CITY OF MERCER ISLAND

DEVELOPMENT SERVICES GROUP

9611 SE 36TH STREET | MERCER ISLAND, WA 98040

PHONE: 206.275.7605 | www.mercergov.org

Inspection Requests: Online: www.MyBuildingPermits.com VM: 206.275.7730

Geologic Hazard Areas

Requirements for a Statement of Risk by the Geotechnical Engineer.

Per Section 19.07.060.D.2 of the Mercer Island City Code, development within geologic hazard areas require that a Geotechnical Engineer licensed within the State of Washington provide a statement of risk with supporting documentation indicating that one of the following conditions can be met:

a. The geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe; or

b. An evaluation of site specific subsurface conditions demonstrates that the proposed development is not located in a geologic hazard area; or

c. Development practices are proposed for the alteration that would render the development as safe as if it were not located in a geologic hazard area; or

d. The alteration is so minor as not to pose a threat to the public health, safety and welfare.

LEE JOUNGIM
C/O BENNY KIM
7415 Ballinger Way
Edmonds, WA 98026

Attn: Benny Kim, Lee Joungim
Re: Risk Statement
8114 West Mercer Way Mercer Island Parcel#: 3358500974

Per section 19.07.060.D.2 of the Mercer Island City Code, development within geologic hazard areas requires a risk statement.

a) The hazard area will be modified per CS2 Engineer's structural design to mitigate the existing steep slope, including but not limited to; maintain a vegetated slope, and a pile supported, stepped concrete foundation. This will provide that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe.
b) Review of the city of Mercer Island Erosion Hazard map defines an erosion hazard as: >15% slope; and soils having "severe" rill and inter-rill erosion hazard according to USDA Soil Conservation Service (SCS). The slopes are >15% the erosion hazard is labeled "severe" per the SCS. The placement of the pile supported foundation is intended to mitigate the steep slope hazard.
c) The addition of the pile foundation is necessary and sufficient for a stable foundation as if it were not located in a geologic hazard area. The pile foundation poses no threat to the public health, safety and welfare.
d) No other site work is necessary or recommended for site stabilization.

We have reviewed the drawings (from CS2 Engineers dated 7/26/2017 rev 7) and calculations (from DES dated July 21, 2017) provided. Drawing and calculations conforman to the design and recommendations to the geotechnical report.

If you have any questions concerning this report, the procedures used, or if we can be of any further assistance please call us at **(206) 786-8645**.

Respectfully,
JJA, INC
Jason E.C. Bell, P.E.
Senior Engineer

JASON E. C. BELL
STATE OF WASHINGTON
37343
REGISTERED
PROFESSIONAL ENGINEER

JJA File#: 16018	Date: 2017.10.30

Lee Joungim,
8114 West Mercer Way Mercer Island

LEE JOUNGIM
C/O BENNY KIM
7415 Ballinger Way
Edmonds, WA 98026

Attn: Benny Kim, Lee Joungim
Re: Geotechnical Recommendations
8114 West Mercer Way Mercer Island Parcel#: 3358500974

The West side is close to an easement. The average slope of the property was measured to be 35% downhill to the North. A 1H:1V slope for foundation excavation is as steep as should be implemented without shoring for excavations greater than 4 feet. Contractor should be cautious when excavating adjacent to the utility easement. We have reviewed the drawings from CS2 Engineers and verified geotechnical input values. Design values for lateral earth pressures were provided in the geotechnical letter dated 7-6-2016. They are provided again in this letter. Due to the revised house location, shoring is required

The foundation is scheduled to have 4 inch diameter pin piles at 42" on center typically (detail 4/S-6). This arrangement of piles is typical of pile supported foundations and will function per the design. If piles are to be spaced less than 3d apart, then the group effect reduction in capacity is prudent. Given a 4 inch diameter pile, the minimum spacing would be (3x4"=) 12 inch on center. If the piles are spaced at 12 inch on center or greater, the group effect does not need to be implemented (Bengt H. Fellenius 2004 "Unified design of piled foundations").

