Earth Solutions NW LLC

Geotechnical Engineering
Geology
Environmental Scientists
Construction Monitoring

GEOTECHNICAL ENGINEERING STUDY
PROPOSED SINGLE-FAMILY RESIDENCES
8404 - 207TH PLACE NORTHEAST
ARLINGTON, WASHINGTON

ES-2750

1805 - 136th Place N.E., Suite 201   Bellevue, WA 98005
(425) 449-4704   Fax (425) 449-4711
www.earthsolutionsnw.com

PREPARED FOR

WASHINGTON FEDERAL SAVINGS
C/O NOVASTAR DEVELOPMENT

May 9, 2013

Scott S. Riegel, L.G.
Project Manager

Kyle R. Campbell, P.E.
Principal

GEOTECHNICAL ENGINEERING STUDY
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Bellevue, Washington 98005
Ph: 425-449-4704 Fax: 425-449-4711
Toll Free: 866-336-8710

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in-this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

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Earth Solutions NW LLC

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- Geotechnical Engineering
- Construction Monitoring
- Environmental Sciences

May 9, 2013
ES-2750

Washington Federal Savings
c/o Novastar Development
18215 – 72nd Avenue South
Kent, Washington 98032

Attention: Mr. Wayne Potter

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, Proposed Single-Family Residences, 8404 – 207th Place Northeast, Arlington, Washington".

The site is generally underlain by ancient landslide deposits made up of silt and sand in a loose grading to dense condition. Groundwater was not observed at the boring locations during the fieldwork (April 2013). In our opinion, the proposed construction of a single-family residences and associated improvements is feasible from a geotechnical standpoint provided the recommendations detailed in this report are followed. Based on our study, the proposed residential structures should be supported conventional shallow foundation bearing on at least 24 inches of granular structural fill. The primary geotechnical considerations associated with the proposed development include foundation support, maintaining or improving slope stability, structural fill placement and compaction, and appropriate foundation setback criteria with respect to the existing slope areas of the site. The steep slopes located on-site and should be considered sensitive. Site designs should be developed in a manner which minimizes impacts to the slopes and associated buffers.

Geotechnical recommendations related to the proposed site development are provided in this geotechnical engineering study. If you have questions regarding the content of this report, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Scott S. Riegel, L.G.
Project Manager

1805 - 136th Place N.E., Suite 201 • Bellevue, WA 98005 • (425) 449-4704 • FAX (425) 449-4711

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GEOTECHNICAL ENGINEERING STUDY
PROPOSED SINGLE-FAMILY RESIDENCES
8404 - 207TH PLACE NORTHEAST
ARLINGTON, WASHINGTON

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INTRODUCTION

General

This geotechnical engineering study was prepared for the proposed single-family residences to be constructed at the terminus of 207th Place Northeast in Arlington, Washington. The approximate location of the subject property is illustrated on the Vicinity Map (Plate 1). The purpose of this study was to perform a subsurface exploration and develop geotechnical recommendations for the proposed site development. Our scope of services for completing this geotechnical engineering study included the following:

- Subsurface exploration including drilling one boring on each of the two subject lots;
- Engineering analyses, and;
- Preparation of this report.

The following documents were reviewed as part of preparing this geotechnical engineering study:

- Preliminary site Plan prepared by ADC Wastewater Engineering, and;
- Arlington Municipal Code, Chapter 20.88.630.

Project Description

We understand the site will be undergoing a boundary line adjustment (BLA) which will create two new residential tax parcels. We understand each lot will be developed with a single-family residence and associated improvements. The approximate limits of the subject property are illustrated on the Boring Location Plan (Plate 2).

The residential structures will likely consist of two to three stories of relatively lightly-loaded wood-framing supported on conventional foundations. Based on our experience with similar developments, we anticipate wall loads on the order of 1 to 2 kips per lineal foot and slab-on-grade loading of 150 pounds per square foot (psf).

On-site septic systems for each lot will be incorporated into site designs. Both systems will be located to the west of the new residences.

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations in this report, and provide supplement recommendations.

Surface

The subject site is located near the terminus of 207th Place Northeast in Arlington, Washington, and consists of a single residential parcel which is bordered to the north and east by a City of Arlington water tank and distribution line, to the south by a portion of Burn Road and to the west by a commercial property located at the toe of a steep slope.

The site is located near the crest of a natural slope about 150 feet in total height and topography descends gently to the west from the eastern property boundaries for a distance of about 100 to 150 feet at which point topography descends steeply off the west and south project limits to the valley floor and Burn Road.

Vegetation across the site consists primarily of forest with a moderate understory. The site is currently vacant and no indications of past grading were observed at the time of the site visit.

Subsurface

A representative of ESNW observed, logged and sampled two borings (one on each lot) using a limited access drill rig and operator contracted by ESNW for purposes of assessing soil conditions, characterizing and classifying the site soils and assessing the near-surface groundwater conditions. The approximate locations of the borings are illustrated on the Boring Location Plan (Plate 2). Please refer to the boring logs provided in appendix A for a more detailed description of the subsurface conditions.

At boring location B-1 about five feet of loose to medium dense silty sand (Unified Soil Classification SM) was encountered. Stiff elastic silt (MH) was encountered extending from about 5 feet to about 30 feet. Non-plastic, dense to very dense silt (ML) was encountered extending to the termination depth of 66.5 feet below existing grade.

At boring location B-2, about five feet of loose to medium dense silty sand (Unified Soil Classification SM) was encountered. Non-plastic, medium dense to dense silt (ML) was encountered extending to a depth of about 60 feet. Very dense sand (SP) was encountered extending from 60 feet to the termination depth of 66.5 feet below existing grade.

The moisture content of the silt was below the liquid limits derived from laboratory Atterberg Limits testing. The sand deposit at boring location B-2 was damp, with moisture contents ranging from about 2.7 to 3.9 percent. Soil relative density generally increased with depth.

Geologic Setting

The geologic map titled Geologic Map of the Arlington East Quadrangle, Minard 1985 identifies glacial till (Qvt) across the upper slope and Advance outwash (Qva) towards the base of the slope.

The Snohomish County Soil Survey (SCS) generally describes the near-surface soil deposits, and indicates the eastern approximately one-half of the site is underlain by Pastik silt loam (Map Unit 49) and the western portion of the site is underlain by Tokul-Winston gravelly loam (Map Unit 77). These soils are described as moderately well drained, forming on terraces and escarpments. The parent material for Pastik silt loam is lacustrine deposits and the parent material for the Tokul-Winston gravelly loam is basal till. The erosion hazard for these soils is described as severe.

In general, the soils observed at the site are consistent with a lacustrine depositional origin as described by the SCS resource. Advance outwash was encountered below the fine-grained deposits.

Groundwater

Groundwater seepage was not encountered at the boring locations at the time of our fieldwork (April 2013). In our opinion, the presence of perched seepage zones should be expected in the deeper site excavations, such as utility excavations. Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater seepage flow rates are higher during the wetter, winter months.

Critical Areas Assessment

As part of our report preparation, we assessed the site in terms of critical areas as defined in the Arlington Municipal Code Chapter 20.88 – Critical Areas.

Landslide Hazard Assessment

The descending slope along the northern and western site boundaries is inclined more than 40 percent and is estimated to be on the order of 80 to 120 feet in height. The slope is vegetated with a mixture of deciduous and fir trees with a moderate understory. There were no signs of slope failure such as head scarps, bare slopes or groundwater seeps along the surface during the slope reconnaissance conducted during the fieldwork. In our opinion, the steep slope along the western and southern site boundary would exhibit a moderate risk for shallow landslide hazard activity in the present condition. We would expect landslide activity to be limited to debris flow in nature.

Slope Stability Evaluation

ESNW evaluated slope stability in the current configuration and the post-construction configuration based on topographic information presented on the referenced site plan and the conditions encountered the exploration sites. Two cross-sections were evaluated, one on each lot, designated A-A' and B-B' on the Boring Location Plan. Topographic representation outside the area included in the site plan survey was estimated based on readily available topographic information and conditions observed during the fieldwork.

ESNW evaluated global stability using the GeoStudio SlopeW 2007 revision 7.17 software modeling program. The analysis was focused on a deep-seated rotational failure mode. Based on the site setting and soil conditions underlying the slope, shallow debris-flow failures would be expected during the normal course of the natural weathering process.

The results of our analysis included as Appendix B. Seismic and static conditions were modeled for post-construction conditions. The results indicate a minimum factor of safety (FOS) of 1.2 for seismic conditions and 2.0 for static conditions in the post-construction configuration for Section A-A'. The results indicate a minimum FOS of 1.2 for seismic conditions and 1.7 for static conditions in the post-construction configuration for Section B-B'. Specific modeling parameters are provided in the SlopeW computer output in Appendix C. A piezometric layer was not used due to the conditions encountered at the boring locations.

Erosion Hazard Assessment

The slopes throughout the majority of the site consist primarily of fine-grained deposits. The soils encountered during our fieldwork would exhibit a severe erosion hazard. In our opinion, the use of Best Management Practices (BMPs) during construction, and the incorporation of the recommendations provided in this report, will adequately mitigate the erosion hazard at the site.

Seismic Hazard Assessment

The subject site is located near the top of a steep slope complex. The site soils consist of deposits of silt and sand with varying degrees of relative density and consistency. Given the soil gradation and groundwater conditions across the site, in our opinion the risk of seismically induced liquefaction is low. The risk of seismically-induced landslide activity was evaluated in the slope stability evaluation section of this report Base on the results of the modeling analysis, in our opinion, the proposed development plans will not increase the risk of seismically-induced landslide activity.

Analysis of Proposal and Mitigating Measures

Based on review of the referenced site plan, no alterations are planned for the steep slope or landslide hazard areas for either lot. The proposed residential structures have been located in areas where grading would be minimized. The results of the slope stability analysis indicate a total buffer and setback of 40 feet from the top of the descending slopes will not increase the potential for instability along the slope areas. The proposal will not increase surface water discharge or the potential for instability along the steep slopes and therefore, in our opinion, conforms to the Critical Areas Requirements outlined in Section VI of Chapter 20.88.630 of the Arlington Municipal Code.

In our opinion, the potential for debris flow activity can be adequately mitigated by controlling surface water runoff above the slopes, and maintaining vegetative cover on the slopes. This assessment does not account for unforeseen or changed conditions or the slope conditions uphill from the subject site. Surface water should not be allowed to flow over or pond above the slopes and vegetative cover should be maintained along the existing slopes.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, the proposed construction of two single-family residences is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include foundation support, maintaining or improving slope stability, structural fill placement and compaction, and foundation setback criteria with respect to the existing slope areas of the site. The steep slopes located on-site and should be considered sensitive. Site designs should be developed in a manner which minimizes impacts to the slopes and associated buffers.
In our opinion, the soils generated from cuts throughout the site are not suitable for use as structural fill. The soils encountered at the exploration sites generally have a high sensitivity to moisture, and placement and compaction of these soils during wet weather conditions may be difficult. In our opinion, imported material should be used for structural fill.

This study has been prepared for the exclusive use of Washington Federal Savings, Novastar Development and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

The primary geotechnical considerations during the proposed site preparation and earthwork activities will involve building pad area subgrade preparation, structural fill placement and compaction.

Foundation Excavations

In our opinion, the new residences should incorporate a crawlspace that would effectively remove a minimum of two feet of existing soil. This approach would reduce new foundation loads on the sensitive slopes present on-site. Foundations should be overexcavated a minimum of 24 inches and grades restored using imported structural fill.

In-situ Soils

From a geotechnical standpoint, the fine-grained soils encountered at the test sites are generally not suitable for use as structural fill. The moisture sensitivity of the native soils can be generally characterized as high with respect to the silty sand and silt soils. The soils encountered at the test sites were generally in a moist to wet condition at the time of the exploration (April 2013). Fill used for structural areas should consist of imported material.

Imported Soil

Imported soil intended for use as structural fill should consist of a well-graded granular soil with a maximum aggregate grain size of six inches, and a moisture content that is at or near the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well graded granular soil with a fines content of 5 percent or less defined as the percent passing the #200 sieve, based on the minus three-quarter inch fraction.

Structural Fill Placement

In general, areas to receive structural fill should be sufficiently stripped of organic matter and other deleterious material. The majority of the organic matter associated with trees, brush, root balls, and groundcover should be removed from the fill areas. The geotechnical engineer should observe cleared and stripped areas of the site prior to structural fill placement.

