ATTACHMENT H:

ICE GEOTECH 2013

Report
Preliminary Geotechnical Engineering Services
King County Children and Family Justice Center
Redevelopment Project
1211 East Alder Street
Seattle, Washington

November 26, 2013
ICE File No. 0105-011

Prepared For:
Parametrix

Prepared By:
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November 26, 2013

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We are pleased to submit five original copies and an electronic copy of our "Report, Preliminary Geotechnical Engineering Services, King County Children and Family Justice Center Redevelopment Project, 1211 East Alder Street, Seattle, Washington." Icicle Creek Engineers' services were completed in general accordance with the Subconsultant Agreement for Professional Services between Parametrix and ICE, and were authorized in writing by John Perlic of Parametrix on June 26, 2013. Our report was submitted in draft form for your review and comment on August 6, September 23 and October 25, 2013.

Please contact us if you require additional information or an interpretation of the information presented in this report. We appreciate the opportunity to be of service to you.

Yours very truly,

Icicle Creek Engineers, Inc.

Brian R. Beaman, PE, LEG, LHG
Principal Engineer/Geologist/Hydrogeologist

Document ID: 0105011.Cover Letter
Attachments

cc: Jenny Bailey, Parametrix (email)

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KING COUNTY CHILDREN AND FAMILY JUSTICE CENTER
REDEVELOPMENT PROJECT
1211 EAST ALDER STREET
SEATTLE, WASHINGTON

1.0 INTRODUCTION

This report presents the results of our preliminary geotechnical engineering services related to the redevelopment of the King County Children and Family Justice Center (Youth Services Center - YSC) located at 1211 East Alder Street in Seattle, Washington. The purpose of this study was to evaluate subsurface conditions at the site and to provide preliminary geotechnical recommendations for the design and construction of the proposed structures. We expect that additional geotechnical investigation and analysis will be required as the project progresses through the Design-Build process. The location of the King County YSC is shown on the Vicinity Map, Figure 1.

2.0 PROJECT DESCRIPTION

We understand that the approximately 9 acre King County YSC site will be redeveloped. The site currently includes the Alder Tower (built in 1972), the Alder Wing (built/remodeled in 1951/1972) and the Spruce Youth Detention Facility (built in 1991). These buildings will be demolished and replaced with a new Courthouse, Juvenile Detention Facility and a Parking Garage at the locations shown on the Site Plan, Figure 2. The new Courthouse may include one level below grade, the Juvenile Detention Facility may be constructed at or near existing grade, and the Parking Garage may be up to four levels below grade. The redevelopment layout generally clusters the new buildings toward the center of the site. The construction of these facilities will be procured by a Design-Build process.

The northwest, southwest and southeast corners of the site may eventually be used for retail/residential development. The northeast corner of the site may be used as open (public) space.

3.0 SITE CONDITIONS

3.1 SURFACE CONDITIONS

The King County YSC site is located southeast of downtown Seattle within the base of a wide valley bordered to the east and west by gently sloping hillsides. The site is bordered by mixed commercial and residential properties to the west (12th Avenue) and to the north, east and south (East Remington Court, 14th Avenue and East Spruce Street, respectively) by residential properties. The ground surface slopes gently down from north to south (though in a series of benches and steeper intervening slopes because of past site grading) from about Elevation 260 feet at the northwest corner to about Elevation 215 feet at the southeast corner (45 feet of vertical relief).

The northwest corner of the site is currently used for parking. The northeast corner is open space (lawn and scattered trees). The existing courthouse (Alder Tower), roughly centered within the site, is a multiple level building with a basement. The Alder Wing is situated at grade (no basement) to the northeast of the Alder Tower. The Spruce Youth Detention Facility is also built at grade in the south part of the site. Grass-covered slopes typically separate the different benched levels where parking/access or buildings are located.

Based on our review of historical aerial photographs for 1936, 1968, 1990, 1998 and 2009 (Google Earth, King County iMAP and USGS Explorer), the King County YSC site has a long history of use. In the 1936 aerial photograph, the entire property appears to be developed with higher density residential housing. The 1968 aerial photograph shows the Alder Wing in the northeast part of the site surrounded by residential housing. The 1990 aerial photograph show that the entire central and north part of the site is similar to the current layout (Courthouse, Alder Wing and parking area), along with the south part of the site cleared for the 1991 construction of the Spruce Youth Detention Facility.

3.2 SUBSURFACE CONDITIONS

Subsurface conditions at the King County YSC site were explored by drilling nine test borings (Borings B-1 through B-9) at the locations shown on Figure 2. Piezometers (for measuring ground water) were installed in three of the borings (Borings B-2, B-3 and B-9. Ground water monitor wells (for measuring and testing ground water) were installed in three of the borings (Boring/Monitor Wells B-6/MW-6, B-7/MW-7 and B-8/MW-8). Details of our subsurface exploration program, along with the boring/monitor well logs and moisture content test results from the test borings are presented in Appendix A. Details of the laboratory testing program and the results of the laboratory testing (grain size analysis) are presented in Appendix B.

Based on regional geologic mapping by the US Geological Survey (USGS, 2005), the King County YSC site is underlain by native soils consisting of Vashon age Recessional Outwash and Advance Outwash deposits. Recessional Outwash typically consists of normally consolidated (medium dense/stiff) stratified (layered) silt (fine-grained), and sand with some gravel (coarse-grained). The Advance Outwash typically consists of stratified to massive (non-layered) silt and sand with small amounts of gravel in a dense or very stiff/hard condition as a result of being overridden by glacial ice.

Based on our review of historical aerial photographs and site observations, it is apparent that the ground surface has been significantly modified by previous grading (cuts and fills) to provide relatively level building and parking areas.

The test borings completed for this study (Boring B-1 through B-9) encountered relatively uniform conditions characterized by four primary soil (geologic) units referred to as follows: 1) Fill, 2) Recessional Outwash – Fine-Grained, 3) Recessional Outwash – Coarse-Grained, and 4) Advance Outwash – Transitional Beds. The interpreted vertical distribution of the geologic units is shown on the Geologic Cross-Section A-A', Figure 3 and Geologic Cross-Sections B-B', C-C' and D-D', Figure 4.

The soil units encountered in the test borings are described below and are summarized in the following table, along with our ground water observations.

Fill – The surficial Fill consists of about 2 to 18 feet of loose to medium dense to dense silty sand and sand or soft to hard (desiccated) sandy silt with variable amounts of gravel and brick/wood/plastic fragments (debris). The amount of debris observed in the soil samples was small. Fill consisting of gravel with variable silt was encountered in Borings B-4 and B-7. A thin layer of buried topsoil was encountered beneath the Fill in Boring B-7. It is likely that the Fill consists of on-site native soils (Recessional Outwash) that was graded (cut) and used for fill in other areas of the site. For this reason, the characterization of the Fill was difficult because of its similarity with the native Recessional Outwash deposits.

Recessional Outwash – Fine-Grained – Recessional Outwash – Fine-Grained, where encountered, consists of medium stiff to very stiff sandy silt, silt and clayey silt with variable amounts of gravel and medium/coarse sand (typically a trace of gravel) and occasional thin layers of fine sand. Medium dense silty fine to medium sand was encountered in Boring B-7.

Recessional Outwash – Coarse-Grained – Recessional Outwash – Coarse-Grained, where encountered, consists of medium dense sand, sand with silt or silty sand with variable amounts of gravel. Medium dense fine to coarse gravel with sand was encountered in Boring B-6.

Advance Outwash – Transitional Beds – Advance Outwash – Transitional Beds consists of dense to very dense sand, sand with silt and silty/clayey sand with variable amounts of gravel or very stiff to hard silt, sandy silt and clayey silt with variable amounts of gravel (typically no gravel) and occasional thin layers of fine sand or sand with silt. At the base of Boring B-9, the test boring likely encountered a soil deposit referred to as the "Lawton Clay," which is a common marker bed in the downtown Seattle area (typically occurring below Elevation 200 feet).

The following is a summary of soil and ground water conditions encountered in the borings/monitor wells.

Boring Number	Fill Thickness (feet)	Recessional Outwash – Fine Grained Thickness (feet)	Recessional Outwash – Coarse-Grained Thickness (feet)	Top of Advance Outwash – Transitional Beds (feet)	Depth to Ground Water (feet)	Boring Total Depth (feet)
B-1	9	-	9	18	16.2 (ATD)*	30.4
B-2	8	4	-	12	13.5/14.4**	30.9
B-3	2½	8	4½	15	5.0/4.6**	25.4
B-4	18	5	-	23	23.0 (ATD)*	31.0
B-5	2	-	-	2	7.6 (ATD)*	25.5
B-6/MW-6	4	13½	5	22½	12.4/12.6**	25.4
B-7/MW-7	7	9½	6	22½	13.1/13.4**	51.5
B-8/MW-8	13 ½	13½	7	34	21.0/20.2**	51.5
B-9	3	-	12	15	9.0/9.1**	51.5

*ATD = at the time of drilling
** = measured with electronic water level indicator on July 18, 2013/October 18, 2013

3.3 GROUND WATER CONDITIONS

Ground water was observed in the test borings as shown in the preceding table from a depth of about 5 to 23 feet below the ground surface. The interpreted ground water level below the site is shown on Figures 3 and 4.

It should be noted that during drilling, ground water was not encountered until penetrating the Recessional Outwash – Fine-Grained deposits. Once, penetrated, the ground water rose (slowly) several feet which suggests that a "confining layer" (a layer of low permeability soil; likely the Recessional Outwash – Fine-Grained deposit) overlies the "aquifer" (the more permeable deposit; likely Recessional Outwash – Coarse-Grained or the sandier layers within the Advance Outwash – Transitional Beds). Even after the piezometers or monitor wells were installed, the ground water level continued to slowly rise several inches to several feet suggesting that the aquifer was of relatively low permeability.

Based on our interpretation of ground water levels from the elevation measurements in the borings or monitor wells, it appears that the ground water gradient (flow direction) is from the north-northwest to the south-southeast.

4.0 ENVIRONMENTALLY CRITICAL AREAS

The City of Seattle has regionally mapped and regulated Environmentally Critical Areas (referred to as ECA's) including Steep Slopes, Potential Slide, Liquefaction Prone and Known Slide areas (as these ESAs pertain to geotechnical considerations) in accordance to Seattle Municipal Code (SMC) 25.09. Based on our review of the regional mapping of ECAs (listed above) and our site observations, there is one Steep Slope ECA in the southeast part of the site which appears to be an engineered slope (not natural). This slope is less than 10-feet high and is therefore exempt from regulation. No other ECAs have been mapped at the site.

5.0 PRELIMINARY INFILTRATION ANALYSIS

5.1 GENERAL

Preliminary infiltration analysis was completed in general accordance with Method 2 (USDA Soil Textural Classification), and Method 3 (ASTM Gradation Testing D_{10} Method) as described in the Washington State Department of Ecology's February 2005 Stormwater Management Manual for Western Washington (SMMWW). The particle size distribution reports that were used as the basis for our analysis are presented in Appendix B.

This method of infiltration testing can be used as a screening tool to provide a preliminary evaluation of field and design infiltration rates. Should on-site stormwater infiltration be considered, additional infiltration testing will be required by completing a field Pilot Infiltration Tests (PIT) in accordance with Appendix E of the Seattle Stormwater Manual (November 2009).

5.2 USDA SOIL TEXTURAL CLASSIFICATION

The following is a summary of our infiltration analysis using Method 2(USDA Soil Textural Classification):

Boring Number	Soil Type	Sample Depth (feet)	USDA Type	Infiltration Rate (iph)(1)(2)(3)
B-1	Recessional Outwash Coarse-Grained	10.0-11.5	Sandy Loam	4 / 1
B-2	Recessional Outwash Fine-Grained	10.0-11.5	Silt Loam	- / -
B-5	Advance Outwash	10.5-16.0	Loamy Sand	4 / 2
B-6	Recessional Outwash Fine-Grained	10.0-11.5	Silt Loam	- / -
B-9	Recessional Outwash Coarse-Grained	10.0-16.4	Sand	8 / 4

(1) iph = inches per hour
(2) Short-term (field) infiltration rate / long-term (design) infiltration rate (includes correction factor to account for maintenance and biofouling). The long-term infiltration rate should be used for the design (sizing) of infiltration facilities.
(3) Silt Loam is not appropriate for stormwater infiltration.

5.3 ASTM GRADATION TESTING D_{10} METHOD

The following is a summary of our infiltration analysis using Method 3 (ASTM Gradation Testing D_{10} Method):

Boring Number	Soil Type	Sample Depth (feet)	D_{10}	Long Term (Design) Infiltration Rate (iph)[1]
B-1	Recessional Outwash Coarse-Grained	10.0-11.5	0.005	<<0.8
B-2	Recessional Outwash Fine-Grained	10.0-11.5	0.003	<<0.8
B-5	Advance Outwash	10.5-16.0	0.02	<0.8
B-6	Recessional Outwash Fine-Grained	10.0-11.5	0.002	<<0.8
B-9	Recessional Outwash Coarse-Grained	10.0-16.4	0.07	0.8

(1) << = much less than

6.0 SEISMIC DESIGN CONSIDERATIONS

The Puget Sound lowland is located in the fore arc of the Cascadia Subduction Zone. Seismicity of this region is attributed primarily to the subduction zone interaction between the Juan de Fuca plate, the continental fore arc of the North American plate, and the landward continental arc. The Juan de Fuca plate is subducting beneath the North American plate. The majority of historical earthquakes occur at depths of 20 miles or less. Most major earthquakes (magnitude greater the 8.5) occur within the deep, subcrustal zone (more than 20-mile depth).

Thick deposits of glacial and non-glacial sediments occur throughout most of the Puget Sound Basin. Due to the thick sediment cover, little is known regarding the nature of faults in the underlying bedrock. The Seattle Fault, the Southern Whidbey Island Fault and the Tacoma Fault zones are the only known structural geology features that have indicated ground displacement in the Quaternary age glacial, interglacial and post-glacial sediments in the Puget Sound region. The King County YSC site is located north of the Seattle Fault Zone according to the USGS (Pacific Northwest Geologic Mapping and Urban Hazards, *Geomaps*). Recent geologic evidence indicates that Seattle Fault activity occurred as recently as 1,100 years ago.

