Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

GEOTECHNICAL ENGINEERING STUDY
PROPOSED TOWNHOMES
113 – 27TH AVENUE SOUTHEAST
PUYALLUP, WASHINGTON

ES-10212

15365 NE 90th Street, Suite 100 • Redmond, WA 98052 • (425) 449-4704
3130 Varney Lane, Suite 105 • Pasco, WA 99301 • (509) 905-0275
esnw.com

PREPARED FOR

LLOYD ENTERPRISES, INC.

January 28, 2025

Adam Z. Shier, L.G.
Project Geologist

01/28/2025

Keven D. Hoffmann, P.E.
Associate Principal Engineer

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Important Information about This

Geotechnical-Engineering Report

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

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

January 28, 2025
ES-10212

Lloyd Enterprises, Inc.
PO Box 3889
Federal Way, Washington 98063

Attention: Randy Lloyd

Greetings:

Earth Solutions NW, LLC (ESNW) is pleased to present this report to support the proposed development. Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. Subsurface exploration indicates the site is underlain predominantly by recessional outwash deposits. The native soils were observed in a chiefly moist and medium dense to dense condition extending to the termination depth of all subsurface explorations advanced across the site. Slight caving was noted at representative subsurface exploration locations within the recessional outwash deposits due to the cohesionless nature of the native soil.

Based on our findings, the proposed townhome structures may be constructed on conventional continuous and spread footing foundations bearing upon competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. Native soil conditions considered suitable for support of the proposed structures will likely be encountered beginning at a depth of about two to three feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of the soil to the specifications of structural fill or overexcavation and replacement with suitable structural fill will be necessary.

The gravel-dominant native soils exhibit excellent infiltration characteristics and are suitable to support large-scale infiltration design. Further discussion can be found within the *Preliminary Infiltration Design* section of this study.

Pertinent geotechnical recommendations for the proposed residential development are provided in this report. We appreciate the opportunity to be of service to you on this project. Please call if you have any questions about this report or if we can be of further assistance.

Sincerely,

EARTH SOLUTIONS NW, LLC

Adam Z. Shier, L.G.
Project Geologist

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PUYALLUP, WASHINGTON

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INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed residential development to be constructed at 113 – 27th Avenue Southeast, in Puyallup, Washington. The purpose of this study was to develop geotechnical recommendations to aid with the design and construction of the subject project. The following tasks were completed as part of our scope of services for this project:

- Subsurface exploration to characterize the soil and groundwater conditions.
- Preliminary infiltration evaluation based primarily on our field observations and laboratory analyses, including estimated infiltration rates using the Soil Grain Size Analysis method.
- Laboratory testing of representative soil samples collected on site.
- Engineering analyses for the proposed residential development.
- Preparation of this report.

Project Description

According to the referenced preliminary site plan, the site is proposed to be developed with nine townhome units. An ingress/egress and utilities easement will be maintained from 27th Avenue Southeast. The stormwater tract is currently proposed in the southern section of the subject area.

At the time of report submission, specific building load plans were not available for review; however, based on our experience with similar developments, the proposed residential structures will likely be two to three stories in height and constructed using relatively lightly loaded wood framing supported on conventional foundations. Perimeter footing loads will likely be about 1 to 2 kips per linear foot. Slab-on-grade loading is anticipated to be approximately 150 pounds per square foot (psf).

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

SITE CONDITIONS

Surface

The subject site is located north of 27th Avenue Southeast, approximately 200 feet east of the intersection of South Meridian, in Puyallup, Washington. The approximate site location is illustrated on Plate 1 (Vicinity Map). The overall site area consists of one tax parcel (Pierce County Parcel No. 0419032099), totaling a gross site area of approximately 0.73 acres.

The subject site is currently unoccupied, and vegetation consists of field grass, mature trees, and brush. Based on review of readily available topographic information, site topography generally descends towards the north and northwest with total elevation change of about 35 feet across the subject site (with varying slope inclinations). Isolated portions of the site contain steep slope areas of 40 percent (or greater) inclination and vertical elevation change of at least 10 feet. Further discussion on pertinent geologically hazardous areas can be found in the *Geologic Hazard Areas* section of this report.

Subsurface

An ESNW representative observed, logged, and sampled four test pits and three soil borings across the site. The subsurface explorations were completed to assess and classify the site soils and to characterize the groundwater conditions within areas proposed for new development. The borings were completed on November 20, 2024, with a maximum drilling depth of about 18 feet below the existing ground surface (bgs). The test pits were completed on November 26, 2024, with a maximum excavation depth of about 15 feet bgs.

The approximate subsurface exploration locations are depicted on Plate 2 (Subsurface Exploration Plan). Please refer to the subsurface exploration logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the subsurface 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 and Fill

Topsoil was encountered at one of the test pit locations within the upper six inches of existing grades. Deeper or shallower pockets of topsoil may be encountered locally across the site. The topsoil was characterized by a dark brown color, the presence of fine organic material, and small root intrusions.

Limited fill was observed at two of the test pit locations and one of the boring locations in proximity to previous site development. The fill extended from the surface to a depth of roughly one-and-one-half-foot bgs at the test pit locations and a depth of about seven feet at the boring location. The observed fill is likely attributed to the previous site development and consisted primarily of silty sand and silty gravel (USCS: SM and GM, respectively).

Native Soil

Underlying topsoil and limited fill, native soils consisted primarily of silty gravel, well-graded gravel with variable silt and sand content, poorly graded gravel with silt and sand, and silty sand with gravel (USCS: GM, GW, GW-GM, GP-GM, and SM, respectively). The native soils were observed to be in a chiefly moist and medium dense to dense condition and extended to the maximum termination depth of 18 feet bgs. Slight caving was noted at the test pit locations due to the cohesionless nature of the native soil.

Geologic Setting

The referenced geologic map resource identifies recessional outwash (Qgo) deposits as the primary geologic unit underlying the site. As reported on the geologic map resource, the recessional outwash is described as silt, clay, sand, and gravel deposited by glacial meltwater. Additionally, recessional outwash gravels, locally known as Steilacoom gravel (Qgo_{sg}), are mapped immediately north and west of the subject site. As reported on the geologic map resource, the Steilacoom gravel outwash is described as pebbles with boulders.

The referenced Web Soil Survey (WSS) identifies two distinct soil types across the subject site: Everett very gravelly sandy loam, 8 to 15 percent slopes, is mapped across the northern two-thirds of the site; and Kitsap silt loam, 2 to 8 percent slopes, is mapped within the southern one-third of the site. Everett series soils are associated with moraines, eskers, and kames and are derived from sandy and gravelly glacial outwash. The Kitsap series soils are associated with terraces and are derived from glaciolacustrine deposits.

Based on the subsurface investigation, the soil conditions observed at the test pit and boring locations generally correlate with recessional outwash, specifically the Steilacoom gravel deposits outlined in this section.

Groundwater

During the November 2024 subsurface explorations, groundwater seepage was not encountered at the subsurface exploration 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 should be expected in site excavations, particularly if excavations are made during the wetter months of the year.

Two groundwater monitoring standpipe piezometers and one groundwater monitoring well were installed during the subsurface explorations for groundwater monitoring purposes. ESNW is currently contracted to complete groundwater monitoring services during the 2024–2025 wet season. ESNW will evaluate the seasonal high groundwater table elevation and prepare a summary letter once the 2024–2025 wet season concludes and the monitoring data is analyzed.

GEOLOGIC HAZARD AREAS

ESNW understands that the City of Puyallup recognizes areas susceptible to the processes of landslides, erosion, seismic, and volcanic activity as geologically hazardous areas, as outlined in Chapter 21.06 of the Puyallup Municipal Code (PMC). Based on our investigation, the site contains a landslide hazard area.

Slope Reconnaissance

During our site visits, ESNW completed a reconnaissance across the on-site slope areas to identify signs of instability. The sloped areas on the site are generally vegetated with mature trees, saplings, and groundcover, which consists primarily of ferns and shrubs. No obvious signs of recent erosion or soil movement were observed during the slope reconnaissance. Based on our investigation, the observed slope areas generally exhibit good stability in the current condition and configuration.

Landslide Hazard Areas

PMC 21.06.1210 defines a landslide hazard area as an area subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include any areas susceptible to landslide because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors, and include, at a minimum, the following:

1. Areas of historic failures, such as:

    a. Those areas delineated by the USDA NRCS as having a significant limitation for building site development;

    b. Those coastal areas mapped as class “u” (unstable), “uos” (unstable old slides), and “urs” (unstable recent slides) in the Department of Ecology Washington Coastal Atlas; or

    c. Areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the United States Geological Survey or Washington Department of Natural Resources.

2. Areas with all three of the following characteristics:

   a. Slopes steeper than 15 percent;

   b. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and

   c. Springs or groundwater seepage.

3. Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of this epoch.

4. Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials.

5. Slopes having gradients steeper than 80 percent subject to rockfall during seismic shaking.

6. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones.

7. Areas that show evidence of or are at risk from snow avalanches.

8. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding.

9. Any area with a slope of 40 percent or steeper and with a vertical relief of 10 or more feet except areas composed of bedrock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least 10 feet of vertical relief.

Criteria “1” through “8” either do not apply to the site or refer to geologic conditions which are not present on the site. Criterion “9” applies to the descending slope located in proximity to the northern property boundary. As such, the site contains a landslide hazard area, as defined by the PMC, due to the presence of the slope.

Slope Stability Analysis

Due to the proximity of the proposed project to an identified landslide hazard area, ESNW evaluated slope stability across the subject site with primary focus on areas likely to be influenced by the proposed modifications and the landslide hazard area. Global slope stability analysis was completed using the 2024 GeoStudio Slope/W modeling program to reflect existing and proposed conditions in both static and seismic scenarios, including foundation loading where applicable. The analysis focused primarily on deep-seated rotational failures and was completed using topographic data available through the referenced documents. One cross-section (A-A’) was prepared and is depicted on Plate 2 (Subsurface Exploration Plan).

The soil stratigraphy was modeled as one distinct soil unit based on conditions observed during the subsurface explorations. We utilized relatively conservative strength parameters in our slope modeling, which are outlined in the table below. Additional modeling parameters are presented in Appendix C. Groundwater was not included in the modeling, since a pervasive groundwater condition was not observed during the November 2024 subsurface explorations.

Soil Unit	Density	Unit Weight (pcf)	Cohesion (psf)	Internal Friction Angle (deg)
Outwash	Medium dense	135	0 (static) 0 (seismic)	36

Our analyses indicate the proposed site modifications will improve overall slope stability by reducing slope loading, as the proposed site modification and excavation will reduce the overall soil mass and driving forces for downslope failure. Safety factors for the proposed condition (including new foundation and seismic loading) reflect an improvement over the existing condition. In our opinion, the proposed development and positioning of the new residential townhome structures should be considered feasible from a geotechnical standpoint.

Our analyses indicate the proposed townhome construction will not have an adverse impact on global slope stability (and will instead have a positive impact), and the site will maintain acceptable factor-of-safety (FOS) values in the post-construction condition. In general, the modeling suggests the site is stable, and in our opinion, the identified 20-foot rear yard setback is adequate from a geotechnical standpoint.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our investigation, construction of the proposed townhome development is feasible from a geotechnical standpoint. The primary geotechnical considerations associated with the proposed development include site preparation and earthwork, utility installation, foundation support, slab-on-grade support, the suitability of using on-site soils as structural fill, and stormwater facility installation and drainage.

Subsurface exploration indicates the site is underlain by native gravel soils consisting primarily of recessional outwash gravels. The native soils were observed to be in a chiefly dry and medium dense to dense condition and extended to the maximum termination depth of 18 feet bgs. Slight caving was noted at the subsurface exploration locations due to the cohesionless nature of the native soil.

In general, competent native soil suitable for support of foundations will likely be encountered beginning at depths of about two to three feet bgs across the site. The proposed structures can be constructed on conventional continuous and spread foundations supported on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil.

The gravel-dominant native soils exhibit excellent infiltration characteristics and are suitable to support large-scale infiltration design. The local groundwater table was not observed during the November 2024 exploration. Further discussion can be found within the *Preliminary Infiltration Design* section of this study.

Site Preparation and Earthwork

Initial site preparation activities will consist of installing temporary erosion control measures, establishing grading limits, and site clearing and stripping activities. Subsequent earthwork activities will involve mass site grading and installation of infrastructure and stormwater management improvements.

Temporary Erosion Control

The following temporary erosion and sediment control (TESC) Best Management Practices (BMPs) are offered:

- Temporary construction entrances and drive lanes, consisting of at least six inches of quarry spalls, should be considered to both minimize off-site soil tracking and provide a stable access entrance surface. Placing geotextile fabric underneath the quarry spalls will provide greater stability, if needed.

