Attachment 10

RCVD 5/9/2019

Materials Testing & Consulting, Inc.

Geotechnical Engineering ● Materials Testing ● Special Inspection ● Environmental Consulting

February 8, 2019

Urban Olympia 9 LLC
Attn: Walker John
P.O. Box 7534
Olympia, WA 98507

c/o: Thomas Architecture Studios
525 Columbia Street SW
Olympia, WA
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Subject: Report of Geotechnical Investigation and Engineering
Urban Olympia
Corner of State Ave NW & Water St NW
Olympia, WA

MTC Project No.: 18S023-02

Dear Mr. John:

This letter transmits our Geotechnical Investigation and Engineering Report for the above-referenced project. Materials Testing & Consulting, Inc. (MTC) performed this geotechnical engineering study in accordance with our Proposal for Geotechnical Services, dated October 26, 2018.

We would be pleased to continue our role as your geotechnical engineering consultants during the project phases of planning and construction. We also have a keen interest in providing materials testing and special inspection during construction of this project. We will be pleased to meet with you at your convenience to discuss these services.

We appreciate the opportunity to provide geotechnical engineering services to you for this project. If you have any questions regarding this report, or if we can provide assistance with other aspects of the project, please contact me at (360) 534-9777.

Respectfully Submitted,
MATERIALS TESTING & CONSULTING, INC.

Medhanie G. Tecle, P.E.
Engineering Manager

Luke Preston McCann, G.I.T.
Senior Geologist

Attachment: Report of Geotechnical Investigation and Engineering

REPORT OF GEOTECHNICAL INVESTIGATION AND ENGINEERING

URBAN OLYMPIA

INTERSECTION OF STATE AVE NW & WATER ST NW
OLYMPIA WASHINGTON

Prepared for:

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February 8, 2019
MTC Project No.: 18S023-02

Table of Contents

1.0 INTRODUCTION

1.1 GENERAL

This report presents the findings and recommendations of Materials Testing & Consulting, Inc.'s (MTC) geotechnical investigation and engineering conducted in support of new developments, facility design, and construction. A regional vicinity and existing aerial photo of the project site are shown in Figures 1 and 2 of Appendices A and B, respectively.

1.2 PROJECT DESCRIPTION

MTC understands the project mainly entails the design and construction of a new mixed-use building, comprising retail and parking on the ground floor and 4 stories of apartment units above. Exterior improvements are anticipated to include infrastructure for auto access and parking, flatworks, and other necessary site amenities. MTC has been contracted to perform a geotechnical investigation of the proposed site to provide foundation and site development recommendations. Exploration locations were chosen by the client and altered as needed to avoid existing utilities.

MTC understands that the proposed building is anticipated to employ a deep foundation or ground improvement elements in support of an integrated concrete and wood-framed construction. It is anticipated that loads will be typical for the type and materials of construction and that no unusually large, industrial, or vibratory loads are expected. MTC should be allowed to review the final plans and specifications for the project to ensure that the recommendations presented herein are appropriate. Recommendations and conclusions presented by this report will need to be re-evaluated in the event that significant changes to the proposed construction are made.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of our study was to explore and document subsurface conditions at the site, assess geohazard conditions, and to provide geotechnical engineering recommendations for design and construction of the proposed development. Our scope of services was consistent with that presented in our Proposal for Geotechnical Engineering Services, dated October 26, 2018.

2.0 SITE EXPLORATION

2.1 FIELD WORK

Site exploration activities were performed on January 11, 2019. Exploration location was marked in the field by an MTC Project Geologist with respect to the provided map and cleared for private conductible utilities. Our exploration location was selected by an MTC Project Geologist prior to field work to provide safest access to relevant soil conditions. The geologist directed borehole advancement and sampling procedures, observed and logged samples, and recorded SPT (Standard Penetration Test) results. Activities involved observing the drilling of one (1) hollow-stem-auger boring located in the northeast corner of the property where the main structure is proposed. The borehole was advanced within the vicinity of the anticipated development footprint areas to a depth of approximately 100 feet below present grade (BPG) in general accordance with the specified contract depth. During advancement of the boring, the geologist logged, visually classified, and sampled the encountered subsurface soils in accordance with the Unified Soil Classification System (USCS) as well as ASTM D2487. Representative soil samples were collected of each unit encountered, identified according to boring location and depth, and placed in plastic bags to protect against moisture loss, and transported to an MTC laboratory for supplemental classification and analysis.

Complete borehole log is provided in Appendix D of this report. Exploration location is shown in Figure 2 of Appendix B.

3.0 EXISTING SOIL CONDITIONS

3.1 SITE SURFACE CONDITIONS

The project area is entirely flat consisting of an asphalt and a gravel parking area. Regionally, the site is located adjacent to the Bud Inlet in an area dominated by varying historic industrial fill, presenting generally flat topography.

3.2 AREA GEOLOGY

The *Geologic Map of the Tumwater 7.5-minute Quadrangle, Thurston County (Walsh et al. 2003)*, published by the Washington State Department of Natural Resources (DNR), indicates that the site is mapped as historic fills (Qf), commonly described as mixed clay, silt, sand and / or gravels placed to significantly raise or redefine topography. Fills can consist of engineered and nonengineered fills where placement is considered to be structurally significant. Soils of this nature in this area commonly have high ground water, and are potentially liquefiable due to their loose, compressible, and saturated nature.

3.3 SURFACE AND SUBSURFACE SOIL CONDITIONS

The exploration log in Appendix D present details of surface and subsurface soils encountered. The soils are generally characterized as follows in stratigraphic order of depth:

- **Parking Surface – Asphalt, Concrete, Crushed Surface Rock:**
  Existing surface developments include a heavily cracked concrete slab over the eastern portion of the site, with asphalt patching in places. Gravel lot surfacing covers the western portions of the site. These exist over a thin layer of leveling construction fill.

- **Historic Uncontrolled Grade Fill:**
  Present beneath site surfacing, our boring exposed variable layers composed of loose sandy soils containing varying quantities of wood debris, sea shell fragments and other intermixed debris. These sediments were observed to extend approximately 15 feet BPG, with the amounts of detritus material decreasing with depth.

- **Native Coarse-grained Deposits (possible intermixed fill) – Sand and Gravel (SP, GP):**
  Beneath historic fills, native sediments encountered from approximately 15 to 55 feet BPG were variable units of sands and gravels. These sediments were generally gray in color, medium dense, and wet, with gravel up to 1.0 inch in diameter.

- **Underlying Fine-grained Deposits (Possible Pre-glacial Lacustrine Deposits) – Silt (ML):**
  Beneath historic grade fill, native soils were primarily fine-grained silts. These soils were gray in color, stiff to very stiff in consistency, moderately cohesive, wet, and contained variably low amounts of sand. Laboratory test results of sediment encountered at 60 feet BPG revealed a

plasticity index of 2.9 percent, which indicates generally low plasticity. This unit was encountered through the maximum depths explored beyond 100 feet to approximately 102.5 feet BPG.

3.4 SURFACE AND GROUNDWATER CONDITIONS

MTC assessed general site conditions in terms of design considerations for potential on-site stormwater management feasibility. Projects in the feasibility or conceptual design stage are typically anticipated to incorporate on-site infiltration to the extent and use feasible for the existing subsurface conditions. We understand the project will be subject to the Washington Department of Ecology *Stormwater Management Manual for Western Washington* (DoE SMMWW).

Natural surface water features were not present within the project area at the time of this study. Bud Inlet is located approximately 75 feet west of the anticipated building footprint, separated from the engineered embankment by Water Street SW.

Available geotechnical data from nearby developments in similar soil conditions report an observed water table near 7 feet BPG, and perched water conditions as shallow as 3 feet BPG. MTC recommends the design consider the potential max seasonal water table to be approximately 3 feet below present grade at this time.

With noted shallow reported water table elevations in the vicinity, conditions appear generally prohibitive to in-ground infiltration facilities, as well as structural basement features. Embedded foundation elements will need to account for potential hydrostatic pressure, uplift, and dewatering methods.

MTC's scope of work did not include determination or monitoring of seasonal groundwater elevation variations, formal documentation of wet season site conditions, or conclusive measurement of groundwater elevations at depths past the extent feasible for explorations at the time of the field explorations.

4.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

4.1 GENERAL SITE SOIL CONDITIONS

The results of MTC's investigation indicate shallow and deep subsurface conditions at the proposed building area consist of generally loose historic artificial grade fill, and other liquefiable deposits of variable composition, containing various thicknesses of silt, sands, and localized areas containing relict organic debris. Therefore, local soil conditions pose significant difficulty for all aspects of site design and are generally not be suitable for direct support of foundations without amendment.

