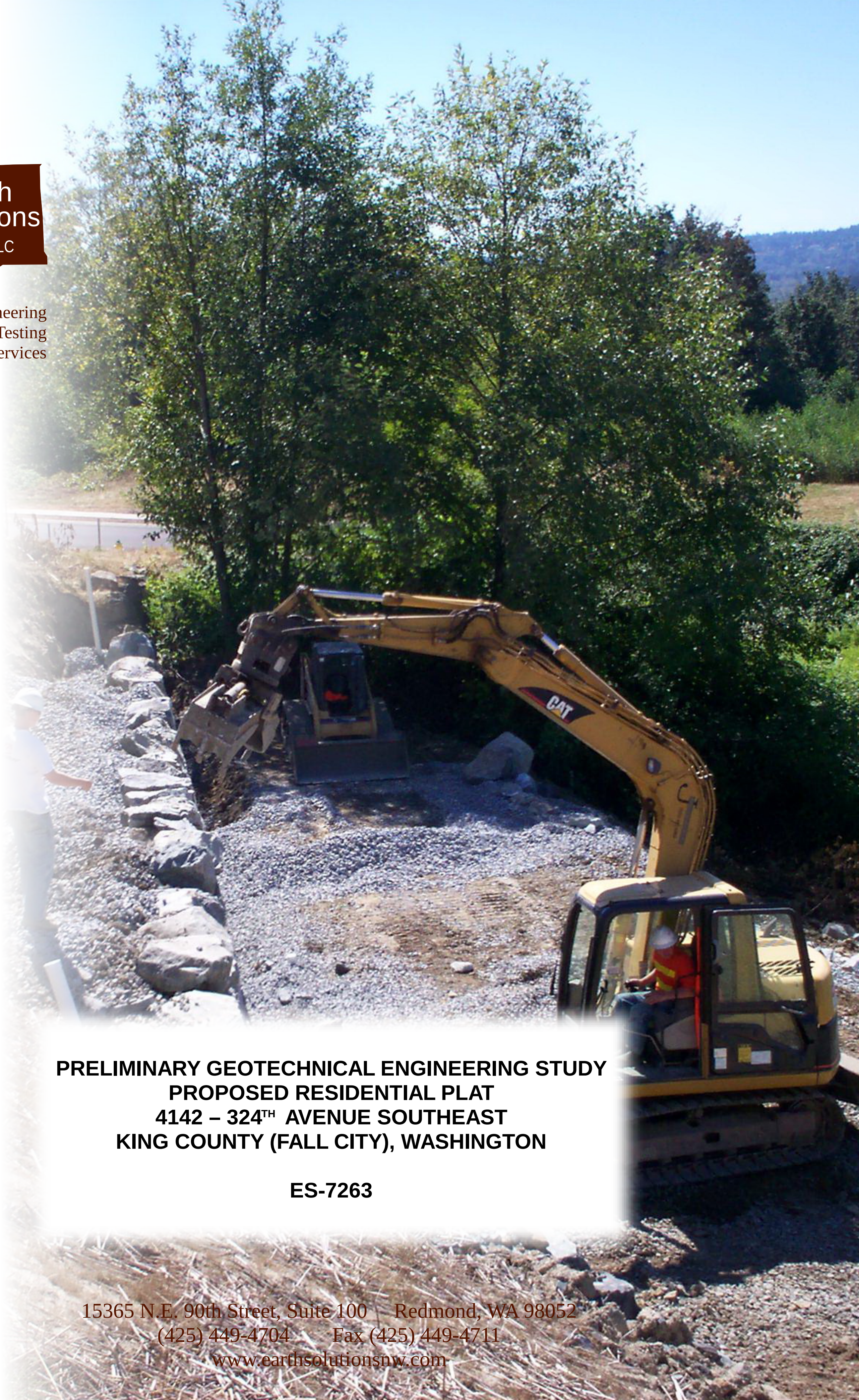
Earth Solutions NW LLC

Geotechnical Engineering
Construction Observation/Testing
Environmental Services




# PRELIMINARY GEOTECHNICAL ENGINEERING STUDY
# PROPOSED RESIDENTIAL PLAT
# 4142 – 324TH AVENUE SOUTHEAST
# KING COUNTY (FALL CITY), WASHINGTON

**ES-7263**

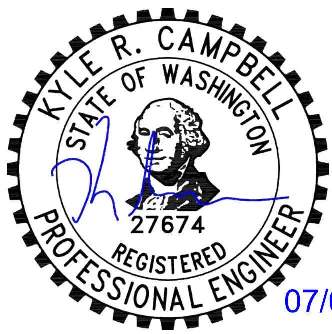
15365 N.E. 90th Street, Suite 100 | Redmond, WA 98052
(425) 449-4704 Fax (425) 449-4711
www.earthsolutionsnw.com

**PREPARED FOR**

**MS. LAURA CHA**
**c/o D.R. STRONG CONSULTING ENGINEERS, INC.**

**July 9, 2020**

_______________________
**Scott S. Riegel, L.G., L.E.G.**
**Senior Project Manager**



07/09/2020

_______________________
**Kyle R. Campbell, P.E.**
**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

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Earth Solutions NW LLC

Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

July 9, 2020
ES-7263

Ms. Laura Cha
c/o D.R. Strong Consulting Engineers, Inc.
620 – 7th Avenue
Kirkland, Washington 98033

Attention: Mr. Yoshio Piediscalzi

Dear Mr. Piediscalzi:

Earth Solutions NW, LLC (ESNW) is pleased to present this geotechnical engineering report for the proposed residential plat, to be constructed at 4142 – 324th Avenue Southeast, King County (Fall City), Washington. Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. The proposed residential 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.