- Silt fencing should be placed around the construction site perimeter.

- When not in use, soil stockpiles should be covered or otherwise protected.

- Temporary measures for controlling surface water runoff, such as interceptor trenches, sumps, or swales, should be installed prior to beginning earthwork activities.

- Dry soils disturbed during construction should be wetted to minimize dust and airborne soil erosion.

Additional TESC BMPs, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. TESC BMPs must be actively monitored, and may be modified during construction as site conditions require and in consultation with the site erosion control lead, to ensure BMPs are performing as intended.

Excavations and Slopes

Based on the soil conditions observed at the subsurface exploration locations, excavation activities are likely to expose cohesionless native gravel soils beginning at depths of approximately 12 to 36 inches below the existing ground surface. In accordance with Federal Occupation Safety and Health Administration and Washington Industrial Safety and Health Act soil classifications and maximum allowable temporary slope inclinations, the native cohesionless gravel is classified as Type C soil and should be sloped no steeper than one-and-one-half to one horizontal (1.5H:1V) during construction.

Permanent slopes should be planted with vegetation to both enhance stability and minimize erosion and should maintain a gradient of 2H:1V or flatter. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations, as necessary. If the recommended temporary slope inclinations cannot be achieved, temporary shoring may be necessary to support excavations.

In-situ and Imported Soil

The in-situ soils encountered at the subject site have a low sensitivity to moisture and were generally in a dry to moist condition at the time of exploration. Soils anticipated to be exposed on site will likely be too dry to attain adequate compaction in situ and will require moisture conditioning (through the addition of water) prior to use as structural fill. An ESNW representative should be contacted to determine the suitability of in-situ soils for use as structural fill at the time of construction.

Imported soil intended for use as structural fill should be evaluated by ESNW during construction. The imported soil must be workable to the optimum moisture content, as determined by the Modified Proctor Method (ASTM D1557), at the time of placement and compaction. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. Structural fill placed and compacted during site grading activities should meet the following specifications and guidelines:

- Structural fill material — Granular soil*****
- Moisture content — At or slightly above optimum**
- Relative compaction — 95 percent (Modified Proctor)
- Loose lift thickness (maximum) — 12 inches

* *Existing soil may not be suitable for use as structural fill unless at (or slightly above) the optimum moisture content at the time of placement and compaction.*

** *Soil shall not be placed dry of the optimum moisture content and should be evaluated by ESNW during construction.*

With respect to underground utility installations and backfill, local jurisdictions may dictate the soil type(s) and compaction requirements. Areas of otherwise unsuitable material and debris should be removed from structural areas and replaced with structural fill.

<u>Foundations</u>

The proposed structures can be constructed on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. Provided site earthwork activities are completed in accordance with the recommendations provided above, suitable soil conditions are expected to be exposed at foundation subgrade elevations.

Where loose or unsuitable soil conditions are encountered at foundation subgrade elevations, compaction of the soils to the specifications of structural fill or overexcavation and replacement with suitable structural fill will likely be necessary. An ESNW representative should be contacted to confirm suitability of foundation subgrades at the time of construction.

Provided the structures will be supported as described above, the following parameters may be used for design of the new foundations:

- Allowable soil bearing capacity — 2,500 psf
- Passive earth pressure — 300 pcf
- Coefficient of friction — 0.40

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The passive earth pressure and coefficient of friction values include a safety factor of 1.5. With structural loading as expected, total settlement in the range of one inch is anticipated, with differential settlement of about one-half inch. The majority of the settlement should occur during construction as dead loads are applied.

Seismic Design

The 2021 International Building Code (2021 IBC) recognizes ASCE 7-16 (formally known as the Minimum Design Loads and Associated Criteria for Buildings and Other Structures manual) for seismic design, specifically with respect to earthquake loads. Based on the soil conditions encountered at the test pit and boring locations, the parameters and values provided below are recommended for seismic design per the 2021 IBC.

Parameter	**Value**
Site Class	D*
Mapped short period spectral response acceleration, S_S (g)	1.264
Mapped 1-second period spectral response acceleration, S_1 (g)	0.436
Short period site coefficient, F_a	1.0
Long period site coefficient, F_v	1.864**
Adjusted short period spectral response acceleration, S_{MS} (g)	1.264
Adjusted 1-second period spectral response acceleration, S_{M1} (g)	0.813**
Design short period spectral response acceleration, S_{DS} (g)	0.843
Design 1-second period spectral response acceleration, S_{D1} (g)	0.542**

* *Assumes dense native soil conditions, encountered to a maximum depth of 18 feet bgs during the November 2024 field exploration, remain dense to at least 100 feet bgs. Based on our experience with the project geologic setting (recessional deposits) across the Puget Sound region, site soils are likely consistent with this assumption.*

** *Values assume F_v may be determined using linear interpolation per Table 11.4-2 in ASCE 7-16.*

Liquefaction Susceptibility

The referenced liquefaction susceptibility map indicates the subject site possesses very low liquefaction susceptibility. Liquefaction is a phenomenon that can occur within a soil profile as a result of an intense ground shaking or loading condition. Most commonly, liquefaction is caused by ground shaking during an earthquake. Sand or silt soil profiles that are loose, cohesionless, and present below the groundwater table are most susceptible to liquefaction. During the ground shaking, the soil contracts, and porewater pressure increases. The increased porewater pressure occurs quickly and without sufficient time to dissipate, resulting in water flowing upward to the ground surface and a liquefied soil condition. Soil in a liquefied condition possesses very little shear strength in comparison to the drained condition, which can result in a loss of foundation support for structures.

In our opinion, site susceptibility to liquefaction may be considered low. This opinion is based on the lack of shallow groundwater conditions and the relatively dense, gravel-dominant characteristics of the native soil.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed structures should be supported on firm and unyielding subgrades. Unstable or yielding subgrade areas should be recompacted or overexcavated and replaced with suitable structural fill prior to slab construction.

Where free-draining native gravel soils are not exposed at the subgrade, a capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below the slab. The free-draining material should have a fines content of 5 percent or less defined as the percent passing the number 200 sieve, based on the minus three-quarters-inch fraction. In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If used, the vapor barrier should consist of a material specifically designed to function as a vapor barrier and should be installed in accordance with the manufacturer’s specifications.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for design:

- Active earth pressure (unrestrained condition) 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) 55 pcf
- Traffic surcharge* (passenger vehicles) 70 psf (rectangular distribution)
- Passive earth pressure 300 pcf (equivalent fluid)
- Coefficient of friction 0.40
- Seismic surcharge 8H psf**
- Allowable soil bearing capacity 2,500 psf

* *Where applicable.*
** *Where H equals the retained height (in feet).*

The above passive earth pressure and coefficient of friction values include a safety factor of 1.5 and are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along with the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of less permeable soil if desired. A sheet drain may be considered instead of free-draining backfill. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. A typical retaining wall drainage detail is provided on Plate 3. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Drainage

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. Grades adjacent to buildings should be sloped away from the buildings at a gradient of either at least 2 percent for a horizontal distance of 10 feet or the maximum allowed by adjacent structures.

In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4. However, due to the well-drained nature of the native recessional outwash, elimination of footing drains may be feasible from a geotechnical standpoint. ESNW should be consulted to further evaluate the need for footing drains at the time of foundation construction. If buildings will incorporate crawlspaces rather than slab-on-grade, it is our opinion that a crawlspace drain system can be used in lieu of perimeter footing drains. The crawlspace drain must provide positive drainage to an appropriate outlet.

Preliminary Infiltration Design

From a geotechnical standpoint, infiltration is considered feasible where targeted within the native outwash gravels, such as those exposed at the subsurface exploration locations. Per local mapping designations, the on-site soils are primarily associated with the Everett very gravelly sandy loam soil series and are assigned to hydrologic soil group A. In accordance with Option 3 in Volume V of the 2019 Stormwater Management Manual for Western Washington (2019 SWMMWW), the Soil Grain Size Analysis method was used to determine design infiltration rates. The table below depicts sample locations and depths, encountered soil types, appropriate safety factors, and calculated design rates (based on the Massmann [2003] equation).

Test Location ID	Test Depth	K_{sat} initial	CF_v	CF_t	CF_m	K_{sat} design
B-1	10.0 ft	>100 in/hr	0.9	0.5	0.9	>30 in/hr
B-1	15.0 ft	>100 in/hr				>30 in/hr
TP-3	9.0 ft	92 in/hr				>30 in/hr
TP-3	15.0 ft	55 in/hr				22 in/hr
TP-4	3.0 ft	>>100 in/hr				>>30 in/hr
TP-4	10.0 ft	>>100 in/hr				>>30 in/hr

Based on utilization of the Soil Grain Size Analysis method, design infiltration rates of between 22.0 in/hr and greater than 30 in/hr were calculated for the native outwash gravels. **It is our opinion that the lowest rate (22 in/hr) be used for preliminary sizing and initial design** of facilities that will target the native outwash gravels. As project plans develop, it may prove beneficial to re-evaluate the recommendations provided herein, which could yield higher recommended design infiltration rates based on review of specific facility locations, depths, and groundwater table conditions. Regardless of the allowable design methods allowed by the 2019 SWMMWW, ESNW recommends completion of in-situ testing, prior to acceptance of the final stormwater design, as a means to lower the risk associated with infiltration designs based solely on grain size analysis.

An ESNW representative should be requested to confirm soil conditions are as anticipated, provide confirmation testing, and provide additional recommendations as necessary, during construction. Infiltration facilities must also maintain adequate separation from the underlying groundwater table. Groundwater monitoring wells were installed at representative test pit and boring locations to allow for seasonal groundwater level monitoring during the 2024–2025 wet season. ESNW would be pleased to provide additional consulting services pertaining to infiltration feasibility and design, if requested.

Preliminary Pavement Sections

The performance of site pavements is largely related to the condition of the underlying subgrade. To ensure adequate pavement performance, the subgrade should be in a firm and unyielding condition when subjected to proofrolling with a loaded dump truck. Structural fill in pavement areas should be compacted to the specifications previously detailed in this report. Soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas containing unsuitable or yielding subgrade conditions will require remedial measures, such as overexcavation and/or placement of thicker crushed rock or structural fill sections, prior to pavement.

We anticipate new pavement sections will be subjected primarily to passenger vehicle traffic. For lightly loaded pavement areas subjected primarily to passenger vehicles, the following preliminary pavement sections may be considered:

- A minimum of two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB).

- A minimum of two inches of HMA placed over three inches of asphalt-treated base (ATB).

Heavier traffic areas generally require thicker pavement sections depending on site usage, pavement life expectancy, and site traffic. For preliminary design purposes, the following pavement sections for occasional truck traffic and access roadways may be considered:

- Three inches of HMA placed over six inches of CRB.

- Three inches of HMA placed over four and one-half inches of ATB.

The HMA, ATB, and CRB materials should conform to WSDOT and/or City of Puyallup specifications. All soil base material should be compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by ASTM D1557. Final pavement design recommendations, including recommendations for heavy traffic areas, access roads, and frontage improvement areas, can be provided once final traffic loading has been determined. Road standards utilized by the City of Puyallup may supersede the recommendations provided in this report.

If an inverted crown will be used for roadway surfaces, drainage measures should be included in the design to prevent accumulation of water in the subgrade adjacent to catch basins. Such measures should consist of finger drains extending from the catch basins.

Utility Support and Trench Backfill

In our opinion, the on-site soil will generally be suitable for support of utilities. Use of the native soil as structural backfill in the utility trench excavations will depend on the in-situ moisture content at the time of placement and compaction. If native soil is placed below the optimum moisture content, settlement will likely occur once wet weather impacts the trenches. As such, backfill soils should be properly moisture conditioned, as necessary, to ensure acceptability of the soil moisture content at the time of placement and compaction. Utility trench backfill should be placed and compacted to the specifications of structural fill provided in this report or to the applicable requirements of the presiding jurisdiction. Due to the presence of gravel outwash soils, particles larger than six inches in size should be removed and not used as utility trench backfill material.

LIMITATIONS

This study has been prepared for the exclusive use of Lloyd Enterprises, Inc., and its representatives. The recommendations and conclusions provided in this study are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. No warranty, express or implied, is made. Variations in the subsurface conditions observed at the test locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this study if variations are encountered.

