Geotechnical Engineering Report

Franklin Academy Expansion
3000 Northwest Avenue
Bellingham, Washington

Prepared For:

The Franklin Academy
1509 East Victor Street
Bellingham, WA 98225

Attn: Gretchen Bucsko

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February 2, 2024
Project No. 23-3437

The Franklin Academy
1509 East Victor Street
Bellingham, WA 98225

Attn: **Gretchen Bucsko**

Regarding: **Geotechnical Engineering Evaluation**
Franklin Academy Expansion
3000 Northwest Avenue
Bellingham, Washington
Parcel No. 380224412399

Dear. Ms. Bucsko,

As requested, GeoTest Services, Inc. is pleased to submit the following report summarizing the results of our geotechnical engineering investigation for the proposed Franklin Academy expansion, located at 3000 Northwest Avenue Bellingham, Washington. This report has been prepared in general accordance with the terms and conditions established in our services agreement dated November 29, 2023. We appreciate 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.

JOSEPH SCHMIDT STATE OF WASHINGTON 55631 REGISTERED PROFESSIONAL ENGINEER
02/02/2024

State of Washington 23013813 Licensed Geologist Devin O. Murphy
2/2/2024

Joe Schmidt, P.E.
Geotechnical Department Manager

Devin Murphy, L.G.
Geotechnical Project Manager

Enclosure: Final Geotechnical 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:

- Exploration of soil and groundwater conditions underlying the site by advancing 2 test pits excavated with a tracked excavator and operator, provided by the client, to evaluate subsurface conditions.

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

- Provide a written report containing a description of surface and subsurface conditions, exploration logs, with findings and recommendations pertaining to site preparation and grading activities, including stripping depths, subgrade preparation below planned structures, reuse of onsite soils, and criteria for selection, placement, and compaction of structural fill.
- Provide recommendations for foundation support of the structures and slabs including subgrade preparation, allowable soil bearing pressure, bearing elevations, frost penetration and depth, estimates of settlement, subsurface drainage, parameters for lateral load resistance, and a sliding coefficient for native soil.
- A summary of surface and subsurface soil and groundwater conditions observed at the site during our field exploration. Including descriptions of subsurface profiles or bearing stratum and the potential seasonal effects of groundwater.
- A discussion of the Seismic Site Class considerations based on the 2021 International Building Code (IBC). Along with an evaluation of liquefaction potential for the site based on regional seismic risk maps.
- Discussion of excavation considerations including recommendations for allowable excavation slope inclinations for temporary and permanent slopes, classification of soil types per OSHA regulations, geotechnical consulting, and construction monitoring.
- Assess geologically hazardous areas (if present) per the City of Bellingham Municipal Code (BMC) Chapter 16.55.410.

PROJECT DESCRIPTION

It is our understanding that there are plans to construct a new addition at the existing Franklin Academy Robin Hall building located at 3000 Northwest Avenue in Bellingham, Washington. The existing building occupies 17,305 square feet and is situated east of Northwest Avenue and north of East Victor Street. Based on documents provided by the project team, we understand approximately 2,025 square feet of the existing building along the western alignment will be demolished and replaced with a new 7,425 square foot, two story addition. While formal structural plans are not available at the time of this report, the new addition is anticipated to be wood framed and supported by shallow, conventional foundations with slab-on-grade floors. As such, building loading conditions are expected to be relatively light in scale.

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 parcel occupies approximately 1.70 acres and is located along the east side of Northwest Avenue in Bellingham, Washington. The site is immediately bordered to the west by Northwest Avenue, to the north by a commercial shopping center, to the east by Walnut Street, and to the south by East Victor Street. More broadly, the project vicinity is occupied by residential development with lesser commercial development to the northwest.

Image 1. General site surface conditions. Photo perspective is facing north from the southwest corner of the site facing north. Photo taken on 12-20-23.

The parcel currently supports the existing Robin Hall building. The proposed area of improvements consists of a 7,425 square foot area located along the southwest margin of the existing building. The development area currently supports a 2,025 square foot single story addition to the main building. The area of the proposed addition is largely enclosed by a 6-foot-tall open brick wall. It is our understanding that the existing addition and associated wall will be demolished as part of the proposed improvements. The site of the planned improvements gently slopes down to the southwest with an elevation change of roughly 2 vertical feet across approximately 175 horizontal feet. Vegetation generally consists of a manicured lawn, a single mature tree in the northern margin of site, and ornamental trees within the area enclosed by the brick wall. No surface water was observed at the time of our visit conducted on December 20, 2023.

Subsurface Soil Conditions

Subsurface conditions were explored by advancing 2 test pits (TP-1 and TP-2) on December 20, 2023. The explorations were advanced to depths ranging from 9.8 and 9.9 feet below ground surface (BGS) with a client provided excavator and operator and under the direction and observation of a GeoTest Staff Geologist. Soil classification generally followed the guidelines of the American Society for Testing and Materials (ASTM) D2487 and D2488. Approximate locations of these explorations have been plotted on the *Site and Exploration Plan* (Figure 2). A *Soil Classification System and Key* is presented as Figure 4. Detailed exploration logs can be found in Figures 5 – *Test Pit Logs,* with laboratory results as Figures 6 through 7.

Image 2. Typical subsurface soil profile as observed in TP-2. Photo taken on 12-20-23.

Subsurface soils conditions generally consisted of loose, brown, damp, silty sand with abundant organics (topsoil) that extended from the surface to approximately 0.8 and 0.4 feet BGS in TP-1 and TP-2, respectively. Underlying the topsoil was undocumented fill consisting of loose, brown to gray, damp, slightly silty to silty, gravelly sand containing scattered construction debris consisting of pieces of brick and asphalt that extended to 3.3 feet BGS in both test pits. Within TP-1, a thin horizon of relict topsoil consisting of medium stiff, dark brown to black, damp, sandy silt was encountered at the base of the fill material and extending to 3.9 feet BGS.

Underlying the relict topsoil and undocumented fill was undisturbed native glacial outwash consisting of medium dense, tan to reddish brown, damp, silty, gravelly sand that extended to the termination depths of the explorations. It should be noted that within TP-1, a large rectangular concrete block was observed within the excavation sidewall at approximately 5 feet BGS and extended down to 9 feet BGS.

General Geologic Conditions

General geologic conditions at the project site were reviewed according to the *Geologic Map of the Bellingham Quadrangle, Washington* (Lapen, 2000). According to the referenced map, the geologic materials underlying the project site consist of glacial outwash (Unit Qgo_s) from the Sumas Stade of the Frasier Glaciation.

Lapen describes glacial outwash as "moderately to well-sorted cobbly gravel, gravelly sand, sandy gravel, sand, and rare silt. Clasts are angular to subrounded, commonly imbricated, and derived from the Coast Plutonic Complex in British Columbia and nearby sources. Bedding is commonly planar in fine-grained sediments and trough cross-bedded in coarser deposits. Color is typically olive-gray, gray, and brown depending on oxidation state and lithologic content."

The subsurface materials that were encountered within our test pit explorations appear to support the mapped glacial outwash and glaciomarine drift. However, it should be noted that geologic maps are produced at regional scales and that, in general, some level of variation between mapped geology and site soils should generally be anticipated.

Based on our review of the Washington State Department of Natural Resources (DNR) *Geologic Information Portal*, there are no active tectonic faults or mapped landslides within the immediate vicinity of the project site. The nearest mapped fault is located over 4.3 miles to the northwest of the subject area. This tectonic feature is identified by Kelsey et al. (2010) as the Birch Bay fault, an inferred fault trace, detected as a geophysical lineament.

Groundwater

Groundwater was not encountered within our explorations. GeoTest reviewed the Washington State Department of Ecology *Well Report Viewer* site and found no logs reporting static groundwater conditions in the vicinity of the project 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 will fluctuate depending on local subsurface conditions, precipitation, and changes in on-site and offsite use.

Web Soil Survey

According to the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) *Web Soil Survey* website, one relevant soil unit is present on the subject property, Kickerville-Urban land complex, 0 to 3 percent slopes. Please reference Table 1 below for the general characteristics of this unit. Based on the erosion "K" factor assigned by the NRCS, the soil present on-site is considered to be "highly" susceptible to erosion. Values of the erosion factor "K" range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Table 1 USDA NRCS Soil Classifications	
Map Unit Symbol	**82**
Map Unit Name	Kickerville-Urban land complex, 0 to 3 percent slopes
Soil Description	Ashy silty loam over very gravelly loam underlain by very gravelly sand
Landform	Terraces
Parent Material	Loess and volcanic ash over glacial outwash
Land Capability Classification	None Specified
Erosion K Factor, Whole Soil	0.49

The existing site soil observed at the project site appeared to be generally consistent with the *Web Soil Survey* descriptions. Further discussion is provided in the *Erosion Hazard Areas* section of this report.

