GEOTECH
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JN 24099

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Subject: **Foundation and Critical Area Considerations**
Proposed Addition
3817 – 80th Avenue Southeast
Mercer Island, Washington

Greetings:

This report presents our geotechnical engineering report related to the planned work associated with the construction of the addition to your existing home. The scope of our services consisted of assessing the site surface and subsurface conditions, and then developing this summary report.

Based on the plans prepared by Baylis Architects, we understand that a new addition is proposed to be constructed near the southwestern corner of the existing residence's lower level. The addition will consist of a single-story and will not be underlain by basement space. As a part of this work, a portion of the lower level of the residence will be partially remodeled, reconfiguring the layout of the living space. It appears that a modification to an interior bearing wall may be needed, but no other structural modifications within the residence are anticipated at this time. The floor level of the new addition is shown to match that of the existing lower level. At its closest, the southern wall of the addition will extend to approximately 7.5 feet from the southern property line. Excavations of only a few feet are anticipated.

The City of Mercer Island GIS maps the western portion of the property, west of the existing residence, to lie within both a Potential Landslide Hazard and Erosion Hazard area. There are no steep slopes mapped on, or around, your property. There are no mapped landslides on, or near, your property.

SITE CONDITIONS

We visited the subject property on March 19, 2024 to meet with the client, and to observe the existing site conditions. The existing residence consists of two stories. The main living space is situated on the second story, which is accessed via a stairway that extends up from the driveway. The lower floor consists of the garage and living space that is partially bunkered into the higher northern grade. A deck situated at the elevation of the upper floor extends west of the residence, and a covered patio is situated near the southeastern corner of the garage. The remainder of the property is covered with grass and scattered landscaping.

The ground surface on the property and in the surrounding area generally slopes downward toward the south and west. The relatively flat grade of the driveway wraps around the south and west sides of the property. The northern side of the property is elevated approximately 4 to 6 feet above the lower driveway and yard.

A short slope descends into the neighboring southern property across a graded landscape slope and rockery. This slope, at its tallest, is around 3 to 4 feet in height. The grade also descends from the flat rear yard into the lower western lot across a slope that is around 8 to 10 feet tall. This slope is mostly moderately inclined; however, a short rockery is located at the toe of this slope well into the neighboring western parcel. It appears that the toe of this short slope was oversteepened when the rockery was likely cut into its base. The top of this short slope is at least 30 feet from the edge of the western wall of the house and addition.

We saw no indications of recent slope movement on the site. No previous landslides have been documented on the *Mercer Island Landslide Hazard Assessment* map on or around the subject property. Two identified landslides are mapped several lots north of the site; however, no information regarding these slide events could be found. Several of these more distant northern lots contain steeply inclined slopes different from the site conditions, which may have been attributed to the mapped landslides.

We are familiar with the native subsurface conditions on the property from review of published geologic maps, as well as the excavation of three shallow test holes conducted within the addition footprint. The geologic mapping indicates that this area is underlain by glacial drift, which typically consists of a glacially-compressed mixture of gravel, silt, and fine-grained sand. During the recent site visit, three test holes were excavated near the southwest, southeast, and northern extent of the addition area. Beneath the existing site grades, loose fill soils were encountered in all three exploration locations, extending to depths of 2 to 3 feet. Test Hole 3, which was excavated near the existing residence's foundation, revealed the base of the footing at a depth of 12 inches. Native, loose, root laden, weathered silty sand was revealed beneath the fill soil, and extended to a depth of 2 to 4 feet before becoming medium-dense and denser. At this location, the footing of the existing house is sitting on the fill and the underlying loose soils. In Test Holes 1 and 2, the silty sand was observed to be slightly cemented, and became dense beneath depths of 3 to 5.5 feet; the dense soils continued to the base of the test holes. No groundwater was observed during excavation.

<u>CONCLUSIONS AND RECOMMENDATIONS</u>

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 site and surrounding area are underlain by competent, medium-dense and denser, glacially-compressed native soils. These competent soils were observed to be relatively shallow near the north and southeast corners of the addition footprint, deepening to the southwest. The test holes indicate that excavation of 3 to 4 feet below the existing grade will be needed to reach medium-dense to dense soils suitable for new foundations. In this case, either the foundations could be lowered to bear directly atop the underlying dense native soils, or compacted rock fill could be used to backfill any overexcavation and re-establish the foundation elevations. Excavations conducted near the existing residence foundations at the tie in locations would need to be excavated and backfilled promptly so as not to undermine the existing foundations, which were found to bear at a shallow depth on looser soils. If deeper excavations are not warranted or are too extensive given the tight project area, the addition foundations could also be supported on small diameter pipe piles, which would be driven through the upper, loose soils, to refusal in the underlying glacially compressed soils that underlie the site. Recommendations for ***Conventional Foundations*** and ***Pipe Piles*** are presented in subsequent sections of this report.

Considering that the south foundation of the existing house was poured on unsuitable soils, it will be important that the loads from the new addition are supported entirely by new foundations excavated to bearing soils. If the existing foundations are needed to support additional load, they should first be underpinned. This would involve excavating underneath the existing footings to remove the fill and loose soil, and then filling that excavation with concrete. This underpinning usually is accomplished in alternating 2-foot sections to avoid destabilizing the existing footing.

Critical Area Discussion Per MICC 19.07:

Seismic Hazard: The underlying glacially-compressed soils beneath the site are not susceptible to seismic liquefaction. The chosen foundation system for this project will be supported on the underlying medium-dense and denser soils, which are competent for support of new foundation loads.

Potential Landslide Hazard: The planned addition is not close to any steep or tall slope areas. The dense, glacially-compressed soils that underlie the site are not susceptible to instability, even during a strong earthquake. The stability of the short slope on the western side of the site, over 30 feet west of the house, will not be adversely affected by the shallow excavations needed for the new development. This sloped area also does not pose a risk to the planned new construction. No buffer or other mitigation measures are required to address the Potential Landslide Hazard mapping of the site.

Erosion Hazard: The site disturbance for the proposed development will be limited and will occur primarily on gently-slope ground. The mapped Erosion Hazard west of the house will not be disturbed. The potential for erosion problems during site work can be mitigated by implementing proper temporary erosion control measures that will depend heavily on the weather conditions that are encountered. We anticipate that a silt fence or straw wattle will be needed around the downslope sides of any work areas. Existing ground cover and landscaping should be left in place wherever possible to minimize the amount of exposed soil. Small soil stockpiles should be covered with plastic during wet weather. Soil and mud should not be tracked onto the adjoining streets, and silty water must be prevented from traveling off the site. It should be possible to complete the planned addition during the wet season without adverse impacts to the site and neighboring lots. As with any construction project, it can be necessary to periodically maintain or modify temporary erosion control measures to address specific site and weather conditions.

Once we have reviewed the final plans for the development incorporating the recommendations of this report, we can provide a “statement of risk” to satisfy City of Mercer Island conditions.

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 Soil).

The IBC and ASCE 7 require that the potential for liquefaction (soil strength loss) during an earthquake be evaluated for the peak ground acceleration of the Maximum Considered Earthquake (MCE), which has a probability of occurring once in 2,475 years (2 percent probability of occurring in a 50-year period). The dense soils beneath the site are not susceptible to seismic liquefaction under the ground motions of the MCE because of the absence of near-surface groundwater.

CONVENTIONAL FOUNDATIONS

New conventional continuous and spread footings should bear on undisturbed, medium-dense and denser, native soil, or on compacted, clean rock structural fill placed above this competent native soil. Prior to placing structural fill beneath foundations, the excavation should be observed by the geotechnical engineer to document that adequate bearing soils have been exposed.

We recommend that continuous and individual spread footings have minimum widths of 12 and 16 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.

Depending on the final site grades, overexcavation may be required below the footings to expose competent native soil. Unless lean concrete is used to fill an overexcavated hole, the overexcavation must be at least as wide at the bottom as the sum of the depth of the overexcavation and the footing width. For example, an overexcavation extending 2 feet below the bottom of a 2-foot-wide footing must be at least 4 feet wide at the base of the excavation. If lean concrete is used, the overexcavation need only extend 6 inches beyond the edges of the footing. A typical detail for overexcavation beneath footings is attached as Plate 4.

An allowable bearing pressure of 2,000 pounds per square foot (psf) is appropriate for footings supported on competent native soil, or on compacted, angular rock fill placed atop the competent medium-dense and denser native soils. 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, or on structural fill up to 5 feet in thickness, will be about one-inch, with differential settlements on the order of one-half-inch in a distance of 20 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	250 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. The above ultimate values for passive earth pressure and coefficient of friction do not include a safety factor.

PIPE PILES

A 2-inch-diameter pipe pile driven with a minimum 90-pound jackhammer or a 140-pound Rhino hammer to a final penetration rate of 1-inch or less for one minute of continuous driving may be assigned an allowable compressive load of 3 tons.

Extra-strong, Schedule 80 steel pipe should be used for 2-inch-diameter piles. The site soils are not highly organic, and are not located near salt water. As a result, they do not have an elevated corrosion potential. Considering this, it is our opinion that standard “black” pipe can be used, and corrosion protection, such as galvanizing, is not necessary for the pipe piles.

Pile caps and grade beams should be used to transmit loads to the piles. Isolated pile caps, should include a minimum of two piles to reduce the potential for eccentric loads being applied to the piles. Subsequent sections of pipe can be connected with slip or threaded couplers, or they can be welded together. If slip couplers are used, they should fit snugly into the pipe sections. This may require that shims be used or that beads of welding flux be applied to the outside of the coupler.

Lateral loads due to wind or seismic forces may be resisted by passive earth pressure acting on the vertical, embedded portions of the foundation. For this condition, the foundation must be either poured directly against relatively level, undisturbed soil or be surrounded by level compacted fill. We recommend using a passive earth pressure of 250 pounds per cubic foot (pcf) for this resistance. We recommend a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above ultimate passive value.

BUILDING FLOORS

The existing fill and topsoil are unsuitable to support floor slabs, as noticeable post-construction settlement would result. The building floors can be constructed as slabs-on-grade atop competent native soil, or on structural fill placed over the competent native soils. 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. Alternately, the addition floors could be constructed as a framed floor atop a crawlspace.

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 recommends a minimum 10-mil thickness vapor retarder for better durability and long term performance than is provided by 6-mil plastic sheeting that has historically been used. 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.

We recommend that the contractor, the project materials engineer, and the owner discuss these issues and review recent ACI literature and ASTM E-1643 for installation guidelines and guidance on the use of the protection/blotter material.

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 footing drain detail is attached to this report as Plate 5. For the best long-term performance, perforated PVC pipe is recommended for all subsurface drains. Clean-outs should be provided for potential future flushing or cleaning of footing drains.

Drainage inside the building's footprint should also be provided where (1) a crawl space or slab will slope or be lower than the surrounding ground surface, (2) an excavation encounters significant seepage, or (3) an excavation for a building will be close to the expected high groundwater elevations. We can provide recommendations for interior drains, should they become necessary, during excavation and foundation construction.

As a minimum, a vapor retarder, as defined in the ***Building Floors*** 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 a few inches of free draining gravel underneath the vapor retarder is also prudent to limit 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 away from buildings and 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 the addition should slope away at least one to 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.

LIMITATIONS

This report has been prepared for the exclusive use of Tom Walsh and Elaine Winters, 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

In addition to reviewing the final plans, 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.

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.

3/27/2024

Matthew K. McGinnis
Geotechnical Engineer

Marc R. McGinnis, P.E.
Principal

Attachments: Vicinity Map, Site Plan, Test Hole Logs, Overexcavation Detail, Footing Drain Detail

cc: **Baylis Architects** – Jin Wan
via email: wanj@baylisarchitects.com

MKM/MRM:kg

NORTH

(Source: King County iMap)

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VICINITY MAP

3817 - 80th Avenue Southeast
Mercer Island, Washington

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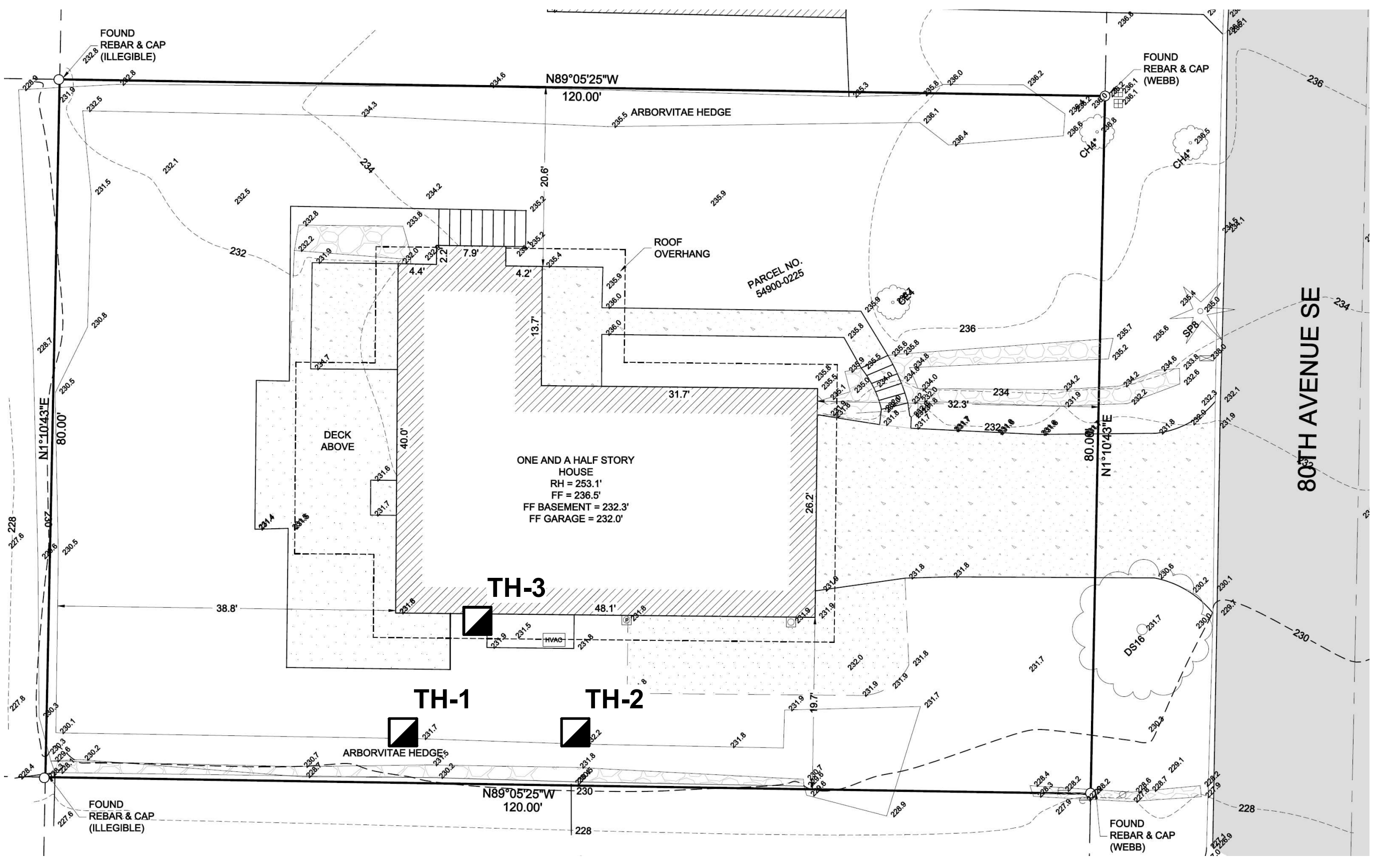
NORTH



Legend:

◪ Test Hole Location

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SITE EXPLORATION PLAN

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TEST HOLE 1

Depth (Feet)	Soil Description
0.0 – 3.0	Brown to dark-brown gravelly, silty SAND with trace plastic debris, roots, and decayed organics, fine-grained, moist, loose [**FILL**]
3.0 – 6.0	Grayish-brown mottled orange, very silty SAND with abundant roots, fine-grained, very moist, loose **[SM]** - 4', becomes gray, heavily rusted, less roots, medium-dense - 5.5', becomes slightly cemented, dense

Test Hole was terminated at 6.0 feet on March 19, 2024.
No groundwater seepage was encountered in the test hole.
No caving was observed during excavation.

TEST HOLE 2

Depth (Feet)	Soil Description
0.0 – 2.0	Brown to dark-brown gravelly, silty SAND with trace plastic debris, roots, and decayed organics, fine-grained, moist, loose [**FILL**]
2.0 – 4.0	Gray-brown mottled orange, very silty sand, fine-grained, moist, medium-dense **[SM]** - 3.5', becomes slightly cemented, dense

Test Hole was terminated at 4.0 feet on March 19, 2024.
No groundwater seepage was encountered in the test hole.
No caving was observed during excavation.