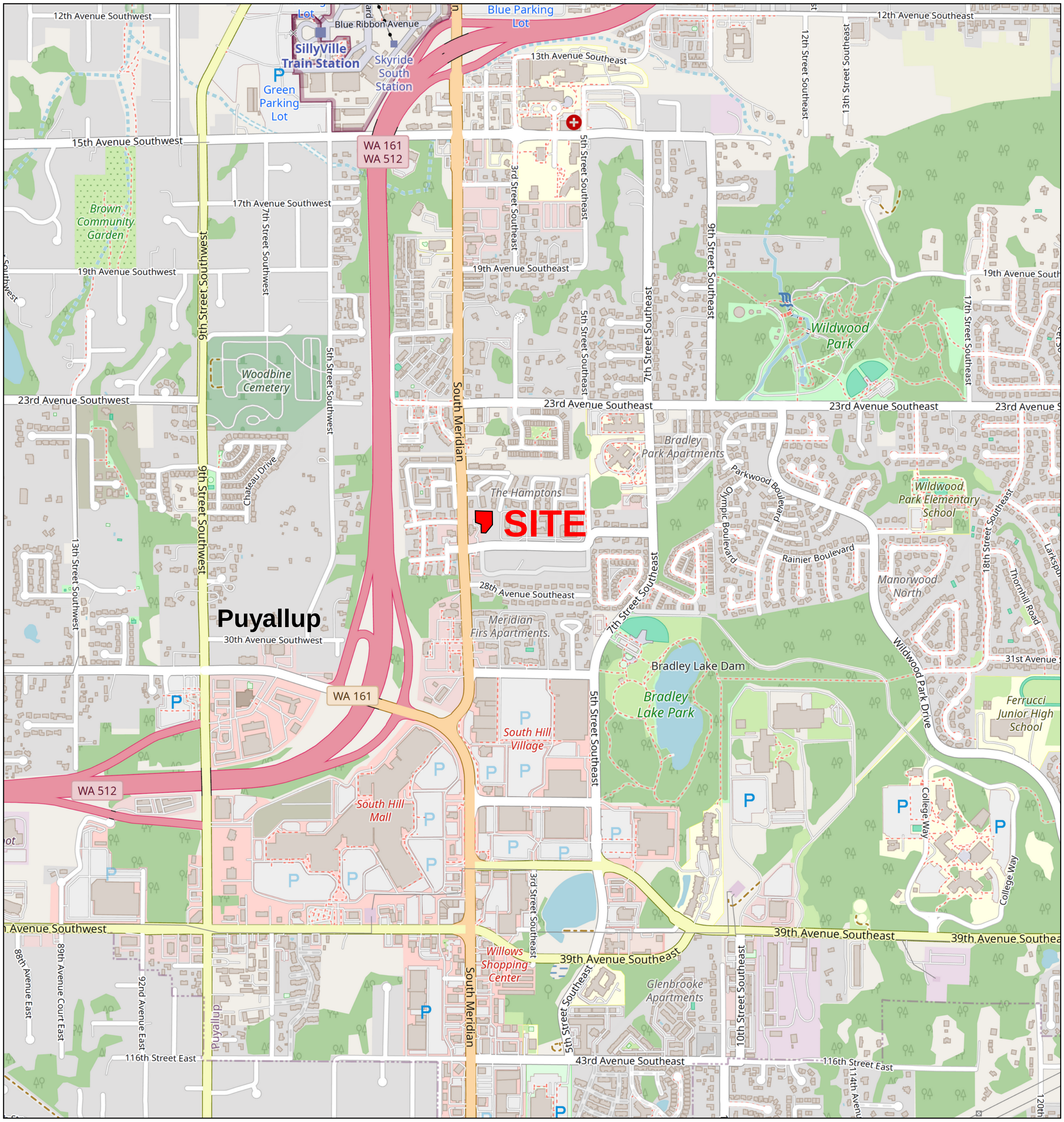
Additional Services

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

REFERENCES

The following documents were reviewed as part of the preparation of this study:

- 2019 Stormwater Management Manual for Western Washington
- Chapter 21.06, Article XII of the Puyallup Municipal Code
- Geologic Map of the Tacoma 1:100,000-Scale Quadrangle, Washington, prepared by James E. Schuster et al., dated 2015
- Liquefaction Susceptibility Map of Pierce County, Washington, by Palmer, S.P. et al., dated September 2004
- Preliminary Site Plan (9 Units), prepared by CES NW, Inc., dated November 5, 2024
- Web Soil Survey, maintained by the Natural Resources Conservation Service under the United States Department of Agriculture



Reference:
Pierce County, Washington
OpenStreetMap.org

NORTH

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

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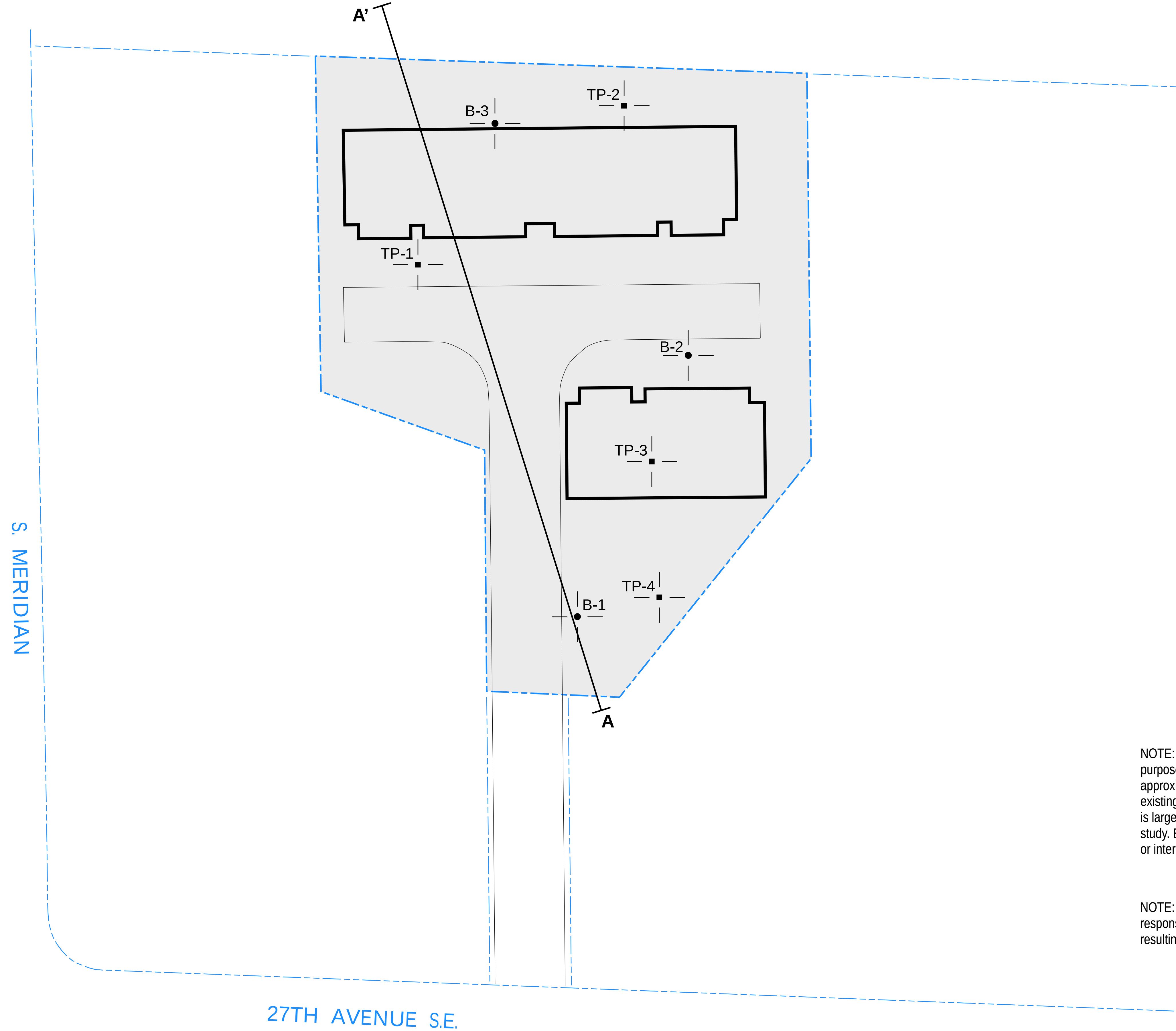
Vicinity Map
27th Avenue S.E. Townhomes
Puyallup, Washington

Drawn MRS	Date 12/27/2024	Proj. No. 10212
Checked AZS	Date Dec. 2024	Plate 1



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-10212, Nov. 2024

B-1 — Approximate Location of ESNW Boring, Proj. No. ES-10212.01, Nov. 2024

Subject Site

Proposed Building

NORTH

NOT - TO - SCALE

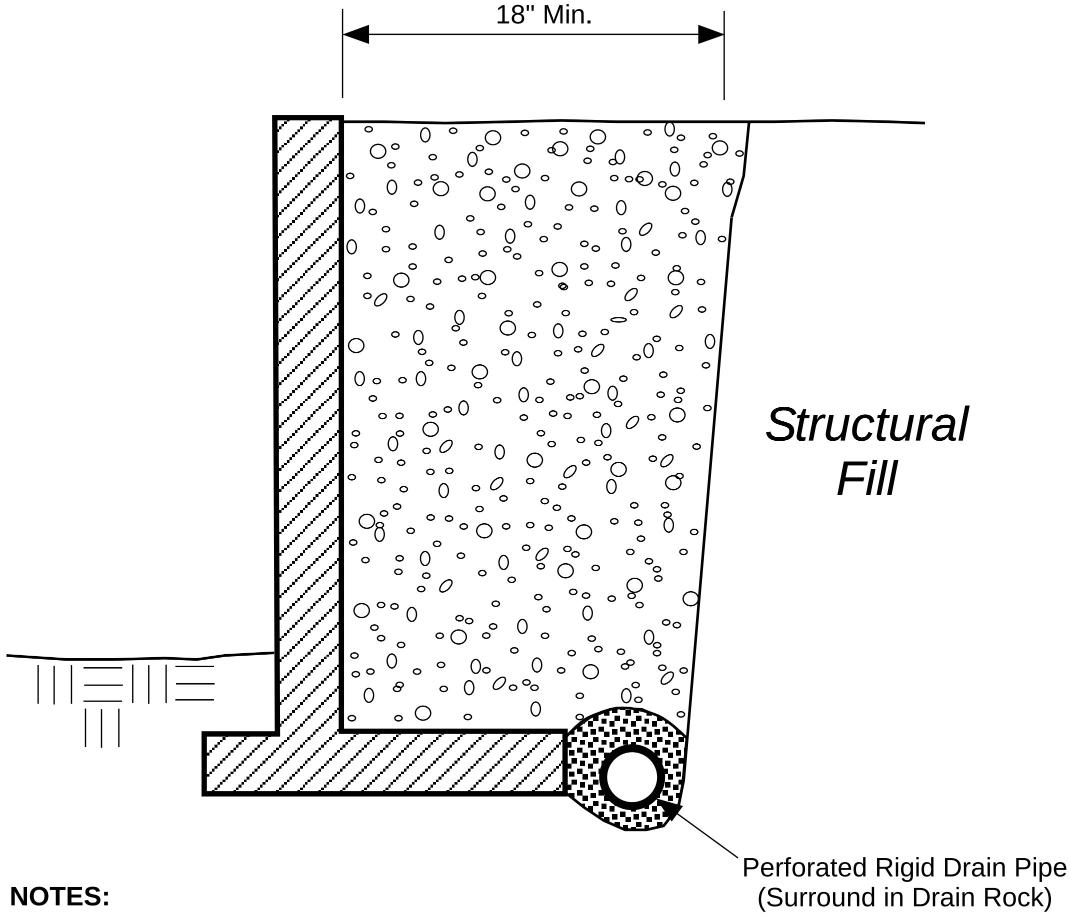
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided 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
27th Avenue S.E. Townhomes
Puyallup, Washington

Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Drawn	MRS
Checked	AZS
Date	01/22/2025
Proj. No.	10212
Plate	2



NOTES:

- Free-draining Backfill should consist of soil having less than 5 percent fines. Percent passing No. 4 sieve should be 25 to 75 percent.
- Sheet Drain may be feasible in lieu of Free-draining Backfill, per ESNW recommendations.
- Drain Pipe should consist of perforated, rigid PVC Pipe surrounded with 1-inch Drain Rock.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