GEOLOGICALLY HAZARDOUS AREAS

According to the Bellingham Municipal Code (BMC) 16.55.410, geologically hazardous areas include areas susceptible to landslide, erosion, rock fall, subsidence, earthquake, or other geological events. They pose a threat to the health and safety of citizens when incompatible development is sited in areas of significant hazard. In this section we present a review of the site and proposed development in accordance with the BMC 16.55.410-16.55.460, specifically relating to geologic hazards on and within roughly 200 feet of the project site.

Erosion Hazard Areas – BMC 16.55.420(A)

According to BMC 16.55.420(A), Erosion Hazard Areas are, *areas prone to soil erosion. Specifically, these areas include any area where the soil type is predominantly (greater that 50 percent) comprised of sand, clay, silt, and/or organic matter and the slope is greater than 30 percent.*

The soils underlying the project site are greater than 50 percent sand and silt and the *USDA Web Soil Survey* classifies native deposits as having a high erosion rate. However, the topography does not contain slopes in excess of 30 percent grade. Therefore, **the subject site is not considered an Erosion Hazard Area per the Bellingham Municipal Code**. Although not considered an erosion hazard, we recommend the following mitigations be included in order to reduce the risk of erosion during and immediately following construction:

- All clearing and grading activities for future residence construction will need to incorporate Best Management Practices (BMP’s) for erosion control in compliance with current Bellingham Municipal Codes and standards.

- We recommend that appropriate silt fencing be incorporated into the construction plan for erosion control.

- We recommend that onsite BMP's be implemented during construction. Areas of native vegetation should be left in place or may be enhanced by adding additional native plant species and/or other vegetation enhancements.

- Removal of vegetation and trees without proper mitigation may increase the risk of failure for the surficial soils during periods of wet weather. Planting additional native vegetation in areas disturbed by excavation activities will help maintain near surface slope stability by providing a stable root base within the near surface soils.

- Proper drainage controls have a significant effect on erosion. All surface water and any collected drainage water should not be allowed to be concentrated and discharged down towards steep on or off-site slopes. All collected stormwater should be directed to an appropriate collection system.

- All areas disturbed by the construction practices should be vegetated or otherwise protected to limit the potential for erosion as soon as practical during and after construction. Areas requiring immediate protection from the effects of erosion should be covered with either plastic, mulch, or erosion control netting/blankets. Areas requiring permanent stabilizations should be seeded with an approved grass seed mixture, hydroseeded with an approved seed-mulch-fertilizer mixture or landscaped with a suitable planting design.

It should also be noted that the proposed development will be subject to the City of Bellingham Minimum Requirements for Stormwater Mitigation that are set forth in BMC section 15.42.060(F). Various requirements (#1 through #9) may be requested by the City of Bellingham, prior to project permitting.

Landslide Hazard Areas – BMC 16.55.420(B)

The BMC 16.55.420(B) broadly defines Landslide Hazard Areas as, *[areas] prone to landslides and/or subsidence that could include slow to rapid movement of soil, fill materials, rock and other geologic strata resulting in risk of injury or damage to the public and environment. Landslides could result from any combination of soil, slope, topography, underlying geologic structure, hydrology, freeze-thaw, earthquake, and other geologic influences. Specific geologic hazards include slopes with an incline that is equal or greater than 40 percent grade (22 degrees) with a vertical elevation change of at least 10 feet. Slope shall be calculated by identifying slopes that have at least 10 feet of vertical elevation change within a horizontal distance of 25 feet or less.*

The project site does not contain any areas where a vertical elevation change of 10 feet (or more) occurs within a horizontal distance of 25 feet or less. As such, the **project site does not meet the criteria as a Landslide Hazard Area** per BMC and no mitigation for this hazard is required.

Seismic Hazard – BMC 16.55.420(C)

The BMC defines Seismic Hazard Areas as, *areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting. Specific areas of very high response to seismic shaking include areas depicted as "fill" and "alluvial deposits" within Whatcom County's Map Folio of Geologic Hazards, 1995.*

The subject site is mapped as a "*low*" liquefaction susceptibility area (Palmer et al., 2004). However, this map only provides an estimate of the likelihood that soil will liquefy as a result of an earthquake and is meant as a general guide to indicate areas potentially susceptible to liquefaction. The presence of medium dense glacial outwash soils and the absence of encountered groundwater within our explorations support the mapped low susceptibility rating. Uncontrolled fill soils were encountered throughout the site and were composed of loose sands and were not judged to increase the seismic hazard over the native soils. Additionally, the subject area is not mapped by the City of Bellingham *CityIQ* as a high or very high seismic hazard area. Therefore, the **subject site is not considered a seismic hazard area per BMC** and no mitigations beyond design by IBC standards is required.

However, please keep in mind that the Pacific Northwest is seismically active. Large Cascadia subduction zone earthquakes with possible magnitudes of 8 or 9 could produce ground shaking events with the potential to significantly impact the subject property regardless of the subsurface. Cascadia subduction zone earthquakes have occurred 6 times in the last 3,500 years with the most recent taking place in 1700, approximately 324 years ago. They have been determined to have an average reoccurrence interval of approximately 300 to 700 years. (Atwater and Haley, 1997).

The IBC addresses design standards for new construction in this, and other, seismic design categories that in our opinion is an adequate mitigation strategy. Incorporation of these mitigations into project design is the responsibility of the designer. Refer to the *Seismic Design Considerations* section of this report for additional information.

Mine Hazard Areas – BMC 16.55.420(D)

The BMC defines Mine Hazards Areas, as *those areas underlain by or affected by mine workings such as adits, gangways, tunnels, drifts, or airshafts, and those areas of probable sink holes, gas releases, or subsidence due to mine workings.* Specific areas of known and suspected historical mining activity and hazards include areas depicted as coal mine hazard areas within the *Geologic Hazards* Map Folio, Bellingham, Washington, 1991.

Based on the above referenced map, the project site is located above a known historical mine, Bellingham Coal Mine, as indicated on the *Coal Mine Overlay* – Figure 3. As such, the site meets the **criteria as a Mine Hazard Area** as defined by BMC 16.55.420(D).

From 1888 to 1891, the Bellingham Bay Improvement Company purchased 880 acres north of Squalicum Creek and began prospecting the area. Production of coal began in 1918 with the mine entrance located approximately 1,200 feet northeast of the Northwest Avenue and Birchwood Avenue intersections at approximately 94 feet above sea level (ASL). The mine extended to the southwest toward Marine Drive and reached a maximum depth of approximately 1,100 feet below the mine entrance. The coal seam thickness averaged between 12 and 14 feet of which 8 to 9 feet were mined. Approximately 5.3 million tons of coal was removed during the operation of the mine. The mine was closed in 1955 due to market conditions. The entrances were sealed, and the mine was allowed to flood to the current groundwater level.

According to the *Abandoned Bellingham Mine Survey Report* (Tetra Tech, 1984), related coal mine subsidence in the associated with the Bellingham Coal Mine is only well documented within one location. In 1930, a roughly 320-foot by 325-foot area centered near the intersection of East Maplewood Avenue and Walnut Street began to display evidence of coal mine related subsidence. Specific evidence consisted of tension cracks and pavement problems. In addition, 5 residential lots were affected, however the details were not well documented. Although several other instances of subsidence were investigated as part of the referenced survey, it was determined that the other instances of settlement were the result of other causes and were not attributable to coal mine related subsidence.

The proposed improvement is located within a mine hazard area that generally supports existing similarly constructed development. The project site is situated approximately 600 lateral feet south of an area with documented coal mine related subsidence. The subsidence occurred in 1930 while the mine was still in operation. The subsidence occurred in an area that had approximately 225 feet of vertical separation from the elevation of the mine entrance and consisted primarily of surface tension cracking with no reported risk to life-safety. No indication of mine related subsidence was observed during our site investigation or reported in the project vicinity in the last approximately 94 years. Due to the lateral separation from the documented subsidence, an additional vertical separation of 100 feet from the mine to the project site (325 vertical feet total), along with the lack of evidence of subsidence affecting the existing building, and anticipated light loading conditions, it is our opinion that there is a **low risk** of mine related hazards negatively impacting the planned addition. As such, no mitigation measures are recommended for the project.

