



January 31, 2025  
ES-10099.01

## Earth Solutions NW LLC

Geotechnical Engineering, Construction  
Observation/Testing and Environmental Services

RKK Construction, Inc.  
3056 – 70<sup>th</sup> Avenue Southeast  
Mercer Island, Washington 98040

Attention: Jason Koehler

**Subject: Critical Area Report  
78<sup>th</sup> Avenue Southeast Single-Family Residence  
4115 – 78<sup>th</sup> Avenue Southeast  
Mercer Island, Washington**

Dear Jason:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this document addressing the City of Mercer Island (COMI) requirements for a critical area report for the subject site. We performed our work in general accordance with the scope of services outlined in our proposal PES-10099.01 (dated January 23, 2025), which was authorized by you.

### **Project Description**

We understand the project will include construction of a new single-family residential structure and related infrastructure improvements. The proposed residential structure will be two stories in height with a basement-level below grade, and constructed utilizing relatively lightly loaded wood framing supported on conventional continuous and spread footing foundations. We anticipate perimeter footing loads of about 2 to 4 kips per linear foot, column loads of up to 40 kips, and slab-on-grade loading of roughly 150 pounds per square foot (psf).

If the above design assumptions are incorrect or change, ESNW should be contacted to review the recommendations provided in this report. ESNW should review final designs to confirm that our geotechnical recommendations have been incorporated into project plans.

### **Surface**

The subject site is located on the southwest corner of the intersection between West Mercer Way and 78<sup>th</sup> Avenue Southeast in Mercer Island, Washington (parcel number 3623500210). The site is currently undeveloped. The site is vegetated with trees and undergrowth typical of the area.

## **Subsurface**

An ESNW representative previously observed, logged, and sampled a series of three test pits in September of 2024 associated with the referenced geotechnical engineering study (GES). The test pits were excavated at accessible site locations using a limited-access, client-provided excavator and operator. The subsurface exploration was completed to evaluate soil conditions, classify site soils, perform an infiltration investigation based on subsurface observations, and characterize groundwater conditions within the proposed development area. The maximum exploration depth was six feet below the existing ground surface (bgs). The approximate locations of the explorations are depicted on the attached Subsurface Exploration Plan. Please refer to the logs provided in the referenced GES Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the exploration locations were analyzed in general accordance with both Unified Soil Classification System (USCS) and United States Department of Agriculture (USDA) methods and procedures.

## **Topsoil**

Topsoil was observed at the test locations, and was observed in thicknesses up to 12 inches. Topsoil is characterized by its dark brown color, the presence of fine organic material, and small root intrusions. Therefore, topsoil should be expected in excavations where no past grading has occurred.

## **Fill**

Fill was not encountered during the site exploration. The client should anticipate some fill may be encountered adjacent to road and potential utility alignments.

## **Native Soil**

Underlying the topsoil, native soils encountered at the test locations were observed to be medium dense grading to dense silty sand with gravel (Unified Soil Classification, SM) and poorly graded sand with gravel (SP) at the test location within the northwest corner of the site. These soils are consistent with the typical makeup of glacial till except for the poorly graded sand with gravel which could represent the advance outwash layer typically observed below a till cap in glacial depositional environments. Density was observed to increase with depth. In general, the native soil was generally encountered in a moist condition during the time of exploration.

## **Geologic Setting**

Geologic mapping identifies Younger gravel deposits (Qyg) with glacial till (Qt) mapped nearby.

The referenced Web Soil Survey (WSS) identifies Kitsap silt loam (KpC) 2 to 8 percent slopes as the primary unit underlying the subject site, with Arents, Alderwood (AmC) 6 to 15 percent slopes mapped for northwest portion of the subject site. Kitsap series of soils consist of lacustrine deposits. Whereas Arents Alderwood soils are typified by glacial till. Based on our field observations, on-site native soils are representative primarily of till deposits rather than lacustrine, with advance outwash encountered at four feet in depth at test location TP-3.

## **Groundwater**

Groundwater seepage was not observed at the test locations. Groundwater seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. Groundwater seepage flow rates are typically higher during the winter, spring, and early summer months. Therefore, perched groundwater seepage at the contact with the unweathered till should be expected in site excavations, particularly if excavations are made in winter, spring, and early summer months.

## **Geologic Hazard Areas Evaluation**

A review of the City of Mercer Island information was completed to evaluate whether geologically hazardous areas are present within the subject site. The city provides geologic hazard information based on-line in the form of maps. Based on a review of the site conditions, mapping, and site exploration, the subject site is mapped within geologic hazard area consisting of an erosion hazard (known or suspect) with slopes of 15 to 39 percent, and landslide hazard area (known or suspect) with slopes 15 percent and higher (Slope Class ix and v). Additionally, the site is mapped within a seismic hazard area (known or suspect) with a scarp mapped as terminating just to the northwest of the subject site.

The City of Mercer Island (COMI) municipal code requires a critical area study where development is planned within a critical area. ESNW has provided a critical area study in general accordance with the municipal code below. The code item (*italics*) is listed and ESNW response follows each code item needing addressing:

### ***19.07.110 - Critical area study.***

*A. A critical area study shall be required when a development proposal will result in an alteration to one or more critical areas or critical area buffers or when required to determine the potential impact to a critical area.*

*B. The critical area study shall be in the form of a written report supported by graphic information prepared by a qualified professional using guidance based on the best available science consistent with the standards in WAC Chapter 365-195 and shall contain the following items, as applicable to adequately evaluate the proposal, proposed alterations, and mitigation:*

- 1. Disclosure of the presence of critical areas, including a delineation and type or category of critical area, on the development proposal site and any mapped or identifiable critical areas on or off site within the distance equal to the largest potential required buffer applicable to the development proposal area on the applicant's property;*

Based on a review of the site conditions, mapping, and site exploration, the subject site is mapped within geologic hazard area consisting of an erosion hazard (known or suspect) with slopes of 15 to 39 percent, and landslide hazard area (know or suspect) with slopes 15 percent and higher (Slope Class ix and v). The landslide hazard distinction is likely due to the slopes which descend off the site towards Mercer Way. The slope at the roadside (southwest) appears to be the result of past legal grading is on the order of 16 vertical feet total, and inclined at slightly more than 40 percent

The subject site lies in an area described as a seismic hazard based on our review of the COMI mapping for geologic hazards.

*2. A topographic and boundary survey;*

ESNW has included a site plan (Plate 2) which includes the previous test locations and property boundaries (including topography) as an attachment to this document. The topography illustrated on Plate 2 was developed by utilizing the site survey provided ESNW.

