EARTH SOLUTIONS NW

Geotechnical Engineering ■ Earthwork Observation & Testing
Environmental Services ■ CESCL & Stormwater Services

esnw.com info@esnw.com

August 8, 2025
ES-9607.02

Derek and Eileen Cheshire
7615 East Mercer Way
Mercer Island, Washington 98040

**Subject: Response to Land Use Review Comments**
**Cheshire Property**
**7615 East Mercer Way**
**Mercer Island, Washington**

**City File No. CA025-005 SUB 2**

Dear Derek and Eileen:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this response to review comments for the subject project. This response letter addresses city of a city of Mercer Island review comments in the referenced review letter. This update includes a review of the latest submittal plans.

**Plan Updates**

Since issuing the previous response to comments letter the design team has revised the project to include pipe pile and helical anchor support for the new home and a catchment wall along the toe of the ascending slope off the west side of the building pad that was designed to resist impacts generated from a typical debris flow event. The following responses include these components in the specific evaluation.

Pipe piles will consist of three-inch diameter schedule-40 steel driven to refusal estimated at about 40 feet below grade. The pipe piles were designed using an allowable axial capacity of 10 kips and no lateral resistance. Lateral resistance will be provided by helical anchors installed to depths of about 40 feet (torque-confirmed to achieve design capacity) and a capacity of 40 kips. The referenced structural plans were designed using the capacity values provided by ESNW. Installation parameters are provided in the referenced structural plans.

The catchment wall designed off the west side of the building pad at the toe of an ascending natural slope was designed to withstand an impact of 1,200 pounds (per linear foot of wall) applied to the freeboard portion of the wall, which was based on a mobilized soil depth of about two feet. It is important to note that slope gradients decrease at the toe of the slope which will attenuate the debris flow that would be generated further up the slope in the steeper section. In addition, updated slope stability results suggest that the slope will maintain a minimum factor of safety of 1.1 after a design-level earthquake; therefore, any debris flow that may originate on the slope would likely be an isolated unique condition. On this basis, the structural design uses ultimate strength values to reflect this highly unlikely occurrence.

***MI SUB 2 Review Comment 6***

*In the response above, the "…isolated areas of instability, such as within the slope to the west…" will require mitigation recommendations to meet the requirements of the statement of risk provided by the geotechnical engineer. The proposed development should not focus solely on the proposed building, but the entire property, i.e. not only the potential impact of the development on the slope, but the impact of the slope on the development.*

*The Nisqually earthquake produced lower ground motions than those anticipated with the current IBC earthquake loading used for the design of this project. So although the site response after the Nisqually earthquake "shows little to no signs of obvious foundation settlement or displacement", that response is not indicative of how the site will respond under current IBC earthquake design loading.*

**ESNW Response**

Updated slope stability analyses attached evaluated the overall site as well as features adjacent to the building pad. The results of the stability analyses suggest that adequate factor of safety is maintained on the site such that impacts to the structure will not be increased. The new home will be supported by pipe piles and battered helical anchors that will further protect the building from earthquake forces and resulting potential ground deformation. A catchment wall with two feet of freeboard is included in the latest submittal for the base of the slope to the west. This element will provide protection to the residence from debris flow failure, although modeling suggests this occurrence is extremely unlikely.

***MI SUB 2 Review Comment 7***

*From FHWA-NHI-11-032 (see Reference citation at the end of this letter):*

*"While there is some limited information to indicate that the shear strength of soil increases with increasing strain rate, the peak shear strength of soil subjected to cyclic loading is generally assumed to be equal to or less than the peak static strength. If the soil is dry, the static drained shear strength may be used. If the soil is saturated, even if the soil is relatively free draining, the undrained shear strength should be used for seismic analyses because of the rapid nature of earthquake loading. For cohesive soils of low to intermediate sensitivity, the static shear strength of the soil may be reduced by 10-15% when subjected to large magnitude earthquakes (M > 7) to account for a potential reduction in shear strength due to cyclic loading."*

*This FHWA reference does not support the geotechnical engineer of record's response that use of a higher strength under seismic loading is "consistent with local standards and based on published recommendations for values…". In reviewing slope stability analyses submitted by local geotechnical engineers for projects on Mercer Island, the use of higher soil strengths under seismic loading is not the standard of practice.*

*Please revise slope stability analyses to conform to local standard of practice and to the FHWA reference that indicates that "the peak shear strength is generally assumed to be equal or less than the peak static strength".*

**ESNW Response**

Attached.

To evaluate the ascending slope to the west of the building pad, we assumed that this slope represents the intact slope (non-mobilized). A slope reduction calculation was completed for this slope and using average assumed soil parameters the model indicated a minimum FOS value of 1.3 for seismic conditions.

To evaluate the descending slope to the east of the building pad, we assumed that this slope represents the ancient landslide slope (mobilized). A slope reduction calculation was completed for this slope and using reduced (residual) assumed soil parameters based on blow count values reported in the referenced soil logs, the model indicated a minimum FOS value of 1.1 for seismic conditions.

The soil logs used for this analysis had no laboratory index testing on samples. The information used for the analysis was blow counts and field descriptions of soil units. In our opinion, given the scope of this project the information provided in the soil logs is adequate to evaluate the stability of this site. Soil parameters used for the updated modeling are attached that indicate seismic values are equal to static, as requested by the reviewer.

***MI SUB 2 Review Comment 8***

*Please provide the calculation for the slope height reduction factor and the average peak acceleration that takes into account spatial incoherence. Please provide revised slope stability analyses using this average peak acceleration to verify that the FOS is a minimum of 1.1 for the western slope as indicated in ESNW response above.*

*From the debris flow discussion above:*

*"This condition suggests the slope is stable in the current condition and configuration. No modification is proposed for this slope; therefore, the stability will not be adversely impacted by the project."*

*Although no direct impact of the proposed development on the stability of the existing slope to the west is anticipated, the impact of the slope on the proposed development must be assessed. Therefore, not only the current condition, but future stability of the slope must be considered. If slope stability analyses indicate unstable conditions (e.g. under seismic loading conditions), please provide mitigation recommendations.*

**ESNW Response**

Updated slope stability modeling results are attached along with slope height reduction calculations.

To evaluate the ascending slope to the west of the building pad, we assumed that this slope represents the intact slope (non-mobilized). A slope reduction calculation was completed for this slope and using average assumed soil parameters the model indicated a minimum FOS value of 1.3 for seismic conditions.

To evaluate the descending slope to the east of the building pad, we assumed that this slope represents the ancient landslide slope (mobilized). A slope reduction calculation was completed for this slope and using reduced (residual) assumed soil parameters based on blow count values reported in the referenced soil logs, the model indicated a minimum FOS value of 1.1 for seismic conditions.

With respect to soil strength parameters used for slope stability, the western slope was evaluated considering relatively undisturbed conditions and the eastern slope and building pad area were evaluated considering disturbed soil conditions. In either case, the values used were lower than peak values for the particular soil type and condition. WSDOT Chapter 5 and related engineering resources were referenced to determine appropriate soil strength parameters in the updated slope stability modeling. The analytical methods rely on the assumption that limited deformation is acceptable within the soil mass and that the structure can withstand this seismically induced deformation. This assumption allows for apparent cohesion to be used in analyses.

Updated slope stability analyses attached reinforce the opinion that the slope to the west is stable and will remain so subsequent to a design-level earthquake event. With respect to future stability, debris flow would be the most likely scenario. Given the topography, high level of vegetation and soil type, in our opinion, a debris flow would be a highly unlikely event. If a typical debris flow were to develop on this slope, the break in slope gradient at the base would attenuate the energy somewhat. If the flow progressed to the base of the slope, a catchment wall will provide a level of protection commensurate with the event such that life safety will be maintained. The catchment wall includes two feet of freeboard and is designed to withstand the impact forces from a typical debris flow event. No further evaluation or mitigation is warranted for this scenario.

In terms of surface conditions, the slope is heavily vegetated with forested growth and underbrush. Based on the conditions observed at the hand auger boring locations, the slope is comprised of firm glacial drift deposits, consistent with local geologic mapping.

***MI SUB 2 Review Comment 9***

*Based on the variability of the soil conditions encountered at the site, worse or better conditions could be expected. This is the unknown associated with the site given the range of conditions encountered in the subsurface explorations. As such, a different conclusion that considers the range of conditions could be made. For example, post-liquefaction differential settlement could approach the maximum estimated post-liquefaction settlement value and that value may be greater if the subsurface explorations have not encountered the worst condition at the site.*

*Please provide maximum total and differential post-liquefaction settlement estimates so that the structural engineer can assess the potential associated damage and/or life safety issues. Please provide calculations for review to support the post-liquefaction settlement estimates given.*

*The groundwater conditions in borings B-6 and B-7, located to the west and north of the proposed structure seem to be very similar. The effects of liquefaction indicated for the B-7 conditions should be considered in the stability analyses. Please provide residual strength estimates for the liquefiable layers for review and include those strengths in revised stability analyses. Please provide an assessment for lateral spreading and/or debris flow failures using these residual strengths. Please provide associated calculations of lateral spreading and/or debris flow deformations. Please include mitigation recommendations for potential post-liquefaction effects. For example, if debris flow failures are anticipated, please determine debris flow volumes and runout and determine whether the proposed structure could be physically impacted by the debris flow. If so, please provide mitigation measures or provide impact loading values for the structural engineer to consider in the structural design. On the downslope side of the residence, please indicate whether lateral spreading or debris flow would undermine the structure and provide mitigation recommendations.*

*Please provide these results to other project members (e.g. the structural engineer and architect) so that the project team can provide a coordinated design that addresses these deformations without the potential for building collapse.*

*Please have the structural engineer state potential post-liquefaction settlement and lateral deformations in the design criteria section of the General Notes- Structural Design plan sheet.*

*Please have the structural engineer provide a statement on the General Notes- Structural Design plan sheet indicating the design approach used to accommodate the estimated post-liquefaction deformations and whether the proposed structural design can withstand these deformations without building collapse.*

**ESNW Response**

Updated slope stability modeling results attached indicate that the soils under the new house pad will maintain a minimum factor of safety of 1.1 subsequent to a design-level earthquake event. The soil strength parameters used are considered conservative and reflective of a post-landslide condition, based on the N-values recorded in the boring logs. Because the slope is partially comprised of an ancient landslide, the blow-count values represent the in-situ or post-landslide strength and remain valid for the slope stability modeling. The failure surfaces generated from the stability modeling largely occur within the upper 20 feet or so of the soil profile; therefore, based on the analyses, even the weaker soil layer(s) at depth do not contribute to instability during a design-level earthquake event. On this basis, lateral spread is not a highly probable mode of failure for this site. The new home will be supported with pipe piles driven a minimum of 40 feet into the slope soils and helical anchors will be used for lateral restraint. The post-liquefaction deformation predicted to occur on this site will not adversely affect life-safety or building collapse.

Based on site-specific modeling of the site, the slope to the east may subside between three to six inches in response to liquefaction of saturated discrete sandy layers at depth. Slope stability modeling suggests that most instability is limited to the upper soils and therefore, lateral spread is not expected to occur. The building will be supported by pipe piles and helical anchors; therefore, subsidence of soils to the east of the building are expected to be limited to yard space and patio areas that are not pile-supported. This information has been distributed to the design team and is considered in the current submittal.

***MI SUB 2 Review Comment 11***

*The foundation mitigation proposed must meet the requirements of MICC 19.07.160.B.3. Otherwise, the statement of risk required from the geotechnical engineer of record for building and critical area permit approval cannot be made.*

*Since the reviewer's opinion on the appropriate foundation design for the structure continues to differ significantly from the geotechnical engineer of record, an independent third-party review can be requested by the applicant. Please contact the Mercer Island Building Official (gareth.reece@mercergov.org).*

**ESNW Response**

Since issuing the previous response to comments letter the design team has revised the project to include pipe pile and helical anchor support for the new home and a catchment wall along the toe of the ascending slope off the west side of the building pad that was designed to resist impacts generated from a typical debris flow event. The following responses include these components in the specific evaluation.

Pipe piles will consist of three-inch diameter schedule-40 steel driven to refusal estimated at about 40 feet below grade. The pipe piles were designed using an allowable axial capacity of 10 kips and no lateral resistance. Lateral resistance will be provided by helical anchors installed to depths of about 40 feet (torque-confirmed to achieve design capacity) and a capacity of 40 kips. The referenced structural plans were designed using the capacity values provided by ESNW. Installation parameters are provided in the referenced structural plans.

**Plan Review**

As part of this response preparation, the referenced submittal plans were reviewed and conform to the recommendations provided by ESNW during the design process. During the design process, cast-in-place retaining walls were developed for portions of the east and west sides of the project are to provide more useable space. The retaining walls range in height up to about five and one-half feet (exposed). The wall proposed along the western edge of the project will require excavation into a natural, moderately inclined slope (outside regulated steep slope hazard areas). ESNW provided sloped earth pressures to the structural engineering consultant for design purposes and those values are reflected in the current submittal package.