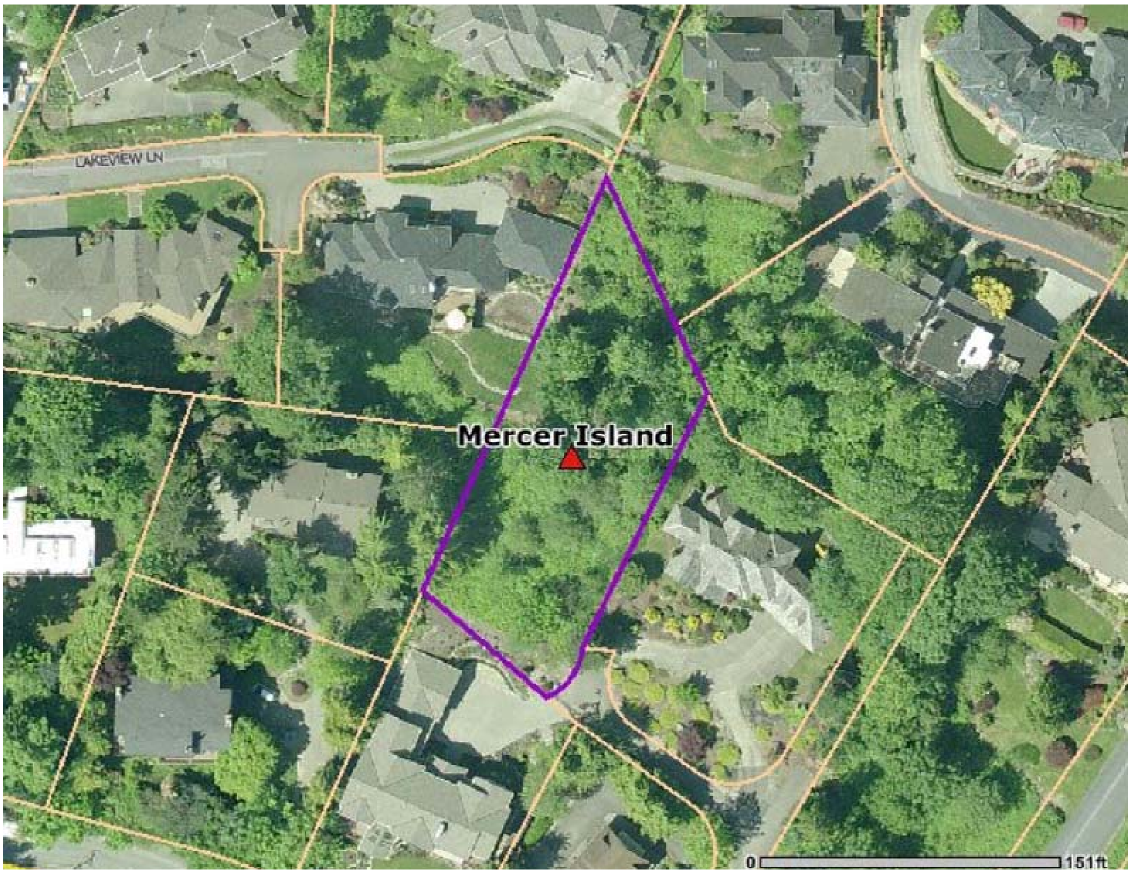
Lateral Earth Pressures:

Lateral earth pressures are dependent upon the backfill materials and their configuration and moisture content. Three inch minus sand and gravel mixtures that are free draining are recommended for backfilling walls greater than four feet tall. Design values for the native soil were obtained by using unit weight of 125 pcf, and phi angle of 34 degrees.

Earth Pressure Coefficients		**Earth Pressure**		
Active, K_a:	0.291	Active:	35	lbs./ft³
At Rest, K_o:	0.450	At Rest:	56	lbs./ft³
Passive, K_p:	3.440	Passive:	442	lbs./ft³
		Coefficient of Friction:	0.4	

If you have any questions concerning this report, the procedures used, or if we can be of any further assistance please call us at **(206) 786-8645**.

Respectfully,
JJA, INC
Jason E.C. Bell, P.E.
Senior Engineer



GEOTECHNICAL ENGINEERING STUDY

PROPOSED LEE RESIDENCE
8114 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

Prepared for

Mr. Benny Kim
An and Kim, LLC
7415 Lake Ballinger Way
Edmonds, WA 98026

by

Pioneer Engineering, Inc.
P. O. Box 33628
Seattle, WA 98133

December 2, 2013

PIONEER ENGINEERING, INC. *Geotechnical Engineering · Earth Science · Water Resources*

December 2, 2013

Mr. Benny Kim
An and Kim, LLC
7415 Lake Ballinger Way
Edmonds, WA 98026

Subject: Geotechnical Engineering Study
Proposed Lee Residence
8114 West Mercer Way
Mercer Island, Washington

Dear Mr. Kim:

At your request, we have updated our 10/4/2013 geotechnical engineering study for the proposed development of Lee Residence and associated utilities at the above address in Mercer Island, Washington. This report presents our subsurface findings and recommendations for the development.

Pin pile foundations are suitable to provide support for the residence by penetrating through upper fractured Lawton Clay into non-fractured hard Lawton Clay deposits. A drainage system will be installed to prevent buildup of hydrostatic pressure behind the basement wall.

We appreciate the opportunity of providing services to you on this project. If you have any questions regarding this report or need further consultation, please feel free to call.

Respectfully submitted,
PIONEER ENGINEERING, INC.

JOSEPH Y.K. WU
STATE OF WASHINGTON
35226
REGISTERED
PROFESSIONAL ENGINEER

12/2/2013

EXPIRES 12/29/2014

Joseph Wu, P.E.
Consulting Geotechnical Engineer

P. O. Box 33628, Seattle, WA 98133
Phone: (206) 427-9118 · Fax: (206) 306-2982

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LIST OF FIGURES

PROJECT DESCRIPTION

The proposed site development will consist of constructing a single-family residence and associated utilities at 8114 West Mercer Way in Mercer Island, Washington. The general location of the site is shown on Figure 1.

Based on a topographic survey site plan and preliminary architectural elevation and floor plans furnished by An and Kim, LLC, the residence will be a three-story, wood-framed structure above a basement and garage. Slabs of the basement and garage will likely be poured on grade. A maximum cut of about 21 feet at the basement's northwest corner is required to reach basement slab subgrade.

SCOPE OF WORK

The purpose of this geotechnical engineering study is to characterize the subsurface soil and water conditions by two test hole explorations, and use such information obtained to provide recommendations for the development. To achieve the purpose, the scope of our services specifically comprises the following items:

1. Explore subsurface soil and water conditions with two test holes to a maximum depth of 21.5 feet. The underlying soils encountered are visually classified;
2. Collect soil samples at selected depths and seal them in sampling bags for further examination;
3. Conduct a site reconnaissance to observe and document existing surface features;
4. Review surficial soil conditions at the site, according to a published geologic map;
5. Prepare a written report to address our findings and recommendations for drainage systems, site preparation and grading, engineered fill and compaction, foundation support, cut and fill slopes, and pavements.