However, should the project team prefer, structural slabs or interconnected grade beam systems could be implemented into the planned structure to reduce the susceptibility to differential settlement if a mine related subsidence event were to occur over the life of the structure. GeoTest should be contacted to provide more detailed recommendations should either structural slab or interconnected grade beam systems be selected for use on this project.

It must be understood that the Owner has been informed of the risk of mine related hazards at the subject property, and that the Owner has fully accepted the risks and potential impacts to life-safety and/or property associated with the existing hazards.

CONCLUSIONS AND RECOMMENDATIONS

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

As previously mentioned, the site is relatively level and contains a thin horizon of topsoil overlying loose undocumented fill soils. The fill soils extended to approximately 3.5 to 4 feet below existing grades and are underlain by medium dense, native glacial outwash sands. The native glacial outwash deposit is, in our opinion, suitable for foundation support. Existing fill, deleterious materials, organics, and loose/unsuitable portions of native soil (if remedial compaction is infeasible) should be removed from areas below foundations and replaced with suitable structural fill. GeoTest anticipates between 3.5 and 4 feet of stripping at most locations to reach suitable, undisturbed, glacial outwash subgrade soils within the vicinity of the proposed development. Stripping depths might vary significantly around the existing surface due to existing structural elements and undocumented backfill remaining from previous site development.

The foundations should be supported by undisturbed, firm, and unyielding glacial outwash soils, on properly placed and compacted structural fill, or on CDF structural trenches extending down to suitable native soils. GeoTest is available to provide commentary and recommendations pertaining to these support options as requested. Further recommendations regarding the placement and compaction of structural fill can be found in the *Fill and Compaction* section of this report.

Due to the depths of undocumented fill encountered at the project site, full removal of these soils underlying pavement and slab-on-grade areas may not be financially favorable. As such, GeoTest is providing a limited overexcavation and replacement option for pavement and slab-on-grade areas detailed below. It should be noted that the Owner must accept that an increased risk of some settlement may occur from the soils underlying these areas.

The native glacial outwash soils encountered at approximately 4 feet BGS generally consisted of slightly silty, gravelly sand and appear to be suitable for the infiltration of stormwater, provided the recommendations contained herein are incorporated into the project design. Adequate separation from the base of the planned infiltration facilities and seasonal high groundwater elevations or restrictive soil conditions must be maintained via appropriate civil design.

Site Preparation and Earthwork

Exposed subgrade under all areas to be occupied by soil-supported floor slabs, spread or continuous foundations, pavement or new sidewalk areas should be recompacted to a firm and unyielding condition and proof rolled with a loaded dump truck, large self-propelled vibrating roller, or similar piece of equipment applicable to the size of the excavation. Recompaction of the near-surface soils does not reduce or eliminate the need for overexcavation of near-surface loose soils or undocumented fill below building areas. The purpose of recompacting and proof rolling near-surface soils is to identify possible loose or soft soil deposits that may have occurred during site excavation activities.

Proof rolling should be carefully observed by a GeoTest geotechnical professional. Areas exhibiting significant deflection, pumping, or over-saturation that cannot be readily compacted should be overexcavated to firm and unyielding 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, the geotechnical professional should observe subgrade conditions to determine if proof rolling is feasible.

If proof rolling is not feasible due to space, elevation, or other constraints, we recommend that alternate methods such as Dynamic Cone Penetrometer or soil probe methods be utilized to verify suitable conditions have been attained.

Please note that the near surface soil is expected to be moisture sensitive. As such, we recommend that earthwork be performed during extended periods of dry weather, such as the summer and early fall, when feasible. Earthwork performed during wet site conditions can incur significant unavoidable expense when compared to dry weather construction.

Foundation Areas

GeoTest recommends that all foundation elements be supported by firm and unyielding native glacial outwash soils or by properly placed and compacted structural fill placed upon undisturbed native deposits. Alternatively, shallow conventional foundations may be placed directly on structural trenches composed of controlled density fill (CDF) that extend down to the undisturbed native soils. We recommend that the structural trenches extend a minimum of 6 inches beyond the foundation footing in all directions and that the excavation be generally free from water prior to CDF placement. We anticipate that structural fill and/or structural trenches will need to extend 3.5 to 4 feet below existing grades in order to reach competent bearing conditions.

Due to the presence of 3.5 to 4 feet of undocumented fill, the conventional approach for shallow foundation elements may not be preferred. Alternative foundation support options include, but are not limited to, driven pin piles and helical anchors. If requested GeoTest can provide commentary and design recommendations for pin piles and helical anchors as part of a separate scope of work.

Pavement and Slab-on-Grade Areas

Undocumented fill soils appear to exist on the property, extending to approximately 3.5 to 4 feet BGS, however, the fill could vary widely across the site, especially in areas that have previously been disturbed by decommissioning activities of the previous refueling station. If left in place, the existing fill soils may cause total settlement to exceed the generally accepted maximum of 1 inch. As the proposed project consists an extension of the existing Robin Hall building, complete removal of fill from within pavement and slab-on-grade areas may not be financially favorable.

In lieu of removing all the undocumented fill soils under pavement and slab-on-grade areas, GeoTest recommends removal of a minimum of 18 inches of the existing fill soils followed by placing a minimum of 18 inches of properly placed and compacted structural fill. This approach requires an acceptance of risk by the Owner that some settlement may occur from soils underlying the pavement section and/or slab-on-grade areas over the life of the structure. Alternatively, all existing uncontrolled fill soils can be removed from new pavement and slab areas and replaced with properly placed and compacted structural fill in accordance with the recommendations presented in the *Fill and Compaction* section of this report.

Fill and Compaction

Structural fill required to obtain final elevations for structural slabs, drive paths or parking areas, must meet our recommendations outlined below. In most cases, any non-organic, predominantly granular soil may be used for fill 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 content, 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 5 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 2 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 Soils

The near surface existing undocumented fill consisted of slightly silty to silty, gravelly sand containing scattered construction debris. It is our opinion, the existing fill soil is suitable for reuse as structural fill when placed at or near optimum moisture contents, as determined by ASTM D1557 (Modified Proctor), provided all contained construction debris is removed prior to placement, and it is allowed for in the project plans and specifications.

Due to the significant organic content and elevated fins, we do not recommend reuse of the topsoil material within structural areas. Any such material should be reused in non-structural areas only or removed from the site.

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 or a well-graded crushed rock. We recommend imported structural fill for dry weather construction be similar to Washington State Department of Transportation (WSDOT) Standard Specification 9-03.14(2) for "Select Borrow" with the added requirement that 100 percent pass a 4-inch-square sieve.

Soil containing more than about 5 percent fines (that portion passing the U.S. No. 200 sieve) cannot consistently be compacted to a dense, non-yielding condition when the water content is greater than optimum. Accordingly, GeoTest recommends that imported structural fill for wet weather construction be similar to WSDOT Standard Specification 9-03.14(1) for "Gravel Borrow" with the added requirement that no more that 5 percent pass the U.S. No. 200 sieve. Due to wet weather or wet site conditions, soil moisture contents could be high enough that it may be very 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 more suitable moisture contents during periods of dry weather or removed and replaced with fill soils at a more suitable range of moisture contents.

Based on local availability and the import fill application to the project, the designer may elect to utilize Crushed Surfacing Base Course or Top Course (CSBC or CSTC) as structural fill. As such, we recommend WSDOT Standard Specification 9-03.9(3), or similar gradation be incorporated into the project plans.

Backfill and Compaction

Structural fill should be placed in horizontal lifts. The structural fill must measure no more than 8 to 10 inches in loose thickness and be thoroughly compacted with appropriate equipment. 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 (Modified Proctor). 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 of imported, clean, 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 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-tire 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 provisions of the 2021 International Building Code, the generally hard glacially derived materials underlying the site appear to support the mapped Site Class D designation, according to ASCE 7-16 Thus, the structural engineer should select the appropriate design response spectrum based on Site Class D soil and the geographical location of the proposed development.

Foundation Support

Shallow conventional spread or isolated foundations are suitable to provide support for the proposed structures provided the following recommendations are incorporated into the project design. Continuous or isolated spread footings should be founded on undisturbed firm and unyielding native glacial outwash deposits or properly placed and compacted structural fill overlying suitable native soil. We anticipate stripping depths within foundation footprints to range from approximately 3 to 4 feet across the project site. However, deeper excavations may be required in areas not explored. As such, we expect the placement of structural fill in order to achieve design foundation elevations. Therefore, we are providing recommendations based on a minimum of 18 inches of structural fill underlying foundational elements. A GeoTest geotechnical professional should confirm that suitable bearing conditions have been reached prior to placement of structural fill or foundation formwork.