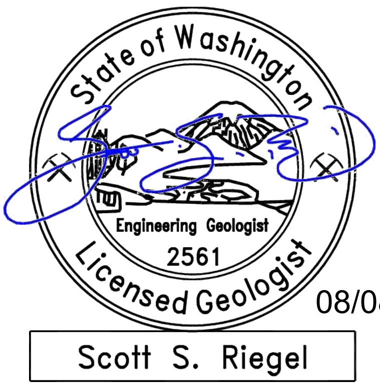
The additional analyses required during the permit review process have demonstrated that while this site contains geologic hazards, the overall stability of the site is favorable, and the project is designed in a thoughtful manner to preserve life-safety. The current design provides an acceptable level of risk mitigation commensurate with the scope of the project.

In our opinion, based on site conditions and slope stability analyses attached to this report, **"The landslide hazard area or seismic hazard area will be modified or the development has been designed so that the risk to the site and adjacent property is eliminated or mitigated such that the site is determined to be safe" (19.07.160.B.3.b).** As noted in the Project Description, the new construction will essentially replace the same footprint area as the existing structure and will be of similar height; therefore, no significant increase in loading is expected from the project. Improved drainage controls will improve the overall stability of this site.

We trust this response letter meets your current needs. Should you have questions regarding the content herein, or require additional information, please call.

Sincerely,

**EARTH SOLUTIONS NW, LLC**




08/08/2025


08/08/2025

Scott S. Riegel, L.G., L.E.G.
Associate Principal Geologist

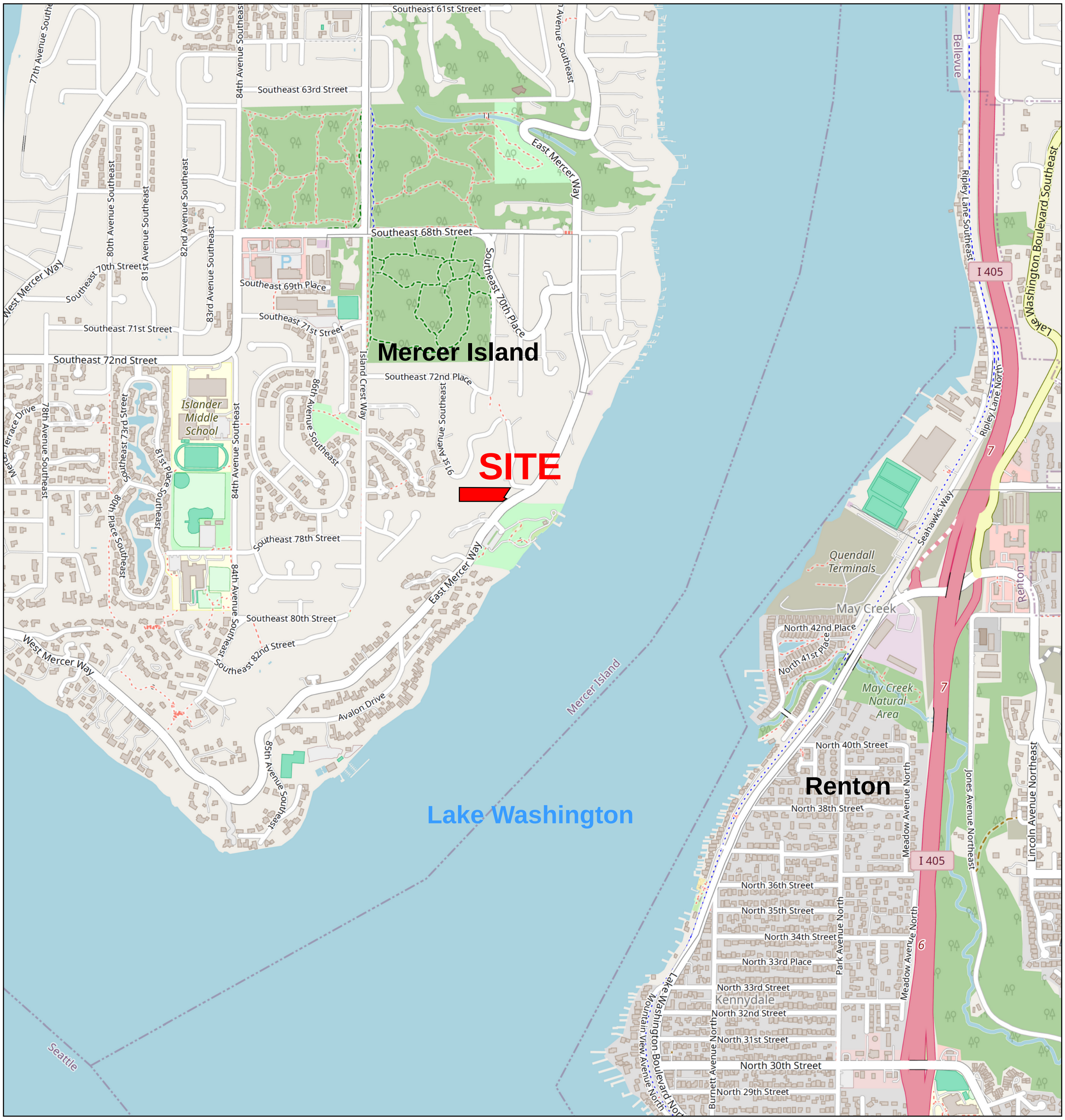
Kyle R. Campbell, P.E.
Senior Principal Engineer

Attachments: Plate 1 – Vicinity Map
Plate 2 – Subsurface Exploration Plan
Subsurface Exploration Logs
SlopeW Output
Liquefaction Analysis

cc: Plus Permit and Land Use Services
Attention: Marianne Stover

References:


- Architectural Plans Sub1, prepared by Patrick D. Lynch, LLC, dated June 9, 2025
- Civil Plans, prepared by LPD Engineering, PLLC, dated August 8, 2025
- Drainage Plan, prepared by LPD Engineering, PLLC, dated June 27, 2025
- Geotechnical Engineering Study, prepared by ESNW, ES-9607.01, updated January 23, 2025
- Review Letter, prepared by City of Mercer Island, dated July 10, 2025
- Structural Plans, prepared by Merrell Design Services, PLLC, dated August 4, 2025




Reference:
King County, Washington
OpenStreetMap.org


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.

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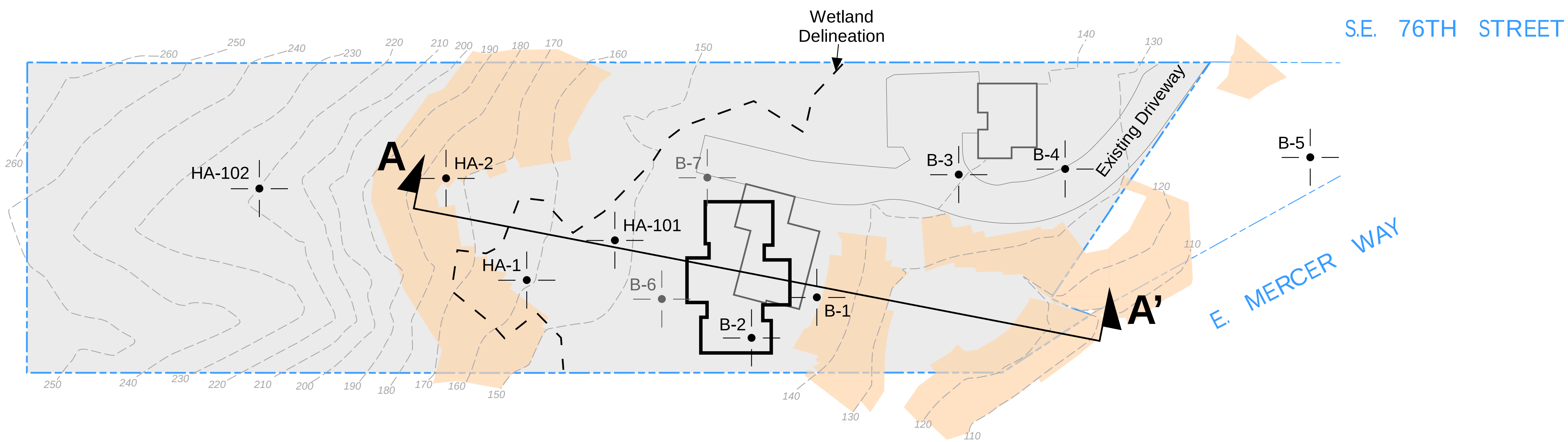
Vicinity Map
Cheshire Property
Mercer Island, Washington

| | | |
|---|---|---|
| Drawn CAM | Date 06/10/2025 | Proj. No. 9607.02 |
| Checked SSR | Date June 2025 | Plate 1 |




## LEGEND

HA-101 — Approximate Location of ESNW Hand Auger Boring, Proj. No. ES-9607.02, June 2025

HA-1 — Approximate Location of ESNW Hand Auger Boring, Proj. No. ES-9607.02, May 2025

B-1 — Approximate Location of Geotech Consultants, Inc. Boring, Job 16095, March 2016

B-6 — Approximate Location of Geotech Consultants, Inc. Boring, Job 23177, June 2023

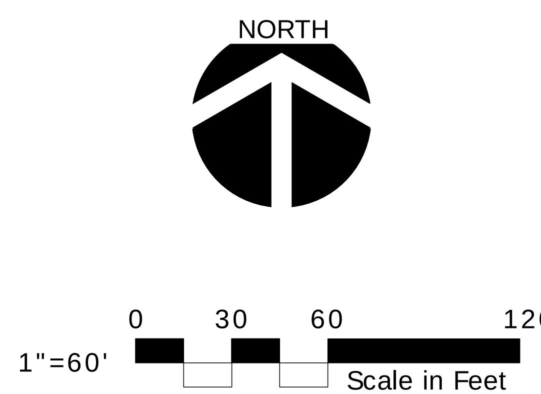
Subject Site

Proposed Building

Existing Building

Cross-Section

Approximate Location of Steep Slope Hazard Area




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.

Subsurface Exploration Plan
Cheshire Property
Mercer Island, Washington

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| | |
|---|---|
| Drawn | CAM |
| Checked | SSR |
| Date | 06/11/2025 |
| Proj. No. | 9607.02 |
| Plate | 2 |

| | | | | |
|---|---|---|---|---|
| Coarse-Grained Soils - More Than 50% Retained on No. 200 Sieve | Gravels - More Than 50% of Coarse Fraction Retained on No. 4 Sieve | < 5% Fines | GW | Well-graded gravel with or without sand, little to no fines |
| | | | GP | Poorly graded gravel with or without sand, little to no fines |
| | | > 12% Fines | GM | Silty gravel with or without sand |
| | | | GC | Clayey gravel with or without sand |
| | Sands - 50% or More of Coarse Fraction Passes No. 4 Sieve | < 5% Fines | SW | Well-graded sand with or without gravel, little to no fines |
| | | | SP | Poorly graded sand with or without gravel, little to no fines |
| | | > 12% Fines | SM | Silty sand with or without gravel |
| | | | SC | Clayey sand with or without gravel |
| Fine-Grained Soils - 50% or More Passes No. 200 Sieve | Silts and Clays Liquid Limit Less Than 50 | | ML | Silt with or without sand or gravel; sandy or gravelly silt |
| | | | CL | Clay of low to medium plasticity; lean clay with or without sand or gravel; sandy or gravelly lean clay |
| | | | OL | Organic clay or silt of low plasticity |
| | Silts and Clays Liquid Limit 50 or More | | MH | Elastic silt with or without sand or gravel; sandy or gravelly elastic silt |
| | | | CH | Clay of high plasticity; fat clay with or without sand or gravel; sandy or gravelly fat clay |
| | | | OH | Organic clay or silt of medium to high plasticity |
| Highly Organic Soils | | | PT | Peat, muck, and other highly organic soils |
| Fill | | | FILL | Made Ground |

## Moisture Content

Dry - Absence of moisture, dusty, dry to the touch

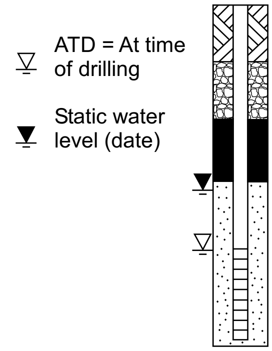
Damp - Perceptible moisture, likely below optimum MC

Moist - Damp but no visible water, likely at/near optimum MC

Wet - Water visible but not free draining, likely above optimum MC

Saturated/Water Bearing - Visible free water, typically below groundwater table

## Symbols




## Terms Describing Relative Density and Consistency

Coarse-Grained Soils:

| Density | SPT blows/foot |
|---|---|
| Very Loose | < 4 |
| Loose | 4 to 9 |
| Medium Dense | 10 to 29 |
| Dense | 30 to 49 |
| Very Dense | ≥ 50 |

Fine-Grained Soils:

| Consistency | SPT blows/foot |
|---|---|
| Very Soft | < 2 |
| Soft | 2 to 3 |
| Medium Stiff | 4 to 7 |
| Stiff | 8 to 14 |
| Very Stiff | 15 to 29 |
| Hard | ≥ 30 |

Test Symbols & Units

Fines = Fines Content (%)

MC = Moisture Content (%)

DD = Dry Density (pcf)

Str = Shear Strength (tsf)

PID = Photoionization Detector (ppm)

OC = Organic Content (%)

CEC = Cation Exchange Capacity (meq/100 g)

LL = Liquid Limit (%)

PL = Plastic Limit (%)

PI = Plasticity Index (%)

## Component Definitions

| Descriptive Term | Size Range and Sieve Number |
|---|---|
| Boulders | Larger than 12" |
| Cobbles | 3" to 12" |
| Gravel | 3" to No. 4 (4.75 mm) |
| Coarse Gravel | 3" to 3/4" |
| Fine Gravel | 3/4" to No. 4 (4.75 mm) |
| Sand | No. 4 (4.75 mm) to No. 200 (0.075 mm) |
| Coarse Sand | No. 4 (4.75 mm) to No. 10 (2.00 mm) |
| Medium Sand | No. 10 (2.00 mm) to No. 40 (0.425 mm) |
| Fine Sand | No. 40 (0.425 mm) to No. 200 (0.075 mm) |
| Silt and Clay | Smaller than No. 200 (0.075 mm) |

## Modifier Definitions

| Percentage by Weight (Approx.) | Modifier |
|---|---|
| < 5 | Trace (sand, silt, clay, gravel) |
| 5 to 14 | Slightly (sandy, silty, clayey, gravelly) |
| 15 to 29 | Sandy, silty, clayey, gravelly |
| ≥ 30 | Very (sandy, silty, clayey, gravelly) |

Classifications of soils in this geotechnical report and as shown on the exploration logs are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates, and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D2487 and D2488 were used as an identification guide for the Unified Soil Classification System.



