Geotechnical Engineering Report

Grandview's North Olympic
N. Olympic Ave and W. Division Street
Arlington, WA

Prepared For:

Grandview North, LLC
P.O. Box 159
Arlington, WA 98223

Attn:
Mr. Scott Wammack

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November 18, 2021
Project No. 21-0952

Grandview North, LLC
P.O. Box 159
Arlington, WA 98223

Attention: Mr. Scott Wammack

Regarding: **Geotechnical Engineering Report**
Grandview's North Olympic
SWC of N. Olympic Avenue and W. Division Street
Arlington, WA 98223

Dear Mr. Wammack,

As requested, GeoTest Services, Inc. [GeoTest] is pleased to submit the following report summarizing the results of our geotechnical engineering evaluation for the Grandview's North Olympic project at the above referenced address in Arlington, Washington (see *Vicinity Map*, Figure 1). This report has been prepared in general accordance with the terms and conditions established in our services agreement dated July 27, 2021 and authorized by yourself.

GeoTest appreciates the opportunity to provide geotechnical services on this project and looks forward to assisting you during the construction phase. Should you have any further questions regarding the information contained within the report, or if we may be of service in other regards, please contact the undersigned.

Respectfully,
GeoTest Services, Inc.

David Trudeau
Staff Geologist

EDWARDO A. GARCIA
STATE OF WASHINGTON
PROFESSIONAL ENGINEER
11-18-21

Edwardo Garcia, P.E.
Geotechnical Department Manager

Enclosure: Geotechnical Engineering Report

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PURPOSE AND SCOPE OF SERVICES

The purpose of this evaluation is to establish general subsurface conditions beneath the site from which conclusions and recommendations pertaining to project design can be formulated. Our scope of services includes the following tasks:

- Explore soil and groundwater conditions underlying the site by advancing a total of 6 test pit explorations with an Owner-provided excavator.

- Perform laboratory testing on representative samples to classify and evaluate the engineering characteristics of the soils encountered and to assess on-site infiltration capability.

- Provide a written report containing a description of surface and subsurface conditions and exploration logs. The findings and recommendations in this report pertain to site preparation and earthwork, including reuse of site soil, and criteria for selection, placement, and compaction of Structural Fill. Included is a discussion of the effects of weather and/or construction equipment on subgrade soils.

- Provide recommendations for foundation support of the structures and slabs including subgrade preparation, allowable soil bearing pressures, bearing elevations, frost penetration and depth, estimates of settlement, subsurface drainage, parameters for lateral load resistance, and pavement sections.

- Provide recommendations for geotechnical monitoring, materials testing, and consultation during construction.

- Assess Geologically Hazardous Areas (if present) per the City of Arlington Municipal Code.

PROJECT DESCRIPTION

The project site consists of two separate properties that total approximately 0.4 acres. The properties currently consist of a gravel parking area and a book store. Minimal landscaping exists on the property, with the landscaping consisting of a few shrubs and a grass strip along the western property boundary. The Centennial Trail borders the property to the west, West Division Street to the north, North Olympic Avenue to the east, and the United States Post Office to the south.

A new mixed-use development is planned for the property. GeoTest was provided with an initial development concept that included a 4-story building with commercial/retail space on the first floor and three floors of apartment space. GeoTest anticipates that new construction will utilize wood-frame construction in conjunction with slab-on-grade floors and shallow conventional

foundations. GeoTest has not been provided with a formalized development plan but it is expected that structural loads will be light to moderate.

SITE CONDITIONS

This section includes a description of the general surface and subsurface conditions observed at the project site during the time of our field investigation. Interpretations of site conditions are based on the results and review of available information, site reconnaissance, subsurface explorations, laboratory testing, and previous experience in the project vicinity.

Image 1. Surface conditions at the property and vicinity. Aerial image dated 2020, taken from Snohomish County Online Property Information website.

Surface Conditions

The rectangular-shaped, approximately 0.4-acre subject property is currently vacant and has been historically graded. GeoTest understands that a convenience store and gas station formerly occupied the property. GeoTest does not have a date for the demolition of the convenience store and decommissioning of the below-grade gas tanks, but this information can likely be obtained if it is needed. The property is located immediately south of West Division Street and north of the Arlington Post Office. The ground cover on the subject property consists of crushed gravel surfacing. The topography across the relatively flat with only a few feet of elevation differential

across the property. No signs of surface water were observed on the proposed development at the time of our site visit in late-October of 2021.

Subsurface Soil Conditions

Subsurface conditions were investigated by conducting six exploratory test pits (Test Pits TP-1 through TP-6) on October 22, 2021. The majority of the test pits were advanced to depths of between 10 and 12 feet below ground surface (BGS) using a Client-provided excavator. GeoTest staff observed the advancement of the test pit explorations and logged the soils encountered. Upon completion of the test pit excavations, soil samples were obtained and the test pit spoils were placed back into the excavation. GeoTest observed that the contractor tamped disturbed soils back into the excavation and then back-bladed the excavation area to make it flat. The approximate locations of these test pits have been plotted on the *Site and Exploration Plan* (Figure 2).

Photo 1. Advancement of Test Pit TP-1. TP-1 was advanced to approximately 12 feet below ground surface. Photo taken on October 22, 2021.

Exploration Test Pits TP-1, TP-2, and TP-4 encountered between 2 and 8 feet of historic fill that appeared to be associated with the demolished building and underground tanks that were located on the property. This fill was loose to medium dense and contained sand, silty sand, concrete debris, brick pieces, and scattered organics. Underlying the historic fill, GeoTest observed medium dense to dense very sandy gravel and gravelly to very gravelly sand that was interpreted to be representative of the native Arlington Gravel member.

Photo 2. Test Pit TP-2. Note uncontrolled, granular fill. The granular fill lacked significant qualities of rounded rock or cobble found in native Arlington Gravel.

Photo 3. Test Pit TP-5. Note surficial gravelly fill overlying native Arlington Gravel at depth.

Exploration Test Pits TP-3, TP-5, and TP-6 generally encountered either topsoil or surficial fill soils associated with the existing parking lot/drive path areas on the property in the upper 12 to 18 inches. The underlying native soils encountered from about 1 to 1.5 feet below existing site grades consisted of medium dense to dense very sandy gravel or very gravelly sands. The native soils were also interpreted to be representative of Arlington Gravel.

More detailed logs of the subsurface conditions encountered within our explorations are presented in the *Test Pit Logs* attached at the end of this report.

General Geologic Conditions

Geologic information for the project site was obtained from the geologic map entitled *Geologic map of the Arlington West 7.5-minute quadrangle, Snohomish County, Washington* (Minard,

1985) published by the United States Geological Survey. According to Minard's map, the subject property is underlain by Recessional Outwash (Marysville Sand Member, Qvrm). Marysville Sand is recorded as being well drained, stratified to massive, with some pebble gravel deposited by meltwater form the stagnating and receding Vashon glacier. Notably, Recessional Outwash (Arlington Gravel Member, Qvra) is mapped in close proximity to the project site. Arlington Gravel consists mostly of well drained stratified outwash sand and gravel, similar to Marysville Sand, but has a generally higher gravel content.

Based on our observations and the generally higher gravel content observed in the exposed soils, it is our opinion that the subsurface soils more closely resemble the Recessional Outwash (Arlington Gravel Member, Qvra). For the purposes of this report, GeoTest has elected to refer to native Recessional Outwash (Arlington Gravel Member) simply as "Arlington Gravel". The encountered soils are generally consistent with the published geological information and our experience with projects in the nearby vicinity.

Groundwater

Groundwater was not encountered at the time of our subsurface explorations. The groundwater conditions reported on the exploration logs are for the specific locations and dates indicated, and therefore may not be indicative of other locations and/or times. Groundwater levels are variable and groundwater conditions will fluctuate depending on local subsurface conditions, precipitation, and changes in on-site and off-site use.

GEOLOGIC HAZARDS

Based on the online Geologic Map of Washington State, published by the Washington State Department of Natural Resources (DNR), the subject site is rated as a very low liquefaction susceptibility area. However, this map only provides an estimate of the likelihood that soil will liquefy as a result of earthquake shaking and is meant as a general guide to delineate areas prone to liquefaction. It should be noted that near-surface groundwater was not encountered in our subsurface explorations, and that the native soils were generally medium-dense to dense and consisted of very gravelly sand and very sandy gravels. Medium dense to dense, higher gravel content soils paired with deeper groundwater elevations support the "very low" risk of liquefaction presented by the DNR regional map.