*3. A statement specifying the accuracy of the report and all assumptions made and relied upon;*

In our opinion, this study is accurate and reliable based on best available science typical of practice in the field of geotechnical engineering for the area. The site-specific data collected and analysis (slope stability, geologic conditions, and liquefaction analysis) by ESNW staff may be relied upon.

*4. A description of the methodologies used to conduct the critical area study, including references;*

ESNW observed, logged, and sampled test pits on the subject site utilizing an excavator and operator retained by the client. The soil samples were returned to ESNW laboratory for sieve and moisture analysis in general accordance with the COMI requirements. ESNW reviewed the topographical data, geologic maps, and critical areas maps (provided by the city) for the subject site and surrounding area to determine the risk of erosion, liquefaction, and landslide on the site. ESNW analysis is based on experience on sites with similar surface and subsurface conditions in the region. In addition, ESNW evaluated the impact of the proposed development on the stability of the most critical slope section using SlopeW computer software.

*5. A scale map of the development proposal site;*

Please see the Subsurface Exploration Plan which is attached to this study.

*6. Photographic records of the site before the proposed alteration occurs;*

ESNW has attached photographs of the site pre-redevelopment.

7. *An assessment of the probable effects to critical areas and associated buffers, including impacts caused by the development proposal and associated alterations to the subject property and impacts to other properties and any critical areas or buffers located on them resulting from the development of the site and the proposed development;*

ESNW analyzed the erosion hazard, liquefaction potential, and landslide hazard on the subject site. Based on the analysis, in our opinion no adverse impacts are anticipated to slope stability or erosion risks on the subject site and surrounding area due to the stable nature of the soil types on the site, considering glacial till deposits exhibit high soil strength parameters.

Final grading plans were utilized for slope stability modeling as part of this report production. ESNW analysis has determined the proposed residence will not place additional surcharging onto the subject slopes. Based on ESNW review of the project plans, the proposed excavation for the residence will result in a condition where the weight of soil removed is more than the weight of the proposed residence, which will result in a partial un-loading of the slopes under concern.

Based on the slope stability analysis and review of the project plans, the proposed site development will not adversely affect the long-term stability of the slopes under concern. The slope stability analysis results in adequate FOS for static and seismic conditions using SlopeW computer models.

Provided disturbed areas resulting from the construction, and industry standard Best Management Practices (BMP) for erosion control for both short and long-term are utilized, the risk of deep-seated rotational slope failures is considered to be negligible over the life of the development. There is a possibility of small surficial debris-flow soil mobilization on the subject slopes. However, given permanent erosion control measures are maintained the risk of debris flow soil mobilization events will be no more than if the site were not to be developed.

The proposed development will not impact any critical areas buffers/conditions on adjacent properties based on our review of the conditions on and off-site provided the recommendations in the referenced GES and this report are adhered to.

In regards to the liquefaction potential on the site, it is our opinion the site maintains a negligible liquefaction hazard. The relative density of the soil underlying the site and lack of a near-surface groundwater table on the site is the primary basis for this opinion.

8. *A description of mitigation sequencing implementation described in section 19.07.100 including steps taken to avoid and minimize critical areas impacts to the greatest extent feasible;*

In this instance there will be some impacts to the buffer (vegetation) on the site through grading. However, the proposed grading and removal of soil within the building footprint on the site will in-essence provide slope integrity in accordance with item F of the City of Mercer Island code Chapter 19.07.100 which states "Monitoring the impact and taking appropriate corrective measures to maintain the integrity of compensating measures."

Following ground disturbance, ESNW recommends any disturbed areas of soil must be re-vegetated in a permanent sense to limit the potential for erosion.

*9. Detailed studies, as required by this chapter, for individual critical area types in order to ensure critical area protection;*

ESNW has provided this document as a detailed study of the critical areas associated with the subject site.

*10. Assessment of potential impacts that may occur on adjacent sites, such as sedimentation or erosion, where applicable; and*

Where erosion control BMP are utilized during and after construction on the subject site, it is our opinion there will be minimal risk of erosion. Furthermore, due to the dense and stable nature of the site soils, there is a low risk of erosion and landslide on the subject site given the project proceeds according to the plans ESNW was provided and reviewed.

*11. A post-design memorandum prepared by a qualified professional confirming that the proposed improvements comply with the design recommendations.*

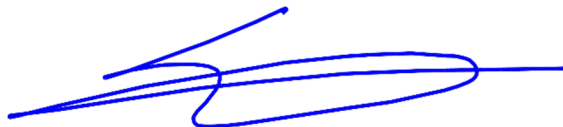
ESNW can provide a plan review upon request by the client.

*C. The critical area study requirement may be waived or modified if the applicant demonstrates that the development proposal will not have an impact on the critical area or its buffer in a manner contrary to the purposes and requirements of this chapter.*

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

Sincerely,

**EARTH SOLUTIONS NW, LLC**



Stephen H. Avril  
Project Manager



01/31/2025

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

Attachments: Plate 1 – Vicinity Map  
Plate 2 – Subsurface Exploration Plan  
Pictures  
SlopeW Output

References:

- Geotechnical Engineering Study, prepared by ESNW, ES-10099, dated November 15, 2024
- RKK Spec House Site Plan, prepared by Sturman Architects, Sheet A1.1, dated January 22, 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.



**Earth Solutions NW LLC**

Geotechnical Engineering, Construction  
Observation/Testing and Environmental Services

**Vicinity Map**  
**78th Avenue S.E. SFR**  
**Mercer Island, Washington**

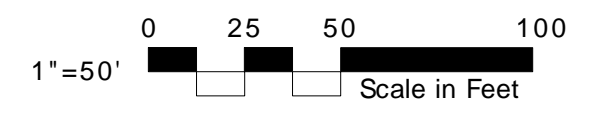
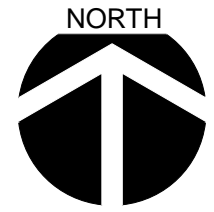
Drawn MRS	Date 01/27/2025	Proj. No. 10099.01
Checked SHA	Date Jan. 2025	Plate 1