An abbreviated listing of major (greater than 5.0 magnitude) earthquake events in the Puget Sound region according to the Pacific Northwest Seismic Network is presented below.

Summary of Major Seismic Events in the Puget Sound Region

Seismic Event	Date	Location	Richter Magnitude
North Cascades Earthquake	December 15, 1872	Chelan, WA	6.8*
Pickering Passage Earthquake	February 15, 1946	Olympia, WA	5.8
Strait of Georgia Earthquake	June 23, 1946	Courtenay, BC	7.4
Olympia Earthquake	April 13, 1949	Olympia, WA	7.1
Seattle-Tacoma Earthquake	April 29, 1965	SeaTac, WA	6.5
Duvall Earthquake	May 3, 1996	Duvall, WA	5.4
Satsop Earthquake	July 3, 1999	Satsop, WA	5.8
Nisqually Earthquake	February 28, 2001	Olympia, WA	6.8

* Estimated from historical information.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 GENERAL

Based on our field exploration program and site observations, the King County YSC site is mantled with a varying thickness of Fill which ranges up to about 18-feet thick in Boring B-4. The natural terrain in this area suggests that the original ground surface sloped gently down from north to south. Where grade changes were needed, a short section of fill slope was created for these transitions. The courthouse building (Alder Tower) has a basement level which required an excavation (cut). It is likely that soil from that excavation was used as Fill in other areas of the King County YSC site, especially in the northwest parking lot area, to level these areas. Because the Fill was locally derived from cuts, distinguishing the Fill from the native underlying soils is difficult. Often Fill placed in parking lot areas or other open use areas is not necessarily well compacted although the results of the test borings suggest that the existing Fill is generally firm.

For excavations that extend below the water table, we expect that well points or dewatering wells will be needed.

We expect that conventional reinforced concrete shallow spread footings should be adequate to support the new buildings provided that these foundations are supported by existing fill that has been determined to be firm and unyielding, the native soils (Recessional Outwash and Advance Outwash), or on a pad of Structural Fill that extends to the native soils. Drilled shafts or piles could be used in areas of thicker Fill. Typically, a deeper foundation is considered if the Fill is more than 10-feet thick and considerable grading would be required to remove this unsuitable Fill.

The near surface soils have a high fines (silt/clay sized particles) content and are moisture sensitive. Earthwork should be planned during the dry season. Also, these soils do not drain well because of the high silt content. The deeper soils tend to be dense, which slows drainage, or are below the ground water level. The King County YSC site is not a good site for stormwater infiltration because of the silty soils.

No ECAs occur at the King County YSC site. Standard design methods (described in more detail later in this report) should be considered for seismic considerations.

7.2 ENVIRONMENTALLY CRITICAL AREAS

Based on our review of the regional mapping of ECAs (listed above) and our site observations, there are no regulated ECAs within the King County YCS site.

7.3 IBC SEISMIC DESIGN CRITERIA

Based on our review of available geologic information and the subsurface soil conditions encountered in the test borings recently completed by ICE, we interpret the native soil conditions at the site to correspond to Seismic Site Class C, as defined by the 2012 International Building Code (IBC). This classification pertains to a very dense soil or rock profile with an average Standard Penetration Test (SPT) of greater than 50.

Seismic design parameters obtained from the USGS Earthquake Hazards Program (Seismic Hazard Curves) include the following:

Seismic Design Parameters	
Peak Horizontal Ground Acceleration Coefficient*	0.030g
Spectral Response Acceleration S_s	1.445
Spectral Response Acceleration S_1	0.488
Site Coefficient F_a	1.0
Site Coefficient F_v	1.312
* earthquake having a 10-percent probability of exceedance in 50 years (corresponding to a return interval of 475 years)	

7.4 LIQUEFACTION ANALYSIS

Our liquefaction analysis of the site was based on a Magnitude 7.5 earthquake occurring directly beneath the site, and a peak horizontal ground acceleration of 0.30g. Liquefaction is the phenomenon wherein soil strength is dramatically reduced when subjected to vibration or shaking. Liquefaction generally occurs in saturated, loose sand deposits, though recent studies have shown that silty sand or sandy silts are also susceptible to liquefaction.

Based on our analysis of liquefaction potential, we expect liquefaction has a very low potential to occur at the King County YCS site because of the dense condition of the underlying soils (Advance Outwash) where ground water is present.

7.5 FOUNDATIONS

7.5.1 Spread Footings

Conventional reinforced concrete shallow spread footings should be adequate to support the new buildings provided that these foundations are supported by existing Fill that has been determined to be firm and unyielding, the native soils (Recessional Outwash and Advance Outwash) or on a pad of Structural Fill that extends to the native soils. The recommended allowable soil bearing pressure will be a function of soil type and footing embedment depth. For a footing that is embedded a minimum of 18 inches, we recommend the following allowable soil bearing pressures.

Soil Type	Allowable Soil Bearing Pressure (psf[1])
Existing Fill (if suitable)	1,500
Structural Fill	2,500
Recessional Outwash	2,500
Advance Outwash	4,000
[1] psf = pounds per square foot	

Minimum footing widths should be 24 inches for individual square footings and 18 inches for continuous footings. Footings should be founded at least 18 inches below the lowest adjacent grade. The allowable bearing pressures given could be increased by one-third for wind or earthquake loads.

For foundations designed as described above, we expect settlements to be less than ¾-inch, with differential settlements (between adjacent footings or over a 20-foot span of continuous footing) less than ½-inch.

7.5.2 Other Foundation Support Options

Drilled shafts could be used for foundation support of the buildings where the existing Fill is thick (sometimes considered when Fill is more than 6- to 10-feet thick which may not be cost-effective to remove). The installation of drilled shafts can be impacted by caving soils, soil heave and large obstructions, and may require a steel casing. The installation process does not generally create vibrations but can cause localized ground settlement in the drilled shaft area. Drilled shafts will generate spoils (soil cuttings) and may require dewatering. Drilled shafts do allow for relatively high vertical capacities that are dependent on the depth of the shaft.

7.6 FLOOR SLABS

In our opinion, a conventional soil-supported slab-on-grade floor can be used in the proposed buildings if the subgrade is properly prepared. To provide uniform bearing conditions and suitable moisture protection beneath the slab, we recommend that it be underlain by the following layers (listed top to bottom).

- Vapor Barrier: A layer of durable plastic sheeting should be placed directly below the floor slab to prevent ground moisture from migrating upward through the slab. However, vapor barriers can be considered optional for use under floor areas that will not be covered with moisture-sensitive materials. If a vapor barrier is used, the contractor should exercise care to avoid puncturing it while casting the slab.
- Capillary Break: To retard the upward wicking of ground water beneath the floor slab and to provide a smooth bearing surface, we recommend that a capillary break be placed directly below the vapor barrier. Ideally, this capillary break will consist of a 6-inch-thick layer of pea gravel or washed rock. Alternatively, angular gravel or crushed rock can be used if it is sufficiently clean and uniform to prevent capillary wicking.
- Subbase Course: A 12-inch-thick layer of structural fill should be placed below the capillary break layer. In our opinion, the subbase should consist of well-graded sand and gravel per 2012 WSDOT Standard Specification 9-03.9(1) (Ballast).
- Separation Fabric: A layer of geotextile should be placed between the native subgrade and the overlying subbase course. We recommend using a durable woven geotextile such as Tencate Mirafi 500X.

A thin layer (typically 2-inches thick) of clean sand is sometimes placed between floor slabs and the vapor barriers to facilitate uniform curing of the slabs. Recent studies, however, have indicated that this "curing course" is not necessary when high-quality concrete is used for the slab, and some structural engineers believe it can be detrimental to a slab's long-term performance. Consequently, we recommend that the project structural engineer be allowed to decide whether a curing course should be used for the proposed buildings.

7.7 SUBGRADE WALLS

Subgrade (below grade) walls should be designed to withstand external lateral soil pressures. Lateral earth pressures are dependent upon the degree of compaction of and quality of the backfill, backslope, drainage provisions and if the wall is allowed to yield laterally. A typical basement wall is braced at the top so does not yield. For this condition (rigid wall), at-rest earth pressures are appropriate for design. If the top of the wall is allowed to yield at least 0.001 times its height, the lateral soils pressures would decrease to active earth pressure values. The recommended lateral earth pressures for subgrade walls are shown on the Subgrade Wall Lateral Earth Pressure Diagram, Figure 5.

Regardless of location or purpose, all backfilled walls should include a curtain drain of pea gravel or washed rock at least 12 inches wide at the back of the wall for its full height. Also, a 4-inch-diameter rigid, perforated drainpipe should be installed within an envelope of the washed rock at the bottom of the curtain drain (behind the heel of the wall) that is wrapped in a nonwoven filter fabric, such as Tencate Mirafi 180N or equal.

7.8 LATERAL RESISTANCE

Lateral forces from soil, wind, or seismic loading may be resisted by friction along the base of the footings and by passive earth pressure against the buried portions of the structure. We recommend that a coefficient of friction of 0.35 be used between cast-in-place concrete soils. An appropriate factor of safety should be used when calculating the resistance to sliding at the base of a footing.

In our opinion, passive earth pressures for footings placed within neat excavations (concrete poured directly against undisturbed soil) against the silt soils may be estimated using an equivalent fluid density of 250 pounds per cubic foot (pcf). Passive earth pressures for footings placed within neat excavations and against the granular (sand) soils could be estimated using an equivalent fluid density of 350 pcf. If Structural Fill is used to backfill around the footings, the passive earth pressure could be estimated using an equivalent fluid pressure of 300 pcf. These values are based on the assumption that footings extend at least 18 inches below the lowest adjacent grade, backfill around the structures is a well-compacted granular fill, and the ground surface is horizontal for a minimum distance of 10 feet from the edge of the footing. The above values include a factor of safety of 1.5. The upper 12 inches of soil that is not protected by floor slab or pavement should not be included in the determination of passive resistance.

7.9 PRELIMINARY INFILTRATION RATES

Based on our infiltration rate analysis as summarized in Section **5.0 PRELIMINARY INFILTRATION ANALYSIS** of this report, the site soils have a relatively low (or zero) infiltration rate. At this time, based on preliminary testing, we recommend the following short-term (field) and long-term (design) infiltration rates.

Preliminary Infiltration Rates		
Soil Type	**Short-Term (field) Infiltration Rate (iph)**	**Long-Term (design) Infiltration Rate (iph)**
Fill	0	0
Recessional Outwash Fine-Grained	0	0
Recessional Outwash Coarse-Grained	2	0.5
Advance Outwash	0	0.8

Should on-site stormwater infiltration be considered, additional infiltration testing will be required by completing a field Pilot Infiltration Tests (PIT) in accordance with Appendix E of the Seattle Stormwater Manual (November 2009).

8.0 CONSTRUCTION CONSIDERATIONS

8.1 SITE PREPARATION

We recommend that the below-grade foundation elements for the demolished structures be removed.

The site soils have a high silt content. These soils are easily disturbed during wet weather conditions. If at all possible, we recommend the earthwork be performed during the drier summer months. It may be necessary to cover the work area surface with crushed rock or quarry spalls in order to minimize disturbance during wet weather construction activities. The crushed rock or quarry spall surfacing would also decrease dust if the project is completed during an extended period of warm, dry weather.

8.2 EXCAVATIONS

8.2.1 Temporary Open Cut Slopes and Underground Utility Trenches

Temporary open cut slopes and underground utility trenches in Advance Outwash should be completed at 0.75H:1V (horizontal to vertical), or flatter. Temporary cut slopes/underground utility trenches greater than 4 feet in depth in Recessional Outwash (Fine- or Coarse-Grained) should be completed at 1H:1V, or flatter. Temporary cut slopes/underground utility trenches in loose fill should be no steeper than 1.5H:1V. Flatter slopes may be necessary if ground water seepage is encountered or if instability is observed.

Some sloughing and raveling of the cut slopes/trenches should be expected. Temporary covering, such as heavy plastic sheeting, should be used to protect these slopes during periods of wet weather. Surface water runoff from above cut slopes/trenches should be prevented from flowing over the slope face by using berms, drainage ditches, swales or other appropriate methods.

If temporary cut slopes or underground utility trenches experience excessive sloughing or raveling during construction, it may become necessary to modify the cut slopes to maintain safe working conditions and protect adjacent facilities or structures. Slopes experiencing problems can be flattened, regraded to add intermediate slope benches, or additional dewatering can be provided if the poor slope performance is related to ground water seepage.

8.2.2 Shored Excavations

It is likely that shored excavations will be necessary for below grade facilities, in particular, the Parking Garage which may have multiple below-grade levels. For the purpose of this report, we will discuss shoring options, as the method of temporary shoring used will be a design consideration based on the specifics of the preferred development plan.

Shored excavations are typically used where there are space limitations for open cuts, or the amount of excavated material required for an open cut is excessive. Often, the temporary shoring can be incorporated into the permanent subgrade walls.

Temporary shoring appropriate for wide and deep excavations for this site include conventional soldier pile and tieback wall systems. Alternatively, a soil nail wall shoring system could be used. A soil nail shoring system would require temporary dewatering during wall installation, depending on the depth of the excavation.

All temporary cut slopes (Section 8.2.1) and shoring must comply with the provisions of Title 296 Washington Administrative Code (WAC), Part N, “Excavation, Trenching and Shoring.” We recommend that temporary excavations, including any temporary shoring, be made the responsibility of the contractor. However, we recommend that the shoring be designed by an engineer licensed in Washington, and that the PE stamped shoring plans and calculations be submitted to the project engineer for review and comment prior to construction.

8.3 DEWATERING

8.3.1 General

The subsurface information obtained from our subsurface exploration program suggests that the site soils have a wide range of permeability. High rates of water infiltration into the excavation are expected where relatively clean sand and gravel are present below the ground water level. Conversely, the silty soils are expected to have a generally lower permeability.

