REDMOND GEOTECHNICAL SERVICES

Geotechnical Investigation and Consultation Services

Proposed 23rd Street Apartments Site

Tax Lot No. 800

23rd Street SE

Salem (Marion County), Oregon

for

Rushing Group of Companies

Project No. 1553.001.G
November 1, 2016

November 1, 2016

Ms. Bo Rushing
Rushing Group of Companies
4336 Commercial Street SE, Suite 140
Salem, Oregon 97302

Dear Ms. Rushing:

Re: Geotechnical Investigation and Consultation Services, Proposed 23rd Street Apartments Site, Tax Lot No. 800, 23rd Street SE, Salem (Marion County), Oregon

Submitted herewith is our report entitled "Geotechnical Investigation and Consultation Services, Proposed 23rd Street Apartments Site, Tax Lot No. 800, 23rd Street SE, Salem (Marion County), Oregon". The scope of our services was outlined in our formal proposal to Ms. Bo Rushing of Rushing Group of Companies dated September 2, 2016. Written authorization of our services was provided by Ms. Bo Rushing on September 16, 2016.

During the course of our investigation, we have kept you and/or others advised of our schedule and preliminary findings. We appreciate the opportunity to assist you with this phase of the project. Should you have any questions regarding this report, please do not hesitate to call.

Sincerely,

Daniel M. Redmond, P.E., G.E.
President/Principal Engineer

REGISTERED PROFESSIONAL
ENGINEER
12309
OREGON
July 15, 1983
DANIEL M. REDMOND
EXP: 12-31-16

Cc: Ms. Janelle Shanahan, P.E.
AKS Engineering & Forestry, LLC

PO Box 20547 • Portland, Oregon 97294 • Fax 503/286-7176 • Phone 503/285-0598

TABLE OF CONTENTS

Table of Contents (continued)

GEOTECHNICAL INVESTIGATION AND CONSULTATION SERVICES
PROPOSED 23RD STREET APARTMENTS SITE
TAX LOT NO. 800, 23RD STREET SE
SALEM (MARION COUNTY), OREGON

INTRODUCTION

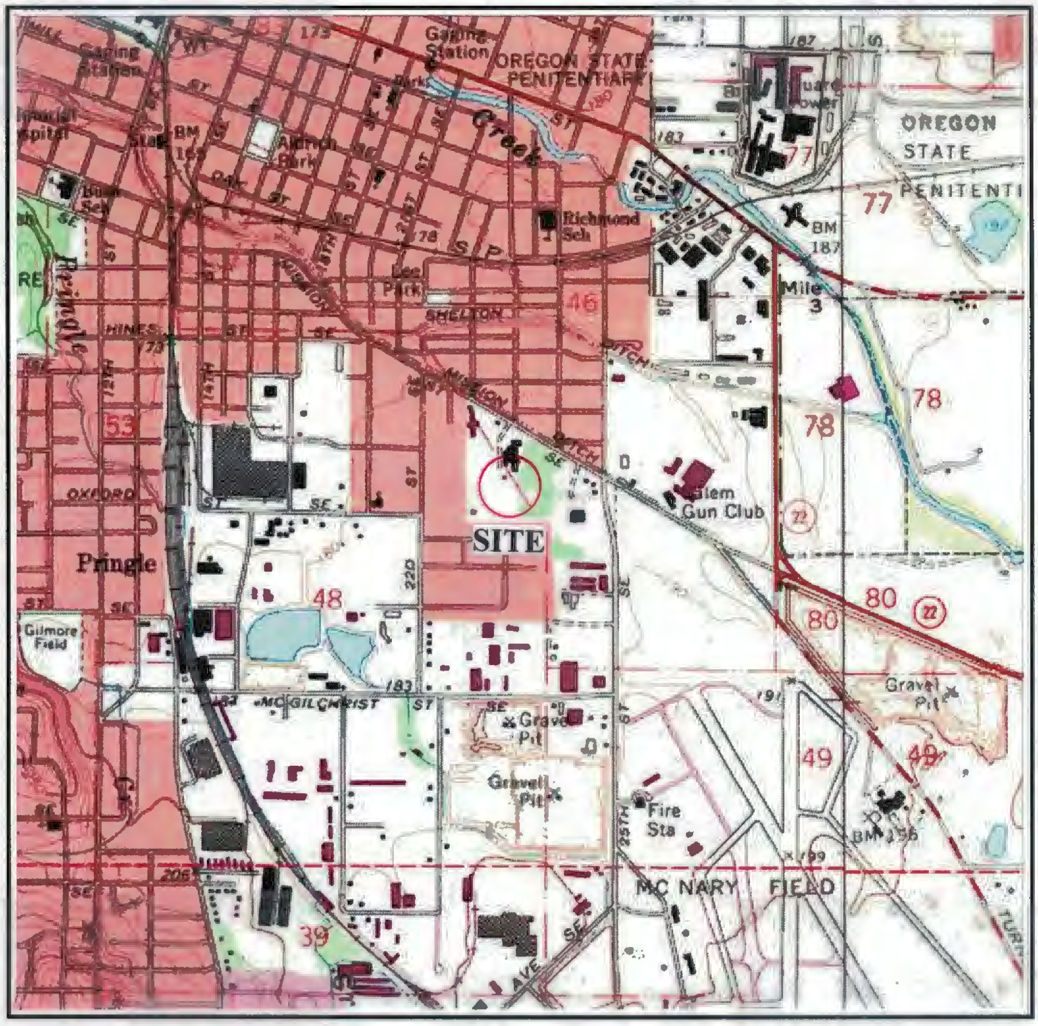
Redmond Geotechnical Services, LLC is please to submit to you the results of our Geotechnical Investigation at the site of the proposed new 23rd Street Apartments development site located to the east of 23rd Street SE and north of Oxford Street SE in Salem (Marion County), Oregon. The general location of the subject site is shown on the Site Vicinity Map, Figure No. 1. The purpose of our geotechnical investigation services at this time was to explore the existing subsurface soils and/or groundwater conditions across the subject site and to develop and/or provide appropriate geotechnical design and construction recommendations for the proposed new apartment project.

PROJECT DESCRIPTION

We understand that present plans for the project is to construct new multi-family apartment buildings at the subject site. Based on a review of the proposed site development plan(s), we understand that the proposed new apartment project will consist of the construction of six (6) new multi-family apartment buildings. Reportedly, the new apartment buildings will be three-story wood-frame structures with a concrete slab-on-grade floor. Support of the new apartment structures is anticipated to include both conventional shallow individual (column) footings and strip (continuous) footings. Structural loading information available at this time indicates the structure loads to be fairly typical for this type of three-story wood-frame construction and is expected to result in maximum dead plus live continuous (strip) and individual (column) footing loads on the order of about 2.0 to 3.0 kips per lineal foot (klf) and 25 to 50 kips, respectively.

Earthwork and grading operations associated with bringing the subject property to finish design grades are unknown at this time but are anticipated to result in only minor cuts and/or fills on the order of approximately one (1) to two (2) feet.

Other associated site improvements for the project will include new underground utility services, concrete curbs and sidewalks, and landscaping as well as new paved parking and drive areas. Additionally, we understand that storm water from impervious areas (i.e., roofs and pavements) of the project site will be collected for possible treatment and/or disposal and will likely include infiltration through various rain gardens and/or drywells constructed throughout the site.



