GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

THE RILEY GROUP, INC.
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PREPARED FOR:

7239 LLC
P.O. BOX 809
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RGI PROJECT NO. 2016-120

27TH STREET SHORT PLAT
7239 SOUTHEAST 27TH STREET
MERCER ISLAND, WASHINGTON 98040

AUGUST 17, 2016

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RILEYGROUP

August 17, 2016

Mr. David Yeh
7239 LLC
P.O. Box 809
Mercer Island, Washington 98040

Subject: **Geotechnical Engineering Report**
27th Street Short Plat
7239 Southeast 27th Street
Mercer Island, Washington 98040
RGI Project No. 2016-120

Dear Mr. Yeh:

As requested, The Riley Group, Inc. (RGI) has prepared this Geotechnical Engineering Report (GER) for the above-referenced site. Our services were completed in accordance with our proposal PRP2016-217 dated July 13, 2016 and authorized by you on the same day. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the test borings completed by RGI at the site on August 2, 2016.

RGI recommends the project plans and specifications be submitted for a general review so that RGI may confirm that the recommendations in this GER are interpreted and implemented properly in the construction documents. RGI also recommends that a representative of our firm be present on site during portions of the project construction to confirm that the soil and groundwater conditions are consistent with those that form the basis for the engineering recommendations in this GER.

If you have any questions or require additional information, please contact us.

Respectfully submitted,

THE RILEY GROUP, INC.

RICKY RUNQI WANG
STATE OF WASHINGTON
35013
REGISTERED
PROFESSIONAL ENGINEER

8/17/2016

Ricky R. Wang, PhD, PE
Principal Engineer

KMW/RW

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Executive Summary

This Executive Summary should be used in conjunction with the entire GER for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and this GER must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included the advancement of four test borings to depths up to 16.5 feet below ground surface (bgs).

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified.

Soil Conditions: The site is underlain by stiff to hard silt to sandy silt with trace of gravel with layers of medium dense silty fine sand.

Groundwater: Groundwater seepage was not encountered during our field exploration.

Foundations: Foundations for the proposed buildings can be supported on conventional continuous and spread footings bearing on competent native soil or new structural fill.

Slab-on-grade: Slab-on-grade floors for the proposed building can be similarly supported.

Pavements: The following pavement sections are recommended for driveways:

- **Flexible** : 2 inches of Hot mix asphalt (HMA) over 6 inches of crushed rock base (CRB) over compacted subgrade
- **Concrete**: 5 inches of concrete over 4 inches of CRB over compacted subgrade

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the proposed 27th Street Short Plat in Mercer Island, Washington. The purpose of this GER is to assess subsurface conditions and provide geotechnical recommendations for the construction of two single-family residences. Our scope of services included field explorations, laboratory testing, engineering analyses, and preparation of this GER.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. If actual features vary or changes are made, RGI should review them in order to modify our recommendations as required. In addition, RGI requests to review the site grading plan, final design drawings and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project Description

The site is located at 7239 Southeast 27th Street in Mercer Island, Washington. The approximate location of the site is shown on Figure 1. The site is currently occupied by a single-family residence in the middle portion of the site.

RGI understands that the client plans to demolish the existing residence and develop it into two single-family residential lots. Our understanding of the project is based on the preliminary project plans prepared by Core Design in May 2016.

Based on our experience with similar construction, RGI anticipates that the proposed buildings will be supported on perimeter walls with bearing loads of 2 to 3 kips per linear foot, and a series of columns with a maximum load up to 100 kips. Slab-on-grade floor loading of 250 pounds per square foot (psf) are expected. RGI also expects that site grading will be needed to reach the final grades.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

On August 2, 2016, RGI observed the advancement of four test borings. Borings B-1 and B-2 were drilled in the proposed driveway and detention tank area and B-3 and B-4 were drilled in the proposed residential lots. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the engineer who continuously observed the drilling. These logs included visual classifications of the materials encountered during drilling as well as our interpretation of the subsurface conditions between samples. The boring logs included in Appendix A represent an interpretation of the field logs and include modifications based on laboratory observation and analysis of the samples.

3.2 LABORATORY TESTING

During the field exploration, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Samples retrieved from the borings were tested for moisture content to aid in soil classification and provide input for the recommendations provided in this GER. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 SURFACE

The site is a rectangular-shaped parcel of land approximately 28,759 square feet in size. The site is bound to the north by Southeast 27th Street, to the east and west by private driveways, and to the south by residential property.

The middle portion of the site is occupied by a single-family residence. The site slopes down from the southwest corner to the northeast corner with an elevation different of about 20 feet or average slope gradient of 10 percent. The eastern edge of the property is mapped as erosion and slide hazard area.

4.2 GEOLOGY

Review of the *Geologic Map of the Mercer Island, Washington* by Kathy G. Troost, etc, (2006) indicates that the soil in the project vicinity is mapped as Advance Outwash Deposits (Map Unit Qva) which is well-sorted sand and gravel deposited by stream from advancing ice sheet. The native soils encountered below the site appears to be different from what was described in the geology map.

4.3 SOILS

The site is underlain by stiff to hard silt to sandy silt with trace of gravel with layers of medium dense silty fine sand.

More detailed descriptions of the subsurface conditions encountered are presented in the borings are included in Appendix A. Sieve analysis was performed on four selected soil samples. The grain-size distribution curves are included in Appendix A.

4.4 GROUNDWATER

Groundwater seepage was not encountered during our field exploration to a maximum depth of 16.5 feet bgs.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation.