Foundation design specifications were not available to MTC at the time of preparation of this report. However, MTC assumes that the building structures will incorporate continuous perimeter grade beams as well as isolated footings with a slab-on-grade floor, incorporating soil amendment, and underpinning as determined by the structural design team. Finished grade is assumed to be similar to existing grade; therefore, shallow conditions of the existing site soils are relevant to slab-on-grade construction.

4.2 SEISMIC DESIGN PARAMETERS AND LIQUEFACTION POTENTIAL

According to the Liquefaction Susceptibility Map of Thurston County, Washington (Palmer et al., 2004), the site is identified as having a high liquefaction susceptibility. This is generally consistent with the findings of MTC's investigation to date. Liquefaction is a phenomenon typically associated with a subsurface profile of relatively loose, cohesionless soils saturated by groundwater. Under seismic shaking the pore pressure can exceed the soil's shear resistance and the soil 'liquefies', which may result in excessive differential settlements that are damaging to structures and disruptive to exterior improvements. The accompanying *Seismic Site Class Map* (Palmer et al., 2004) classifies the project regional vicinity as *Site Class D to E* depending on site-level variations and deviations. These seismic map designations appear directly related to the geologic mapping of the project vicinity as a lahar deposit exhibiting shallow groundwater.

The USGS Seismic Design Map Tool was used to determine seismic design coefficients and spectral response accelerations assuming Site Class D, representing a generally stiff or dense soil profile (upper 100 feet). Parameters in Table 1 were calculated using 2008 USGS hazard data and 2012/2015 International Building Code standards. ASCE 7-10 was referenced for site Peak Ground Acceleration.

Table 1. Seismic Design Parameters – Site Class D

Mapped Acceleration Parameters (MCE horizontal)	S_S	1.33 g
	S_1	0.546 g
Site Coefficient Values	F_a	1.000
	F_v	1.500
Calculated Peak SRA	S_{MS}	1.330 g
	S_{M1}	0.820 g
Design Peak SRA (*2/3 of peak*)	S_{DS}	0.887g
	S_{D1}	0.546 g
MCE Peak Ground Acceleration Maximum (PGA_M)		0.500
Seismic Design Category – Short Period (0.2 Second) Acceleration		D
Seismic Design Category – 1-Second Period Acceleration		D

Based on the findings of this study, the site is generally considered to have a high risk of liquefaction-induced settlement due to the relatively loose silty and sandy soils and relatively shallow reported groundwater. Liquefaction analysis was completed to further constrain the potential settlement that could be induced by a design-magnitude seismic event, and to address the need for additional mitigations to facilitate the proposed construction.

4.3 LIQUEFACTION HAZARD ANALYSIS

MTC performed a site-specific analysis of liquefaction susceptibility and resulting ground subsidence from available site exploration data collected via hollow stem auger borings with standard penetration testing. Blow count intervals were then correlated to soil stratigraphy as directly observed in split-spoon samples. The adopted groundwater level for liquefaction analysis corresponds to interpreted winter season typical groundwater conditions reported by nearby sites, which were not observed directly at the time of the study due to mud-roatary drilling interference.

Analysis was completed using LiquefyPro, Version 5.8h, published by CivilTech Software©. LiquefyPro performs liquefaction settlement analysis in accordance with the latest National Center for Earthquake Engineering Research (NCEER) Workshop recommended procedures and provides several options for the treatment of data inputs. Settlement estimates were obtained utilizing methods of Tokimatsu & Seed (1987). A 7.0 magnitude earthquake event was applied. Calculations were completed for maximum considered earthquake peak ground acceleration (0.500g) as provided by USGS resources, in accordance with ASCE 7-10 guidelines. To most accurately reflect liquefaction risk of existing conditions, no factor of safety or external surface load was applied. For purposes of assessing a conservative scenario of liquefaction potential, the predominantly fine-grained members of the stratigraphy were not prohibited from liquefication. Table 2 summarizes the results of MTC's liquefaction analysis represented graphically in Appendix C.

Table 2. Summary of Liquefaction-induced Settlement Estimates and Inputs

ANALYSIS SCENARIO	**BH-1 Total Settlement Potential**
Tokimatsu & Seed (1987)	9.57 inches
Anticipated Max Water Table	3.0 feet BPG
Earthquake Magnitude	7.0
MCE Peak Ground Acceleration	PGA-max = 0.500 g
Factor of Safety	FS = 1.0

In considering settlement during liquefaction, the most critical area considered for a development of this size is the upper 50 feet of soil. In this hypothetical situation, where no ground improvements are made to the site, settlement in the order of up to nearly 10 inches appears likely to occur during an earth quake. Further consideration of the entire lower 100-foot soil column indicated the potential of over 17 inches of settlement.

In our opinion, this magnitude of potential seismic-induced settlement represents a moderately high site response to liquefaction, warranting the use of deep supporting foundation mechanisms or approved alternative ground improvements. As a rule-of-thumb, differential settlement may amount to roughly half of total vertical settlement. Given the calculated total settlement values of up to around 10 inches, as much as about 5 inches is estimated for potential differential settlement resulting from liquefaction across the building site. It is advisable that additional reinforcements be added to concentrated load foundations as a discretionary measure to counteract differential settlement in the event of a seismic event.

4.4 OTHER CRITICAL AREA, SLOPE, AND STRUCTURAL CONSIDERATIONS

Based on limited review and observation of adjacent vicinity features, the site does not appear to be within the presence of any qualifying critical slopes that might require establishing non-disturbance buffers. The waterside embankment appears to be generally setback more than 50 feet from the property, and proposed developments will bear on deep pile foundations, eliminating the need for further setbacks within the site at this time. MTC recommends the design team review available plan sets and as-builts to confirm no nearby structures adjacent to the site incorporate design features such as soil nail tiebacks, battered piles, or designated no-load-zones, that might enter within the site boundaries or intersect newly proposed developments.

4.5 FOUNDATIONS & PILE RECOMMENDATIONS

Two requirements must be fulfilled in the design of foundations. First, the load must be less than the ultimate bearing capacity of the foundation soils to maintain stability; and secondly, the differential settlement must not exceed an amount that will produce adverse behavior of the structure. The allowable settlement is usually exceeded before bearing capacity considerations become important; thus, the allowable bearing pressure is normally controlled by settlement considerations including differential settlement. Excess settlement due to adverse soil conditions may be a result of shallow soils noted to be in a soft or loose state and fine-grained components having a medium plastic consistency.

The findings of MTC's targeted subsurface explorations and site reconnaissance appear consistent with available geologic literature. As shown in Table 3, soils beyond 30 feet BPG appear generally medium dense and suitable for bearing moderate pile loads. Alternatives to pile foundations, such as compaction grouting or partial replacement and mat foundation construction, are considered less desirable at this time due to the thickness of liquefiable fill and soil deposits and the excessive extent of anticipated deep settlement.

MTC provides the following site- and development-specific recommendations to be followed for final design, and to reduce the inherent risks of development within the vicinity of a geologically hazardous critical area. These recommendations pertain to pile construction and general exterior surface improvements as discussed with the client to date. In the event that alternative or additional improvements are considered to be required, MTC recommends we be contacted for geotechnical engineering consultation and analysis as appropriate to address the proposed scope of work at that time.

Due to the inherent complexity of designing pile foundations in a liquefaction hazard area with no feasibly accessible bearing unit, MTC recommends final pile design be evaluated and calculated by a licensed and reputable structural engineer familiar with deep pile design and computer modeling of such designs. For pile design by the structural engineer, MTC recommends the following soil parameters be considered when completing calculations for pile bearing, uplift capacities, and lateral load contributions (as shown in Table 4):

Table 3. Summarized Soil Parameters

Layer	Soil Type	Depth / Extent (feet BPG)	Total (wet) Unit Weight (PCF)	Friction Angle (degrees)	Average SPT N Values
1	SP - Sand	0 - 15	120	35	6
2	GP – Gravel with Sand	15 - 25	135	37	21
3	SP - Sand	25 – 30	120	35	13
4	GP – Gravel	30 – 40	135	37	28
5	SP - Sand	40 – 55	125	35	25
6	ML – Silt (low plasticity)	55 – 100+	120	30	22

Table 4. Lateral Earth Pressures

Soil Type	Active Pressure (PSF*H)	At-Rest Pressure (PSF*H)	Seismic Surcharge (PSF*H)	Grade Beam Lateral Equivalent Fluid Weight (PCF)	Grade Beam Coefficient of Friction
Existing Soils	30	60	10	165	0.32
New Structural Fill	35	55	10	200	0.38

4.5.1 PRELIMINARY PILE DESIGN RECOMMENDATIONS

Auger cast piles, or an approved alternative, are recommended to support all major structural foundations to protect against potential future settlement, and earthquake induced settlement, which appears feasible based on the results of our site explorations. Several other adjacent structures in the downtown area commonly bear on mid-length, 18" diameter, auger cast, friction piles or similar deep foundations. MTC assumes the piles will be attached to the existing foundation via structural brackets or bolting, or encased directly into new concrete footings via rebar or similar attachment (to be specified by the design structural engineer).