The subject property and surrounding areas are flat. Thus, there does not appear to be Geologically Hazardous Areas on or in the vicinity of the subject property, per the City of Arlington Municipal Code Part VI *(Geologically Hazardous Areas),* relating to seismic hazards, landslide hazards, or erosion hazards. Thus, GeoTest does not have any formal recommendations for mitigating seismic, landslides, or erosion hazards as these types of hazards do not appear to be on or near the projects site.

CONCLUSIONS AND RECOMMENDATIONS

Our understanding of the project site suggests that a convenience store and underground gas tanks previously occupied portions of the project site. GeoTest has been informed by members of the project team that the tanks were pulled from the property and that the required paperwork and/or permitting was submitted to the State of Washington to receive a "No Further Action" designation. GeoTest has not, however, been provided with documentation showing the previous tank and/or building locations, nor has GeoTest been provided with information regarding the tank depths or the depth of any excavations associated with the tank decommissioning. Because of the "No Further Action" designation, GeoTest is proceeding under the assumption that additional explorations, testing, or mitigation efforts to address the potential for environmental contamination on the property will not be required.

Because of the previous site use and the placement of historic, uncontrolled fill on the property, it should be assumed that extensive stripping and/or overexcavation may be required to remove unsuitable materials from the proposed area of construction. Uncontrolled fill in the generally eastern and southern portions of the property are expected to require significant efforts to completely remove these materials, with the maximum removal depth being equal to the depth of the former underground tanks. Uncontrolled fill in the generally western portion of the project is expected to be much shallower, typically in the range of 12 to 18 inches in depth.

Our subsurface explorations in the eastern portion of the property encountered variable amounts of uncontrolled, loose to medium dense fill materials with construction debris in and around the assumed location of the former convenience store and tank location. Uncontrolled fill materials are not suitable for the support of foundation elements and must be either removed from the site or the Owner must utilize construction techniques that extend through the entirety of the uncontrolled fill. The fill materials that GeoTest encountered in our test pits extended to a depth of about 8 feet below existing site grades. It should be expected, however, that uncontrolled fill in and around the former tank locations is likely to be deeper than what GeoTest encountered. Because the location and depth of the tanks is currently unknown, it may be advantageous to either secure records of the tank decommissioning or to use historic information (i.e., surveys, site photos, or decommissioning records) not currently available to better establish the tank location. GeoTest can also perform supplemental explorations in or around the tank locations to confirm the limits and/or depth of the uncontrolled fill.

In the generally western portion of the property, medium dense to dense gravelly sands and sandy gravels were encountered at shallow depths. Native, firm and unyielding subgrade soils are suitable for the direct support of foundation elements. It is generally assumed that 12 to 18 inches of stripping below existing site grades will be required to address existing near-surface fill materials that currently cover a large portion of the property.

Based on the granular nature of the native soils encountered in the test pits, it appears that the native Arlington Gravel is suitable for the conventional infiltration of stormwater. GeoTest has presented preliminary design infiltration rates based on grain size analyses per the *Stormwater Management Manual for Western Washington*, in the *Stormwater Infiltration Potential* section of this report.

Site Preparation and Earthwork

The portions of the site proposed for foundations and floor slabs should be prepared by removing existing topsoil, loose fill (if present), deleterious material, and significant accumulations of organics. In and around the former location of the convenience store and underground gas tanks, substantial amounts of uncontrolled fill materials should be expected. Our test pit explorations encountered between 2 and 8 feet of uncontrolled fill, but it should be expected that deeper fill depths are present on the property. It should be expected that the areas of the deepest uncontrolled fill will be at lest equal to the installed depth of the tanks. GeoTest does not currently have records of the tank depths and strongly recommends that additional studies be performed to determine the location and depth of the tanks. If full removal of the uncontrolled fill is not desired, construction techniques that include a basement or an approach that extends the footings through the fill may be desired.

Prior to placement of any foundation elements or Structural Fill, the exposed subgrade under all areas to be occupied by soil-supported floor slabs, spread, or continuous foundations should be recompacted to a firm and unyielding condition. Verification of compaction should be performed by qualified geotechnical personnel. The purpose of this effort is to identify loose or soft soil deposits so that, if feasible, the soil disturbed during site work can be recompacted.

Proof rolling should be carefully observed by qualified geotechnical personnel. Areas exhibiting significant deflection, pumping, or over-saturation that cannot be readily compacted should be overexcavated to firm soil. Overexcavated areas should be backfilled with compacted granular material placed in accordance with subsequent recommendations for Structural Fill. During periods of wet weather, proof rolling could damage the exposed subgrade. Under these conditions, qualified geotechnical personnel should observe subgrade conditions to determine if proof rolling is feasible.

Proof rolling may not be feasible for certain locations within excavations, trench areas, or other difficult access zones when using a full-size dump truck or other large machinery. In this situation, we recommend alternate means of verification such as Dynamic Cone Penetrometer (DCP) testing or soil probe methods be employed to verify suitability of field conditions. Furthermore, the site soils may require additional support by a woven geotextile fabric or geogrid material due to their soft and generally sensitive nature. Once the final building alignment is determined, GeoTest recommends that we be present during construction to observe site conditions and

make further recommendations regarding the use of geotextile or geogrid supporting fabric below new structures.

Fill and Compaction

Structural Fill used to obtain final elevations for footings and soil-supported floor slabs must be properly placed and compacted. In most cases, any non-organic, predominantly granular soil may be used for fill material provided the material is properly moisture conditioned prior to placement and compaction, and the specified degree of compaction is obtained. Material containing topsoil, wood, trash, organic material, or construction debris is not suitable for reuse as Structural Fill and should be properly disposed offsite or placed in nonstructural areas.

Soils containing more than approximately five percent fines are considered moisture sensitive and are difficult to compact to a firm and unyielding condition when over the optimum moisture content by more than approximately two percent. The optimum moisture content is that which allows the greatest dry density to be achieved at a given level of compactive effort.

Reuse of On-Site Soil – Existing Fill

The existing fill soils that we observed in Test Pits TP-1, TP-2, and TP-4 consisted of silty sands with significant quantities of concrete, brick, and scattered organics. These materials are not suitable for reuse in Structural Fill applications. This material should be removed from the project site.

Reuse of On-Site Soil – Native Soil

The native, on-site soils consisted of gravelly sands and sandy gravels with generally low silt contents. It is GeoTest's opinion that the native Arlington Gravel soil is suitable for reuse as Structural Fill when placed at or near optimum moisture contents, as determined by ASTM D1557, and if allowed for in the project plans and specifications. Materials with elevated levels of organics, if present, cannot be reused as Structural Fill and should be segregated from mineral soils.

The contractor and owner should be prepared to manage over optimum moisture content soils. Moisture content of the site soils may be difficult to control during periods of wet weather.

Imported Structural Fill

GeoTest recommends that imported Structural Fill consist of clean, well-graded sandy gravel, gravelly sand, or other approved naturally occurring granular material (pit run) with at least 30 percent retained on the No. 4 sieve, or a well-graded crushed rock. Structural fill for dry weather construction may contain up to 10 percent fines (that portion passing the U.S. No. 200 sieve)

based on the portion passing the U.S. No. 4 sieve. The use of an imported fill having more than 10 percent fines may be feasible, but the use of these soils should generally be reviewed by the design team prior to the start of construction.

Imported Structural Fill with less than five percent fines should be used during wet weather conditions. Due to wet site conditions, soil moisture contents could be high enough that it may be difficult to compact even clean imported select granular fill to a firm and unyielding condition. Soils with an over-optimum moisture content should be scarified and dried back to a suitable moisture content during periods of dry weather or removed and replaced with drier Structural Fill.

Backfill and Compaction

Structural Fill should be placed in horizontal lifts. The Structural Fill must measure 8 to 10 inches in loose thickness and be thoroughly compacted. All Structural Fill placed under load bearing areas should be compacted to at least 95 percent of the maximum dry density, as determined using test method ASTM D1557. The top of the compacted Structural Fill should extend outside all foundations and other structural improvements a minimum distance equal to the thickness of the fill. We recommend that compaction be tested after placement of each lift in the fill pad.