4.5 SEISMIC CONSIDERATIONS

Based on the 2012 International Building Code (IBC), RGI recommends the follow seismic parameters in Table 1 be used for design.

Table 1 IBC Seismic Parameters

2012 IBC Parameter	Value
Site Soil Class[1]	D[2]
Site Latitude	47.58745 N
Site Longitude	122.24748 W
Maximum considered earthquake spectral response acceleration parameters (g)	S_s =1.378, S_1 =0.531
Spectral response acceleration parameters adjusted for site class (g)	S_{ms} =1.378, S_{m1} =0.796
Design spectral response acceleration parameters (g)	S_{ds} =0.918, S_{d1} =0.531

1 Note: In general accordance with the USGS *2012 International Building Code*. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2 Note: The *2012 International Building Code* requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Test borings extended to a maximum depth of 16.5 feet, and this seismic site class definition considers that stiff soil continues below the maximum depth of the subsurface exploration.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus reducing or eliminating the soil's strength.

RGI reviewed the results of the field and laboratory testing and assessed the potential for liquefaction of the site's soil during an earthquake. Since the site is underlain by stiff to hard silt and the groundwater level is deeper than our exploraions, RGI considers that the possibility of liquefaction during an earthquake is minimal.

4.6 Geologic Hazard Areas

RGI reviewed the City of Mercer Island Municipal Codes (19.07.060 and 19.16). The review indicates that a narrow area along the eastern property line is mapped as geologic hazard area of both soil erosion and landslide.

On August 2, 2016, RGI performed a site reconnaissance to evaluate the area along the eastern property line. During our field observations, we did not find any steep slope or indications of landslide or history of ground movement.

Based on our observation, the potential of landslide along the eastern property line does not exist. The soil erosion hazard is minimal if the geotechnical recommendations are incorporated into the project design and construction. In our opinion, the proposed development will not have any impact to the site stability or increase the potential of soil erosion on the site or on adjacent sites. RGI recommends that this site not be considered a geologic hazard area.

5.0 Discussion and Recommendations

5.1 Geotechnical Considerations

Based on our observations, explorations and analysis, the site is suitable for the proposed construction from a geotechnical standpoint. RGI recommends that foundations for the proposed buildings be supported on conventional spread footings bearing on competent native soil or new structural fill if needed. Slab-on-grade floors and pavement sections can be similarly supported.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.1.1 Erosion and Sediment Control

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Establishing a quarry spall construction entrance

- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than one day during wet weather or one week in dry weather
- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.1.2 STRIPPING

Stripping efforts should include removal of pavements, vegetation, organic materials, and deleterious debris from areas slated for building, pavement, and utility construction. The test borings encountered up to 6 inches of topsoil and rootmass. Deeper areas of stripping may be required.

5.1.3 EXCAVATIONS

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. The site soils consist of silty soils. Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1H:1V (Horizontal:Vertical) in native soil. If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered. Shoring recommendations are provided in the following section of this GER.

For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least 5 feet from the top of the cut
- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized
- Surface water is diverted away from the excavation
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2 EARTHWORK

After completion of the temporary cuts and removal of the soils to subgrade elevation, the site earthwork is expected to consist of excavating foundations, installing under slab utilities and preparing the slab subgrade. The earthwork should take place in the dry season (June through September).

5.2.1 SITE PREPARATION

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with compacted structural fill. If earthwork is completed during the wet season (typically October through May), it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond that which would be expected during the drier summer and fall months.

5.2.2 STRUCTURAL FILL

RGI recommends fill below the foundation and floor slab, behind retaining walls, and below pavement and hardscape surfaces be placed in accordance with the following recommendations for structural fill.

The suitability of excavated site soils and import soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the U.S. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve. Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is that moisture that results in the greatest compacted dry density with a specified compactive effort.

The native soil contains a large amount of fines and is generally not suitable to be used as structural fill. It is necessary to import clean, granular soils to complete site work that meet the grading requirements listed in Table 2 to be used as structural fill.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
3 inches	100
No. 4 sieve	75 percent
No. 200 sieve	5 percent *

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by American Society of Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils:	95	+2	-2
General Fill (non-structural areas)	On-site soils or approved imported fill soils:	90	+3	-2
Pavement – Subgrade and Base Course	On-site granular or approved imported fill soils:	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.2.3 WET WEATHER CONSTRUCTION CONSIDERATIONS

RGI recommends that preparation for site grading and construction include procedures intended to drain ponded water, control surface water runoff, and to collect shallow subsurface seepage zones in excavations where encountered. It will not be possible to successfully compact the subgrade or utilize on-site soils as structural fill if accumulated water is not drained prior to grading or if drainage is not controlled during construction. Attempting to grade the site without adequate drainage control measures will reduce the amount of on-site soil effectively available for use, increase the amount of select import fill materials required, and ultimately increase the cost of the earthwork phases of the project. Free water should not be allowed to pond on the subgrade soils. RGI anticipates that the use of berms and shallow drainage ditches, with sumps and pumps in utility trenches, will be required for surface water control during wet weather and/or wet site conditions.

5.3 FOUNDATIONS

Following site preparation and grading, the proposed building foundations can be supported on conventional spread footings bearing on competent native soil or new structural fill. Where loose or soft soils or other unsuitable soils are encountered in the proposed building footprint, they should be overexcavated and backfilled with structural fill.

Table 4 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf[1]
Friction Coefficient	0.30
Passive pressure (equivalent fluid pressure)	250 pcf[2]
Minimum foundation dimensions	Columns: 24 inches Walls: 16 inches

1. psf = pounds per square foot
2. pcf = pounds per cubic foot

The allowable foundation bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because it can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.2.2. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

Perimeter foundations exposed to weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab. Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings.