Based on the findings by Herrera Environmental Consultants (November 25, 2013), possible ground water contamination was detected at the site; this report should be reviewed by the contractor for additional details related to possible ground water contaminates and worker exposure/disposal considerations for dewatering and disposal.

Because of the variability in soil permeability and depth to ground water, several dewatering methods would be appropriate for this project. These include pumped wells, wellpoints and open (sump) pumping. A combination of these methods may also be required to achieve dry working conditions in some areas. Descriptions of these dewatering methods as they apply to this project are presented below.

8.3.2 Pumped Wells

Individually pumped wells may be considered for dewatering excavations. Pumped wells that have been properly installed and developed are capable of producing high discharge rates. Pumped wells are generally the most effective dewatering method in areas where the ground water level is more than 15 feet below the ground surface.

We recommend that all dewatering wells installed for this project be properly developed to remove fine sediment from the immediate vicinity of the well screens. Proper development is essential for producing efficient wells and greatly reduces the turbidity of the water discharged from the well. Filter packs consisting of graded sand and fine gravel should be installed around the well screens in areas where the aquifer contains a high percentage of fine sand and silt.

8.3.3 Wellpoints

Wellpoints are effective for dewatering all types of soils, whether pumping small amounts of water from silt or large quantities of water from coarse sand and gravel. The volume of water generated by a wellpoint system is typically less than the volume generated by a corresponding system of pumped wells because the wellpoints are generally installed to a shallower depth. Because of the shallower completion depth, the volume of aquifer that contributes water to a wellpoint system is less than for a comparable deep pumped well system.

Wellpoint systems are most suitable for dewatering shallow excavations where the water table must be lowered no more than about 15 feet below the ground surface. Multiple wellpoint stages are generally required beyond that depth because of the physical limitations of suction lift. Dewatering can be accomplished at depths greater than 15 feet where the excavation allows installation of the wellpoint system below the original grade.

8.3.4 Open Pumping

Open pumping involves removing water that has seeped into the excavation by pumping from a sump that has been prepared in the base of the excavation. Drainage ditches that are connected to the sump are typically excavated along the sidewalls of the excavation. The excavation for the sump and the drainage ditches should be backfilled with gravel or crushed rock to reduce the amount of sediment in the water pumped from the sump. In our experience, a slotted casing or perforated 55-gallon drum that is installed in the sump backfill provides a suitable housing for a submersible pump.

We recommend that open pumping be used primarily to supplement the two predrainage methods (pumped wells and wellpoints) discussed above. Some supplemental open pumping will probably be necessary in excavations that are predrained with wells or wellpoints. Open pumping is useful for removing perched water that seeps into the excavation and ground water that passes between the wells or wellpoints at depth. The amount of water removed from the excavation by open pumping should be minimized because of high turbidity levels. Temporary storage of dewatering effluent from the sumps in a settlement tank or basin will likely be required to reduce sediment content prior to discharging the water.

8.3.5 Predrainage Schedule

The maximum drawdown of the water table in the immediate vicinity of pumped wells or wellpoints is often achieved several hours after the start of pumping. However, complete dewatering of the saturated zone within the cone of depression may require several days. This lag reflects the time it takes for vertical drainage of all the water stored in the saturated zone. We recommend pumping from wells or wellpoints for several days prior to excavation to permit sufficient vertical drainage of the aquifer.

We recommend installing piezometers in the area surrounding an excavation where significant dewatering is anticipated. The piezometers will be used to monitor the effectiveness of the dewatering system prior to the start of excavation. The discharge capacity of the dewatering system may need to be modified based on the water level measurements in the piezometers.

8.3.6 Water Disposal

Disposal of ground water from within excavations or from pumped wells or wellpoints may require special dewatering disposal plans and permits in the City of Seattle. Disposal water may need to be monitored in accordance with permit requirements, possibly for turbidity, pH and other parameters.

As previously mentioned, findings by Herrera Environmental Consultants (November 25, 2013) indicate possible ground water contamination at the site. This report should be reviewed by the contractor for additional details related to ground water contaminates and worker exposure/disposal considerations.

8.4 STRUCTURAL FILL

The term Structural Fill refers to materials placed under building foundations, vaults, slab-on-grade floors, sidewalks, driveway slabs, asphaltic pavements, and other such load-bearing features. We recommend that all new fill used in these applications at the project site meet the following Structural Fill criteria regarding composition, placement, and compaction.

Typical Structural Fill materials include clean sand, gravel, pea gravel, washed rock, crushed rock, quarry spalls, controlled-density fill (CDF), lean-mix concrete (LMC), well-graded mixtures of sand and gravel (commonly called “gravel borrow” or “pit-run”), and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as Structural Fill in certain applications. Structural Fill should not contain any organic material or debris, nor should it contain any individual particles greater than about 6 inches in diameter except in special applications.

The existing Fill and native soils that underlie the site have a relatively high silt content, which renders them very sensitive to moisture conditions. However, if properly moisture-conditioned, the existing Fill and native soils may be used for Structural Fill.

The suitability of a given soil for Structural Fill use depends primarily on its grain-size distribution and moisture content at the time it is placed. As the fines (silt – soil particles passing the US Standard No.

200 sieve) content increases, a soil becomes more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 3 percentage points above or below optimum. For fill placement during wet-weather site work, we recommend using clean granular material, which refers to sand and gravel soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the US Standard No. 4 sieve.

As a guideline, Structural Fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness. The actual lift thickness will depend on the quality of the fill and the type of compaction equipment used. Each lift should be thoroughly compacted with a mechanical compactor. We recommend using a minimum compaction standard of 95 percent of the maximum dry density (MDD) obtained in accordance with ASTM Test Method D 1557.

Special materials such as pea gravel, washed rock, quarry spalls, CDF and LMC do not require the same rigorous placement and compaction procedures, but they should be placed in a manner suitable for the purpose.

Regardless of material or location, Structural Fill should be placed over firm, unyielding subgrades prepared as previously described in this report. Structural Fill compaction should be evaluated by means of in-place density tests and/or proofrolling/probing observations (as deemed appropriate) performed during fill placement so that soil compaction can be evaluated, and compaction procedures modified as may be appropriate for the existing conditions.

8.5 PAVEMENT DESIGN CRITERIA

Our recommended design pavement sections assume that the subgrade areas will be prepared as recommended in Section **8.1 SITE PREPARATION** of this report and that paving will be completed during periods of generally dry weather. Based on the medium dense/stiff or better soils encountered in our borings and assuming Structural Fill conditions, we have assumed a California Bearing Ratio (CBR) value of 10 for the existing subgrade soils.

We recommend that the pavement subgrade be thoroughly proofrolled prior to placing Structural Fill, subbase material if required, base material and asphalt concrete. Areas that yield or deflect more than about ½ inch should be recompacted or otherwise repaired to achieve a firm and unyielding condition.

The design pavement section for areas subjected to automobile traffic with only occasional trucks (light-duty pavement section) should consist of at least 2½ inches of asphalt concrete over a base course of at least 4 inches of crushed rock. Portions of roadways and parking areas which will be subjected to frequent truck traffic (moderate-duty pavement section) should be paved with at least 3 inches of asphalt concrete underlain by at least 6 inches of crushed rock. We further recommend that a subbase layer be placed below the base course; the subbase layer should consist of at least 12 inches of well-drained sand and gravel in accordance with the 2012 WSDOT Standard Specification 9-03.9(1) (Ballast), modified to contain less than 5 percent fines. The subbase material should be compacted as Structural Fill.

The crushed rock should conform to the 2012 WSDOT Standard Specifications, Section 9-03.9(3), (Crushed Surfacing - Base Course). The crushed rock should be compacted to at least 95 percent of MDD obtained in accordance with ASTM Test Method D 1557.

8.6 PERMANENT DRAINAGE CONSIDERATIONS

Footing drains should be provided for the exterior footings of structures. These drains should consist of a 4-inch-diameter rigid, perforated drainpipe installed at the outside base of the perimeter footing. The perforated drainpipe should be embedded in a zone of washed gravel with a uniform diameter between ¾ inch and 1¼ inch. The washed rock should be completely encapsulated with a nonwoven geotextile separation/drainage fabric such as Tencate Mirafi 140N or equal. We recommend at least one clean-out riser for the footing and roof tight-line drains per 50 linear feet of pipe. Clean-out caps should be clearly marked. More clean-out risers may be required if there are right angle turns in the exterior wall. The footing and roof drains should connect to a suitable discharge point. The footing drain should be independent from the roof tight-line drain.

We recommend that the ground surface be sloped away from the building area to permit drainage away from the foundations. Appropriate surface swales, drainage ditches and or French drains should be installed to control and collect surface runoff.

French drains are often located along the toe of slopes to intercept surface water runoff and are usually a design decision during construction. French drains should be at least 18-inches wide and 24-inches deep with at least one clean-out riser per 50 linear feet of pipe. Clean-out caps should be clearly marked. The French drain trench should be lined with a nonwoven geotextile fabric such as Tencate Mirafi 140N, or equal. A 4-inch-diameter rigid, perforated drainpipe should be placed along with washed rock with a uniform diameter between ¾ inch and 1¼ inch.

We recommend that the ground surface adjacent to structures be sloped to drain surface water away from the structure.

8.7 EROSION AND SEDIMENTATION CONTROL

The surface at the site is gently sloping, though “terracing” of the site may create localized steeper slope areas. The near-surface site soils consist of sand and silt which is highly erodible where sloped surfaces are exposed to runoff (such as benched terraces slopes and soil stockpiles).

Erosion and sediment controls (Best Management Practices – BMPs) are recommended during construction to reduce the impacts to the surrounding area. Erosion controls should be designed to prevent sediment transport. This may be accomplished by constructing water bars or utilizing other methods to control surface water runoff, and constructing silt fences and/or sediment ponds to control sedimentation. If construction is accomplished during the winter months, we further recommend that temporary erosion protection be provided consisting of covering exposed soil areas with plastic sheeting.

Temporary erosion and sedimentation controls should comply with the appropriate regulating agency. Control of off-site transport of sediment will be an important consideration. In our opinion, conventional BMPs prescribed by the appropriate regulating agency will be appropriate. We strongly recommend that BMPs be installed prior to site grading activities. Typically, stormwater runoff can be routed to the existing site storm drain system. However, this may require a permit from the appropriate agency. It is probable that there is a threshold for turbidity for construction area stormwater runoff to the storm drain system. If highly turbid water is present, it may need to be detained in portable tanks (such as Baker tanks) to allow for sediment filtering or settling prior to discharge to the storm drain system.

The goal of erosion/sedimentation control system design should be to 1) prevent mobilization of sediment, and 2) efficiently trap sediment in surface runoff before it can be transported off site. We recommend that the project grading plans and temporary erosion and sediment control (TESC) plans be prepared by a civil engineer properly qualified for, and attentive to, the erosion/sedimentation issue.

The near-surface site soils will be very difficult to filter or precipitate once suspended in surface runoff. Therefore, it will be important to cover stockpiles and avoid vehicle traffic on exposed soil, especially during wet weather.

Dust control may be necessary during dry weather. Proper traffic surfaces such as crushed rock, quarry spalls or asphalt treated base (ATB) will help significantly. Water on unpaved surfaces will provide adequate dust control.

Permanent erosion control measures should be established in exposed soil areas as soon as practical following construction.

9.0 SELECTED REFERENCES

City of Seattle, Department of Planning and Development, http://web1.seattle.gov/dpd/maps/dpdgis.aspx, GIS mapping tool.

City of Seattle, Municipal Code Chapter 25.09, *Regulations for Environmentally Critical Areas*.

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USGS Earthquake Hazards Program,http://earthquake.usgs.gov/hazards/designmaps/grdmotion.php

Washington State Department of Ecology, February 2005, Stormwater Management Manual for Western Washington (SMMWW), Volume III, Hydrologic Analysis and Flow Control Design/BMPs, 181 pages

10.0 USE OF THIS REPORT

We have prepared this report for use by Parametrix and King County. The data and report should be provided to prospective contractors for bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

The current design plans are conceptual. If there are any changes in the grades, locations, configurations or types of facilities planned, the conclusions and recommendations presented in this report may not be fully applicable. We request that we be given the opportunity to review our conclusions and recommendations and to provide written modification or verification, as appropriate as the design plans are developed. When the design has been finalized, we recommend that the final design drawings and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended.

There are possible variations in subsurface conditions between the locations of the explorations and also with time. A contingency for unexpected conditions should be included in the project budget and schedule. Sufficient observation, testing and consultation should be provided by our firm during construction to evaluate whether the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions encountered during the work differ from those anticipated, and to evaluate whether or not earthwork and foundation installation activities comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty or other conditions, express or implied, should be understood.

****

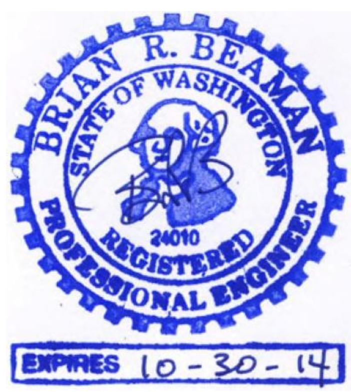
We trust this report meets your present needs. Please call if you have any questions.

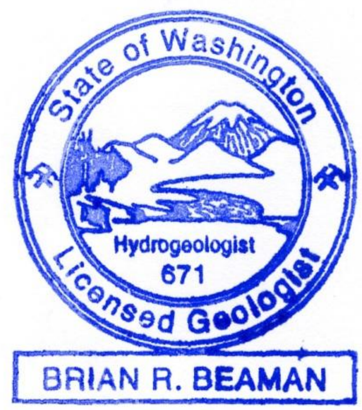
Yours very truly,
Icicle Creek Engineers, Inc.