Wet Weather Earthwork

Native soils may be susceptible to degradation during wet weather. As a result, it may be difficult to control the moisture content of site soils during the wet season. If construction takes place during wet weather, GeoTest recommends that Structural Fill consist of imported, clean, well-graded sandy gravel or gravelly sand as described above. If fill is to be placed or earthwork is to be performed in wet conditions, the contractor may reduce soil disturbance by:

- Limiting the size of areas that are stripped of topsoil and left exposed
- Accomplishing earthwork in small sections
- Limiting construction traffic over unprotected soil
- Sloping excavated surfaces to promote runoff
- Limiting the size and type of construction equipment used
- Providing gravel 'working mats' over areas of prepared subgrade
- Removing wet surficial soil prior to commencing fill placement each day
- Sealing the exposed ground surface by rolling with a smooth drum compactor or rubber-tired roller at the end of each working day
- Providing up-gradient perimeter ditches or low earthen berms and using temporary sumps to collect runoff and prevent water from ponding and damaging exposed subgrades

Seismic Design Considerations

The Pacific Northwest is seismically active, and the site could be subject to movement from a moderate or major earthquake. Consequently, moderate levels of seismic shaking should be accounted for during the design life of the project, and the proposed structure should be designed to resist earthquake loading using appropriate design methodology.

For structures designed using the seismic design provisions of the 2018 International Building Code, the native soil underlying the site is classified as Site Class D, according to ASCE 7-16. The structural engineer should select the appropriate design response spectrum based on Site Class D soil and the geographical location of the proposed construction.

Foundation Support

Continuous or isolated spread footings founded on proof-rolled, undisturbed, medium-dense, gravelly sand or sandy gravel (Arlington Gravel), or on properly compacted Structural Fill placed directly over undisturbed native soil can provide support for the proposed foundation elements.

GeoTest encountered uncontrolled fill soils on the subject property that was between 2 to 8 feet thick at the exploration locations. Because of historic site use, GeoTest has reason to believe that uncontrolled fill exists at deeper elevations, specifically in the vicinity of historic tank locations. The uncontrolled fill contained construction debris and GeoTest is not aware of any formal documentation during the placement of this fill. As such, it is GeoTest's opinion existing, uncontrolled fill is not suitable for the support of foundation elements. Existing uncontrolled fill must be completely removed from below foundation areas. Due to the anticipated depth of the uncontrolled fill, strategies that incorporate a basement, structural trenches that extend through the uncontrolled fill, or deep foundation alternatives should be considered for this site.

Foundations should be placed on firm and unyielding native soil, or on Structural Fill placed over firm and unyielding native soil. GeoTest recommends that qualified geotechnical personnel confirm that suitable bearing conditions have been reached prior to placement of Structural Fill or foundation formwork.

Continuous and isolated spread footings should be founded 18 inches, minimum, below the lowest adjacent final grade for freeze/thaw protection. The footings should be sized in accordance with the structural engineer's prescribed design criteria and seismic considerations.

GeoTest recommends that the design team specifically review new foundation locations in close proximity to property lines. If a basement or deepened foundations will be utilized for this project, consideration must be given with regard to planned construction approaches. It is not unreasonable to expect that temporary shoring may be required if large or deep excavations are required close to property lines, municipal right-of-ways, or sensitive, off-site utilities.

Allowable Bearing Capacity

Assuming the above foundation support criteria are satisfied, continuous or isolated spread footings founded directly on firm and unyielding Arlington Gravel, or on Structural Fill placed directly over firm and unyielding native soil may be proportioned using a net allowable soil bearing pressure of 2,500 pounds per square foot (psf).

The 'net allowable bearing pressure' refers to the pressure that can be imposed on the soil at foundation level. This pressure includes all dead loads, live loads, the weight of the footing, and any backfill placed above the footing. The net allowable bearing pressure may be increased by one-third for transient wind or seismic loads.

Foundation Settlement

Settlement of shallow foundations depends on foundation size and bearing pressure, as well as the strength and compressibility characteristics of the underlying soil. If construction is accomplished as recommended and at the maximum allowable soil bearing pressure, GeoTest estimates the total settlement of building foundations to be less than one inch. Differential settlement between two adjacent load-bearing components supported on competent soil is estimated to be less than one half the total settlement.

Our estimates assume that foundations will not be placed on uncontrolled fill soils that exists on the property.

Floor Support

Floor slabs may be supported on firm and unyielding native subgrades, on properly placed and compacted Structural Fill placed over firm and unyielding native subgrades, or on grade beams that extend down to firm and unyielding native subgrades. GeoTest does not currently have a plan set showing floor slab elevations. It should, however, be noted that unsuitable, uncontrolled fill soils exist on the property. Unsuitable, uncontrolled fills were observed to extend 8 feet below existing site grades in the eastern portion of the site. Historic site use suggests that uncontrolled fill materials may extend deeper than what was observed in our explorations.

GeoTest recommends that interior concrete slab-on-grade floors be underlain with at least 6 inches of clean, compacted, free-draining gravel. The gravel should contain less than 3 percent passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The purpose of this gravel layer is to provide uniform support for the slab, provide a capillary break, and act as a drainage layer. To help reduce the potential for water vapor migration through floor slabs, a continuous 15-mil minimum thick polyethylene sheet with tape-sealed joints should be installed below the slab to serve as an impermeable vapor barrier.

The vapor barrier should be installed and sealed in accordance with the manufacturer's instructions.

Exterior concrete slabs-on-grade, such as sidewalks, may be supported directly on undisturbed native soils or on properly placed and compacted Structural Fill; however, long-term performance will be enhanced if exterior slabs are placed on a layer of clean, durable, well-draining granular material.

Foundation and Site Drainage

Positive surface gradients should be provided adjacent to the proposed construction to direct surface water away from improved areas and toward suitable drainage facilities. Roof drainage should not be introduced into the perimeter footing drains but should be separately discharged directly to the stormwater collection system or similar municipality-approved outlet. Pavement and sidewalk areas, if present, should be sloped and drainage gradients should be maintained to carry surface water away from buildings and toward an approved stormwater collection system. Surface water should not be allowed to pond and soak into the ground surface near buildings or paved areas during or after construction. Construction excavations should be sloped to drain to sumps where water from seepage, rainfall, and runoff can be collected and pumped to a suitable discharge facility.

To reduce the potential for groundwater and surface water to seep into interior spaces, GeoTest recommends that an exterior footing drain system be constructed around the perimeter of new building foundations as shown in the *Conceptual Footing and Wall Drain Section* (Figure 3) of this report. The drain should consist of a perforated pipe measuring 4 inches in diameter at minimum, surrounded by at least 12 inches of filtering media. The pipe should be sloped to carry water to an approved collection system.

The filtering media may consist of open-graded drain rock wrapped in a nonwoven geotextile fabric such as Mirafi 140N (or equivalent) or wrapped with a graded sand and gravel filter. For foundations supporting retaining walls, drainage backfill should be carried up the back of the wall and be at least 12 inches wide. The drainage backfill should extend from the foundation drain to within approximately 1 foot of the finished grade and consist of open-graded drain rock containing less than 3 percent fines by weight passing the U.S. Standard No. 200 sieve (based on a wet sieve analysis of that portion passing the U.S. Standard No. 4 sieve). The invert of the footing drain pipe should be placed at approximately the same elevation as the bottom of the footing or 12 inches below the adjacent floor slab grade, whichever is deeper, so that water will be contained. This process prevents water from seeping through walls or floor slabs. The drain system should include cleanouts to allow for periodic maintenance and inspection.

Please understand that the above recommendations are intended to assist the design engineer and/or architect in development of foundation and site drainage parameters and are based on

our experience with similar projects in the area. The final foundation and site drainage plan that will be incorporated into the project plans is to be determined by the design team.

Resistance to Lateral Loads

The lateral earth pressures that develop against foundation walls will depend on the method of backfill placement, degree of compaction, slope of backfill, type of backfill material, provisions for drainage, magnitude and location of any adjacent surcharge loads, and the degree to which the wall can yield laterally during or after placement of backfill. If the wall is allowed to rotate or yield so the top of the wall moves an amount equal to or greater than about 0.001 to 0.002 times its height (a yielding wall), the soil pressure exerted comprises the active soil pressure. When a wall is restrained against lateral movement or tilting (a nonyielding wall), the soil pressure exerted comprises the at rest soil pressure. Wall restraint may develop if a rigid structural network is constructed prior to backfilling or if the wall is inherently stiff.

GeoTest recommends that yielding walls under drained conditions be designed for an equivalent fluid density of 35 pounds per cubic foot (pcf), for Structural Fill in active soil conditions. Nonyielding walls under drained conditions should be designed for an equivalent fluid density of 55 pcf, for Structural Fill in at-rest conditions. The wall design should include appropriate lateral pressures caused by surcharge loads located within a horizontal distance equal to or less than the height of the wall. For uniform surcharge pressures, a uniformly distributed lateral pressure equal to 35 percent and 50 percent of the vertical surcharge pressure should be added to the lateral soil pressures for yielding and nonyielding walls, respectively.