SITE CONDITIONS

Surface Conditions

The site is an irregularly-shaped vacant urban lot surrounded by private properties, accessible from West Mercer Way by a private driveway shared by the residences at 8118, 8122 and 8126. It covers an area of 0.40 acre, measured about 32 feet along the driveway.

Topographically, the site is situated slightly above the toe of a broad regional slope descending southwesterly to Lake Washington. Within the site, the ground surface descends steeply southerly to a group of mature deciduous trees in the mid-northern portion of the site. Following a similar gradient, the ground continues to decline to a paved apron of the driveway. The open space is covered mostly with berry, fern and grass, except that a pine tree stands near the north end of the apron, and four fir and one spruce trees line near the site's west corner.

Geologic Mapping

A geologic map, *Geologic Map of Mercer Island, Washington,* prepared by Kathy G. Troost and Aaron P. Wisher in October, 2006 was referenced for the geologic and soil conditions at the site. According to this map, the surficial soil unit is mapped as deposits of Vashon Advance Outwash (Q_{va}) at the site, in a close proximity to underlying Lawton Clay (Q_{vlc}).

Vashon Advance Outwash was deposited mostly from the meltwater front flowing from the advancing glacier. The composition of this soil unit consists generally of gravel and sand with trace to no silt. Due to the process of glaciation, its soil profile typically has coarse particles in the upper portion, and finer in the lower. In general, it is in a dense condition and of high permeability, and suitable to serve as foundation bearing soils. When a structure is bearing on such soils, the majority of foundation settlement occurs during construction.

Lawton Clay was a glacial and non-glacial deposit generally underlying Vashon Advance Outwash deposits. They consist mostly of massive, thick or thin beds and lamination of gray to dark-gray clay, silt and fine to very-fine sand. The fine-grained sediment mostly was deposited in water bodies such as lakes or streams prior to the advance of the ice front of glaciation. The sediments were mostly deposited during the transitional period near the end of pre-Fraser interglacial (Olympia Interglaciation) time and into early Fraser glacial time. In general, Lawton Clay deposits are very stiff to hard in their natural, undisturbed state.

Colluvium generally refers to loose, unconsolidated sediments deposited at the base of hillslopes by the natural process of rainwash, overland sheetflow or other forms of unconcentrated flow. It is often composed of a variable range of sediments ranging from silt to rock (fragment) inclusions.

Subsurface Exploration

Subsurface conditions were explored with two test holes (TH-1 and TH-2) to a maximum depth of 21.5 feet on September 27, 2013, using a portable drilling rig owned and operated by CN Drilling, Inc. Locations of test holes are determined by tape measurements with reference to the existing surface features shown on the survey plan, and they should be considered as only accurate to the measuring method used. Approximate locations of the test holes are shown on Figure 2.

Standard Penetration Tests (SPTs) are conducted in the test holes using a standard split-spoon sampler of a 2-inch outside diameter, driven with a 140-pound hammer that was raised and released at a 30-inch free fall distance, in accordance with ASTM D1586. The sampler is driven 18 inches by the hammer and the total number of blows for the last 12 inches is recorded as the “N” value in test hole logs. The number of blows required to advance the sampler for the given distance is an indication of density of granular soils or consistency of cohesive soils.

Subsurface exploration was continuously monitored by an engineer from our firm who documented subsurface soil and water conditions encountered, maintained a log of each hole, obtained representative soil samples, and observed pertinent site features. The final test hole logs represent our interpretations of subsurface conditions explored. The stratification lines in the logs indicate approximate boundaries between soil types. Actual transitions may be more gradual in the natural geologic setting. The soil samples obtained from the test holes are visually classified in general accordance with Unified Soil Classification System (USCS) as shown on Figure 3.

Subsurface Soils

In general, soil conditions explored in both test holes were consistent with regional geologic settings. In TH-1, a layer of Vashon Advance Outwash deposits consisting mostly of well-graded sandy gravel and light gray silty medium sand was first encountered, underlain by light gray to gray Lawton Clay deposits. A thin layer of colluvium was observed to overlie Lawton Clay deposits in TH-2. The upper portion of Lawton Clay appeared fractured with less shear strength. More detailed information of soil conditions is presented in Figures 4 and 5.

Groundwater Conditions

Groundwater was not encountered in both test holes. Groundwater levels generally fluctuate with seasons, depending on the amount of precipitation and surface runoff, denseness of groundcover, purposes of land use, and other factors.

DISSCUSSIONS AND RECOMMENDATIONS

Based on the soil and groundwater conditions encountered in our subsurface exploration, it is our opinion that, from a geotechnical engineering viewpoint, the site is suitable for the proposed development provided that recommendations in this report are closely followed.

Deep foundation systems are required to penetrate through upper fractured Lawton Clay into non-fractured hard Lawton Clay deposits. Among these foundation systems suitable for site conditions are drilled pier foundations, augered cast-in-place pile foundations and pipe (pin) pile foundations. Pin pile foundations are the best option in consideration of budget management and constructability for local residential developments. Recommendations for this system are addressed in FOUNDATION SUPPORT.

The site is underlain predominantly by Lawton Clay deposits containing a high amount of fines (soil particles passing through the U.S. No. 200 sieve by weight based on the fraction of the soil sample batch passing through the U.S. No. 4 sieve by weight) which make it difficult to compact such soils to meet the criteria in wetter months. Grading activities must be started and completed after a substantial period of fair weather in the dry season, in order to reduce the adverse impacts upon engineered fill from precipitation.

