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May 11, 2016

JN 16162

Rahul Shinde and Pashmi Vaney
4207 West Mercer Way
Mercer Island, Washington 98040

via email: shinde-rahul@gmail.com and pashmi@gmail.com

Subject: **Transmittal Letter – Geotechnical Engineering Study**
Proposed Remodel or Reconstruction of Existing Residence
4207 West Mercer Way
Mercer Island, Washington

Dear Mr. Shinde and Ms. Vaney:

We are pleased to present this geotechnical engineering report for your residential project in Mercer Island. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design considerations for foundations, slope stability, subsurface drainage, and retaining walls. This work was authorized by your acceptance of our proposal, P-9417, dated March 30, 2016.

The attached report contains a discussion of the study and our recommendations. Please contact us if there are any questions regarding this report, or for further assistance during the design and construction phases of this project.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

Thor Christensen, P.E.
Senior Engineer

cc: **Studio Ectypos** – Lucia Pirzio-Biroli
via email: lucia@studioectypos.com

TRC/MRM:mc

GEOTECHNICAL ENGINEERING STUDY
Proposed Remodel or Reconstruction of Existing Residence
4207 West Mercer Way
Mercer Island, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed residential project to be located in Mercer Island.

We were provided with a topographic survey of the property prepared by GeoDimensions dated January 26, 2007. Development of the property is in the initial stages, and detailed plans have not yet been prepared. We understand that the residence may be remodeled, and a potential addition constructed on the eastern side of the home. Alternatively, the existing residence would be replaced with a new, larger structure extending further to the east.

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE

The Vicinity Map, Plate 1, illustrates the general location of the site in Mercer Island. The subject property is a large, generally-rectangular lot bordered to the north by West Mercer Way. The surrounding lots are all developed with single-family homes..

The upper, northern portion of the site is relatively flat and near the level of West Mercer Way. A one-and-a-half story residence with a partial basement that daylights toward the south is located in this upper flat area. A carport is attached to the north side of the residence. There is an asphalt driveway and parking area to the east of the carport. Along the south side of the parking area is a concrete retaining wall having a height of 3 to 4 feet. This wall appears to retain fill that has been placed to create the relatively level parking area.

There are small decks off the southwest and southeast corners of the house. To the south of these decks, and the eastern parking area the ground drops steeply downward toward the south. Locally, the ground surface is steepest immediately below the southern decks, which may be the result of past grading for the original site development. The steep slope area is heavily overgrown. We did not observe any indications of recent slope instability at the site. However, in early 1996 we provided consultation concerning a landslide that occurred on the steep slope below the eastern parking lot retaining wall following extended heavy rainfall. The landslide was relatively shallow, and involved primarily fill material that had been improperly placed on the steep slope during the development of this property and the adjacent eastern lot. No structures were damaged by that slide, and the area of the previous soil movement is now overgrown.

SUBSURFACE

The subsurface conditions were explored by drilling four test borings at the approximate locations shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

The borings were drilled on April 29, 2016 using a track-mounted, hollow-stem auger drill and a portable Acker drill that utilizes a small, gasoline-powered engine to advance a hollow-stem auger to the sampling depth. Samples were taken at approximate 2.5 and 5-foot intervals with a standard penetration sampler. This split-spoon sampler, which has a 2-inch outside diameter, is driven into the soil with a 140-pound hammer falling 30 inches. The number of blows required to advance the sampler a given distance is an indication of the soil density or consistency. A geotechnical engineer from our staff observed the drilling process, logged the test borings, and obtained representative samples of the soil encountered. The Test Boring Logs are attached as Plates 3 through 6.

Soil Conditions

Boring 1 was conducted at the top of the steep slope, immediately to the south of the existing southwestern deck. Beneath a layer of topsoil, this exploration encountered native silt sand that became medium-dense within 2 to 3 feet of the ground surface, and very dense below a depth of 5 feet. No fill was encountered in this boring. We conducted Boring 2 on the steep slope to the east of the southeastern house corner, downslope of the parking area retaining wall. This is within the area that may have been affected by the 1996 landslide. The upper approximately 7 feet of the boring revealed loose to medium-dense sand and silty sand. Below this was dense to very dense silt and silty sand.

Borings 3 and 4 were drilled above the steep slope and found loose to medium-dense silt and silty sand extending to an approximate depth of 15 feet. Dense silt and silty sand was observed below this depth.

The dense to very dense soils encountered in the borings have been glacially compressed.

Groundwater Conditions

The borings were conducted following a very wet fall and winter. Even so, no groundwater seepage was observed in the test borings.

It should be noted that groundwater levels vary seasonally with rainfall and other factors and are typically highest during the normally wet winter and spring months. We anticipate that groundwater could be found in more permeable soil layers and between the looser near-surface soil and the underlying denser soil.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. If a transition in soil type occurred between samples in the borings, the depth of the transition was interpreted. The relative densities and moisture descriptions indicated on the test boring logs are interpretive descriptions based on the conditions observed during drilling.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

THIS SECTION CONTAINS A SUMMARY OF OUR STUDY AND FINDINGS FOR THE PURPOSES OF A GENERAL OVERVIEW ONLY. MORE SPECIFIC RECOMMENDATIONS AND CONCLUSIONS ARE CONTAINED IN THE REMAINDER OF THIS REPORT. ANY PARTY RELYING ON THIS REPORT SHOULD READ THE ENTIRE DOCUMENT.

The test borings conducted for this study encountered medium-dense silty sand to silt at depths of approximately 5 feet. These medium-dense soils are suitable to support new construction using conventional foundations following stabilization of the sloping ground, as discussed below. Subgrades excavated in the silty native soils will be easily disturbed by foot and equipment traffic during the placement of foundation forms and rebar. As a result, we recommend that several inches of clean crushed rock be placed over the subgrades once they have been prepared to reduce the potential for disturbance.