For structures designed using the seismic design provisions of the International Building Code, GeoTest recommends that foundation walls include a seismic surcharge in addition to the equivalent fluid densities presented above. We recommend that a seismic surcharge of approximately 8H (where H is the height of the wall) be used for design purposes. This surcharge assumes that the wall is allowed to rotate or yield. If the wall is restrained, GeoTest should be contacted so that we can provide a revised seismic surcharge pressure.

Passive earth pressures developed against the sides of building foundations, in conjunction with friction developed between the base of the footings and the supporting subgrade, will resist lateral loads transmitted from the structure to its foundation. For design purposes, the passive resistance of well-compacted fill placed against the sides of foundations is equivalent to a fluid with a density of 300 pcf. The recommended value includes a safety factor of about 1.5 and is based on the assumption that the ground surface adjacent to the structure is level in the direction of movement for a distance equal to or greater than twice the embedment depth. The recommended value also assumes drained conditions that will prevent the buildup of hydrostatic pressure in the compacted fill. Foundation walls should include a drain system constructed in general accordance with the recommendations presented in the *Foundation and Site Drainage* section of this report. In design computations, the upper 12 inches of passive resistance should

be neglected if the soil is not covered by floor slabs or pavement. If future plans call for the removal of the soil providing resistance, the passive resistance should not be considered.

An allowable coefficient of base friction of 0.35, applied to vertical dead loads only, may be used between the underlying imported granular Structural Fill and the base of the footing.

If passive and frictional resistance are considered together, one half the recommended passive soil resistance value should be used since larger strains are required to mobilize the passive soil resistance as compared to frictional resistance. A safety factor of about 1.5 is included in the base friction design value. GeoTest does not recommend increasing the coefficient of friction to resist seismic or wind loads.

Temporary and Permanent Slopes

The contractor is responsible for construction slope configurations and maintaining safe working conditions, including temporary excavation stability. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored during and after excavation for any evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring.

Temporary excavations in excess of 4 feet should be shored or sloped in accordance with Safety Standards for Construction Work Part N, WAC 296-155-66403.

Temporary unsupported excavations in the near-surface uncontrolled fill soils encountered at the project site are classified as a Type C soil according to WAC 296-155-66401 and may be sloped as steep as 1.5H: 1:V (Horizontal: Vertical). Underlying the fill soils, temporary unsupported excavations in the native Arlington Gravel soils are classified as a Type B soil and may be sloped as steep as 1H: 1V. All soils encountered are classified as Type C soil in the presence of groundwater seepage. Flatter slopes or temporary shoring may be required in areas where groundwater flow is present and unstable conditions develop.

Temporary slopes and excavations should be protected as soon as possible using appropriate methods to prevent erosion from occurring during periods of wet weather.

GeoTest recommends that permanent cut or fill slopes be designed for inclinations of 2H:1V or flatter. Permanent cuts or fills used in detention ponds, retention ponds, or earth slopes intended to hold water should be 3H:1V or flatter. All permanent slopes should be vegetated or otherwise protected to limit the potential for erosion as soon as practical after construction.

Utilities

It is important that utility trenches be properly backfilled and compacted to reduce cracking or localized loss of foundation, slab, or pavement support. GeoTest anticipates that excavations for new shallow underground utilities will expose historic, uncontrolled fill materials or native Arlington Gravel.

Trench backfill in improved areas (beneath structures, pavements, sidewalks, etc.) should consist of Structural Fill as defined in the *Fill and Compaction* section of this report. Outside of improved areas, trench backfill may consist of reused native material provided the backfill can be compacted to the project specifications and that cobbles over 4 inches in diameter are removed prior to placing the material. Trench backfill should be placed and compacted in general accordance with the recommendations presented in the *Fill and Compaction* section of this report.

Surcharge loads on trench support systems due to construction equipment, stockpiled material, and vehicle traffic should be included in the design of any anticipated shoring system. The contractor should implement measures to prevent surface water runoff from entering trenches and excavations. In addition, vibration as a result of construction activity and traffic may cause caving of the trench walls.

The contractor is responsible for trench configurations. All applicable local, state, and federal safety codes should be followed. All open cuts should be monitored by the contractor during excavation for any evidence of instability. If instability is detected, the contractor should flatten the side slopes or install temporary shoring. If groundwater or groundwater seepage is present, and the trench is not properly dewatered, the soil within the trench zone may be prone to caving, channeling, and running. Trench widths may be substantially wider than under dewatered conditions.

Pavement Subgrade Preparation

Pavement sections are often a choice between higher initial cost with lower maintenance fees, or lower initial costs with more frequent maintenance fees. For this reason, GeoTest recommends that the owner participate in the site pavement selection. Site grading plans should include provisions for sloping of the subgrade soils in proposed pavement areas so that passive drainage of the pavement section(s) can proceed uninterrupted during the life of the project.

New pavement subgrade should be stripped of any existing fill (if present), organics, and other deleterious materials and compacted to a firm and unyielding condition. In areas where uncontrolled fill exists, the Owner may wish to only strip to 3 feet below finished pavement grades and compact the exposed uncontrolled fill to a firm and unyielding condition. If the subgrades are not suitable after site preparation, a geotextile may be considered to help stabilize

the exposed subgrades. If a geotextile is used, GeoTest recommends the use of Tensar TriAx TX-140 or performance equivalent placed between prepared subgrade soils and new Structural Fill.

Prior to placement of pavement materials, pavement subgrades should be proof rolled as described in the *Site Preparation and Earthwork* section of this report.

Asphalt Pavement Sections

We anticipate that asphalt pavement will be used for new access drive and parking areas. We recommend a standard, or "light duty", pavement section consist of 2.5 inches of ½-inch HMA asphalt above a *minimum* of 6 inches of crushed surfacing base course (CSBC) meeting criteria set forth in the Washington State Department of Transportation (WSDOT) Standard Specification 9-03.9[3]. Areas that will be accessed by more heavily loaded vehicles, emergency access vehicles, semi and garbage trucks, etc. will require a thicker asphalt section and should be designed using a paving section consisting of 4 inches of Class ½-inch HMA asphalt surfacing above a *minimum* of 6 inches of CSBC meeting criteria set forth in WSDOT Standard Specification 9-03.9[3].

GeoTest is available for further consultation regarding pavement selection if necessary. We may review or modify our pavement section recommendations based on further discussion or analysis with the project team and/or Owner. The above pavement sections are initial recommendations and may be accepted or modified by the site civil engineer based on the actual finished site grading elevations and the Owner's preferences.

Stormwater Infiltration Potential

Based on the presence of predominantly granular materials and the lack of a restriction layer that would otherwise impact infiltration facilities, it is our opinion that the on-site infiltration of stormwater into the native Arlington Gravel is feasible for this project site. GeoTest expects that infiltration facilities will be located in the western portion of the site based on natural sloping site grades. Further, the eastern portion of the site is underlain by uncontrolled fill. It should be expected that the requirements presented in the Stormwater Management Manual for Western Washington would disallow infiltration in uncontrolled fill.

Test Pit Gradation Results

From the explorations excavated in the areas of interest, four representative soil samples were selected and mechanically tested for grain size distribution and calculation according to the soil grain size analysis method, Section V-5.4 of the *2019* SMMWW. A summary of these results is reproduced in Table 1 below:

Table 1 Preliminary Infiltration Results Based on Grain Size Analysis		
Test Pit ID & Depth	**Geologic Unit**	**Preliminary, Corrected K_{sat} Infiltration Rate [in/hr]**
TP-3 (4 ft)	Arlington Gravel	10*
TP-4 (4 ft)	Arlington Gravel	8.3
TP-5 (3 ft)	Arlington Gravel	8.0
TP-6 (3 ft)	Arlington Gravel	10*

Notes:
- Ksat = Initial Saturated Hydraulic Conductivity
- Correction Factors Used: CFv = 0.33, CFt = 0.40, CFm =0.9
- Total Correction Factor = 0.12
- Rates presented are representative of loose conditions and do not consider the relative density of the soil
- ***GeoTest does not recommend utilizing a rate over 10 inches per hour without first verifying with an in-situ field infiltration test. See *Design Considerations* section for more information.**

It should be noted that the rates presented in Table 1 are representative of loose soil conditions and do not consider dense or compacted soil. In our experience, infiltration rates based on grain size analyses overestimate the actual infiltration rate of the soil. At the time of this report, GeoTest does not have a Civil plan sheet showing the location of facilities or the bottom-of-facility elevations.