With spread-footing foundations designed in accordance with the recommendations in this section, maximum total and differential post-construction settlements of 1 inch and 1/2 inch, respectively, should be expected.

5.4 RETAINING WALL

If retaining walls are needed for the basements or the detention structure, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design.

Table 5 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity	2,500 psf
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H for restrained walls should be applied to the wall surface.

Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.3.

5.5 SLAB-ON-GRADE CONSTRUCTION

Once site preparation has been completed as described in Section 5.2, suitable support for slab-on-grade construction should be provided. Immediately below the floor slab, RGI recommends placing a 4-inch-thick capillary break layer of clean, free-draining pea gravel, washed rock, or crushed rock that has less than 5 percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab. Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter-thick plastic membrane should be placed on a 4-inch-thick layer of clean gravel or rock. For the anticipated floor slab loading, we estimate post-construction floor settlements of ¼- to ½-inch.

5.6 DRAINAGE

5.6.1 SURFACE

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 SUBSURFACE

RGI recommends installing perimeter foundation or retaining wall drains, details shown on Figures 3 and 4. The foundation or retaining wall drains and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge.

5.7 UTILITIES

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with City of Mercer Island specifications. At a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2.2. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by ASTM D1557. The onsite excavated soil is generally not suitable for use as structural fill, imported structural fill may be required for trench backfill as recommended Table 2.

5.8 PAVEMENTS

Pavement subgrades should be prepared as described in Section 5.2 of this GER and as discussed below. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. This condition should be verified by proofrolling with heavy construction equipment to verify this condition.

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with flexible asphalt concrete surfacing.

- **For driveway areas**: 2 inches of hot mix asphalt (HMA) over 6 inches of crushed rock base (CRB) over compacted subgrade

The asphalt paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for Hot Mix Asphalt Class 1/2 inch and CRB surfacing. If concrete drive way is preferred, the following section can be used.

- **For driveway areas**: 5 inches of concrete over 4 inches of CRB over compacted subgrade

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than two percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a proposal.

7.0 Limitations

This GER is the property of RGI, 7239 LLC, and their designated agents. Within the limits of the scope and budget, this GER was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This GER is intended for specific application to the 27th Street Short Plat project at 7239 Southeast 27th Street in Mercer Island, Washington, and for the exclusive use of 7239 LLC and their authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, we can provide a proposal for these services.

The analyses and recommendations presented in this GER are based upon data obtained from the test exploration performed on site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this GER prior to proceeding with construction.

It is client's responsibility to see that all parties to the project, including the designers, contractors, subcontractors, are made aware of this GER in its entirety. The use of information contained in this GER for bidding purposes should be done at the contractor's option and risk.

USGS, 2014, Mercer Island, Washington
USGS, 2014, Seattle South, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

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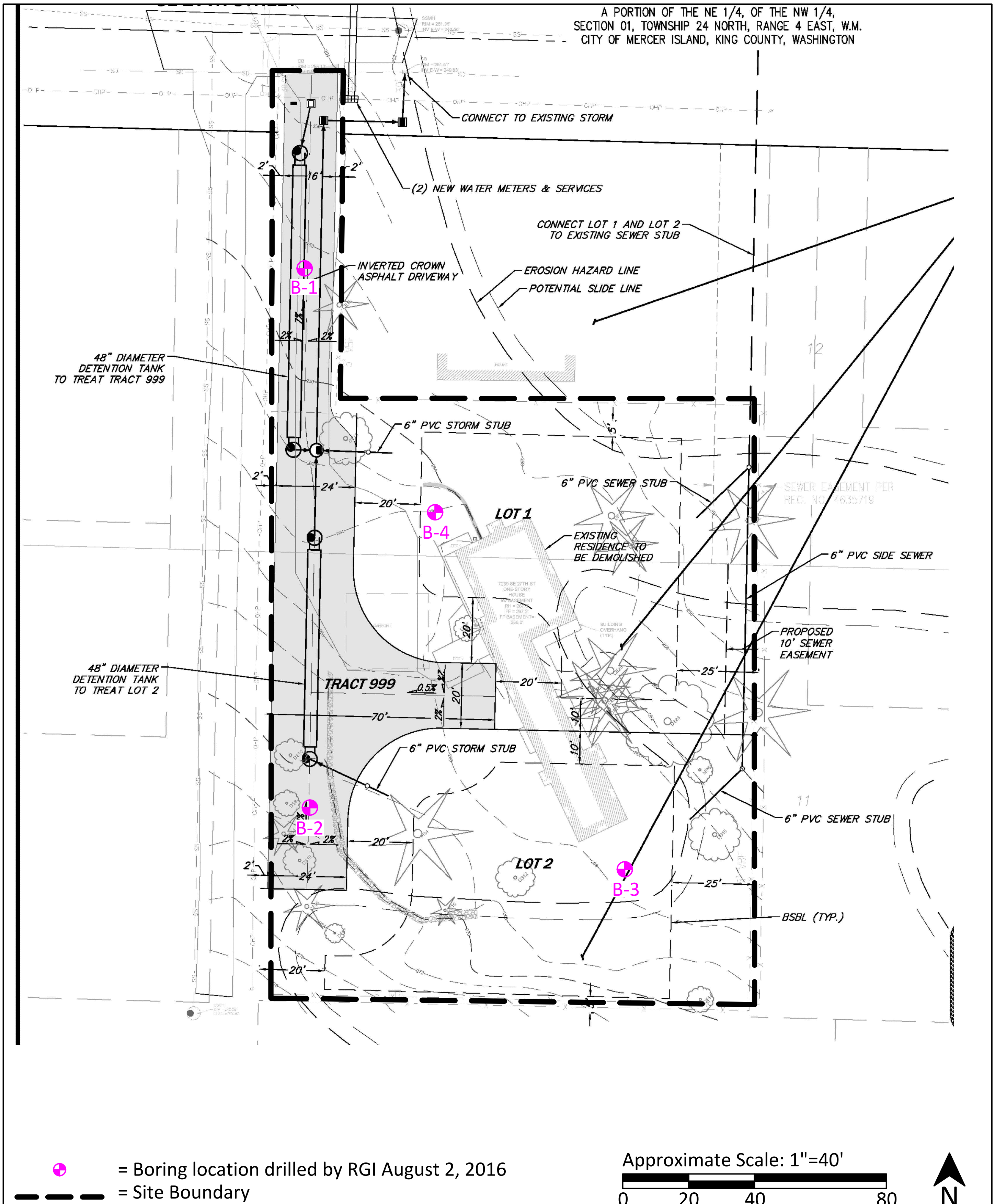
27th Street Short Plat		Figure 1
RGI Project Number 2016-120	Site Vicinity Map	Date Drawn: 08/2016
Address: 7239 Southeast 27th Street, Mercer Island, Washington 98040		