Our study indicates the site is underlain primarily by alluvial fan deposits increasing in density with depth. We did not encounter groundwater during our exploration completed on May 15, 2020. However, the contractor should be prepared to respond to and manage zones of groundwater seepage during construction, if grading occurs during the rainy season. Competent native soil suitable for support of foundations will likely be encountered at depths of about two to four feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill, will be necessary.

In our opinion, based on infiltration testing performed at the subject property, native sand and gravel soils should be considered suitable for infiltration purposes from a geotechnical standpoint.

We appreciate the opportunity to be of service to you on this project. If you have questions regarding the content of this geotechnical engineering study, please call.

Sincerely,

**EARTH SOLUTIONS NW, LLC**

Scott S. Riegel, L.G., L.E.G.
Senior Project Manager

15365 N.E. 90th Street, Suite 100 • Redmond, WA 98052 • (425) 449-4704 • FAX (425) 449-4711

**Table of Contents**

**ES-7263**

**Table of Contents**

**Cont'd**

**ES-7263**

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**PROPOSED RESIDENTIAL PLAT**
**4142 – 324$^{TH}$ AVENUE SOUTHEAST**
**KING COUNTY (FALL CITY), WASHINGTON**

**ES-7263**

## INTRODUCTION

### General

This preliminary geotechnical engineering study (study) was prepared for the proposed residential plat to be completed at 4142 – 324$^{th}$ Avenue Southeast. The purpose of this study was to provide geotechnical recommendations for currently proposed development plans. In accordance with our proposal, the following services were completed to prepare this study:

- Subsurface exploration consisting of test pits;
- Small-scale Pilot Infiltration Testing (PIT);
- Laboratory testing of soil samples collected at the test pit locations, and;
- Engineering analyses and review.

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

- Cha Preliminary Short Plat Cover Sheet, prepared by D. R. Strong Consulting Engineers, Inc., dated October 30, 2019;
- King County Surface Water Design Manual (KCSWDM), Provided by King County, Washington, updated June 15, 2016;
- Online Web Soil Survey (WSS) resource, maintained by the Natural Resources Conservation Service under the United States Department of Agriculture (USDA);
- King County Municipal Code (KCMC), Title 21A.24 Critical Areas, updated August 1, 2019;
- Critical Areas – Geologic Map, provided by the King County, dated March 2018;
- King County Liquefaction Susceptibility, endorsed by the King County Flood Control District, dated May 2010, and;
- Geologic Map of the Fall City 7.5-minute quadrangle, King County, Washington, prepared by Dragovich, J. D. et. al. 2007.

## Project Description

We understand that the existing single-family residence will be removed, and a series of new single-family residential lots, an access road, and related site improvements will be constructed. Site ingress and egress will be provided off 324th Avenue Southeast. Although specific stormwater management plans were not available to us at the time of writing this report, we assume that stormwater will be infiltrated on site to the extent practical.

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 lineal foot (klf), and slab-on-grade loading is anticipated to be approximately 150 pounds per square foot (psf).

Based on the nearly level topography existing at the subject property, we assume that grade cuts and/or fills of about five feet or less will be used to achieve design elevations. Stormwater management facilities will likely require cuts in excess of five feet to construct.

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

# SITE CONDITIONS

## Surface

The subject site is located along the east side of 324th Avenue Southeast in the Fall City area of unincorporated King County, Washington. The roughly rectangular site consists of one tax parcel (King County Parcel Number 1524079033), totaling about 3.7 acres. The approximate site location is depicted on Plate 1 (Vicinity Map).

The site is bordered to the north and south by residential development to the east by the Chief Kanim Middle School campus and to the west by 324th Avenue Southeast. Site topography is relatively level, with a total elevation change of about four feet or less across the subject property. The site is currently developed with a single-family residence, an outbuilding, and associated improvements. Vegetation generally consists of landscaping around the residence and field grass elsewhere.

## Subsurface

An ESNW representative observed, logged, and sampled six test pits, excavated at accessible locations within the property boundaries, on May 15, 2020, using a mini-trackhoe and operator retained by our firm. The test pits were completed to assess and classify site soils as well as to characterize groundwater conditions within accessible areas of the site. The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the test pit logs provided in Appendix A for a more detailed description of subsurface conditions. Representative soil samples collected at the test pit locations were analyzed in accordance with both Unified Soil Classification System (USCS) and USDA methods and procedures.

### Topsoil and Fill

Topsoil was encountered in the upper approximately three to seven inches of existing grades at the test pit locations, with an average topsoil thickness of about six inches. The topsoil was characterized by dark brown color, the presence of fine organic material, and small root intrusions.

We did not encounter fill at the test pit locations during our fieldwork. Fill may be present on the site within developed areas. If fill is encountered during clearing and grading, ESNW should evaluate the fill soils for use as structural material.

### Native Soil

Underlying topsoil, native soils were classified primarily as loose to medium dense silty sand and sandy silt (USCS: SM and ML), encountered in the upper approximately two to six and one-half feet below existing grades. Underlying these soils, well-graded gravels (USCS: GW, GP) and poorly graded sand (USCS: SP) was present and continued to the maximum termination depth of about seven and one-half feet below the existing ground surface (bgs). In isolated layer of silty gravel with sand (USCS: GM) was encountered below the sand/silt soils at test pit location TP-5. These conditions are generally consistent with the makeup of an alluvial fan deposit. Native soils were encountered in a generally wet condition in the upper layers, and in a damp condition in the gravels encountered at depth across the majority of the site.

