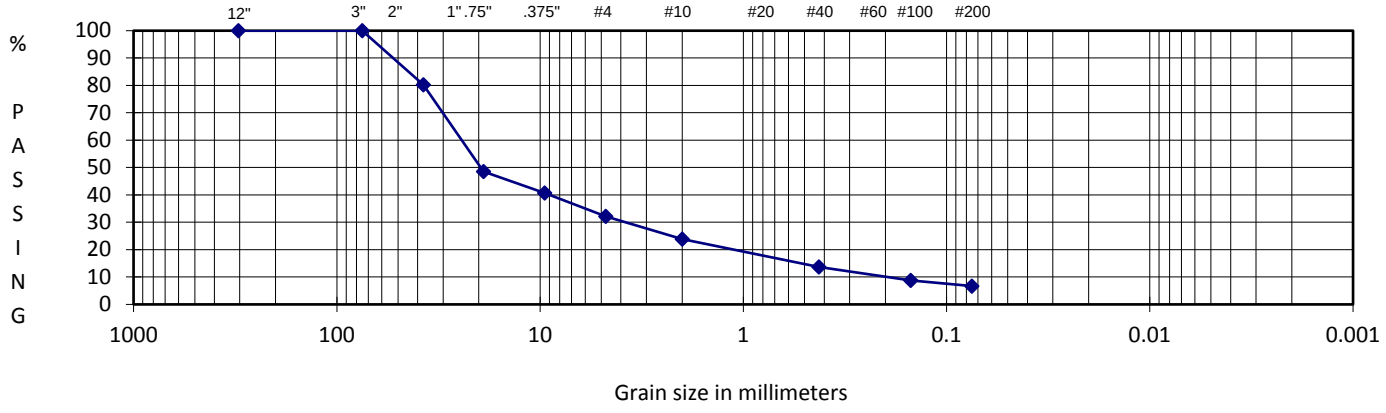
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		697.0
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		681.4

% COBBLES	**0.0**
% C GRAVEL	**51.5**
% F GRAVEL	**16.4**
% C SAND	**8.3**
% M SAND	**10.1**
% F SAND	**7.0**
% FINES	**6.7**
% TOTAL	**100.0**
D10 (mm)	0.2
D30 (mm)	3.7
D60 (mm)	24
Cu	120.0
Cc	2.9

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	150.6	135.00	19.81	80.19	coarse gravel
1.0"					coarse gravel
0.75"	366.4	350.80	51.48	48.52	fine gravel
0.50"					fine gravel
0.375"	420.0	404.40	59.35	40.65	fine gravel
#4	478.0	462.40	67.86	32.14	coarse sand
#10	534.7	519.10	76.18	23.82	medium sand
#20					medium sand
#40	603.5	587.90	86.28	13.72	fine sand
#60					fine sand
#100	637.6	622.00	91.28	8.72	fine sand
#200	651.3	635.70	93.29	6.71	fines
PAN	697.0	681.40	100.00	0.00	silt/clay



DESCRIPTION Sandy GRAVEL with some silt

USCS GW-GM

Prepared For: Windward Real Estate

Reviewed By: RW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	B-201	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	15'	
TECH/TEST DATE	ELW - 5/23/2016		**DATE RECEIVED**	5/9/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	945.9
Wt Dry Soil & Tare (gm)	(w2)	881.4
Weight of Tare (gm)	(w3)	15.8
Weight of Water (gm)	(w4=w1-w2)	64.5
Weight of Dry Soil (gm)	(w5=w2-w3)	865.6
Moisture Content (%)	(w4/w5)*100	7

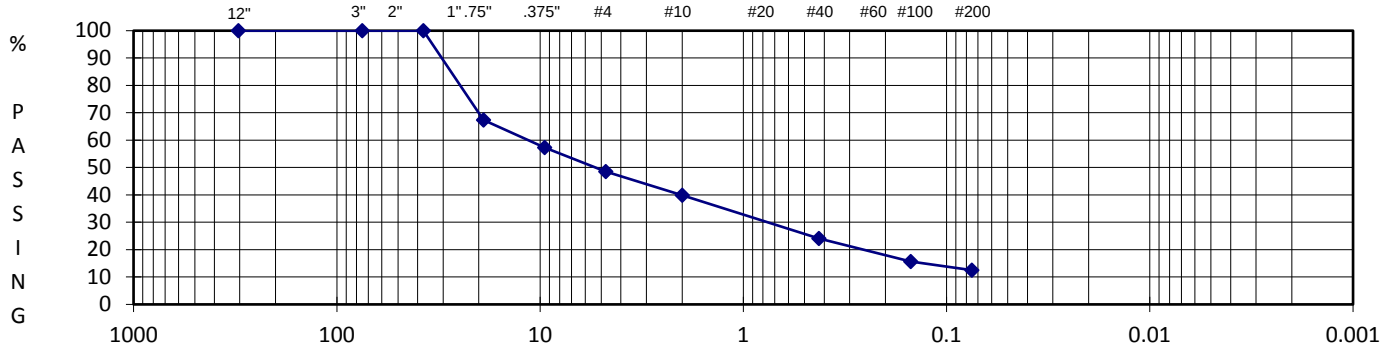
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		881.4
Tare Weight (gm)		15.8
(W6) Total Dry Weight (gm)		865.6

% COBBLES	**0.0**
% C GRAVEL	**32.6**
% F GRAVEL	**18.8**
% C SAND	**8.7**
% M SAND	**15.7**
% F SAND	**11.6**
% FINES	**12.5**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.8	0.00	0.00	100.00	cobbles
3.0"	15.8	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.8	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	298.0	282.20	32.60	67.40	fine gravel
0.50"					fine gravel
0.375"	385.3	369.50	42.69	57.31	fine gravel
#4	461.0	445.20	51.43	48.57	coarse sand
#10	536.2	520.40	60.12	39.88	medium sand
#20					medium sand
#40	672.5	656.70	75.87	24.13	fine sand
#60					fine sand
#100	745.5	729.70	84.30	15.70	fine sand
#200	773.1	757.30	87.49	12.51	fines
PAN	881.4	865.60	100.00	0.00	silt/clay



DESCRIPTION	Silty sandy GRAVEL
USCS	GM

Prepared For: Windward Real Estate

Reviewed By: RW

RILEYGROUP

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FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	B-201	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	26'	
TECH/TEST DATE	ELW - 5/23/2016		**DATE RECEIVED**	5/9/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1074.4
Wt Dry Soil & Tare (gm)	(w2)	979.3
Weight of Tare (gm)	(w3)	15.8
Weight of Water (gm)	(w4=w1-w2)	95.1
Weight of Dry Soil (gm)	(w5=w2-w3)	963.5
Moisture Content (%)	(w4/w5)*100	10

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

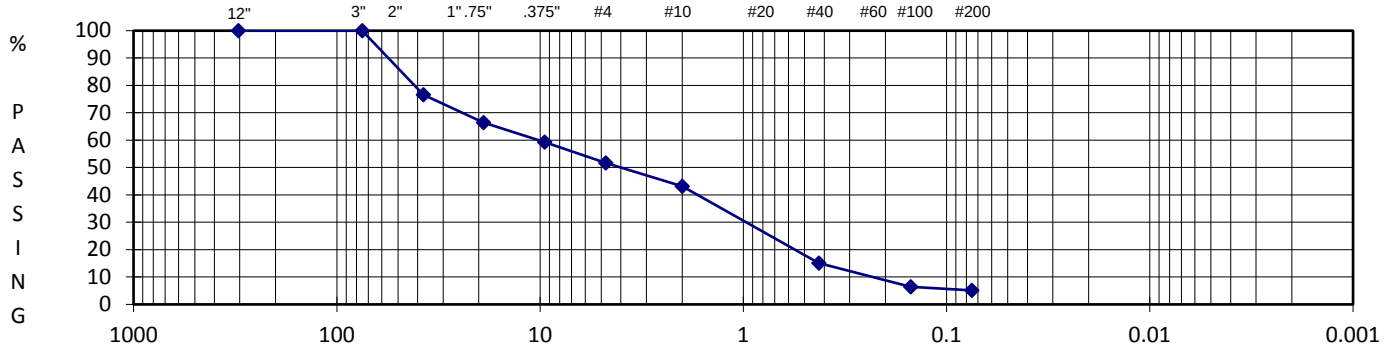
Weight Of Sample (gm)		979.3
Tare Weight (gm)		15.8
(W6) Total Dry Weight (gm)		963.5

% COBBLES	**0.0**
% C GRAVEL	**33.5**
% F GRAVEL	**14.8**
% C SAND	**8.4**
% M SAND	**28.2**
% F SAND	**9.9**
% FINES	**5.1**
% TOTAL	**100.0**

D10 (mm)	0.23
D30 (mm)	0.95
D60 (mm)	10
Cu	43.5
Cc	0.4

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.8	0.00	0.00	100.00	cobbles
3.0"	15.8	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	241.2	225.40	23.39	76.61	coarse gravel
1.0"					coarse gravel
0.75"	338.8	323.00	33.52	66.48	fine gravel
0.50"					fine gravel
0.375"	408.1	392.30	40.72	59.28	fine gravel
#4	481.6	465.80	48.34	51.66	coarse sand
#10	563.0	547.20	56.79	43.21	medium sand
#20					medium sand
#40	834.4	818.60	84.96	15.04	fine sand
#60					fine sand
#100	917.1	901.30	93.54	6.46	fine sand
#200	929.9	914.10	94.87	5.13	fines
PAN	979.3	963.50	100.00	0.00	silt/clay



DESCRIPTION Gravelly SAND with some silt

USCS SP-SM

Prepared For: Windward Real Estate

Reviewed By: RW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-202	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	9'	
TECH/TEST DATE	ELW - 5/3/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1732.5
Wt Dry Soil & Tare (gm)	(w2)	1677.5
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	55.0
Weight of Dry Soil (gm)	(w5=w2-w3)	1661.9
Moisture Content (%)	(w4/w5)*100	3

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

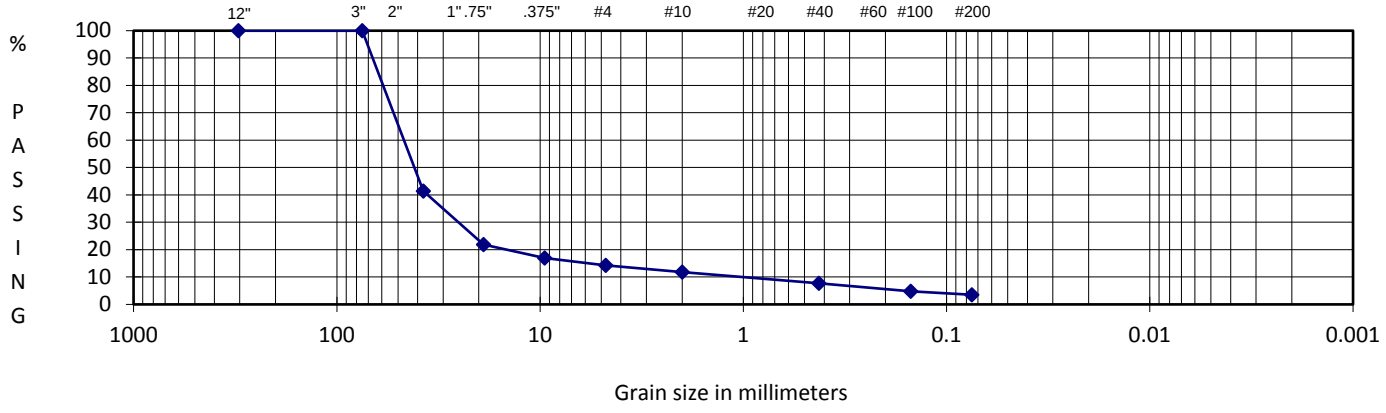
Weight Of Sample (gm)		1677.5
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		1661.9

% COBBLES	**0.0**
% C GRAVEL	**78.1**
% F GRAVEL	**7.6**
% C SAND	**2.4**
% M SAND	**4.1**
% F SAND	**4.2**
% FINES	**3.5**
% TOTAL	**100.0**

D10 (mm)	0.9
D30 (mm)	25
D60 (mm)	48
Cu	53.3
Cc	14.5

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	988.9	973.30	58.57	41.43	coarse gravel
1.0"					coarse gravel
0.75"	1314.0	1298.40	78.13	21.87	fine gravel
0.50"					fine gravel
0.375"	1395.5	1379.90	83.03	16.97	fine gravel
#4	1441.1	1425.50	85.78	14.22	coarse sand
#10	1481.0	1465.40	88.18	11.82	medium sand
#20					medium sand
#40	1549.4	1533.80	92.29	7.71	fine sand
#60					fine sand
#100	1598.4	1582.80	95.24	4.76	fine sand
#200	1618.9	1603.30	96.47	3.53	fines
PAN	1677.5	1661.90	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with trace sand and silt
USCS	GP

Prepared For: Windward Real Estate

Reviewed By: RW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-203	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	9'	
TECH/TEST DATE	ELW - 5/3/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1228.9
Wt Dry Soil & Tare (gm)	(w2)	1182.5
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	46.4
Weight of Dry Soil (gm)	(w5=w2-w3)	1166.9
Moisture Content (%)	(w4/w5)*100	4