SALEM WEST QUADRANGLE
OREGON
7.5 MINUTE SERIES (TOPOGRAPHIC)

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DOTTED LINES CROSSING RIVER REPRESENT 5 FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

SITE VICINITY MAP

Project No. 1553.002.G	**23rd STREET APARTMENTS**	Figure No. 1

SCOPE OF WORK

The purpose of our geotechnical studies was to evaluate the overall site subsurface soil and/or groundwater conditions underlying the site with regard to the proposed new multi-family apartment construction at the site and any associated impacts or concerns with respect to the new apartment development as well as provide appropriate geotechnical design and construction recommendations for the project. Specifically, our geotechnical investigation included the following scope of work items:

1. A detailed field reconnaissance and subsurface exploration program of the soil and ground water conditions underlying the site by means of eight (8) exploratory test pits. The exploratory test pits were excavated to depths ranging from about five (5) to six (6) feet beneath existing site grades at the approximate locations as shown on the Site Exploration Map, Figure No. 2. Additionally, field infiltration testing was also performed within six (6) of the exploratory test pits (TH-#1 through TH-#6) in general conformance with current EPA and/or the City of Salem Encased Falling Head test method(s).

2. Laboratory testing to evaluate and identify pertinent physical and engineering properties of the subsurface soils encountered relative to the planned site development and construction at the site. The laboratory testing program included tests to help evaluate the natural (field) moisture content and dry density, maximum dry density and optimum moisture content, gradational characteristics, and Atterberg Limits as well as direct shear strength and "R"-value testing.

3. A literature review and engineering evaluation and assessment of the regional seismicity to evaluate the potential ground motion hazard(s) at the subject site. The evaluation and assessment included a review of the regional earthquake history and sources such as potential seismic sources, maximum credible earthquakes, and reoccurrence intervals as well as a discussion of the possible ground response to the selected design earthquake(s), fault rupture, landsliding, liquefaction, and tsunami and seiche flooding.

4. Engineering analyses utilizing the field and laboratory data as a basis for furnishing recommendations for foundation support of the proposed new apartment structures. Recommendations include maximum design allowable contact bearing pressure(s), depth of footing embedment, estimates of foundation settlement, lateral soil resistance, and foundation subgrade preparation. Additionally, construction and/or permanent subsurface water drainage considerations have also been prepared. Further, our report includes recommendations regarding site preparation, placement and compaction of structural fill materials, suitability of the on-site soils for use as structural fill, criteria for import fill materials, and preparation of foundation, pavement and/or floor slab subgrades.

5. Development of various flexible pavement design sections for both the private access drives vehicle and parking areas as well as for any heavy vehicle traffic areas.

SITE CONDITIONS

Site Geology

Available geologic mapping of the area and/or subject site indicates that the near surface soils consist of alluvial soil deposits comprised of silt, sand, and gravel derived from Pleistocene age catastrophic pre-glacial flooding of the Willamette River system. These alluvial deposits may be several tens of feet in thickness and are underlain by semi-consolidated to consolidated conglomerate gravels of Pleistocene age.

Surface Conditions

The subject proposed new 23rd Street Apartments development property is generally irregular in shape and encompasses approximate 2.9 acres. The proposed new multi-family apartment property is roughly bounded to the west by 23rd Street SE, to the south by Oxford Street SE, and to the north and east by existing and developed commercial property.

The subject proposed 23rd Street Apartments development site is generally unimproved and generally consists of existing open commercial land. However, the site has previously been graded resulting in the placement of about 6 to 12 inches of granular and/or gravel fill.

Surface vegetation across the proposed new multi-family apartment site generally consists of a light growth of grass and weeds as well as an occasional tree.

Topographically, the site is characterized as relatively flat-lying to gently sloping terrain (less than 5 percent) descending downward towards the southwest with overall topographic relief estimated at about one (1) to two (2) feet and is estimated to lie at about Elevation 180 feet.

Subsurface Soil Conditions

Our understanding of the subsurface soil conditions underlying the site was developed by means of eight (8) exploratory test pits excavated to depths ranging from about five (5) to six (6) feet beneath existing site grades on September 30, 2016 with track mounted excavating equipment. The location of the exploratory test pits were located in the field by marking off distances from existing and/or known site features and are shown in relation to the proposed new apartment structures and/or the existing site improvements on the Site Exploration Map, Figure No. 2. Detailed logs of the test pit explorations, presenting conditions encountered at each location explored, are presented in the Appendix, Figure No's. A-4 through A-7.

The exploratory test pits performed during this study were observed by staff from Redmond Geotechnical Services, LLC who logged each of the test pits and obtained representative samples of the subsurface soils encountered across the site. All subsurface soils encountered at the site and/or within the exploratory test borings were logged and classified in general conformance with the Unified Soil Classification System (USCS) which is outlined on Figure No. A-3.

The test pit explorations revealed that the subject site is generally underlain by native soil deposits comprised of Lacustrine and Fluvial sedimentary soil deposits of Pleistocene age. However, the site is surfaced with fill materials. Specifically, the subsurface soils underlying the project area consists of a surficial layer of fill materials comprised of gray-brown, moist, medium dense, silty, sandy gravel and gravelly sand which generally extends to a depth of approximately 6 to 12 inches beneath existing surface grades. These surficial fill materials, which contain traces of organics, appear to be at least moderately well compacted and are best characterized by relatively moderate strength and low to moderate compressibility. These surficial fill materials were inturn underlain by lacustrine and fluvial sedimentary subgrade soils. Specifically, the surficial fill materials were found to be underlain by an upper unit of dark gray-brown, moist to very moist, medium stiff, clayey, sandy silt to silty sand subgrade soils to depths of about one (1) to three (3) feet beneath existing site grades. These clayey, sandy silt to silty sand subgrade soils, which were found to contain some traces of organics and are believed to represent the old topsoil zone, are best characterized by relatively low to moderate strength and moderate compressibility. These upper clayey, sandy silt to silty sand subgrade soils were inturn underlain by medium to gray-brown, moist, medium dense to dense, silty, sandy gravel with cobbles to the maximum depth explored of about six (6) feet beneath existing site and/or surface grades. These silty, sandy gravel with cobbles soil deposits are best characterized by relatively moderate strength and low to moderate compressibility.

Groundwater

Groundwater was not encountered within any of the exploratory test pit explorations (TH-#1 through TH-#8) at the time of excavating to depths of at least six (6.0) feet beneath existing site grades. Additionally, based on a review of available water wells in the area, the apparent depth to seasonal high groundwater in the area of the subject site is greater than 10 feet. However, groundwater elevations at and/or below the subject site may fluctuate seasonally in accordance with rainfall conditions as well as changes in site utilization. Further, due to the presence of relatively permeable subgrade soils within the near surface slightly clayey, sandy silt to silty sand subgrade soils, water is generally not anticipated to perch near to and/or at the ground surface during periods of peak and/or prolonged rainfall.

INFILTRATION TESTING

We performed six (6) field infiltration tests at the site on September 30, 2016. The infiltration tests were performed in test borings TH-#1 through TH-#6 at depths of about 1.5 and 4.0 feet beneath existing site grades. The subgrade soils consisted of silty, sandy gravel with cobbles. The field infiltration testing was performed in general conformance with current EPA and/or the City of Salem Encased Falling Head Test Method which consisted of driving a 6-inch inner diameter PVC pipe approximately 6 inches into the exposed soil horizon at the test location. Using a steady water flow, water was discharged into the pipe and allowed to penetrate the subgrade soils. The water level was adjusted over a two (2) hour period and allowed to achieve a saturated subgrade soil condition consistent with the bottom elevation of the surrounding test hole excavation.