Kathy S. Killman, LEG
Principal Engineering Geologist

Brian R. Beaman, PE, LEG, LHG
Principal Engineer/Geologist/Hydrogeologist

Document ID: 0105011.rep





FIGURES

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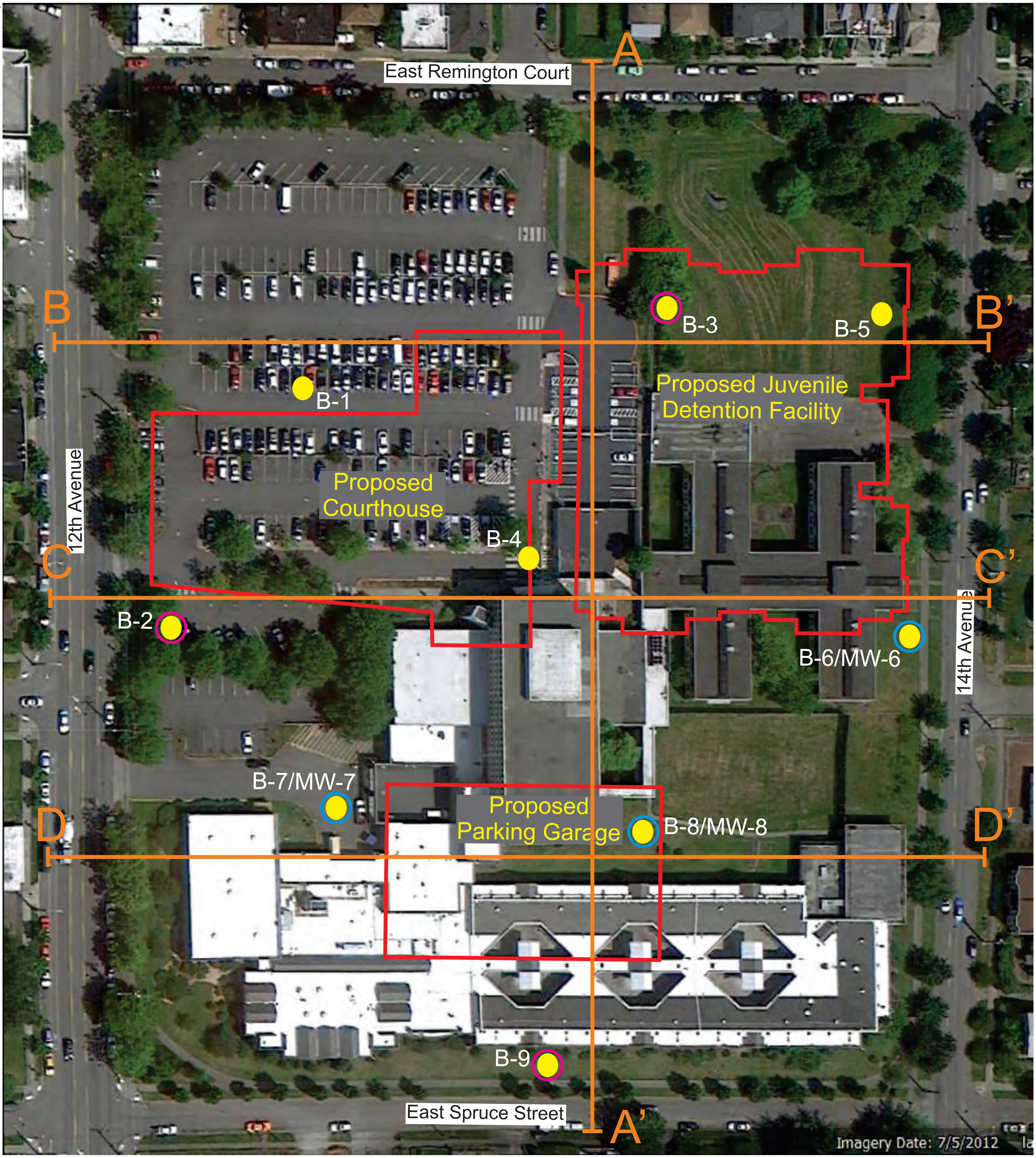
Vicinity Map - Figure 1



Aerial Photograph obtained from Google Earth

The location of proposed structures is based on King County Children & Family Justice Center Project Update, Issue 1, January 2013

0 100 200
Scale in Feet

EXPLANATION

Proposed Structures

B-2 Boring/Monitor Well Location
indicates piezometer (pink) or monitor well (blue) installation

A A' Geologic Cross-Section Location
(see Figures 3 and 4)

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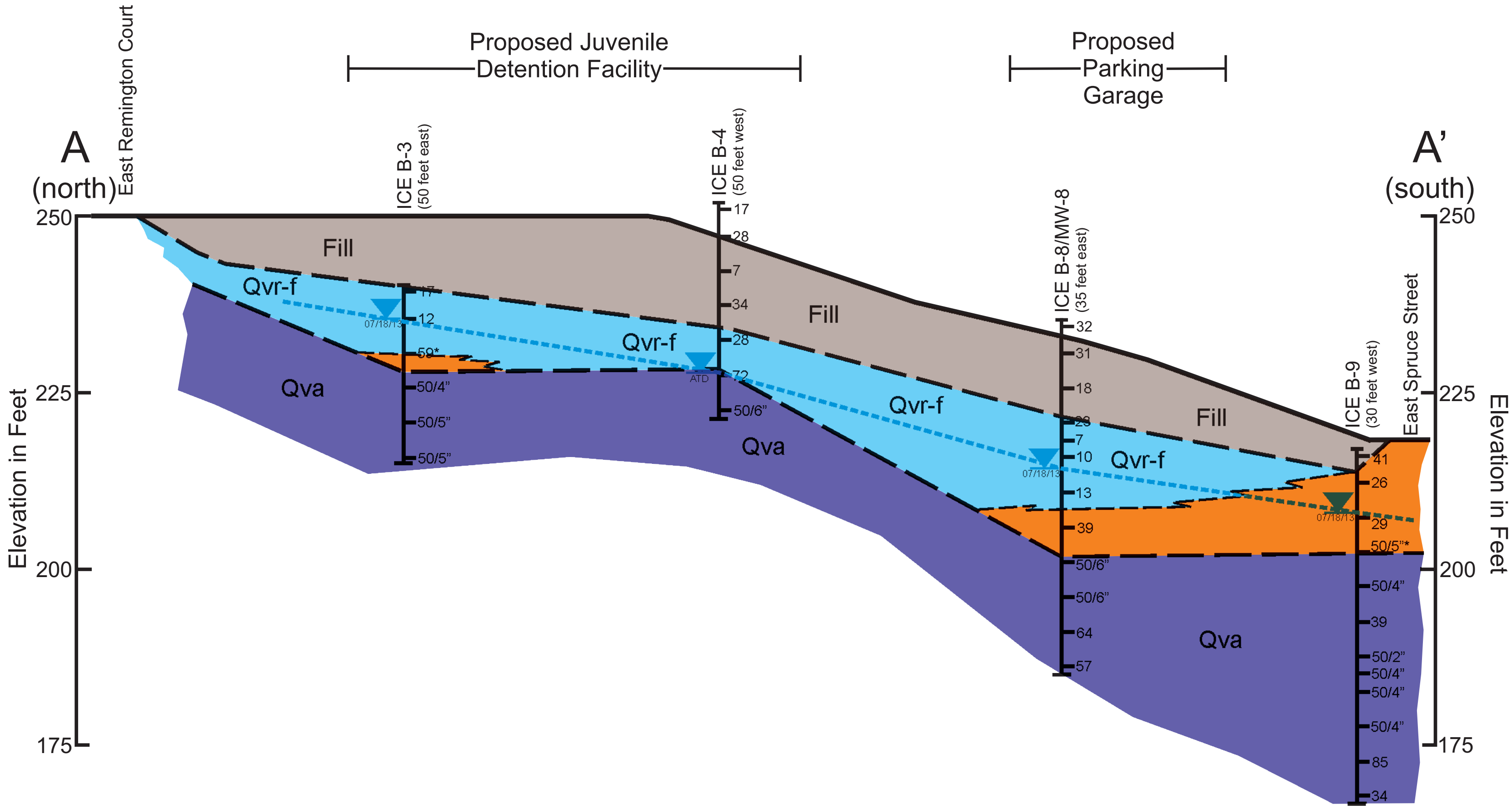
Site Plan - Figure 2



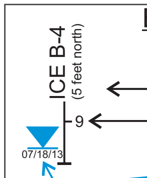
Notes:
1) Geologic cross-section locations shown on the Site Plan, Figure 2.
2) See report text for description of geologic and hydrogeologic conditions.
3) Subsurface soil and ground water conditions shown on the geologic section are based on widely-spaced explorations. Actual subsurface conditions may vary.
4) "?" indicates inferred location of geologic contract or ground water level.
5) Boring logs are included in Appendix A.
6) The apparent volume of Fill is likely overstated as shown on the cross-sections as the existing buildings are built, in part, into the ground. The existing building profiles below grade are not shown on these cross-sections.

Geologic Units

Fill	Fill
Qvr-f	Recessional Outwash - Fine-Grained
Qvr-c	Recessional Outwash - Coarse-Grained
Qva	Advance Outwash - Transitional Beds

0 100 200 Approx. Horizontal Scale in Feet
0 25 50 Approx. Vertical Scale in Feet

EXPLANATION



Test Boring Location (offset from cross-section line as indicated)
SPT Blow Count
Ground Water Level (on date indicated)

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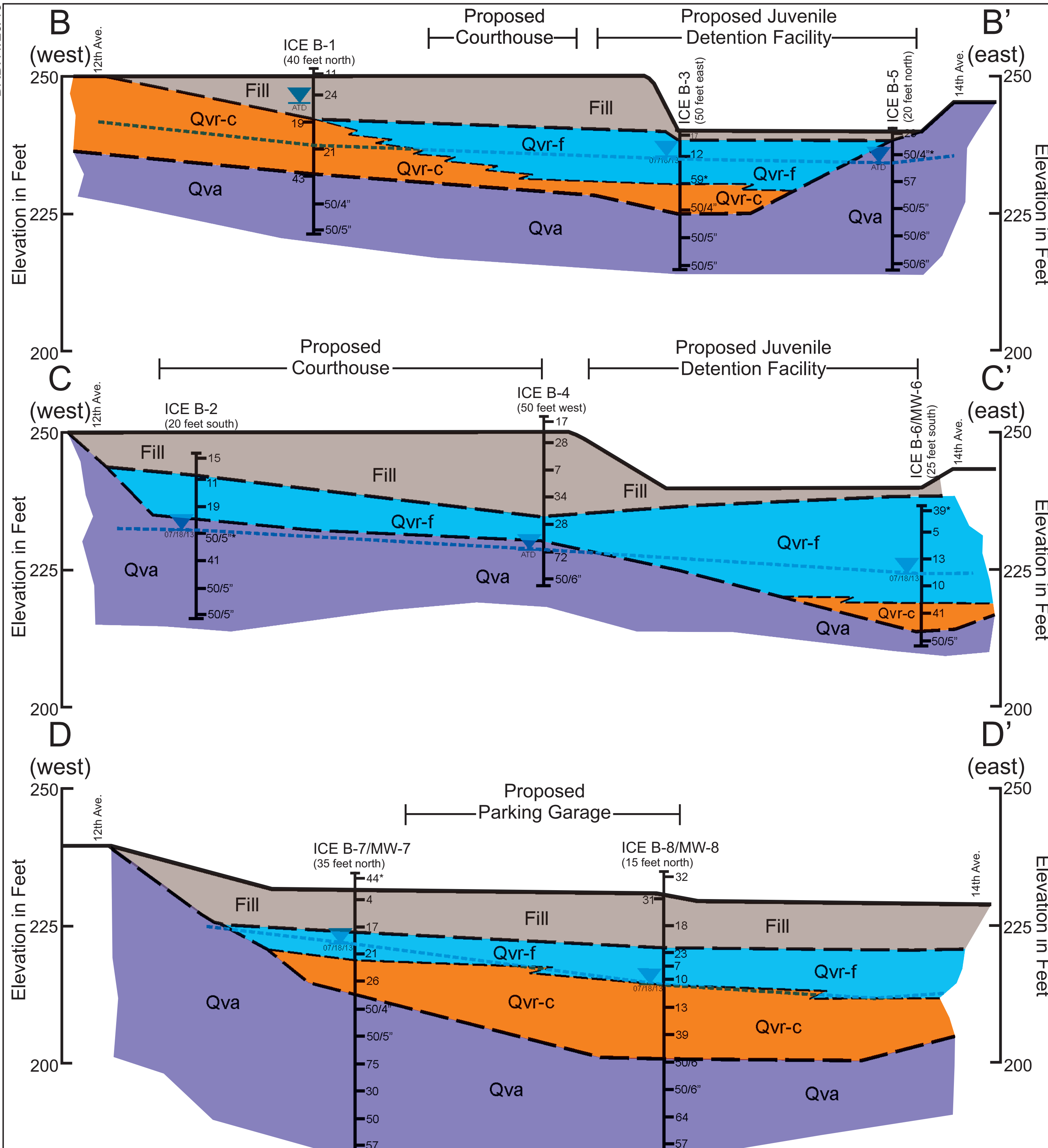
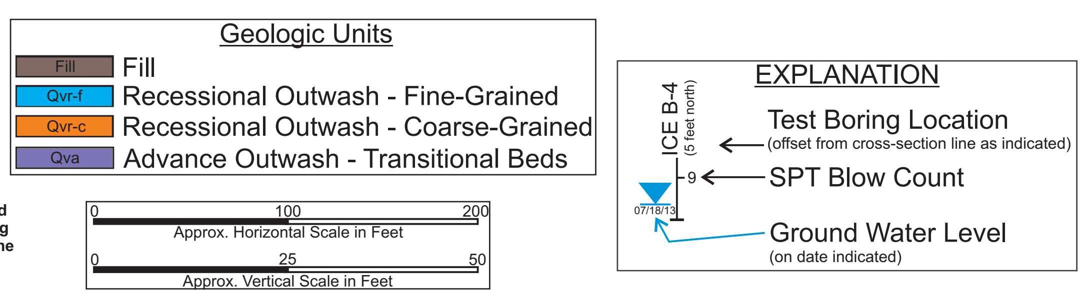
Geologic Cross-Section A-A' - Figure 3



