GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

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PREPARED FOR:

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RGI PROJECT NO. 2022-007-2

OSTROMS PLAT
8322 STEILACOOM ROAD SOUTHEAST
LACEY, WASHINGTON

JUNE 28, 2022

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RILEYGROUP

June 28, 2022

Raelyn Hulquist
D.R. Horton
11241 Slater Avenue Northeast, Suite 200
Kirkland, Washington 98034

Subject: **Geotechnical Engineering Report**
Ostroms Plat
8322 Steilacoom Road Southeast
Lacey, Washington
RGI Project No. 2022-007-2

Dear Raelyn Hulquist:

As requested, The Riley Group, Inc. (RGI) has performed a Geotechnical Engineering Report (GER) for the Ostroms Plat project located at 8322 Steilacoom Road Southeast, Lacey, Washington. Our services were completed in accordance with our proposal dated January 11, 2022 and authorized by Clint Lucas with D.R. Horton on February 14, 2022. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the monitoring wells and test pits completed by RGI at the site on January 20, and February 3 and 4, 2022.

RGI recommends that you submit the project plans and specifications to RGI for a general review so that we 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.

KRISTINA MARIE WELLER
STATE OF WASHINGTON
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REGISTERED
PROFESSIONAL ENGINEER

6/28/22

Eric L. Woods, LG
Project Geologist

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Principal Geotechnical Engineer

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Executive Summary

This Executive Summary should be used in conjunction with the entire Geotechnical Engineering Report (GER) for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the 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 2 monitoring wells and 11 test pits to approximate depths of 5 to 25 feet below existing site grades.

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 soils encountered during field exploration include up to 12 feet of loose to medium dense fill comprised of gravel with some sand and trace silt and silty sandy gravel over medium dense native deposits of silty sandy gravel, sandy gravel with trace silt, and gravel with trace to some sand and silt. The gravel deposits were underlain by dense silty sand with gravel at a depth of 14 feet at TP-2.

Groundwater: Light groundwater seepage was encountered at two locations at depths of 13.5 to 23.5 feet during our subsurface exploration.

Foundations: Foundations for the proposed building may be supported on conventional spread footings bearing on medium dense native soil or structural fill.

Slab-on-grade: Slab-on-grade floors and slabs for the proposed building can be supported on medium dense native soil or structural fill.

Pavements: The following pavement sections are recommended in accordance with the City of Lacey standards:

- **For minor local access streets**: 4 inches of Hot Mix Asphalt (HMA) class ½ inch PG 64-22 over 2 inches of crushed surfacing base course (CSBC) over 13 inches of ballast or 9 inches of crushed surfacing base course (CSBC)
- **For concrete pavement areas**: 4 inches of concrete for sidewalks and 6 inches for driveways over 1 inch of CSTC or well graded sand

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the Ostroms Plat project in Lacey, Washington. The purpose of this evaluation is to assess subsurface conditions and provide geotechnical recommendations for the construction of a residential development with associated roadways and infrastructure. 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 project site is located at 8322 Steilacoom Road Southeast in Lacey, Washington. The approximate location of the site is shown on Figure 1.

The existing site is occupied by several concrete buildings with asphalt, concrete, and gravel roadways. RGI understands the existing structures are to be demolished and the site is to be developed with a 193-lot residential plat with associated paved streets and utilities, and stormwater facilities.

At the time of preparing this GER, building plans were not available for our review. Based on our experience with similar construction, RGI anticipates that the proposed residences will be supported on perimeter walls with bearing loads of two to six kips per linear foot, and a series of columns with a maximum load up to 30 kips. Slab-on-grade floor loading of 150 pounds per square foot (psf) are expected.

3.0 Field Exploration and Laboratory Testing

3.1 FIELD EXPLORATION

On January 20, RGI observed the drilling of 2 monitoring wells and on February 3 and 4, 2022 the excavation of 11 test pits. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the geologist that continuously observed the excavation or drilling. These logs included visual classifications of the materials encountered during excavation and drilling as well as our interpretation of the subsurface conditions between samples. The monitoring well and test pit 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. Selected samples retrieved from the test pits were tested for moisture content and grain size analysis 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 subject site is an irregular-shaped parcel of land approximately 33.86 acres in size. The site is bound to the north and east by residential property, to the south by Steilacoom Road Southeast, and to the west by Marvin Road Southeast.

The existing site is occupied by several concrete buildings and asphalt, concrete, and gravel roadways and parking areas. The site slopes generally north with about 18 feet of elevation change across the site. The site is vegetated with grass, blackberries, decorative shrubs, and small- to large-diameter trees.

4.2 Geology

Review of the *Geologic Map of the Lacey 7.5-minute Quadrangle, Thurston County, Washington,* by Robert L. Logan, etc. (2003) indicates that the soil in the project vicinity is mapped as Vashon recessional outwash (Qgo), which is stratified sand and gravel deposited by meltwater streams issuing from the receding Vashon ice sheet. These descriptions are generally similar to the findings in our field explorations.

4.3 Soils

The soils encountered during field exploration include up to 12 feet of loose to medium dense fill comprised of gravel with some sand and trace silt and silty sandy gravel over medium dense native deposits of silty sandy gravel, sandy gravel with trace silt, and gravel with trace to some sand and silt. The gravel deposits were underlain by dense silty sand with gravel at a depth of 14 feet at TP-2.

More detailed descriptions of the subsurface conditions encountered are presented in the test pits included in Appendix A. Sieve analysis was performed on five selected soil samples. Grain size distribution curves are included in Appendix A.

4.4 GROUNDWATER

Light groundwater seepage was encountered at two locations at depths of 13.5 to 23.5 feet during our subsurface exploration.

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. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.5 SEISMIC CONSIDERATIONS

Based on the International Building Code (IBC), RGI recommends the follow seismic parameters for design.

Table 1 IBC

Parameter	2018 Value
Site Soil Class[1]	D[2]
Site Latitude	47.0483
Site Longitude	-122.7609
Short Period Spectral Response Acceleration, S_S (g)	1.378
1-Second Period Spectral Response Acceleration, S_1 (g)	0.5
Adjusted Short Period Spectral Response Acceleration, S_{MS} (g)	1.378
Adjusted 1-Sec Period Spectral Response Acceleration, S_{M1} (g)	0.9[3]
Numeric seismic design value at 0.2 second; S_{DS}(g)	0.919
Numeric seismic design value at 1.0 second; S_{D1}(g)	0.6[3]

1. Note: In general accordance with Chapter 20 of ASCE 7-16, the Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2. Note: ASCE 7-16 require 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 pits extended to a maximum depth of 25 feet, and this seismic site class definition considers that very dense soil continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

3. Note: In accordance with ASCE 11.4.8, a ground motion hazard analysis is not required for the following cases:

- Structures on Site Class E sites with S_S greater than or equal to 1.0, provided the site coefficient Fa is taken as equal to that of Site Class C.
- Structures on Site Class D sites with S_1 greater than or equal to 0.2, provided that the value of the seismic response coefficient Cs is determined by Eq. 12.8-2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for $T_L \geq T > 1.5T_s$ or Eq. 12.8-4 for T > TL.

- Structures on Site Class E sites with S_1 greater than or equal to 0.2, provided that T is less than or equal to T_s and the equivalent static force procedure is used for design.