# EXPLORATION LOG KEY

# BORING NUMBER HA-101



**PROJECT NUMBER** ES-9607.02
**PROJECT NAME** Cheshire Property
**DATE STARTED** 6/4/25 **COMPLETED** 6/4/25
**GROUND ELEVATION**
**DRILLING CONTRACTOR** ESNW Rep
**LATITUDE** 47.53453 **LONGITUDE** -122.21661
**LOGGED BY** JMN **CHECKED BY** SSR
**GROUND WATER LEVEL:**
**NOTES**
**AT TIME OF DRILLING**
**SURFACE CONDITIONS** Field grass & underbrush
**AFTER DRILLING**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | TPSL | 0.5 | Dark brown TOPSOIL with thin roots and gravel |
| | | SM | | Brown silty SAND with gravel, medium dense, moist<br>-probed 4"<br>-becomes dense<br>-probed 2" |
| 2.5 | | | 3.0 | |

Hand auger boring terminated at 3.0 feet below existing grade due to refusal on significant gravel content of soil. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

# BORING NUMBER HA-102



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**PROJECT NUMBER** ES-9607.02
**PROJECT NAME** Cheshire Property
**DATE STARTED** 6/4/25 **COMPLETED** 6/4/25
**GROUND ELEVATION**
**DRILLING CONTRACTOR** ESNW Rep
**LATITUDE** 47.53461 **LONGITUDE** -122.21725
**LOGGED BY** JMN **CHECKED BY** SSR
**GROUND WATER LEVEL:**
**NOTES**
▽ **AT TIME OF DRILLING**
**SURFACE CONDITIONS** Forest floor
**AFTER DRILLING**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | TPSL | 0.5 | Dark brown TOPSOIL with roots to 1.5' |
| | | SP-SM | | Tan poorly graded SAND with silt and gravel, loose, damp<br>-becomes gray, medium dense |
| 2.5 | | | 3.0 | |
| | | SM | 3.5 | Gray silty SAND, medium dense, moist<br>-mottled texture |

Hand auger boring terminated at 3.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9607-2.GPJ - GINT US.GDT - 8/6/25

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# BORING NUMBER HA-1



**PROJECT NUMBER** ES-9607.02
**PROJECT NAME** Cheshire Property
**DATE STARTED** 5/13/25 **COMPLETED** 5/13/25
**GROUND ELEVATION**
**DRILLING CONTRACTOR** ESNW Rep
**LATITUDE** 47.53450 **LONGITUDE** -122.21680
**LOGGED BY** JMN **CHECKED BY** SSR
**GROUND WATER LEVEL:**
**NOTES**
∇ **AT TIME OF DRILLING**
**SURFACE CONDITIONS** Forest floor
**AFTER DRILLING**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | TPSL | | Dark brown TOPSOIL with roots and gravel |
| | | | 1.0 | |
| | | SM | | Gray silty SAND with gravel, medium dense, moist<br>-mottled, probed 6"<br>-becomes wet, light groundwater seepage |
| 2.5 | | | | -increased gravel content, probed 6"<br>-probed 4" |
| | | | 3.0 | |

Hand auger boring terminated at 3.0 feet below existing grade due to refusal on gravel. Groundwater seepage encountered at 2.0 feet during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

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# BORING NUMBER HA-2



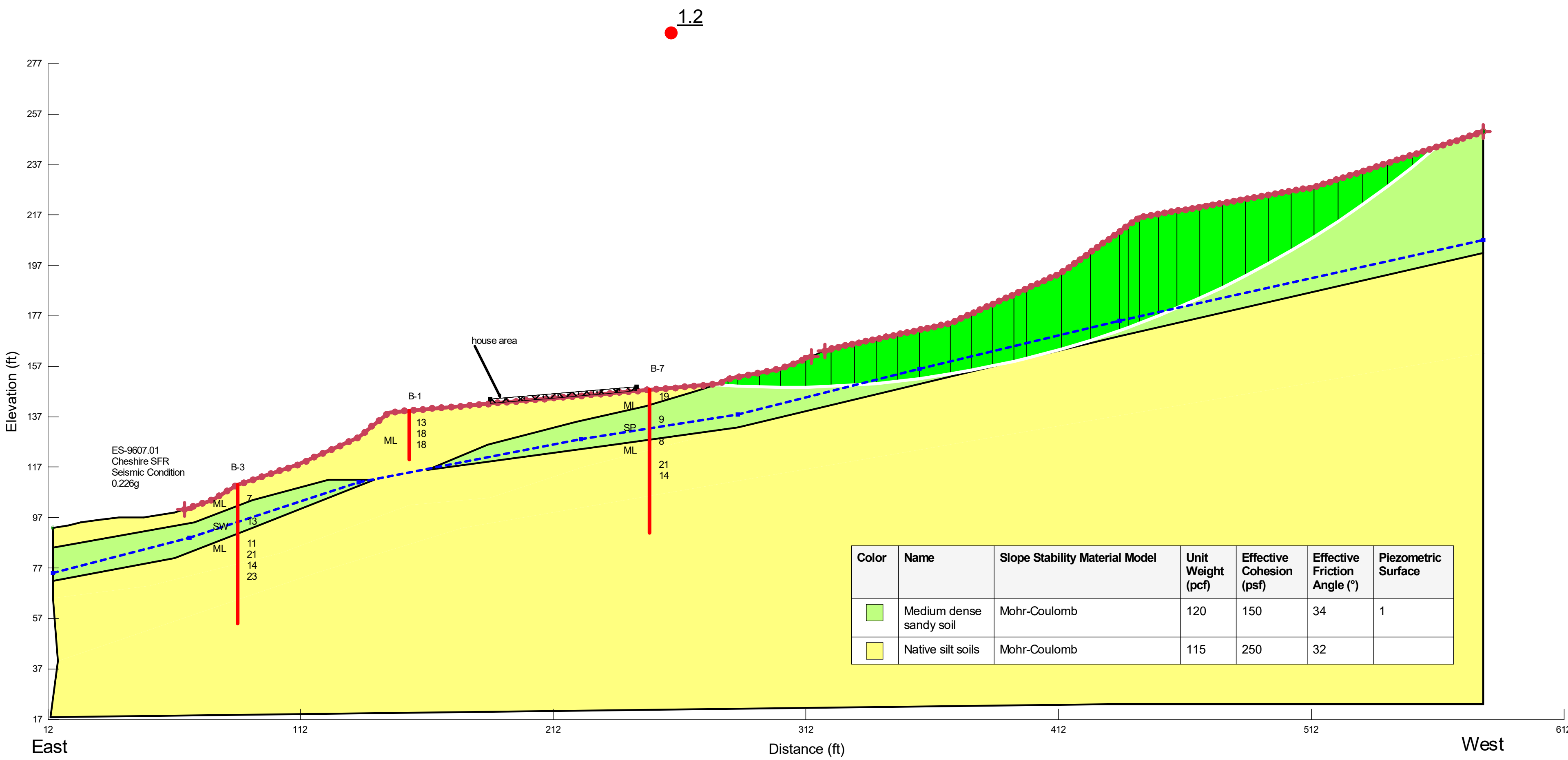
**PROJECT NUMBER** ES-9607.02
**PROJECT NAME** Cheshire Property
**DATE STARTED** 5/13/25 **COMPLETED** 5/13/25
**GROUND ELEVATION**
**DRILLING CONTRACTOR** ESNW Rep
**LATITUDE** 47.53463 **LONGITUDE** -122.21695
**LOGGED BY** JMN **CHECKED BY** SSR
**GROUND WATER LEVEL:**
**NOTES**
**AT TIME OF DRILLING**
**SURFACE CONDITIONS** Forest floor
**AFTER DRILLING**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | TPSL | | 0.9 | Dark brown TOPSOIL with roots |
| 2.5 | | SM | | 3.5 | Brown silty SAND with gravel, medium dense, moist<br>-probed 8"<br>-becomes gray, wet, mottled, probed 6"<br>-increased silt content<br>-probed 6" |

Hand auger boring terminated at 3.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

LIMITATIONS: Ground elevation (if listed) is approximate; the test location was not surveyed. Coordinates are approximate and based on the WGS84 datum. Do not rely on this test log as a standalone document. Refer to the text of the geotechnical report for a complete understanding of subsurface conditions.

GENERAL BH / TP / WELL - 9607-2.GPJ - GINT US.GDT - 8/6/25




| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) | Piezometric Surface |
|---|---|---|---|---|---|---|
| | Medium dense sandy soil | Mohr-Coulomb | 120 | 150 | 34 | 1 |
| | Native silt soils | Mohr-Coulomb | 115 | 250 | 32 | |

EARTH SOLUTIONS NW

Name: Brian C. Snow, L.G.
Date: July 29, 2025
Project Number: ES-9607.02
Project Name: Cheshire Property
Scale: N/A

# $K_s$ Calculations – West Slope

## Equations:

$K_s = r \times \alpha \times PGA_m$

$\alpha = 1 + 0.01H(0.5\beta - 1)$

$\beta = \frac{S_{m1}}{PGA_m}$

## Given Variables:

$r = 0.5$ (ductile system)

$PGA_m = 0.685$ (Site Class D)

$H = 100$ ft

$S_{m1} = 0.903$*

* Per ASCE Table 11.4-2 Linear Interpolation

## Solve for $\beta$

$\beta = \frac{0.903}{0.685} = 1.318$

## Solve for $\alpha$

$\alpha = 1 + 1(0.659 - 1)$

$\alpha = 1 + (-0.341)$

$\alpha = 0.659$

## Solve for $K_s$

$K_s = 0.5 \times 0.659 \times 0.685$

$K_s = 0.226$

# Seismic



## File Information

File Version: 11.08
Product Version: 25.1.0.1058
Title: Cheshire SFR ES-9607.01
Created By: Scott Riegel
Last Edited By: Brian Snow
Revision Number: 99
Date: 08/06/2025
Time: 08:43:12 AM
File Name: BCS seismic west slope draft 7.29.25.gsz
Directory: C:\Users\Brian.snow\Desktop\Desktop Working\9607.02 - (SLOPE) Cheshire Property\
Last Solved Date: 08/06/2025
Last Solved Time: 08:43:20 AM

## Project Settings

Unit System: U.S. Customary Units

## Analysis Settings

### Seismic

- Kind: SLOPE/W
- Analysis Type: Limit Equilibrium
- Settings
  - Method: Morgenstern-Price
  - Side Function Settings
    - Side Function: Half-Sine
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Staged Rapid Drawdown Analysis: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Slip Surface Settings
    - Search Method: Entry and Exit
    - Specify Radius Tangent Lines: No
    - Direction of Movement: Right to Left
    - Use Passive Mode: No
    - No. of Critical Slip Surfaces to Store: 1
  - Geometry Settings
    - Minimum Slip Surface Depth: 3 ft
    - Number of Columns: 30
  - Tension Crack Option: (none)
- Optimization
  - Optimize Critical Slip Surface: No
- Convergence
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable Difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Maximum Absolute Lambda: 2

## Materials

### Native silt soils

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 250 psf
Effective Friction Angle: 32 °
Phi-B: 0 °

