Exhibit F

GEO CONSULTANTS NORTHWEST

October 7, 2016

Brownstone Homes LLC
P.O. Box 2375
Lake Oswego, Oregon 97035

Attn: Randy Myers

Subject: Geotechnical Evaluation
Kellogg Creek Development
GCN Project 1121

This report presents the results of our preliminary geotechnical investigation for the proposed Kellogg Creek Development in Milwaukie, Oregon. This report was prepared in accordance with our proposal letter dated July 27, 2016. The report summarizes the work accomplished and provides our conclusions and recommendations for site development.

PROJECT INFORMATION

Brownstone Homes is considering purchase of the Kellogg Creek site in Milwaukie, Oregon for construction of a residential development. The property is Zoned for R-3 and R-10 residential building construction. The site relative to surrounding features is shown in Figure 1.

Site development plans have not yet been prepared for the project. A site topographic and boundary survey was in progress at the time this report was written. We expect that development will include single-family and multi-family buildings, public and private streets, underground utilities. Storm water will be detained on-site before flowing to Mount Scott Creek. The site layout is shown in Figure 2.

SCOPE OF WORK

The purpose of our services was to explore the site and provide conclusions and recommendations for design and construction. The following describes our specific scope of services:

- Coordinate and manage the field investigation, including utility locates, authorization for site access, access preparation, scheduling of subcontractors and GCN staff.
- Observe excavation of 15 shallow test pits to depths up to 12 feet below the existing ground surface. Maintain a log of soil, rock, and groundwater encountered and obtain soil samples for return to our laboratory for further evaluation and testing. We classify soil in general accordance with the Unified Soil Classification System.
- Determine the moisture content and dry unit weight of select samples obtained from the explorations in general conformance with ASTM D2216 and ASTM D2937 respectively.
- Provide a written Geotechnical Report summarizing our explorations, geotechnical analysis, conclusions, and recommendations that include:
  - A discussion on the regional geology and the seismic setting of the site that includes the general geologic features of the surface and underlying deposits, and provide seismic design criteria in accordance with the Oregon Structural Specialty Code.

- Recommendations for site preparation, grading and drainage, compaction criteria, and wet-weather earthwork procedures.
- Recommendations for excavation, utility trenches, backfill materials, and backfill compaction.
- Recommendations for design and construction of shallow-spread foundations, including allowable design bearing pressures, minimum footing depth and width, lateral resistance to sliding, and estimates of settlement.
- Geotechnical engineering recommendations for the design and construction of concrete floor slabs, including an anticipated value for subgrade modulus.
- Design criteria for cast –in-place embedded building walls including lateral earth pressure, drainage, backfill material, and backfill compaction.
- A discussion of groundwater conditions on the site and recommendations for subsurface drainage of foundations, floor slabs, and pavement.

SITE CONDITIONS

The approximate 18 acre site is bisected Mount Scott Creek, a perennial drainage channel that flows to Kellogg Creek and then to the Willamette River, about 2 miles to the west. The once nearly flat site has been partially filled from off-site sources, creating irregular terrain. The site was The following paragraphs describe the site geology, seismic setting, and both surface and subsurface features of the site.

SITE GEOLOGY

The site is located in the Portland Basin in an area filled with sediment deposited during glacial outburst flooding of the Columbia River and its tributaries[1]. The floods deposited gravel, silt and sand with a total thickness of several hundred feet in some areas. The last of the events is believed to have occurred at the end of the last glacial period 9,000 to 10,000 years ago[2]. The glacial flood deposits are overlain with a thin mantle of younger alluvial sediment deposited over the last 10,000 years.

The near surface flood deposits are underlain by a thick sequence of basalt flows belonging to the Miocene age Columbia River Basalt Group (CRBG). Geologic structure mapping indicates that the basalt lies about 300 feet below the ground surface (Madin, 1990).

SEISMIC SETTING

The Portland area is subject to seismic events stemming from three possible sources: the Cascadia Subduction Zone (CSZ) , intraslab faults within the Juan de Fuca Plate, and crustal faults in the North American Plate.

[1] Madin, I.P., 1990, Earthquake Hazard Geology Maps of the Portland Metropolitan Area, Oregon; Oregon Department of Geology and Mineral Industries, Open File Report O-90-02, map scale 1:24,000.

[2] Waitt, R. B. Jr., 1985, Case for Periodic Colossal Jokulhlaups from Pleistocene Lake Missoula; Geological Society of America Bulletin, v. 96, no. 10, p. 1271-1286.

Maximum magnitude for a CSZ event is expected to be in the range of Moment Magnitude (MW) 9.0. Intraslab events have occurred on a frequent basis in the Puget Sound, contributing small magnitude ground motions in Western Oregon.

Quaternary crustal faults within 8 miles of the site are the East Bank Fault about 3 miles to the northeast, and the Portland Hills and Oatfield Faults about 0.2 and 1.5 miles to the southwest, respectively.

The contribution of potential earthquake-induced ground motion from all known sources, including the faults described above, are included in probabilistic ground motion maps developed by the USGS. Seismic site characterization and design recommendations based on USGS mapping and analysis are implemented in the International Building Code. Seismic design parameters for the project site are provided in Table 1 below.

TABLE 1 – SEISMIC DESIGN PARAMETERS

2012 IBC CODE BASED RESPONSE SPECTRUM MCE_R GROUND MOTION - 5% DAMPING 1% IN 50 YEARS PROBABILITY OF COLLAPSE	
S_S	0.966g
S_1	0.412g
MAPPED MAXIMUM CONSIDERED EARTHQUAKE SPECTRAL RESPONSE ACCELERATION PARAMETER (SITE CLASS C)	
F_a	1.014
F_v	1.388
S_{MS}	0.979g
S_{M1}	0.572g
DESIGN SPECTRAL RESPONSE ACCELERATION PARAMETER	
S_{DS}	0.653g
S_{D1}	0.381g

SURFACE CONDITIONS

The approximate 18 acre Kellogg Creek site is located on relatively flat land that is currently undeveloped. The site is bordered by Highway 224 on the north, Kellogg Creek Drive on the south, North Clackamas City Park on the west and a church property on the east. The site is currently undeveloped, vegetated with open grassland, brush, and clusters of young to moderate age deciduous trees.

The elevation of the property ranges from about 60 to 75 feet above mean sea level. Embankment slopes about 8 feet tall lie adjacent to Mount Scott Creek.

Fill has been placed on the site at some point in the past. Historical USGS topographic maps indicate the fill was likely not present in 1981. Historical aerial photos show the fill was present in 1995.

The fill ranges in thickness up to more than 12 feet as observed in our test pit explorations. An approximate 10-foot-tall fill zone in the central portion of the site terminates at its western extend with steep constructed slope that is inclined at about 2H:1V (horizontal to vertical).

SUBSURFACE CONDITIONS

We explored subsurface conditions at the site by observing the excavation of fifteen shallow test pits (TP-1through TP-15) on August 24, 2016 at the approximate locations shown in Figure 2. The test pits were excavated to depths up to 12 feet below ground surface (bgs).

Soil samples obtained from the test pits were returned to our soil laboratory for additional evaluation. Selected samples were used to determine soil moisture content and dry unit weight. The exploration logs and descriptions of field and laboratory procedures are included in Attachment A.

We encountered fill in thirteen test pits, ranging from 1-1/2 to more than 12 feet thick. Native soil beneath the fill consisted of 2-1/2 to 6 foot thick layer of loose to medium dense fine sand and silty sand, that was in turn underlain by gravel and boulders attributed to the Missoula Floods. Each layer is discussed below.

MAN MADE FILL

We encountered fill in 13 of 15 test pits extending from the ground surface to depths varying from 1-1/2 feet to greater than 12 feet. Subtle differences color and gravel content suggest the fill was paced at two different times using material from at least two sources.

South of the Mt. Scott Creek on the western side of the site, the fill appeared to include just one of the materials source materials. The fill in this area was up 3-1/2 feet thick.

The fill in the remainder of the site, north of Mt. Scott Creek and on the eastern side south of the creek, the fill included the underlying thinner fill with a thicker layer of less gravelly fill.

In general the upper fill material was stiff to very-stiff with trace to some sand, gravel and cobbles. There were isolated zones of soft and medium-stiff fill, particularly near the native/fill interface.

Field strength tests of the fill (pocket penetrometer) and the moisture content of samples returned to our laboratory indicated the fill was likely placed as structural fill. The fill at the fill/native interface that had high moisture and low compacted density. The fill included trace amounts of fine organic material and debris consisting of concrete and asphalt up to 12 inches in diameter. There were a few boulders up to 2 feet in diameter encountered in one test pit and some wire in another.

The moisture content and dry unit weight of seven samples of the fill obtained from thin wall (Shelby) tubes are presented in Table 2.

TABLE 2 – MOISTURE AND DENSITY OF FILL SAMPLES

TEST PIT	DEPTH (FT)	SOIL TYPE	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (PCF)
TP-7	2	SILT WITH TRACE GRAVEL	16	101
TP-8	8	SILT WITH TRACE SAND	26	96
TP-10	8	SILT WITH TRACE GRAVEL	22	96
TP-11	8	SILT WITH TRACE GRAVEL	19	109
TP-12	5	SILT WITH TRACE GRAVEL	15	105
TP-13	5	SILT WITH TRACE SAND	33	86
TP-14	3	SILT WITH TRACE SAND AND GRAVEL	17	85

It is our understanding that the fill was from a nearby construction project. Documentation of the fill placement is not available. Historical aerial photographs spanning the period of 1995 to 2014 show the will was placed prior to 1995.