Free-draining Structural Backfill

1-inch Drain Rock

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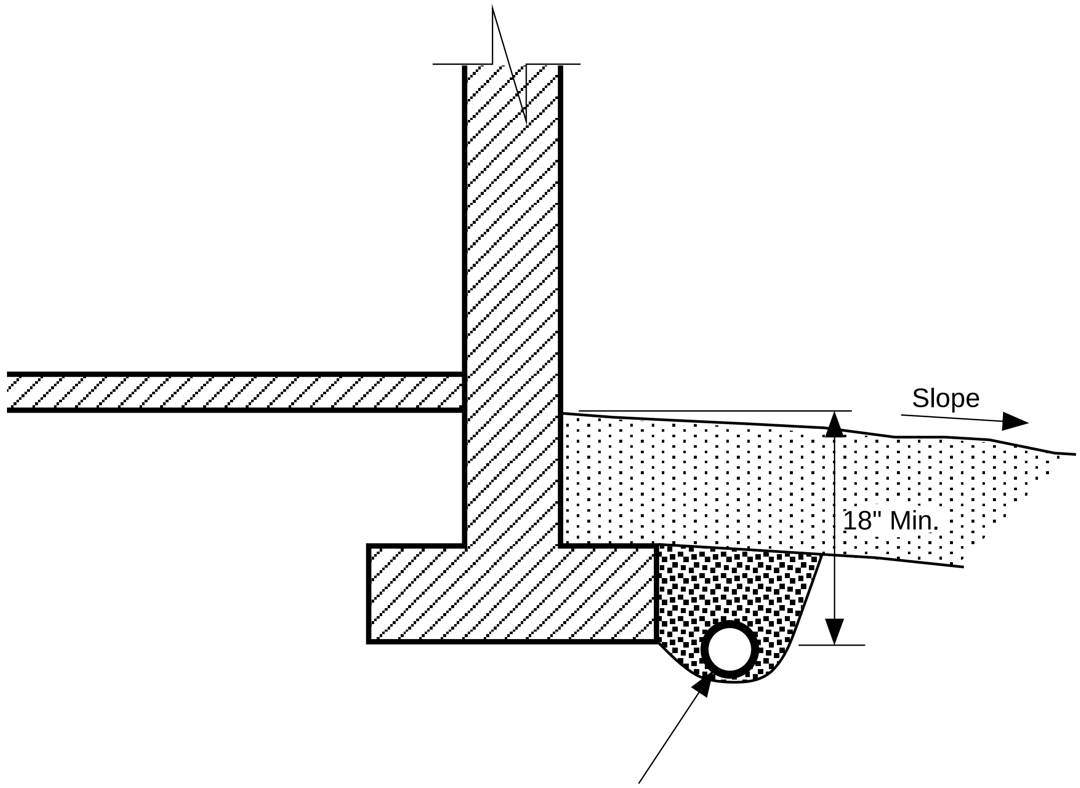
Retaining Wall Drainage Detail
27th Avenue S.E. Townhomes
Puyallup, Washington

Drawn MRS	Date 12/27/2024	Proj. No. 10212
Checked AZS	Date Dec. 2024	Plate 3



NOTES:

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

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

LEGEND:

(dotted pattern)	Surface Seal: native soil or other low-permeability material.
(dense pattern)	1-inch Drain Rock

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Footing Drain Detail
27th Avenue S.E. Townhomes
Puyallup, Washington

Drawn MRS	Date 12/27/2024	Proj. No. 10212
Checked AZS	Date Dec. 2024	Plate 4

Appendix A

Subsurface Exploration Logs

ES-10212

Subsurface conditions on site were explored on November 20 and 26, 2024. On November 20, 2024, three borings were advanced to a maximum depth of about 18 feet bgs using a hollow-stem auger drill rig and operators retained by ESNW. On November 26, 2024, four test pits were excavated to a maximum depth of approximately 15 feet bgs using a trackhoe and operator retained by ESNW. The approximate locations of the exploration sites are illustrated on Plate 2 of this study. The subsurface exploration logs are provided in this Appendix.

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

Major Divisions			Symbol	Description
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

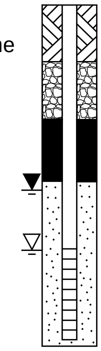
Wet - Water visible but not free draining, likely above optimum MC

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

Symbols

ATD = At time of drilling

Static water level (date)



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.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

EXPLORATION LOG KEY

Earth Solutions NW LLC
15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

BORING NUMBER B-1

PROJECT NUMBER ES-10212.01
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/20/24 **COMPLETED** 11/20/24
GROUND ELEVATION
DRILLING CONTRACTOR Geologic Drill Partners
LATITUDE 47.16625 **LONGITUDE** -122.29241
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF DRILLING**
SURFACE CONDITIONS Field grass
AFTER DRILLING

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					SM		Brown silty SAND with gravel, medium dense, moist to wet (Fill)
2.5	SS	6	15-15-12 (27)	MC = 20.3			
5.0	SS	22	3-5-9 (14)	MC = 15.0			
7.0					GW-GM		Gray well-graded GRAVEL with silt, dense, moist
7.5	SS	44	18-20-16 (36)	MC = 2.8			
9.5					SM		Gray silty SAND with gravel, medium dense, moist [USDA Classification: very gravelly coarse sandy LOAM]
10.0	SS	11	8-12-8 (20)	MC = 5.8 Fines = 14.6			
12.5							
13.0					GM		Gray silty GRAVEL with sand, medium dense to very dense, moist
15.0							

(Continued Next Page)

Earth Solutions NW LLC

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Branch Office: Pasco, WA

BORING NUMBER B-1

PROJECT NUMBER ES-10212.01
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/20/24 **COMPLETED** 11/20/24
GROUND ELEVATION
DRILLING CONTRACTOR Geologic Drill Partners
LATITUDE 47.16625 **LONGITUDE** -122.29241
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
AT TIME OF DRILLING
SURFACE CONDITIONS Field grass
AFTER DRILLING

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
15.0	SS	33	10-14-15 (29)	MC = 6.4 Fines = 12.9	GM		Gray silty GRAVEL with sand, medium dense to very dense, moist *(continued)* [USDA Classification: extremely gravelly coarse sandy LOAM]
17.5	SS	17	50/6"	MC = 7.5		18.0	

Boring terminated at 18.0 feet below existing grade. No groundwater encountered during drilling. 2" PVC standpipe installed to bottom of boring. Lower 10.0 feet slotted. Well ID: BQN 110. Boring backfilled with bentonite/sand.

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 - 10212-1.GPJ - GINT US.GDT - 1/28/25

Earth Solutions NW LLC
15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

BORING NUMBER B-2

PROJECT NUMBER ES-10212.01
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/20/24 **COMPLETED** 11/20/24
GROUND ELEVATION
DRILLING CONTRACTOR Geologic Drill Partners
LATITUDE 47.16650 **LONGITUDE** -122.29222
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
AT TIME OF DRILLING
SURFACE CONDITIONS Field grass
AFTER DRILLING

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					GM		Brown silty GRAVEL, medium dense, moist to wet
2.5	SS	6	5-8-5 (13)	MC = 19.3			
5.0	SS	18	5-7-50/5"	MC = 9.7			
7.0					GW-GM		Gray well-graded GRAVEL with silt and sand, dense, moist
7.5	SS	11	3-14-21 (35)	MC = 1.7			
10.0	SS	11	22-22-21 (43)	MC = 6.9			
12.5							

Boring terminated at 12.5 feet below existing grade due to refusal on cobbles. No groundwater encountered during drilling. Boring backfilled with bentonite.

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.

Earth Solutions NW LLC
15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

BORING NUMBER B-3

PROJECT NUMBER ES-10212.01
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/20/24 **COMPLETED** 11/20/24
GROUND ELEVATION
DRILLING CONTRACTOR Geologic Drill Partners
LATITUDE 47.16672 **LONGITUDE** -122.29252
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF DRILLING**
SURFACE CONDITIONS Field grass
AFTER DRILLING

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0					GM		Gray silty GRAVEL, dense, moist
2.5	SS	11	14-16-27 (43)	MC = 4.6			
5.0	SS	11	46-27-21 (48)	MC = 5.3		7.0	

Boring terminated at 7.0 feet below existing grade due to refusal on gravel. No groundwater encountered during drilling. Boring backfilled with bentonite.

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.

Earth Solutions NW LLC
15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-10212
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/26/24 **COMPLETED** 11/26/24
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 47.16655 **LONGITUDE** -122.29262
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Ivy
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.5	Dark brown TOPSOIL, roots
			GW		Brown well-graded GRAVEL with sand, loose to medium dense, moist
					-probed 1/2"
	GB	MC = 5.4 Fines = 1.5			[USDA Classification: extremely gravelly coarse SAND]
					-probed 1/2"
5					-becomes gray
	GB	MC = 5.0			
10	GB	MC = 3.9			
15	GB	MC = 3.1		15.0	

Test pit terminated at 15.0 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.

Earth Solutions NW LLC
15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

TEST PIT NUMBER TP-2

PROJECT NUMBER ES-10212
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/26/24 **COMPLETED** 11/26/24
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 47.16668 **LONGITUDE** -122.29243
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Field grass
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GM	1.5	Brown silty GRAVEL, loose to medium dense, moist (Fill) -probed 1/2"- 1" -roots -bricks and glass debris
	GB	MC = 2.8	GW		Gray well-graded GRAVEL with sand, medium dense, dry to moist -probed 1/2"
5					-slight caving 0' to 10.5'
	GB	MC = 4.3			
10					
	GB	MC = 2.3			
15	GB	MC = 1.8		15.0	Test pit terminated at 15.0 feet below existing grade. No groundwater encountered during excavation. Caving observed from TOH to 10.5 feet.

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.

15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

TEST PIT NUMBER TP-3

PROJECT NUMBER ES-10212
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/26/24 **COMPLETED** 11/26/24
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 47.16641 **LONGITUDE** -122.29233
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
AT TIME OF EXCAVATION
SURFACE CONDITIONS Brush
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			SM		Gray silty SAND with gravel, medium dense, moist (Fill) -probed 1"
1.5					
	GB	MC = 3.3	GW-GM		Brown well-graded GRAVEL with silt and sand, medium dense, moist
5					-probed 1/2"
					-becomes gray
	GB	MC = 6.5 Fines = 6.6			[USDA Classification: extremely gravelly loamy coarse SAND]
10					
	GB	MC = 5.7			
13.0			GP-GM		Poorly graded GRAVEL with silt and sand, medium dense, moist
15 / 15.0	GB	MC = 6.6 Fines = 7.8			[USDA Classification: extremely gravelly coarse sandy LOAM]

Test pit terminated at 15.0 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.

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Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

TEST PIT NUMBER TP-4

PROJECT NUMBER ES-10212
PROJECT NAME 27th Avenue S.E. Townhomes
DATE STARTED 11/26/24 **COMPLETED** 11/26/24
GROUND ELEVATION
EXCAVATION CONTRACTOR NW Excavating
LATITUDE 47.16624 **LONGITUDE** -122.29225
LOGGED BY AZS **CHECKED BY** KDH
GROUND WATER LEVEL:
NOTES
∇ **AT TIME OF EXCAVATION**
SURFACE CONDITIONS Groundcover
AFTER EXCAVATION

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			GM	2.0	Brown silty GRAVEL, medium dense, moist -probed 1/2"
	GB	MC = 4.5 Fines = 3.7	GW	5.0	Gray well-graded GRAVEL with sand, loose to medium dense, moist [USDA Classification: extremely gravelly coarse sandy LOAM] -probed 1/2" -moderate to severe caving TOH to BOH
5	GB	MC = 2.8	GW-GM	10.0	Gray well-graded GRAVEL with silt, loose to medium dense, moist [USDA Classification: extremely gravelly silt LOAM]
10	GB	MC = 3.6 Fines = 5.0			

Test pit terminated at 10.0 feet below existing grade due to caving. No groundwater during excavation. Caving observed from from TOH to BOH.

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.