SITE PREPARATION AND GRADING

Site preparation includes clearing and grubbing of groundcover, implementations of temporary erosion and sediment control (TESC) measures, and readiness of subgrade.

Prior to starting construction activities, a filter fence should be installed along the lower boundary of the site, in conjunction with a highly visible grid fence to delineate the construction (or clearing) limits. The entrance, parking, and loading areas should be paved with a minimum 12-inch-thick layer of quarry spalls (generally 2 to 4 inches in size), underlain by non-woven geotextile to prevent on-site sediments from being tracked onto the street. The filter fence and spall pad serve as TESC measures during construction. They should remain in place until full replacements with permanent ESC measures.

Clearing of ground includes stripping and grubbing of all surface vegetation within the clearing limits. Occasional overexcavation may be required when local weak soil pockets encountered. Overexcavation should be backfilled with engineered fill and compacted to a stable condition, following the recommendations in ENGINEERED FILL AND COMPACTION. On-site topsoil is unsuitable for use in any area to withstand loads. This topsoil should be disposed of at approved locations or used solely for landscaping purposes.

If grading operations are to be extended into the wet season, the following strategies and methods of ESC should be implemented:

- The bare and disturbed ground outside the construction limits should be protected with a layer of straw mulch (a minimum thickness of 2 inches; about 2 bales per 1,000 square feet of land) during any period of precipitation, in order to minimize soil erosion by storm runoff. Straw should be air-dried and free of any undesirable weed or coarse material.
- Cut/fill slopes and stockpiles of soils should be covered with durable plastic sheeting weighed down by securely-anchored sand bags if they are to remain unworked for more than 12 hours; other disturbed areas should be covered with straw mulch as addressed above if they are to remain unworked for more than 2 days.
- TESC measures in place should have regular inspection weekly and more frequent inspection immediately before, during and after significant precipitation events.

ENGINEERED FILL AND COMPACTION

Engineered fill is the material placed under footings, on-grade slabs and pavements where it withstands loads. Engineered fill should be free of organic, construction debris and other deleterious substances. It should consist of clean soils with individual particles not greater than 4 inches in size

On-site Lawton Clay deposits generally contain a high content of fines and are difficult to compact to meet the criteria when used in wet weather. Free-draining granular materials such as 2-inch-minus crushed rock with no more than 5 percent of fines or on-site clean Vashon Advance Outwash deposits may be used in structural areas.

Engineered fill should be placed per loose lift not more than 10 inches in thickness, and compacted to meet the required percentage of maximum dry density determined by ASTM D1557 (Modified Proctor Method) as summarized in the following table:

Applicable Area	Maximum Dry Soil Density
Under Grade Beams	95%
Under Driveway and on-Grade Slab	95% for upper 2 feet, 90% below
Structural Wall Backfill	95% for upper 3 feet, 90% below
Utility Trench Backfill	95% for upper 4 feet, 90% below

Controlled Density Fill (CDF) may be used as an alternative for engineered fill. CDF (a flowable, self compacting, rigid setting and low density material) is generally used in over-excavation in the footing or utility trenches. Wherever applicable, there is neither the compaction effort required to densify this fill, nor density tests needed to ensure compliance with the criteria. Its flowability enables this material to displace standing water in a footing (or utility) trench and access difficult spots. CDF has a typical minimum slump of 10 inches and a 30-day compressive strength of 200 pounds per square inch (psi) or less. Low compressive strength allows CDF for easy excavation in case of any design alteration during construction.

CUT AND FILL SLOPES

Under no circumstances should cut banks be greater than the limits specified by the safety regulations of local, state, and federal government, if worker have to perform the construction work in the foundation and utility trenches.

Any unsupported temporary cut greater than 4 feet in height should be sloped no steeper than 1H:1V in topsoil, colluvium and Vashon Advance Outwash deposits; 3/4H:1V in very stiff or hard Lawton Clay deposits. The bottom 4 feet may be cut vertically into hard Lawton Clay. These recommended inclinations of excavation are based on the assumption that no groundwater will be encountered during excavation. If groundwater is encountered during excavation, work should be halted immediately and our on-site representative informed to re-evaluate slope stability. Permanent cut or fill slopes should have an inclination no steeper than 2H: 1V.

FOUNDATION SUPPORT

Pin Pile Foundations

Pin pile foundations generally consist of concrete grade beams and steel pin piles (ASTM A53, Grade B) that penetrate through upper weak fractured Lawton Clay into non-fractured hard Lawton Clay deposits. Two-inch, three-inch and four-inch pin piles are used individually or in combination for residential development projects. Their specifications, design capacities and "refusal" criteria are tabulated below:

Size	Outside Diameter (O.D.)	Schedule	Design Capacity
2-inch	2.375"	80	4 kips
3-inch	3.5"	40	12 kips
4-inch	4.5"	40	20 kips

Size	"Refusal" Criteria
2-inch	Less than one inch of penetration in 60 seconds for a minimum continuous driving duration of one minute, under percussion of a 90-pound pneumatic jackhammer.
3-inch	Less than one inch of penetration in 12 seconds for a minimum continuous driving duration of one minute, under percussion of a 650-pound TB-225 hydraulic hammer.
4-inch	Less than one inch of penetration in 16 seconds for a minimum continuous driving duration of one minute, under percussion of an 850-pound TB-325 hydraulic hammer.

Battered piles must be incorporated into the foundation system to provide lateral resistance. A minimum distance of 18 inches should be maintained between the adjacent exterior finish grade and the grade beam bottom to avoid structural distress by the frost effect. Pin piles should be driven to meet the "refusal" criteria in order to render design capacities. Piles are usually driven in an alternate order so that temporary loss of soil strength during pile-driving would not affect subsequent installation.