Notes:

1) Geologic cross-section locations shown on the Site Plan, Figure 2.
2) See report text for description of geologic and hydrogeologic conditions.
3) Subsurface soil and ground water conditions shown on the geologic section are based on widely-spaced explorations. Actual subsurface conditions may vary.
4) "?" indicates inferred location of geologic contract or ground water level.
5) Boring logs are included in Appendix A.
6) **The apparent volume of Fill is likely overstated as shown on the cross-sections as the existing buildings are built, in part, into the ground. The existing building profiles below grade are not shown on these cross-sections.**



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Icicle Creek Engineers Geologic Cross-Sections B-B'/C-C'/D-D' - Figure 4

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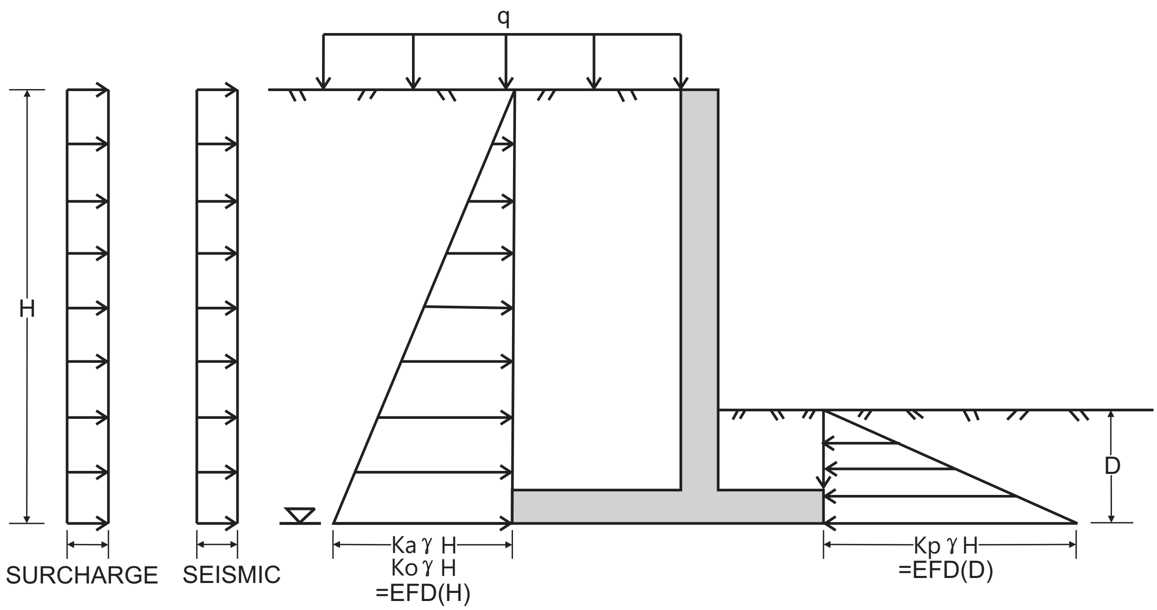

ACTIVE CONDITION
EFD = Ka + 35 pcf
Seismic = 9H
Surcharge = Kaq; Ka = 0.27

AT-REST CONDITION
EFD = Ko + 56 pcf
Seismic = 14H
Surcharge = Koq; Ko = 0.43

PASSIVE CONDITION
Silt; EFD = 250 pcf
Sand; EFD = 350 pcf
Silt/Sand; EFD = 300 pcf

NOTES
γ = 130 pcf (pounds per cubic foot)
Ko = At-Rest Earth Pressure Coefficient
Ka = Active Earth Pressure Coefficient
Kp = Passive Earth Pressure Coefficient
EFD = Equivalent Fluid Density
q = Vertical Surcharge Load
pcf = pounds per cubic foot
▽ = Ground Water Level

KEY ASSUMPTIONS
1. Drained Condition; no hydrostatic pressure
2. Level Backslope
3. Uniform Surcharge
4. See Report for additional details

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Subgrade Walls
Lateral Earth Pressure Diagram - Figure 5

APPENDIX A

SUBSURFACE EXPLORATION PROGRAM

APPENDIX A
SUBSURFACE EXPLORATION PROGRAM

A.0 SUBSURFACE EXPLORATION PROGRAM

A.1 TEST BORINGS

Subsurface conditions at the King County YSC site were explored by drilling nine test borings (Borings B-1 through B-9) to depths ranging from about 25.4 to 51.5 feet. The test borings were drilled on July 12, 13 and 14, 2013 using trailer or track-mounted, hollow-stem auger drilling equipment owned and operated by Boretec, Inc. of Valleyford, Washington. We supplemented this subsurface data with test borings that have been drilled by others on the site. The locations of the test borings completed for this study are shown on Figure 2.

The explorations were continuously observed by an engineering geologist from ICE who classified the soils, obtained representative soil samples, observed ground water conditions and prepared a detailed log of each exploration. After completion, Borings B-1, B-4 and B-5 were backfilled in general accordance with Washington State Department of Ecology guidelines. Borings B-2, B-3, and B-6 through B-9 were completed as piezometers or monitor wells as described below.

The soil consistencies noted on the boring logs are based on the conditions observed, our experience and judgment, and blow count data obtained during drilling. Representative samples were obtained from the test borings by collecting soil samples at 5-foot depth intervals using a 1.5-inch inside diameter split barrel (SPT – Standard Penetration Test) sampler. The sampler was driven 18 inches, if possible, by a 140-pound weight falling a minimum vertical distance of 30 inches. The number of blows required to drive the sampler the last 12 inches, or other indicated distance, was recorded on the boring log.

Soils encountered were classified in general accordance with the classification system described in Figure A-1. The boring logs are presented in Figures A-2 through A-10.

Petroleum-like odors were observed in the drill cuttings and/or soil samples from about 5 to 10 feet in Boring B-2. Wood fragments with petroleum-like odor were also observed in the drill cuttings from about 5 to 10 feet in Boring B-2.

Piezometers (for measuring ground water) were installed in three of the borings (Borings B-2, B-3 and B-9). Ground water monitor wells (for measuring and testing ground water) were installed in three of the borings (Boring/Monitor Wells B-6/MW-6, B-7/MW-7 and B-8/MW-8). Piezometer and Monitor Well installation details are shown on the Figures A-2 through A-10.

The boring logs are based on our interpretation of the field and laboratory data and indicate the various types of soil encountered. They also indicate the depths at which the soil characteristics change, although the change might actually be gradual. If the change occurred between samples in the boring, it was interpreted.

Ground surface elevations of the test borings as noted on the boring logs were surveyed by Parametrix.

Decontamination procedures were following prior to drilling and monitor well installation for Borings/Monitor Wells B-6/MW-6, B-7/MW-7 and B-8/MW-8. Decontamination procedures included a hot water pressure wash of the drilling and sampling equipment.

Soil cuttings and decontamination water from Boring B-2 was placed in three labeled 55-gallon drums (two soil cuttings and one water). The drums were stored in the southwest area of the site where other drums were located (the other drums contain soil cuttings or water from recent environmental studies completed by Herrera Environmental Consultants). We understand that Herrera Environmental Consultants will dispose of our drummed soil cuttings and waste water along with the drummed soil and waste water generated during their environmental site studies.

A.2 GROUND WATER MEASUREMENTS

The approximate depth to ground water was observed during the drilling of Borings B-1, B-4 and B-5; these observations are noted on the boring logs in Appendix A. The depth to ground water in the piezometers (Borings B-2, B-3 and B-9) and the monitor wells (Monitor Wells MW-6, MW-7 and MW-8) was measured using an electric water level indicator on July 18 and October 18, 2013; these measurements are noted on the borings/monitor well logs in Appendix A.

Unified Soil Classification System

MAJOR DIVISIONS			Soil Classification and Generalized Group Description	
Coarse-Grained Soils More than 50% retained on the No. 200 sieve	GRAVEL More than 50% of coarse fraction retained on the No. 4 sieve	CLEAN GRAVEL	GW	Well-graded gravels
			GP	Poorly-graded gravels
		GRAVEL WITH FINES	GM	Gravel and silt mixtures
			GC	Gravel and clay mixtures
	SAND More than 50% of coarse fraction passes the No. 4 sieve	CLEAN SAND	SW	Well-graded sand
			SP	Poorly-graded sand
		SAND WITH FINES	SM	Sand and silt mixtures
			SC	Sand and clay mixtures
Fine-Grained Soils More than 50% passing the No. 200 sieve	SILT AND CLAY Liquid Limit less than 50	INORGANIC	ML	Low-plasticity silts
			CL	Low-plasticity clays
		ORGANIC	OL	Low plasicity organic silts and organic clays
	SILT AND CLAY Liquid Limit greater than 50	INORGANIC	MH	High-plasticity silts
			CH	High-plasticity clays
		ORGANIC	OH	High-plasticity organic silts and organic clays
Highly Organic Soils	Primarily organic matter with organic odor		PT	Peat

Notes: 1) Soil classification based on visual classification of soil is based on ASTM D 2488.
2) Soil classification using laboratory tests is based on ASTM D 2487-00.
3) Description of soil density or consistency is based on interpretation of blow count data and/or test data.

Soil Particle Size Definitions

Component	Size Range
Boulders	Coarser than 12 inch
Cobbles	3 inch to 12 inch
Gravel	3 inch to No. 4 (4.78 mm)
Coarse	3 inch to 3/4 inch
Fine	3/4 inch to No. 4 (4.78 mm)
Sand	No. 4 (4.78 mm) to No. 200 (0.074mm)
Coarse	No. 4 (4.78 mm) to No. 10 (2.0 mm)
Medium	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Finer than No. 200 (0.074 mm)

Soil Moisture Modifiers

Soil Moisture	Description
Dry	Absence of moisture
Moist	Damp, but no visible water
Wet	Visible water

Key to Boring Log Symbols

Sampling Method	Boring Log Symbol	Description
Blows required to drive a 2.4 inch I.D. split-barrel sampler 12-inches or other indicated distance using a 300-pound hammer falling 30 inches.	34	Location of relatively undisturbed sample
	12	Location of disturbed sample
	21	Location of sample attempt with no recovery
Blows required to drive a 1.5-inch I.D. split barrel sampler (SPT - Standard Penetration Test) 12-inches or other indicated distance using a 140-pound hammer falling 30 inches.	14	Location of sample obtained in general accordance with Standard Penetration Test (ASTM D-1586) test procedures.
	30	Location of SPT sampling attempt with no recovery.
Pushed Sampler	P	Sampler pushed with the weight of the hammer or against weight of the drilling rig.
Grab Sample	G	Sample obtained from drill cuttings.

Note: The lines separating soil types on the logs represents approximate boundaries only. The actual boundaries may vary or be gradual.

Laboratory Tests

Test	Symbol
Moisture Content	MC
Density	DN
Grain Size	GS
Percent Fines	PF
Atterberg Limits	AL
Hydrometer Analysis	HA
Consolidation	CN
Compaction	CP
Permeability	PM
Unconfined Compression	UC
Unconsolidated Undrained TX	UU
Consolidated Undrained TX	CU
Consolidated Drained TX	CD
Chemical Analysis	CA

Boring B-1

Latitude 47.60496; Longitude -122.31611

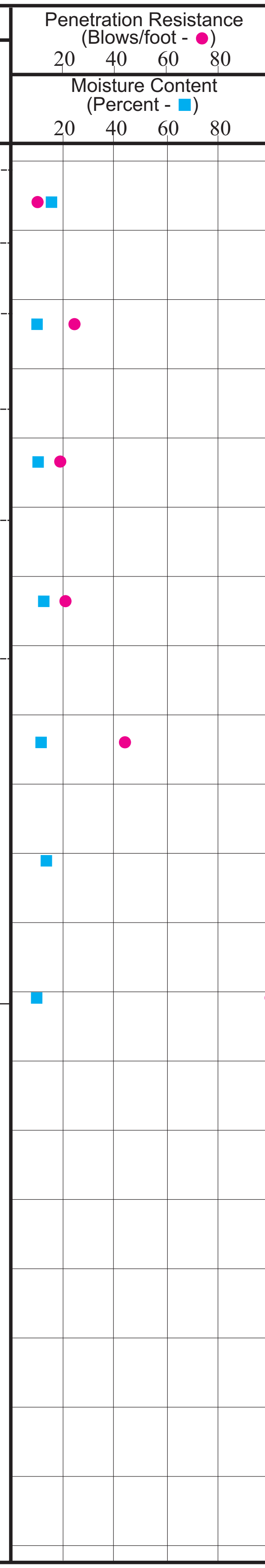
Approximate Elevation: 252.9 feet

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Description (Soil Profile)	Group Symbol	Blow Count	Laboratory Testing
0	Asphalt Pavement (3 inches)			
0–3	Brown and greenish-gray sandy SILT with a trace of fine gravel and charcoal and brick fragments (stiff, moist) (Fill)	ML	11	MC
3–5.5	Light grayish-brown, dark brown and reddish-yellow silty fine to medium SAND with occasional gravel and brick fragments (medium dense, moist) (Fill)	SM		
5.5–9	Grayish-brown fine to medium SAND with a trace of silt (medium dense, moist) (Fill)	SP	24	MC
9–13	Brown, light grayish-brown and reddish-yellow silty fine to medium SAND with gravel (medium dense, moist) (Recessional Outwash - Coarse-Grained)	SM	19	MC GS
13–18	Light grayish-brown silty fine to medium SAND with a trace of gravel and fine to medium SAND with silt and a trace of gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SM/ SP-SM	21	MC
18–30.4	Gray silty fine to medium SAND with occasional gravel and thin layers of medium sand (dense to very dense) (Advance Outwash - Transitional Beds)	SM	43	MC
25	grades to with gravel at about 25 feet	SM	50/4”	MC
30		SM	50/5”	MC
30.4	Boring completed at approximately 30.4 feet on July 12, 2013			