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, and roadway areas. Fills placed to construct permanent slopes, retaining wall, and utility trench backfill areas are also considered structural fill. Soils placed in structural areas should be placed in maximum 12-inch loose lifts and compacted to a relative compaction of 95 percent, based on the maximum dry density as determined by the Modified Proctor Method (ASTM D-1557-02).

Slope Fill Placement

In general, fill placement between the residences and the top of the steep slope areas should be avoided. Fill can be placed elsewhere on site to accomplish the design grading. ESNW should review the final grading plans to confirm the recommendations in this report are incorporated.

Erosion Control

Temporary erosion control measures should include, at a minimum, silt fencing placed along the downslope perimeter of the construction envelope, and a construction entrance consisting of quarry spalls, as needed, to minimize off-site soil tracking and to provide a firm surface. Surface water should not be allowed to flow over any temporary or permanent slopes. Interceptor drains or swales should be considered for controlling surface water flow patterns, as appropriate. The geotechnical engineer should observe the erosion control measures, and provide supplement recommendations for minimizing erosion during construction, as necessary.

Foundations

Based on the results of our study, the proposed residential structures can be supported on conventional spread and continuous footings bearing on a minimum of two feet of imported structural fill. Building pad fill areas should be compacted to the specifications of structural fill previously described in this report. Where loose or unsuitable soil conditions are encountered at foundation subgrade elevations, compaction of the soils to the specifications of structural fill, or overexcavation and replacement with structural fill may be necessary.

For design the following parameters can be used for the foundation design:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 250 pcf
- Coefficient of friction 0.35

The passive earth pressure and friction values provided above assume the foundations are backfilled with structural fill and supported on at least two feet of structural fill. A factor-of-safety of 1.5 has been applied to these passive resistance and friction values.

For short term wind and seismic loading, a one-third increase in the allowable soil bearing capacity can be assumed.
With structural loading as expected, total settlement in the range of one inch is anticipated, with differential settlement of approximately one-half of an inch. The majority of the settlements should occur during construction, as dead loads are applied.

Foundation Setbacks

In our opinion, foundations should maintain a minimum setback of 40 feet from the top of the steep slope areas. This setback includes a 25-foot no disturbance buffer and 15-foot Building Setback Limit (BSBL). Provided the recommendations detailed in this report are incorporated into site designs, in our opinion the proposed project will not increase surface water discharge or the potential for landslide activity. The geotechnical engineer should observe the building pad construction to confirm conditions are as anticipated and that the foundation elements will perform as intended.

Slab-On-Grade Floors

Slab-on-grade floors should be supported on competent native soil or structural fill. Unstable or yielding areas of the subgrade should be recompacted or overexcavated and replaced with suitable structural fill prior to construction of the slab. A capillary break consisting of a minimum of four inches of free draining crushed rock or gravel should be placed below the slab. The free draining material should have a fines content of 5 percent or less (percent passing the #200 sieve, based on the minus three-quarter inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier will be used, it should be a material specifically designed for that use and should be installed in accordance with the manufacturer's specifications.

Seismic Considerations

The 2009 International Building Code specifies several soil profiles that are used as a basis for seismic design of structures. If the project will be permitted using the 2009 IBC, based on the soil conditions observed at the test sites, Site Class C, from table 1613.5.2, should be used for design.

The 2012 IBC recognizes ASCE for seismic site class definitions. If the project will be permitted under the 2012 IBC, in accordance with Table 20.3-1 of ASCE, Minimum Design Loads for Buildings and Other Structures, Site Class C, should be used for design.

In our opinion, liquefaction susceptibility at this site is low. The relative density of the site soils and the absence of a uniform, shallow groundwater table is the primary basis for this designation.

Retaining Walls

Retaining walls should be designed to resist earth pressures and applicable surcharge loads. For preliminary design, the following parameters can be assumed for retaining wall design:

- Active earth pressure (yielding condition — 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 55 pcf
- Traffic surcharge (passenger vehicles) — 70 psf (rectangular distribution)
- Passive earth pressure — 250 pcf (equivalent fluid)
- Coefficient of friction — 0.35
- Allowable soil bearing capacity — 2,500 psf

Additional surcharge loading from foundations, sloped backfill, or other loading should be included in the retaining wall design. Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design. The geotechnical engineer should review retaining wall designs to verify the earth pressure values have been incorporated into design, and to provide additional recommendations, if necessary.

Retaining walls should be backfilled with free draining material that extends along the height of the wall, and a distance of at least 18 inches behind the wall. The upper one foot of the wall backfill can consist of a less permeable (surface seal) soil, if desired. A rigid, perforated drain pipe should be placed along the base of the wall, and connected to an approved discharge location. Where desired, the use of a sheet drain in lieu of free draining backfill can be considered. However, the geotechnical engineer should review the proposed use of sheet drain, and provide supplement drainage recommendations.

Excavations and Slopes

The Federal and state Occupation Safety and Health Administration (OSHA/WISHA) classifies soils in terms of minimum safe slope inclinations. Based on the soil conditions encountered during our fieldwork, the site soils would generally be classified by OSHA/WISHA as Type C. Temporary slopes over four feet in height in Type C soils should be sloped no steeper than 1.5H:1V (Horizontal:Vertical). The geotechnical engineer should observe temporary and permanent slopes to verify that the inclination is appropriate, and to provide additional grading recommendations, as necessary. If temporary slopes cannot be constructed in accordance with OSHA/WISHA guidelines, temporary shoring may be necessary.

Permanent slopes should maintain a gradient of 2H:1V, or flatter, and should be planted with an appropriate species of vegetation to enhance stability and to minimize erosion.

Utility Support and Trench Backfill

In our opinion, the soils observed at the test sites are generally suitable for support of utilities. Excessively loose, organic, or otherwise unsuitable soils encountered in the trench excavations should not be used for supporting utilities. In general, the on-site soils observed at the test sites should be suitable for use as structural backfill in the utility trench excavations, provided the soil is at or near the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soils may be necessary at some locations prior to use as structural fill. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report, or to the applicable specifications of the city or county jurisdiction.

Drainage

Groundwater seepage was not observed at the test locations explored during April 2013. Localized zones of groundwater seepage should be expected in the site excavations and utility excavations, such as utility improvements or in the near-surface soil zone located above the silt layer. Temporary measures to control groundwater seepage and surface water runoff during construction will likely involve interceptor trenches, sedimentation ponds, and sumps areas. Based on the results of our study and conditions observed at the test sites, we do not anticipate extensive dewatering of excavations will be necessary.

In our opinion, perimeter drains should be installed at or below the invert of the building footing foundations. A typical footing drain detail is provided on Plate 3 of this report.

Where conveyance will occur over sloped areas of the site, we recommend using fuse-welded joints, HDPE UV-resistant piping and anchors. Discharge point should incorporate an energy dissipator system.

Water discharge shall not occur on or above the steep slope areas of the site.

LIMITATIONS

The recommendations and conclusions provided in this geotechnical engineering study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. A warranty is not expressed or implied. Variations in the soil and groundwater conditions observed at the test sites may exist, and may not become evident until construction. ESNW should reevaluate the conclusions in this geotechnical engineering study if variations are encountered.

Additional Services

ESNW should have an opportunity to review the final design with respect to the geotechnical recommendations provided in this report. ESNW should also be retained to provide testing and consultation services during construction.

Reference:
Snohomish County, Washington
Map 317
By The Thomas Guide
Rand McNally
32nd Edition

NORTH

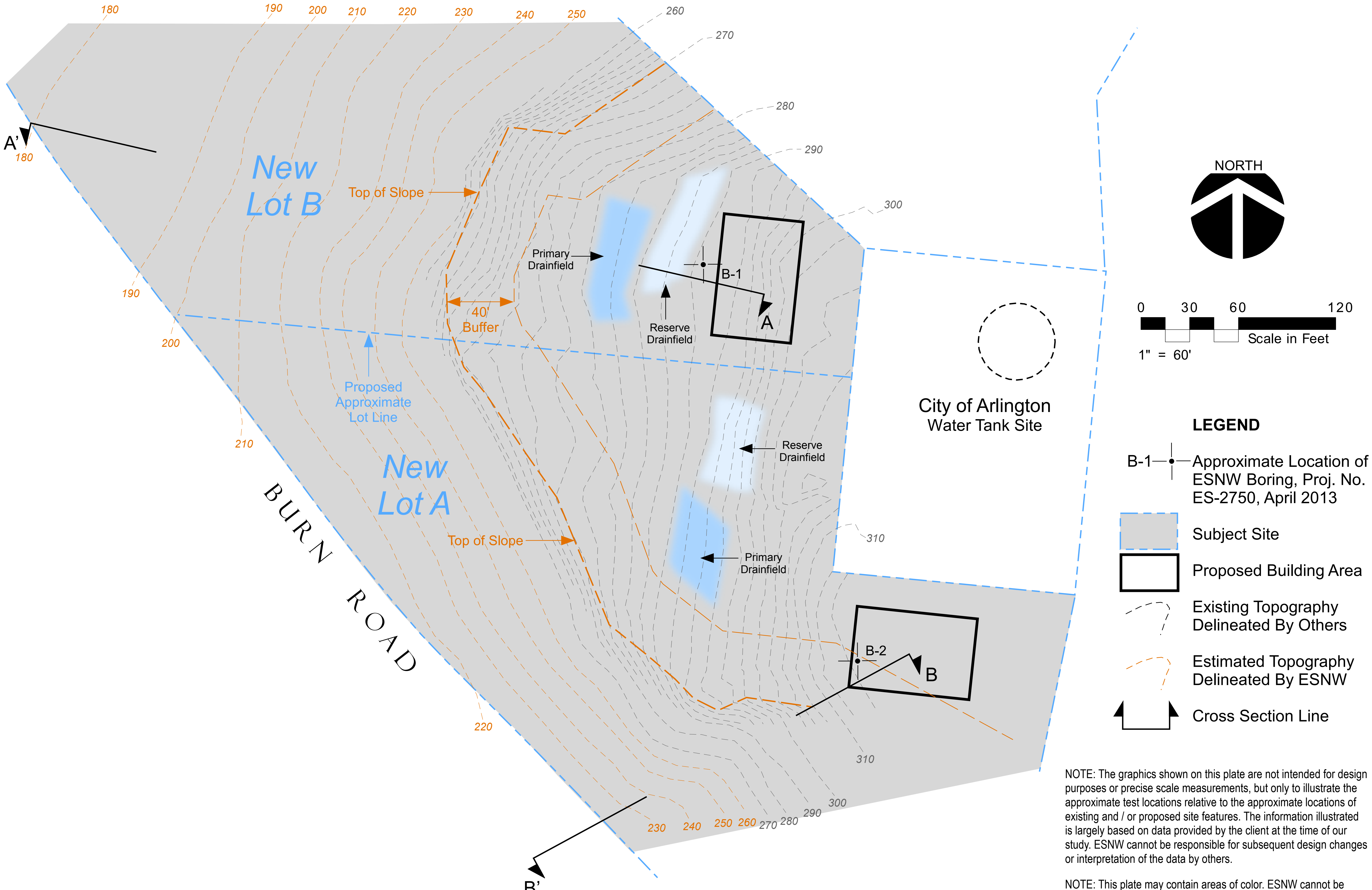
NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Monitoring and Environmental Sciences