### Medium dense sandy soil

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 150 psf

Effective Friction Angle: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

## Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (66, 100.33333) ft
Left-Zone Right Coordinate: (314, 160.8) ft
Left-Zone Increment: 70
Right Type: Range
Right-Zone Left Coordinate: (319.5, 163) ft
Right-Zone Right Coordinate: (580, 250) ft
Right-Zone Increment: 100
Radius Increments: 4

## Slip Surface Limits

Left Coordinate: (14, 93) ft
Right Coordinate: (580, 250) ft

## Piezometric Surfaces

### Piezometric Surface 1

#### Coordinates

| | X | Y |
|---|---|---|
| Coordinate 1 | 14 ft | 75 ft |
| Coordinate 2 | 68 ft | 89 ft |
| Coordinate 3 | 135 ft | 111 ft |
| Coordinate 4 | 223 ft | 128 ft |
| Coordinate 5 | 285 ft | 138 ft |
| Coordinate 6 | 357 ft | 156 ft |
| Coordinate 7 | 436 ft | 175 ft |
| Coordinate 8 | 580 ft | 207 ft |

## Seismic Coefficients

Horz Seismic Coef.: 0.226

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 125 pcf
Direction: Vertical

#### Coordinates

| | X | Y |
|---|---|---|
| | 187 ft | 144 ft |
| | 245 ft | 149 ft |

## Geometry

Name: Seismic

### Settings

View: 2D
Element Thickness: 1 ft

### Points

| | X | Y |
|---|---|---|
| Point 1 | 87 ft | 110 ft |
| Point 2 | 25 ft | 95 ft |
| Point 3 | 14 ft | 93 ft |
| Point 4 | 16 ft | 40 ft |
| Point 5 | 118 ft | 75 ft |
| Point 6 | 176 ft | 93 ft |
| Point 7 | 433 ft | 137 ft |

| | | |
|---|---|---|
| Point 8 | 13 ft | 18 ft |
| Point 9 | 432 ft | 23 ft |
| Point 10 | 71 ft | 59 ft |
| Point 11 | 436 ft | 169 ft |
| Point 12 | 187 ft | 105 ft |
| Point 13 | 155.05084 ft | 101.94916 ft |
| Point 14 | 104 ft | 83 ft |
| Point 15 | 14 ft | 65 ft |
| Point 16 | 77 ft | 104 ft |
| Point 17 | 62 ft | 99 ft |
| Point 18 | 50 ft | 97 ft |
| Point 19 | 40 ft | 97 ft |
| Point 20 | 32 ft | 96 ft |
| Point 21 | 20 ft | 94 ft |
| Point 22 | 111 ft | 118 ft |
| Point 23 | 224 ft | 117 ft |
| Point 24 | 52 ft | 70 ft |
| Point 25 | 277.42857 ft | 150 ft |
| Point 26 | 147 ft | 138.74483 ft |
| Point 27 | 135 ft | 128.89655 ft |
| Point 28 | 106 ft | 116.33333 ft |
| Point 29 | 155 ft | 139.43518 ft |
| Point 30 | 169 ft | 140.64329 ft |
| Point 31 | 190 ft | 142.45546 ft |
| Point 32 | 211 ft | 144.26763 ft |
| Point 33 | 225 ft | 145.47574 ft |
| Point 34 | 234 ft | 146.25238 ft |
| Point 35 | 241 ft | 146.85644 ft |
| Point 36 | 250 ft | 147.63308 ft |
| Point 37 | 264 ft | 148.8412 ft |
| Point 38 | 248 ft | 141 ft |
| Point 39 | 221 ft | 135 ft |
| Point 40 | 186 ft | 126 ft |
| Point 41 | 162 ft | 116 ft |
| Point 42 | 236 ft | 126 ft |
| Point 43 | 285 ft | 132.74194 ft |
| Point 44 | 123 ft | 112 ft |
| Point 45 | 93 ft | 104 ft |
| Point 46 | 70 ft | 95 ft |
| Point 47 | 14 ft | 85 ft |
| Point 48 | 14 ft | 72 ft |
| Point 49 | 62 ft | 81 ft |
| Point 50 | 93 ft | 93 ft |
| Point 51 | 141 ft | 112 ft |
| Point 52 | 267 ft | 146.81068 ft |
| Point 53 | 270.88889 ft | 148 ft |
| Point 54 | 281 ft | 152 ft |
| Point 55 | 266 ft | 142 ft |
| Point 56 | 302 ft | 156 ft |
| Point 57 | 322 ft | 164 ft |
| Point 58 | 369 ft | 174 ft |
| Point 59 | 413 ft | 194 ft |
| Point 60 | 444 ft | 216 ft |
| Point 61 | 513 ft | 228 ft |
| Point 62 | 580 ft | 250 ft |
| Point 63 | 580 ft | 23 ft |
| Point 64 | 439.58071 ft | 212.86373 ft |
| Point 65 | 580 ft | 202 ft |
| Point 66 | 580 ft | 162 ft |

## Regions

| | Material | Points | Area |
|---|---|---|---|
| Region 1 | Native silt soils | 37,36,35,34,33,32,31,30,29,26,27,22,28,1,16,17,18,19,20,2,21,3,47,46,45,44,51,50,49,48,15,24,14,13,12,23,43,42,41,40,39,38,52,53,25 | 5,571.8 ft² |
| Region 2 | Native silt soils | 6,5,10,4,8,9,63,66,7 | 50,368 ft² |
| Region 3 | Native silt soils | 43,23,12,13,14,24,15,4,10,5,6,7,66,65,11 | 13,407 ft² |
| Region 4 | Medium dense | 59,58,57,56,54,25,53,52,38,39,40,41,42,43,11,65,62,61,60,64 | 11,391 ft² |

| | | | |
|---|---|---|---|
| | sandy soil | | |
| Region 5 | Medium dense sandy soil | 44,45,46,47,48,49,50,51 | 1,295.5 ft² |

## Slip Results

Slip Surfaces Analysed: 28640 of 35855 converged

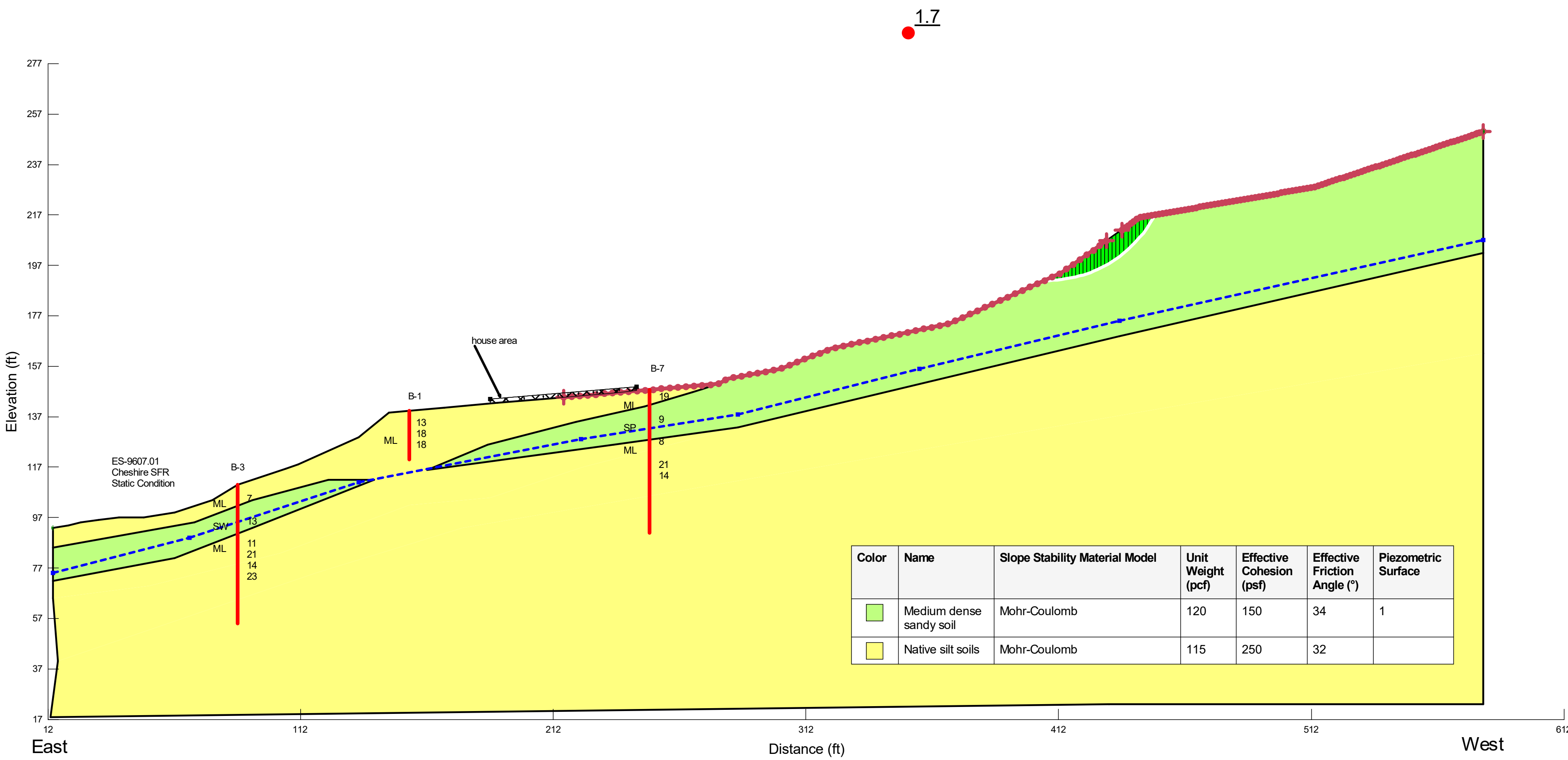
## Current Slip Surface

Slip Surface: 30,262
Factor of Safety: 1.2
Volume: 6,171.56 ft³
Weight: 740,585.85 lbf
Resisting Moment: 1.8636969e+08 lbf·ft
Activating Moment: 1.5155315e+08 lbf·ft
Resisting Force: 444,351.23 lbf
Activating Force: 361,462.21 lbf
Slip Rank: 1 of 35,855 slip surfaces
Exit: (561.53481, 243.9368) ft
Entry: (275.01567, 149.79178) ft
Radius: 393.6943 ft
Center: (304.75108, 542.36153) ft

### Slip Columns

| | X | Y | PWP | Base Normal Stress | Frictional Strength | Cohesive Strength | Suction Strength | Column Base Material |
|---|---|---|---|---|---|---|---|---|
| Column 1 | 556.68133 ft | 239.89425 ft | -2,375.9537 psf | 132.81577 psf | 89.585368 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 2 | 546.97437 ft | 232.06301 ft | -2,021.8874 psf | 512.40798 psf | 345.62355 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 3 | 537.26741 ft | 224.72151 ft | -1,698.3809 psf | 843.4225 psf | 568.89566 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 4 | 527.56044 ft | 217.83645 ft | -1,403.3562 psf | 1,135.1082 psf | 765.64017 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 5 | 517.85348 ft | 211.37928 ft | -1,135.0324 psf | 1,395.3686 psf | 941.18802 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 6 | 508.48705 ft | 205.52472 ft | -899.5886 psf | 1,680.1557 psf | 1,133.2793 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 7 | 499.46115 ft | 200.22672 ft | -694.15287 psf | 1,996.9422 psf | 1,346.9546 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 8 | 490.43526 ft | 195.24427 ft | -508.40675 psf | 2,303.2876 psf | 1,553.5871 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 9 | 481.40936 ft | 190.56393 ft | -341.51275 psf | 2,603.8868 psf | 1,756.3438 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 10 | 472.38346 ft | 186.17379 ft | -192.72694 psf | 2,902.6512 psf | 1,957.8629 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 11 | 463.35757 ft | 182.06322 ft | -61.386762 psf | 3,202.5996 psf | 2,160.1807 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 12 | 455.13346 ft | 178.54260 ft | 44.259227 psf | 3,475.6712 psf | 2,314.5166 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 13 | 447.71115 ft | 175.56219 ft | 127.31389 psf | 3,717.3517 psf | 2,421.5111 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 14 | 441.79035 ft | 173.29530 ft | 186.66631 psf | 3,799.4806 psf | 2,436.874 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 15 | 437.79035 ft | 171.83200 ft | 222.50963 psf | 3,723.9752 psf | 2,361.7683 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 16 | 430.25000 ft | 169.25508 ft | 272.18907 psf | 3,564.4829 psf | 2,220.6802 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 17 | 418.75000 ft | 165.58128 ft | 328.8473 psf | 3,286.1659 psf | 1,994.7366 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 18 | 406.03721 ft | 161.98750 ft | 362.31068 psf | 3,095.3809 psf | 1,843.4792 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 19 | 396.67016 ft | 159.55613 ft | 373.4509 psf | 3,035.5213 psf | 1,795.5891 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 20 | 390.05491 ft | 158.04415 ft | 368.52006 psf | 2,963.9351 psf | 1,750.6296 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 21 | 381.63295 ft | 156.27094 ft | 352.77474 psf | 2,843.1585 psf | 1,679.7851 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 22 | 373.21098 ft | 154.68878 ft | 325.10776 psf | 2,682.3148 psf | 1,589.9562 psf | 150 psf | 0 psf | Medium dense sandy soil |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Column 23 | 363.00000 ft | 153.04744 ft | 274.2852 psf | 2,599.6103 psf | 1,568.4516 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 24 | 352.70609 ft | 151.62274 ft | 206.15614 psf | 2,586.246 psf | 1,605.3909 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 25 | 344.11827 ft | 150.66419 ft | 131.99922 psf | 2,522.6595 psf | 1,612.5207 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 26 | 335.53045 ft | 149.89589 ft | 45.971643 psf | 2,410.6517 psf | 1,594.9969 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 27 | 326.61827 ft | 149.30220 ft | -56.012577 psf | 2,233.298 psf | 1,506.3785 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 28 | 317.00000 ft | 148.88962 ft | -180.31249 psf | 1,862.3403 psf | 1,256.1644 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 29 | 307.00000 ft | 148.70541 ft | -324.81739 psf | 1,319.6144 psf | 890.09116 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 30 | 297.75000 ft | 148.75244 ft | -472.05205 psf | 906.22754 psf | 611.25819 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 31 | 289.25000 ft | 148.99551 ft | -619.81967 psf | 630.95918 psf | 425.58734 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 32 | 283.00000 ft | 149.27365 ft | -723.60491 psf | 420.89216 psf | 283.89534 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 33 | 279.21429 ft | 149.50039 ft | -775.85506 psf | 207.05135 psf | 139.6579 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 34 | 276.91950 ft | 149.65255 ft | -808.44535 psf | 51.040722 psf | 34.427402 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 35 | 275.71305 ft | 149.74020 ft | 0 psf | 31.170107 psf | 19.477245 psf | 250 psf | 0 psf | Native silt soils |




| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) | Piezometric Surface |
|---|---|---|---|---|---|---|
| (green) | Medium dense sandy soil | Mohr-Coulomb | 120 | 150 | 34 | 1 |
| (yellow) | Native silt soils | Mohr-Coulomb | 115 | 250 | 32 | |

# Static



## File Information

- File Version: 11.08
- Product Version: 25.1.0.1058
- Title: Cheshire SFR ES-9607.01
- Created By: Scott Riegel
- Last Edited By: Brian Snow
- Revision Number: 99
- Date: 08/06/2025
- Time: 08:43:12 AM
- File Name: BCS seismic west slope draft 7.29.25.gsz
- Directory: C:\Users\Brian.snow\Desktop\Desktop Working\9607.02 - (SLOPE) Cheshire Property\
- Last Solved Date: 08/06/2025
- Last Solved Time: 08:43:26 AM

## Project Settings

- Unit System: U.S. Customary Units

## Analysis Settings

### Static

- Kind: SLOPE/W
- Analysis Type: Limit Equilibrium
- Settings
  - Method: Morgenstern-Price
  - Side Function Settings
    - Side Function: Half-Sine
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Staged Rapid Drawdown Analysis: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Slip Surface Settings
    - Search Method: Entry and Exit
    - Specify Radius Tangent Lines: No
    - Direction of Movement: Right to Left
    - Use Passive Mode: No
    - No. of Critical Slip Surfaces to Store: 1
  - Geometry Settings
    - Minimum Slip Surface Depth: 3 ft
    - Number of Columns: 30
  - Tension Crack Option: (none)
- Optimization
  - Optimize Critical Slip Surface: No
- Convergence
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable Difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Maximum Absolute Lambda: 2

## Materials

### Native silt soils

- Slope Stability Material Model: Mohr-Coulomb
- Unit Weight: 115 pcf
- Effective Cohesion: 250 psf
- Effective Friction Angle: 32 °
- Phi-B: 0 °

### Medium dense sandy soil

- Slope Stability Material Model: Mohr-Coulomb
- Unit Weight: 120 pcf
- Effective Cohesion: 150 psf

Effective Friction Angle: 34 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

## Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (216, 144.6991) ft
Left-Zone Right Coordinate: (431, 206.77419) ft
Left-Zone Increment: 70
Right Type: Range
Right-Zone Left Coordinate: (436.95455, 211) ft
Right-Zone Right Coordinate: (580, 250) ft
Right-Zone Increment: 100
Radius Increments: 4

## Slip Surface Limits

Left Coordinate: (14, 93) ft
Right Coordinate: (580, 250) ft

## Piezometric Surfaces

### Piezometric Surface 1

#### Coordinates

| | X | Y |
|---|---|---|
| Coordinate 1 | 14 ft | 75 ft |
| Coordinate 2 | 68 ft | 89 ft |
| Coordinate 3 | 135 ft | 111 ft |
| Coordinate 4 | 223 ft | 128 ft |
| Coordinate 5 | 285 ft | 138 ft |
| Coordinate 6 | 357 ft | 156 ft |
| Coordinate 7 | 436 ft | 175 ft |
| Coordinate 8 | 580 ft | 207 ft |

## Seismic Coefficients

Horz Seismic Coef.: 0

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 125 pcf
Direction: Vertical

#### Coordinates

| | X | Y |
|---|---|---|
| | 187 ft | 144 ft |
| | 245 ft | 149 ft |

## Geometry

Name: Static

### Settings

View: 2D
Element Thickness: 1 ft

### Points

| | X | Y |
|---|---|---|
| Point 1 | 87 ft | 110 ft |
| Point 2 | 25 ft | 95 ft |
| Point 3 | 14 ft | 93 ft |
| Point 4 | 16 ft | 40 ft |
| Point 5 | 118 ft | 75 ft |
| Point 6 | 176 ft | 93 ft |
| Point 7 | 433 ft | 137 ft |

| | | |
|---|---|---|
| Point 8 | 13 ft | 18 ft |
| Point 9 | 432 ft | 23 ft |
| Point 10 | 71 ft | 59 ft |
| Point 11 | 436 ft | 169 ft |
| Point 12 | 187 ft | 105 ft |
| Point 13 | 155.05084 ft | 101.94916 ft |
| Point 14 | 104 ft | 83 ft |
| Point 15 | 14 ft | 65 ft |
| Point 16 | 77 ft | 104 ft |
| Point 17 | 62 ft | 99 ft |
| Point 18 | 50 ft | 97 ft |
| Point 19 | 40 ft | 97 ft |
| Point 20 | 32 ft | 96 ft |
| Point 21 | 20 ft | 94 ft |
| Point 22 | 111 ft | 118 ft |
| Point 23 | 224 ft | 117 ft |
| Point 24 | 52 ft | 70 ft |
| Point 25 | 277.42857 ft | 150 ft |
| Point 26 | 147 ft | 138.74483 ft |
| Point 27 | 135 ft | 128.89655 ft |
| Point 28 | 106 ft | 116.33333 ft |
| Point 29 | 155 ft | 139.43518 ft |
| Point 30 | 169 ft | 140.64329 ft |
| Point 31 | 190 ft | 142.45546 ft |
| Point 32 | 211 ft | 144.26763 ft |
| Point 33 | 225 ft | 145.47574 ft |
| Point 34 | 234 ft | 146.25238 ft |
| Point 35 | 241 ft | 146.85644 ft |
| Point 36 | 250 ft | 147.63308 ft |
| Point 37 | 264 ft | 148.8412 ft |
| Point 38 | 248 ft | 141 ft |
| Point 39 | 221 ft | 135 ft |
| Point 40 | 186 ft | 126 ft |
| Point 41 | 162 ft | 116 ft |
| Point 42 | 236 ft | 126 ft |
| Point 43 | 285 ft | 132.74194 ft |
| Point 44 | 123 ft | 112 ft |
| Point 45 | 93 ft | 104 ft |
| Point 46 | 70 ft | 95 ft |
| Point 47 | 14 ft | 85 ft |
| Point 48 | 14 ft | 72 ft |
| Point 49 | 62 ft | 81 ft |
| Point 50 | 93 ft | 93 ft |
| Point 51 | 141 ft | 112 ft |
| Point 52 | 267 ft | 146.81068 ft |
| Point 53 | 270.88889 ft | 148 ft |
| Point 54 | 281 ft | 152 ft |
| Point 55 | 266 ft | 142 ft |
| Point 56 | 302 ft | 156 ft |
| Point 57 | 322 ft | 164 ft |
| Point 58 | 369 ft | 174 ft |
| Point 59 | 413 ft | 194 ft |
| Point 60 | 444 ft | 216 ft |
| Point 61 | 513 ft | 228 ft |
| Point 62 | 580 ft | 250 ft |
| Point 63 | 580 ft | 23 ft |
| Point 64 | 439.58071 ft | 212.86373 ft |
| Point 65 | 580 ft | 202 ft |
| Point 66 | 580 ft | 162 ft |

## Regions

| | Material | Points | Area |
|---|---|---|---|
| Region 1 | Native silt soils | 37,36,35,34,33,32,31,30,29,26,27,22,28,1,16,17,18,19,20,2,21,3,47,46,45,44,51,50,49,48,15,24,14,13,12,23,43,42,41,40,39,38,52,53,25 | 5,571.8 ft² |
| Region 2 | Native silt soils | 6,5,10,4,8,9,63,66,7 | 50,368 ft² |
| Region 3 | Native silt soils | 43,23,12,13,14,24,15,4,10,5,6,7,66,65,11 | 13,407 ft² |
| Region 4 | Medium dense | 59,58,57,56,54,25,53,52,38,39,40,41,42,43,11,65,62,61,60,64 | 11,391 ft² |

| | | | |
|---|---|---|---|
| | sandy soil | | |
| Region 5 | Medium dense sandy soil | 44,45,46,47,48,49,50,51 | 1,295.5 ft² |

## Slip Results

Slip Surfaces Analysed: 34760 of 35855 converged

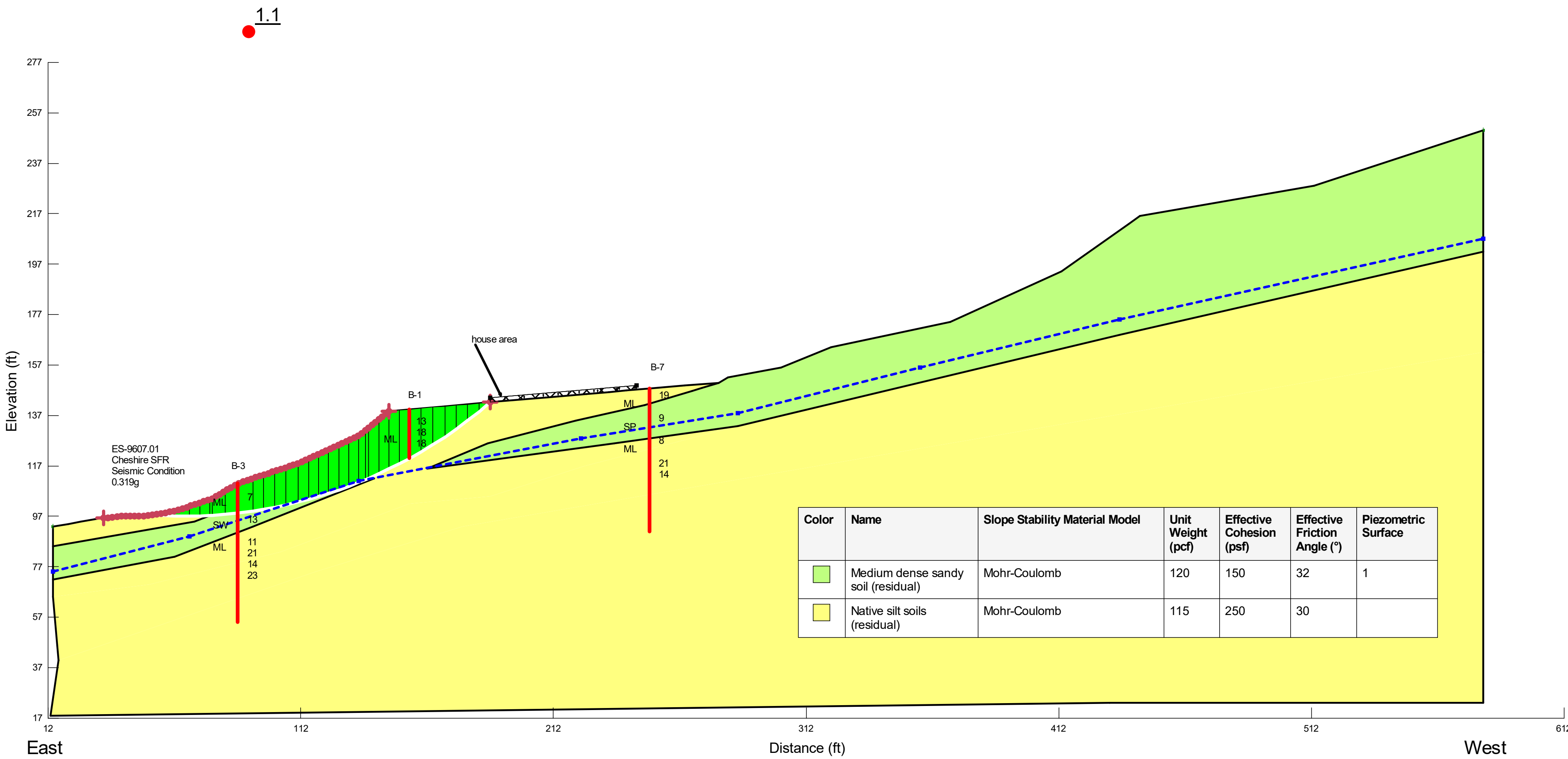
## Current Slip Surface

Slip Surface: 30,858
Factor of Safety: 1.7
Volume: 279.68942 ft³
Weight: 33,562.731 lbf
Resisting Moment: 1,370,532.6 lbf·ft
Activating Moment: 808,505.59 lbf·ft
Resisting Force: 23,856.078 lbf
Activating Force: 14,076.504 lbf
Slip Rank: 1 of 35,855 slip surfaces
Exit: (450.18723, 217.07604) ft
Entry: (406.50945, 191.04975) ft
Radius: 48.352468 ft
Center: (407.29449, 239.39584) ft