### Geologic Setting

The referenced geologic map resource identifies Alluvial Fan (Qaf) deposits as underlying the site. Alluvial fans are formed during periods of erosion and deposition, with the local source of this deposition being the Raging River, located south of Fall City. Variable periods of depositional energy are represented in the thick layers of well-graded gravels (higher energy) underlying the silts and sands (lower energy). The referenced WSS resource identifies Everett very gravelly sandy loam (Map Unit Symbol: EvB), with slopes of 0 to 8 percent, as the primary soil unit underlying the subject site. The Everett series was formed in outwash areas. In our opinion, the soil conditions observed throughout the majority of the site are generally consistent with alluvial fan deposits, as described in this section.

### Groundwater

No groundwater was encountered during our subsurface exploration completed on May 15, 2020. However, it is possible that zones of perched groundwater seepage may be exposed during general earthwork activities if grading occurs during the rainy season. 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.

### Critical Areas Assessment

Chapter 21A.24, Critical Areas, of the KCMC provides designation and performance criteria for identifying specific critical areas and developing site development plans which will not adversely impact the site or surrounding properties. Based on our review of the referenced King County critical areas map and our on-site field observations, the site does not lie within landslide, erosion, or liquefaction hazardous areas.

We understand that the subject site is located within the Rattlesnake Mountain fault zone. The Rattlesnake Mountain fault zone is not well understood nor is extensive mapping readily available regarding actual surface expression, geometry, or historic seismicity. The fault zone follows a general northwestern trend and is thought to be related to the Whidbey Island fault zone complex. Based on publicly available seismic data, no recent large-scale movement has been associated with the Rattlesnake Mountain fault zone; however, there is some data to suggest that the area has potential for a larger seismic event.

## DISCUSSION AND RECOMMENDATIONS

### General

Based on the results of our investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. The primary geotechnical considerations are related to foundation design and structural fill placement and compaction.

Typical residential 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. Competent native soil suitable for support of foundations will likely be encountered at depths of about two to four feet below existing grades. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill, will be necessary.

We presume stormwater runoff will be managed using infiltration facilities constructed on site. In our opinion, native sand and gravel soils encountered generally below about six feet are suitable for infiltration purposes from a geotechnical standpoint. Further discussion of infiltration capabilities can be found in the *Infiltration Evaluation* section of this report.

This study has been prepared for the exclusive use of Ms. Laura Cha, D. R. Strong Consulting Engineers, Inc. and their representatives. No warranty, expressed or implied, is made. This study has been prepared in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area.

## Site Preparation and Earthwork

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

### Temporary Erosion Control

The following temporary erosion control measures 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. Placement of a geotextile fabric beneath the quarry spalls will provide greater stability, if needed.
- Silt fencing should be placed around the clearing limits of the site.
- 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 interceptor swales, should be installed prior to beginning earthwork activities.
- Dry soils disturbed during construction should be wetted to control dust migration.

Additional Best Management Practices, as specified by the project civil engineer and indicated on the plans, should be incorporated into construction activities. Temporary erosion control measures may be modified during construction as site conditions require, as approved by ESNW.

### Stripping

Topsoil was encountered within the upper approximately three to seven inches. The organic-rich topsoil should be stripped and segregated into a stockpile for later use on site or to export. The material remaining immediately below the topsoil may have some root zones and will likely be variable in composition, density, and/or moisture content. The material exposed after initial topsoil stripping will likely not be suitable for direct structural support and will likely need to either be compacted in place or stripped and stockpiled for reuse as fill; depending on the time of year stripping occurs, the soil exposed below the topsoil may be too wet to compact adequately and may need to be aerated or otherwise treated. ESNW should observe initial stripping activities to provide recommendations regarding stripping depths and material suitability.

**Excavations and Slopes**

Excavation activities are likely to encounter both loose to medium dense soil and denser soils at depth. Based on the soil conditions observed at the test pit locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

- Loose to medium dense soil; fill — 1.5H:1V (Type C)
- Soil with groundwater seepage — 1.5H:1V (Type C)
- Medium dense to dense, undisturbed native soil — 1H:1V (Type B)

Steeper temporary slope inclinations within undisturbed, dense native soil may be feasible based on the soil and groundwater conditions exposed within the excavations. If pursued, ESNW can evaluate the feasibility of utilizing steeper temporary slopes at the time of construction.

The presence of perched groundwater may cause localized sloughing of temporary slopes due to excess seepage forces. 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. Permanent slopes should be planted with vegetation to both enhance stability and minimize erosion and should maintain a gradient of 2H:1V or flatter.

**In-situ and Imported Soils**

On-site silty sand and silt soils generally encountered in the upper approximately six feet are moisture sensitive, and successful use of these soils as structural fill will largely be dictated by the moisture content at the time of placement and compaction. Remedial measures, such as soil aeration and/or cement treatment (where approved by the local jurisdiction or utility district), may be necessary as part of site grading and earthwork activities. If the on-site soils cannot be successfully compacted, the use of an imported soil may be necessary. In our opinion, a contingency should be provided in the project budget for export of soil that cannot be successfully compacted as structural fill, particularly if grading activities take place during periods of extended rainfall activity. In general, 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**

Foundation and slab subgrade surfaces should consist of competent, undisturbed native soil (cut areas) or structural fill placed on a competent native soil surface. ESNW should observe subgrade areas prior to placing formwork. Supplementary recommendations for subgrade improvement may be provided at the time of construction; such as additional 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 backfill 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, typical residential 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 a competent native subgrade. Competent native soil suitable for support of foundations will likely be encountered beginning at depths of about two to four feet bgs. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill, will be necessary.