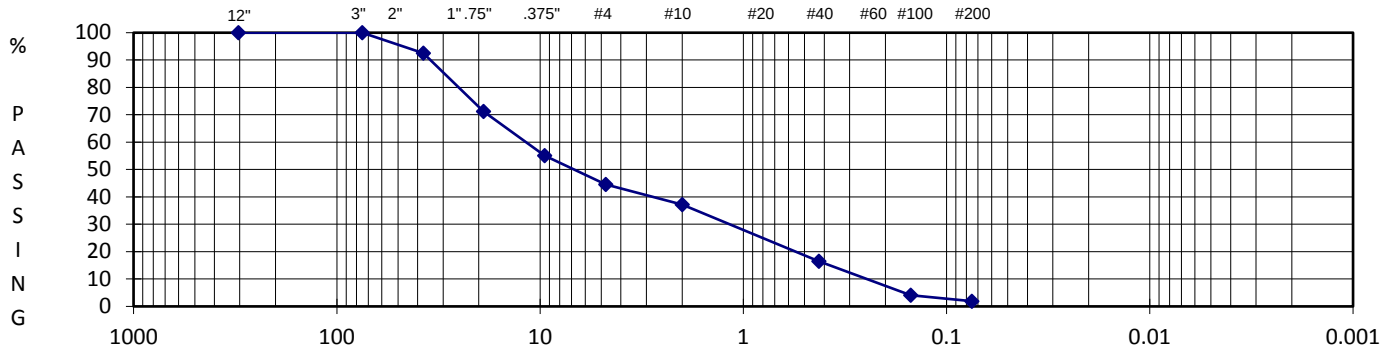
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		1182.5
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		1166.9

% COBBLES	**0.0**
% C GRAVEL	**28.8**
% F GRAVEL	**26.6**
% C SAND	**7.4**
% M SAND	**20.7**
% F SAND	**14.6**
% FINES	**1.9**
% TOTAL	**100.0**
D10 (mm)	0.25
D30 (mm)	1.2
D60 (mm)	12
Cu	48.0
Cc	0.5

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	102.5	86.90	7.45	92.55	coarse gravel
1.0"					coarse gravel
0.75"	351.8	336.20	28.81	71.19	fine gravel
0.50"					fine gravel
0.375"	539.6	524.00	44.91	55.09	fine gravel
#4	662.7	647.10	55.45	44.55	coarse sand
#10	748.5	732.90	62.81	37.19	medium sand
#20					medium sand
#40	989.6	974.00	83.47	16.53	fine sand
#60					fine sand
#100	1135.4	1119.80	95.96	4.04	fine sand
#200	1160.2	1144.60	98.09	1.91	fines
PAN	1182.5	1166.90	100.00	0.00	silt/clay



DESCRIPTION	Sandy GRAVEL with trace silt
USCS	GP

Prepared For: Windward Real Estate

Reviewed By: RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-204	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	10'	
TECH/TEST DATE	ELW - 5/3/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	1335.1
Wt Dry Soil & Tare (gm)	(w2)	1262.7
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	72.4
Weight of Dry Soil (gm)	(w5=w2-w3)	1247.0
Moisture Content (%)	(w4/w5)*100	6

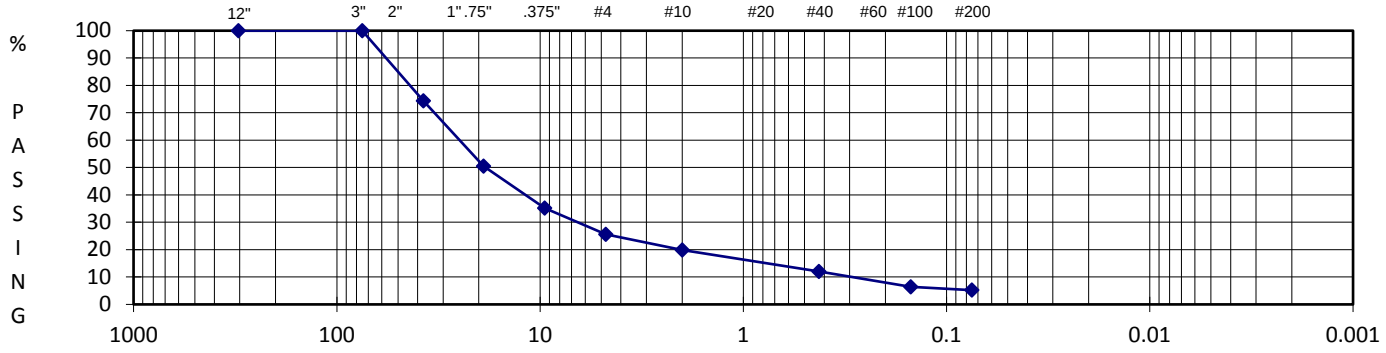
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		1262.7
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		1247.0

% COBBLES	**0.0**
% C GRAVEL	**49.5**
% F GRAVEL	**25.0**
% C SAND	**5.7**
% M SAND	**7.9**
% F SAND	**6.8**
% FINES	**5.2**
% TOTAL	**100.0**
D10 (mm)	0.3
D30 (mm)	6.5
D60 (mm)	25
Cu	83.3
Cc	5.6

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	334.8	319.10	25.59	74.41	coarse gravel
1.0"					coarse gravel
0.75"	632.7	617.00	49.48	50.52	fine gravel
0.50"					fine gravel
0.375"	824.0	808.30	64.82	35.18	fine gravel
#4	943.9	928.20	74.43	25.57	coarse sand
#10	1014.9	999.20	80.13	19.87	medium sand
#20					medium sand
#40	1113.1	1097.40	88.00	12.00	fine sand
#60					fine sand
#100	1182.0	1166.30	93.53	6.47	fine sand
#200	1197.8	1182.10	94.80	5.20	fines
PAN	1262.7	1247.00	100.00	0.00	silt/clay



DESCRIPTION GRAVEL with some sand and silt

USCS GP-GM

Prepared For: Windward Real Estate

Reviewed By: RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-206	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	8'	
TECH/TEST DATE	ELW - 5/3/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	549.8
Wt Dry Soil & Tare (gm)	(w2)	489.6
Weight of Tare (gm)	(w3)	15.5
Weight of Water (gm)	(w4=w1-w2)	60.2
Weight of Dry Soil (gm)	(w5=w2-w3)	474.1
Moisture Content (%)	(w4/w5)*100	13

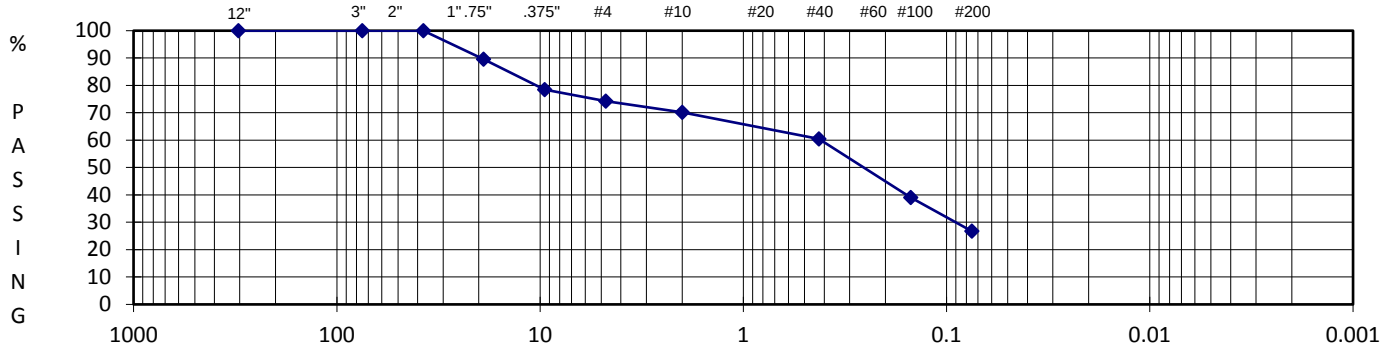
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		489.6
Tare Weight (gm)		15.5
(W6) Total Dry Weight (gm)		474.1

% COBBLES	**0.0**
% C GRAVEL	**10.5**
% F GRAVEL	**15.3**
% C SAND	**4.1**
% M SAND	**9.7**
% F SAND	**33.7**
% FINES	**26.7**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.5	0.00	0.00	100.00	cobbles
3.0"	15.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.5	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	65.1	49.60	10.46	89.54	fine gravel
0.50"					fine gravel
0.375"	117.4	101.90	21.49	78.51	fine gravel
#4	137.5	122.00	25.73	74.27	coarse sand
#10	157.1	141.60	29.87	70.13	medium sand
#20					medium sand
#40	203.0	187.50	39.55	60.45	fine sand
#60					fine sand
#100	304.6	289.10	60.98	39.02	fine sand
#200	362.9	347.40	73.28	26.72	fines
PAN	489.6	474.10	100.00	0.00	silt/clay



DESCRIPTION	Gravelly silty SAND
USCS	SM

Prepared For: Windward Real Estate

Reviewed By: RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property	**SAMPLE ID/TYPE**	TP-211
PROJECT NO.	2015-046	**SAMPLE DEPTH**	12.5'
TECH/TEST DATE	ELW-PLL - 5/26/2016	**DATE RECEIVED**	5/3/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	376.5
Wt Dry Soil & Tare (gm)	(w2)	285.9
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	90.6
Weight of Dry Soil (gm)	(w5=w2-w3)	270.2
Moisture Content (%)	(w4/w5)*100	34

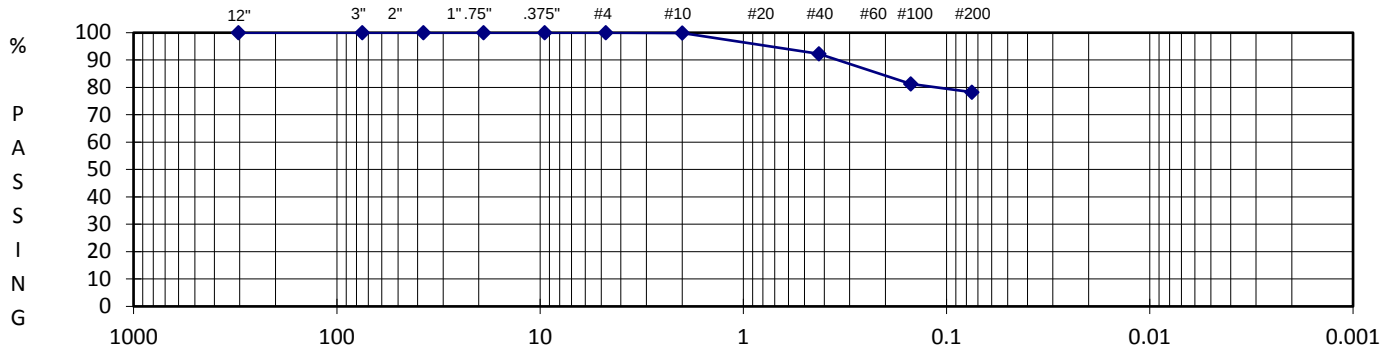
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		285.9
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		270.2

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.0**
% C SAND	**0.1**
% M SAND	**7.6**
% F SAND	**14.0**
% FINES	**78.3**
% TOTAL	**100.0**
D10 (mm)	NA
D30 (mm)	NA
D60 (mm)	NA
Cu	#VALUE!
Cc	#VALUE!

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.7	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.7	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.7	0.00	0.00	100.00	fine gravel
#4	15.7	0.00	0.00	100.00	coarse sand
#10	16.0	0.30	0.11	99.89	medium sand
#20					medium sand
#40	36.6	20.90	7.74	92.26	fine sand
#60					fine sand
#100	66.2	50.50	18.69	81.31	fine sand
#200	74.4	58.70	21.72	78.28	fines
PAN	285.9	270.20	100.00	0.00	silt/clay



DESCRIPTION	SILT with some sand
USCS	ML

Prepared For: Windward Real Estate

Reviewed By: RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-212	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	9'	
TECH/TEST DATE	ELW-PLL - 5/26/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	398.9
Wt Dry Soil & Tare (gm)	(w2)	356.4
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	42.5
Weight of Dry Soil (gm)	(w5=w2-w3)	340.8
Moisture Content (%)	(w4/w5)*100	12

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

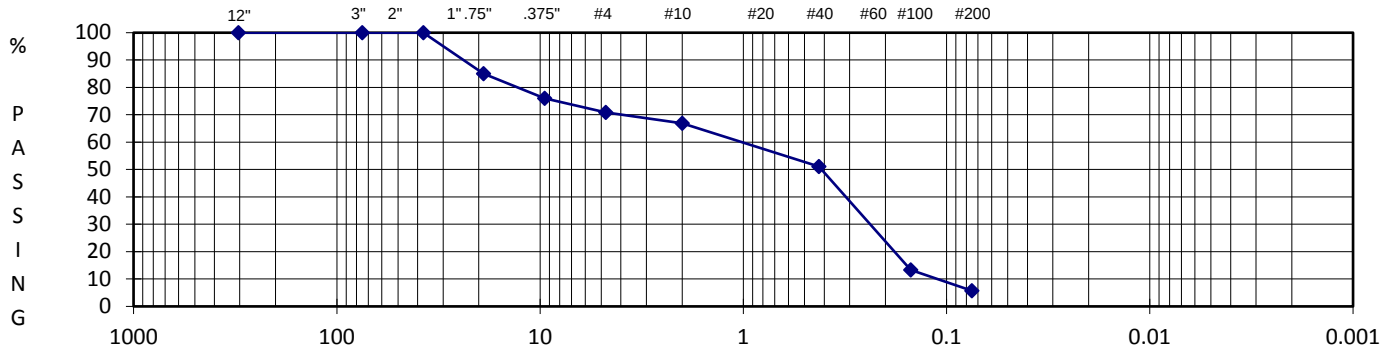
Weight Of Sample (gm)		356.4
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		340.8

% COBBLES	**0.0**
% C GRAVEL	**15.0**
% F GRAVEL	**14.1**
% C SAND	**4.0**
% M SAND	**15.8**
% F SAND	**45.4**
% FINES	**5.7**
% TOTAL	**100.0**

D10 (mm)	0.12
D30 (mm)	0.24
D60 (mm)	1
Cu	8.3
Cc	0.5

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	66.7	51.10	14.99	85.01	fine gravel
0.50"					fine gravel
0.375"	97.4	81.80	24.00	76.00	fine gravel
#4	114.7	99.10	29.08	70.92	coarse sand
#10	128.5	112.90	33.13	66.87	medium sand
#20					medium sand
#40	182.3	166.70	48.91	51.09	fine sand
#60					fine sand
#100	311.1	295.50	86.71	13.29	fine sand
#200	336.9	321.30	94.28	5.72	fines
PAN	356.4	340.80	100.00	0.00	silt/clay