The above exceptions do not apply to seismically isolated structures, structures with damping systems or structures designed using the response history procedures of Chapter 16.

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 medium dense gravel and lacks an established shallow groundwater table, RGI considers that the possibility of liquefaction during an earthquake is low. Review of the *Liquefaction Susceptibility Map of Thurston County, Washington* by Stephen P. Palmer, etc. (2004) indicates the site is mapped as having a very low liquefaction susceptibility.

4.6 Geologic Hazard Areas

Regulated geologically hazardous areas include erosion, landslide, earthquake, or other geological hazards. Based on the definitions in the Thurston County Code, the site does not contain geologically hazardous areas.

5.0 Discussion and Recommendations

5.1 Geotechnical Considerations

Based on our study, the site is suitable for the proposed construction from a geotechnical standpoint. Foundations for the proposed building can be supported on conventional spread footings bearing on medium dense native soil or structural fill. Slab-on-grade floors and pavements 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.

5.2 Earthwork

Earthwork during plat work will include excavating the retention ponds, grading the lots, installing underground utilities, preparing roadway and sidewalk subgrades. The existing fill soils should be evaluated during construction and may need to be removed under structures and roadways. It may be possible to reuse some of the materials for structural fill provided the organic content is suitable and the debris is removed from the soils.

Earthwork for the home construction, should include excavating and backfilling building foundations and tying into the lot utilities.

5.2.1 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
- Retaining existing vegetation whenever feasible
- 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.

5.2.2 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 pits encountered 6 to 30 inches of topsoil and rootmass. Deeper areas of stripping may be required in forested or heavily vegetated areas of the site.

5.2.3 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 gravel with varying amounts of sand and silt.

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 1.5H:1V (Horizontal:Vertical). 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. 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 five 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.

5.2.4 SITE PREPARATION

RGI anticipates that some areas of loose or soft soil will be exposed upon completion of stripping and grubbing. Proofrolling and subgrade verification should be considered an essential step in site preparation. After stripping, grubbing, and prior to placement of structural fill, RGI recommends proofrolling building and pavement subgrades and areas to receive structural fill. These areas should moisture conditioned and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of

Testing and Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Proofrolling and adequate subgrade compaction can only be achieved when the soils are within approximately ± 2 percent moisture content of the optimum moisture content. Soils which appear firm after stripping and grubbing may be proofrolled with a heavy compactor, loaded double-axle dump truck, or other heavy equipment under the observation of an RGI representative. This observer will assess the subgrade conditions prior to filling. The need for or advisability of proofrolling due to soil moisture conditions should be determined at the time of construction. In wet areas it may be necessary to hand probe the exposed subgrades in lieu of proofrolling with mechanical equipment.

If fill is placed in areas of the site where existing slopes are steeper than 5:1 (Horizontal:Vertical), the area should be benched to reduce the potential for slippage between existing slopes and fills. Benches should be wide enough to accommodate compaction and earth moving equipment, and to allow placement of horizontal lifts of fill.

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. In order to maximize utilization of site soils as structural fill, RGI recommends that the earthwork portion of this project be completed during extended periods of warm and dry weather if possible. If earthwork is completed during the wet season (typically November 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.

5.2.5 STRUCTURAL FILL

Once stripping, clearing and other preparing operations are complete, cuts and fills can be made to establish desired building grades. Prior to placing fill, RGI recommends proof-rolling as described above. The existing fill soils should be evaluated during construction and may need to be removed under structures and roadways. It may be possible to reuse some of the materials for structural fill provided the organic content is suitable and the debris is removed from the soils.

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 structural fill should be placed after completion of site preparation procedures as described above.

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.

Non-organic site soils are only considered suitable for structural fill provided that their moisture content is within about two percent of the optimum moisture level as determined by ASTM D1557. Excavated site soils may not be suitable for re-use as structural fill depending on the moisture content and weather conditions at the time of construction. If soils are stockpiled for future reuse and wet weather is anticipated, the stockpile should be protected with plastic sheeting that is securely anchored.

Even during dry weather, moisture conditioning (such as, windrowing and drying) of site soils to be reused as structural fill may be required. Even during the summer, delays in grading can occur due to excessively high moisture conditions of the soils or due to precipitation. If wet weather occurs, the upper wetted portion of the site soils may need to be scarified and allowed to dry prior to further earthwork, or may need to be wasted from the site.

If on-site soils are or become unusable, it may become 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
4 inches	100
No. 4 sieve	22 to 100
No. 200 sieve	0 to 5*

*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 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.

5.2.6 Cut and Fill Slopes

All permanent cut and fill slopes (except interior slopes of infiltration pond) should be graded with a finished inclination no greater than 2H:1V. The interior slopes of the infiltration pond must be graded with a slope gradient no steeper than 3H:1V. Upon completion of construction, the slope face should be trackwalked, compacted and vegetated, or provided with other physical means to guard against erosion. All fill placed for slope construction should meet the structural fill requirements as described in Section 5.2.5.

Final grades at the top of the slopes must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe of the slope.

5.2.7 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 foundation can be supported on conventional spread footings bearing on medium dense native soil or structural fill. Loose, organic, or other unsuitable soils may be encountered in the proposed building footprint. If unsuitable soils are encountered, they should be overexcavated and backfilled with structural fill.

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.

Table 4 Foundation Design

Design Parameter	Value
Allowable Bearing Capacity	2,000 psf[1]
Friction Coefficient	0.30
Passive pressure (equivalent fluid pressure)	250 pcf[2]

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 they 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 5.2.5. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

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 Walls

If retaining walls are needed for the residences, retaining walls in ponds or for underground vaults, RGI recommends cast-in-place concrete walls be used. Modula block wall may be used for grade changes outside of structures.

The magnitude of earth pressure development on cast-in-place 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 in Figure 3.

With wall backfill placed and compacted as recommended, level backfill 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 - Structural Fill Dense native soils	2,500 psf 4,000 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 in psf 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. RGI recommends that the concrete slab be placed on top of medium dense native soil or structural fill. Immediately below the floor slab, RGI recommends placing a four-inch thick capillary break layer of clean, free-draining sand or gravel that has less than five 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.

For the anticipated floor slab loading, we estimate post-construction floor settlements of 1/4- to 1/2-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 drains. A typical footing drain detail is shown on Figure 4. The foundation 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.

5.6.3 INFILTRATION

RGI understands that an infiltration system is being considered for the on-site disposal of stormwater run-off at the Site. A small-scale Pilot Infiltration Test (PIT) was completed in test pit TP-1 in accordance with the City of Lacey 2022 Stormwater Design Manual (CLSDM). The test pit dimensions were 4 feet by 8 feet, with the test conducted at approximately 6 feet below grade. Soil conditions at the PIT testing horizon are gravel.

Table 6 Measured Infiltration Rates

Test Location	Test Depth	Measured Rate (inches/hour)	K_{sat} Design (inches/hour
TP-1	6	140	21

A Total Correction Factor was applied to the field measured infiltration rate.

Total Correction Factor $CF_T = CF_v$ X CF_t X CF_m

Site variability (CF_v) = 0.33

Test Method (CF_t) = 0.5 Small scale PIT

Influent Control (CF_m) = 0.9

CF_T = 0.33 X 0.5 X 0.9 = 0.15

Application of the Total Correction Factor yields a K_{sat} Design rate of **21 inches/hour**.