We generally do not recommend smaller diameter piles be used for new construction or full-scale underpinning applications. Alternative pile types, diameters, allowable loads, spacing, and thicknesses may be considered at the structural engineer's discretion. Analysis of soil resistivity and cathodic protection was outside the general scope of services for this project. Additional laboratory testing may be completed at the request of the design team and approval of the client, if deemed necessary.

These recommendations assume continuous observation and inspection of their installations will be performed to verifying embedment conditions, and that load testing will be completed following installation. This typically entails use of the ASTM D1143-07 "Quick Load Test Method" to verify pile capacity is reached up to twice the design value for a minimum of 3% of piles (1 minimum, 5 maximum per project) without failure due to excessive settlement of the test pile under short-term loading. Typically, the contractor will execute the load testing under the observation of the geotechnical consultant.

4.5.2 PILE CONSTRUCTION

MTC recommends the design team seek consultation with a reputable local pile construction firm to confirm anticipated construction and design loads meet or exceed manufacturer's recommended specifications. In the instance where there is a conflict between design and manufacturer's stipulations, we recommend the more conservative specifications be met.

MTC recommends we be contacted to review pile plans and specifications, to ensure they are consistent with the recommendations provided herein. In addition, MTC should be retained for construction phase testing, observation, and engineering consultation services relating to pile installations, as well as special inspections such as welding if required. We recommend pile driving and load testing be observed and documented on a full-time basis by an MTC representative to ensure refusal criteria are met and to provide a record of subsurface construction.

4.5.3 FOOTPRINT SURCHARGE

To limit floor slab and pavement section settlement, MT recommends the design team consider surcharging the proposed development footprint. Steps to accomplish this, typically include the placement of approximately 4 feet of imported surcharge fill above the proposed final top of subgrade elevation, with the fill extending a minimum of 2 feet beyond the edges of the proposed footprint. Soil shall have a minimum in place density of 120 pcf. Soil does not need to meet any specific WSDOT specification, but often contractors prefer to import suitable material planed for use as structural fill, to be reused during construction for replacing discarded poor site soils.

MTC recommends that the imported surcharge fill section be covered in plastic sheeting, held in place with either sand bags or stakes, after placement to prevent erosion and the transmission of turbid water from the site. Total settlement for the site soil types is generally between 2 and 4 inches after completion of surcharging, usually takes up to 6 weeks to complete. Full site settlement analysis was outside the scope of this investigation.

4.5.4 SITE AMENITIES AND DETACHED MINOR STRUCTURES

MTC understands that ground improvements, such as pile foundations may not be economical for smaller, detached site amenities such as transformer and generator pads, fences, sign footings, bench & shelter footings, trash enclosures, etc. For these minor developments, if approved by the structural engineer, the following limited foundation recommendations may be used on a case-by-case basis:

- **Allowable Soil Bearing Capacity:**
  500 pounds per square foot (psf), or 800 psf may be used for footings that bear on a 12-inch or 24-inch (respectively) minimum section of structural fill, separated on all sides (wrapped) from underlying alluvial soils by a layer of approved geogrid or geofabric, and compacted per the recommendations presented in section *5.2 Structural Fill Materials and Compaction.* Approved geofabric shall be placed with a minimum 12" overlap at joints and placed in accordance with the manufacturer's recommended instructions.

  The allowable bearing capacity may be increased by 1/3 for transient loading due to wind and seismic events. Ground stabilization fabric may be a suitable solution to limit overexcavation. If considered for use, MTC should be contacted to evaluate exposed subgrade conditions during construction and to provide recommendations for fabric specifications and installation.

- **Minimum Footing Depth:**
  For a shallow perimeter and spread footing system, all exterior footings shall be embedded a minimum of 18 inches and all interior footings shall be embedded a minimum of 12 inches below the lowest adjacent finished grade, but not less than the depth required by design.

- **Connections:**
  MTC recommends any utility connections to detached features utilize flexible attachments to accommodate possible seismic induced settlement.

4.5.5 BUILDING SLAB-ON-GRADE FLOOR

MTC anticipates that slab-on-grade floors are planned for the interior of the proposed building. Based on typical construction practices, we assume finished slab grade will be similar to or marginally above present grade for the below recommendations. If floor grades are planned to be substantially raised or lowered from existing grade, MTC should be contacted to provide revised or alternative recommendations.

Removal of unsuitable soils from beneath slab areas will likely not be feasible due to their overwhelming presence. In general, surface organics and overriding top soils should be removed from beneath slab sections. To mitigate the pervasive soft soil condition across the site MTC recommends considering the following parameters for slab-on-grade design and construction.

- **Subgrade Modulus:**
  A Subgrade Modulus (k) of 150 pci is recommended for use in design of slab-on-grade interior floors or exterior slabs constructed on the minimum-thickness base pad as recommended over undisturbed native soils, or properly compacted structural fills.

- **Base Pad:**
  A 12-inch minimum section of structural fill separated from native soils by a layer of approved geogrid or geofabric is recommended to be installed beneath all floor slabs. As noted below, capillary break material may account for a portion of the base fill section if composed of compacted angular material approved as structural fill.

  The minimum base pad thickness assumes construction will occur in the dry season during good weather conditions. If work occurs in the spring or fall or during prolonged wet weather, the pad thickness may need to be increased for constructability over shallow moisture-sensitive subgrades, and additional ground stabilization may be needed. Because of these concerns, we recommend slab construction not be conducted in the winter months if possible.

- **Proof Roll:**
  Prior to the placement of capillary break material and slab construction, the exposed structural fill base pad section shall be proof-rolled with a fully loaded dump truck to confirm no soft or deflecting areas are present. This is to ensure the subgrade is evenly prepared and adequate for support of the slab. MTC recommends that we be contacted for observation of the proof roll and visual confirmation of prepared base suitability. Areas of excessive yielding should be excavated to suitably firm conditions and backfilled with structural fill.

- **Capillary Break:**
  A capillary break will be helpful to maintain a dry slab floor and reduce the potential for floor damage resulting from shallow perched water inundation. To provide a capillary moisture break, a 6-inch thick, properly compacted granular mat consisting of open-graded, free-draining angular aggregate is recommended below floor slabs. To provide additional slab structural support, or to substitute for a structural fill base pad where specified, MTC recommends the capillary break should consist of crushed rock all passing the 1-inch sieve and no more than 3 percent (by weight) passing the U.S. No. #4 sieve, compacted in accordance with *Section 5.2.2* of this report.

- **Vapor Barrier:**
  A vapor retarding membrane such as 10 mil polyethylene film should be placed beneath all floor slabs to prevent transmission of moisture where floor coverings may be affected. Care should be taken during construction not to puncture or damage the membrane. To protect the membrane, a layer of sand no more than 2 inches thick may be placed over the membrane if desired. If excessive relict organic fill material is discovered at any location, additional sealant or more industrial gas barriers may be required to prevent off-gassing of decaying material from infiltrating the new structure. These measures shall be determined by the structural engineer to meet local code requirements as necessary.

- **Structural Design Considerations:**
  MTC assumes design and specifications of slabs will be assessed by the project design engineer. We suggest a minimum unreinforced concrete structural section of 6.0 inches be considered to help protect against cracking and localized settlement, especially where larger equipment or localized loads are anticipated. It is generally recommended that any floor slabs and annular exterior concrete paving subject to vehicular loading be designed to incorporate reinforcing. Additionally, some level of reinforcing, such as a wire mesh may be desirable to prolong slab life

due to the overwhelming presence of such poor underlying soils. It should be noted that MTC does not express any guarantee or warranty for proposed slab sections.

Additionally, the structural engineer may wish to consider additional underpinning of slabs in a similar fashion to methods stipulated for foundations. This is especially advisable for slabs experiencing increased loads.

4.6 PAVEMENT DESIGN RECOMMENDATIONS

Exploration results indicate soil consistencies are generally poor. MTC recommends, applying a conservative bulk CBR value of 2.0 for pavement design, based on observed soft and loose shallow soil conditions at likely subgrade depths. MTC's scope of services does not include detailed CBR assessment, or advanced laboratory testing.

MTC recommends incorporating geogrid at subgrade level to reduce the need for thicker sections of base aggregate and prevent accelerated degradation of the pavement section. Revised pavement sections were derived assuming the incorporation of commonly available Tensar Technology TriAx TX160 geogrid, representing a standard level of geotextile application, or an equivalent product. Geogrid materials shall be placed in accordance with the manufacturer's recommended instructions.