Provided the 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 about one-half inch is anticipated. The majority of the settlements 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 subject site possesses moderate to high liquefaction susceptibility. Liquefaction is a phenomenon where saturated and loose sands 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 is considered low. The absence of a uniformly established, shallow groundwater table and generally coarse soil gradation are the primary basis for this consideration.

## Slab-on-Grade Floors

Slab-on-grade floors for residential structures should be supported on competent, well-compacted, firm, and unyielding subgrades. 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 at least four inches of free-draining crushed rock or gravel should be placed below each 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 the slab should be considered. If a vapor barrier is used, it should be a material specifically designed for that use and 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 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**

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

The above design parameters 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 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 a less permeable soil if desired. 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.

## <u>Drainage</u>

Zones of perched groundwater seepage may be exposed in site excavations if grading occurs during the rainy season, particularly within deeper excavations for utilities and stormwater facilities. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches, interceptor swales, and sumps. ESNW should be consulted during preliminary grading to both identify areas of seepage and provide recommendations to reduce the potential for seepage-related instability.

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. In our opinion, foundation drains should be installed along building perimeter footings. A typical foundation drain detail is provided on Plate 4.

## <u>Infiltration Evaluation</u>

We completed two small-scale Pilot Infiltration tests (PITs) in general accordance with the 2016 KCSWDM guidelines. The PITs were completed at test pit locations TP-1 through TP-3 at a depth of four feet, within a sand and gravel soil deposits. The PITs were completed by excavating three-foot by four-foot (infiltration surface) test pits and following the prescribed PIT procedure to determine measured infiltration rates within the native soils; the test pits were excavated deeper after completing the infiltration testing. It was not possible to develop a hydraulic head for the testing; however, we estimated the infiltration rate based on the conditions encountered at each test area. Based on the results of the PITs, the following infiltration design parameters are recommended:

- Measured Infiltration Rate — TP-1 120 in./hr.; TP-2 90 in./hr.; TP-3 100 in./hr.
- $F_{Testing}$ — 0.50
- $F_{Geometry}$ — 1
- $F_{Plugging}$ — 0.9
- Calculated Design Infiltration Rate — 40.5 in./hr.

Using these correction factors, a rate of 40.5 inches per hour was calculated. However, Section 5.2.1 of the KCSWDM states that the design infiltration rate must not exceed 20 inches per hour, on this basis, for the coarse-grained soils underlying the site, an infiltration rate of **20 inches per hour** should be used for design. No groundwater was observed below the test depth after the pits were advanced to a maximum depth of seven and one-half feet below existing grade.

In our opinion, infiltration for this site is feasible for the subject property. We recommend infiltration facility base be kept as shallow as practical within the sand and gravel alluvial deposits to provide the maximum separation from groundwater influence. ESNW should review the proposed grading and drainage plans to confirm the recommendations in this report are followed, and to provide additional recommendations.

## 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), or;
- 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 areas may be considered:

- Three inches of HMA placed over six inches of CRB, or;
- Three inches of HMA placed over four-and-one-half inches of ATB.

A representative of ESNW should be requested to observe subgrade conditions prior to placement of CRB or ATB. The HMA, ATB, and CRB materials should conform to WSDOT 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 can be provided once final traffic loading has been determined. Road standards utilized by the governing jurisdiction may supersede the recommendations provided in this report.

**Utility Support and Trench Backfill**

Remedial measures may be necessary in some areas to provide support for shallow utilities, such as overexcavation and replacement with structural fill and/or placement of geotextile fabric. Groundwater seepage may be encountered within utility excavations, and caving of trench walls will likely occur in the gravel soil and where groundwater is encountered. Depending on the time of year and conditions encountered, dewatering or temporary trench shoring may be necessary during utility excavation and installation depending on the conditions exposed.

On-site soils may be suitable for use as structural backfill throughout utility trench excavations provided the soil is at (or slightly above) the optimum moisture content at the time of placement and compaction. Moisture conditioning of the soils may be necessary at some locations prior to use as structural fill. Each section of the utility lines must be adequately supported in the bedding material. Utility trench backfill should be placed and compacted to the specifications of structural fill as previously detailed in this report or to the applicable specifications of responsible jurisdiction or agency.

## 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 report. ESNW should also be retained to provide testing and consultation services during construction.


Reference:
King 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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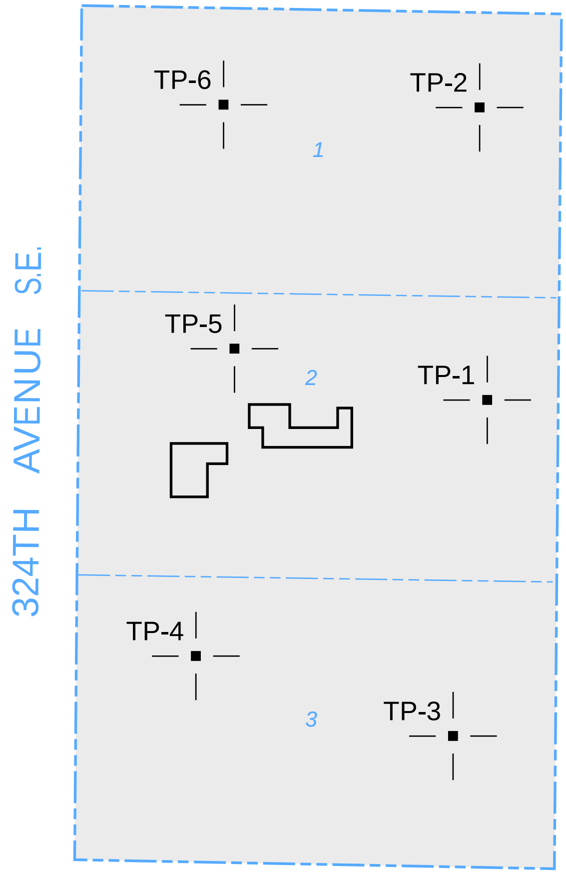
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