Drawn MRS
Checked SHA
Date 01/31/2025
Proj. No. 10099.01
Plate 2

**LEGEND**

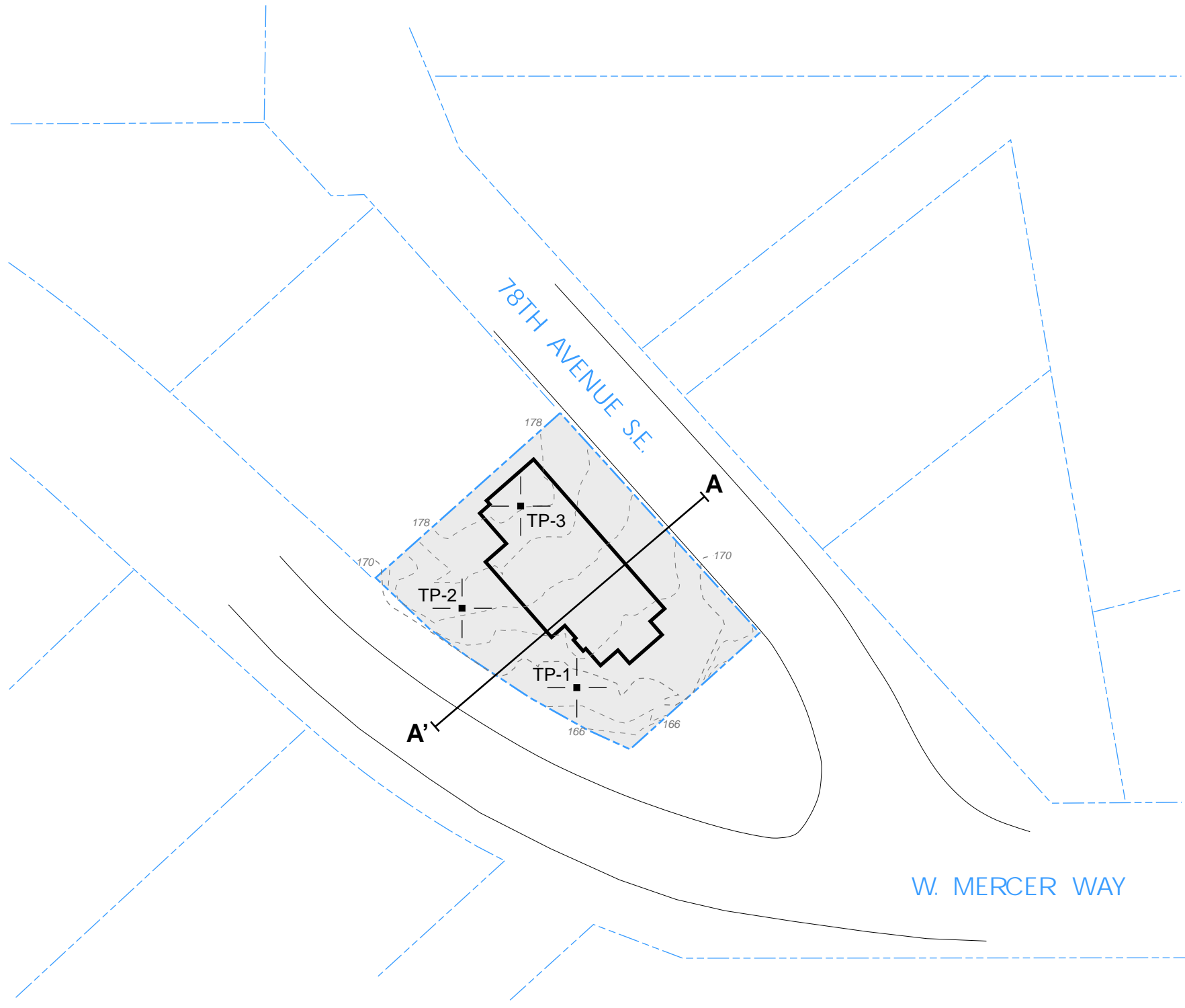
- TP-1 | ■ | Approximate Location of ESNW Test Pit, Proj. No. ES-10099, Sept. 2024
- ▭ | Subject Site
- ▭ | Proposed Building
- | Cross-Section



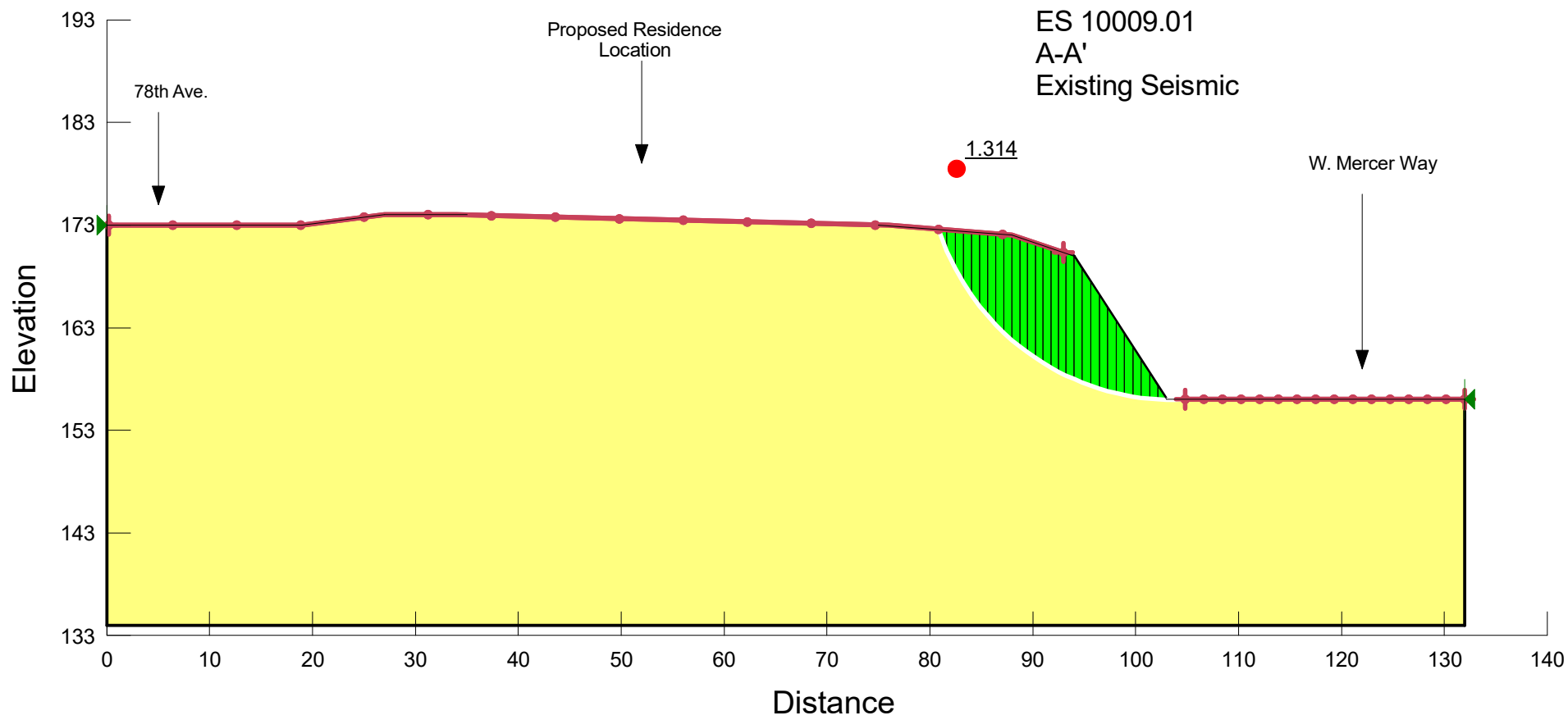
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided 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.