DESCRIPTION	SAND with some gravel, some silt
USCS	SP-SM

Prepared For: Windward Real Estate

Reviewed By: RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-217	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	8'	
TECH/TEST DATE	ELW-PLL - 5/26/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	633.4
Wt Dry Soil & Tare (gm)	(w2)	577.7
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	55.7
Weight of Dry Soil (gm)	(w5=w2-w3)	562.1
Moisture Content (%)	(w4/w5)*100	10

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

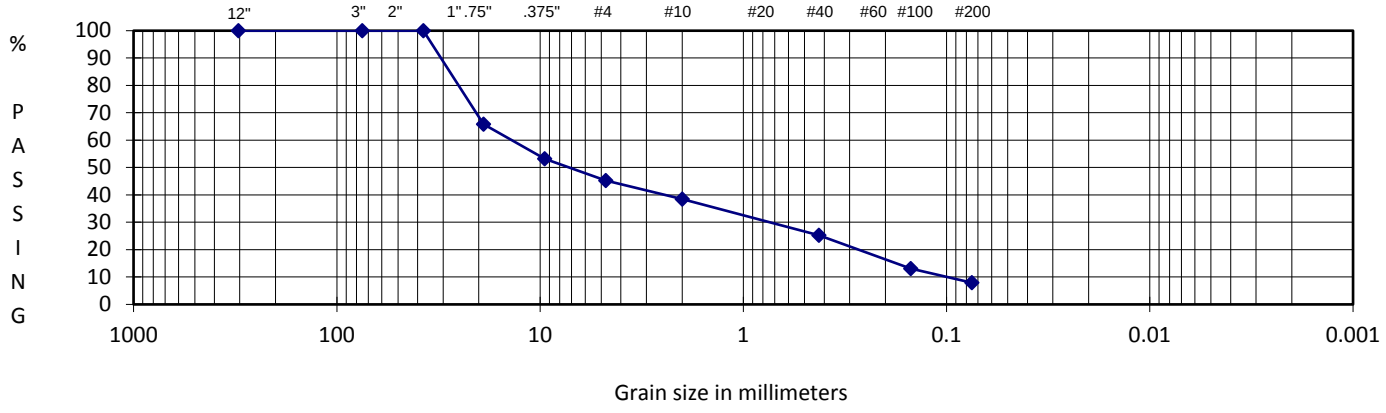
Weight Of Sample (gm)		577.7
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		562.1

% COBBLES	**0.0**
% C GRAVEL	**34.2**
% F GRAVEL	**20.6**
% C SAND	**6.7**
% M SAND	**13.2**
% F SAND	**17.4**
% FINES	**7.9**
% TOTAL	**100.0**

D10 (mm)	0.096
D30 (mm)	0.74
D60 (mm)	14
Cu	145.8
Cc	0.4

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	207.9	192.30	34.21	65.79	fine gravel
0.50"					fine gravel
0.375"	278.8	263.20	46.82	53.18	fine gravel
#4	323.6	308.00	54.79	45.21	coarse sand
#10	361.3	345.70	61.50	38.50	medium sand
#20					medium sand
#40	435.6	420.00	74.72	25.28	fine sand
#60					fine sand
#100	503.8	488.20	86.85	13.15	fine sand
#200	533.2	517.60	92.08	7.92	fines
PAN	577.7	562.10	100.00	0.00	silt/clay



DESCRIPTION Sandy GRAVEL with some silt

USCS GP-GM

Prepared For: Windward Real Estate

Reviewed By: RW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property		**SAMPLE ID/TYPE**	TP-218	
PROJECT NO.	2015-046		**SAMPLE DEPTH**	9'	
TECH/TEST DATE	ELW-PLL - 5/26/2016		**DATE RECEIVED**	5/3/2016	

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	217.4
Wt Dry Soil & Tare (gm)	(w2)	156.3
Weight of Tare (gm)	(w3)	15.7
Weight of Water (gm)	(w4=w1-w2)	61.1
Weight of Dry Soil (gm)	(w5=w2-w3)	140.6
Moisture Content (%)	(w4/w5)*100	43

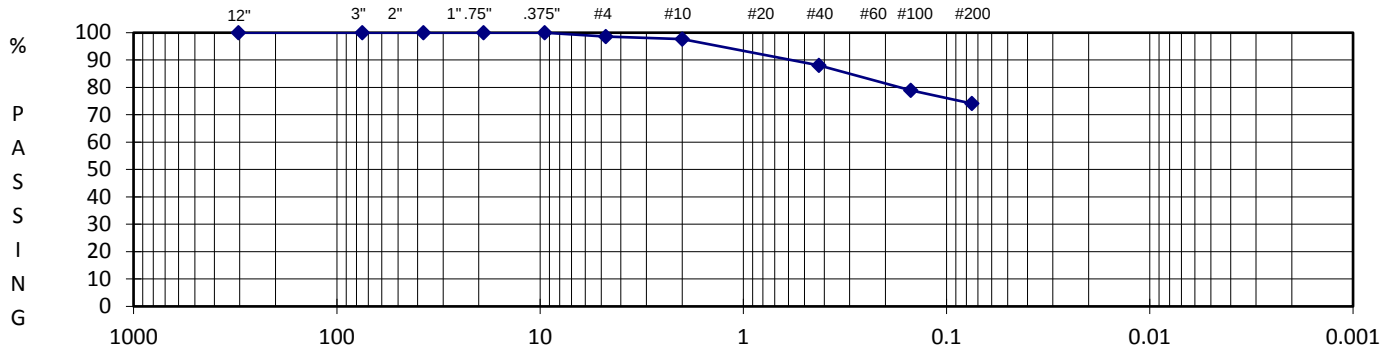
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

Weight Of Sample (gm)		156.3
Tare Weight (gm)		15.7
(W6) Total Dry Weight (gm)		140.6

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**1.4**
% C SAND	**0.9**
% M SAND	**9.6**
% F SAND	**13.9**
% FINES	**74.1**
% TOTAL	**100.0**
D10 (mm)	NA
D30 (mm)	NA
D60 (mm)	NA
Cu	#VALUE!
Cc	#VALUE!

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.7	0.00	0.00	100.00	cobbles
3.0"	15.7	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.7	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.7	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.7	0.00	0.00	100.00	fine gravel
#4	17.7	2.00	1.42	98.58	coarse sand
#10	19.0	3.30	2.35	97.65	medium sand
#20					medium sand
#40	32.5	16.80	11.95	88.05	fine sand
#60					fine sand
#100	45.3	29.60	21.05	78.95	fine sand
#200	52.1	36.40	25.89	74.11	fines
PAN	156.3	140.60	100.00	0.00	silt/clay



DESCRIPTION	SILT with some sand, trace gravel
USCS	ML

Prepared For: Windward Real Estate

Reviewed By: RW

RILEYGROUP

THE RILEY GROUP, INC.
17522 Bothell Way NE
Bothell, WA 98011

PHONE: (425) 415-0551
FAX: (425) 415-0311

GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Bergsma Property	**SAMPLE ID/TYPE**	TP-219
PROJECT NO.	2015-046	**SAMPLE DEPTH**	7.5'
TECH/TEST DATE	ELW-PLL - 5/26/2016	**DATE RECEIVED**	5/3/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	356.6
Wt Dry Soil & Tare (gm)	(w2)	306.7
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	49.9
Weight of Dry Soil (gm)	(w5=w2-w3)	291.1
Moisture Content (%)	(w4/w5)*100	17

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

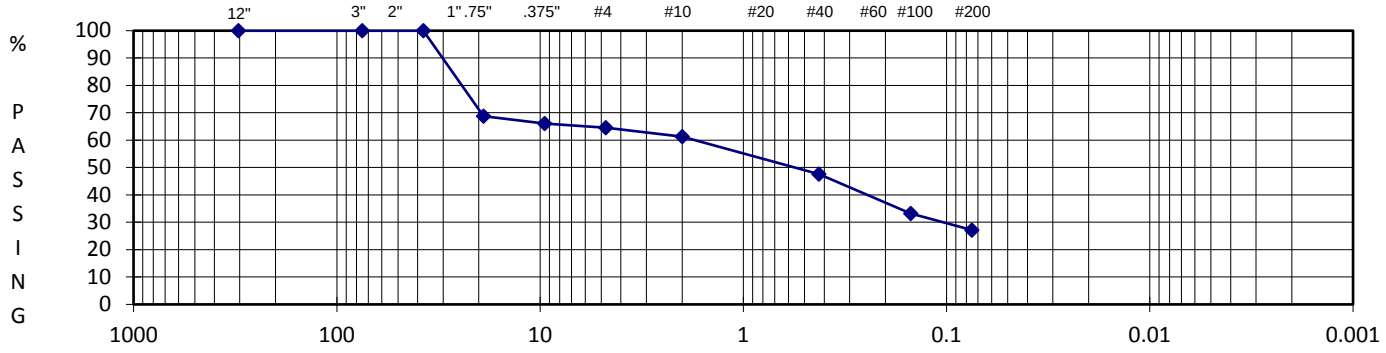
Weight Of Sample (gm)		306.7
Tare Weight (gm)		15.6
(W6) Total Dry Weight (gm)		291.1

% COBBLES	**0.0**
% C GRAVEL	**31.2**
% F GRAVEL	**4.2**
% C SAND	**3.3**
% M SAND	**13.7**
% F SAND	**20.4**
% FINES	**27.2**
% TOTAL	**100.0**

D10 (mm)	NA
D30 (mm)	0.1
D60 (mm)	1.8
Cu	#VALUE!
Cc	#VALUE!

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	106.4	90.80	31.19	68.81	fine gravel
0.50"					fine gravel
0.375"	114.3	98.70	33.91	66.09	fine gravel
#4	118.7	103.10	35.42	64.58	coarse sand
#10	128.2	112.60	38.68	61.32	medium sand
#20					medium sand
#40	168.2	152.60	52.42	47.58	fine sand
#60					fine sand
#100	209.9	194.30	66.75	33.25	fine sand
#200	227.6	212.00	72.83	27.17	fines
PAN	306.7	291.10	100.00	0.00	silt/clay



DESCRIPTION	Gravelly silty SAND
USCS	SM

Prepared For: Windward Real Estate

Reviewed By: RW

RILEYGROUP

HWA GEOSCIENCES INC.
Geotechnical & Pavement Engineering • Hydrogeology • Geoenvironmental • Inspection & Testing

May 24, 2016
HWA Project No. 2015-128-23 T300

Riley Group
17522 Bothell Way NE
Bothell, Washington 98011

Attention: Mr. Ricky Wang, PhD, P.E., G.E.
Mr. Eric Woods, L.G.

Subject: **Materials Laboratory Report**
Bergsma Property
Client Project Number: 2015-046

Dear Mr. Wang and Mr. Woods,

In accordance with your request, HWA GeoSciences Inc. (HWA) performed laboratory testing for the above referenced project. Herein we present the results of our laboratory analyses, which are summarized on the attached reports. The laboratory testing program was performed in general accordance with your instructions and appropriate ASTM Standards as outlined below.

SAMPLE DESCRIPTION: The subject samples were delivered to our laboratory on May 13, 2016 by Riley Group personnel. The samples were delivered as intact cores in 4-inch PVC liners and designated according to Riley Group's specified sample numbers. Each sample was described for engineering purposes and the descriptions are as follows:

B-202, S-1 @ 9-9.5 feet – Olive brown, Sandy SILT with gravel (ML)
B-202, S-2 @ 24.5-25 feet – Dark gray, Lean CLAY (CL)
B-202, S-3 @ 29.5-30 feet – Dark gray, Lean CLAY (CL)

SHEAR STRENGTH PARAMETERS OF SOIL: Direct shear tests were conducted on each sample in general accordance with ASTM D3080. Each sample was transferred from the PVC lining to brass rings for testing. The samples remained intact during this process for B-202, S-2 and B-202, S-3 and no remolding was required. B-202, S-1 required some remolding due to interference with gravels during the trimming process, but effort was made to minimize sample disturbance. Several points were run on each sample at normal stresses indicated by the client. The results of these tests are presented on Figures 1 through 3. The indicated shear stress at each point represents the maximum value obtained. The apparent cohesion and friction angle of the soil for the peak are inferred from a least-squares linear regression of the test points, as indicated on Figures 1 through 3.

21312 30th Drive SE
Suite 110
Bothell, WA 98021-7010
Tel: 425.774.0106
Fax: 425.774.2714
www.hwageo.com

CLOSURE: Experience has shown that test values on soil and other natural materials vary with each representative sample. As such, HWA has no knowledge as to the extent and quantity of material the tested samples may represent. HWA also makes no warranty as to how representative either the samples tested or the test results obtained are to actual field conditions. It is a well-established fact that sampling methods present varying degrees of disturbance that affect sample representativeness.

No copy should be made of this report except in its entirety.

We appreciate the opportunity to provide laboratory testing services on this project. Should you have any questions or comments, or if we may be of further service, please call.

HWA GEOSCIENCES INC.