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 Lacey specifications. At a minimum, trench backfill should be placed and compacted as structural fill, as described in Section 5.2.5. 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 the referenced ASTM D1557. As noted, soils excavated on site should be suitable for use as backfill material. If on-site soils are or become unusable or do not meet the City of Lacey specifications, imported structural fill meeting the gradation provided in Table 2 should be used for trench backfill.

5.8 Pavements

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

5.8.1 Flexible Pavements

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 minor local access streets:** 4 inches of Hot Mix Asphalt (HMA) class ½ inch PG 64-22 over 2 inches of crushed surfacing base course (CSBC) over 13 inches of ballast or 9 inches of crushed surfacing base course (CSBC)

5.8.2 Concrete Pavements

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

- **For concrete pavement areas**: 4 inches of concrete for sidewalks and 6 inches for driveways over 1 inch of CSTC or well graded sand

The paving materials used should conform to the WSDOT specifications for HMA, concrete paving, and 9-03.9(3) Crushed Surfacing.

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 2 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 cost proposal.

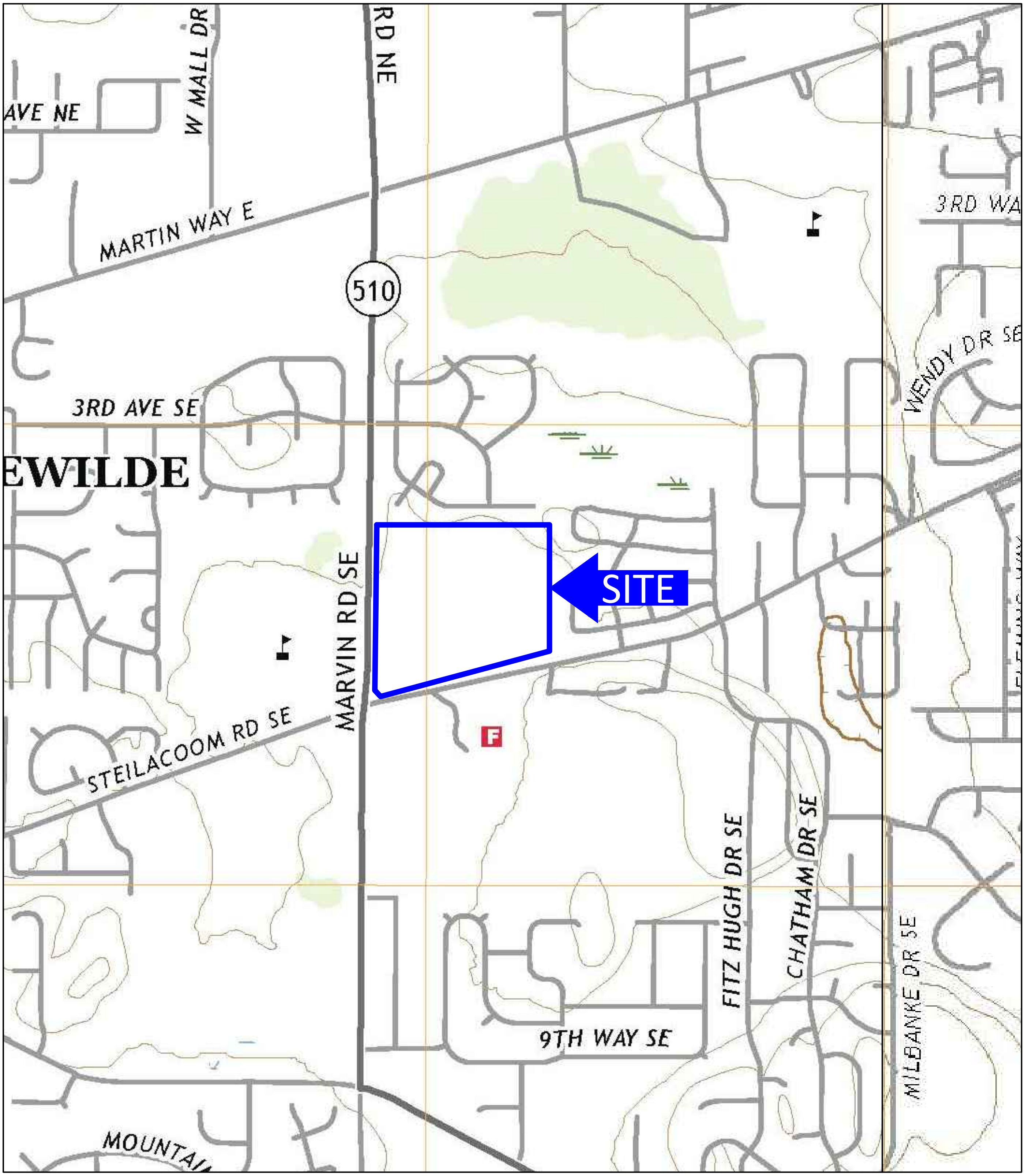
7.0 Limitations

This GER is the property of RGI, D.R. Horton, and its 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 GER was issued. This GER is intended for specific application to the Ostroms Plat project in Lacey, Washington, and for the exclusive use of D.R. Horton and its 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 explorations 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 the 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, 2020, Nisqually, Washington
USGS, 2020, Lacey, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

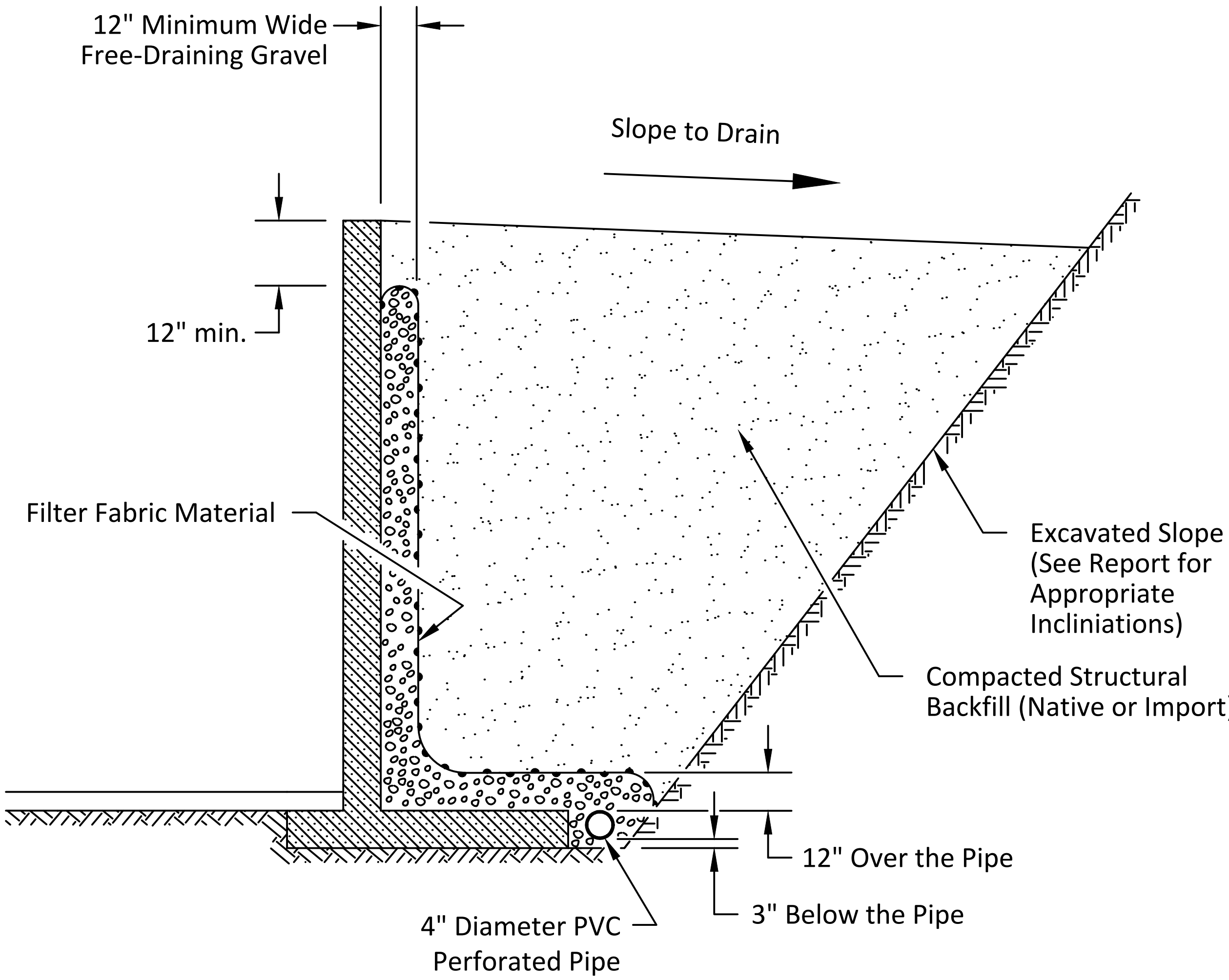
RILEYGROUP
Corporate Office
17522 Bothell Way Northeast
Bothell, Washington 98011
Phone: 425.415.0551
Fax: 425.415.0311

