GEOTECHNICAL ENGINEERING STUDY

PROPOSED OFFICE/APARTMENT SITE
9420 RAINIER AVENUE SOUTH
SEATTLE, WASHINGTON
G-1489

Prepared for

Ms. Maria Brooks
Escrow Affairs, Inc.
9262 B 57th Avenue South
Seattle, WA 98118

January 14, 2002

GEO GROUP NORTHWEST, INC.
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GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists
& Environmental Scientists

January 14, 2002

Project No. G-1489

Ms. Maria Brooks
Escrow Affairs, Inc.
9262 B 57th Avenue South
Seattle, WA 98118

Subject: **Geotechnical Engineering Study**
Proposed Apartment Site
9420 Rainier Avenue South
Seattle, Washington

Dear Ms. Brooks:

We are pleased to submit herewith our report titled "Geotechnical Engineering Study, Proposed Office/Apartment Site, 9420 Rainier Avenue South, Seattle, Washington". This report presents our findings and geotechnical recommendations for the proposed construction of an combined retail-apartment unit building on the lot.

The subsurface soil and groundwater conditions were investigated by drilling two exploratory borings. Fill soil was encountered in the borings to a depth of about 14 feet. The Fill generally consisted of loose to very loose silty Sand and sandy Silt. The Fill is underlain by loose alluvial soils consisting of sandy Silt and silty Sand to depths of 17.5 to 22 feet. Underlying the loose alluvium are dense alluvial soils consisting of interbedded Sands and Silts. Groundwater seepage was encountered below about 13 feet and the static water level is about 5.5 feet below the ground surface.

Based on the subsurface soil conditions and the results of our analyses, we recommend that the new building structures be supported on pile foundations that extend down beyond the loose soils and are embedded a minimum of five feet into the dense underlying soils. Because of the high water table, the piles should be installed by the augercast method.

Our recommendations, along with other geotechnically related aspects of the project, are discussed in more detail in the text of the attached report. We appreciate the opportunity to

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perform this geotechnical study and look forward to working with you in the construction phase of the project. If you or your design team have any questions about the content of this report, or if we can be of further assistance, please call.

Respectfully Submitted,
GEO GROUP NORTHWEST, INC.

William Chang

William Chang, P.E.
Principal

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GEOTECHNICAL ENGINEERING STUDY
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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The subject lot is located at 9420 Rainier Avenue South, Seattle, Washington as shown on the Vicinity Map, Plate 1. The 0.2 acre lot is occupied by an existing 800 square foot building that fronts Rainier Avenue South, as shown on the Site Plan, Plate 2.

Based on discussions with Mr. & Mrs. Brooks, purchasers of the property, we understand that a new building is planned that will provide both office space and apartment units on the site. Architect plans, including size and location for the new building have not been developed as of the writing of this report.

This geotechnical study was limited to the subject property. Geo Group Northwest, Inc. should be retained to review the final plans for the project to confirm the validity of the recommendations contained in this report if there are significant changes to the above plans to the site.

1.2 SCOPE OF SERVICES

The scope of work performed is in general accordance with our proposal dated December 26, 2001. Tasks included:

1. Exploration of the subsurface soil and groundwater conditions by drilling two borings, to a maximum depth of 30.5 feet.

2. Classification of the site soils, laboratory analyses, and preparation of boring logs.

3. Engineering analyses including analysis for liquefaction potential, settlement potential, foundation support, slab-on-grade floors, excavations, pavement section design, and earthwork criteria.

4. Preparation of this geotechnical report with the results of the study.

This report has been prepared for specific application to this project for the exclusive use of Mrs. Maria Brooks and her representatives. We recommend that this report in its entirety be included in the project contract documents for the information of the contractor.

2.0 SITE CONDITIONS

2.1 SURFACE

The subject property consists of Lot 5 and the eastern 20 feet of Lot 4, except the northern 25 feet thereof, in Block 66 of Rainier Beach in King County Washington. The lot is trapezoidal in shape measuring 120.76 feet along the east property line and 70 feet along the north property line, as shown on the Site Plan, Plate 2. The subject property is bounded to the north by a residential apartment complex, to the east and west by commercially developed properties and to the south by Rainier Avenue South.

A 40 foot by 20 foot one-story wood frame office building is located faces Rainier Avenue South in the southern portion of the property. The lot is flat, paved and is currently being used to store vehicles.

Topographically, the area south of the site slopes down to the north, toward Rainier Avenue South and the valley area of Rainier Beach. The subject lot is situated on a bench at the base of the slope. The lot is flat with an elevation of approximately 38 feet according to the GIS data prepared by the City of Seattle, as shown on the Site Plan, Plate 2 of illustrations. There is a moderately steep north descending slope located just beyond the north property line. The slope height of 14 feet and a gradient of 35 percent. The slope and the northern 25 feet of the site is heavily vegetated with blackberry vines.

2.3 SUBSURFACE

According to the Preliminary Geologic Map of Seattle and Vicinity, Washington, by H. H. Waldron, B. A. Liesch, D. R. Mullineaux, and D. R. Crandell, published by the U.S. Geological

Survey in 1962, the site area is underlain by Alluvium (Qa). Alluvium consists of relative young deposits of sands and silts, including clays and peat, deposited by streams. Unconfined perched groundwater is common.

On January 3, 2002, the subsurface conditions of the project site were explored by drilling two borings to a depth of up to 30.5 feet. The borings were located approximately as shown on the Site Plan, Plate 2. Stored cars on the lot were moved to allow access to the boring locations.

Soil samples were collected by driving a split-spoon sampling tube with a 140 pound hammer. The soil conditions were logged, standard penetration test (SPT) blow counts recorded, and soil samples collected by a geologist from our office. The soil samples were brought to our office for laboratory analysis of moisture content and verification of the field soil classifications.