= Boring location drilled by RGI August 2, 2016

= Site Boundary

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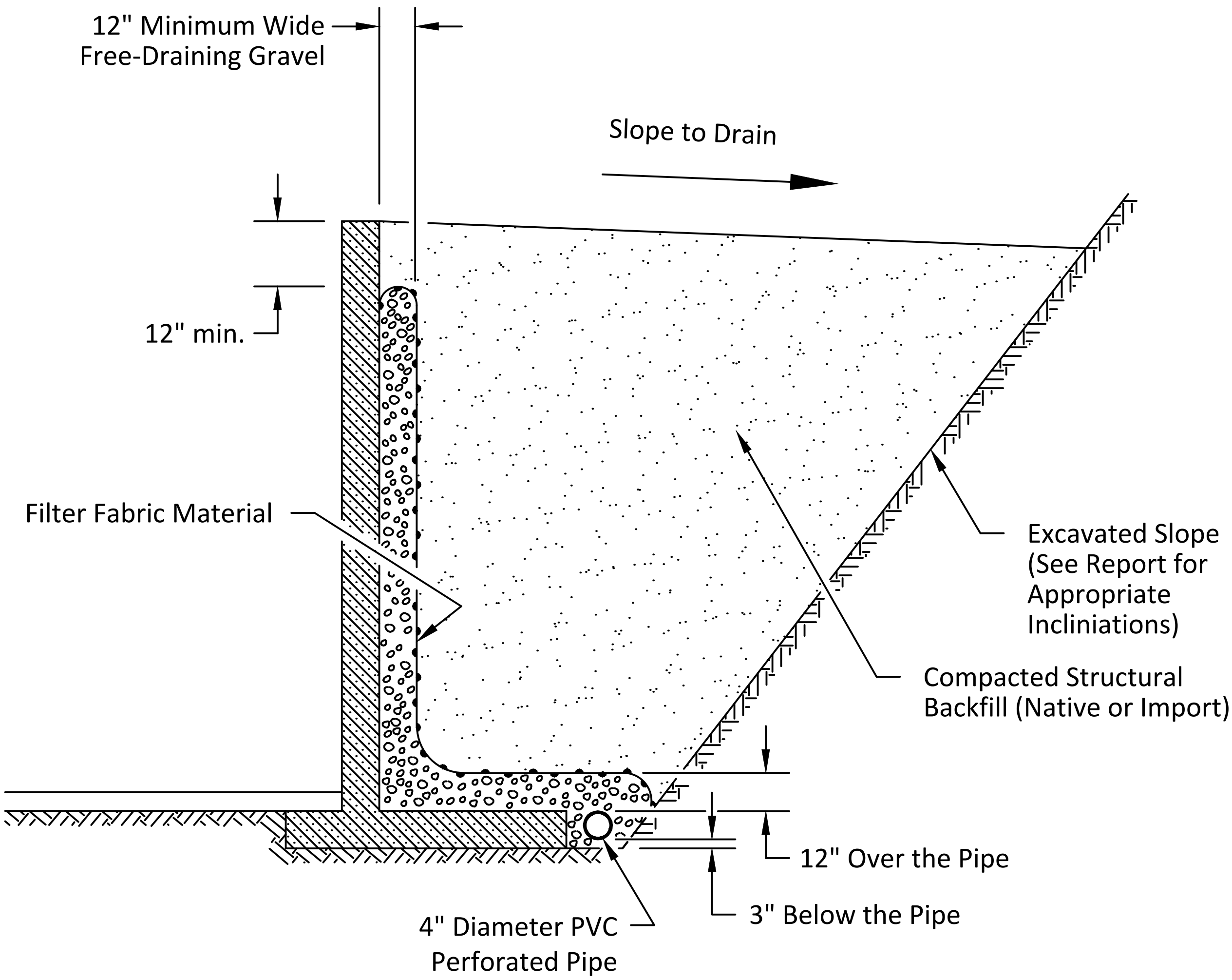
27th Street Short Plat		Figure 2
RGI Project Number 2016-120	Geotechnical Exploration Plan	Date Drawn: 08/2016
Address: 7239 Southeast 27th Street, Mercer Island, Washington 98040		



