Geotechnical Engineering Report

Construction Office and Scale Relocation
5802 Cemetery Road
Arlington, WA 98223

Prepared For:

Reece Construction Company
Attn: Mr. Andy Reece
PO Box 1531
Marysville, WA 98270

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November 25, 2020
Project No. 20-0888

Reece Construction Company
PO Box 1531
Marysville, WA 98270

Attention: **Mr. Andy Reece**

Regarding: **Geotechnical Engineering Report**
Construction Office and Scale Relocation
5802 Cemetery Road
Arlington, WA 98223

Dear Mr. Reece,

As requested, GeoTest Services, Inc. [GeoTest] is pleased to submit the following report summarizing the results of our geotechnical engineering evaluation for the proposed Construction Office and Scale Relocation, located at 5802 Cemetery Road in Arlington, WA (see *Vicinity Map*, Figure 1). This report has been prepared in general accordance with the terms and conditions established in our services agreement dated October 16, 2020 and authorized by yourself.

GeoTest appreciates the opportunity to provide geotechnical services on this project and look 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.

GERRY D. BAUTISTA
STATE OF WASHINGTON
51531
REGISTERED
PROFESSIONAL ENGINEER

11/25/2020

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Project Geotechnical Engineer

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 the project design can be formulated. Our scope of services includes the following tasks:

- Explore soil and groundwater conditions underlying the site by excavating four exploratory test pits with a track-mounted excavator supplied by yourself.

- 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 subsurface conditions and exploration logs. The findings and recommendations in this report pertain to site preparation and earthwork, fill and compaction, seismic design, foundation recommendations, concrete slab-on-grade construction, foundation and site drainage, infiltration feasibility, utilities, temporary and permanent slopes, pavement structures, geotechnical consultation, and construction monitoring.

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

PROJECT DESCRIPTION

GeoTest understands that a new two-story building is planned for the existing construction yard. The new building will be situated on the northeast portion of the parcel fronting Cemetery Road. The building footprint will be approximately 4,600 square feet with the square footage of both the upper and lower floors totaling about 8,000 square feet. GeoTest has not been provided formal plans, but we expect that new construction will utilize shallow conventional foundations with slab-on-grade floors and typical wood- or steel-frame construction. Structural loads are expected to be light.

GeoTest understands that part of the site improvements will include relocating the truck scales that currently exist on the northern portion of the subject property and the construction of a scale house at the central portion of the subject site. Similar to the planned two-story building, GeoTest anticipates the use of shallow conventional foundations and light structural loads. Since the property is relatively flat, GeoTest does not anticipate significant amounts of grading.

It is expected that new impervious surfaces will generate stormwater runoff that will need to be addressed in general accordance with the *Stormwater Manual for Western Washington* (SMMWW). This is the stormwater manual currently enacted by the City of Arlington. Preliminary

concepts regarding stormwater infiltration were not developed at the time this report was written.

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.

Surface Conditions

The subject property consists of two parcels (Parcel Nos. 31051500200800 and 31051500200700) totaling 13.88 acres, in which both have historically been gravel pits since between 1998 and 2000. Both parcels currently contain multiple buildings, warehouses, trailers, concrete pads, roadway asphalt, and construction equipment. The entire gravel pit is bowl shaped, presumably from mining operations over the last 20 years. A U-shaped drive path that starts and ends at Cemetery Road serves both parcels. From the northern property line of the subject property (approximate elevation of 125 feet), the ground generally slopes from north to south at less than 5 percent inclination over approximately 13 feet in vertical relief.

Downslope from the northern entrance into the two properties, the current scale house resides just south of a small rectangular green building. Stockpiles of various borrow types, topsoil, sands, gravels, and other aggregate types—such as recycled concrete and recycled asphalt—can be found within the southern parcel. The southern portion of the bowl-shaped property slopes up towards the southern entrance into the site from 59th Avenue NE.

During our site visit, the vicinity of the proposed construction office was comprised of a flat grassy section upslope from a flat, gravelly, staging area for miscellaneous construction materials; both are separated by a green chain-link fence. The current location of the proposed scale is central between both parcels in a relatively flat area.

Image 1. The approximate vicinity of the proposed construction office, which is currently a staging area of construction materials; facing east. (Images 1 through 4 taken on October 30, 2020.)

Image 2. The approximate vicinity of the proposed scale relocation area.

Subsurface Soil Conditions

Subsurface conditions were explored by advancing four exploratory test pits (TP-1 through TP-4) on October 30, 2020. The explorations were each advanced to an approximate depth of 8.0 feet below ground surface (BGS) using a track-mounted excavator provided by Reece Construction. Approximate locations and cross sections of these explorations have been plotted on the *Site and Exploration Plan* (Figure 2). More detailed logs of the subsurface conditions encountered within our explorations are presented in the enclosed *Test Pit Logs* attached to the end of this report.

TP-2 through TP-4 were excavated in the proposed construction office area at the northeast portion of the property. TP-2 and TP-4 encountered native, medium dense, light tan, damp, poorly graded gravels and sands (Arlington Gravel) at or near existing grade. TP-3, excavated north of the proposed building, encountered approximately 2.0 feet of topsoil and previously placed fill consisting of medium-dense, slightly gravelly sand, overlying Arlington Gravel. The Arlington Gravel soils were encountered to the maximum explored depth of the test pits.

TP-1 was excavated near the proposed scale relocation area at the center of the subject property. This test pit encountered approximately 3.2 feet of alternating and different colored layers of previously placed, graded, and compacted fill soils. The observed fill layers consisted of dense, black recycled asphalt, clean sand, and very silty sand, all overlying native, medium dense to dense, light tan to gray, medium to fine grained, poorly graded sands (Marysville Sand). It should be noted that no relict topsoil was encountered between the fill soils and the underlying native soils. The Marysville Sand was encountered to the maximum explored depth of the test pit.

Image 3. Subsurface soil conditions within TP-1 near the proposed scale location, consisting of multiple lifts of dense to very dense compacted fill overlying native Marysville Sand; facing southwest.

Image 4. Subsurface soil conditions within TP-2 near the proposed construction office location, with observations of native, well-graded gravels and poorly graded sands (Arlington Gravel); facing south.

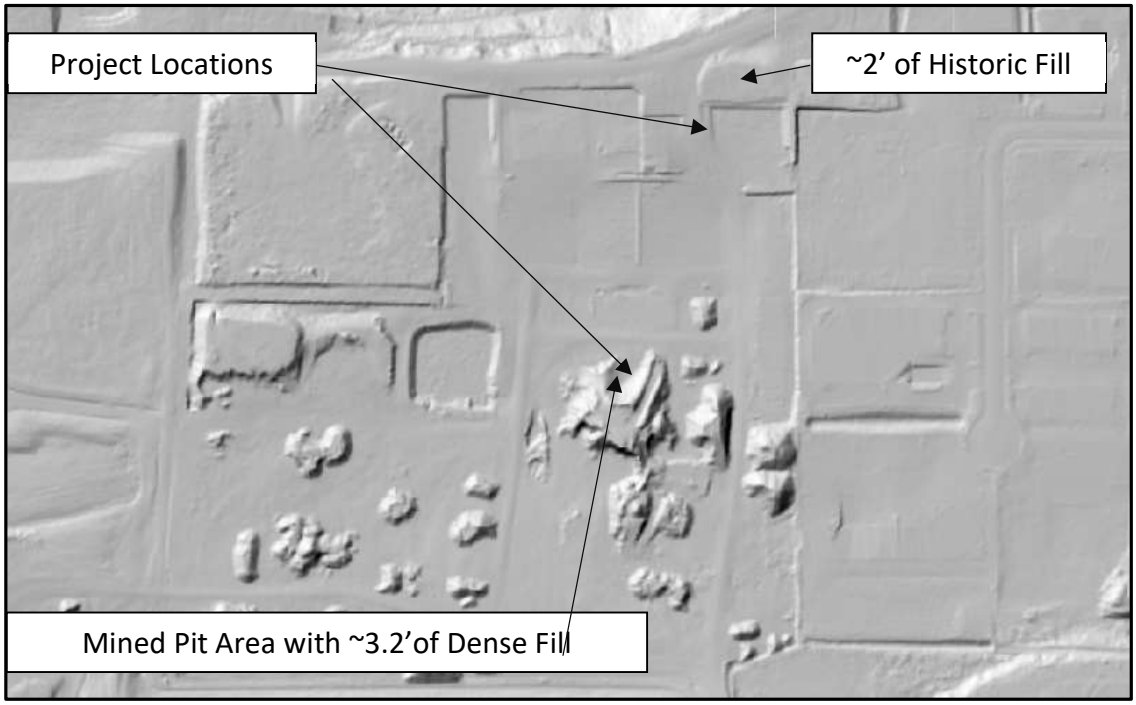

Image 5. LiDAR imaging showing the project location and surface conditions.
(Source: WA DNR Washington LiDAR Portal)