Design Considerations

Stormwater infiltration potential is a function of the relative permeability of the site soils, and the separation between the base of the stormwater facility and the groundwater table. Based on the results presented in Table 1, it is GeoTest's opinion that the on-site infiltration is feasible for the Arlington Gravel soils in the western half of the subject site.

For facilities that will be founded in Arlington Gravel found at least 4 feet below existing site grades and in the western half of the project site, GeoTest recommends a preliminary corrected infiltration rate of **8 inches per hour.** GeoTest does not recommend that any infiltration facilities be placed in uncontrolled fill materials.

Please note that the rates given in this section are representative of preliminary design infiltration rates. If a higher infiltration rate is required, the design rate would best be established by performing a Pilot Infiltration Test. This testing is outside of the scope of work of this report. However, GeoTest can provide a fee estimate for this testing upon request.

Stormwater Treatment

The stormwater facilities on-site may require some form of pollutant pretreatment with an amended soil prior to on-site infiltration or offsite discharge. Because the project site has been previously stripped, topsoil does not exist on the property. Further, the native soils underlying the project area consist of gravelly sand and sandy gravel. These soils do not have significant amounts of organic materials and it was determined by GeoTest that reusing the on-site materials as an amended soil would not be feasible without the addition of organics, mulch, or similar approaches to achieve the necessary cation exchange capacity and/or organic content of an amended soil.

The Owner may wish to import a pre-mixed amended soil if such a soil is required as part of the Stormwater Management plan.

Geotechnical Consultation and Construction Monitoring

GeoTest recommends that we be involved in the project design review process. The purpose of the review is to verify that the recommendations presented in this report are understood and incorporated in the design and specifications.

We also recommend that geotechnical construction monitoring services be provided. These services should include observation by GeoTest personnel during Structural Fill placement, compaction activities and subgrade preparation operations to confirm that design subgrade conditions are obtained beneath the areas of improvement.

Periodic field density testing should be performed to verify that the appropriate degree of compaction is obtained. The purpose of these services is to observe compliance with the design concepts, specifications, and recommendations of this report. In the event that subsurface conditions differ from those anticipated before the start of construction, GeoTest Services, Inc. would be pleased to provide revised recommendations appropriate to the conditions revealed during construction.

GeoTest is available to provide a full range of materials testing and special inspection during construction as required by the local building department and the International Building Code. This may include specific construction inspections on materials such as reinforced concrete, reinforced masonry, wood framing, and structural steel. These services are supported by our fully accredited materials testing laboratories.

USE OF THIS REPORT

GeoTest Services, Inc. has prepared this report for the exclusive use of Grandview North, LLC, and their design consultants for specific application to the design of the proposed Grandview's

North Olympic project located at the southwest corner of North Olympic Avenue and West Division Street in Arlington, Washington. Use of this report by others is at the user's sole risk. This report is not applicable to other site locations. Our services are conducted in accordance with accepted practices of the geotechnical engineering profession; no other warranty, express or implied, is made as to the professional advice included in this report.

Our site explorations indicate subsurface conditions at the dates and locations indicated. It is not warranted that these conditions are representative of conditions at other locations and times. The analyses, conclusions, and recommendations contained in this report are based on site conditions to the limited depth and time of our explorations, a geological reconnaissance of the area, and a review of previously published geological information for the site. If variations in subsurface conditions are encountered during construction that differ from those contained within this report, GeoTest should be allowed to review the recommendations and, if necessary, make revisions. If there is a substantial lapse of time between submission of this report and the start of construction, or if conditions change due to construction operations at or adjacent to the project site, we recommend that we review this report to determine the applicability of the conclusions and recommendations contained herein.

The earthwork contractor is responsible to perform all work in conformance with all applicable WISHA/OSHA regulations. GeoTest Services, Inc. is not responsible for job site safety on this project, and this responsibility is specifically disclaimed.

Attachments:	Figure 1	Vicinity Map
	Figure 2	Site and Exploration Plan
	Figure 3	Conceptual Footing and Wall Drain Section
	Figure 4	Soil Classification System and Key
	Figures 5 – 10	Test Pit Logs
	Figure 11-12	Grain Size Analysis
	Attached	Report Limitations and Guidelines for its Use

REFERENCES

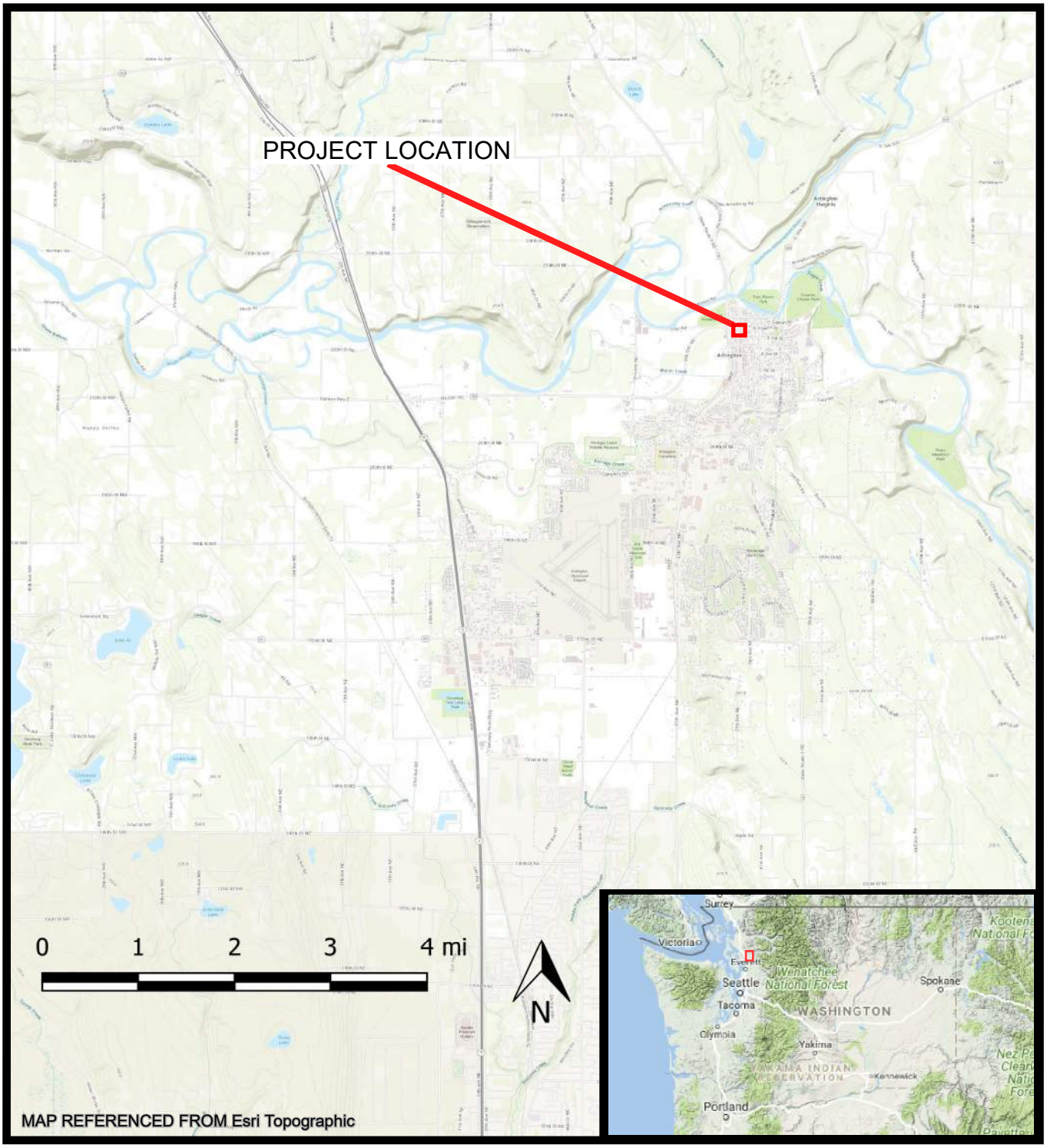
Arlington Municipal Code, *Chapter 20.93.600 (Geologically Hazardous Areas).*

Gariepy, D., Graul, C., Heye, A., Howie, D., Labib, F., & Song, K. (n.d.), *2019 Stormwater Management Manual for Western Washington* (2019 SMMWW) (pp. 1-1108) (United States, Washington State Department of Ecology).

Minard, J.P., 1985. *Geologic map of the Arlington East 7.5-minute quadrangle, Snohomish County, Washington [map].* Scale 1:24,000. US Geological Survey MF-1739.

PDS Map Portal. Snohomish County Planning and Development Services - Online Web Services. Retrieved on November 11, 2021.