Appendix B

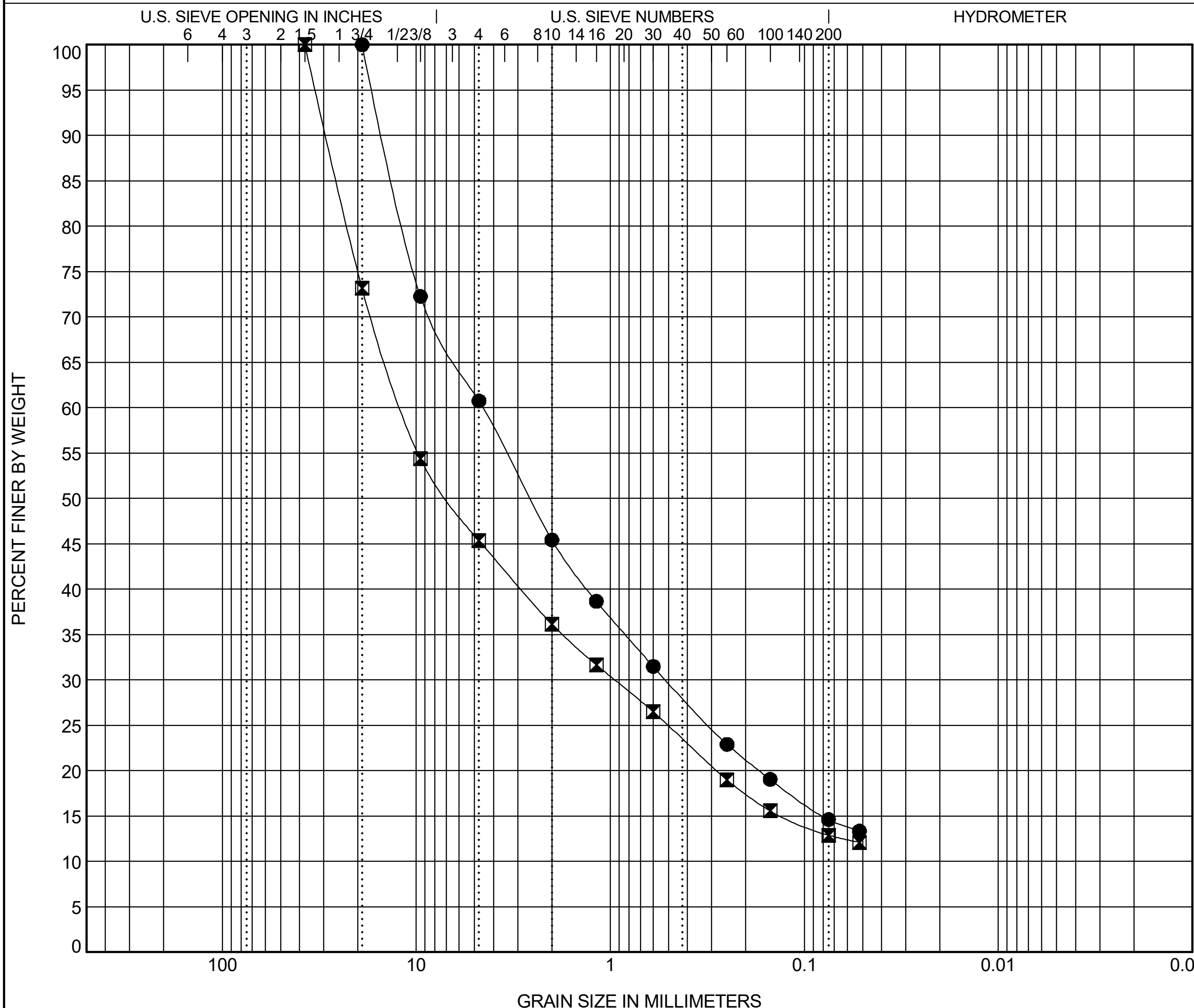
Laboratory Test Results

ES-10212

Earth Solutions NW LLC
15365 NE 90th Street, Suite 100
Redmond, WA 98052
Office (425) 449-4704 | esnw.com
Branch Office: Pasco, WA

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-10212.01 **PROJECT NAME** 27th Avenue S.E. Townhomes



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	B-01	10.00ft.	**USDA: Gray Very Gravelly Coarse Sandy Loam. USCS: SM with Gravel.**		
⊠	B-01	15.00ft.	**USDA: Gray Extremely Gravelly Coarse Sandy Loam. USCS: GM with Sand.**		

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**B-01**	**10.0ft.**	**19**	**4.55**	**0.515**					**14.6**	
⊠	**B-01**	**15.0ft.**	**37.5**	**11.686**	**0.949**					**12.9**	

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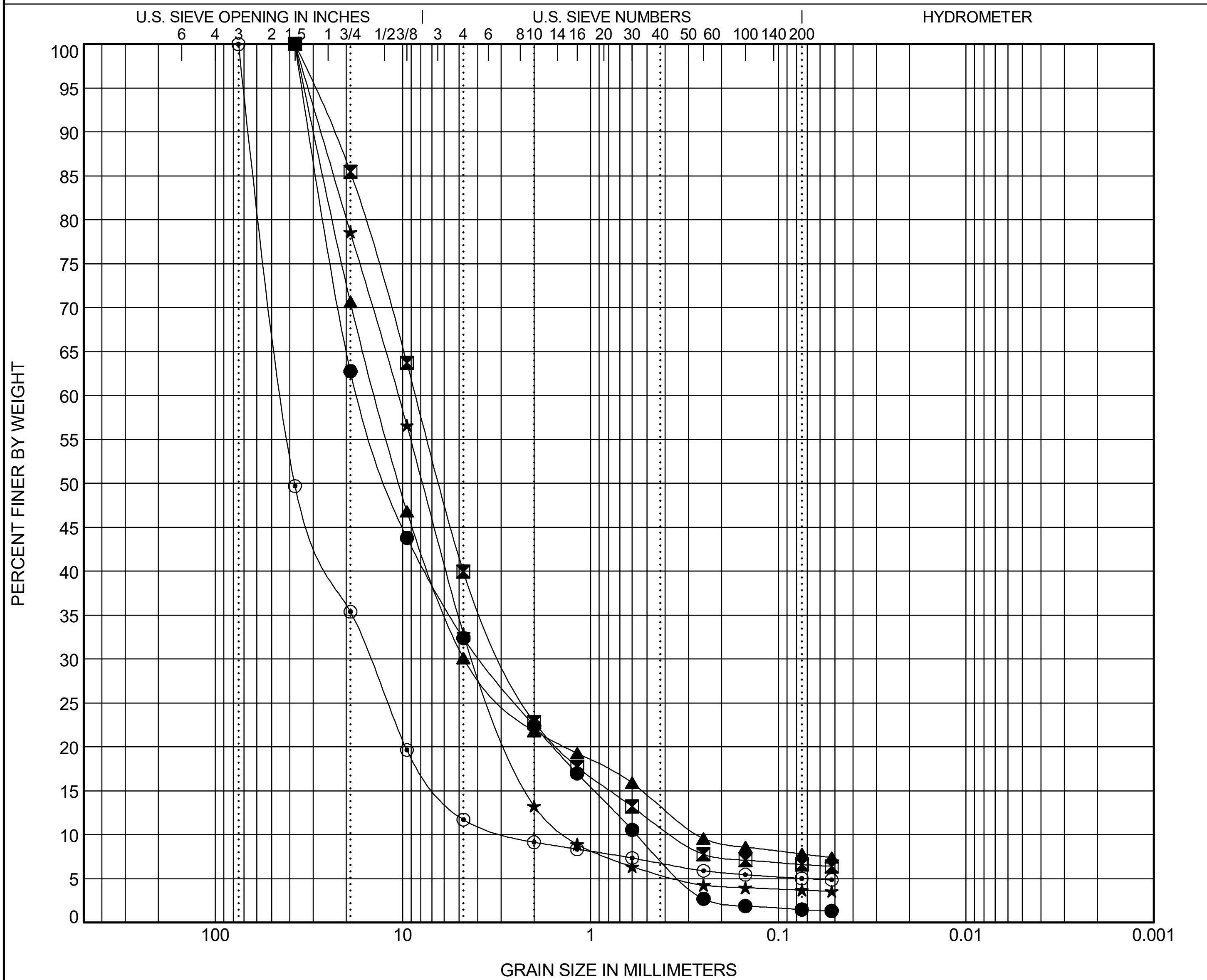
Branch Office: Pasco, WA

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-10212 **PROJECT NAME** 27th Avenue S.E. Townhomes



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

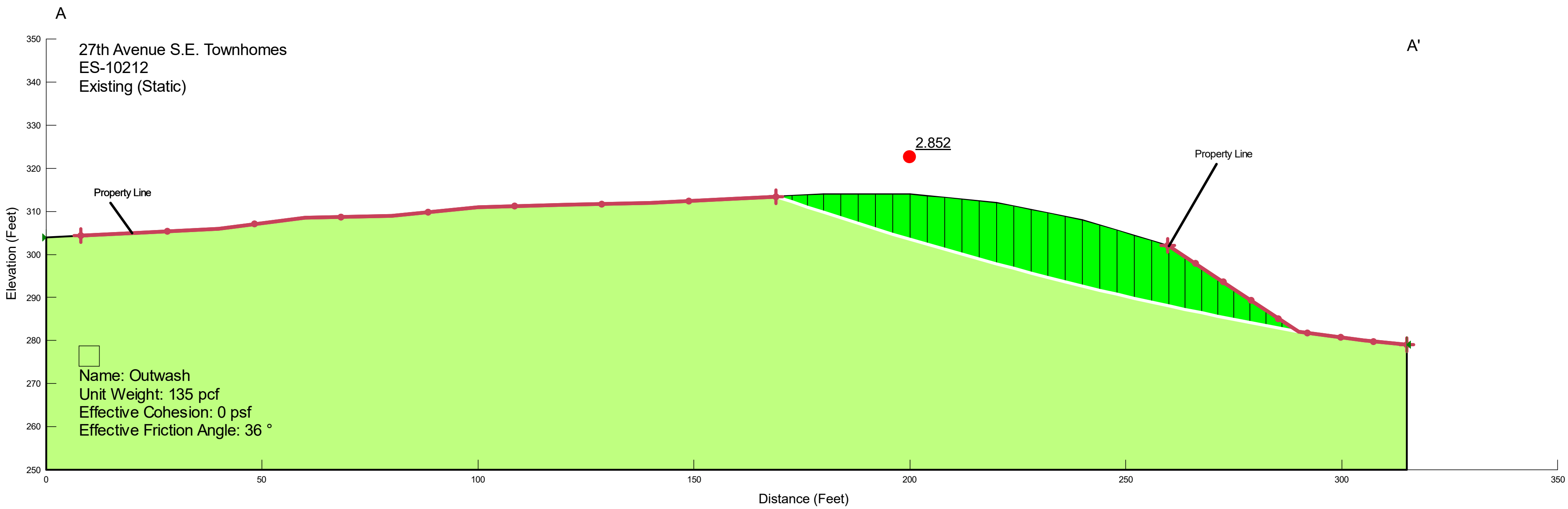
	Specimen Identification		Classification	Cc	Cu
●	**TP-01**	**3.00ft.**	**USDA: Brown Extremely Gravelly Coarse Sand. USCS: GW with Sand.**	**1.54**	**30.47**
⧗	**TP-03**	**9.00ft.**	**USDA: Gray Extremely Gravelly Loamy Coarse Sand. USCS: GW-GM with Sand.**	**2.71**	**23.86**
▲	**TP-03**	**15.00ft.**	**USDA: Gray Extremely Gravelly Coarse Sandy Loam. USCS: GP-GM with Sand.**	**5.95**	**52.56**
★	**TP-04**	**3.00ft.**	**USDA: Gray Extremely Gravelly Coarse Sandy Loam. USCS: GW with Sand.**	**1.23**	**7.87**
⊙	**TP-04**	**10.00ft.**	**USDA: Gray Extremely Gravelly Silt Loam. USCS: GW-GM.**	**1.96**	**16.30**

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**TP-01**	**3.0ft.**	**37.5**	**17.165**	**3.859**	**0.563**				**1.5**	
⧗	**TP-03**	**9.0ft.**	**37.5**	**8.527**	**2.873**	**0.357**				**6.6**	
▲	**TP-03**	**15.0ft.**	**37.5**	**13.935**	**4.69**	**0.265**				**7.8**	
★	**TP-04**	**3.0ft.**	**37.5**	**10.571**	**4.185**	**1.344**				**3.7**	
⊙	**TP-04**	**10.0ft.**	**75**	**43.215**	**14.982**	**2.651**				**5.0**	

Appendix C

Slope/W Computer Output

ES-10212


A
A'
27th Avenue S.E. Townhomes
ES-10212
Existing (Static)
2.852
Property Line
Property Line
Name: Outwash
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 36 °
Elevation (Feet)
Distance (Feet)
350
340
330
320
310
300
290
280
270
260
250
0
50
100
150
200
250
300
350

Slope Stability

File Information

File Version: 11.06
Tool Version: 24.1.0.1406
Title: Cedar Cove
Created By: Adam Shier
Last Edited By: Adam Shier
Revision Number: 97
Date: 01/23/2025
Time: 10:02:22 AM
File Name: 27th ave townhomes existing (Static).gsz
Directory: C:\Users\adam.shier\Desktop\SLope W\
Last Solved Date: 01/23/2025
Last Solved Time: 10:02:23 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Analysis Type: Morgenstern-Price
- Settings
  - Side Function
    - Intercolumn 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
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 4 ft
    - Minimum Slip Surface Volume: 35.314667 ft^3

Number of Columns: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50
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

