GEOTECHNICAL FEASBILITY REPORT
PROPOSED AFFORDABLE HOUSING DEVELOPMENT
2901 27th Avenue South
Seattle, Washington

PROJECT NO. 19-311.100
December 2019

Prepared for:

Enterprise Community Development

PanGEO INCORPORATED

Geotechnical & Earthquake Engineering Consultants

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December 6, 2019
PanGEO Project No. 19-311.100

Mr. James Madden
Enterprise Community Development
70 Corporate Center
11000 Broken Land Parkway, Suite 700
Columbia, Maryland 21044

Subject: Geotechnical Feasibility Study
Proposed Affordable Housing Development
2901 27th Avenue South, Seattle, Washington

Dear Mr. Madden:

As requested, PanGEO, Inc. is pleased to present this geotechnical feasibility report to assist the project team with evaluating the feasibility of constructing a proposed affordable housing development at 2901 27th Avenue South in Seattle, Washington. Detailed engineering recommendations will be provided during the design phase of the project, after the design of the planned improvements is defined.

In preparing this report, we reviewed the logs from six borings and two test pits located within the site and the logs of five additional borings drilled near the site for the Sound Transit South Link project. Based on the results of our review, the main geotechnical design issues for the project are summarized below:

- The depth competent soils for foundation support ranges from 10 to 40 feet deep (below the existing ground surface).
- The subject site is mapped by the Seattle Department of Construction and Inspection as steep slope, potential slide, and liquefaction hazard environmentally critical areas (ECAs) and contains known slides. The project will need to be designed to maintain the stability of the known slide and to stabilize the potential slide ECA.
- The site may fall under Seismic Site Class F under the 2015/2018 International Building Code (IBC) due to the presence of potentially liquefiable soils. If the

fundamental period of the buildings is less than 0.50 then Seismic Site Class D or E may be appropriate, however additional exploration and analysis would be needed to make this determination. Otherwise a site-specific ground response analysis will be required to evaluate the design ground motions, and is likely to results in higher design ground motions.

- Building support can be provided using a combination of conventional footings (assuming basement excavation exposes competent soils in some areas) and pile foundation. Preliminary recommendations for augercast piles and small diameter pipe piles are included in this report. Ground improvements such as aggregate piers may not be appropriate because the soft soils maybe too thick and soft for this method to be effective.
- One or two levels of below grade parking are being considered for this site. Temporary excavations can be accomplished using convention open cuts where there is sufficient room to allow for 1.5H:1V (Horizontal:Vertical) slopes. Where there is insufficient room to allow for open cuts or if a zero-lot line excavation is planned, then temporary shoring consisting of cantilevered soldier piles or soldier piles with temporary tiebacks will be needed.
- Based on review of historical groundwater data, groundwater levels may be as shallow as four feet below existing grade. Depending on the planned excavation depths, construction dewatering may be needed. Alternatively, watertight shoring or other construction methods could be used to mitigate the need for dewatering.

Should you have any questions, please do not hesitate to contact us.

Sincerely,

Scott D. Dinkelman, LEG
Senior Engineering Geologist

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GEOTECHNICAL FEASIBILITY REPORT
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2901 27TH AVENUE SOUTH
SEATTLE, WASHINGTON

1.0 GENERAL

As requested, PanGEO, Inc. is pleased to present this geotechnical feasibility report for the proposed mixed-use development located at 2901 27th Avenue South in Seattle, Washington. This study was performed in general accordance with our mutually agreed scope of services outlined in our proposal dated October 24, 2019. Our scope of services included reviewing readily available geologic and geotechnical data in the site vicinity, conducting a site reconnaissance, performing engineering analyses and evaluations, and preparing the following report.

The primary objective of this geotechnical feasibility report is to assist you with your feasibility assessment of developing the site with an affordable housing development. Additional geotechnical exploration including test borings and cone penetrometer tests will be needed during the final design and permitting phase of the project. In addition, it may be necessary to modify our recommendations if the design concept will be significantly different than our understanding of the project as described in this report.

2.0 SITE AND PROJECT DESCRIPTION

The subject site is located at 2901 27th Avenue South in the Rainier Valley neighborhood of Seattle, Washington, as shown on Figure 1, Vicinity Map. The irregular shaped site comprises three separate tax parcels (King County Parcel Nos. 308500-2100, 713880-0025, and 713830-0015) with an aggregate area of about 4 acres. The parcels are outlined on the attached Figure 2, Site Plan. An aerial view and images and of the current site conditions can be seen in Plates 1 through 4, below.

For the purpose of easily describing these parcels, we have identified them as north, central and south, as described below:

- The north parcel (713830-0015) is located at 2600 South Forest Street. It is a rectangular-shaped parcel that comprises about 0.31 acres. The north parcel is developed with an asphalt paved parking lot and is bordered to the west by 26th Avenue South, to the south by South Forest Street, and to the north and east by commercial buildings. The north parcel is bisected by an elevated section of the Sound Transit South Link light rail line.

- The central parcel (308500-2100) is located at 2901 27th Avenue South and is roughly rectangular in shape extending about 550 feet in the north-south direction by 300 feet in the east-west direction. According to King County tax records the parcel is about 3.3 acres. This parcel slopes down from west to east, with 20 to 25 feet of elevation change across the width of the property. The central parcel is bordered by a parking lot to the west, Cheasty Boulevard to the south, South Forest Street to the north, and the Mt Baker Light Rail Station to the east.

  The central parcel contains two existing buildings: the former UW Laundry building in the north half of the parcel and a one-story former grocery store building in the south half of the parcel. The UW Laundry building consists of multiple attached one- and two-story buildings that are of concrete masonry unit construction. The westernmost building is a portion of the former Rainier Bowl bowling alley which was constructed in 1958. The other laundry facility buildings were additions constructed in 1984. The UW Laundry buildings are benched into the site slope, with the west side of the building comprised of a 10- to 15-foot high retaining wall.

  On the west side of the building is a 10- to 12-foot wide asphalt paved access road. On the west side of the access road is a 4- to 6-foot high ecology block wall that steps up to the adjacent property to the west.

  The south building is a one-story former grocery store building that is constructed at grade. The south building is surrounded by asphalt parking and drive areas.

  Based on our review, portions of the existing buildings are supported on pile foundations.

- The south parcel (713880-0025) is located at 2929 27th Avenue South. It is trapezoidal in shape, extending 180 feet in the north-south direction by 170 feet in the east-west direction and comprises about 0.5 acres. The south parcel is relatively flat with less than five feet of elevation change across the width of the property and is developed with an asphalt-paved parking lot.

A topographic survey was not available at the time of this study. Based on our review of the Seattle Department of Construction and Inspection (SDCI) GIS website 2-foot contours, and our on-site observations, the site slopes down from the west to the east, with about 20 to 25 feet of elevation change across the site. Most of the elevation change occurs in the western portion of the site where the existing improvements have been benched into the slope with a series of retaining walls ranging from four to 15 feet high, and graded slopes and ramps have been constructed to provide access around the west side of the site.

Plate 1: *Aerial view of the site illustrating the approximate site boundary and existing conditions.*

North is toward the top of the image.

Plate 2: *View of the east side of the UW Laundry site. Looking from north to south.*

Plate 3: *View of slope/access ramp on the west side of the UW Laundry site.*

Plate 4: *View of the former grocery store building in the south portion of the central parcel.*

Looking from south to north.

The UW Laundry facility is visible in background of image.

We understand the property will be redeveloped with a multiple building, multi-story affordable housing residential development. No specific layout or building concept has been determined at this time. One or two levels of below grade parking are being considered for the planned improvements.

The conclusions and recommendations in this report are based on our preliminary understanding of the proposed development, which is in turn based on the project information provided. If the above project description is incorrect, or the project information changes, we should be consulted to review the recommendations contained in this study and make modifications, if needed. In any case, PanGEO should be retained to provide a review of the final design to confirm that our geotechnical recommendations have been correctly interpreted and adequately implemented in the construction documents.

3.0 PREVIOUS SUBSURFACE EXPLORATIONS

In preparing this report, we reviewed the logs and subsurface profiles of selected explorations from previous geotechnical studies completed at the site and in the site vicinity. Specifically, the following explorations were reviewed:

- **Hart Crowser, Inc.:** We reviewed the logs of six borings (B-1 through B-6) which were drilled within the subject site for the geotechnical study for the UW Laundry site in 1982. The locations of these borings are shown on Figure 2 as the B-series borings. Logs of the B-series of borings and subsurface profile through the east half of the central parcel profile is included in Appendix A of this report.
- **Golder Associates, Inc.:** Five borings (GC-20, GC-22, GC-23, GC-75 and GC-76) were drilled for a portion of the Sound Transit South Link in March 2001. The borings were located to the north, east and south sides of the UW Laundry site and are shown on Figure 2 as the GC-series borings. The logs of these borings are included in Appendix B.
- **Geotech Consultants, Inc.:** We also reviewed the logs of two test pits (TP-1 and TP-2) excavated in January 2002 on the south side of the south building in the central parcel for a refrigerator and freezer addition. The locations of these test pits are shown on Figure 2 as TP-1 and TP-2 and the test pit logs are provided in Appendix C.

4.0 INTERPRETED SUBSURFACE CONDITIONS

4.1 SITE GEOLOGY

Based on review of *The Geologic Map of Seattle – a Progress Report* (Troost et al., 2005), the Quaternary-age geologic units mapped near the site consist of the following deposits ordered from most recent to oldest:

- ***Vashon Recessional Lacustrine (Geologic Map Unit Qvrl):*** Consists of laminated silt and clay with localized sand and peat layers. This soil has not been glacially overridden and is typically very soft to stiff.
- ***Ice Contact Deposits (Qvi):*** Consists of interlayered till and outwash deposits. The outwash consists of sand and gravel with varying amounts of silt. These units may or may not have been glacially overridden. Where overridden, the ice contact deposits are typically dense to very dense. Where they have not been overridden, the ice contact deposits may range from loose to dense.
- ***Lawton Clay (Qvlc):*** Consists of laminated to massive silt, clayey silt, and clay that was deposited in proglacial lakes during the Vashon Stade of the Fraser

glaciation. This soil unit has been glacial overridden and is typically very stiff to hard.

4.2 INTERPRETED SOIL CONDITIONS

The boring logs provided in Appendices A, B and C provide a detailed description of the subsurface conditions encountered. In summary, the site is underlain by a sequence of soft/loose compressible soils of varying thickness, which is in turn underlain by hard silt and clay is that considered competent for foundation support. The depth to competent hard silt and clay ranged from about 10 feet along the west side of the site, to at least 40 feet along the east side of the site. The overlying unsuitable soils include fill, colluvium, buried topsoil and organic soils, and soft silt and clay.

4.3 GROUNDWATER

Groundwater was encountered at 4 to 14½ feet below grade in the previous explorations. With the planned one to two levels of below grade parking, groundwater will need to be a design consideration. It should also be noted that groundwater conditions are not static and that groundwater levels and seepage rates will fluctuate depending on the season, amount of precipitation, surface water runoff, and other factors. Groundwater levels and seepage rates are higher in the wetter winter months, typically October through May.

5.0 ENVIRONMENTALLY CRITICAL AREAS CONSIDERATIONS

Based on our review of the City of Seattle Department of Construction and Inspection (SDCI) environmentally critical area (ECA) maps, the southwest portion of the central parcel is mapped as a steep slope ECA, the west portion of the central parcel is mapped as a potential landslide ECA and a known slide ECA, and almost the entirety of the three parcels is mapped as a liquefaction-prone ECA.

5.1 STEEP SLOPE ENVIRONMENTALLY CRITICAL AREA

The site is mapped as containing a steep slope environmentally critical area (ECA). The approximate extent of the steep slope ECA, as defined by SDCI is shown on Plate 5, below. In order to assess the steep slope hazard, we conducted a reconnaissance of the site during our field exploration and reviewed historical landslide records compiled by the Seattle Department of Transportation (SDOT).

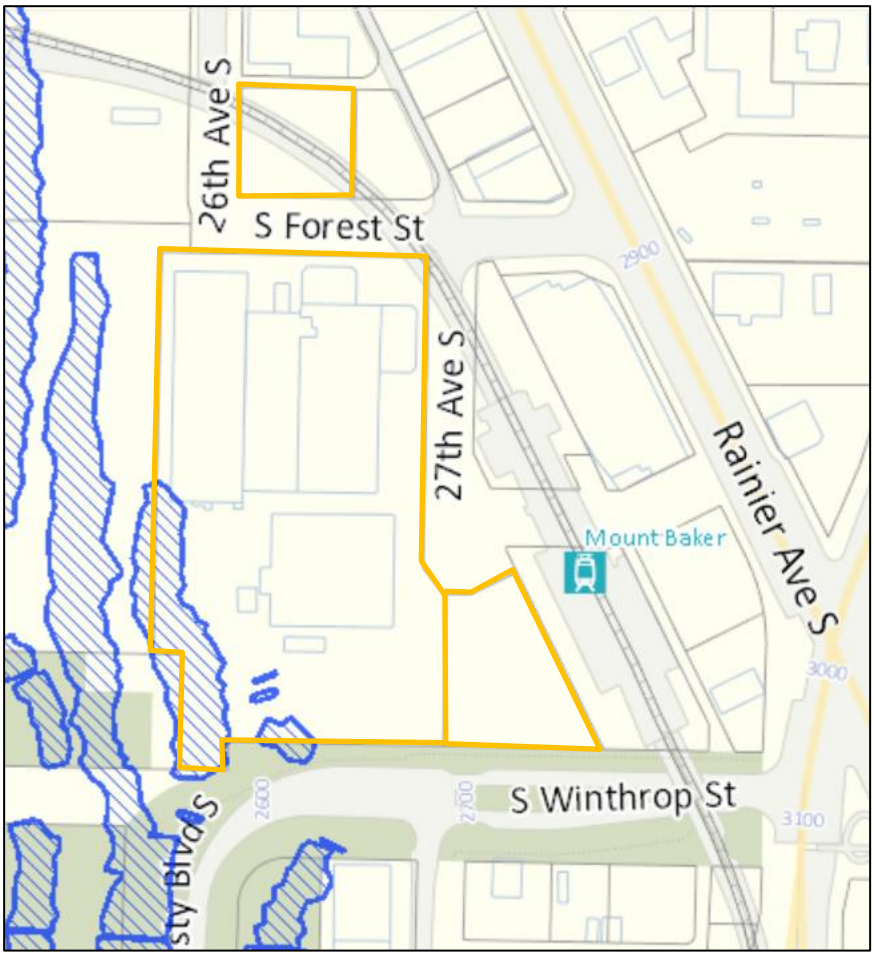

Plate 5: *Approximate lateral extent of SDCI defined steep slope hazard ECA.*

5.1.1 Slope Reconnaissance

We conducted a preliminary reconnaissance of the west slope observe the current condition of the site slopes. During our reconnaissance, we did not observe indications of recent slope movement or additional movement of the historical slope failures.

