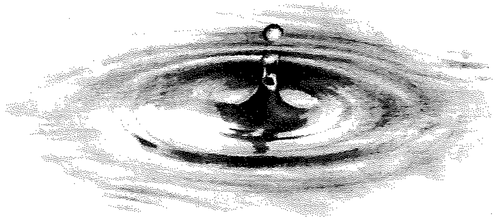
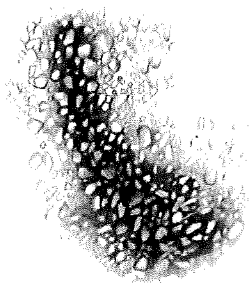
Geotechnical Engineering

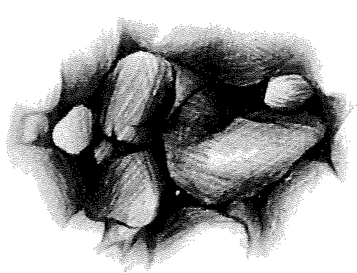


Water Resources



Environmental Assessments and Remediation

Sustainable Development Services



Geologic Assessments

Associated Earth Sciences, Inc.

Celebrating Over 25 Years of Service

Subsurface Exploration, Geologic Hazards, and Preliminary Geotechnical Engineering Report

PROPOSED WESTERN STATE HOSPITAL COMMISSARY AND KITCHEN BUILDING

Lakewood, Washington

Prepared for

NAC | Architecture

Project No. KE040805B
January 14, 2010

Associated Earth Sciences, Inc.

Celebrating Over 25 Years of Service

January 14, 2010
Project No. KE040805B

NAC|Architecture
2201 6th Avenue, Suite 1405
Seattle, Washington 98121

Attention: Mr. Steve Shiver

Subject: Subsurface Exploration, Geologic Hazards, and
Preliminary Geotechnical Engineering Report
Proposed Western State Hospital Commissary and Kitchen Building
9601 Steilacoom Boulevard Southwest
Lakewood, Washington

Dear Mr. Shiver:

We are pleased to present these copies of our preliminary report for the referenced project. This report summarizes the results of our subsurface exploration, geologic hazards, and geotechnical engineering studies, and offers preliminary recommendations for the design and development of the proposed project. Our report is based on preliminary project plans that were current at the time it was written. We should be allowed to review the recommendations presented in this report and modify them, if needed, if substantial changes are made to project plans.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions regarding this report or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Kurt D. Merriman, P.E.
Principal Engineer

copy via e-mail: SShiver@NACARCHITECTURE.com

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SUBSURFACE EXPLORATION, GEOLOGIC HAZARDS, AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PROPOSED WESTERN STATE HOSPITAL COMMISSARY AND KITCHEN BUILDING

Lakewood, Washington

Prepared for:
NAC | Architecture
2201 6th Avenue, Suite 1405
Seattle, Washington 98121

Prepared by:
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January 14, 2010
Project No. KE040805B

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazards, and preliminary geotechnical engineering studies for the proposed new kitchen and commissary building. The site location is presented on the "Vicinity Map," Figure 1. The approximate locations of exploration borings completed for this study are shown on the "Site and Exploration Plan," Figure 2. Logs of the subsurface explorations completed for this study are included in the Appendix.

1.1 Purpose and Scope

The purpose of this study was to provide geotechnical engineering design recommendations to be utilized in the preliminary design of the project. This study included a review of selected available geologic literature, advancing five exploration borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water. Geotechnical engineering studies were completed to establish recommendations for the type of suitable foundations and floors, allowable foundation soil bearing pressure, anticipated foundation and floor settlement, pavement recommendations, and drainage considerations. This report summarizes our fieldwork and offers recommendations based on our present understanding of the project. We recommend that we be allowed to review the recommendations presented in this report and revise them, if needed, when a project design has been finalized.

1.2 Authorization

Authorization to proceed with this study was granted by means of a signed copy of our scope of work and cost proposal dated November 12, 2009. This report has been prepared for the exclusive use of NAC|Architecture and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The project area is located on the existing Western State Hospital campus in Lakewood, Washington. The project site is located immediately north of the Wards building (Building 9), on the north-central part of the campus. Another building previously occupied the site, but was badly damaged during the Nisqually earthquake on February 28, 2001 and was later demolished. The demolished building had a basement, which was filled after the building was demolished. The fill placed after the basement was demolished was evident in our subsurface explorations. Anecdotal information suggests that underground tunnels were also present below the former building, though no tunnels were depicted on plans available to us. The deeper existing fill encountered at the location of EB-3 coincided with the location of a reported previously existing tunnel. We were provided with two drawings showing the former building in plan view, and in two elevation/section views.

The project site is currently occupied by grass and Scotch broom, with gravel parking around the perimeter in some areas. Topography slopes generally down to the north, with overall vertical relief in the project area of approximately 6 feet. No areas on-site appear to meet City of Lakewood definitions for Erosion Hazard, Landslide Hazard, or Seismic Hazard areas, as defined in *Lakewood Municipal Code* Section 14a.146.000. Existing topography was created by regrading following demolition of the previously existing building in the area.

The project will include construction of a new building that will house a kitchen, commissary, medical work area, and warehouse space. The building will be a one-story structure with relatively light foundation loads. Structural loads were not available when this report was written, however for the purpose of preparing this report, we have assumed continuous foundation loads on the order of 1 to 2 tons per foot, and column loads of up to approximately 50 tons. The new building will have a finished floor elevation of 236 feet. The planned finished floor elevation is approximately 1 foot below existing grades within the south part of the building footprint, and approximately 5 feet above existing grades below the north part of the building footprint.

3.0 SUBSURFACE EXPLORATION

Our subsurface exploration completed for this project included advancing five exploration borings. The conclusions and recommendations presented in this report are based on the explorations completed for this study. The locations and depths of the explorations were completed within site and budget constraints.

3.1 Exploration Borings

The exploration borings were completed by advancing hollow-stem auger tools with a track-mounted drill rig. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. The exploration borings were continuously observed and logged by a representative from our firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials*

(ASTM):D 1586. This test and sampling method consists of driving a standard 2-inch, outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing, as necessary.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations may not become fully evident until construction.