# Vicinity Map
## Cha Short Plat
## King County (Fall City), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 07/02/2020 | Proj. No. 7263 |
| Checked SSR | Date July 2020 | Plate 1 |



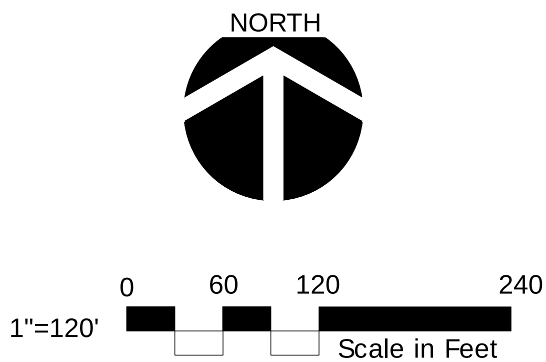

**LEGEND**

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-7263, May 2020

Subject Site

2 — Proposed Lot Number

Existing Building




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.

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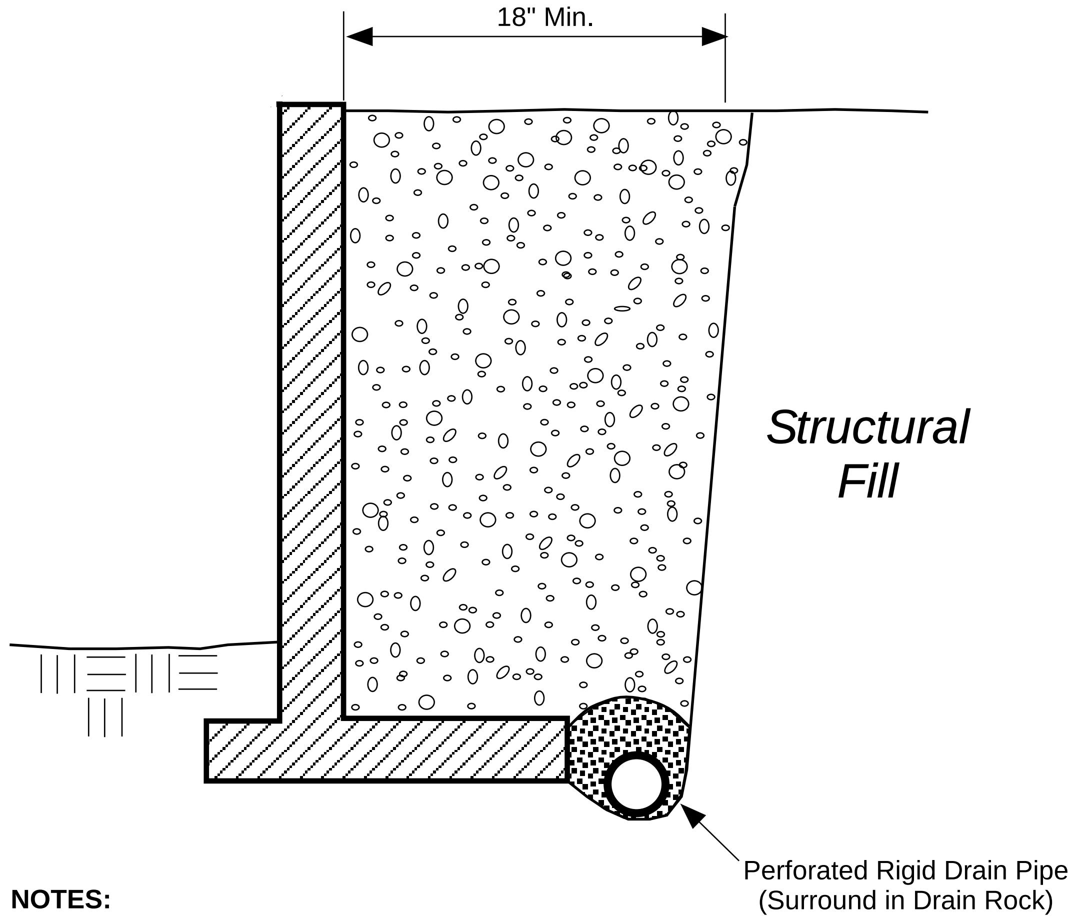
**Test Pit Location Plan**
**Cha Short Plat**
**King County (Fall City), Washington**