Reference Topography:  
 Site Plan, Sheet A1.1, RKK House,  
 prepared by Sturman Architects,  
 dated January 22, 2025







# ES10099.01

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## File Information

File Version: 10.00  
Created By: Steve Avril  
Last Edited By: Steve Avril  
Revision Number: 14  
Date: 01/27/2025  
Time: 10:09:45 AM  
Tool Version: 10.0.0.17401  
File Name: ES 10099.01 A-A' Existing Seismic.gsz  
Directory: C:\Users\steve.avril\Documents\  
Last Solved Date: 01/27/2025  
Last Solved Time: 10:09:50 AM

## Project Settings

Unit System: U.S. Customary Units

## Analysis Settings

### ES10099.01

Description: A-A'  
Kind: SLOPE/W  
Method: Morgenstern-Price

#### Settings

##### Side Function

Interslice force function option: Half-Sine

PWP Conditions from: (none)

Unit Weight of Water: 62.430189 pcf

#### Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1

Optimize Critical Slip Surface Location: No

Tension Crack Option: (none)

#### Distribution

F of S Calculation Option: Constant

#### Advanced

##### Geometry Settings

Minimum Slip Surface Depth: 0.1 ft

Number of Slices: 30

##### 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  
Max Absolute Lambda: 2

## Materials

### Native Till

Model: Mohr-Coulomb  
Unit Weight: 125 pcf  
Cohesion': 250 psf  
Phi': 38 °  
Phi-B: 0 °

## Slip Surface Entry and Exit

Left Type: Range  
Left-Zone Left Coordinate: (0.19287, 173) ft  
Left-Zone Right Coordinate: (93, 170.33333) ft  
Left-Zone Increment: 15  
Right Type: Range  
Right-Zone Left Coordinate: (104.81521, 156) ft  
Right-Zone Right Coordinate: (132, 156) ft  
Right-Zone Increment: 15  
Radius Increments: 15

## Slip Surface Limits

Left Coordinate: (0, 173) ft  
Right Coordinate: (132, 156) ft

## Seismic Coefficients

Horz Seismic Coef.: 0.365

## Points

	X	Y
Point 1	0 ft	173 ft
Point 2	19 ft	173 ft
Point 3	27 ft	174 ft
Point 4	34 ft	174 ft
Point 5	34 ft	173.99859 ft
Point 6	76 ft	172.98775 ft
Point 7	76 ft	173 ft
Point 8	88 ft	172 ft
Point 9	94 ft	170 ft
Point 10	103 ft	156 ft
Point 11	132 ft	156 ft
Point 12	132 ft	134 ft
Point 13	0 ft	134 ft

## Regions

	Material	Points	Area
Region 1	Native Till	1,2,3,4,5,6,7,8,9,10,11,12,13	4,578.7 ft <sup>2</sup>