Vicinity Map
Krouse Property
Arlington, Washington

Drwn. GLS	Date 04/24/2013	Proj. No. 2750
Checked HTW	Date April 2013	Plate 1



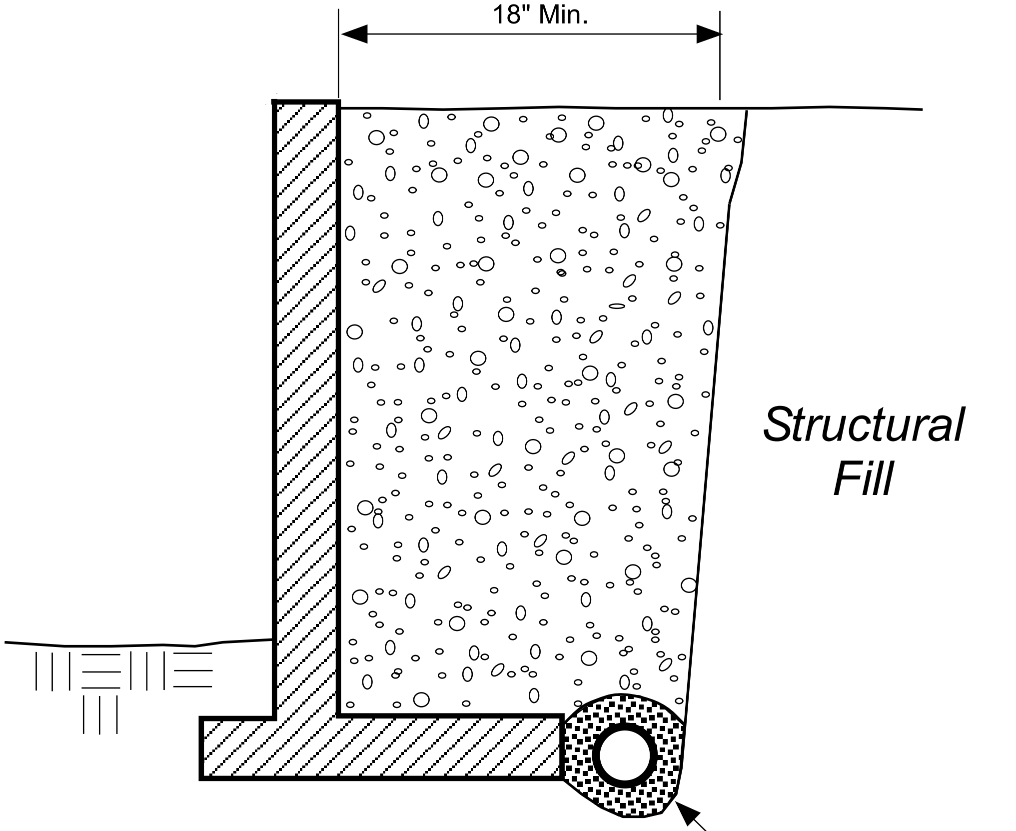
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Boring Location Plan
Krouse Property
Arlington, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

Drwn. By GLS
Checked By HTW
Date 04/24/2013
Proj. No. 2750
Plate 2

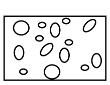


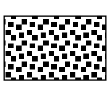
NOTES:

- Free Draining Backfill should consist of soil having less than 5 percent fines. Percent passing #4 should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free Draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1" Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

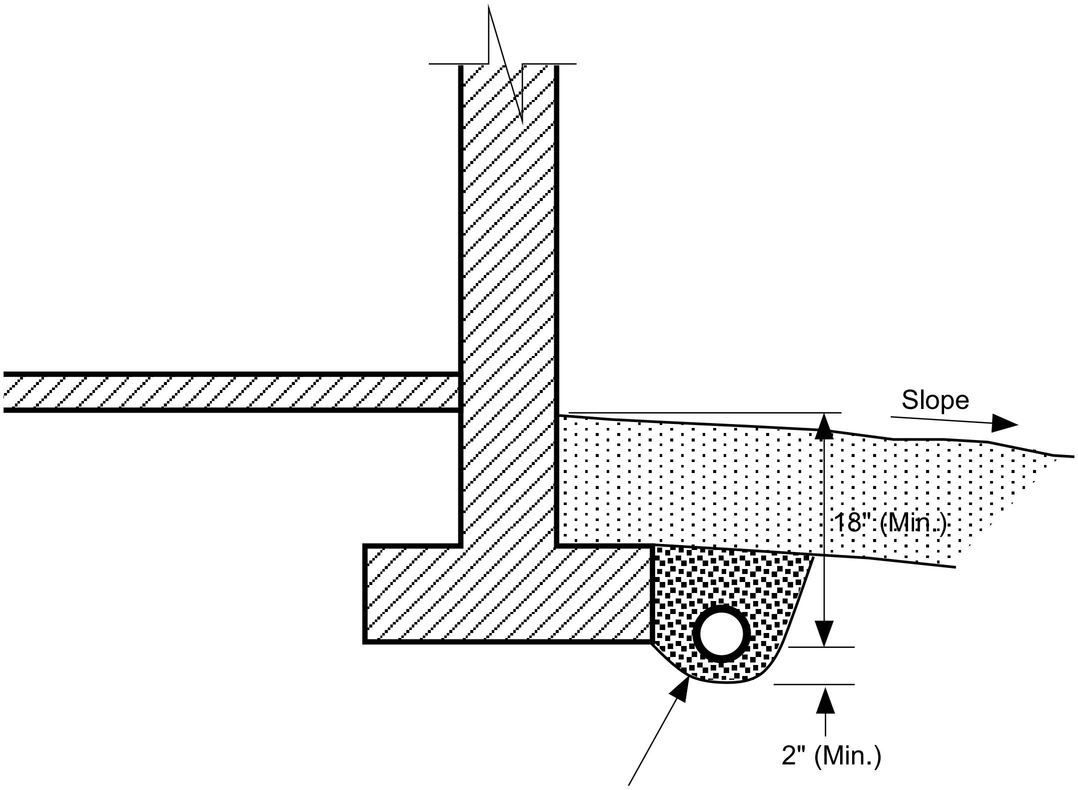

Free Draining Structural Backfill


1 inch Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

RETAINING WALL DRAINAGE DETAIL
Krouse Property
Arlington, Washington

Drwn. GLS	Date 04/30/2013	Proj. No. 2750
Checked HTW	Date April 2013	Plate 3



NOTES:

- Do NOT tie roof downspouts to Footing Drain.
- Surface Seal to consist of 12" of less permeable, suitable soil. Slope away from building.

SCHEMATIC ONLY - NOT OT SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Surface Seal; native soil or other low permeability material.

1" Drain Rock

Earth Solutions NW LLC
Geotechnical Engineering, Construction Monitoring and Environmental Sciences

FOOTING DRAIN DETAIL
Krouse Property
Arlington, Washington

Drwn. GLS	Date 04/30/2013	Proj. No. 2750
Checked HTW	Date April 2013	Plate 4

APPENDIX A

SUBSURFACE EXPLORATION

ES-2750

The subsurface conditions were explored by advancing two borings at the approximate locations illustrated on Plate 2 of this report. The boring logs are provided in this Appendix. The subsurface exploration was completed in April 2013.

The final logs represent the interpretations of the field logs and the results of laboratory analyses. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual.

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

BORING NUMBER B-1

Earth Solutions NW
1805 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-284-3300

CLIENT Washington Federal

PROJECT NAME Krouse Property

PROJECT NUMBER 2750

PROJECT LOCATION Arlington, Washington

DATE STARTED 4/4/13 **COMPLETED** 4/4/13

GROUND ELEVATION 291 ft **HOLE SIZE**

DRILLING CONTRACTOR Boretec

GROUND WATER LEVELS:

DRILLING METHOD HSA

AT TIME OF DRILLING ---

LOGGED BY HTW **CHECKED BY** HTW

AT END OF DRILLING ---

NOTES Depth of Topsoil & Sod 6"- 12": brush

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					SM		Brown silty SAND with organics, medium dense, wet
							-thin layer of coarse sand
	SS	100	3-8-8 (16)	MC = 34.10%			
5							5.0 — 286.0
	SS	100	6-12-15 (27)	MC = 35.00%	MH		Brown grayish brown elastic SILT, very stiff, wet
	SS	100	6-10-10 (20)	MC = 36.40%			-becomes gray
10	SS	100	6-8-15 (23)	MC = 37.30%			-becomes blue
15	SS	100	6-7-10 (17)	MC = 39.70%			
20							

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	8-4-19 (23)	MC = 8.10%	MH		Brown grayish brown elastic SILT, very stiff, wet *(continued)*
							-layer of coarse sand and gravel and silty sand with gravel, moist to wet
25	SS	100	16-12-18 (30)	MC = 36.30%			-thin layer of sand
30	SS	100	10-18-26 (44)	MC = 23.90%	ML	30.0	261.0 Becomes gray SILT, dense, moist to wet
35	SS	100	12-16-23 (39)	MC = 29.40%			
40	SS	100	12-22-41 (63)	MC = 23.40%			-becomes very dense

CLIENT Washington Federal
PROJECT NAME Krouse Property
PROJECT NUMBER 2750
PROJECT LOCATION Arlington, Washington

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
					ML		Becomes gray SILT, dense, moist to wet *(continued)*
45	SS	100	13-27-47 (74)	MC = 24.30%			
50	SS	100	25-50	MC = 14.70%			
55	SS	100	26-45-50/5"	MC = 16.50%			
60	SS	100	11-18-33 (51)	MC = 24.60%			
65	SS	100	14-50/5"	MC = 25.10%			-becomes gray

Earth Solutions NW
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Bellevue, Washington 98005
Telephone: 425-284-3300

BORING NUMBER B-1

CLIENT Washington Federal

PROJECT NAME Krouse Property

PROJECT NUMBER 2750

PROJECT LOCATION Arlington, Washington

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
					ML		Becomes gray SILT, dense, moist to wet *(continued)*
						66.5	224.5
							Boring terminated at 66.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with bentonite. Bottom of hole at 66.5 feet.

Earth Solutions NW
1805 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-284-3300

BORING NUMBER B-2

CLIENT Washington Federal
PROJECT NAME Krouse Property
PROJECT NUMBER 2750
PROJECT LOCATION Arlington, Washington
DATE STARTED 4/4/13 **COMPLETED** 4/4/13
GROUND ELEVATION 312 ft **HOLE SIZE**
DRILLING CONTRACTOR Boretec
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING ---
LOGGED BY HTW **CHECKED BY** HTW
AT END OF DRILLING ---
NOTES Depth of Topsoil & Sod 6": brush
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					SM		Brown silty SAND, loose, wet
	SS	100	5-3-2 (5)	MC = 19.00%			
							-increasing silty content
5						5.0	307.0
	SS	100	6-8-8 (16)	MC = 27.20%	ML		Becomes grayish brown SILT, medium dense, moist to wet
							-intermittent layers of coarse sand
	SS	100	9-15-22 (37)	MC = 29.70%			
10	SS	100	7-10-11 (21)	MC = 31.00%			
15	SS	100	8-11-16 (27)	MC = 33.60%			
20							

BORING NUMBER B-2

CLIENT Washington Federal **PROJECT NAME** Krouse Property

PROJECT NUMBER 2750 **PROJECT LOCATION** Arlington, Washington

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	SS	100	19-24-31 (55)	MC = 25.90%	ML		Becomes grayish brown SILT, medium dense, moist to wet *(continued)* -becomes gray, very dense
25	SS	100	17-28-50 (78)	MC = 21.50%			
30	SS	100	17-39-50/5"	MC = 22.80%			
35	SS	100	11-19-30 (49)	MC = 29.90%			
40	SS	100	7-26-50 (76)	MC = 26.70%			

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Bellevue, Washington 98005
Telephone: 425-284-3300

BORING NUMBER B-2

CLIENT Washington Federal

PROJECT NAME Krouse Property

PROJECT NUMBER 2750

PROJECT LOCATION Arlington, Washington

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
					ML		Becomes grayish brown SILT, medium dense, moist to wet *(continued)*
45	SS	100	19-50/4"	MC = 15.90%			-trace gravel
50	SS	100	11-25-43 (68)	MC = 27.60%			
55	SS	100	27-50	MC = 23.30%			
60	SS	100	32-50/5"	MC = 2.70%	SP		60.0 / 252.0 Poorly graded SAND with gravel, very dense, moist
65	SS	100	37-50/5"	MC = 3.90%			

Earth Solutions NW
1805 136th Place N.E., Suite 201
Bellevue, Washington 98005
Telephone: 425-284-3300

BORING NUMBER B-2

CLIENT Washington Federal
PROJECT NAME Krouse Property
PROJECT NUMBER 2750
PROJECT LOCATION Arlington, Washington

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
					SP		Poorly graded SAND with gravel, very dense, moist *(continued)*
						66.5	245.5
							Boring terminated at 66.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with bentonite. Bottom of hole at 66.5 feet.