To provide proper support, GeoTest recommends that existing topsoil be removed from beneath building foundations down to the native soils. The exposed native soils should be remedially compacted to a firm and unyielding condition with a smooth-drum roller or a similar piece of construction equipment. Once suitable bearing conditions have been confirmed, then structural fill may be placed and compacted to reach planned grades. We recommend that foundations be placed on similar subgrade conditions to prevent differential settlement from occurring.

Localized additional excavation, if necessary, can be backfilled to the design footing elevation with structural fill or controlled density fill (CDF). In areas requiring additional excavation to competent native soil using structural fill as backfill, the limits of the additional excavation should extend laterally beyond the edge of each side of the footing a distance equal to the depth of the excavation below the base of the footing. If CDF is used to backfill the additional excavation, the limits of the additional excavation need only extend a nominal distance beyond the width of the footing. In addition, GeoTest recommends that foundation elements for the proposed structure bear entirely on similar soil conditions to help prevent differential settlement from occurring.

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 on a minimum of 18 inches of properly placed and compacted import structural fill over suitable subgrade soils may be proportioned using a net allowable soil bearing pressure of up to 3,000 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 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 a minimum of 18 inches of properly placed and compacted structural fill placed over suitable existing fill soils. Prior to placement of structural fill, the existing fill soil (or native soils if exposed) should be remedially compacted, and proof rolled or otherwise verified as recommended in the *Site Preparation and Earthwork* section of this report. We recommend that a GeoTest geotechnical professional verify suitable native subgrade conditions have been achieved prior to placement of structural fill, capillary break, concrete formwork, or reinforcement.

GeoTest recommends that interior concrete slab-on-grade floors be underlain with at least 6 inches of clean, compacted, free-draining crushed gravel to serve as capillary break. This material should be a clear, crushed, ¾-inch rock with no fines or similar. The purpose of this gravel layer is to provide uniform support for the slab, provide a capillary break, and act as a drainage layer. Structural fill material installed below the capillary break, should be placed, and compacted in accordance with the recommendations presented in the *Backfill and Compaction* and *Import Structural Fill* sections of this report. To help reduce the potential for water vapor migration through floor slabs, a continuous 10- to 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. American Concrete Institute (ACI) guidelines suggest that the slab may be poured directly on the vapor barrier.

A modulus of subgrade reaction of 200 pounds per cubic inch (pci) for a minimum of 12 inches of structural fill over suitably prepared existing fill should be appropriate for use in design. This value is assuming site preparations prior to slab installation follow the minimum soil preparation measures recommendations above.

Exterior concrete slabs-on-grade, such as sidewalks or patios, may be supported directly on approved existing fill, or on properly placed and compacted structural fill existing fill soil. 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 buildings 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 approved outlet. Pavement and sidewalk areas, if present, should be sloped and drainage gradients should be maintained to carry surface water away from the building 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 and to maintain drained conditions along foundation stem walls, GeoTest recommends that an exterior footing drain system be constructed around the perimeter of new building foundations as shown in the *Conceptual Footing & Wall Drain Section* (Figure 4) 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 should consist of open-graded drain rock wrapped in a nonwoven geotextile fabric such as Tencate® Mirafi® 140N or industry equivalent. 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 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 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 project details is to be determined by the project team. GeoTest may provide additional consultation and plan review for site drainage if requested by the client.

Resistance to Lateral Loads

The lateral earth pressures that develop against foundations and/or 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 provisions of the 2021 International Building Code, GeoTest recommends that retaining walls include a seismic surcharge of approximately 8*H psf (where H is the height of the wall in feet) be used for design purposes. The seismic surcharge should be modeled as a rectangular distribution with the resultant force applied at the midpoint of the wall. The 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 a well-compacted fill placed against the sides of foundations is equivalent to a fluid with a density of 300 pounds per cubic foot. The recommended value includes a safety factor of about 1.5 and assumes drained conditions that will prevent the buildup of hydrostatic pressure in the compacted fill. The passive resistance value assumes that the ground surface adjacent to the structure is level and the representative soil unit extend in the direction of movement for a distance equal to or greater than twice the embedment depth. 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.

Allowable coefficient of base friction value of 0.35 may be used for foundations founded directly on suitably prepared structural fill. 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. 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 which extend in excess of 4 feet should be shored or sloped in accordance with Safety Standards for Construction Work Part N, WAC 296-155-66403. The relatively coarse grained, existing fill and native outwash soils found underlying the project site are classified as a Type C soil according to WAC 296-155-66401. As such, temporary, unsupported excavations founded in this soil unit may be sloped as steep as 1.5:1 (Horizontal: Vertical). All soils encountered are classified as Type C soil in the presence of groundwater seepage.

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

Utility trenches must be properly backfilled and compacted to reduce cracking or localized loss of foundation, slab, or pavement section support. Excavations for new shallow underground utilities are expected to be placed within either the existing fill or native glacial outwash soils.

Trench backfill in improved areas (beneath structures, drive paths, sidewalks, etc.) should consist of structural fill as defined in the *Fill and Compaction* section of this report. Trench backfill should be placed and compacted in general accordance with the recommendations presented in the *Fill and Compaction* section of this report. Trench backfill may also consist of CDF.

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 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 if not properly dewatered, as opposed to under dewatered conditions.

Pavement Subgrade Preparation

Site grading plans should include provisions for sloping the subgrade soils in proposed pavement areas, so that passive drainage of the pavement sections(s) can proceed uninterrupted during the life span of the project. The proposed pavement areas should be prepared by removing topsoil to expose the underlying existing undocumented fill. We recommend pavements be founded on a minimum of 18 inches of structural fill. This may include the recommended base section. The approved native soils should be remedially compacted prior to the placement of structural fill.

GeoTest is available to further consult, review, and modify our pavement section recommendations based on further discussion with the project team. The below pavement sections should be considered initial recommendations and may be accepted and/or modified by the site civil engineer based on the actual finished site grading elevations and/or the owner's preferences.

Flexible Pavement Sections – Light Duty

If utilized within light vehicle parking and lower traffic roadway areas, we recommend a standard, or "light duty," pavement section consist of 2.5 inches of Class ½-inch HMA asphalt above 2 inches of Crushed Surfacing Top Course (CSTC) over a suitable base section is recommended. The base material for the pavement section should consist of 6 inches of Crushed Surfacing Base Course (CSBC) or 8 inches of Gravel Borrow. We recommend that both CSBC and CSTC meet the Washington State Department of Transportation (WSDOT) Standard Specification 9-03.9(3) and that the Gravel Borrow meet the WSDOT Standard Specification 9-03.14(1) with the added requirement that 100 percent of the material pass the 2-inch sieve.

Flexible Pavement Sections – Heavy Duty

Fire truck lanes and other areas that will be accessed by more heavily loaded vehicles, i.e., garbage trucks, etc. will require a thicker pavement and base section. We recommend a heavy-duty pavement section consisting of 4 inches of Class ½-inch HMA over 2 inches of CSTC over a suitable base section. The base material for the pavement section should consist of 10 inches of Gravel Borrow or 8 inches of CSBC. We recommend that both CSBC, CSTC, and Gravel Borrow meet the above referenced WSDOT Standard Specifications.

Concrete Pavements

Concrete pavements could be used for access drives, parking areas, sidewalks, aprons, and support structures. Design of concrete pavements is a function of concrete strength, reinforcement steel, and the anticipated loading conditions for the pavement area. GeoTest expects that concrete pavement sections, if utilized, will be at least 6 inches thick and be founded on a minimum of 8 inches of gravel base section, as defined above. For concrete pavements placed on an 8-inch-thick compacted gravel base section, a vertical modulus of subgrade reaction of 200 pci may be used in design. The design of concrete access and parking areas will need to be performed by a structural engineer. GeoTest recommends that subgrade soils supporting concrete pavement sections include minor grade changes to allow for passive drainage away from the pavement.

Stormwater Infiltration Potential

Based on the evaluation of the data collected during this investigation, it is our opinion that the native glacial outwash underlying the site is suitable for onsite infiltration. Groundwater was not encountered during our excavations to approximately 10 feet BGS. However, the silt dominant relict topsoil encountered at approximately 3.5 feet BGS is considered a “hydraulically restrictive” layer as defined by the 2019 *Stormwater Management Manual for Western Washington* (SMMWW). Furthermore, we do not recommend infiltrating into the existing undocumented fill. As such, we recommend that the base of infiltration facilities be founded within the native glacial outwash encountered at approximately 4 feet BGS.

