Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services

GEOTECHNICAL ENGINEERING STUDY
PROPOSED RESIDENTIAL DEVELOPMENT
3000 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

ES-2964.01

1805 - 136th Place N.E., Suite 201   Bellevue, WA 98005
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www.earthsolutionsnw.com

PREPARED FOR

OB MERCER ISLAND PROPERTIES, LLC

November 29, 2018

Adam Z. Shier, G.I.T.
Staff Geologist

RAYMOND A COGLAS
STATE OF WASHINGTON
36018
REGISTERED
PROFESSIONAL ENGINEER

11/29/18

Raymond A. Coglas, P.E.
Principal Engineer

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Important Information About Your

Geotechnical Engineering Report

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

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

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

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

Read the Full Report

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

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

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

A Geotechnical Engineering Report Is Subject to Misinterpretation

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

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

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

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

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

ASFE
The Best People on Earth

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Earth Solutions NW LLC

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

November 29, 2018
ES-2964.01

OB Mercer Island Properties, LLC
5712 East Lake Sammamish Parkway Southeast, Suite 100
Issaquah, Washington 98029

Attention: Mr. Eric Hansen

Dear Mr. Hansen:

Earth Solutions NW, LLC (ESNW) is pleased to present this report titled "Geotechnical Engineering Study, Proposed Residential Development, 3000 West Mercer Way, Mercer Island, Washington". Based on the results of our investigation, construction of the proposed single-family residences and related improvements is feasible from a geotechnical standpoint. Our study indicates the site is underlain primarily by limited areas of fill and glacial till deposits. During our subsurface exploration completed on November 13, 2018, groundwater seepage was not encountered at the test pit locations.

In our opinion, the proposed single-family residences may be supported on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill. We anticipate competent native soil suitable for support of the new foundations will be encountered beginning at depths of approximately two to three feet below existing grades across the majority of the site. Where encountered, loose or unsuitable subgrade areas should be mechanically compacted and/or overexcavated and replaced with structural fill, as recommended by ESNW at the time of construction.

This report provides recommendations for foundation subgrade preparation, foundation and retaining wall design parameters, drainage, and other pertinent geotechnical recommendations. The opportunity to be of service to you is appreciated. If you have any questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

Adam Z. Shier, G.I.T.
Staff Geologist

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GEOTECHNICAL ENGINEERING STUDY
PROPOSED RESIDENTIAL DEVELOPMENT
3000 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

ES-2964.01

INTRODUCTION

General

This geotechnical engineering study (study) was prepared for the proposed residential development to be constructed at 3000 West Mercer Way, in Mercer Island, Washington. The purpose of this study was to provide geotechnical recommendations for currently proposed development plans. Our scope of services for completing this study included the following:

- Test pits for purposes of characterizing site soil conditions;
- Laboratory testing of soil samples collected at the test pit locations;
- Conducting engineering analyses, and;
- Preparation of this report.

The following documents and maps were reviewed as part of our report preparation:

- Geologic Map of Mercer Island, Washington, by Kathy G. Troost and Aaron P. Wisher, October 2006;
- Mercer Island Seismic Hazard Assessment, Landslide Hazard Assessment, and Erosion Hazard Assessment maps, by Kathy G. Troost and Aaron P. Wisher, April 2009;
- Mercer Island City Code (MICC);
- Stormwater Management Manual for Western Washington, prepared by the Washington State Department of Ecology, amended December 2014;
- Surface Water Design Manual, prepared by the King County Department of Natural Resources and Parks, dated April 24, 2016;
- Low Impact Development Infiltration Feasibility on Mercer Island, Prepared by Herrera;
- Liquefaction Susceptibility Map of King County, Washington, endorsed by the King County Flood Control District, May 2010;
- Conceptual Site Plan, prepared by Blueline, dated July 24, 2018, and;
- Online Web Soil Survey (WSS) resource, provided by the Natural Resources Conservation Service (NRCS) under the United States Department of Agriculture (USDA).

Project Description

Based on the referenced plans, the site will be developed with 14 new single-family residences, an access roadway, and associated infrastructure improvements. Given the local topographic relief across the site, grade cuts and/or fills up to about 10 feet are anticipated to achieve finish grades. Retaining walls and/or rockeries may be incorporated into final designs to accommodate grade transitions, where necessary. Although final plans are still being developed, we anticipate stormwater management will be accomplished through a conventional detention system, as required.

At the time this report was prepared, specific building load values were not available for review. However, we anticipate the proposed residential structures will consist of relatively lightly loaded wood framing supported on conventional foundations. Based on our experience with similar developments, we estimate wall loads of about 1 to 2 kips per linear foot and slab-on-grade loading of about 150 pounds per square foot (psf) will be incorporated into final designs.

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

SITE CONDITIONS

Surface

The subject site is located at 3000 West Mercer Way, immediately southwest of the intersection with Southeast 28th Street, in Mercer Island, Washington. The property is comprised of one tax parcel (King County Parcel No. 217450-2425) totaling roughly 2.87 acres. The property is currently developed with a Boys & Girls Clubs of King County facility, parking areas, and associated improvements.

The site is bordered to the north by Southeast 28th Street, to the east by West Mercer Way, to the south by Southeast 30th Street, and to the west by 62nd Avenue Southeast. Vegetation is comprised primarily of lawn areas, with mature trees along the property boundaries of the site perimeter. Site topography ascends generally from southwest to northeast, and we estimate about 35 feet of elevation change occurs across the site.