NATIVE SAND AND SILTY SAND

We encountered native sand and silty sand below the fill that ranged from 2-1/2 to 6 feet thick. There was no fill encountered in test pits TP-4 and TP-15.

The sand and silty sand was loose to medium dense with moisture contents ranging from 20 to 50 percent of the dry soil weight. The dry unit weight of four select samples obtained in this unit varied between 78 and 98 pounds per cubic foot (pcf).

DENSE GRAVEL

We encountered dense sandy gravel beneath the native sand and silty sand. The gravel corresponds to coarse Missoula Flood deposits.

GROUNDWATER

We encountered groundwater in seven of the fifteen test pits at depths of 3 to 12 feet below the ground surface. The test pits were excavated on August 24, 2016 near the end of the dry season.

USGS mapping[3] indicates that regional groundwater in the vicinity of the site is about 65 to 70 feet above mean sea. This corresponds to existing ground surface elevations on the site.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our field explorations and engineering analysis, it is our opinion that the site can be developed as proposed.

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[3] USGS Scientific Investigations Report 2008-5059, *Estimated Depth to Groundwater and Configuration of the Water Table in the Portland*, *Oregon Area*.

The primary geotechnical considerations for the site are the widespread presence of potentially unsuitable fill that could include zones of soft soil. We understand that mass grading will result in movement of much of the existing fill and that low areas will be filled in with the existing soil on the site. We recommend that the ground surface in all areas where old fill will remain that it be reprocessed to a depth of two feet below subgrade elevation.

Soft alluvial soil with shallow groundwater underlies the western portion of the site in the vicinity of TP-3, TP-4 and TP-15. We expect that this area will likely receive structural fill to raise the grade above the FEMA flood plain elevation. It may be necessary to stabilize the ground surface before structural fill can be placed. In very dry conditions the surface could potentially be scarified and compacted. Alternate approaches include placement of a granular blanket as a capillary break and amendment of the area with portland cement.

Subsurface soil includes a layer of loose sand at the ground surface that existed before the fill was placed. This sand will likely be unstable if encountered in utility trenches and will run when beneath water. Underground utility construction in areas that penetrate to the native soil surface may require dewatering.

Our recommendations for project design and construction are provided below.

1. <u>Site Preparation</u>

The existing heavily rooted zone of grass and organics should be stripped and removed from the site in all proposed building and pavement areas and for a 5-foot margin around such areas. Based on our explorations, the depth of stripping will be about 4 inches although greater stripping depths may be required to remove localized zones of loose or organic soil. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

Existing fill ranging from 3 feet to greater than 12 feet thick underlies about three quarters of the site. In areas that will not otherwise be processed, we recommend removing or scarifying the stripped ground surface to depth of 24 inches. The scarified soil should be compacted as recommended for structural fill.

Trees, shrubs, and brush should be removed from all building and paved areas. Root balls should be grubbed out to a depth such that all roots or parts of roots greater than ½-inch in diameter are removed. The depth of excavation to remove root balls of trees could exceed 5 feet bgs.

The on-site silt can be sensitive to small changes in moisture content and may be difficult to compact adequately during wet weather. Accordingly, scarification and compaction of the subgrade may only be possible during extended dry periods and following moisture conditioning of the soil.

After stripping, scarification and required site cutting have been completed, we recommend proofrolling the subgrade with a fully loaded dump truck or similar size, rubber-tire construction equipment to identify areas of excessive yielding. The proofrolling should be observed by a member of our geotechnical staff, who will evaluate the subgrade. If areas of excessive yielding are identified, the material should be excavated and replaced with compacted materials recommended for structural fill. Areas that appear to be too wet and soft to support proofrolling equipment should be prepared in accordance with the recommendations for wet weather construction presented in the following section of this report.

The test pits excavations were backfilled using relatively minimal compactive effort. Therefore, soft spots can be expected at these locations. We recommend that these relatively uncompacted soils be removed from the test pits located within the proposed building and paved areas to a depth of 3-feet below finished subgrade. The resulting excavation should be brought back to grade with structural fill.

2. Wet Weather Construction Considerations

Fine-grained soils on the site are easily disturbed during the wet season. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork should be planned and executed to minimize subgrade disturbance.

The base rock thickness for project streets, as described below in the section titled "Pavement Recommendations," are intended to support post construction design traffic loads. The base rock thickness determined for post construction traffic will not support construction traffic or pavement construction when the subgrade soils are wet. Accordingly, if construction is planned for periods when the subgrade soils are not dry and firm, then an increased thickness of base rock or other methods to support construction traffic will be required.

If construction occurs during wet conditions, site preparation activities may need to be accomplished using track-mounted equipment, loading removed material into trucks supported on granular haul roads. The use of granular haul roads or staging areas will be necessary for support of construction traffic during wet conditions.

Wetland areas and forested areas may require prolonged periods of dry weather to moisture condition the underlying soil before fill can be placed and compacted. The project schedule should consider timing of mass grading to coincide with the dry weather months.

We recommend that a minimum of 2-inch thickness of granular material be placed at the base of footing excavations made in wet weather conditions. The granular material reduces water softening of subgrade soils and reduces subgrade disturbance during placement of forms and reinforcement.

3. Excavations

The stability of temporary excavation slopes is a function of many factors, including soil type, soil density, slope inclination, slope height, the presence of groundwater, and the duration of exposure. Generally, the likelihood of slope failure increases as the cut is deepened and as the duration of exposure increases. For this reason, we recommend that the excavation contractor maintain adequate slopes and setbacks.

Temporary slope safety should remain the responsibility of the contractor, who is continually present at the site and is able to monitor the performance of the excavation and modify construction practices to reflect varying conditions.

Regardless of inclination, temporary slopes should be protected from surface runoff of storm water. This can typically be accomplished using berms or swales located along the top of the slope, and by placing plastic tarpaulins over the slope.

Temporary cut slopes for the construction of the embedded foundation walls should be limited to 1H:1V. Permanent cut and fill slopes should be limited to 2H:1V or flatter.

4. Utility Trench Excavations

The sand and silty sand encountered at the original ground surface are susceptible to slumping and running if below the water table. The silt contents of these units decrease with depth and it is likely that clean sands will be encountered. It may be necessary to dewater utility trench excavations that extend below the water table. We recommend that additional explorations be conducted to determine the character of soils at the depths of the utilities and permeability testing should be conducted to determine parameters for dewatering system design.

5. Structural Fill

General. All fill within building, pavement, and sidewalk areas should be placed as compacted structural fill. All structural fill materials should be compacted to at least 95% of the maximum dry density as determined by ASTM D 698.

The earthwork contractor's compactive effort should be evaluated on the basis of field observations, and lift thicknesses should be adjusted accordingly to meet compaction requirements. The moisture content for compaction should be within about 3% of optimum.

No brush, roots, construction debris, or other deleterious material should be placed within the structural fills. Additional information regarding specific types of fill is provided below.

On-Site Soil. The on-site soil is suitable for use as structural fill provided it can be moisture-conditioned, separated from concentrations of organics and other unsuitable material, and compacted to the specified density. The fill should be placed in lifts with a maximum loose thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density as determined by ASTM D 698.

Imported Granular Material. Imported granular fill material may include sand, gravel, or fragmental rock with a maximum size on the order of 4 inches and with not more than about 5% passing the No. 200 sieve (washed analysis). Material satisfying these requirements can usually be placed during periods of wet weather. The first lift of granular fill placed over a fine-grained subgrade should be about 18 in. thick and subsequent lifts about 12 inches thick when using medium- to heavy-weight vibratory rollers. Granular structural fill should be limited to a maximum size of about 1-½ inch when compacted with hand-operated equipment.

Utility Trench Backfill. Utility trench backfill should consist of granular fill limited to a maximum size of about 1 ½ inch. The granular trench backfill should be compacted to at least 95% of the maximum dry density as determined by ASTM D 698 in the upper 3 feet of the trench and to at least 90% of this density below this depth. Lift thicknesses should be evaluated on the basis of field density tests; however, particular care should be taken when operating hoe-mounted compactors to prevent damage to the newly placed conduits. Flooding or jetting to compact the trench backfill should not be permitted. Native materials can be used for trench backfill in unimproved areas where a soft trench and future settlement of the backfill can be tolerated.

Free-Draining Fill. Free-draining material should have less than 2% passing the No. 200 sieve (washed analysis). Examples of materials that would satisfy this requirement include ¾ to ¼ inch, 1½ to ¾ inch, or 3- to 1-in. crushed rock.

6. Cement Amended Fill

Portland cement can be used to stabilize and strengthen soils or to permit use of native soils when moisture contents are above optimum. The amount of cement used to amend the soils generally varies with moisture content and clay content. For planning purposes, we expect acceptable soil strength will be obtained using an amendment rate of 5 pounds portland cement tilled to a depth of 12 inches.

The permeability of amended soil is extremely low. Accordingly, amendment should not be completed in landscape areas or, the amended material should be removed from landscape areas prior to planting.

7. Shallow Foundations

In our opinion, the proposed structures can be supported on continuous or isolated column footings founded on reprocessed and new structural fill.

Continuous wall and spread footings and retaining wall footings should be proportioned for an allowable bearing pressure of 1,500 pounds per square foot (psf). Footing embedment should be as required by the Oregon Structural Specialty Code. For this allowable bearing pressure, foundations should be at least 14 inches wide.