Design Parameters

Basement walls restrained to displace and rotate at the top should be designed for a lateral soil pressure in an "at-rest" condition; retaining walls free to displace and rotate at the top should be designed using an active soil pressure. A lateral soil pressure of 55 pounds per cubic foot (pcf) of Equivalent Fluid Density (EFD) should be used for designing basement walls and 35 pcf of EFD for retaining walls, assuming the backfill is well-drained and level.

The friction force between the foundation and the subgrade, and the passive soil pressure acting on the under-grade portion of the foundation provide resistance to lateral loads. For better development of lateral resistance, the foundation must be poured directly against undisturbed, very stiff or hard Lawton Clay deposits or against engineered fill of adequate compaction. We recommend that a passive soil pressure, 430 pcf of EFD, and a coefficient of friction equal to 0.40 be used for calculating passive soil resistance. The top one foot of the passive soil pressure can be neglected due to ground disturbance by construction activities. The above passive soil pressure is based on the assumption that the backfill is level and adequately compacted. The above passive soil pressure and coefficient of friction are ultimate and unfactored. Proper factors of safety should be included in design.

Seismic Design Considerations

Design of a single-family or a two-family residential building (townhouse) should be in compliance with the standards and specifications stated in 2012 International Building Code (2012 IBC), as amended by City of Mercer Island. Based on the 2012 IBC, the site is located in a zone of Seismic Design Category D with a classified Site Class D.

Based on the location of the site (Latitude: 47.53042, Longitude: -122.23285 from King County iMap), the values of 0.2-second and 1-second spectral response accelerations are computed for seismic design parameters from an interactive tool at the USGS website. These design values and corresponding site coefficients are listed below:

Regional Earthquake Ground Motion for the 0.2-Second Spectral Response Acceleration, Site Class D S_S = *1.467 g*

Regional Earthquake Ground Motion for the 1-Second Spectral Response Acceleration, Site Class D S_1 = *0.558 g*

Regional Earthquake Ground Motion for the 0.2-Second Spectral Response Design Parameter, Site Class D S_{DS} = *0.978 g*

Regional Earthquake Ground Motion for the 1-Second Spectral Response Design Parameter, Site Class D S_{D1} = *0.558 g*

Site Coefficient F_a *as a Function of Site Class and Mapped Spectral Response Acceleration at a 0.2-second Period* (S_s) F_a = *1.00*

Site Coefficient F_v *as a Function of Site Class and Mapped Spectral Response Acceleration at a 1-Second Period* (S_1) F_v = *1.50*

PRECAST BLOCK WALL

Gravity and geogrid-reinforced block walls are common types of precast concrete block walls available in market. With versatile facing features, constructability and cost-effectiveness, compared to the concrete wall within a wall height of about 20 feet, the block walls have gained popularity in the construction industry. Gravity block (Ultrablock or Redi-Rock) walls are recommended for the application at this site.

The keyway trench should be excavated to firm, undisturbed subgrade soils, immediately followed by installation of a leveling pad. This pad should consist of 6-inch-thick clean crushed rock (5/8-inch in size) with no more than 2 percent of fines placed over subgrade and compacted to a non-yielding condition. A column of drain fill should be placed at least 12 inches wide behind the wall up to the capping topsoil or finish grade. Drain fill conforms to the specifications for the rock in the leveling pad.

The base course should be set on the leveling pad. In general, each course of blocks is placed at a 1H:10V to 1H:8V face inclination with a specific minimum toe embedment and frontslope below:

Min. Toe Embedment	Frontslope	Min. Toe Embedment	Frontslope
6”	Level	18”	1H:2V
12”	1H:1V	24”	1H:3V

A minimum 6-inch-diameter, rigid, perforated PVC pipe should be installed along the heel of the keyway trench, and wrapped with a layer of non-woven geotextile. This drain pipe is placed at a positive drainage slope to generate gravity flow and tightlined to discharge. Block walls should be designed following the manufacturer’s design guidelines.

ON-GRADE SLAB AND PAVEMENT

In general, the driveway pavement and on-grade slab should be supported on firm subgrade prepared as addressed in SITE PREPARATION AND GRADING and ENGINEERED FILL AND COMPACTION of this report. For the unheated areas such as a garage or a storage room, the on-grade slab should be placed over a durable vapor retarder (6-mil plastic membrane) underlain by a layer of capillary break to keep moisture from migrating upward. The capillary break should be composed of a minimum 4-inch-thick layer of free-draining 5/8-inch crushed rock containing no more than 2 percent of fines. For the heated areas, an additional layer of Styrofoam may be placed between the slab and the vapor retarder to enhance insulation.

We recommend that a flexible pavement section be composed of 3 inches of Asphalt Concrete (AC) over 6 inches of Crushed Rock Base (CRB), or 3 inches of AC over 4 inches of Asphalt Treated Base (ATB). A rigid pavement section consisting of 5 inches of concrete over 5 inches of adequately compacted 2-inch-minus CRB may be used as an alternative.

DRAINAGE SYSTEMS

Surface Drainage

The finish ground should be graded such that surface water is directed away from the building. Standing water should not be present within the building limits or in areas of foundations, on-grade slabs or pavements. Storm runoff on the impervious surfaces collected by downspouts and/or captured by catch basins should be tightlined to discharge to a stormwater drainage system. Roof downspout drainlines should not be connected to the basement wall drainage system. Sufficient cleanouts should be installed at strategic locations to allow for regular maintenance of stormwater drainage systems.