Comments/ Ground Water Observations

Asphalt

Soil Cuttings

Bentonite Backfill

Ground water encountered at about 16.2 feet at the time of drilling

See Figures A-1 and A-2 for explanation of symbols

Boring B-2

Latitude 47.60451; Longitude -122.31653

Approximate Elevation: 246.5 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (2 inches)			
0–2.7	Light brown fine to medium SAND with silt and fine roots (medium dense, moist) (Fill)	SP-SM	15	MC
2.7–8	Dark brown and dark gray sandy SILT with a trace of gravel, wood debris (stiff, moist) (Fill)	ML	11	MC
8–12	Brownish-gray and reddish-yellow sandy SILT with a trace of gravel (very stiff, moist) (Recessional Outwash - Fine-Grained)	ML	19	MC GS
12–20	Brown and reddish-yellow silty fine to medium SAND with gravel (very dense, moist) (Advance Outwash - Transitional Beds)	SM	50/5”	MC
20–30.9	Gray silty fine to medium SAND with occasional gravel (dense, moist) (Advance Outwash - Transitional Beds)	SM	41	MC
	becomes wet at about 21 feet			
	grades to very dense	SM	50/5”	MC
		SM	50/5”	MC
	Boring completed at approximately 30.9 feet on July 14, 2013			

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

Ground Water Monitor Well Construction Details and Measurements:

- Flush Grade Steel Monument
- Concrete Plug
- Bentonite Backfill
- 1¼-inch PVC Solid Pipe
- Ground water measured at 13.5 feet (7/18/13) and 14.4 feet (10/18/13)
- Sand Backfill
- 1¼-inch PVC Slotted Pipe
- Bentonite Backfill

See Figure A-1 for explanation of symbols

JMS/BRB:11/26/13

Boring B-3

Latitude 47.60511; Longitude -122.31502

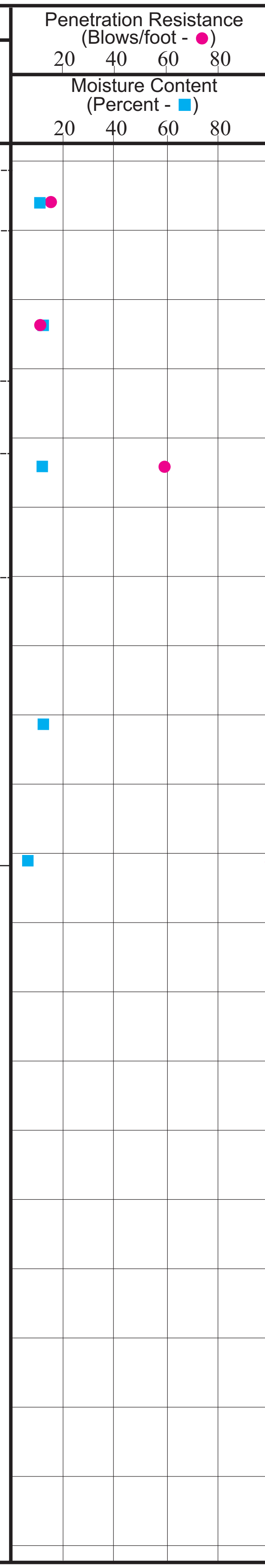
Approximate Elevation: 240.4 feet

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (4 inches)			
	Brown, reddish-yellow and greenish-gray sandy SILT with a trace of gravel (very stiff, moist) (Fill)	ML	17	MC
	Gray sandy SILT with a trace of gravel and occasional thin layers of fine sand with silt (stiff, moist) (Recessional Outwash - Fine-Grained)	ML	12	MC
	Gray clayey SILT with sand and a trace of fine gravel (stiff, moist) (Recessional Outwash - Fine-Grained)	ML		
10	Brown fine to medium SAND with occasional gravel and a trace of silt (very dense*, wet) (Recessional Outwash - Coarse-Grained)	SP	59*	MC
15	Gray silty fine to medium SAND with occasional gravel (very dense, moist) (Advance Outwash - Transitional Beds)	SM	50/4”	MC
20		SM	50/5”	MC
25		SM	50/5”	MC

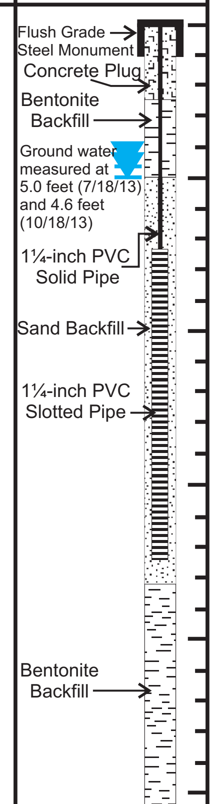
Boring completed at approximately 25.4 feet on July 12, 2013

* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) / Moisture Content (Percent - ■)



Ground Water Monitor Well Construction Details and Measurements



Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

See Figure A-1 for explanation of symbols

JMS:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Boring B-4

Latitude 47.60496; Longitude -122.31611

Approximate Elevation: 252.9 feet

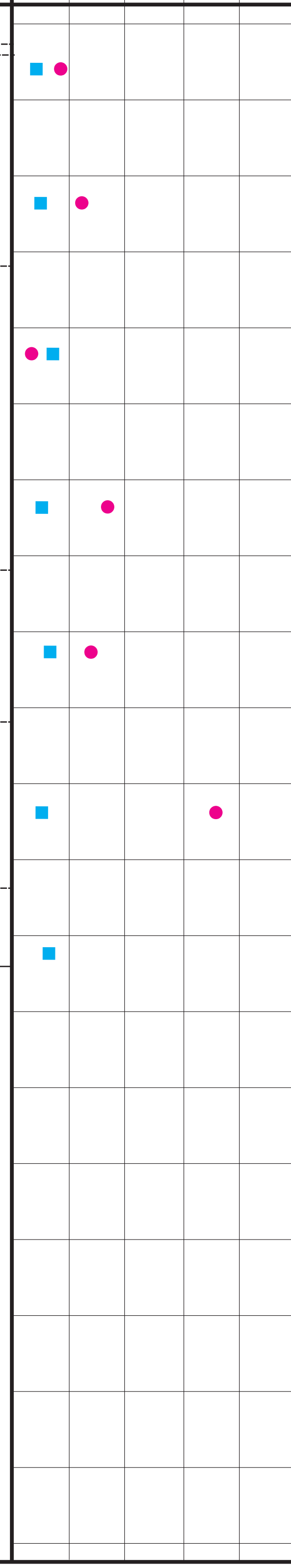
Depth in Feet	Soil Profile: Description	Group Symbol	Blow Count	Laboratory Testing	Comments/ Ground Water Observations
0	Asphalt Pavement (8 inches)				Asphalt
	Crushed Rock (4 inches)				
	Brown, dark grayish-brown silty fine to coarse SAND with gravel and occasional brick fragments (medium dense, moist) (Fill)	SM	17	MC	Soil Cuttings
5	grades to dark brown, dark greenish-gray and white	SM	28	MC	
	Dark brown silty fine to coarse GRAVEL with sand, brick fragments, trace organics and wood fragments (loose, moist) (Fill)	GM	7	MC	Bentonite Backfill
15	becomes brown, greenish-gray and reddish-yellow with plastic fragments, dense*	GM	34*	MC	
	Gray sandy SILT with a trace of gravel (very stiff, moist to wet) (Recessional Outwash - Fine-Grained)	ML	28	MC	
	Grayish-brown fine to medium SAND with silt and gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SP-SM	72	MC	Ground water encountered at about 23 feet at the time of drilling
	Gray silty SAND with a trace of gravel (very dense, moist to wet) (Advance Outwash - Transitional Beds)	SM	50/6”	MC	
31	Boring completed at approximately 31.0 feet on July 13, 2013				

* density and blow count may not be representative because of the presence of gravel

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80



See Figure A-1 for explanation of symbols

Boring B-5

Latitude 47.60512; Longitude -122.31445

Approximate Elevation: 240.5 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Soil Profile: Description	Group Symbol	Blow Count	Laboratory Testing	Comments/ Ground Water Observations
0	Sod and Topsoil (3 inches)				
	Brown and reddish-yellow silty fine to medium SAND with occasional gravel (medium dense, dry to moist) (Fill)	SM	29	MC	
	Brown silty fine to medium SAND with gravel (very dense*, moist) (Advance Outwash - Transitional Beds)				
5	becomes wet at about 6 feet	SM	50/4"*	MC	Ground water encountered at about 7.6 feet at the time of drilling
	Gray fine to medium SAND (very dense, wet) (Advance Outwash - Transitional Beds)	SP			
10	Gray silty fine to medium SAND with gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SM	57	MC GS	Bentonite Backfill
15		SM	50/5"	MC GS	
	Gray silty fine to medium SAND with a trace of gravel and thin layers of sand with silt (very dense, moist to wet) (Advance Outwash - Transitional Beds)				
20		SM/ SP-SM	50/6"	MC	
	Gray sandy SILT with occasional gravel and thin layers of medium sand (hard, moist) (Advance Outwash - Transitional Beds)				
25		ML	50/6"	MC	

Boring completed at approximately 25.5 feet on July 12, 2013

* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - 🟦) 20 40 60 80

Depth in Feet: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

See Figure A-1 for explanation of symbols

Boring B-6/Monitor Well MW-6

Latitude 47.60448; Longitude -122.31437

Approximate Elevation: 236.3 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Description (Soil Profile)	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (3 inches)			
0–4	Light brown silty fine to medium SAND with occasional gravel (dense*, dry to moist) (Fill)	SM	39*	MC
4–6.5	Brown and reddish-yellow sandy SILT (medium stiff, moist) (Recessional Outwash - Fine-Grained)	ML	5	MC
6.5–12.5	Grayish-brown sandy SILT with a trace of gravel (stiff, moist) (Recessional Outwash - Fine-Grained)	ML	13	MC GS
12.5–17.5	Gray clayey SILT with sand and a trace of gravel (stiff, moist to wet) (Recessional Outwash - Fine-Grained)	ML	10	MC
17.5–22.5	Gray fine to coarse GRAVEL with sand and a trace of silt (dense to very dense*, wet) (Recessional Outwash - Coarse-Grained)	GP	50*	MC
22.5–25.4	Gray SILT with variable fine sand and a trace of gravel (hard, moist) (Advance Outwash - Transitional Beds)	ML	50/5”	MC

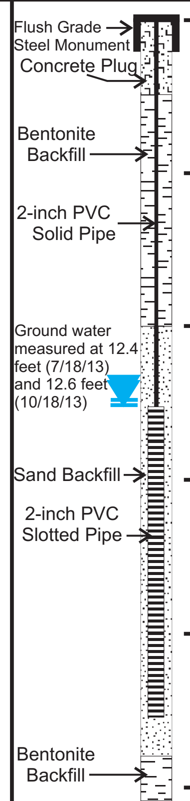
Boring completed at approximately 25.4 feet on July 14, 2013

* density and blow count may not be representative because of the presence of gravel

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

Comments/ Ground Water Observations



See Figure A-1 for explanation of symbols

Boring B-7/Monitor Well MW-7

Latitude 47.60414; Longitude -122.31605

Approximate Elevation: 235.8 feet

JMS/BRB:11/26/13

Logged by:JMS

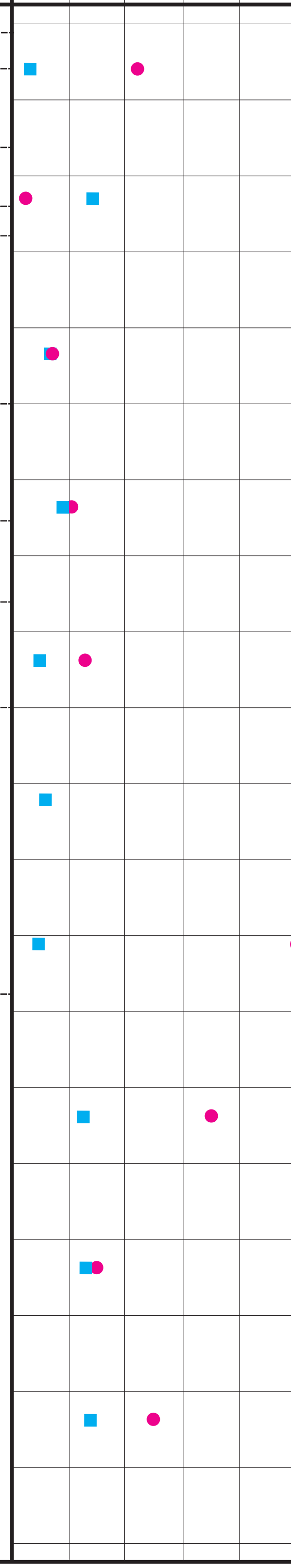
Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