## Slip Results

Slip Surfaces Analysed: 2901 of 4096 converged

### Current Slip Surface

Slip Surface: 3,339

Factor of Safety: 1.314

Volume: 168.88619 ft<sup>3</sup>

Weight: 21,110.773 lbf

Resisting Moment: 486,128.19 lbf·ft

Activating Moment: 370,053.78 lbf·ft

Resisting Force: 17,430.768 lbf

Activating Force: 13,268.557 lbf

Slip Rank: 1 of 4,096 slip surfaces

Exit: (104.81521, 156) ft

Entry: (80.867551, 172.59437) ft

Radius: 23.877697 ft

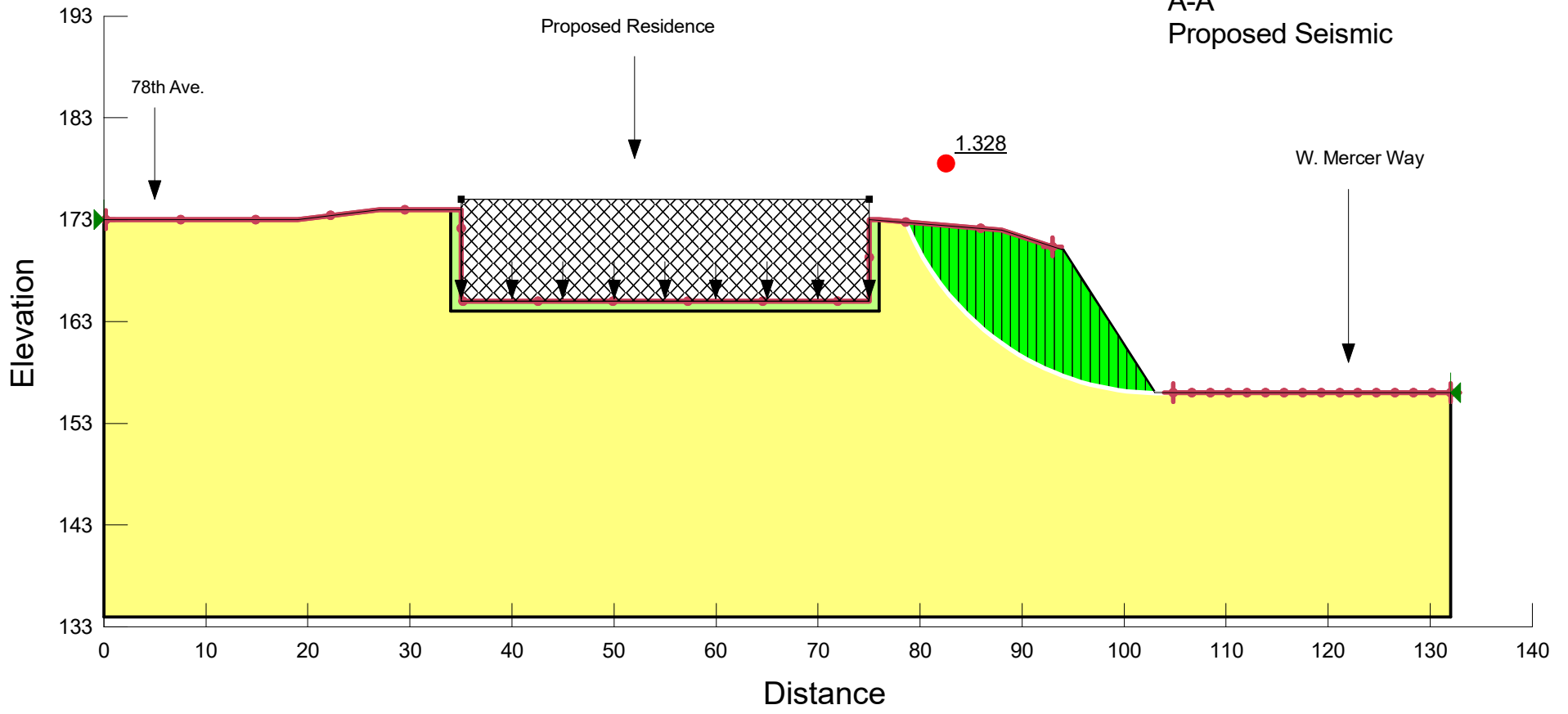
Center: (103.61694, 179.84761) ft

### Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	81.263798 ft	171.52954 ft	0 psf	-121.58913 psf	-94.995836 psf	250 psf	0 psf	Native Till
Slice 2	82.056292 ft	169.62867 ft	0 psf	14.947943 psf	11.678613 psf	250 psf	0 psf	Native Till
Slice 3	82.848787 ft	168.09257 ft	0 psf	102.40876 psf	80.010494 psf	250 psf	0 psf	Native Till
Slice 4	83.641281 ft	166.78649 ft	0 psf	161.85584 psf	126.45564 psf	250 psf	0 psf	Native Till
Slice 5	84.433775 ft	165.64525 ft	0 psf	204.13436 psf	159.48724 psf	250 psf	0 psf	Native Till
Slice 6	85.22627 ft	164.63114 ft	0 psf	235.68393 psf	184.13647 psf	250 psf	0 psf	Native Till
Slice 7	86.018764 ft	163.71986 ft	0 psf	261.03927 psf	203.94623 psf	250 psf	0 psf	Native Till
Slice 8	86.811258 ft	162.89468 ft	0 psf	283.93307 psf	221.83283 psf	250 psf	0 psf	Native Till
Slice 9	87.603753 ft	162.14347 ft	0 psf	307.72347 psf	240.41992 psf	250 psf	0 psf	Native Till
Slice 10	88.375 ft	161.47398 ft	0 psf	331.65496 psf	259.11726 psf	250 psf	0 psf	Native Till
Slice 11	89.125 ft	160.87644 ft	0 psf	358.51889 psf	280.10565 psf	250 psf	0 psf	Native Till
Slice 12	89.875 ft	160.32601 ft	0 psf	395.30444 psf	308.84568 psf	250 psf	0 psf	Native Till

Slice 13	90.625 ft	159.81878 ft	0 psf	445.27415 psf	347.88629 psf	250 psf	0 psf	Native Till
Slice 14	91.375 ft	159.35155 ft	0 psf	512.07572 psf	400.0774 psf	250 psf	0 psf	Native Till
Slice 15	92.125 ft	158.92163 ft	0 psf	599.57046 psf	468.43578 psf	250 psf	0 psf	Native Till
Slice 16	92.875 ft	158.52676 ft	0 psf	711.49798 psf	555.88315 psf	250 psf	0 psf	Native Till
Slice 17	93.625 ft	158.16502 ft	0 psf	850.86765 psf	664.77066 psf	250 psf	0 psf	Native Till
Slice 18	94.409091 ft	157.82119 ft	0 psf	999.66353 psf	781.02275 psf	250 psf	0 psf	Native Till
Slice 19	95.227273 ft	157.49662 ft	0 psf	1,146.7724 psf	895.9568 psf	250 psf	0 psf	Native Till
Slice 20	96.045455 ft	157.20626 ft	0 psf	1,293.4272 psf	1,010.5361 psf	250 psf	0 psf	Native Till
Slice 21	96.863636 ft	156.9488 ft	0 psf	1,416.8057 psf	1,106.93 psf	250 psf	0 psf	Native Till
Slice 22	97.681818 ft	156.72316 ft	0 psf	1,490.0311 psf	1,164.1399 psf	250 psf	0 psf	Native Till
Slice 23	98.5 ft	156.52839 ft	0 psf	1,488.1425 psf	1,162.6644 psf	250 psf	0 psf	Native Till
Slice 24	99.318182 ft	156.36374 ft	0 psf	1,395.6754 psf	1,090.4211 psf	250 psf	0 psf	Native Till
Slice 25	100.13636 ft	156.22857 ft	0 psf	1,212.919 psf	947.63616 psf	250 psf	0 psf	Native Till
Slice 26	100.95455 ft	156.12238 ft	0 psf	957.66647 psf	748.21105 psf	250 psf	0 psf	Native Till
Slice 27	101.77273 ft	156.04478 ft	0 psf	660.7755 psf	516.2544 psf	250 psf	0 psf	Native Till
Slice 28	102.59091 ft	155.99548 ft	0 psf	356.68358 psf	278.67175 psf	250 psf	0 psf	Native Till
Slice 29	103.4538 ft	155.97478 ft	0 psf	150.73309 psf	117.7656 psf	250 psf	0 psf	Native Till
Slice 30	104.36141 ft	155.98584 ft	0 psf	51.332592 psf	40.105416 psf	250 psf	0 psf	Native Till

ES 10099.01  
A-A'  
Proposed Seismic



# ES10099.01

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## File Information

File Version: 10.00  
Created By: Steve Avril  
Last Edited By: Steve Avril  
Revision Number: 14  
Date: 01/27/2025  
Time: 10:26:16 AM  
Tool Version: 10.0.0.17401  
File Name: ES 10099.01 A-A' Seismic.gsz  
Directory: C:\Users\steve.avril\Documents\  
Last Solved Date: 01/27/2025  
Last Solved Time: 10:26:20 AM