Ostroms Plat		Figure 1
RGI Project Number: 2022-007-2	Site Vicinity Map	Date Drawn: 06/2022
Address: 8322 Steilacoom Road Southeast, Lacey, Washington 98513		

= Monitoring well by RGI, 01/20/22
= Test pit by RGI, 02/03-04/22
= Site boundary

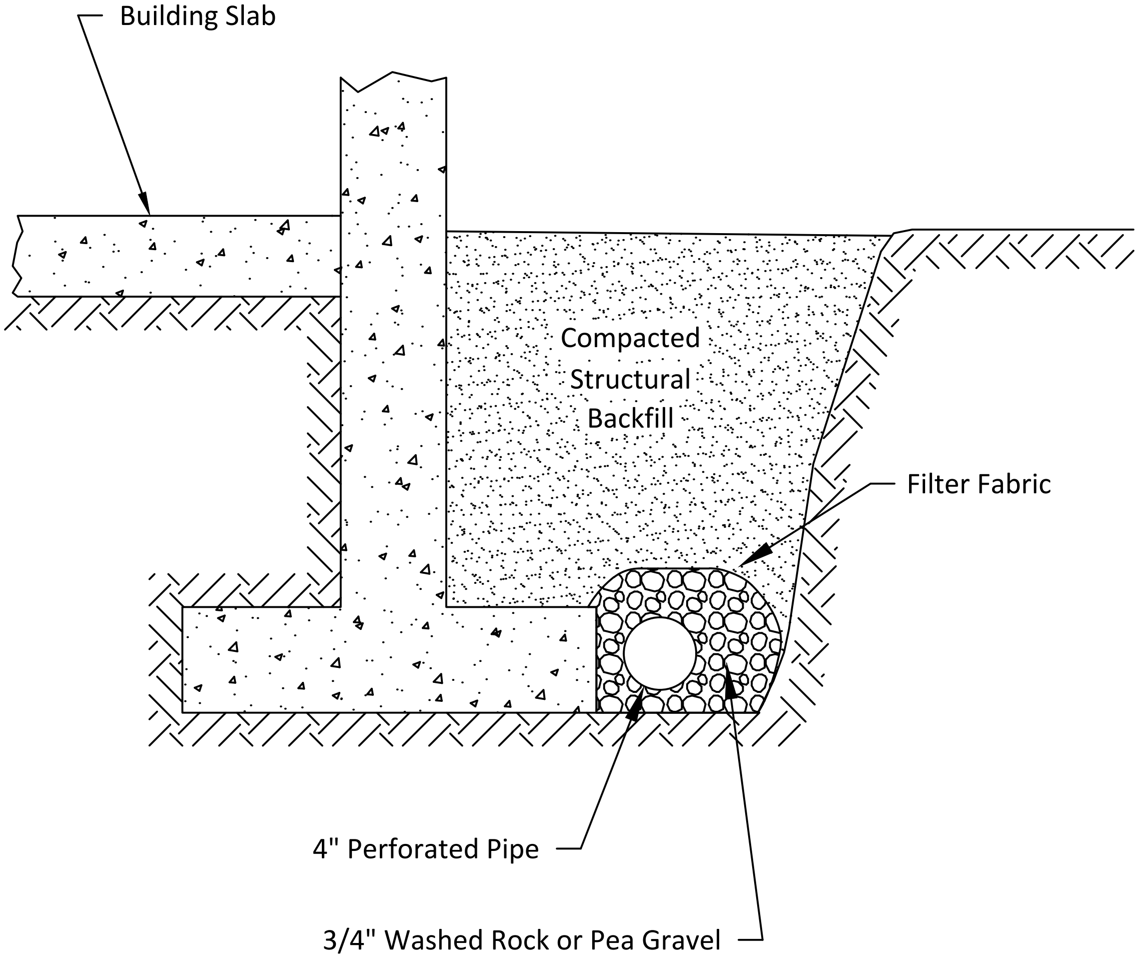
Approximate Scale: 1"=200'
0 100 200 400
N

Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	Ostroms Plat		Figure 2
	RGI Project Number: 2022-007-2	Geotechnical Exploration Plan	Date Drawn: 06/2022
	Address: 8322 Steilacoom Road Southeast, Lacey, Washington 98513		



Not to Scale

RILEYGROUP Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	Ostroms Plat	Figure 3
	RGI Project Number: 2022-007-2 / Retaining Wall Drainage Detail	Date Drawn: 06/2022
	Address: 8322 Steilacoom Road Southeast, Lacey, Washington 98513	



Not to Scale

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Fax: 425.415.0311

Ostroms Plat		Figure 4
RGI Project Number: 2022-007-2	Typical Footing Drain Detail	Date Drawn: 06/2022
Address: 8322 Steilacoom Road Southeast, Lacey, Washington 98513		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On January 20, and February 3 and 4, 2022, RGI performed field explorations using a drill rig and an excavator. We explored subsurface soil conditions at the site by observing the excavation/drilling of 2 monitoring wells and 11 test pits to a maximum depth of 25 feet below existing grade. The well and test pit locations are shown on Figure 2. The well and test pit locations were approximately determined by measurements from existing property lines and paved roads.

A geologist 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, plasticity, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with ASTM 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 pit logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses was determined using D6913-04(2009) Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis (ASTM D6913) on five of the samples.