Daniel Walton
Laboratory Technician

Steven E. Greene, L.G., L.E.G.
Principal Engineering Geologist
Vice President

HWA GEOSCIENCES INC. Materials Testing Laboratory

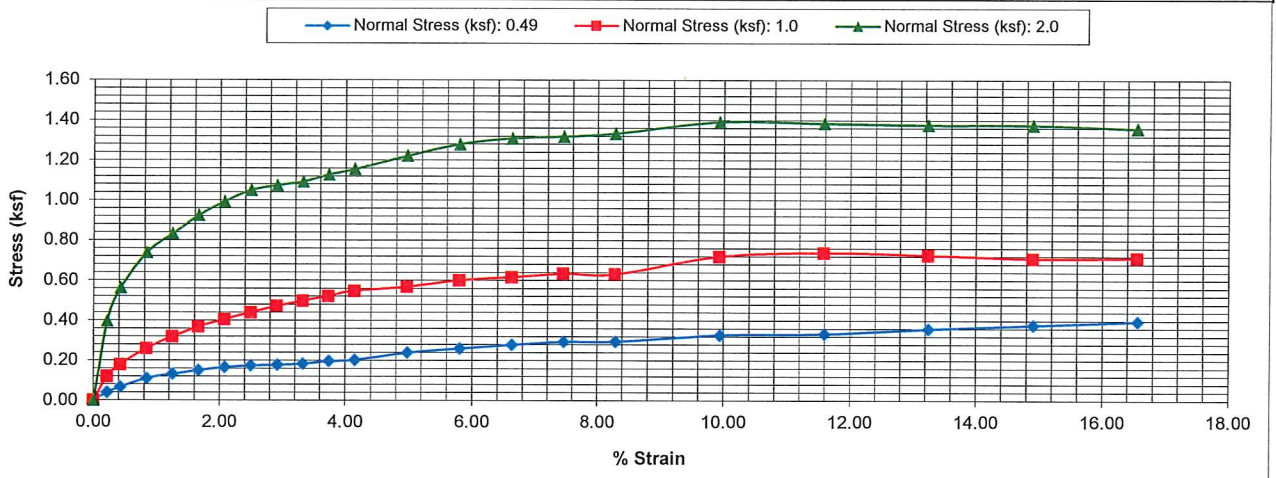
Direct Shear Test of Soils Under Consolidated Drained Conditions (ASTM D 3080)

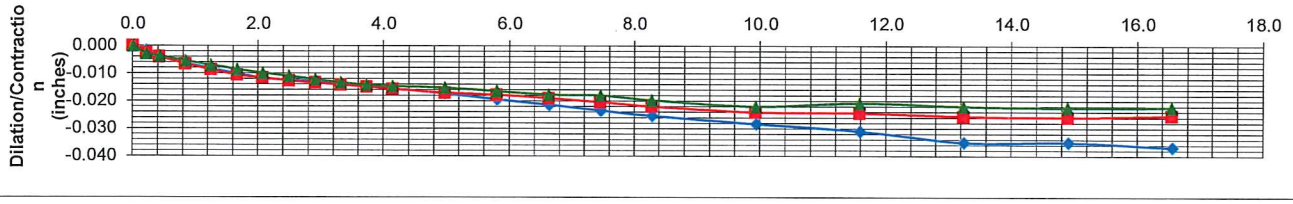
Project Name:	MLT for Riley Group - Bergsma Property	**Project Number:**	2015-128 T300
Sample Point:	B-202 **Sample No.:** S-1	**Sample Depth:**	9-9.5 feet
Soil Description:	sandy SILT with gravel		
Soil Color:	Olive brown	Strain rate:	0.1 % per min.
Soil Group Symbol:	ML	Soil Specific Gravity:	2.65 (assumed)

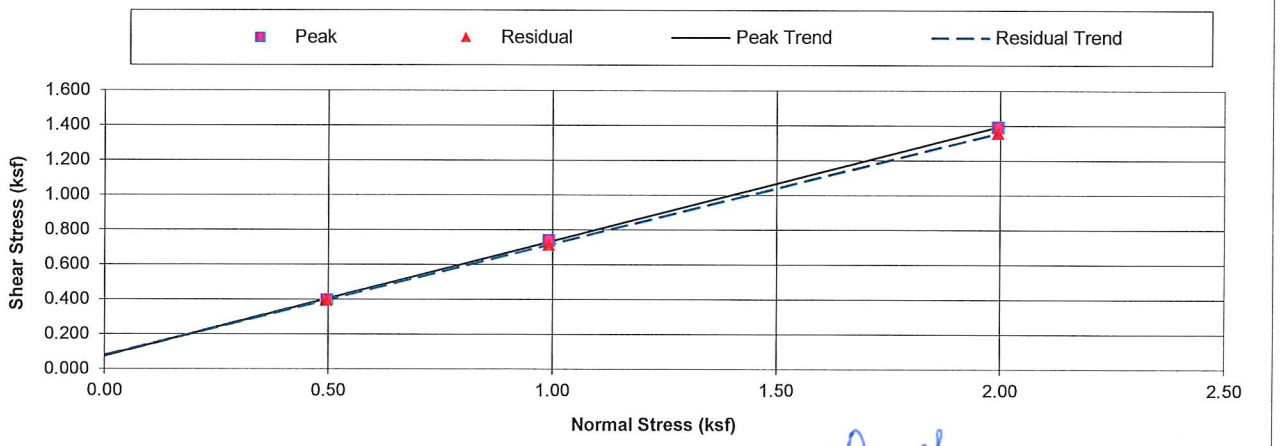
Normal Stress (ksf)	0.49	0.99	1.99	**Average**
Peak Stress (ksf)	0.397	0.739	1.392	
Residual Stress (ksf)	0.397	0.714	1.358	
Initial Moisture Content (%):	18.2	18.2	18.2	18.2
Wet Unit Weight (pcf):	114.2	110.4	114.3	112.9
Dry Unit Weight (pcf):	96.6	93.4	96.7	95.6
Calculated Void Ratio	0.712	0.771	0.711	0.731
Calculated Porosity	0.416	0.435	0.415	0.422
Calculated Saturation (%)	67.8	62.5	67.9	66.1
Final Moisture Content (%)	24.9	26.8	24.3	25.3

Indicated Strength Parameters

	Cohesion (ksf)	phi Angle (degrees)
Peak	0.1	33.5
Residual	0.1	32.7







Checked By: _____ Figure 1

HWA GeoSciences Inc. Materials Testing Laboratory

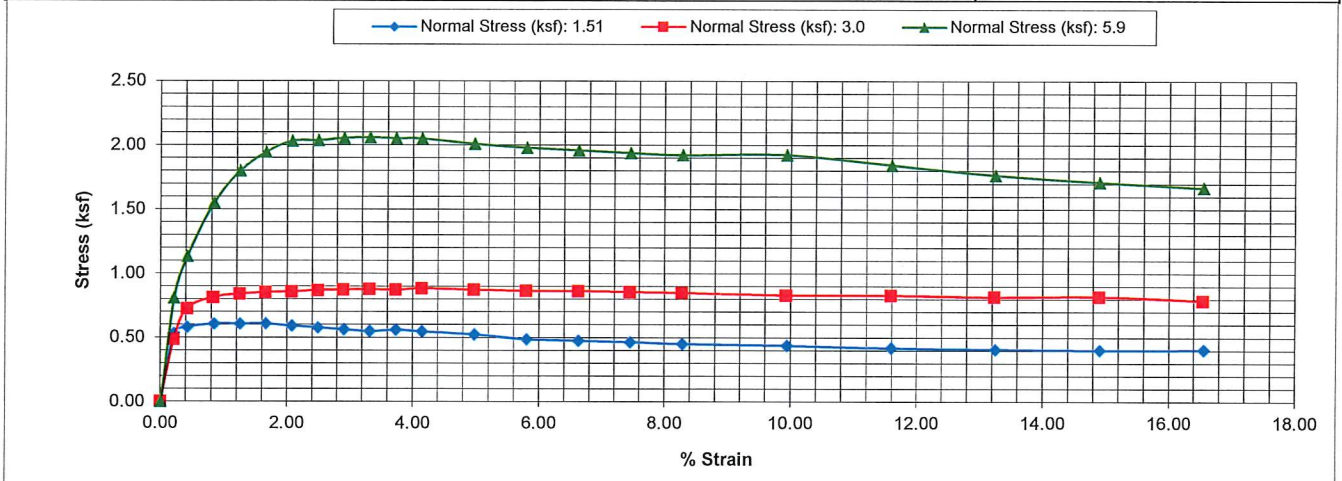
Direct Shear Test of Soils Under Consolidated Drained Conditions (ASTM D 3080)

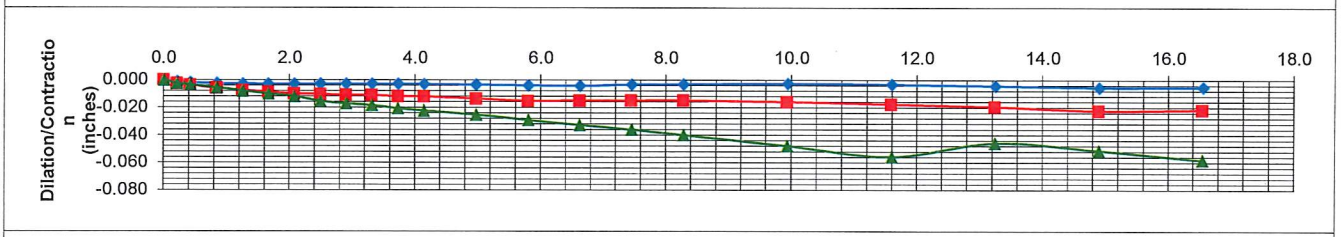
Project Name:	MLT for Riley Group - Bergsma Property	**Project Number:**	2015-128 T300
Sample Point:	B-202 **Sample No.:** S-2	**Sample Depth:**	24.5-25 feet
Soil Description:	lean CLAY		
Soil Color:	Dark gray	Strain rate:	0.1 % per min.
Soil Group Symbol:	CL	Soil Specific Gravity:	2.65 (assumed)

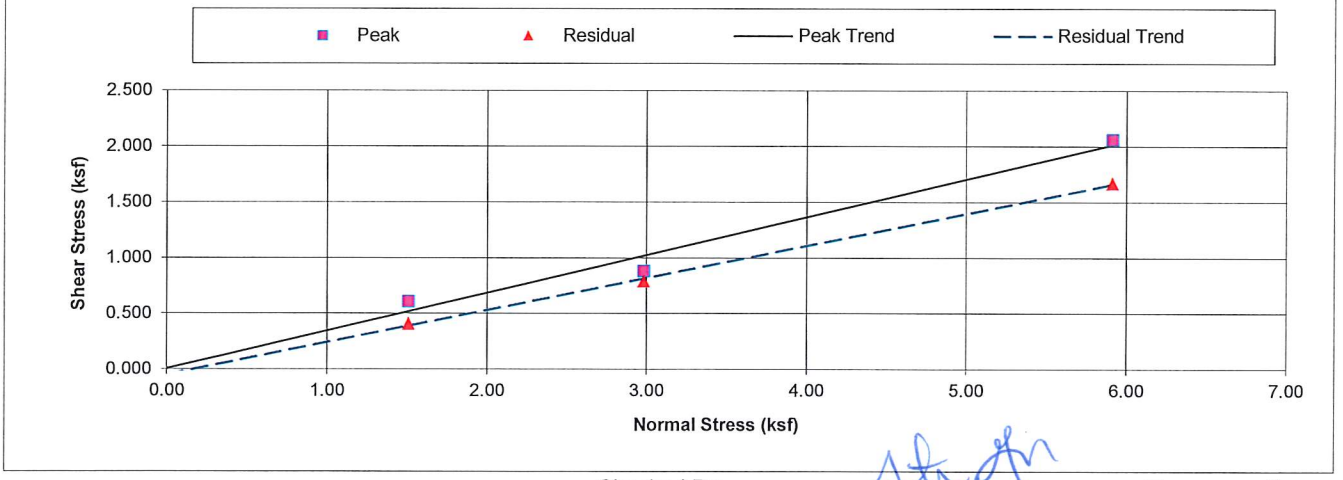
Normal Stress (ksf)	1.51	2.98	5.91	**Average**
Peak Stress (ksf)	0.609	0.883	2.060	
Residual Stress (ksf)	0.406	0.788	1.669	
Initial Moisture Content (%):	45.6	45.6	45.6	45.6
Wet Unit Weight (pcf):	110.6	109.5	108.6	109.6
Dry Unit Weight (pcf):	75.9	75.2	74.6	75.2
Calculated Void Ratio	1.178	1.198	1.217	1.198
Calculated Porosity	0.541	0.545	0.549	0.545
Calculated Saturation (%)	102.6	100.9	99.4	101.0
Final Moisture Content (%)	46.3	46.6	45.6	46.1

Indicated Strength Parameters

	Cohesion (ksf)	phi Angle (degrees)
Peak	0.0	18.8
Residual	0.0	16.1







Checked By: _____ Figure 2

HWA GeoSciences Inc. Materials Testing Laboratory

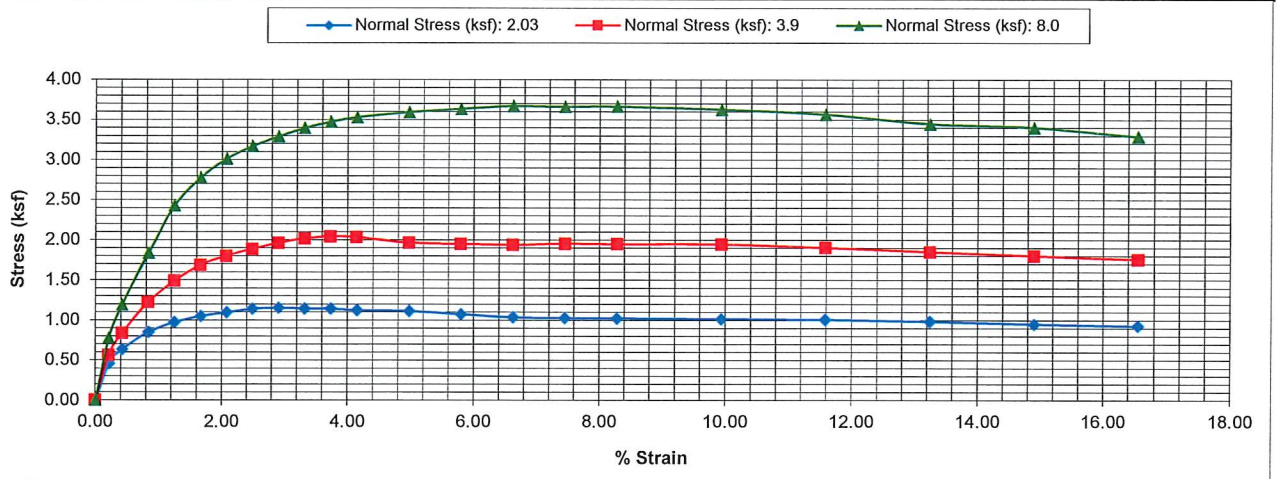
Direct Shear Test of Soils Under Consolidated Drained Conditions (ASTM D 3080)