Not to Scale

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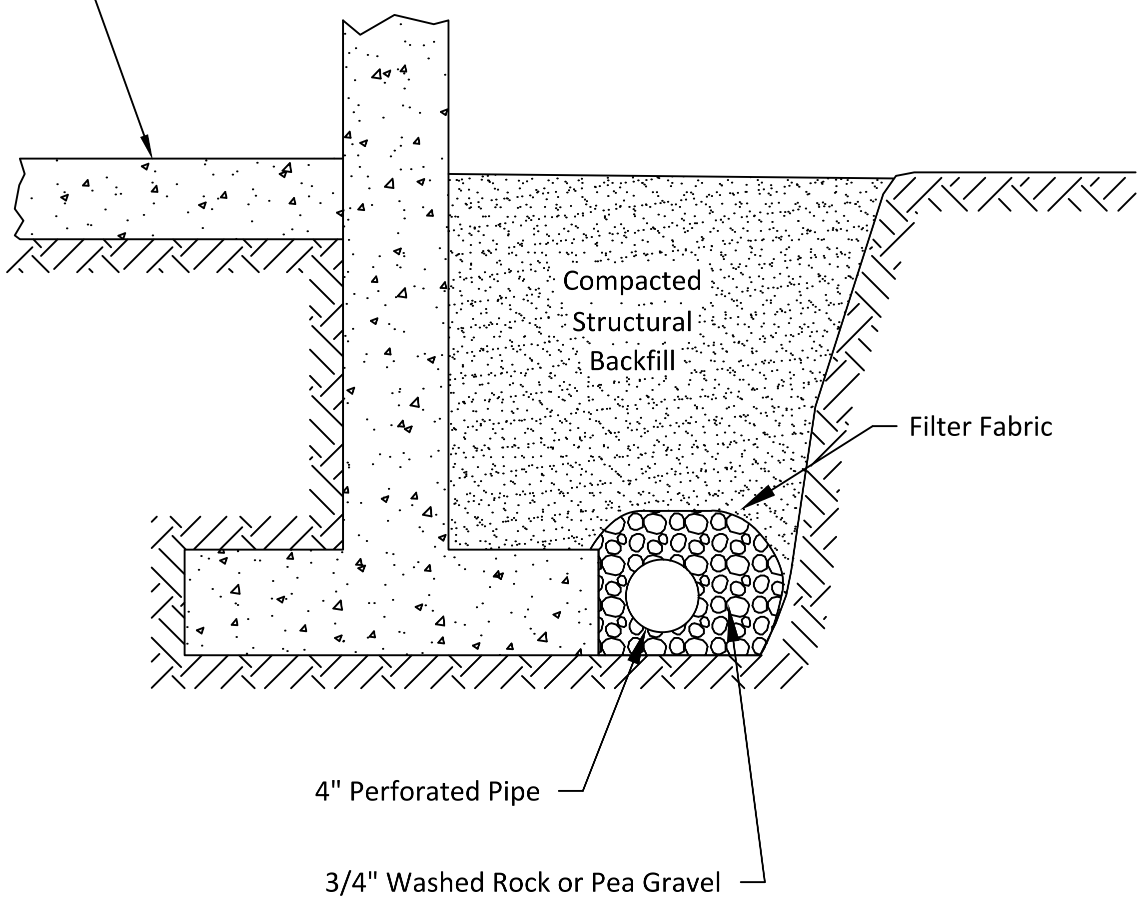
27th Street Short Plat		Figure 3
RGI Project Number 2016-120	Retaining Wall Drainage Detail	Date Drawn: 08/2016
Address: 7239 Southeast 27th Street, Mercer Island, Washington 98040		



Not to Scale

RILEYGROUP Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	27th Street Short Plat		Figure 4
	RGI Project Number 2016-120	Typical Footing Drain Detail	Date Drawn: 08/2016
	Address: 7239 Southeast 27th Street, Mercer Island, Washington 98040		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On August 2, RGI explored the subsurface soil conditions at the site by observing the drilling of four test borings to a depth of 16.5 feet bgs. The test boring locations are shown on Figure 2. The test boring locations were approximately determined by measurements from existing property lines and paved roads.

A engineer from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each test exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in house laboratory based on visual observation, texture, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with the American Society of Testing and Materials D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical sample was measured and is reported on the test boring logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses for the greater than 75 micrometer portion of the samples were performed in accordance with American Society of Testing and Materials D422 Standard Test Method for Particle-Size Analysis of Soils (ASTM D422) on four of the samples, the results of which are attached in Appendix A.

Project Name: **27th Street Short Plat**	Boring No.: **B-1**
Project Number: **2016-120**	**Sheet 1 of 1**
Client: **7239 LLC**	RILEYGROUP

Date(s) Drilled: **8/2/2016**	Logged By: **RW**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **8" auger**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **260**
Groundwater Level and Date Measured: **Not Encountered**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **7239 Southeast 27th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
260	0					Asphalt		2" asphalt over crushed rock base	
						ML		Brown sandy SILT with trace gravel, very stiff, moist	
		SPT		17					16
255	5	SPT		53				Becomes hard, 58% fines	15
250	10	SPT		70					14
245	15	SPT		68					
								Boring terminated at 16' 6"	
240	20								
235	25								
230	30								

Project Name: **27th Street Short Plat**	Boring No.: **B-2**
Project Number: **2016-120**	**Sheet 1 of 1**
Client: **7239 LLC**	RILEYGROUP