General Geologic Conditions

Geologic information for the project site was obtained from the *Geologic map of the Arlington West 7.5-minute quadrangle, Snohomish County, Washington* (Minard, 1985) published by the U.S. Geological Survey. This map indicates that the project site is underlain by Vashon Drift Recessional Outwash consisting of the Marysville Sand Member (map unit Qvrm). The Marysville Sand Member consists of mostly well-drained, outwash sand with minor amounts of gravel. The older Arlington Gravel Member (map unit Qvra) of the Vashon Drift Recessional Outwash is also mapped northeast of the project site, underlying the Marysville Sand. Deposits of the Arlington Gravel consist of mostly well-drained and stratified sand and gravel deposits. Sediments of both soil types were deposited as valley fill by meltwater flowing south from the stagnating and receding Vashon Glacier during the Pleistocene Epoch.

The soils encountered at the central portion of the site (TP-1) were generally similar to that of the mapped Marysville Sand Member, according to Minard. The soils encountered at the northeast portion of the site (TP-1 through TP-4) were generally similar to that of the mapped Arlington Gravel Member. It should be noted that the soil boundaries shown on the Minard map are approximate. The native soils encountered in our explorations are consistent with soils that we have encountered with nearby projects.

For the purposes of this report, we have referred to the native soils as Marysville Sand and Arlington Gravel.

Groundwater

At the time of our investigation on October 30, 2020, groundwater was not encountered in any of our explorations. Based on a review of publicly available well log data from the Washington Department Ecology *Well Log Viewer* and potentiometric surface maps in Newcomb (1952), the regional water table in the Marysville Sand appears to be at depths of generally 60 to 70 feet BGS in the vicinity of the site.

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 fluctuate depending on local subsurface conditions, precipitation, and changes in on-site and off-site use.

GEOLOGIC HAZARDS

As the subject property is located within the City of Arlington, GeoTest reviewed Chapter 20.93.600 (Geologically Hazardous Areas) of the Arlington Municipal Code. Since the subject property is relatively flat with very little minor elevation gradients, it is GeoTest's opinion that the subject property does not contain hazards pertaining to erosion or landslides (i.e., not an

Erosion Hazard or Steep Slope Hazard). However, the subject property is mapped as having a low to moderate susceptibility to liquefaction. This is addressed in the next section.

Seismic and Liquefaction Hazards

Based on a review of information obtained from the Washington State Department of Natural Resources *Geologic Information Portal*, the subject site is classified as having a low to moderate liquefaction susceptibility. However, this map only provides an estimate of the likelihood that the soil will liquefy as a result of an earthquake and is meant as a general guide to delineate areas prone to liquefaction.

Liquefaction is defined as a significant rise in porewater pressure within a soil mass caused by earthquake-induced cyclic shaking. The shear strength of liquefiable soils is reduced during large and/or long duration earthquakes as the soil consistency approaches that of semi-solid slurry. Liquefaction can result in significant and widespread structural damage if not properly mitigated. Deposits of loose, granular soil below the groundwater table are most susceptible to liquefaction. Damage caused by foundation rotation, lateral spreading, and other ground movements can result from soil liquefaction.

Based on our subsurface explorations, the site is underlain by native, medium-dense, very gravelly, sandy soils. GeoTest did not encounter the regional groundwater table during our explorations and a review of local well log data and published potentiometric surface maps suggest it is more than 20 feet BGS in the vicinity of the site. Due to these factors, it is GeoTest's opinion that the potential for liquefaction underlying the subject property is low. Thus, it is our opinion that the site does not require mitigations to address liquefaction concerns.

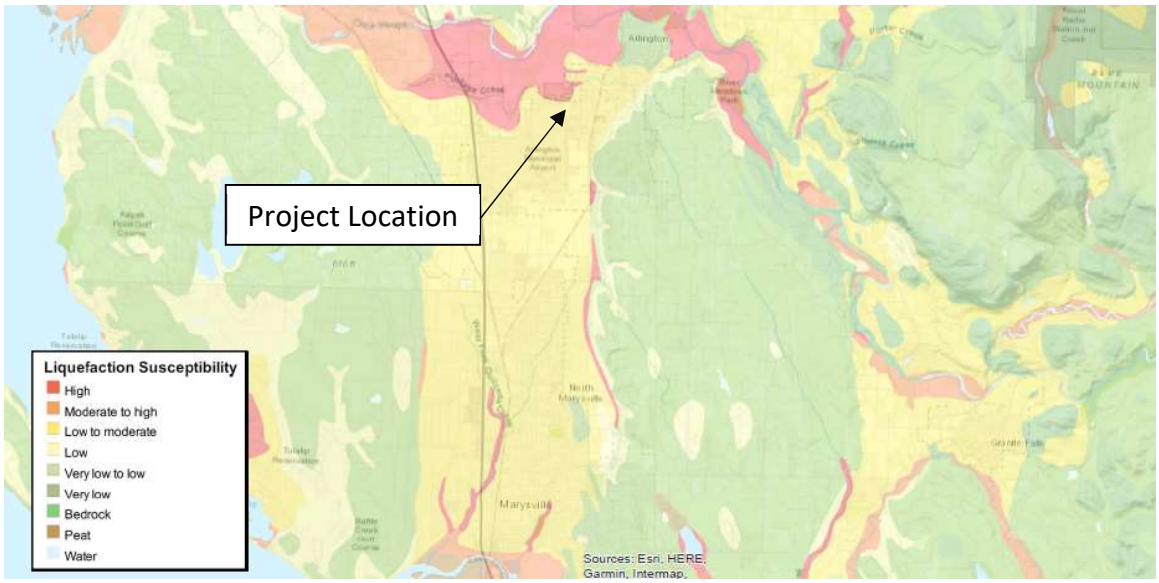

Image 6. Map showing liquefaction hazard susceptibility. Yellow depicts "low to moderate" susceptibility in the vicinity of the subject property. (Source: Washington Geologic Information Portal.)

CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation of the data collected during this investigation, it is GeoTest's opinion that the subsurface conditions at the site are suitable for the proposed development, provided the recommendations contained herein are incorporated into the project design.

In the proposed building area (northeast corner of the subject property), the subsurface soils generally consisted of native, medium-dense, gravelly sand or sandy gravel (Arlington Gravel) at or near existing grade. North of the proposed building footprint, approximately 2 feet of topsoil and medium-dense, previously placed fill soils were encountered over the native Arlington Gravel. GeoTest recommends that topsoil, if encountered, be removed from the building footprint down to the existing, non-organic, medium-dense fill soils or native Arlington Gravel. GeoTest generally anticipates that about 1 to 1.5 feet of stripping will be needed in order to remove near-surface, organic soils and to expose the non-organic, medium-dense fill soils or native Arlington Gravel.