Project No. 1553.002.G

23rd STREET APARTMENTS

SITE EXPLORATION PLAN

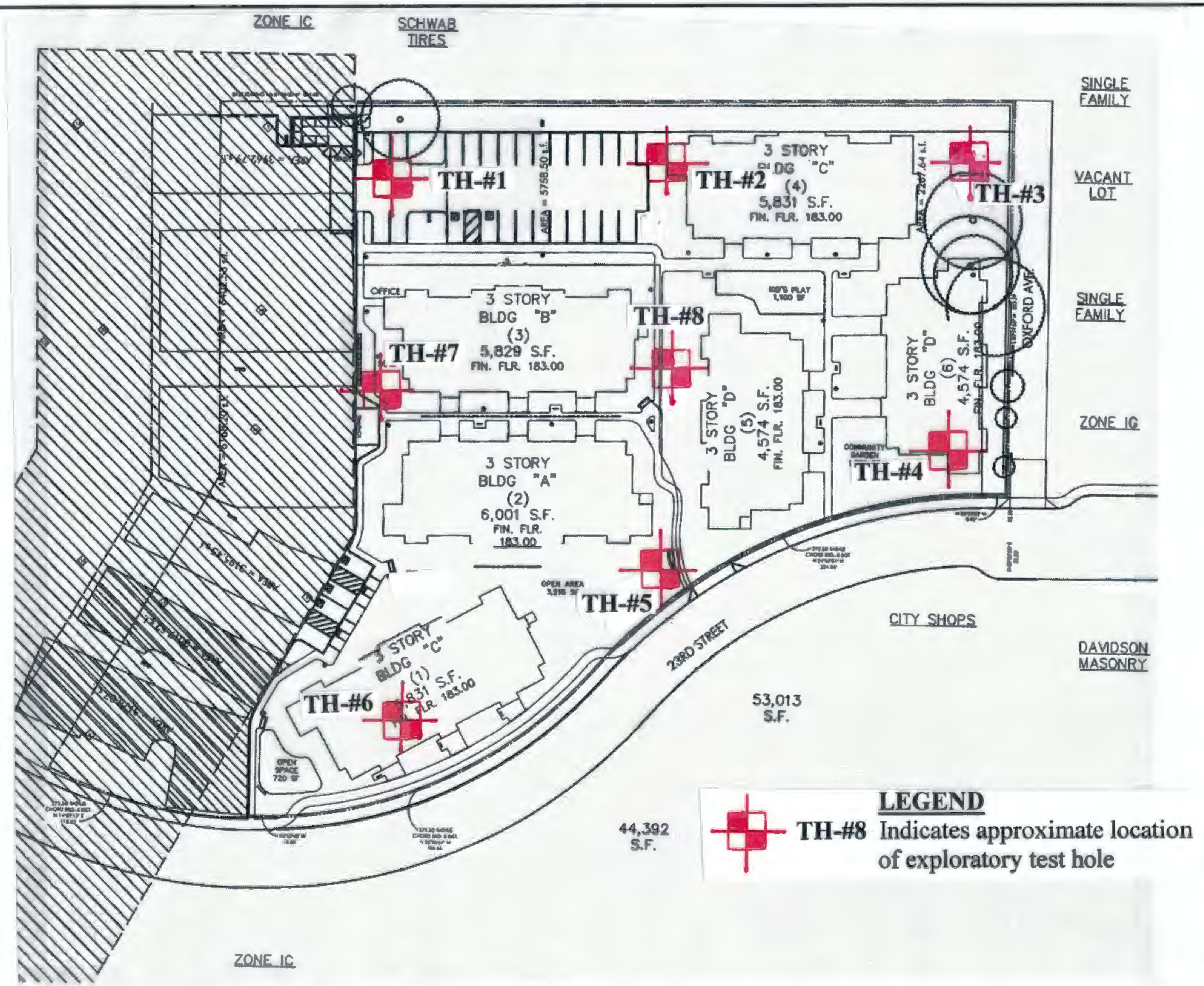


Figure No. 2

Following the required saturation period, water was again added into the pipe and the time and/or rate at which the water level dropped was monitored and recorded. Each 6-inch drop in the water level was recorded until a consistent infiltration rate was observed and/or repeated.

Based on the results of the field infiltration testing, we have found that the underlying silty, sandy gravel subgrade soil deposits posses an ultimate infiltration rate on the order of about 18.0 to 32.0 inches per hour (in/hr).

LABORATORY TESTING

Representative samples of the on-site subsurface soils were collected at selected depths and intervals from various test pit excavations and returned to our laboratory for further examination and testing and/or to aid in the classification of the subsurface soils as well as to help evaluate and identify their engineering strength and compressibility characteristics. The laboratory testing consisted of visual and textural sample inspection, moisture content and dry density determinations, maximum dry density and optimum moisture content, gradation analyses and Atterberg Limits as well as direct shear strength and "R"-value tests. Results of the various laboratory tests are presented in the Appendix, Figure No's. A-8 through A-12.

SEISMICITY AND EARTHQUAKE SOURCES

The seismicity of the southwest Washington and northwest Oregon area, and hence the potential for ground shaking, is controlled by three separate fault mechanisms. These include the Cascadia Subduction Zone (CSZ), the mid-depth intraplate zone, and the relatively shallow crustal zone. Descriptions of these potential earthquake sources are presented below.

The CSZ is located offshore and extends from northern California to British Columbia. Within this zone, the oceanic Juan de Fuca Plate is being subducted beneath the continental North American Plate to the east. The interface between these two plates is located at a depth of approximately 15 to 20 kilometers (km). The seismicity of the CSZ is subject to several uncertainties, including the maximum earthquake magnitude and the recurrence intervals associated with various magnitude earthquakes. Anecdotal evidence of previous CSZ earthquakes has been observed within coastal marshes along the Washington and Oregon coastlines. Sequences of interlayered peat and sands have been interpreted to be the result of large Subduction zone earthquakes occurring at intervals on the order of 300 to 500 years, with the most recent event taking place approximately 300 years ago. A recent study by Geomatrix (1995) suggests that the maximum earthquake associated with the CSZ is moment magnitude (Mw) 8 to 9.

This is based on an empirical expression relating moment magnitude to the area of fault rupture derived from earthquakes that have occurred within Subduction zones in other parts of the world. An Mw 9 earthquake would involve a rupture of the entire CSZ. As discussed by Geomatrix (1995) this has not occurred in other subduction zones that have exhibited much higher levels of historical seismicity than the CSZ, and is considered unlikely. For the purpose of this study an earthquake of Mw 8.5 was assumed to occur within the CSZ.

The intraplate zone encompasses the portion of the subducting Juan de Fuca Plate located at a depth of approximately 30 to 50 km below western Washington and western Oregon. Very low levels of seismicity have been observed within the intraplate zone in western Oregon and western Washington. However, much higher levels of seismicity within this zone have been recorded in Washington and California. Several reasons for this seismic quiescence were suggested in the Geomatrix (1995) study and include changes in the direction of Subduction between Oregon, Washington, and British Columbia as well as the effects of volcanic activity along the Cascade Range. Historical activity associated with the intraplate zone includes the 1949 Olympia magnitude 7.1 and the 1965 Puget Sound magnitude 6.5 earthquakes. Based on the data presented within the Geomatrix (1995) report, an earthquake of magnitude 7.25 has been chosen to represent the seismic potential of the intraplate zone.