5.1.2 Steep Slope Area Setbacks

The City of Seattle requires a setback of 15 feet from steep slope areas, unless a *Relief from Prohibition on Steep Slope and Erosion Hazard Area Development* is granted by the City. Due to the history of development at this site, it may be possible to obtain what SDCI refers to as *Relief from Prohibition on Steep Slope and Erosion Hazard Area Development*. In order to obtain the "relief" it would need to be shown the slopes were created by previous

legal grading and the slopes did not meet the definition of a Steep Slope ECA prior to the grading.

5.2 Potential Landslide Hazard Area

The west portion of the central parcel is mapped as a potential landslide hazard ECA due to geologic conditions. The area to the west of the site is mapped as an Uncertain Landslide Area in Landslides Mapped using LIDAR Imagery, Seattle, Washington, USGS OFR-2004-1396 (Schulz, 2004) and as a Zone 2 Landslide in Map Showing Susceptibility Estimated from LIDAR Mapping and Historical Landslide Records, Seattle, Washington, USGS OFR-2005-1405 (Schulz, 2005). The approximate extent of the potential landslide hazard ECA is shown on Plate 6, below.

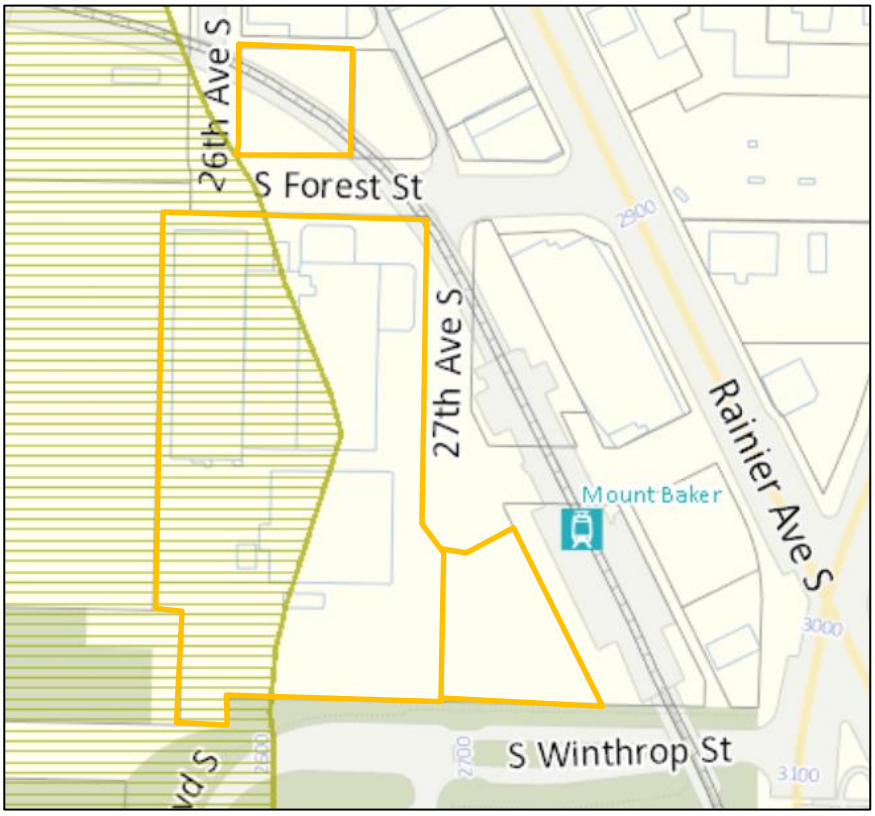

Plate 6: *Approximate lateral extent of SDCI mapped potential slide ECA (yellow hatched area).*

When new construction occurs in potential slide areas, the Seattle Building Code requires that the entire developed area of the site be completely stabilized. Stabilizing the developed area will need to be a consideration with the design of the planned improvements. This

can be accomplished through the construction of retaining structures and control of surface water drainage.

5.3 KNOWN SLIDE ENVIRONMENTALLY CRITICAL AREA

The western portion of the site is mapped by the City of Seattle as a known slide ECA due the presence of slope failures to the west of the site. The approximate area of the know slide ECAs are shown in Plate 7, below.

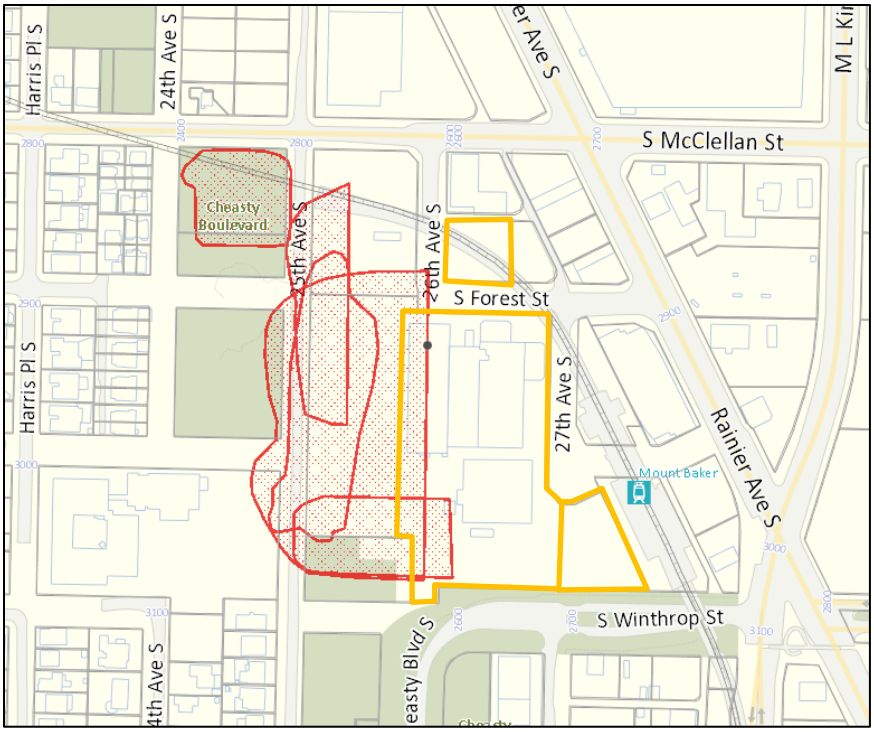

Plate 7: *Approximate lateral extent of SDCI mapped known slide ECA*

As part of our study, we performed a review of historical slope failure records of these known slides, including SDCI maps, the Seattle Landslide Study (Shannon and Wilson, 2003), City of Seattle records, and PanGEO project files and records. Our review identified the following historical information regarding slope failures in the vicinity of the site:

<u>2508 Forest Street:</u> On April 9, 1931 slope movement occurred along 25th Avenue South between South MeClellan Street and South Forest Street. The slope movement appeared to have been caused by surface water or groundwater seepage collecting on 25th Avenue South and in a wooded area west of 25th Avenue South. The slide caused the house at this address to move downslope about six to ten inches and resulted in a downset of an approximately 250-foot long section of 25th Avenue South by 1½ to 2 feet.

25th Avenue South at South McClellan Street: A series of slides occurred in the vicinity of 25th Avenue South and South McClellan Street between 1933 and 1934.

- December 20, 1933 – Two-foot downset occurred along the alignment of 25th Avenue South to the south of South McClellan Street.
- December 27, 1933 – A slide was reported at the southwest corner of 25th Avenue South and South Hinds Street.
- January 8, 1934 – A slide occurred involving two blocks at 25th Avenue South and South McClellan Street.

2901 27th Avenue South: A series of slope movements were triggered starting in the summer of 1957 when the toe of the slope on the west side of 2901 27th Avenue South was excavated to allow for construction of the Rainer Bowl bowling alley. The slide was described as a deep-seated failure with the toe of the failure at the elevation of the central parcel that extended up to the alignment of 25th Avenue South, about 200 feet west and 70 to 80 feet up slope.

In January and February of 1958 there was additional movement which expanded the slope failure and the slide eventually extended between South Stevens Street at the south and South McClellan Street to the north, damaging 25th Avenue South. Plate 8 below is a photo of the slope failure obtained by SDOT in January 1958.

Plate 8: *View of 1958 slide looking from South Winthrop Street to the north.*

The Rainier Bowl building is in upper right of photo.

The toe of the slide is visible in center of photo.

Date: January 8, 1958

The cause of the slide was excavation at the base of the slope, uncontrolled surface water drainage and groundwater seepage.

There are no records of additional movement affecting slope west of the site after 1958.

When new construction occurs in potential slide areas, the Seattle Building Code requires that the entire developed area of the site be completely stabilized. This can be accomplished through the construction of retaining structures, and properly-designed demolition plan to maintain the stability of the existing walls.

5.4 Seismic Hazard (Liquefaction) Environmentally Critical Area

A seismic hazard ECA is defined by the City as an area that will be susceptible to liquefaction during a design level seismic event. The lateral extent of the seismic hazard ECA is shown on Plate 9, below. Soil liquefaction is a condition where saturated cohesionless soils undergo a substantial loss of strength due to the build-up of excess pore water pressures resulting from cyclic stress applications induced by earthquakes. Soils most susceptible to liquefaction are loose, uniformly graded sands and loose silts with little cohesion that are below the groundwater.

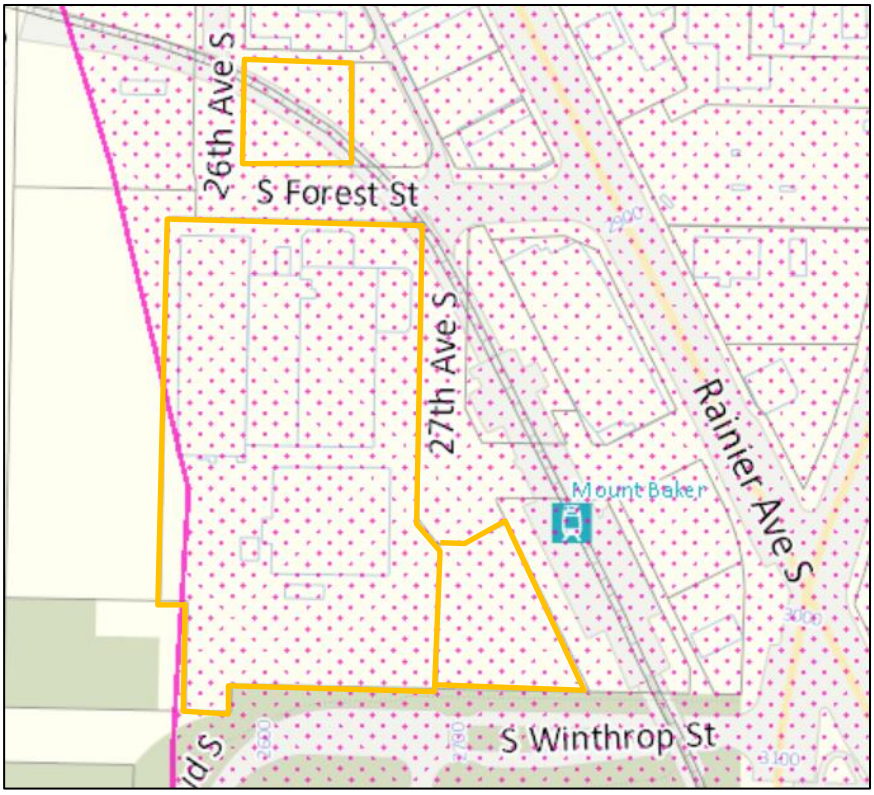

Plate 9: *Approximate lateral extent of SDCI-defined liquefaction hazard ECA.*

Liquefaction is a process that can occur when soils lose shear strength for short periods of time during a seismic event. Ground shaking of sufficient strength and duration results in the loss of grain-to-grain contact and an increase in pore water pressure, causing the soil to behave as a fluid. Soils with a potential for liquefaction are typically cohesionless, predominately silt and sand sized, must be loose, and be below the groundwater table.

Based on review of available subsurface information groundwater was identified at between 4 to 14½ feet below site grades. The upper sand layer identified in the previous borings is water bearing and ranges from loose to medium dense. This soil may be potentially liquefiable. The use of piles extending into the hard silt and clay layer should adequately address the effects of soil liquefaction on the building foundation. We also envision the use of a structural slab for the floor.

6.0 GEOTECHNICAL RECOMMENDATIONS

6.1 SEISMIC DESIGN PARAMETERS

The 2015 International Building Code (IBC) seismic design section provides a basis for seismic design of structures. The site will likely fall under Seismic Class F under the 2015/2018 International Building Code (IBC) due to the presence of potentially liquefiable soils and a site-specific seismic ground response analysis will likely be required. If the fundamental period of the buildings is less that 0.50 seconds, then Seismic Site Class E could be used for design.