## Project Settings

Unit System: U.S. Customary Units

## Analysis Settings

### ES10099.01

Description: A-A'  
Kind: SLOPE/W  
Method: Morgenstern-Price

#### Settings

##### Side Function

Interslice force function option: Half-Sine

PWP Conditions from: (none)

Unit Weight of Water: 62.430189 pcf

#### Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1

Optimize Critical Slip Surface Location: No

Tension Crack Option: (none)

#### Distribution

F of S Calculation Option: Constant

#### Advanced

##### Geometry Settings

Minimum Slip Surface Depth: 0.1 ft

Number of Slices: 30

##### 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  
Max Absolute Lambda: 2

## Materials

### Native Till

Model: Mohr-Coulomb  
Unit Weight: 125 pcf  
Cohesion': 250 psf  
Phi': 38 °  
Phi-B: 0 °

### Foundation and Stem Walls

Model: High Strength  
Unit Weight: 160 pcf

## Slip Surface Entry and Exit

Left Type: Range  
Left-Zone Left Coordinate: (0.19287, 173) ft  
Left-Zone Right Coordinate: (93, 170.33333) ft  
Left-Zone Increment: 15  
Right Type: Range  
Right-Zone Left Coordinate: (104.81521, 156) ft  
Right-Zone Right Coordinate: (132, 156) ft  
Right-Zone Increment: 15  
Radius Increments: 15

## Slip Surface Limits

Left Coordinate: (0, 173) ft  
Right Coordinate: (132, 156) ft

## Seismic Coefficients

Horz Seismic Coef.: 0.365

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 250 pcf  
Direction: Vertical

#### Coordinates

	X	Y
	35 ft	175 ft
	75 ft	175 ft

## Points

	X	Y
Point 1	0 ft	173 ft
Point 2	19 ft	173 ft
Point 3	27 ft	174 ft
Point 4	34 ft	174 ft
Point 5	34 ft	164 ft
Point 6	76 ft	164 ft
Point 7	76 ft	173 ft
Point 8	88 ft	172 ft
Point 9	94 ft	170 ft
Point 10	103 ft	156 ft
Point 11	132 ft	156 ft
Point 12	132 ft	134 ft
Point 13	0 ft	134 ft
Point 14	35 ft	174 ft
Point 15	35 ft	165 ft
Point 16	75 ft	165 ft
Point 17	75 ft	173 ft

## Regions

	Material	Points	Area
Region 1	Native Till	1,2,3,4,5,6,7,8,9,10,11,12,13	4,180 ft <sup>2</sup>
Region 2	Foundation and Stem Walls	4,14,15,16,17,7,6,5	59 ft <sup>2</sup>