The third source of seismicity that can result in ground shaking within the Vancouver and southwest Washington area is near-surface crustal earthquakes occurring within the North American Plate. The historical seismicity of crustal earthquakes in this area is higher than the seismicity associated with the CSZ and the intraplate zone. The 1993 Scotts Mills (magnitude 5.6) and Klamath Falls (magnitude 6.0), Oregon earthquakes were crustal earthquakes.

Liquefaction

Seismic induced soil liquefaction is a phenomenon in which loose, granular soils and some silty soils, located below the water table, develop high pore water pressures and lose strength due to ground vibrations induced by earthquakes. Soil liquefaction can result in lateral flow of material into river channels, ground settlements and increased lateral and uplift pressures on underground structures. Buildings supported on soils that have liquefied often settle and tilt and may displace laterally. Soils located above the ground water table cannot liquefy, but granular soils located above the water table may settle during the earthquake shaking.

Our review of the subsurface soil test pit logs from our exploratory field explorations (TH-#1 through TH-#8) and laboratory test results indicates that the site is generally underlain by medium dense to dense, silty, sandy gravel to depths of at least 6.0 feet beneath existing site grades. Additionally, groundwater was generally not encountered at the site during our field exploration work to depths of at least 6.0 feet.

As such, due to the anticipated depth to groundwater and the relative density characteristics of the underlying silty, sandy gravel subgrade soils beneath the site, it is our opinion that the native soil deposits located beneath the subject site do not have the potential for liquefaction during the design earthquake motions previously described. A more detailed liquefaction assessment was not part of the scope of work for this Geotechnical Investigation.

Landslides

No ancient and/or active landslides were observed or are known to be present on the subject site. Additionally, due to the relatively flat-lying to gently sloping nature of the subject site, the risk of seismic induced slope instability at the site resulting in landslides and/or lateral earth movements do not appear to present a serious potential geologic hazard.

Surface Rupture

Although the site is generally located within a region of the country known for seismic activity, no known faults exist on and/or immediately adjacent to the subject site. As such, the risk of surface rupture due to faulting is considered negligible. The closest know fault to the subject site is the Mt. Angel Fault which is located approximately 15 miles to the northeast.

Tsunami and Seiche

A tsunami, or seismic sea wave, is produced when a major fault under the ocean floor moves vertically and shifts the water column above it. A seiche is a periodic oscillation of a body of water resulting in changing water levels, sometimes caused by an earthquake. Tsunami and seiche are not considered a potential hazard at this site because the site is not near to the coast and/or there are no adjacent significant bodies of water.

Flooding and Erosion

Stream flooding is a potential hazard that should be considered in lowland areas of Marion County and Salem. The FEMA (Federal Emergency Management Agency) flood maps should be reviewed as part of the design for the proposed new multi-family apartment structures and any associated site improvements. Elevations of structures on the site should be designed based upon consultants reports, FEMA (Federal Emergency Management Agency), and Marion County requirements for the 100-year flood levels of any nearby creeks and/or streams.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on the results of our field explorations, laboratory testing, and engineering analyses, it is our opinion that the site is suitable for the proposed new 23rd Street Apartments development and its associated site improvements provided that the recommendations contained within this report are properly incorporated into the design and construction of the project.

The primary features of concern at the site are 1) the presence of surficial fill materials across the site and 2) the presence of the underlying upper layer of the old topsoil zone.

In regards to the existing surficial fill materials across the site, we are not aware of any records or information which exists with regard to the placement and compaction of the existing surficial fill materials. While the results of our field explorations and laboratory testing generally indicate that the existing fill materials are at least moderately well compacted, the possibility exists that some of the existing fill materials are less than moderately compacted. Additionally, the existing surficial fill materials were found to contain traces of and/or occasional organics. As such, some level of risk should be considered should it be decided to develop the subject site with the existing fill materials in-place and not remove them in their entirety from beneath the proposed building pad areas and/or paved parking and drive areas.

With regard to the presence of the underlying upper layer of old topsoil remnants, it appears that the site was stripped and cleared of the existing surface vegetation prior to the placement of the existing surficial fill materials. However, the underlying upper layer of the old topsoil zone was found to contain some traces of organics and/or roots. Additionally, the underlying upper layer of the old topsoil zone is considered to posses only low to moderate strength and moderate compressibility characteristics. In this regard, while it may be decided to leave the existing surficial fill materials and underlying upper old topsoil remnants in-place and not remove them in their entirety, we recommend that consideration be given to at least embedding the proposed new apartment building foundations to bear directly on the underlying layer of medium dense, silty, sandy gravel deposits.

The following sections of this report provide specific recommendations regarding subgrade preparation and grading as well as foundation and floor slab design and construction for the new 23rd Street Apartments project.

Site Preparation

As an initial step in site preparation, we recommend that the proposed new apartment building area(s) and its associated structural and/or site improvement area(s) be stripped and cleared of all existing improvements, any existing unsuitable fill materials, surface debris, existing vegetation, topsoil materials, and/or any other deleterious materials present at the time of construction. In general, we envision that the site stripping to remove existing vegetation and topsoil materials will generally be about 1 to 2 inches. However, localized areas requiring deeper removals may be encountered and should be evaluated at the time of construction by the Geotechnical Engineer. The stripped and cleared materials should be properly disposed of as they are generally considered unsuitable for use/reuse as fill materials.

Following the completion of the site stripping and clearing work and prior to the placement of any required structural fill materials and/or structural improvements, the exposed subgrade soils within the planned structural improvement area(s) should be inspected and approved by the Geotechnical Engineer and possibly proof-rolled with a half and/or fully loaded dump truck. Areas found to be soft or otherwise unsuitable should be over-excavated and removed or scarified and recompacted as structural fill. During wet and/or inclement weather conditions, proof rolling and/or scarification and recompaction as noted above may not be appropriate.

The on-site native silty sand and sandy gravel subgrade soil materials are generally considered suitable for use/reuse as structural fill materials provided that they are free of organic materials, debris, and rock fragments in excess of about 6 inches in dimension. However, if site grading is performed during wet or inclement weather conditions, the use of the on-site silty sand native soil materials which contain significant silt and clay sized particles will be difficult at best. In this regard, during wet or inclement weather conditions, we recommend that an import structural fill material be utilized which should consist of a free-draining (clean) granular fill (sand & gravel) containing no more than about 5 percent fines. Representative samples of the materials which are to be used as structural fill materials should be submitted to the Geotechnical Engineer and/or laboratory for approval and determination of the maximum dry density and optimum moisture content for compaction.

In general, all site earthwork and grading activities should be scheduled for the drier summer months (June through September) if possible. However, if wet weather site preparation and grading is required, it is generally recommended that the stripping of topsoil materials be accomplished with a tracked excavator utilizing a large smooth-toothed bucket working from areas yet to be excavated. Additionally, the loading of strippings into trucks and/or protection of moisture sensitive subgrade soils will also be required during wet weather grading and construction. In this regard, we recommend that areas in which construction equipment will be traveling be protected by covering the exposed subgrade soils with a geotextile fabric such as Mirafi 140N followed by at least 12 inches or more of crushed aggregate base rock. Further, the geotextile fabric should have a minimum Mullen burst strength of at least 250 pounds per square inch for puncture resistance and an apparent opening size (AOS) between the U.S. Standard No. 70 and No. 100 sieves.