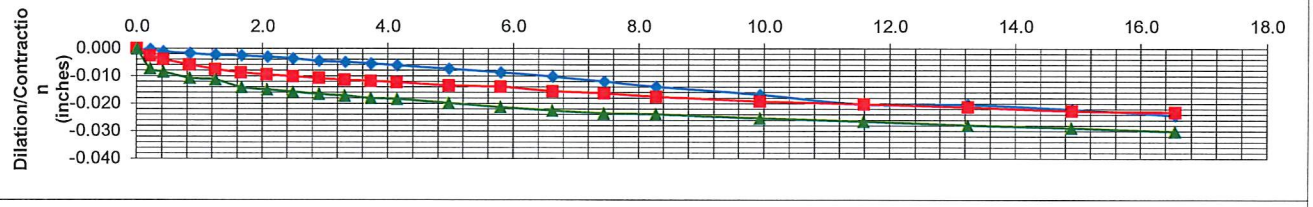
Project Name:	MLT for Riley Group - Bergsma Property	**Project Number:**	2015-128 T300
Sample Point:	B-202 **Sample No.:** S-3	**Sample Depth:**	29.5-30 feet
Soil Description:	lean CLAY		
Soil Color:	Dark gray	Strain rate:	0.1 % per min.
Soil Group Symbol:	CL	Soil Specific Gravity:	2.65 (assumed)

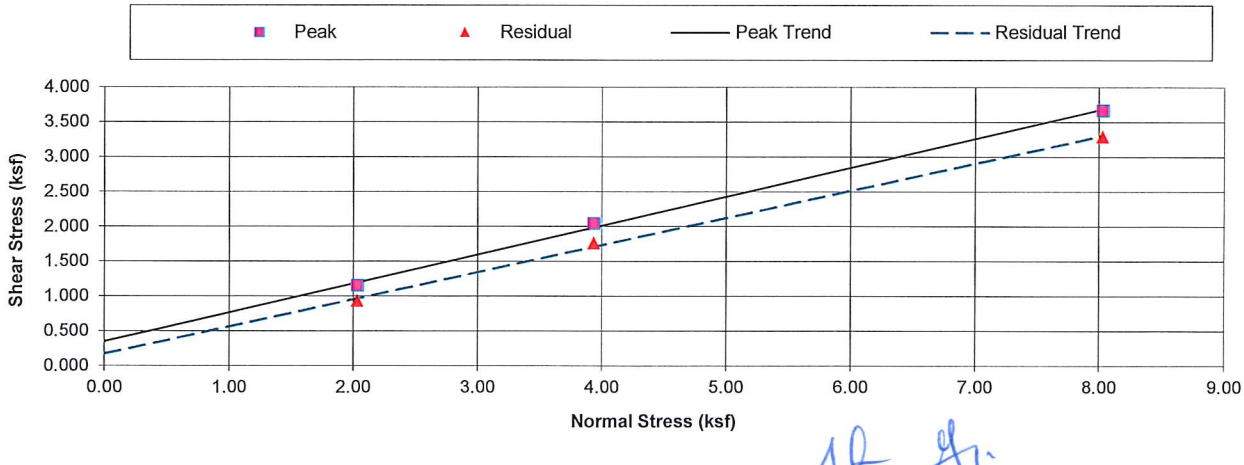
Normal Stress (ksf)	2.03	3.93	8.03	**Average**
Peak Stress (ksf)	1.154	2.044	3.670	
Residual Stress (ksf)	0.930	1.760	3.291	
Initial Moisture Content (%):	29.1	29.1	29.1	29.1
Wet Unit Weight (pcf):	121.8	122.6	121.7	122.0
Dry Unit Weight (pcf):	94.4	94.9	94.3	94.5
Calculated Void Ratio	0.752	0.742	0.754	0.749
Calculated Porosity	0.429	0.426	0.430	0.428
Calculated Saturation (%)	102.5	103.9	102.2	102.9
Final Moisture Content (%)	30.5	28.6	28.8	29.3

Indicated Strength Parameters

	Cohesion (ksf)	phi Angle (degrees)
Peak	0.4	22.6
Residual	0.2	21.3







Checked By: _____ Figure 3

Bergsma Plat

Issaquah, Washington

GeoTechnical Testing Laboratory

Geotechnical Testing Laboratory, Inc.
10011 Blomberg Street SW
Olympia, WA 98512
Phone#: (360) 754-4612
Fax#: (360) 754-4848

Columbia Basin Laboratory, Inc.
127 4th Street
Soap Lake, WA 98851
Phone#: (509) 246-9193
Fax#: (509) 246-9183

www.GeoTechnicalTestingLab.com

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 1 | N47° 32.558' W122° 04.107' | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 18 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	tex-ture	% org.	% clay	Liqd Lmt	Plas Lmt	Plas Indx	struc-ture	mott-ling	cemen-tation	Loading Rate gal/ft^2/day	Soil Textural Classification
1	Brown gravelly silty sand		A		cm	brown											
2																	
3																	
4																	
5																	
6																	
7	Light grayish brown silty					lt gray											
8	sand					brown											
9	Moist gray silt					Gray											
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	

Not encountered

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 2 | N47° 32.553 | W122° 04.137 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Brown gravelly silty sand		A	Not encountered	cm	brown	Sa	SG		Not Present	
2											
3											
4											
5	Light grayish brown silty					lt gray brown	Sa-Si	Mas		Mod	
6	sand										
7	Moist gray silt					Gray	Si	Mas		Mod	
8											
9											
10											
11											
12											

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 GPS Location **File #:**

Field Test Pit : 3 N47° 32.578 W122° 04.146 **Client:** MDZ Construction

Type of hole: Backhoe **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	boriz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Brown loamy silt		A		cm	brown	Sa	SG		Not Present	
2											
3	Moist gray silt					Gray	Si	Mas		Mod	
4											
5											
6											
7											
8				Not encountered							
9											
10											
11											
12											

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 4 | N47° 32.572 | W122° 04.117 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Brown gravelly silty sand		A		cm	brown	Sa	SG		NP	
2					ff						
3	Silty sand with some				NP	Lt brown	Si-Sa-Gr	SG		NP	
4	gravel				NP						
5				Not encountered	NP						
6					NP						
7					NP						
8					NP						
9					NP						
10					NP						
11	Moist gray silt				NP	Gray	Si	Mas		Mod	
12					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 5 | N47° 32.557 | W122° 04.703 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 8 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Light brown loam sand		A	Not encountered	cm	brown	Sa	SG		NP	
2					lT				distinct		
3	Interbedded clay and sand				NP	Lt brown	Si-Sa-Gr	SG		NP	
4					NP						
5					NP						
6					NP						
7					NP						
8					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 6 | N47° 32.582 | W122° 04.223 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 6 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Light brown loam sand		A	Not encountered	cm	brown	Sa	SG		NP	
2					ft				distinct		
3	Interbedded clay and sand				NP	Lt brown	Si-Sa-Gr	Mas		NP	
4					NP						
5					NP						
6					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 7 | N47° 32.598 | W122° 04.207 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 10 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Light brown loam sand		A		cm	brown	Sa	SG		NP	
2					ft						
3				Not encountered	NP						
4	Moist gray silt				NP		Cl-Si	Mas			
5											
6											
7					NP						
8					NP						
9											
10											

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 8 | N47° 32.652 | W122° 04.204 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Sand with gravel		A	Not encountered	cm	brown	Sa	SG		NP	
2					cf						
3					cf						
4					NP						
5					NP						
6					NP						
7					NP						
8					NP						
9					NP						
10					NP						
11					NP						
12					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 9 | N47° 32.656 | W122° 04.164 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 10 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Gravelly sand loam		A		cm	brown	Gr-Sa-Lm	SG		NP	
2					cf						
3	Moist gray silt			Not encountered	cf	Gray					
4					NP						
5					NP						
6					NP						
7					NP						
8					NP						
9					NP						
10					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 10 | N47° 32.658 | W122° 04.143 | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Gravelly sand loam		A		cm	brown	Gr-Sa-Lm	SG		NP	
2					cf						
3	Moist gray silt			Not encountered	cf	Gray					
4					NP						
5					NP						
6					NP						
7					NP						
8					NP						
9					NP						
10											
11											
12					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 11 | No Reception | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Sandy Loam		A		cm	Reddish	Sa-Lm	SG		NP	
2					cf	Brown					
3	Gravelly sand			Not encountered	cf		Gr-Sa	Sg			
4					NP	Light gray brown					
5					NP						
6	Moist gray silt				NP	Gray	Si	Mas		Mod	
7					NP						
8					NP						
9					NP						
10											
11											
12	Boulders				NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 12 | No Reception | **Client:** MDZ Construction

Type of hole: Backhoe | Near Creek on Slope Road (at bottom) | **Depth Excavated:** 6 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Sandy Loam		A	Not encountered	cm	Reddish	Sa-Lm	SG		NP	
2					cf	Brown					
3	Gray Silt				cf	Gray	Si	Mas		Mod	
4					NP						
5					NP						
6					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 13 | No Reception | **Client:** MDZ Construction

Type of hole: Backhoe | Slope Road (1/2 way up road) | **Depth Excavated:** 6 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Gravelly sand		A	Not encountered	cm	Reddish	Sa-Lm	SG		NP	
2					cf	Brown					
3					cf						
4	Gray Silt				NP	Gray	Si	Mas		Mod	
5					NP						
6					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 14 | N47° 32.629' | W122° 04.092 | **Client:** MDZ Construction

Type of hole: Backhoe | Slope Road (Crest) | **Depth Excavated:** 6 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Gravelly sand		A	Not encountered	cm	Reddish	Sa-Lm	SG		NP	
2					cf	Brown					
3					cf						
4					NP						
5	Gray Silt				NP	Gray	Si	Mas		Mod	
6					NP						

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 15 | N47° 32.605' | W122° 04.109' | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 8 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Gravelly sand		A	Not encountered	cm	Reddish	Sa-Lm	SG		NP	
2					cf	Brown					
3	Gray brown silty sand				cf	Gray	Si-Sa	Sg		Mod	
4					NP	Brown					
5					NP						
6											
7											
8											

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 GPS Location **File #:**

Field Test Pit : 16 N47° 32.599' W122° 04.140' **Client:** MDZ Construction

Type of hole: Backhoe **Depth Excavated:** 10 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Gravelly sand		A		cm	Brown	Sa-Lm	SG		NP	
2	Fine grained sand with silt				cf	Grayish	Sa-Si	Mas		Mod	
3					cf	brown					
4					NP						
5					NP						
6											
7											
8											
9											
10											

Not encountered

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 17 | N47° 32.587' | W122° 04.176' | **Client:** MDZ Construction

Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Forest Duff		A	Not encountered	cm	Brown	Sa-Lm	SG		NP	
2	Clay				cf	Grayish	Sa-Si	Mas		Mod	
3					cf	brown					
4					NP						
5					NP						
6											
7											
8											
9											
10											
11											
12	Interbedded silt and clay					Gray	Si-Cl	Mas		Mod	

GEOTECHNICAL TESTING LAB

Date: 11/8/2007 | GPS Location | **File #:**

Field Test Pit : 18 | N47° 32.569' | W122° 04.260' | **Client:** MDZ Construction

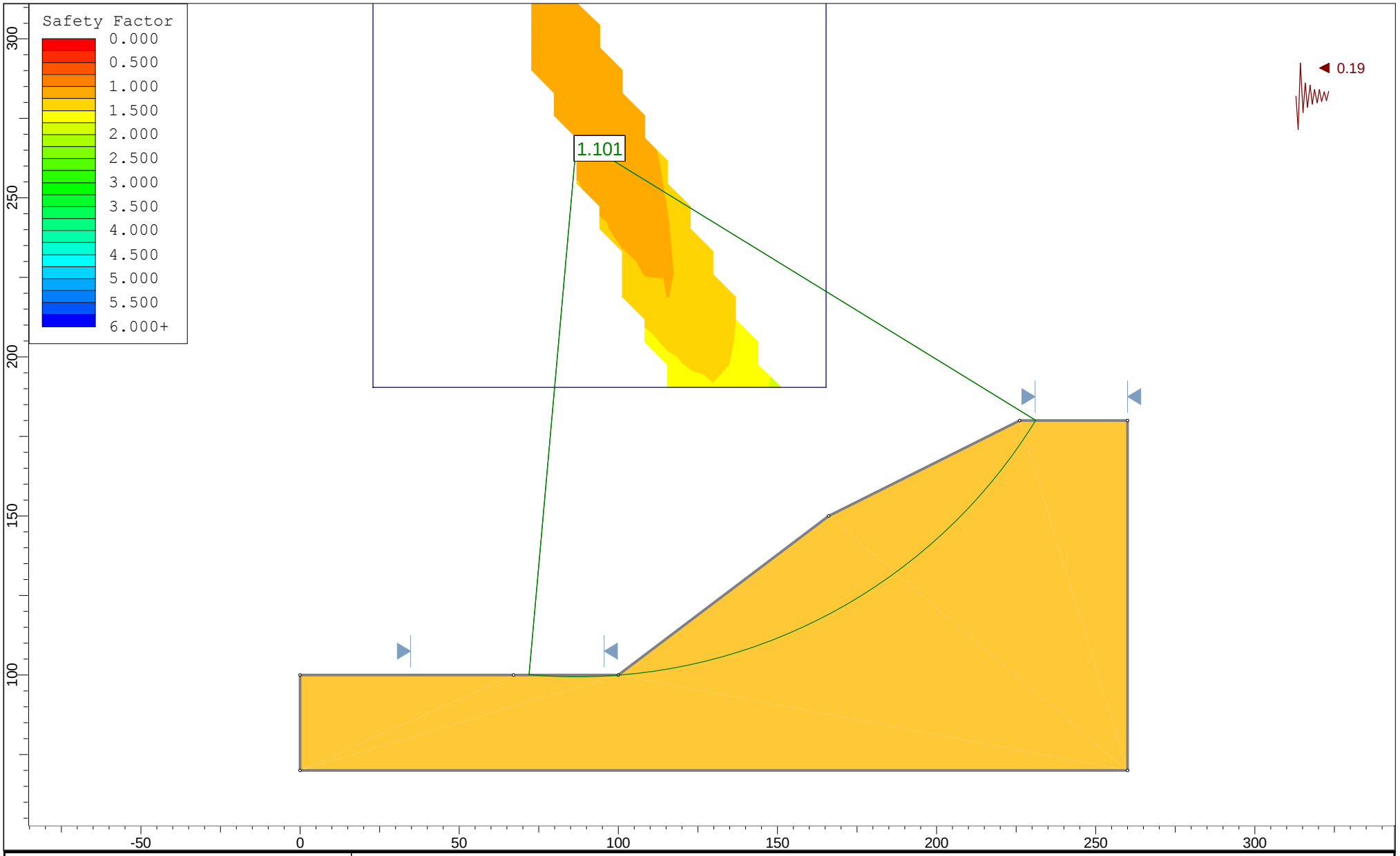
Type of hole: Backhoe | **Depth Excavated:** 12 Feet