The following table summarizes the proposed minimum pavement sections.

Table 5. Summary of Minimum Flexible Pavement Sections **(in inches)**

Scenario	Pavement	CSTC	Gravel Base	Geogrid*
Heavy Pavement Section	4	2	8	Yes
Car Access and Parking	3	2	5	Yes

*Tensar Technology – TriAx TX160 geogrid placed directly above subgrade per the manufacturer's specifications.

The following recommendations are made assuming that the existing uncontrolled fill soils will remain. Existing fill soils at the new bottom subgrade level should be graded level with minimal disturbance, and compacted in place where dominantly fine grain soils are not exposed. Smooth bladed equipment should be used for final grading. For any saturated, organic rich, or deteriorated soils encountered, unsuitable soils shall be removed and replaced with approved compacted imported structural fill. This will provide an even surface for paving application that will also serve as additional support to the flexible pavement sections that can increase design life and reduce repair regularity in the long term.

One of the important considerations in designing a high-quality and durable pavement is providing adequate drainage. Drainage design for the proposed pavement section is outside of the scope of MTC for this project. It is important that bird baths (leeching basins) and surface waves are not created during construction of the HMA layer. A proper slope should be allowed and drainage should be provided along the edges of pavements and around catch basins to prevent the accumulation of free water within the base course, which otherwise may result in subgrade softening and pavement deterioration under exposure and repeated traffic conditions.

All pavements require regular maintenance and repair of damages due to wear and tear in order to maintain their serviceable life. However, after 10 years of service, a normal pavement structure is likely to deteriorate to a point where pavement rehabilitation may be required to maintain the serviceability. The deterioration is more likely if the pavement is constructed over poor subgrade soils or in areas of higher traffic volumes.

These recommended sections should be considered preliminary until verifying the parameters, traffic loading, and assumed grading are applicable to final project design. We recommend pavement sections be reviewed by the civil designer, who may apply an alternative section for final project use based on the conditions reported herein and final design and construction preferences.

4.6.1 Rigid Pavements and Flatworks

Rigid pavement components are commonly utilized for portions of accesses and ancillary exterior improvements. The project civil design engineer may reevaluate the general recommendations outlined below for pavement thicknesses and base sections if necessary to ensure proper application to a given structure and use. MTC recommends that we be contacted for further consultation if the below sections are proposed to be reduced.

Concrete driveway aprons and curb alignments, if utilized, should consist of a minimum 6-inch thickness of unreinforced concrete pavement over structural base fill. Base thickness should correspond to related location and anticipated traffic loading. For light traffic areas, a 6-inch minimum base thickness (total 12-inch section) over geogrid can be applied. For heavy traffic zones, we recommend allotting a 12-inch minimum base section over geogrid.

For other paved areas which experience repeated truck traffic, equipment or truck parking areas, entrances and exit aprons, or contain trash dumpster loading zones, a Portland Cement Concrete (PCC) pavement should be used. The PCC layer thickness is recommended to be 8.0 inches with a minimum of 6.0 inches thick crushed stone base course over geogrid, but may be modified depending on the final design. The reinforcement details for PCC layers should be designed by the project design engineer as the project conditions dictate.

Concrete sidewalks, walkways and patios if present may consist of a minimum 4-inch section of plain concrete (unreinforced) installed over a 6-inch minimum compacted base of crushed rock over suitably firm subgrade or geogrid.

Specifications for concrete aprons and flatworks are often predetermined by the local municipality, and may conflict with the above. In this case, we recommend either adhering to the more stringent option, or contacting MTC for clarification.

4.7 INFILTRATION FEASIBILITY

In general, the results of MTC's investigation indicate that site soil conditions as a whole present significant limitations for conventional on-site infiltration design. The soils observed strongly corollate with variable fill of an inconsistent composition. The reported perched and shallow water table (as shallow as 3 feet BPG) in the area presents additional limitations.

Due to these numerous inconsistencies, and settlement susceptible soils on site, it is recommended that any alternatives to infiltration be explored if at all possible. If the project designer must move forward with infiltration, it is recommended that in field small-scale Pilot Infiltration Testing (PIT) be conducted at proposed infiltration locations to accurately determine if infiltration is at all feasible. MTC can provide these services in a follow-up scope of work if requested by the client.

4.8 SITE DRAINAGE CONTROLS

MTC recommends exterior drainage improvements be implemented with site development to limit the adverse effects of piping and influx on site in the winter months. Roof drains, footing drains, and pavement or flatwork stormwater catchments should all be incorporated and delineated by the project civil engineer. These stormwater management features should be tightlined to the project designed stormwater management features or outfalls. This will limit the amount of transient water within proximity to the building during its vertical migration. We recommend free draining features be separated from native soils by a nonwoven geotextile fabric to preclude the buildup and piping of fine-grained soils. Infiltration of site stormwater is anticipated to be infeasible do to the overwhelming presence of variable fill soils across the site to great depths.

5.0 CONSTRUCTION RECOMMENDATIONS

5.1 EARTHWORK

5.1.1 SCOPE OF SITE GRADING

A grading plan was not available to MTC at the time of this report. However, based on provided conceptual plans, this study assumes finished site grade will approximate current grade. Therefore, depths referred to in this report are considered roughly equivalent to final depths.

5.1.2 EXCAVATION

Excavations can generally be performed with conventional earthmoving equipment such as bulldozers, scrapers, and excavators.

5.1.3 SUBGRADE EVALUATION AND PREPARATION

After excavations have been completed to the planned subgrade elevations, but before placing fill or structural elements, the exposed subgrade should be evaluated under the full-time observation and guidance of an MTC representative. Where appropriate, the subgrade should be proof-rolled with a minimum of two passes with a fully loaded dump truck, water truck or scraper. In circumstances where this seems unfeasible, an MTC representative may use alternative methods for subgrade evaluation.

Any loose soil should be compacted to a firm and unyielding condition and at least to 95 percent of the modified Proctor maximum dry density per ASTM D1557. Any areas that are identified as being soft or yielding during subgrade evaluation should be overexcavated to a firm and unyielding condition or to the depth determined by the geotechnical engineer. Where overexcavation is performed below a structure, the overexcavation area should extend beyond the outside of the footing a distance equal to the depth of the overexcavation below the footing. The overexcavated areas should be backfilled with properly compacted structural fill.

5.1.4 SITE PREPARATION, EROSION CONTROL AND WET WEATHER CONSTRUCTION

Any silty or organic rich native soils may be moisture-sensitive and become soft and difficult to traverse with construction equipment when wet. During wet weather, the contractor should take measures to protect any exposed soil subgrades, limit construction traffic during earthwork activities, and limit machine use only to areas undergoing active preparation.

Once the geotechnical engineer has approved a subgrade, further measures should be implemented to prevent degradation or disturbance of the subgrade. These measures could include, but are not limited to, placing a layer of crushed rock or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tarp and keeping construction traffic off the subgrade. Once subgrade has been approved, any disturbance because the subgrade was not protected should be repaired by the contractor at no cost to the owner.

During wet weather, earthen berms or other methods should be used to prevent runoff from draining into excavations. All runoff should be collected and disposed of properly. Measures may also be required to reduce the moisture content of on-site soils in the event of wet weather. These measures can include, but are not limited to, air drying and soil amendment, etc.

MTC recommends earthwork activities take place during the summer dry season.

5.2 STRUCTURAL FILL MATERIALS AND COMPACTION

5.2.1 MATERIALS

All material placed below structures or pavement areas should be considered structural fill. Structural fill material shall be free of deleterious materials, have a maximum particle size of 4 inches, and be compactable to the required compaction level.

In general, excavated native soils are not considered suitable for reuse as structural fill. Materials utilized for trench back fill shall conform to Section 9-03.19, Trench Backfill, of the most recent edition (at the time of construction) of the State of Washington Department of Transportation *Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT Standard Specifications).* Materials utilize as grade fill beneath roads shall conform to WSDOT Section 9-03.10, Gravel Base. Soils with fines content near or greater than 10% fines content may likely be moisture sensitive and become difficult to use during wet weather. Care should be taken by the earthwork contractor during grading to avoid contaminating stockpiled soils that are planned for reuse as structural fill with native organic materials.

Imported material can be used as structural fill. Imported structural fill material should conform to the WSDOT manual Section 9-03.14(1), Gravel Borrow. Alternatively, in situations where perched water conditions are encountered during construction and pumping of the water is unfeasible structural fill may be composed of permeable railroad ballast conforming to WSDOT Standard Specification 9-03.9(2), so long as the material is separated from native subgrade soils by a layer of non-wover geofabric with a 12-inch overlap at joints. Controlled-density fill (CDF) or lean mix concrete can be used as an alternative to structural fill materials, except in areas where free-draining materials are required or specified.