In the proposed scale area (center of subject property), the subsurface soils generally encountered approximately 3.2 feet of layered, medium-dense to dense fill soils overlying native sand (Marysville Sand). No relict topsoil was encountered between the fill soils and the underlying native soils. For the proposed scale and scale house, GeoTest recommends that any near-surface topsoil, if encountered, be removed from the building footprint down to the existing, medium-dense to dense, non-organic, fill soils. Footings for the scale and scale house can then bear directly on properly prepared, existing fill soils, or directly on the native Marysville Sand if encountered.

Once competent soils have been exposed, GeoTest recommends that the subgrade surface be compacted to a firm and unyielding condition with an appropriate piece of construction equipment. The foundations can then bear directly on the prepared fill or native subgrade.

The native Marysville Sand and Arlington Gravel soils appear to be suitable for stormwater infiltration. GeoTest has presented preliminary design infiltration rates based on grain size analyses, per the SMMWW, in a subsequent section of this report.

Site Preparation and Earthwork

The portions of the site proposed for foundations should be prepared by removing existing topsoil, deleterious material, and significant accumulations of organics. Prior to placement of any foundation elements or structural fill, the exposed subgrade under all areas to be occupied by foundations should be viewed by a qualified geotechnical professional. The exposed subgrade soils should be compacted to a firm and unyielding condition prior to the placement of structural fill or foundation elements.

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.

Fill and Compaction

Structural fill used to obtain final elevations for footings and soil-supported concrete slabs must be properly placed and compacted. In most cases, suitable, 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 off-site 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

The near-surface fill soils below the topsoil encountered in our test pit explorations appeared to be non-organic and thus may potentially be suitable for reuse as structural fill when placed at or near optimum moisture contents (as determined as ASTM D1557), and if allowed for in the project plans and specifications.

The on-site, native Marysville Sand and Arlington Gravel are 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. The near-surface, weathered soils may contain elevated silt contents and may be difficult to use during periods of wet weather.

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 over-optimum moisture contents 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

If construction takes place during wet weather, GeoTest recommends that structural fill consist native or imported, clean, well-graded sand or sand and gravel 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 Marysville Sand and Arlington Gravel are 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 remedially compacted, firm and unyielding, non-organic, previously placed fill soils or native Marysville Sand/Arlington Gravel soils can provide foundation support for the proposed improvements. As discussed previously, for the proposed two-story building at the northeast corner of the subject property, we expect that approximately 1 to 1.5 of stripping will be required to remove the near-surface organic topsoil and to expose the existing, non-organic, medium-dense fill soils. In the area of the proposed scale and scale house, we expect the stripping depths to be minimal. 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.

Allowable Bearing Capacity

Assuming the above foundation support criteria are satisfied, continuous or isolated spread footings founded directly on native, remedially compacted, firm and unyielding, existing non-organic fill soils, or native Marysville Sand/Arlington Gravel may be proportioned using a net allowable soil bearing pressure of 2,000 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 under static conditions 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.

Floor Support

Conventional slab-on-grade floor construction is feasible for the planned site improvements. Floor slabs may be supported on properly prepared native subgrade or on properly placed and compacted structural fill placed over properly prepared native soil. Prior to placement of the structural fill, the native soil should be proof-rolled as recommended in the *Site Preparation and Earthwork* section of this report.

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 10-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.

Foundation and Site Drainage

Positive surface gradients should be provided adjacent to new foundation areas to direct surface water away from the building 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 foundation areas towards 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 *Typical Footing 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 concrete 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.

Resistance to Lateral Loads

The lateral earth pressures that develop against retaining 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. Design of walls 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 retaining 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 350 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. Retaining 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 foundations will bear directly on the native Marysville Sand soils, an allowable coefficient of 0.30 should be used.

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 Marysville Sand encountered at the project site are classified as a Type B soil according to WAC 296-155-66401 and may be sloped as steep as 1H: 1V (Horizontal: Vertical). All soils encountered are classified as Type C soil in the presence of

groundwater seepage and may be sloped as steep as 1.5:1. 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. All permanent slopes should be vegetated or otherwise protected to limit the potential for erosion as soon as practical after construction.

Utilities

Utility trenches must be properly backfilled and compacted to reduce cracking or localized loss of foundation, slab, or pavement support. Excavations for new shallow underground utilities are expected to be placed within native Marysville Sand.

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. Trench backfill should be placed and compacted in general accordance with the recommendations presented in the *Fill and Compaction* section of this report and *Typical Utility Trench Section* (Figure 4).

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.

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 is feasible for this project site. GeoTest was not provided with any conceptual drawings of proposed stormwater infiltration facilities for this report. However, GeoTest understands that stormwater may be routed toward existing stormwater facilities on-site. GeoTest is aware that current facilities may need to be expanded.

Test Pit Gradation Results

From the explorations excavated in the areas of interest, two representative soil samples were selected and mechanically tested for grain size distribution 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	Uncorrected K_{sat} Infiltration Rate [in/hr]	Corrected K_{sat} Infiltration Rate [in/hr]
TP-3 (3.5 ft)	Marysville Sand	64.8	**10.0***
TP-5 (10 ft)	Arlington Gravel	132.0	**10.0***

Notes:
- Ksat = Initial Saturated Hydraulic Conductivity
- Correction Factors Used: CFv = 0.50, CFt = 0.40, CFm =0.90
- Total Correction Factor = 0.18
- Rates presented are representative of loose conditions and do not consider the relative density of the soil
*** GeoTest does not recommend utilizing Ksat rates greater than 10.00 in/hr for infiltration facilities.**

It should be noted that the rates presented in Table 1 are representative of loose soil conditions and do not take into account the relative density of the soil. Additionally, estimates from the grain size approach will give order-of-magnitude estimates for hydraulic conductivity for soils that are relatively coarse-grained (Massman, 2003). In our experience, infiltration rates based on grain size analysis 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 subject site. For facilities based in the unweathered Marysville Sand/unweathered Arlington Gravel soils, GeoTest recommends a preliminary corrected infiltration rate of **10 inches per hour.** The unweathered soils were generally encountered at approximately 2 to 3.5 feet BGS in the test pits.

Please note that the calculated 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 on-site stormwater facilities may require some form of pollutant pretreatment with an amended soil prior to on-site infiltration or off-site discharge. The reuse of on-site topsoil is often the most sustainable and cost-effective method for pollutant treatment purposes. Cation exchange capacities, organic contents, and pH of site subsurface soils were also tested to determine possible pollutant treatment suitability.

Cation exchange capacity, organic content, and pH tests were performed (by Northwest Agricultural Consultants) on three soil samples collected from the explorations performed for this project. A summary of the laboratory test results is presented in Table 2 below:

Table 2
Cation Exchange Capacity, Organic Content, and pH Laboratory Test Results

Test Pit ID	Sample Depth (ft)	Geologic Unit	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH
TP-1	3.7	Marysville Sand	4.3	0.75	7.5
TP-2	1.1	Arlington Gravel	3.5	1.17	6.4
TP-4	2.1	Arlington Gravel	2.7	0.70	6.4

Suitability for on-site pollutant treatment is determined in accordance with SSC-6 of the Washington State Department of Ecology *Stormwater Management Manual for Western Washington*. Soils with an organic content of greater than or equal to 1 percent and a cation exchange capacity of greater than or equal to 5 meq/100 grams are characterized as suitable for stormwater treatment.

The site has been previously stripped; thus, we do not expect significantly thick layers of organic topsoil underlying the surface. However, if organic topsoil is encountered during site preparation, we would expect that it would likely be suitable for stormwater treatment. The native, near-surface weathered Marysville Sand or Arlington Gravel extending to an approximate depth of 2.5 feet BGS would not appear to be suitable for stormwater treatment.

On-site soils can be amended by mixing higher silt content soils or adding mulch (or other admixtures) to elevate the cation exchange capacity and organic contents. On-site amended soil requires additional testing to confirm compliance with ecological regulations. GeoTest is available to perform additional laboratory testing as part of an expanded scope of services if the

soil is to be amended. Alternatively, the Owner may elect to import amended soils with the desired properties for planned treatment facilities.