All structural fill materials placed within the new apartment building and/or pavement areas should be moistened or dried as necessary to near (within 3 percent) optimum moisture conditions and compacted by mechanical means to a minimum of 92 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Structural fill materials should be placed in lifts (layers) such that when compacted do not exceed about 8 inches. Additionally, all fill materials placed within three (3) lineal feet of the perimeter (limits) of the proposed senior care structure and/or pavements should be considered structural fill. All aspects of the site grading should be monitored and approved by a representative of Redmond Geotechnical Services, LLC.

Foundation Support

Based on the results of our investigation, it is our opinion that the site of the proposed new 23rd Street Apartments development is generally suitable for support of the three-story wood-frame apartment structure(s) provided that the following foundation design recommendations are followed. As noted herein, some level of risk must be considered acceptable should the proposed new apartment structures be supported by the existing undocumented surficial fill materials and/or underlying old topsoil remnants. The following sections of this report present specific foundation design and construction recommendations for the planned new multi-family apartment structure(s).

Shallow Foundations

In general, conventional shallow continuous (strip) footings and individual (spread) column footings may be supported by approved native and re-compacted subgrade silty sand soil materials and/or structural fill soils based on an allowable contact bearing pressure of about 2,000 pounds per square foot (psf). However, where higher allowable contact bearing pressures are desired and/or required, an allowable contact bearing pressure of 2,500 psf may be used for design where foundations are supported by a minimum of at least 12 inches or more of compacted crushed aggregate base rock (granular) fill material. These recommended allowable contact bearing pressures are intended for dead loads and sustained live loads and may be increased by one-third for the total of all loads including short-term wind or seismic loads. In general, continuous strip footings should have a minimum width of at least 16 inches and be embedded at least 18 inches below the lowest adjacent finish grade (includes frost protection). Individual column footings (where required) should be embedded at least 18 inches below grade and have a minimum width of at least 24 inches.

Total and differential settlements of foundations constructed as recommended above and supported by approved native subgrade soils or by properly compacted structural fill materials are expected to be well within the tolerable limits for this type of three-story wood-frame structure and should generally be less than about 1-inch and 1/2-inch, respectively.

Allowable lateral frictional resistance between the base of the footing element and the supporting subgrade bearing soil can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.35 and 0.45 for native silty sand subgrade soils and/or import gravel fill materials respectively. In addition, lateral loads may be resisted by passive earth pressures on footings poured "neat" against in-situ (native) subgrade soils or properly backfilled with structural fill materials based on an equivalent fluid density of 250 pounds per cubic foot (pcf). This recommended value includes a factor of safety of approximately 1.5 which is appropriate due to the amount of movement required to develop full passive resistance.

Floor Slab Support

In order to provide uniform subgrade reaction beneath concrete slab-on-grade floors, we recommend that the floor slab area be underlain by a minimum of 6 inches of free-draining (less than 5 percent passing the No. 200 sieve), well-graded, crushed rock. The crushed rock should help provide a capillary break to prevent migration of moisture through the slab. Additional moisture protection, where needed, can be provided by using a 10-mil polyolefin geo-membrane sheeting such as StegoWrap.

The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Where floor slab subgrade materials are undisturbed, firm and stable and where the underslab aggregate base rock section has been prepared and compacted as recommended above, we recommend that a modulus of subgrade reaction of 250 pci be used for design.

Retaining/Below Grade Walls

Retaining and/or below grade walls should be designed to resist lateral earth pressures imposed by native soils or granular backfill materials as well as any adjacent surcharge loads. For walls which are unrestrained at the top and free to rotate about their base, we recommend that active earth pressures be computed on the basis of the following equivalent fluid densities:

Non-Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Sand (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	35	30
3H:1V	60	50
2H:1V	90	80

For walls which are fully restrained at the top and prevented from rotation about their base, we recommend that at-rest earth pressures be computed on the basis of the following equivalent fluid densities:

Restrained Retaining Wall Pressure Design Recommendations

Slope Backfill (Horizontal/Vertical)	Equivalent Fluid Density/Sand (pcf)	Equivalent Fluid Density/Gravel (pcf)
Level	45	35
3H:1V	65	60
2H:1V	95	90

The above recommended values assume that the walls will be adequately drained to prevent the buildup of hydrostatic pressures. Where wall drainage will not be present and/or if adjacent surcharge loading is present, the above recommended values will be significantly higher.

Backfill materials behind walls should be compacted to 90 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. Special care should be taken to avoid over-compaction near the walls which could result in higher lateral earth pressures than those indicated herein. In areas within three (3) to five (5) feet behind walls, we recommend the use of hand-operated compaction equipment.

Pavements

Flexible pavement design for the project was determined on the basis of projected (anticipated) traffic volume and loading conditions relative to laboratory subgrade soil strength ("R"-value) characteristics.

Based on an average laboratory subgrade "R"-value of 40 (Resilient Modulus = 5,000 to 10,000) and utilizing the Asphalt Institute Flexible Pavement Design Procedures and/or the American Association of State Highway and Transportation Officials (AASHTO) 1993 "Design of Pavement Structures" manual, we recommend that the asphaltic concrete pavement section(s) for the new retail development areas at the site consist of the following:

	Asphaltic Concrete Thickness (inches)	**Crushed Base Rock Thickness (inches)**
Automobile Parking Areas	2.5	6.0
Automobile Drive Areas	3.0	8.0

Note: Where heavy vehicle traffic is anticipated such as those required for fire and/or garbage trucks, we recommend that the automobile drive area pavement section be increased by adding 1.0 inches of asphaltic concrete and 3.0 inches of aggregate base rock. Additionally, for wet weather construction, we recommend a minimum gravel base rock thickness of at least 12 inches. Further, the above recommended flexible pavement section(s) assumes a design life of 20 years.

Pavement Subgrade, Base Course & Asphalt Materials

The above recommended pavement section(s) were based on the design assumptions listed herein and on the assumption that construction of the pavement section(s) will be completed during an extended period of reasonably dry weather. All thicknesses given are intended to be the minimum acceptable. Increased base rock sections and the use of geotextile fabric may be required during wet and/or inclement weather conditions and/or in order to adequately support construction traffic and protect the subgrade during construction. Additionally, the above recommended pavement section(s) assume that the subgrade will be prepared as recommended herein, that the exposed subgrade soils will be properly protected from rain and construction traffic, and that the subgrade is firm and unyielding at the time of paving. Further, it assumes that the subgrade is graded to prevent any ponding of water which may tend to accumulate in the base course.

Pavement base course materials should consist of well-graded 1-1/2 inch and/or 3/4-inch minus crushed base rock having less than 5 percent fine materials passing the No. 200 sieve. The base course and asphaltic concrete materials should conform to the requirements set forth in the latest edition of the Oregon Department of Transportation, Standard Specifications for Highway Construction. The base course materials should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 (AASHTO T-180) test procedures. The asphaltic concrete paving materials should be compacted to at least 92 percent of the theoretical maximum density as determined by the ASTM D-2041 (Rice Gravity) test method.