APPENDIX B

LABORATORY TEST RESULTS

ES-2750

Earth Solutions NW
1805 - 136th Place N.E., Suite 201
Bellevue, WA 98005
Telephone: 425-284-3300

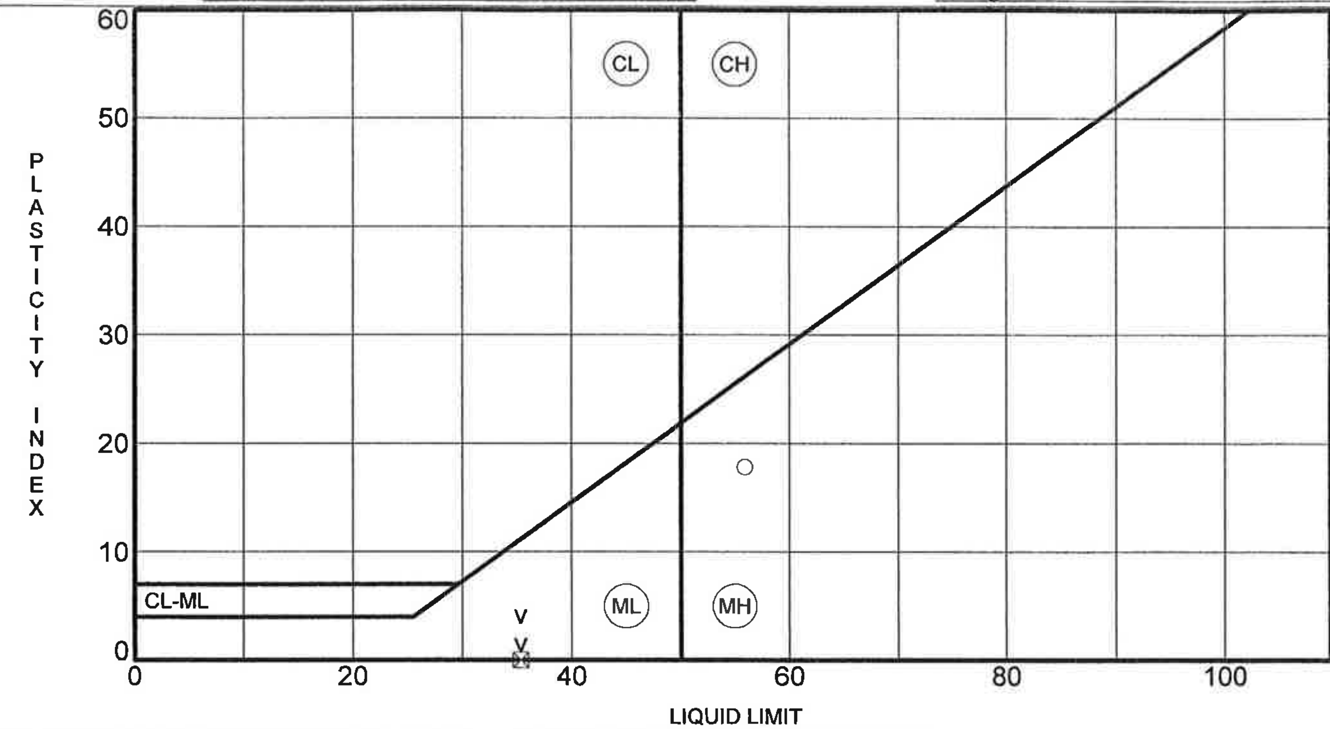
ATTERBERG LIMITS' RESULTS

CLIENT Washington Federal

PROJECT NAME Krouse Property

PROJECT NUMBER ES-2750

PROJECT LOCATION Arlington

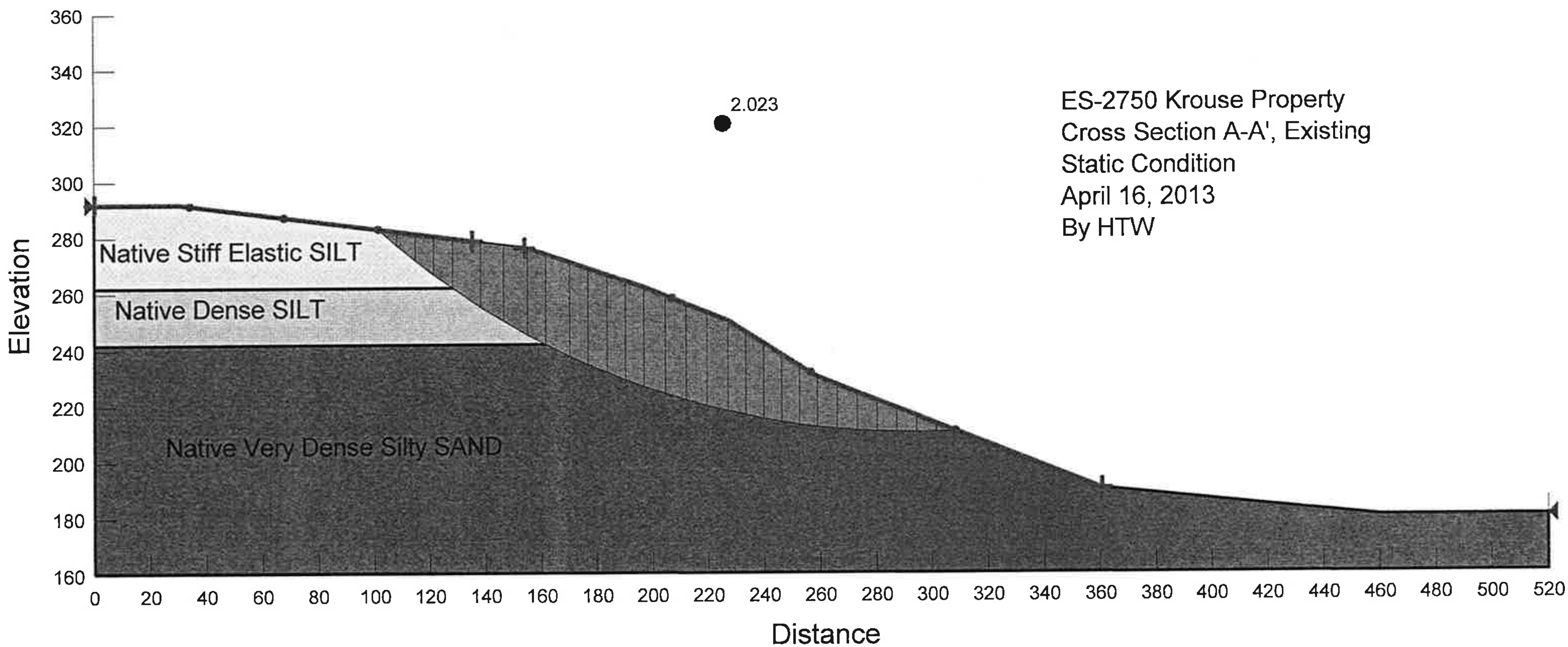


	Specimen Identification		LL	PL	PI	Fines	Classification
○	**B-1**	**7.5**	**56**	**38**	**18**		**Gray Elastic Silt, MH**
⊠	**B-2**	**50.0**	**35**	**35**	**NP**		**Brown Silt, ML**

APPENDIX C

SLOPE STABILITY OUTPUT

ES-2750


ES-2750 Krouse Property
Cross Section A-A', Existing
Static Condition
April 16, 2013
By HTW
2.023
Native Stiff Elastic SILT
Native Dense SILT
Native Very Dense Silty SAND
Elevation
360
340
320
300
280
260
240
220
200
180
160
Distance
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520

SLOPE/W Analysis

File Information

- Created By: Henry Wright
- Revision Number: 4
- Last Edited By: Henry Wright
- Date: 4/16/2013
- Time: 11:15:31 AM
- File Name: Boring 1 Lot, Existing, Static.gsz
- Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
- Last Solved Date: 4/16/2013
- Last Solved Time: 11:15:35 AM

Project Settings

- Length(L) Units: feet
- Time(t) Units: Seconds
- Force(F) Units: lbf
- Pressure(p) Units: psf
- Strength Units: psf
- Unit Weight of Water: 62.4 pcf
- View: 2D

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- SlipSurface
  - Direction of movement: Left to Right
  - Allow Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced
  - Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Very Stiff Elastic SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 28 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Silty SAND

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.25289, 292) ft
Left-Zone Right Coordinate: (135.20039, 278.53435) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (154.06255, 276.11999) ft
Right-Zone Right Coordinate: (360.77609, 189.92239) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 292) ft
Right Coordinate: (520, 180) ft

Regions

	Material	Points	Area (ft^2)
Region 1	Native Very Stiff Elastic SILT	1,2,3,11,12,15,9	4296.0026
Region 2	Native Dense SILT	9,15,12,7,16,10	4485.5091
Region 3	Native Very Dense Silty SAND	10,13,5,14,4,8,7,16	29237.594

Points

	X (ft)	Y (ft)
Point 1	0	292
Point 2	30	292
Point 3	155	276
Point 4	460	180
Point 5	520	160
Point 6	0	0
Point 7	259	230
Point 8	360	190
Point 9	0	262
Point 10	0	242
Point 11	197	262
Point 12	227	250
Point 13	0	160.80344
Point 14	520	180
Point 15	138.33291	262
Point 16	170.173	241.93398

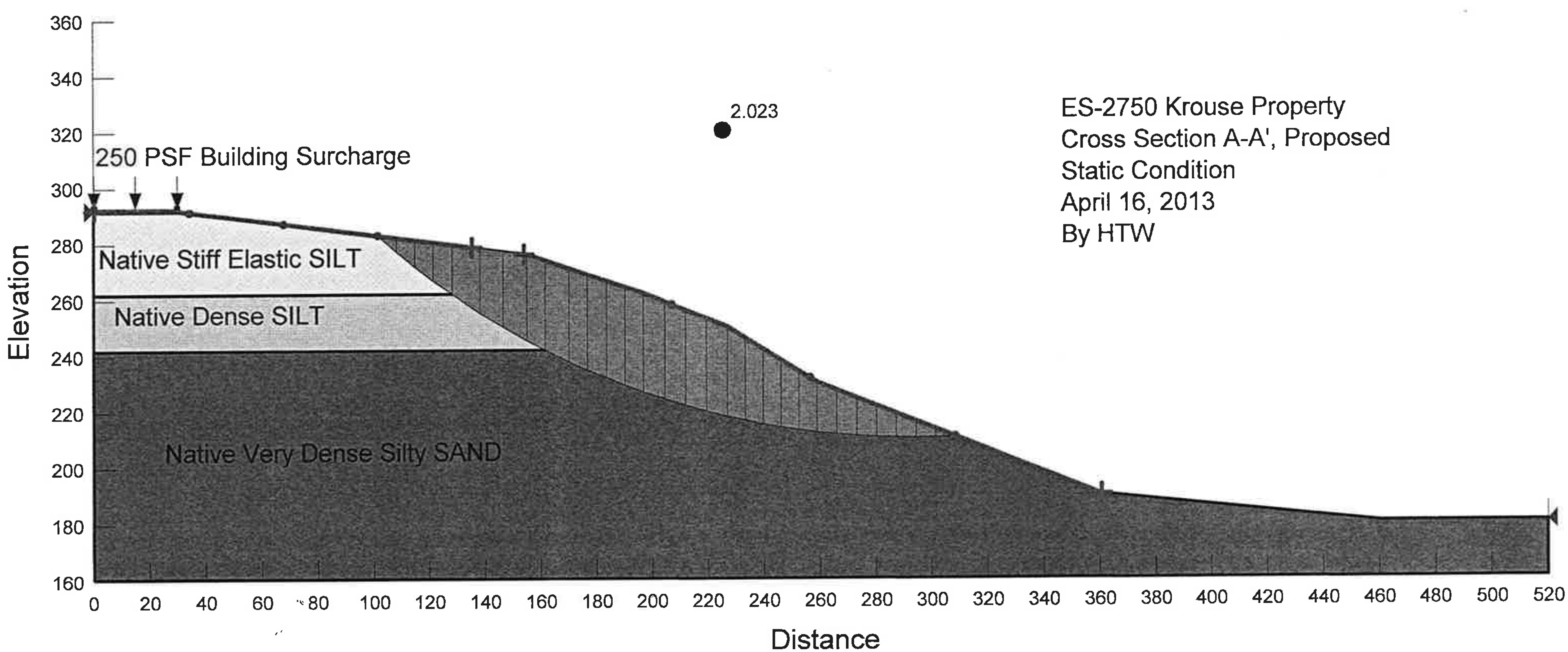
Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	122	1.757	(362.03, 524.539)	334.618	(135.2, 278.534)	(360.776, 189.922)

Slices of Slip Surface: 122

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	122	138.50035	275.5716	0	150.18667	79.855666	200
2	122	145.1002	269.79865	0	592.50219	315.039	200
3	122	151.70005	264.32125	0	998.64251	530.98764	200
4	122	156.4847	260.4982	0	1250.2246	664.75619	200
5	122	161.51345	256.6893	0	1416.6058	885.19353	200
6	122	168.60155	251.52525	0	1692.3355	1057.4886	200
7	122	175.68965	246.6379	0	1949.0123	1217.8781	200
8	122	182.77775	242.01295	0	2190.0354	1368.486	200
9	122	191.6609	236.60525	0	2484.1627	1675.5889	0
10	122	200.75	231.38305	0	2742.1479	1849.6021	0