Project Name: **Ostroms Plat**	Well No.: **MW-1**
Project Number: **2022-007-1**	**Sheet 1 of 1**
Client: **DR Horton**	

Date(s) Drilled: **01/20/22**	Logged By: **JH**	Surface Conditions: **Grass**
Drilling Method(s): **Geoprobe**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **20 feet bgs**
Drill Rig Type: **Geoprobe 7730 DT**	Drilling Contractor: **RGI**	Approximate Surface Elevation (feet amsl): **n/a**
Groundwater Level and Date Measured: **Not Encountered**	Sampling Method(s): **Continuous**	Hammer Data : **n/a**
Borehole Backfill: **Bentonite**	Location: **8322 Steilacoom Road Southeast, Lacey, Washington 98513**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	PID Reading, ppb	Recovery (percent)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	REMARKS AND OTHER TESTS
	0					Topsoil		Topsoil		Concrete 0-1'
						GP		Tan, sandy GRAVEL with trace silt, dense, moist		1" Blank PVC Well Casing 0-10 Bentonite 1'-9'
	5									
								Becomes gray		
	10					GP		Gray, GRAVEL with some sand, trace silt, dense, moist		Sand Pack 9'-20'
	15					GP		Gray, sandy GRAVEL, trace silt		1" Well Screen 10'-20'
	20							Test probe refusal 20 feet bgs		

Project Name: **Ostroms Plat**	Well No.: **MW-2**
Project Number: **2022-007-1**	**Sheet 1 of 2**
Client: **DR Horton**	RILEYGROUP

Date(s) Drilled: **01/20/22**	Logged By: **JH**	Surface Conditions: **Grass**
Drilling Method(s): **Geoprobe**	Drill Bit Size/Type: **2.25"**	Total Depth of Borehole: **25 feet bgs**
Drill Rig Type: **Geoprobe 7730 DT**	Drilling Contractor: **RGI**	Approximate Surface Elevation (feet amsl): **n/a**
Groundwater Level and Date Measured: **23.5'**	Sampling Method(s): **Continuous**	Hammer Data : **n/a**
Borehole Backfill: **Native Soil**	Location: **8322 Steilacoom Road Southeast, Lacey, Washington 98513**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	PID Reading, ppb	Recovery (percent)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	REMARKS AND OTHER TESTS
	0					Topsoil		Topsoil		Concrete 0-1'
						GP		Tan, sandy GRAVEL, trace silt, dense, moist		1" Blank PVC Well Casing 0-15 Bentonite 1'-14'
	5									
								Becomes gray		
	10					GP		Gray, GRAVEL with some sand, trace silt, dense, moist		
	15					GP		Gray, sandy GRAVEL, trace silt, dense, moist		Sand Pack 14'-25' 1" Well Screen 15'-25'
	20									

Project Name: **Ostroms Plat**
Project Number: **2022-007-1**
Client: **DR Horton**

RILEYGROUP

Well No.: **MW-2**

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	PID Reading, ppb	Recovery (percent)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	REMARKS AND OTHER TESTS
	20					GP		Gray, sandy GRAVEL, trace silt, dense, moist		
	25							Test probe refusal 25 feet bgs Groundwater encountered @ 23.5 feet		
	30									
	35									
	40									
	45									
	50									

Project Name: **Ostroms Plat**
Project Number: **2022-007-1**
Client: **DR Horton**

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Boring Log Key
Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	PID Reading, ppb	Recovery (percent)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Well Log	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11

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 PID Reading, ppb: The reading from a photo-ionization detector, in parts per million.
6 Recovery (percent): Percent Recovery
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 Well Log: Graphical representation of well installed upon completion of drilling and sampling.
11 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

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

Bentonite chips
Portland Cement Concrete
Poorly graded GRAVEL (GP)
Poorly graded SAND (SP)

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.

Project Name: **Ostroms Plat**	**Test Pit No.: TP-1**
Project Number: **2022-007-2**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **9 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		Black gravelly topsoil with trace garbage debris, loose, moist (Fill)	
				GP		Brown GRAVEL with trace sand and silt, medium dense, moist	
		Grab					3% moisture, 1% fines
	5						
						Infiltration test at 6'	
		Grab					3% moisture, 2% fines
				GW		Brown GRAVEL with trace sand and silt, medium dense, moist	
						Abundant cobbles and boulders	
		Grab					3% moisture, 1% fines
						Test Pit terminated at 9'	
	10						
	15						

Project Name: **Ostroms Plat**
Project Number: **2022-007-2**
Client: **D.R. Horton**

RILEYGROUP

Test Pit No.: TP-2

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Blackberries**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **14.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Seepage at 13.5'**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		2.5' topsoil	
				GP-GM		Brown GRAVEL with some sand and silt, medium dense, moist	
	5			GP		Gray GRAVEL with trace sand and silt, medium dense, moist	
						Occasional cobble	
						Abundant cobbles	
	10						
						Occasional boulder	
						Light groundwater seepage	
				SM		Gray silty SAND with some gravel, dense, moist	9% moisture
						Test Pit terminated at 14.5'	
	15						

Project Name: **Ostroms Plat**
Project Number: **2022-007-2**
Client: **D.R. Horton**

RILEYGROUP

Test Pit No.: TP-3

Sheet 1 of 1

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **12 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		12" topsoil	
				Fill		Gray GRAVEL with some sand and trace silt, medium dense, moist (Fill)	
				TPSL		Topsoil	
	5			GP-GM		Brown GRAVEL with some sand and silt, medium dense, moist	14% moisture
				GP		Gray GRAVEL with trace sand and silt, medium dense, moist	3% moisture
	10						
						Test Pit terminated at 12'	
	15						

Project Name: **Ostroms Plat**	**Test Pit No.: TP-4**
Project Number: **2022-007-2**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		6" topsoil	
				Fill		Gray GRAVEL with some sand and trace silt, medium dense, moist (Fill)	
				GP		Brown GRAVEL with trace sand and silt, medium dense, moist	
		Grab					5% moisture
						Occasional cobble	
	5						
						Test Pit terminated at 6'	
	10						
	15						

Project Name: **Ostroms Plat** Project Number: **2022-007-2** Client: **D.R. Horton**	RILEYGROUP # Test Pit No.: TP-5 **Sheet 1 of 1**

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **12.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		Gravelly topsoil	
				Fill		Brown GRAVEL with some sand and trace silt, medium dense, moist	
		Grab				Contains concrete rubble to 12'	8% moisture, 4% fines
	5						
	10						
				GP		Brown GRAVEL with some sand and trace silt, medium dense, moist	
						Test Pit terminated at 12.5'	
	15						

Project Name: **Ostroms Plat**
Project Number: **2022-007-2**
Client: **D.R. Horton**

RILEYGROUP

Test Pit No.: TP-6

Sheet 1 of 1

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **9 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s)	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		6" topsoil	
				Fill		Dark brown GRAVEL with some sand and trace silt, medium dense, moist (Fill)	
						Contains concrete and wood debris	
	5						
				GP		Brown GRAVEL with some sand, medium dense, moist	
						Test Pit terminated at 9'	
	10						
	15						

Project Name: **Ostroms Plat**	Test Pit No.: TP-7
Project Number: **2022-007-2**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **13.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s)	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		6" topsoil	
				Fill		Brown GRAVEL with some sand and trace silt, loose to medium dense, moist (Fill)	
	5						
						Becomes black, moist to wet	
	10						
				GM		Brown silty sandy GRAVEL, medium dense, moist	
						Test Pit terminated at 13.5'	
	15						