Washington Interactive Geologic Map. Washington State Department of Natural Resources - Online Web Services. Retrieved on November 16, 2021.



GEOTEST

Date: 11-8-21	By: DT	Scale: As Shown	Project 21-0952

VICINITY MAP

GRANDVIEW'S NORTH OLYMPIC

SWC OF N. OLYMPIC AVENUE AND W. DIVISION STREET

ARLINGTON, WA 98223

Figure 1

N

40 Feet

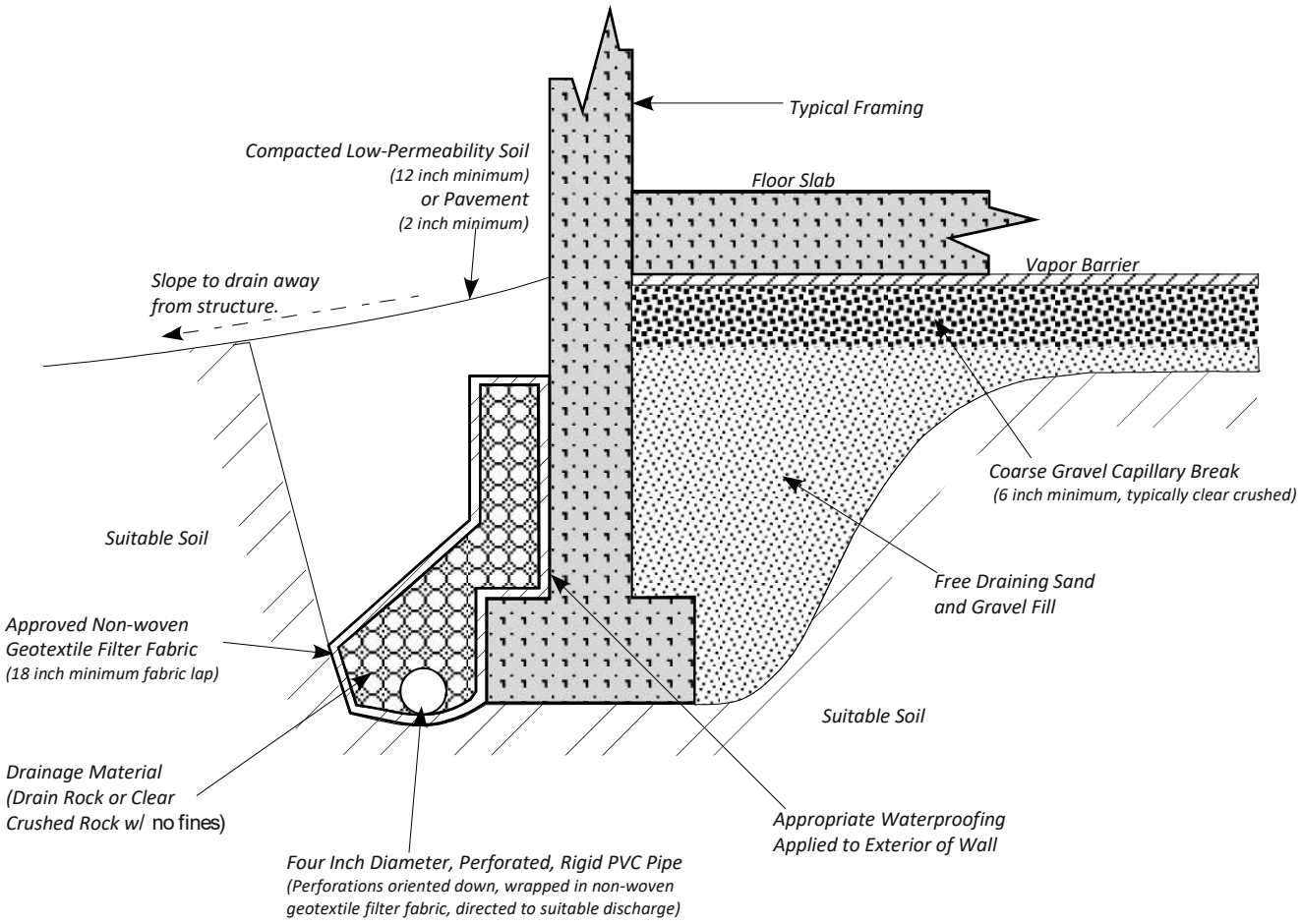
GEOTEST

Date: 11.4.19	By: NG	Scale: As shown	Project 21-0952

SITE AND EXPLORATION PLAN
GRANDVIEW'S NORTH OLYMPIC
SWC OF N. OLYMPIC AVENUE AND DIVISION STREET
ARLINGTON, WA 98223

Figure 2

CONCEPTUAL FOOTINGS WITH INTERIOR SLAB-ON-GRADE



Notes:

This figure is not intended to be representative of a design. This figure is intended to present concepts that can be incorporated into a functional foundation drain designed by a Civil Engineer. In all cases, refer to the Civil plan sheet for drain details and elevations.

Footings should be properly buried for frost protection in accordance with International Building Code or local building codes (Typically 18 inches below exterior finished grades).

The footing drain will need to be modified from this typical drawing to fit the dimensions of the planned footing and slab configuration.

GEOTEST	Date: 11-16-21	By: DT	Scale: None
	CONCEPTUAL FOOTING & WALL DRAIN SECTION **GRANDVIEW'S NORTH OLYMPIC** **SWC OF N. OLYMPIC AVENUE AND W. DIVISION STREET** **ARLINGTON, WA**		Project **21-0952** Figure **3**

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL	TYPICAL DESCRIPTIONS[1][2]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

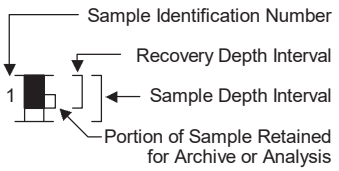
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

Notes:
1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
2. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent:	> 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents:	> 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
	> 12% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents:	> 5% and ≤ 12% - "slightly gravelly," "slightly sandy," "slightly silty," etc.
	≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

Drilling and Sampling Key

SAMPLE NUMBER & INTERVAL



SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Other - See text if applicable

Groundwater

▽ ATD — Approximate water elevation at time of drilling (ATD) or on date noted. Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
GT	Other Geotechnical Testing
CA	Chemical Analysis

GEOTEST

Grandview's North Olympic
SWC N. Oly. Ave./ W. Division
Arlington, Washington

Soil Classification System and Key

Figure 4

TEST PIT LOG

Test Pit No. TP-1

PROJECT: Grandview N. Olympic **PROJECT NO.:** 21-0952
LOCATION: Arlington, WA **DATE:** 10/22/21
EXPLORATION METHOD: Backhoe **ELEVATION:**
CONTRACTOR/DRILLER: E&D Excavating **LOGGED BY:** D. Trudeau
DEPTH TO WATER TABLE: ▽ N/A **PERCHED WATER:** ▼ N/a **CAVING** C

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA: SAMPLE & TEST DATA	SOIL SAMPLE AND TEST DATA: USCS SYMBOL	SOIL PROFILE DESCRIPTION
0			3/4 Inch Crushed Gravel (FILL)
1			Medium dense. Brown. Moist. Silty, sandy gravel (FILL). Few Bricks, metal, cement debris.
2	1		
3			
4	2		
5	3		Loose. Brown-red. Moist. Silt with gravel Few organics. (FILL)
6			
7	4		
8	5	SW/GW	Dense. Gray. Moist. Very gravelly SAND. (Arlington Gravel)
9			
10	6		
11			
12	7	SW/GW	Very Moist. Faint petroleum odor.

Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols used.

Test Pit TP-1 was terminated at 12.0 ft below site grades on 10/22/21

Figure: 5

Notes:

TEST PIT LOG

Test Pit No. TP-2

PROJECT: Grandview N. Olympic | **PROJECT NO.:** 21-0952
LOCATION: Arlington, WA | **DATE:** 10/22/21
EXPLORATION METHOD: Backhoe | **ELEVATION:**
CONTRACTOR/DRILLER: E&D Excavating | **LOGGED BY:** D. Trudeau
DEPTH TO WATER TABLE: ▽ N/A | **PERCHED WATER:** ▼ N/A | **CAVING** C

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA: SAMPLE & TEST DATA	SOIL SAMPLE AND TEST DATA: USCS SYMBOL	SOIL PROFILE DESCRIPTION
0			3/4 Inch Crushed Gravel (FILL)
1	8		Medium dense. Brown. Moist. Silty sand few gravel. (FILL)
2			
3	9		
4			
5	10		
6			
7			Concrete and brick FILL debris
8	11	SW/GW	Dense. Gray. Moist. Very gravelly SAND. (Arlington Gravel)
9			
10	12	SW/GW	Faint petroleum odor
11			
12			

Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols used.