Depth (in)	Field Description	Change in Soils	horiz	high water level	roots	color	Texture	Structure	Mottling	Cementation	Soil Textural Classification
1	Forest Duff		A	Not encountered	cm	Brown	Sa-Lm	SG		NP	
2	Silty clay (dry)				cf	Grayish	Si-Cl	Mas		Mod	
3					cf	brown					
4					NP						
5					NP						
6											
7											
8											
9											
10											
11											
12	Gravelly sand (shot gravel)					Gray	Si-Cl	Mas		Mod	

APPENDIX B
SLOPE STABILITY ANALYSIS

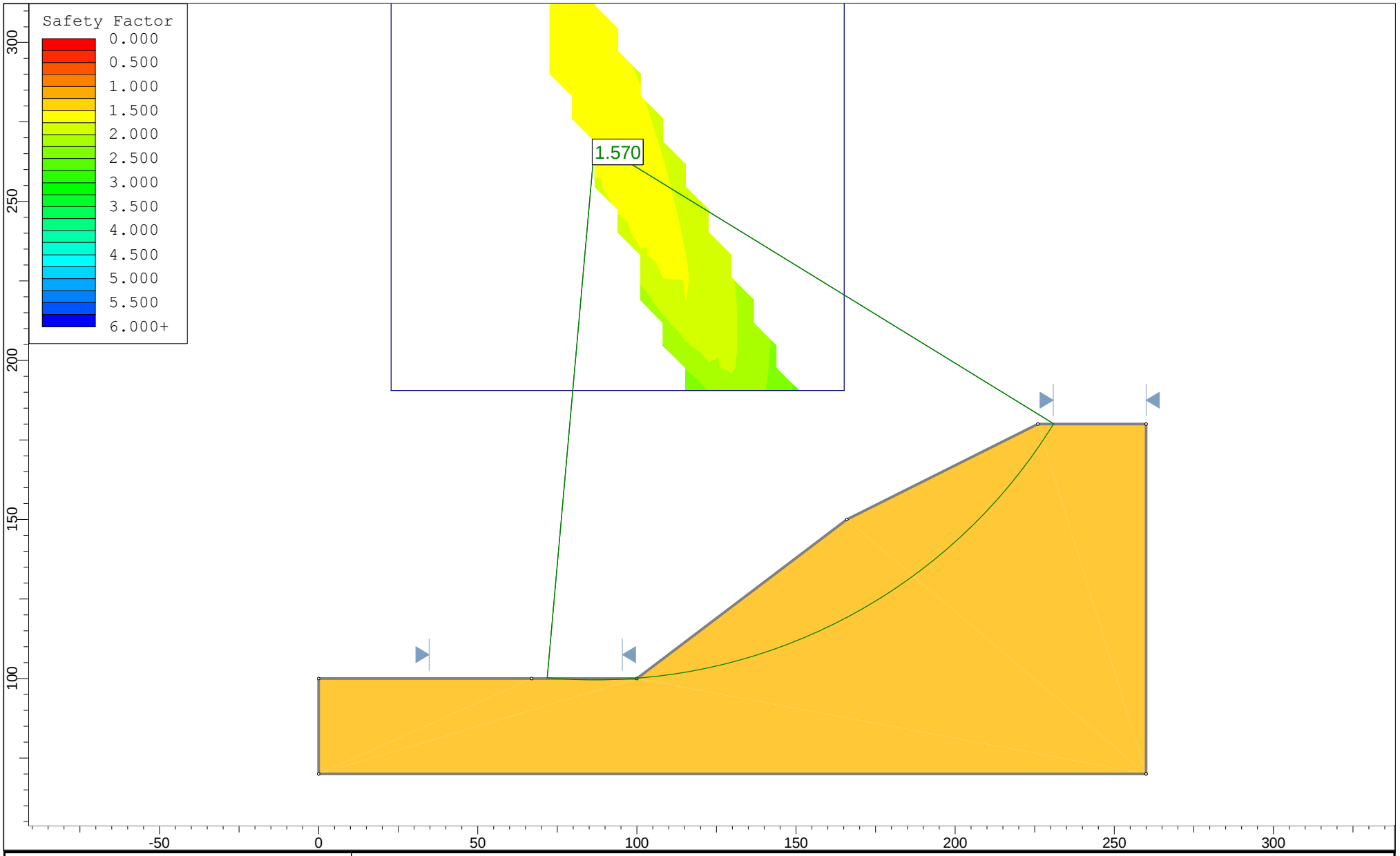
RGI performed the slope stability analysis by using a computer program, Slide version 6.0, which was developed by Rocscience. The slope data is based on the site plans (C2.0) prepared by PACE dated July 14, 2017. The slope profiles and soil parameters used for the analysis are shown in the report.

For seismic analysis, peak ground acceleration (PGA) was determined to be 0.545g based on ASCE 7-10 Standard. Following the procedure recommended in NCHRP Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments (Report 611) and FHWA LRFD Seismic Analysis and Design of Transportation Geotechnical Features and Structural Foundations Manual (2011), a seismic coefficient of 0.19 was determined which is used in the pseudo-static slope stability analysis.



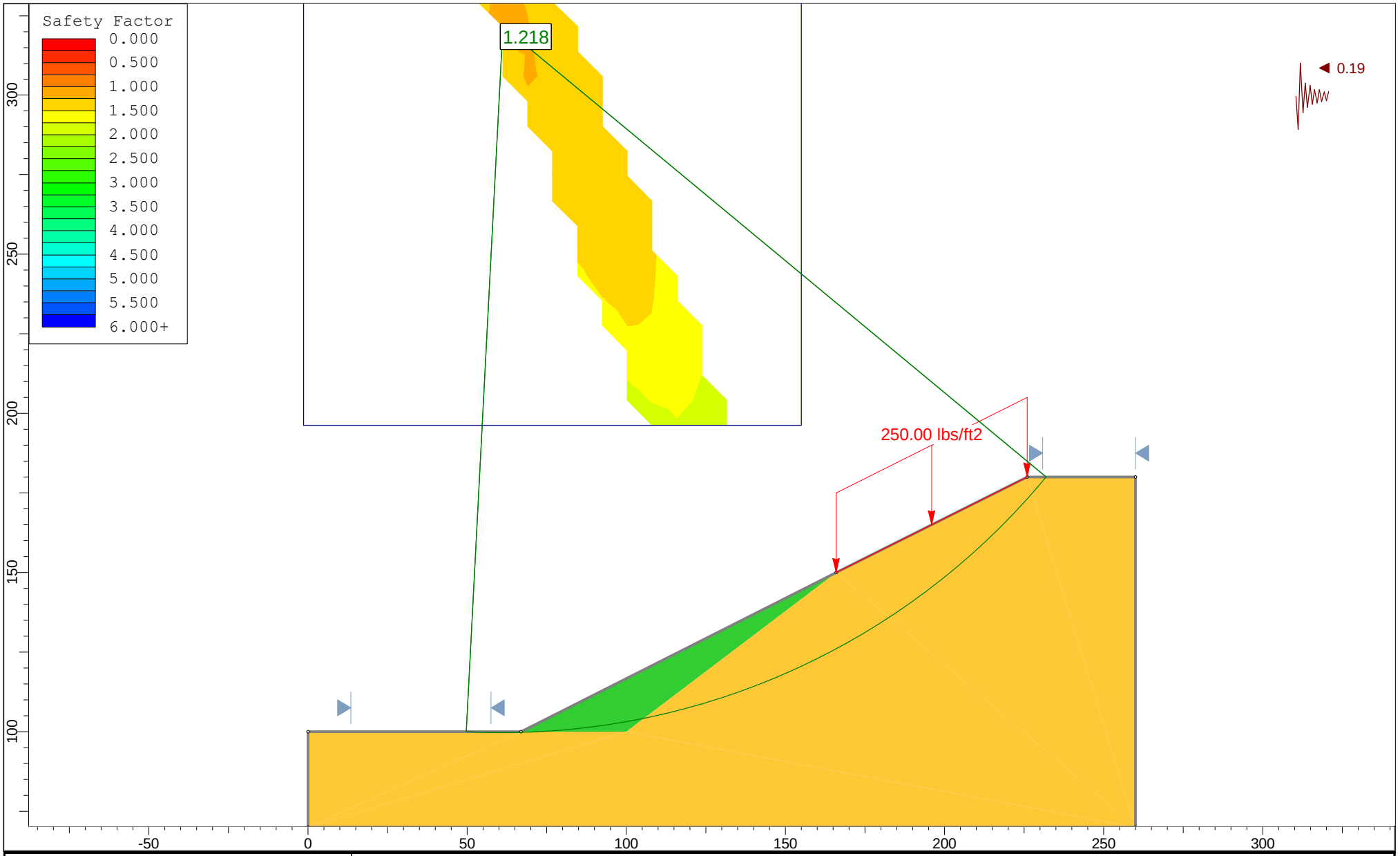
rocscience	Project: Bergsma Short Plat		
	Analysis Description: Cross Section H-H' - Existing Seismic		
	Drawn By: RW	Scale: 1:500	Company: Riley Group, Inc.
	Date: 8/24/2017, 1:58:44 PM		File Name: Section H-H' Lot 53 Existing - Seismic.slim

SLIDEINTERPRET 6.009



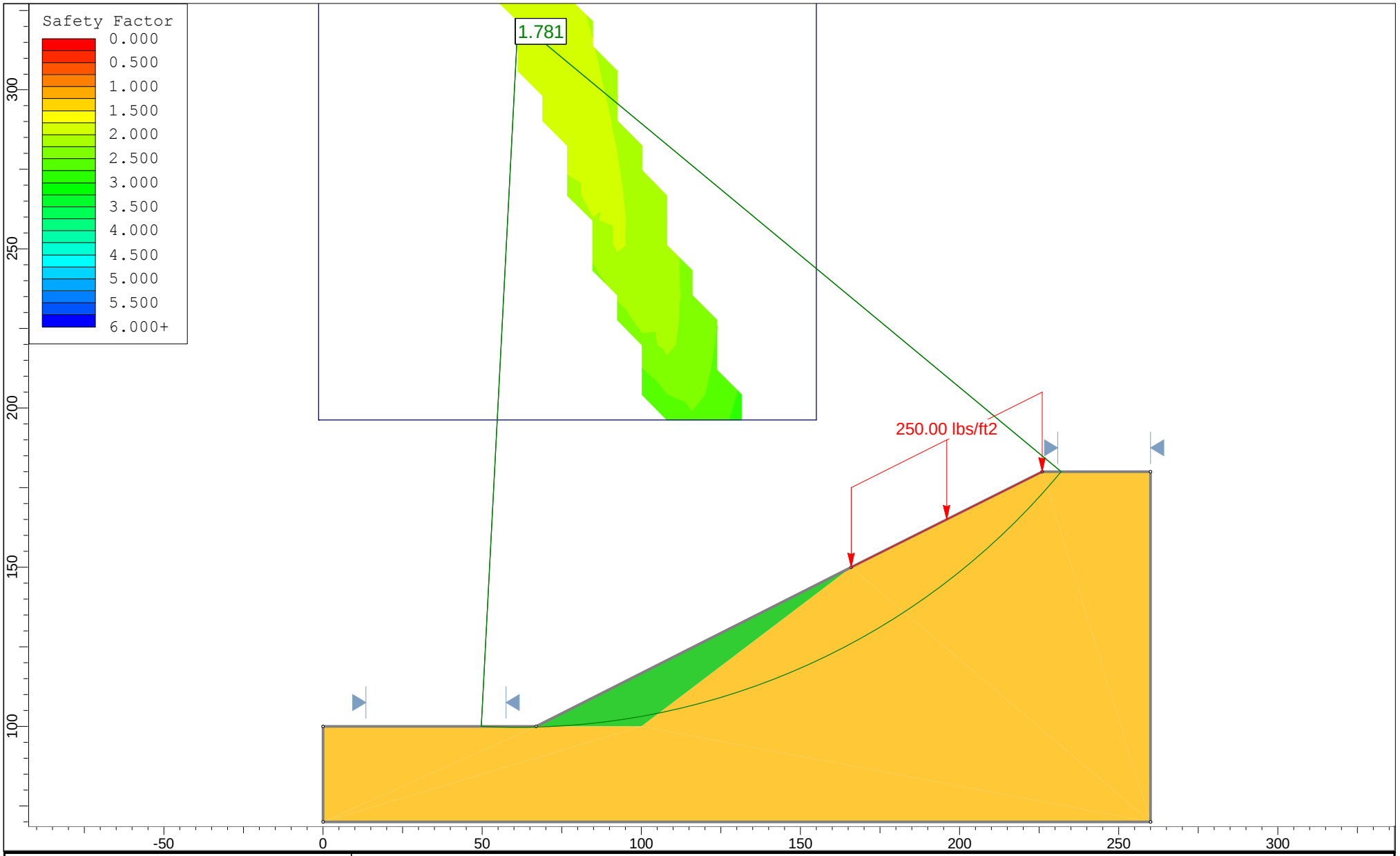
Project	Bergsma Short Plat		
Analysis Description	Cross Section H-H' - Existing Static		
Drawn By	RW	Scale 1:500	Company Riley Group, Inc.
Date	8/24/2017, 1:58:44 PM		File Name Section H-H' Lot 53 Existing.slim