Project Name: **Ostroms Plat**	Test Pit No.: TP-8
Project Number: **2022-007-2**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass, Moss**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s)	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		12" topsoil	
				Fill		Brown silty sandy GRAVEL, medium dense, moist (Fill) Concrete debris	
	5						
				GM		Reddish brown silty sandy GRAVEL, medium dense, moist	
						Test Pit terminated at 6.5'	
	10						
	15						

Project Name: **Ostroms Plat**	RILEYGROUP
Project Number: **2022-007-2**	Test Pit No.: TP-9
Client: **D.R. Horton**	**Sheet 1 of 1**

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass, Moss**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		18" topsoil	
				GP-GM		Brown GRAVEL with some sand and silt, medium dense, moist	
	5			GP		Gray GRAVEL with some sand and trace silt, medium dense, moist Contains sand lenses	
		Grab					2% moisture
						Test Pit terminated at 6'	
	10						
	15						

Project Name: **Ostroms Plat**
Project Number: **2022-007-2**
Client: **D.R. Horton**

Test Pit No.: TP-10

Sheet 1 of 1

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		8" topsoil	
				Fill		Brown GRAVEL with some sand and trace silt, medium dense, moist (Fill)	
		Grab		GP		Gray GRAVEL with some sand and trace silt, medium dense, moist	3% moisture
	5					Test Pit terminated at 5'	
	10						
	15						

Project Name: **Ostroms Plat**	Test Pit No.: TP-11
Project Number: **2022-007-2**	**Sheet 1 of 1**
Client: **D.R. Horton**	RILEYGROUP

Date(s) Excavated: **2/3/2022**	Logged By **ELW**	Surface Conditions: **Grass**
Excavation Method: **Test Pit**	Bucket Size: **N/A**	Total Depth of Excavation: **6.5 feet bgs**
Excavator Type: **Tracked Excavator**	Excavating Contractor: **Client Provided**	Approximate Surface Elevation **N/A**
Groundwater Level: **Not Encountered**	Sampling Method(s) **Grab**	Compaction Method **Bucket**
Test Pit Backfill: **Cuttings**	Location **8322 Steilacoom Road Southeast, Lacey, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
	0			TPSL		12" gravelly topsoil	
				GW		Reddish brown GRAVEL with trace sand and silt, medium dense, moist	5% moisture, 1% fines
				GP		Gray sandy GRAVEL with trace silt, medium dense, moist	4% moisture
	5						
						Test Pit terminated at 6.5'	
	10						
	15						

Project Name: **Ostroms Plat**
Project Number: **2022-007-2**
Client: **D.R. Horton**

Key to Logs

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8

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 Number: Sample identification number.
5 USCS Symbol: USCS symbol of the subsurface material.
6 Graphic Log: Graphic depiction of the subsurface material encountered.
7 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
8 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

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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

AF
Silty GRAVEL (GM)
Poorly graded GRAVEL (GP)
Poorly graded GRAVEL with Silt (GP-GM)
Well graded GRAVEL (GW)
Silty SAND (SM)
Topsoil

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
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.

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

PROJECT TITLE	Ostroms Plat	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2022-007-1	SAMPLE DEPTH	2.5'
TECH/TEST DATE	CM/EW 2/10/2022	DATE RECEIVED	2/4/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	848.8
Wt Dry Soil & Tare (gm)	(w2)	825.4
Weight of Tare (gm)	(w3)	133.3
Weight of Water (gm)	(w4=w1-w2)	23.4
Weight of Dry Soil (gm)	(w5=w2-w3)	692.1
Moisture Content (%)	(w4/w5)*100	3

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

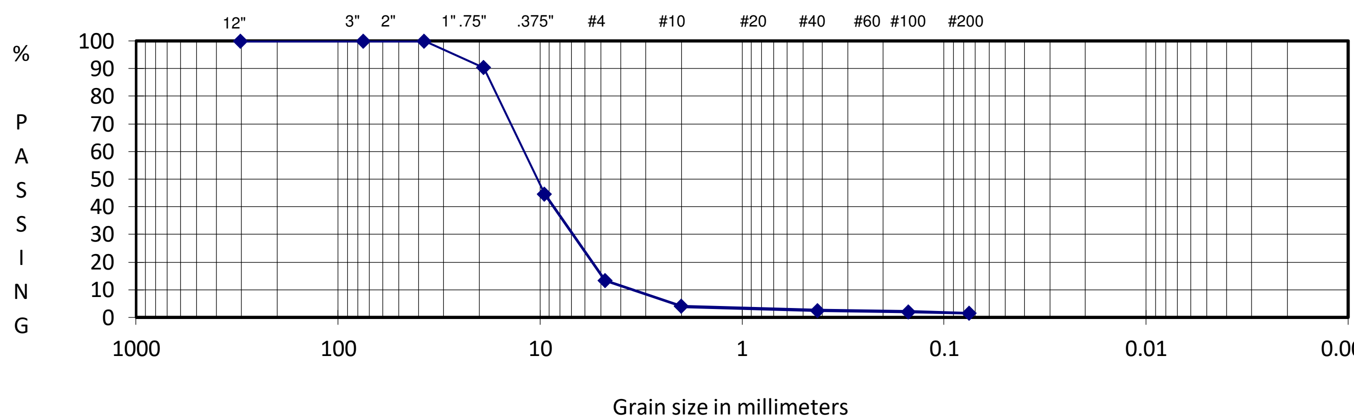
	Weight Of Sample (gm)	825.4
	Tare Weight (gm)	133.3
(W6)	Total Dry Weight (gm)	692.1

% COBBLES	0.0
% C GRAVEL	9.6
% F GRAVEL	77.2
% C SAND	9.3
% M SAND	1.4
% F SAND	1.1
% FINES	1.4
% TOTAL	100.0

D10 (mm)	3.4
D30 (mm)	6.9
D60 (mm)	13
Cu	3.8
Cc	1.1

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	133.3	0.00	0.00	100.00	cobbles
3.0"	133.3	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	133.3	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	200.0	66.70	9.64	90.36	fine gravel
0.50"					fine gravel
0.375"	516.2	382.90	55.32	44.68	fine gravel
#4	734.0	600.70	86.79	13.21	coarse sand
#10	798.1	664.80	96.06	3.94	medium sand
#20					medium sand
#40	807.9	674.60	97.47	2.53	fine sand
#60					fine sand
#100	811.6	678.30	98.01	1.99	fine sand
#200	815.6	682.30	98.58	1.42	fines
PAN	825.4	692.10	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with trace sand and silt
USCS	GP

Prepared For:
D.R. Horton

Reviewed By:
ELW

RILEYGROUP

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

PROJECT TITLE	Ostroms Plat	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2022-007-1	SAMPLE DEPTH	6'
TECH/TEST DATE	CM/EW 2/10/2022	DATE RECEIVED	2/4/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	885.6
Wt Dry Soil & Tare (gm)	(w2)	861.5
Weight of Tare (gm)	(w3)	76.4
Weight of Water (gm)	(w4=w1-w2)	24.1
Weight of Dry Soil (gm)	(w5=w2-w3)	785.1
Moisture Content (%)	(w4/w5)*100	3