The recommended allowable bearing pressure applies to the total of dead plus long-term live loads. The allowable bearing pressure may be increased by a factor of 3 for short-term wind or seismic loads.

The allowable bearing capacity is provided to limit differential and total settlement to ½ inch and 1inch respectively, for static loading conditions.

8. Slab-on-Grade Floors

Satisfactory subgrade support for lightly-loaded building floor slabs can be obtained on the undisturbed native soil or on engineered structural fill. A subgrade modulus of 100 pounds per cubic inch may be used to design floor slabs.

A minimum 6-inch-thick layer of free draining fill should be placed and compacted over the prepared subgrade to assist as a capillary break and blanket drain. The free draining fill layer may be capped with a 1- to 2-inch-thick layer of clean ¾ inch minus crushed rock that contains no more than 5% fines.

A vapor retarder manufactured for use beneath floor slabs should be installed above the free draining fill in inhabited spaces and spaces that will receive floor coverings. Careful attention should be made during construction to prevent perforating the retarder and to seal edges and utility penetrations. We recommend following ACI 302.1, Chapter 3 with regard to installing a vapor retarder.

9. Retaining Walls & Embedded Building Walls

The following recommendations assume that the walls are less than 12 feet in height, backfill extends a distance behind the wall equal to the wall height, and that the backfill is well drained and meets the requirements detailed above for imported granular material. Reevaluation of our recommendations will be required if retaining walls vary from these assumptions.

In general, cantilever retaining walls yield under lateral loads and should be designed with active lateral earth pressures. Restrained walls, such as embedded building walls and vaults should be designed to withstand at-rest lateral earth pressures. We recommend using the lateral earth pressures shown in Table 3. The loads are provided as equivalent fluid density (G). Diagrams showing use of the lateral earth pressures in design calculations are provided in Figure 3.

TABLE 3 – EQUIVALENT FLUID DENSITY (G) ACTING ON RETAINING WALLS

WALL TYPE	BACKFILL CONDITION	BACKFILL COMPONENT (PCF)	SURCHARGE COMPONENT (PSF)	SEISMIC COMPONENT (PCF)
YIELDING WALL	FLAT	30	80	*
	2H:1V	45		*
NON-YIELDING WALL	FLAT	50	120	*
	2H:1V	70		*

* Seismic components are not necessary for cast in place retaining walls less than 12 feet tall that are designed with a static factor of safety equal to 1.5[4].

Static lateral earth pressures acting on a retaining wall should be increased to account for surcharge loadings resulting from any traffic, construction equipment, material stockpiles, or structures located within a horizontal distance equal to the wall height. We have included lateral earth pressures for surcharge loads up to 250 psf placed as a distributed load within the distance H from the wall face.

Retaining wall drains should consist of a perforated drainpipe embedded in a minimum 1-foot-wide zone of free draining fill that is wrapped 360 degrees around by a geotextile filter that overlaps a minimum of 6 inches. The geotextile filter should be placed between the granular materials and the native soil to prevent movement of fines into the clean granular material. The geotextile filter should be a non-woven fabric with an apparent opening size between the U.S. Standard No. 70 and No. 100 Sieve sizes and a water permittivity of greater than 1.5 sec^{-1}.

Backfill for retaining walls should extend a horizontal distance of H from the back of wall, where H is the embedded height, and compacted as recommended for structural fill, with the exception of backfill placed immediately adjacent to walls. To reduce pressure on walls, backfill located within a horizontal distance of 3 feet from retaining walls should be compacted to approximately 90% of the maximum dry density, as determined by ASTM D698, and should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment.

[4] Sitar, Mikola and Candia, "Seismically Induced Lateral Earth Pressure on Retaining Structures and Basement Walls", GeoCongress 2012.

10. Lateral Resistance

Lateral loads of buildings and retaining walls can be resisted by passive earth pressure on the sides of footings or by friction on the base of the footings but not both. We recommend using the equivalent fluid pressures and coefficients of friction provided in Table 4 for design of foundations.

TABLE 4 – LATERAL RESISTANCE FACTORS

SOIL TYPE	EQUIVALENT FLUID PRESSURE (ɣ – PCF)	FRICTION COEFFICIENT (µ)
ON-SITE SILT	350	0.4
IMPORTED CRUSHED ROCK	800	0.6

In order to develop the tabulated capacity for passive resistance using on-site silt, concrete must be placed directly against the walls of the footing excavations. When using the value for imported crushed rock, the rock should extend a minimum horizontal distance equal to half of the footing embedment (Embedment/2) and should be compacted to not less than 95% of the dry density as determined by ASTM D698. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance.

11. Site Drainage

As a matter of good construction practice, we recommend that perimeter drains be installed for all buildings. Perimeter drains should consist of perforated drainpipe embedded in a zone of free draining fill that is wrapped in a non-woven geotextile filter. The pipe should be connected to a tightline drainpipe leading to storm drain facilities.

Foundation and crawl space drainage should be sloped to drain to a sump or low point drain outlet. Water should not be allowed to pond within crawl spaces.

Roof drains be connected to a tightline drainpipe leading to storm drain outlet facilities. Pavement surfaces and open space areas should be sloped such that surface water runoff is collected and routed to suitable discharge points. Ground surfaces adjacent to buildings should be sloped to drain away from the buildings.

12. French Drains

French drains should be installed if groundwater seepage is encountered during construction. The drains should consist of a 3-inch diameter perforated pipe within an envelope of uniformly graded drain rock with a maximum particle size of 3 inches, and less than 2 percent passing the U.S. Standard No. 200 Sieve. The drain rock should extend at least 6 inches on all sides of the pipe.

The gravel envelope should extend upward to the top of the slope and should be wrapped with filter fabric to reduce the migration of fines from the surrounding soil. The geotextile filter should be a non-woven fabric with an AOS between the U.S. Standard No. 70 and No. 100 Sieve size and a water permittivity of greater than 1.5 sec-1. Details for construction of french drains are provided in Figure 4.

13. <u>On-Site Asphalt Pavement</u>

The pavement subgrade should be prepared in accordance with the previously described recommendations described in the "Site Preparation," "Wet Weather Construction," and "Structural Fill" sections of this report.

Our pavement recommendations are based on a subgrade stiffness using a California Bearing Ratio value of 3. We do not have specific information on the frequency and type of vehicles that will use the area; however, we have assumed that post construction traffic conditions will consist of no more than five heavy trucks per day.

Our analysis shows that a pavement section consisting of a minimum of 4 inches of AC pavement underlain by a minimum of 10.0 inches of crushed rock base will be required to support anticipated traffic loads over a design life of 20 years.

These thicknesses are intended to be the minimum acceptable and are based on the assumption that construction will be completed during an extended period of dry weather. Construction of pavement when subgrade soils are wet will require an increased thickness of crushed rock base or stabilized subgrade as described above in the "Cement Amended Fill" section of this report. If subgrade is stabilized with portland cement, the crushed rock base thickness can be reduced to 6.0 inches in the public roadways of the project and 4.0 inches in the private roadways.

The AC pavement should conform to Section 0074 of the Standard Specification for Highway Construction, Oregon Highway Specifications. We recommend half inch dense graded Hot Mix Asphalt Concrete for Design Level 2 using Performance Grade Asphalt PG-70-22. The aggregate base should conform to Section 02630 of the specifications with the addition that no more than 5 percent of the material by dry weight passes a U.S. Standard No. 200 Sieve.

Aggregate base should be placed in one lift and compacted to not less than 95% of the modified Proctor maximum dry density (ASTM D1557). Aggregate base should be placed in one lift and compacted to not less than 95 percent of the maximum dry density as determined by ASTM D 698. Aggregate base contaminated with soil during construction should be removed and replaced before paving.

ADDITIONAL SERVICES

Because the future performance and integrity of the structural elements will depend largely on proper site preparation, drainage, fill placement, and construction procedures, monitoring and testing (geotechnical special inspection) by experienced geotechnical personnel should be considered an integral part of the design and construction process. Consequently, we recommend that GCN be retained to provide the following post-investigation services:

- Review construction plans and specifications to verify that our design criteria presented in this report have been properly integrated into the design.
- Attend a pre-construction conference with the design team and contractor to discuss geotechnical related construction issues.
- Observe fill areas and footing subgrade both before fill material or base rock is placed and before footings are constructed in order to verify the soil conditions.

- Prepare a post-construction letter-of-compliance summarizing our field observations, inspections, and test results.

LIMITATIONS

This report was prepared for the exclusive use of Brownstone Homes and members of the design team for this specific project. It should be made available to prospective contractors for information on the factual data only, and not as a warranty of subsurface conditions, such as those interpreted from the explorations and discussed in this report.

The recommendations contained in this report are preliminary, and are based on information derived through site reconnaissance, subsurface testing, and knowledge of the site area. Variation of conditions within the area and the presence of unsuitable materials are possible and cannot be determined until exposed during construction. Accordingly, GCN's recommendations can be finalized only through GCN's observation of the project's earthwork construction. GCN accepts no responsibility or liability for any party's reliance on GCN's preliminary recommendations.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by exploratory methods. Such unexpected conditions frequently require that additional expenditures be made to attain properly-constructed projects. Therefore, a contingency fund is recommended to accommodate the potential for extra costs.

Within the limitations of the scope of work, schedule, and budget, the analyses, conclusions, and recommendations presented in this report were prepared in accordance with generally-accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no warranty, either express or implied.

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We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,
GEO Consultants Northwest, Inc.