11	122	208.25	227.3794	0	2913.995	1965.5144	0
12	122	215.75	223.6159	0	3074.648	2073.8763	0
13	122	223.25	220.08365	0	3223.3209	2174.1574	0
14	122	231	216.67185	0	3258.4117	2197.8265	0
15	122	239	213.3878	0	3170.1786	2138.3124	0
16	122	247	210.3418	0	3051.4305	2058.2159	0
17	122	255	207.5269	0	2898.2734	1954.9101	0
18	122	262.8846	204.9712	0	2809.8666	1895.2789	0
19	122	270.65385	202.66325	0	2789.7918	1881.7383	0
20	122	278.4231	200.558	0	2735.1274	1844.8667	0
21	122	286.1923	198.6515	0	2643.0315	1782.7473	0
22	122	293.96155	196.9404	0	2511.7307	1694.1837	0
23	122	301.7308	195.42155	0	2340.1761	1578.4687	0
24	122	309.5	194.0923	0	2128.9516	1435.996	0
25	122	317.2692	192.9504	0	1879.665	1267.85	0
26	122	325.03845	191.9939	0	1595.4664	1076.1557	0
27	122	332.8077	191.22125	0	1280.2488	863.53871	0
28	122	340.5769	190.6311	0	939.10933	633.43724	0
29	122	348.34615	190.2225	0	577.33442	389.41698	0
30	122	356.1154	189.99485	0	200.23306	135.05891	0
31	122	360.38805	189.9243	0	4.723364	3.1859493	0



ES-2750 Krouse Property
Cross Section A-A', Proposed
Static Condition
April 16, 2013
By HTW
250 PSF Building Surcharge
2.023
Native Stiff Elastic SILT
Native Dense SILT
Native Very Dense Silty SAND
Elevation
Distance
360
340
320
300
280
260
240
220
200
180
160
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520

SLOPE/W Analysis

File Information

Created By: Henry Wright
Revision Number: 3
Last Edited By: Henry Wright
Date: 4/16/2013
Time: 11:06:53 AM
File Name: Boring 1 Lot, Proposed, Static.gsz
Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
Last Solved Date: 4/16/2013
Last Solved Time: 11:06:54 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- SlipSurface
  - Direction of movement: Left to Right
  - Allow Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced
  - Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Very Stiff Elastic SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 28 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Silty SAND

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.25289, 292) ft
Left-Zone Right Coordinate: (135.20039, 278.53435) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (154.06255, 276.11999) ft
Right-Zone Right Coordinate: (360.77609, 189.92239) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 292) ft
Right Coordinate: (520, 180) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	0.2054651	293.07335
	29.997628	293.07143

Regions

	Material	Points	Area (ft²)
Region 1	Native Very Stiff Elastic SILT	1,2,3,11,12,15,9	4296.0026
Region 2	Native Dense SILT	9,15,12,7,16,10	4485.5091
Region 3	Native Very Dense Silty SAND	10,13,5,14,4,8,7,16	29237.594

Points

	X (ft)	Y (ft)
Point 1	0	292
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Point 7	259	230
Point 8	360	190
Point 9	0	262
Point 10	0	242
Point 11	197	262
Point 12	227	250
Point 13	0	160.80344
Point 14	520	180
Point 15	138.33291	262
Point 16	170.173	241.93398

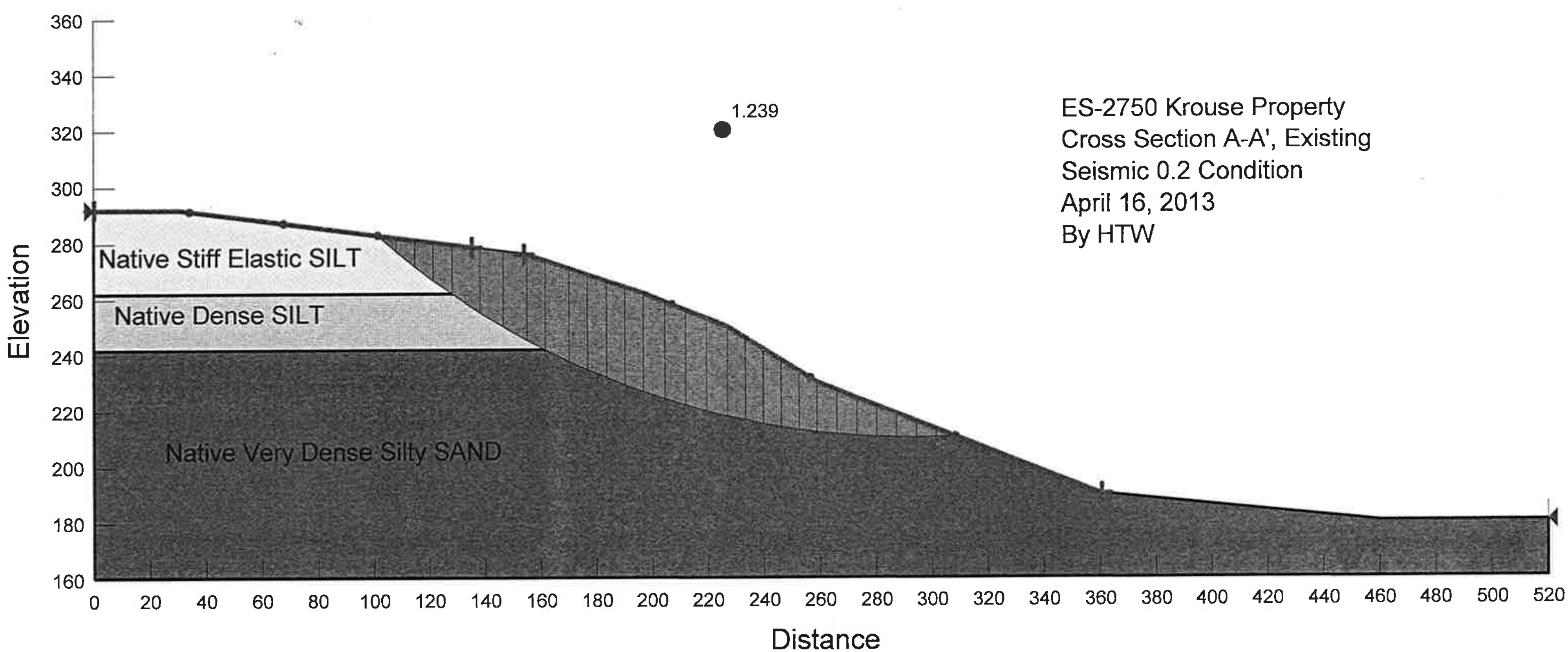
Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	122	1.757	(362.03, 524.539)	334.618	(135.2, 278.534)	(360.776, 189.922)

Slices of Slip Surface: 122

	Slip			PWP	Base Normal	Frictional	Cohesive

	Surface	X (ft)	Y (ft)	(psf)	Stress (psf)	Strength (psf)	Strength (psf)
1	122	138.50035	275.5716	0	150.18667	79.855666	200
2	122	145.1002	269.79865	0	592.50219	315.039	200
3	122	151.70005	264.32125	0	998.64251	530.98764	200
4	122	156.4847	260.4982	0	1250.2246	664.75619	200
5	122	161.51345	256.6893	0	1416.6058	885.19353	200
6	122	168.60155	251.52525	0	1692.3355	1057.4886	200
7	122	175.68965	246.6379	0	1949.0123	1217.8781	200
8	122	182.77775	242.01295	0	2190.0354	1368.486	200
9	122	191.6609	236.60525	0	2484.1627	1675.5889	0
10	122	200.75	231.38305	0	2742.1479	1849.6021	0
11	122	208.25	227.3794	0	2913.995	1965.5144	0
12	122	215.75	223.6159	0	3074.648	2073.8763	0
13	122	223.25	220.08365	0	3223.3209	2174.1574	0
14	122	231	216.67185	0	3258.4117	2197.8265	0
15	122	239	213.3878	0	3170.1786	2138.3124	0
16	122	247	210.3418	0	3051.4305	2058.2159	0
17	122	255	207.5269	0	2898.2734	1954.9101	0
18	122	262.8846	204.9712	0	2809.8666	1895.2789	0
19	122	270.65385	202.66325	0	2789.7918	1881.7383	0
20	122	278.4231	200.558	0	2735.1274	1844.8667	0
21	122	286.1923	198.6515	0	2643.0315	1782.7473	0
22	122	293.96155	196.9404	0	2511.7307	1694.1837	0
23	122	301.7308	195.42155	0	2340.1761	1578.4687	0
24	122	309.5	194.0923	0	2128.9516	1435.996	0
25	122	317.2692	192.9504	0	1879.665	1267.85	0
26	122	325.03845	191.9939	0	1595.4664	1076.1557	0
27	122	332.8077	191.22125	0	1280.2488	863.53871	0
28	122	340.5769	190.6311	0	939.10933	633.43724	0
29	122	348.34615	190.2225	0	577.33442	389.41698	0
30	122	356.1154	189.99485	0	200.23306	135.05891	0
31	122	360.38805	189.9243	0	4.723364	3.1859493	0


ES-2750 Krouse Property
Cross Section A-A', Existing
Seismic 0.2 Condition
April 16, 2013
By HTW
1.239
Native Stiff Elastic SILT
Native Dense SILT
Native Very Dense Silty SAND
Elevation
Distance

SLOPE/W Analysis

File Information

- Created By: Henry Wright
- Revision Number: 8
- Last Edited By: Henry Wright
- Date: 4/16/2013
- Time: 11:46:41 AM
- File Name: Boring 1 Lot, Existing, Seismic 0.2.gsz
- Directory: C:\Users\henry.wright\Documents\SlopeW\2750\

Project Settings

- Length(L) Units: feet
- Time(t) Units: Seconds
- Force(F) Units: lbf
- Pressure(p) Units: psf
- Strength Units: psf
- Unit Weight of Water: 62.4 pcf
- View: 2D

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- SlipSurface
  - Direction of movement: Left to Right
  - Allow Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced
  - Number of Slices: 30
  - Optimization Tolerance: 0.01
  - Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Very Stiff Elastic SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 28 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Silty SAND

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.25289, 292) ft
Left-Zone Right Coordinate: (135.20039, 278.53435) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (154.06255, 276.11999) ft
Right-Zone Right Coordinate: (360.77609, 189.92239) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 292) ft
Right Coordinate: (520, 180) ft