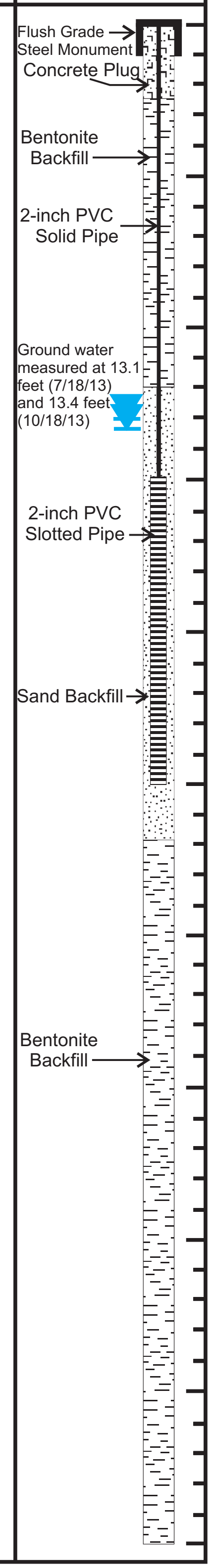
Depth in Feet	Description (Soil Profile)	Group Symbol	Blow Count	Laboratory Testing
0	Asphalt Pavement (3.5 inches)			
	Brown fine to coarse GRAVEL with silt and sand (dense, moist) (Fill)	GP-GM	44*	MC
	Brown silty GRAVEL with sand and occasional brick and wood fragments (dense*, moist) (Fill)	GM		
5	Reddish-yellow and greenish-gray sandy SILT (soft to medium stiff) (moist to wet) (Fill)	ML	4	MC
	Dark brown organic SILT with wood fragments (soft to medium stiff) (moist to wet) (Buried Topsoil)	OL		
10	Grayish-brown and reddish-yellow sandy SILT/silty fine to medium SAND (very stiff/medium dense, moist) (Recessional Outwash - Fine-Grained)	ML/ SM	17	MC
15	Gray to grayish-brown clayey SILT (very stiff, moist to wet) (Recessional Outwash - Fine-Grained)	ML	21	MC
	Grayish brown medium to fine SAND with silt and gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SP-SM		
20	Interlayered gray fine to medium SAND with silt and occasional gravel and gray silty fine to medium SAND with occasional gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SP-SM/ SM	26	MC
25	Gray silty fine to medium SAND with occasional gravel (very dense, moist to wet) (Advance Outwash - Transitional Beds)	SM	50/4”	MC
30		SM	50/5”	MC
35	Gray sandy SILT with thin layers of fine sand (hard, moist) (Advance Outwash - Transitional Beds)	ML	75	
40	becomes moist to wet	ML	30	
45		ML	50	
50				

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80



Comments/ Ground Water Observations



See Figure A-1 for explanation of symbols

Boring B-7/Monitor Well MW-7

JMS/BRB:11/26/13

Depth in Feet	Description (Soil Profile)	Group Symbol	Blow Count	Penetration Resistance (Blows/foot)	Moisture Content (Percent)	Laboratory Testing	Comments/ Ground Water Observations
50	Gray sandy SILT with variable amounts of fine sand and thin layers of fine sand (hard, moist to wet) (Advance Outwash - Transitional Beds)	ML	57			MC	Bentonite Backfill
	Boring completed at approximately 51.5 feet on July 14, 2013						

* density and blow count may not be representative because of the presence of gravel

Depth scale: 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

See Figures A-1 and A-2 for explanation of symbols

Boring B-8/Monitor Well MW-8

Latitude 47.60413; Longitude -122.31514

Approximate Elevation: 235.9 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing	Comments/ Ground Water Observations
0	Sod and Topsoil (4 inches)				Flush Grade Steel Monument; Concrete Plug
	Light brown silty fine to medium SAND with occasional gravel (dense, dry to moist) (Fill)	SM	32	MC	
5	Brown sandy SILT (hard, moist) (Fill)	ML	31	MC	Bentonite Backfill
10		ML	18		
	Greenish-gray and grayish-brown fine to medium silty SAND with occasional gravel (medium dense, moist) (Fill)	SM			2-inch PVC Solid Pipe
		SM	23	MC	
	Grayish-brown clayey SILT (very stiff, moist) (Recessional Outwash - Fine-Grained)	ML			
15	becomes gray, sandy, medium stiff, with fine sand partings at about 15 feet	ML	7	MC	
20	grades to with a trace gravel, stiff at about 20 feet	ML	10	MC	Ground water measured at 21.0 feet (7/18/13) and 20.2 feet (10/18/13)
25	grades to with occasional gravel, moist to wet at about 25 feet; grades to brown at about 26 feet	ML	13	MC	2-inch PVC Slotted Pipe; Sand Backfill
	Grayish brown fine to medium SAND with silt and gravel (dense*, wet) (Recessional Outwash - Coarse-Grained)	SP-SM	39*		
35	Grayish brown fine to medium SAND with silt and gravel (dense*, wet) (Advance Outwash - Transitional Beds)	SP-SM	50/6”		
	Gray silty fine to medium SAND with gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SM	50/6”		Bentonite Backfill
45	Gray SILT (hard, wet) (Advance Outwash - Transitional Beds)	ML	64		
	Grayish-brown fine to medium SAND with silt and gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SP-SM			
50	Gray silty fine SAND (very dense, wet) (Advance Outwash - Transitional Beds)	SM			

Penetration Resistance (Blows/foot - ●) 20 40 60 80

Moisture Content (Percent - ■) 20 40 60 80

See Figure A-1 for explanation of symbols

Boring B-8/Monitor Well MW-8

Depth in Feet	Soil Profile: Description	Graphic Log	Sample Data: Group Symbol	Sample Data: Blow Count	Sample Data: Sample Location	Penetration Resistance (Blows/foot - ●) 20 40 60 80 / Moisture Content (Percent - ■) 20 40 60 80	Laboratory Testing	Comments/ Ground Water Observations
50	Gray clayey SILT and SILT (hard, moist) (Advance Outwash - Transitional Beds)		ML	57		■ ●	MC	Bentonite Backfill
	Boring completed at approximately 51.5 feet on July 13, 2013 * density and blow count may not be representative because of the presence of gravel							
55								
60								
65								
70								
75								
80								
85								
90								
95								
100								

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

See Figure A-1 for explanation of symbols

Boring B-9

Latitude 47.60361; Longitude -122.31545

Approximate Elevation: 217.0 feet

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Depth in Feet	Soil Profile – Description	Group Symbol	Blow Count	Laboratory Testing
0	Sod and Topsoil (4 inches)			
	Light brown silty fine SAND with gravel and occasional concrete fragments (dense*, dry to moist) (Fill)	SM	41*	MC
5	Brown, reddish-yellow and gray silty fine to coarse SAND with occasional fine gravel (medium dense, moist) (Recessional Outwash - Coarse-Grained)	SM	26	MC
10	Brown fine to medium SAND with silt and gravel (medium dense, wet) (Recessional Outwash - Coarse-Grained)	SP-SM	29	MC GS
15	Brown fine to medium SAND with gravel and thin layers sandy silt (very dense, wet) (Advance Outwash - Transitional Beds)	SP	50/5"*	MC GS
20	Gray sandy SILT and silty fine SAND (hard/very dense, moist) (Advance Outwash - Transitional Beds)	ML/SM		
	Reddish-yellow fine to medium SAND with silt (very dense, wet) (Advance Outwash - Transitional Beds)	SP-SM	50/4"	MC
25	Gray silty fine to medium SAND with occasional gravel (dense, moist) (Advance Outwash - Transitional Beds)	SM	39	MC
30		SM	50/2"	
	Gray sandy SILT and silty fine SAND (hard/very dense, moist to wet) (Advance Outwash - Transitional Beds)	ML/SM	50/4"	
35	Gray SILT (hard, moist) (Advance Outwash - Transitional Beds)	ML	50/4"	
40	Gray silty fine to medium SAND with gravel (very dense, wet) (Advance Outwash - Transitional Beds)	SM	50/4"	
45	Gray silty CLAY (hard, moist) (Advance Outwash - Transitional Beds)	CL	85	
50				

Penetration Resistance (Blows/foot - ●) 20 40 60 80; Moisture Content (Percent - ■) 20 40 60 80

Comments/Ground Water Observations:

- Flush Grade Steel Monument
- Concrete Plug
- Ground water measured at 9.0 feet (7/18/13) and 9.1 feet (10/18/13)
- Bentonite Backfill
- 1¼-inch PVC Solid Pipe
- 1¼-inch PVC Slotted Pipe
- Sand Backfill
- Bentonite Backfill

See Figure A-1 for explanation of symbols

JMS/BRB:11/26/13

Logged by:JMS

Project Name: Parametrix GT, King County Youth Services Center

ICE File No. 0105-011

Boring B-9

Depth in Feet	Soil Profile: Description	Graphic Log	Sample Data: Group Symbol	Blow Count	Sample Location	Penetration Resistance (Blows/foot) / Moisture Content (Percent)	Laboratory Testing	Comments/ Ground Water Observations
50	Gray silty CLAY (hard, moist) (Advance Outwash - Transitional Beds)		CL	34			MC	Bentonite Backfill
	Boring completed at approximately 51.5 feet on July 12, 2013							
	* density and blow count may not be representative because of the presence of gravel							

Depth scale: 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100

Penetration Resistance / Moisture Content scale: 20, 40, 60, 80

See Figure A-1 for explanation of symbols

APPENDIX B

LABORATORY TESTING PROGRAM

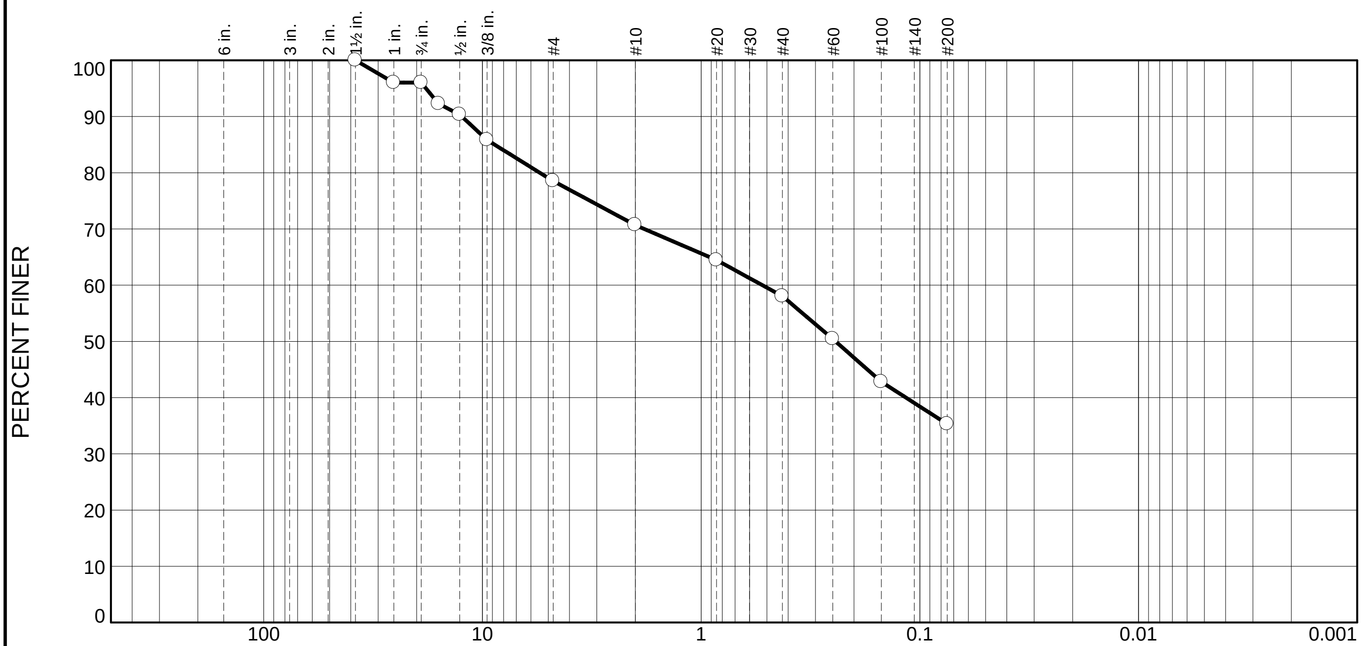
APPENDIX B
LABORATORY TESTING PROGRAM

B.0 LABORATORY TESTING PROGRAM

The soil samples obtained from the test borings were returned to Icicle Creek Engineers laboratory for further visual examination and laboratory testing. Selected samples were tested to determine moisture content in general accordance with ASTM Test Method D 2216. The results of the moisture content tests are presented on the boring logs in Appendix A.

The laboratory testing program also included particle size distribution (grain size analysis) by ASTM Test Methods C 117 (modified) and C 136. The test results are presented on Figures B-1 through B-5.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.0	17.5	7.8	12.6	22.8	35.3	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1.0	96.0		
3/4	96.0		
5/8	92.3		
1/2	90.3		
3/8	85.8		
#4	78.5		
#10	70.7		
#20	64.5		
#40	58.1		
#60	50.4		
#100	42.8		
#200	35.3		

* (no specification provided)

Material Description

Brown silty fine to medium SAND with gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= SM AASHTO (M 145)=

Coefficients

D_{90}= 12.4289 D_{85}= 8.8011 D_{60}= 0.5244
D_{50}= 0.2428 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

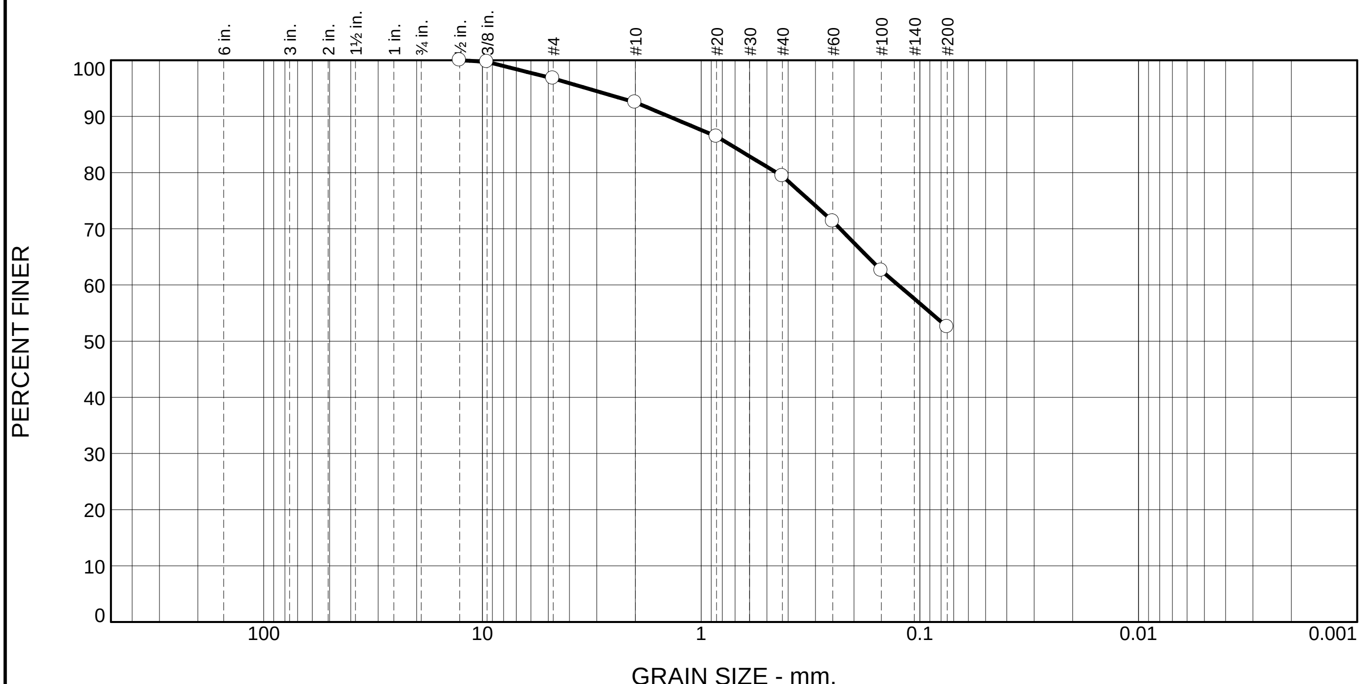
Date Received: 07/15/13 **Date Tested:** 7/25-7/26/13
Tested By: HAL/SAW
Checked By: KSK
Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 11.5 Feet **Date Sampled:** 07/12/13
Sample Number: Boring B-1, S-3