Basement Wall Drainage

A drainage system should be installed to prevent buildup of hydrostatic pressure behind the basement wall. This system consists of a 4-inch-diameter minimum, rigid, perforated PVC pipe with its invert placed slightly below the bottom of perimeter grade beams, and bedded on at least 3-inch-thick washed rock (5/8-inch in size) and covered with a minimum of 6 inches of same drain rock containing no more than 2 percent of fines. Such rock should be wrapped with a layer of durable non-woven geotextile. The drain pipe should have a sufficient gradient to generate flow by gravity. A drain mat such as Mirafi G100N should be placed to the full depth of the wall and hydraulically connected to the pipe. A typical basement wall drainage system is illustrated on Figure 6.

Damp-Proofing

A damp-proof coating composed of a bituminous coating, or 3 pounds per square yard of acrylic modified cement, or 1/8-inch coating of surface-bonding mortar in compliance with ASTM C887, or any materials permitted for waterproofing by the section 1805.3.2 of 2012 IBC, can be applied to the under-grade portion of concrete walls.

LIMITATIONS

This report has been prepared for the specific application to this project for the exclusive use of Mr. Benny Kim and his authorized personnel. The conclusions and interpretations in this report, however, should not be construed as a warranty of the subsurface conditions.

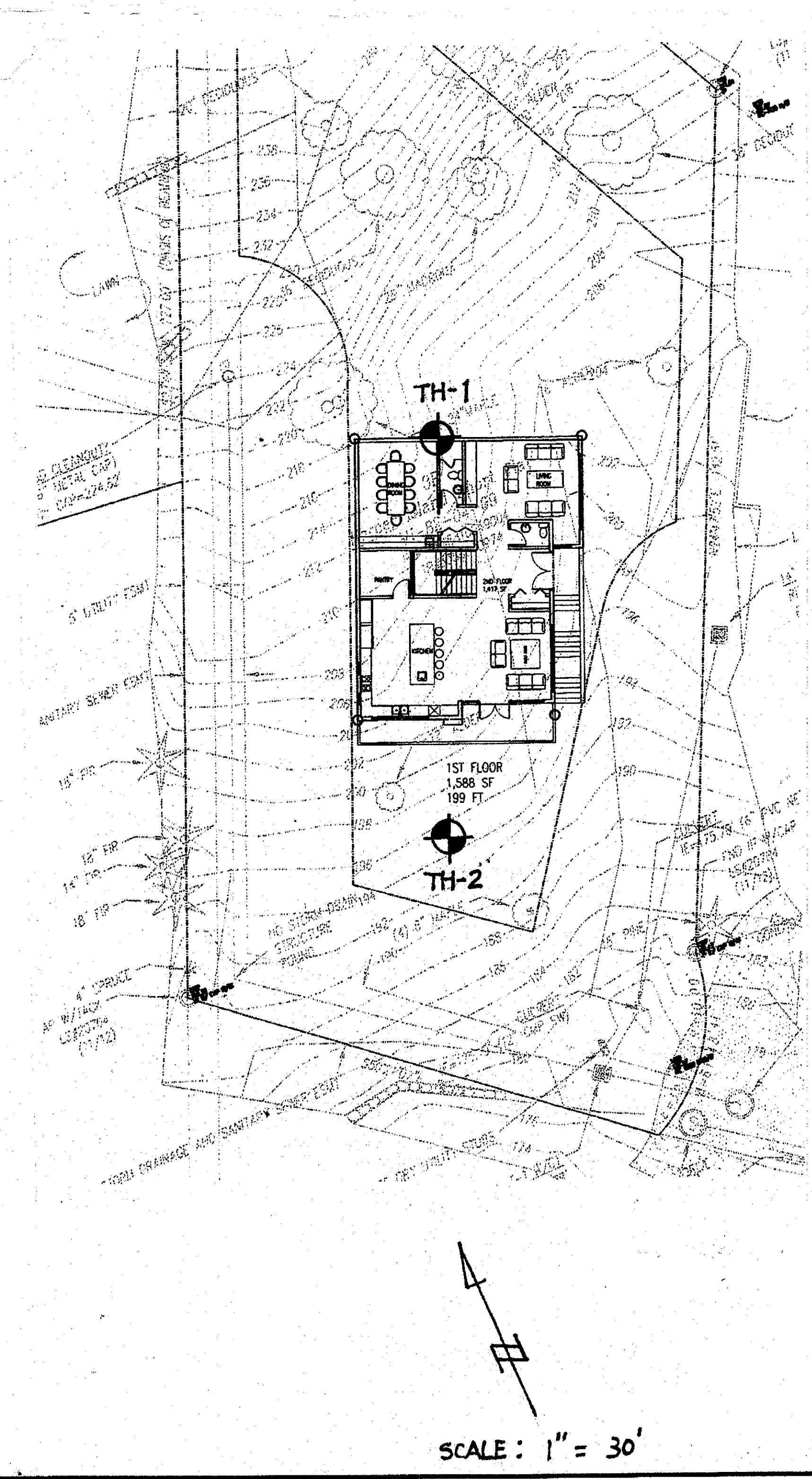
Our geotechnical recommendations are based on the soil conditions encountered in the test holes, engineering analyses, and our experience and engineering judgment. The recommendations are professional opinions derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in local areas. No warranty, expressed or implied, is made.

Soil and groundwater conditions stated in this report may vary from those actually encountered during construction. If variations appear then, we should be retained to re-evaluate the recommendations of this report, and to verify or modify them in writing prior to proceeding with subsequent work.