Seismic Loads

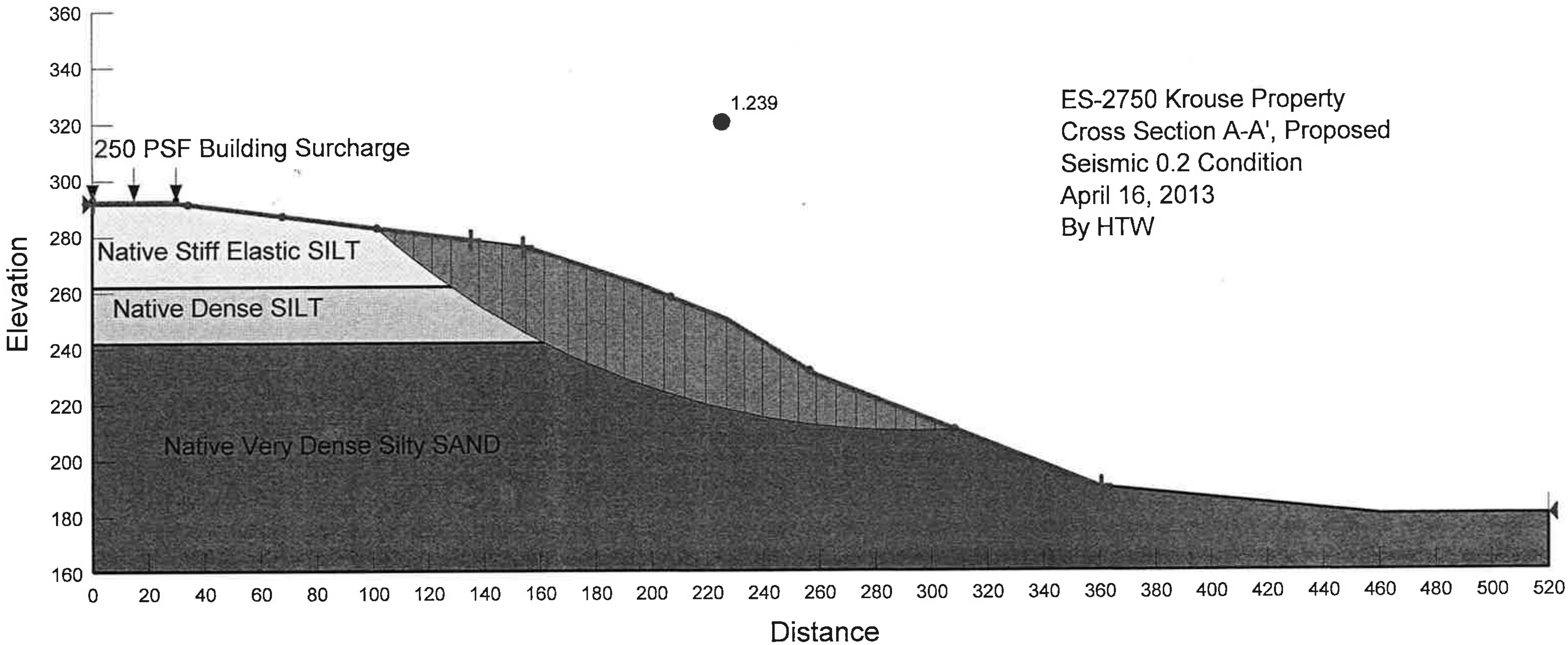
Horz Seismic Load: 0.2
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	Native Very Stiff Elastic SILT	1,2,3,11,12,15,9	4296.0026
Region 2	Native Dense SILT	9,15,12,7,16,10	4485.5091
Region 3	Native Very Dense Silty SAND	10,13,5,14,4,8,7,16	29237.594

Points

	X (ft)	Y (ft)
Point 1	0	292
Point 2	30	292
Point 3	155	276
Point 4	460	180
Point 5	520	160
Point 6	0	0
Point 7	259	230
Point 8	360	190
Point 9	0	262
Point 10	0	242
Point 11	197	262
Point 12	227	250
Point 13	0	160.80344
Point 14	520	180
Point 15	138.33291	262
Point 16	170.173	241.93398



ES-2750 Krouse Property
Cross Section A-A', Proposed
Seismic 0.2 Condition
April 16, 2013
By HTW
1.239
250 PSF Building Surcharge
Native Stiff Elastic SILT
Native Dense SILT
Native Very Dense Silty SAND
Elevation
360
340
320
300
280
260
240
220
200
180
160
Distance
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520

SLOPE/W Analysis

File Information

Created By: Henry Wright
Revision Number: 4
Last Edited By: Henry Wright
Date: 4/16/2013
Time: 11:08:38 AM
File Name: Boring 1 Lot, Proposed, Seismic 0.2.gsz
Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
Last Solved Date: 4/16/2013
Last Solved Time: 11:08:43 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- SlipSurface
  - Direction of movement: Left to Right
  - Allow Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced
  - Number of Slices: 30

Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Very Stiff Elastic SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 28 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 200 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Silty SAND

Model: Mohr-Coulomb
Unit Weight: 128 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.25289, 292) ft
Left-Zone Right Coordinate: (135.20039, 278.53435) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (154.06255, 276.11999) ft
Right-Zone Right Coordinate: (360.77609, 189.92239) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 292) ft
Right Coordinate: (520, 180) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	0.2054651	293.07335
	29.997628	293.07143

Seismic Loads

Horz Seismic Load: 0.2
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Native Very Stiff Elastic SILT	1,2,3,11,12,15,9	4296.0026
Region 2	Native Dense SILT	9,15,12,7,16,10	4485.5091
Region 3	Native Very Dense Silty SAND	10,13,5,14,4,8,7,16	29237.594

Points

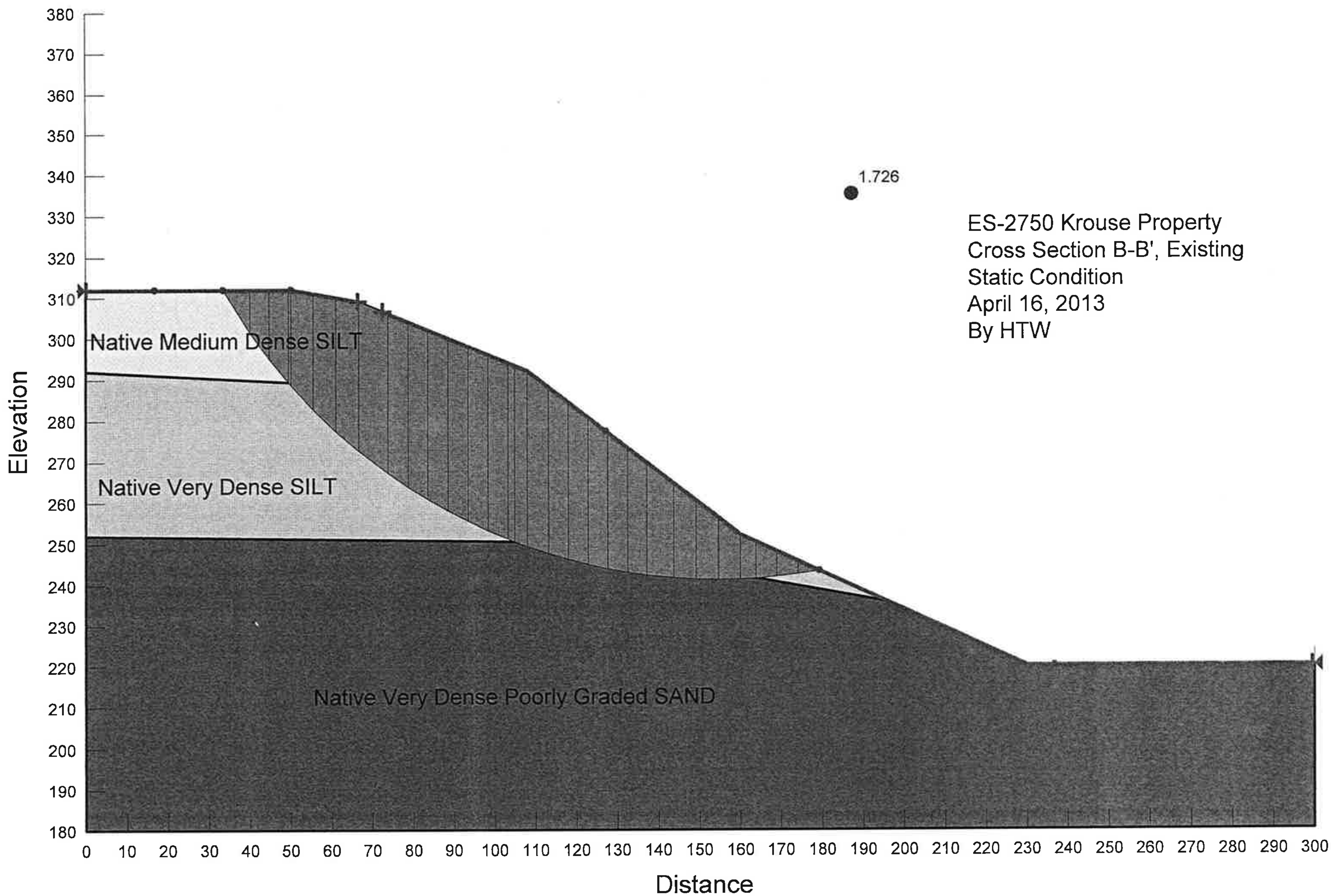
	X (ft)	Y (ft)
Point 1	0	292
Point 2	30	292
Point 3	155	276
Point 4	460	180
Point 5	520	160
Point 6	0	0
Point 7	259	230
Point 8	360	190
Point 9	0	262
Point 10	0	242
Point 11	197	262
Point 12	227	250
Point 13	0	160.80344
Point 14	520	180
Point 15	138.33291	262
Point 16	170.173	241.93398

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	122	1.110	(362.03, 524.539)	334.618	(135.2, 278.534)	(360.776, 189.922)

Slices of Slip Surface: 122

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	122	138.50035	275.5716	0	95.354608	50.700945	200
2	122	145.1002	269.79865	0	487.11104	259.00153	200
3	122	151.70005	264.32125	0	834.3762	443.6457	200
4	122	156.4847	260.4982	0	1043.3951	554.78302	200
5	122	161.51345	256.6893	0	1173.8978	733.53277	200
6	122	168.60155	251.52525	0	1398.6719	873.98721	200
7	122	175.68965	246.6379	0	1607.3229	1004.3668	200
8	122	182.77775	242.01295	0	1804.897	1127.8248	200
9	122	191.6609	236.60525	0	2044.8281	1379.254	0
10	122	200.75	231.38305	0	2266.8018	1528.9771	0
11	122	208.25	227.3794	0	2428.3686	1637.9553	0
12	122	215.75	223.6159	0	2594.3841	1749.9342	0
13	122	223.25	220.08365	0	2765.2036	1865.1534	0
14	122	231	216.67185	0	2852.6342	1924.1261	0
15	122	239	213.3878	0	2843.652	1918.0675	0
16	122	247	210.3418	0	2813.9692	1898.0462	0
17	122	255	207.5269	0	2754.1413	1857.6918	0
18	122	262.8846	204.9712	0	2751.1049	1855.6437	0
19	122	270.65385	202.66325	0	2806.879	1893.2638	0
20	122	278.4231	200.558	0	2819.3772	1901.6939	0
21	122	286.1923	198.6515	0	2779.9281	1875.0852	0
22	122	293.96155	196.9404	0	2682.4896	1809.3621	0
23	122	301.7308	195.42155	0	2524.2605	1702.6352	0
24	122	309.5	194.0923	0	2306.1523	1555.5194	0
25	122	317.2692	192.9504	0	2033.4975	1371.6114	0
26	122	325.03845	191.9939	0	1714.6914	1156.574	0
27	122	332.8077	191.22125	0	1360.9383	917.96448	0
28	122	340.5769	190.6311	0	983.86063	663.62238	0
29	122	348.34615	190.2225	0	594.83758	401.22302	0
30	122	356.1154	189.99485	0	203.03856	136.95124	0
31	122	360.38805	189.9243	0	4.7256833	3.1875137	0


ES-2750 Krouse Property
Cross Section B-B', Existing
Static Condition
April 16, 2013
By HTW
1.726
Native Medium Dense SILT
Native Very Dense SILT
Native Very Dense Poorly Graded SAND
Elevation
Distance
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300

Slope Stability

File Information

Title: ES-2750, Boring 2 Lot, Proposed, Static
Created By: Henry Wright
Revision Number: 33
Last Edited By: Henry Wright
Date: 4/16/2013
Time: 11:31:55 AM
File Name: Boring 2 Lot, Existing, Static.gsz
Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
Last Solved Date: 4/16/2013
Last Solved Time: 11:31:58 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- SlipSurface
  - Direction of movement: Left to Right
  - Allow Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Medium Dense SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 29 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 300 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Poorly Graded SAND

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.12526, 312) ft
Left-Zone Right Coordinate: (66.388871, 309.04114) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (72.448051, 306.59927) ft
Right-Zone Right Coordinate: (299.36267, 220) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 312) ft
Right Coordinate: (300, 220) ft

Seismic Loads

Horz Seismic Load: 0

Regions

	Material	Points	Area (ft^2)
Region 1	Native Medium Dense SILT	4,5,6,7,8,15,14,13,11	2289.8032
Region 2	Native Dense SILT	11,13,14,15,9,18,17,16,12	5274.2644
Region 3	Native Very Dense Poorly Graded SAND	12,16,17,18,10,1,2,3	17694.973

Points

	X (ft)	Y (ft)
Point 1	300	220
Point 2	300	180
Point 3	0	180
Point 4	0	312
Point 5	40	312
Point 6	50	312
Point 7	66.590114	309.00481
Point 8	108	292
Point 9	160	252
Point 10	230	220
Point 11	0	292
Point 12	0	252
Point 13	73.804924	288
Point 14	103.27173	280.29746
Point 15	137.22286	269.52088
Point 16	113.22057	250.29904
Point 17	143.75061	245
Point 18	195.90751	235.58514