Date(s) Drilled: **8/2/2016**	Logged By: **RW**	Surface Conditions: **Grass**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **8" auger**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **272**
Groundwater Level and Date Measured: **Not Encountered**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **7239 Southeast 27th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
272	0					ML		Brown SILT with trace sand, stiff, moist	
		SPT		14					36
267	5							85% fines	
		SPT		14					28
262	10					SM		Gray silty fine SAND, medium dense, moist	
		SPT		21					31
257	15					ML		Gray sandy SILT, very stiff, moist to wet	
		SPT		19					41
								Boring terminated at 16' 6"	
252	20								
247	25								
242	30								

Project Name: **27th Street Short Plat**	Boring No.: **B-3**
Project Number: **2016-120**	**Sheet 1 of 1**
Client: **7239 LLC**	RILEYGROUP

Date(s) Drilled: **8/2/2016**	Logged By: **RW**	Surface Conditions: **Grass**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **8" auger**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **268**
Groundwater Level and Date Measured: **Not Encountered**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **7239 Southeast 27th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
268	0					ML		Brown SILT with trace sand, stiff, damp	
		SPT		14					12
263	5	SPT		15				Becomes stiff to very stiff, 86% fines	33
258	10	SPT		15				Becomes wet	30
253	15	SPT		13		SM		Brown silty fine SAND, medium dense, wet	31
								Boring terminated at 16' 6"	
248	20								
243	25								
238	30								

Project Name: **27th Street Short Plat**	Boring No.: **B-4**
Project Number: **2016-120**	**Sheet 1 of 1**
Client: **7239 LLC**	RILEYGROUP

Date(s) Drilled: **8/2/2016**	Logged By: **RW**	Surface Conditions: **Grass**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **8" auger**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **Tracked Drill Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **264**
Groundwater Level and Date Measured: **Not Encountered**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **7239 Southeast 27th Street, Mercer Island, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
264	0					ML		Brown sandy SILT with trace gravel, medium stiff to stiff, damp	
		SPT		8					12
259	5	SPT		17				Becomes very stiff, 57% fines	14
254	10	SPT		44				Becomes hard, increase in gravel	12
249	15	SPT		13		ML		Brown sandy SILT, stiff, moist	32
								Boring terminated at 16' 6"	
244	20								
239	25								
234	30								

Project Name: **27th Street Short Plat** Project Number: **2016-120** Client: **7239 LLC**	RILEYGROUP **Key to Log of Boring** **Sheet 1 of 1**

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample ID: Sample identification number.
5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6 Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7 USCS Symbol: USCS symbol of the subsurface material.
8 Graphic Log: Graphic depiction of the subsurface material encountered.
9 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10 Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Asphaltic Concrete (AC)
SILT, SILT w/SAND, SANDY SILT (ML)
Silty SAND (SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Continuous
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
? Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

THE RILEY GROUP, INC.
17522 Bothell Way NE
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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	27th Street Short Plat	SAMPLE ID/TYPE	B-1
PROJECT NO.	2016-120	SAMPLE DEPTH	5
TECH/TEST DATE	AV 8/5/2016	DATE RECEIVED	8/3/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	736.3
Wt Dry Soil & Tare (gm)	(w2)	643.0
Weight of Tare (gm)	(w3)	15.9
Weight of Water (gm)	(w4=w1-w2)	93.3
Weight of Dry Soil (gm)	(w5=w2-w3)	627.1
Moisture Content (%)	(w4/w5)*100	15

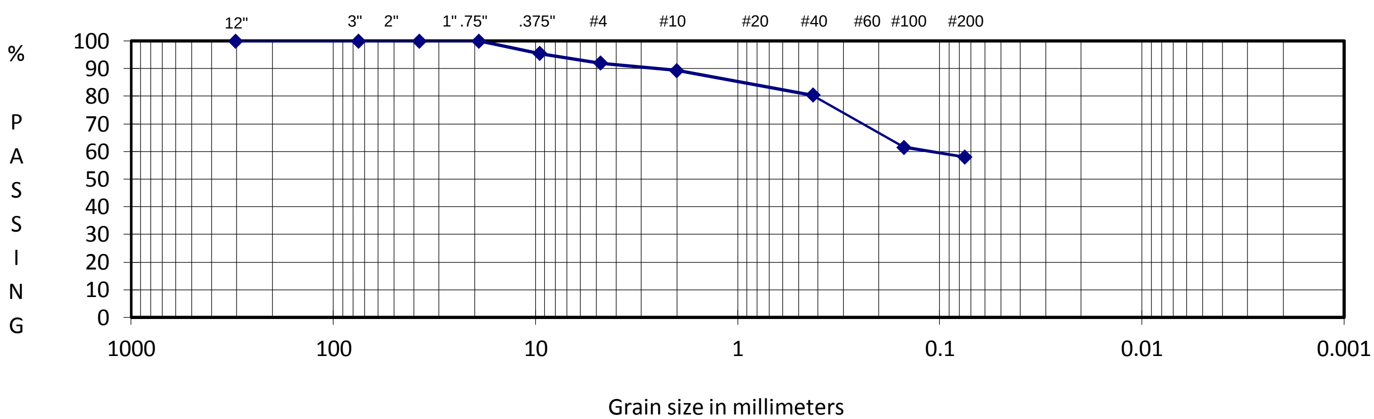
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	643.0
	Tare Weight (gm)	15.9
(W6)	Total Dry Weight (gm)	627.1