SLIDEINTERPRET 6.009



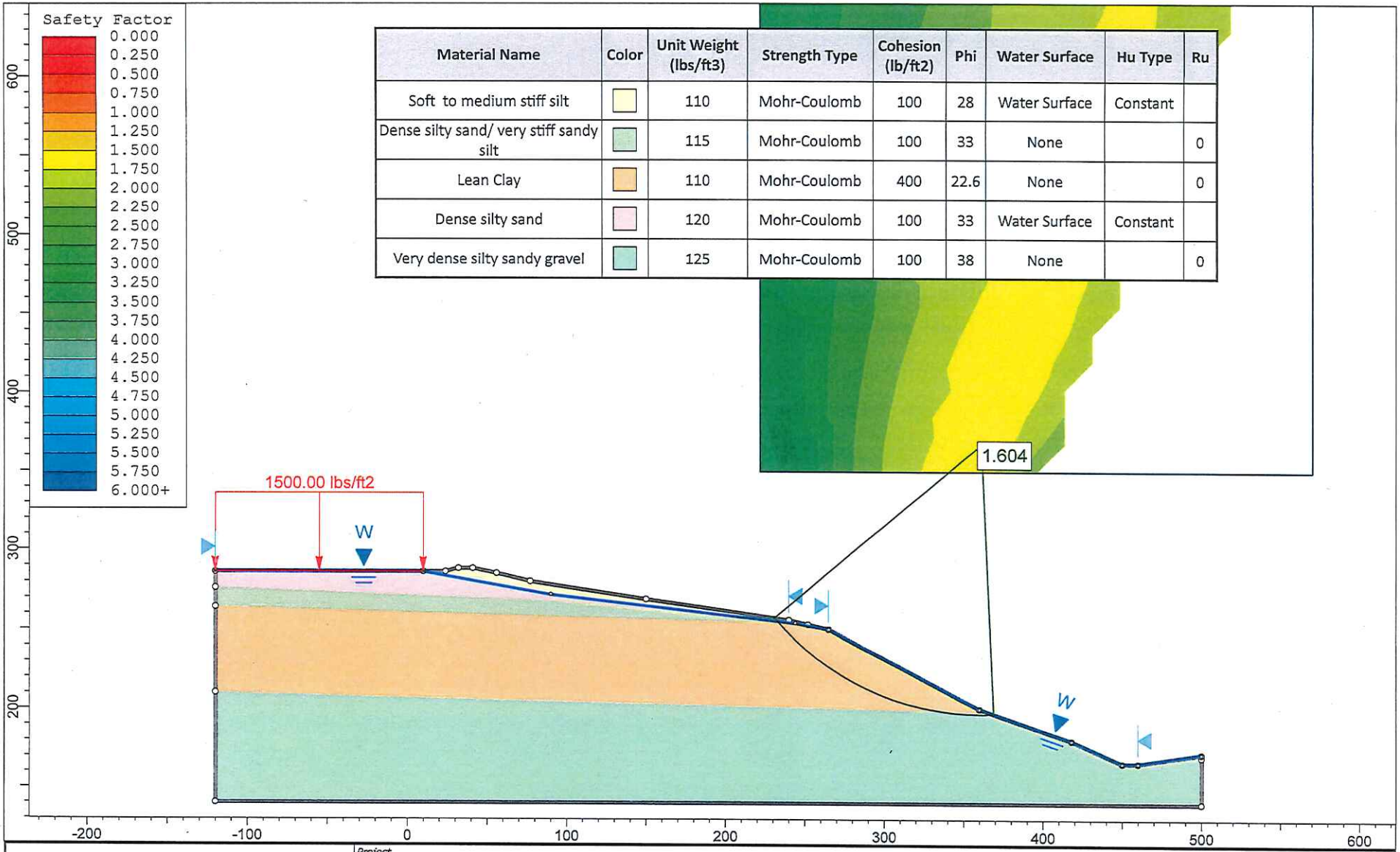
rocscience	Project: Bergsma Short Plat		
	Analysis Description: Cross Section H-H' - Proposed Seismic		
	Drawn By: RW	Scale: 1:500	Company: Riley Group, Inc.
	Date: 8/24/2017, 1:58:44 PM		File Name: Section H-H' Lot 53 Proposed - Seismic.slim

SLIDEINTERPRET 6.009



rocscience	Project: Bergsma Short Plat		
	Analysis Description: Cross Section H-H' - Proposed Static		
	Drawn By: RW	Scale: 1:500	Company: Riley Group, Inc.
	Date: 8/24/2017, 1:58:44 PM		File Name: Section H-H' Lot 53 Proposed - Static.slim

SLIDEINTERPRET 6.009

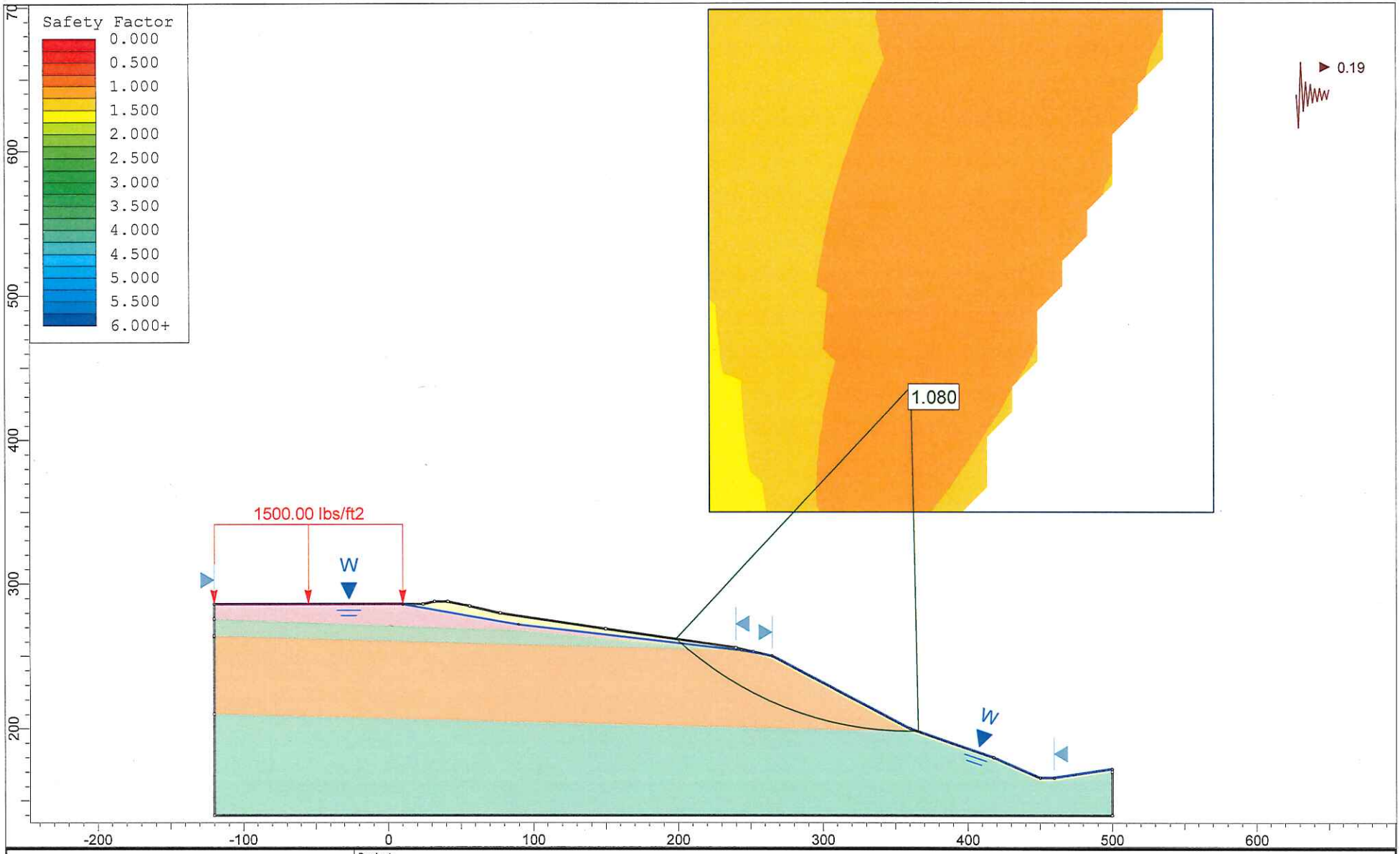


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
Soft to medium stiff silt		110	Mohr-Coulomb	100	28	Water Surface	Constant	
Dense silty sand/ very stiff sandy silt		115	Mohr-Coulomb	100	33	None		0
Lean Clay		110	Mohr-Coulomb	400	22.6	None		0
Dense silty sand		120	Mohr-Coulomb	100	33	Water Surface	Constant	
Very dense silty sandy gravel		125	Mohr-Coulomb	100	38	None		0

rocscience

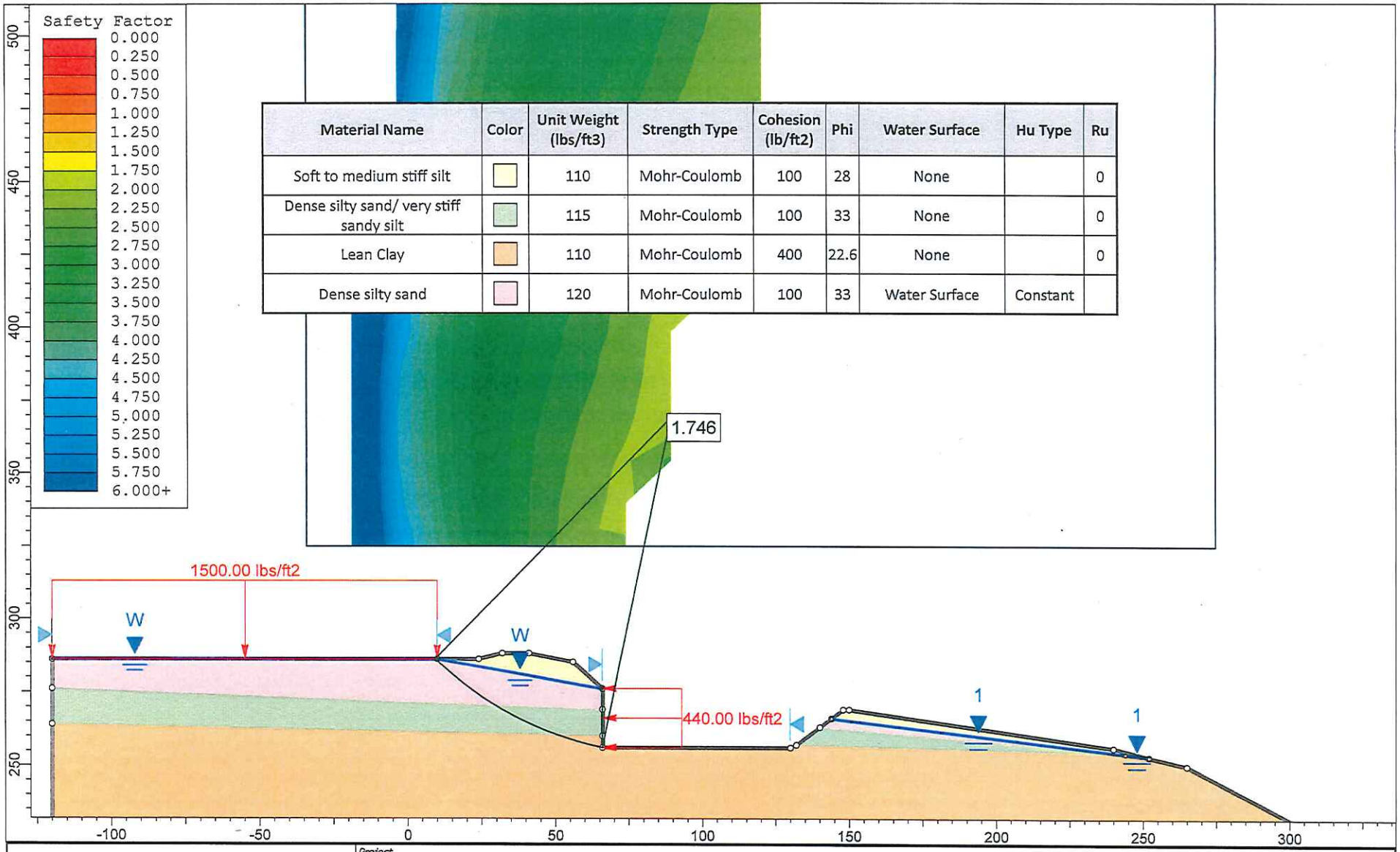
SLIDEINTERPRET 6.009

Project	Bergsma Property				
Analysis Description	Existing - Static				
Drawn By	ELW	Scale	1:1000	Company	The Riley Group, Inc.
Date	6/12/2016, 2:04:53 PM			File Name	Existing Static.slim



rocscience	Project	Bergsma Property		
	Analysis Description	Existing - Seismic		
	Drawn By	ELW	Scale 1:1098	Company The Riley Group, Inc.
	Date	6/12/2016, 2:04:53 PM		File Name Existing Seismic(.19g).slim