## Slip Results

Slip Surfaces Analysed: 1137 of 4096 converged

## Current Slip Surface

Slip Surface: 3,338

Factor of Safety: 1.328

Volume: 193.15332 ft<sup>3</sup>

Weight: 24,144.165 lbf

Resisting Moment: 612,330.52 lbf·ft

Activating Moment: 461,245.13 lbf·ft

Resisting Force: 20,053.918 lbf

Activating Force: 15,104.44 lbf

Slip Rank: 1 of 4,096 slip surfaces

Exit: (104.81521, 156) ft

Entry: (78.612145, 172.78232) ft

Radius: 26.612916 ft

Center: (103.35865, 182.57303) ft

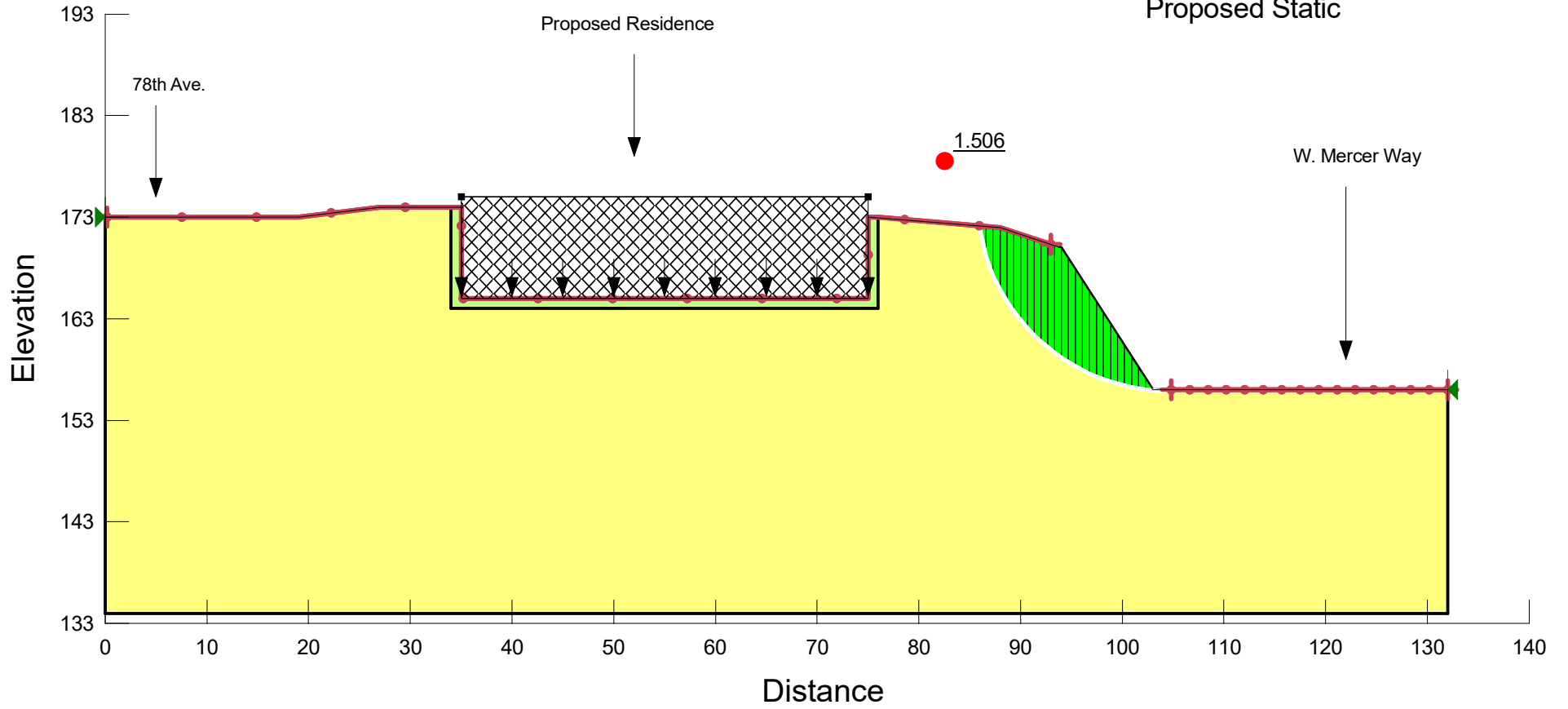
## Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
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Slice 1	79.038865 ft	171.81745 ft	0 psf	-109.50553 psf	-85.555099 psf	250 psf	0 psf	Native Till
Slice 2	79.892307 ft	170.05279 ft	0 psf	20.284059 psf	15.847644 psf	250 psf	0 psf	Native Till
Slice 3	80.745748 ft	168.56419 ft	0 psf	107.01257 psf	83.607382 psf	250 psf	0 psf	Native Till
Slice 4	81.59919 ft	167.26868 ft	0 psf	167.63379 psf	130.96987 psf	250 psf	0 psf	Native Till
Slice 5	82.452631 ft	166.11977 ft	0 psf	211.57191 psf	165.29809 psf	250 psf	0 psf	Native Till
Slice 6	83.306072 ft	165.08818 ft	0 psf	244.82122 psf	191.2753 psf	250 psf	0 psf	Native Till
Slice 7	84.159514 ft	164.154 ft	0 psf	271.68979 psf	212.26732 psf	250 psf	0 psf	Native Till
Slice 8	85.012955 ft	163.30295 ft	0 psf	295.66955 psf	231.00237 psf	250 psf	0 psf	Native Till
Slice 9	85.866397 ft	162.52439 ft	0 psf	319.92015 psf	249.94902 psf	250 psf	0 psf	Native Till
Slice 10	86.719838 ft	161.81012 ft	0 psf	347.58783 psf	271.56537 psf	250 psf	0 psf	Native Till
Slice 11	87.573279 ft	161.15368 ft	0 psf	382.05242 psf	298.49206 psf	250 psf	0 psf	Native Till
Slice 12	88.428571 ft	160.54867 ft	0 psf	423.358 psf	330.76352 psf	250 psf	0 psf	Native Till
Slice 13	89.285714 ft	159.99107 ft	0 psf	475.70009 psf	371.65764 psf	250 psf	0 psf	Native Till
Slice 14	90.142857 ft	159.47873 ft	0 psf	547.27269 psf	427.57628 psf	250 psf	0 psf	Native Till
Slice 15	91 ft	159.00871 ft	0 psf	642.52641 psf	501.99665 psf	250 psf	0 psf	Native Till
Slice 16	91.857143 ft	158.57851 ft	0 psf	765.67024 psf	598.20715 psf	250 psf	0 psf	Native Till
Slice 17	92.714286 ft	158.18602 ft	0 psf	919.79207 psf	718.62033 psf	250 psf	0 psf	Native Till
Slice 18	93.571429 ft	157.82944 ft	0 psf	1,105.4517 psf	863.67354 psf	250 psf	0 psf	Native Till
Slice 19	94.45 ft	157.50003 ft	0 psf	1,288.1018 psf	1,006.3754 psf	250 psf	0 psf	Native Till
Slice 20	95.35 ft	157.19811 ft	0 psf	1,441.1955 psf	1,125.9853 psf	250 psf	0 psf	Native Till
Slice 21	96.25 ft	156.93133 ft	0 psf	1,564.0447 psf	1,221.9656 psf	250 psf	0 psf	Native Till
Slice 22	97.15 ft	156.6986 ft	0 psf	1,626.2917 psf	1,270.5984 psf	250 psf	0 psf	Native Till
Slice 23	98.05 ft	156.499 ft	0 psf	1,601.5894 psf	1,251.2988 psf	250 psf	0 psf	Native Till
Slice 24	98.95 ft	156.33178 ft	0 psf	1,477.0044 psf	1,153.9623 psf	250 psf	0 psf	Native Till
Slice 25	99.85 ft	156.19632 ft	0 psf	1,259.3496 psf	983.91175 psf	250 psf	0 psf	Native Till
Slice 26	100.75 ft	156.09213 ft	0 psf	974.10002 psf	761.05034 psf	250 psf	0 psf	Native Till

Slice 27	101.65 ft	156.01885 ft	0 psf	656.48216 psf	512.90008 psf	250 psf	0 psf	Native Till
Slice 28	102.55 ft	155.97621 ft	0 psf	339.46836 psf	265.22175 psf	250 psf	0 psf	Native Till
Slice 29	103.4538 ft	155.96415 ft	0 psf	136.6758 psf	106.78284 psf	250 psf	0 psf	Native Till
Slice 30	104.36141 ft	155.98289 ft	0 psf	48.580833 psf	37.955507 psf	250 psf	0 psf	Native Till

ES 10099.01  
A-A'  
Proposed Static



# ES10099.01

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## File Information

File Version: 10.00  
Created By: Steve Avril  
Last Edited By: Steve Avril  
Revision Number: 12  
Date: 01/27/2025  
Time: 10:24:04 AM  
Tool Version: 10.0.0.17401  
File Name: ES 10099.01 A-A' Static.gsz  
Directory: C:\Users\steve.avril\Documents\  
Last Solved Date: 01/27/2025  
Last Solved Time: 10:24:08 AM

## Project Settings

Unit System: U.S. Customary Units

## Analysis Settings

### ES10099.01

Description: A-A'  
Kind: SLOPE/W  
Method: Morgenstern-Price

#### Settings

##### Side Function

Interslice force function option: Half-Sine

PWP Conditions from: (none)

Unit Weight of Water: 62.430189 pcf

#### Slip Surface

Direction of movement: Left to Right

Use Passive Mode: No

Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1

Optimize Critical Slip Surface Location: No

Tension Crack Option: (none)

#### Distribution

F of S Calculation Option: Constant

#### Advanced

##### Geometry Settings

Minimum Slip Surface Depth: 0.1 ft

Number of Slices: 30

##### 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  
Max Absolute Lambda: 2

## Materials

### Native Till

Model: Mohr-Coulomb  
Unit Weight: 125 pcf  
Cohesion': 100 psf  
Phi': 38 °  
Phi-B: 0 °

### Foundation and Stem Walls

Model: High Strength  
Unit Weight: 160 pcf

## Slip Surface Entry and Exit

Left Type: Range  
Left-Zone Left Coordinate: (0.19287, 173) ft  
Left-Zone Right Coordinate: (93, 170.33333) ft  
Left-Zone Increment: 15  
Right Type: Range  
Right-Zone Left Coordinate: (104.81521, 156) ft  
Right-Zone Right Coordinate: (132, 156) ft  
Right-Zone Increment: 15  
Radius Increments: 15