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 Reece Construction Company and their design consultants for specific application to the design of the proposed Construction Office and Scale Relocation located at 5802 Cemetery Road 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 USGS geological information for the site. If variations

in subsurface conditions are encountered during construction that differs from those contained within this report, GeoTest should be allowed to review the recommendations contained in this report 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; this responsibility is specifically disclaimed.

Attachments:	Figure 1	Site Vicinity Map
	Figure 2	Site and Exploration Plan
	Figure 3	Typical Footing and Wall Drain Section
	Figure 4	Typical Utility Trench Section
	Figure 5	Soil Classification System and Key
	Figure 6 - 9	Test Pit Logs
	Figure 10 - 12	Grain Size Analysis
	Attached	Northwest Agricultural Consultants Results
	Attached	Report Limitations and Guidelines for its Use

REFERENCES

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 West 7.5-minute quadrangle, Snohomish County, Washington [map].* 1:24,000. US Geological Survey MF-1740.

Newcomb, R.C., 1952, Ground-water resources of Snohomish County, Washington: U.S. Geological Survey, Water-Supply Paper 1135, scale 1:62,500.

PDS Map Portal. Snohomish County Planning and Development Services - Online Web Services. Retrieved November 2020.

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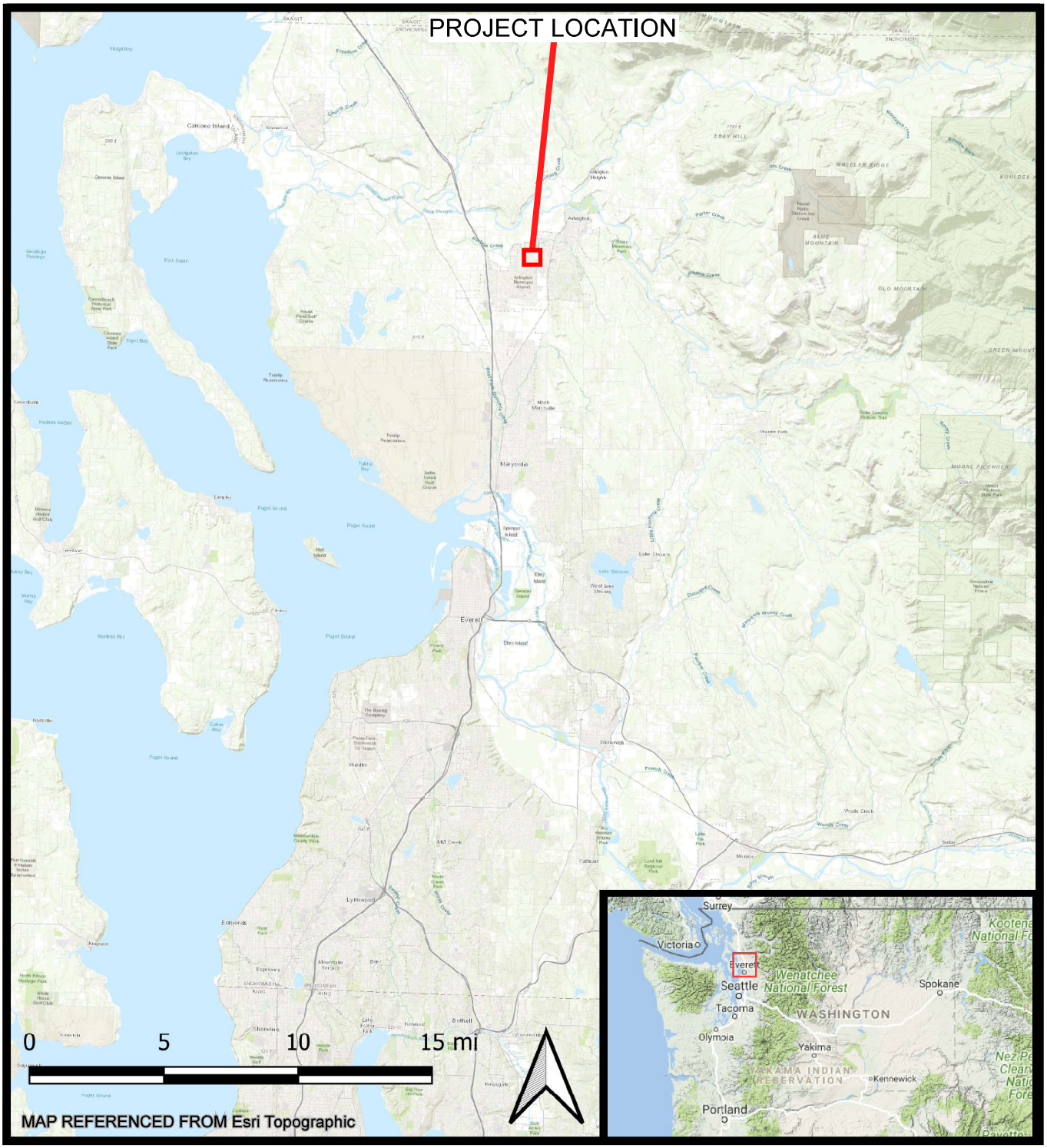