In Boring B-1, the subsurface soils consisted of approximately 14.5 feet of mottled brown and gray, loose to very loose, silty Sand and sandy Silt (FILL). From 14.5 feet to 17 feet, we encountered loose, fine silty SAND, wet and oxidized. Below 17.5 feet the soils were medium dense to dense and consisted of Sand interbedded with Silt.

The soils encountered in Boring B-2 consisted of approximately 12 feet of loose to very loose, mottled brown and gray, sandy Silty and Silt (FILL). The native soils under the fill consisted of gray, medium stiff, Silt to a depth of 15 feet, underlain by brown, medium stiff, Silt with some organics and brown fine Sands interbedded with Silt. Detailed descriptions of the soils encountered are presented on the Boring Logs in Appendix A at the back of this report.

2.4 GROUNDWATER

Groundwater seepage was encountered at about 13 to 15 feet in the borings. A water level was measured at 5.5 feet below the ground surface in Boring B-2 after 30 minutes of observation, indicating that there is a hydrostatic head pressure on the water zone. Groundwater levels can fluctuate seasonally, depending on rainfall, surface runoff, and other factors.

3.0 GEOHAZARD ASSESSMENT

Review of Environmental Critical Area maps from the City of Seattle identifies the project site as being in a liquefaction prone area. The site is not a steep slope area, potential slide area, or known slide area. The slopes to the north of the site are identified as a riparian corridor and as having a slope 40 percent or greater.

3.1 SLOPES

Based on the City GIS information the slopes north of the property line are up to 14 feet in height with an average gradient of 35 to 57 percent. Building structures supported on piles could be constructed anywhere on the property. Use of the northern portion of the site for parking is acceptable, however we recommend the parking area be set back a minimum of ten feet from the top of the slope and the top of the slope be fenced or a guard rail installed.

3.2 LIQUEFACTION POTENTIAL

Liquefaction is a phenomenon where loose, granular, cohesionless soil below the water table temporarily loses strength and behaves as a liquid due to strong shaking or vibrations, such as occurs in earthquakes. Clean, loose, saturated granular soils, such as uniformly graded, fine-grained sands and non-plastic silts that lie within 50 feet of the ground surface are most susceptible to liquefaction. The result of soil liquefaction can include ground settlement, sand boils, and lateral spreading.

The exploratory borings at the project site encountered loose fill consisting of sandy Silt and Silt, underlain by loose alluvial and dense Sand that in our opinion are not susceptible to liquefaction either because of the high silt content of the loose sandy Silt, or the high density of the Sands under the 100 year design earthquake loading.

3.3 RIPARIAN CORRIDOR

The northern portion of the project site is identified as being within a riparian corridor (stream channel). We understand that their was formerly a drainage channel north of the site, which is now in a pipe.

3.4 MINIMUM RISK STATEMENT

It is our professional opinion that the subject property is currently stable and will not increase the potential for soil movement during or after the subject construction provided that the recommendations contained herein are implemented in the design and construction of the project. The proposed development will present a minimal risk of instability to the site property and adjacent property during or after the construction, provided the recommendations contained in this Geotechnical Engineering Study are implemented.

4.0 SEISMICITY EVALUATION

4.1 PUGET SOUND SEISMIC HISTORY

The greater Puget Sound area has experienced a number of small to moderate earthquakes and occasionally strong shocks during the brief 155-year historical record in the Pacific Northwest. The major earthquakes in the region are believed to be associated with deep-seated plate tectonic activity. Major faults within the region have not been active in the Holocene Age (geologic period dating since the last glacial retreat 14,000 years ago), consequently, none are known to be associated with historical seismicity.

The following historical seismically significant earthquakes have been recorded in the Puget Sound region:

EARTHQUAKE HISTORY		
Location	**Date**	**Richter Magnitude**
Olympia	April 13, 1949	7.1
Seattle-Tacoma	April 29, 1965	6.5
Vashon Island	January 28, 1995	5.0
Duvall	May 2, 1996	5.4
Nisqually	February 28, 2001	6.8

4.2 UNIFORM BUILDING CODE

We are recommending the new building be pile supported. The piles will extend past the loose material and be embedded into the dense underlying soils. The 1997 Uniform Building Code (UBC), classifies western Washington as Seismic Zone 3 (Figure 16-2), and assigns a Seismic Zone Factor, Z, of 0.30 (Table 16-I). The site soils below 17.5 to 22 feet best correspond to a Soil Profile Type of S_D - Stiff Soil Profile (Table 16-J). Based on a Seismic Zone Factor (Z) of 0.3 and a Soil Profile Type of S_D, the Seismic Coefficient Ca is 0.36 (Table 16-Q) and the Seismic Coefficient Cv is 0.54 (Table 16-R) for the site.

4.3 CITY OF SEATTLE DIRECTOR'S RULE

The geotechnical design recommendations have taken into consideration a one in 100 year seismic event (earthquake ground motion that has a 40% probability of being exceeded in 50 years). The design earthquake selected, in accordance with DCLU Director's Rule 3-93, is a magnitude 6.5 near crustal event with a peak horizontal ground acceleration of 0.20g. Calculations of soil bearing capacity, general soil stability and equivalent fluid pressure presented in this report reflect this one in 100 year seismic event.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 GENERAL

Based on the results of our study, it is our opinion that the site is geotechnically suitable for the proposed development of a combined office-apartment building. Due to the existence of loose soils and their potential for settlement, the structure should be supported on piles and the . Specific recommendations regarding site development are presented in the following sections.