### Slip Columns

| | X | Y | PWP | Base Normal Stress | Frictional Strength | Cohesive Strength | Suction Strength | Column Base Material |
|---|---|---|---|---|---|---|---|---|
| Column 1 | 449.41383 ft | 215.70124 ft | -2,353.7525 psf | -1.2899824 psf | -0.87010414 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 2 | 447.86702 ft | 213.13170 ft | -2,214.8621 psf | 173.06935 psf | 116.73675 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 3 | 446.32021 ft | 210.87856 ft | -2,095.7149 psf | 320.91634 psf | 216.46081 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 4 | 444.77340 ft | 208.87057 ft | -1,991.8658 psf | 451.3074 psf | 304.41069 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 5 | 443.26345 ft | 207.10065 ft | -1,902.3608 psf | 539.59551 psf | 363.96177 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 6 | 441.79035 ft | 205.53006 ft | -1,824.7831 psf | 589.12648 psf | 397.37083 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 7 | 440.31726 ft | 204.09088 ft | -1,755.4047 psf | 633.5774 psf | 427.35335 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 8 | 438.68553 ft | 202.63747 ft | -1,687.3389 psf | 678.02119 psf | 457.33106 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 9 | 436.89518 ft | 201.17964 ft | -1,621.1963 psf | 723.23213 psf | 487.82623 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 10 | 435.28125 ft | 199.97598 ft | -1,569.2881 psf | 761.22976 psf | 513.45596 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 11 | 433.84375 ft | 198.99339 ft | -1,529.5477 psf | 792.14591 psf | 534.30916 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 12 | 432.40625 ft | 198.08418 ft | -1,494.3867 psf | 820.30908 psf | 553.30546 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 13 | 430.96875 ft | 197.24361 ft | -1,463.5081 psf | 845.09178 psf | 570.0216 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 14 | 429.53125 ft | 196.46762 ft | -1,436.6599 psf | 865.59723 psf | 583.8527 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 15 | 428.09375 ft | 195.75277 ft | -1,413.6266 psf | 880.67444 psf | 594.02241 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 16 | 426.65625 ft | 195.09609 ft | -1,394.2233 psf | 888.94822 psf | 599.60315 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 17 | 425.21875 ft | 194.49503 ft | -1,378.2905 psf | 888.87187 psf | 599.55165 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 18 | 423.78125 ft | 193.94738 ft | -1,365.6903 psf | 878.80908 psf | 592.76421 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 19 | 422.34375 ft | 193.45122 ft | -1,356.3033 psf | 857.14851 psf | 578.15397 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 20 | 420.90625 ft | 193.00490 ft | -1,350.0264 psf | 822.44878 psf | 554.74871 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 21 | 419.46875 ft | 192.60699 ft | -1,346.7704 psf | 773.60423 psf | 521.80264 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 22 | 418.03125 ft | 192.25627 ft | -1,346.4588 psf | 710.01261 psf | 478.90956 psf | 150 psf | 0 psf | Medium dense sandy soil |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Column 23 | 416.59375 ft | 191.95168 ft | -1,349.0261 psf | 631.71839 psf | 426.09943 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 24 | 415.15625 ft | 191.69235 ft | -1,354.4172 psf | 539.50161 psf | 363.89843 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 25 | 413.71875 ft | 191.47754 ft | -1,362.5863 psf | 434.8863 psf | 293.33451 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 26 | 412.18868 ft | 191.29862 ft | -1,374.3845 psf | 337.61944 psf | 227.72719 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 27 | 410.56604 ft | 191.16103 ft | -1,390.1511 psf | 248.79033 psf | 167.81119 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 28 | 408.94340 ft | 191.07832 ft | -1,409.3415 psf | 152.5434 psf | 102.89182 psf | 150 psf | 0 psf | Medium dense sandy soil |
| Column 29 | 407.32077 ft | 191.05019 ft | -1,431.9382 psf | 51.98783 psf | 35.066234 psf | 150 psf | 0 psf | Medium dense sandy soil |




| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) | Piezometric Surface |
|---|---|---|---|---|---|---|
| | Medium dense sandy soil (residual) | Mohr-Coulomb | 120 | 150 | 32 | 1 |
| | Native silt soils (residual) | Mohr-Coulomb | 115 | 250 | 30 | |

EARTH SOLUTIONS NW

Name: Brian C. Snow, L.G.
Date: July 29, 2025
Project Number: ES-9607.02
Project Name: Cheshire Property
Scale: N/A

# $K_s$ Calculations — East Slope

**Equations:**

$$K_s = r \times \alpha \times PGA_m$$

$$\alpha = 1 + 0.01H(0.5\beta - 1)$$

$$\beta = \frac{S_{m1}}{PGA_m}$$

**Given Variables:**

$r = 0.5$ (ductile system)

$PGA_m = 0.685$ (Site Class D)

$H = 20$ ft

$S_{m1} = 0.903$*

* Per ASCE Table 11.4-2 Linear Interpolation

**Solve for $\beta$**

$$\beta = \frac{0.903}{0.685} = 1.318$$

**Solve for $\alpha$**

$$\alpha = 1 + 0.2(0.659 - 1)$$

$$\alpha = 1 + 0.2(-0.341)$$

$$\alpha = 1 + (-0.068)$$

$$\alpha = 0.932$$

**Solve for $K_s$**

$$K_s = 0.5 \times 0.932 \times 0.685$$

$$K_s = 0.319$$

# Seismic



## File Information

File Version: 11.08
Product Version: 25.1.0.1058
Title: Cheshire SFR ES-9607.01
Created By: Scott Riegel
Last Edited By: Brian Snow
Revision Number: 112
Date: 08/06/2025
Time: 08:45:31 AM
File Name: BCS seismic east slope (residual) draft 7.29.25.gsz
Directory: C:\Users\Brian.snow\Desktop\Desktop Working\9607.02 - (SLOPE) Cheshire Property\
Last Solved Date: 08/06/2025
Last Solved Time: 08:45:31 AM

## Project Settings

Unit System: U.S. Customary Units

## Analysis Settings

### Seismic

- Kind: SLOPE/W
- Analysis Type: Limit Equilibrium
- Settings
  - Method: Morgenstern-Price
  - Side Function Settings
    - Side Function: Half-Sine
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Staged Rapid Drawdown Analysis: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Slip Surface Settings
    - Search Method: Entry and Exit
    - Specify Radius Tangent Lines: No
    - Direction of Movement: Right to Left
    - Use Passive Mode: No
    - No. of Critical Slip Surfaces to Store: 1
  - Geometry Settings
    - Minimum Slip Surface Depth: 3 ft
    - Number of Columns: 30
  - Tension Crack Option: (none)
- Optimization
  - Optimize Critical Slip Surface: No
- Convergence
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable Difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Maximum Absolute Lambda: 2

## Materials

### Native silt soils (residual)

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 250 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

### Medium dense sandy soil (residual)

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 150 psf
Effective Friction Angle: 32 °

Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

## Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (34, 96.25) ft
Left-Zone Right Coordinate: (147, 138.74483) ft
Left-Zone Increment: 70
Right Type: Point
Right Coordinate: (187, 142.19658) ft
Right-Zone Increment: 100
Radius Increments: 4

## Slip Surface Limits

Left Coordinate: (14, 93) ft
Right Coordinate: (580, 250) ft

## Piezometric Surfaces

### Piezometric Surface 1

#### Coordinates

| | X | Y |
|---|---|---|
| Coordinate 1 | 14 ft | 75 ft |
| Coordinate 2 | 68 ft | 89 ft |
| Coordinate 3 | 135 ft | 111 ft |
| Coordinate 4 | 223 ft | 128 ft |
| Coordinate 5 | 285 ft | 138 ft |
| Coordinate 6 | 357 ft | 156 ft |
| Coordinate 7 | 436 ft | 175 ft |
| Coordinate 8 | 580 ft | 207 ft |

## Seismic Coefficients

Horz Seismic Coef.: 0.319

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 125 pcf
Direction: Vertical

#### Coordinates

| | X | Y |
|---|---|---|
| | 187 ft | 144 ft |
| | 245 ft | 149 ft |

## Geometry

Name: Seismic

### Settings

View: 2D
Element Thickness: 1 ft

### Points

| | X | Y |
|---|---|---|
| Point 1 | 87 ft | 110 ft |
| Point 2 | 25 ft | 95 ft |
| Point 3 | 14 ft | 93 ft |
| Point 4 | 16 ft | 40 ft |
| Point 5 | 118 ft | 75 ft |
| Point 6 | 176 ft | 93 ft |
| Point 7 | 433 ft | 137 ft |
| Point 8 | 13 ft | 18 ft |
| Point 9 | 432 ft | 23 ft |

| | | |
|---|---|---|
| Point 10 | 71 ft | 59 ft |
| Point 11 | 436 ft | 169 ft |
| Point 12 | 187 ft | 105 ft |
| Point 13 | 155.05084 ft | 101.94916 ft |
| Point 14 | 104 ft | 83 ft |
| Point 15 | 14 ft | 65 ft |
| Point 16 | 77 ft | 104 ft |
| Point 17 | 62 ft | 99 ft |
| Point 18 | 50 ft | 97 ft |
| Point 19 | 40 ft | 97 ft |
| Point 20 | 32 ft | 96 ft |
| Point 21 | 20 ft | 94 ft |
| Point 22 | 111 ft | 118 ft |
| Point 23 | 224 ft | 117 ft |
| Point 24 | 52 ft | 70 ft |
| Point 25 | 277.42857 ft | 150 ft |
| Point 26 | 147 ft | 138.74483 ft |
| Point 27 | 135 ft | 128.89655 ft |
| Point 28 | 106 ft | 116.33333 ft |
| Point 29 | 155 ft | 139.43518 ft |
| Point 30 | 169 ft | 140.64329 ft |
| Point 31 | 190 ft | 142.45546 ft |
| Point 32 | 211 ft | 144.26763 ft |
| Point 33 | 225 ft | 145.47574 ft |
| Point 34 | 234 ft | 146.25238 ft |
| Point 35 | 241 ft | 146.85644 ft |
| Point 36 | 250 ft | 147.63308 ft |
| Point 37 | 264 ft | 148.8412 ft |
| Point 38 | 248 ft | 141 ft |
| Point 39 | 221 ft | 135 ft |
| Point 40 | 186 ft | 126 ft |
| Point 41 | 162 ft | 116 ft |
| Point 42 | 236 ft | 126 ft |
| Point 43 | 285 ft | 132.74194 ft |
| Point 44 | 123 ft | 112 ft |
| Point 45 | 93 ft | 104 ft |
| Point 46 | 70 ft | 95 ft |
| Point 47 | 14 ft | 85 ft |
| Point 48 | 14 ft | 72 ft |
| Point 49 | 62 ft | 81 ft |
| Point 50 | 93 ft | 93 ft |
| Point 51 | 141 ft | 112 ft |
| Point 52 | 267 ft | 146.81068 ft |
| Point 53 | 270.88889 ft | 148 ft |
| Point 54 | 281 ft | 152 ft |
| Point 55 | 266 ft | 142 ft |
| Point 56 | 302 ft | 156 ft |
| Point 57 | 322 ft | 164 ft |
| Point 58 | 369 ft | 174 ft |
| Point 59 | 413 ft | 194 ft |
| Point 60 | 444 ft | 216 ft |
| Point 61 | 513 ft | 228 ft |
| Point 62 | 580 ft | 250 ft |
| Point 63 | 580 ft | 23 ft |
| Point 64 | 439.58071 ft | 212.86373 ft |
| Point 65 | 580 ft | 202 ft |
| Point 66 | 580 ft | 162 ft |