Test Pit TP-2 was terminated at 12.0 ft below site grades on 10/22/21

Figure: 6

Notes:

TEST PIT LOG

Test Pit No. TP-3

PROJECT: Grandview N. Olympic **PROJECT NO.:** 21-0952
LOCATION: Arlington, WA **DATE:** 10/22/21
EXPLORATION METHOD: Backhoe **ELEVATION:**
CONTRACTOR/DRILLER: E&D Excavating **LOGGED BY:** D. Trudeau
DEPTH TO WATER TABLE: ▽ N/A **PERCHED WATER:** ▽ N/A **CAVING** C

ELEVATION/ DEPTH	SAMPLE & TEST DATA		USCS SYMBOL	SOIL PROFILE DESCRIPTION
0				3/4 Inch Crushed Gravel (FILL)
1			GW	Medium dense. Brown. Moist. Sandy GRAVEL trace silt. Rounded Cobbles up to 12 Inches. (Arlington Gravel)
2	13			
3			GW	Dense. Gray. Moist. Sandy GRAVEL trace silt. Rounded Cobbles up to 12 Inches. (Arlington Gravel)
4	14	W = 4.0 GS	GW	
5				
6	15	W = 10.2 GS	SP SP	Dense. Gray. Moist. Very gravelly SAND trace silt. (Arlington Gravel)
7				
8	16			
9				
10	17			
11				
12	18			Very Moist

Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols used.

Test Pit TP-3 was terminated at 12.0 ft below site grades on 10/22/21

Figure: 7

Notes:

TEST PIT LOG

Test Pit No. TP-4

PROJECT: Grandview N. Olympic **PROJECT NO.:** 21-0952
LOCATION: Arlington, WA **DATE:** 10/22/21
EXPLORATION METHOD: Backhoe **ELEVATION:**
CONTRACTOR/DRILLER: E&D Excavating **LOGGED BY:** D. Trudeau
DEPTH TO WATER TABLE: ▽ N/A **PERCHED WATER:** ▼ N/A **CAVING** C

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA		USCS SYMBOL	SOIL PROFILE DESCRIPTION
0				3/4 Inch Crushed Gravel (FILL)
1				Medium dense. Gray-brown. Moist. Gravelly SAND, slightly silty. (FILL) Cement debris.
2	19			Concrete floor slab. Old building?
3			GW	Medium Dense. Brown. Moist. Very sandy GRAVEL trace silt. (Arlington Gravel)
4	20	W = 4.6 GS	GW GW	Dense. Gray-brown. Moist. Very sandy GRAVEL trace silt. Rounded Cobbles up to 12 Inches. (Arlington Gravel)
5				
6				
7				
8	21			
9				
10	22			

Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols used.

Test Pit TP-4 was terminated at 10.0 ft below site grades on 10/22/21

Figure: 8

Notes:

TEST PIT LOG

Test Pit No. TP-5

PROJECT: Grandview N. Olympic **PROJECT NO.:** 21-0952
LOCATION: Arlington, WA **DATE:** 10/22/21
EXPLORATION METHOD: Backhoe **ELEVATION:**
CONTRACTOR/DRILLER: E&D Excavating **LOGGED BY:** D. Trudeau
DEPTH TO WATER TABLE: ▽ N/A **PERCHED WATER:** ▽ N/A **CAVING** C

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA			USCS SYMBOL	SOIL PROFILE DESCRIPTION
	SAMPLE & TEST DATA				
0					3/4 Inch Crushed Gravel (FILL)
	23				Soft. Black. Moist. SILT with sand and organics. (TOPSOIL)
1				GW	Dense. Brown. Moist. Sandy GRAVEL trace silt. Cobbles to 12" (Arlingotn Gravel)
2					
3	24		W = 4.1 GS	GW	
4					
5					
6	25		W = 9.3 GS	GW GW	32" Boulder.
7					
8	26			SP	Dense. Gray. Moist. Very gravelly SAND
9					
10	27				

Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols used.

Test Pit TP-5 was terminated at 10.0 ft below site grades on 10/22/21

Figure: 9

Notes:

TEST PIT LOG

Test Pit No. TP-6

PROJECT: Grandview N. Olympic **PROJECT NO.:** 21-0952
LOCATION: Arlington, WA **DATE:** 10/22/21
EXPLORATION METHOD: Backhoe **ELEVATION:**
CONTRACTOR/DRILLER: E&D Excavating **LOGGED BY:** D. Trudeau
DEPTH TO WATER TABLE: ▽ **PERCHED WATER:** ▼ **CAVING** C

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA			USCS SYMBOL	SOIL PROFILE DESCRIPTION
	SAMPLE & TEST DATA				
0				SM	Loose. Brown. Moist. Silty SAND few organics (Topsoil)
	28				Dense. Dark Gray. Moist. Sandy Gravel. Railroad ballast. (FILL)
1	29				
				GW	Dense. Brown-gray. Moist. Very sandy GRAVEL trace silt. (Arlington Gravel)
2					
3	30		W = 5.4 GS	GW	
4					
5					

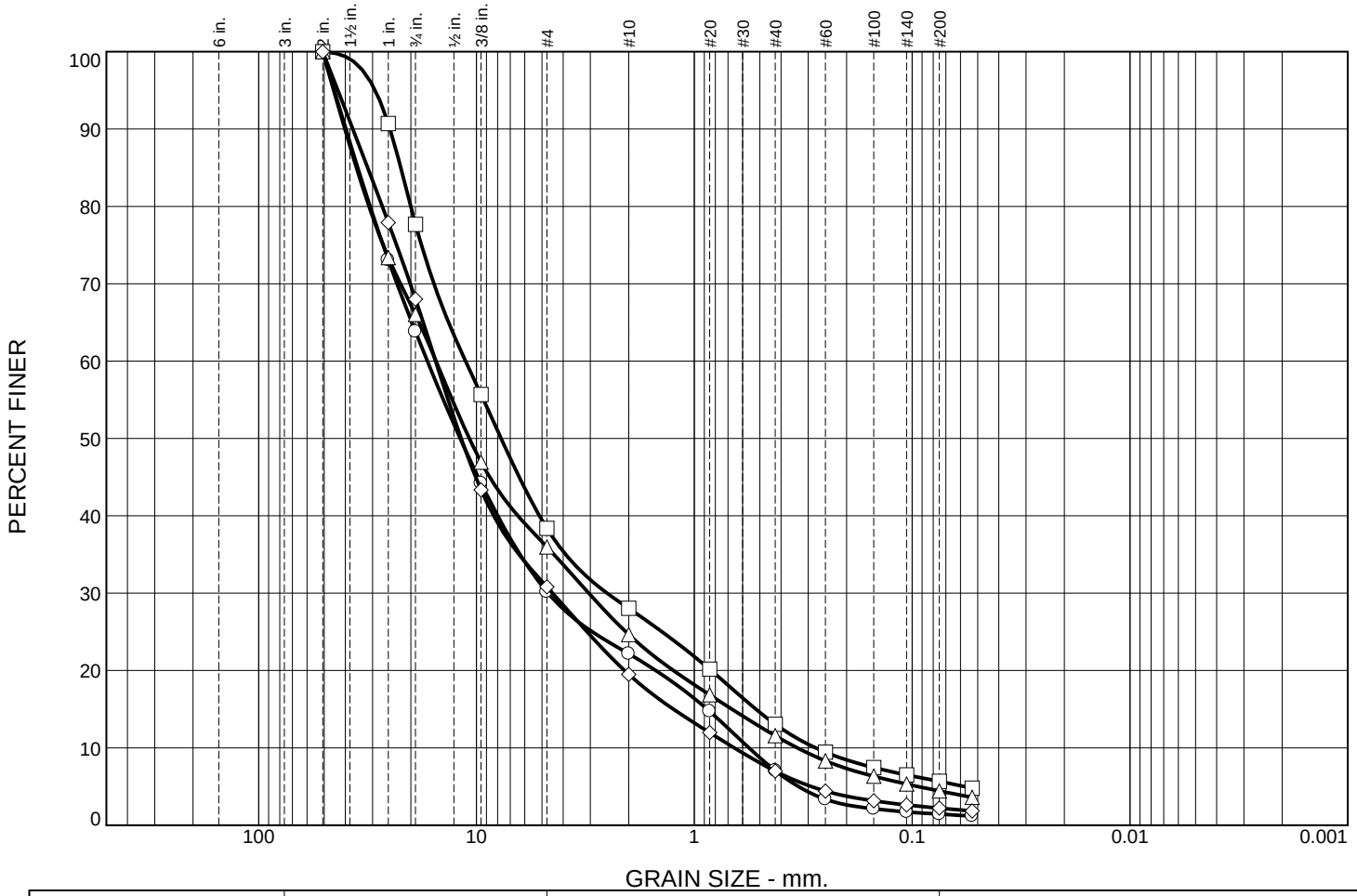
Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols used.