Subsurface

As part of the subsurface exploration, six test pits were excavated at accessible locations within the property boundaries on November 13, 2018, using a trackhoe and operator retained by ESNW. The test pits were completed for purposes of assessment and classification of site soils as well as characterization of groundwater conditions within areas proposed for new development. The test pits were advanced to maximum depths of approximately five and-one-half to seven and-one-half feet below the existing ground surface (bgs). Please refer to the test pit logs provided in Appendix A for a more detailed description of the subsurface conditions.

Topsoil and Fill

Topsoil was encountered generally within the upper 3 to 18 inches of existing grades at the test pit locations. The topsoil was characterized by dark brown color, the presence of fine organic material, and small root intrusions. Based on our field observations, we estimate topsoil will be encountered with an average thickness of eight inches across the site.

Fill was encountered at TP-1, TP-2, and TP-4 during our fieldwork. The fill was classified chiefly as silty sand and extended to depths of about two and one-half to three feet bgs. Fill may be present in proximity to the existing structures and utility alignments. If fill is encountered, it may be suitable for re-use as structural fill; however, an ESNW representative should be retained during the construction phase of site development to evaluate the suitability for on-site existing fill soils to be used as structural fill.

Native Soil

Underlying the topsoil and fill, native soils consisted of silty sand and silt (USCS: SM and ML, respectively) at the test pit locations, generally consistent with the typical makeup of glacial till. The in-situ density of the native soil was characterized as medium dense to very dense. Native soils were encountered primarily in a moist condition, extending to the maximum exploration depth of about seven and-one-half feet bgs.

Geologic Setting

The referenced geologic map resource identifies glacial till (Qvt) deposits as the primary native soil unit underlying the subject site. Vashon glacial till is chiefly a non-sorted mixture of clay, silt, sand, pebbles, cobbles, and boulders. The till is compact and locally referred to as “hardpan”, due to the compaction caused by the great weight of substantially thick, overriding ice. The referenced WSS resource identifies Kitsap silt loam (Map Unit Symbol: KpB) as the primary soil unit underlying the subject site. The Kitsap series was formed in terraces and originates from lacustrine deposits. Based on our field observations, on-site native soils are generally consistent with glacial till (Qvt) deposits.

Groundwater

Groundwater seepage was not encountered during our fieldwork on November 13, 2018. The presence of groundwater seepage should be expected in excavations, especially in a perched condition at the contact between weathered and unweathered glacial till. Where encountered, groundwater will likely be representative of discrete, perched seepage zones rather than a seasonal high groundwater table. Seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months.

Geologically Hazardous Areas Assessment

The MICC was reviewed to evaluate the presence of geologically hazardous areas on site. Based on our investigation and review, geologically hazardous areas are not present on or adjacent to the site.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, the proposed structures can be supported on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill. We anticipate competent native soil, suitable for support of foundations, will be encountered beginning at depths of about two to three feet below existing grades across the majority of the site. Slab-on-grade floors should be supported on dense native soil, re-compacted native soil, or new structural fill. Organic material exposed at subgrade elevations must be removed, and grades should be restored with structural fill. Where loose, organic, or other unsuitable material is encountered at or below footing subgrade elevations, the incompetent material should be removed and replaced with structural fill, as necessary.

This report has been prepared for the exclusive use of OB Mercer Island Properties, LLC and their representatives. No warranty, expressed or implied, is made. This report has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

Site Preparation and Earthwork

Site preparation activities will consist of installing temporary erosion control measures and performing clearing and site stripping (as necessary). Given the local topographic relief across the site, grade cuts and/or fills up to about 10 feet are anticipated to achieve finish grades. Retaining walls and/or rockeries may be incorporated into final designs to accommodate grade transitions, where necessary.

Temporary Erosion Control

A temporary construction entrance and drive lane, consisting of at least six inches of quarry spalls, should be considered to minimize off-site soil tracking and to provide a stable access entrance surface. Geotextile fabric may also be considered underlying the quarry spalls for greater stability of the temporary construction entrance. Utilization of the existing paved driveway as a means of stable ingress and/or egress may be considered during construction activities. Erosion control measures should consist of silt fencing or similar sediment barriers placed around the site perimeter, especially down-gradient areas. Soil stockpiles should be covered or otherwise protected to reduce soil erosion. Temporary approaches for controlling surface water runoff should be established prior to beginning earthwork activities. Additional Best Management Practices (BMPs), as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities.

In-situ and Imported Soils

Native soils are moisture sensitive, and successful use of native soils as structural fill will largely be dictated by the moisture content at the time of placement and compaction. If the on-site soils cannot be successfully compacted, the use of an imported soil may be necessary. Soils with fines contents greater than 5 percent typically degrade rapidly when exposed to periods of rainfall.

Imported soil intended for use as structural fill should consist of a well-graded, granular soil with a moisture content that is at or slightly above the optimum level. During wet weather conditions, imported soil intended for use as structural fill should consist of a well-graded, granular soil with a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction).

Subgrade Preparation

Following site stripping and removal of existing improvements, cuts and fills will be completed to establish proposed subgrade elevations throughout the site. ESNW should observe the subgrades during initial site preparation activities to confirm soil conditions are as anticipated and to provide supplementary recommendations for subgrade preparation, as necessary. The process of removing existing structures may produce voids where old foundations are removed and where crawl space or basement areas may have been present. Complete restoration of voids from old foundation areas must be executed as part of overall subgrade and building pad preparation activities. The following guidelines for preparing building subgrade areas should be incorporated into the final design:

- Where voids and related demolition disturbances extend below planned subgrade elevations, restoration of these areas should be completed. Structural fill should be used to restore voids or unstable areas resulting from the removal of existing structural elements.