Excavation/Slopes

Temporary excavations of up to about three (3) feet in depth may be constructed with near vertical inclinations. Temporary excavations greater than about three (3) feet but less than eight (8) feet should be excavated with inclinations of at least 1 to 1 (horizontal to vertical) or properly braced/shored. Where excavations are planned to exceed about eight (8) feet, this office should be consulted. All shoring systems and/or temporary excavation bracing for the project should be the responsibility of the excavation contractor.

Depending on the time of year in which trench excavations occur, trench dewatering may be required in order to maintain dry working conditions if the invert elevations of the proposed utilities are located at and/or below the groundwater level. If groundwater is encountered during utility excavation work, we recommend placing trench stabilization materials along the base of the excavation. Trench stabilization materials should consist of 1-foot of well-graded gravel, crushed gravel, or crushed rock with a maximum particle size of 4 inches and less than 5 percent fines passing the No. 200 sieve. The material should be free of organic matter and other deleterious material and placed in a single lift and compacted until well keyed.

Surface Drainage/Groundwater

We recommend that positive measures be taken to properly finish grade the site so that drainage waters from the building and landscaping areas as well as adjacent properties or buildings are directed away from the new apartment structures foundations and/or floor slabs. All roof drainage should be directed into conduits that carry runoff water away from the new apartment building(s) to a suitable outfall. Roof downspouts should not be connected to foundation drains. A minimum ground slope of about 2 percent is generally recommended in unpaved areas around the buildings.

Groundwater was not encountered at the site in any of the exploratory test pits (TH-#1 through TH-#8) at the time of excavating to depths of at least 6.0 feet beneath existing site grades. Additionally, although groundwater levels beneath the site may fluctuate seasonally in accordance with rainfall conditions and/or changes in site utilization, due to the relative permeability of the near surface and/or subsurface soils beneath the site, we are generally of the opinion that groundwater elevations in the area and/or beneath the subject site will not likely temporarily pond/perch near the ground surface during periods of prolonged rainfall.

As such, based on our current understand of the site grading required to bring the subject site to finish design grades, we are of the opinion that an underslab drainage system is not required for the proposed apartment structures. Additionally, due to the relative permeability of the subgrade soils within the foundation bearing level of the proposed new apartment structures, we are generally of the opinion that a footing/foundation drainage system is not required around the perimeter of the proposed apartment structures. However, a foundation drain is recommended for any below grade footing and/or retaining walls. A typical recommended perimeter footing and/or retaining wall drain detail is shown on Figure No. 3.

Design Infiltration Rates

Based on the results of our field infiltration testing, we recommend using the following infiltration rates to design the storm water infiltration and/or disposal systems for the project:

Subgrade Soil Type	**Recommended Infiltration Rate**
silty, sandy GRAVEL with cobbles (GM)	9.0-16.0 inches per hour (in/hr)

Note: A safety factor of two (2) was used to calculate the above recommended design infiltration rate(s). Additionally, given the gradational variability of the on-site silty, gravelly sand to sandy gravel subgrade soils beneath the site, it is generally recommended that field testing be performed during and/or following construction of the on-site storm water infiltration system in order to confirm that the above recommended design infiltration rates are appropriate.

Seismic Design Considerations

Structures at the site should be designed to resist earthquake loading in accordance with the methodology described in the latest edition of the 2014 Oregon State Structural Specialty Code (OSSC) and/or Amendments to the 2015 International Building Code (IBC). The maximum considered earthquake ground motion for short period and 1.0 period spectral response may be determined from the Washington State Structural Specialty Code and/or Figures 1613 (1) and 1613 (2) of the 2009 National Earthquake Hazard Reduction Program (NEHRP) "Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" published by the Building Seismic Safety Council. We recommend Site Class "C" be used for design per Table 1613.5.2.

Using this information, the structural engineer can select the appropriate site coefficient values (F_a and F_v) from Tables 1613.5.3 (1) and 1613.5.3 (2) of the 2015 IBC to determine the maximum considered earthquake spectral response acceleration for the project. However, we have assumed the following response spectrum for the project:

Table 1. IBC Seismic Design Parameters

Site Class	S_S	S_1	F_a	F_v	S_{MS}	S_{M1}	S_{DS}	S_{D1}
C	0.917	0.432	1.033	1.368	0.947	0.591	0.632	0.394

Notes: 1. S_S and S_1 were established based on the USGS 2012 mapped maximum considered earthquake spectral acceleration maps for 2% probability of exceedence in 50 years.

2. F_a and F_v were established based on IBC 2015 tables 1613.5.3 (1) and 1613.5.3 (2) using the selected S_S and S_1 values.

CONSTRUCTION MONITORING AND TESTING

We recommend that **Redmond Geotechnical Services, LLC** be retained to provide construction monitoring and testing services during all earthwork operations for the proposed new 23rd Street Apartments development. The purpose of our monitoring services would be to confirm that the site conditions reported herein are as anticipated, provide field recommendations as required based on the actual conditions encountered, document the activities of the grading contractor and assess his/her compliance with the project specifications and recommendations. It is important that our representative meet with the contractor prior to grading to help establish a plan that will minimize costly over-excavation and site preparation work. Of primary importance will be observations made during site preparation, structural fill placement, footing excavations and construction as well as any retaining wall backfill.

CLOSURE AND LIMITATIONS

This report is intended for the exclusive use of the addressee and/or their representative(s) to use to design and construct the proposed new apartment structures and any associated site improvements described herein as well as to prepare any related construction documents. The conclusions and recommendations contained in this report are based on site conditions as they presently exist and assume that the explorations are representative of the subsurface conditions between the explorations and/or across the study area. The data, analyses, and recommendations herein may not be appropriate for other structures and/or purposes. We recommend that parties contemplating other structures and/or purposes contact our office. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report. Additionally, the above recommendations are contingent on Redmond Geotechnical Services, LLC being retained to provide all site inspections and construction monitoring services associated with the site grading and earthwork operations as well as all foundation excavation and preparation work for this project. Redmond Geotechnical Services, LLC will not assume any responsibility and/or liability for any engineering judgment, inspection and/or testing services performed by others.

It is the owners/developers responsibility for insuring that the project designers and/or contractors involved with this project implement our recommendations into the final design plans, specifications and/or construction activities for the project. Further, in order to avoid delays during construction, we recommend that the final design plans and specifications for the project be reviewed by our office to evaluate as to whether our recommendations have been properly interpreted and incorporated into the project.

If during any future site grading and construction, subsurface conditions different from those encountered in the explorations are observed or appear to be present beneath excavations, we should be advised immediately so that we may review these conditions and evaluate whether modifications of the design criteria are required. We also should be advised if significant modifications of the proposed site development are anticipated so that we may review our conclusions and recommendations.

LEVEL OF CARE

The services performed by the Geotechnical Engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in the area under similar budget and time restraints. No warranty or other conditions, either expressed or implied, is made.

REFERENCES

Adams, John, 1984, Active Deformation of the Pacific Northwest Continental Margin: Tectonics, v.3, no. 4, p. 449-472.

Applied Technology Council, ATC-13, 1985, Earthquake Damage Evaluation Data for California.

Atwater, B.F., 1992, Geologic evidence for earthquakes during the past 2000 years along the Copalis River, southern coastal Washington: Journal of Geophysical Research, v. 97, p. 1901-1919.

Atwater, B.F., 1987a, A periodic Holocene recurrence of widespread, probably coseismic Subsidence in southwestern Washington: EOS, v. 68, no. 44.