Outwash

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 36 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (8, 304.4) ft
Left-Zone Right Coordinate: (169, 313.45) ft
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: (259.67204, 302.09839) ft
Right-Zone Right Coordinate: (315, 279) ft
Right-Zone Increment: 8
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 304) ft
Right Coordinate: (315, 279) ft

Seismic Coefficients

Horz Seismic Coef.: 0

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	304 ft
Point 2	20 ft	305 ft
Point 3	40 ft	306 ft
Point 4	60 ft	308.5 ft
Point 5	80 ft	309 ft
Point 6	100 ft	311 ft
Point 7	120 ft	311.5 ft
Point 8	140 ft	312 ft
Point 9	160 ft	313 ft
Point 10	180 ft	314 ft
Point 11	200 ft	314 ft
Point 12	220 ft	312 ft
Point 13	240 ft	308 ft
Point 14	260 ft	302 ft
Point 15	275 ft	292 ft
Point 16	290 ft	282 ft
Point 17	305 ft	280 ft
Point 18	315 ft	279 ft
Point 19	315 ft	250 ft
Point 20	0 ft	250 ft

Regions

	Material	Points	Area
Region 1	Outwash	20,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19	17,560 ft^2

Slip Results

Slip Surfaces Analysed: 345 of 405 converged

Current Slip Surface

Slip Surface: 386

Factor of Safety: 2.852

Volume: 1,218.9642 ft^3

Weight: 164,560.17 lbf

Resisting Moment: 95,208,558 lbf·ft

Activating Moment: 33,386,797 lbf·ft

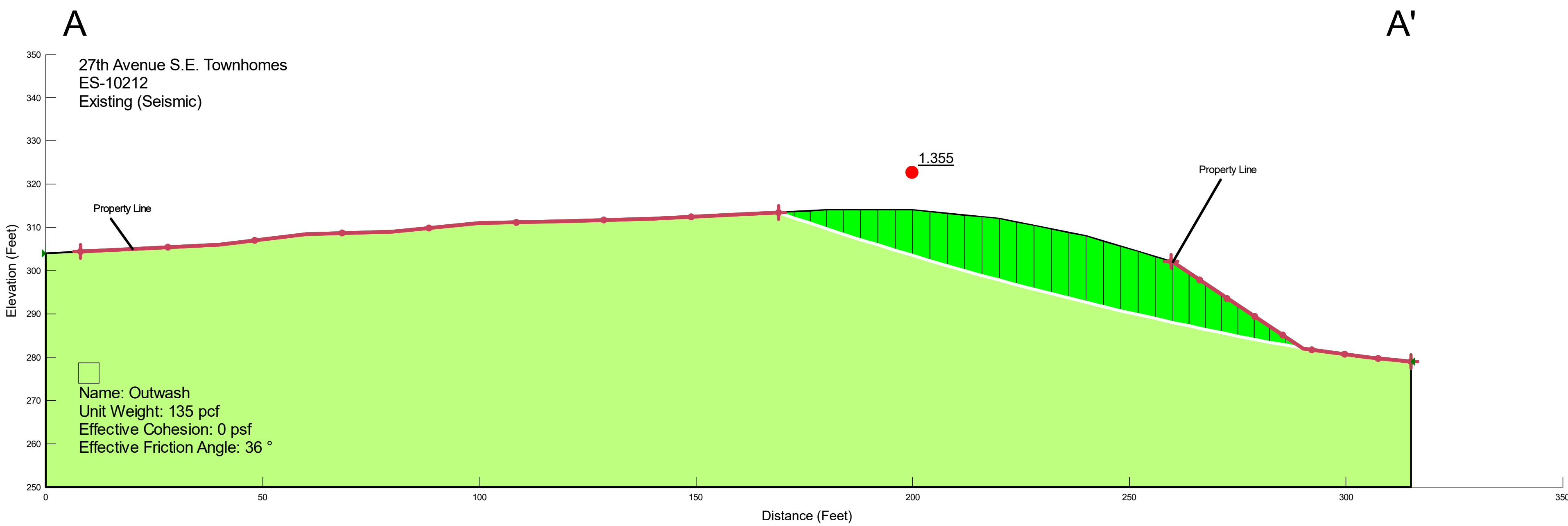
Resisting Force: 112,272.38 lbf

Activating Force: 39,370.541 lbf
Slip Rank: 1 of 405 slip surfaces
Exit: (289.81024, 282.12651) ft
Entry: (169, 313.45) ft
Radius: 821.29911 ft
Center: (434.93857, 1,090.5014) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	170.83333 ft	312.82738 ft	0 psf	88.546972 psf	64.333141 psf	0 psf	0 psf	Outwash
Column 2	174.50000 ft	311.59177 ft	0 psf	264.04968 psf	191.84332 psf	0 psf	0 psf	Outwash
Column 3	178.16667 ft	310.37534 ft	0 psf	436.70207 psf	317.28263 psf	0 psf	0 psf	Outwash
Column 4	182.00000 ft	309.12450 ft	0 psf	602.003 psf	437.38078 psf	0 psf	0 psf	Outwash
Column 5	186.00000 ft	307.84095 ft	0 psf	760.04827 psf	552.20739 psf	0 psf	0 psf	Outwash
Column 6	190.00000 ft	306.57991 ft	0 psf	915.69393 psf	665.29058 psf	0 psf	0 psf	Outwash
Column 7	194.00000 ft	305.34127 ft	0 psf	1,069.2213 psf	776.83476 psf	0 psf	0 psf	Outwash
Column 8	198.00000 ft	304.12493 ft	0 psf	1,220.8826 psf	887.02311 psf	0 psf	0 psf	Outwash
Column 9	202.00000 ft	302.93079 ft	0 psf	1,346.0142 psf	977.93655 psf	0 psf	0 psf	Outwash
Column 10	206.00000 ft	301.75873 ft	0 psf	1,444.6576 psf	1,049.6052 psf	0 psf	0 psf	Outwash
Column 11	210.00000 ft	300.60868 ft	0 psf	1,541.7274 psf	1,120.1305 psf	0 psf	0 psf	Outwash
Column 12	214.00000 ft	299.48052 ft	0 psf	1,637.2303 psf	1,189.5175 psf	0 psf	0 psf	Outwash
Column 13	218.00000 ft	298.37416 ft	0 psf	1,731.1263 psf	1,257.7369 psf	0 psf	0 psf	Outwash
Column 14	222.00000 ft	297.28953 ft	0 psf	1,798.155 psf	1,306.4361 psf	0 psf	0 psf	Outwash
Column 15	226.00000 ft	296.22651 ft	0 psf	1,837.974 psf	1,335.3663 psf	0 psf	0 psf	Outwash
Column 16	230.00000 ft	295.18504 ft	0 psf	1,875.5041 psf	1,362.6335 psf	0 psf	0 psf	Outwash
Column 17	234.00000 ft	294.16502 ft	0 psf	1,910.5363 psf	1,388.0859 psf	0 psf	0 psf	Outwash
Column 18	238.00000 ft	293.16637 ft	0 psf	1,942.8478 psf	1,411.5615 psf	0 psf	0 psf	Outwash
Column 19	242.00000 ft	292.18901 ft	0 psf	1,946.6853 psf	1,414.3496 psf	0 psf	0 psf	Outwash
Column 20	246.00000 ft	291.23286 ft	0 psf	1,921.6355 psf	1,396.1499 psf	0 psf	0 psf	Outwash
Column 21	250.00000 ft	290.29786 ft	0 psf	1,892.9808 psf	1,375.331 psf	0 psf	0 psf	Outwash

Column 22	254.00000 ft	289.38391 ft	0 psf	1,860.5775 psf	1,351.7887 psf	0 psf	0 psf	Outwash
Column 23	258.00000 ft	288.49096 ft	0 psf	1,824.3202 psf	1,325.4462 psf	0 psf	0 psf	Outwash
Column 24	261.87500 ft	287.64555 ft	0 psf	1,696.891 psf	1,232.8634 psf	0 psf	0 psf	Outwash
Column 25	265.62500 ft	286.84635 ft	0 psf	1,478.334 psf	1,074.0725 psf	0 psf	0 psf	Outwash
Column 26	269.37500 ft	286.06542 ft	0 psf	1,256.3131 psf	912.76489 psf	0 psf	0 psf	Outwash
Column 27	273.12500 ft	285.30272 ft	0 psf	1,031.1301 psf	749.15988 psf	0 psf	0 psf	Outwash
Column 28	276.85128 ft	284.56279 ft	0 psf	804.57542 psf	584.55826 psf	0 psf	0 psf	Outwash
Column 29	280.55384 ft	283.84534 ft	0 psf	577.02905 psf	419.23614 psf	0 psf	0 psf	Outwash
Column 30	284.25640 ft	283.14551 ft	0 psf	347.40406 psf	252.40382 psf	0 psf	0 psf	Outwash
Column 31	287.95896 ft	282.46325 ft	0 psf	116.0283 psf	84.299493 psf	0 psf	0 psf	Outwash


A
A'
27th Avenue S.E. Townhomes
ES-10212
Existing (Seismic)
1.355
Property Line
Property Line
Name: Outwash
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 36 °
Elevation (Feet)
Distance (Feet)
350
340
330
320
310
300
290
280
270
260
250
0
50
100
150
200
250
300
350

Slope Stability

File Information

File Version: 11.06
Tool Version: 24.1.0.1406
Title: Cedar Cove
Created By: Adam Shier
Last Edited By: Adam Shier
Revision Number: 97
Date: 01/23/2025
Time: 09:59:22 AM
File Name: 27th ave townhomes existing (Seismic).gsz
Directory: C:\Users\adam.shier\Desktop\SLope W\
Last Solved Date: 01/23/2025
Last Solved Time: 10:04:07 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Slope Stability

Kind: SLOPE/W
Analysis Type: Morgenstern-Price
Settings
- Side Function
  - Intercolumn 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

Convergence
- Geometry Settings
  - Minimum Slip Surface Depth: 2 ft
  - Minimum Slip Surface Volume: 35.314667 ft^3

Number of Columns: 30

Factor of Safety Convergence Settings

Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001

Under-Relaxation Criteria

Initial Rate: 1

Minimum Rate: 0.1

Rate Reduction Factor: 0.65

Reduction Frequency (iterations): 50

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

Outwash

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 135 pcf

Effective Cohesion: 0 psf

Effective Friction Angle: 36 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range

Left-Zone Left Coordinate: (8, 304.4) ft

Left-Zone Right Coordinate: (169, 313.45) ft

Left-Zone Increment: 8

Right Type: Range

Right-Zone Left Coordinate: (259.67204, 302.09839) ft

Right-Zone Right Coordinate: (315, 279) ft

Right-Zone Increment: 8

Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 304) ft

Right Coordinate: (315, 279) ft

Seismic Coefficients

Horz Seismic Coef.: 0.25

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	304 ft
Point 2	20 ft	305 ft
Point 3	40 ft	306 ft
Point 4	60 ft	308.5 ft
Point 5	80 ft	309 ft
Point 6	100 ft	311 ft
Point 7	120 ft	311.5 ft
Point 8	140 ft	312 ft
Point 9	160 ft	313 ft
Point 10	180 ft	314 ft
Point 11	200 ft	314 ft
Point 12	220 ft	312 ft
Point 13	240 ft	308 ft
Point 14	260 ft	302 ft
Point 15	275 ft	292 ft
Point 16	290 ft	282 ft
Point 17	305 ft	280 ft
Point 18	315 ft	279 ft
Point 19	315 ft	250 ft
Point 20	0 ft	250 ft

Regions

	Material	Points	Area
Region 1	Outwash	20,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19	17,560 ft²