5.2 SITE PREPARATION AND GENERAL EARTHWORK

The building, driveway and parking areas should be stripped and cleared. The existing asphalt is generally in poor condition and is probably not worth saving. Silt fences should be installed around areas to be disturbed by construction activity, especially along the top of the slope, to prevent sediment-laden surface runoff from being discharged off-site. During wet weather,

exposed soils will be subject to erosion and should be compacted and/or covered with plastic tarps to minimize erosion.

We recommend the subgrade below sidewalks and driveways be proof-rolled with a piece of heavy construction equipment. Any soft spots or disturbed areas thus detected should be recompacted or excavated and replaced with compacted structural fill. To protect utilities from settlement, we recommend that the bottom of utility trenches be compacted using a backhoe mounted "hoe-pack".

5.2.1 Structural Fill

Although the building will be on piles, we recommend all fill material used to achieve design site elevations below the building foundation, slab-on-grade floors, and pavement areas meet the requirements for structural fill. During wet weather, material to be used as structural fill should have the following specifications:

1. Be free-draining, granular material, which contains no more than three (5) percent fines (silt and clay-size particles passing the No. 200 mesh sieve);

2. Be free of organic and other deleterious substances;

3. Have a maximum size of three (3) inches.

All fill material should be placed at or near the optimum moisture content. The optimum moisture content is the water content in soil that enables the soil to be compacted to the highest dry density for a given compaction effort.

Due to its silt content, the existing fill soils on the site are moisture sensitive and should not be used as fill material during wet weather conditions. During wet weather we recommend using a free draining pit-run type of material (less than 5-percent fines). During dry weather, any compactable non-organic soil meeting the above maximum size criteria may be used as structural fill provided the material is near the optimum moisture content for compaction purposes.

Structural fill should be placed in thin horizontal lifts not exceeding ten inches in loose thickness.

Each lift should be compacted to at least 95 percent of maximum dry density, as determined by ASTM Test Designation D-1557 (Modified Proctor). Fill under driveways and walks should be placed in similar thin horizontal lifts and be compacted to at least 90 percent of maximum density, with the exception of the upper twelve (12) inches. The top twelve (12) inches should be compacted to at least 95 percent maximum density.

Within the City right-of-way, the City of Seattle compaction standards require compaction to 95 percent of the maximum dry density, as determined by ASTM Test Designation D-698 (Standard Proctor). This standard would be applicable for fills under streets, pavements and sidewalks. The City typically requires that the compaction of fill soils be monitored and documented for quality control purposes. Geo Group Northwest, Inc. can provide earthwork monitoring services, including evaluating the suitability of structural fill materials and providing compaction monitoring.

5.3 FOUNDATIONS

We recommend that an augercast concrete pile foundation system be used to support the proposed structure. The pile foundation should penetrate through the loose to medium dense soils, with a minimum embedment of 5 feet into the dense interbedded sands and silts (SPT "N" values greater than 30 blows per foot). For adequate embedment, we recommend the piles have a minimum length of 28 feet. The piles should be steel reinforced and have a center bar that extends to the base of the pile. Steel reinforcement should be designed by a structural engineer.

We recommend the concrete piles have a minimum diameter of 14 inches. For concrete piles 14 to 18 inches in diameter embedded a minimum of 5 feet into the underlying dense soils, the following allowable bearing capacities may be used:

Pile Diameter (Inches)	Pile Embedment (Feet)	Allowable Bearing (Tons)	Allowable Uplift (Tons)
14	5	32	16
16	5	40	20
18	5	52	26

No reduction in pile capacity is required if the pile spacing is at least three times the pile diameter. A one-third increase in the above allowable pile capacities can be used when considering short-term transitory wind or seismic loads.

Lateral forces can also be resisted by the passive earth pressures acting on the grade beams, and friction between the grade beams and the subgrade. To fully mobilize the passive pressure resistance, the grade beams must be poured "neat" against compacted fill. Our recommended allowable passive soil pressure for lateral resistance is 300 pcf equivalent fluid weight. A coefficient of friction of 0.30 may be used between the subgrade and the grade beams. We estimate that the maximum total post-construction settlement should be one-half (1/2) inch or less, and the differential settlement across building width should be one-quarter (1/2) inch or less.

The performance of piles depends on how and to what bearing stratum the piles are installed. It is critical that judgement and experience be used as a basis for determining the embedment length and acceptability of each pile. Therefore, we recommend that Geo Group Northwest, Inc. be retained to monitor the pile installation operation, collect and interpret installation data, and verify suitable bearing stratum. We also suggest that the contractor's equipment and installation procedure be reviewed by Geo Group Northwest, Inc. prior to pile installation to help mitigate problems which may delay work progress.

5.4 SLAB-ON-GRADE FLOORS

Due to the existence of loose fill soils on the site, over time slab-on-grade floors could settle, crack and be unacceptable. We recommend that floor be structurally supported. Slab-on-grade floors should be steel reinforced and tied into the grade beams. Alternately, the structure could be designed with supported wood floors. .

To avoid moisture build-up on the subgrade, slab-on-grade floors should be placed on a capillary break, which is in turn placed on the compacted subgrade. The capillary break should consist of a minimum of a six (6) inch thick layer of free-draining gravel, or crushed rock, containing no more than five (5) percent fines, passing the No. 4 sieve (1/4 inch opening size). A vapor barrier, such as a 6-mil plastic membrane, is recommended to be placed over the capillary break beneath the slab to reduce water vapor transmission through the slab. Two to four inches of sand may be placed over the barrier membrane for protection during construction.