Atwater, B.F., 1987b, Evidence for great Holocene earthquakes along the outer coast of Washington State: Science, v. 236, no. 4804, pp. 942-944.

Campbell, K.W., 1990, Empirical prediction of near-surface soil and soft-rock ground motion for the Diablo Canyon Power Plant site, San Luis Obispo County, California: Dames & Moore report to Lawrence Livermore National Laboratory.

Carver, G.A., and Burke, R.M., 1987, Late Holocene paleoseismicity of the southern end of the Cascadia Subduction zone [abs.]: EOS, v. 68, no. 44, p. 1240.

Chase, R.L., Tiffin, D.L., Murray, J.W., 1975, The western Canadian continental margin: In Yorath, C.J., Parker, E.R., Glass, D.J., editors, Canada's continental margins and offshore petroleum exploration: Canadian Society of Petroleum Geologists Memoir 4, p. 701-721.

Crouse, C.B., 1991a, Ground motion attenuation equations for earthquakes on the Cascadia Subduction Zone: Earthquake Spectra, v. 7, no. 2, pp. 201-236.

Crouse, C.B., 1991b, Errata to Crouse (1991a), Earthquake Spectra, v. 7, no. 3, p. 506.

Darienzo, M.E., and Peterson, C.D., 1987, Episodic tectonic subsidence recorded in late Holocene salt marshes, northern Oregon central Cascadia margin: Tectonics, v. 9, p. 1-22.

Darienzo, M.E., and Peterson, C.D., 1987, Episodic tectonic subsidence recorded in late Holocene salt marshes northwest Oregon [abs]: EOS, v. 68, no. 44, p. 1469.

EERI (Earthquake Engineering Research Institute), 1993, The March 25, 1993, Scotts Mill Earthquake, Western Oregon's Wake-Up Call: EERI Newsletter, Vol. 27, No. 5, May.

Geomatrix, 1995 Seismic Design Mapping, State of Oregon: Final Report to Oregon Department of Transportation, January.

Geologic Map Series (GMS-49), Map of Oregon Seismicity, 1841-1986 dated 1986.

Geologic Map Series (GMS-97), Geologic Map of the Salem West Quadrangle, Marion County, Oregon dated 1995.

Grant, W.C., and McLaren, D.D., 1987, Evidence for Holocene Subduction earthquakes along the northern Oregon coast [abs]: EOS v. 68, no. 44, p. 1239.

Grant, W.C., Atwater, B.F., Carver, G.A., Darienzo, M.E., Nelson, A.R., Peterson, C.D., and Vick, G.S., 1989, Radiocarbon dating of late Holocene coastal subsidence above the Cascadia Subduction zone-compilation for Washington, Oregon, and northern California, [abs]: EOS Transactions of the American Geophysical Union, v. 70, p. 1331.

International Conference of Building Officials (ICBO), 1994, Uniform Building Code: 1994 Edition, Whittier, CA. 1994.

Joyner, W.B., and Boore, D.M., 1998, Measurement, characterization and prediction of strong ground motion: Earthquake Engineering and Soil Dynamics II – Recent Advances in Ground Motion Evaluation, ASCE Geotech. Special Publ. No. 20, p. 43-102.

Riddihough, R.P., 1984, Recent movements of the Juan de Fuca plate system: Journal of Geophysical Research, v. 89, no. B8, p. 6980-6994.

Youngs, R.R., Day, S.M., and Stevens, J.L., 1998, Near field ground motions on rock for large Subduction earthquakes: Earthquake Engineering and Soil Dynamics II – Recent Advances in Ground Motion Evaluation, ASCE Geotech. Special Publ. No. 20, p. 445-462.

Appendix "A"

Log of Test Pits and Laboratory Test Results

APPENDIX

FIELD EXPLORATIONS AND LABORATORY TESTING

FIELD EXPLORATION

Subsurface conditions at the site were explored by excavating eight (8) exploratory test pits on September 30, 2016. The approximate location of the test pit explorations are shown in relation to the proposed new senior apartment structures and its associated site improvements on the Site Exploration Map, Figure No. 2.

The test pits were excavated using track-mounted excavating equipment in general conformance with ASTM Methods in Vol. 4.08, D-1586-94 and D-1587-83. The test pits were excavated to depths ranging from about 5.0 to 6.0 feet beneath existing site grades. Detailed logs of the test pits are presented on the Log of Test Pits, Figure No's. A-4 through A-7. The soils were classified in accordance with the Unified Soil Classification System (USCS), which is outlined on Figure No. A-3.

The exploration program was coordinated by a field engineer who monitored the excavating and exploration activity, obtained representative samples of the subsurface soils encountered, classified the soils by visual and textural examination, and maintained continuous logs of the subsurface conditions. Disturbed and/or undisturbed samples of the subsurface soils were obtained at appropriate depths and/or intervals and placed in plastic bags and/or with a thin walled ring sample.

Groundwater was not encountered within any of the exploratory test pits (TH-#1 through TH-#8) at the time of excavating at depths of between five (5) and six (6) feet beneath existing site grades.

LABORATORY TESTING

Pertinent physical and engineering characteristics of the soils encountered during our subsurface investigation were evaluated by a laboratory testing program to be used as a basis for selection of soil design parameters and for correlation purposes. Selected tests were conducted on representative soil samples. The program consisted of tests to evaluate the existing (in-situ) moisture-density, maximum dry density and optimum moisture content, Atterberg Limits and gradational characteristics as well as direct shear strength and "R"-value tests.

Dry Density and Moisture Content Determinations

Density and moisture content determinations were performed on both disturbed and relatively undisturbed samples from the test boring explorations in general conformance with ASTM Vol. 4.08 Part D-216. The results of these tests were used to calculate existing overburden pressures and to correlate strength and compressibility characteristics of the soils. Test results are shown on the boring logs at the appropriate sample depths.

Maximum Dry Density

Two (2) Maximum Dry Density tests were performed on representative samples of the sandy silt and/or sandy gravel subgrade soils in accordance with ASTM Vol. 4.08 Part D-1557-78. The test was conducted to facilitate classification of the soils and for correlation purposes. Test results appear on Figure No. A-8.

Atterberg Limits

Liquid Limit (LL) and Plastic Limit (PL) tests were performed on a representative sample of the clayey, sandy silt subgrade soils in accordance with ASTM Vol. 4.08 Part D-4318-85. The test results were conducted to help facilitate the classification of the subgrade soils and for correlation purposes. The test results are shown graphically on Figure No. A-9.

Gradation Analysis

Gradation analyses were performed on representative samples of the subsurface soils in accordance with ASTM Vol. 4.08 Part D-422. The test results were used to classify the soil in accordance with the Unified Soil Classification System (USCS). The test results are shown graphically on Figure No. A-10.

Direct Shear Strength Test

One (1) Direct Shear Strength test was performed on a relatively undisturbed and/or remolded sample at a continuous rate of shearing deflection (0.02 inches per minute) in accordance with ASTM Vol. 4.08 Part D-3080-79. The test results were used to determine engineering strength properties and are shown graphically on Figure No. A-11.

"R"-Value Tests

Two (2) "R"-value tests were performed on representative samples of the near surface sandy silt to silty sand subgrade soils in general conformance with ASTM Vol. 4.08 Part D-2844. The test results were used to help evaluate the subgrade soil supporting and performance capabilities when subjected to vehicle traffic loading. The test results are shown on Figure No. A-12.