ICICLE CREEK ENGINEERS, INC.
Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-1

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.2	4.3	13.1	26.9	52.5	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2	100.0		
3/8	99.7		
#4	96.8		
#10	92.5		
#20	86.4		
#40	79.4		
#60	71.3		
#100	62.6		
#200	52.5		

* (no specification provided)

Material Description

Brownish-gray and reddish-yellow sandy SILT with a trace of gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 1.4035 D_{85}= 0.7379 D_{60}= 0.1256

D_{50}= D_{30}= D_{15}=

D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/24/-7/25/13

Tested By: HAL/SAW

Checked By: KSK

Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 11.5 Feet **Date Sampled:** 07/14/13

Sample Number: Boring B-2, S-3

ICICLE CREEK ENGINEERS, INC.

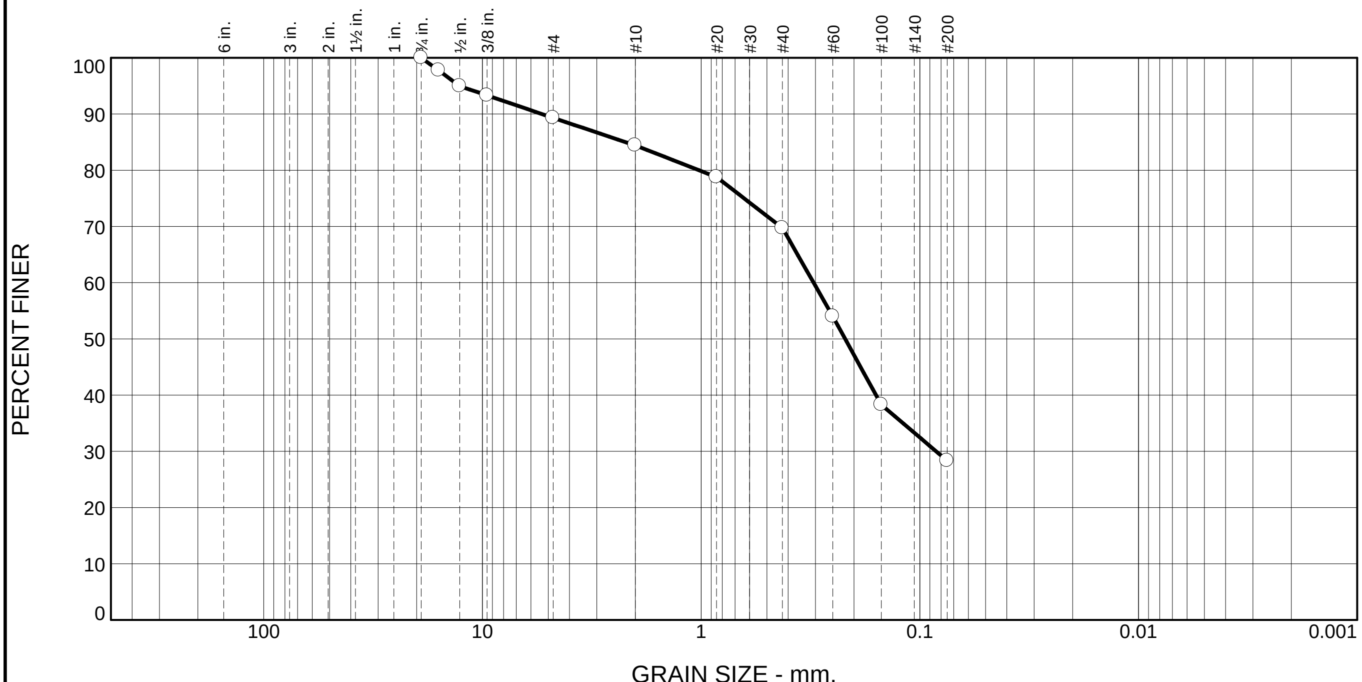
Carnation, WA

Client: King County / Parametrix

Project: King County Children and Family Justice Center

Project No: 0105-011 **Figure** B-2

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.7	4.9	14.7	41.4	28.3	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4	100.0		
5/8	97.8		
1/2	95.0		
3/8	93.3		
#4	89.3		
#10	84.4		
#20	78.8		
#40	69.7		
#60	54.0		
#100	38.3		
#200	28.3		

* (no specification provided)

Material Description

Gray silty fine to medium SAND with gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=**

Coefficients

D_{90}= 5.3478 D_{85}= 2.2153 D_{60}= 0.3060
D_{50}= 0.2195 D_{30}= 0.0842 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/24-7/25/13

Tested By: HAL/SAW

Checked By: KSK

Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10.5 - 15.9 Feet **Date Sampled:** 7/12/13

Sample Number: Boring B-5, S-3b/4 an4

ICICLE CREEK ENGINEERS, INC.

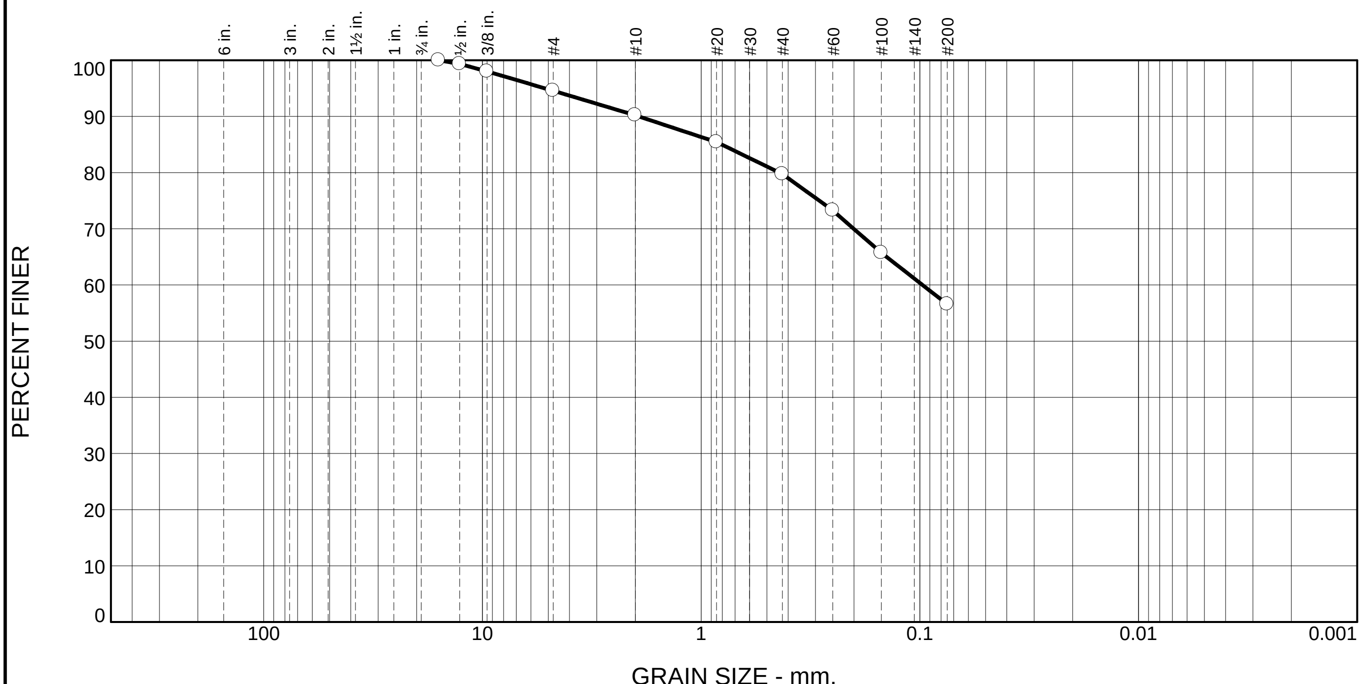
Carnation, WA

Client: King County / Parametrix

Project: King County Children and Family Justice Center

Project No: 0105-011 **Figure** B-3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.4	4.4	10.5	23.1	56.6	

TEST RESULTS			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
5/8	100.0		
1/2	99.3		
3/8	98.0		
#4	94.6		
#10	90.2		
#20	85.4		
#40	79.7		
#60	73.3		
#100	65.7		
#200	56.6		

* (no specification provided)

Material Description

Grayish-brown sandy SILT with a trace of gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= ML **AASHTO (M 145)=**

Coefficients

D_{90}= 1.9277 D_{85}= 0.8056 D_{60}= 0.0972
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/24-7/25/13
Tested By: HAL/SAW
Checked By: KSK
Title: Principal Eng Geologist

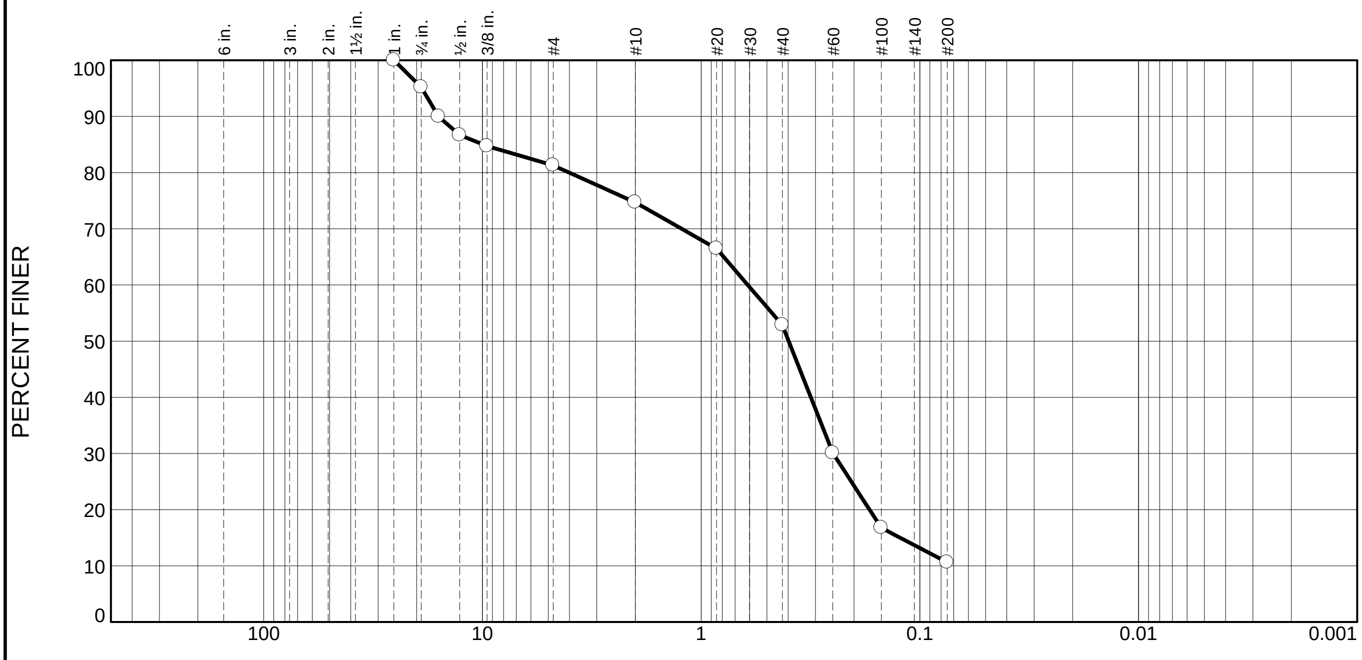
Source of Sample: Soil Samples from Borings **Depth:** 10 - 11.5 Feet **Date Sampled:** 7/14/13
Sample Number: Boring B-6, S-3

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-4

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.8	13.9	6.6	21.9	42.2	10.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1	100.0		
3/4	95.2		
5/8	90.0		
1/2	86.7		
3/8	84.7		
#4	81.3		
#10	74.7		
#20	66.5		
#40	52.8		
#60	30.1		
#100	16.8		
#200	10.6		

* (no specification provided)

Material Description

Brown fine to medium SAND with silt and gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=**

Coefficients

D_{90}= 15.8915 D_{85}= 9.9121 D_{60}= 0.6117
D_{50}= 0.3977 D_{30}= 0.2491 D_{15}= 0.1229
D_{10}= C_u= C_c=

Remarks

Date Received: 07/15/13 **Date Tested:** 7/24-7/25/13
Tested By: HAL/SAW
Checked By: KSK
Title: Principal Eng Geologist

Source of Sample: Soil Samples from Borings **Depth:** 10 - 16.4 Feet **Date Sampled:** 7/12/13
Sample Number: Boring B-9, S-3/S-4

ICICLE CREEK ENGINEERS, INC.

Carnation, WA

Client: King County / Parametrix
Project: King County Children and Family Justice Center
Project No: 0105-011 **Figure** B-5