4.1 Stratigraphy

Surficial Topsoil

Each of the borings encountered surficial topsoil on the order of 6 to 8 inches thick. Topsoil is not suitable for structural support, and should be stripped from structural areas. Excavated topsoil may be suitable for reuse in landscape areas. Topsoil should be expected to increase in volume when excavated by a swell factor on the order of 25 to 30 percent.

Fill

Existing fill was encountered in each of our explorations to maximum depths of approximately 15 feet below the existing ground surface. Existing fill consisted primarily of materials that resembled native soils, though other materials were also observed. The existing fill was observed to contain organic material in some areas. Demolition waste was also observed in existing fill, and consisted of brick, concrete, and smaller quantities of other materials. The percentage of brick and concrete rubble was typically visually estimated at 20 percent or less, though layers of pure brick rubble up to approximately 2 feet thick were observed. Existing fill is not suitable for structural support without remedial preparation as described in the "Site Preparation" section of this report. Existing fill should be replaced below planned building areas, and should be re-worked under paving. Excavated existing fill material is suitable for reuse in structural fill applications if it is free of excessive organic material and other deleterious materials.

When the original building on-site was demolished in 2004/2005, Associated Earth Sciences, Inc. (AESI) visited the site to discuss density testing of the fill material that was placed in the excavation following building demolition. AESI was ultimately not asked to provide density testing during fill placement. To the best of our knowledge, the compaction of the existing fill was not tested when it was placed. If testing was performed, some of the existing fill may be suitable for foundation support without removal and replacement/recompaction. Without compaction documentation, however, the conservative assumption is that the existing fill is too variable in density and composition to support new foundations without the risk of greater than acceptable settlement.

Recessional Outwash

Below the surficial fill, each of our exploration borings encountered medium dense to dense gravel and sand with relatively low silt content interpreted as Vashon outwash associated with glacial lake Puyallup. These materials resemble high-energy alluvial sediments, and are suitable for support of light to moderate foundation loads with normal preparation procedures. Excavated outwash sediments at this site are expected to perform well in structural fill applications.

Advance Outwash

Exploration boring EB-1 encountered very dense sand at a depth of approximately 35 feet that is interpreted to represent Vashon advance outwash sediments. Advance outwash was deposited by meltwater streams from an advancing glacier, and was subsequently compacted by the weight of the overlying glacial ice. Advance outwash is unlikely to be used for direct foundation support or structural fill for this project due to the depth below the existing ground surface on the order of 35 feet.

Published Geologic Map

We reviewed published geologic mapping for the project (Troost, K.G., Booth, D.B., and Borden, R.K., in review, *Geologic Map of the Steilacoom 7.5-minute Quadrangle, Washington:* U.S. Geological Survey [USGS] Miscellaneous Field Investigation, scale 1:24,000). This map indicates that the site is expected to be underlain at shallow depths by recessional outwash sediments. Advance outwash is mapped at lower elevations to the northwest.

4.2 Hydrology

No free ground water was observed in any of the borings completed for this study with the exception of some thin, weak seepage zones within existing fill at the location of EB-4. Relatively high moisture contents were observed in existing fill above the native sediments in several areas. At this site, ground water seepage should be expected to develop seasonally within silty zones of the existing fill. Such perched ground water is common and is typically addressed on construction sites by use of interceptor swales or other similar methods.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and ground and surface water conditions, as observed and discussed herein. The discussion will be limited to slope stability, seismic, and erosion issues.

5.0 SLOPE HAZARDS AND MITIGATIONS

Existing slopes within and immediately adjacent to the project area appear to have been created by previous site grading. In light of the geometry and subsurface conditions of the existing site slopes, the site appears to have a low risk of substantial slope failures. No quantitative slope stability analysis was completed as part of this study, and none is warranted, in our opinion. The existing site slopes do not meet the City of Lakewood definition for Landslide Hazard Areas, as defined in *Lakewood Municipal Code* Section 14a.146.000.

Steeper slopes exist outside of the project area to the northwest, associated with an existing ravine. The side slopes of this ravine likely do meet the definition of Landslide Hazard Areas, as defined by the City of Lakewood. We do not have topographic survey data for this slope area, however the existing slopes that may be considered by the City to be Landslide Hazard Areas are approximately 275 feet from the nearest portion of the planned new building. Published regional-scale topographic maps indicate that these slopes are approximately 60 feet tall, which appears generally consistent with our visual observations. Therefore, these slopes appear to be sufficiently distant from the planned building that they would be outside of prescriptive slope setbacks and buffers.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The following discussion is a general assessment of seismic hazards that is intended to be useful to the owner in terms of understanding seismic issues, and to the structural engineer for structural design. In our opinion, the site does not include areas that meet the definition of Seismic Hazards, as defined by *Lakewood Municipal Code* Section 14a.146.000.

Earthquakes occur regularly in the Puget Lowland. The majority of these events are small, and are usually not felt by people. However, large earthquakes do occur, as evidenced by the 1949, 7.2-magnitude event; the 2001, 6.8-magnitude event; and the 1965, 6.5-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. Earthquakes that are generated at such depths usually do not result in fault rupture at the ground surface. However current research indicates that surficial ground rupture is possible in the Tacoma Fault Zone. The Tacoma Fault Zone is not thoroughly mapped or well understood. We are not aware of detailed maps of active faults in the project area. The best available mapping depicts multiple traces of the Tacoma Fault, all oriented northwest-southeast and passing north of the site. We are available to discuss current research related to surface faulting in the project area.

6.2 Seismically Induced Landslides

In our opinion, the risk of seismically induced landslides at this site is low due to the moderate inclination of site slopes in the project area and the presence of medium dense to dense, unsaturated granular soils below the project. The steeper slopes to the west are sufficiently distant from the planned project that the risk for damage to the planned project as a result of failures on those slopes appears to be low, in our opinion.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

The site is underlain by medium dense to dense granular sediments, with no free ground water to the full depths explored of 40 to 45 feet. The liquefaction potential of the site is therefore low, in our opinion. We did not complete a detailed liquefaction analysis, and none is warranted, in our opinion.