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

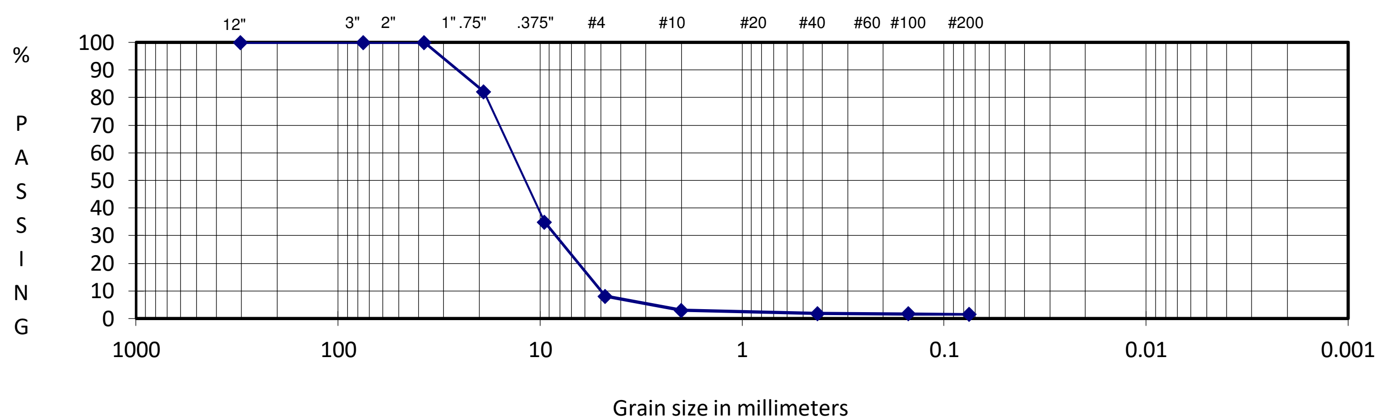
	Weight Of Sample (gm)	861.5
	Tare Weight (gm)	76.4
(W6)	Total Dry Weight (gm)	785.1

% COBBLES	0.0
% C GRAVEL	17.9
% F GRAVEL	74.1
% C SAND	5.1
% M SAND	1.1
% F SAND	0.3
% FINES	1.5
% TOTAL	100.0

D10 (mm)	4.9
D30 (mm)	8.5
D60 (mm)	15
Cu	3.1
Cc	1.0

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	76.4	0.00	0.00	100.00	cobbles
3.0"	76.4	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	76.4	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	217.2	140.80	17.93	82.07	fine gravel
0.50"					fine gravel
0.375"	587.6	511.20	65.11	34.89	fine gravel
#4	798.8	722.40	92.01	7.99	coarse sand
#10	838.7	762.30	97.10	2.90	medium sand
#20					medium sand
#40	847.0	770.60	98.15	1.85	fine sand
#60					fine sand
#100	848.2	771.80	98.31	1.69	fine sand
#200	849.5	773.10	98.47	1.53	fines
PAN	861.5	785.10	100.00	0.00	silt/clay



DESCRIPTION GRAVEL with trace sand and silt

USCS GP

Prepared For:
D.R. Horton

Reviewed By:
ELW

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

PROJECT TITLE	Ostroms Plat	SAMPLE ID/TYPE	TP-1
PROJECT NO.	2022-007-1	SAMPLE DEPTH	8.5'
TECH/TEST DATE	CM/EW 2/10/2022	DATE RECEIVED	2/4/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	780.6
Wt Dry Soil & Tare (gm)	(w2)	760.9
Weight of Tare (gm)	(w3)	125.5
Weight of Water (gm)	(w4=w1-w2)	19.7
Weight of Dry Soil (gm)	(w5=w2-w3)	635.4
Moisture Content (%)	(w4/w5)*100	3

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

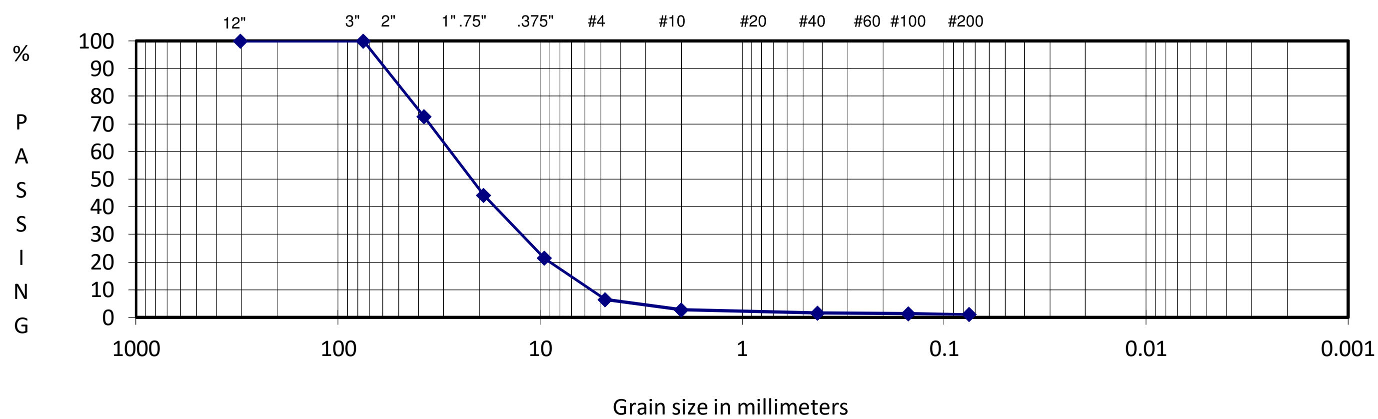
	Weight Of Sample (gm)	760.9
	Tare Weight (gm)	125.5
(W6)	Total Dry Weight (gm)	635.4

% COBBLES	0.0
% C GRAVEL	55.9
% F GRAVEL	37.7
% C SAND	3.7
% M SAND	1.2
% F SAND	0.5
% FINES	1.1
% TOTAL	100.0

D10 (mm)	5.7
D30 (mm)	13
D60 (mm)	28
Cu	4.9
Cc	1.1

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	125.5	0.00	0.00	100.00	cobbles
3.0"	125.5	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	300.5	175.00	27.54	72.46	coarse gravel
1.0"					coarse gravel
0.75"	480.7	355.20	55.90	44.10	fine gravel
0.50"					fine gravel
0.375"	625.4	499.90	78.67	21.33	fine gravel
#4	720.2	594.70	93.59	6.41	coarse sand
#10	743.4	617.90	97.25	2.75	medium sand
#20					medium sand
#40	750.8	625.30	98.41	1.59	fine sand
#60					fine sand
#100	752.6	627.10	98.69	1.31	fine sand
#200	754.0	628.50	98.91	1.09	fines
PAN	760.9	635.40	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with trace sand and silt
USCS	GW

Prepared For:
D.R. Horton

Reviewed By:
ELW

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

PROJECT TITLE	Ostroms Plat	**SAMPLE ID/TYPE**	TP-5
PROJECT NO.	2022-007-1	**SAMPLE DEPTH**	2'
TECH/TEST DATE	CM/EW 2/10/2022	**DATE RECEIVED**	2/4/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	886.7
Wt Dry Soil & Tare (gm)	(w2)	819.1
Weight of Tare (gm)	(w3)	16.0
Weight of Water (gm)	(w4=w1-w2)	67.6
Weight of Dry Soil (gm)	(w5=w2-w3)	803.1
Moisture Content (%)	(w4/w5)*100	8