Slip Results

Slip Surfaces Analysed: 385 of 405 converged

Current Slip Surface

Slip Surface: 386

Factor of Safety: 1.355

Volume: 1,218.9642 ft³

Weight: 164,560.17 lbf

Resisting Moment: 89,258,755 lbf·ft

Activating Moment: 65,855,552 lbf·ft

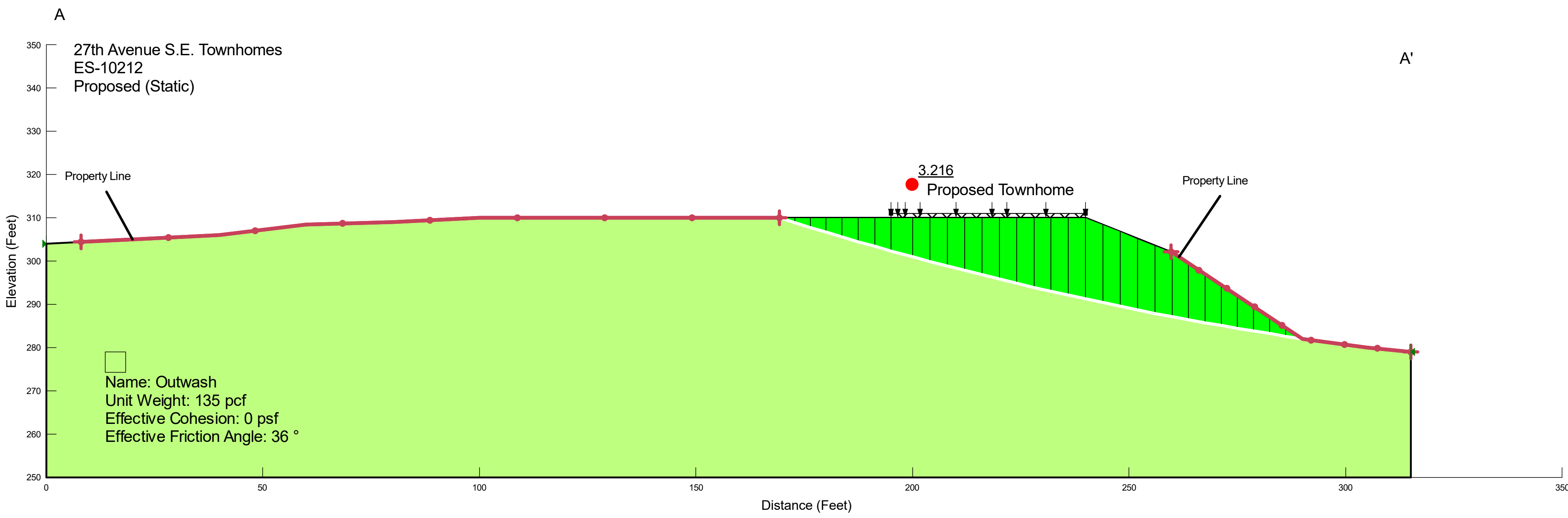
Resisting Force: 105,318.99 lbf

Activating Force: 77,711.766 lbf
Slip Rank: 1 of 405 slip surfaces
Exit: (289.81024, 282.12651) ft
Entry: (169, 313.45) ft
Radius: 821.29911 ft
Center: (434.93857, 1,090.5014) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	170.83333 ft	312.82738 ft	0 psf	80.559833 psf	58.530145 psf	0 psf	0 psf	Outwash
Column 2	174.50000 ft	311.59177 ft	0 psf	237.27442 psf	172.38996 psf	0 psf	0 psf	Outwash
Column 3	178.16667 ft	310.37534 ft	0 psf	387.17556 psf	281.29951 psf	0 psf	0 psf	Outwash
Column 4	182.00000 ft	309.12450 ft	0 psf	526.32782 psf	382.39954 psf	0 psf	0 psf	Outwash
Column 5	186.00000 ft	307.84095 ft	0 psf	655.53627 psf	476.27498 psf	0 psf	0 psf	Outwash
Column 6	190.00000 ft	306.57991 ft	0 psf	780.59471 psf	567.13525 psf	0 psf	0 psf	Outwash
Column 7	194.00000 ft	305.34127 ft	0 psf	903.0953 psf	656.13714 psf	0 psf	0 psf	Outwash
Column 8	198.00000 ft	304.12493 ft	0 psf	1,024.8827 psf	744.6209 psf	0 psf	0 psf	Outwash
Column 9	202.00000 ft	302.93079 ft	0 psf	1,126.3236 psf	818.322 psf	0 psf	0 psf	Outwash
Column 10	206.00000 ft	301.75873 ft	0 psf	1,209.5154 psf	878.76438 psf	0 psf	0 psf	Outwash
Column 11	210.00000 ft	300.60868 ft	0 psf	1,298.0389 psf	943.08043 psf	0 psf	0 psf	Outwash
Column 12	214.00000 ft	299.48052 ft	0 psf	1,393.3609 psf	1,012.3359 psf	0 psf	0 psf	Outwash
Column 13	218.00000 ft	298.37416 ft	0 psf	1,496.4685 psf	1,087.248 psf	0 psf	0 psf	Outwash
Column 14	222.00000 ft	297.28953 ft	0 psf	1,584.9465 psf	1,151.531 psf	0 psf	0 psf	Outwash
Column 15	226.00000 ft	296.22651 ft	0 psf	1,657.1283 psf	1,203.9742 psf	0 psf	0 psf	Outwash
Column 16	230.00000 ft	295.18504 ft	0 psf	1,733.4054 psf	1,259.3928 psf	0 psf	0 psf	Outwash
Column 17	234.00000 ft	294.16502 ft	0 psf	1,810.8423 psf	1,315.6539 psf	0 psf	0 psf	Outwash
Column 18	238.00000 ft	293.16637 ft	0 psf	1,885.8431 psf	1,370.1452 psf	0 psf	0 psf	Outwash
Column 19	242.00000 ft	292.18901 ft	0 psf	1,930.1175 psf	1,402.3124 psf	0 psf	0 psf	Outwash
Column 20	246.00000 ft	291.23286 ft	0 psf	1,939.1072 psf	1,408.8438 psf	0 psf	0 psf	Outwash
Column 21	250.00000 ft	290.29786 ft	0 psf	1,934.3011 psf	1,405.352 psf	0 psf	0 psf	Outwash

Column 22	254.00000 ft	289.38391 ft	0 psf	1,914.3154 psf	1,390.8315 psf	0 psf	0 psf	Outwash
Column 23	258.00000 ft	288.49096 ft	0 psf	1,879.1183 psf	1,365.2593 psf	0 psf	0 psf	Outwash
Column 24	261.87500 ft	287.64555 ft	0 psf	1,744.5087 psf	1,267.4598 psf	0 psf	0 psf	Outwash
Column 25	265.62500 ft	286.84635 ft	0 psf	1,514.0175 psf	1,099.9981 psf	0 psf	0 psf	Outwash
Column 26	269.37500 ft	286.06542 ft	0 psf	1,277.6318 psf	928.2538 psf	0 psf	0 psf	Outwash
Column 27	273.12500 ft	285.30272 ft	0 psf	1,038.7339 psf	754.68434 psf	0 psf	0 psf	Outwash
Column 28	276.85128 ft	284.56279 ft	0 psf	801.5819 psf	582.38334 psf	0 psf	0 psf	Outwash
Column 29	280.55384 ft	283.84534 ft	0 psf	568.08794 psf	412.74005 psf	0 psf	0 psf	Outwash
Column 30	284.25640 ft	283.14551 ft	0 psf	337.90713 psf	245.5039 psf	0 psf	0 psf	Outwash
Column 31	287.95896 ft	282.46325 ft	0 psf	111.63109 psf	81.104737 psf	0 psf	0 psf	Outwash


A
A'
27th Avenue S.E. Townhomes
ES-10212
Proposed (Static)
Property Line
Property Line
3.216
Proposed Townhome
Name: Outwash
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 36 °
Elevation (Feet)
Distance (Feet)
350
340
330
320
310
300
290
280
270
260
250
0
50
100
150
200
250
300
350

Slope Stability

File Information

File Version: 11.06
Tool Version: 24.1.0.1406
Title: Cedar Cove
Created By: Adam Shier
Last Edited By: Adam Shier
Revision Number: 103
Date: 01/23/2025
Time: 10:05:44 AM
File Name: 27th ave townhomes proposed (Static).gsz
Directory: C:\Users\adam.shier\Desktop\SLope W\
Last Solved Date: 01/23/2025
Last Solved Time: 10:05:45 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Analysis Type: Morgenstern-Price
- Settings
  - Side Function
    - Intercolumn 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
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 4 ft
    - Minimum Slip Surface Volume: 35.314667 ft^3

Number of Columns: 30

Factor of Safety Convergence Settings

Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.01

Under-Relaxation Criteria

Initial Rate: 1

Minimum Rate: 0.1

Rate Reduction Factor: 0.65

Reduction Frequency (iterations): 50

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

Outwash

Slope Stability Material Model: Mohr-Coulomb

Unit Weight: 135 pcf

Effective Cohesion: 0 psf

Effective Friction Angle: 36 °

Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range

Left-Zone Left Coordinate: (8, 304.4) ft

Left-Zone Right Coordinate: (169.31731, 310) ft

Left-Zone Increment: 8

Right Type: Range

Right-Zone Left Coordinate: (259.68335, 302.12666) ft

Right-Zone Right Coordinate: (315, 279) ft

Right-Zone Increment: 8

Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 304) ft

Right Coordinate: (315, 279) ft

Seismic Coefficients

Horz Seismic Coef.: 0

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf

Direction: Vertical

Coordinates

	X	Y
	195 ft	311 ft
	240 ft	311 ft

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	304 ft
Point 2	20 ft	305 ft
Point 3	40 ft	306 ft
Point 4	60 ft	308.5 ft
Point 5	80 ft	309 ft
Point 6	100 ft	310 ft
Point 7	120 ft	310 ft
Point 8	140 ft	310 ft
Point 9	160 ft	310 ft
Point 10	180 ft	310 ft
Point 11	200 ft	310 ft
Point 12	220 ft	310 ft
Point 13	240 ft	310 ft
Point 14	260 ft	302 ft
Point 15	275 ft	292 ft
Point 16	290 ft	282 ft
Point 17	305 ft	280 ft
Point 18	315 ft	279 ft
Point 19	315 ft	250 ft
Point 20	0 ft	250 ft

Regions

	Material	Points	Area
Region 1	Outwash	20,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19	17,250 ft^2