ADDITIONAL SERVICES

We recommend that Pioneer Engineering, Inc. (PEI) be retained to perform a general review of the final design and specifications of the proposed development, and to verify that our geotechnical recommendations have been properly interpreted and implemented in the design plans and construction documents. We also recommend PEI be retained to provide monitoring services for geotechnical aspects of the construction work of this project. This is to observe compliance with the design concepts, specifications or recommendations and to allow for design changes in the event subsurface conditions differ from those anticipated prior to start of construction.

PIONEER ENGINEERING, INC. Geotechnical Engineering · Earth Science · Water Resources	VICINITY MAP PROPOSED SINGLE-FAMILY RESIDENCE 8114 WEST MERCER WAY MERCER ISLAND, WASHINGTON
	PROJ. NO. G13A21	DATE 10/3/13	FIGURE 1



PIONEER ENGINEERING, INC.

Geotechnical Engineering · Earth Science · Water Resources

SITE AND EXPLORATION PLAN
PROPOSED SINGLE-FAMILY RESIDENCE
8114 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

PROJ. NO. G13A21	DATE 10/3/13	FIGURE 2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAIN DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS MORE THAN 50% RETAINED ON THE NO. 200 SIEVE	**GRAVEL** MORE THAN 50% OF COARSE FRACTION RETAINED ON THE NO. 4 SIEVE	CLEAN GRAVEL	**GW**	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	**GM**	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSING PASSING NO. 4 SIEVE	CLEAN SAND	**SW**	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	**SM**	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS MORE THAN 50% PASSING THE NO. 200 SIEVE	**SILT AND CLAY** LIQUID LIMIT LESS THAN 50%	INORGANIC	**ML**	SILT, SANDY SILT
			CL	LEAN CLAY
		ORGANIC	**OL**	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50% OR MORE	INORGANIC	**MH**	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	**OH**	ORGANIC SILT, ORGANIC CLAY
HIGHLY ORGANIC SOILS			**PT**	PEAT

NOTE:

1. FIELD CLASSIFICATION BASED ON VISUAL EXAMINATION OF SOIL IN GENERAL ACCORDANCE WITH ASTM D2488.
2. SOIL CLASSIFICATION USING LABORATORY TESTS IS BASED ON ASTM D2487.
3. DESCRIPTIONS OF SOIL DENSITY OR CONSISTENCY ARE BASED ON INTERPRETATION OF BLOW-COUNT DATA, VISUAL APPEARANCE OF SOILS, AND/OR TEST DATA.

SOIL MOISTURE INDICATORS:

DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH.

SLIGHTLY MOIST - TRACE MOISTURE, NOT DUSTY.

MOIST - DAMP, BUT NO VISUAL WATER.

VERY MOIST - VERY DAMP, MOISTURE FELT TO THE TOUCH.

WET - VISUAL FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED FROM BELOW WATER TABLE.

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USCS CHART
PROPOSED SNGLE-FAMILY RESIDENCE
8114 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

PROJ. NO. G13A21 DATE 10/3/13 FIGURE 3

TEST HOLE NO. TH-1

Logged By: JW   Date: 9/27/13   Ground Elev. 212.0 ±

Depth ft.	USCS	Soil Description	Sample Type	Sample No.	(N) Blows/ft.	Other Test
0	SM	Brown, silty, fine SAND, some coarse gravel, trace organics, loose, slightly moist. (8" Topsoil)	SS	1	1,2,2	45% Sample Recovery
	GW	Well-graded sandy GRAVEL, loose to medium-dense, slightly moist. (Vashon Advance Outwash)				
5	SM/SP	Light gray, silty, medium SAND, some fine gravel, medium-dense, moist. (Vashon Advance Outwash)	SS	2	11,16,8	50% Sample Recovery
10	ML	Gray, SILT, slightly fractured, slightly moist, very stiff. (Lawton Clay)	SS	3	8,6,13	100% Sample Recovery
15	ML	Gray, SILT, slightly fractured, dry, very stiff. (Lawton Clay)	SS	4	7,10,11	100% Sample Recovery
20	ML	Gray, SILT, dry, hard. (Lawton Clay)	SS	5	9,15,18	100% Sample Recovery
		Test hole terminated @ 21.5 ft, no groundwater encountered during drilling.				

LEGEND: SS - 2" O.D. Split-Spoon Sample
ST - 3" O.D. Shelby-Tube Sample
B - Bulk Sample

GROUNDWATER: Seal
∇ Water Level
Observation Well Tip

Soil Sampling

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TEST HOLE LOG
PROPOSED SINGLE-FAMILY RESIDENCE
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PROJ. NO. G13A21 DATE 10/3/13 FIGURE 4

TEST HOLE NO. TH-2

Logged By: JW   Date: 9/27/13   Ground Elev. 195.0 ±

Depth ft.	USCS	Soil Description	Sample Type	Sample No.	(N) Blows/ ft.	Other Test
0	SM	Brown, silty, fine SAND, with gray silt inclusion, trace fine gravel, loose, very moist. (Colluvium)	SS	1	2,2,4	45% Sample Recovery
5	ML	Light gray, sandy SILT, some fine gravel, some orange staining, fractured, stiff, moist. (Lawton Clay)	SS	2	2,4,6	100% Sample Recovery
		- Gravel encountered @ 8'.				
10	ML	Gray, SILT, fractured, slightly moist, stiff. (Lawton Clay)	SS	3	2,4,5	100% Sample Recovery
		- Hard drilling from 12.5'.				
15	ML	Gray, SILT, dry, very stiff. (Lawton Clay)	SS	4	9,9,12	100% Sample Recovery
		Test hole terminated @ 16.5 ft, no groundwater encountered during drilling.				
20						