Table 1, on the next page below provides seismic design parameters for the site that are in conformance with the 2015 IBC, which specifies a design earthquake having a 2% probability of occurrence in 50 years (return interval of 2,475 years), and the 2008 USGS seismic hazard maps.

TABLE 1: 2015 IBC Seismic Design Parameters
(assuming building period less than 0.5 seconds)

Site Class	Spectral Acceleration at 0.2 sec. [g] S_S	Spectral Acceleration at 1.0 sec. [g] S_1	Site Coefficients		Design Spectral Response Parameters		Control Periods [sec.]	
			F_a	F_v	S_{DS}	S_{D1}	T_O	T_S
E	1.426	0.550	0.900	2.400	0.855	0.880	0.206	1.029

The spectral response accelerations were obtained from the USGS Earthquake Hazards Program Interpolated Probabilistic Ground Motion website (2008 data) for the project latitude and longitude.

For buildings with periods equal or greater than 0.5 seconds, a site specific ground response analysis will need to be performed to determine the proper design ground motions.

6.2 FOUNDATIONS

The proposed buildings will be constructed with one or two levels of below grade parking. Based on the review of the previous exploration logs, the upper loose to medium dense water bearing sand below the site may be susceptible to liquefaction induced settlement. Below the upper sand layer is a soft clay unit that extends to a depth of about 10 feet below grade on the west side of the site to 40 feet below grade on the east side of the site.

These soils will not be suitable for direct support of structural loads. In our opinion, piles are the most appropriate foundation option. All piles should extend at least 15 feet into the hard silt (the top of hard silt is about 10 to 40 feet below ground surface). Either the use of augercast piles or driven 6- and 8-inch steel pipes piles are considered appropriate.

Depending on the proposed building location and foundation level, competent bearing soils may be present at the foundation level, especially in the west portion of the site. As such, the use of conventional footings is also considered appropriate in these area.

We also considered the use of ground improvement, such as aggregate piers to densify the underlying soils which would allow for building support using spread footing foundations. However, due to the depth of treatment that would be required, and the presence of soft

clay that may not provide adequate confinement for the aggregate piers, it does not appear that this option is practical.

It should be noted the existing structures may be supported on pile foundations. The existing piles will need to be considered in laying out the piles for the proposed buildings.

6.2.1 Augercast Piles

Several pile types are suitable for this project, including augercast piles, drilled piers, or drill-and-grouted micropiles. From our experience, augercast piles are likely the most economical pile option. Augercast piles are constructed by advancing a hollow-stem auger into the ground to a design pile tip elevation. When the needed embedment is achieved, grout is injected through the hollow stem of the auger under pressure and the auger is slowly withdrawn. Reinforcing steel is then set into the uncured grout column.

Augercast piles should be embedded into the hard silt and clay underlying the site. No reduction in pile capacity is required if the piles are installed on a center-to-center spacing of three pile diameters.

Axial Capacity – Table 2, below, presents preliminary augercast pile capacities based on the piles achieving 15 feet of embedment into the hard silt at 10 to 40 feet below the site.

TABLE 2: Preliminary 18-Inch Augercast Pile Axial Capacities
(Based on 15 Feet Embedment into hard silt)

Loading Condition	Pile Diameter	
	18-Inch	24-Inch
Axial Compression	50 tons	80 tons
Axial Tension Uplift	30 tons	40 tons
Notes: These values include a factor of safety of 2.0 for static conditions		

The values for axial compression under static conditions do not include downdrag forces due to liquefaction. Additional exploration and site-specific seismic analysis would need to be performed to evaluate the effects of liquefaction induced downdrag forces.

Lateral loads can also be resisted by the bending capacity of the piles and the passive soil pressure acting against grade beams and pile caps. During the final design phase of the project, PanGEO is available to analyze the capacities of piles under lateral loads, based on the pile layout, geometry, and design loads provided by the structural engineer.

Augercast Pile Settlement: We estimate total pile settlement of piles bearing within the dense to very dense advance outwash soil unit due to application of dead loads will be about one inch, with differential settlement of one-half inch. This settlement assumes the piles will be loaded to their full allowable capacity. The estimated settlement should primarily occur as the dead loads are applied and should be fully realized within three to four weeks after application of the dead loads.

6.2.2 Driven Small Diameter Piles

Small diameter driven steel pipe piles, or pin piles, may also be considered, provided these piles will not be needed to carry tension loads. We are providing recommendations for six- and eight-inch diameter piles. The structural engineer should evaluate the pile sizing and spacing based on the anticipated loads.

The pipe should consist of schedule 40 galvanized pipe. The piles should meet the criteria for ASTM A-53 Grade "A" pipe. In order to achieve their allowable capacities, the piles should be driven to the refusal criteria specified in Table 3, below:

TABLE 3: Pin Pile Driving and Refusal Criteria

Pile Diameter	Hammer Size (pounds)	Refusal Criteria	Allowable Pile Capacity
6-Inch	3,000	Less than one inch of penetration for six seconds of continuous driving at 500 blows per minute, over three cycles.	15 tons
8-Inch	3,000	Less than one inch of penetration for six seconds of continuous driving at 500 blows per minute, over three cycles.	25 tons

Pipe piles are typically provided in manageable lengths with straight cut ends. As each length is driven into the ground, additional lengths can be connected with compression fitted sleeve couplers. We discourage welding of pipe joints, particularly when galvanized pipe is used, as we have frequently observed welds break during driving.

Lateral Forces: Due to the slenderness of pipe piles, the lateral capacity of vertical pipe piles should be ignored in design calculations. Some resistance to lateral loads may be accomplished by battering the piles at a slope of 3H:12V (Horizontal:Vertical), or steeper.

Lateral forces from wind or seismic loading may be resisted by the passive earth pressures acting against the pile caps. Passive resistance values may be determined using an equivalent fluid weight of 300 pounds per cubic foot (pcf). This value includes a safety factor of about 1.5 assuming that properly compacted granular fill will be placed adjacent to and surrounding the pile caps and grade beams and extend a horizontal distance equal to two times the height of the pile caps.

Estimated Pile Length: We anticipate the piles will achieve refusal in the underlying hard silt. The required pile length in order to develop the recommended pile capacity is expected to vary across the footprint of the structure, depending on the actual driving conditions encountered. For planning and cost estimating purposes we anticipate pile lengths will be in the range of 35 to 40 feet below grade. The actual pile length will depend on meeting the refusal criteria.

6.2.3 Potential Existing Piles

We anticipate portions of the existing buildings are supported on piles. The pile locations will need to be considered in laying out the foundations for the proposed buildings.

The existing piles should also be removed to at least three feet below the bottom of the proposed foundations and slabs and backfilled with structural fill to prevent "hard points" below the new structures that could result in excessive differential settlement and the potential for cracking.

6.3 FLOOR SLABS

We recommend the use of structural floors supported on pile foundations.

If heated space or spaces that are sensitive to moisture intrusion are planned for the parking garage level, the concrete floors should be underlain by a capillary break meeting the gradational requirements provided in Table 4, on the next page.

TABLE 4: Capillary Break Gradation

Sieve Size	Percent Passing
¾-inch	100
No. 4	0 – 10
No. 100	0 – 5
No. 200	0 – 3

The capillary break should be placed on subgrade soils that have been compacted to a dense and unyielding condition.

A 10-mil polyethylene vapor barrier should also be placed directly below the slab. Construction joints should be incorporated into the floor slab to control cracking.

7.0 TEMPORARY EXCAVATIONS AND SHORING

Preliminary plans for the future development of this property may include one or two levels of below grade parking, which would require a cut extending to a depth of 10 to 20 feet below existing grade. In our opinion, the excavations can be accomplished using a combination of open cuts with temporary slopes and vertical cuts supported by temporary shoring.

7.1 TEMPORARY EXCAVATIONS

The contractor is responsible for maintaining safe excavation slopes and/or shoring. Temporary excavations should be constructed in accordance with Part N of the WAC (Washington Administrative Code) 296-155. For planning purposes, temporary excavations may be sloped as steep as 1.5H:1V (Horizontal:Vertical). PanGEO should be retained to review the temporary excavation plans.

Temporary excavations should be evaluated in the field during construction based on actual observed soil conditions. If seepage is encountered, excavation slope inclinations may need to be reduced. During wet weather, the cut slopes may need to be flattened to reduce potential erosion or should be covered with plastic sheeting.

Where temporary excavations of this inclination cannot be accommodated, then temporary shoring should be used.

7.2 SOLDIER PILE TEMPORARY SHORING

In our opinion, temporary shoring consisting of cantilevered soldier piles and soldier piles with tiebacks with timber lagging would be appropriate for this site.

The use of soil nail shoring, although typically more economical than soldier piles, would likely encounter some construction difficulties due to the presence of fill and shallow groundwater seepage at this site such as caving and ground loss that could lead to excessive movements. As a result, it is our opinion that soil nail shoring is not appropriate for this site.

A soldier pile wall consists of vertical steel beams, typically spaced from 6 to 8 feet apart along the proposed excavation wall, spanned by timber lagging. Prior to the start of excavation, the steel beams are installed into holes drilled to a design depth and then backfilled with lean mix or structural concrete. As the excavation proceeds downward and the steel piles are subsequently exposed, timber lagging is installed between the piles to support the soils between piles. Due to the height of the proposed excavation, one or two levels of tiebacks likely will be required to maintain stability of the soldier pile walls. In general, tiebacks are typically used for wall heights greater than about 12 feet to achieve a more economical design.

PanGEO will provide design pressure during the design phase of the project, when the building layout and depth of excavation are available.

8.0 RECOMMENDED ADDITIONAL SERVICES

As the proposed development plan is formalized and the layout of proposed buildings and depth of excavations are determined, a project specific geotechnical study should be performed. This study should include the following additional services:

- Geotechnical explorations consisting of geotechnical borings and cone penetrometer tests should be conducted at the site. The locations of the explorations should be determined based on the planned building layout.
- Standpipe piezometer monitoring wells should be installed several of the borings and groundwater levels should be monitored using pressure transducers/data loggers so that seasonal fluctuations in groundwater levels can be evaluated to better define requirements for construction dewatering, permanent below-grade

waterproofing needs, hydrostatic pressures against below-grade walls, and uplift forces on the building.

- A liquefaction evaluation should be performed to evaluate the potential for liquefaction in the water bearing medium dense sands encountered below the site.
- An analysis of the stability of the slope to the west of the site should be performed that considers measures to mitigate impacts to the existing landslides and recommendations for stabilizing the site.

9.0 CLOSURE

We have prepared this report for Enterprise Community Development and the project design team. Recommendations contained in this report are based on a site reconnaissance, a subsurface exploration program, review of pertinent subsurface information, and our understanding of the project. The study was performed using a mutually agreed-upon scope of work.

Variations in soil conditions may exist between the locations of the explorations and the actual conditions underlying the site. The nature and extent of soil variations may not be evident until construction occurs. If any soil conditions are encountered at the site that are different from those described in this report, we should be notified immediately to review the applicability of our recommendations. Additionally, we should also be notified to review the applicability of our recommendations if there are any changes in the project scope.

Our scope of services does not include services related to construction safety precautions. Our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design. Additionally, the scope of our services specifically excludes the assessment of environmental characteristics, particularly those involving hazardous substances. We are not mold consultants nor are our recommendations to be interpreted as being preventative of mold development. A mold specialist should be consulted for all mold-related issues.

This report has been prepared for planning and design purposes for specific application to the proposed project in accordance with the generally accepted standards of local practice at the time this report was written. No warranty, express or implied, is made.

This report may be used only by the client and for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both off and on-site), or other factors including advances in our understanding of applied science, may change over time and could materially affect our findings. Therefore, this report should not be relied upon after 24 months from its issuance. PanGEO should be notified if the project is delayed by more than 24 months from the date of this report so that we may review the applicability of our conclusions considering the time lapse.

It is the client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk. Any party other than the client who wishes to use this report shall notify PanGEO of such intended use and for permission to copy this report. Based on the intended use of the report, PanGEO may require that additional work be performed and that an updated report be reissued. Noncompliance with any of these requirements will release PanGEO from any liability resulting from the use this report.

Sincerely,

PanGEO, Inc.