Test Pit TP-6 was terminated at 5.0 ft below site grades on 10/22/21

Figure: 10

Notes:

Grain Size Test Data



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	36	34	8	15	6	1	
□	0	22	40	10	15	7	6	
△	0	34	30	11	13	8	4	
◇	0	32	37	12	12	5	2	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○		24	3.0	Sandy GRAVEL trace silt	GW
□		30	3.0	Very sandy GRAVEL trace silt	GW
△		20	4.0	Very sandy Gravel trace silt	GW
◇		14	4.0	Sandy GRAVEL trace silt	GW

GEOTEST
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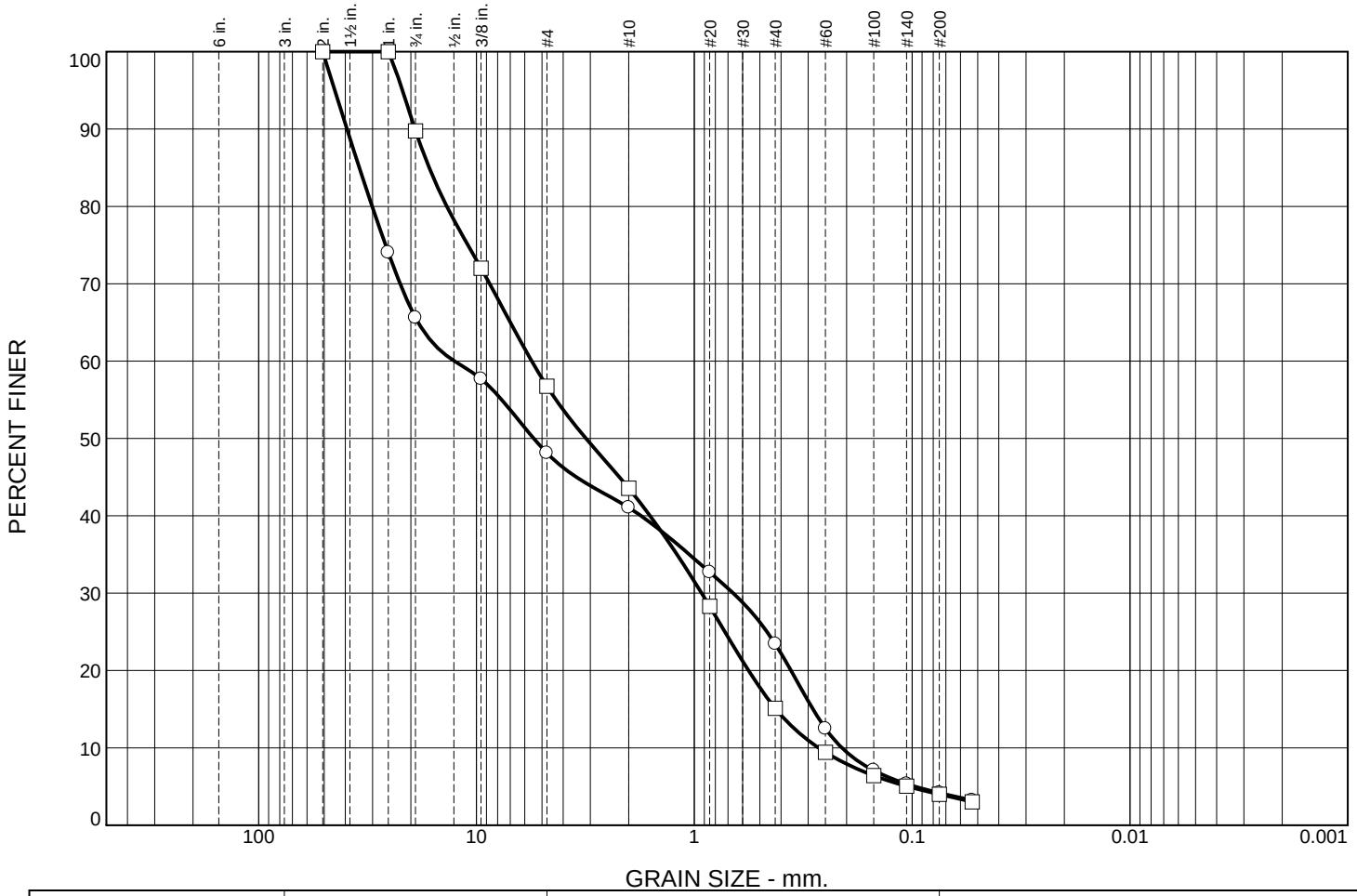
Bellingham | Arlington | Oak Harbor
www.geotest-inc.com

Client: Grandview
Project: Grandview N. Olympic
Project No.: 21-0952
Figure 11

Tested By: JAC **Checked By:** DT

Grain Size Test Data



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0	34	18	7	18	19	4	
□	0	10	33	13	29	11	4	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○		25	6.0	Very sandy GRAVEL trace silt	GW
□		15	6.0	Very gravelly SAND trace silt	SP

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Client: Grandview
Project: Grandview N. Olympic
Project No.: 21-0952
Figure 12

Tested By: JAC **Checked By:** DT

REPORT LIMITATIONS AND GUIDELINES FOR ITS USE[1]

Subsurface issues may cause 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:

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

At GeoTest our geotechnical engineers and geologists structure their services to meet specific needs of our clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of an owner, 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 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

GeoTest's geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the clients 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 GeoTest, who conducted the study specifically states 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.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

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, for example, 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 construction,
- alterations in drainage designs; or
- composition of the design team; the passage of time; man-made alterations and construction whether on or adjacent to the site; or by natural alterations and events, such as floods, earthquakes or groundwater fluctuations; or project ownership.

Always inform GeoTest's 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

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. Do not rely on the findings and conclusions of this 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 GeoTest before applying the report to determine if it is still relevant. A minor amount of additional testing or analysis will help determine if the report remains applicable.

Most Geotechnical and Geologic Findings are Professional Opinions

Our site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoTest's engineers and geologists 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 GeoTest who developed this report to provide construction observation is the most effective method of managing the risks associated with anticipated or unanticipated conditions.

1Information in this document is based upon material developed by ASFE, Professional Firms Practicing in the Geosciences(asfe.org)

A Report's Recommendations are Not Final

Do not over-rely on the construction recommendations included in this report. Those recommendations are not final, because geotechnical engineers or geologists develop them principally from judgment and opinion. GeoTest's geotechnical engineers or geologists can finalize their recommendations only by observing actual subsurface conditions revealed during construction. GeoTest cannot assume responsibility or liability for the report's recommendations if our firm does not perform the construction observation.

A Geotechnical Engineering or Geologic Report may be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. Lower that risk by having GeoTest confer with appropriate members of the design team after submitting the report. Also, we suggest retaining GeoTest to review pertinent elements of the design teams plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having GeoTest participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do not Redraw the Exploration Logs

Our geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors of omissions, the logs included in this report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable; but recognizes 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, consider advising the 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 GeoTest and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid 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, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

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In addition, it is recommended that a contingency for unanticipated conditions be included in your project budget and schedule.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering or geology is far less exact than other engineering disciplines. This lack of understanding can create unrealistic expectations that can lead to disappointments, claims, and disputes. To help reduce risk, GeoTest includes an explanatory limitations section in our reports. Read these provisions closely. Ask questions and we encourage our clients or their representative to contact our office if you are unclear as to how these provisions apply to your project.

Environmental Concerns Are Not Covered in this Geotechnical or Geologic Report

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

Obtain Professional Assistance to Deal with Biological Pollutants

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts biological pollutants from growing on indoor surfaces. Biological pollutants includes but is not limited to molds, fungi, spores, bacteria and viruses. To be effective, all such strategies should be devised for the express purpose of prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional biological pollutant prevention consultant. Because just a small amount of water or moisture can lead to the development of severe biological infestations, a number of prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of this study, the geotechnical engineer or geologist in charge of this project is not a biological pollutant prevention consultant; none of the services preformed in connection with this geotechnical engineering or geological study were designed or conducted for the purpose of preventing biological infestations.

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