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

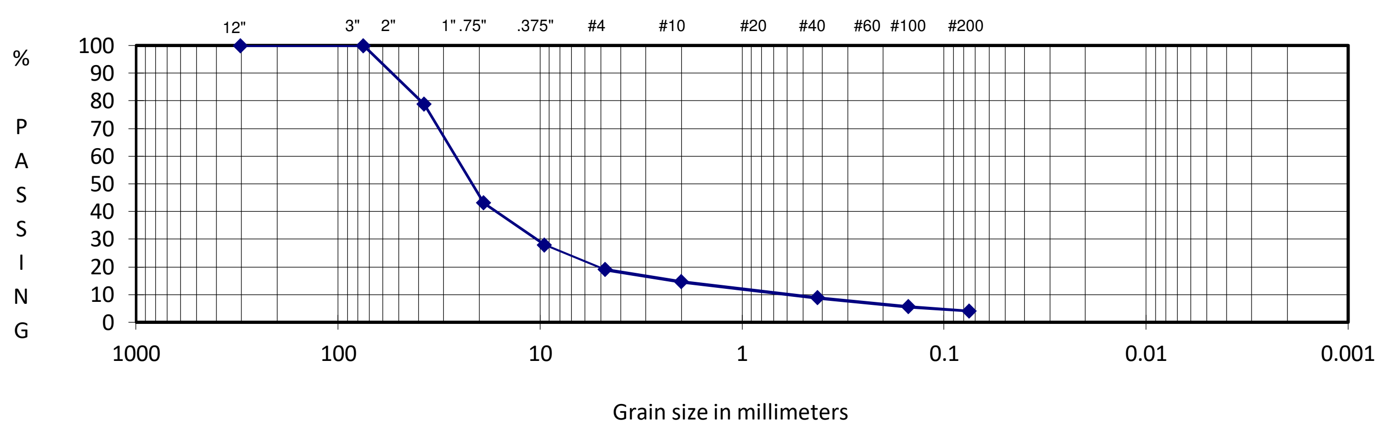
	Weight Of Sample (gm)	819.1
	Tare Weight (gm)	16.0
(W6)	Total Dry Weight (gm)	803.1

% COBBLES	0.0
% C GRAVEL	56.8
% F GRAVEL	24.1
% C SAND	4.4
% M SAND	5.8
% F SAND	4.9
% FINES	3.9
% TOTAL	100.0

D10 (mm)	0.6
D30 (mm)	10
D60 (mm)	27
Cu	45.0
Cc	6.2

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.0	0.00	0.00	100.00	cobbles
3.0"	16.0	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	186.3	170.30	21.21	78.79	coarse gravel
1.0"					coarse gravel
0.75"	472.4	456.40	56.83	43.17	fine gravel
0.50"					fine gravel
0.375"	594.6	578.60	72.05	27.95	fine gravel
#4	666.0	650.00	80.94	19.06	coarse sand
#10	701.4	685.40	85.34	14.66	medium sand
#20					medium sand
#40	747.8	731.80	91.12	8.88	fine sand
#60					fine sand
#100	774.3	758.30	94.42	5.58	fine sand
#200	787.4	771.40	96.05	3.95	fines
PAN	819.1	803.10	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with some sand and trace silt
USCS	GP

Prepared For:
D.R. Horton

Reviewed By:
ELW

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

PROJECT TITLE	Ostroms Plat	SAMPLE ID/TYPE	TP-11
PROJECT NO.	2022-007-1	SAMPLE DEPTH	1.5'
TECH/TEST DATE	CM/EW 2/10/2022	DATE RECEIVED	2/4/2022

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	785.0
Wt Dry Soil & Tare (gm)	(w2)	751.1
Weight of Tare (gm)	(w3)	16.1
Weight of Water (gm)	(w4=w1-w2)	33.9
Weight of Dry Soil (gm)	(w5=w2-w3)	735.0
Moisture Content (%)	(w4/w5)*100	5

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

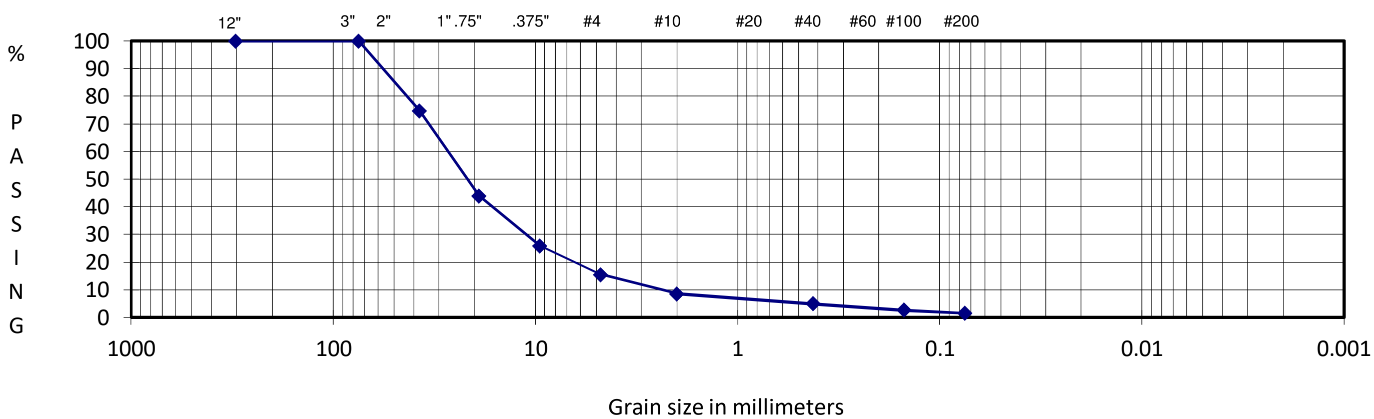
	Weight Of Sample (gm)	751.1
	Tare Weight (gm)	16.1
(W6)	Total Dry Weight (gm)	735.0

% COBBLES	0.0
% C GRAVEL	56.0
% F GRAVEL	28.6
% C SAND	6.8
% M SAND	3.6
% F SAND	3.6
% FINES	1.4
% TOTAL	100.0

D10 (mm)	2.3
D30 (mm)	11
D60 (mm)	28
Cu	12.2
Cc	1.9

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.1	0.00	0.00	100.00	cobbles
3.0"	16.1	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	202.1	186.00	25.31	74.69	coarse gravel
1.0"					coarse gravel
0.75"	427.9	411.80	56.03	43.97	fine gravel
0.50"					fine gravel
0.375"	560.7	544.60	74.10	25.90	fine gravel
#4	637.9	621.80	84.60	15.40	coarse sand
#10	688.2	672.10	91.44	8.56	medium sand
#20					medium sand
#40	714.6	698.50	95.03	4.97	fine sand
#60					fine sand
#100	731.8	715.70	97.37	2.63	fine sand
#200	740.8	724.70	98.60	1.40	fines
PAN	751.1	735.00	100.00	0.00	silt/clay



DESCRIPTION	GRAVEL with trace sand and silt
USCS	GW

Prepared For:
D.R. Horton

Reviewed By:
ELW

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