5.5 EXCAVATIONS AND SLOPES

Under no circumstances should temporary excavation slopes be greater than the limits specified in local, state, and national government safety regulations. Temporary cuts greater than four feet in height should be sloped at an inclination no steeper than 1H:1V (Horizontal:Vertical). If slopes of this inclination or flatter cannot be constructed, and if excavations greater than four feet in depth are required, temporary shoring may be necessary. Criteria for the design of temporary shoring can be provided by Geo Group Northwest, Inc., if required.

If the excavation extends below the groundwater table at an estimated depth of 5.5 feet below the ground surface, the excavation will not stand at the recommended 1H:1V temporary excavation slope and Geo Group Northwest, Inc. needs to be informed of the actual excavation geometry so that other measures such as dewatering and temporary shoring can be incorporated in the excavation plan.

Permanent fill slopes should be inclined no steeper than 2H:1V. Steeper fill slopes could be constructed with the use of geogrids for soil reinforcement. Criteria for the design of geogrid soil reinforcement can be provided by Geo Group Northwest, Inc. if required. Permanent cut slopes should be inclined no steeper than 2H:1V. All permanently exposed slopes should be planted with an appropriate species of vegetation to reduce erosion and improve the stability of the surficial layer of soil.

5.6 DRAINAGE

5.6.1 Surface Drainage

The final site grades should allow surface water to be directed away from the building and off the site. If feasible, the ground be sloped at a gradient of three (3) percent for a distance of at least ten feet away from the building except in areas that are to be paved.

During construction, water should not be allowed to stand in any area where footings, slabs, or pavements are to be constructed. Loose surfaces should be sealed at night by compacting the surface to reduce the potential for moisture infiltration into the soils.

5.6.2 Footing and Wall Drains

We recommend that drains be installed around the foundation perimeter. The drains should consist of a four (4) inch minimum diameter, perforated or slotted, rigid drain pipe laid at the invert of the footing with a gradient sufficient to generate flow (see Plate 3 - Typical Footing Drain). The drain line should be bedded on, surrounded by, and covered with a free-draining rock, pea gravel, or other free-draining granular material. Once the drains are installed, the excavation along the foundation should be backfilled with a compacted structural fill.

Under no circumstances should roof downspout drain lines be connected to the footing drain system. All roof downspouts must be separately tightlined to discharge into the storm water collection system. We recommend that sufficient cleanouts be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems. Footing and roof drain lines should be discharged into the city storm drain. Water should be discharged onto the slope at the north edge of the property.

5.7 PAVEMENTS

The adequacy of site pavements is strictly related to the condition of the underlying subgrade. If this is inadequate, no matter what pavement section is constructed, settlement or movement of the subgrade will be reflected up through the paving. In order to avoid this situation, we recommend site pavement consist of reinforced concrete. The use of unreinforced asphalt concrete could result in settlement and cracking. Periodic patching and refinishing of the parking lot area may be required. We recommend the subgrade in the parking and driveway areas be compacted until firm and unyielding. Fill soils should be compacted to the structural fill compaction criteria. The final soil subgrade should be proof-rolled with a piece of heavy construction equipment, such as a fully loaded dump truck, to verify that the subgrade is unyielding. Proof-rolling should be performed under the observation of a representative of Geo Group Northwest. If soft, wet or unstable subgrade is present, the unsuitable soils should be over-excavated and replaced with a compacted structural fill or a crushed rock material.

We recommend parking and driveway area pavement section designs consist of the following:

MINIMUM PAVEMENT SECTION

Parking Areas (Light Traffic Load Areas)	
Class "B" Asphalt Concrete (AC)	2-inches
Crushed Rock Base (CRB)	4-inches
Driveway Areas (Heavy Traffic Load Areas)	
Class "B" Asphalt Concrete (AC)	3-inches
Crushed Rock Base (CRB)	6-inches

6.0 LIMITATIONS

Our recommendations and conclusions are based on the site conditions and soils observed, engineering analyses, and our experience and engineering judgement. The conclusions and recommendations are professional opinions derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No other warranty, expressed or implied, is made.

The recommendations submitted in this report are based upon the data obtained during our site visit and boring information. Soil and groundwater conditions may vary from those anticipated. In the event that soil conditions vary from those anticipated, Geo Group Northwest, Inc. should be contacted in order to reevaluate the recommendations of this report and to modify or verify them in writing prior to proceeding with the construction.

7.0 ADDITIONAL SERVICES

The following geotechnical special inspection services are recommended for the project:

- Pile installation;
- Structural fill placement and compaction testing, including backfill of utility trenches;
- Installation of foundation drains
- Proof-rolling

We recommend that Geo Group Northwest, Inc. be retained to perform a general review of the final design and specifications of the proposed residential development, to verify that the earthwork and foundation recommendations have been properly interpreted and implemented in the design and in the construction documents.

We recommend that Geo Group Northwest, Inc. be retained to provide monitoring and testing services for geotechnical-related work during construction. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