6.4 Ground Motion

Structural design of the planned building should follow the current applicable building code. The applicable code at the time this report was written is the 2008 *International Building Code* (IBC). The site soils are consistent with 2008 IBC Site Class "C". The 2008 IBC seismic design parameters for short period (S_S) and 1-second period (S_1) spectral acceleration values were determined by the latitude and longitude of the project site using the USGS software utility *Seismic Hazard Curves and Uniform Response Spectra*. The USGS software interpolated ground motions at the project site as follows for periods of 0.2 and 1.0 seconds, respectively, with a 2 percent chance of exceedence in 50 years: $S_S = 1.198$, $S_1 = 0.419$.

7.0 EROSION HAZARDS AND MITIGATIONS

The following discussion addresses Washington State Department of Ecology (Ecology) erosion control regulations that will be applicable to the project. The City of Lakewood definition for Erosion Hazard Areas, as contained in *Lakewood Municipal Code* Section 14a.146.000, is linked to published mapping and soil types. The United States Department of Agriculture Soil Conservation Service map for the project area identified the site as being underlain by soil type 41a Spanaway Gravelly Sandy Loam. This unit is listed as having a low erosion potential on the published map. Therefore, in our opinion, the site does not contain areas that meet the City definition for Erosion Hazard Areas. The following recommendations are related to compliance with Ecology management of erosion on construction sites. The state requirements are detailed, and in our opinion, addressing the state requirements is likely to also comply with City of Lakewood requirements that might be applicable.

As of October 1, 2008, the Ecology Construction Storm Water General Permit (also known as the National Pollutant Discharge Elimination System [NPDES] permit) requires weekly Temporary Erosion and Sedimentation Control (TESC) inspections and turbidity monitoring for all sites 1 or more acres in size that discharge storm water to surface waters of the state. Because we anticipate that the proposed project will require disturbance of more than 1 acre, we anticipate that these inspection and reporting requirements will be triggered. The following recommendations are related to general erosion potential and mitigation.

The erosion potential of the site soils is high. The most effective erosion control measure is the maintenance of adequate ground cover. Maintaining cover measures atop disturbed ground provides the greatest reduction to the potential generation of turbid runoff and sediment transport. During the local wet season (October 1st through March 31st), exposed soil should not remain uncovered for more than 2 days unless it is actively being worked. Ground-cover measures can include erosion control matting, plastic sheeting, straw mulch, crushed rock or recycled concrete, or mature hydroseed.

Some fine-grained surface soils are the result of natural weathering processes that have broken down parent materials into their mineral components. These mineral components can have an inherent electrical charge. Electrically charged mineral fines will attract oppositely charged particles and can combine (flocculate) to form larger particles that will settle out of suspension. The sediments produced during the recent glaciation of Puget Sound are, however, most commonly the suspended soils that are carried by site storm water. The fine-grained fraction of the glacially derived soil is referred to as "rock flour," which is primarily a silt-sized particle with no electrical charge. These particles, once suspended in water, may have settling times in periods of months, not hours.

Therefore, the flow length within a temporary sediment control trap or pond has virtually no effect on the water quality of the discharge, since sediment will not settle out of suspension in the time it takes to flow from one end of the pond to the other. Reduction of turbidity from a construction site is almost entirely a function of cover measures and flow control. Temporary sediment traps and ponds are necessary to control the release rate of the runoff and to provide a catchment for sand-sized and larger soil particles, but are very ineffective at reducing the turbidity of the runoff.

To mitigate the erosion hazards and potential for off-site sediment transport, we recommend the following:

1. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and storm water runoff. It is easier to keep the soil on the ground than to remove it from storm water. The owner and the design team should include adequate ground-cover measures, access roads, and staging areas in the project bid to give the selected contractor a workable site. The selected contractor needs to be prepared to implement and maintain the required measures to reduce the amount of exposed ground. A site maintenance plan should be in place in the event storm water turbidity measurements are greater than the Ecology standards.

2. All TESC measures for a given area to be graded or otherwise worked should be installed prior to any activity within that area. The recommended sequence of construction within a given area would be to install sediment traps and/or ponds and establish perimeter flow control prior to starting mass grading.

3. During the wetter months of the year, or when large storm events are predicted during the summer months, each work area should be stabilized so that if showers occur, the work area can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration the area will be left un-worked. During the winter months, areas that are to be left un-worked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work

area after a storm event. The stabilization process also includes establishing temporary storm water conveyance channels through work areas to route runoff to the approved treatment facilities.

4. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch, as recommended in the erosion control plan. Straw mulch provides the most cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

5. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport. Under no circumstances should concentrated discharges be allowed to flow over significant slopes.

6. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering with plastic sheeting, the use of low stockpiles in flat areas, or the use of straw bales/silt fences around pile perimeters. During the period between October 1st and March 31st, these measures are required.

7. On-site erosion control inspections and turbidity monitoring should be performed in accordance with Ecology requirements. Weekly and monthly reporting to Ecology should be performed on a regularly scheduled basis. TESC monitoring should be part of the weekly construction team meetings. Temporary and permanent erosion control and drainage measures should be adjusted and maintained, as necessary, at the time of construction.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate mitigation elements (best management practices) during construction, as recommended by the erosion control inspector, the potential adverse impacts from erosion on the project may be mitigated.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

The site is underlain by native soils consisting of medium dense to dense gravel and sand. Very dense, glacially consolidated soils were observed at depth in one of the five borings completed for this study. These native materials are suitable for structural support with proper preparation. The native soils are covered by a layer of surficial existing fill that is of variable composition and density. Existing fill should be removed and recompacted where it occurs below the planned building, and warrants remedial preparation where it occurs below paving and similar lightly loaded structures.

9.0 SITE PREPARATION

Erosion and surface water control should be established around the clearing limits to satisfy local requirements. Any remaining foundations, floor slabs, paving, and buried utilities should be removed where they are located below planned construction areas. Existing vegetation and topsoil should also be removed. All disturbed soils resulting from demolition activities should be removed to expose underlying, undisturbed native sediments and replaced with structural fill, as needed. All excavations below final grade made for demolition activities should also be backfilled, as needed, with structural fill.

Once any demolition work has been completed, existing fill should be addressed. The observed fill depth was between approximately 5 and 15 feet. We anticipate that the depth of existing fill closely matches the lowest elevations of the previous structure that was demolished, and we therefore recommend that detailed foundation drawings of the former building be available in the field when removing existing fill. The foundation drawings will help identify the expected depth and lateral extent of existing fill. It appears likely that the fill depth across the footprint of the planned building is typically on the order of 5 to 8 feet, with deeper existing fill in the proximity of EB-3 where anecdotal information suggests an access tunnel formerly existed.