SIEVE ANALYSIS

% COBBLES	0.0	
% C GRAVEL	0.0	
% F GRAVEL	8.0	
% C SAND	2.8	
% M SAND	8.8	
% F SAND	22.5	
% FINES	57.9	
% TOTAL	100.0	
D10 (mm)		
D30 (mm)		
D60 (mm)		
Cu		
Cc		

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.9	0.00	0.00	100.00	cobbles
3.0"	15.9	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.9	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.9	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	44.8	28.90	4.61	95.39	fine gravel
#4	66.0	50.10	7.99	92.01	coarse sand
#10	83.3	67.40	10.75	89.25	medium sand
#20					medium sand
#40	138.7	122.80	19.58	80.42	fine sand
#60					fine sand
#100	257.4	241.50	38.51	61.49	fine sand
#200	279.7	263.80	42.07	57.93	fines
PAN	643.0	627.10	100.00	0.00	silt/clay



DESCRIPTION	Sandy SILT with trace gravel
USCS	ML

Prepared For: 7239 LLC

Reviewed By: KW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	27th Street Short Plat	SAMPLE ID/TYPE	B-2
PROJECT NO.	2016-120	SAMPLE DEPTH	5
TECH/TEST DATE	AV 8/5/2016	DATE RECEIVED	8/3/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	472.8
Wt Dry Soil & Tare (gm)	(w2)	373.0
Weight of Tare (gm)	(w3)	15.9
Weight of Water (gm)	(w4=w1-w2)	99.8
Weight of Dry Soil (gm)	(w5=w2-w3)	357.1
Moisture Content (%)	(w4/w5)*100	28

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

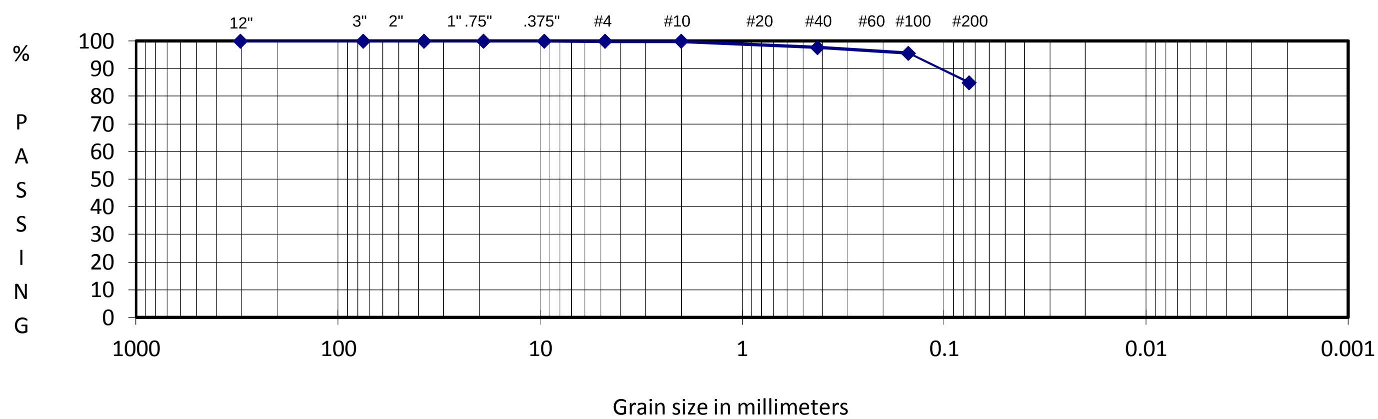
	Weight Of Sample (gm)	373.0
	Tare Weight (gm)	15.9
(W6)	Total Dry Weight (gm)	357.1

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.2
% C SAND	0.0
% M SAND	2.2
% F SAND	12.7
% FINES	84.9
% TOTAL	100.0

D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.9	0.00	0.00	100.00	cobbles
3.0"	15.9	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.9	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.9	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.9	0.00	0.00	100.00	fine gravel
#4	16.5	0.60	0.17	99.83	coarse sand
#10	16.6	0.70	0.20	99.80	medium sand
#20					medium sand
#40	24.3	8.40	2.35	97.65	fine sand
#60					fine sand
#100	31.9	16.00	4.48	95.52	fine sand
#200	69.7	53.80	15.07	84.93	fines
PAN	373.0	357.10	100.00	0.00	silt/clay



DESCRIPTION	SILT with trace sand
USCS	ML

Prepared For: 7239 LLC

Reviewed By: KW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	27th Street Short Plat	SAMPLE ID/TYPE	B-3
PROJECT NO.	2016-120	SAMPLE DEPTH	5
TECH/TEST DATE	AV 8/5/2016	DATE RECEIVED	8/3/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	523.2
Wt Dry Soil & Tare (gm)	(w2)	396.8
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	126.4
Weight of Dry Soil (gm)	(w5=w2-w3)	381.2
Moisture Content (%)	(w4/w5)*100	33