| | | |
|---|---|---|
| Drwn. CAM | Date 07/02/2020 | Proj. No. 7263 |
| Checked SSR | Date July 2020 | 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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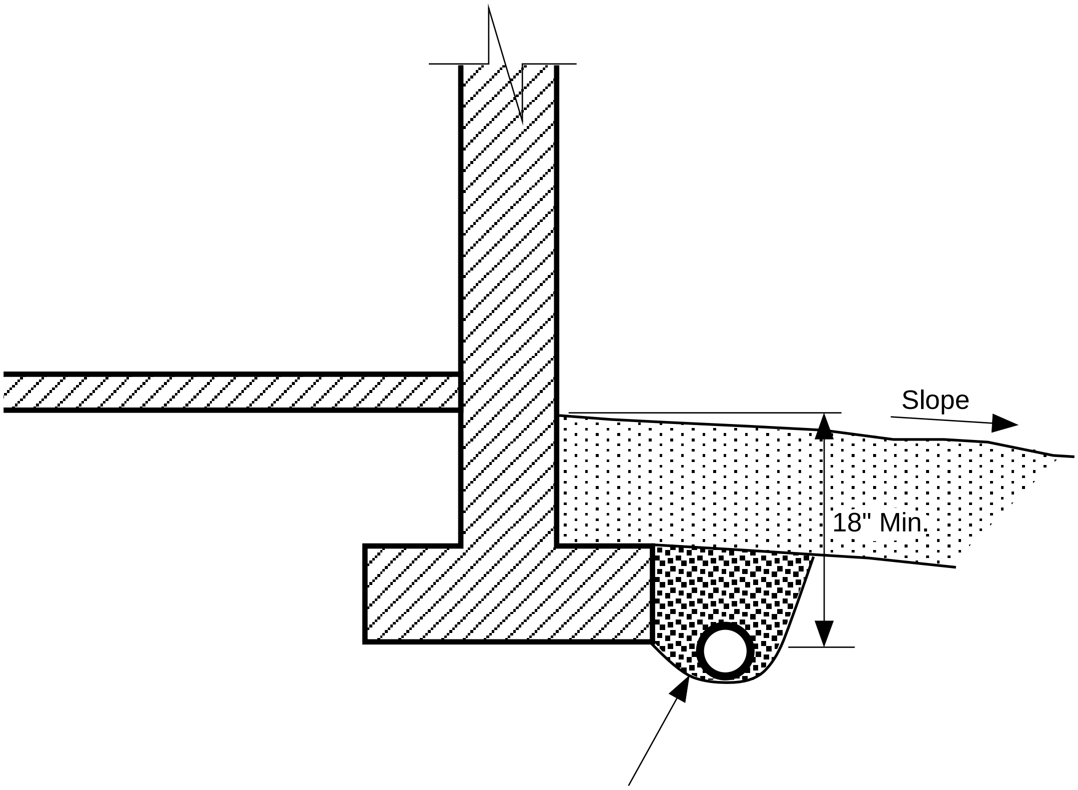
Retaining Wall Drainage Detail
Cha Short Plat
King County (Fall City), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 07/09/2020 | Proj. No. 7263 |
| Checked SSR | Date July 2020 | 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
Cha Short Plat
King County (Fall City), Washington

| | | |
|---|---|---|
| Drwn. CAM | Date 07/09/2020 | Proj. No. 7263 |
| Checked SSR | Date July 2020 | Plate 4 |

## Appendix A

## Subsurface Exploration
## Test Pit Logs

## ES-7263

Subsurface conditions at the subject site were explored on May 15, 2020 by excavating six test pits using a trackhoe and operator retained by our firm. The approximate locations of the test pits are illustrated on Plate 2 of this study. The test pit logs are provided in this Appendix. The test pits were advanced to a maximum depth of approximately 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 | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | GRAVELS WITH FINES | | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) | | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | SAND AND SANDY SOILS | CLEAN SANDS | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) | | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | SANDS WITH FINES | | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) | | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS | 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 |
| MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | 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, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# TEST PIT NUMBER TP-1



**PROJECT NUMBER** ES-7263
**PROJECT NAME** Cha Short Plat
**DATE STARTED** 5/15/20 **COMPLETED** 5/15/20
**GROUND ELEVATION** **TEST PIT SIZE**
**EXCAVATION CONTRACTOR** NW Excavating
**GROUND WATER LEVELS:**
**EXCAVATION METHOD**
**AT TIME OF EXCAVATION** ---
**LOGGED BY** AZS **CHECKED BY** SSR
**AT END OF EXCAVATION** ---
**NOTES** Depth of Topsoil & Sod 4": field grass
**AFTER EXCAVATION** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | TPSL | 0.4 | Dark brown TOPSOIL |
| | | MC = 5.10% | SM | 2.0 | Brown silty SAND with gravel, medium dense, moist |
| 5 | | MC = 4.20%<br>Fines = 2.50%<br>MC = 3.90% | GW | 7.5 | Gray well-graded GRAVEL with sand, medium dense, moist<br>-slight caving from 2' to BOH<br>-infiltration test at 4'<br>[USDA Classification: extremely gravelly coarse SAND]<br>-cobbles |

Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. Caving observed from 2.0 feet to BOH.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# TEST PIT NUMBER TP-2



**PROJECT NUMBER** ES-7263
**PROJECT NAME** Cha Short Plat
**DATE STARTED** 5/15/20 **COMPLETED** 5/15/20
**GROUND ELEVATION** **TEST PIT SIZE**
**EXCAVATION CONTRACTOR** NW Excavating
**GROUND WATER LEVELS:**
**EXCAVATION METHOD**
**AT TIME OF EXCAVATION** ---
**LOGGED BY** AZS **CHECKED BY** SSR
**AT END OF EXCAVATION** ---
**NOTES** Depth of Topsoil & Sod 6": field grass
**AFTER EXCAVATION** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | TPSL | 0.5 | Dark brown TOPSOIL |
| | | MC = 24.00% | ML | 3.0 | Brown sandy SILT, loose to medium dense, moist |
| 5 | | MC = 2.60%<br>Fines = 0.90%<br>MC = 5.40% | GP | 7.5 | Gray poorly graded GRAVEL with sand, medium dense, moist<br>-slight caving from 3' to BOH<br>-infiltration test at 4'<br>[USDA Classification: extremely gravelly coarse SAND] |

Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. Caving observed from 3.0 feet to BOH.