- Recompact, or overexcavate and replace, areas of existing fill or loose native soil exposed at building subgrade elevations. Overexcavations should extend into competent native soils, and structural fill should be utilized to restore subgrade elevations as necessary.

- ESNW should confirm subgrade conditions, as well as the required level of recompaction and/or overexcavation and replacement, during site preparation activities. ESNW should also evaluate the overall suitability of prepared subgrade areas following site preparation activities.

Supplementary recommendations for subgrade improvement may be provided at the time of construction and would likely include further mechanical compaction and/or overexcavation and replacement with suitable structural fill.

Structural Fill

Structural fill is defined as compacted soil placed in foundation, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench areas. Soils placed in structural areas should be placed in loose lifts of 12 inches or less and compacted to a relative compaction of 95 percent, based on the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557). For soil placed in utility trenches underlying structural areas, compaction requirements are dictated by the local city, county, or utility district and are typically specified to a relative compaction of at least 95 percent.

Foundations

In our opinion, the proposed residential structures may be supported on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill. We anticipate competent native soil suitable for support of the new foundations will be encountered beginning at depths of about two to three feet bgs across the majority of the site. Loose or unsuitable subgrade areas should be mechanically compacted and/or overexcavated and replaced with structural fill, as recommended by ESNW at the time of construction. Provided foundations will be supported as prescribed, the following parameters may be used for design:

- Allowable soil bearing capacity 2,500 psf
- Passive earth pressure 300 pcf (equivalent fluid)
- 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 above passive pressure and friction values include a factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch and differential settlement of approximately one-half inch is anticipated. The majority of anticipated settlement should occur during construction, as dead loads are applied.

Seismic Design

The 2015 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. In accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class D should be used for design.

The referenced liquefaction susceptibility map indicates the site and surrounding areas maintain very low to low liquefaction susceptibility. Liquefaction is a phenomenon where saturated and loose soils suddenly lose internal strength and behave as a fluid. This behavior is in response to increased pore water pressures resulting from an earthquake or other intense ground shaking. In our opinion, site susceptibility to liquefaction may be characterized as low. The relative density and cohesive nature of the native soils as well as the absence of an established, near-surface groundwater table were the primary bases for this characterization.

Slab-on-Grade Floors

Slab-on-grade floors for the proposed residential structures should be supported on well-compacted, firm and unyielding subgrades. Where feasible, native soils exposed at the slab-on-grade subgrade levels can likely be compacted in situ to the specifications of structural fill. Unstable or yielding subgrade areas should be recompacted, or overexcavated and replaced with suitable structural fill, prior to slab construction.

A capillary break consisting of a minimum of four inches of free-draining crushed rock or gravel should be placed below slab. The free-draining material should have 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). In areas where slab moisture is undesirable, installation of a vapor barrier below each slab should be considered. If a vapor barrier is to be utilized, it should be a material specifically designed for use as a vapor barrier and should be installed in accordance with the specifications of the manufacturer.

Retaining Walls

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

- Active earth pressure (unrestrained condition) 35 pcf
- At-rest earth pressure (restrained condition) 55 pcf
- Traffic surcharge* (passenger vehicles) 70 psf (rectangular distribution)
- Passive earth pressure 300 pcf
- Coefficient of friction 0.40
- Seismic surcharge 6H psf**

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

Additional surcharge loading from adjacent foundations, sloped backfill, retaining walls, or other loads should be included in the retaining wall design. Drainage should be provided behind retaining walls such that hydrostatic pressures do not develop. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Retaining walls should be backfilled with at least 18 inches of free-draining material or suitable sheet drainage that extends along the height of the wall. The upper one foot of the wall backfill may consist of a less permeable soil, if desired. A perforated drain pipe 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.

Drainage

Shallow groundwater seepage was not encountered at the time of our subsurface exploration. However, localized zones of seepage should be expected in excavations. Where localized zones of groundwater seepage are encountered, temporary measures to control groundwater seepage may be needed. Temporary measures to control groundwater seepage and surface water runoff during construction will likely involve passive elements such as interceptor trenches and sumps, as necessary.

Surface grades must be designed to direct water away from slopes and buildings. The grade adjacent to buildings should be sloped away from the buildings at a gradient of at least 2 percent for a horizontal distance of four feet (minimum) and ten feet (maximum) as building and property setbacks allow. In our opinion, perimeter footing drains should be installed at or below the invert of the building footings. A typical footing drain detail is provided on Plate 4 of this report.

Infiltration Feasibility

This infiltration feasibility evaluation is primarily based on our field observations, laboratory testing of representative soils samples, and local geologic mapping.

Site soils consist of medium dense to very dense glacial till deposits beginning at relatively shallow depths in relation to existing site gradients. These soils can further be classified as loam, according to USDA textural analysis. Irrespective of gravel content, fines contents within the native till were roughly 42 to 96 percent at the tested locations. Based on our experience with similar deposits, these soils typically exhibit negligible infiltration capacity. From a geotechnical standpoint, native soils are characteristic of hydraulically restrictive soil layers and should be considered impervious for practicable design purposes. Additionally, review of the referenced low Impact Development Infiltration Feasibility on Mercer Island Map indicates the site is within an area where infiltrating LID facilities are not permitted.

Considering the above, it is our opinion the site is not feasible for infiltrating LID facilities or similar BMPS. We recommend alternative means of stormwater management be considered for this project.