We recommend that existing fill be removed from below areas of planned foundations to expose underlying, undisturbed native sediments, followed by restoration of the planned foundation grade with structural fill. Removal of existing fill should extend laterally beyond the building footprint by a distance equal to the depth of overexcavation. For example, if existing fill is removed to a depth of 2 feet below a planned footing area, the excavation should also extend laterally 2 feet beyond the building footprint in that area. Where existing fill is removed and replaced with structural fill, conventional shallow foundations may be used for building support. If earthwork for the project is completed in dry site and weather conditions, we anticipate that a portion of the excavated existing fill material can be recompacted as structural fill to restore planned elevations. Any existing fill that contains substantial organic material or demolition waste should be segregated and removed from the site or placed in non-structural areas. The remaining material will likely be suitable for reuse in structural fill applications. Reuse of on-site soils for structural fill may require aeration and drying to reduce moisture contents at the time of construction.

Below areas of planned paving, it would be possible to leave existing fill in place with some remedial preparation. We recommend that paving areas be stripped of existing topsoil, and proof-rolled and compacted as described later in this report for preparation of paving subgrades. If the resulting surface is firm and unyielding and compacted to 95 percent or more of the modified Proctor maximum dry density, no further preparation is required. If the subgrade is wet or yielding, we recommend that a portion of the existing fill be removed and replaced with material that is capable of being compacted under field conditions that are present at the time the work is completed. Decisions on appropriate preparation procedures should be made in the field at the time of construction when site, soil, and weather conditions are known. A typical scenario might include replacement of the upper 2 feet of existing fill with new structural fill. During wet site or weather conditions, select fill may be needed for this application. It should be noted that leaving existing fill in place below planned paving carries some risks of future settlement. Such risks are offset by a substantial saving in initial construction costs. We are available to answer questions regarding cost savings and risks associated with leaving the existing fill in place below planned paving. If an increased risk of future settlement is not acceptable, all existing fill should be removed and replaced with structural fill, as recommended above for building areas.

9.1 Construction Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth-drum rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access may be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased if drainage efforts are not accomplished in a timely sequence. If an effective drainage system is not utilized, project delays and increased costs could be incurred due to the greater quantities of wet and unsuitable fill, or poor access and unstable conditions.

We anticipate that perched ground water could be encountered in excavations completed during construction. We do not anticipate the need for extensive dewatering in advance of excavating. The contractor should be prepared to intercept any ground water seepage entering the excavations and route it to a suitable discharge location. Drainage recommendations are included in Section 11.1 of this report.

Final exterior grades should promote free and positive drainage away from the building at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. We recommend that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeter be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the structure.

9.2 Subgrade Protection

If building construction will proceed during the winter, we recommend the use of a working surface of sand and gravel, crushed rock, or quarry spalls to protect exposed soils, particularly in areas supporting concentrated equipment traffic. In winter construction staging areas and areas that will be subjected to repeated heavy loads, such as those that occur during construction of masonry walls, a minimum thickness of 12 inches of quarry spalls or 18 inches of pit run sand and gravel is recommended. If subgrade conditions are soft and silty, a geotextile separation fabric, such as Mirafi 500x or approved equivalent, should be used between the subgrade and the new fill. For building pads where floor slabs and foundation construction will be completed in the winter, a similar working surface should be used, composed of at least 6 inches of pit run sand and gravel or crushed rock. Construction of working surfaces from advancing fill pads could be used to avoid directly exposing the subgrade soils to vehicular traffic.

Foundation subgrades may require protection from foot and equipment traffic and ponding of runoff during wet weather conditions. Typically, compacted crushed rock or a lean-mix concrete mat placed over a properly prepared subgrade provides adequate subgrade protection. Foundation concrete should be placed and excavations backfilled as soon as possible to protect the bearing surface.

9.3 Proof-Rolling and Subgrade Compaction

Following the recommended demolition, site stripping, and planned excavation, the stripped subgrade within the building areas should be proof-rolled with heavy, rubber-tired construction equipment, such as a fully loaded, tandem-axle dump truck. Proof-rolling should be performed prior to structural fill placement or foundation excavation. The proof-roll should be monitored by the geotechnical engineer so that any soft or yielding subgrade soils or areas of remaining existing fill can be identified. Any soft/loose, yielding soils or existing fill should be removed to a stable subgrade. The subgrade should then be scarified, adjusted in moisture content, and recompacted to the required density. Proof-rolling should only be attempted if soil moisture contents are at or near optimum moisture content. Proof-rolling of wet subgrades could result in further degradation. Low areas and excavations may then be raised to the planned finished grade with compacted structural fill. Subgrade preparation and selection, placement, and compaction of structural fill should be performed under engineering-controlled conditions in accordance with the project specifications.

9.4 Overexcavation/Stabilization

Construction during extended wet weather periods could create the need to overexcavate exposed soils if they become disturbed and cannot be recompacted due to elevated moisture content and/or weather conditions. Even during dry weather periods, soft/wet soils, which may need to be overexcavated, may be encountered in some portions of the site. If overexcavation is necessary, it should be confirmed through continuous observation and testing by AESI. Soils that have become unstable may require remedial measures in the form of one or more of the following:

1. Drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry and warm weather.

2. Removal of affected soils to expose a suitable bearing subgrade and replacement with compacted structural fill.

3. Mechanical stabilization with a coarse crushed aggregate compacted into the subgrade, possibly in conjunction with a geotextile.

4. Soil/cement admixture stabilization.

9.5 Wet Weather Conditions

If construction proceeds during an extended wet weather construction period and the moisture-sensitive site soils become wet, they will become unstable. Therefore, the bids for site grading operations should be based upon the time of year that construction will proceed. It is expected that in wet conditions, additional soils may need to be removed and/or other stabilization methods used, such as a coarse crushed rock working mat to develop a stable condition if silty subgrade soils are disturbed in the presence of excess moisture. The severity of construction disturbance will be dependent, in part, on the precautions that are taken by the contractor to protect the moisture- and disturbance-sensitive site soils. If overexcavation is necessary, it should be confirmed through continuous observation and testing by a representative of our firm.