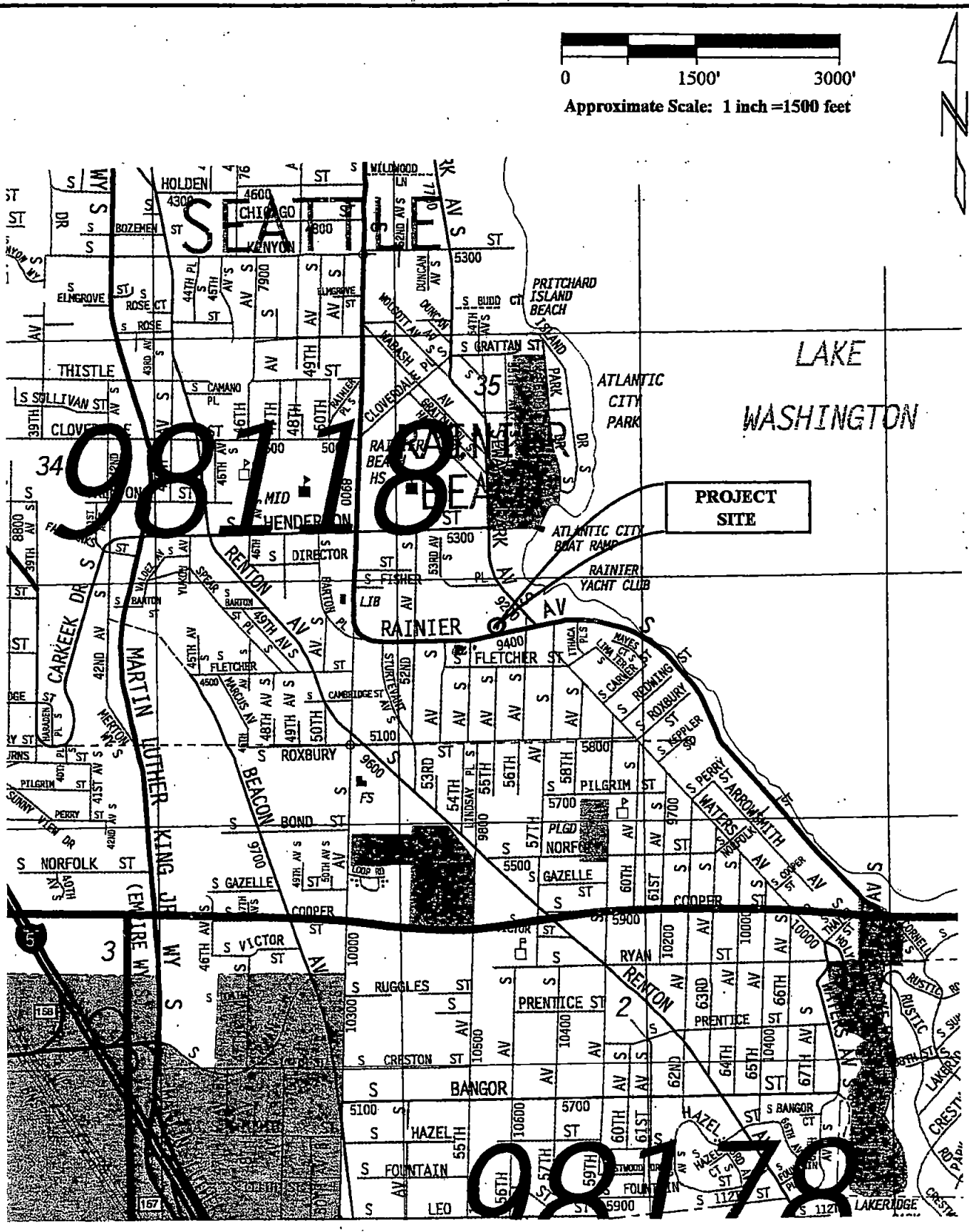
Respectfully submitted,
GEO GROUP NORTHWEST, INC.