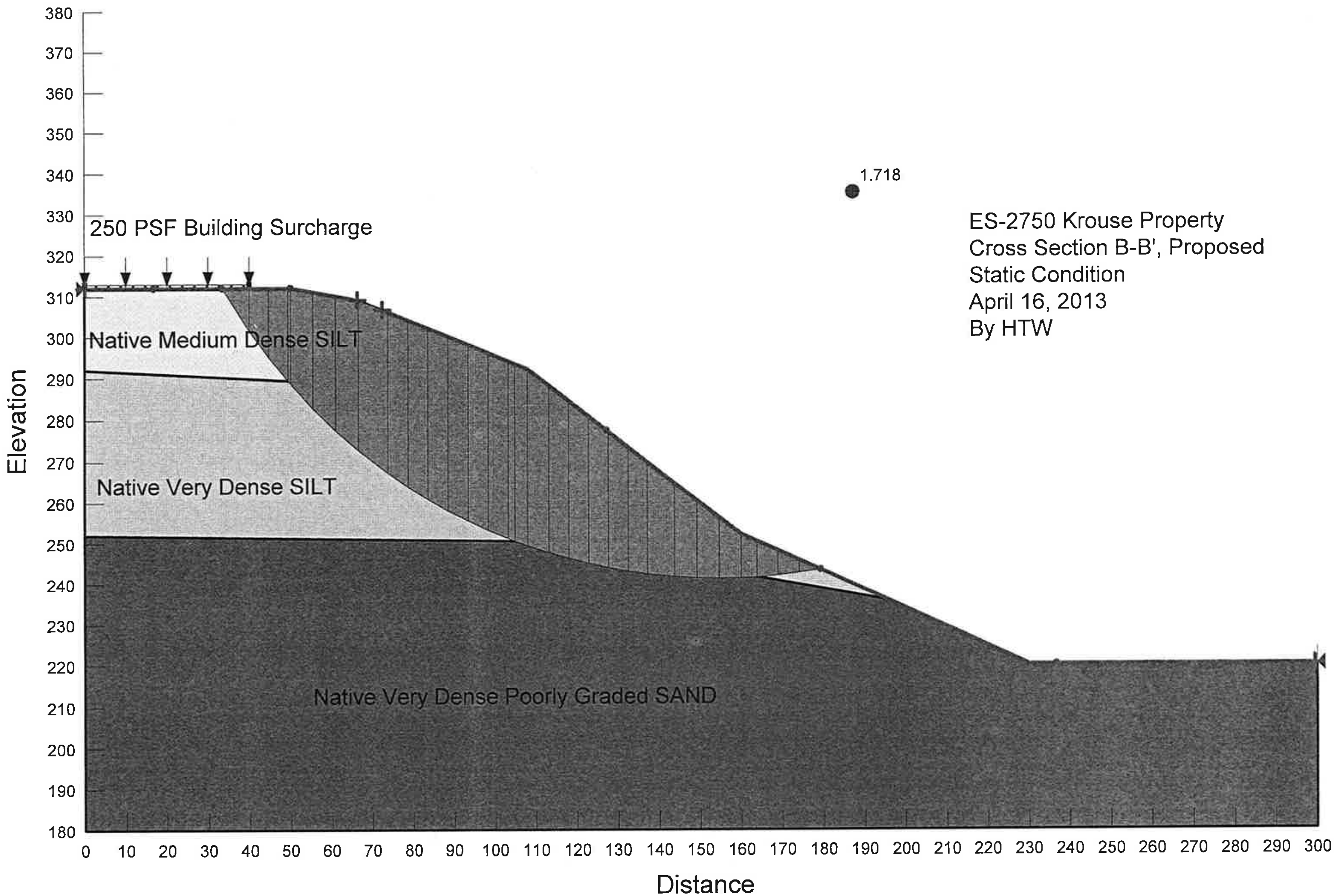
Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	92	1.416	(273.89, 530.897)	313.105	(50.0213, 311.996)	(227.159, 221.299)

Slices of Slip Surface: 92

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	92	52.7828	309.2415	0	88.821347	49.234477	200
2	92	58.305725	303.8647	0	452.98079	251.09135	200
3	92	63.82865	298.7438	0	785.95738	435.66329	200
4	92	69.320765	293.8882	0	1042.7913	578.02866	200

5	92	74.78208	289.28105	0	1229.9579	681.77682	200
6	92	80.73261	284.5066	0	1385.602	865.82021	300
7	92	87.172355	279.59005	0	1611.0605	1006.7023	300
8	92	93.612105	274.92995	0	1824.511	1140.081	300
9	92	100.05184	270.51255	0	2028.4062	1267.4889	300
10	92	105.63585	266.8564	0	2198.812	1373.9702	300
11	92	110.9223	263.5684	0	2263.4145	1414.3384	300
12	92	116.76685	260.0914	0	2245.6402	1403.2318	300
13	92	122.6114	256.78315	0	2214.1992	1383.5852	300
14	92	128.456	253.63755	0	2167.0281	1354.1095	300
15	92	134.3006	250.6491	0	2101.8606	1313.3883	300
16	92	139.9	247.92585	0	2010.5865	1256.3539	300
17	92	145.2542	245.45175	0	1892.4537	1182.5363	300
18	92	150.9485	242.9571	0	1728.9083	1166.1634	0
19	92	156.98285	240.4544	0	1548.6944	1044.6076	0
20	92	162.9923	238.10655	0	1443.6017	973.72162	0
21	92	168.9769	235.909	0	1418.5878	956.84953	0
22	92	174.9615	233.84825	0	1369.9974	924.07494	0
23	92	180.94605	231.92145	0	1297.0746	874.88785	0
24	92	186.9306	230.1261	0	1199.7373	809.23304	0
25	92	192.9152	228.4598	0	1078.7076	727.59744	0
26	92	199.0326	226.8891	0	927.80658	625.81344	0
27	92	205.2828	225.41775	0	748.37248	504.78361	0
28	92	211.533	224.08075	0	550.47132	371.29759	0
29	92	217.78325	222.87635	0	337.72739	227.8	0
30	92	224.0335	221.803	0	113.74833	76.724218	0



ES-2750 Krouse Property
Cross Section B-B', Proposed
Static Condition
April 16, 2013
By HTW
250 PSF Building Surcharge
1.718
Native Medium Dense SILT
Native Very Dense SILT
Native Very Dense Poorly Graded SAND
Elevation
Distance
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
230
220
210
200
190
180
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300

Slope Stability

File Information

Title: ES-2750, Boring 2 Lot, Proposed, Static
Created By: Henry Wright
Revision Number: 34
Last Edited By: Henry Wright
Date: 4/16/2013
Time: 11:30:32 AM
File Name: Boring 2 Lot, Proposed, Static.gsz
Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
Last Solved Date: 4/16/2013
Last Solved Time: 11:30:34 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: (none)

SlipSurface
- Direction of movement: Left to Right
- Allow Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution
- FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Medium Dense SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 29 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 300 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Poorly Graded SAND

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.12526, 312) ft
Left-Zone Right Coordinate: (66.388871, 309.04114) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (72.448051, 306.59927) ft
Right-Zone Right Coordinate: (299.36267, 220) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 312) ft
Right Coordinate: (300, 220) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	0.1185691	313.03099
	39.978656	313.03099

Seismic Loads

Horz Seismic Load: 0

Regions

	Material	Points	Area (ft²)
Region 1	Native Medium Dense SILT	4,5,6,7,8,15,14,13,11	2289.8032
Region 2	Native Dense SILT	11,13,14,15,9,18,17,16,12	5274.2644
Region 3	Native Very Dense Poorly Graded SAND	12,16,17,18,10,1,2,3	17694.973

Points

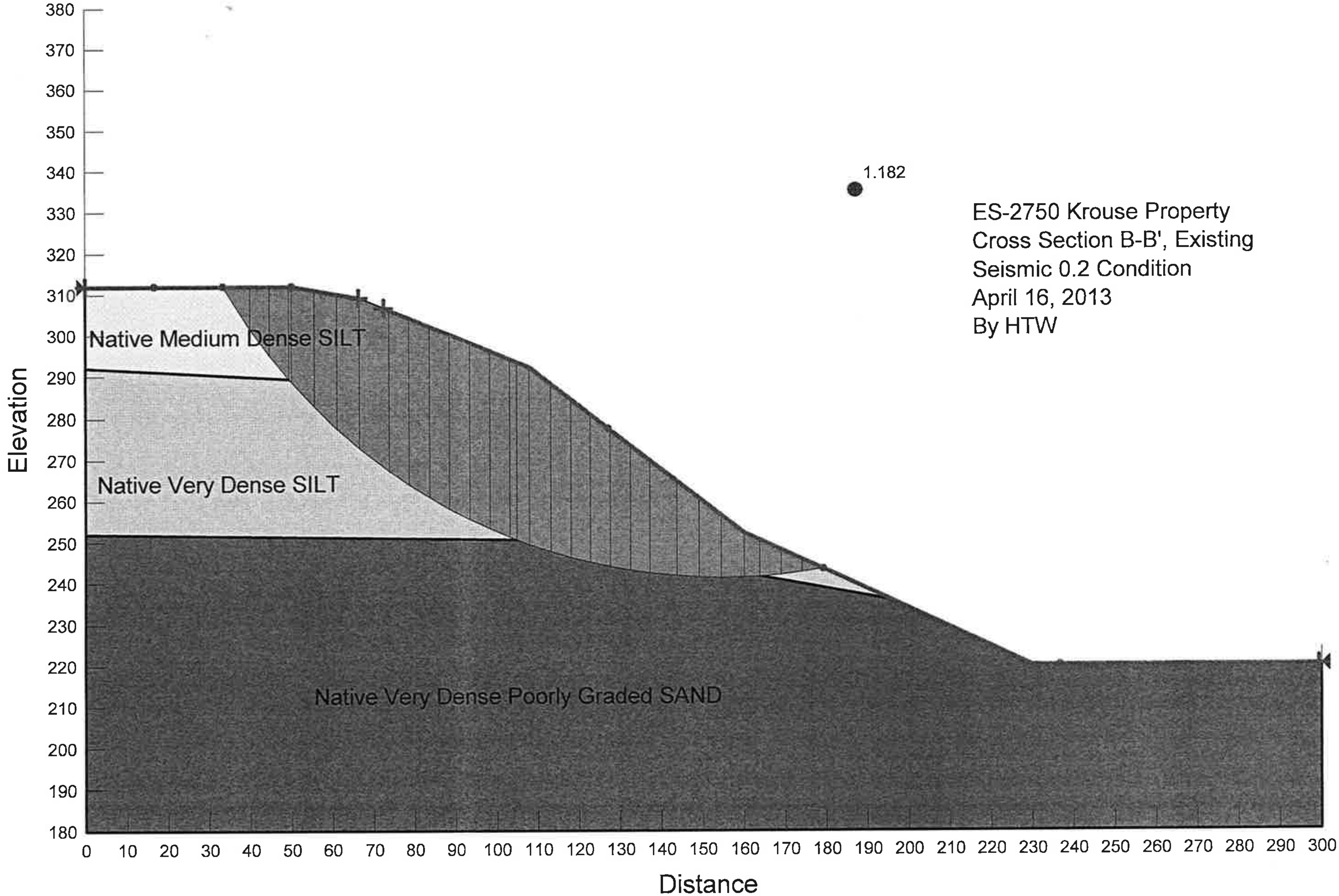
	X (ft)	Y (ft)
Point 1	300	220
Point 2	300	180
Point 3	0	180
Point 4	0	312
Point 5	40	312
Point 6	50	312
Point 7	66.590114	309.00481
Point 8	108	292
Point 9	160	252
Point 10	230	220
Point 11	0	292
Point 12	0	252
Point 13	73.804924	288
Point 14	103.27173	280.29746
Point 15	137.22286	269.52088
Point 16	113.22057	250.29904
Point 17	143.75061	245
Point 18	195.90751	235.58514

Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	92	1.416	(273.89, 530.897)	313.105	(50.0213, 311.996)	(227.159, 221.299)