9.6 Temporary and Permanent Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the existing fill can be made at a maximum slope of 1.5H:1V (Horizontal:Vertical) or flatter. Temporary slopes in unsaturated recessional outwash may also be planned at 1.5H:1V. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. If ground water seepage is encountered in cut slopes, or if surface water is not routed away from temporary cut slope faces, flatter slopes will be required. In addition, WISHA/OSHA regulations should be followed at all times. Permanent cut and structural fill slopes that are not intended to be exposed to surface water should be designed at inclinations of 2H:1V or flatter. All permanent cut or fill slopes should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM:D 1557, and the slopes should be protected from erosion by sheet plastic until vegetation cover can be established during favorable weather.

9.7 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill or foundation components. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill or foundation components. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

10.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type and placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer, the upper 12 inches of exposed ground in areas to receive fill should be recompacted to 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. If the subgrade contains silty soils and too much moisture, adequate recompaction may be difficult or impossible to obtain, and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. In the case of roadway and utility trench filling, the backfill should be placed and compacted in accordance with current City of Lakewood codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the roadway edges before sloping down at an angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The native recessional outwash sediments are gravelly, and are expected to be suitable for use in structural fill applications under a relatively wide range of site and weather conditions. The existing fill soils present on-site contained significant amounts of silt and are considered moisture-sensitive. Existing fill soils from which excessive organic material and demolition waste have been excluded are expected to be suitable for reuse in structural fill applications during dry site and weather conditions when moisture conditions can be controlled by aeration and drying, as needed. If fill is placed during wet weather or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction with at least 25 percent retained on the No. 4 sieve.

A representative from our firm should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses, and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing program.

11.0 FOUNDATIONS

Spread footings may be used for building support when founded directly on undisturbed recessional outwash sediments, or on structural fill placed above suitable native deposits, as previously discussed. We recommend that an allowable bearing pressure of 3,000 pounds per square foot (psf) be used for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. If higher foundation soil bearing pressures are needed, we should be allowed to offer situation-specific recommendations.

Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum, and no footing should be founded in or above organic or loose soils. All footings should have a minimum width of 18 inches.

It should be noted that the area bound by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as described above should be on the order of ¾ inch or less. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the governing municipality. Perimeter footing drains should be provided, as discussed under the "Drainage Considerations" section of this report.

11.1 Drainage Considerations

Foundations should be provided with foundation drains. Drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed pea gravel. The drains should be constructed with sufficient gradient to allow gravity discharge away from the proposed building. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the proposed structure to achieve surface drainage.

12.0 FLOOR SUPPORT

Floor slabs can be supported on suitable native sediments, or on structural fill placed above suitable native sediments. Floor slabs should be cast atop a minimum of 4 inches of clean, washed, crushed rock or pea gravel to act as a capillary break. Areas of subgrade that are disturbed (loosened) during construction should be compacted to a non-yielding condition prior to placement of capillary break material. Floor slabs should also be protected from dampness by an impervious moisture barrier at least 10 mils thick. The moisture barrier should be placed between the capillary break material and the concrete slab.

13.0 FOUNDATION WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 50 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

As required by the 2008 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 5H and 10H psf, where H is the wall height in feet for the active and at-rest loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils, or imported structural fill compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in settlement of the slab-on-grade or other structures supported above the walls. Thus, the compaction level is critical and must be tested by our firm during placement. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum 1-foot-wide blanket drain to within 1 foot of finish grade for the full wall height using imported, washed gravel against the walls. The blanket drain should be continuous with and freely communicate with the footing drain.

13.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the natural outwash soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters:

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

14.0 PAVEMENT RECOMMENDATIONS

Pavement areas should be prepared in accordance with the "Site Preparation" section of this report. If the stripped native soil or existing fill pavement subgrade can be compacted to 95 percent of ASTM:D 1557 and is firm and unyielding, no additional overexcavation is required. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

The pavement sections included in this report section are for driveway and parking areas on-site, and are not applicable to right-of-way improvements. At this time, we are not aware of any planned right-of-way improvements; however, if any new paving of public streets is required, we should be allowed to offer situation-specific recommendations.

The exposed ground should be recompacted to 95 percent of ASTM:D 1557. If required, structural fill may then be placed to achieve desired subbase grades. Upon completion of the recompaction and structural fill, a pavement section consisting of 2½ inches of asphaltic concrete pavement (ACP) underlain by 4 inches of 1¼-inch crushed surfacing base course is the recommended minimum in areas of planned passenger car driving and parking. In heavy traffic areas, a minimum pavement section consisting of 3 inches of ACP underlain by 2 inches of ⅝-inch crushed surfacing top course and 4 inches of 1¼-inch crushed surfacing base course is recommended. The crushed rock courses must be compacted to 95 percent of the maximum density, as determined by ASTM:D 1557. All paving materials should meet gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications.

Depending on construction staging and desired performance, the crushed base course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a native or structural fill subgrade compacted to a minimum of 95 percent relative density, and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected. The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

Our report is based on a preliminary site layout drawing which was used as the basis for Figure 2 of this report. We recommend that AESI perform a geotechnical review of the plans prior to final design completion.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundation system depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of our currently approved scope of work.