GEOTEST	Date: 11-11-2020	By: TAC	Scale: As Shown

VICINITY MAP

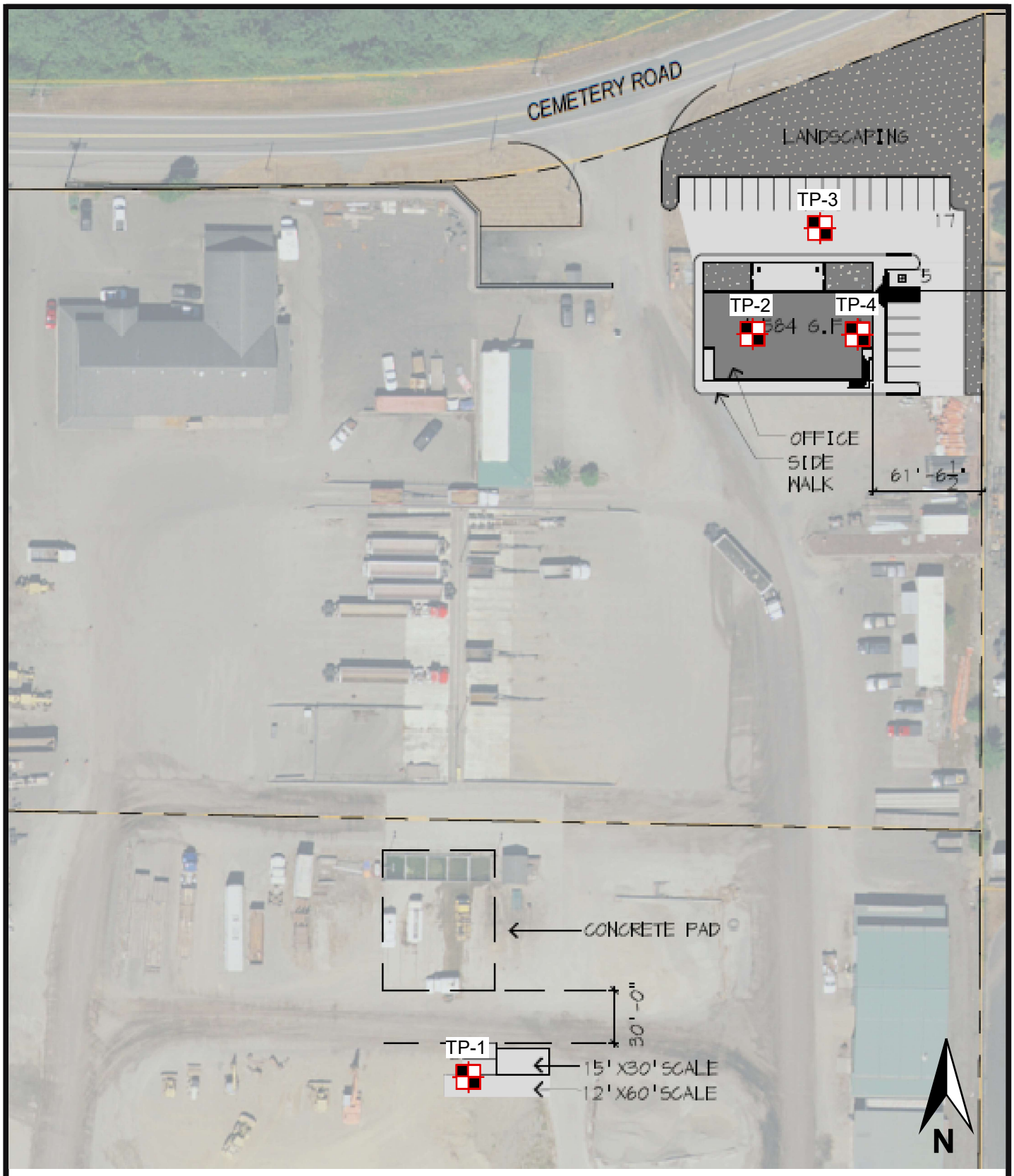
CONSTRUCTION OFFICE AND SCALE RELOCATION

5802 CEMETERY ROAD

ARLINGTON, WA 98223

Project **20-0888**

Figure **1**



SITE PLAN SOURCED FROM 2812 ARCHITECTURE

TP-# = Approximate Test Pit Location

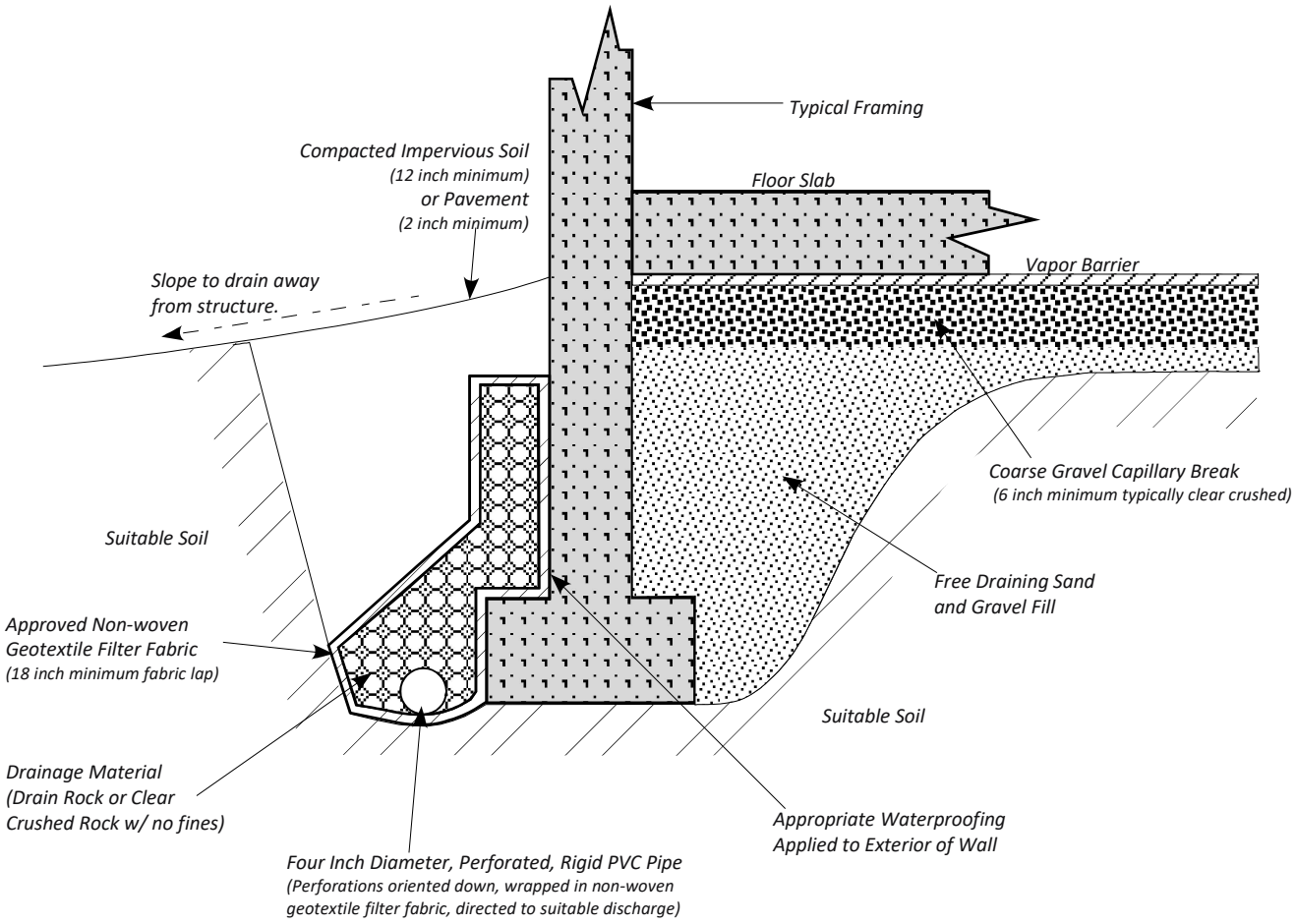
GEOTEST

Date: 11-11-2020	By: TAC	Scale: NTS	Project 20-0888

SITE AND EXPLORATION PLAN
CONSTRUCTION OFFICE AND SCALE RELOCATION
5802 CEMETERY ROAD
ARLINGTON, WA 98223

Figure 2

SHALLOW 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.

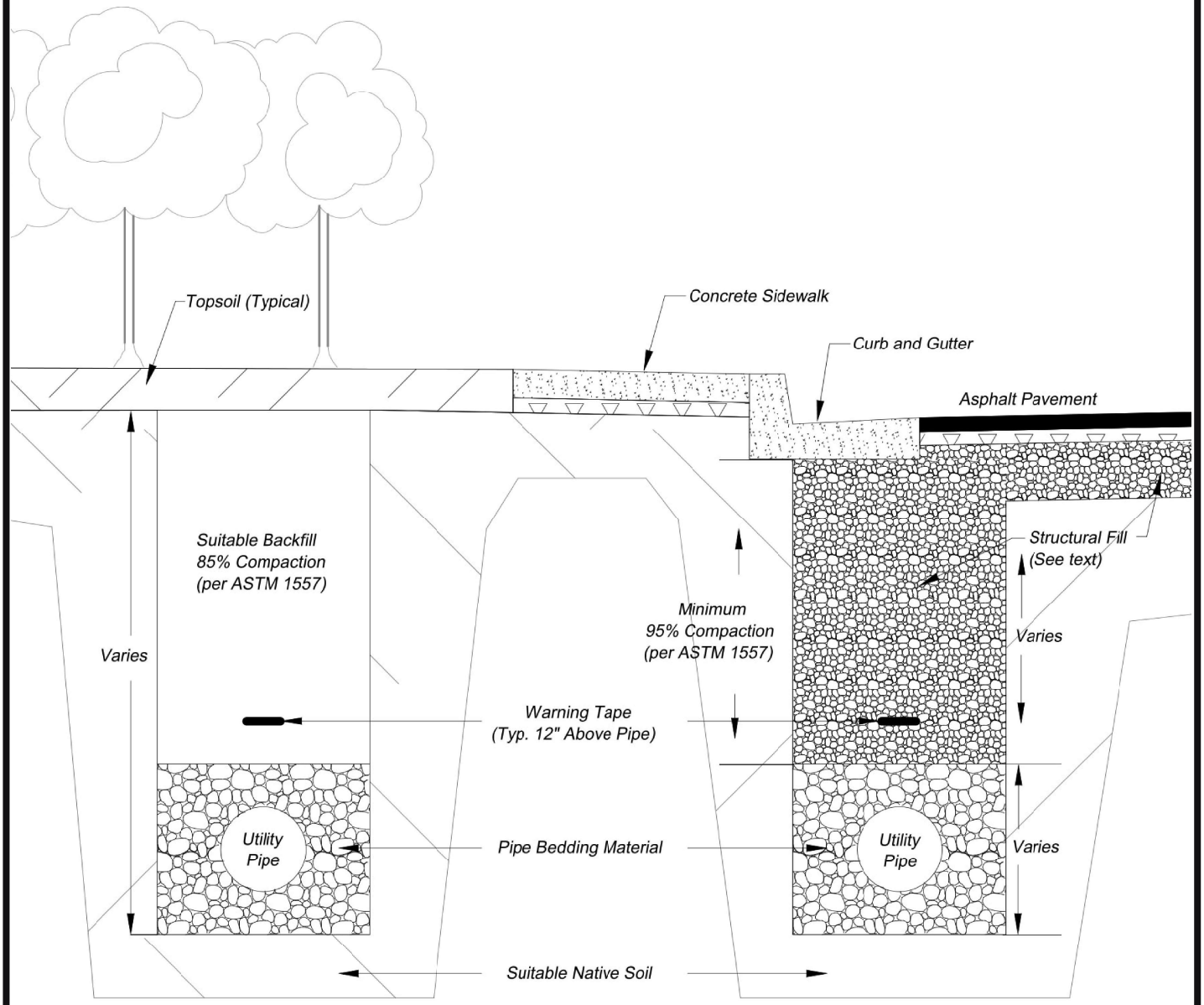
Footings should be properly buried for frost protection in accordance with the International Building Code or local Municipal building codes.
(Typically 18 inches below exterior finished grades)

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: 11-11-2020	By: TAC	Scale: None
	TYPICAL FOOTING & WALL DRAIN SECTION		Project **20-0888**
	CONSTRUCTION OFFICE AND SCALE RELOCATION		Figure
	5802 CEMETERY ROAD		**3**
	ARLINGTON, WA 98223		

LANDSCAPING AREAS

LOAD BEARING AREAS



GEOTEST	Date: 11-11-2020	By: TAC	Scale: None

TYPICAL UTILITY TRENCH SECTION

CONSTRUCTION OFFICE AND SCALE RELOCATION
5802 CEMETERY ROAD
ARLINGTON, WA 98223

Project
20-0888

Figure
4

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

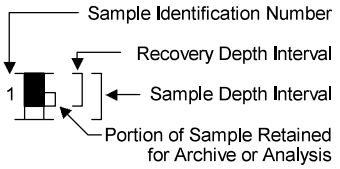
OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

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

Construction Office and Scale Relocation
Arlington, WA 98223

Soil Classification System and Key

Figure 5

TEST PIT LOG

Test Pit No. TP-1

PROJECT: Reece Construction Office and Scale Relocation | **PROJECT NO.:** 20-0888
LOCATION: 5802 Cemetery Road, Arlington, WA 98223 | **DATE:** 10/30/2020
EXPLORATION METHOD: Tracked Excavator | **ELEVATION:** 112
CONTRACTOR/DRILLER: Kyle with Reece Construction | **LOGGED BY:** Tristan C.
DEPTH TO WATER TABLE: NA | **PERCHED WATER:** NA | **CAVING** NA

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA			USCS SYMBOL		SOIL PROFILE DESCRIPTION
	SAMPLE & TEST DATA					
112 – 0					SM	Medium dense, light brown, wet, gravelly, silty SAND (Fill)
	TP1-0.7	d	W = 5.7 GS		GW	Dense, black, damp, very sandy GRAVEL, trace silt, oil stained (Fill - Recycled Asphalt)
1					SP	Dense, light tan, damp, fine SAND, trace silt, poorly graded (Fill)
110 – 2	TP1-1.7	d	W = 8.2 GS			1" of achieved penetration with a 3/8" T-Probe @ 1.7' BGS
					SM	Dense, light brown, damp, very silty, fine SAND (Fill)
3	TP1-3.0	d	W = 18.9 GS		SP	Dense, light tan to gray, damp, medium to fine SAND, trace silt, poorly graded (Marysville Sand)
108 – 4	TP1-3.7	d				2" of achieved penetration with a 3/8" T-Probe @ 3.5' BGS
5						Transitions to medium dense at 4.5' BGS
106 – 6	TP1-6.2	d	W = 5.4 GS			
7						
104 – 8						

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 8.0 ft below site grades on 10/30/2020

Figure: 6

Notes:

TEST PIT LOG

Test Pit No. TP-2

PROJECT: Reece Construction Office and Scale Relocation **PROJECT NO.:** 20-0888
LOCATION: 5802 Cemetery Road, Arlington, WA 98223 **DATE:** 10/30/2020
EXPLORATION METHOD: Tracked Excavator **ELEVATION:** 123
CONTRACTOR/DRILLER: Kyle with Reece Construction **LOGGED BY:** Tristan C.
DEPTH TO WATER TABLE: ▽ NA **PERCHED WATER:** ▼ NA **CAVING** C NA

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA: SAMPLE & TEST DATA			SOIL SAMPLE AND TEST DATA: USCS SYMBOL	SOIL PROFILE DESCRIPTION
124 — 0				GP	Medium dense, light tan, moist, sandy GRAVEL, poorly graded, coarse grained (Arlington Gravel)
1	TP2-1.1	d			
122 — 2	TP2-2.2	d	W = 3.4 GS	SP	Medium dense, light tan to gray, moist, very gravelly SAND, poorly graded, coarse to finely grained (Arlington Gravel)
3	TP2-3.1	d	W = 5.0 GS	SP	Dense, gray, damp, very gravelly SAND, trace silt, poorly graded (Arlington Gravel)
120 — 4					
5	TP2-4.5	d	W = 6.5 GS		Transitions to slightly gravelly @ 4.5' BGS
118 — 6					
7					
116 — 8					

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 8.0 ft below site grades on 10/30/2020

Figure: 7

Notes:

TEST PIT LOG

Test Pit No. TP-3

PROJECT: Reece Construction Office and Scale Relocation **PROJECT NO.:** 20-0888
LOCATION: 5802 Cemetery Road, Arlington, WA 98223 **DATE:** 10/30/2020
EXPLORATION METHOD: Tracked Excavator **ELEVATION:** 127
CONTRACTOR/DRILLER: Kyle with Reece Construction **LOGGED BY:** Tristan C.
DEPTH TO WATER TABLE: ▽ NA **PERCHED WATER:** ▼ NA **CAVING** C 2.5

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA: SAMPLE & TEST DATA			SOIL SAMPLE AND TEST DATA: USCS SYMBOL	SOIL PROFILE DESCRIPTION
123 / 0				SM	Loose, dark brown, moist, very silty SAND, roots, sod (Topsoil)
1	10	d		SP-SM	Medium dense, tan, damp, slightly gravelly SAND (Fill)
121 / 2				GP	Medium dense, weathered orange/tan, damp, sandy GRAVEL, coarse to finely grained (Arlington Gravel) 6" of penetration achieved with 3/8" steel T-probe @ 3.0' BGS
3	TP3-3.0	d			
119 / 4	TP3-4.2	d	W = 4.2 GS	GP	Medium dense, light tan, damp, very sandy GRAVEL, poorly graded, coarse and fine grained (Arlington Gravel)
5					
117 / 6					
7					
115 / 8					

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 8.0 ft below site grades on 10/30/2020

Figure: 8

Notes:

TEST PIT LOG

Test Pit No. TP-4

PROJECT: Reece Construction Office and Scale Relocation **PROJECT NO.:** 20-0888
LOCATION: 5802 Cemetery Road, Arlington, WA 98223 **DATE:** 10/30/2020
EXPLORATION METHOD: Tracked Excavator **ELEVATION:** 123
CONTRACTOR/DRILLER: Kyle with Reece Construction **LOGGED BY:** Tristan C.
DEPTH TO WATER TABLE: NA **PERCHED WATER:** NA **CAVING** NA

ELEVATION/ DEPTH	SOIL SAMPLE AND TEST DATA: SAMPLE & TEST DATA		SOIL SAMPLE AND TEST DATA: USCS SYMBOL	SOIL PROFILE DESCRIPTION
123 – 0			SP	Medium dense, light tan, damp, gravelly SAND, trace silt, poorly graded (Arlington Gravel)
121 – 2	TP4-2.1	d		
119 – 4			GP	Medium dense, light tan, damp, sandy GRAVEL, trace silt, poorly graded, coarse to fine grained (Arlington Gravel)
			SP	Medium dense, light tan, slightly gravelly SAND, trace silt (Arlington Gravel)
117 – 6	TP4-6.0	d		
115 – 8				

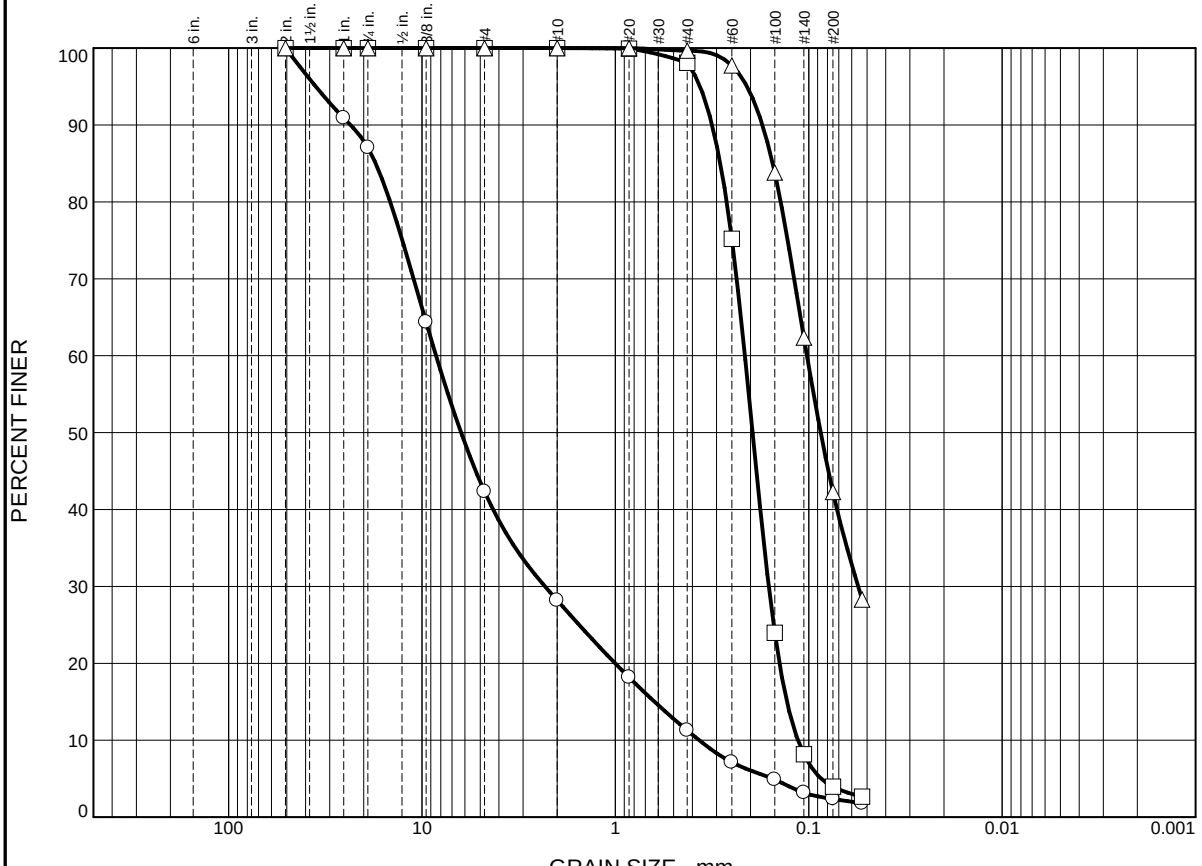
Reference Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key' figure for an explanation of the graphics/symbols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

Test Pit TP-4 was terminated at 8.0 ft below site grades on 10/30/2020

Figure: 9

Notes:

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	13.0	44.7	14.1	16.9	8.9	2.4	
□	0.0	0.0	0.0	0.0	1.9	94.1	4.0	
△	0.0	0.0	0.0	0.0	0.3	57.4	42.3	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		NV	NP	17.3578	8.4603	6.2769	2.3132	0.6270	0.3687	1.72	22.95
□		NV	NP	0.2867	0.2140	0.1952	0.1610	0.1298	0.1138	1.06	1.88
△				0.1536	0.1022	0.0868	0.0555				

Material Description	USCS	AASHTO
○ Very sandy GRAVEL, trace silt, well graded	GW	A-1-a
□ Fine SAND, trace silt, poorly graded	SP	A-3
△ Very silty, fine SAND	SM	

Project No. 20-0888 **Client:** Reece Construction Company

Project: Reece Construction Office and Scale Relocation

○ **Depth:** 0.7 **Sample Number:** TP1-0.7

□ **Depth:** 1.7 **Sample Number:** TP1-1.7

△ **Depth:** 3.0 **Sample Number:** TP1-3.0

Date: ○ 10/30/2020 □ 10/30/2020 △ 10/30/2020

Remarks:

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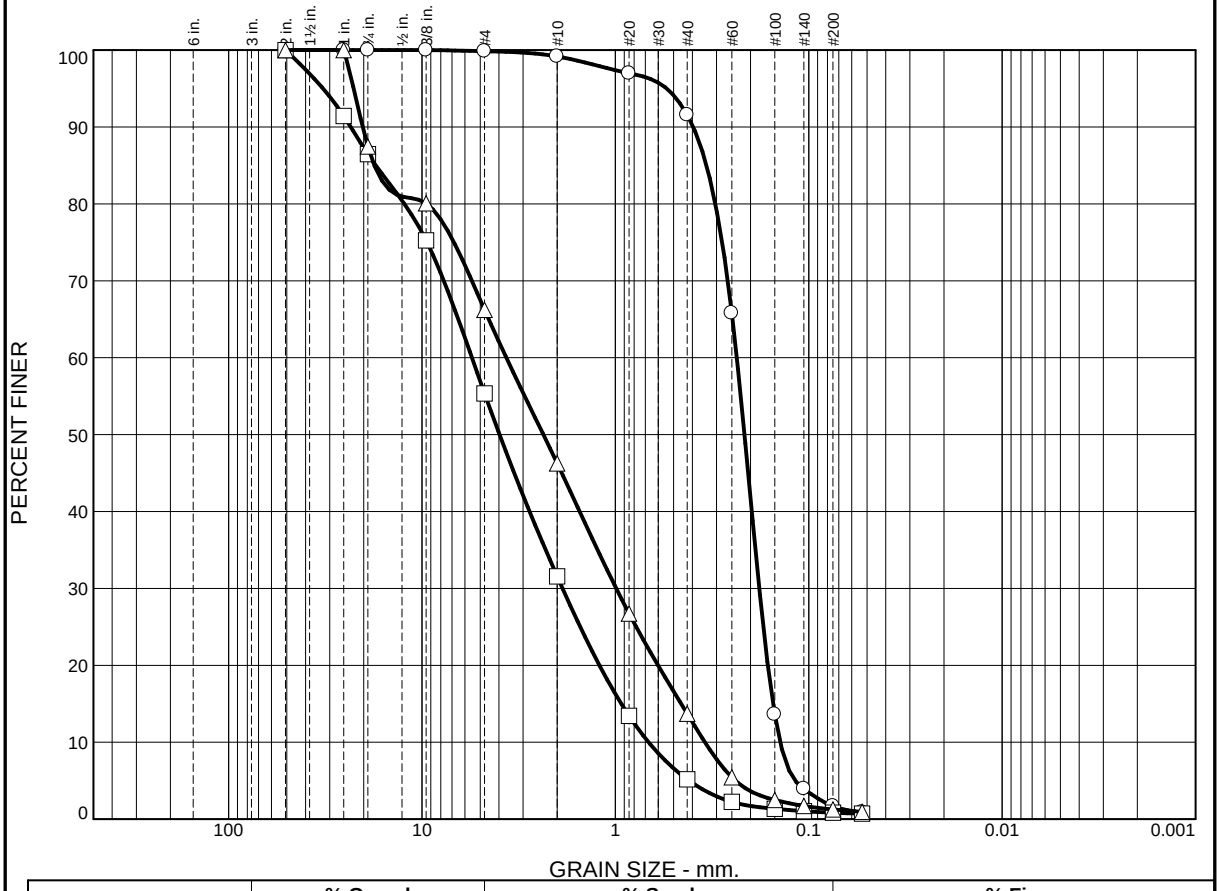
Figure 10