Frozen soil is not suitable for use as structural fill. Fill material may not be placed on frozen soil.

The contractor should submit samples of each of the required earthwork materials to the geotechnical engineer for evaluation and approval prior to delivery to the site. The samples should be submitted at least 5 days prior to their delivery and sufficiently in advance of the work to allow the contractor to identify alternative sources if the material proves unsatisfactory.

5.2.2 UTILITY TRENCHES AND EXCAVATIONS

Pipe bedding material should conform to the manufacturer's recommendations and be worked around the pipe to provide uniform support. Cobbles exposed in the bottom of utility excavations should be covered with pipe bedding or removed to avoid inducing concentrated stresses on the pipe.

5.2.3 FILL PLACEMENT AND COMPACTION

Prior to placement and compaction, structural fill should be moisture conditioned to within 3 percent of its optimum moisture content. Loose lifts of structural fill shall not exceed 8 inches in thickness. All structural fill shall be compacted to a firm and unyielding condition and to a minimum percent compaction based on its modified Proctor maximum dry density as determined per ASTM D1557. Structural fill placed beneath each of the following shall be compacted to the indicated percent compaction:

Foundation and Floor Slab Subgrades:	95 Percent
Pavement Subgrades (upper 2 feet):	95 Percent
Pavement Subgrades (below 2 feet):	90 Percent
Utility Trenches (upper 4 feet):	95 Percent
Utility Trenches (below 4 feet):	90 Percent

Jetting or flooding is not a substitute for mechanical compaction and should not be allowed.

Note: For lateral and bearing support, structural fill placement below footings shall extend at minimum a distance past each edge of the base of the footing equal to the depth of structural fill placed below the footing [e.g., for a 2.0-foot wide footing, fills placed to approximately 1.5 feet below footing grade will require a minimum backfill width of 5.0 feet (1.5 feet each side plus 2.0-foot width of footing)].

We recommend that fill placed on slopes steeper than 3:1 (H:V) be 'benched' in accordance with hillside terraces entry of section 2-03.3(14) of the WSDOT Standard Specifications.

We recommend structural fill placement and compaction be observed on a full-time basis by an MTC representative. A sufficient number of tests should be performed to verify compaction of each lift. The number of tests required will vary depending on the fill material, its moisture condition and the equipment being used. Initially, more frequent tests will be required while the contractor establishes the means and methods required to achieve proper compaction.

5.3 TEMPORARY EXCAVATIONS AND SLOPES

All excavations and slopes must comply with applicable local, state, and federal safety regulations. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing soil type information solely as a service to our client for planning purposes. Under no circumstances should the information be interpreted to mean that MTC is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred. The contractor shall be responsible for the safety of personnel working in utility trenches. Given that steep excavations in native soils may be prone to caving, we recommend all utility trenches, but particularly those greater than 4 feet in depth, be supported in accordance with state and federal safety regulations. Temporary excavations in the existing upper weathered native soils should be inclined no steeper than 2H:1V, although applying lesser grades may be necessary depending on actual conditions encountered and the potential presence of water seepage. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed near the top of any excavation.

Temporary excavations and slopes should be protected from the elements by covering with plastic sheeting or some other similar impermeable material. Sheeting sections should overlap by at least 12 inches and be tightly secured with sandbags, tires, staking, or other means to prevent wind from exposing the soils under the sheeting.

6.0 ADDITIONAL RECOMMENDED SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during construction to verify compliance with these recommendations. Testing and observations performed during construction should include, but not necessarily be limited to, the following:

- Geotechnical plan review and engineering consultation as needed prior to construction phase,
- Observations and testing during site preparation, earthwork, structural fill, and pavement section placement,
- Consultation on temporary excavation cutslopes and shoring if needed,
- Testing and inspection of any concrete or masonry included in the final construction plans, and
- Consultation as may be required during construction.

We strongly recommend that MTC be retained for the construction of this project to provide these and other services. Our knowledge of the project site and the design recommendations contained herein will be of benefit in the event that difficulties arise and either modifications or additional geotechnical engineering recommendations are required or desired. We can also, in a timely fashion observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

We further recommend that project plans and specifications be reviewed by us to verify compatibility with our conclusions and recommendations.

Also, MTC retains fully accredited, WABO-certified laboratory and inspection personnel, and is available for this project's testing, observation and inspection needs. Information concerning the scope and cost for these services can be obtained from our office.

7.0 LIMITATIONS

Recommendations contained in this report are based on our understanding of the proposed development and construction activities, our field observations and exploration and our laboratory test results. It is possible that soil and groundwater conditions could vary and differ between or beyond the points explored. If soil or groundwater conditions are encountered during construction that vary or differ from those described herein, we should be notified immediately in order that a review may be made and supplemental recommendations provided. If the scope of the proposed construction, including the proposed loads or structural locations, changes from that described in this report, our recommendations should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty, express or implied, is made. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by MTC during the construction phase in order to evaluate compliance with our recommendations. Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the author of this report, are only mentioned in the given standard; they are not incorporated into it or "included by referenced", as that latter term is used relative to contracts or other matters of law.

This report may be used only by Urban Olympia LLC and their relevant project design consultants, and only for the purposes stated within a reasonable time from its issuance, but in no event later than 18 months from the date of the report. Note that if another firm assumes Geotechnical Engineer of Record responsibilities they need to review this report and either concur with the findings, conclusions, and recommendations or provide alternate findings, conclusions and recommendation under the guidance of a professional engineer registered in the State of Washington. The recommendations of this report are based on the assumption that the Geotechnical Engineer of Record has reviewed and agrees with the findings, conclusion and recommendations of this report.

Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required with the passage of time. Based on the intended use of the report, MTC may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by Urban Olympia LLC or anyone else will release MTC from any liability resulting from the use of this report by any unauthorized party and Urban Olympia LLC agrees to defend, indemnify, and hold harmless MTC from any claim or liability associated with such unauthorized use or non-compliance. We recommend that MTC be given the opportunity to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted. We assume no responsibility for misinterpretation of our recommendations.

The scope of work for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

Appendix A. SITE LOCATION AND VICINITY

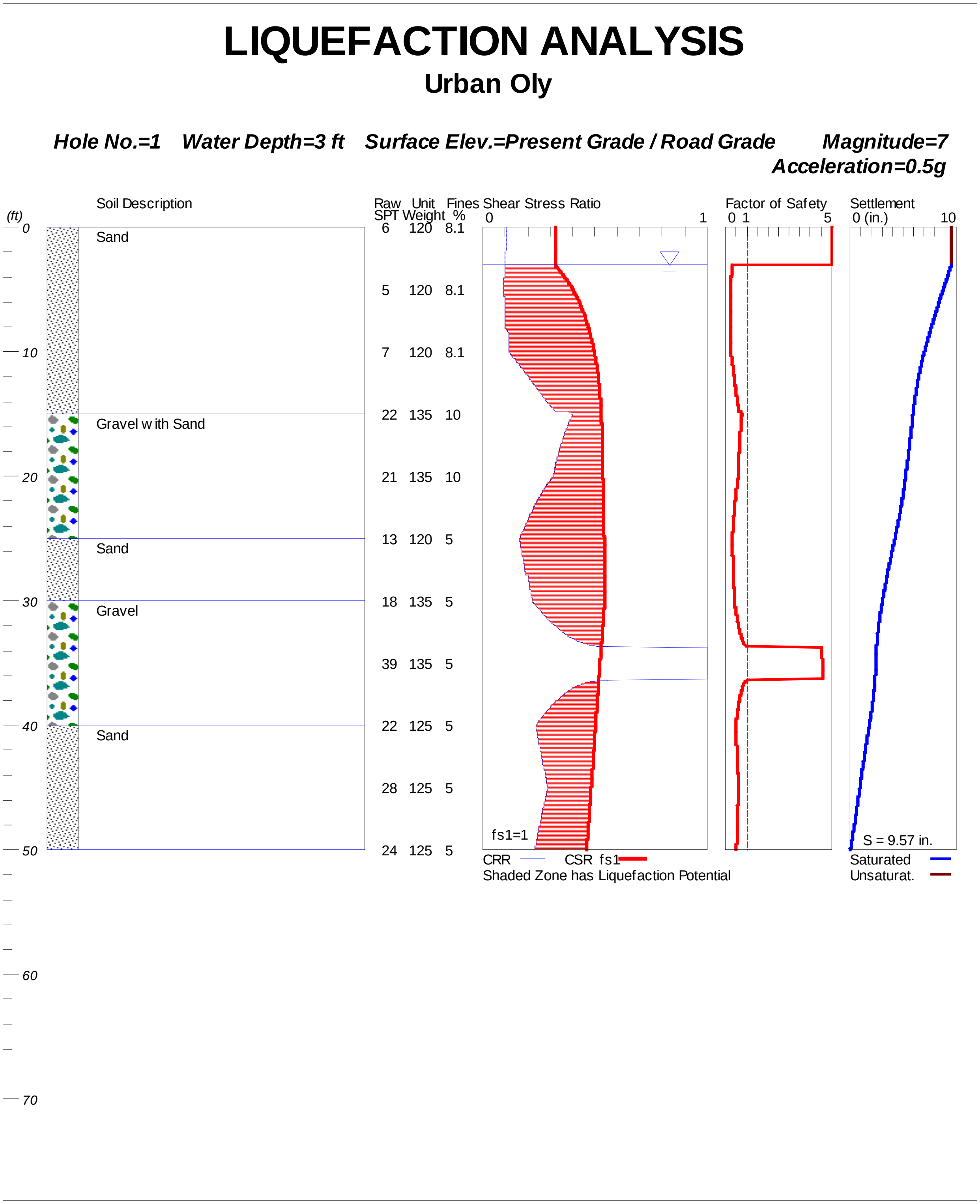
Materials Testing & Consulting, Inc. 2118 Black Lake Blvd SW Olympia, WA	**Site Location & Vicinity Maps** Urban Olympia Olympia, WA	**FIGURE** **1**