Scott D. Dinkelman, LEG, LHG
Senior Engineering Geologist

Siew L. Tan, P.E.
Principal Geotechnical Engineer

10.0 REFERENCES

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http://earthquake.usgs.gov/designmaps/us/application.php

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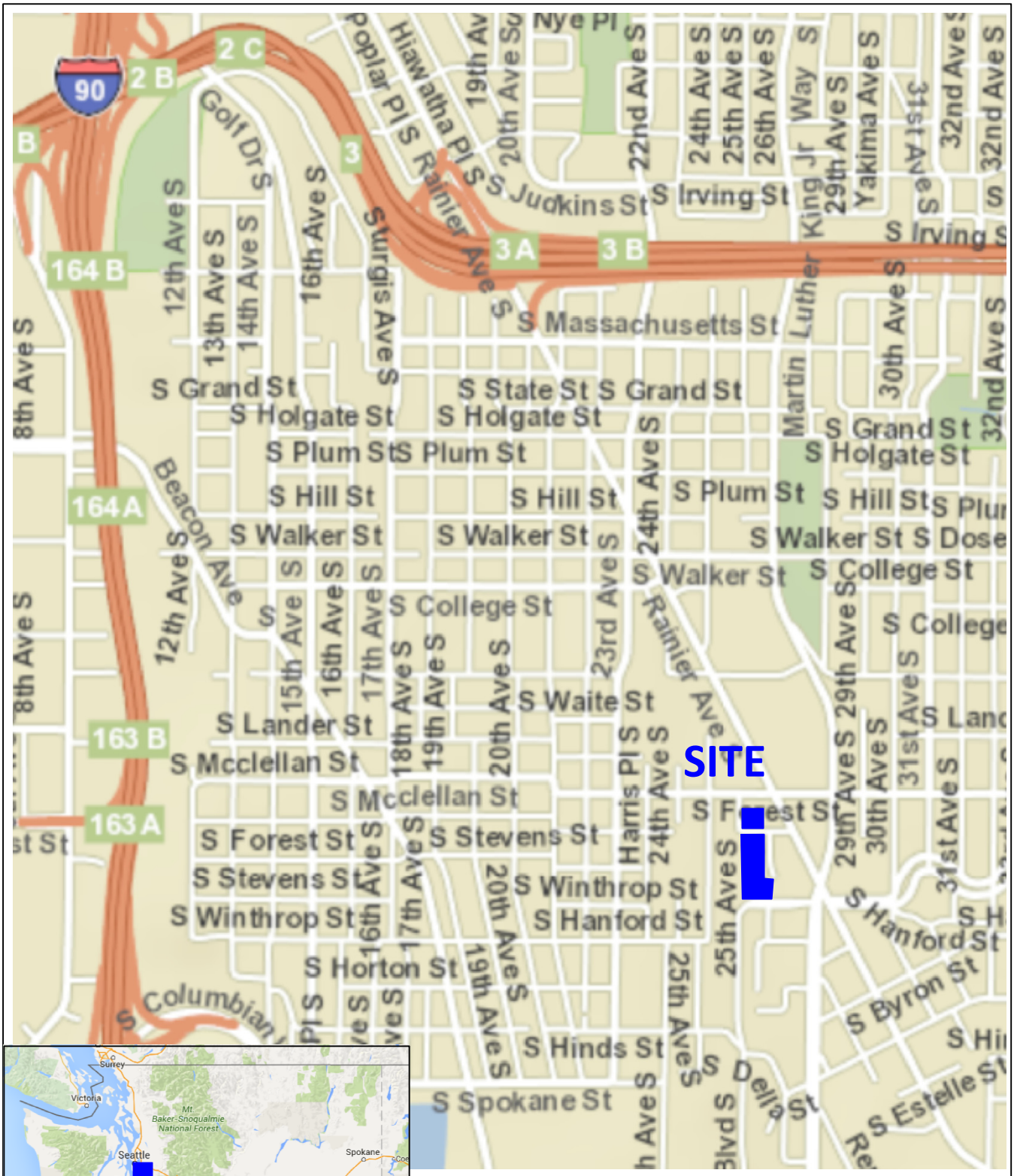


Base Map: WSDOT GeoPortal

NORTH

Not-To-Scale

PanGEO INCORPORATED

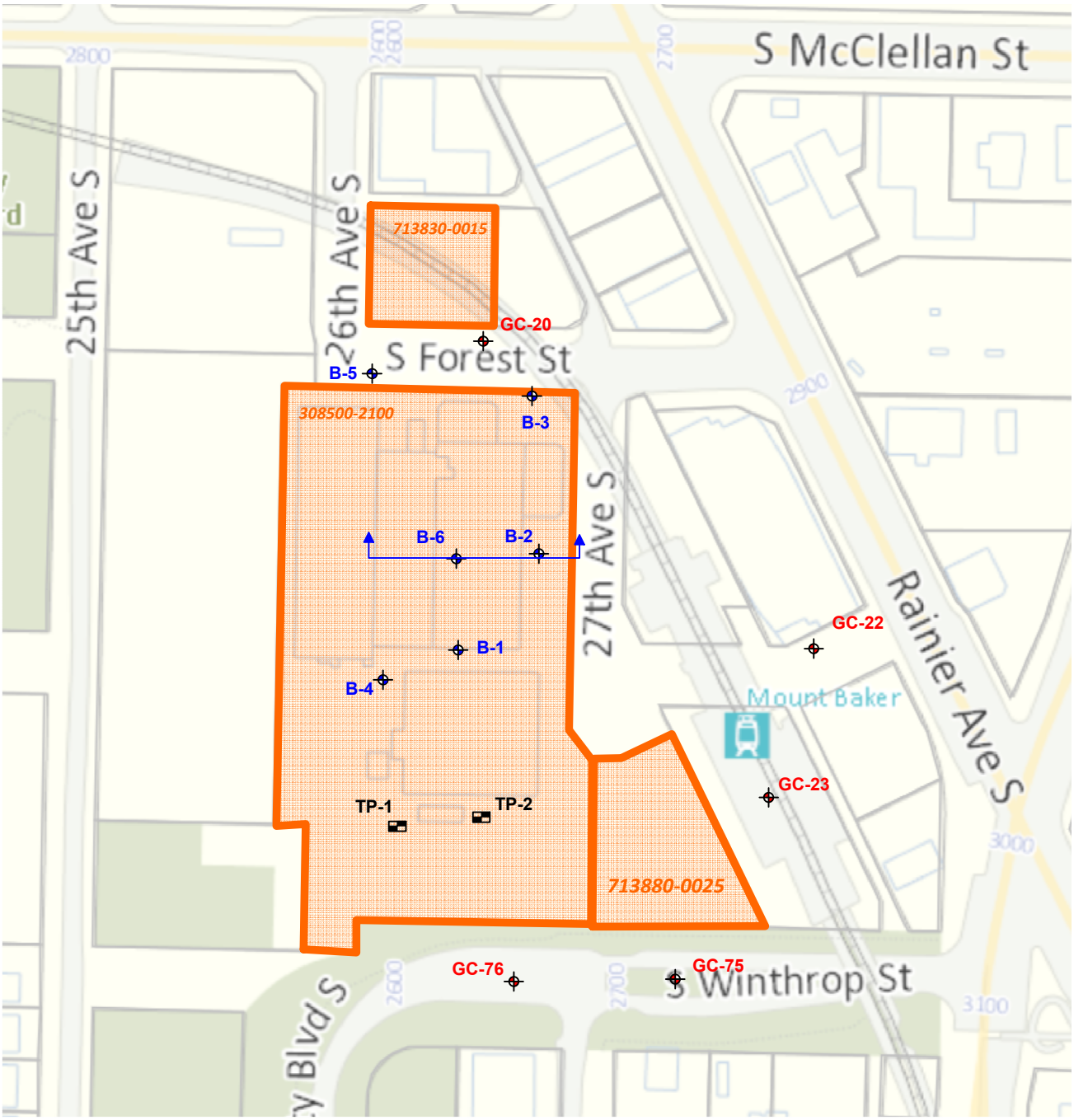
Proposed Affordable Housing Development
2901 27th Ave South
Seattle, WA

VICINITY MAP

Project No. **19-311.100**

Figure No. **1**

file.grf w/ file.dat 12/4/19 (09:31) SDD



LEGEND:

- Subject Site
- Approximate Boring Location, Hart Crowser, 1982
- Approximate Boring Location, Golder Associates, March 2001
- Approximate Test Pit Location, GeoTech Consultants, January 2002
- Generalized Subsurface Profile Location, Hart Crowser, Included in Appendix A

NORTH

NOT-TO-SCALE

PanGEO INCORPORATED

Proposed Affordable Housing Development
2901 27th Ave S
Seattle, WA

SITE PLAN

Project No. **19-311.100**

Figure No. **2**

file.grf w/ file.dat 12/6/19 (13:48) SDD

APPENDIX A

HART CROWSER, INC.
B-SERIES BORING LOGS

Boring Log B-1

SOIL INTERPRETATION

STANDARD PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

LABORATORY TESTS

Approximate Ground Surface Elevation in Feet 45

ASPHALT

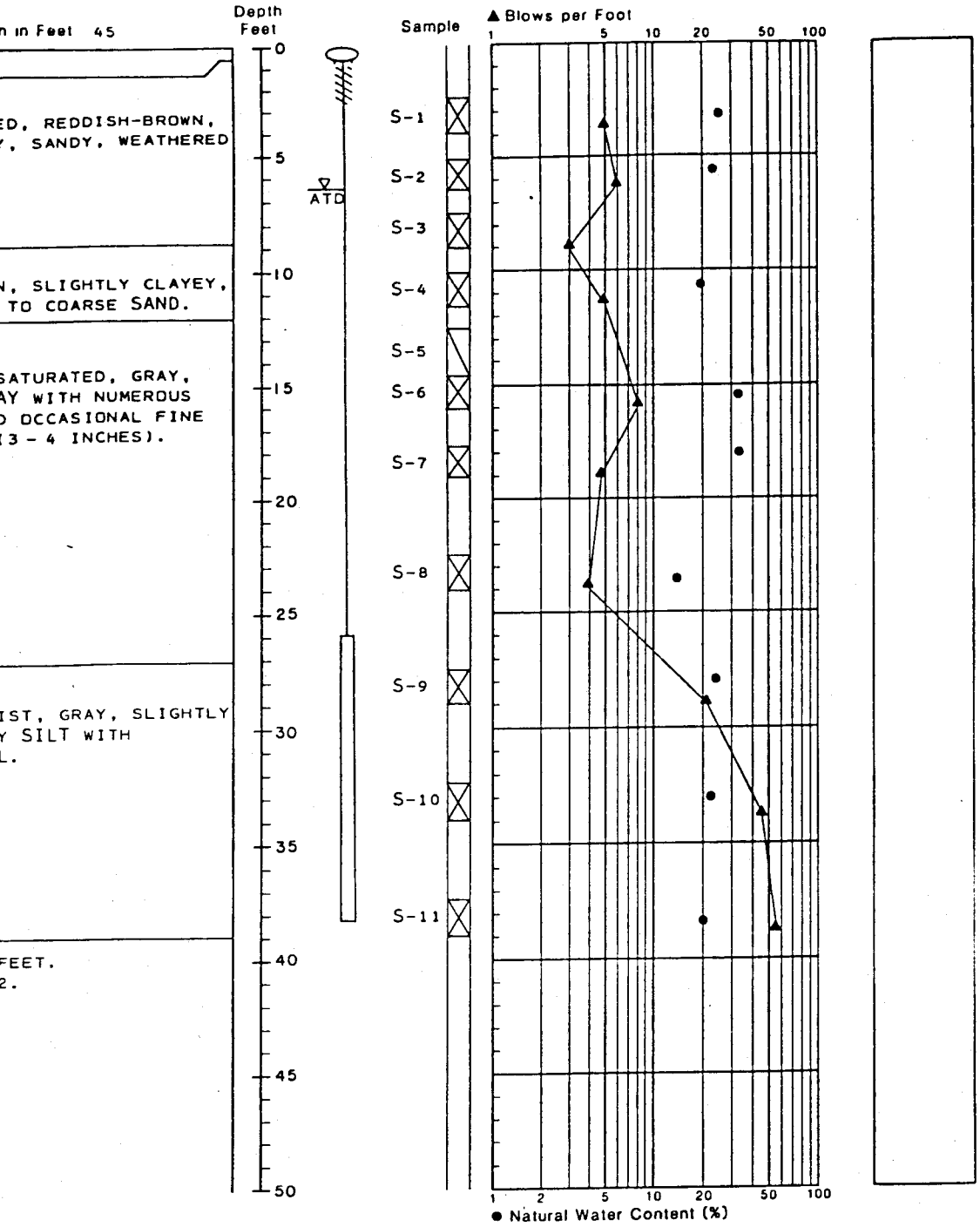
FILL:
LOOSE, DAMP TO SATURATED, REDDISH-BROWN, SLIGHTLY CLAYEY, SILTY, SANDY, WEATHERED ROCK (GRAVEL SIZE).

UPPER SANDS:
LOOSE, SATURATED, BROWN, SLIGHTLY CLAYEY, SILTY, GRAVELLY, FINE TO COARSE SAND.

SOFT CLAYS:
SOFT TO MEDIUM STIFF, SATURATED, GRAY, CLAY SILT TO SILTY CLAY WITH NUMEROUS FINE SAND PARTINGS AND OCCASIONAL FINE TO COARSE SAND LENSE (3 - 4 INCHES).

HARD SILTS:
VERY STIFF TO HARD, MOIST, GRAY, SLIGHTLY SANDY, SLIGHLTY CLAYEY SILT WITH OCCASIONAL FINE GRAVEL.

BOTTOM OF BORING 39.0 FEET.
BORING COMPLETED 3/3/82.



Groundwater Level

Bentonite Seal
2/4/81
ATD
Water Level (Date) At Time of Drilling
Observation Well Tip or Slotted Section

Sampling

2" O.D. Split Spoon Sample
3" O.D. Shelby Tube Sample
Cutting Sample
* No Sample Recovery

Laboratory Tests

GS	Grain Size Analysis	TUU	Triaxial Unconsolidated Undrained
CN	Consolidation Test	TCU	Triaxial Consolidated Undrained
K	Permeability Test	TCD	Triaxial Consolidated Drained
DS	Direct Shear		
QU	Unconfined Compression, tsf		
TV	Torvane, tsf		
PP	Pocket Penetrometer, tsf		

Water Content (%)

Plastic Limit — Natural Water Content — Liquid Limit

Notes

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

J-1118 July 1982
HART-CROWSER & associates inc.
Figure A-1

605911

P.O.# 852624

oring Log B-2

SOIL
INTERPRETATION

Approximate Ground Surface Elevation in Feet 43.5

ASPHALT

FILL:
LOOSE TO MEDIUM DENSE, WET, MOTTLED BROWNISH-GRAY, SLIGHTLY GRAVELLY, SLIGHTLY CLAYEY, SILTY FINE TO COARSE SAND TO CLAYEY SANDY SILT, OCCASIONAL SCATTERED ORGANICS.

CLAYEY SILTS: STIFF, WET, TAN, MOTTLED, SLIGHTLY SANDY, CLAYEY SILT (DESSICATED)

UPPER SANDS:
MEDIUM DENSE TO DENSE, SATURATED, GRAY, SLIGHTLY SILTY, GRAVELLY, FINE TO MEDIUM SAND.

SOFT CLAYS: STIFF, SATURATED, GRAY, CLAYEY SILT (DESSICATED).

VERY SOFT, SATURATED, GRAY, CLAYEY SILT TO SILTY CLAY WITH OCCASIONAL FINE SAND LENSE AND NUMEROUS SAND PARTINGS.