Representative soil samples were selected and mechanically tested for grain size distribution and calculation according to the soil grain size analysis method, Section 3.3.6 of the 2019 SMMWW. Calculated infiltration rates are representative of loose soil conditions, and do not take into account relative soil density, particle shape, and stratigraphic effects. Results of grain-size analysis were provided to the project team prior to performance testing to support preliminary design.

GeoTest performed grainsize analysis calculations on 4 soil samples to derive preliminary calculated saturated hydraulic conductivity values to be used in the preliminary design and planning stages of civil stormwater design. The subsequently presented rates assume that the proposed infiltration facility is founded within the native glacial outwash at approximately 4 feet BGS. GeoTest recommends that a **preliminary calculated saturated hydraulic conductivity value of 3.0 inch per hour** be used if infiltration facilities for the purpose of planning and preliminary civil design. This rate has been corrected in accordance with the procedure listed in the SMMWW. Collectively, the partial correction factors result in a total correction factor of 0.18, which has been applied to the preliminary calculated saturated hydraulic conductivity value, presented above. However, this rate does not take into account material density, or additional reduction factors which may be needed to address groundwater mounding below conceptual facilities. Geotest recommends that a 5 foot separation from the seasonal high groundwater elevation and the base of the facility be maintained.

Based on grain-size analysis methods, it is our opinion that the native glacial outwash soil are considered feasible for prescriptive downspout infiltration. Downspout infiltration trenches are reported to use prescriptive sizing per SMMWW (2019) BMP T5.10A which is established by evaluation of USDA soil texture classification.

The native glacial outwash soils contain fines contents ranging from 5 to 18 percent and have USDA soil texture classification of predominantly *Sandy Loam.* This classification may be used for downspout infiltration trench sizing placed within the native glacial outwash.

Stormwater Treatment

The stormwater facilities onsite may require some form of pollutant pretreatment with an existing or amended soil prior to offsite discharge. Cation exchange capacities, organic contents, and pH of the site near surface soils were tested to determine possible pollutant treatment suitability.

Subcontracted laboratory tests were performed by Northwest Agricultural Consultants on three soil samples collected from the explorations shown in Table 2. A summary of the laboratory test results is presented below. Subcontracted testing results are also attached at the end of this report.

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

Exploration ID & Depth	Geologic Unit	Cation Exchange Capacity (meq/100 grams)	Organic Content (%)	pH
TP-1 (0.6 ft)	Topsoil	7.6	2.71	5.2
TP-2 (0.8 ft)	Topsoil	7.6	2.09	5.4
Test Method		EPA 9081	ASTM D2974	SM 4500-H^+ B

- 2019 SMMWW SSC-6 Criteria for Treatment:
- **CEC ≥ 5.0 meq/100g**
- **Organic Content ≥ 1%**

Suitability for the use of onsite soils for pollutant treatment is determined in accordance with Site Suitability Criteria, SSC-6 of the 2019 SMMWW. 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. Based on the results shown in Table 2 above, the topsoil encountered onsite is suitable for reuse as pollutant treatment media.

Onsite amended soil may require 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 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 subgrade preparation operations, structural fill placement, compaction activities and pin or pipe pile installation, 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 on any new fill material. 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 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 laboratory.

USE OF THIS REPORT

GeoTest Services has prepared this report for the exclusive use of The Franklin Academy and their design consultants for the specific application to the design of the proposed expansion project at 3000 Northwest Drive in Bellingham, 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 for performing 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	Coal Mine Overlay
Figure 4	Conceptual Footing and Wall Drain Section
Figure 5	Soil Classification System and Key
Figure 6	Exploration Logs
Figures 7 and 8	Laboratory Test Results
	NW Agricultural Consultants Test Results (1 Page)
	Report Limitations and Guidelines for Use (4 Pages)

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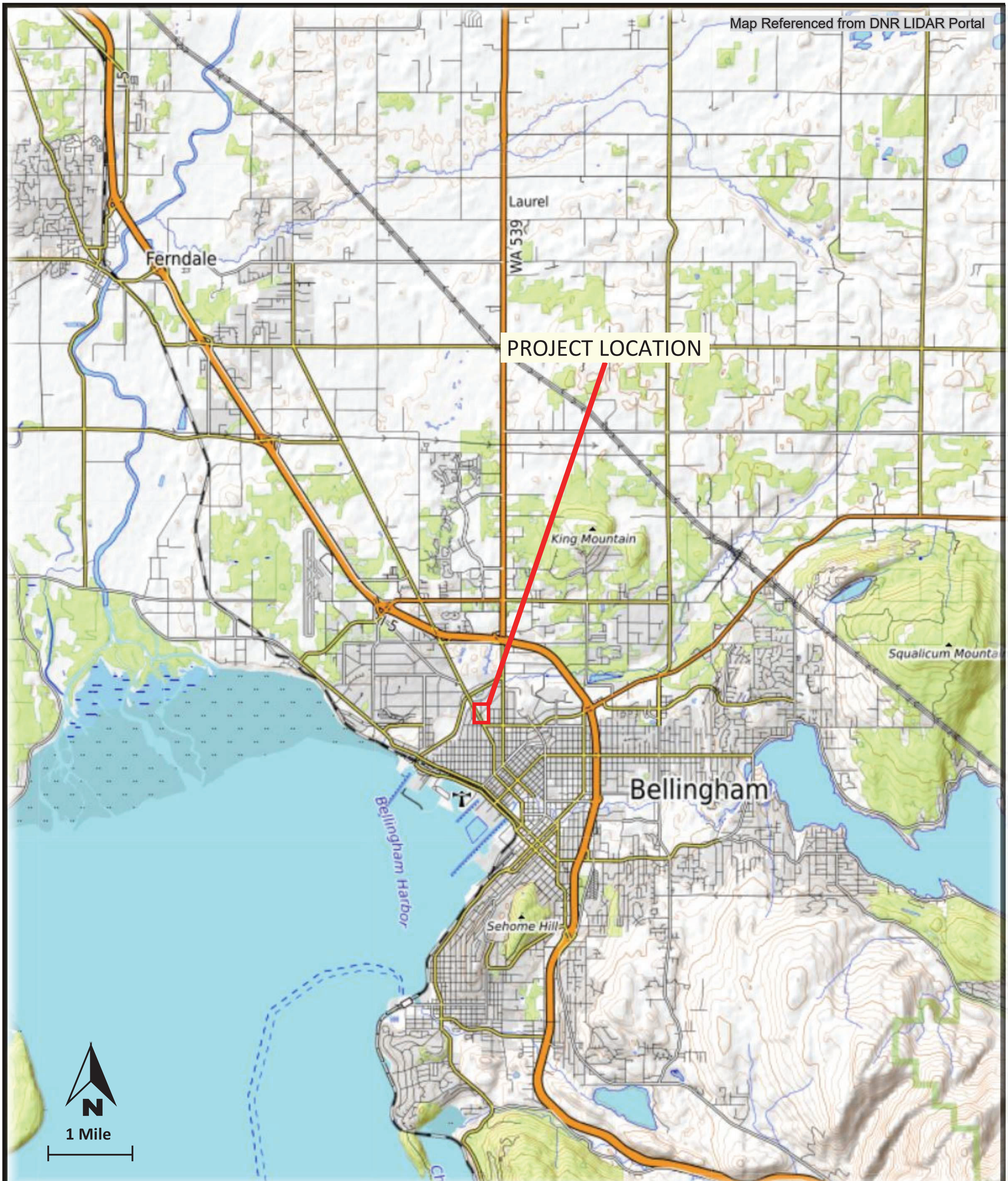
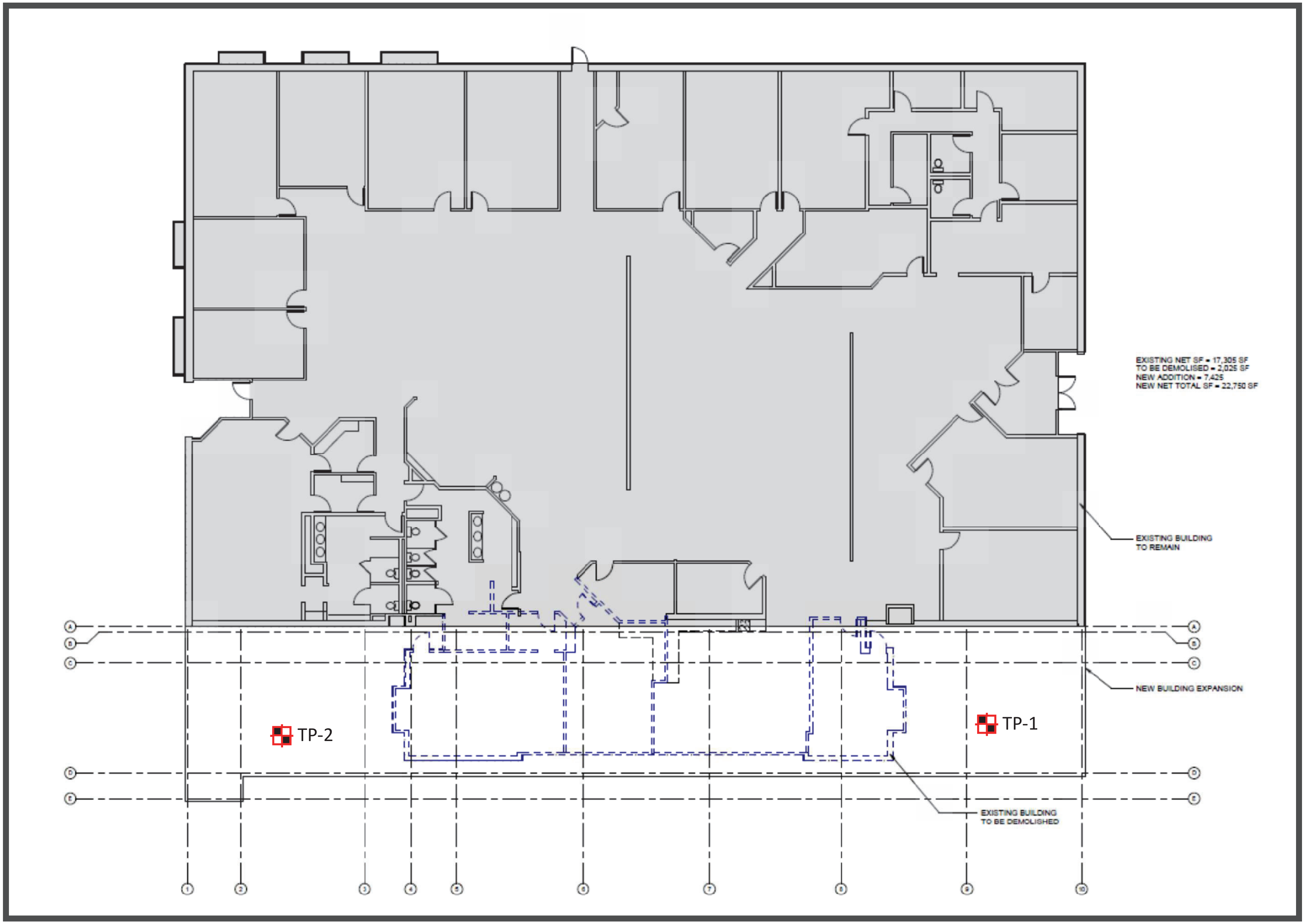