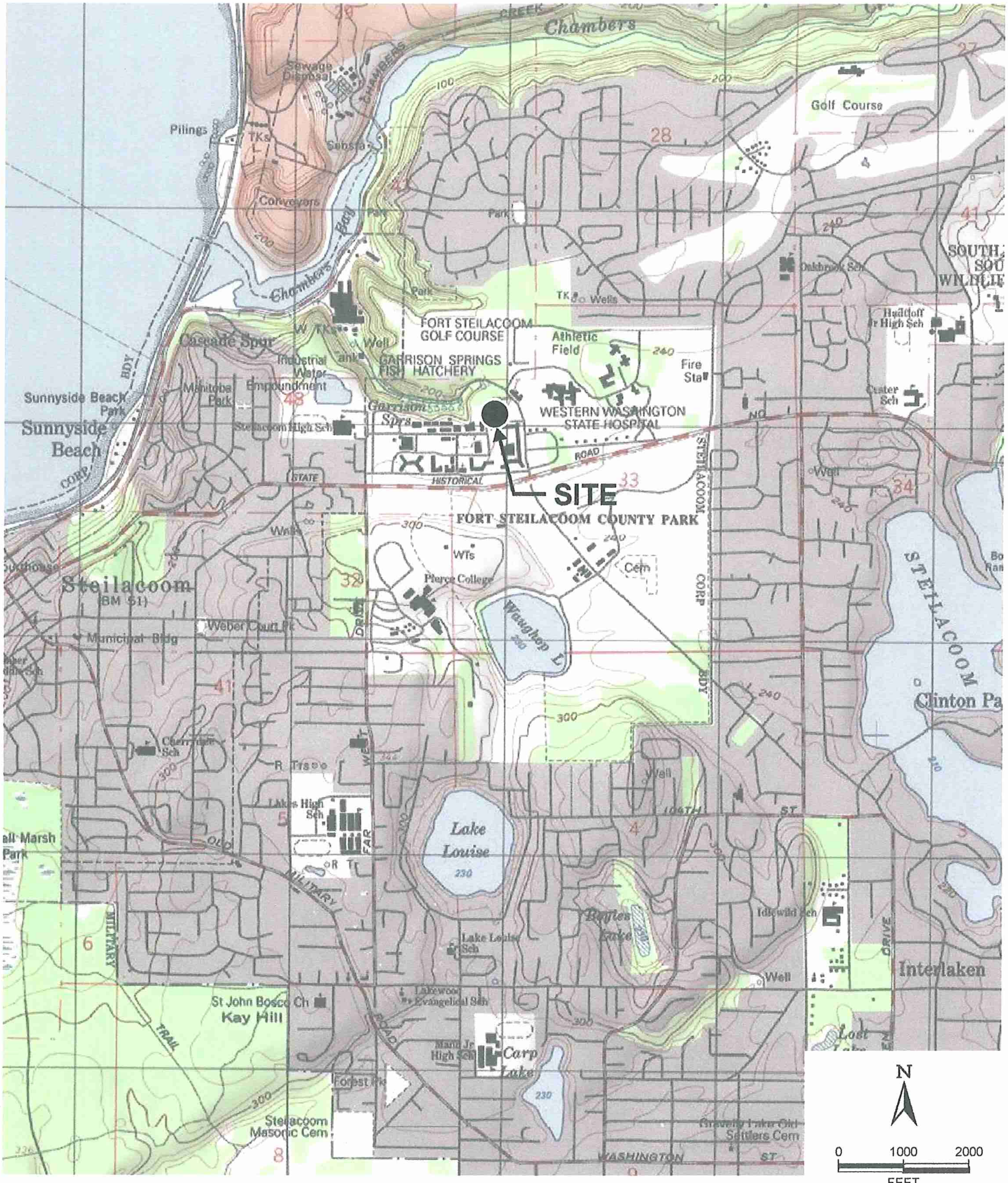
We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Bruce W. Guenzler, L.E.G.
Project Geologist

Kurt D. Merriman, P.E.
Principal Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Exploration Plan
	Appendix:	Exploration Logs



REFERENCE: USGS TOPO!

Associated Earth Sciences, Inc.