Tested By: JC **Checked By:** TAC

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.7	7.6	89.9	1.7	
□	0.0	13.5	31.1	23.8	26.4	4.4	0.8	
△	0.0	12.5	21.3	20.0	32.5	12.4	1.3	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		NV	NP	0.3378	0.2357	0.2150	0.1802	0.1531	0.1406	0.98	1.68
□		NV	NP	17.3447	5.5189	3.9716	1.8769	0.9323	0.6736	0.95	8.19
△		NV	NP	17.6359	3.6622	2.3576	0.9903	0.4568	0.3443	0.78	10.64

Material Description	USCS	AASHTO
○ Medium to fine SAND, trace silt, poorly graded	SP	A-3
□ Very gravelly SAND, poorly graded	SP	A-1-a
△ Very gravelly SAND, trace silt, poorly graded	SP	A-1-a

Project No. 20-0888 **Client:** Reece Construction Company

Project: Reece Construction Office and Scale Relocation

○ **Depth:** 6.2 **Sample Number:** TP1-6.2

□ **Depth:** 2.2 **Sample Number:** TP2-2.2

△ **Depth:** 3.1 **Sample Number:** TP2-3.1

Date: ○ 10/30/2020 □ 10/30/2020 △ 10/30/2020

Remarks:

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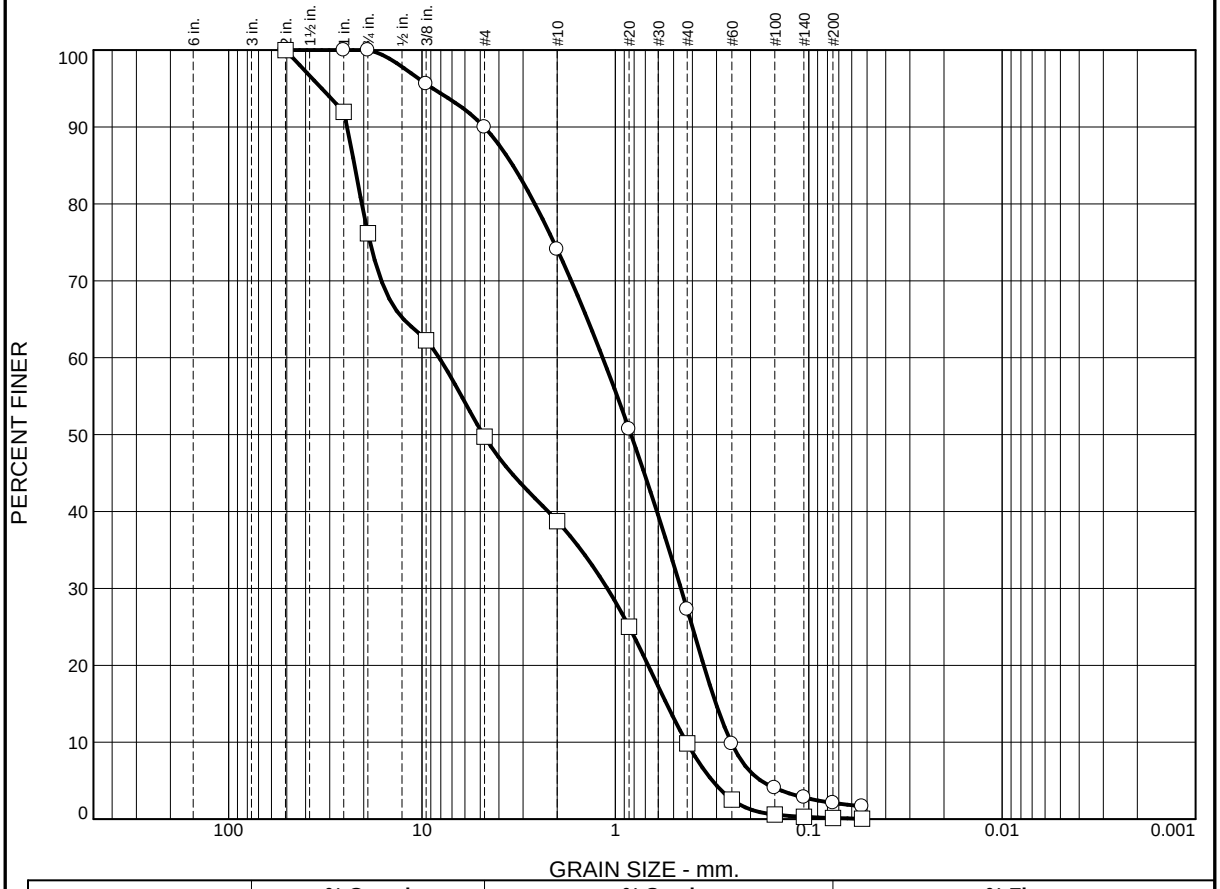
Figure 11

Tested By: JC **Checked By:** TAC

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	10.1	15.8	46.8	25.2	2.1	
□	0.0	23.8	26.5	11.0	28.9	9.6	0.2	

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○		NV	NP	3.3875	1.1630	0.8304	0.4580	0.3017	0.2522	0.72	4.61
□		NV	NP	22.3251	8.1501	4.8214	1.1004	0.5435	0.4283	0.35	19.03

Material Description	USCS	AASHTO
○ Slightly gravelly SAND, trace silt, poorly graded	SP	A-1-b
□ Very sandy GRAVEL, poorly graded	GP	A-1-a

Project No. 20-0888 **Client:** Reece Construction Company

Project: Reece Construction Office and Scale Relocation

○ **Depth:** 4.5 **Sample Number:** TP2-4.5

□ **Depth:** 4.2 **Sample Number:** TP3-4.2

Date: ○ 10/30/2020 □ 10/30/2020

Remarks:

GEOTEST
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Figure 12

Tested By: JC **Checked By:** TAC

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NAPT

GeoTest Services Inc.
741 Marine Drive
Bellingham, WA 98225

Report: 53596-1-1
Date: November 3, 2020
Project No: 20-0888
Project Name: Reece Construction Office & Scale Relocation

Sample ID	pH	Organic Matter	Cation Exchange Capacity
TP-1 @ 3.7’	7.5	0.75%	4.3 meq/100g
TP-2 @ 1.1’	6.4	1.17%	3.5 meq/100g
TP-4 @ 2.1’	6.4	0.70%	2.7 meq/100g
Method	**SM 4500-H^+ B**	**ASTM D2974**	**EPA 9081**

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.

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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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