GEOTEST
An RMA Company

Date: 12-26-23	By: GS	Scale: As Shown	Project 23-3437
VICINITY MAP FRANKLIN ACADEMY EXPANSION 3000 NORTHWEST AVENUE BELLINGHAM, WASHINGTON			Figure 1

Site Plan Provided By Zervas Group



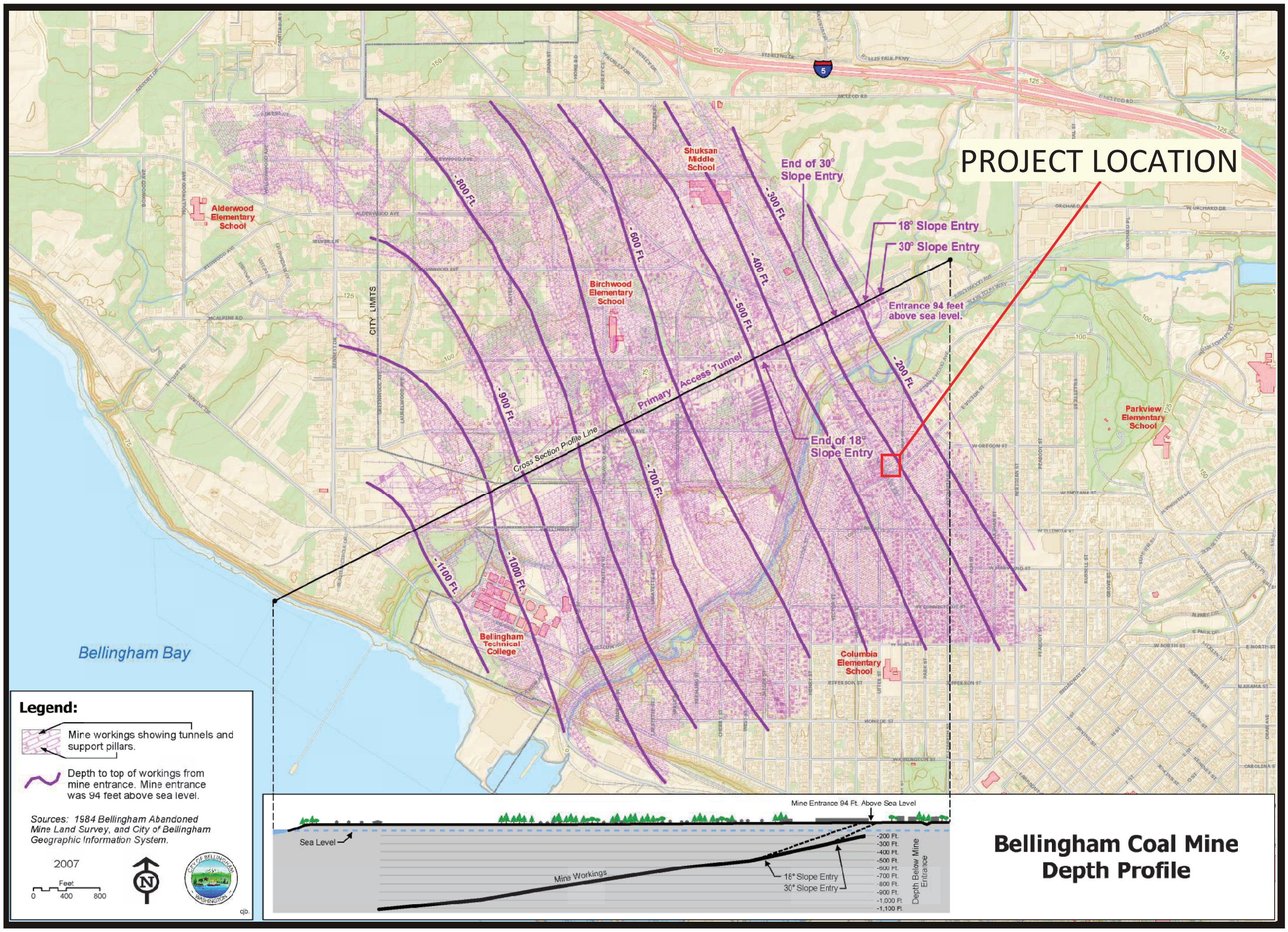
TP-# = Approximate Test Pit Location

20 Feet

GEOTEST An RMA Company

Date:1-12-24	By: DM	Scale: As Shown	Project 23-3437
SITE AND EXPLORATION PLAN FRANKLIN ACADEMY EXPANSION 3000 NORTHWEST AVENUE BELLINGHAM, WASHINGTON			Figure 2