VICINITY MAP

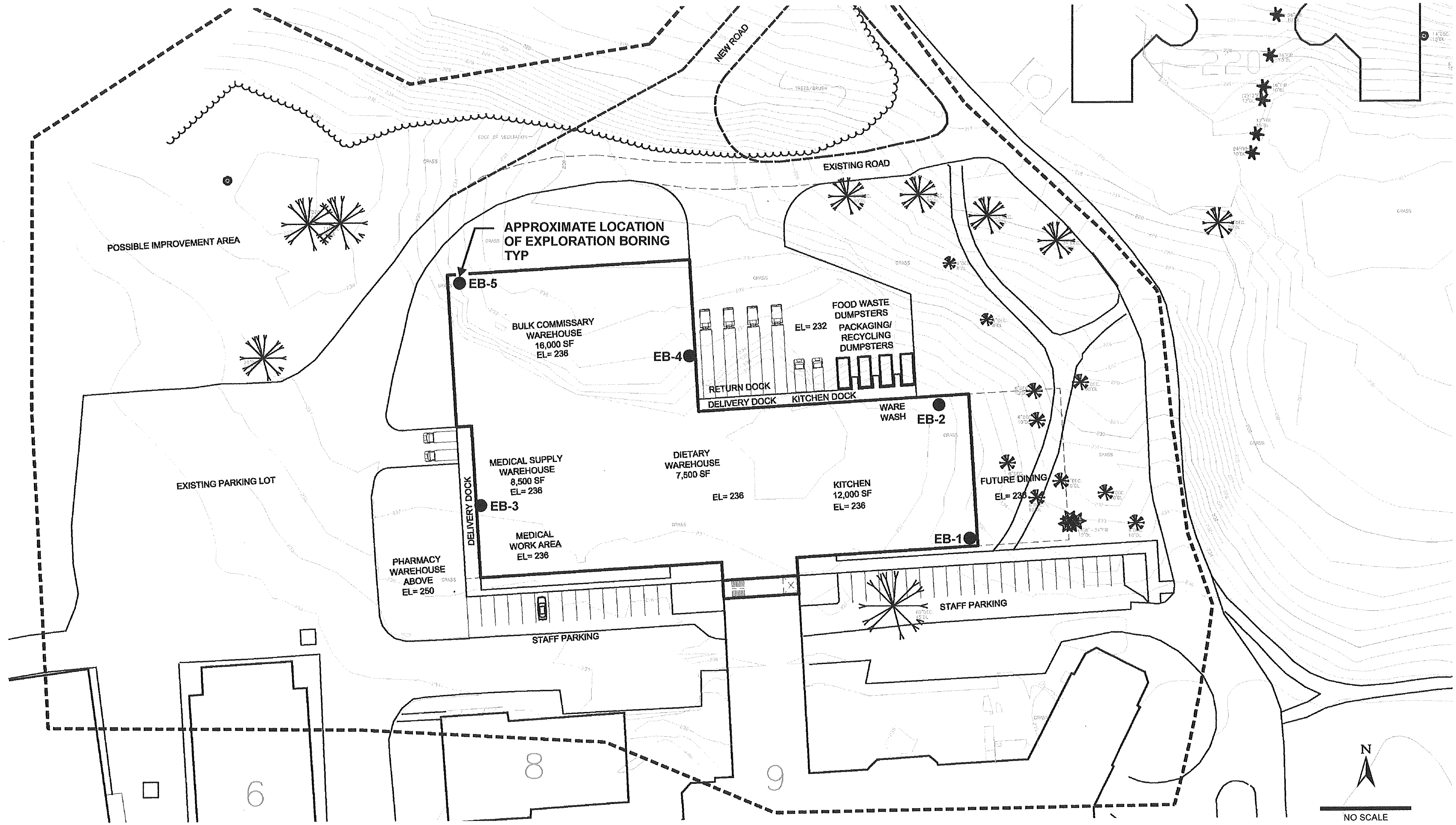
WESTERN STATE HOSPITAL COMMISSARY
LAKEWOOD, WASHINGTON

FIGURE 1

DATE 12/09

PROJ. NO. KE040805B

04805 Western State Hospital \ 040805 Vcinity.cdr



REFERENCE: NAC ARCHITECTURE

04805 Western State Hospital | 040805 Site and Expl.cdr

Associated Earth Sciences, Inc.

SITE AND EXPLORATION PLAN

WESTERN STATE HOSPITAL COMMISSARY
LAKEWOOD, WASHINGTON

FIGURE 2
DATE 12/09
PROJ. NO. KE040805B

APPENDIX

Major Division		Fines	Symbol	Description
Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines[5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥15% Fines[5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines[5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥15% Fines[5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT[2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT[2] blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

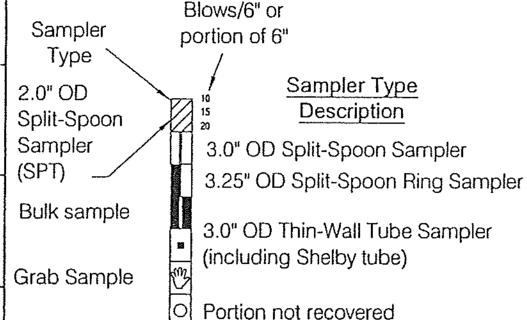
(3) Estimated Percentage

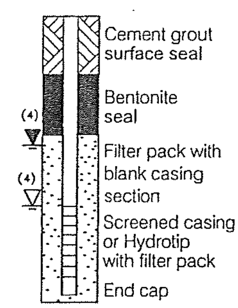
Component	Percentage by Weight
Trace	<5
Few	5 to 10
Little	15 to 25
With	- Non-primary coarse constituents: ≥ 15% - Fines content between 5% and 15%

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 15%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Associated Earth Sciences, Inc.

EXPLORATION LOG KEY

Associated Earth Sciences, Inc.	Exploration Log		
	Project Number: KE040805B	Exploration Number: EB-1	Sheet: 1 of 2

Project Name: Western State Hospital Commissary
Location: Lakewood, WA
Driller/Equipment: Gregory/CME 850
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): 235'
Datum: NAC Architecture
Date Start/Finish: 12/15/09,12/15/09
Hole Diameter (in): 8"

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Grass and topsoil.		
		Fill		
	S-1	Loose to medium dense (blow count overstated), moist, dark brown, fine to coarse GRAVEL (brick rubble), few silt and fine sand.	4 9 9	18
5		**Recessional Outwash**		
	S-2	Medium dense, moist, light brown, fine to coarse GRAVEL, with fine to coarse sand, few to trace silt (GW).	8 8 8	16
10	S-3	Dense, moist, light brown, fine to coarse GRAVEL, with fine to coarse sand, trace to few silt (GW); no stratification or structure.	7 13 24	37
15	S-4	As above, little cobbles (based on drill action).	4 15 21	37
20	S-5	As above, grading to slightly finer in gravel fraction, and with fewer cobbles (GW).	11 15 18	33
25	S-6	No recovery. Pushed a gravel/cobble. Blow count may be overstated.	6 13 40	53
30	S-7	Dense, moist, brown, fine to coarse GRAVEL, with fine to coarse sand, few silt; no stratification or structure (GW).	6 14 22	36
		Advance Outwash		
35	S-8	Very dense, moist, brown, fine SAND, few to little silt, with silt stringers to 3" (SP with ML).	13 29 38	67

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.	Exploration Log		
	Project Number KE040805B	Exploration Number EB-1	Sheet 2 of 2

Project Name	Western State Hospital Commissary	Ground Surface Elevation (ft)	235'
Location	Lakewood, WA	Datum	NAC Architecture
Driller/Equipment	Gregory/CME 850	Date Start/Finish	12/15/09,12/15/09
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8"

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-9		Grades without silt stringers and with few fine gravel (SW).			26 37 35	▲72	
				Bottom of exploration boring at 41.5 feet					
45									
50									
55									
60									
65									
70									
75									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Exploration Log

Project Number	Exploration Number	Sheet
KE040805B	EB-2	1 of 2

Project Name	Western State Hospital Commissary	Ground Surface Elevation (ft)	235'
Location	Lakewood, WA	Datum	NAC Architecture
Driller/Equipment	Gregory/CME 850	Date Start/Finish	12/15/09,12/15/09
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8"

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
				Grass and topsoil.					
				Fill Brick rubble.					
5		S-1		**Recessional Outwash** Medium dense, moist, brown, fine to coarse GRAVEL, with fine to coarse sand, few silt (GW); no stratification.			10 11 13	▲24	
10		S-2		Low recovery. Blow count may be overstated. Drill action suggests cobbles.			9 14 12	▲26	
15		S-3		Same texture as S-1.			9 11 12	▲23	
20		S-4		Dense, moist, brown, fine to coarse GRAVEL, with fine to coarse sand, few silt, few cobbles (GW); no stratification.			11 16 30	▲46	
25		S-5		Medium dense, moist, brown, fine GRAVEL, with medium to coarse sand, trace fine sand and silt (GP).			5 7 13	▲20	
30		S-6		No textural change.			5 10 14	▲24	
35		S-7		No textural change: Increase in SPT driving resistance last 2".			7 7 15	▲22	

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.

Exploration Log

Project Number	Exploration Number	Sheet
KE040805B	EB-2	2 of 2

Project Name: Western State Hospital Commissary
Location: Lakewood, WA
Driller/Equipment: Gregory/CME 850
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 235'
Datum: NAC Architecture
Date Start/Finish: 12/15/09,12/15/09
Hole Diameter (in): 8"

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-8		Becomes dense. No textural change.			10 16 19	▲35	
				Bottom of exploration boring at 41.5 feet					
45									
50									
55									
60									
65									
70									
75									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
∇ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.