Excavations and Slopes

The Federal Occupation Safety and Health Administration (OSHA) and the Washington Industrial Safety and Health Act (WISHA) provide soil classification in terms of temporary slope inclinations. Based on the soil conditions encountered at the test pit locations, the weathered glacial till encountered in the upper approximately four to five feet of the test pit locations and where fill and/or groundwater seepage is exposed are classified as Type C by OSHA and WISHA. Temporary slopes over four feet in height in Type C soils must be sloped no steeper than 1.5H:1V (Horizontal:Vertical). Dense to very dense, unweathered, native glacial till where groundwater seepage is not exposed would be classified as Type A by OSHA and WISHA. Temporary slopes over four feet in height in Type A soils must be sloped no steeper than 0.75H:1V. The presence of perched groundwater may cause caving of the temporary slopes. ESNW should observe site excavations to confirm soil types and allowable slope inclinations are appropriate for the soil exposed by the excavation; steeper temporary slope inclinations may be feasible and should be evaluated by ESNW during construction. If the recommended temporary slope inclination cannot be achieved, temporary shoring may be necessary to support excavations.

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

Utility Support and Trench Backfill

In our opinion, the soils observed at the test pit locations are generally suitable for support of utilities. The native soils are moisture sensitive, and successful use of native soils as structural backfill in utility trench excavations will largely depend on in-situ moisture contents at the time of placement and compaction. Moisture conditioning or cement treatment of the soils may be necessary at some locations prior to use as structural fill. If utility backfill occurs during wet weather, either cement treatment (where allowed by the presiding jurisdiction) of native soils or import of suitable structural fill will be necessary. Utility trench backfill should be placed and compacted to either the specifications of structural fill provided in this report or to the applicable requirements of the presiding jurisdiction.

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 detailed in the *Site Preparation and Earthwork* section of this report. Soft, wet, or otherwise unsuitable subgrade areas may still exist after base grading activities. Areas of unsuitable or yielding subgrade conditions may require remedial measures, such as overexcavation and replacement with structural fill or thicker crushed rock sections, prior to pavement.

For relatively lightly loaded pavements subjected to automobiles and occasional truck traffic, the following sections may be considered for preliminary design:

- Two inches of hot-mix asphalt (HMA) placed over four inches of crushed rock base (CRB), or;
- Two inches of HMA placed over three inches of asphalt-treated base (ATB).

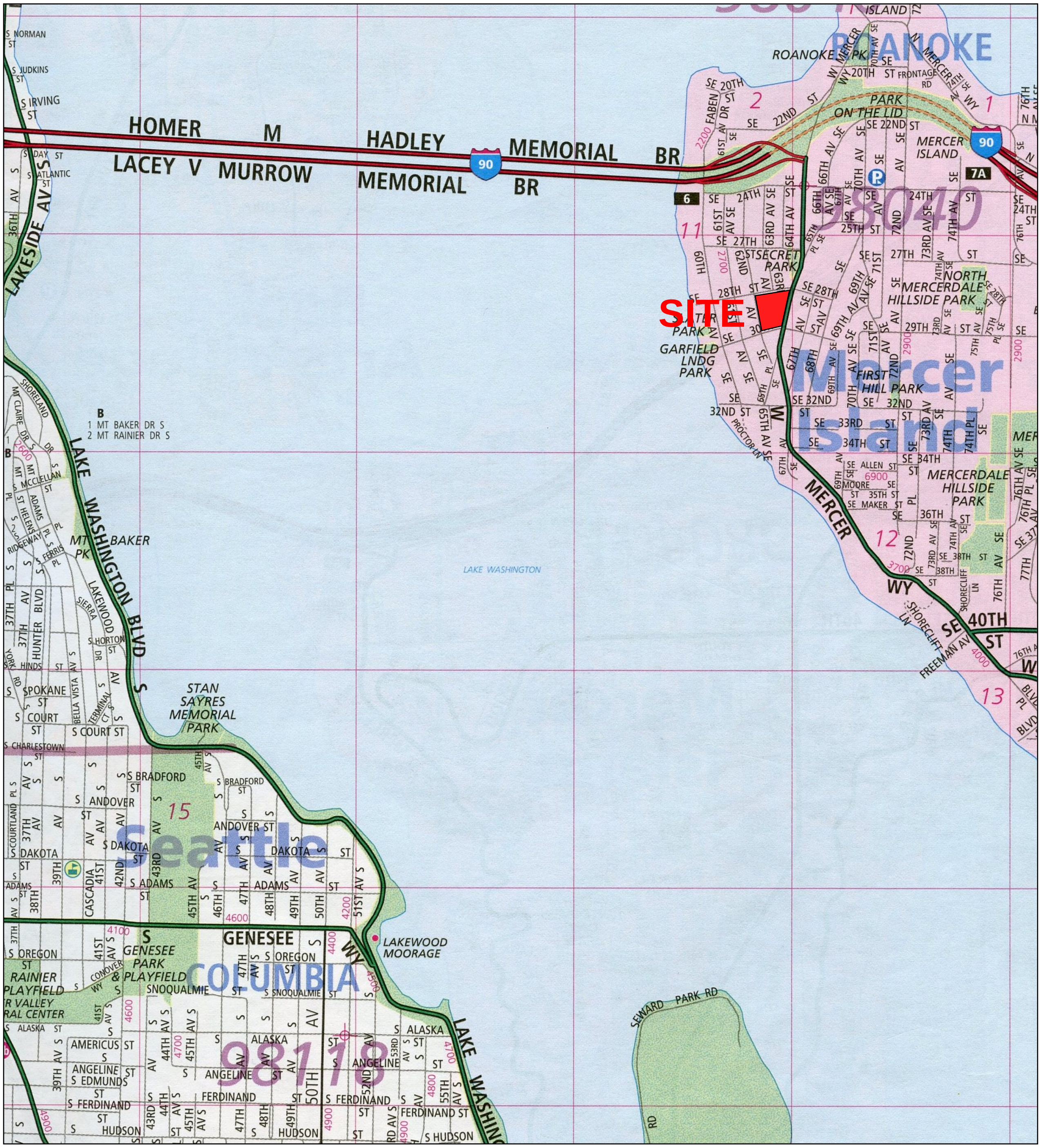
Main access drives and frontage improvement areas may require thicker pavement sections. The HMA, CRB and ATB materials should conform to WSDOT specifications. The City of Mercer Island or King County minimum pavement requirements may supersede the recommendations provided in this report.