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

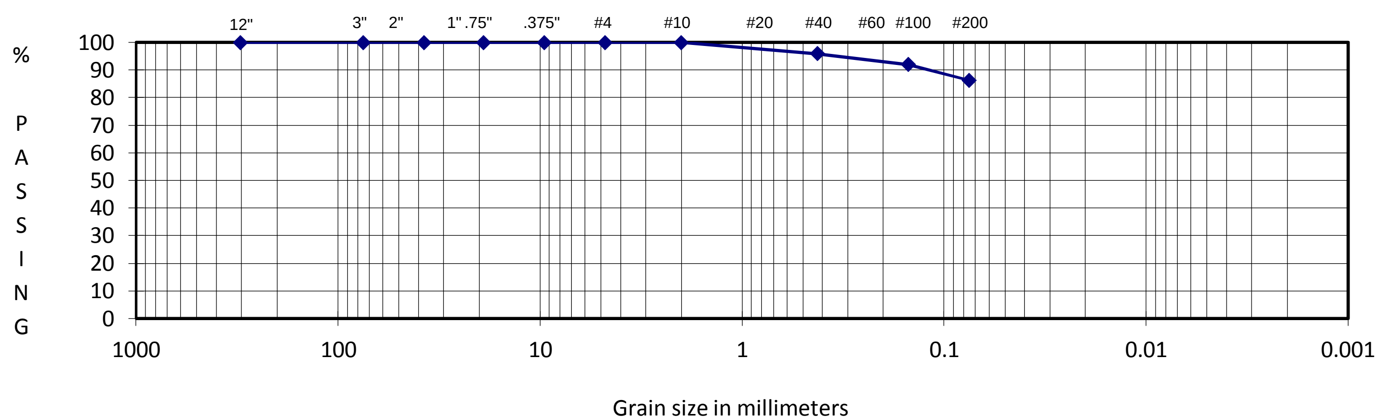
	Weight Of Sample (gm)	396.8
	Tare Weight (gm)	15.6
(W6)	Total Dry Weight (gm)	381.2

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.0
% C SAND	0.1
% M SAND	4.0
% F SAND	9.6
% FINES	86.3
% TOTAL	100.0

D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.6	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.6	0.00	0.00	100.00	fine gravel
#4	15.6	0.00	0.00	100.00	coarse sand
#10	16.0	0.40	0.10	99.90	medium sand
#20					medium sand
#40	31.2	15.60	4.09	95.91	fine sand
#60					fine sand
#100	46.1	30.50	8.00	92.00	fine sand
#200	67.9	52.30	13.72	86.28	fines
PAN	396.8	381.20	100.00	0.00	silt/clay



DESCRIPTION SILT with trace sand

USCS ML

Prepared For: 7239 LLC

Reviewed By: KW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	27th Street Short Plat	SAMPLE ID/TYPE	B-4
PROJECT NO.	2016-120	SAMPLE DEPTH	5
TECH/TEST DATE	AV 8/5/2016	DATE RECEIVED	8/3/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	540.0
Wt Dry Soil & Tare (gm)	(w2)	475.9
Weight of Tare (gm)	(w3)	15.6
Weight of Water (gm)	(w4=w1-w2)	64.1
Weight of Dry Soil (gm)	(w5=w2-w3)	460.3
Moisture Content (%)	(w4/w5)*100	14

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

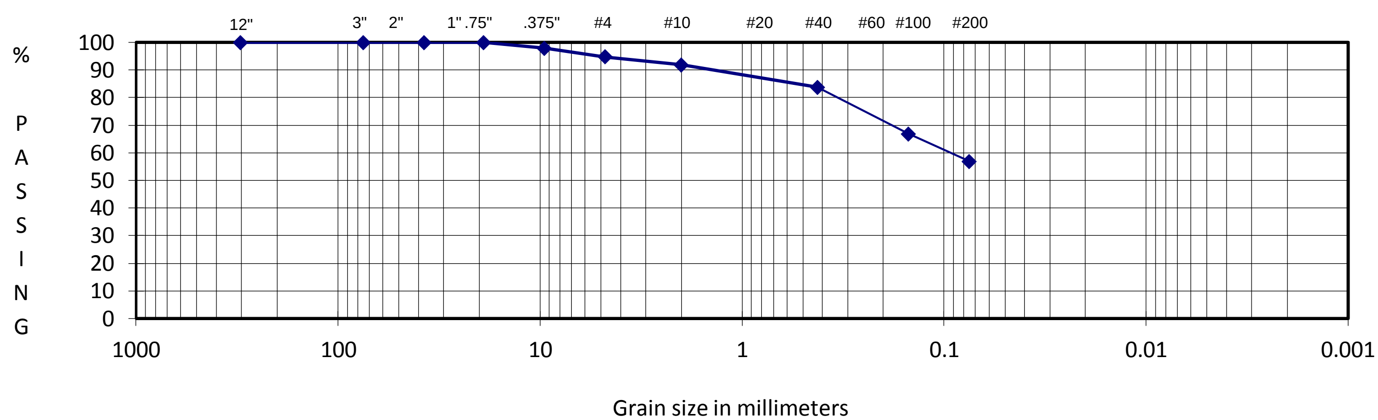
	Weight Of Sample (gm)	475.9
	Tare Weight (gm)	15.6
(W6)	Total Dry Weight (gm)	460.3

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.6	0.00	0.00	100.00	cobbles
3.0"	15.6	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.6	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.6	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	25.7	10.10	2.19	97.81	fine gravel
#4	39.9	24.30	5.28	94.72	coarse sand
#10	53.0	37.40	8.13	91.87	medium sand
#20					medium sand
#40	90.2	74.60	16.21	83.79	fine sand
#60					fine sand
#100	168.5	152.90	33.22	66.78	fine sand
#200	213.8	198.20	43.06	56.94	fines
PAN	475.9	460.30	100.00	0.00	silt/clay

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	5.3
% C SAND	2.8
% M SAND	8.1
% F SAND	26.9
% FINES	56.9
% TOTAL	100.0

D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	



DESCRIPTION	Sandy SILT with trace gravel
USCS	ML

Prepared For: 7239 LLC

Reviewed By: KW

RILEYGROUP