REGISTERED PROFESSIONAL ENGINEER 63231 OREGON JAN. 23, 2001 BRITTON W. GENTRY

EXPIRES 06/30/2017

Brad L. Hupy, PE, GE
Principal

Britton W. Gentry, PE, GE
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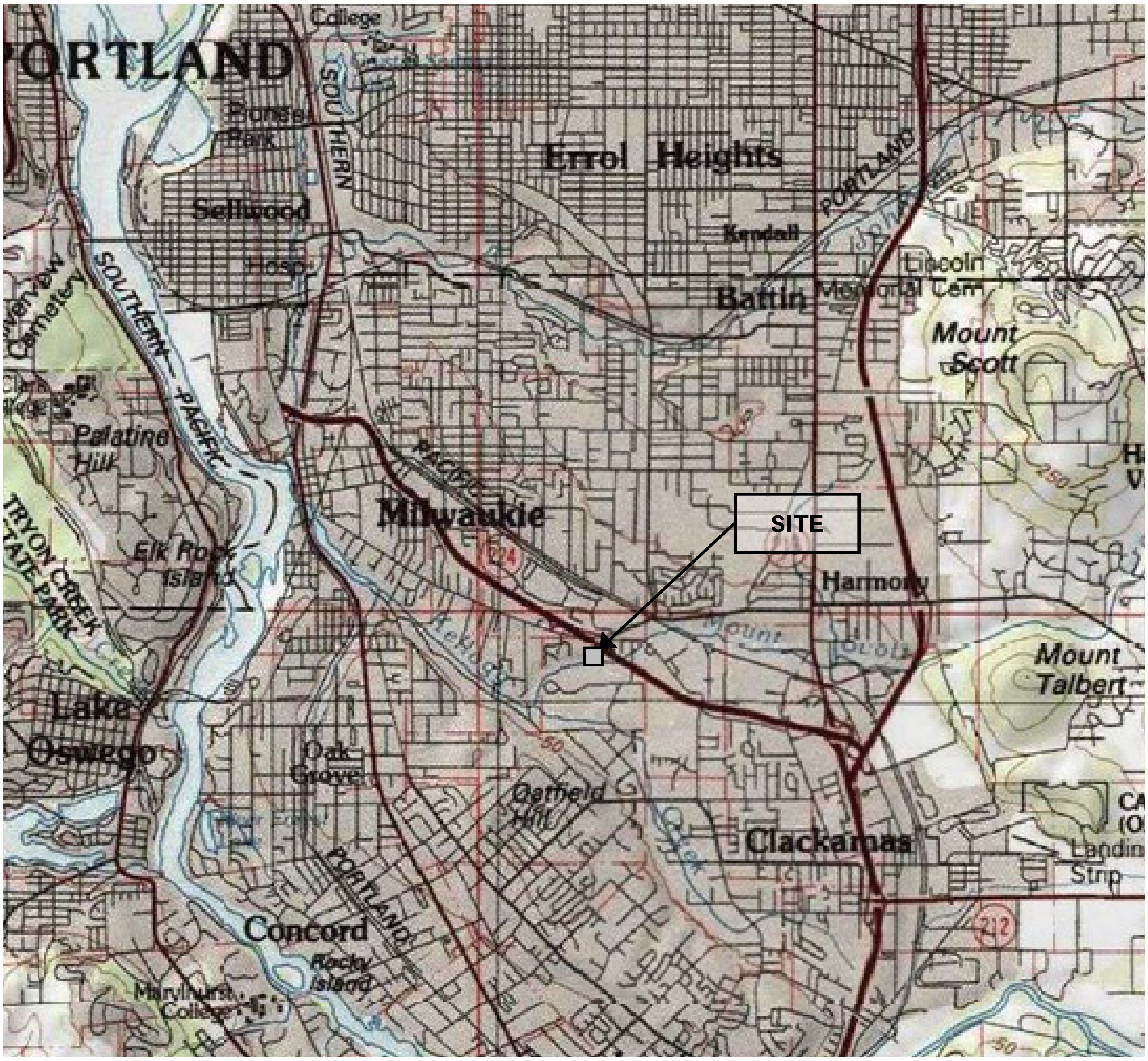
Figures: Figure 1 – Site Vicinity
Figure 2 – Preliminary Site Layout with Explorations
Figure 3 – Retaining Wall Pressures
Figure 4 – French Drain Details

Attachments: Attachment A – Field Exploration and Laboratory Testing



GLADSTONE QUADRANGLE - 2015 PROVIDED BY
ACME MAPPER 2.1

LAT 45.426 N, LON 122.603 W, T2S, R2E, SEC 6

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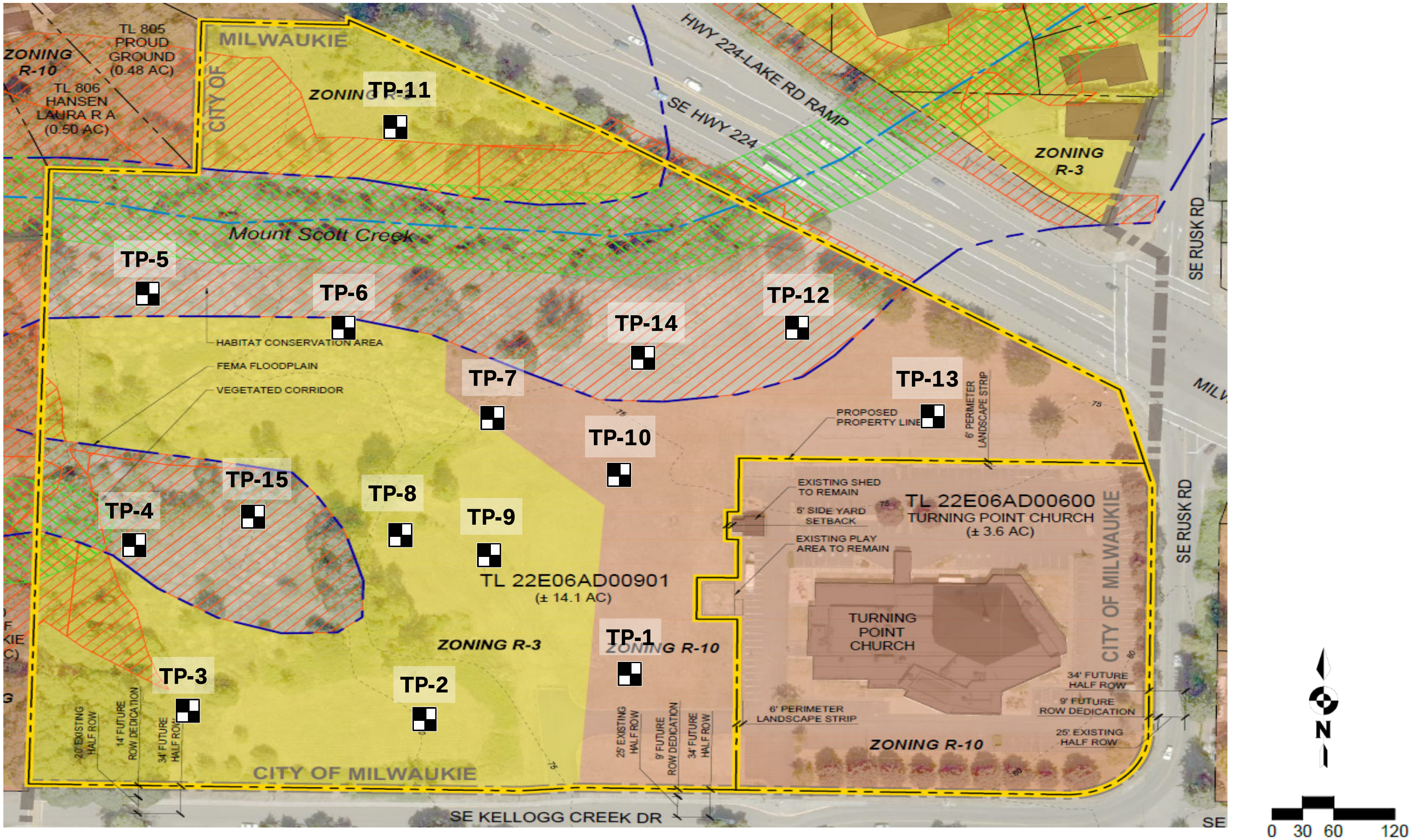
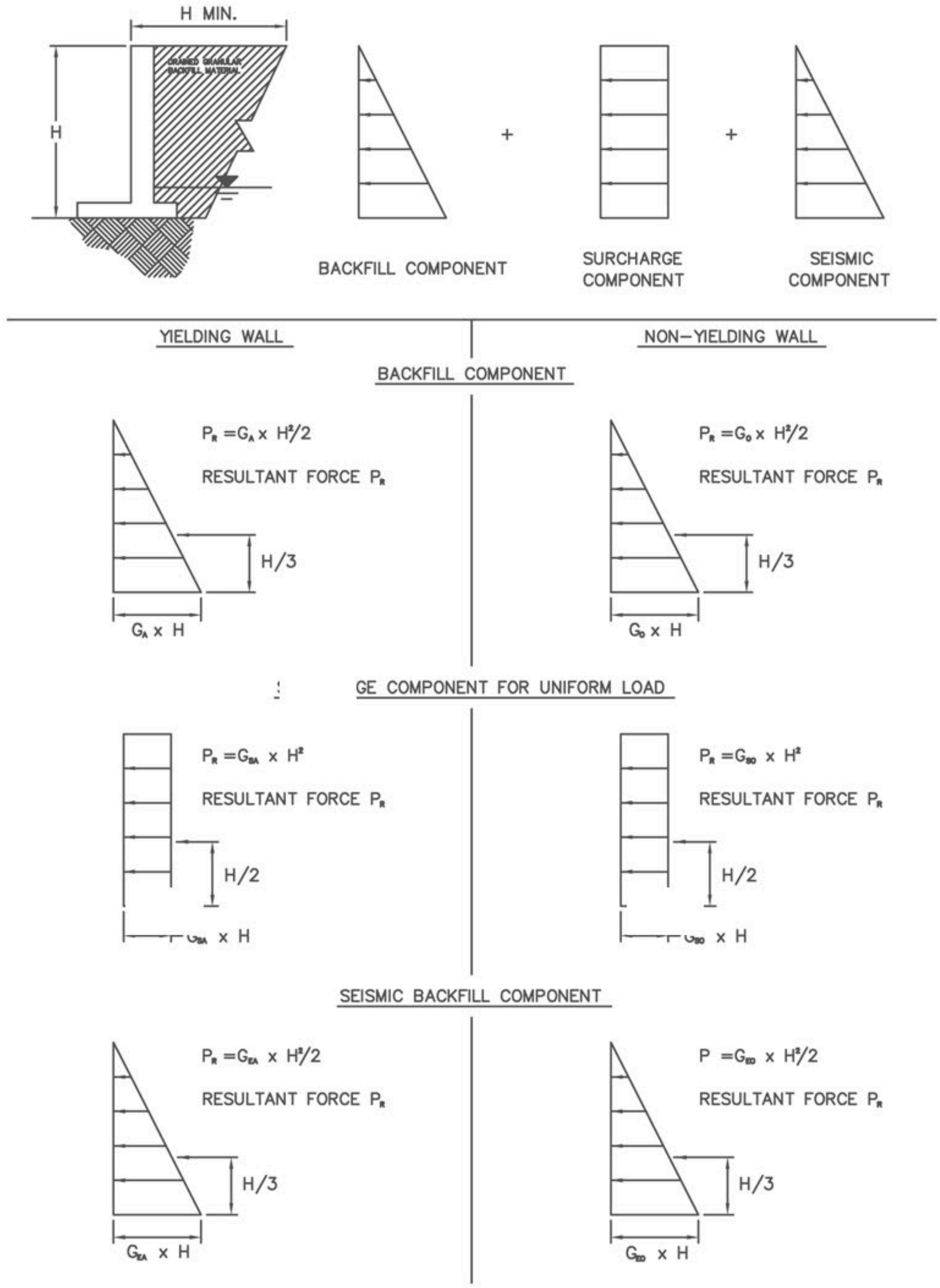
GEO CONSULTANTS NORTHWEST	SEPT 2016	**1121 - BROWNSTONE KELLOGG CREEK**	
824 SE 12th Avenue Portland, OR 97214	Drawn By: TAC	**SITE VICINITY**	**FIGURE 1**