Slices of Slip Surface: 92

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	92	52.7828	309.2415	0	88.821347	49.234477	200
2	92	58.305725	303.8647	0	452.98079	251.09135	200
3	92	63.82865	298.7438	0	785.95738	435.66329	200
4	92	69.320765	293.8882	0	1042.7913	578.02866	200
5	92	74.78208	289.28105	0	1229.9579	681.77682	200
6	92	80.73261	284.5066	0	1385.602	865.82021	300
7	92	87.172355	279.59005	0	1611.0605	1006.7023	300
8	92	93.612105	274.92995	0	1824.511	1140.081	300
9	92	100.05184	270.51255	0	2028.4062	1267.4889	300
10	92	105.63585	266.8564	0	2198.812	1373.9702	300
11	92	110.9223	263.5684	0	2263.4145	1414.3384	300
12	92	116.76685	260.0914	0	2245.6402	1403.2318	300
13	92	122.6114	256.78315	0	2214.1992	1383.5852	300
14	92	128.456	253.63755	0	2167.0281	1354.1095	300
15	92	134.3006	250.6491	0	2101.8606	1313.3883	300
16	92	139.9	247.92585	0	2010.5865	1256.3539	300
17	92	145.2542	245.45175	0	1892.4537	1182.5363	300
18	92	150.9485	242.9571	0	1728.9083	1166.1634	0
19	92	156.98285	240.4544	0	1548.6944	1044.6076	0
20	92	162.9923	238.10655	0	1443.6017	973.72162	0
21	92	168.9769	235.909	0	1418.5878	956.84953	0
22	92	174.9615	233.84825	0	1369.9974	924.07494	0
23	92	180.94605	231.92145	0	1297.0746	874.88785	0
24	92	186.9306	230.1261	0	1199.7373	809.23304	0
25	92	192.9152	228.4598	0	1078.7076	727.59744	0
26	92	199.0326	226.8891	0	927.80658	625.81344	0
27	92	205.2828	225.41775	0	748.37248	504.78361	0
28	92	211.533	224.08075	0	550.47132	371.29759	0
29	92	217.78325	222.87635	0	337.72739	227.8	0
30	92	224.0335	221.803	0	113.74833	76.724218	0



ES-2750 Krouse Property
Cross Section B-B', Existing
Seismic 0.2 Condition
April 16, 2013
By HTW

Slope Stability

File Information

Title: ES-2750, Boring 2 Lot, Proposed, Static
Created By: Henry Wright
Revision Number: 35
Last Edited By: Henry Wright
Date: 4/16/2013
Time: 11:33:29 AM
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Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
Last Solved Date: 4/16/2013
Last Solved Time: 11:33:32 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Method: Morgenstern-Price
- Settings
  - Side Function
    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
- SlipSurface
  - Direction of movement: Left to Right
  - Allow Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: (none)
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native Medium Dense SILT

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion: 200 psf
Phi: 29 °
Phi-B: 0 °

Native Dense SILT

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 300 psf
Phi: 32 °
Phi-B: 0 °

Native Very Dense Poorly Graded SAND

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0.12526, 312) ft
Left-Zone Right Coordinate: (66.388871, 309.04114) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (72.448051, 306.59927) ft
Right-Zone Right Coordinate: (299.36267, 220) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 312) ft
Right Coordinate: (300, 220) ft

Seismic Loads

Horz Seismic Load: 0.2

Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	Native Medium Dense SILT	4,5,6,7,8,15,14,13,11	2289.8032
Region 2	Native Dense SILT	11,13,14,15,9,18,17,16,12	5274.2644
Region 3	Native Very Dense Poorly Graded SAND	12,16,17,18,10,1,2,3	17694.973

Points

	X (ft)	Y (ft)
Point 1	300	220
Point 2	300	180
Point 3	0	180
Point 4	0	312
Point 5	40	312
Point 6	50	312
Point 7	66.590114	309.00481
Point 8	108	292
Point 9	160	252
Point 10	230	220
Point 11	0	292
Point 12	0	252
Point 13	73.804924	288
Point 14	103.27173	280.29746
Point 15	137.22286	269.52088
Point 16	113.22057	250.29904
Point 17	143.75061	245
Point 18	195.90751	235.58514

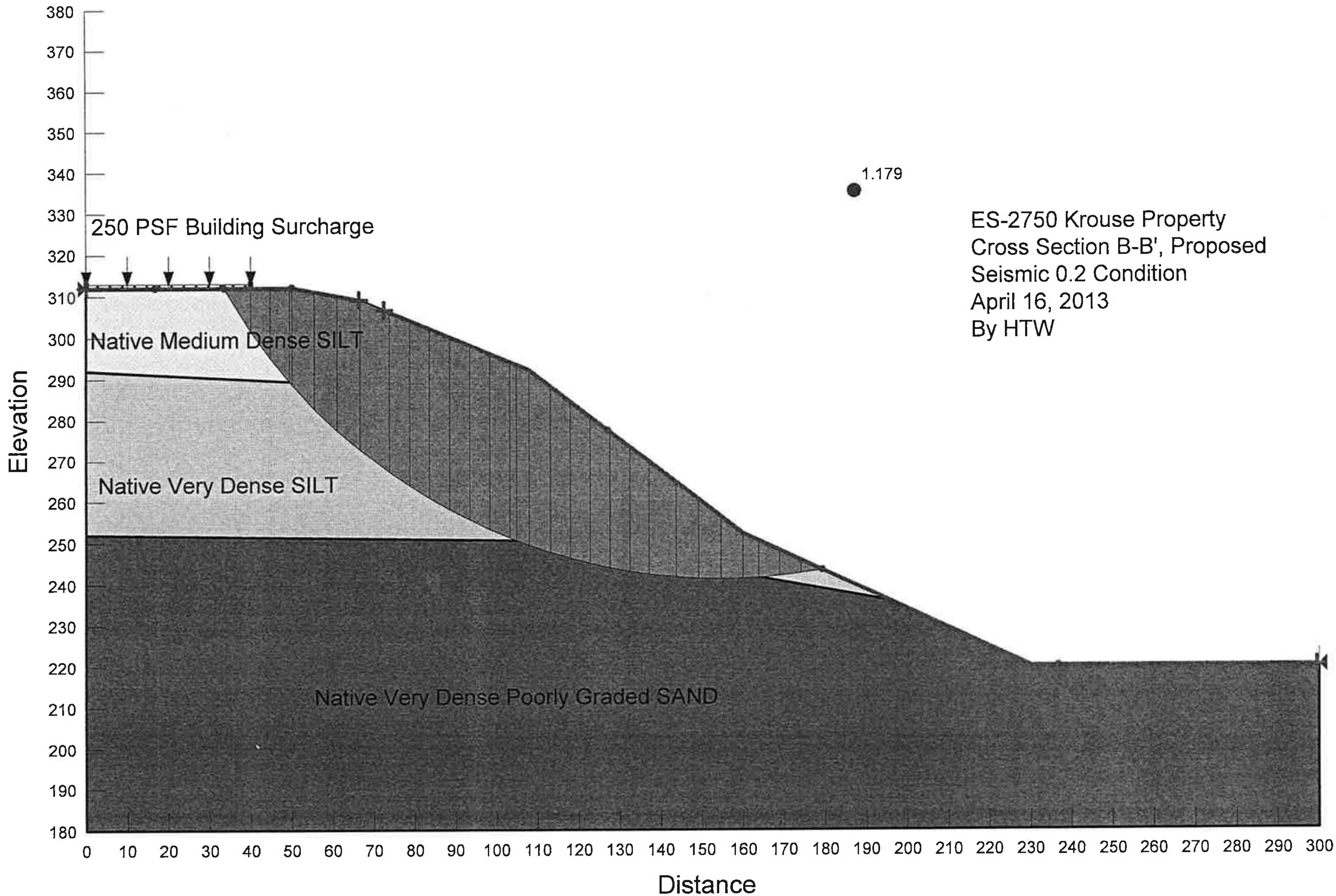
Critical Slip Surfaces

	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	92	0.957	(273.89, 530.897)	313.105	(50.0213, 311.996)	(227.159, 221.299)

Slices of Slip Surface: 92

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	92	52.7828	309.2415	0	40.566906	22.486603	200
2	92	58.305725	303.8647	0	363.40876	201.44077	200
3	92	63.82865	298.7438	0	646.71645	358.48078	200

4	92	69.320765	293.8882	0	856.27264	474.63967	200
5	92	74.78208	289.28105	0	1002.2968	555.5822	200
6	92	80.73261	284.5066	0	1126.3241	703.80538	300
7	92	87.172355	279.59005	0	1313.9024	821.01733	300
8	92	93.612105	274.92995	0	1493.7859	933.421	300
9	92	100.05184	270.51255	0	1670.9232	1044.1087	300
10	92	105.63585	266.8564	0	1824.9711	1140.3685	300
11	92	110.9223	263.5684	0	1897.7444	1185.8423	300
12	92	116.76685	260.0914	0	1911.6209	1194.5133	300
13	92	122.6114	256.78315	0	1921.1897	1200.4926	300
14	92	128.456	253.63755	0	1922.9306	1201.5804	300
15	92	134.3006	250.6491	0	1912.5645	1195.1029	300
16	92	139.9	247.92585	0	1877.9091	1173.4478	300
17	92	145.2542	245.45175	0	1814.8076	1134.0176	300
18	92	150.9485	242.9571	0	1615.9745	1089.9885	0
19	92	156.98285	240.4544	0	1486.3408	1002.5495	0
20	92	162.9923	238.10655	0	1419.3497	957.36346	0
21	92	168.9769	235.909	0	1421.1067	958.5486	0
22	92	174.9615	233.84825	0	1392.4302	939.20601	0
23	92	180.94605	231.92145	0	1331.2052	897.90923	0
24	92	186.9306	230.1261	0	1237.2191	834.51481	0
25	92	192.9152	228.4598	0	1112.2971	750.25388	0
26	92	199.0326	226.8891	0	952.2904	642.32799	0
27	92	205.2828	225.41775	0	761.45417	513.60732	0
28	92	211.533	224.08075	0	553.51303	373.34925	0
29	92	217.78325	222.87635	0	334.98855	225.95263	0
30	92	224.0335	221.803	0	111.39641	75.137827	0


Elevation
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330
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210
220
230
240
250
260
270
280
290
300
Distance
250 PSF Building Surcharge
1.179
ES-2750 Krouse Property
Cross Section B-B', Proposed
Seismic 0.2 Condition
April 16, 2013
By HTW
Native Medium Dense SILT
Native Very Dense SILT
Native Very Dense Poorly Graded SAND

Slope Stability

File Information

Title: ES-2750, Boring 2 Lot, Proposed, Static
Created By: Henry Wright
Revision Number: 33
Last Edited By: Henry Wright
Date: 4/16/2013
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File Name: Boring 2 Lot, Proposed, Seismic 0.2.gsz
Directory: C:\Users\henry.wright\Documents\SlopeW\2660.01\
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    - Interslice force function option: Half-Sine
  - PWP Conditions Source: (none)
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  - FOS Calculation Option: Constant
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Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 300 psf
Phi: 32 °
Phi-B: 0 °

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Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion: 0 psf
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Left Coordinate: (0, 312) ft
Right Coordinate: (300, 220) ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
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	39.978656	313.03099

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Horz Seismic Load: 0.2
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7	92	87.172355	279.59005	0	1313.9024	821.01733	300
8	92	93.612105	274.92995	0	1493.7859	933.421	300
9	92	100.05184	270.51255	0	1670.9232	1044.1087	300
10	92	105.63585	266.8564	0	1824.9711	1140.3685	300
11	92	110.9223	263.5684	0	1897.7444	1185.8423	300
12	92	116.76685	260.0914	0	1911.6209	1194.5133	300
13	92	122.6114	256.78315	0	1921.1897	1200.4926	300
14	92	128.456	253.63755	0	1922.9306	1201.5804	300
15	92	134.3006	250.6491	0	1912.5645	1195.1029	300
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17	92	145.2542	245.45175	0	1814.8076	1134.0176	300
18	92	150.9485	242.9571	0	1615.9745	1089.9885	0
19	92	156.98285	240.4544	0	1486.3408	1002.5495	0
20	92	162.9923	238.10655	0	1419.3497	957.36346	0
21	92	168.9769	235.909	0	1421.1067	958.5486	0
22	92	174.9615	233.84825	0	1392.4302	939.20601	0
23	92	180.94605	231.92145	0	1331.2052	897.90923	0
24	92	186.9306	230.1261	0	1237.2191	834.51481	0
25	92	192.9152	228.4598	0	1112.2971	750.25388	0
26	92	199.0326	226.8891	0	952.2904	642.32799	0
27	92	205.2828	225.41775	0	761.45417	513.60732	0
28	92	211.533	224.08075	0	553.51303	373.34925	0
29	92	217.78325	222.87635	0	334.98855	225.95263	0
30	92	224.0335	221.803	0	111.39641	75.137827	0

REPORT DISTRIBUTION

ES-2750

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