LIMITATIONS

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. A warranty is neither expressed nor implied. Variations in the soil and groundwater conditions observed at the test pit 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 final project plans with respect to the geotechnical recommendations provided in this study. ESNW should also be retained to provide observation, testing and consultation services during planning, development, and construction activities.



Reference:
King County, Washington
Map 595
By The Thomas Guide
Rand McNally
32nd Edition

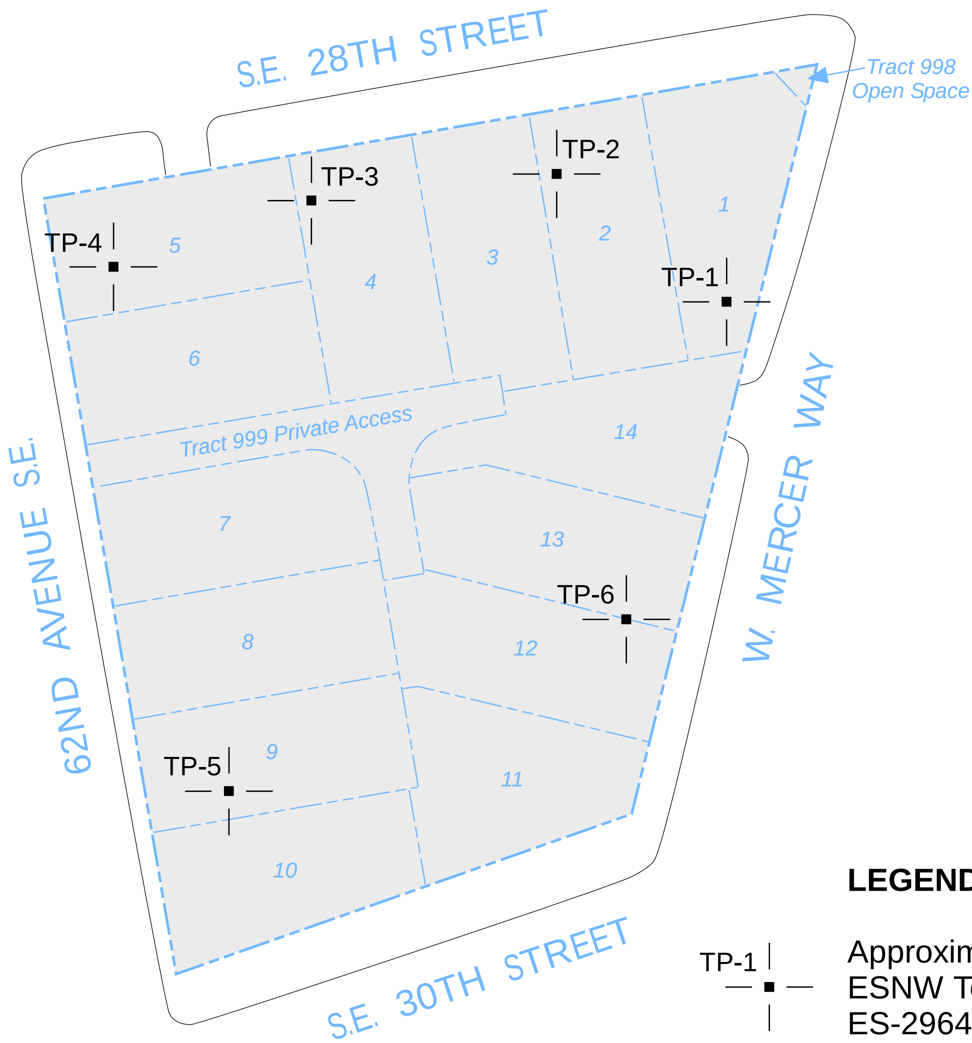
NORTH

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

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

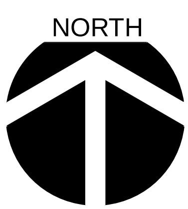
Vicinity Map
3000 W. Mercer
Mercer Island, Washington

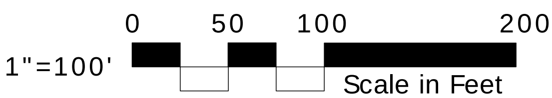
Drwn. CAM	Date 11/21/2018	Proj. No. 2964.01
Checked AZS	Date Nov. 2018	Plate 1



LEGEND

TP-1	Approximate Location of ESNW Test Pit, Proj. No. ES-2964.01, Nov. 2018
	Subject Site
5	Proposed Lot Number