TEST HOLE 3

Depth (Feet)	Soil Description
0.0 – 1.0	Pea Gravel
1.0 - 2.0	Brown to Dark-brown gravelly, silty SAND with decayed organics and glass debris, fine-grained, moist, loose **[FILL]** - Bottom of foundation 12-inches below ground surface
2.0 – 5.0	Grayish-brown mottled orange, very silty SAND with roots, fine-grained, moist, loose to medium-dense **[SM]** - 2.5', with abundant small roots - 3', becomes gray, dense

Test Hole was terminated at 5.0 feet on March 19, 2024.
No groundwater seepage was encountered in the test hole.
No caving was observed during excavation.

***NOTE** – Letters in brackets **[ ]** denote the USCS soil classification.

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TEST HOLE LOGS

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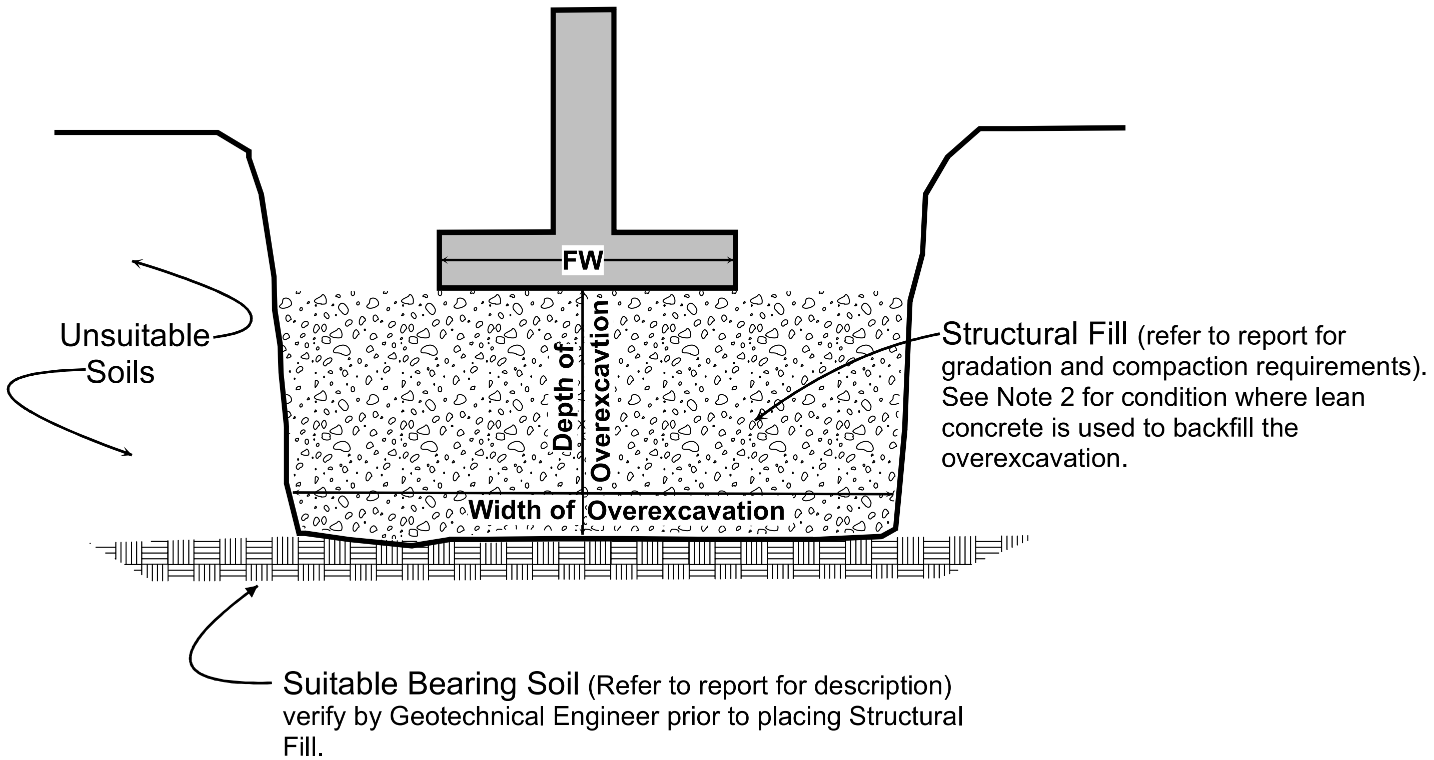

Width of Overexcavation = Footing Width (FW) + Depth of Overexcavation

NOTES:

1. Refer to report text for additional overexcavation, foundation, and structural fill considerations.
2. Where lean concrete (minimum 1-1/2 sacks of cement per cubic yard) is used to backfill the overexcavation, the overexcavation must extend only 6 inches beyond the edges of the footing.

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TYPICAL FOOTING OVEREXCAVATION

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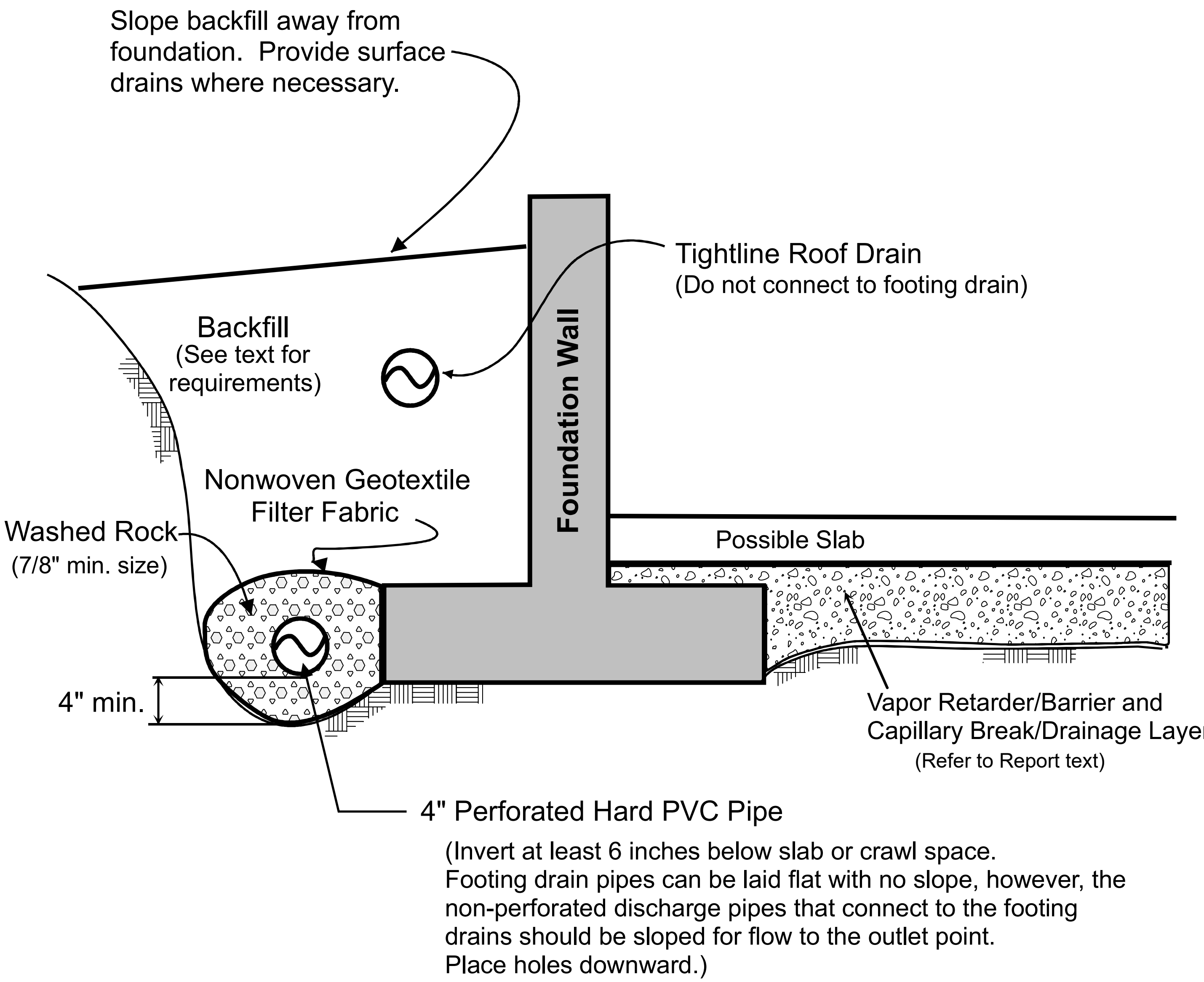

NOTES:

(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

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