VERY STIFF, SATURATED, GRAY, SLIGHTLY CLAYEY, SLIGHTLY FINE SANDY SILT. (TRANSITIONAL LAWTON)

MEDIUM DENSE, SATURATED, GRAY, CLAYEY, SILTY, FINE SAND TO SANDY SILTY CLAY.

HARD SILTS:
VERY STIFF TO HARD, WET, GRAY, SLIGHTLY GRAVELLY, SANDY SILT WITH OCCASIONAL GRAVEL. LAWTON SILT

Depth Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

▽ ATD

STANDARD
PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

Sample: S-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, S-9, S-10, S-11, S-12, S-13, S-14, S-15, S-16, S-17

▲ Blows per Foot
1 5 10 20 50 100

1 2 5 10 20 50 100
● Natural Water Content (%)

LABORATORY
TESTS

GS
CN

Groundwater Level
Bentonite Seal
2/4/81
ATD
Water Level (Date) At Time of Drilling
Observation Well Tip or Slotted Section

Sampling
2" O.D. Split Spoon Sample
3" O.D. Shelby Tube Sample
Cutting Sample
★ No Sample Recovery

Laboratory Tests
GS Grain Size Analysis
CN Consolidation Test
K Permeability Test
DS Direct Shear
QU Unconfined Compression, tsf
TV Torvane, tsf
PP Pocket Penetrometer, tsf
TUU Triaxial Unconsolidated Undrained
TCU Triaxial Consolidated Undrained
TCD Triaxial Consolidated Drained

Water Content (%)
Plastic Limit — Natural Water Content — Liquid Limit

Notes
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

SOIL
INTERPRETATION

Approximate Ground Surface Elevation in Feet

LAWTON SILT

BOTTOM OF BORING 53.0 FEET.
BORING COMPLETED 3/2/82.

Depth Feet: 50, 55

STANDARD
PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

Sample: S-18

▲ Blows per Foot
1 5 10 20 50 100
60/6"

1 2 5 10 20 50 100
● Natural Water Content (%)

LABORATORY
TESTS

Groundwater Level
Bentonite Seal
2/4/81
ATD
Water Level (Date) At Time of Drilling
Observation Well Tip or Slotted Section

Sampling
2" O.D. Split Spoon Sample
3" O.D. Shelby Tube Sample
Cutting Sample
★ No Sample Recovery

Laboratory Tests
GS Grain Size Analysis
CN Consolidation Test
K Permeability Test
DS Direct Shear
QU Unconfined Compression, tsf
TV Torvane, tsf
PP Pocket Penetrometer, tsf
TUU Triaxial Unconsolidated Undrained
TCU Triaxial Consolidated Undrained
TCD Triaxial Consolidated Drained

Water Content (%)
Plastic Limit — Natural Water Content — Liquid Limit

Notes
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

605911

J-1118 July 1982
HART-CROWSER & associates inc.
Figure A-2

P.O. #852621

oring Log B-3

SOIL
TERPRETATION

STANDARD
PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

LABORATORY
TESTS

Approximate Ground Surface Elevation in Feet 45

Depth Feet

FILL:
LOOSE TO MEDIUM DENSE, GRAY BROWN, SLIGHTLY GRAVELLY, SLIGHTLY CLAYEY, SILTY FINE TO MEDIUM SAND WITH SMALL PIECES OF BRICK.

MEDIUM STIFF, SATURATED, SANDY CLAYEY, SILT WITH WOOD DEBRIS.

SOFT CLAYS:
MEDIUM STIFF, SATURATED, GRAY, BROWN, SLIGHTLY FINE SANDY, CLAYEY SILT WITH OCCASIONAL SCATTERED FINE GRAVEL.

VERY SOFT, SATURATED, GRAY, CLAYEY SILT TO SILTY CLAY.

ATD

RODS FELL 4'

Sample

▲ Blows per Foot

S-1 S-2 S-3 S-4 S-5 S-6 S-7 S-8 S-9 S-10 S-11 S-12

CN

● Natural Water Content (%)

SOIL
INTERPRETATION

Approximate Ground Surface Elevation in Feet

Depth Feet

HARD SILTS:
HARD, MOIST, GRAY, SLIGHTLY FINE GRAVELLY SLIGHTLY SANDY, SLIGHTLY CLAYEY SILT. (LAWTON SILT)

BOTTOM OF BORING 54.0 FEET.
BORING COMPLETED 3/3/82.

STANDARD
PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

LABORATORY
TESTS

Sample

▲ Blows per Foot

S-13

● Natural Water Content (%)

Groundwater Level

Bentonite Seal

2/24/81 ATD

Water Level (Date) At Time of Drilling

Observation Well Tip or Slotted Section

Sampling

- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- Cutting Sample
- * No Sample Recovery

Laboratory Tests

GS	Grain Size Analysis	TUU	Triaxial Unconsolidated Undrained
CN	Consolidation Test	TCU	Triaxial Consolidated Undrained
K	Permeability Test	TCD	Triaxial Consolidated Drained
DS	Direct Shear		
QU	Unconfined Compression, tsf		
TV	Torvane, tsf		
PP	Pocket Penetrometer, tsf		

Water Content (%)

Plastic Limit — Natural Water Content — Liquid Limit

Notes

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

J-1118 July 1982
HART-CROWSER & associates inc.
Figure A-3

P.O. [illegible] 605211

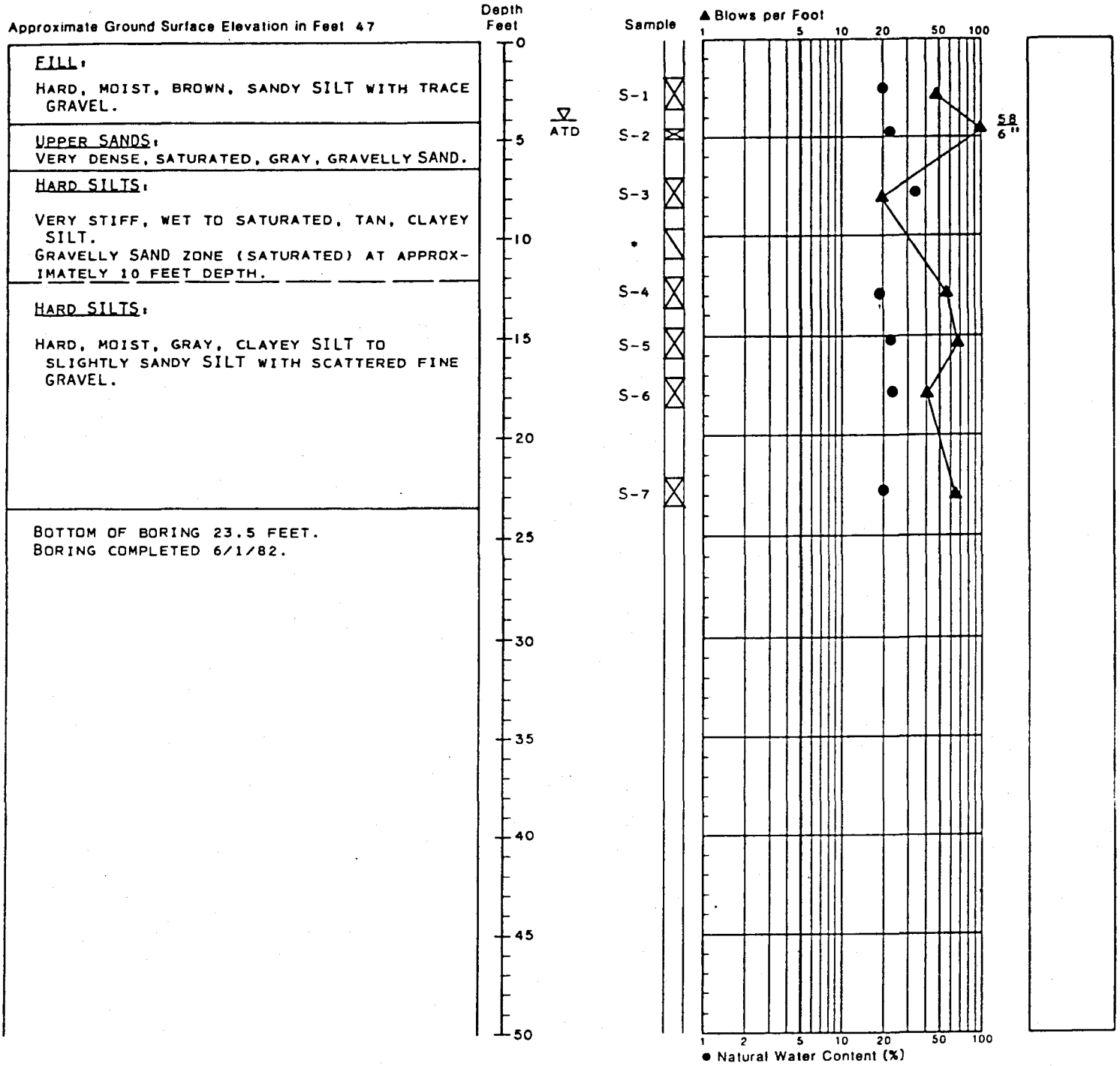
Boring Log B-4

SOIL
INTERPRETATION

STANDARD
PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

LABORATORY
TESTS

Approximate Ground Surface Elevation in Feet 47



FILL:
HARD, MOIST, BROWN, SANDY SILT WITH TRACE GRAVEL.

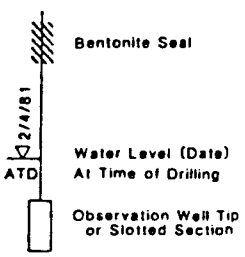
UPPER SANDS:
VERY DENSE, SATURATED, GRAY, GRAVELLY SAND.

HARD SILTS:
VERY STIFF, WET TO SATURATED, TAN, CLAYEY SILT.
GRAVELLY SAND ZONE (SATURATED) AT APPROXIMATELY 10 FEET DEPTH.

HARD SILTS:
HARD, MOIST, GRAY, CLAYEY SILT TO SLIGHTLY SANDY SILT WITH SCATTERED FINE GRAVEL.

BOTTOM OF BORING 23.5 FEET.
BORING COMPLETED 6/1/82.

Groundwater Level



Sampling

- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- Cutting Sample
- * No Sample Recovery

Laboratory Tests

GS	Grain Size Analysis
CN	Consolidation Test
K	Permeability Test
DS	Direct Shear
OU	Unconfined Compression, tsf
TV	Torvane, tsf
PP	Pocket Penetrometer, tsf
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained

Water Content (%)

Plastic Limit — Natural — Liquid Limit
Water Content

Notes

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

605911

J-1118 July 1982
HART-CROWSER & associates inc.
Figure A-4
P.O. #852624

Boring Log B-5

SOIL INTERPRETATION

STANDARD PENETRATION RESISTANCE
(140 pound weight, 30 inch drop)

LABORATORY TESTS

Approximate Ground Surface Elevation in Feet 56

ASPHALT

FILL:

MEDIUM STIFF TO STIFF, WET, BROWN TO DARK BROWN, GRAVELLY, SANDY SILT WITH ASPHALT FRAGMENTS.

SOFT CLAYS:

SOFT TO VERY STIFF, WET, BROWN TO TAN, CLAYEY SILT.

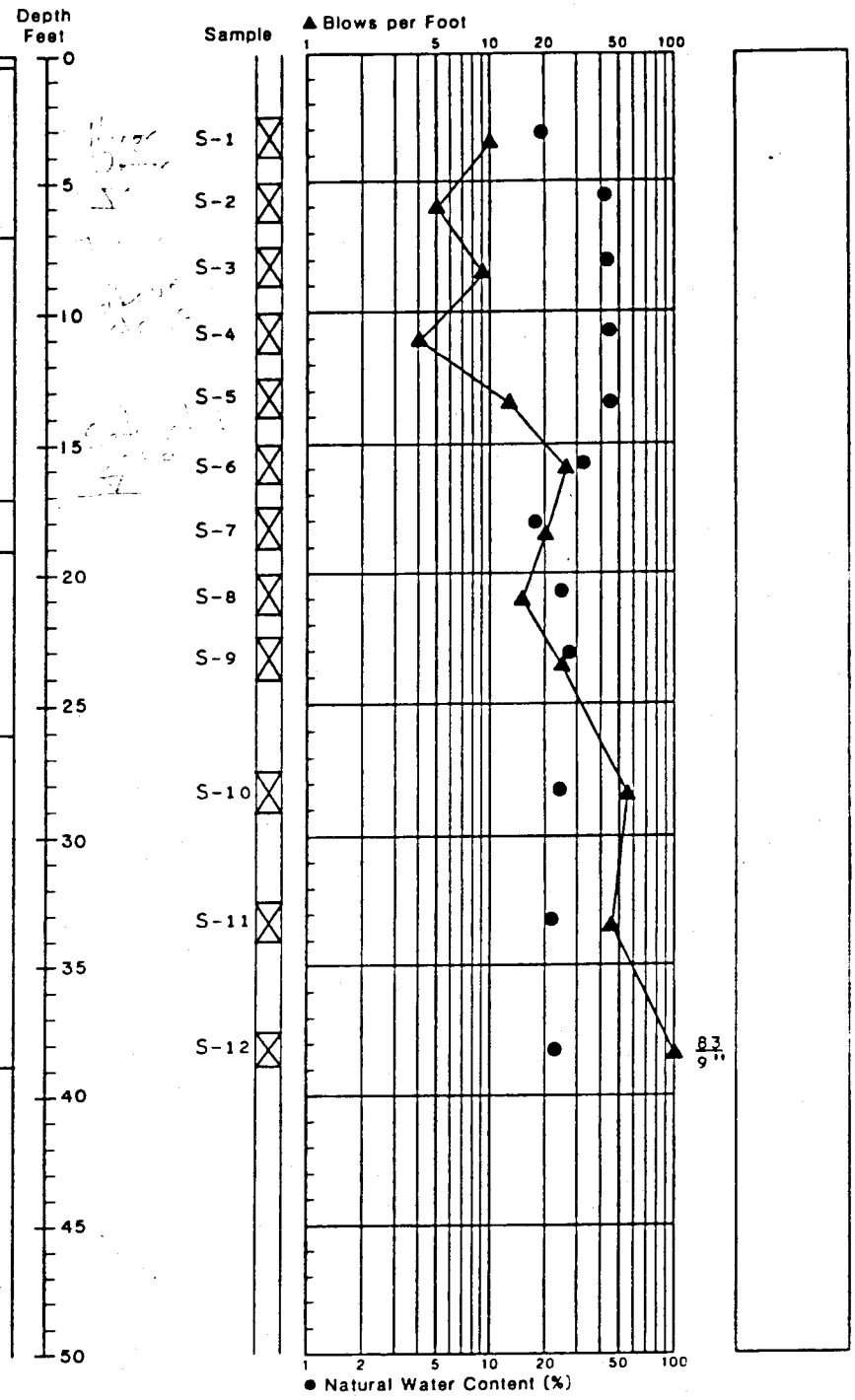
MEDIUM DENSE, SATURATED, GRAY, FINE TO COARSE SAND.

HARD SILTS:

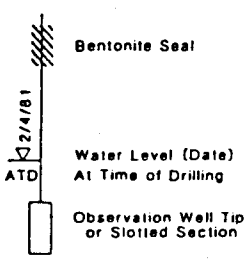
VERY STIFF, WET, GRAY, CLAYEY SILT (TRACE ORGANIC AT APPROXIMATELY 20 FEET DEPTH.)

HARD, WET, GRAY, SLIGHTLY SANDY, CLAYEY SILT WITH SCATTERED GRAVEL TO VERY DENSE, WET, GRAY, SILTY FINE SAND.

BOTTOM OF BORING 29.8 FEET.
BORING COMPLETED 6/1/82.



Groundwater Level



Sampling

- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- Cutting Sample
- No Sample Recovery

Laboratory Tests

GS	Grain Size Analysis
CN	Consolidation Test
K	Permeability Test
DS	Direct Shear
QU	Unconfined Compression, tsf
TV	Torvane, tsf
PP	Pocket Penetrometer, tsf
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained

Water Content (%)

Plastic Limit — Natural Water Content — Liquid Limit

Notes

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

605911

J-1118 July 1982

HART-CROWSER & associates inc.

Figure A-5

P.O. #852624

Boring Log B-6

SOIL INTERPRETATION

PORTER PENETRATION RESISTANCE

(40 Pound Weight ,20 Inch Drop)

LABORATORY TESTS

Approximate Ground Surface Elevation in Feet 45

Depth Feet

Sample

△ Blows per Foot

1 5 10 20 50 100

FILL:

(MEDIUM DENSE), MOIST, BROWN, GRAVELLY, SILTY SAND WITH WEATHERED ROCK.

UPPER SANDS:

(LOOSE TO MEDIUM DENSE), MOIST TO SATURATED, GRAY, SILTY, GRAVELLY SAND.

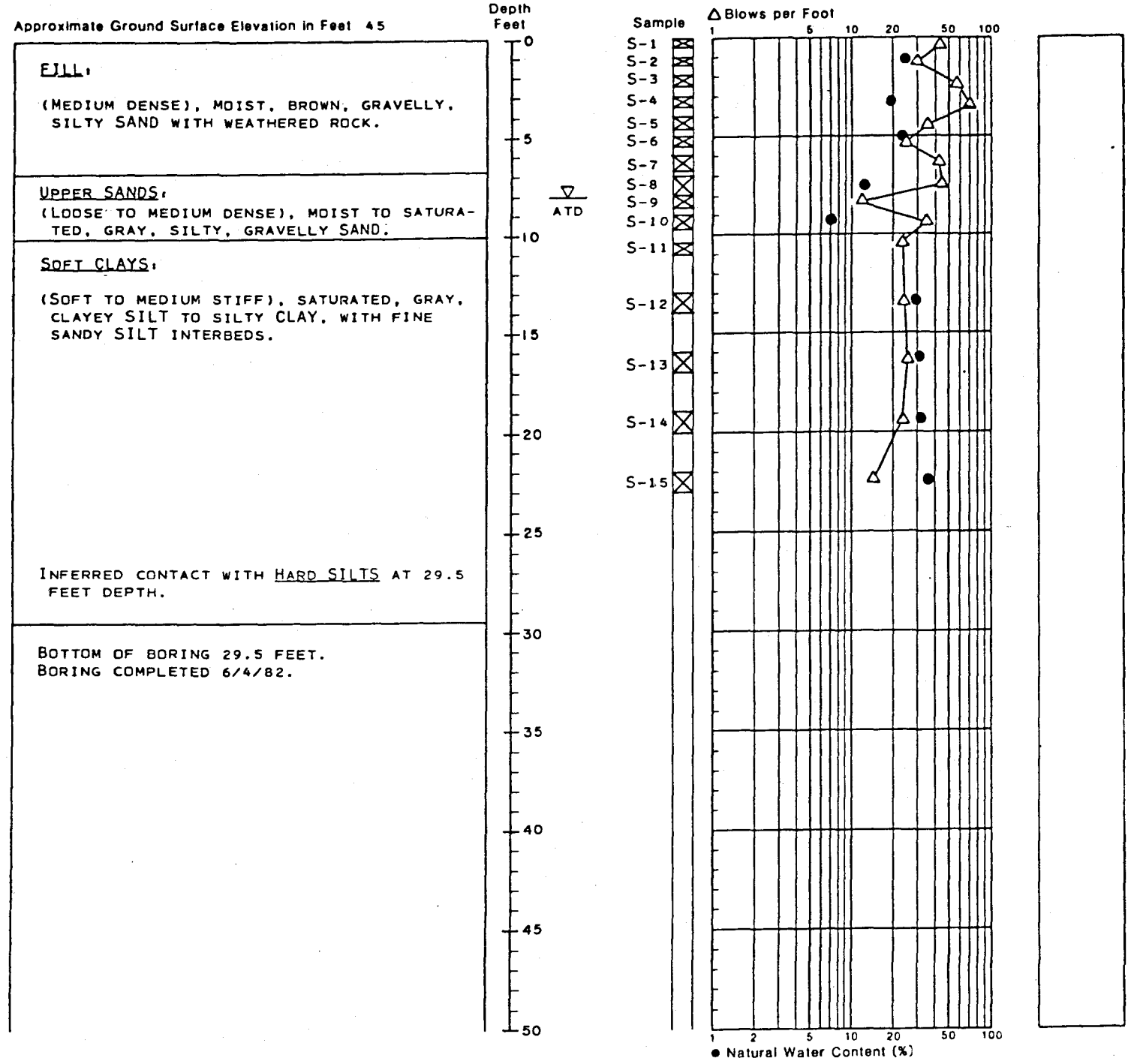
ATD

SOFT CLAYS:

(SOFT TO MEDIUM STIFF), SATURATED, GRAY, CLAYEY SILT TO SILTY CLAY, WITH FINE SANDY SILT INTERBEDS.

INFERRED CONTACT WITH HARD SILTS AT 29.5 FEET DEPTH.

BOTTOM OF BORING 29.5 FEET.
BORING COMPLETED 6/4/82.



Groundwater Level

Bentonite Seal

2/4/81 ATD

Water Level (Date) At Time of Drilling

Observation Well Tip or Slotted Section

Sampling

2" O.D. Split Spoon Sample

3" O.D. Shelby Tube Sample

Cutting Sample

No Sample Recovery

Laboratory Tests

GS	Grain Size Analysis
CN	Consolidation Test
K	Permeability Test
DS	Direct Shear
QU	Unconfined Compression, tsf
TV	Torvane, tsf
PP	Pocket Penetrometer, tsf
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained

Water Content (%)

Plastic Limit — Natural Water Content — Liquid Limit

Notes

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level, if indicated, is for the date specified and may vary with the time of year.

605011

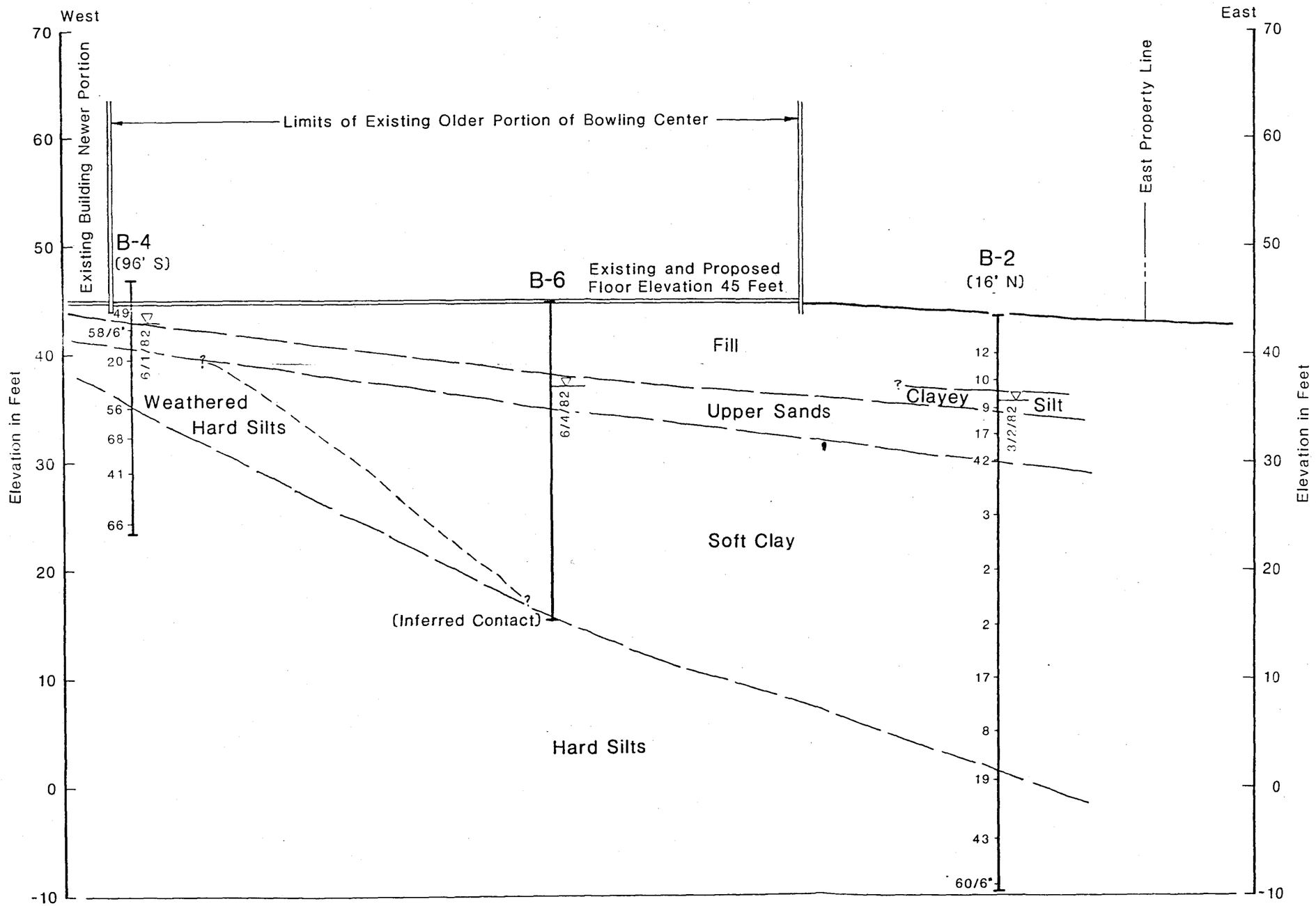
J-1118 July 1982

HART-CROWSER & associates inc.

Figure A-6

P.O. #852624

Generalized Subsurface Profile



B-4 Boring Number
(96' S) Offset Distance and Direction
Water Level
6/1/82 Date
56 SPT Value

NOTE: The stratum lines are based upon interpolation between borings and may not represent actual subsurface conditions.

0 20 40
Horizontal Scale in Feet
Vertical Exaggeration X 2

J-1118 July 1982
HART-CROWSER & associates inc.
Figure 3

APPENDIX B

GOLDER ASSOCIATES, INC.

GC-SERIES BORING LOGS

RECORD OF BOREHOLE GC-20

SHEET 1 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: 2nd and Forest

DRILLING METHOD: HSA
DRILLING DATE: 10/23/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS GRAPHIC
0	6" Hollow Stem Auger (HSA)	0.0 - 0.3 3" Asphalt			0.3							Concrete →
		0.3 - 7.0 Very loose, dark yellowish brown, silty SAND, little gravel, moist. (FILL or COLLUVIUM)	SM			1	SS	2-1-3	4	0.6/1.5	■	
5						2	SS	3-2-1	3	0.2/1.5	■	
		7.0 - 12.0 Firm, olive gray, CLAY, mottled with gold oxidized zones, no obvious structure, moist. (FILL?)	CH		7.0	3	SS	1-2-4	6	1.3/1.5	■	
10						4	SH			0.8/2.5	■	
		12.0 - 45.0 Very soft to firm, dark yellowish brown, nonstratified, CLAY, little fine subrounded gravel, little sand, wet. (LACUSTRINE DEPOSITS) (HI)			12.0	5	SS	3-3-4	7	1.5/1.5	■	
		W: 47 LL: 44 PL: 25	CH to CL			6	SH			2.5/2.5	■ O	Additional water contents: 6b=33
15						7	SS	1-3-4	7	1.5/1.5	■	Bentonite Chips →
20		Log continued on next page										

12/19/00

BOREHOLE RECORD ...\OREGC1.GPJ GLDR_WA.GDT 5/8/01

1 in to 3 ft
DRILLING CONTRACTOR: Ramlo Drilling
DRILLER: Clyde Moore

LOGGED: PLR/M.Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-20

SHEET 2 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: 2nd and Forest

DRILLING METHOD: HSA
DRILLING DATE: 10/23/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
	6" Hollow Stem Auger (HSA)	at 20' - Very soft, olive gray, CLAY with interbeds of fine sand ranging from 3-4mm to 7-9mm in thickness, wet. (LAKE DEPOSITS) (HI)	CH to CL			8	SS	0-0-1	1	1.5/1.5		
		12.0 - 45.0 Very soft to firm, dark yellowish brown, nonstratified, CLAY, little fine subrounded gravel, little sand, wet. (LACUSTRINE DEPOSITS) (HI) *(Continued)*										
		W= 43 LL= 39 PL= 17				9	SH			2.3/2.5		Additional water contents: 9b=33
25						10	SS	2-1-2	3	1.5/1.5		
						11	SS	2-1-4	5	1.5/1.5		
30						12	SS	0-0-0	0	1.5/1.5		
		W= 46 LL= 50 PL= 20				13	SS	1-0-1	1	1.5/1.5		Sand →
35						14	SS	0-2-2	4	1.5/1.5		

Log continued on next page

to 3 ft
NG CONTRACTOR: Ramlo Drilling
ER: Clyde Moore

LOGGED: PLS/MW Wehler
CHECKED: D. Finlay
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-20

SHEET 3 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: 2nd and Forest

DRILLING METHOD: HSA
DRILLING DATE: 10/23/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS GRAPHIC
		12.0 - 45.0 Very soft to firm, dark yellowish brown, nonstratified, CLAY, little fine subrounded gravel, little sand, wet. (LACUSTRINE DEPOSITS) (HI) *(Continued)*	CH to CL									
						15	SS	1-1-2	3	1.5/1.5	■	
45		45.0 - 46.5 Gravelly CLAY	GC		45.0							
		46.5 - 90.0 Very stiff to hard, olive gray, bedded to 55' then massive, CLAY, little gravel, little sand, fractureed with "slickensides" at 30 degrees to vertical predominantly, dry. (GLACIOMARINE DEPOSITS) (Qpgm) (CH?)			46.5							
						16	SS	3-6-10	16	1.4/1.5	■	
50												
			CH			17	SS	6-14-22	36	1.5/1.5	■	
55												
						18	SS	8-14-23	37	1.5/1.5	■	
60		Log continued on next page										

6" Hollow Stem Auger (HSA)

1 in to 3 ft
DRILLING CONTRACTOR: Ramlo Drilling
DRILLER: Clyde Moore

LOGGED: PLR/M.Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

BOREHOLE RECORD BOREGC1.GPJ GLDR_WA.GDT 5/8/01

RECORD OF BOREHOLE GC-20

SHEET 4 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: 2nd and Forest

DRILLING METHOD: HSA
DRILLING DATE: 10/23/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p — W — W_l	NOTES WATER LEVELS / GRAPHIC
		46.5 - 90.0 Very stiff to hard, olive gray, bedded to 55' then massive, CLAY, little gravel, little sand, fractureed with "slickensides" at 30 degrees to vertical predominantly, dry. (GLACIOMARINE DEPOSITS) (Qpgm) (CH?) *(Continued)*										
						19	SS	6-11-14	25	1.5/1.5	■	
65												
						20	SS	12-20-30	50	1.5/1.5	■	Backfill and Bentonite Chips →
70			CH									
						21	SS	25-34-25	>50	1.5/1.5	>>■	
						22	SS	15-25-29	>50	1.5/1.5	>>■	

Log continued on next page

CONTRACTOR: Ramlo Drilling
Clyde Moore

LOGGED: PL[illegible]hler
CHECKED: [illegible]
DATE: 03/08/[illegible]

Golder Associates

RECORD OF BOREHOLE GC-20

SHEET 5 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: 2nd and Forest

DRILLING METHOD: HSA
DRILLING DATE: 10/23/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p — W — W_l	NOTES WATER LEVELS / GRAPHIC
	6" Hollow Stem Auger (HSA)	46.5 - 90.0 Very stiff to hard, olive gray, bedded to 55' then massive, CLAY, little gravel, little sand, fractureed with "slickensides" at 30 degrees to vertical predominantly, dry. (GLACIOMARINE DEPOSITS) (Qpgm) (CH?) *(Continued)*	CH									
						23	SS	7-22-25	47	1.5 / 1.5	■	
85												
						24	SS	12-21-27	48	1.5 / 1.5	■	
90		Boring completed at 90.0 ft.			90.0							
95												
100												

1 in to 3 ft
DRILLING CONTRACTOR: Ramlo Drilling
DRILLER: Clyde Moore

LOGGED: PLR/M.Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

BOREHOLE RECO...OREGC1.GPJ GLDR_WA.GDT 5/8/01

RECORD OF BOREHOLE GC-22

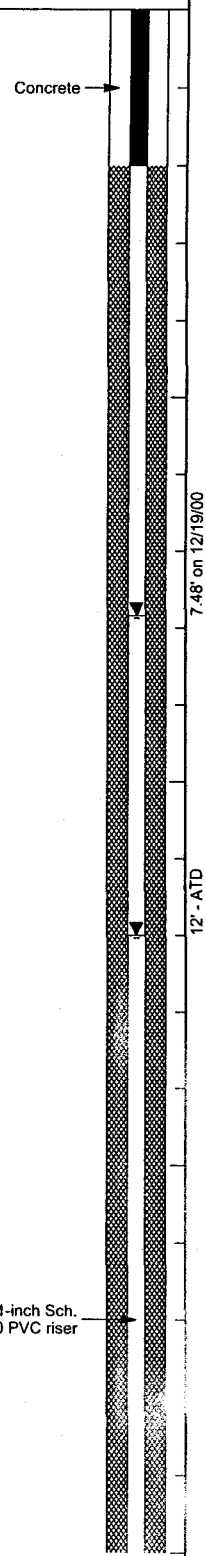
SHEET 1 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment #3
DRILLING METHOD: HSA
DRILLING DATE: 8/14/00
DRILL RIG: Mobile B-59
DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed
ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p — W — W_l
0	4" I.D. Hollow Stem Auger (HSA) with SPT Autohammer	0.0 - 0.5 Asphalt									
		0.5 - 5.0 Firm, medium gray to olive brown, mottled, nonstratified, SILTY CLAY, trace to little subrounded to rounded fine gravel, trace to little fine to coarse sand, trace wood, trace brick, damp. (FILL)	CL		0.5	1	SS	2-3-4	7	1.2 / 1.5	
						2	SS	2-3-4	7	1.2 / 1.5	
5		5.0 - 7.0 Stiff, medium gray to olive brown and brown, nonstratified, fine sandy SILT, trace subrounded to rounded gravel, trace brick, trace charcoal debris, trace asphalt(?), trace wood, moist. (FILL)	ML		5.0	3	SS	3-7-6	13	1.5 / 1.5	
		7.0 - 8.5 Soft, medium gray to olive brown, nonstratified, CLAYEY SILT, trace wood debris, moist. (FILL?)	ML		7.0	4	SS	2-2-2	4	1.5 / 1.5	
		8.5 - 9.5 Soft, dark brown, ORGANIC SILT, moist. (PEAT?)	OL		8.5						
10		9.5 - 63.5 Soft to very soft, gray to bluish gray to brownish gray to yellowish brown, massive to chaotically laminated to laminated, SILTY CLAY, CLAYEY SILT, and CLAY, trace fine to coarse sand throughout, trace to little fine to medium sand laminae and interbeds, trace wood, moist to wet. (LACUSTRINE DEPOSIT) (HI)	CL, ML to CH		9.5	5	SS	1-1-3	4	1.3 / 1.5	
		W= 42									
		W= 40				6	SS	1-2-2	4	1.5 / 1.5	
15		W= 41				7	SS	1-1-1	2	1.5 / 1.5	
		W= 49 LL= 52 PL= 20				8	SS	0-0-0	0	1.5 / 1.5	
20		continued on next page									

NOTES WATER LEVELS

GRAPHIC



ft

DRILLING CONTRACTOR: Straightline

DRILLER: Mike R.

LOGGED: C. Allen

CHECKED: Findley

DATE: 03/[illegible]/2001

Golder Associates

RECORD OF BOREHOLE GC-22

SHEET 2 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment #3

DRILLING METHOD: HSA
DRILLING DATE: 8/14/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS GRAPHIC
	4" I.D. Hollow Stem Auger (HSA) with SPT Autohammer	9.5 - 63.5 Soft to very soft, gray to bluish gray to brownish gray to yellowish brown, massive to chaotically laminated to laminated, SILTY CLAY, CLAYEY SILT, and CLAY, trace fine to coarse sand throughout, trace to little fine to medium sand laminae and interbeds, trace wood, moist to wet. *(LACUSTRINE DEPOSIT) (HI) (Continued)*	CL, ML to CH			9	SS	0-1-0	1	1.5/1.5	■	
25												Bentonite Chips and Bentonite Grout
		W= 29 LL= 39 PL= 16				10	SS	0-0-0	0	1.5/1.5	■ W	
30												
		W= 50				11	SS	0-0-0	0	1.5/1.5	■ O	
35												
		W= 42				12	SS	0-0-1	1	1.5/1.5	■ O	
40		Log continued on next page										

1 in to 3 ft
DRILLING CONTRACTOR: Straightline
DRILLER: Mike R.

LOGGED: C. Allen
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

BOREHOLE RECORD - OREGC1.GPJ GLDR_WA.GDT 5/8/01

RECORD OF BOREHOLE GC-22

SHEET 3 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment #3

DRILLING METHOD: HSA
DRILLING DATE: 8/14/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
	4" I.D. Hollow Stem Auger (HSA) with 5/7" Autohammer	9.5 - 63.5 Soft to very soft, gray to bluish gray to brownish gray to yellowish brown, massive to chaotically laminated to laminated, SILTY CLAY, CLAYEY SILT, and CLAY, trace fine to coarse sand throughout, trace to little fine to medium sand laminae and interbeds, trace wood, moist to wet. (LACUSTRINE DEPOSIT) (HI) *(Continued)*										
						13	SS	0-0-0	0	1.5/1.5		
45												
		W= 25 LL= 29 PL= 17				14	SS	0-0-0	0	1.5/1.5		
50			CL, ML to CH									Bentonite Chips
						15	SS	0-0-0	0	1.5/1.5		
55												10/20 Silica Sand
		W= 42				16	SS	0-0-0	0	1.3/1.5		
		Log continued on next page										

ft
NG CONTRACTOR: Straightline
R: Mike R.

LOGGED: len
CHECKED: Findley
DATE: 03/ /2001

Golder Associates

RECORD OF BOREHOLE GC-22

SHEET 4 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment #3

DRILLING METHOD: HSA
DRILLING DATE: 8/14/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
	4" I.D. Hollow Stem Auger (HSA) with SPT Autohammer	9.5 - 63.5 Soft to very soft, gray to bluish gray to brownish gray to yellowish brown, massive to chaotically laminated to laminated, SILTY CLAY, CLAYEY SILT, and CLAY, *trace fine to coarse sand throughout*, trace to little fine to medium sand laminae and interbeds, trace wood, moist to wet. (LACUSTRINE DEPOSIT) (HI) *(Continued)*	CL, ML to CH									1-inch Sch. 40 PVC 10-slot screen
		63.5 - 65.0 Dense, medium gray, nonstratified, fine to medium SAND, trace silt, wet. (GLACIOMARINE DRIFT) (Qpgm)	SP		63.5	17	SS	0-21-21	42	1.2/1.5	■	
65		65.0 - 99.5 Hard, medium gray, massive, SILTY CLAY to CLAY, trace to little subrounded to angular faceted fine to coarse gravel, trace to little fine to coarse sand, trace wood, moist. (GLACIOMARINE DRIFT) (Qpgm)			65.0							
						18	SS	8-15-21	36	1.5/1.5	■	
70		Scattered gravels noted in drill action from 71 to 72'	CL									
						19	SS	5-13-22	35	1.5/1.5	■	Bentonite Chips
75												
						20	SS	8-14-21	35	1.5/1.5	■	
80		Log continued on next page										

1 in to 3 ft
DRILLING CONTRACTOR: Straightline
DRILLER: Mike R.

LOGGED: C. Allen
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

BOREHOLE RECORD - OREGC1.GPJ GLDR_WA.GDT 5/30/01

RECORD OF BOREHOLE GC-22

SHEET 5 of 5

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment #3

DRILLING METHOD: HSA
DRILLING DATE: 8/14/00
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p — W — W_l	NOTES WATER LEVELS / GRAPHIC
	4" I.D. Hollow Stem Auger (HSA) with SPT Autohammer	65.0 - 99.5 Hard, medium gray, massive, SILTY CLAY to CLAY, trace to little subrounded to angular faceted fine to coarse gravel, trace to little fine to coarse sand, trace wood, moist. (GLACIOMARINE DRIFT) (Qpgm) *(Continued)*										
						21	SS	16-18-22	40	1.5/1.5		
85												
						22	SS	10-17-23	40	1.5/1.5		
90			CL									Bentonite Grout
						23	SS	12-16-24	40	1.5/1.5		
95												
						24	SS	12-17-24	41	1.5/1.5		
		Boring completed at 99.5 ft.			99.5							

1 [illegible] ft
[illegible]NG CONTRACTOR: Straightline
[illegible]R: Mike R.