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15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# TEST PIT NUMBER TP-3



**PROJECT NUMBER** ES-7263
**PROJECT NAME** Cha Short Plat
**DATE STARTED** 5/15/20 **COMPLETED** 5/15/20
**GROUND ELEVATION** ______ **TEST PIT SIZE** ______
**EXCAVATION CONTRACTOR** NW Excavating
**GROUND WATER LEVELS:**
**EXCAVATION METHOD** ______
**AT TIME OF EXCAVATION** ---
**LOGGED BY** AZS **CHECKED BY** SSR
**AT END OF EXCAVATION** ---
**NOTES** Depth of Topsoil & Sod 6": field grass
**AFTER EXCAVATION** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | TPSL | 0.5 | Dark brown TOPSOIL |
| | | MC = 21.70% | ML | 4.0 | Tan sandy SILT, medium dense, moist |
| 5 | | MC = 5.10%<br>Fines = 3.20% | GW | 6.0 | Gray well-graded GRAVEL with sand, medium dense, moist<br>-infiltration test at 4.5'<br>[USDA Classification: extremely gravelly SAND] |
| | | MC = 4.50%<br>Fines = 1.00% | GP | 7.5 | Gray poorly graded GRAVEL with sand, medium dense, moist<br>[USDA Classification: extremely gravelly coarse SAND] |

Test pit terminated at 7.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# TEST PIT NUMBER TP-4



**PROJECT NUMBER** ES-7263
**PROJECT NAME** Cha Short Plat
**DATE STARTED** 5/15/20 **COMPLETED** 5/15/20
**GROUND ELEVATION** **TEST PIT SIZE**
**EXCAVATION CONTRACTOR** NW Excavating
**GROUND WATER LEVELS:**
**EXCAVATION METHOD**
**AT TIME OF EXCAVATION** ---
**LOGGED BY** AZS **CHECKED BY** SSR
**AT END OF EXCAVATION** ---
**NOTES** Depth of Topsoil & Sod 6": field grass
**AFTER EXCAVATION** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | TPSL | | 0.5 | Dark brown TOPSOIL |
| | | MC = 23.70% | ML | | 2.5 | Brown sandy SILT, loose to medium dense, moist |
| 5 | | MC = 4.30%<br>MC = 3.00% | SP | | 7.0 | Gray poorly graded SAND with gravel, medium dense, moist<br>-slight caving from 2.5' to BOH<br>-cobbles |

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. Caving observed from 2.5 feet to BOH.

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15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# TEST PIT NUMBER TP-5



**PROJECT NUMBER** ES-7263
**PROJECT NAME** Cha Short Plat
**DATE STARTED** 5/15/20 **COMPLETED** 5/15/20
**GROUND ELEVATION** **TEST PIT SIZE**
**EXCAVATION CONTRACTOR** NW Excavating
**GROUND WATER LEVELS:**
**EXCAVATION METHOD**
**AT TIME OF EXCAVATION** ---
**LOGGED BY** AZS **CHECKED BY** SSR
**AT END OF EXCAVATION** ---
**NOTES** Depth of Topsoil & Sod 6": field grass
**AFTER EXCAVATION** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | TPSL | 0.5 | Dark brown TOPSOIL |
| | | MC = 21.80%<br>Fines = 65.70% | ML | | Brown sandy SILT, loose to medium dense, moist<br>[USDA Classification: slightly gravelly LOAM] |
| 5 | | MC = 29.10% | | 6.5 | |
| | | MC = 12.00% | GM | 7.0 | Gray silty GRAVEL, medium dense, moist |

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

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15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# TEST PIT NUMBER TP-6



**PROJECT NUMBER** ES-7263
**PROJECT NAME** Cha Short Plat
**DATE STARTED** 5/15/20 **COMPLETED** 5/15/20
**GROUND ELEVATION** **TEST PIT SIZE**
**EXCAVATION CONTRACTOR** NW Excavating
**GROUND WATER LEVELS:**
**EXCAVATION METHOD**
**AT TIME OF EXCAVATION** ---
**LOGGED BY** AZS **CHECKED BY** SSR
**AT END OF EXCAVATION** ---
**NOTES** Depth of Topsoil & Sod 7": field grass
**AFTER EXCAVATION** ---

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | TPSL | 0.6 | Dark brown TOPSOIL |
| | | MC = 31.70% | ML | | Brown sandy SILT, loose to medium dense, moist |
| 5 | | MC = 30.80% | | 6.0 | |
| | | MC = 2.00% | GP | 7.0 | Gray poorly graded GRAVEL, medium dense, moist |

Test pit terminated at 7.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.

# Appendix B

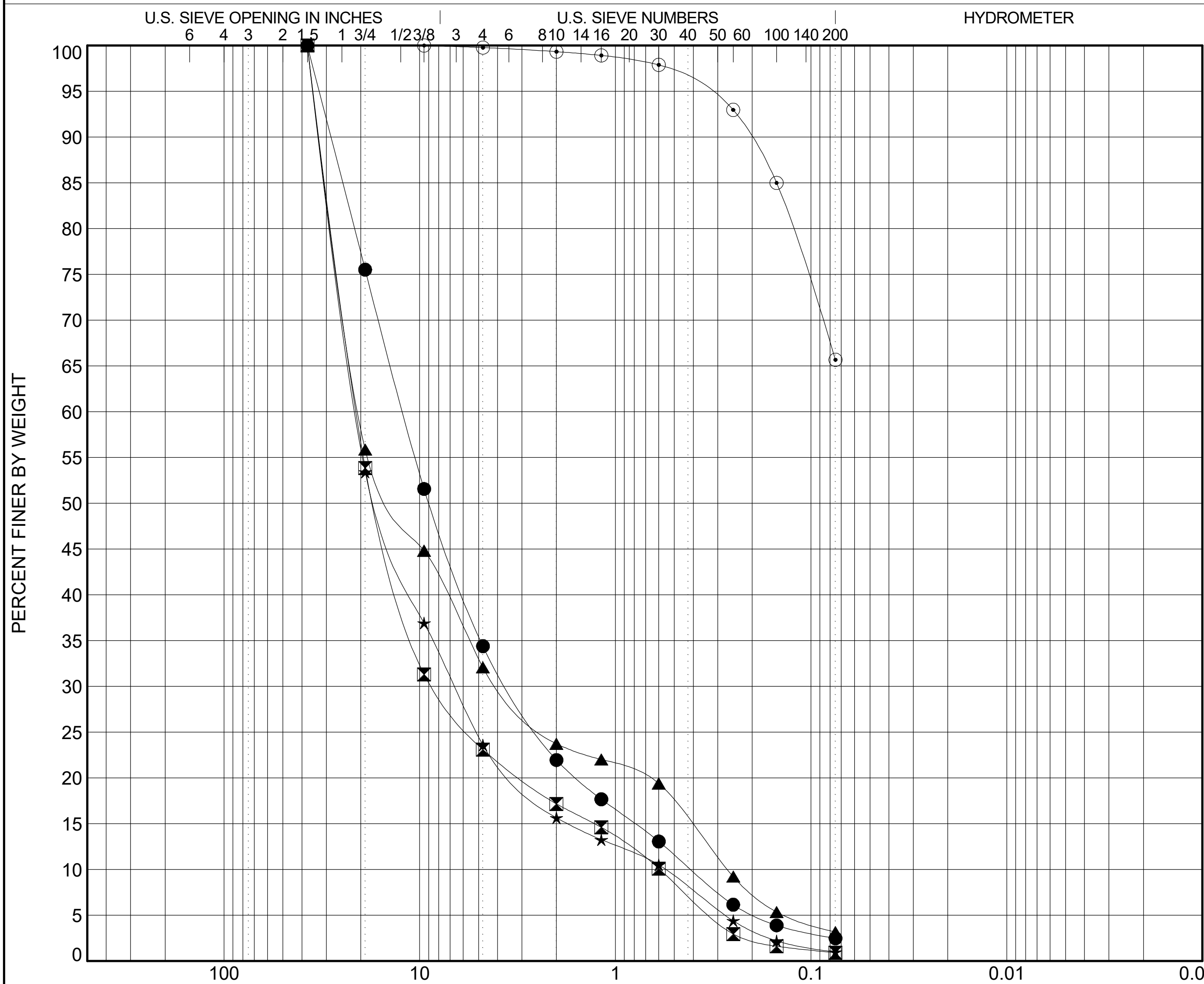
# Laboratory Test Results

# ES-7263

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

# GRAIN SIZE DISTRIBUTION

**PROJECT NUMBER** ES-7263 **PROJECT NAME** Cha Short Plat




| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| Specimen Identification | | | Classification | Cc | Cu |
|---|---|---|---|---|---|
| ● | **TP-01** | **4.00ft.** | **USDA: Gray Extremely Gravelly Coarse Sand. USCS: GW with Sand.** | **2.48** | **29.78** |
| ⧗ | **TP-02** | **4.00ft.** | **USDA: Gray Extremely Gravelly Coarse Sand. USCS: GP with Sand.** | **5.87** | **35.12** |
| ▲ | **TP-03** | **4.50ft.** | **USDA: Gray Extremely Gravelly Sand. USCS: GW with Sand.** | **2.71** | **75.78** |
| ★ | **TP-03** | **7.50ft.** | **USDA: Gray Extremely Gravelly Coarse Sand. USCS: GP with Sand.** | **3.76** | **37.45** |
| ⊙ | **TP-05** | **1.00ft.** | **USDA: Brown Slightly Gravelly Loam. USCS: Sandy ML.** | | |

| Specimen Identification | | | D100 | D60 | D30 | D10 | LL | PL | PI | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ● | **TP-01** | **4.0ft.** | **37.5** | **12.127** | **3.5** | **0.407** | | | | **2.5** | |
| ⧗ | **TP-02** | **4.0ft.** | **37.5** | **20.805** | **8.507** | **0.592** | | | | **0.9** | |
| ▲ | **TP-03** | **4.5ft.** | **37.5** | **20.25** | **3.831** | **0.267** | | | | **3.2** | |
| ★ | **TP-03** | **7.5ft.** | **37.5** | **20.917** | **6.629** | **0.559** | | | | **1.0** | |
| ⊙ | **TP-05** | **1.0ft.** | **9.5** | | | | | | | **65.7** | |

**Report Distribution**

**ES-7263**

**EMAIL ONLY**

**Ms. Laura Cha**
**c/o D.R. Strong Consulting Engineers, Inc.**
**620 – 7th Avenue**
**Kirkland, Washington 98033**

**Attention: Mr. Yoshio Piediscalzi**