Wade J. Lassey
Engineering Geologist

William Chang, P.E.
Principal

ILLUSTRATIONS

G-0953

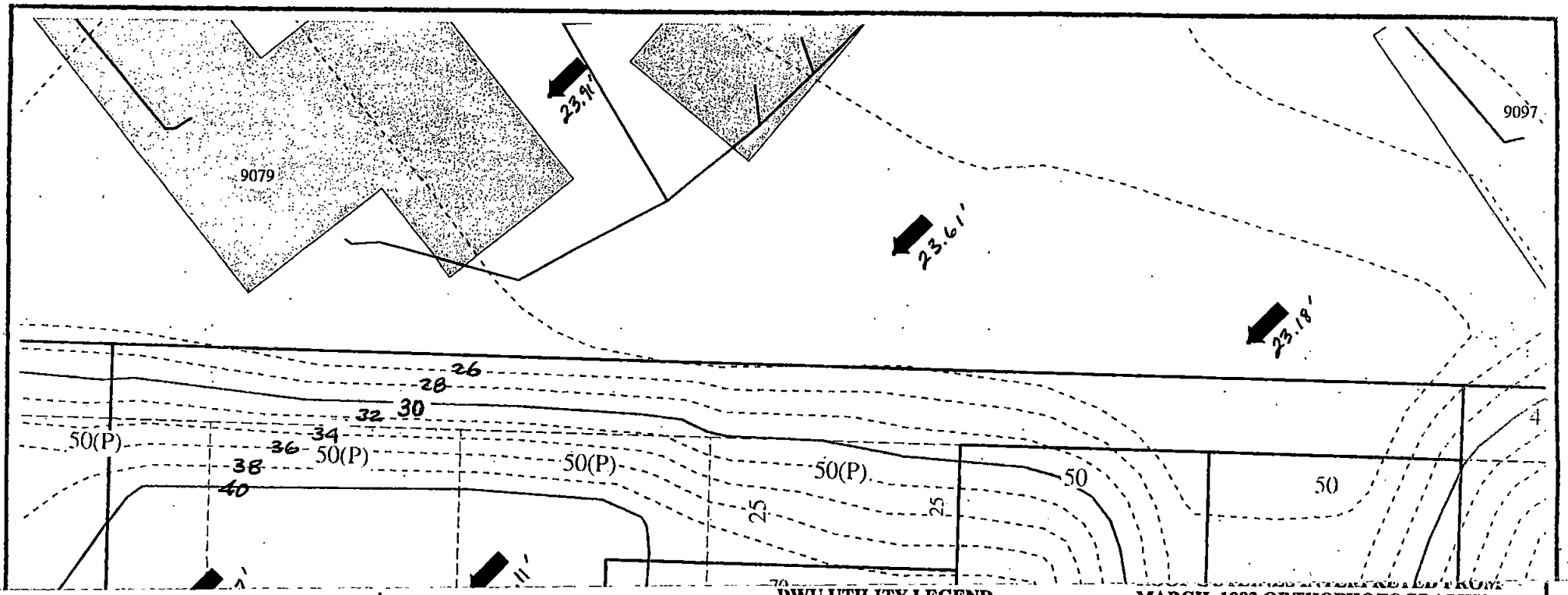


GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

VICINITY MAP

OFFICE / APARTMENT SITE
9420 RAINIER AVENUE SOUTH
SEATTLE, WASHINGTON

SCALE	DATE	MADE	CHKD	JOB NO.	PLATE
1"=1500'	1/9/02	WJL	WC	G-1489	1



N

S

0 30 60

FEET

B-1 BORINGNUMBER & APPROXIMATE LOCATION

Parcel Line
Legal Line
10' Interval Contour *
2' Interval Contour *
Pavement Edge
40.84' Spot Elevation *
9999 Address Number

DWU UTILITY LEGEND

Metro Sewer Mainline
Sewer Mainline
Drainage Mainline
Combined Sewer/Drainage Mainline
Drainage Lateral (Inspected)
Drainage Lateral (Not Inspected)
Side Sewer (Inspected)
Side Sewer (Not Inspected)
Abandoned Pipe

Arrows designate direction of flow

WATER UTILITY LEGEND

Water Mainline
Water Service
Hydrant

MARCH, 1993 ORTHOPHOTOGRAPHY

Building
Garage
Deck
Patio
Obscured
Unknown

NOTE: Conversion from City of Seattle Datum to NAVD88 Datum
To convert between City of Seattle and NAVD88 Datums, use:
("City of Seattle Datum" + 9.7ft = NAVD88).
There are inconsistencies in the City of Seattle Datum, the conversion may vary up to +/-1ft in specific areas throughout the City. In areas and applications where a more accurate conversion factor is critical, elevations should be field checked and vertical relationships between the two datums be determined for that particular area.

Produced by the Seattle Public Utilities –Geographic Systems Section on December 31, 2001

PORTION OF:
Central Geographic Data Base Tile# 185
1/4 Section-Township-Range: SW35 –24 –4
Kroll Page # 81.W

* DATUM: NAVD88

PLATE 2

SITE PLAN

OFFICE / APARTMENT SITE
9420 RAINIER AVENUE SOUTH
SEATTLE, WASHINGTON

GEO Group Northwest, Inc.
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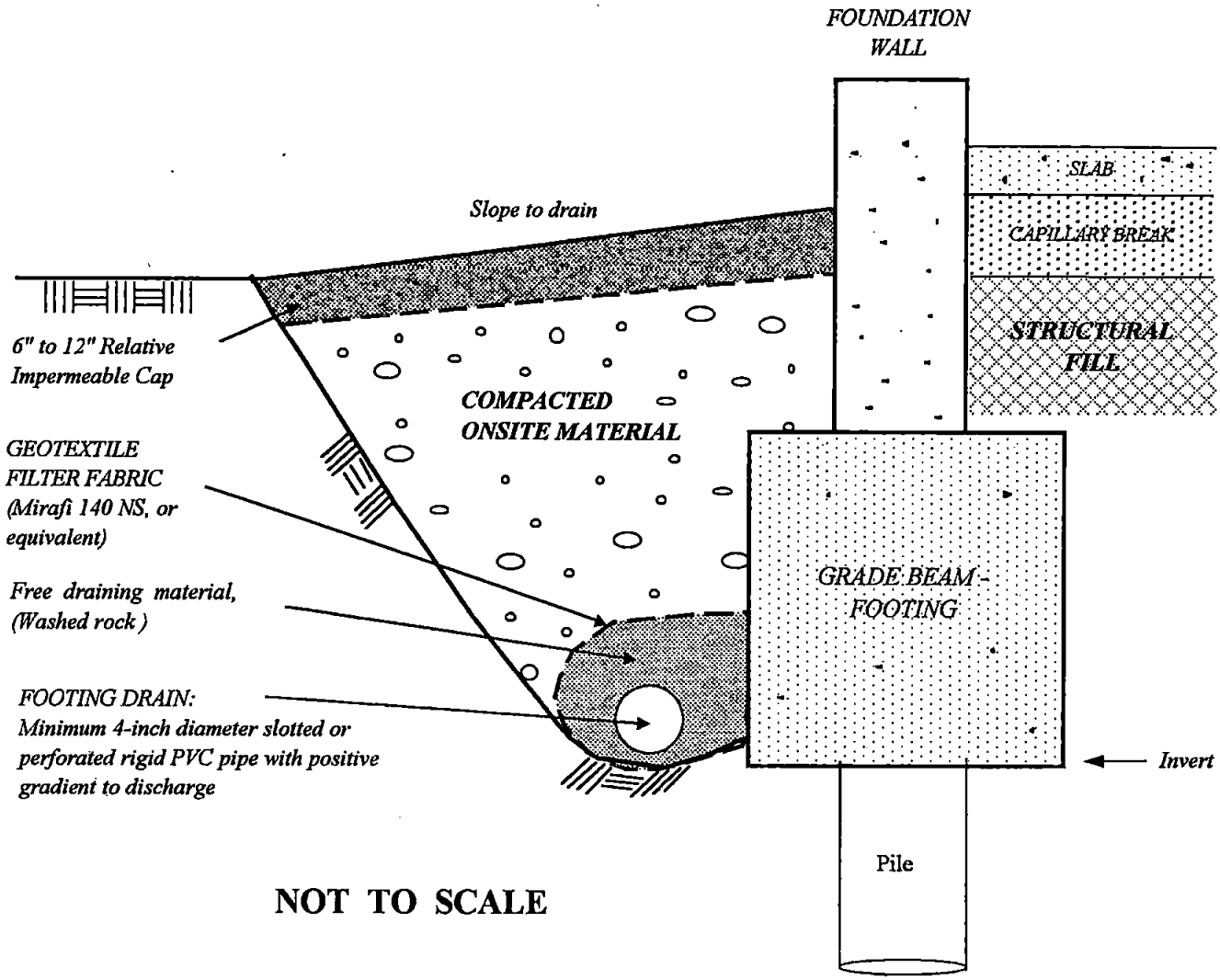
SCALE	1" = 30'	DATE	1/9/02	MADE	WJL	CHKD	WC	JOB NO.	G-1489