Exploration Log

Project Number	Exploration Number	Sheet
KE040805B	EB-3	1 of 2

Project Name: Western State Hospital Commissary
Location: Lakewood, WA
Driller/Equipment: Gregory/CME 850
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 237'
Datum: NAC Architecture
Date Start/Finish: 12/15/09,12/15/09
Hole Diameter (in): 8"

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
	S-1	Grass and topsoil. **Fill** Medium dense, moist, dark brown, fine to coarse GRAVEL, with brick and concrete, little fine to coarse sand and silt (GW).	7 8 8	16
5	S-2	As above.	4 7 8	15
10	S-3	Trace recovery of fill as above. Blow count may be overstated.	13 20 20	40
15	S-4	No recovery - rock. Fill (slough) in shoe. Blow count overstated. **Recessional Outwash**	50/4"	50/4"
	S-5	Dense, moist, brown, fine to coarse GRAVEL, with fine to coarse sand, few silt (GW); no stratification.	5 10 21	31
20	S-6	Becomes dense, gradation as above.	16 20 23	43
25	S-7	Dense, very moist (no free water), brown, fine to coarse GRAVEL, with medium to coarse sand, few silt; no stratification.	15 18 12	30
30	S-8	Low recovery. Continues very moist. No free water.	7 22 22	44
35	S-9	Becomes medium dense. Gradation as above.	6 7 9	16

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.	Exploration Log		
	Project Number KE040805B	Exploration Number EB-3	Sheet 2 of 2

Project Name	Western State Hospital Commissary	Ground Surface Elevation (ft)	237'
Location	Lakewood, WA	Datum	NAC Architecture
Driller/Equipment	Gregory/CME 850	Date Start/Finish	12/15/09,12/15/09
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8"

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-10		Gradation as above.			10 12 15	▲27	
				Bottom of exploration boring at 41.5 feet					
45									
50									
55									
60									
65									
70									
75									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.	Exploration Log		
	Project Number: KE040805B	Exploration Number: EB-4	Sheet: 1 of 2

Project Name: Western State Hospital Commissary
Location: Lakewood, WA
Driller/Equipment: Gregory/CME 850
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): 234'
Datum: NAC Architecture
Date Start/Finish: 12/16/09,12/16/09
Hole Diameter (in): 8"

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Grass and topsoil.		
		Fill		
	S-1	Medium dense, very moist, dark brown, fine GRAVEL, with fine to coarse sand, few silt (GP); brick and concrete rubble 20%.	12 13 11	24
5	S-2	Low recovery of fill as above. Fill in cuttings.	6 9 9	18
		Thin zones of perched seepage.		
		Recessional Outwash		
10	S-3	Dense, moist, brown, fine to coarse GRAVEL, with fine to coarse sand, few silt, trace cobbles (GW); no stratification.	9 16 15	31
15	S-4	Grades to medium dense with predominantly medium to coarse sand (GW).	7 8 10	18
20	S-5	Gradation of sand fraction returns to fine to coarse.	4 14 14	28
25	S-6	Dense to very dense (blow count overstated), moist, brown, fine to coarse GRAVEL, with fine to coarse sand, few silt, trace cobbles (GW); no stratification.	6 21 35	56
30	S-7	Gradation as above, but medium dense.	15 13 10	23
35	S-8	Grades to trace silt.	12 13 9	22

Column headings also include: S T, Graphic Symbol, Well Completion, Water Level, Other Tests; Blows/Foot scale 10 20 30 40.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.

Exploration Log

Project Number	Exploration Number	Sheet
KE040805B	EB-4	2 of 2

Project Name: Western State Hospital Commissary
Location: Lakewood, WA
Driller/Equipment: Gregory/CME 850
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 234'
Datum: NAC Architecture
Date Start/Finish: 12/16/09,12/16/09
Hole Diameter (in): 8"

Depth (ft)	ST	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-9		Grades to dense.			10 18 18	▲36	
				Bottom of exploration boring at 41.5 feet					
45									
50									
55									
60									
65									
70									
75									

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.	Exploration Log		
	Project Number KE040805B	Exploration Number EB-5	Sheet 1 of 2

Project Name	Western State Hospital Commissary	Ground Surface Elevation (ft)	234'
Location	Lakewood, WA	Datum	NAC Architecture
Driller/Equipment	Gregory/CME 850	Date Start/Finish	12/16/09,12/16/09
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8"

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Grass and topsoil.					
				Fill					
		S-1		Loose, very moist, dark brown, fine to coarse SAND, with fine to coarse gravel, little silt (SM); 5% brick and concrete rubble.			4 4 6	10	
5		S-2		Blow count overstated.			2 10 20	30	
				Recessional Outwash					
10		S-3		Dense, moist, brown, fine to coarse GRAVEL, with fine to coarse sand, trace silty trace cobbles (GW); no stratification.			10 21 14	35	
15		S-4		As above.			12 14 19	33	
20		S-5		As above.			5 18 21	39	
25		S-6		As above.			5 20 29	49	
30		S-7		Very dense (blow count may be overstated), moist, brown, fine to coarse SAND, with fine to coarse gravel, trace silt (SW); no stratification.			7 40 38	78	
35		S-8		Gradation as above, but medium dense.			6 10 10	20	

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

Associated Earth Sciences, Inc.

Exploration Log

Project Number	Exploration Number	Sheet
KE040805B	EB-5	2 of 2

Project Name	Western State Hospital Commissary	Ground Surface Elevation (ft)	234'
Location	Lakewood, WA	Datum	NAC Architecture
Driller/Equipment	Gregory/CME 850	Date Start/Finish	12/16/09,12/16/09
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	8"

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
	S-9	Medium dense, moist, brown, fine GRAVEL, with fine to coarse sand, trace silt (GW).	4 5 9	▲14
45	S-10	Medium dense, moist, brown, fine SAND, trace silt, trace fine gravel (SP).	10 12 12	▲24
		Bottom of exploration boring at 46.5 feet		
50				
55				
60				
65				
70				
75				

Columns: Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10, 20, 30, 40) | Other Tests

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- Water Level ()
- Water Level at time of drilling (ATD)

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Approved by: