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REVISED GEOTECHNICAL ENGINEERING REPORT
BRICKYARD RIDGE RESIDENTIAL DEVELOPMENT
WOODINVILLE, WASHINGTON
FOR
BRICKYARD RIDGE, LLC

DECEMBER 2013

RECEIVED
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CITY OF WOODINVILLE
DEVELOPMENT SERVICES

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December 12, 2013

Mr. Tom DeDonato
Brickyard Ridge, LLC
10257 NE 64th Street
Kirkland, Washington 98033

Revised Geotechnical Engineering Report
Brickyard Ridge Residential Development
Woodinville, Washington
RN File No. 2800-001A

Dear Mr. DeDonato:

This letter serves as a transmittal for three copies of our report for the Brickyard Ridge Residential Development project, located at the intersection of 154th Avenue and Woodinville–Duvall Road in Woodinville. The project-site includes King County tax parcels 3244500135, 1126059156, and 1126059152.

We appreciate the opportunity of working with you on this project. If you have any questions regarding this report, please contact us.

Sincerely,

Rick B. Powell, PE
Principal Engineer

BAG:RBP:am

Three Copies Submitted
Six Figures
Appendix A and B

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INTRODUCTION

This report presents the results of our geotechnical engineering investigation for the proposed residential project located in Woodinville, Washington. The site is located at the intersection of 154th Avenue and Woodinville – Duvall Road and includes King County tax parcels 3244500135, 1126059156, and 1126059152, as shown on the Vicinity Map in Figure 1. The City of Woodinville Municipal Code (WMC 21.24.310(1)(b)) requires a specific geotechnical study to evaluate subsurface conditions for the development of 40 percent (or steeper) slopes, which are designated as potential landslide hazard areas in WMC 21.24.290(2)(b)(vi). We, as Cornerstone Geotechnical, Inc., prepared a preliminary version of this report dated February 10, 2006 and a revised version of this report dated May 19, 2009. We have recently been provided with CPH Consultants "Brickyard Plat Overall Grading and Utility Plan" dated April 2, 2013 and a draft "Preliminary Site Plan" dated April 2013. We have revised this version of our report based on the provided plans.

We have been provided with a letter from City of Woodinville, dated November 14, 2013. We also met with the City representatives and we understand that the existing code does not currently distinguish between the natural steep slopes or a manmade cut or fill slopes. Therefore, the existing driveway fills and cuts that are currently shown on the site plan are now "Landslide Hazard" areas per code. The City representatives have asked us to provide additional information about the areas that could be left as is and those that we propose should be allowed to be altered to a **better and more stable state**.

PROJECT DESCRIPTION

The development will consist of 13 lots, with associated access roads and underground utilities. A stormwater detention vault is planned at the southwest corner of 154th Avenue and Woodinville-Duvall Road. An ecology block retaining wall with cuts of up to 12 feet is planned along the south side of Woodinville-Duvall Road. Rockeries are planned in the northeast corner of the site and the southwest portion of tax parcel 3244500135. This rockery and planned cut and fill slopes will have backslopes as steep as 2 Horizontal to 1 Vertical (2H:1V). All existing structures at the site will be removed.

SCOPE

The purpose of this study is to explore and characterize the subsurface conditions and present recommendations for site development. Specifically, our scope of services as outlined in our Services Agreement, dated April 19, 2013 includes the following:

1. Design meeting to discuss possible site improvement options.
2. Review and comment on possible options.
3. Review existing geotechnical report.
4. Explore the subsurface soil and groundwater conditions in the area of Lots 1 through 9.
5. Prepare an updated geotechnical report containing the results of our subsurface explorations, and our conclusions and recommendations for geotechnical design elements of the project.

SITE CONDITIONS

The irregularly-shaped project site has maximum dimensions of approximately 860 feet in the east-west direction and 590 feet in the north-south direction. The site is bordered by NE

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Woodinville–Duvall Road to the north and by residential areas to the south, west and east. Two residences are located on the site. Additional existing structures include a large shop and garage. The layout of the site is shown on the Site Plan in Figure 2.

The surface has an overall slope downward toward the north with more gentle slopes and flat areas near Woodinville-Duvall Road, as shown on the Site Plan. The elevations of the site range from 430 feet in the northwest corner to 505 feet along portions of the south edge of the site. There are some localized slopes with inclination steeper than 2H:1V and greater than 10 feet in height, which are associated with man-made cuts around the existing shop and gravel access road near the middle of the site. The remaining steep slope areas appear to be natural. The site is wooded, with brush and trees up to approximately 3 feet in diameter scattered throughout the site.

Geology

Most of the Puget Sound Region was affected by past intrusion of continental glaciation. The last period of glaciation, the Vashon Stade of the Fraser Glaciation, ended approximately 14,000 years ago. Many of the geomorphic features seen today are a result of scouring and overriding by glacial ice. During the Vashon Stade, areas of the Puget Sound region were overridden by over 3,000 feet of ice. Soil layers overridden by the ice sheet were compacted to a much greater extent than those that were not. Part of a typical glacial sequence within the area of the site includes the following soil deposits from newest to oldest:

Artificial Fill (af) – Fill material is often locally placed by human activities, consistency will depend on the source of the fill. The thickness and expanse of this material will be dependent on extent of fill required to grade land to the desired elevations. Density of the fill will depend on earthwork activities and compaction efforts made during the placement of the material.

Recessional Outwash (Qvr) – These deposits were derived from the stagnating and receding Vashon glacier and consist mostly of stratified sand and gravel, but include unstratified ablation and melt-out deposits. Recessional deposits were not compacted by the glacier and are typically not as dense as those that were.

Vashon Till (Qvt) – The till is a non-sorted mixture of clay, sand, pebbles, cobbles and boulders, all in variable amounts. The till was deposited directly by the ice as it advanced over and eroded irregular surfaces of previously deposited formations and sediments. The till was well compacted by the advancing glacier and exhibits high strength and stability. Drainage is considered very poor in the till.

Advance Outwash (Qva) – The advance outwash typically is a thick section of mostly clean, pebbly sand with increasing amounts of gravel higher in the section. The advance outwash was placed by the advancing glaciers and was overridden and well compacted by the glacier.

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The geologic units for this area are mapped on the Geologic Map of the Bothell Quadrangle, Snohomish and King Counties, Washington, by James P. Minard (US Geologic Survey, 1985). The site is primarily mapped as being underlain by a deposit of advance outwash, with glacial till mapped at the south edge of the site. Our site explorations encountered glacial drift in the upland portions of the site and advance outwash on the lower portions of the site. Glacial drift is similar to glacial till, but may exhibit more sorting of various soil grain sizes.

Explorations

We explored subsurface conditions at the site on April 25, 2013 by excavating five test pits with a mini excavator. The test pits were excavated to depths of 7.0 to 11.0 feet below the ground surface. The explorations were located in the field by a representative from this firm who also examined the soils and geologic conditions encountered, and maintained logs of the test pits. The approximate locations of the test pits are shown on the Site Plan in Figure 2. The soils were visually classified in general accordance with the Unified Soil Classification System, a copy of which is presented as Figure 3. The logs of the test pits are presented in Figures 4 and 5. Previous explorations for the site were performed on September 8, 2004 and January 24, 2006. The logs of these test pits are included in Appendix A.

Subsurface Conditions

General: A brief description of the conditions encountered in our explorations is included below. For a more detailed description of the soils encountered, review the Test Pit Logs in Figures 4 and 5 and Appendix A.

April 24, 2013 Explorations: Test Pits 1 through 5 generally encountered ½ to 1 foot of forest duff consisting of dark brown silty sand with organics. Underlying the forest duff in Test Pits 1 and 2 we encountered approximately 3 feet of medium dense grayish-brown slightly mottled silty fine sand interpreted as weathered glacial drift. Unweathered glacial drift consisting of dense to very dense gray silty fine sand with varying amounts of gravel was disclosed below the weathered zone to the depths explored of 8½ and 7 feet, respectively.

In Test Pits 3 through 5 we encountered approximately 3 to 4 feet of reddish-gray silty sand with gravel interpreted as a weathered zone. Underlying the weathered zone we encountered advance outwash consisting of medium dense to very dense brownish-gray to gray silty sand with varying amounts of silt, gravel, and cobbles. This material extended to the depths explored in Test Pits 3 through 5 ranging from 10½ to 11 feet.

January 24, 2006 Explorations: Generally, we encountered glacial drift with till-like characteristics (drift/till) in the upper portion of the site (Test Pits 1 through 5). This drift/till overlies advance outwash in Test Pits 1 and 5. We classified the soil at the bottom of Test Pit 3 as being glacial drift, but with advance outwash-like characteristics. Advance outwash was encountered at lower elevations (Test Pits 6 and 7).

Our explorations typically encountered a surficial layer of topsoil that averaged about 1 foot in thickness. Beneath this, Test Pits 1 through 5 encountered 2.0 to 3.0 feet of loose to medium dense orange-brown silty fine sand with trace gravel and root fragments classified as a weathered drift/till. Underlying that subsurface zone, a slightly weathered drift/till consisting of

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dense to very dense rust-stained, gray silty fine sand with gravel, approximately 8 inches in thickness was encountered. Beneath the weathered zone, there was unweathered drift/till, consisting of dense to very dense gray silty fine sand with gravel and extending to the bottom of exploration in Test Pits 2 and 4.

Underlying the drift/till, an advance outwash soil horizon was encountered in Test Pits 1 and 5. This horizon consisted of dense to very dense gray sand ranging from fine to coarse and containing gravel and trace silt. The material at the bottom of Test Pit 3 was similar to that encountered in Test Pits 1 and 5, but contained more silt.

Test Pits 6 and 7 were excavated at lower elevations. Beneath an approximately 12-inch-thick layer of topsoil, we encountered a weathered zone of loose to medium dense orange-brown silty fine sand with trace gravel and root fragments, about 2.5 feet in thickness. Underlying this weathered zone, there was a layer of dense to very dense gray to brownish gray fine to coarse sand with gravel and trace silt, classified as advance outwash.

September 8, 2004 Explorations: Test Pits 1 and 2 encountered 5.5 and 4.0 feet of surficial fill material, respectively. The fill consisted of loose grayish-brown to brown silty sand with gravel and roots and was found overlying an approximately 6-inch-thick layer of topsoil. Beneath the fill and topsoil, a weathered advance outwash soil horizon, approximately 4 feet in thickness, was encountered in Test Pits 1 and 2. Beneath the weathered zone was unweathered advance outwash, consisting of dense to very dense gray silty fine to medium sand with gravel in Test Pit 1, and very dense gray, rust-stained fine to medium sand with gravel and silt in Test Pit 2.

Test Pit 5 was located at a higher elevation. Beneath a surficial 6-inch layer of topsoil we encountered a layer of weathered till, 1.0 foot in thickness. Underlying this weathered zone was unweathered till that consisted of dense to very dense gray silty fine sand with gravel, extending to the bottom of the excavation at a depth of 6.0 feet.

Hydrologic Conditions

We did not encounter groundwater seepage in any of the test pits. We observed rust staining and mottling in the test pits in the upland portions of the site between about 1.0 and 4.5 feet. This mottled zone could be a sign of perched water. The dense to very dense drift interpreted to underlie the site is considered poorly draining. During the wetter times of the year, we expect perched water conditions will occur on top of layers of lower permeable soils, such as the drift. Perched water does not represent a regional groundwater "table" within the upper soil horizons. Volumes of perched ground water vary depending upon the time of year and the upslope recharge conditions. We did not observe any indication of surface seepage during our site reconnaissance during the wet season.

We did not observe any groundwater or noticeable seepage from the advance outwash deposit. Therefore, the water table within the advance outwash is below the depth of our explorations.

Slope Areas (>10 feet tall and >40% Angle)
We provide the following table to best estimate each potential steep slope and landslide hazard area. **Keep in mind, the site is cored by dense, glacial till as described above and is typically very stable.** We have provided the following table and Figure 6 to show the location of each Steep Slope Area.

Steep Slope Area	Man Made	Existing Cut or Fill, Natural Slope	Alteration 21.24.310 (1) (b) (Satisfy all three criteria)
A	Yes	Cut - for Wood-Duvall Rd	Yes
B	Yes	Fill - for Existing Residence	Yes
C	Yes	Fill - for Driveway	Yes
D	Yes	Fill - for Driveway	Yes
E	Yes/No	Cut - for existing building and driveway/some natural	Yes, Required for Roadway/ Portion of Natural slope will not be altered.
F	No	Natural Slope	Not Planned to be Altered
G	Yes	Fill - for Utility Corridor	Yes, Completed during residential development with appropriate design
H	Yes	Fill - for Utility Corridor	Yes, Completed during residential development with appropriate design
I	Yes	Fill - for Utility Corridor	Yes, Completed during residential development with appropriate design
J	No	Natural Slope	Yes, Completed during residential development with appropriate design
K	No	Natural Slope	Yes, Completed during residential development with appropriate design
L	No	Natural Slope	Not Planned to be altered
M	No	Natural Slope	Not Planned to be altered
N	No	Natural Slope	Not Planned to be altered

The planned improvements will grade the existing manmade slopes of Steep Slope Area A through E to a more stable condition. A portion of Steep Slope Area E is a natural slope but will need to be slightly modified to allow the construction of the roadway.

CONCLUSIONS AND RECOMMENDATIONS

General

It is our opinion that the site is compatible with the planned development. The underlying medium dense to very dense glacial deposits are capable of supporting the planned structures and pavements. We recommend that foundations for the structures extend through any topsoil, loose, or disturbed soils, and bear on the underlying medium dense to very dense native glacial soils, or on structural fill extending to these soils. Three explorations in the northwestern portion of the subject property encountered between 2½ and 5½ feet of fill. We have not evaluated the extent of the fill, and it is possible that other areas of fill exist.

The drift soils likely to be exposed during construction are moisture sensitive and will disturb easily when wet or during wet conditions. The outwash is less moisture sensitive, but it will be

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difficult to separate the two for mass grading. We recommend that construction take place during the drier summer months, if possible. If construction takes place during the wet season, additional expenses and delays should be expected due to the wet conditions. Additional expenses could include additional depth of site stripping, export of on-site soil, the import of clean granular soil for fill, and the need to place a blanket of rock spalls in the access roads and paved areas prior to placing structural fill.

Geologic Hazards

Landslide Hazards: The core material in the steep slope areas is inferred to be comprised of very dense glacial deposits consisting of drift, till, or advance outwash. We consider these soils to be of high strength and stable with regard to deep-seated slope failures. We did not observe any evidence of deep-seated slope failures at the site. The vertically-oriented trees along the steep slopes, along with the age of the existing residences, indicate that the slopes have performed well for many years. In our opinion the City's classification of all the slopes as Landslide Hazard areas does not appear to be appropriate.

Our recommendations, outlined below, should provide a suitable factor of safety against adverse impacts to meet the standards of subsection (1)(b) of WMC 21.24.310 to allow alterations of designated landslide hazard areas. There are many areas within the site that would be considered landslide hazard areas due to slope inclination under WMC 21.24.290(2)(b)(vi). Some of these slopes have been created through past grading activities and some areas appear to be natural slopes. **It is our opinion that all of these slopes could be regraded or walls could be used to create a more stable condition.** Per City Code WMC21.24.310(1)(b):

> (i) The development will not increase surface water discharge or sedimentation to adjacent properties beyond predevelopment conditions;
>
> (ii) The development will not decrease slope stability on adjacent properties; and
>
> (iii) Such alterations will not adversely impact other critical areas.

Therefore, it is our opinion the steep slope areas A through E should be allowed to be modified to a better and more stable condition.

It is our opinion that all landslide hazard areas not specifically removed from the Alteration section will have a reduced buffer from 50 feet down to 10 feet because of the underlying dense glacial soils. It also our opinion that steep slope G, H, I, J, and K could be altered if the development of the residences show that the WMC 212.24.310(1)(b) is satisfied.

Erosion Hazard: The erosion hazard criteria used for determination of affected areas includes soil type, slope gradient, vegetation cover, and groundwater conditions. The erosion sensitivity is related to vegetative cover and the specific surface soil types (group classification), which are related to the underlying geologic soil units. We reviewed the Web Soil Survey by the Natural Resources Conservation Service (NRCS) to determine the erosion hazard of the on-site soils. The site surface soils were classified using the NRCS classification system as Alderwood

gravelly sandy loam (AgC). The corresponding geologic unit for these soils is basal till, which is in general agreement with the soils encountered in our site explorations. The erosion hazard for the soil is listed as being moderate for moderately sloping conditions.

Seismic Hazard

It is our opinion based on our subsurface explorations that the Soil Profile in accordance with the 2009 and 2012 International Building Code (IBC) is Site Class C with Seismic Design Category D. We used the US Geological Survey program "U.S. Seismic Design Maps Web Application." The design maps summary reports for the 2009 and 2012 IBC are included in this report as Appendix B.

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The underlying dense till, drift and outwash soils are considered to have a very low potential for liquefaction and amplification of ground motion.

Site Preparation and Grading

The first step of site preparation should be to strip the vegetation, topsoil, or loose soils to expose medium dense or firmer native soils in pavement and building areas. The excavated material should be removed from the site, or stockpiled for later use as landscaping fill. The resulting subgrade should be compacted to a firm, non-yielding condition. Areas observed to pump or yield should be repaired prior to placing hard surfaces.

Structural Fill

General: All fill placed beneath buildings, pavements or other settlement sensitive features should be placed as structural fill. Structural fill, by definition, is placed in accordance with prescribed methods and standards, and is observed by an experienced geotechnical professional or soils technician. Field observation procedures would include the performance of a representative number of in-place density tests to document the attainment of the desired degree of relative compaction.

Materials: Imported structural fill should consist of a good quality, free-draining granular soil, free of organics and other deleterious material, and be well graded to a maximum size of about 3 inches. Imported, all-weather structural fill should contain no more than 5 percent fines (soil finer than a Standard U.S. No. 200 sieve), based on that fraction passing the U.S. 3/4-inch sieve. The use of on-site soil as structural fill will be dependent on moisture content control. Some drying of the native soils may be necessary in order to achieve compaction. During warm, sunny days this could be accomplished by spreading the material in thin lifts and compacting. Some aeration and/or addition of moisture may also be necessary. We expect that compaction of the native soils to structural fill specifications would be difficult, if not impossible, during wet weather.

Fill Placement: Following subgrade preparation, placement of the structural fill may proceed. Fill should be placed in 8- to 10-inch-thick uniform lifts, and each lift should be spread evenly and be thoroughly compacted prior to placement of subsequent lifts. All structural fill underlying building areas, and within a depth of 2 feet below pavement and sidewalk subgrade,

should be compacted to at least 95 percent of its maximum dry density. Maximum dry density, in this report, refers to that density as determined by the ASTM D1557 compaction test procedure. Fill more than 2 feet beneath sidewalks and pavement subgrades should be compacted to at least 90 percent of the maximum dry density. The moisture content of the soil to be compacted should be within about 2 percent of optimum so that a readily compactable condition exists. It may be necessary to overexcavate and remove wet surficial soils in cases where drying to a compactable condition is not feasible. All compaction should be accomplished by equipment of a type and size sufficient to attain the desired degree of compaction.

Temporary and Permanent Slopes

Temporary: Temporary cut slope stability is a function of many factors, such as the type and consistency of soils, depth of the cut, surcharge loads adjacent to the excavation, length of time a cut remains open, and the presence of surface or groundwater. It is exceedingly difficult under these variable conditions to estimate a stable temporary cut slope geometry. Therefore, it should be the responsibility of the contractor to maintain safe slope configurations, since the contractor is continuously at the job site, able to observe the nature and condition of the cut slopes, and able to monitor the subsurface materials and groundwater conditions encountered.

For planning purposes, we recommend that temporary cuts in the near-surface weathered outwash soils be no steeper than 1.5 Horizontal to 1 Vertical (1.5H:1V). Cuts in the dense outwash may stand at 1H:1V. Cuts in the dense to very dense drift soils may stand at a 0.75H:1V inclination or possibly steeper. If groundwater seepage is encountered, we would expect that flatter inclinations would be necessary.

We recommend that cut slopes be protected from erosion. Measures taken may include covering cut slopes with plastic sheeting and diverting surface runoff away from the top of cut slopes. We do not recommend vertical slopes for cuts deeper than 4 feet, if worker access is necessary. We recommend that cut slope heights and inclinations conform to local and WISHA/OSHA standards.

Permanent: Final slope inclinations for granular structural fill and the native soils should be no steeper than 2H:1V. Lightly compacted fills, common fills, or structural fill predominately consisting of fine grained soils should be no steeper than 3H:1V. Common fills are defined as fill material with some organics that are "trackrolled" into place. They would not meet the compaction specification of structural fill. Final slopes should be vegetated and covered with straw or jute netting. The vegetation should be maintained until it is established.

Per section WMC 21.24.310(1)(b) the permanent planned slopes shall be designed to satisfy the required criteria alterations. The planned improvements satisfy this code as follows:

- The development will not increase uncontrolled surface water discharge or sedimentation to adjacent properties beyond predevelopment conditions. Currently the site is planned with a stormwater detention system that will help control stormwater for the site.

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- The alteration of the proposed steep slopes will not decrease slope stability on adjacent properties provided the cuts are made per our recommendations. We emphasize the subsurface soils consist of glacial deposits overridden by the past glaciation, and are in a dense state.

- The engineered-designed-permanent slopes will not alter other critical areas.

Due to the sloping conditions and variable soils encountered in our explorations, we should be retained to review any changes in the grading plans for the planned residential lots at the site after those plans have been prepared. We should also review site grading, detention vault, and retaining wall plans after they have been finalized.

Foundations

Conventional shallow spread foundations should be founded on undisturbed, medium dense or firmer soil. If the soil at the planned bottom of footing elevation is not suitable, it should be overexcavated to expose suitable bearing soil. Footings should extend at least 18 inches below the lowest adjacent finished ground surface for frost protection. Minimum foundation widths should conform to IBC requirements. Standing water should not be allowed to accumulate in footing trenches. All loose or disturbed soil should be removed from the foundation excavation prior to placing concrete.

For foundations constructed as outlined above, we recommend an allowable design bearing pressure of 3,000 pounds per square foot (psf) be used for the footing design. This value may be increased by one third for short-term transitory wind or seismic loads. Potential foundation settlement using the recommended allowable bearing pressure is estimated to be less than 1-inch total and ½-inch differential between footings or across a distance of about 30 feet. Higher soil bearing values may be appropriate with wider footings. These higher values can be determined after a review of a specific design.

Retaining Walls

An ecology block retaining wall with cuts of up to 12 feet is planned along the south side of Woodinville-Duvall Road. A rockery is planned in the northeast corner of the site and a 14 foot high structural reinforced concrete wall is planned in the southwest portion of tax parcel 3244500135. The ecology block wall, rockery and structural reinforced concrete wall will have backslopes as steep as 2 Horizontal to 1 Vertical (2H:1V).

In our opinion rockeries will be suitable for use where the planned retaining walls will have exposed heights of up to 8 feet facing glacial till. Associated Rockery Contractors (ARC) guidelines should be followed when constructing rockeries. For higher walls we recommend other wall types, such as ultra-block, reinforced earth, soil nails or soldier piles. Alternatively, a tiered rockery system could be used. We should be retained to prepare designs for any rockeries that are tiered or over 8 feet in height and block or MSE retaining walls, and to provide geotechnical design recommendations for the design of other wall types, which would be designed by others.

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Lateral Loads

The lateral earth pressure acting on retaining walls is dependent on the nature and density of the soil behind the wall, the amount of lateral wall movement, which can occur as backfill is placed, and the inclination of the backfill. Walls that are free to yield at least one-thousandth of the height of the wall are in an "active" condition. Walls restrained from movement by stiffness or bracing are in an "at-rest" condition. Active earth pressure and at-rest earth pressure can be calculated based on equivalent fluid density. Equivalent fluid densities for active and at-rest earth pressure of 35 pounds per cubic foot (pcf) and 55 pcf, respectively, may be used for design for a level backslope. These values assume that the on-site soils or imported granular fill are used for backfill, and that the wall backfill is drained. The preceding values do not include the effects of surcharges, such as due to traffic, foundation loads or other surface loads. Surcharge effects should be considered where appropriate. The above drained active and at-rest values should be increased by a uniform pressure of 6.6H and 20.7H psf, when considering seismic conditions. H represents the wall height.

The above lateral pressures may be resisted by friction at the base of the wall and passive resistance against the foundation. A coefficient of friction of 0.54 may be used to determine the base friction in the native glacial soils. An equivalent fluid density of 220 pcf may be used for passive resistance design. To achieve this value of passive pressure, the foundations should be poured "neat" against the native dense soils, or compacted fill should be used as backfill against the front of the footing, and the soil in front of the wall should extend a horizontal distance at least equal to three times the foundation depth. A factor of safety of 2.0 has been applied to the passive pressure to account for required movements to generate these pressures. The friction coefficient does not include a factor of safety.

All wall backfill should be well compacted. Care should be taken to prevent the buildup of excess lateral soil pressures due to overcompaction of the wall backfill.

Slabs-On-Grade

Slab-on-grade areas should be prepared as recommended in the **Site Preparation and Grading** subsection. Slabs should be supported on medium dense or firmer native soils, or on structural fill extending to these soils. Where moisture control is a concern, we recommend that slabs be underlain by 6 inches of pea gravel for use as a capillary break. A suitable vapor barrier, such as heavy plastic sheeting, should be placed over the capillary break. An additional 2-inch-thick damp sand blanket can be used to cover the vapor barrier to protect the membrane and to aid in curing the concrete. This will also help prevent cement paste bleeding down into the capillary break through joints or tears in the vapor barrier. The capillary break material should be connected to the footing drains to provide positive drainage.

Drainage

We recommend that runoff from impervious surfaces, such as roofs, driveway and access roadways, be collected and routed to an appropriate storm water discharge system. The finished ground surface should be sloped at a gradient of 5 percent minimum for a distance of at least 10 feet away from the buildings, or to an approved method of diverting water from the

foundation, per IBC Section 1803.3. Surface water should be collected by permanent catch basins and drain lines, and be discharged into a storm drain system.

We recommend that footing drains be used around all of the structures where moisture control is important. The underlying drift and till soils may pond water that could accumulate in crawlspaces. It is good practice to use footing drains installed at least 1 foot below the planned finished floor slab or crawlspace elevation to provide drainage for the crawlspace. At a minimum, crawlspaces should be sloped to drain to an outlet tied to the drainage system. If drains are omitted around slab-on-grade floors where moisture control is important, the slab should be a minimum of 1 foot above surrounding grades.

Where used, footing drains should consist of 4-inch-diameter, perforated PVC pipe that is surrounded by free-draining material, such as pea gravel. Footing drains should discharge into tightlines leading to an appropriate collection and discharge point. Crawlspaces should be sloped to drain, and a positive connection should be made into the foundation drainage system. For slabs-on-grade, a drainage path should be provided from the capillary break material to the footing drain system. Roof drains should not be connected to wall or footing drains.

Detention Vault

We understand that a stormwater detention vault is planned west of 154th Avenue and about 20 feet south of NE Woodinville-Duvall Road. The concrete walls of the stormwater detention vault may be supported on footing foundations bearing on the underlying dense soils. We recommend a soil bearing pressure of 5,000 pounds per square foot (psf) for the design of the wall footings poured on undisturbed dense advance glacial outwash.

We recommend that footing drains be installed on the outside of perimeter footings. The footing drains should be at least 4 inches in diameter and should consist of perforated or slotted, rigid, smooth-walled PVC pipe, laid at the bottom of the footings. The drain line should be surrounded with free-draining pea gravel or coarse sand and wrapped with a layer of non-woven filter fabric. A vertical drainage blanket at least 12 inches thick, consisting of compacted pea gravel or other free-draining granular soils, should be placed against the walls. A vertical drain mat, such as Miradrain 6000 by Mirafi Inc., may be placed against the walls in lieu of the vertical drainage blanket. Structural fill is then placed behind the vertical drainage blanket or drain mat to backfill the walls. The vertical drainage blanket or drain mat should be hydraulically connected to the drain line at the base of the walls. Sufficient number of cleanouts at strategic locations should be installed for periodical cleaning of the wall drain line to prevent clogging.

The perimeter walls of the concrete vault with a lid would be restrained at their top from horizontal movement and should be designed for at-rest lateral soil pressure, while the perimeter walls of a vault without a lid would be unrestrained at the top and may be designed for active lateral soil pressure. Recommended drained active and at-rest earth pressures as well as seismic lateral loading is provided in the **Lateral Load** section of this report. For <u>undrained</u> soil conditions, the active and at-rest pressures should be increased to 80 pcf and 90 pcf, respectively. Undrained conditions may occur in the lower portion of the vault if there is not suitable fall to place a wall drain at the footing elevation.

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All wall backfill should be well compacted. Care should be taken to prevent the buildup of excess lateral soil pressures due to overcompaction of the wall backfill.

Utilities

Our explorations indicate that deep dewatering will not be needed to install standard depth utilities. Anticipated groundwater is expected to be handled with pumps in the trenches. We also expect that some groundwater seepage may develop during and following the wetter times of the year. We expect this seepage to mostly occur in pockets. We do not expect significant volumes of water in these excavations.

The soils likely to be exposed in utility trenches after site stripping are considered highly moisture sensitive. We recommend that they be considered for trench backfill during the drier portions of the year. Provided these soils are within 2 percent of their optimum moisture content, they should be suitable to meet compaction specifications. During the wet season, it may be difficult to achieve compaction specifications; therefore, soil amendment with kiln dust or cement may be needed to achieve proper compaction with the on-site materials.

Pavement Subgrade

The performance of roadway pavement is critically related to the conditions of the underlying subgrade. We recommend that the subgrade soils within the roadways be prepared as described in the **Site Preparation and Grading** subsection of this report. Prior to placing base material, the subgrade soils should be compacted to a non-yielding state with a vibratory roller compactor and then proof-rolled with a piece of heavy construction equipment, such as a fully-loaded dump truck. Any areas with excessive weaving or flexing should be overexcavated and recompacted or replaced with a structural fill or crushed rock placed and compacted in accordance with recommendations provided in the **Structural Fill** subsection of this report.

CONSTRUCTION OBSERVATION

We should be retained to provide observation and consultation services during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, and to provide recommendations for design changes, should the conditions revealed during the work differ from those anticipated. As part of our services, we would also evaluate whether or not earthwork and foundation installation activities comply with contract plans and specifications.

USE OF THIS REPORT

We have prepared this report for Brickyard Ridge LLC and its agents, for use in planning and design of this project. The data and report should be provided to prospective contractors for their bidding and estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of subsurface conditions.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractors' methods, techniques, sequences or procedures, except as specifically described in our report, for consideration in design. There are possible variations in subsurface conditions. We recommend that project

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planning include contingencies in budget and schedule, should areas be found with conditions that vary from those described in this report.

Within the limitations of scope, schedule and budget for our services, we have strived to take care that our services have been completed in accordance with generally accepted practices followed in this area at the time this report was prepared. No other conditions, expressed or implied, should be understood.

We appreciate the opportunity to be of service to you. If there are any questions concerning this report or if we can provide additional services, please call.

Sincerely,

Robinson Noble, Inc.

for BAG.

Barbara A. Gallagher, PE
Senior Project Engineer

RICK B. POWELL
STATE OF WASHINGTON
30530
REGISTERED
PROFESSIONAL ENGINEER

12/12/2013

Rick B. Powell, PE
Principal Engineer

BAG:RBP:am

Three Copies Submitted
Six Figures
Appendix A and B

EXHIBIT 13
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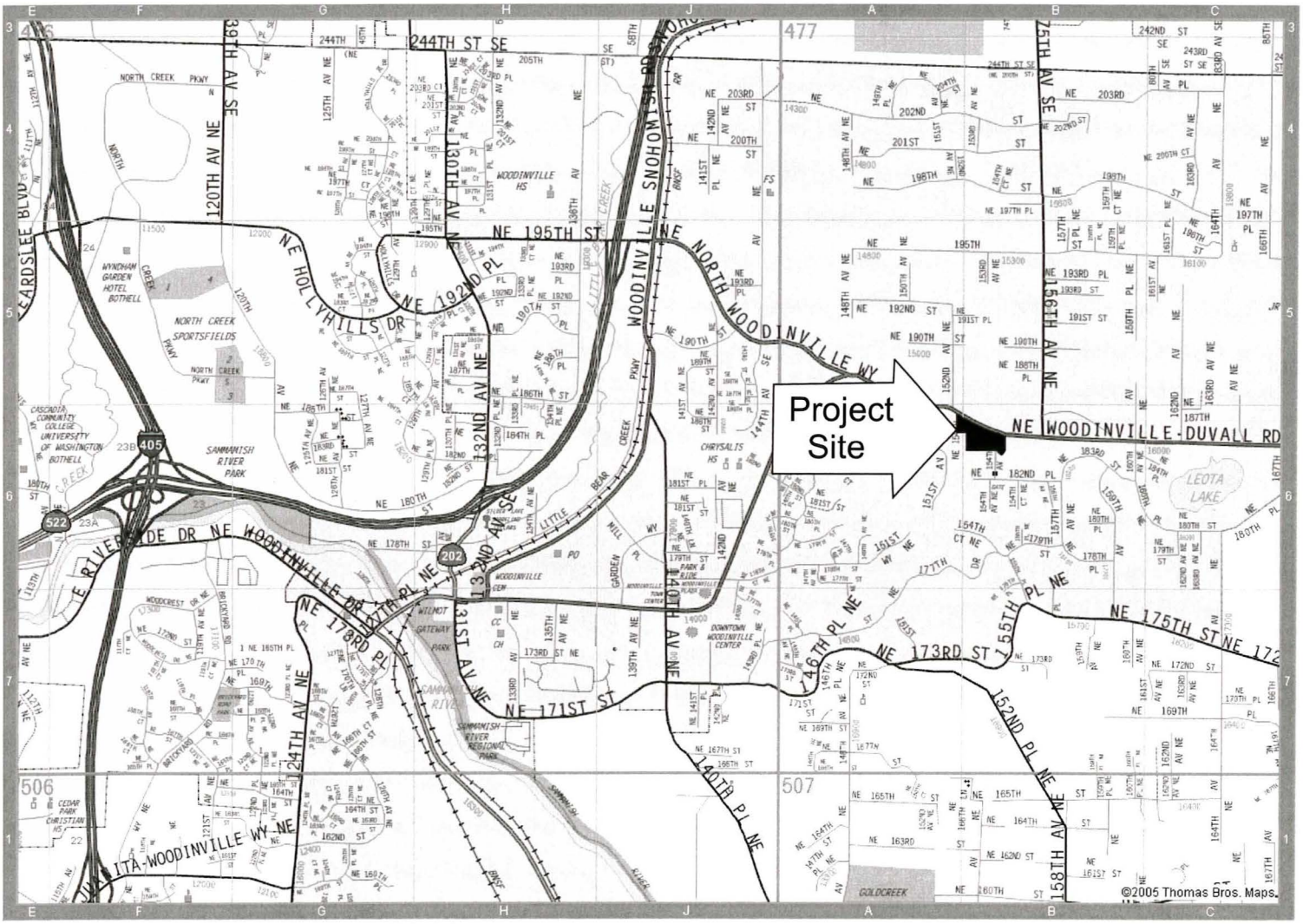
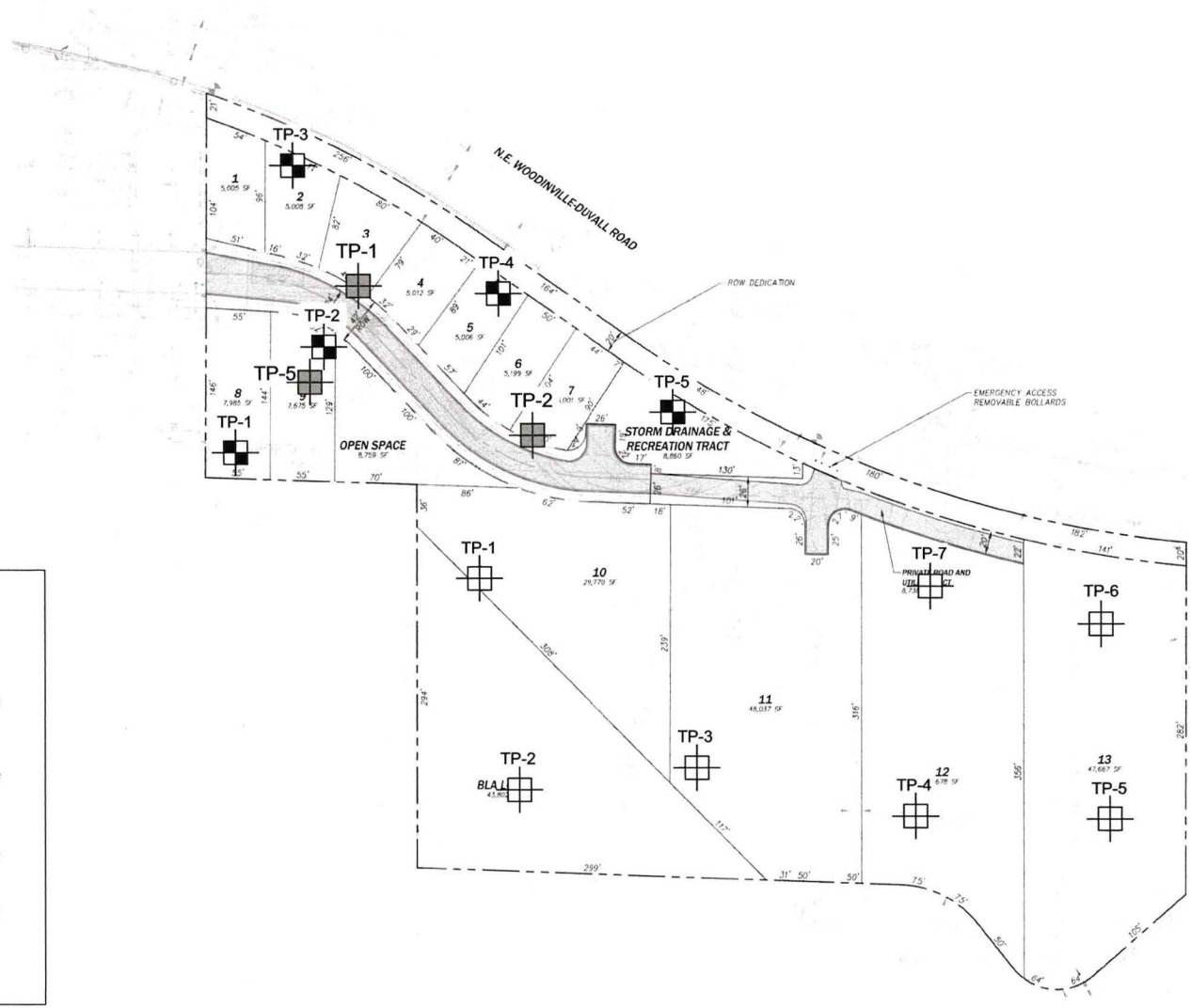


ROBINSON NOBLE		PM: RBP December 2013 2800-001A		Figure 1 Vicinity Map Brickyard Ridge, LLC: Brickyard Ridge



LEGEND

TP-1 Number and Approximate Location of 2013 Test Pit

TP-1 Number and Approximate Location of 2006 Test Pit

TP-1 Number and Approximate Location of 2004 Test Pit

0 100 200

Approximate Scale 1" = 100'

ROBINSON NOBLE

Note: Basemap taken from "Brickyard Ridge Plat Preliminary Site Plan" prepared by CP|H Consultants dated 4/2013.

PM: RBP
December 2013
2800-001A

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Figure 2
Site Plan
Brickyard Ridge, LLC: Brickyard Ridge

Unified Soil Classification System

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MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE - GRAINED SOILS MORE THAN 50% RETAINED ON number 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON 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 PASSES 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% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50%	INORGANIC	ML	SILT
			CL	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 CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-83.
2) Soil classification using laboratory tests is based on ASTM D 2487-83.
3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS

Dry- Absence of moisture, dusty, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

ROBINSON NOBLE	PM: RBP December 2013 2800-001A	King County	Figure 3 Unified Soil Classification System Brickyard Ridge, LLC: Brickyard Ridge

LOG OF EXPLORATION

DEPTH	USC	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 0.5	SM	Dark brown silty sand with organics (loose moist) **(Forest Duff)**
0.5 – 2.5	SM	Brown silty sand with trace roots (medium dense, moist) (MC=36.5%)
2.5 – 3.5	SM	Grayish-brown slightly mottled silty sand (medium dense, moist to wet) **(Weathered Glacial Drift)** (MC=24.6%)
3.5 – 8.5	SM	Gray silty fine sand (dense, moist) **(Glacial Drift)** (MC=19.2%)
		Samples were collected at 1.0, 3.0 and 8.5 feet Groundwater seepage was not encountered Test pit caving was not encountered Test pit was completed at 8.5 feet on 4/25/2013
TEST PIT TWO		
0.0 – 1.0	SM	Dark brown silty sand with organics (loose moist) **(Forest Duff)**
1.0 – 4.0	SM	Brownish-gray slightly mottled silty fine sand with gravel (medium dense, moist) **(Weathered Glacial Drift)** (MC=14.5%)
4.0 – 5.5	SM	Gray silty fine sand with gravel trace cobbles (dense, moist) **(Glacial Drift)** (MC=10.4%)
5.5 – 7.0	SM	Gray silty fine sand with gravel trace cobbles (very dense, moist) **(Glacial Drift)** (MC=7.8%)
		Samples were collected at 3.5, 5.5 and 7.0 feet Groundwater seepage was not encountered Test pit caving was not encountered Test pit was completed at 7.0 feet on 4/25/2013
TEST PIT THREE		
0.0 – 2.5	SM	Brown silty sand (loose, moist) **(Fill)** MC=14.9%
2.5 – 3.0	SM	Dark brown silty sand with roots (relic topsoil)
3.0 – 7.0	SP-SM	Grayish brown fine sand with silt and gravel (medium dense to dense, moist) **(Weathered Advance Outwash)** (MC=12.8%)
7.0 – 9.0	SP-SM	Brownish-gray fine sand with silt, gravel and trace cobbles (dense to very dense, moist) **(Advance Outwash)** (MC=8.6%)
9.0 – 10.5	SP	Brownish-gray fine sand with gravel, trace cobbles and trace silt (very dense, moist) **(Advance Outwash)** (MC=10.7%)
		Sample was collected at 2.0, 5.0, 8.0 and 10.5 feet Groundwater seepage was not encountered Test pit caving was not encountered Test pit was completed at 10.5 feet on 4/25/2013

LOG OF EXPLORATION

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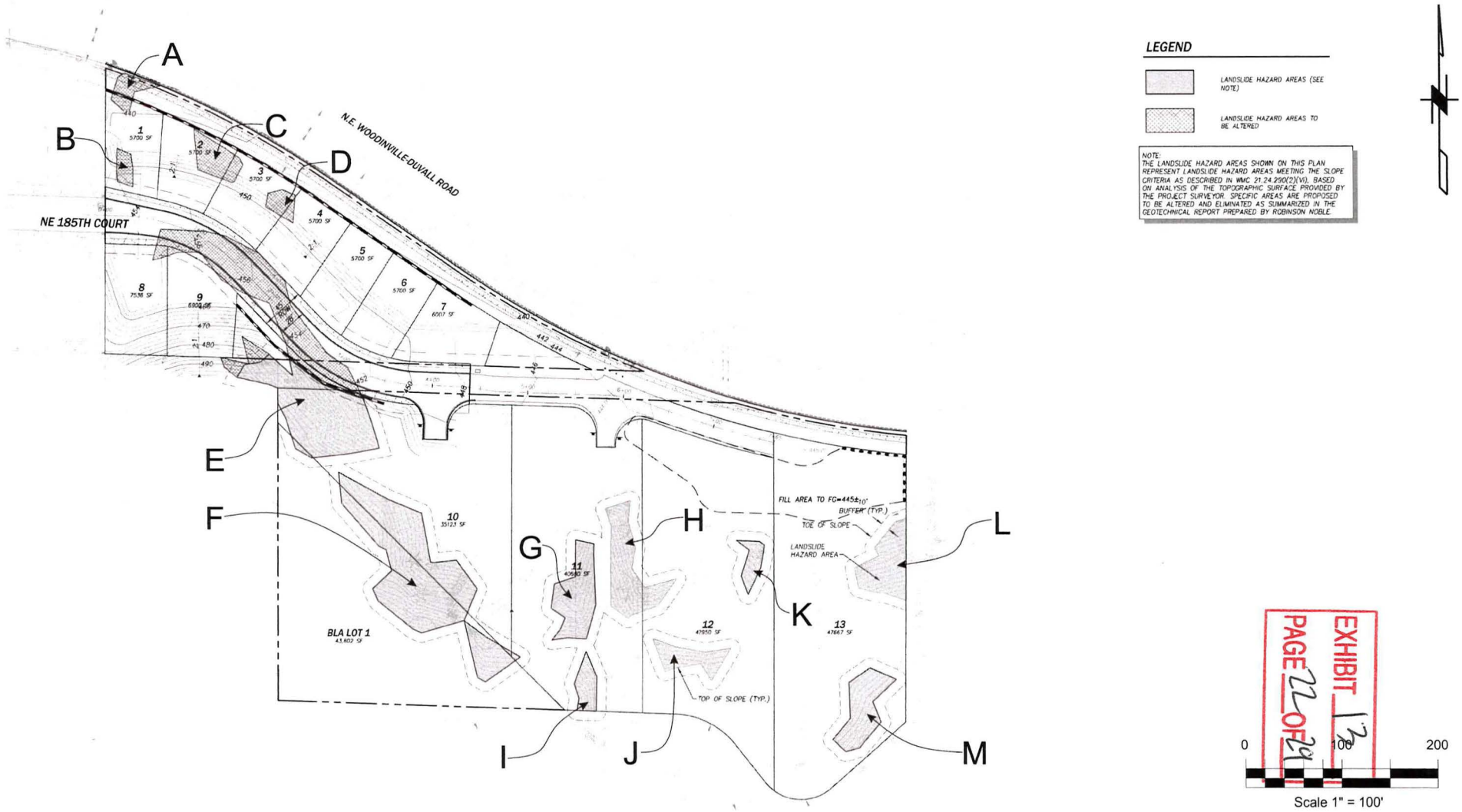
DEPTH	USC	SOIL DESCRIPTION
TEST PIT FOUR		
0.0 – 0.5	SM	Dark brown silty sand with organics (loose moist) **(Forest Duff)**
0.5 – 4.0	SM	Reddish-brown silty fine sand trace fine roots (medium dense, moist) **(Weathered Zone)** (MC=15.4%)
4.0 – 9.0	SP-SM	Gray fine sand with silt and gravel (dense, moist) **(Advance Outwash)** (MC=14.8%)
9.0 – 11.0	SP-SM	Gray fine sand with silt and gravel (very dense, moist) **(Advance Outwash)** (MC=7.1% and 8.2%)
		Samples were collected at 2.0, 4.5, 10.0 and 11.0 Groundwater seepage was not encountered Test pit caving was not encountered Test pit was completed at 11.0 feet on 4/25/2013
TEST PIT FIVE		
0.0 – 1.0	SM	Dark brown silty sand with organics (loose moist) **(Forest Duff)**
1.0 – 5.0	SM	Reddish-brown silty fine sand trace fine roots (medium dense, moist) **(Weathered Zone)** MC=17.6%
5.0 – 10.0	SP-SM	Gray fine sand with silt and trace gravel (medium dense to dense, moist) **(Advance Outwash)** (MC=15.5%)
10.0 – 11.0	SP-SM	Gray fine sand with silt and gravel (very dense, moist) **(Advance Outwash)** (MC=6.9%)
		Samples were collected at 1.5 and 5.5 feet Groundwater seepage was not encountered Test pit caving was not encountered Test pit was completed at 11.0 feet on 4/25/2013

CITY OF WOODINVILLE , KING COUNTY, WA PTN. OF SEC. 11, TWP 26N, R5E W.M.



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ROBINSON NOBLE	Note: Basemap taken from "Brickyard Ridge Plat Slope Analysis Exhibit" prepared by CP|H Consultants dated 12/05/13.	PM: RBP December 2013 2800-001A		Figure 6 Slope Analysis Exhibit Brickyard Ridge, LLC: Brickyard Ridge

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Appendix A

LOG OF EXPLORATION

DEPTH	USC	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 0.8	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
0.8 – 2.8	SM	ORANGE BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED DRIFT/TILL)**
2.8 – 3.2	SM	RUST-STAINED GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(SLIGHTLY WEATHERED DRIFT/TILL)**
3.2 – 5.0	SM	GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(DRIFT/TILL)**
5.0 – 9.0	SP - SM	GRAY FINE TO MEDIUM SAND WITH GRAVEL AND SILT (DENSE, MOIST) **(ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 0.5, 2.0, 3.0, 4.0, 5.5 AND 8.5 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 9.0 FEET ON 01/24/06
TEST PIT TWO		
0.0 – 0.9	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
0.9 – 2.9	SM	ORANGE BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED DRIFT/TILL)**
2.9 – 3.3	SM	RUST-STAINED GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(SLIGHTLY WEATHERED DRIFT/TILL)**
3.3 – 8.8	SM	GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(DRIFT/TILL)**
		SAMPLES WERE COLLECTED AT 0.5, 2.2, 3.0, 4.0, 5.5 AND 8.6 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.8 FEET ON 01/24/06
TEST PIT THREE		
0.0 – 1.0	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
1.0 – 3.5	SM	ORANGE BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED DRIFT/TILL)**
3.5 – 3.8	SM	RUST-STAINED GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(SLIGHTLY WEATHERED DRIFT/TILL)**
3.8 – 7.0	SM	SLIGHT RUST-STAINED GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(DRIFT/TILL)**
7.0 – 8.7	SM	GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(DRIFT/ ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 0.5, 2.0, 3.0, 4.0, 5.5 AND 8.7 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 8.7 FEET ON 01/24/06

LOG OF EXPLORATION

DEPTH	USC	SOIL DESCRIPTION
TEST PIT FOUR		
0.0 – 1.5	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
1.5 – 3.9	SM	ORANGE BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED DRIFT/TILL)**
3.9 – 4.3	SM	RUST-STAINED GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(SLIGHTLY WEATHERED DRIFT/TILL)**
4.3 – 6.8	SM	GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(DRIFT/TILL)**
		SAMPLES WERE COLLECTED AT 0.8, 3.0, 4.2 AND 6.8 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.8 FEET ON 01/24/06
TEST PIT FIVE		
0.0 – 1.0	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
1.0 – 4.0	SM	ORANGE BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED TILL)**
4.0 – 4.4	SM	RUST-STAINED GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(SLIGHTLY WEATHERED TILL)**
4.4 – 5.3	SM	GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(TILL)**
5.3 – 9.0	SW	GRAY FINE TO COARSE SAND WITH GRAVEL AND TRACE SILT (DENSE TO VERY DENSE, MOIST TO WET) **(ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 0.5, 2.0, 4.1, 5.4 AND 8.8 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 9.0 FEET ON 01/24/06
TEST PIT SIX		
0.0 – 1.0	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
1.0 – 3.4	SM	ORANGE-BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED ADVANCE OUTWASH)**
3.4 – 9.0	SP-SM	GRAY TO BROWNISH GRAY FINE TO COARSE SAND WITH GRAVEL AND SILT (DENSE TO VERY DENSE, MOIST TO WET) **(ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 0.5, 3.0, 4.2 AND 9.0 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 9.0 FEET ON 01/24/06
TEST PIT SEVEN		
0.0 – 0.9	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
0.9 – 3.5	SM	ORANGE-BROWN SILTY FINE SAND WITH TRACE GRAVEL AND ROOTS (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED ADVANCE OUTWASH)**
3.5 – 9.0	SW	GRAY TO BROWNISH GRAY FINE TO COARSE SAND WITH GRAVEL AND TRACE SILT (DENSE TO VERY DENSE, MOIST TO WET) **(ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 0.5, 3.1, 4.2, 5.5, AND 9.0 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 9.0 FEET ON 01/24/06

LOG OF EXPLORATION

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DEPTH	USC	SOIL DESCRIPTION
TEST PIT ONE		
0.0 – 5.5	SM	GRAY-BROWN SILTY FINE SAND WITH GRAVEL AND ROOTS (LOOSE, MOIST) **(FILL)**
5.5 – 5.8	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
5.8 – 9.0	SM	BROWN SILTY SAND WITH GRAVEL (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED ADVANCE OUTWASH)**
9.0 – 10.0	SM	GRAY SILTY FINE TO MEDIUM SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 3.0, 6.0, 9.0 AND 10.0 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.0 FEET ON 9/8/04
TEST PIT TWO		
0.0 – 4.0	SM	BROWN SILTY FINE SAND WITH GRAVEL (LOOSE, MOIST) **(FILL)**
4.0 – 4.5	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
4.5 – 8.0	SP-SM	BROWN FINE SAND WITH GRAVEL AND SILT (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED ADVANCE OUTWASH)**
8.0 – 10.0	SP-SM	RUST-STAINED GRAY FINE TO MEDIUM SAND WITH GRAVEL AND SILT (VERY DENSE, MOIST) **(ADVANCE OUTWASH)**
		SAMPLES WERE COLLECTED AT 8.0 AND 10.0 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 10.0 FEET ON 9/8/04
TEST PIT FIVE		
0.0 – 0.5	SM	DARK BROWN SILTY FINE SAND WITH ORGANICS (LOOSE, MOIST) **(TOPSOIL)**
0.5 – 1.5	SM	BROWN SILTY FINE SAND WITH GRAVEL (LOOSE TO MEDIUM DENSE, MOIST) **(WEATHERED TILL)**
1.5 – 6.0	SM	GRAY SILTY FINE SAND WITH GRAVEL (DENSE TO VERY DENSE, MOIST) **(TILL)**
		SAMPLE WAS COLLECTED AT 5.0 FEET GROUND WATER SEEPAGE WAS NOT ENCOUNTERED TEST PIT CAVING WAS NOT ENCOUNTERED TEST PIT WAS COMPLETED AT 6.0 FEET ON 9/8/04

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Appendix B

USGS Design Maps Summary Report

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User–Specified Input

Report Title Brickyard Ridge
Thu April 25, 2013 22:44:25 UTC

Building Code Reference Document 2012 International Building Code
(which makes use of 2008 USGS hazard data)

Site Coordinates 47.76151°N, 122.13467°W

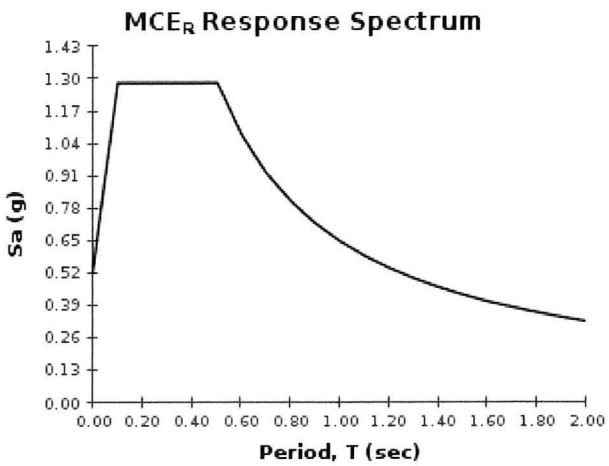
Site Soil Classification Site Class C – "Very Dense Soil and Soft Rock"

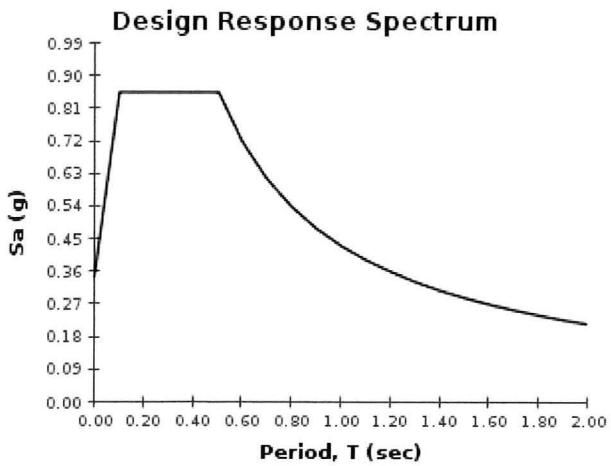
Risk Category I/II/III

USGS–Provided Output

S_S =	1.282 g	S_{MS} =	1.282 g	S_{DS} =	0.854 g
S_1 =	0.496 g	S_{M1} =	0.647 g	S_{D1} =	0.431 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





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USGS Design Maps Summary Report

EXHIBIT 13
PAGE 29 OF 29

User–Specified Input

Report Title Brickyard Ridge
Thu April 25, 2013 22:45:58 UTC

Building Code Reference Document 2006/2009 International Building Code
(which makes use of 2002 USGS hazard data)

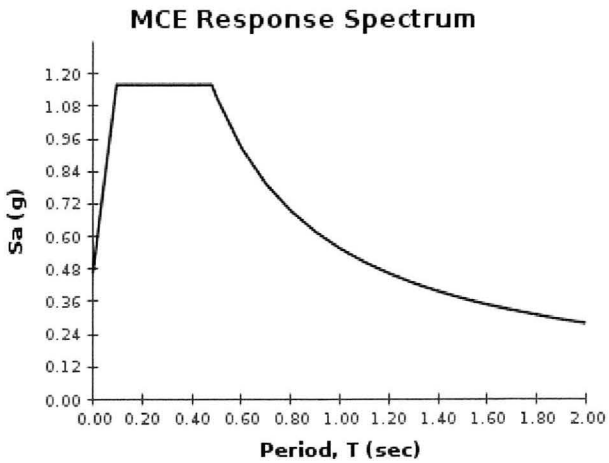
Site Coordinates 47.76151°N, 122.13467°W

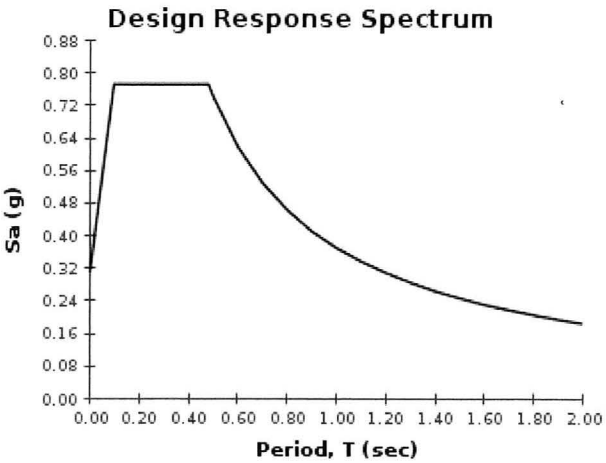
Site Soil Classification Site Class C – "Very Dense Soil and Soft Rock"

Occupancy Category Occupancy Category I

USGS–Provided Output

S_S =	1.159 g	S_{MS} =	1.159 g	S_{DS} =	0.772 g
S_1 =	0.395 g	S_{M1} =	0.555 g	S_{D1} =	0.370 g





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