A significant geotechnical consideration of the project is the potential for instability of the steep slope in the southern portion of the site. Future shallow movement of the steep slope south of the residence is possible. To maintain stability of the new residence or the renovated existing residence, a stabilization retaining wall will be needed at the southern edge of any development considered to be new construction by the City of Mercer Island. Even if some of the existing residence will remain and Code does not require a stabilization wall adjacent to that portion by Code, in our opinion it would be prudent to construct the stabilization wall along the full southern edge of the residence to protect the complete structure. Based on the recent test borings, there is a potential for shallow slope failures to extend approximately 8 to 10 feet deep at the south edge of the residence, and so the stabilization wall should be designed to retain 10 feet of unsupported soil as measured from the existing ground surface. The stabilization wall should consist of closely spaced, heavily-reinforced concrete piles. These piles can also be used to support the southern edge of the residence. Depending on the final development plans, the stabilization piles may need to return along the west and east sides of the new development area

The recommendations within this report are intended to protect the planned development from damage due to future shallow slope movement. They are also intended to prevent new construction from adversely affecting the stability of the slope. Soil and clearing debris should not be placed on the slope. Runoff from all impervious areas should be collected and piped to an approved storm drain located away from the slope. On-site infiltration or dispersion of storm water is not acceptable.

In order to satisfy the City of Mercer Island's requirements, we make the following statement:

> The development practices that we have recommended in this report should render the new construction as safe as if it were not located in a geologic hazard area.

The erosion control measures needed during the site development will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence will be needed around the downslope sides of any cleared areas. Such a silt fence may need to be strengthened to act as a debris barrier to collect soil spilled from drilling of the stabilization piles or from excavation for the new construction. Existing pavements, ground cover, and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Rocked staging areas and construction access roads should be provided to reduce the amount of soil or mud carried off the property by trucks and equipment. Trucks should not be allowed to drive off of the paved or rock-covered areas. Cut slopes and soil stockpiles should be covered with plastic during wet weather. Following clearing or rough grading, it may be necessary to mulch or hydroseed bare areas that will not be immediately covered with landscaping or an impervious surface. On most construction projects, it is necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

The drainage and/or waterproofing recommendations presented in this report are intended only to prevent active seepage from flowing through concrete walls or slabs. Even in the absence of active seepage into and beneath structures, water vapor can migrate through walls, slabs, and floors from the surrounding soil, and can even be transmitted from slabs and foundation walls due to the concrete curing process. Water vapor also results from occupant uses, such as cooking and bathing. Excessive water vapor trapped within structures can result in a variety of undesirable conditions, including, but not limited to, moisture problems with flooring systems, excessively moist air within occupied areas, and the growth of molds, fungi, and other biological organisms that may be harmful to the health of the occupants. The designer or architect must consider the potential vapor sources and likely occupant uses, and provide sufficient ventilation, either passive or mechanical, to prevent a build up of excessive water vapor within the planned structure.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

We recommend including this report, in its entirety, in the project contract documents. This report should also be provided to any future property owners so they will be aware of our findings and recommendations.

SEISMIC CONSIDERATIONS

In accordance with the International Building Code (IBC), the site class within 100 feet of the ground surface is best represented by Site Class Type D (Stiff Site Class). The site soils are not susceptible to seismic liquefaction because of their dense nature and the absence of near-surface groundwater. This statement regarding liquefaction includes the knowledge of the peak ground acceleration that is anticipated during the Maximum Considered Earthquake (MCE), which has a return period of once in 2,475 years.

DRILLED CONCRETE PILE S

The contractor should be prepared to case the holes or use the slurry method if caving soil or heavy groundwater seepage is encountered. Excessive ground loss in the drilled holes must be avoided to reduce the potential for settlement of adjacent structures. If water is present in a hole at the time concrete is poured, concrete must be tremied to the bottom of the hole.

The drilled piles for a stabilization wall should be spaced no more than 3 feet edge-to-edge, so that the soil above the theoretical failure plane can arch between the piles if a landslide occurs downslope of the wall.. The piles should be designed for an active soil pressure equal to that pressure exerted by an equivalent fluid with a unit weight of 40 pcf for a total depth of 10 feet beginning at the top of existing ground. This active soil pressure should be assumed to act over the center-to-center pile spacing. An ultimate passive soil pressure equal to that pressure exerted by a fluid with a density of 400 pcf will resist the lateral movement of the piles below the 10-foot depth. This value does not include a safety factor. The minimum pile length should be 30 feet. These design considerations are illustrated on the Closely Spaced Pile Stabilization Detail, Plate 8.

For a minimum embedment of 10 feet into the medium dense to dense native soils, and a pile diameter of 16 inches, we recommend assuming an allowable compressive capacity of 20 tons per pile.

CONVENTIONAL FOUNDATIONS

We recommend that continuous and individual spread footings have minimum widths of 16 and 24 inches, respectively. Exterior footings should also be bottomed at least 18 inches below the lowest adjacent finish ground surface for protection against frost and erosion. The local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

An allowable bearing pressure of 2,500 pounds per square foot (psf) is appropriate for footings supported on competent native soil. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent native soil will be about one-inch, with differential settlements on the order of one-half-inch in a distance of 30 feet along a continuous footing with a uniform load.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level, well-compacted fill. We recommend using the following ultimate values for the foundation's resistance to lateral loading:

PARAMETER	ULTIMATE VALUE
Coefficient of Friction	0.40
Passive Earth Pressure	350 pcf

Where: pcf is Pounds per Cubic Foot, and Passive Earth Pressure is computed using the Equivalent Fluid Density.

If the ground in front of a foundation is loose or sloping, the passive earth pressure given above will not be appropriate. We recommend maintaining a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above ultimate values.

FOUNDATION AND RETAINING WALLS

Retaining walls backfilled on only one side should be designed to resist the lateral earth pressures imposed by the soil they retain.

The following recommended parameters are for walls that restrain level backfill:

PARAMETER	VALUE
Active Earth Pressure *	35 pcf
Passive Earth Pressure	350 pcf
Coefficient of Friction	0.40
Soil Unit Weight	130 pcf

Where: pcf is Pounds per Cubic Foot, and Active and Passive Earth Pressures are computed using the Equivalent Fluid Pressures.

*** For a restrained wall that cannot deflect at least 0.002 times its height, a uniform lateral pressure equal to 10 psf times the height of the wall should be added to the above active equivalent fluid pressure.**

The design values given above do not include the effects of any hydrostatic pressures behind the walls and assume that no surcharges, such as those caused by slopes, vehicles, or adjacent foundations will be exerted on the walls. If these conditions exist, those pressures should be added to the above lateral soil pressures. Where sloping backfill is desired behind the walls, we will need to be given the wall dimensions and the slope of the backfill in order to provide the appropriate design earth pressures. The surcharge due to traffic loads behind a wall can typically be accounted for by adding a uniform pressure equal to 2 feet multiplied by the above active fluid density. Heavy construction equipment should not be operated behind retaining and foundation walls within a distance equal to the height of a wall, unless the walls are designed for the additional lateral pressures resulting from the equipment.

The values given above are to be used to design only permanent foundation and retaining walls that are to be backfilled, such as conventional walls constructed of reinforced concrete or masonry. It is not appropriate to use the above earth pressures and soil unit weight to back-calculate soil strength parameters for design of other types of retaining walls, such as soldier pile, reinforced earth, modular or soil nail walls. We can assist with design of these types of walls, if desired. The passive pressure given is appropriate only for a shear key poured directly against undisturbed native soil, or for the depth of level, well-compacted fill placed in front of a retaining or foundation wall. The values for friction and passive resistance are ultimate values and do not include a safety factor. Restrained wall soil parameters should be utilized for a distance of 1.5 times the wall height from corners or bends in the walls. This is intended to reduce the amount of cracking that can occur where a wall is restrained by a corner.

Wall Pressures Due to Seismic Forces

The surcharge wall loads that could be imposed by the design earthquake can be modeled by adding a uniform lateral pressure to the above-recommended active pressure. The recommended surcharge pressure is 8**H** pounds per square foot (psf), where **H** is the design retention height of the wall. Using this increased pressure, the safety factor against sliding and overturning can be reduced to 1.2 for the seismic analysis.

Retaining Wall Backfill and Waterproofing

Backfill placed behind retaining or foundation walls should be coarse, free-draining structural fill containing no organics. This backfill should contain no more than 5 percent silt or clay particles and have no gravel greater than 4 inches in diameter. The percentage of particles passing the No. 4 sieve should be between 25 and 70 percent. If the native silty sand is used as backfill, a minimum 12-inch thickness of free-draining gravel should first be placed against the walls to allow rapid drainage downward to the footing drains.

The purpose of these backfill requirements is to ensure that the design criteria for a retaining wall are not exceeded because of a build-up of hydrostatic pressure behind the wall. Also, subsurface drainage systems are not intended to handle large volumes of water from surface runoff. The top 12 to 18 inches of the backfill should consist of a compacted, relatively impermeable soil or topsoil, or the surface should be paved. The ground surface must also slope away from backfilled walls to reduce the potential for surface water to percolate into the backfill. Water percolating through pervious surfaces (pavers, gravel, permeable pavement, etc.) must also be prevented from flowing toward walls or into the backfill zone. The compacted subgrade below pervious surfaces and any associated drainage layer should therefore be sloped away. Alternatively, a membrane and subsurface collection system could be provided below a pervious surface.

It is critical that the wall backfill be placed in lifts and be properly compacted, in order for the above-recommended design earth pressures to be appropriate. The wall design criteria assume that the backfill will be well-compacted in lifts no thicker than 12 inches. The compaction of backfill near the walls should be accomplished with hand-operated equipment to prevent the walls from being overloaded by the higher soil forces that occur during compaction. The section entitled ***General Earthwork and Structural Fill*** contains additional recommendations regarding the placement and compaction of structural fill behind retaining and foundation walls.

The above recommendations are not intended to waterproof below-grade walls, or to prevent the formation of mold, mildew or fungi in interior spaces. Over time, the performance of subsurface drainage systems can degrade, subsurface groundwater flow patterns can change, and utilities can break or develop leaks. Therefore, waterproofing should be provided where future seepage through the walls is not acceptable. This typically includes limiting cold-joints and wall penetrations, and using bentonite panels or membranes on the outside of the walls. There are a variety of different waterproofing materials and systems, which should be installed by an experienced contractor familiar with the anticipated construction and subsurface conditions. Applying a thin coat of asphalt emulsion to the outside face of a wall is not considered waterproofing, and will only help to reduce moisture generated from water vapor or capillary action from seeping through the concrete. As with any project, adequate ventilation of basement and crawl space areas is important to prevent a build up of water vapor that is commonly transmitted through concrete walls from the surrounding soil, even when seepage is not present. This is appropriate even when waterproofing is applied to the outside of foundation and retaining walls. We recommend that you contact an experienced envelope consultant if detailed recommendations or specifications related to waterproofing design, or minimizing the potential for infestations of mold and mildew are desired.

The ***General***, ***Slabs-On-Grade***, and ***Drainage Considerations*** sections should be reviewed for additional recommendations related to the control of groundwater and excess water vapor for the anticipated construction.

SLABS-ON-GRADE

The building floors can be constructed as slabs-on-grade atop competent native soil, or on structural fill. The subgrade soil must be in a firm, non-yielding condition at the time of slab construction or underslab fill placement. Any soft areas encountered should be excavated and replaced with select, imported structural fill.

Even where the exposed soils appear dry, water vapor will tend to naturally migrate upward through the soil to the new constructed space above it. This can affect moisture-sensitive flooring, cause imperfections or damage to the slab, or simply allow excessive water vapor into the space above the slab. All interior slabs-on-grade should be underlain by a capillary break drainage layer consisting of a minimum 4-inch thickness of clean gravel or crushed rock that has a fines content (percent passing the No. 200 sieve) of less than 3 percent and a sand content (percent passing the No. 4 sieve) of no more than 10 percent. Pea gravel or crushed rock are typically used for this layer.

As noted by the American Concrete Institute (ACI) in the *Guides for Concrete Floor and Slab Structures*, proper moisture protection is desirable immediately below any on-grade slab that will be covered by tile, wood, carpet, impermeable floor coverings, or any moisture-sensitive equipment or products. ACI also notes that vapor *retarders* such as 6-mil plastic sheeting have been used in the past, but are now recommending a minimum 10-mil thickness for better durability and long term performance. A vapor retarder is defined as a material with a permeance of less than 0.3 perms, as determined by ASTM E 96. It is possible that concrete admixtures may meet this specification, although the manufacturers of the admixtures should be consulted. Where vapor retarders are used under slabs, their edges should overlap by at least 6 inches and be sealed with adhesive tape. The sheeting should extend to the foundation walls for maximum vapor protection. If no potential for vapor passage through the slab is desired, a vapor *barrier* should be used. A vapor barrier, as defined by ACI, is a product with a water transmission rate of 0.01 perms when tested in accordance with ASTM E 96. Reinforced membranes having sealed overlaps can meet this requirement.

The ***General***, ***Permanent Foundation and Retaining Walls***, and ***Drainage Considerations*** sections should be reviewed for additional recommendations related to the control of groundwater and excess water vapor for the anticipated construction.

EXCAVATIONS AND SLOPES

Excavation slopes should not exceed the limits specified in local, state, and national government safety regulations. Temporary cuts to a depth of about 4 feet may be attempted vertically in unsaturated soil, if there are no indications of slope instability. However, vertical cuts should not be made near property boundaries, or existing utilities and structures. Based upon Washington Administrative Code (WAC) 296, Part N, the soil at the subject site would generally be classified as Type B. Therefore, temporary cut slopes greater than 4 feet in height should not be excavated at an inclination steeper than 1:1 (Horizontal:Vertical), extending continuously between the top and the bottom of a cut.

The above-recommended temporary slope inclination is based on the conditions exposed in our explorations, and on what has been successful at other sites with similar soil conditions. It is possible that variations in soil and groundwater conditions will require modifications to the inclination at which temporary slopes can stand. Temporary cuts are those that will remain unsupported for a relatively short duration to allow for the construction of foundations, retaining walls, or utilities. Temporary cut slopes should be protected with plastic sheeting during wet weather. It is also important that surface runoff be directed away from the top of temporary slope cuts. Cut slopes should also be backfilled or retained as soon as possible to reduce the potential for instability. Please note that sand or loose soil can cave suddenly and without warning. Excavation, foundation, and utility contractors should be made especially aware of this potential danger. These recommendations may need to be modified if the area near the potential cuts has been disturbed in the past by utility installation, or if settlement-sensitive utilities are located nearby.

All permanent cuts into native soil should be inclined no steeper than 2.5:1 (H:V). Water should not be allowed to flow uncontrolled over the top of any temporary or permanent slope. All permanently exposed slopes should be seeded with an appropriate species of vegetation to reduce erosion and improve the stability of the surficial layer of soil.

Any disturbance to the existing steep slope outside of the building limits may reduce the stability of the slope. Damage to the existing vegetation and ground should be minimized, and any disturbed areas should be revegetated as soon as possible. Soil from the excavation should not be placed on the slope, and this may require the off-site disposal of any surplus soil.

DRAINAGE CONSIDERATIONS

Footing drains should be used where: (1) Crawl spaces or basements will be below a structure; (2) A slab is below the outside grade; or, (3) The outside grade does not slope downward from a building. Drains should also be placed at the base of all earth-retaining walls. These drains should be surrounded by at least 6 inches of 1-inch-minus, washed rock that is encircled with non-woven, geotextile filter fabric (Mirafi 140N, Supac 4NP, or similar material). At its highest point, a perforated pipe invert should be at least 6 inches below the bottom of a slab floor or the level of a crawl space. The discharge pipe for subsurface drains should be sloped for flow to the outlet point. Roof and surface water drains must not discharge into the foundation drain system. A typical drain detail is attached to this report as Plate 7. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains.

As a minimum, a vapor retarder, as defined in the ***Slabs-On-Grade*** section, should be provided in any crawl space area to limit the transmission of water vapor from the underlying soils. Crawl space grades are sometimes left near the elevation of the bottom of the footings. As a result, an outlet drain is recommended for all crawl spaces to prevent an accumulation of any water that may bypass the footing drains. Providing even a few inches of free draining gravel underneath the vapor retarder limits the potential for seepage to build up on top of the vapor retarder.

No groundwater was observed during our field work. If seepage is encountered in an excavation, it should be drained from the site by directing it through drainage ditches, perforated pipe, or French drains, or by pumping it from sumps interconnected by shallow connector trenches at the bottom of the excavation.

The excavation and site should be graded so that surface water is directed off the site and away from the tops of slopes. Water should not be allowed to stand in any area where foundations, slabs, or pavements are to be constructed. Final site grading in areas adjacent to a building should slope away at least 2 percent, except where the area is paved. Surface drains should be provided where necessary to prevent ponding of water behind foundation or retaining walls. A discussion of grading and drainage related to pervious surfaces near walls and structures is contained in the ***Foundation and Retaining Walls*** section. Water from roof, storm water, and foundation drains should not be discharged onto slopes; it should be tightlined to a suitable outfall located away from any slopes.

GENERAL EARTHWORK AND STRUCTURAL FILL

All building and pavement areas should be stripped of surface vegetation, topsoil, organic soil, and other deleterious material. The stripped or removed materials should not be mixed with any materials to be used as structural fill, but they could be used in non-structural areas, such as landscape beds.

Structural fill is defined as any fill, including utility backfill, placed under, or close to, a building, behind permanent retaining or foundation walls, or in other areas where the underlying soil needs to support loads. All structural fill should be placed in horizontal lifts with a moisture content at, or near, the optimum moisture content. The optimum moisture content is that moisture content that results in the greatest compacted dry density. The moisture content of fill is very important and must be closely controlled during the filling and compaction process.

The allowable thickness of the fill lift will depend on the material type selected, the compaction equipment used, and the number of passes made to compact the lift. The loose lift thickness should not exceed 12 inches. We recommend testing the fill as it is placed. If the fill is not sufficiently compacted, it can be recompacted before another lift is placed. This eliminates the need to remove the fill to achieve the required compaction. The following table presents recommended relative compactions for structural fill:

LOCATION OF FILL PLACEMENT	MINIMUM RELATIVE COMPACTION
Beneath slabs or walkways	95%
Filled slopes and behind retaining walls	90%
Beneath pavements	95% for upper 12 inches of subgrade; 90% below that level

Where: Minimum Relative Compaction is the ratio, expressed in percentages, of the compacted dry density to the maximum dry density, as determined in accordance with ASTM Test Designation D 1557-91 (Modified Proctor).

Structural fill that will be placed in wet weather should consist of a coarse, granular soil with a silt or clay content of no more than 5 percent. The percentage of particles passing the No. 200 sieve should be measured from that portion of soil passing the three-quarter-inch sieve.

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our exploration and assume that the soil and groundwater conditions encountered in the test borings are representative of subsurface conditions on the site. If the subsurface conditions encountered during construction are significantly different from those observed in our explorations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking samples in test borings. Subsurface conditions can also vary between exploration locations. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project. It is recommended that the owner consider providing a contingency fund to accommodate such potential extra costs and risks. This is a standard recommendation for all projects.

The recommendations presented in this report are directed toward the protection of only the proposed new construction from damage due to slope movement. Predicting the future behavior of steep slopes and the potential effects of development on their stability is an inexact and imperfect science that is currently based mostly on the past behavior of slopes with similar characteristics. Landslides and soil movement can occur on steep slopes before, during, or after the development of property. The owner of any property containing, or located close to steep slopes must ultimately accept the possibility that some slope movement could occur, resulting in possible loss of ground or damage to the facilities around the proposed development.

This report has been prepared for the exclusive use of Rahul Shinde and Pashmi Vaney and their representatives for specific application to this project and site. Our conclusions and recommendations are professional opinions derived in accordance with our understanding of current local standards of practice, and within the scope of our services. No warranty is expressed or implied. The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design. Our services also do not include assessing or minimizing the potential for biological hazards, such as mold, bacteria, mildew and fungi in either the existing or proposed site development.

ADDITIONAL SERVICES

Geotech Consultants, Inc. should be retained to provide geotechnical consultation, testing, and observation services during construction. This is to confirm that subsurface conditions are consistent with those indicated by our exploration, to evaluate whether earthwork and foundation construction activities comply with the general intent of the recommendations presented in this report, and to provide suggestions for design changes in the event subsurface conditions differ from those anticipated prior to the start of construction. However, our work would not include the supervision or direction of the actual work of the contractor and its employees or agents. Also, job and site safety, and dimensional measurements, will be the responsibility of the contractor.

During the construction phase, we will provide geotechnical observation and testing services when requested by you or your representatives. Please be aware that we can only document site work we actually observe. It is still the responsibility of your contractor or on-site construction team to verify that our recommendations are being followed, whether we are present at the site or not.

The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 6	Test Boring Logs
Plate 7	Typical Footing Drain Detail
Plate 8	Closely Spaced Pile Stabilization Detail

We appreciate the opportunity to be of service on this project. Please contact us if you have any questions, or if we can be of further assistance.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

Thor Christensen, P.E.
Senior Engineer

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REGISTERED
PROFESSIONAL ENGINEER

5/11/16

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Principal

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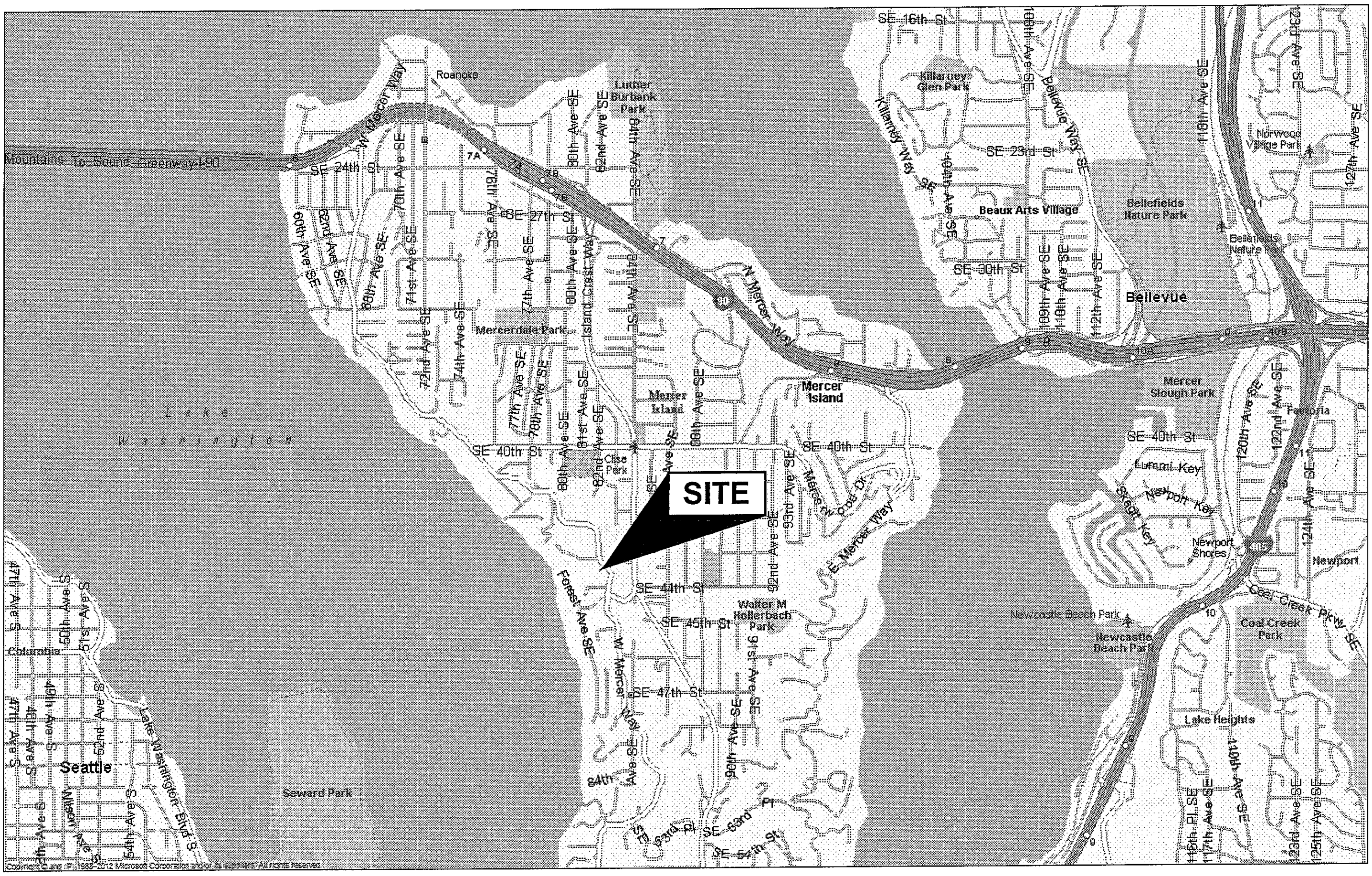


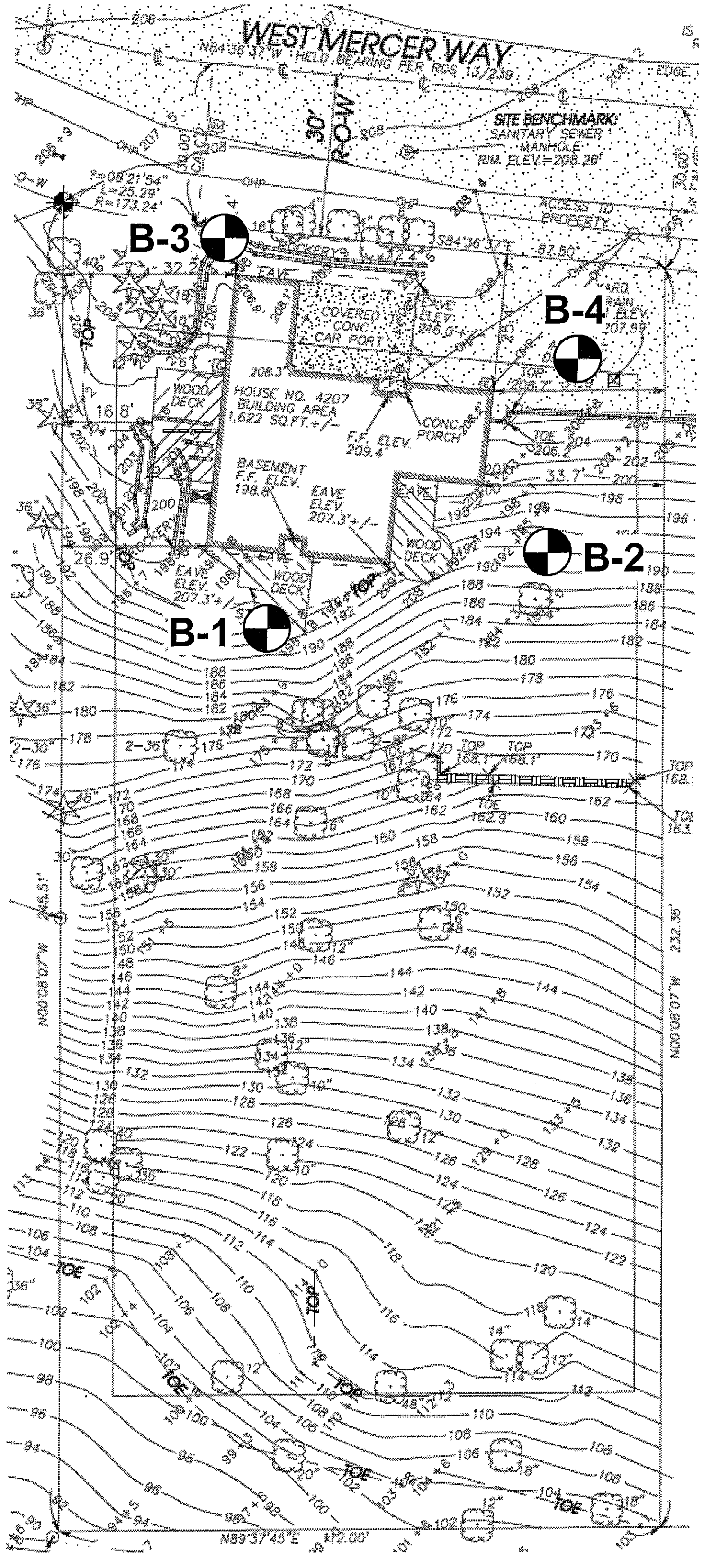
(Source: Microsoft MapPoint, 2013)

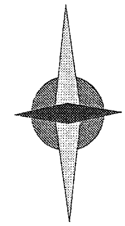
GEOTECH CONSULTANTS, INC.

VICINITY MAP

4207 West Mercer Way
Mercer Island, Washington

Job No:	Date:		Plate:
16162	May 2016		1





Legend:

◪ Test Pit Location

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SITE EXPLORATION PLAN

4207 West Mercer Way
Mercer Island, Washington

Job No:	Date:		Plate:
16162	May 2016	No Scale	2

BORING 1

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
					SM	Topsoil over; Gray-brown silty SAND, fine-grained, moist, loose to medium-dense
			29	1		-becomes medium-dense
5			55	2		-becomes very dense
			77	3		-with occasional seams of clean sand
10			68	4		
15						
20						

*** Test boring was terminated at 11.5 feet on April 29, 2016.**
*** No groundwater was encountered during drilling.**

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TEST BORING LOG
4207 West Mercer Way
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
16162	May 2016	TRC	3

BORING 2

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
0						Topsoil over;
					SM	Gray-brown silty SAND with gravel, fine to coarse-grained, moist, loose to medium-dense
			13	1		-becomes medium-dense
5					SW	Gray SAND, fine to coarse-grained, moist, medium-dense
			14	2	SM	Gray-brown silty SAND, fine-grained, moist, medium-dense
			43	3	ML	Gray-brown SILT, non-plastic, moist, dense
10			38	4	ML/SM	Gray-brown SILT to silty SAND, non-plastic, fine-grained, moist, dense
15			61	5	SM	Gray-brown silty SAND, fine-grained, moist, very dense
20						

*** Test boring was terminated at 16.5 feet on April 29, 2016.**
*** No groundwater was encountered during drilling.**

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TEST BORING LOG

4207 West Mercer Way
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
16162	May 2016	TRC	4

BORING 3

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
0					SM	Topsoil over; Brown silty SAND, fine-grained, moist, loose
			8	1		
5			14	2		-becomes medium-dense
			12	3		
10			15	4		-becomes gray-brown
					SW	Gray-brown SAND, fine to coarse-grained, moist, medium-dense
15			26	5	SM	Gray-brown silty SAND, fine-grained, moist, medium-dense
20			43	6		-becomes dense

*** Test boring was terminated at 21.5 feet on April 29, 2016.**
*** No groundwater was encountered during drilling.**

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TEST BORING LOG

4207 West Mercer Way
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
16162	May 2016	TRC	5

BORING 4

Depth (ft.)	Moisture	Water Table	Blows per Foot	Sample	USCS	Description
						2.5 inches of asphalt over;
			8	1	SM	Gray-brown silty SAND with a thin layer of organic silt, fine-grained, moist, loose
5			12	2	ML/SM	Gray-brown SILT to silty SAND, non-plastic, fine-grained, moist, medium-dense
			16	3		-becomes slightly plastic
10			20	4	SM	Gray-brown silty SAND, fine-grained, moist, medium-dense
15			32	5	ML/SM	Gray-brown SILT to silty SAND, non-plastic, fine-grained, moist, dense
20			32	6	ML	Gray-brown SILT, slightly plastic, moist, dense

* **Test boring was terminated at 21.5 feet on April 29, 2016.**
* **No groundwater was encountered during drilling.**

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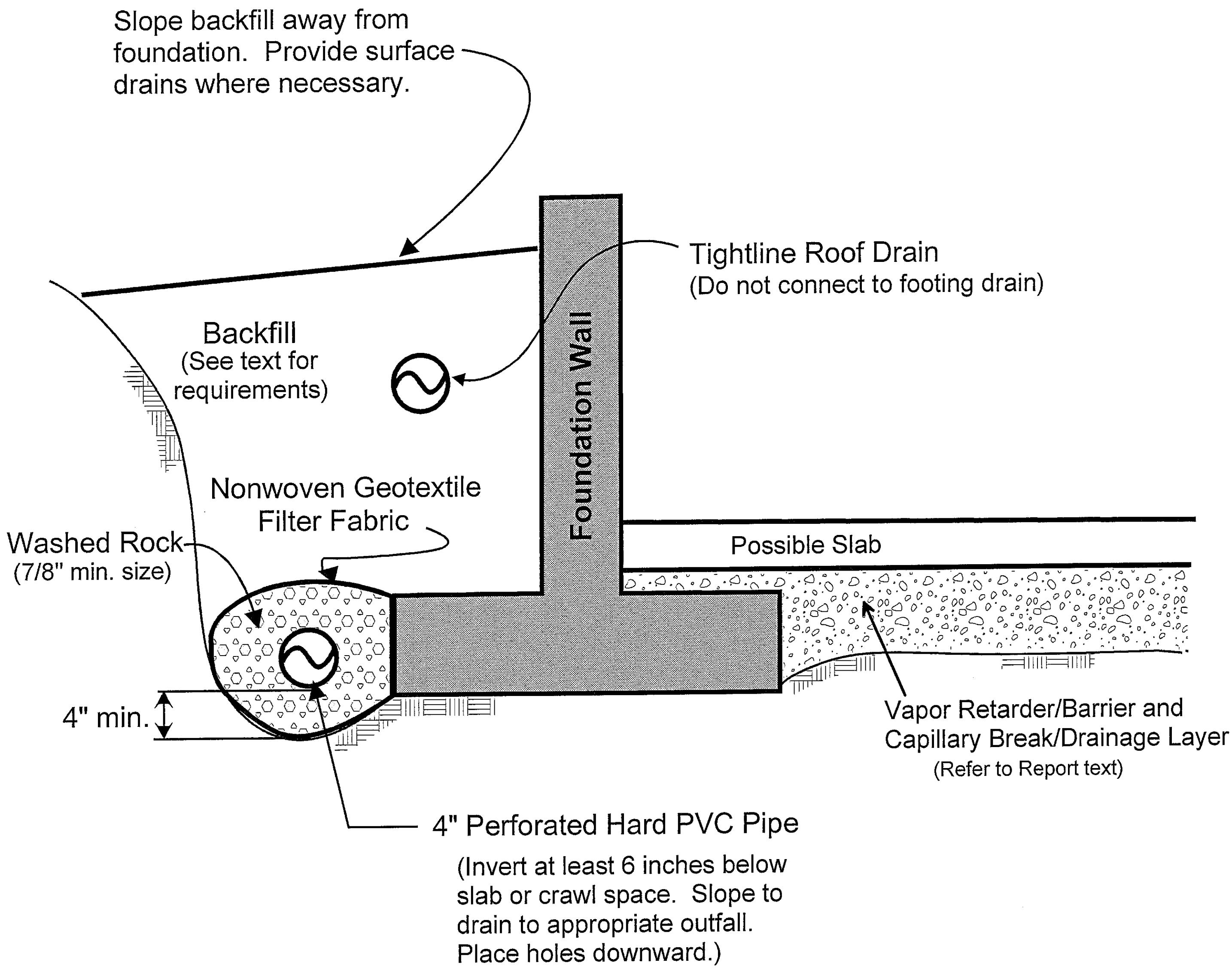
TEST BORING LOG
4207 West Mercer Way
Mercer Island, Washington

Job	Date:	Logged by:	Plate:
16162	May 2016	TRC	6



NOTES:

(1) In crawl spaces, provide an outlet drain to prevent buildup of water that bypasses the perimeter footing drains.

(2) Refer to report text for additional drainage, waterproofing, and slab considerations.

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FOOTING DRAIN DETAIL

4207 West Mercer Way
Mercer Island, Washington

Job No:	Date:		Plate:
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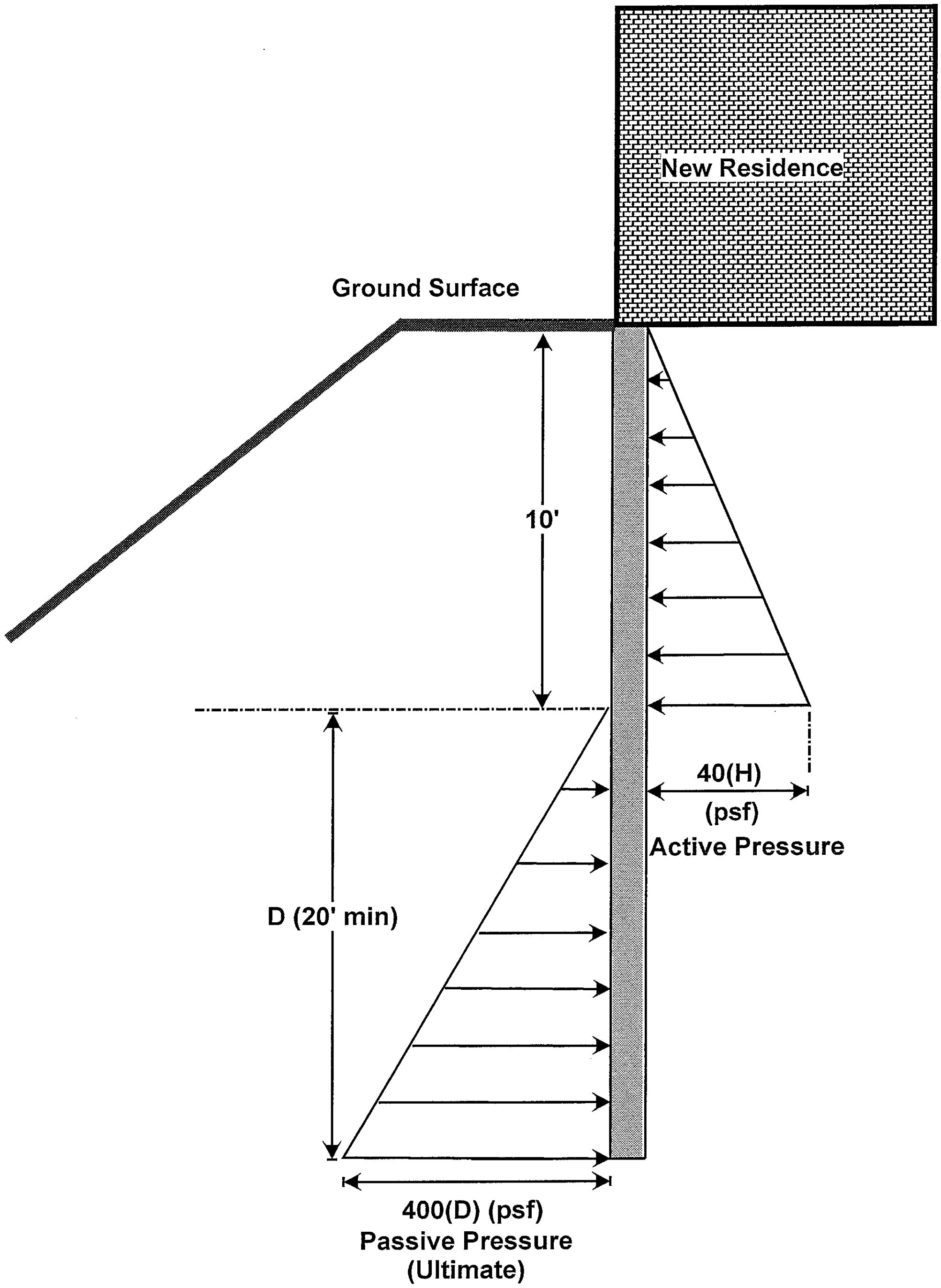

Notes:

(1) The report should be referenced for specifics regarding design and installation.
(2) Active pressures act over the pile spacing.
(3) Passive pressures act over twice the grouted pile diameter.

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Closely Spaced Pile Stabilization Detail
4207 West Mercer Way
Mercer Island, Washington

Job No:	Date:		Plate:
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