TP-1 TEST PITS EXCAVATED AUGUST 24, 2016 – LOCATIONS APPROXIMATE

BASE DRAWING "CONCEPTUAL SITE PLAN" PREPARED BY DOWL, DATED JULY 6, 2016

GEO CONSULTANTS NORTHWEST	OCT 2016	**1121 - BROWNSTONE KELLOGG CREEK**		
824 SE 12th Avenue Portland, OR 97214	Drawn By: TAC	**SITE LAYOUT & EXPLORATION**		**FIGURE 2**

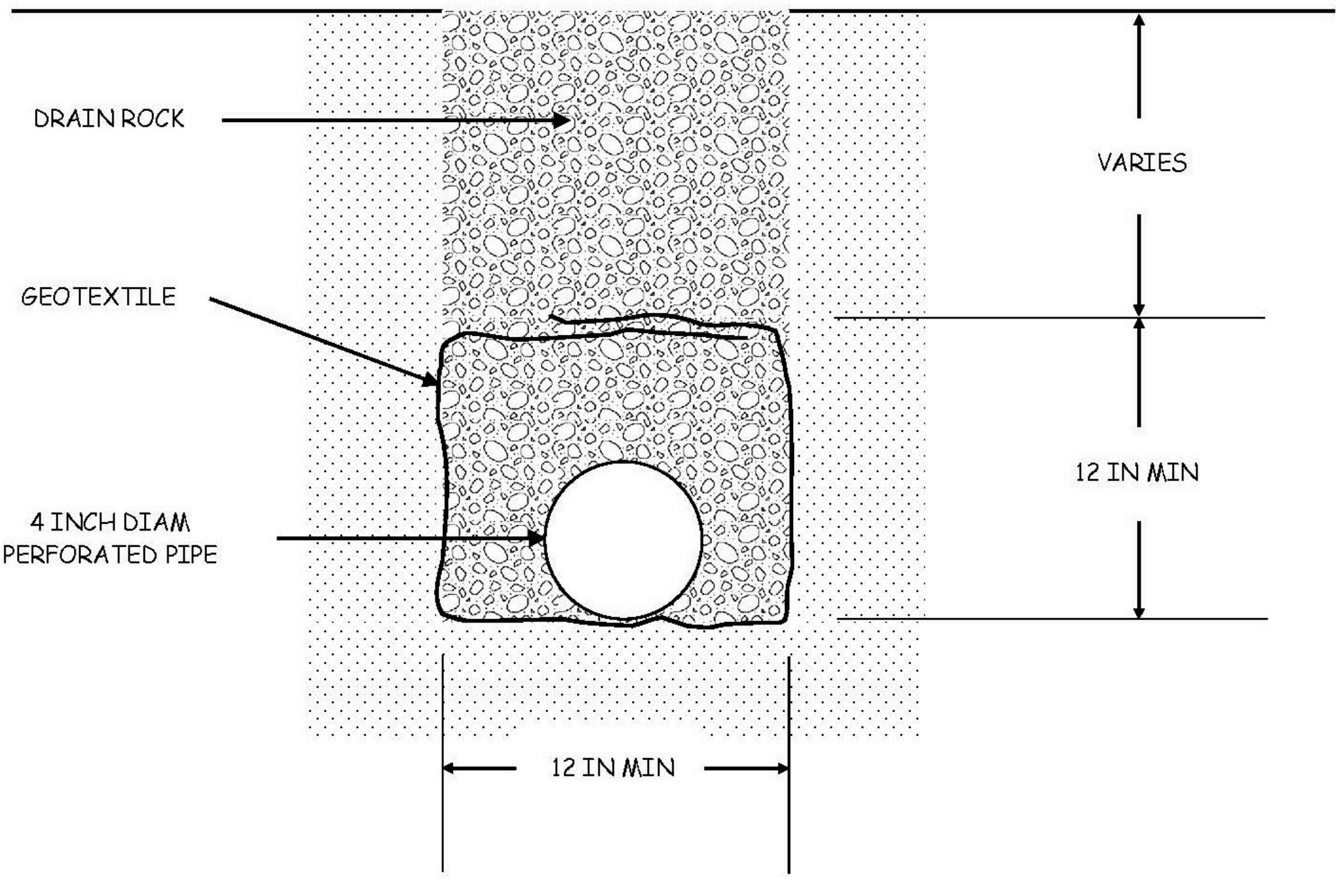


NOTE:

1. SEE REPORT TEXT FOR VALUE OF G.

A: ACTIVE O: AT-REST S: SURCHARGE E: EARTHQUAKE

GEO CONSULTANTS NORTHWEST	OCT 2016	**1121 - BROWNSTONE KELLOGG CREEK**	
824 SE 12th Avenue Portland, OR 97214	Drawn By: BLH	**RETAINING WALL PRESSURES**	**FIGURE 3**



1. INSTALL A GEOTEXTILE FILTER IN TRENCH TO WRAP DRAIN ROCK WITH OVERLAP AT THE TOP AS SHOWN.
2. DRAIN ROCK SHALL BE PEA GRAVEL OR WASHED DRAIN ROCK. EXTEND TO GROUND SURFACE ABOVE GEOTEXTILE FILTER TO DESIGN SUBGRADE ELEVATION.
3. USE A NON-WOVEN GEOTEXTILE FILTER WITH AN APPARENT OPENING SIZE BETWEEN THE U.S. STANDARD NO. 70 AND NO. 100 SIEVES, AND A WATER PERMITTIVITY OF GREATER THAN 1.5 SEC^{-1}.

GEO CONSULTANTS NORTHWEST	OCT 2016	**1121 - BROWNSTONE KELLOGG CREEK**	
824 SE 12th Avenue Portland, OR 97214	Drawn By: BLH	**FRENCH DRAIN DETAIL**	**FIGURE 4**

ATTACHMENT A

FIELD EXPLORATION PROCEDURES

LABORATORY TESTING PROCEDURES

KEY TO BORING AND TEST PIT LOGS

TEST PIT LOGS

FIELD EXPLORATION PROCEDURES

GENERAL

We explored subsurface conditions at the site by excavating fifteen test pits (TP-1 through TP-15) to depths of up to 12 feet below ground surface (bgs) on August 24, 2016. The test pits were excavated with a rubber-tire excavator operated by Fischer Excavating of Banks, Oregon. The approximate test pit locations are shown in Figure 2.

A member of GCN's staff was present during the explorations to record soil, rock, and groundwater conditions encountered in our boring and to obtain soil samples for laboratory testing.