## Regions

| | Material | Points | Area |
|---|---|---|---|
| Region 1 | Native silt soils (residual) | 37,36,35,34,33,32,31,30,29,26,27,22,28,1,16,17,18,19,20,2,21,3,47,46,45,44,51,50,49,48,15,24,14,13,12,23,43,42,41,40,39,38,52,53,25 | 5,571.8 ft² |
| Region 2 | Native silt soils (residual) | 6,5,10,4,8,9,63,66,7 | 50,368 ft² |
| Region 3 | Native silt soils (residual) | 43,23,12,13,14,24,15,4,10,5,6,7,66,65,11 | 13,407 ft² |
| Region 4 | Medium dense | 59,58,57,56,54,25,53,52,38,39,40,41,42,43,11,65,62,61,60,64 | 11,391 ft² |

| | sandy soil (residual) | | |
|---|---|---|---|
| Region 5 | Medium dense sandy soil (residual) | 44,45,46,47,48,49,50,51 | 1,295.5 ft² |

## Slip Results

Slip Surfaces Analysed: 342 of 355 converged

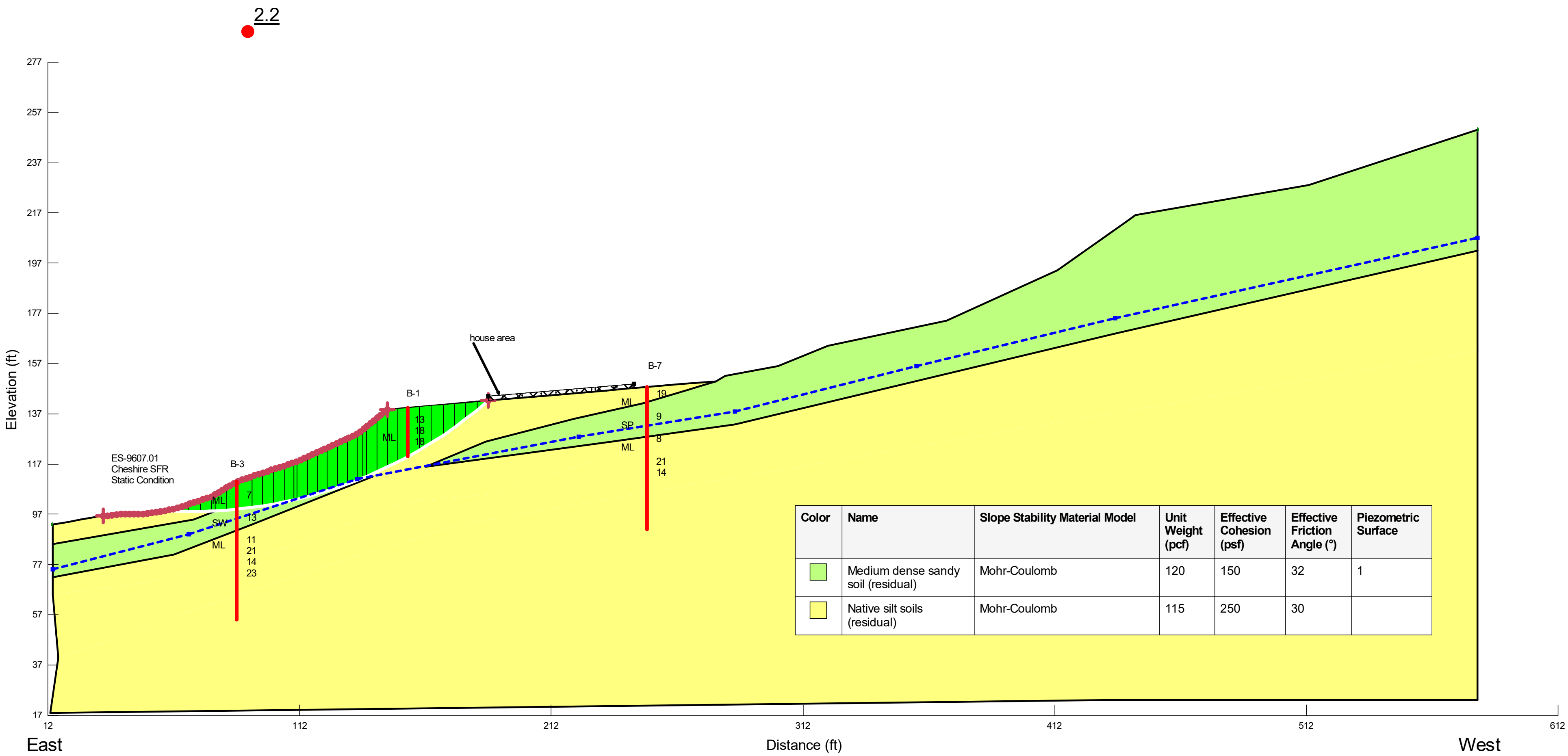
## Current Slip Surface

Slip Surface: 57
Factor of Safety: 1.1
Volume: 1,665.3195 ft³
Weight: 192,846.64 lbf
Resisting Moment: 24,070,334 lbf·ft
Activating Moment: 22,034,923 lbf·ft
Resisting Force: 121,609.51 lbf
Activating Force: 111,389.01 lbf
Slip Rank: 1 of 355 slip surfaces
Exit: (187, 142.19658) ft
Entry: (53.216355, 97.536059) ft
Radius: 184.96363 ft
Center: (65.963667, 282.05991) ft

### Slip Columns

| | X | Y | PWP | Base Normal Stress | Frictional Strength | Cohesive Strength | Suction Strength | Column Base Material |
|---|---|---|---|---|---|---|---|---|
| Column 1 | 184.75000 ft | 140.31107 ft | 0 psf | 10.654844 psf | 6.1515772 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 2 | 180.25000 ft | 136.65706 ft | 0 psf | 281.72348 psf | 162.65313 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 3 | 175.75000 ft | 133.22883 ft | 0 psf | 519.21134 psf | 299.76681 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 4 | 171.25000 ft | 130.01109 ft | 0 psf | 730.28042 psf | 421.62759 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 5 | 166.66667 ft | 126.93831 ft | 0 psf | 924.50571 psf | 533.76362 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 6 | 162.00000 ft | 124.00576 ft | 0 psf | 1,107.308 psf | 639.30458 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 7 | 157.33333 ft | 121.26213 ft | 0 psf | 1,280.627 psf | 739.37037 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 8 | 153.00000 ft | 118.86958 ft | 0 psf | 1,438.1698 psf | 830.32775 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 9 | 149.00000 ft | 116.79799 ft | 0 psf | 1,583.4977 psf | 914.23285 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 10 | 144.92603 ft | 114.81389 ft | 0 psf | 1,619.5415 psf | 935.0427 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 11 | 140.77808 ft | 112.91735 ft | 0 psf | 1,544.5673 psf | 891.75633 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 12 | 138.08650 ft | 111.73847 ft | -8.8743007 psf | 1,491.6608 psf | 932.09313 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 13 | 136.23445 ft | 110.96993 ft | 16.757189 psf | 1,456.6886 psf | 899.76899 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 14 | 133.00000 ft | 109.68511 ft | 41.069831 psf | 1,453.0232 psf | 882.28641 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 15 | 129.00000 ft | 108.18225 ft | 52.890257 psf | 1,496.6248 psf | 902.14547 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 16 | 125.00000 ft | 106.78355 ft | 58.211084 psf | 1,540.7204 psf | 926.37466 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 17 | 121.00000 ft | 105.48653 ft | 57.186868 psf | 1,581.7699 psf | 952.66524 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 18 | 117.00000 ft | 104.28897 ft | 49.956579 psf | 1,617.1507 psf | 979.29157 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 19 | 113.00000 ft | 103.18886 ft | 36.644942 psf | 1,645.488 psf | 1,005.3167 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 20 | 108.50000 ft | 102.07211 ft | 14.126967 psf | 1,692.8448 psf | 1,048.9793 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 21 | 103.83333 ft | 101.02805 ft | -16.341424 psf | 1,744.2683 psf | 1,089.9398 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 22 | 99.50000 ft | 100.17532 ft | -51.918774 psf | 1,762.4367 psf | 1,101.2927 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Column 23 | 95.16667 ft | 99.42937 ft | -94.159564 psf | 1,751.2363 psf | 1,094.2939 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 24 | 90.00000 ft | 98.68967 ft | -153.86515 psf | 1,690.0762 psf | 1,056.0768 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 25 | 84.50000 ft | 98.04459 ft | -226.30507 psf | 1,493.616 psf | 933.31486 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 26 | 79.50000 ft | 97.60929 ft | -301.59013 psf | 1,176.7713 psf | 735.32833 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 27 | 76.53109 ft | 97.39899 ft | -349.29889 psf | 985.109 psf | 615.56442 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 28 | 74.04664 ft | 97.28399 ft | 0 psf | 899.18885 psf | 519.14692 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 29 | 70.01555 ft | 97.15165 ft | 0 psf | 717.45918 psf | 414.22525 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 30 | 65.00000 ft | 97.12312 ft | 0 psf | 469.13464 psf | 270.85501 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 31 | 59.80409 ft | 97.21192 ft | 0 psf | 242.2543 psf | 139.86559 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 32 | 55.41227 ft | 97.41058 ft | 0 psf | 92.34674 psf | 53.316415 psf | 250 psf | 0 psf | Native silt soils (residual) |




| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) | Piezometric Surface |
|---|---|---|---|---|---|---|
| (green) | Medium dense sandy soil (residual) | Mohr-Coulomb | 120 | 150 | 32 | 1 |
| (yellow) | Native silt soils (residual) | Mohr-Coulomb | 115 | 250 | 30 | |

# Static



## File Information

File Version: 11.08
Product Version: 25.1.0.1058
Title: Cheshire SFR ES-9607.01
Created By: Scott Riegel
Last Edited By: Brian Snow
Revision Number: 112
Date: 08/06/2025
Time: 08:45:31 AM
File Name: BCS seismic east slope (residual) draft 7.29.25.gsz
Directory: C:\Users\Brian.snow\Desktop\Desktop Working\9607.02 - (SLOPE) Cheshire Property\
Last Solved Date: 08/06/2025
Last Solved Time: 08:45:31 AM

## Project Settings

Unit System: U.S. Customary Units

## Analysis Settings

### Static

- Kind: SLOPE/W
- Analysis Type: Limit Equilibrium
- Settings
  - Method: Morgenstern-Price
  - Side Function Settings
    - Side Function: Half-Sine
  - PWP Conditions from: Piezometric Surfaces
  - Apply Phreatic Correction: No
  - Staged Rapid Drawdown Analysis: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Slip Surface Settings
    - Search Method: Entry and Exit
    - Specify Radius Tangent Lines: No
    - Direction of Movement: Right to Left
    - Use Passive Mode: No
    - No. of Critical Slip Surfaces to Store: 1
  - Geometry Settings
    - Minimum Slip Surface Depth: 3 ft
    - Number of Columns: 30
  - Tension Crack Option: (none)
- Optimization
  - Optimize Critical Slip Surface: No
- Convergence
  - Factor of Safety Convergence Settings
    - Maximum Number of Iterations: 100
    - Tolerable Difference in F of S: 0.001
  - Solution Settings
    - Search Method: Root Finder
    - Tolerable difference between starting and converged F of S: 3
    - Maximum iterations to calculate converged lambda: 20
    - Maximum Absolute Lambda: 2

## Materials

### Native silt soils (residual)

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 115 pcf
Effective Cohesion: 250 psf
Effective Friction Angle: 30 °
Phi-B: 0 °

### Medium dense sandy soil (residual)

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 150 psf
Effective Friction Angle: 32 °

Phi-B: 0 °
Pore Water Pressure
Piezometric Surface: 1

## Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (34, 96.25) ft
Left-Zone Right Coordinate: (147, 138.74483) ft
Left-Zone Increment: 70
Right Type: Point
Right Coordinate: (187, 142.19658) ft
Right-Zone Increment: 100
Radius Increments: 4

## Slip Surface Limits

Left Coordinate: (14, 93) ft
Right Coordinate: (580, 250) ft

## Piezometric Surfaces

### Piezometric Surface 1

#### Coordinates

| | X | Y |
|---|---|---|
| Coordinate 1 | 14 ft | 75 ft |
| Coordinate 2 | 68 ft | 89 ft |
| Coordinate 3 | 135 ft | 111 ft |
| Coordinate 4 | 223 ft | 128 ft |
| Coordinate 5 | 285 ft | 138 ft |
| Coordinate 6 | 357 ft | 156 ft |
| Coordinate 7 | 436 ft | 175 ft |
| Coordinate 8 | 580 ft | 207 ft |

## Seismic Coefficients

Horz Seismic Coef.: 0

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 125 pcf
Direction: Vertical