NOT TO SCALE

NOTES:

1.) Do not replace rigid PVC pipe with flexiible corrugated plastic pipe.

2.) Perforated or slotted PVC pipe should be tight jointed and laid with perforations or slots down, with positive gradient to discharge.

3.) Do not connect roof downspout drains into the footing drain lines.

4.) Exterior backfill should be compacted to 90% of maximum dry density based on Modified Proctor. The top 12-inches to be compacted to 95% of maximum dry density if backfill is to support sidewalks, driveway, etc.

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TYPICAL FOOTING DRAIN DETAIL
OFFICE / APARTMENT SITE
9420 RAINIER AVENUE SOUTH
SEATTLE, WASHINGTON

SCALE NONE	DATE 1/9/02	MADE WJL	CHKD WC	JOB NO. G-1489	PLATE 3

APPENDIX A

G-0953

LEGEND OF SOIL CLASSIFICATION AND PENETRATION TEST

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (More Than Half by Weight Larger Than No. 200 Sieve)	GRAVELS (More Than Half Coarse Grains Larger Than No. 4 Sieve)	CLEAN GRAVELS (little or no fines)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, AND GRAVEL-SAND MIXTURES LITTLE OR NO FINES
		DIRTY GRAVELS (with some fines)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More Than Half Coarse Grains Smaller Than No. 4 Sieve)	CLEAN SANDS (little or no fines)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		DIRTY SANDS (with some fines)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS (More Than Half by Weight Larger Than No. 200 Sieve)	SILTS (Below A-Line on Plasticity Chart, Negligible Organic)	Liquid Limit < 50%	ML	INORGANIC SILTS, ROCK FLOUR, SANDY SILTS OF SLIGHT PLASTICITY
		Liquid Limit > 50%	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOIL
	CLAYS (Above A-Line on Plasticity Chart, Negligible Organic)	Liquid Limit < 30%	CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, CLEAN CLAYS
		Liquid Limit > 50%	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	ORGANIC SILTS & CLAYS (Below A-Line on Plasticity Chart)	Liquid Limit < 50%	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		Liquid Limit > 50%	OH	ORGANIC CLAYS OF HIGH PLASTICITY
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

LABORATORY CLASSIFICATION CRITERIA

DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN SIZE DISTRIBUTION CURVE

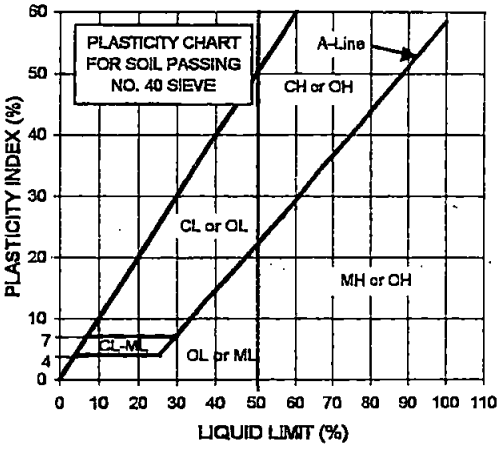
COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:

< 5% Fine Grained: GW, GP, SW, SP

> 12% Fine Grained: GM, GC, SM, SC

5 to 12% Fine Grained: use dual symbols

Cu = (D60 / D10) greater than 4 Cc = ($(D30^2)$ / (D10 * D60) between 1 and 3		
NOT MEETING ABOVE REQUIREMENTS		
CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE or P.I. LESS THAN 4	
	ATTERBERG LIMITS ABOVE "A" LINE or P.I. MORE THAN 7	
Cu = (D60 / D10) greater than 6 Cc = ($(D30^2)$ / (D10 * D60) between 1 and 3		
NOT MEETING ABOVE REQUIREMENTS		
CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE with P.I. LESS THAN 4	
	ATTERBERG LIMITS ABOVE "A" LINE with P.I. MORE THAN 7	



SOIL PARTICLE SIZE

FRACTION	U.S. STANDARD SIEVE			
	Passing		Retained	
	Sieve	Size (mm)	Sieve	Size (mm)
SILT / CLAY	#200	0.075		
SAND				
FINE	#40	0.425	#200	0.075
MEDIUM	#10	2.00	#40	0.425
COARSE	#4	4.75	#10	2.00
GRAVEL				
FINE		19	#4	4.75
COARSE		76		19
COBBLES	76 mm to 203 mm			
BOULDERS	> 203 mm			
ROCK FRAGMENTS	> 76 mm			
ROCK	>0.76 cubic meter in volume			

GENERAL GUIDANCE OF SOIL ENGINEERING PROPERTIES FROM STANDARD PENETRATION TEST (SPT)