SOIL SAMPLING

Representative grab samples of the soil observed in the explorations were obtained from the test pit walls and/or base using the excavator bucket. Relatively undisturbed soil samples were obtained using a standard Shelby tube in general accordance with guidelines presented in ASTM D 1587, the Standard Practice for Thin-walled Tube Sampling of Soils. Samples obtained in the exploration were sealed in airtight, plastic bags or the Shelby tubes to retain moisture and returned to our laboratory for additional examination and testing. The test pits were loosely backfilled.

FIELD CLASSIFICATION

Soil samples were initially classified visually in the field. Consistency, color, relative moisture, degree of plasticity, peculiar odors, and other distinguishing characteristics of the soil samples were noted. The terminology used is described in the key and glossary that follow.

SUMMARY EXPLORATION LOGS

Results from the test pits are shown in the summary exploration logs. The left-hand portion of a log provides our interpretation of the soil encountered, sample depths, and groundwater information. The right-hand, graphic portion of a log shows the results of pocket penetrometer and laboratory testing. Soil descriptions and interfaces between soil types shown in summary logs are interpretive, and actual transitions may be gradual.

LABORATORY TESTING PROCEDURES

Soil samples obtained during field explorations are examined in our laboratory, and representative samples may be selected for further testing. The testing program included visual-manual classification and natural moisture content.

VISUAL-MANUAL CLASSIFICATION

Soil samples are classified in general accordance with guidelines presented in ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. The physical characteristics of the samples are noted and the field classifications are modified, where necessary, in accordance with ASTM terminology, though certain terminology that incorporates current local engineering practice may be used. The term which best described the major portion of the sample is used to describe the soil type.

NATURAL MOISTURE CONTENT

Natural moisture content is determined in general accordance with guidelines presented in ASTM D2216, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

DRY UNIT WEIGHT (IN-PLACE DRY DENSITY)

Dry unit weight (in-place dry density) testing is performed in general accordance with guidelines presented in ASTM D2937, Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method. The dry unit weight is defined as the ratio of the dry weight of the soil sample to the volume of that sample. The dry unit weight typically is expressed in pounds per cubic foot.

BORING AND TEST PIT LOGS

DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for exploration by our field representative. The log contains information concerning soil and groundwater encountered, sampling depths, sampler types used and identification of samples selected for laboratory analysis. The final logs presented in this report represent our interpretation of subsurface conditions based on the contents of the field logs, observations made during explorations, and the results of laboratory testing. Our recommendations are based on the contents of the final logs and the information contained therein, and not on the field logs.

SOIL CLASSIFICATION SYSTEM

Soil samples are classified in the field in general accordance with the United Soil Classification System (USCS) presented in ASTM D2488 “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).” Final logs reflect field soil classifications and laboratory testing results. A summary of the USCS is provided on page 3. Classifications and sampling intervals are shown in the logs.

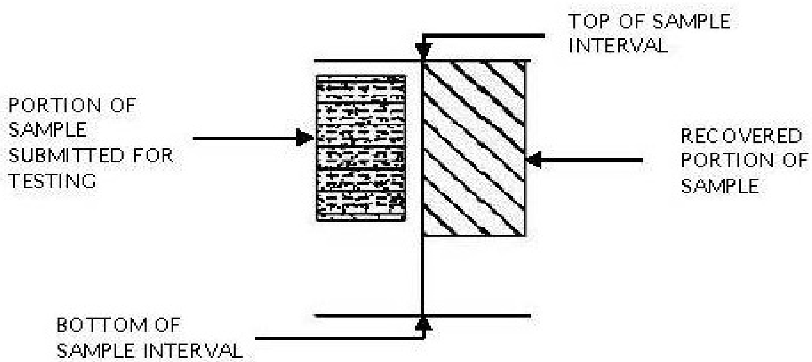
VARIATION OF SOIL BETWEEN EXPLORATIONS

The final logs and related information depict subsurface conditions only at the specific location and on the date(s) indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ.

TRANSITION BETWEEN SOIL AND ROCK CLASSIFICATIONS

The lines designating the interface between soil, fill, or rock on the final logs and on the subsurface profiles presented in the report are determined by interpolation and are, therefore, approximate. The transition between the materials may be abrupt or gradual. Only at specific exploration locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes.

BORING LOG SAMPLES



GEO CONSULTANTS NORTHWEST	2016	KEY TO BORING AND TEST PIT LOGS	
824 SE 12th Avenue Portland, OR 97214	Drawn By: GCN	GENERAL INFORMATION	1/5

EXPLORATION LOG SYMBOLS

- Sample Location with No Sample Recovery
- Sample Location Using Direct Push Sampler (ASTM D 6282)
- Sample Location Using Ring-Lined Barrel Sampler (ASTM D 3550)
- Sample Location Using Split-Barrel Sampler (ASTM D 1586)
- Sample Location Using Thin-Walled Tube Sampler (ASTM D 1587)
- Rock Core Interval
- Grab Sample Location
- Soil Sample Submitted for Chemical Testing
- Soil Sample Submitted for Physical Property Testing
- Water Sample Screened Interval
- Water Sample Submitted for Chemical Testing
- Water Sample Tested in the Field
- Groundwater Level Encountered While Drilling
- Static Groundwater Level
- Perched Groundwater
- Groundwater Level at Time of Sampling

SOIL CHARACTER

Granular Soil		Cohesive Soil		
Density	Standard Penetration Test *	Consistency	Standard Penetration Test*	Unconfined Compressive Strength (tsf)
Very Loose	0 - 4	Very Soft	Less Than 2	Less Than 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.5
Medium Dense	10 - 30	Medium Stiff	4 - 8	0.50 - 1.0
Dense	30 - 50	Stiff	8 - 16	1.0 - 2.0
Very Dense	Greater Than 50	Very Stiff	16 - 32	2.0 - 4.0
Blows Required to Drive a Split-Barrel Sampler 12 inches		Hard	Greater Than 32	Greater Than 4.0

DEFINITIONS AND ABBREVIATIONS

AT	ATTERBERG LIMITS TEST	ND	NON DETECT	PPB	PARTS PER BILLION
BGS	BELOW GROUND SURFACE	NEG	NEGATIVE RESULT	PPM	PARTS PER MILLION
CO	CONSOLIDATION TEST	NS	NO VISIBLE SHEEN	PSF	POUNDS PER SQUARE FOOT
DS	DIRECT SHEAR TEST	OC	ORGANIC CONTENT	RS	SOIL RESISTIVITY TEST
DW	DRY UNIT WEIGHT	P	PUSHED SAMPLE	S4	SUDAN IV SOIL TEST
GS	MECHANICAL GRAIN SIZE TEST	P200	P200 FINES CONTENT TEST	SG	SPECIFIC GRAVITY TEST
HS	HEAVY SHEEN	PCF	POUNDS PER CUBIC FOOT	SPT	STD. PENETRATION TEST
HYD	HYDROMETER TEST	PH	SOIL pH	SS	SLIGHT SHEEN
MC	MOISTURE CONTENT	PID	PHOTOIONIZATION DETECTOR	TO	TOREVANE
MG/KG	MILLIGRAMS PER KILOGRAM	POS	POSITIVE RESULT	TSF	TONS PER SQUARE FOOT
MS	MODERATE SHEEN	PP	POCKET PENETROMETER	UV	ULTRAVIOLET LIGHT TEST

GRAIN SIZE DEFINITIONS			MINOR FRACTIONS IN FINE GRAINED SOIL		GROUNDWATER SEEPAGE	
SAND	FINE	No. 200 to No. 40	No Mention (CLAY, SILT)	< 15 percent	Slow	< 1 gpm
	MEDIUM	No. 40 to No. 10	With Sand, With Gravel	15 to 30 percent	Moderate	1-3 gpm
	COARSE	No. 10 to No. 4	Sandy, Gravelly	30 to 49 percent	Rapid	> 3 gpm
GRAVEL	FINE	No. 4 to 3/4-inch	FIELD MOISTURE OBSERVATION		CAVING	
	COARSE	3/4- to 3-inch	Dry	Absence of moisture, dusty, dry to touch	Minor	
COBBLE		3-inches to 12-inches	Moist	Damp but no visible water.	Moderate	
BOULDER		> 12-inches	Wet	Saturated, below groundwater	Severe	

GEO CONSULTANTS NORTHWEST	2016	KEY TO BORING AND TEST PIT LOGS
824 SE 12th Avenue Portland, OR 97214	Drawn By: GCN	SYMBOLS AND ABBREVIATIONS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

GEO CONSULTANTS NORTHWEST

2016

KEY TO BORING AND TEST PIT LOGS

824 SE 12th Avenue
Portland, OR 97214

Drawn By: GCN

SOIL CLASSIFICATION

ROCK CLASSIFICATION GUIDELINES

HARDNESS		DESCRIPTION
Very soft	(RH-0)	For plastic material only
Soft	(RH-1)	Carved or gouged with a knife
Moderate	(RH-2)	Scratched with a knife
Hard	(RH-3)	Difficult to scratch with a knife
Very hard	(RH-4)	Rock scratches metal; rock cannot be scratched with a knife

STRENGTH	DESCRIPTION
Plastic	Easily deformable with finger pressure
Friable	Crumbles by rubbing with fingers
Weak	Crumbles only under light hammer blows
Moderately Strong	Few heavy hammer blows before breaking
Strong	Withstands few heavy hammer blows and yields large fragments
Very Strong	Withstands many heavy hammer blows, yields dust and small fragments

WEATHERING	DESCRIPTION
Severe	Rock decomposed; thorough discoloration; all fractures extensively coated with clay, oxides, or carbonates.
Moderate	Intense localized discoloration of rock; fracture surfaces coated with weathering minerals.
Little	Slight and intermittent discoloration of rock; few stains on fracture surfaces.
Fresh	Rock unaffected by weathering

FRACTURING	FRACTURE SPACING
Crushed	Less than 5/8 inch to contains clay
Highly Fractured	5/8 inch to 2 inches
Closely Fractured	2 inches to 6 inches
Moderately fractured	6 inches to 1 foot
Little Fractured	1 foot to 4 feet
Massive	Greater than 4 feet

JOINT SPACING	DESCRIPTION
Papery	Less than 1/8 inch
Shaley or Platey	1/8 inch to 5/8 inch
Very Close	5/8 inch to 3 inches
Close	3 inches to 2 feet
Blocky	2 to 4 feet
Massive	Greater than 4 feet

GEO CONSULTANTS NORTHWEST	2016	KEY TO BORING AND TEST PIT LOGS	
824 SE 12th Avenue Portland, OR 97214	Drawn By: GCN	ROCK CLASSIFICATION	4/5

GLOSSARY

Alluvial – Made up of or found in the materials that are left by the water of rivers, streams, floods, etc.