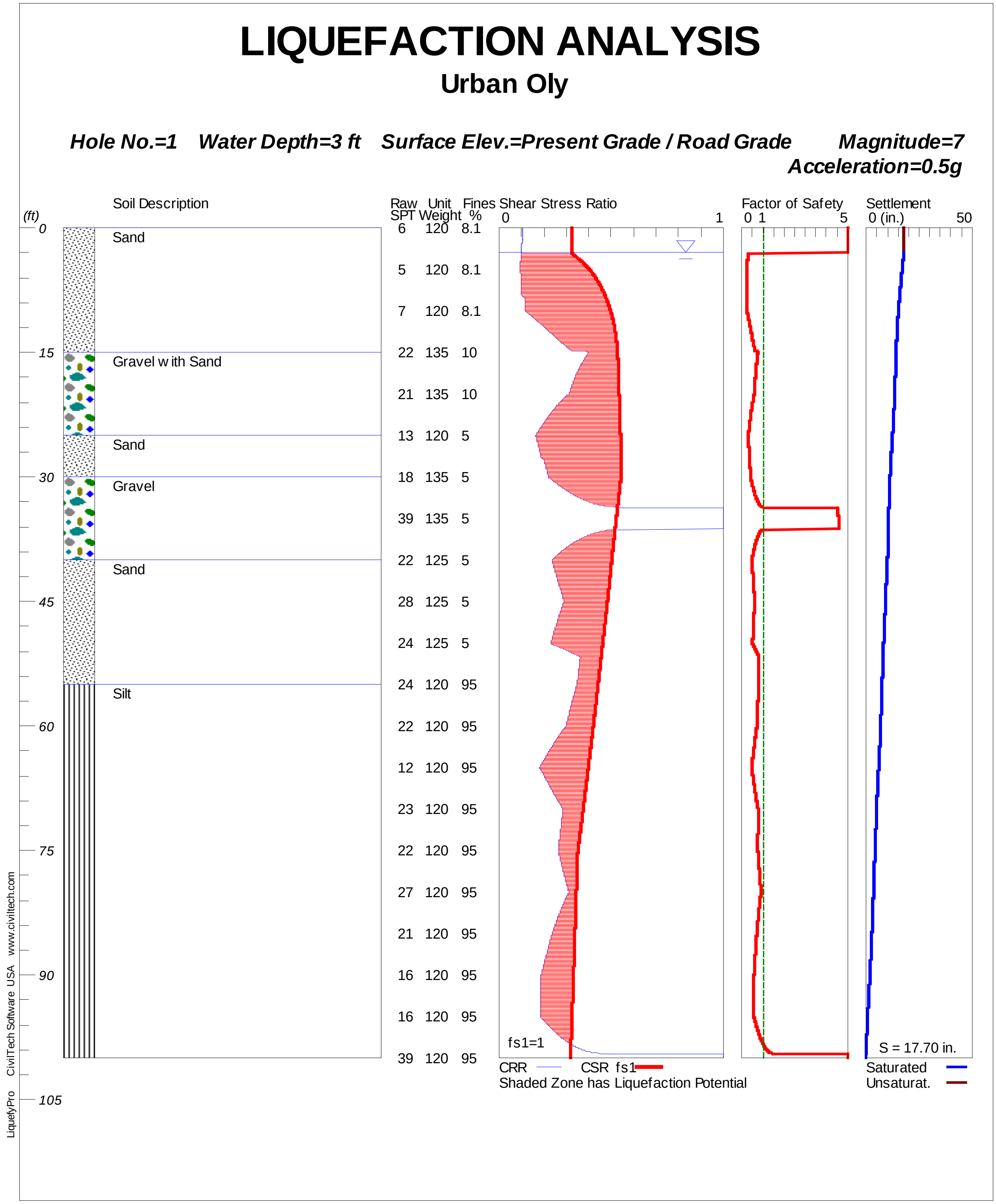
Appendix B. AERIAL MAP WITH EXPLORATION LOCATION

SCALE AND LOCATIONS ARE APPROXIMATE *** Not for Construction ***	0 50 **SCALE (FEET)**	Base Map Source: Google Maps 2019

Materials Testing & Consulting, Inc. 2118 Black Lake Boulevard Olympia, WA 98501	**Site Plan with Exploration Location** Urban Olympia Olympia, WA	**FIGURE** **2**

Appendix C. LIQUEFACTION ANALYSIS





Depth (ft)	Raw SPT	Unit Weight	Fines %
0	6	120	8.1
	5	120	8.1
	7	120	8.1
15	22	135	10
	21	135	10
	13	120	5
30	18	135	5
	39	135	5
	22	125	5
45	28	125	5
	24	125	5
	24	120	95
60	22	120	95
	12	120	95
	23	120	95
75	22	120	95
	27	120	95
	21	120	95
90	16	120	95
	16	120	95
	39	120	95
105			

CivilTech Corporation **BH-1** **Plate A-1**

Appendix D. EXPLORATION LOG

Grab soil samples were collected from each exploration location by an MTC Project Geologist during borehole advancement. Soil samples collected during the field exploration were classified in accordance with ASTM D2487. All samples were placed in plastic bags to limit moisture loss, labeled, and returned to our laboratory for further examination and testing.

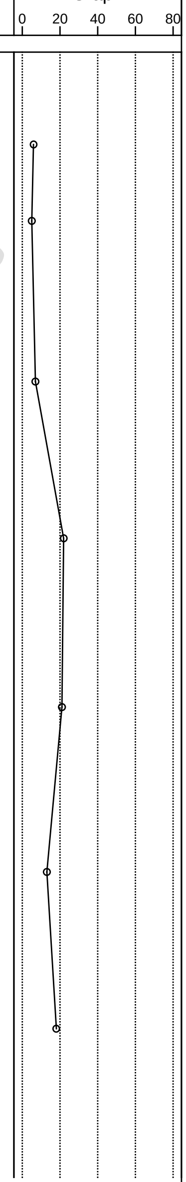
Exploration log is shown in full in this appendix. The exploration was monitored by MTC personnel who examined and classified the materials encountered in accordance with the Unified Soil Classification System (USCS), obtained representative soil samples, and recorded pertinent information including soil sample depths, stratigraphy, soil engineering characteristics, and groundwater occurrence. Upon completion boreholes were backfilled with native soil and bentonite chips, and test pits were backfilled with native soil tailings.

The stratification lines shown on the log represent the approximate boundaries between soil types; actual transitions may be either more gradual or more severe. The conditions depicted are for the date and location indicated only, and it should not necessarily be expected that they are representative of conditions at other locations and times.