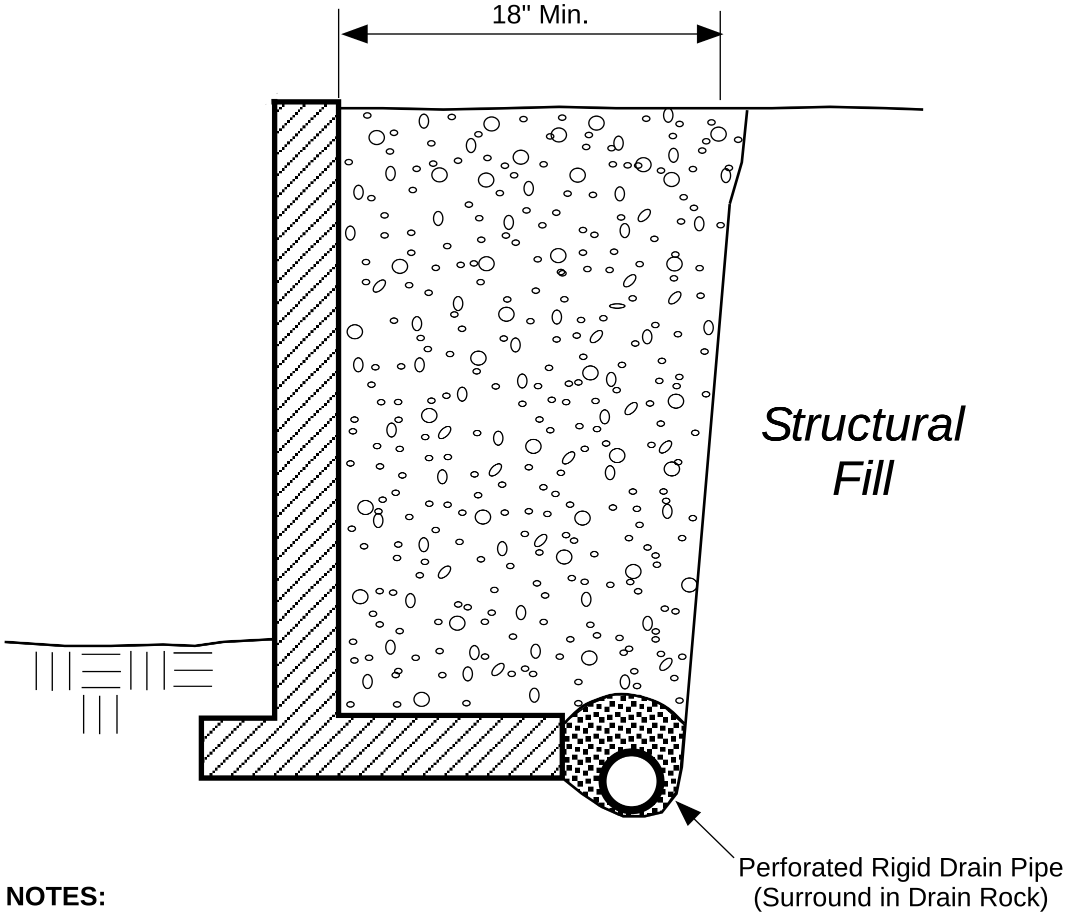
NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided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

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

Test Pit Location Plan
3000 W. Mercer
Mercer Island, Washington

Drwn. CAM	Date 11/21/2018	Proj. No. 2964.01
Checked AZS	Date Nov. 2018	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

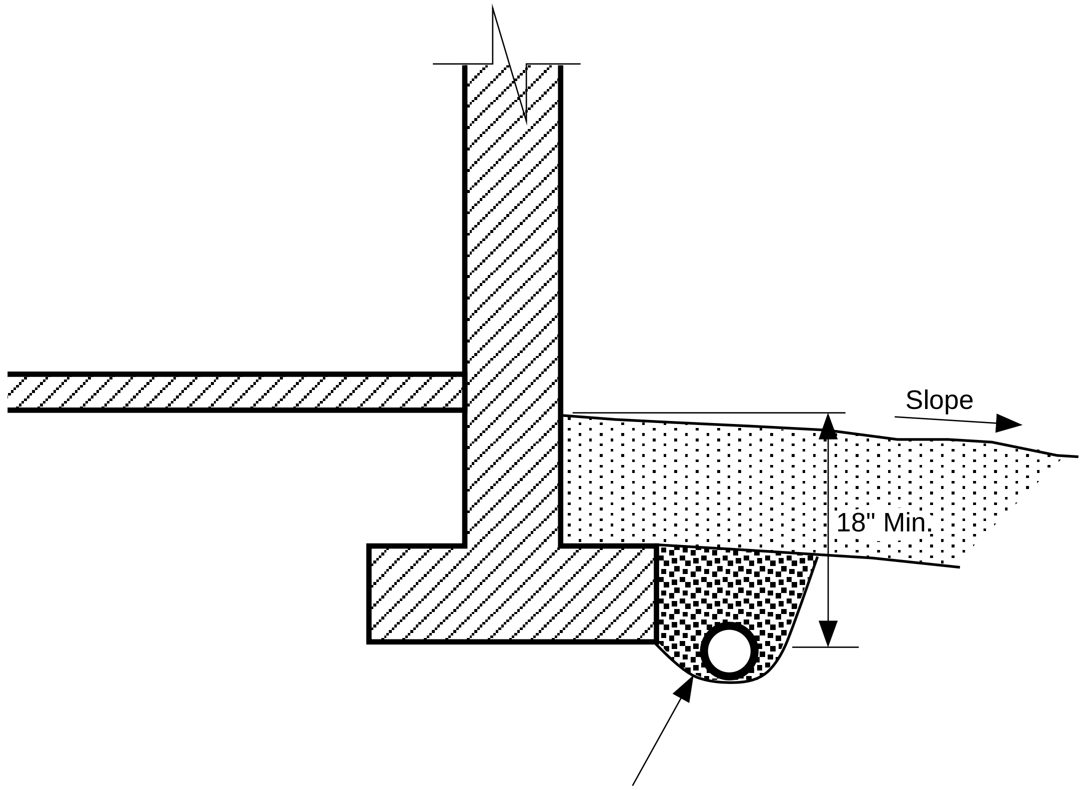
1-inch Drain Rock

Earth Solutions NWLLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Retaining Wall Drainage Detail
3000 W. Mercer
Mercer Island, Washington