Bearing pressure – The total stress transferred from the structure to the foundation, then to the soil below the foundation.

Bulk density (Soil density) – The total mass of water and soil particles contained in a unit volume of soil: lb/ft^3.

Coefficient of active earth pressure – The ratio of the minimum horizontal effective stress of a soil to the vertical effective stress at a single point in a soil mass retained by a retaining wall as the wall moves away from the soil.

Cohesive soil – Clay type soil with angles of internal friction close to zero. Cohesion is the force that holds together molecules or like-particles within a substance.

Colluvium – A loose accumulation of soil and rock fragments deposited through the action of gravity, such as erosion and soil creep.

Differential settlement – The vertical displacement due to settlement of one point in a foundation with respect to another point of the foundation.

Engineered fill – Soil used as fill, such as retaining wall backfill, foundation support, dams, slopes, etc., that are to be placed in accordance with engineered specifications. These specifications may delineate soil grain-size, plasticity, moisture, compaction, angularity, and many other index properties depending on the application.

Excess pore pressure – That increment of pore water pressures greater than hydro-static values, produced by consolidation stresses in compressible materials or by shear strain; excess pore pressure is dissipated during consolidation.

Factor of safety – The ratio of a limiting value of a quantity to the design value of that quantity.

Fines – Material by weight passing the U.S. Standard No. 200 Sieve by washed analysis.

Fluvial – Produced by the action of rivers or streams.

Homogenous soil – A mass of soil where the soil is of one characteristic having the same engineering and index properties.

In situ – Undisturbed, existing field conditions.

Lacustrine – Of a lake, e.g., the depositional environment of a lake.

Liquefaction – The sudden, large decrease of shear strength of cohesionless soil caused by collapse of the soil structure, produced by small shear strains associated with sudden but temporary increase of pore water pressure. Usually a problem in submerged, poorly graded sands within the upper 50 feet of subgrade in earthquake-prone environments.

Maximum dry density – A soil property obtained in the laboratory from a Proctor test. Density of soil at 100% compaction.

Overbank deposit – Sediment that has been deposited on the floodplain of a river or stream by flood waters that have broken through or overtopped the banks.

Permeability – A measure of continuous voids in a soil. The property which allows the flow of water through a soil. See also coefficient of permeability.

Porosity (Pore space) – The ratio of the volume of voids to the total volume: unitless or expressed as a percentage.

Residual soil – Soil that has been formed in place by rock decay.

Shear strength – The maximum shear stress which a soil can sustain under a given set of conditions. For clay, shear strength = cohesion. For sand, shear strength = the product of effective stress and the tangent of the angle of internal friction.

Surcharge – An additional force applied at the exposed upper surface of a restrained soil.

Tuff – An igneous rock (from molten material) that forms from the debris ejected by an explosive volcanic eruption.

Unit weight – The ratio of the total weight of soil to the total volume of a unit of soil: lb/ft^3.

LOG OF TEST PIT TP-01

Depth (feet bgs)	USCS Symbol	Soil Description	Sample	Ground Water	Water Content (percent)	Field Testing	Testing and Laboratory Data
0	ML	Very stiff, light brown SILT FILL with trace sand and trace subrounded to angular gravel; moist. (2-inch thick heavily rooted zone at the ground surface)	1		14	PP=4.0	
						PP=4.0	
			2		14	PP=4.0	
4	ML	Very stiff to stiff, brown SILT FILL with some subrounded gravel, trace sand and trace fine organics; moist.				PP=3.5	
5			3		27	PP=3.5	
		Encountered 6 inch diameter storm drain pipeline at 6 feet.				PP=3.5	
7	SM	Medium dense, brown-gray and orange mottled gray, fine SILTY SAND; moist. **ALLUVIUM**	4		31		
10							
11.5	GW	Dense, light brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; moist.	5		30		
		End at 12 feet in dense native gravel. No caving and no groundwater observed to the depth explored.					
15							

Station: See Figure 2
Logged By: Paul Crenna, CEG
Approximate Elevation:
Excavation Started: 8/24/16
Excavation Completed: 8/24/16

LOG OF TEST PIT TP-02

Depth (feet bgs)	USCS Symbol	Soil Description	Sample	Ground Water	Water Content (percent)	Field Testing	Testing and Laboratory Data
0	ML	Medium stiff, brown SILT FILL with trace sand and some subrounded to subangular gravel and cobbles, trace construction debris (asphalt); moist. (3-inch thick heavily rooted zone at the ground surface)	1		6		
1.5	SM	Medium dense, orange and gray mottled light brown SILTY SAND; moist. **ALLUVIUM**	2		20	PP=4.0	DD = 98 pcf
						PP=3.5	
5			3				
6	GW	Dense, light brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; moist to wet. **MISSOULA FLOOD DEPOSITS**		▼ TS			
			4		27		
			5		15		
10							
		End at 11 feet in dense native gravel. Minor sidewall caving below 5 feet. Rapid groundwater seepage below 6 feet.					
15							

Station: See Figure 2
Logged By: Paul Crenna, CEG
Approximate Elevation:
Excavation Started: 8/24/16
Excavation Completed: 8/24/16

Brownstone - Kellogg Creek

1121

GEO Consultants Northwest
824 SE 12th Avenue
Portland, Oregon 97214
Tel 503-616-9425
Fax

LOGS OF TEST PITS

LOG OF TEST PIT TP-03

DEPTH (feet bgs)	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
0	GM	Medium dense, brown, silty, subrounded GRAVEL FILL with cobbles and organics (fine rootlets throughout); moist. (3-inch thick heavily rooted zone at the ground surface)	1 2	 ▼ TS	19 15	PP=3.5 PP=3.0	
	ML	Soft, blue-gray SILT with trace fine sand; wet. **ALLUVIUM**	3		45	PP=0.25	DD = 78 pcf
5							
	SP	Loose, blue-gray fine SAND with trace silt; wet. **ALLUVIUM**	4		42		
10	GW	Dense, brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; wet. **MISSOULA FLOOD DEPOSITS**					
		End at 12 feet in dense native gravel. Severe sidewall caving. Rapid groundwater seepage below 6 feet.					
15							

Station: See Figure 2 | **Logged By: Paul Crenna, CEG**

Approximate Elevation:

Excavation Started: 8/24/16 | **Excavation Completed: 8/24/16**

LOG OF TEST PIT TP-04

DEPTH (feet bgs)	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
0	ML	Medium stiff, dark brown SILT with some fine organics and trace subrounded gravel; moist. (4-inch thick heavily rooted zone at the ground surface)	1		28	PP=1.5	
	SM	Soft to medium stiff, blue-gray fine SILY SAND with trace fine organics (fragments of carbonized wood); moist to wet. **ALLUVIUM**	2	▼ TS	45	PP=1.0 PP=0.5	
5	SM	Loose to medium dense, blue-gray, fine SILTY SAND; wet. **ALLUVIUM**	3		50		
	GW	Dense, brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; wet. **MISSOULA FLOOD DEPOSITS**					
10							
		End at 12 feet in dense gravel. Moderate sidewall caving. Rapid groundwater seepage below 3 feet.					
15							

Station: See Figure 2 | **Logged By: Paul Crenna, CEG**

Approximate Elevation:

Excavation Started: 8/24/16 | **Excavation Completed: 8/24/16**

Brownstone - Kellogg Creek

1121

GEO Consultants Northwest
824 SE 12th Avenue
Portland, Oregon 97214
Tel 503-616-9425
Fax

LOGS OF TEST PITS

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Stiff, brown SILT FILL with some subrounded to angular gravel; moist. (4-inch thick heavily rooted zone at the ground surface)	1		16	PP=4.0	
			Encountered trace metal wire at 3 feet.	2		22	PP=3.5	
							PP=4.0	
5				3		11		
		GW	Dense, brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; moist.	4		4		
			MISSOULA FLOOD DEPOSIT	5		8		
10			End at 10 feet in dense native gravel.					
			No caving and no groundwater observed to the depth explored.					
15								

Station: See Figure 2 **Logged By:** Paul Crenna, CEG
Approximate Elevation:
Excavation Started: 8/24/16 **Excavation Completed:** 8/24/16