Map Referenced from City of Bellingham Web Page



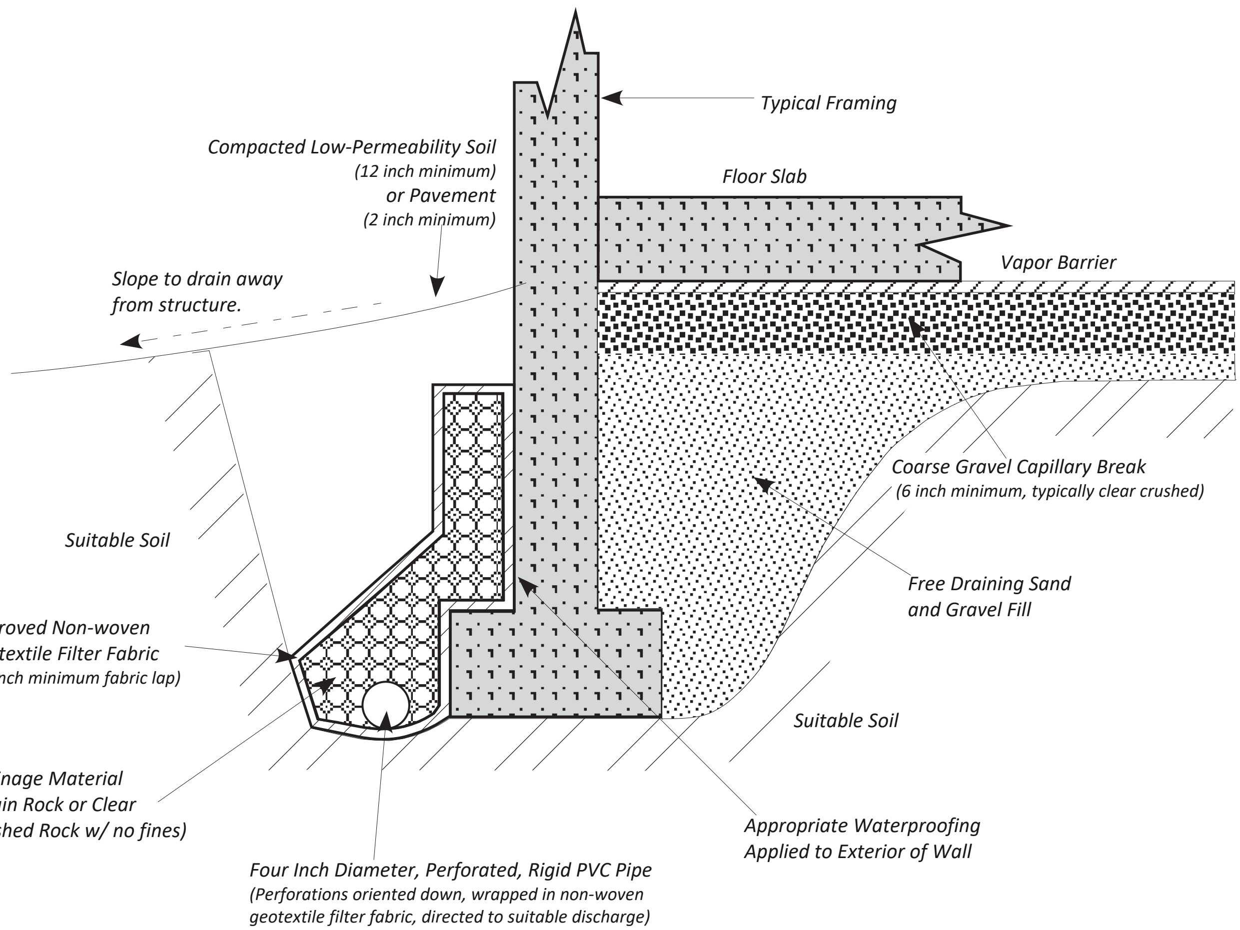
Date:1-12-24	By: DM	Scale: As Shown	Project 23-3437

COAL MINE OVERLAY MAP
FRANKLIN ACADEMY EXPANSION
3000 NORTHWEST AVENUE
BELLINGHAM, WASHINGTON

GEOTEST An RMA Company

Figure 3

CONCEPTUAL FOOTINGS WITH INTERIOR SLAB-ON-GRADE



Notes:

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).

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.

This footing drain detail may need to be modified from this conceptual drawing to fit the dimensions of the planned footing and slab configuration.

GEOTEST
An RMA Company

Date: 12-27-23	By: GS	Scale: None	Project 23-3437
CONCEPTUAL FOOTING & WALL DRAIN SECTION **FRANKLIN ACADEMY EXPANSION** **3000 NORTHWEST AVENUE** **BELLINGHAM, WASHINGTON**			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

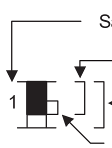
Notes: 1. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test 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 An RMA Company

Franklin Academy Expansion
3000 Northwest Avenue
Bellingham, Washington

Soil Classification System and Key

Figure 5

TP-1

SAMPLE DATA | SOIL PROFILE | GROUNDWATER

Excavation Method: Tracked Excavator
Ground Elevation (ft): 85.5
Excavated By: Ram Constrution/G.Sterlington

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol	Soil Description	Groundwater
0	1	d		SM	Loose, brown to light brown, damp, silty SAND, abundant organics (Topsoil)	Groundwater not encountered.
2	2	d	W = 4 GS	SP-SM	Loose, brown to gray brown, damp, slightly silty, gravelly SAND, scattered construction debris (Undocumented Fill) - Easily penetrated by #4 rebar using a 5-lb hammer at 1.7' BGS	
4	3	d		ML	Medium stiff, black, damp, sandy SILT (Relict Topsoil)	
6	4	d	W = 8 GS	SP-SM	Medium dense, light brown to reddish brown, damp, slightly silty, gravelly SAND (Glacial Outwash) - Barried concrete obstruction in sidewall starting at 5' and extending to 9' BGS	
8	5	d			- Lense of sandy silt and clumbs of silt at 7.2' BGS	
10	6	d	W = 8 GS		- Increase in moisture content at 8.9' BGS	
12						

Test Pit Completed 12/20/23
Total Depth of Test Pit = 9.9 ft.

TP-2

SAMPLE DATA | SOIL PROFILE | GROUNDWATER

Excavation Method: Tracked Excavator
Ground Elevation (ft): 86
Excavated By: Ram Constrution/G.Sterlington

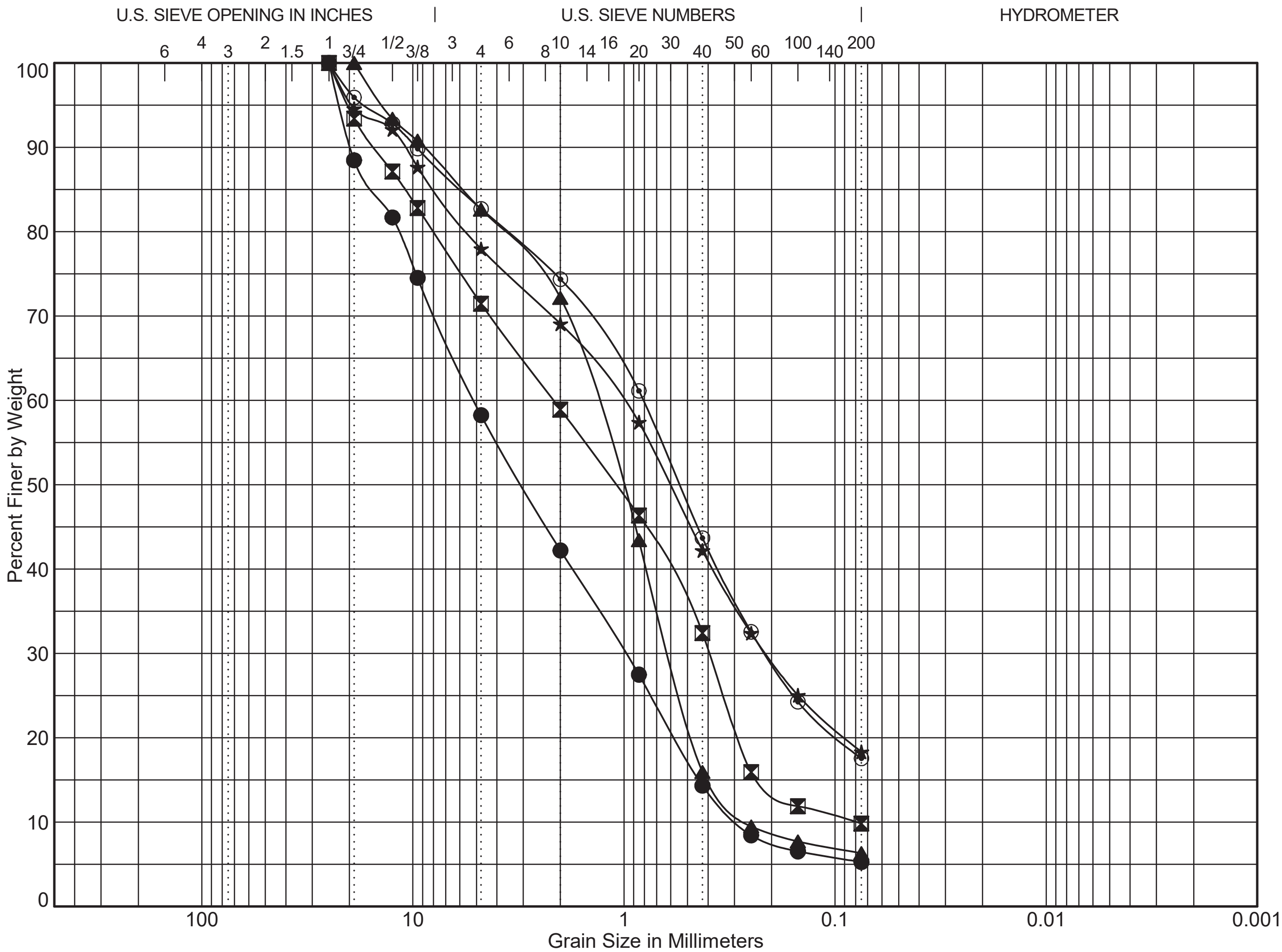
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	USCS Symbol	Soil Description	Groundwater
0	7	d		SM	Loose, brown, damp, silty SAND, abundant organics (Topsoil)	Groundwater not encountered.
2	8	d	W = 11 GS	SM	Loose, reddish brown, damp, silty, gravelly SAND, scattered consruction debris (Undocumented Fill) - Sidewall easily penetrated with #4 rebar and 5-lb hammer at 1.5' BGS - Clumps of silt at 2.3' BGS	
4	9 11	d d	W = 11 GS	SM	Medium dense, tan to reddish tan, damp, silty, gravelly SAND, trace organics (Glacial Outwash)	
6	10 12	d d	W = 9 GS			
8						
10	13 14	d d	W = 4 GS		- Decrease in fines at 9' BGS	
12						