Drwn. CAM	Date 11/21/2018	Proj. No. 2964.01
Checked AZS	Date Nov. 2018	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:

Surface Seal: native soil or other low-permeability material.

1-inch Drain Rock

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Footing Drain Detail
3000 W. Mercer
Mercer Island, Washington

Drwn. CAM	Date 11/21/2018	Proj. No. 2964.01
Checked AZS	Date Nov. 2018	Plate 4

Appendix A

Subsurface Exploration
Test Pit Logs

ES-2964.01

The subsurface conditions at the site were explored by excavating six test pits at the approximate locations illustrated on Plate 2 of this report. The test pit logs are provided in this Appendix. The subsurface exploration was completed on November 13, 2018. The test pits were excavated to a maximum depth of about seven and-one-half feet bgs.

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

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

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

DUAL SYMBOLS are used to indicate borderline soil classifications.

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

Earth Solutions NW
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Bellevue, Washington 98005
Telephone: 425-449-4704
Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-2964.01 **PROJECT NAME** 3000 W. Mercer

DATE STARTED 11/13/18 **COMPLETED** 11/13/18 **GROUND ELEVATION** **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY AZS **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.5	Dark brown TOPSOIL (Fill)
		MC = 19.60% MC = 18.90%	SM	3.0	Gray silty SAND with gravel, medium dense, wet (Fill) -abundant cobbles
5			SM	7.5	Gray silty SAND, medium dense to dense, wet -weakly cemented, iron oxide staining
		MC = 12.40%			Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 7.5 feet.

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TEST PIT NUMBER TP-2

PROJECT NUMBER ES-2964.01 **PROJECT NAME** 3000 W. Mercer

DATE STARTED 11/13/18 **COMPLETED** 11/13/18 **GROUND ELEVATION** **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY AZS **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 3": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.3	Dark brown TOPSOIL (Fill)
		MC = 12.50%	SM	2.5	Brown silty SAND, medium dense, moist (Fill)
5		MC = 7.80% Fines = 29.80% MC = 13.30%	SM	7.0	Gray silty SAND with gravel, dense, moist [USDA Classification: gravelly fine sandy LOAM] -weakly cemented
					Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 7.0 feet.

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TEST PIT NUMBER TP-3

PROJECT NUMBER	ES-2964.01	**PROJECT NAME**	3000 W. Mercer
DATE STARTED	11/13/18	**COMPLETED**	11/13/18
GROUND ELEVATION		**TEST PIT SIZE**	
EXCAVATION CONTRACTOR	NW Excavating	**GROUND WATER LEVELS:**	
EXCAVATION METHOD		**AT TIME OF EXCAVATION**	---
LOGGED BY	AZS	**CHECKED BY**	HTW
AT END OF EXCAVATION	---	**AFTER EXCAVATION**	---
NOTES	Depth of Topsoil & Sod 6": grass		

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.5	Dark brown TOPSOIL
			SM	1.5	Brown silty SAND, medium dense, damp
		MC = 10.30%	SM		Gray silty SAND, dense, moist
					-weakly cemented
5		MC = 11.80%		6.5	
					Test pit terminated at 6.5 feet below existing grade. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 6.5 feet.

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TEST PIT NUMBER TP-4

PROJECT NUMBER ES-2964.01
PROJECT NAME 3000 W. Mercer
DATE STARTED 11/13/18 **COMPLETED** 11/13/18
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR NW Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD
AT TIME OF EXCAVATION ---
LOGGED BY AZS **CHECKED BY** HTW
AT END OF EXCAVATION ---
NOTES Depth of Topsoil & Sod 4": grass
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.4	Dark brown TOPSOIL (Fill)
		MC = 16.70%	SM	2.5	Brownish gray silty SAND with gravel, medium dense, moist (Fill)
5		MC = 16.00%	SM	6.5	Gray silty SAND, dense, moist
		MC = 42.00% Fines = 96.00%	ML	7.5	Gray SILT, dense, wet [USDA Classification: LOAM]
					Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 7.5 feet.

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TEST PIT NUMBER TP-5

PROJECT NUMBER ES-2964.01 **PROJECT NAME** 3000 W. Mercer

DATE STARTED 11/13/18 **COMPLETED** 11/13/18 **GROUND ELEVATION** **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY AZS **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 18": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL
		MC = 11.00%	SM	1.5	Brown silty SAND, medium dense, moist
5			SM	3.5	Gray silty SAND, dense, moist
				5.5	Test pit terminated at 5.5 feet below existing grade. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 5.5 feet.