LOG OF TEST PIT TP-05

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Stiff, brown, subrounded gravelly SILT FILL with trace construction debris (metal, asphalt, concrete) up to 8 inch diameter; moist. (3-inch thick heavily rooted zone at the ground surface)	1		13		
			Encountered occasional boulders to 2 feet diameter.	2		14		
		ML	Stiff, light brown SILT with trace fine sand; moist.				PP=4.0	
5			**ALLUVIUM**	3		21		
		GW	Dense, brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; wet.	4	▼ TS	11		
10			**MISSOULA FLOOD DEPOSIT**					
			End at 12 feet in dense native gravel.					
			Moderate sidewall caving.					
			Slow goundwater seepage below 8 feet.					
15								

Station: See Figure 2 **Logged By:** Paul Crenna, CEG
Approximate Elevation:
Excavation Started: 8/24/16 **Excavation Completed:** 8/24/16

LOG OF TEST PIT TP-06

GEO Consultants Northwest
824 SE 12th Avenue
Portland, Oregon 97214
Tel 503-616-9425
Fax

LOGS OF TEST PITS

LOG OF TEST PIT TP-07

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Very stiff, light brown SILT FILL with trace angular gravel; moist.				PP=4.0	
				1		12		
				2		16	PP=4.0	DD = 101 pcf
							PP=4.0	
				3		12		
		ML	Medium stiff to stiff, brown SILT FILL with trace subrounded gravel and trace construction debris (metal); moist.				PP=2.0	
5			Encountered dark brown layer with trace fine organics from 6 to 7 feet.	4		32		
			Becomes blue-gray below 7 feet.	5		38		
				6		42		
10								
				7		37		
			End at 12 feet in stiff silt fill.					
			No caving and no groundwater observed to the depth explored.					
15								

Station: See Figure 2
Logged By: Paul Crenna, CEG
Approximate Elevation:
Excavation Started: 8/24/16
Excavation Completed: 8/24/16

LOG OF TEST PIT TP-07

LOG OF TEST PIT TP-08

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Very stiff, light brown SILT FILL with trace fine sand; moist. (2-inch thick heavily rooted zone at the ground surface)				PP=4.0	
				1		13	PP=4.0	
							PP=4.0	
				2		20	PP=4.0	
5		ML	Stiff, blue-gray and brown-gray SILT FILL with trace fine organics; moist.	3		16		
				4		26		DD = 96 pcf
				5		25		
10								
			Encountered trace construction debris (concrete and asphalt) up to 18 inch diameter at 11 to 12 feet.	6		30		
			End at 12 feet in stiff silt fill. No caving and no groundwater observed to the depth explored.					
15								

Station: See Figure 2
Logged By: Paul Crenna, CEG
Approximate Elevation:
Excavation Started: 8/24/16
Excavation Completed: 8/24/16

LOG OF TEST PIT TP-08

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Very stiff, light brown SILT FILL with trace sand and angular gravel; moist. (2-inch thick heavily rooted zone at the ground surface)	1		10	PP=4.0	
							PP=4.0	
				2		12	PP=4.0	
		ML	Stiff, blue-gray SILT FILL with trace sand; moist.				PP=4.0	
5				3		25		
			Encountered 3-inch thick grass root zone at 6 feet.					
			Encountered some subrounded gravel and cobbles from 6 to 10 feet.	4		18		
				5		34		
10								
			Encountered dark brown-gray layer with trace fine organics at 11 to 12 feet.	6		48		
			End at 12 feet in stiff silt fill. Minor caving at 6 to 7 feet.					
			No groundwater observed to the depth explored.					
15								

Station: See Figure 2 | **Logged By: Paul Crenna, CEG**

Approximate Elevation:

Excavation Started: 8/24/16 | **Excavation Completed: 8/24/16**

LOG OF TEST PIT TP-09

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Very stiff, light brown SILT FILL with trace fine sand and angular gravel; moist. (2-inch thick heavily rooted zone at the ground surface)				PP=4.0	
							PP=4.0	
							PP=4.0	
				1		16	PP=4.0	
5		ML	Stiff, dark brown-gray SILT FILL with trace subrounded gravel and cobbles, trace fine organics; moist.	2		22		
				3		22		DD = 96 pcf
			Encountered plastic particles at 8 feet.					
10								
			Encountered dark brown layer with trace fine organics at 11 to 12 feet.	4		42		
			End at 12 feet in stiff silt fill. No caving and no groundwater observed to the depth explored.					
15								

Station: See Figure 2 | **Logged By: Paul Crenna, CEG**

Approximate Elevation:

Excavation Started: 8/24/16 | **Excavation Completed: 8/24/16**

LOG OF TEST PIT TP-10

Brownstone - Kellogg Creek

1121

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LOGS OF TEST PITS

LOG OF TEST PIT TP-11

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
0–7		ML	Very stiff, dark brown and brown, subrounded gravelly SILT FILL with cobbles to 4 inch diameter; moist. (4-inch thick heavily rooted zone at the ground surface)	1		14		
				2		14		
5				3		23		
7–12		ML	Stiff, blue-gray SILT FILL with trace subrounded gravel and cobbles, trace fine organics; moist.	4		27		
				5		19		DD = 109 pcf
10				6		28		
12			End at 12 feet in stiff silt fill.					
			No caving and no groundwater observed to the depth explored.					
15								

Station: See Figure 2
Approximate Elevation:
Excavation Started: 8/24/16
Logged By: Paul Crenna, CEG
Excavation Completed: 8/24/16

LOG OF TEST PIT TP-12

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
0–8		ML	Stiff, light brown SILT FILL with trace angular gravel; moist. (3-inch thick heavily rooted zone at the ground surface)	1		13	PP=4.0	
							PP=4.0	
				2		16	PP=4.0	
5				3		15		DD = 105 pcf
8–10		ML	Stiff, blue-gray and brown-gray SILT FILL with trace subrounded gravel and cobbles; moist.	4		8		
10–12		SP	Loose to medium dense, fine to medium SAND with trace silt; wet. **ALLUVIUM**	5	TS	34		
12			End at 12 feet in medium dense native sand. Minor caving below 10 feet.					
			Slow groundwater seepage below 10 1/2 feet.					
15								

Station: See Figure 2
Approximate Elevation:
Excavation Started: 8/24/16
Logged By: Paul Crenna, CEG
Excavation Completed: 8/24/16

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LOGS OF TEST PITS

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Very stiff, light brown SILT FILL with trace sand and subrounded gravel and cobbles; moist. (3-inch thick heavily rooted zone at the ground surface)	1 2		27 42	PP=4.0 PP=4.0 PP=4.0 PP=3.5	
5		ML	Stiff, blue-gray SILT FILL; moist.	3		33		DD = 86 pcf
		SM	Medium dense, light brown fine SILTY SAND grading to fine sand; moist. **ALLUVIUM**	4		32		
10		GW	Dense, light brown, subrounded GRAVEL with sand; moist. **MISSOULA FLOOD DEPOSIT** End at 12 feet in dense native gravel. No caving and no groundwater observed to the depth explored.	5		37		
15								

Station: See Figure 2 **Logged By:** Paul Crenna, CEG

Approximate Elevation:

Excavation Started: 8/24/16 **Excavation Completed:** 8/24/16

LOG OF TEST PIT TP-13

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Very stiff, light brown and brown SILT FILL with trace sand and angular to subrounded gravel and cobbles; moist. (3-inch thick heavily rooted zone at the ground surface)	1 2		12 17	PP=4.0 PP=4.0 PP=4.0 PP=3.5	DD = 85 pcf
5			Encountered occasional debris (asphalt to 12 inch diameter) at 4 feet.	3 4		28 38		DD = 79 pcf
		ML	Stiff, dark brown-gray to blue-gray SILT with trace fine organics in upper foot; moist to wet. **ALLUVIUM**	5	TS	37		
10		GW	Dense, brown, subrounded GRAVEL with sand and cobbles; wet. **MISSOULA FLOOD DEPOSIT** End at 12 feet in dense native gravel. Minor caving below 10 feet. Rapid groundwater seepage below 9 feet.	6				
15								

Station: See Figure 2 **Logged By:** Paul Crenna, CEG

Approximate Elevation:

Excavation Started: 8/24/16 **Excavation Completed:** 8/24/16

LOG OF TEST PIT TP-14

Brownstone - Kellogg Creek

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LOGS OF TEST PITS

DEPTH (feet bgs)	GRAPHIC LOG	USCS SYMBOL	SOIL DESCRIPTION	SAMPLE	GROUND WATER	WATER CONTENT (percent)	FIELD TESTING	TESTING AND LABORATORY DATA
		ML	Medium stiff, dark brown SILT with organics (fine rootlets); moist. (4-inch thick heavily rooted zone at the ground surface)	1		19		
		SM	Medium dense, orange and gray mottled light brown, fine SILTY SAND; moist.	2		43	PP=2.0	DD = 78 pcf
							PP=2.0	
			ALLUVIUM					
5		GW	Dense, brown, subrounded GRAVEL with sand and cobbles to 6 inch diameter; wet.		▼ TS			
			MISSOULA FLOOD DEPOSIT	3				
10			End at 10 feet in dense gravel.					
			Moderate caving below 6 feet.					
			Rapid groundwater seepage below 5 feet.					
15								

Station: See Figure 2 **Logged By:** Paul Crenna, CEG

Approximate Elevation:

Excavation Started: 8/24/16 **Excavation Completed:** 8/24/16

LOG OF TEST PIT TP-15

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