Test Pit Completed 12/20/23
Total Depth of Test Pit = 9.8 ft.

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 explanation of graphics and symbols.

GEOTEST An RMA Company

Franklin Academy Expansion 3000 Northwest Avenue Bellingham, Washington	Log of Test Pits	Figure 6



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

	Point	Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-1	2.1	Slightly silty, gravelly SAND (SP-SM)				0.66	17.79
⊠	TP-1	6.3	Slightly silty, gravelly SAND (SP-SM)				0.90	27.20
▲	TP-1	9.6	Slightly silty, gravelly SAND (SP-SM)				1.01	5.34
★	TP-2	2.1	Silty, gravelly SAND (SM)					
⊙	TP-2	3.8	Silty, gravelly SAND (SM)					

	Point	Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-1	2.1	19.709	5.12	3.046	0.984	0.288	11.5	30.2	16.0	27.9	9.1	5.3
⊠	TP-1	6.3	15.153	2.157	1.09	0.393	0.079	6.6	21.9	12.5	26.5	22.6	9.8
▲	TP-1	9.6	8.896	1.393	1.034	0.606	0.261	0.0	17.4	10.5	56.2	9.6	6.3
★	TP-2	2.1	10.974	1.028	0.606	0.212		5.4	16.6	8.9	26.9	23.9	18.3
⊙	TP-2	3.8	9.646	0.813	0.546	0.214		4.1	13.2	8.3	30.7	26.1	17.6

$C_c = D_{30}^2/(D_{60} * D_{10})$
$C_u = D_{60}/D_{10}$

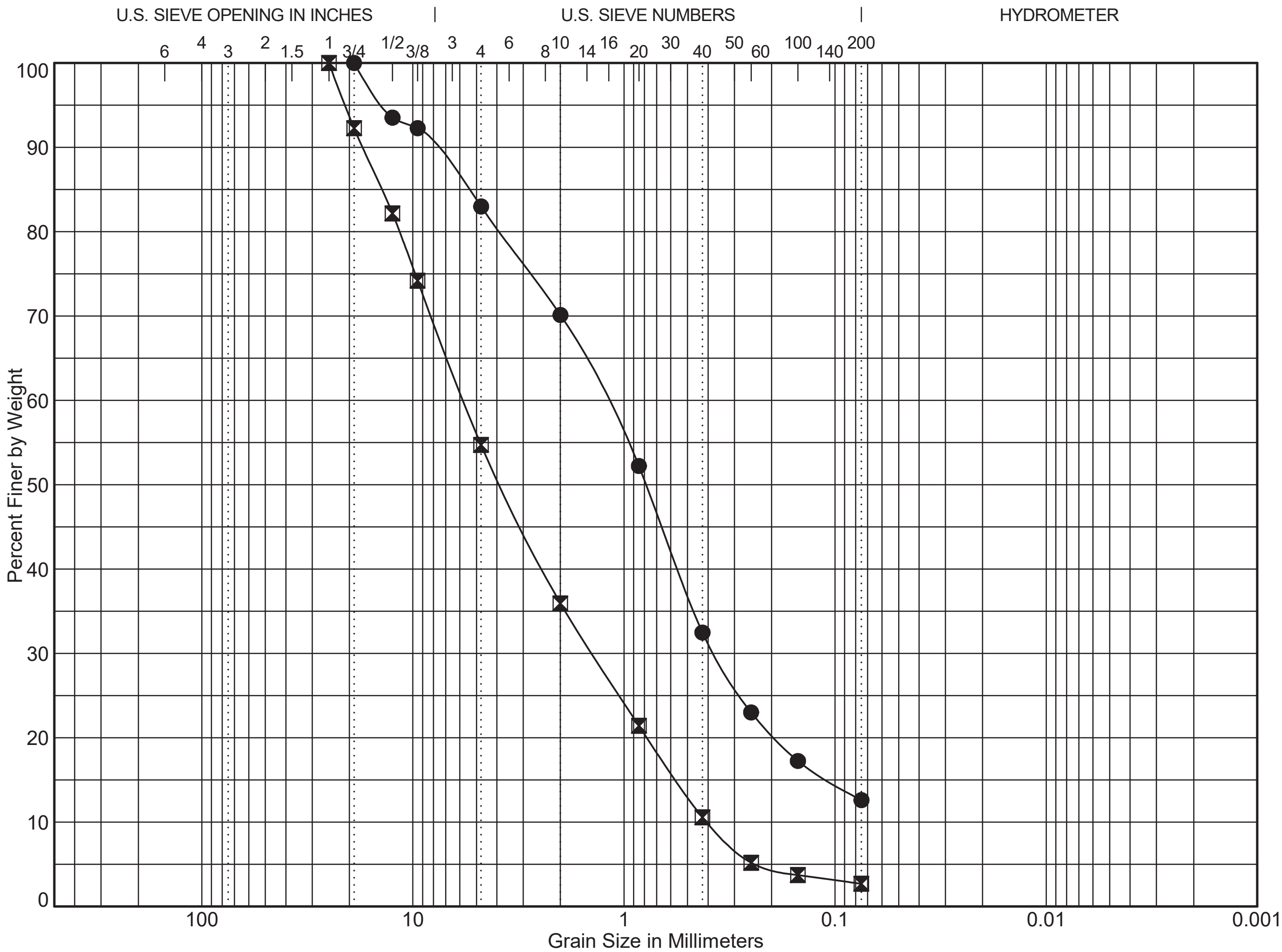
To be well graded: $1 < C_c < 3$ and
$C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST An RMA Company

Franklin Academy Expansion
3000 Northwest Avenue
Bellingham, Washington

Grain Size Test Data

Figure 7



Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Point		Depth	Classification	LL	PL	PI	C_c	C_u
●	TP-2	6.3	Silty, gravelly SAND (SM)					
⊠	TP-2	9.5	Very gravelly SAND, trace silt (SP)				0.86	14.25

Point		Depth	D_{90}	D_{60}	D_{50}	D_{30}	D_{10}	%Coarse Gravel	% Fine Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Fines
●	TP-2	6.3	8.02	1.233	0.786	0.37		0.0	17.0	12.9	37.6	19.9	12.6
⊠	TP-2	9.5	17.301	5.735	3.824	1.41	0.403	7.7	37.6	18.8	25.4	7.9	2.7

$C_c = D_{30}^2/(D_{60} * D_{10})$ To be well graded: $1 < C_c < 3$ and

$C_u = D_{60}/D_{10}$ $C_u > 4$ for GW or $C_u > 6$ for SW

GEOTEST An RMA Company

Franklin Academy Expansion
3000 Northwest Avenue
Bellingham, Washington

Grain Size Test Data

Figure 8

Northwest Agricultural Consultants

2545 W Falls Avenue
Kennewick, WA 99336
509.783.7450
www.nwag.com
lab@nwag.com

PAP-Accredited

NAPT

GeoTest Services Inc.
741 Marine Drive
Bellingham, WA 98225

Report: 66725-1-1
Date: January 26, 2024
Project No: 23-3437
Project Name: Franklin Academy

Sample ID	pH	Organic Matter	Cation Exchange Capacity
TP1 @ 0.6’	5.2	2.71%	7.6 meq/100g
TP2 @ 0.8’	5.4	2.09%	7.6 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.

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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