#### Coordinates

| | X | Y |
|---|---|---|
| | 187 ft | 144 ft |
| | 245 ft | 149 ft |

## Geometry

Name: Static

### Settings

View: 2D
Element Thickness: 1 ft

### Points

| | X | Y |
|---|---|---|
| Point 1 | 87 ft | 110 ft |
| Point 2 | 25 ft | 95 ft |
| Point 3 | 14 ft | 93 ft |
| Point 4 | 16 ft | 40 ft |
| Point 5 | 118 ft | 75 ft |
| Point 6 | 176 ft | 93 ft |
| Point 7 | 433 ft | 137 ft |
| Point 8 | 13 ft | 18 ft |
| Point 9 | 432 ft | 23 ft |

| | | |
|---|---|---|
| Point 10 | 71 ft | 59 ft |
| Point 11 | 436 ft | 169 ft |
| Point 12 | 187 ft | 105 ft |
| Point 13 | 155.05084 ft | 101.94916 ft |
| Point 14 | 104 ft | 83 ft |
| Point 15 | 14 ft | 65 ft |
| Point 16 | 77 ft | 104 ft |
| Point 17 | 62 ft | 99 ft |
| Point 18 | 50 ft | 97 ft |
| Point 19 | 40 ft | 97 ft |
| Point 20 | 32 ft | 96 ft |
| Point 21 | 20 ft | 94 ft |
| Point 22 | 111 ft | 118 ft |
| Point 23 | 224 ft | 117 ft |
| Point 24 | 52 ft | 70 ft |
| Point 25 | 277.42857 ft | 150 ft |
| Point 26 | 147 ft | 138.74483 ft |
| Point 27 | 135 ft | 128.89655 ft |
| Point 28 | 106 ft | 116.33333 ft |
| Point 29 | 155 ft | 139.43518 ft |
| Point 30 | 169 ft | 140.64329 ft |
| Point 31 | 190 ft | 142.45546 ft |
| Point 32 | 211 ft | 144.26763 ft |
| Point 33 | 225 ft | 145.47574 ft |
| Point 34 | 234 ft | 146.25238 ft |
| Point 35 | 241 ft | 146.85644 ft |
| Point 36 | 250 ft | 147.63308 ft |
| Point 37 | 264 ft | 148.8412 ft |
| Point 38 | 248 ft | 141 ft |
| Point 39 | 221 ft | 135 ft |
| Point 40 | 186 ft | 126 ft |
| Point 41 | 162 ft | 116 ft |
| Point 42 | 236 ft | 126 ft |
| Point 43 | 285 ft | 132.74194 ft |
| Point 44 | 123 ft | 112 ft |
| Point 45 | 93 ft | 104 ft |
| Point 46 | 70 ft | 95 ft |
| Point 47 | 14 ft | 85 ft |
| Point 48 | 14 ft | 72 ft |
| Point 49 | 62 ft | 81 ft |
| Point 50 | 93 ft | 93 ft |
| Point 51 | 141 ft | 112 ft |
| Point 52 | 267 ft | 146.81068 ft |
| Point 53 | 270.88889 ft | 148 ft |
| Point 54 | 281 ft | 152 ft |
| Point 55 | 266 ft | 142 ft |
| Point 56 | 302 ft | 156 ft |
| Point 57 | 322 ft | 164 ft |
| Point 58 | 369 ft | 174 ft |
| Point 59 | 413 ft | 194 ft |
| Point 60 | 444 ft | 216 ft |
| Point 61 | 513 ft | 228 ft |
| Point 62 | 580 ft | 250 ft |
| Point 63 | 580 ft | 23 ft |
| Point 64 | 439.58071 ft | 212.86373 ft |
| Point 65 | 580 ft | 202 ft |
| Point 66 | 580 ft | 162 ft |

## Regions

| | Material | Points | Area |
|---|---|---|---|
| Region 1 | Native silt soils (residual) | 37,36,35,34,33,32,31,30,29,26,27,22,28,1,16,17,18,19,20,2,21,3,47,46,45,44,51,50,49,48,15,24,14,13,12,23,43,42,41,40,39,38,52,53,25 | 5,571.8 ft² |
| Region 2 | Native silt soils (residual) | 6,5,10,4,8,9,63,66,7 | 50,368 ft² |
| Region 3 | Native silt soils (residual) | 43,23,12,13,14,24,15,4,10,5,6,7,66,65,11 | 13,407 ft² |
| Region 4 | Medium dense | 59,58,57,56,54,25,53,52,38,39,40,41,42,43,11,65,62,61,60,64 | 11,391 ft² |

| | sandy soil (residual) | | |
|---|---|---|---|
| Region 5 | Medium dense sandy soil (residual) | 44,45,46,47,48,49,50,51 | 1,295.5 ft² |

## Slip Results

Slip Surfaces Analysed: 348 of 355 converged

## Current Slip Surface

Slip Surface: 72
Factor of Safety: 2.2
Volume: 1,619.7132 ft³
Weight: 187,478.66 lbf
Resisting Moment: 24,462,370 lbf·ft
Activating Moment: 11,267,842 lbf·ft
Resisting Force: 126,683.51 lbf
Activating Force: 58,353.86 lbf
Slip Rank: 1 of 355 slip surfaces
Exit: (187, 142.19658) ft
Entry: (58.410369, 98.401728) ft
Radius: 179.20376 ft
Center: (69.241628, 277.27786) ft

### Slip Columns

| | X | Y | PWP | Base Normal Stress | Frictional Strength | Cohesive Strength | Suction Strength | Column Base Material |
|---|---|---|---|---|---|---|---|---|
| Column 1 | 184.75000 ft | 140.29925 ft | 0 psf | 82.679031 psf | 47.734761 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 2 | 180.25000 ft | 136.62612 ft | 0 psf | 394.53773 psf | 227.78647 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 3 | 175.75000 ft | 133.18718 ft | 0 psf | 679.12234 psf | 392.09147 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 4 | 171.25000 ft | 129.96598 ft | 0 psf | 941.98736 psf | 543.85665 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 5 | 166.66667 ft | 126.89628 ft | 0 psf | 1,192.0534 psf | 688.23236 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 6 | 162.00000 ft | 123.97283 ft | 0 psf | 1,432.8793 psf | 827.27325 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 7 | 157.33333 ft | 121.24370 ft | 0 psf | 1,662.9672 psf | 960.11456 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 8 | 153.00000 ft | 118.86888 ft | 0 psf | 1,869.807 psf | 1,079.5336 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 9 | 149.00000 ft | 116.81727 ft | 0 psf | 2,055.3375 psf | 1,186.6497 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 10 | 144.87589 ft | 114.83416 ft | 0 psf | 2,091.4074 psf | 1,207.4746 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 11 | 140.62767 ft | 112.92259 ft | 0 psf | 1,972.8438 psf | 1,139.0219 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 12 | 137.77138 ft | 111.69697 ft | -10.083066 psf | 1,889.2029 psf | 1,180.505 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 13 | 136.01960 ft | 110.98450 ft | 13.258102 psf | 1,836.2842 psf | 1,139.1531 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 14 | 133.00000 ft | 109.81360 ft | 33.051985 psf | 1,811.9817 psf | 1,111.5986 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 15 | 129.00000 ft | 108.34467 ft | 42.755372 psf | 1,821.5654 psf | 1,111.5238 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 16 | 125.00000 ft | 106.98235 ft | 45.806047 psf | 1,820.467 psf | 1,108.9313 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 17 | 121.00000 ft | 105.72410 ft | 42.36261 psf | 1,805.2985 psf | 1,101.6046 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 18 | 117.00000 ft | 104.56764 ft | 32.567087 psf | 1,774.8695 psf | 1,088.7114 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 19 | 113.00000 ft | 103.51095 ft | 16.546382 psf | 1,730.433 psf | 1,070.9552 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 20 | 110.39352 ft | 102.86421 ft | 3.4973464 psf | 1,702.7736 psf | 1,061.8256 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 21 | 107.89352 ft | 102.30284 ft | -12.696856 psf | 1,692.6942 psf | 1,057.7127 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 22 | 103.83333 ft | 101.45828 ft | -43.187755 psf | 1,664.7609 psf | 1,040.2581 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |

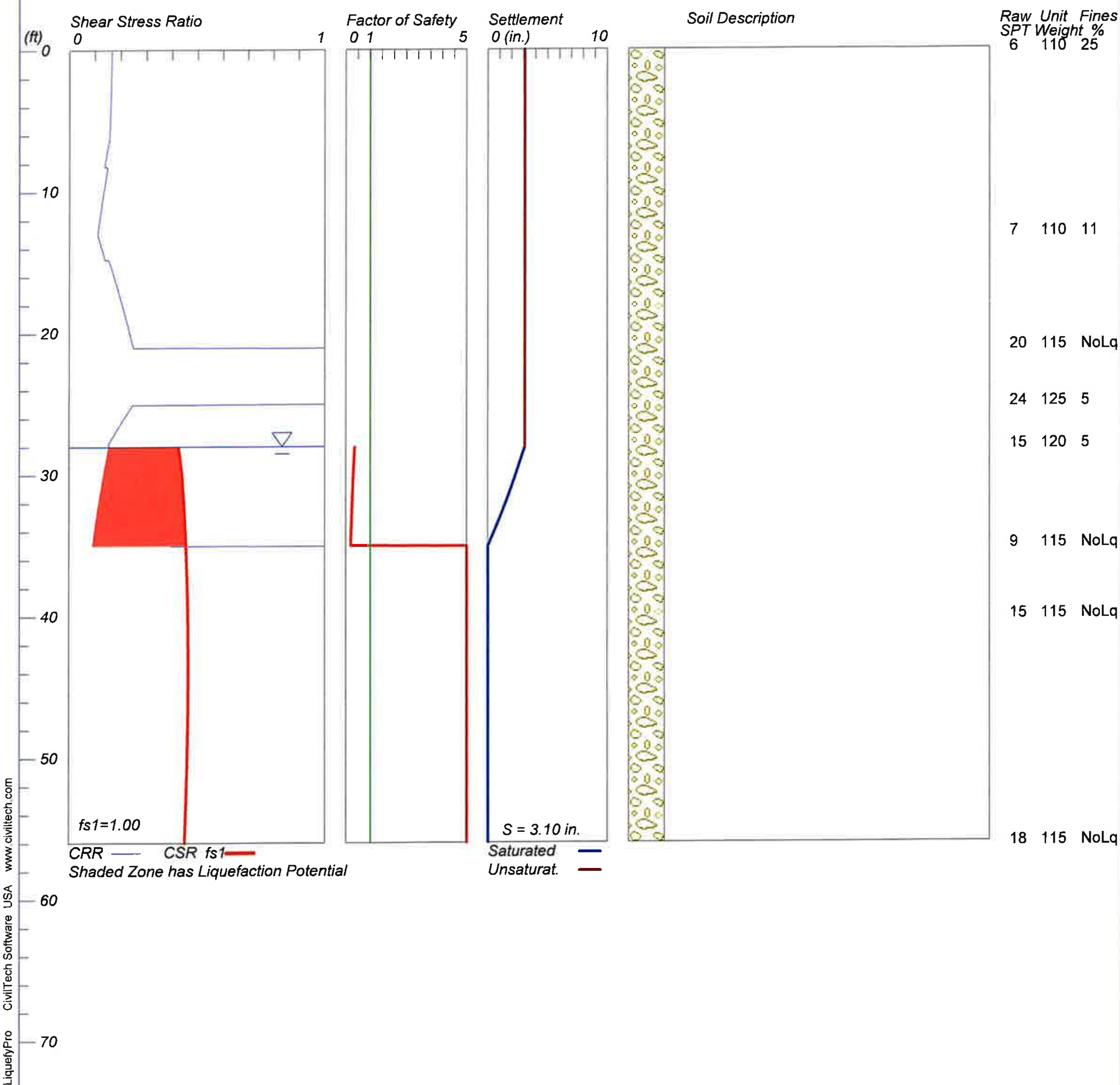
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Column 23 | 99.50000 ft | 100.66080 ft | -82.213105 psf | 1,616.7545 psf | 1,010.2603 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 24 | 95.16667 ft | 99.97280 ft | -128.06989 psf | 1,548.6 psf | 967.67271 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 25 | 90.00000 ft | 99.30608 ft | -192.32928 psf | 1,436.7658 psf | 897.79089 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 26 | 84.86568 ft | 98.76936 ft | -264.03766 psf | 1,232.1375 psf | 769.92496 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 27 | 80.59704 ft | 98.44702 ft | -331.38662 psf | 961.09357 psf | 600.55792 psf | 150 psf | 0 psf | Medium dense sandy soil (residual) |
| Column 28 | 77.73136 ft | 98.27681 ft | 0 psf | 774.86767 psf | 447.37006 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 29 | 74.75000 ft | 98.17293 ft | 0 psf | 641.56079 psf | 370.40529 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 30 | 70.25000 ft | 98.09107 ft | 0 psf | 464.04941 psf | 267.91905 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 31 | 65.00000 ft | 98.14944 ft | 0 psf | 238.27651 psf | 137.56901 psf | 250 psf | 0 psf | Native silt soils (residual) |
| Column 32 | 60.20518 ft | 98.31110 ft | 0 psf | 56.105442 psf | 32.392492 psf | 250 psf | 0 psf | Native silt soils (residual) |

# LIQUEFACTION ANALYSIS

## 7615 E. Mercer Way

***Hole No.=B-6 Water Depth=28 ft***

***Magnitude=7***
***Acceleration=0.7g***




**CivilTech Corporation** **ES-9607.02** **Plate A-1**

# LIQUEFACTION ANALYSIS

## 7615 E. Mercer Way