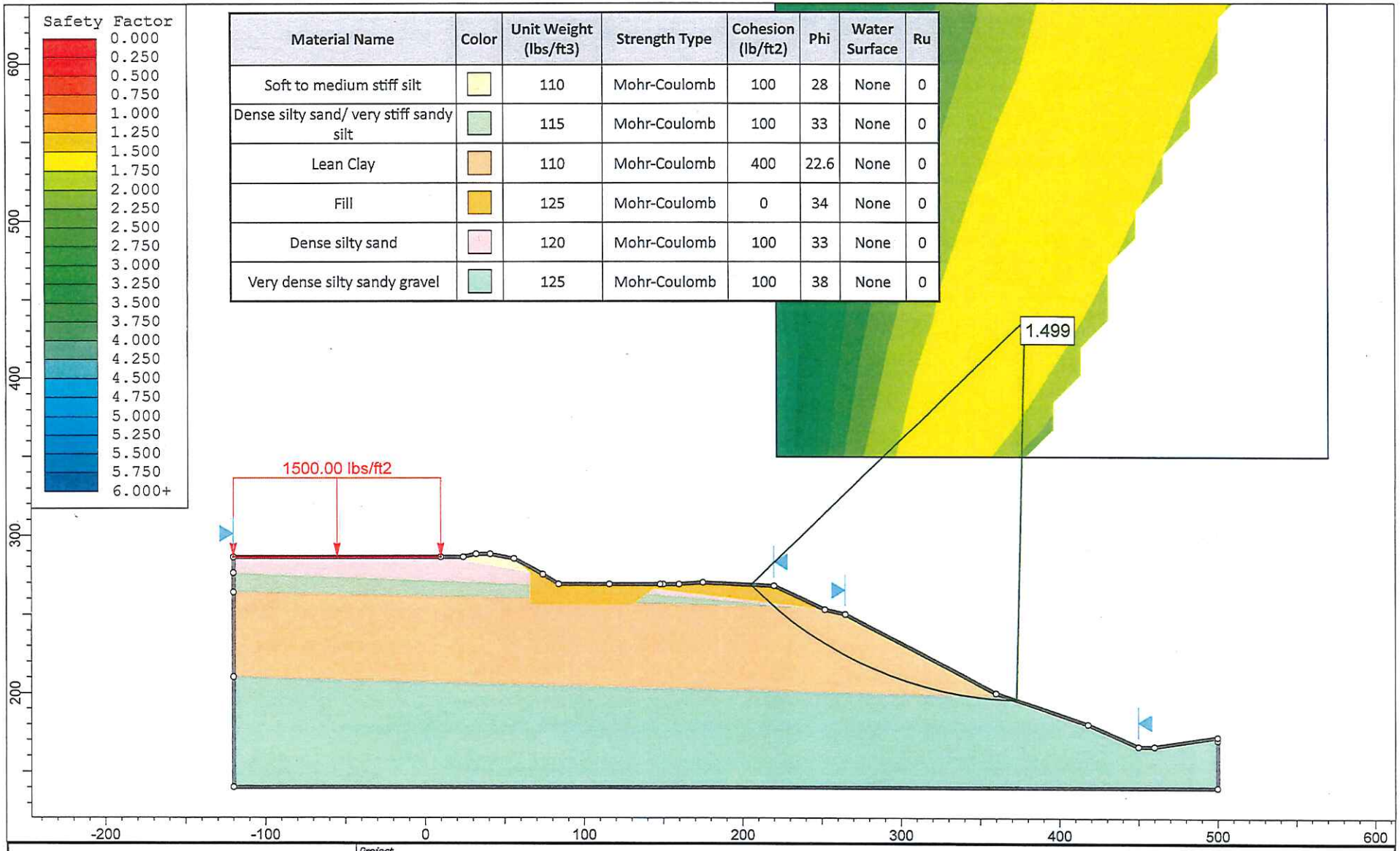
SLIDEINTERPRET 6.009



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Hu Type	Ru
Soft to medium stiff silt		110	Mohr-Coulomb	100	28	None		0
Dense silty sand/ very stiff sandy silt		115	Mohr-Coulomb	100	33	None		0
Lean Clay		110	Mohr-Coulomb	400	22.6	None		0
Dense silty sand		120	Mohr-Coulomb	100	33	Water Surface	Constant	

rocscience	Project	Bergsma Property		
	Analysis Description	Construction - Static		
	Drawn By	ELW	Scale 1:540	Company The Riley Group, Inc.
	Date	6/12/2016, 2:04:53 PM		File Name Construction Static.slim

SLIDEINTERPRET 6.009

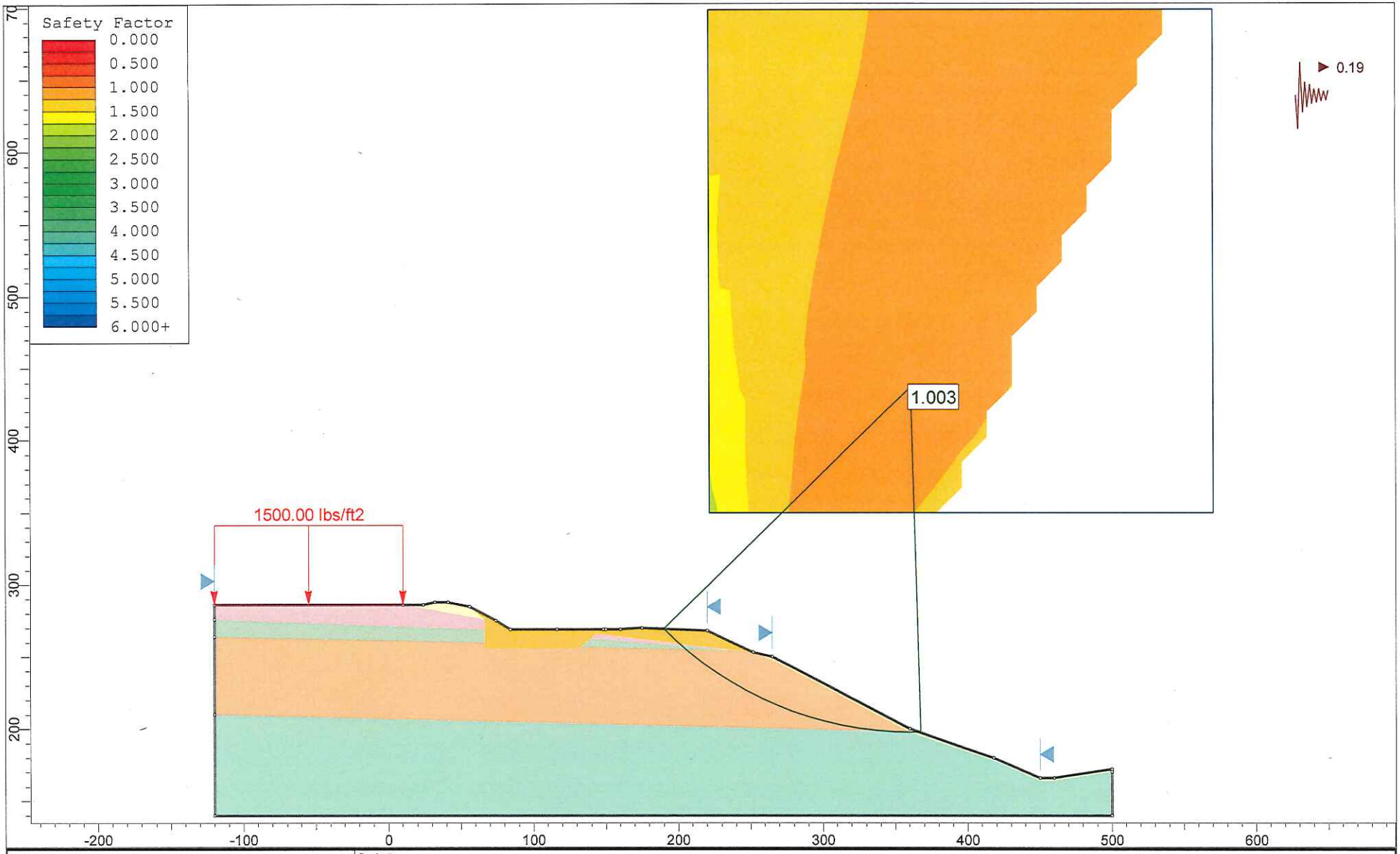


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (lb/ft2)	Phi	Water Surface	Ru
Soft to medium stiff silt		110	Mohr-Coulomb	100	28	None	0
Dense silty sand/ very stiff sandy silt		115	Mohr-Coulomb	100	33	None	0
Lean Clay		110	Mohr-Coulomb	400	22.6	None	0
Fill		125	Mohr-Coulomb	0	34	None	0
Dense silty sand		120	Mohr-Coulomb	100	33	None	0
Very dense silty sandy gravel		125	Mohr-Coulomb	100	38	None	0

rocscience

SLIDEINTERPRET 6.009

Project	Bergsma Property			
Analysis Description	Post-Construction - Static			
Drawn By	ELW	Scale	1:1000	Company: The Riley Group, Inc.
Date	6/12/2016, 2:04:53 PM			File Name: Post-Construction Static.slim



rocscience	Project	Bergsma Property		
	Analysis Description	Post-Construction - Seismic		
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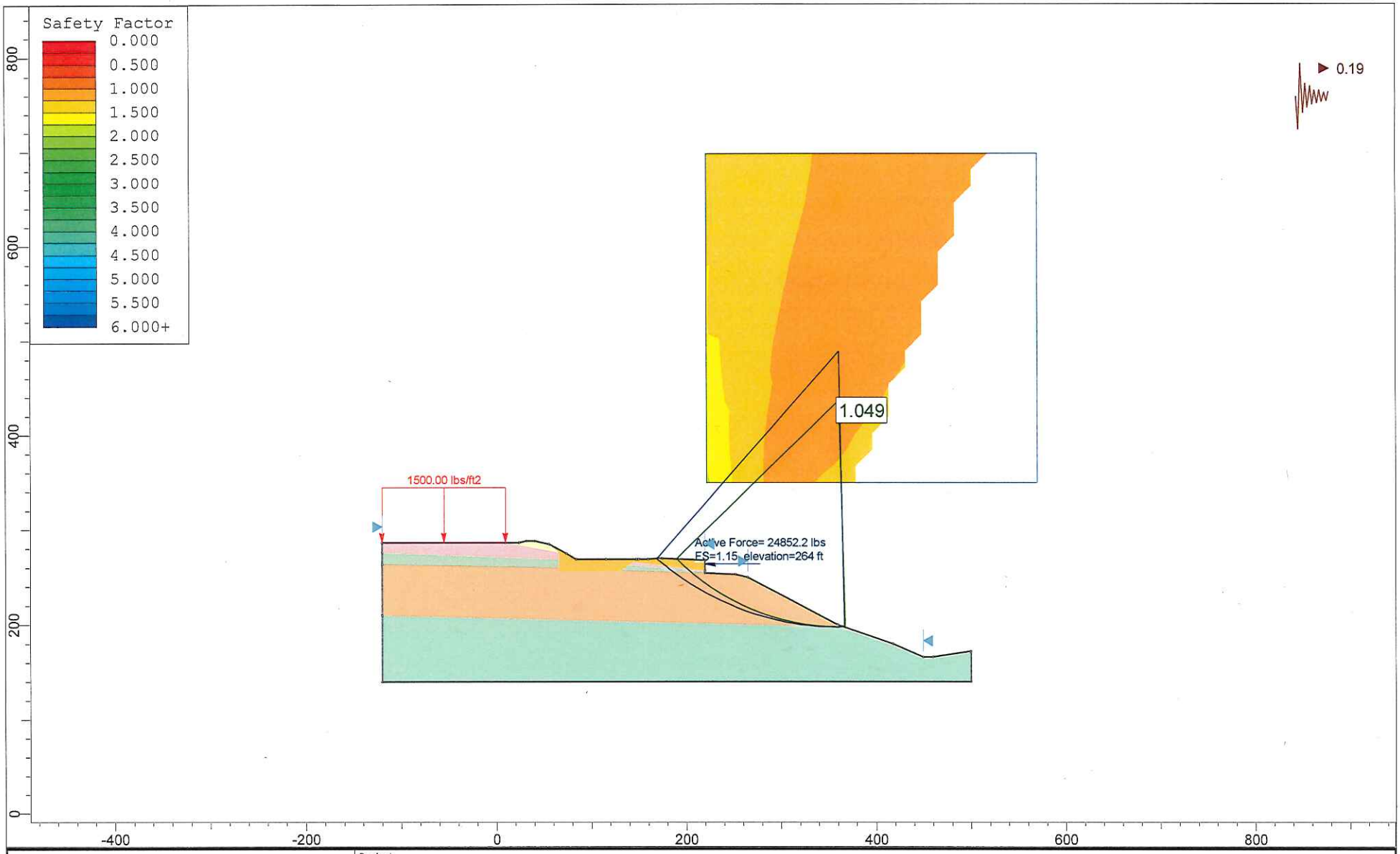
	Date	6/12/2016, 2:04:53 PM		File Name Post-Construction Seismic without wall (.19g).slim

SLIDEINTERPRET 6.009



rocscience	Project	Bergsma Property		
	Analysis Description	Post-Construction - Seismic		
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SLIDEINTERPRET 6.009