LEGEND: SS - 2" O.D. Split-Spoon Sample
ST - 3" O.D. Shelby-Tube Sample
B - Bulk Sample

GROUNDWATER: Seal
∇ Water Level
Observation Well Tip

Soil Sampling

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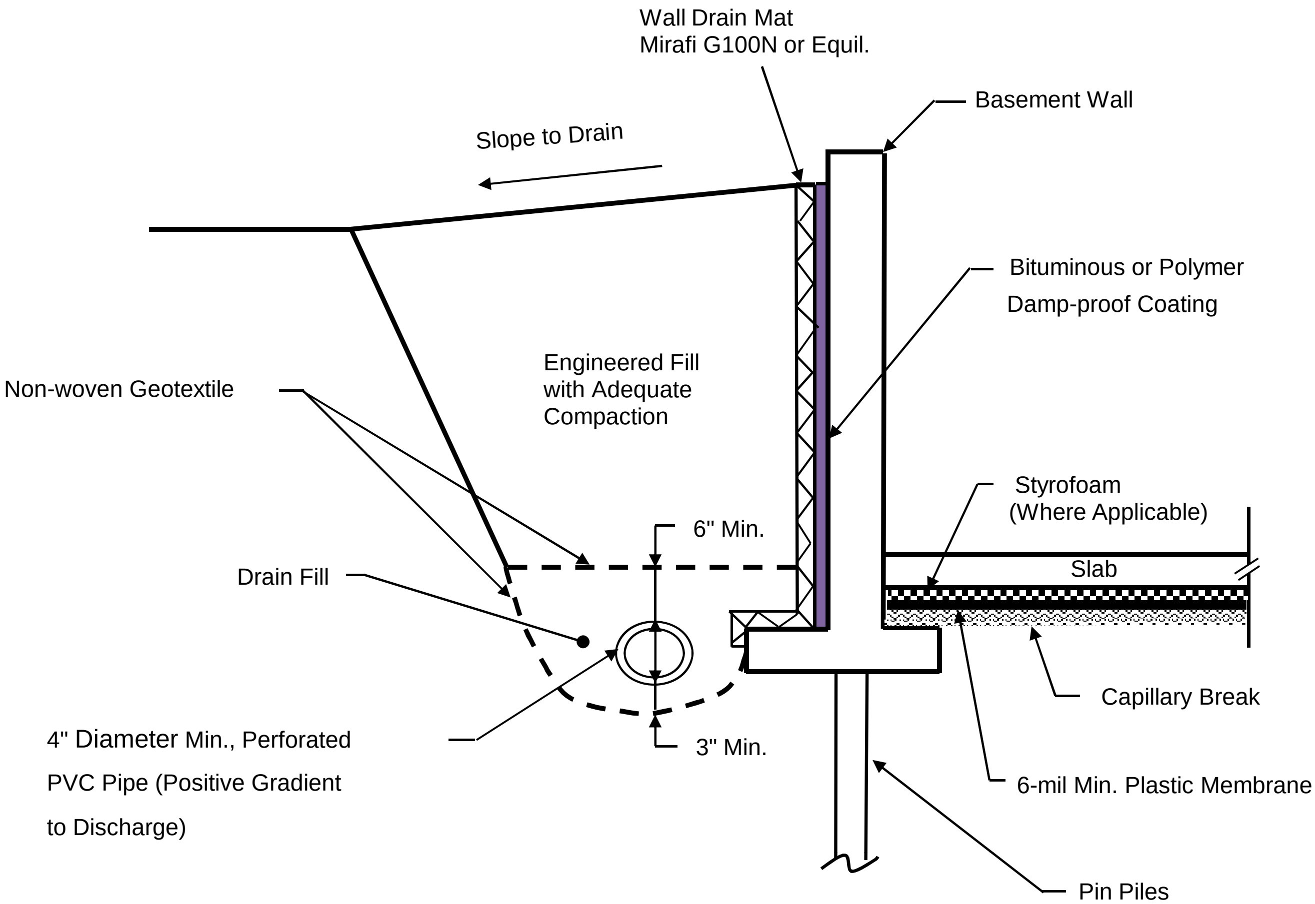
TEST HOLE LOG
PROPOSED SINGLE-FAMILY RESIDENCE
8114 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

PROJ. NO. G13A21 | DATE 10/3/13 | FIGURE 5



Not to Scale

Notes:

1. Engineered fill should consist of clean soils with individual particles no larger than 4 inches in size, and contain no organic and other deleterious substances.
2. Engineered fill should be placed no more than 10 inches thick per loose lift, and compacted to attain the maximum dry density determined by ASTM D1557 (Modified Proctor Method).
3. The top 3 feet of engineered fill should be compacted to at least 95 percent of maximum dry density, and 90 and 90 percent for the remaining.
4. The drain pipe should be a rigid, perforated PVC pipe.
5. A 6-mil plastic membrane should be placed over the capillary break as a vapor retarder.
6. Drain fill and Capillary break should consist of clean 5/8-inch crushed rock containing no more than 2 percent of fines.
7. The damp-proof coating should consist of a bituminous coating, or 3 pounds per square yard of acrylic modified cement, or 1/8 inch coat of surface-bonding mortar in compliance with ASTM C887.

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BASEMENT WALL DRAINAGE SYSTEM
PROPOSED SINGLE-FAMILY RESIDENCE
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MERCER ISLAND, WASHINGTON

PROJ. NO. G13A21	DATE 10/3/13	FIGURE 6