Materials Testing & Consulting Inc. Olympia, WA Geotechnical Consulting	**Log of Boring BH-1** (Page 1 of 3)
Urban Olympia Intersection of State and Water Olympia, WA MTC Project No. 18S023-02	Date Started : 1/11/19 Date Completed : 1/11/19 Sampling Method : Split Spoon 5-ft. intervals Location : NE Corner of Lot; ~25' S of State Logged By : CS

Depth in Feet	USCS	DESCRIPTION	Blow Count
0	SP	SAND, some silt, loose to medium dense, moderate shell fragments (up tp 10%) up to 1/2" diameter. DARK BROWN.	
		Sample S19-0126 *0% Gravel, 91.9% Sand, 8.1% Fines*	6
5		Decreasing shell content with depth (~1%) Trace gravel up to 1/2" diameter.	5
10			7
15	GP	GRAVEL WITH SAND, some silt, loose to medium dense, gravel up to 0.5" diameter. DARK GRAY. *Approximately 70% Gravel, 20% Sand, 10% Fines*	22
20		Increasing gravel content with depth up to 80% (-20')	21
25	SP	SAND, some silt, medium dense, coarse to medium-grained. DARK BROWN-GRAY *Approximately 0% Gravel, 95% Sand, 5% Fines*	13
30	GP	GRAVEL, some sand, trace silt, loose to medium dense, some coarse-grained sandy layers(~2" thick), gravel up to 1" diameter. DARK GRAY *Approximately 80% Gravel, 15% Sand, 5% Fines*	18
35			

Blow Count Graph



Materials Testing & Consulting Inc.
Olympia, WA
Geotechnical Consulting

Log of Boring BH-1

(Page 2 of 3)

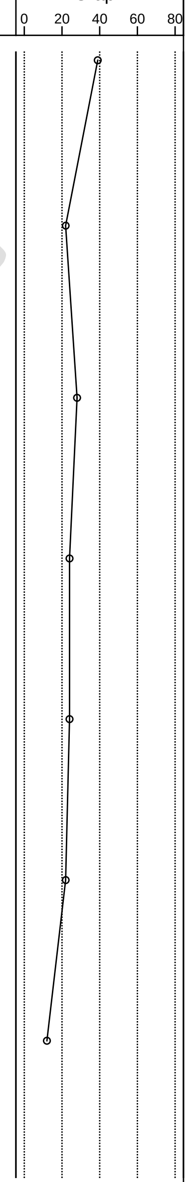
Urban Olympia
Intersection of State and Water
Olympia, WA

MTC Project No. 18S023-02

Date Started	: 1/11/19
Date Completed	: 1/11/19
Sampling Method	: Split Spoon 5-ft. intervals
Location	: NE Corner of Lot; ~25' S of State
Logged By	: CS

Depth in Feet	USCS	DESCRIPTION	Blow Count
35	GP		39
40	SP	SAND, trace silt, medium dense, coarse to medium grained. DARK GRAY *Approximately 10% Gravel, 85% Sand, 5% Fines*	22
45		End gravel content (-45') *Sample S19-0127* *0% Gravel, 89.3% Sand, 10.1% Fines*	28
50			24
55	ML	SILT, trace sand, medium stiff. DARK GRAY *Approximately 0% Gravel, 5% Sand, 95% Fines*	24
60		*Sample S19-0128* *0% Gravel, 4.9% Sand, 95.1% Fines* *LL - 21.5%, PL - 18.6%, PI - 2.9%*	22
65		Sand content varies between 5 and 10 % (-65')	12
70			

Blow Count Graph



Materials Testing & Consulting Inc.
Olympia, WA
Geotechnical Consulting

Log of Boring BH-1

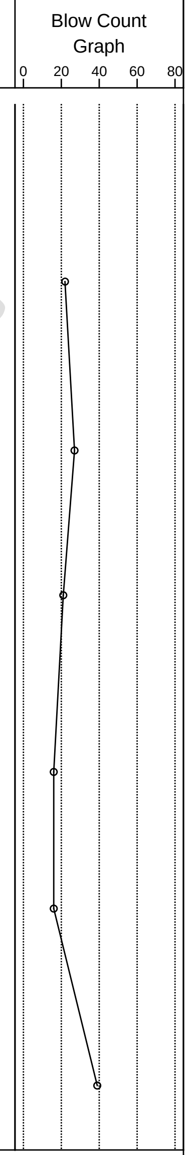
(Page 3 of 3)

Urban Olympia
Intersection of State and Water
Olympia, WA

MTC Project No. 18S023-02

Date Started	: 1/11/19
Date Completed	: 1/11/19
Sampling Method	: Split Spoon 5-ft. intervals
Location	: NE Corner of Lot; ~25' S of State
Logged By	: CS

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Water Level	Blow Count
70						
75						22
80						27
85	ML					21
90						16
95						16
100						39
105			Total Depth 102.5 Boring terminated at contracted depth. No groundwater encountered.			



Appendix E. LABORATORY TEST RESULTS

Laboratory tests were conducted on several representative soil samples to better identify the soil classification of the units encountered and to evaluate the material's general physical properties and engineering characteristics. A brief description of the tests performed for this study is provided below. The results of laboratory tests performed on specific samples are provided at the appropriate sample depths on the individual boring logs. However, it is important to note that these test results may not accurately represent in situ soil conditions. All of our recommendations are based on our interpretation of these test results and their use in guiding our engineering judgment. MTC cannot be responsible for the interpretation of these data by others.

Soil samples for this project will be retained for a period of 3 months following completion of this report, unless we are otherwise directed in writing.

SOIL CLASSIFICATION

Soil samples were visually examined in the field by our representative at the time they were obtained. They were subsequently packaged and returned to our laboratory where they were reexamined and the original description checked and verified or modified. With the help of information obtained from the other classification tests, described below, the samples were described in general accordance with ASTM Standard D2487. The resulting descriptions are provided at the appropriate locations on the individual exploration log, located in Appendix D, and are qualitative only.

GRAIN-SIZE DISTRIBUTION

Grain-size distribution analyses were conducted in general accordance with ASTM Standard D422 on representative soil samples to determine the grain-size distribution of the on-site soil. In addition, soil liquid and plastic limits and plasticity index were determined with ASTM Standard D4318 on representative fine-grained samples. The information gained from these analyses allows us to provide a description and classification of the in-place materials. In turn, this information helps us to understand engineering properties of the soil and thus how the in-place materials will react to conditions such as heavy seepage, traffic action, loading, potential liquefaction, and so forth. The results are presented in this Appendix.

Sieve Report

Project: Urban Olympia
Project #: 18S023-02
Client: Urban Olympia 9 LLC
Source: BH-1 @ 2.5'
Sample#: S19-0126

Date Received: 23-Jan-19
Sampled By: CS
Date Tested: 24-Jan-19
Tested By: FP/JE

ASTM D-2487 Unified Soils Classification System
SP-SM, Poorly graded Sand with Silt
Sample Color:
Gray

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

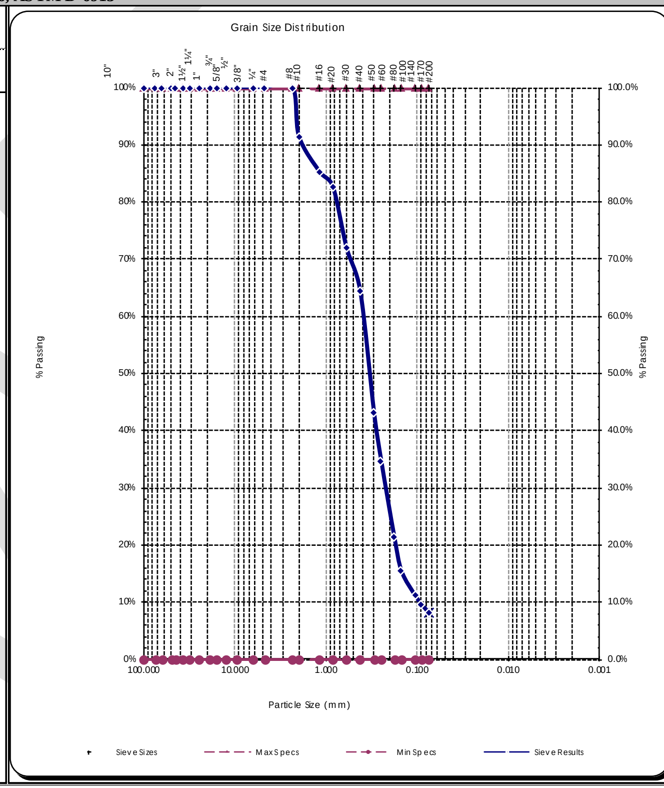
ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.046 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.35
$D_{(10)}$ = 0.094 mm	% Sand = 91.9%	Coeff. of Uniformity, C_U = 4.24
$D_{(15)}$ = 0.146 mm	% Silt & Clay = 8.1%	Fineness Modulus = 1.84
$D_{(30)}$ = 0.225 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.340 mm	Plasticity Index = n/a	Moisture %, as sampled = 26.2%
$D_{(60)}$ = 0.399 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 1.819 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 12/95	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C-136, ASTM D-6913