Earth Solutions NW
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TEST PIT NUMBER TP-6

PROJECT NUMBER ES-2964.01 **PROJECT NAME** 3000 W. Mercer

DATE STARTED 11/13/18 **COMPLETED** 11/13/18 **GROUND ELEVATION** **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY AZS **CHECKED BY** HTW **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 4": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.4	Dark brown TOPSOIL
			SM	1.5	Brown silty SAND, medium dense, damp
		MC = 9.10% Fines = 68.40%	ML		Gray sandy SILT, dense, moist [USDA Classification: slightly gravelly LOAM] -weakly cemented
5		MC = 10.70%		6.0	

Test pit terminated at 6.0 feet below existing grade due to refusal on very dense till. No groundwater encountered during excavation. No caving observed.

Bottom of test pit at 6.0 feet.

Appendix B

Laboratory Test Results

ES-2964.01

Earth Solutions NW, LLC
1805 - 136th PL N.E., Suite 201
Bellevue, WA 98005
Telephone: 425-449-4704
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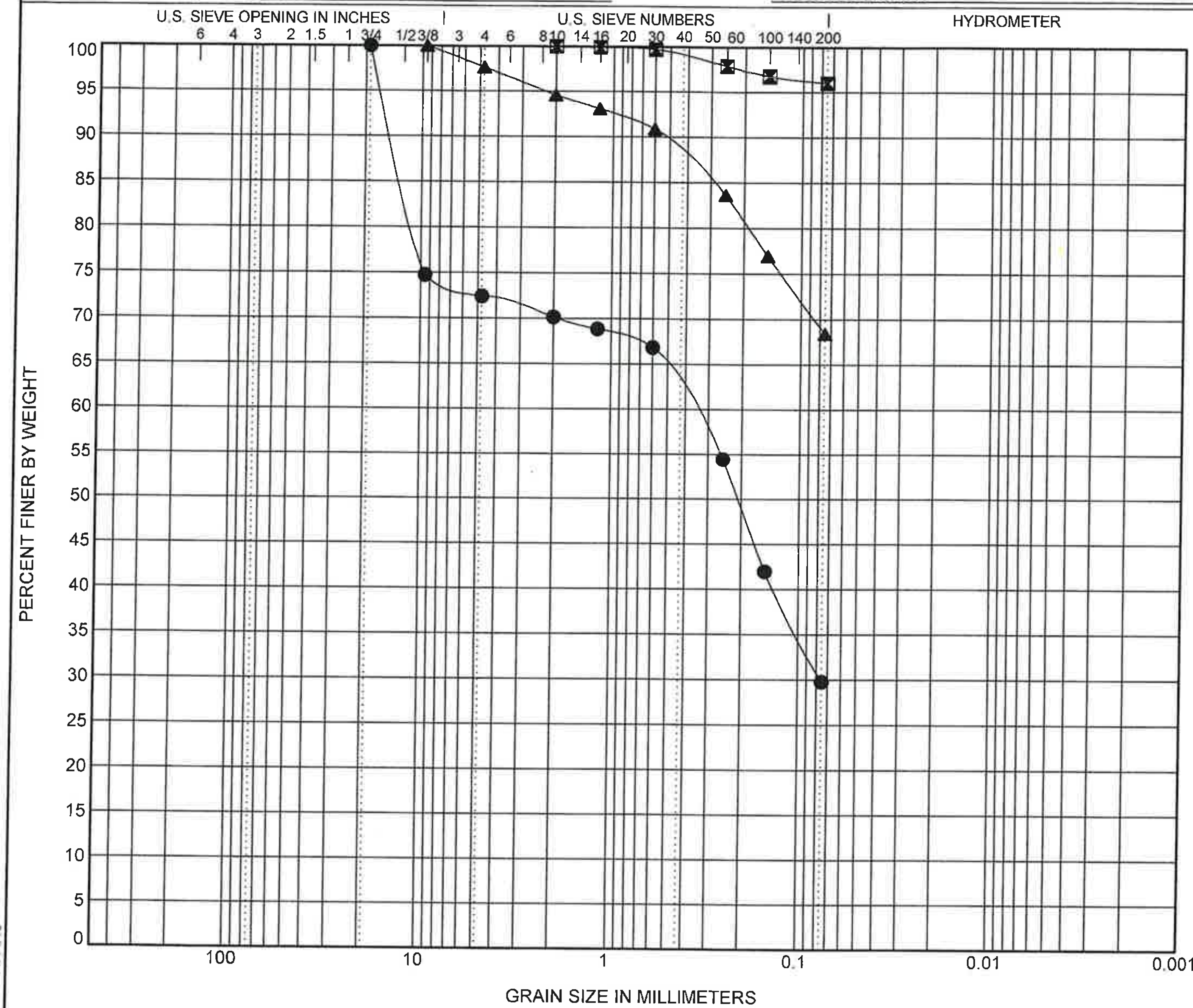
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-2964.01 **PROJECT NAME** 3000 West Mercer



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-02	3.00ft.	**USDA: Brown Gravelly Fine Sandy Loam. USCS: SM with Gravel.**		
⊠ TP-04	7.50ft.	**USDA: Gray Loam. USCS: ML.**		
▲ TP-06	2.00ft.	**USDA: Brown Slightly Gravelly Loam. USCS: Sandy ML.**		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-02	3.0ft.	19	0.371	0.076					29.8	
⊠ TP-04	7.5ft.	2							96.0	
▲ TP-06	2.0ft.	9.5							68.4	

GRAIN SIZE USDA ES-2964.01 3000 WEST MERCER.GPJ GINT US LAB.GDT 11/14/18

Report Distribution

ES-2964.01

<u>EMAIL ONLY</u>

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<u>EMAIL ONLY</u>

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Attention: Mr. Todd Oberg