## Slip Surface Limits

Left Coordinate: (0, 173) ft  
Right Coordinate: (132, 156) ft

## Surcharge Loads

### Surcharge Load 1

Surcharge (Unit Weight): 250 pcf  
Direction: Vertical

#### Coordinates

	X	Y
	35 ft	175 ft
	75 ft	175 ft

## Points

	X	Y
Point 1	0 ft	173 ft

Point 2	19 ft	173 ft
Point 3	27 ft	174 ft
Point 4	34 ft	174 ft
Point 5	34 ft	164 ft
Point 6	76 ft	164 ft
Point 7	76 ft	173 ft
Point 8	88 ft	172 ft
Point 9	94 ft	170 ft
Point 10	103 ft	156 ft
Point 11	132 ft	156 ft
Point 12	132 ft	134 ft
Point 13	0 ft	134 ft
Point 14	35 ft	174 ft
Point 15	35 ft	165 ft
Point 16	75 ft	165 ft
Point 17	75 ft	173 ft

## Regions

	Material	Points	Area
Region 1	Native Till	1,2,3,4,5,6,7,8,9,10,11,12,13	4,180 ft <sup>2</sup>
Region 2	Foundation and Stem Walls	4,14,15,16,17,7,6,5	59 ft <sup>2</sup>

## Slip Results

Slip Surfaces Analysed: 1146 of 4096 converged

## Current Slip Surface

Slip Surface: 3,614

Factor of Safety: 1.506

Volume: 114.71012 ft<sup>3</sup>

Weight: 14,338.765 lbf

Resisting Moment: 235,711.14 lbf·ft

Activating Moment: 156,494.63 lbf·ft

Resisting Force: 9,796.6941 lbf

Activating Force: 6,507.3354 lbf

Slip Rank: 1 of 4,096 slip surfaces

Exit: (106.62753, 156) ft

Entry: (85.932202, 172.17232) ft

Radius: 18.879985 ft

Center: (104.63204, 174.77423) ft

## Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	86.276835 ft	170.64161 ft	0 psf	-28.362331 psf	-22.159082 psf	100 psf	0 psf	Native Till
Slice 2	86.966101 ft	168.1867 ft	0 psf	122.58759 psf	95.775919 psf	100 psf	0 psf	Native Till

Slice 3	87.655367 ft	166.551 ft	0 psf	232.47304 psf	181.62785 psf	100 psf	0 psf	Native Till
Slice 4	88.333333 ft	165.26801 ft	0 psf	318.15067 psf	248.56655 psf	100 psf	0 psf	Native Till
Slice 5	89 ft	164.20356 ft	0 psf	387.73014 psf	302.92799 psf	100 psf	0 psf	Native Till
Slice 6	89.666667 ft	163.27675 ft	0 psf	452.14362 psf	353.25331 psf	100 psf	0 psf	Native Till
Slice 7	90.333333 ft	162.45595 ft	0 psf	514.33124 psf	401.83961 psf	100 psf	0 psf	Native Till
Slice 8	91 ft	161.72092 ft	0 psf	576.33961 psf	450.28585 psf	100 psf	0 psf	Native Till
Slice 9	91.666667 ft	161.05772 ft	0 psf	639.66082 psf	499.75781 psf	100 psf	0 psf	Native Till
Slice 10	92.333333 ft	160.45632 ft	0 psf	705.39264 psf	551.11313 psf	100 psf	0 psf	Native Till
Slice 11	93 ft	159.90916 ft	0 psf	774.30646 psf	604.95451 psf	100 psf	0 psf	Native Till
Slice 12	93.666667 ft	159.41042 ft	0 psf	846.85981 psf	661.6394 psf	100 psf	0 psf	Native Till
Slice 13	94.346154 ft	158.94755 ft	0 psf	887.62044 psf	693.48509 psf	100 psf	0 psf	Native Till
Slice 14	95.038462 ft	158.51829 ft	0 psf	890.75512 psf	695.93418 psf	100 psf	0 psf	Native Till
Slice 15	95.730769 ft	158.1289 ft	0 psf	888.39616 psf	694.09115 psf	100 psf	0 psf	Native Till
Slice 16	96.423077 ft	157.77662 ft	0 psf	878.47269 psf	686.33809 psf	100 psf	0 psf	Native Till
Slice 17	97.115385 ft	157.45917 ft	0 psf	858.62402 psf	670.83061 psf	100 psf	0 psf	Native Till
Slice 18	97.807692 ft	157.17468 ft	0 psf	826.33567 psf	645.60418 psf	100 psf	0 psf	Native Till
Slice 19	98.5 ft	156.92156 ft	0 psf	779.15526 psf	608.7428 psf	100 psf	0 psf	Native Till
Slice 20	99.192308 ft	156.69849 ft	0 psf	714.99177 psf	558.6128 psf	100 psf	0 psf	Native Till
Slice 21	99.884615 ft	156.50437 ft	0 psf	632.47831 psf	494.14621 psf	100 psf	0 psf	Native Till
Slice 22	100.57692 ft	156.33828 ft	0 psf	531.34616 psf	415.13312 psf	100 psf	0 psf	Native Till
Slice 23	101.26923 ft	156.19948 ft	0 psf	412.72643 psf	322.45723 psf	100 psf	0 psf	Native Till
Slice 24	101.96154 ft	156.08734 ft	0 psf	279.27982 psf	218.19731 psf	100 psf	0 psf	Native Till
Slice 25	102.65385 ft	156.0014 ft	0 psf	135.07271 psf	105.53037 psf	100 psf	0 psf	Native Till
Slice 26	103.36275 ft	155.94047 ft	0 psf	60.2398 psf	47.06449 psf	100 psf	0 psf	Native Till
Slice 27	104.08826 ft	155.90557 ft	0 psf	56.441764 psf	44.097139 psf	100 psf	0 psf	Native Till
Slice 28	104.81376 ft	155.89861 ft	0 psf	47.167747 psf	36.851483 psf	100 psf	0 psf	Native Till

Slice 29	105.53927 ft	155.91956 ft	0 psf	33.455824 psf	26.138554 psf	100 psf	0 psf	Native Till
Slice 30	106.26478 ft	155.96851 ft	0 psf	16.476837 psf	12.873116 psf	100 psf	0 psf	Native Till