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50		100%	100.0%	0.0%
3/8"	9.50		100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75		100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		85%	100.0%	0.0%
#20	0.850	83%	83%	100.0%	0.0%
#30	0.600		72%	100.0%	0.0%
#40	0.425	64%	64%	100.0%	0.0%
#50	0.300		43%	100.0%	0.0%
#60	0.250	35%	35%	100.0%	0.0%
#80	0.180	21%	21%	100.0%	0.0%
#100	0.150	15%	15%	100.0%	0.0%
#140	0.106		11%	100.0%	0.0%
#170	0.090		10%	100.0%	0.0%
#200	0.075	8.1%	8.1%	100.0%	0.0%



Sieve Report

Project: Urban Olympia
Project #: 18S023-02
Client: Urban Olympia 9 LLC
Source: BH-1 @ 45'
Sample#: S19-0127

Date Received: 23-Jan-19
Sampled By: CS
Date Tested: 24-Jan-19
Tested By: FP/JE

ASTM D-2487 Unified Soils Classification System
SP-SM, Poorly graded Sand with Silt
Sample Color:
Gray

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

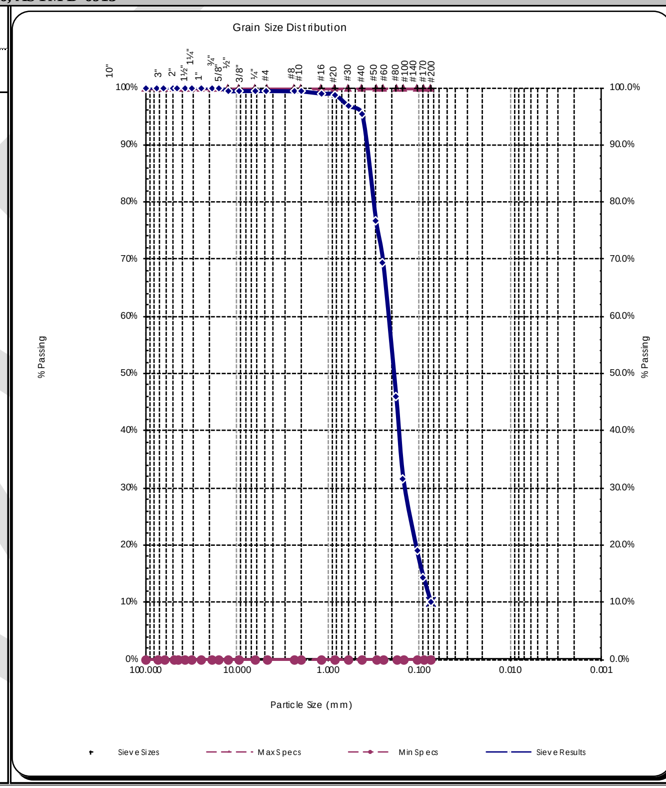
ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.037 mm	% Gravel = 0.6%	Coeff. of Curvature, C_C = 1.27
$D_{(10)}$ = 0.074 mm	% Sand = 89.3%	Coeff. of Uniformity, C_U = 2.98
$D_{(15)}$ = 0.092 mm	% Silt & Clay = 10.1%	Fineness Modulus = 0.98
$D_{(30)}$ = 0.145 mm	Liquid Limit = n/a	Plastic Limit = n/a
$D_{(50)}$ = 0.192 mm	Plasticity Index = n/a	Moisture %, as sampled = 25.9%
$D_{(60)}$ = 0.222 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.389 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 2/19	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C-136, ASTM D-6913

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00	100%	100%	100.0%	0.0%
1/2"	12.50	99%	99%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30	99%	99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		97%	100.0%	0.0%
#40	0.425	95%	95%	100.0%	0.0%
#50	0.300		77%	100.0%	0.0%
#60	0.250	69%	69%	100.0%	0.0%
#80	0.180	46%	46%	100.0%	0.0%
#100	0.150	32%	32%	100.0%	0.0%
#140	0.106		19%	100.0%	0.0%
#170	0.090		14%	100.0%	0.0%
#200	0.075	10.1%	10.1%	100.0%	0.0%



Sieve Report

Project: Urban Olympia
Project #: 18S023-02
Client: Urban Olympia 9 LLC
Source: BH-1 @ 60'
Sample#: S19-0128

Date Received: 23-Jan-19
Sampled By: CS
Date Tested: 24-Jan-19
Tested By: FP/JE

ASTM D-2487 Unified Soils Classification System
ML, Silt
Sample Color:
Gray

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Certificate #: 1366.01, 1366.02 & 1366.04

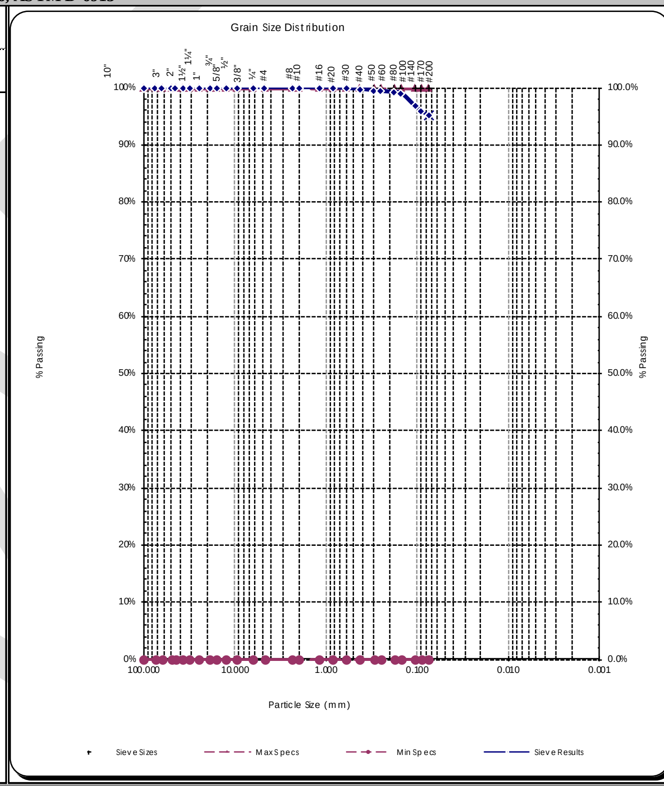
ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821

Specifications
No Specs
Sample Meets Specs ? N/A

$D_{(5)}$ = 0.004 mm	% Gravel = 0.0%	Coeff. of Curvature, C_C = 1.50
$D_{(10)}$ = 0.008 mm	% Sand = 4.9%	Coeff. of Uniformity, C_U = 6.00
$D_{(15)}$ = 0.012 mm	% Silt & Clay = 95.1%	Fineness Modulus = 0.02
$D_{(30)}$ = 0.024 mm	Liquid Limit = 21.5%	Plastic Limit = 18.6%
$D_{(50)}$ = 0.039 mm	Plasticity Index = 2.9%	Moisture %, as sampled = 32.4%
$D_{(60)}$ = 0.047 mm	Sand Equivalent = n/a	Req'd Sand Equivalent =
$D_{(90)}$ = 0.071 mm	Fracture %, 1 Face = n/a	Req'd Fracture %, 1 Face =
Dust Ratio = 41/43	Fracture %, 2+ Faces = n/a	Req'd Fracture %, 2+ Faces =

ASTM C-136, ASTM D-6913

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50		100%	100.0%	0.0%
3/8"	9.50		100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850	100%	100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		99%	100.0%	0.0%
#60	0.250	99%	99%	100.0%	0.0%
#80	0.180	99%	99%	100.0%	0.0%
#100	0.150	99%	99%	100.0%	0.0%
#140	0.106		97%	100.0%	0.0%
#170	0.090		96%	100.0%	0.0%
#200	0.075	95.1%	95.1%	100.0%	0.0%



ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project:	Urban Olympia	**Date Received:**	23-Jan-19
Project #:	18S023-02	**Sampled By:**	CS
Client:	Urban Olympia 9 LLC	**Date Tested:**	24-Jan-19
Source:	BH-1 @ 60'	**Tested By:**	FP/JE
Sample #:	S19-0128		

Unified Soils Classification System, ASTM D-2487
ML, Silt
Sample Color
Gray

Liquid Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.51	30.69	30.91			
Weight of Dry Soils + Pan:	29.65	27.87	27.95			
Weight of Pan:	15.03	14.57	15.24			
Weight of Dry Soils:	14.62	13.30	12.71			
Weight of Moisture:	2.86	2.82	2.96			
% Moisture:	19.6 %	21.2 %	23.3 %			
Number of Blows:	35	23	19			

Liquid Limit @ 25 Blows:	21.5 %
Plastic Limit:	18.6 %
Plasticity Index, I_P:	2.9 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	28.26	26.56				
Weight of Dry Soils + Pan:	26.12	24.56				
Weight of Pan:	14.64	13.75				
Weight of Dry Soils:	11.48	10.81				
Weight of Moisture:	2.14	2.00				
% Moisture:	18.6 %	18.5 %				

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04