SANDY SOILS				SILTY & CLAYEY SOILS		
Blow Counts N	Relative Density %	Friction Angle ϕ, degree	Description	Blow Counts N	Unconfined Strength Qu, tsf	Description
0 - 4	0 - 15		Very Loose	< 2	< 0.25	Very soft
4 - 10	15 - 35	28 - 30	Loose	2 - 4	0.25 - 0.50	Soft
10 - 30	35 - 65	28 - 35	Medium Dense	4 - 8	0.50 - 1.00	Medium Stiff
30 - 50	65 - 85	35 - 42	Dense	8 - 15	1.00 - 2.00	Stiff
> 50	85 - 100	38 - 46	Very Dense	15 - 30	2.00 - 4.00	Very Stiff
				> 30	> 4.00	Hard

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PLATE A1

BORING NO. B-1

Logged By: WJL Date Drilled: 1/3/02 Surface Elev. 38.5 feet +/-

Depth (ft)	USCS	Soil Description	SAMPLE Type	SAMPLE No.	SPT (N) Blows per 6-inches	Water Content %	Other Tests & Comments
		1.5" Asphalt, 3" Crushed Rock		S1	13, 6, 7 N= 13	13.3	
	SM to ML	Mottled brown & gray, silty SAND and sandy SILT, loose to very loose, some fine gravel, moist (**FILL**)		S2	5, 3, 1 N= 4	12.1	Samples S2 - S5: Faint Petroleum Odor, No Staining
5				S3	2, 1, 2 N= 3	12.8	
				S4	2, 2, 1 N= 3	13.0	
10				S5	3, 4, 5 N= 9	15.1	Sample S6: Moderate Petroleum Odor, No Staining
		Moist to wet		S6	2, 1, 2 N= 3		
15	SM	Oxidized orange brown/gray, fine silty SAND, loose, wet		S7	1, 2, 3 N= 5	20.5	Sample S7: Faint Petroleum Odor, No Staining
	SP/ SM/ ML	Brown, fine SAND and silty SAND, interbedded with silt, dense to very dense, trace fine gravel, wet		S8	11, 13, 15 N= 28	16.7	
20				S9	8, 26, 47 N= 73	19.8	Samples S8 - S10: No Petroleum Odor, No Staining
25	SM	Brown, fine silty SAND, dense, wet		S10	12, 21, 27 N= 48	23.5	
		Drilled to 25 feet. Sampled to 26.5 feet.					
30		Water Seepage below 15 feet. Static water level not measured - hole caved. Static water estimated around 7 feet.					
		Sample Collection: 2-inch Split Spoon Sampler driven with 140 lb. hammer.					
35		Boring sealed with medium bentonite chips.					
		Boring located 17 feet north and 25 feet west of NEC of building (middle portion of lot).					

LEGEND:
- 2" O.D. Split-Spoon Sampler
- 3" O.D. Shelby-Tube Sampler
- 3" O.D. California Sampler

GROUNDWATER OBSERVATION WELL:
- seal
- measured water level
- well tip (screen)

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

BORING LOG

GEOTECHNICAL ENGINEERING STUDY
9420 RAINIER AVENUE SOUTH
SEATTLE, WASHINGTON

JOB NO.	G-1489	DATE	1/9/02	PLATE	A2

BORING NO. B-2

Logged By: WJL Date Drilled: 1/3/02 Surface Elev. 38 feet +/-

Depth (ft)	USCS	Soil Description	SAMPLE Type	SAMPLE No.	SPT (N) Blows per 6-inches	Water Content %	Other Tests & Comments
		1.5" Asphalt					
	SM to ML	Mottled brown & gray, sandy SILT and SILT, loose to soft, occasional fine gravel, moist (**FILL**)		S1	4, 5, 4 N= 9	13.5	
5				S2	2, 1, 2 N= 3	17.2	▽ Water Level 5.5 feet B.G.S. (30 min. observation)
10		Brownish gray, silty SAND, very loose, wet, mucky (**FILL?**)		S3	1, 1, 2 N= 3	20.4	
	ML	Gray SILT, medium stiff, wet below 13 to 14 feet, thin woody layer at 15 feet		S4	2, 5, 1 N= 6	20.0	Samples S1 - S3: No Petroleum Odor, No Staining Sample S4: No Petroleum Odor, Possible Heavy Oil Staining
15	ML	Brown SILT with some organics, medium stiff, moist					
20	SM	Mottled gray, fine silty SAND, loose, trace fine gravel, wet		S5	2, 3, 5 N= 8	22.4	Samples S5 & S6: No Petroleum Odor, No Staining
25	SP/ SM/ ML	Brown, fine SAND and silty SAND, interbedded with silt, dense, trace fine gravel, wet		S6	19, 15, 24 N= 39	16.4	
30				S7	16, 17, 24 N= 41	19.4	
35		Drilled to 25 feet. Sampled to 26.5 feet. Wet below 13 feet. Static water level approximately 5.5 feet below the ground surface(bgs). 2-inch Split Spoon Sampler driven with 140 lb. hammer. Boring sealed with medium bentonite chips. Boring located approx. 18 feet east and 10 feet south of NEC of 9416 building in northwestern portion of subject lot.					

LEGEND:
- 2" O.D. Split-Spoon Sampler
- 3" O.D. Shelby-Tube Sampler
- 3" O.D. California Sampler

GROUNDWATER OBSERVATION WELL:
- seal
- ▽ measured water level
- well tip (screen)

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, & Environmental Scientists

BORING LOG

GEOTECHNICAL ENGINEERING STUDY
9420 RAINIER AVENUE SOUTH
SEATTLE, WASHINGTON

JOB NO.	G-1489	DATE	1/15/02	PLATE	A3