Slip Results

Slip Surfaces Analysed: 321 of 405 converged

Current Slip Surface

Slip Surface: 386

Factor of Safety: 3.216

Volume: 1,267.5859 ft³

Weight: 171,124.1 lbf

Resisting Moment: 1.0250855e+08 lbf·ft

Activating Moment: 31,860,652 lbf·ft

Resisting Force: 126,058.57 lbf

Activating Force: 39,225.732 lbf

Slip Rank: 1 of 405 slip surfaces

Exit: (289.93599, 282.04267) ft

Entry: (169.31731, 310) ft

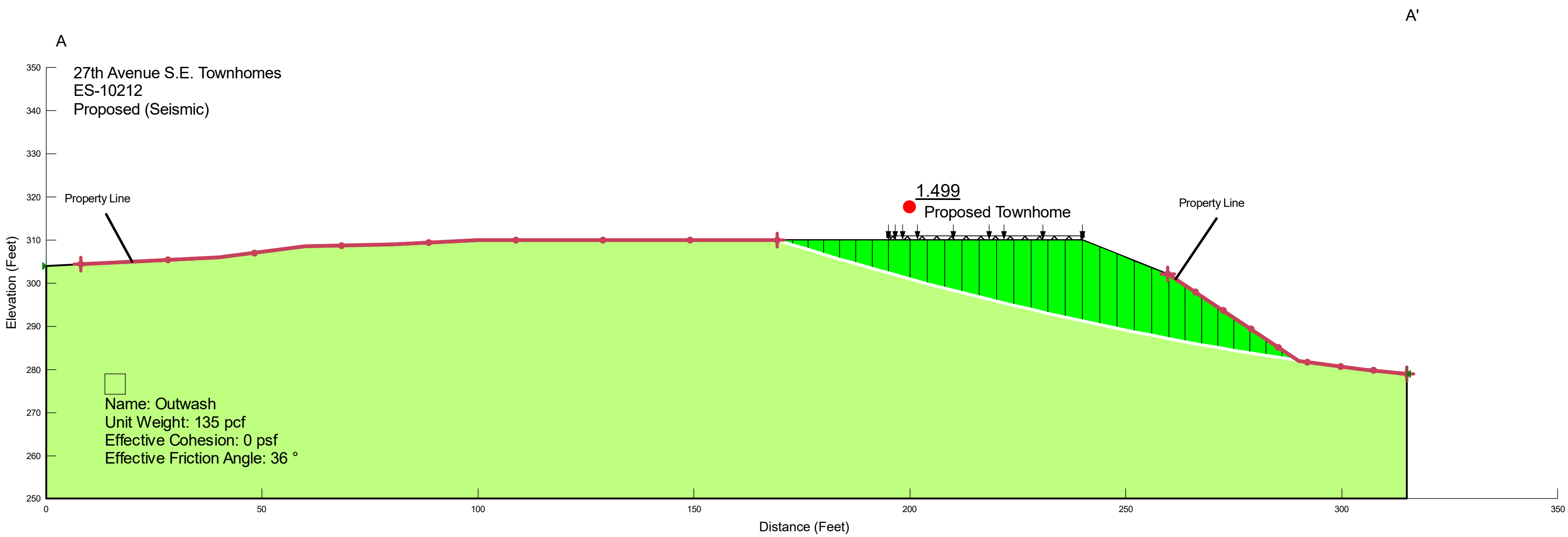
Radius: 792.6777 ft

Center: (408.06406, 1,065.869) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	171.09776 ft	309.44224 ft	0 psf	70.324472 psf	51.093719 psf	0 psf	0 psf	Outwash
Column 2	174.65866 ft	308.33590 ft	0 psf	210.04392 psf	152.60584 psf	0 psf	0 psf	Outwash
Column 3	178.21955 ft	307.24788 ft	0 psf	347.75041 psf	252.65546 psf	0 psf	0 psf	Outwash
Column 4	181.87500 ft	306.15021 ft	0 psf	486.98979 psf	353.8188 psf	0 psf	0 psf	Outwash
Column 5	185.62500 ft	305.04379 ft	0 psf	627.66191 psf	456.02307 psf	0 psf	0 psf	Outwash
Column 6	189.37500 ft	303.95743 ft	0 psf	766.10634 psf	556.60884 psf	0 psf	0 psf	Outwash
Column 7	193.12500 ft	302.89104 ft	0 psf	902.32446 psf	655.5771 psf	0 psf	0 psf	Outwash
Column 8	197.50000 ft	301.67399 ft	0 psf	1,293.5486 psf	939.81808 psf	0 psf	0 psf	Outwash
Column 9	202.00000 ft	300.44672 ft	0 psf	1,451.4783 psf	1,054.5607 psf	0 psf	0 psf	Outwash
Column 10	206.00000 ft	299.38104 ft	0 psf	1,588.9936 psf	1,154.4714 psf	0 psf	0 psf	Outwash
Column 11	210.00000 ft	298.33769 ft	0 psf	1,723.9805 psf	1,252.5452 psf	0 psf	0 psf	Outwash
Column 12	214.00000 ft	297.31657 ft	0 psf	1,856.4399 psf	1,348.7825 psf	0 psf	0 psf	Outwash
Column 13	218.00000 ft	296.31760 ft	0 psf	1,986.3724 psf	1,443.184 psf	0 psf	0 psf	Outwash
Column 14	222.00000 ft	295.34068 ft	0 psf	2,113.7786 psf	1,535.75 psf	0 psf	0 psf	Outwash

Column 15	226.00000 ft	294.38575 ft	0 psf	2,238.6587 psf	1,626.4808 psf	0 psf	0 psf	Outwash
Column 16	230.00000 ft	293.45270 ft	0 psf	2,361.013 psf	1,715.3763 psf	0 psf	0 psf	Outwash
Column 17	234.00000 ft	292.54148 ft	0 psf	2,480.8414 psf	1,802.4368 psf	0 psf	0 psf	Outwash
Column 18	238.00000 ft	291.65199 ft	0 psf	2,598.1438 psf	1,887.6619 psf	0 psf	0 psf	Outwash
Column 19	242.00000 ft	290.78417 ft	0 psf	2,371.4366 psf	1,722.9495 psf	0 psf	0 psf	Outwash
Column 20	246.00000 ft	289.93793 ft	0 psf	2,277.0151 psf	1,654.3483 psf	0 psf	0 psf	Outwash
Column 21	250.00000 ft	289.11322 ft	0 psf	2,179.5881 psf	1,583.5634 psf	0 psf	0 psf	Outwash
Column 22	254.00000 ft	288.30996 ft	0 psf	2,079.1554 psf	1,510.5948 psf	0 psf	0 psf	Outwash
Column 23	258.00000 ft	287.52808 ft	0 psf	1,975.7164 psf	1,435.442 psf	0 psf	0 psf	Outwash
Column 24	261.87500 ft	286.79065 ft	0 psf	1,807.9271 psf	1,313.5359 psf	0 psf	0 psf	Outwash
Column 25	265.62500 ft	286.09632 ft	0 psf	1,575.7667 psf	1,144.8616 psf	0 psf	0 psf	Outwash
Column 26	269.37500 ft	285.42062 ft	0 psf	1,340.6822 psf	974.06266 psf	0 psf	0 psf	Outwash
Column 27	273.12500 ft	284.76351 ft	0 psf	1,102.6725 psf	801.13846 psf	0 psf	0 psf	Outwash
Column 28	276.86700 ft	284.12627 ft	0 psf	862.25594 psf	626.46561 psf	0 psf	0 psf	Outwash
Column 29	280.60100 ft	283.50876 ft	0 psf	619.44463 psf	450.05286 psf	0 psf	0 psf	Outwash
Column 30	284.33500 ft	282.90955 ft	0 psf	373.72843 psf	271.5296 psf	0 psf	0 psf	Outwash
Column 31	288.06900 ft	282.32859 ft	0 psf	125.10539 psf	90.894384 psf	0 psf	0 psf	Outwash


A
A'
27th Avenue S.E. Townhomes
ES-10212
Proposed (Seismic)
Property Line
1.499
Proposed Townhome
Property Line
Name: Outwash
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 36 °
Elevation (Feet)
Distance (Feet)
350
340
330
320
310
300
290
280
270
260
250
0
50
100
150
200
250
300
350

Slope Stability

File Information

File Version: 11.06
Tool Version: 24.1.0.1406
Title: Cedar Cove
Created By: Adam Shier
Last Edited By: Adam Shier
Revision Number: 104
Date: 01/23/2025
Time: 10:10:18 AM
File Name: 27th ave townhomes proposed (Seismic).gsz
Directory: C:\Users\adam.shier\Desktop\SLope W\
Last Solved Date: 01/23/2025
Last Solved Time: 10:10:20 AM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Slope Stability

- Kind: SLOPE/W
- Analysis Type: Morgenstern-Price
- Settings
  - Side Function
    - Intercolumn 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
- Convergence
  - Geometry Settings
    - Minimum Slip Surface Depth: 4 ft
    - Minimum Slip Surface Volume: 35.314667 ft^3

Number of Columns: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.01
Under-Relaxation Criteria
Initial Rate: 1
Minimum Rate: 0.1
Rate Reduction Factor: 0.65
Reduction Frequency (iterations): 50
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

Outwash

Slope Stability Material Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 36 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (8, 304.4) ft
Left-Zone Right Coordinate: (169.31731, 310) ft
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: (259.68335, 302.12666) ft
Right-Zone Right Coordinate: (315, 279) ft
Right-Zone Increment: 8
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 304) ft
Right Coordinate: (315, 279) ft

Seismic Coefficients

Horz Seismic Coef.: 0.25

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 250 pcf

Direction: Vertical

Coordinates

	X	Y
	195 ft	311 ft
	240 ft	311 ft

Geometry

Name: 2D Geometry

Settings

View: 2D

Element Thickness: 1 ft

Points

	X	Y
Point 1	0 ft	304 ft
Point 2	20 ft	305 ft
Point 3	40 ft	306 ft
Point 4	60 ft	308.5 ft
Point 5	80 ft	309 ft
Point 6	100 ft	310 ft
Point 7	120 ft	310 ft
Point 8	140 ft	310 ft
Point 9	160 ft	310 ft
Point 10	180 ft	310 ft
Point 11	200 ft	310 ft
Point 12	220 ft	310 ft
Point 13	240 ft	310 ft
Point 14	260 ft	302 ft
Point 15	275 ft	292 ft
Point 16	290 ft	282 ft
Point 17	305 ft	280 ft
Point 18	315 ft	279 ft
Point 19	315 ft	250 ft
Point 20	0 ft	250 ft

Regions

	Material	Points	Area
Region 1	Outwash	20,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19	17,250 ft^2

Slip Results

Slip Surfaces Analysed: 379 of 405 converged

Current Slip Surface

Slip Surface: 386
Factor of Safety: 1.499
Volume: 1,267.5859 ft³
Weight: 171,124.1 lbf
Resisting Moment: 97,140,757 lbf·ft
Activating Moment: 64,641,320 lbf·ft
Resisting Force: 119,477.57 lbf
Activating Force: 79,915.763 lbf
Slip Rank: 1 of 405 slip surfaces
Exit: (289.93599, 282.04267) ft
Entry: (169.31731, 310) ft
Radius: 792.6777 ft
Center: (408.06406, 1,065.869) ft

Slip Columns

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Column 1	171.09776 ft	309.44224 ft	0 psf	65.403275 psf	47.518261 psf	0 psf	0 psf	Outwash
Column 2	174.65866 ft	308.33590 ft	0 psf	195.55605 psf	142.07978 psf	0 psf	0 psf	Outwash
Column 3	178.21955 ft	307.24788 ft	0 psf	324.11296 psf	235.48185 psf	0 psf	0 psf	Outwash
Column 4	181.87500 ft	306.15021 ft	0 psf	454.38932 psf	330.13316 psf	0 psf	0 psf	Outwash
Column 5	185.62500 ft	305.04379 ft	0 psf	586.30753 psf	425.97735 psf	0 psf	0 psf	Outwash
Column 6	189.37500 ft	303.95743 ft	0 psf	716.43986 psf	520.52402 psf	0 psf	0 psf	Outwash
Column 7	193.12500 ft	302.89104 ft	0 psf	844.78069 psf	613.7691 psf	0 psf	0 psf	Outwash
Column 8	197.50000 ft	301.67399 ft	0 psf	1,212.6509 psf	881.04244 psf	0 psf	0 psf	Outwash
Column 9	202.00000 ft	300.44672 ft	0 psf	1,362.5465 psf	989.948 psf	0 psf	0 psf	Outwash
Column 10	206.00000 ft	299.38104 ft	0 psf	1,493.4305 psf	1,085.0408 psf	0 psf	0 psf	Outwash
Column 11	210.00000 ft	298.33769 ft	0 psf	1,622.2471 psf	1,178.6315 psf	0 psf	0 psf	Outwash
Column 12	214.00000 ft	297.31657 ft	0 psf	1,748.989 psf	1,270.7149 psf	0 psf	0 psf	Outwash
Column 13	218.00000 ft	296.31760 ft	0 psf	1,873.6488 psf	1,361.2856 psf	0 psf	0 psf	Outwash
Column 14	222.00000 ft	295.34068 ft	0 psf	1,996.2191 psf	1,450.338 psf	0 psf	0 psf	Outwash

Column 15	226.00000 ft	294.38575 ft	0 psf	2,116.692 psf	1,537.8668 psf	0 psf	0 psf	Outwash
Column 16	230.00000 ft	293.45270 ft	0 psf	2,235.0599 psf	1,623.8661 psf	0 psf	0 psf	Outwash
Column 17	234.00000 ft	292.54148 ft	0 psf	2,351.3148 psf	1,708.3302 psf	0 psf	0 psf	Outwash
Column 18	238.00000 ft	291.65199 ft	0 psf	2,465.4487 psf	1,791.2533 psf	0 psf	0 psf	Outwash
Column 19	242.00000 ft	290.78417 ft	0 psf	2,253.0217 psf	1,636.9161 psf	0 psf	0 psf	Outwash
Column 20	246.00000 ft	289.93793 ft	0 psf	2,165.9128 psf	1,573.6277 psf	0 psf	0 psf	Outwash
Column 21	250.00000 ft	289.11322 ft	0 psf	2,075.7298 psf	1,508.106 psf	0 psf	0 psf	Outwash
Column 22	254.00000 ft	288.30996 ft	0 psf	1,982.462 psf	1,440.343 psf	0 psf	0 psf	Outwash
Column 23	258.00000 ft	287.52808 ft	0 psf	1,886.0982 psf	1,370.3305 psf	0 psf	0 psf	Outwash
Column 24	261.87500 ft	286.79065 ft	0 psf	1,727.9308 psf	1,255.4152 psf	0 psf	0 psf	Outwash
Column 25	265.62500 ft	286.09632 ft	0 psf	1,507.7421 psf	1,095.4388 psf	0 psf	0 psf	Outwash
Column 26	269.37500 ft	285.42062 ft	0 psf	1,284.2542 psf	933.06531 psf	0 psf	0 psf	Outwash
Column 27	273.12500 ft	284.76351 ft	0 psf	1,057.4554 psf	768.28632 psf	0 psf	0 psf	Outwash
Column 28	276.86700 ft	284.12627 ft	0 psf	827.8305 psf	601.45407 psf	0 psf	0 psf	Outwash
Column 29	280.60100 ft	283.50876 ft	0 psf	595.38351 psf	432.57144 psf	0 psf	0 psf	Outwash
Column 30	284.33500 ft	282.90955 ft	0 psf	359.61681 psf	261.27691 psf	0 psf	0 psf	Outwash
Column 31	288.06900 ft	282.32859 ft	0 psf	120.51744 psf	87.561042 psf	0 psf	0 psf	Outwash