LOGGED: C. Allen
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-23

SHEET 1 of 6

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Cheasty/MLK

DRILLING METHOD: HSA
DRILLING DATE: 10/25/00
DRILL RIG: CME-75

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
0	Hollow Stem Auger	0.0 - 0.5 Asphalt and Gravel Base										
		0.5 - 2.5 Subangular GRAVEL with debris -wood, brick, glass, rubber, vinyl.			0.5							
		2.5 - 7.0 Stiff, greenish-gray to gray and brown, nonstratified, SILTY CLAY, with varying amounts of sand and gravel, wood and brick debris, lenses of clayey silt and silty fine sand at 85', moist. (CL) (FILL)	CL		2.5	1	SS	2-3-6	9	0.7 / 1.5	■	
5						2	SS	3-3-5	8	0.9 / 1.5	■	
		7.0 - 10.0 Stiff, gray to greenish-gray, SILTY CLAY, trace sand, trace gravel, little burnt wood debris and fresh-looking (still yellow) seeds on branch, moist. (CL) (FILL/COLLUVIUM)	CL		7.0	3	SS	1-3-5	8	1.5 / 1.5	■	3" Diameter seismic casing
10		10.0 - 11.0 Stiff, dark brown grading down to light grayish-brown, SILTY CLAY, some organics, roots, trace sand, moist. (PT/OH) (HP)	PT/OH		10.0	4	SS	2-3-6	9	1.5 / 1.5	■	Cement/ Bentonite Grout Additional Moisture Contents: 5b=89; 5c=71; 5d=40; 5e=34; 5f=35; 5g=35; 5h=37
		11.0 - 14.5 Stiff, light bluish-gray, SILTY CLAY with decomposing organics (little and scattered), trace fine sand, some lenses of brown peat, moist (CL) (LACUSTRINE DEPOSIT-HI) W= 36 LL= 55 PL= 21	CL to CH and PT/OH		11.0	5	SH			2.5 / 2.5	■	
15		14.5 - 20.5 Firm, gray with orange mottling, thinly stratified, SILTY CLAY and CLAYEY SILT, little layers of silty fine sand, moist to wet. (CL, ML, SM) (LACUSTRINE DEPOSIT) (HI) W= 41 LL= 33 PL= 24	CL to CH, ML, SM		14.5	6	SS	1-4-3	7	1.5 / 1.5	■	Additional Moisture Content, Liquid Limits and Plastic Limits: 7b=37; 7c=39; 7d=34 LL:57 PL:22; 7e=48; 7f=26; 7g=26; 7h=35; 7i=43
						7	SH			2.5 / 2.5	■	
20		Log continued on next page										ATD - 14.5'

1 in to 3 ft
DRILLING CONTRACTOR: Ramlo Drilling
DRILLER: Clyde Moore

LOGGED: M. Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

BOREHOLE RECORD OREGC1.GPJ GLDR_WA.GDT 5/8/01

RECORD OF BOREHOLE GC-23

SHEET 2 of 6

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Cheasty/MLK

DRILLING METHOD: HSA
DRILLING DATE: 10/25/00
DRILL RIG: CME-75

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS GRAPHIC
		20.5 - 48.0 Very soft, light gray, thinly stratified, SILTY CLAY, little thin beds of fine sand, wet, slick. (CL) (LACUSTRINE DEPOSIT) (HI)			20.5							
						8	SS	0-0-0	0	1.5/1.5		Additional Moisture Contents: 9b=38; 9c=68; 9d=80; 9e=40; 9f=73; 9g=10; 9h=76
25		W= 64 LL= 69 PL= 26				9	SH			2.5/2.5		
						10	SS	0-0-0	0	1.5/1.5		3" Diameter seismic casing
	Hollow Stem Auger	W= 57 LL= 57 PL= 23	CL to CH			11	SH			2.5/2.5		Additional Moisture Contents: 11b=71; 11c=59; 11d=43; 11e=46; 11f=33; 11g=26
												Cement/ Bentonite Grout
						12	SS	0-0-0	0	1.5/1.5		
		at 37.5 - 1.5' thick layer of firm, gray, faintly stratified, fine sandy SILT, trace to little clay, moist. (ML)				13	SS	3-4-3	7	0.5/1.5		
		W= 59 LL= 57 PL= 23				14	SH			2.5/2.5		Additional

Log continued on next page

ft
NG CONTRACTOR: Ramlo Drilling
R: Clyde Moore

LOGGED: M. Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-23

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Cheasty/MLK
DRILLING METHOD: HSA
DRILLING DATE: 10/25/00
DRILL RIG: CME-75
DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed
ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS GRAPHIC
	Hollow Stem Auger	20.5 - 48.0 Very soft, light gray, thinly stratified, SILTY CLAY, little thin beds of fine sand, wet, slick. (CL) (LACUSTRINE DEPOSIT) (HI) *(Continued)*	CL to CH			14	SH			2.5/2.5		Moisture Content, Liquid Limit, Plastic Limit: 14b=66, LL: 57, PL: 23
						15	SS	0-0-0	0	1.5/1.5		
45												
		48.0 - 51.0 Compact, gray, nonstratified to faintly laminated, silty fine SAND/fine sandy SILT, moist. (SM/ML) (HI)	SM/ML		48.0	16	SS	0-5-15	20	1.5/1.5		3" Diameter seismic casing
50												
		51.0 - 56.5 Very soft, light gray, thinly stratified, SILTY CLAY, little thin beds of fine sand, wet, slick. (CL) (LACUSTRINE DEPOSITS) (HI)	CL		51.0	17	SS	0-0-0	0	1.5/1.5		Cement/ Bentonite Grout
55						18	SH			1.5/2.5		
		56.5 - 100.0 Very stiff to hard, gray, massive to faintly laminated, SILTY CLAY, little to some sand, trace to some subangular and subrounded gravel, trace shell fragments, moist. (CL) (GLACIOMARINE DEPOSITS) (Qpgm)	CL		56.5	19	SS	4-9-13	22	1.5/1.5		
60		Log continued on next page										

1 in to 3 ft
DRILLING CONTRACTOR: Ramlo Drilling
DRILLER: Clyde Moore
LOGGED: M. Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-23

SHEET 4 of 6

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Cheasty/MLK

DRILLING METHOD: HSA
DRILLING DATE: 10/25/00
DRILL RIG: CME-75

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS GRAPHIC
		56.5 - 100.0 Very stiff to hard, gray, massive to faintly laminated, SILTY CLAY, little to some sand, trace to some subangular and subrounded gravel, trace shell fragments, moist. (CL) (GLACIOMARINE DEPOSITS) (Qpgm) *(Continued)*										
						20	SS	9-18-26	44	1.5/1.5	■	
65												
		at 67.5' - becomes gray to dark gray and massive				21	SS	12-21-26	47	1.5/1.5	■	3" Diameter seismic casing
70			CL									Cement/ Bentonite Grout
		at 72.5' - becomes damp to moist, absence of shell fragments				22	SS	12-19-27	46	1.5/1.5	■	
75												
						23	SS	9-21-26	47	1.5/1.5	■	

Log continued on next page

ft
NG CONTRACTOR: Ramlo Drilling
ER: Clyde Moore

LOGGED:
CHECKED: dley
DATE: 03/ /001

Golder Associates

RECORD OF BOREHOLE GC-23

SHEET 5 of 6

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Cheasty/MLK

DRILLING METHOD: HSA
DRILLING DATE: 10/25/00
DRILL RIG: CME-75

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
		56.5 - 100.0 Very stiff to hard, gray, massive to faintly laminated, SILTY CLAY, little to some sand, trace to some subangular and subrounded gravel, trace shell fragments, moist. (CL) (GLACIOMARINE DEPOSITS) (Qpgm) *(Continued)*										
						24	SS	11-20-27	47	1.5/1.5	■	
85												
		at 87.5' - increase in silt content (CL/ML)				25	SS	16-21-29	50	1.5/1.5	■	3" Diameter seismic casing
90	Hollow Stem Auger		CL									Cement/ Bentonite Grout
		at 92.5' - decrease in silt content (CL)				26	SS	12-23-24	47	1.5/1.5	■	
95												
						27	SS	13-21-25	46	1.5/1.5	■	
100		Log continued on next page										

1 in to 3 ft
DRILLING CONTRACTOR: Ramlo Drilling
DRILLER: Clyde Moore

LOGGED: M. Stiehler
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-23

SHEET 6 of 6

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Cheasty/MLK

DRILLING METHOD: HSA
DRILLING DATE: 10/25/00
DRILL RIG: CME-75

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
		Boring completed at 100.0 ft.			100.0							
105												
110												
115												

ft
NG CONTRACTOR: Ramlo Drilling
ER: Clyde Moore

LOGGED: M. S[illegible]ner
CHECKED: D. Findley
DATE: 03/08/2001

Golder Associates

RECORD OF BOREHOLE GC-75

SHEET 1 of 1

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment 3/MLK

DRILLING METHOD: HSA
DRILLING DATE: 3/20/01
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 56.9
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40) / WATER CONTENT (PERCENT) W_p W W_l	NOTES WATER LEVELS / GRAPHIC
0	Hollow Stem Auger (HSA)	0.0 - 0.3 ASPHALT			56.6							
		0.3 - 0.6 sandy GRAVEL with concrete debris.	GW		56.3							
		0.6 - 4.6 Very stiff, tannish gray, mottled, massive, CLAYEY SILT, little fine sand, little gravel, damp. (COLLUVIUM/FILL?)			0.6	1	SS	12-13-15	28	1.0 / 1.5		
			ML			2	SS	4-9-9	18	1.0 / 1.5		
					52.3							
5		4.6 - 10.4 Stiff to firm, gray to dark gray, CLAYEY SILT, little sand, little gravel, little lenses of silty SAND and fine to medium SAND, thin threads and small lenses of topsoil, trace to little woody debris, moist to wet. (COLLUVIUM/FILL?)			4.6	3	SS	2-4-5	9	0.7 / 1.5		Bentonite
			ML			4	SS	1-4-5	9	0.8 / 1.5		
10					46.5							
		10.4 - 11.3 Very loose to loose, dark brown, organic silty SAND/sandy SILT, trace to little gravel, damp to moist. (TOPSOIL)	SM-ML		10.4	5	SS	1-2-3	5	1.4 / 1.5		
		11.3 - 11.5 Firm, dark gray, massive, CLAYEY SILT, moist. (LAKE DEPOSITS)	ML		45.6							
					11.5							
		No contamination observed Boring completed at 11.5 ft.										
15												
20												

1 inch = 3 ft
DRILLING CONTRACTOR: Straightline
DRILLER: Clyde Moore

LOGGED: M Stiehler
CHECKED: F Mocker
DATE: 3/23/2001

Golder Associates

BOREHOLE - TYPICAL BORING LOG GLDR WA

RECORD OF BOREHOLE GC-76

SHEET 1 of 1

PROJECT: Sound Transit/ / WA
PROJECT NUMBER: 003-1112
LOCATION: Segment 3/MLK

DRILLING METHOD: HSA
DRILLING DATE: 3/20/01
DRILL RIG: Mobile B-59

DATUM: Local/MSL
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 64.0
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	NOTES WATER LEVELS / GRAPHIC
0	Hollow Stem Auger (HSA)	0.0 - 0.3 ASPHALT			63.7						
		0.3 - 0.6 sandy GRAVEL with concrete debris.	GW		63.4 / 0.6						
		0.6 - 7.4 Very stiff to stiff, tannish gray, mottled, massive, CLAYEY SILT, little to trace fine *sand, little to trace gravel, damp.*	ML			1	SS	14-12-11	23	1.5 / 1.5	
		Bulk Sample collected from 0.5 to 4'				2	SS	6-6-5	11	1.4 / 1.5	
5		@5': becomes moist with lenses of gray silt, thin threads of topsoil, woody debris. (COLLUVIUM)				3	SS	2-4-4	8	0.9 / 1.5	Bentonite
		7.4 - 11.5 Firm, gray and dark gray, CLAYEY SILT to sandy SILT, trace to little gravel, little lenses of silty sand, thin threads of topsoil, moist. (COLLUVIUM)			56.6 / 7.4	4	SS	2-2-4	6	1.0 / 1.5	
10		@10': some woody debris	ML			5	SS	1-3-3	6	0.2 / 1.5	
		No contamination observed Boring completed at 11.5 ft.			52.5 / 11.5						
15											
20											

PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)
WATER CONTENT (PERCENT) W_p — W — W_l

1 in to 3 ft
DRILLING CONTRACTOR: Straightline
DRILLER: Clyde Moore

LOGGED: M. Stiehler
CHECKED: F. Mocker
DATE: 3/23/2001

Golder Associates

BOREHOLE RECORD BOREGC2.GPJ GLDR_WA.GDT 4/17/01

APPENDIX C

GEOTECH CONSULTANTS, INC.

TP-SERIES TEST PIT LOGS

TEST PIT 1

Depth (ft.) | Moisture Content (%) | Water Table | USCS | Description | Elevation ~ 3'

	FILL	Gray and brown, gravelly, silty SAND, fine- to medium-grained, with concrete and asphalt debris and organics, very moist, loose ***(FILL)***
		Dark brown Topsoil
5	SP	Brown, gravelly SAND, moist, medium-dense ***(Possible FILL)***
	ML	Tan, slightly sandy SILT, low-plasticity, moderately fractured, with iron stains and occasional gravel, moist, stiff
10		- becomes very moist, medium-stiff to stiff
15		

*** Test Pit was terminated at 11 feet on January 16, 2002.**
*** Trace groundwater seepage was observed at 5 feet during excavation.**
*** No caving was observed during excavation.**

TEST PIT 2

Depth (ft.) | Moisture Content (%) | Water Table | USCS | Description | Elevation 0'

	FILL	Gravelly SAND and sandy SILT, very moist, loose ***(FILL)***
	ML	Tan, slightly sandy SILT, low-plasticity, with iron stains and occasional gravel, moist, stiff
5		- becomes very moist, medium-stiff to stiff
10		
15		

*** Test Pit was terminated at 9 feet on January 16, 2002.**
*** No groundwater seepage was observed during excavation.**
*** No caving was observed during excavation.**

GEOTECH CONSULTANTS, INC.

TEST PIT LOGS

2129 - 27th Avenue South
Seattle, Washington

Job No:	Date:	Logged by:	Plate:
02034	Jan. 2002	JHS	3