The following figures are attached and complete the Appendix:

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS — MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS — MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS — LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

DEFINITION OF TERMS

	U.S. STANDARD SERIES SIEVE: 200	40	10	4	CLEAR SQUARE SIEVE OPENINGS: 3/4"	3"	12"	
SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS	
	FINE	MEDIUM	COARSE	FINE	COARSE			

GRAIN SIZES

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT†
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

CLAYS AND PLASTIC SILTS	STRENGTH‡	BLOWS/FOOT†
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

†Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

REDMOND GEOTECHNICAL SERVICES
PO Box 20547 • Portland, Oregon 97294

KEY TO EXPLORATORY TEST PIT LOGS
Unified Soil Classification System (ASTM D-2487)

23rd STREET APARTMENTS
Salem, Oregon

PROJECT NO.	DATE	Figure A-3
1553.002.G	Nov 1, 2016	

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 9/30/16

SOIL DESCRIPTION

TEST PIT NO. TH-#1 ELEVATION

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					GM	FILL: Gray-brown, moist, medium dense, Crushed Aggregate Bae Rock (1"-minus)
	X			18.8		
	X			12.5	ML/	NATIVE GROUND: Dark gray-brown, very moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist to very moist, medium dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

TEST PIT NO. TH_#2 ELEVATION

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					SM	FILL: Medium brown, moist, loose, sandy gravelly SILT with organics
					ML/ SM	NATIVE GROUND: Drak gray-brown, very moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1553.002.G | 23rd STREET APARTMENTS | FIGURE NO. A-4

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 9/30/16

SOIL DESCRIPTION

TEST PIT NO. TH-#3 ELEVATION

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					SM	FILL: Medium brown, moist, loose, silty, gravelly SAND with organics
	X			12.9	ML/SM	NATIVE GROUND: Drak gray-brown, very moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
	X			11.1		
5					GM	Gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

TEST PIT NO. TH-#4 ELEVATION

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					SM	FILL: Medium brown, moist, loose, silty, gravelly SAND with organics
					ML/SM	NATIVE GROUND: Dark gray-brown, very moist, medium stiff, sandy, clayey SILT with oragnics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1553.002.G 23rd STREET APARTMENTS FIGURE NO. A-5

BACKHOE COMPANY: Gene S. McMurrin BUCKET SIZE: 24 inches DATE: 9/30/16

SOIL DESCRIPTION

TEST PIT NO. TH-#5 ELEVATION

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					GM	FILL: Gray-brown, moist, medium dense, silty sandy GRAVEL with traces of organics
	X			11.6	ML/SM	NATIVE GROUND: Dark gray-brown, moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 6.0 feet No groundwater encountered at time of exploration
10						
15						

TEST PIT NO. TH-#6 ELEVATION

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					GM	FILL: Gray-brown, moist, medium dense, Crushed Aggregate Base Rock (1"-minus)
					ML/SM	NATIVE GROUND: Dark gray-brown, very moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1553.002.G | 23rd STREET APARTMENTS | FIGURE NO. A-6

BACKHOE COMPANY: Gene S. McMurrin **BUCKET SIZE:** 24 inches **DATE:** 9/30/16

SOIL DESCRIPTION

TEST PIT NO. TH-#7 **ELEVATION**

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					GM	FILL: Gray-brown, moist, medium dense, Crushed Aggregate Base Rock (1"-minus)
					ML/SM	NATIVE GROUND: Dark gray-brown, very moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

TEST PIT NO. TH-#8 **ELEVATION**

DEPTH (FEET)	BAG SAMPLE	DENSITY TEST	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0					GM	FILL: Gray-brown, moist, medium dense, Crushed Aggregate Base Rock (1"-minus)
					ML/SM	NATIVE GROUND: Drak gray-brown, very moist, medium stiff, sandy, clayey SILT with organics (Old Topsoil Zone)
5					GM	Medium to gray-brown, moist, medium dense to dense, silty, sandy GRAVEL with cobbles
						Total Depth = 5.0 feet No groundwater encountered at time of exploration
10						
15						

LOG OF TEST PITS

PROJECT NO. 1553.002.G	23r STREET APARTMENTS	FIGURE NO. A-7

MAXIMUM DENSITY TEST RESULTS

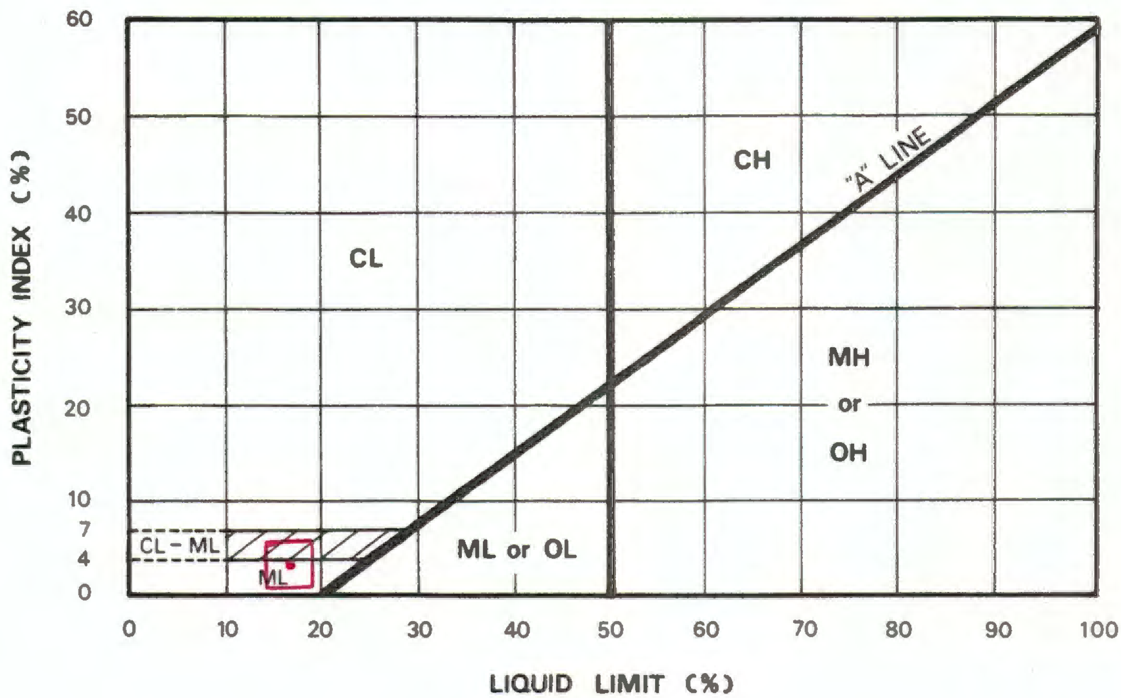
SAMPLE LOCATION	SOIL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
TH-#1 @ 1.5'	Dark gray-brown, sandy, clayey SILT	106.0	15.0
TH-#1 @ 3.5'	Medium to gray-brown, silty, sandy GRAVEL with cobbles	112.0	12.5

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (pcf)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (%)	EXPANSION INDEX	EXPANSIVE CLASS.

MAXIMUM DENSITY & EXPANSION INDEX TEST RESULTS

PROJECT NO.: 1553.002.G	23rd STREET APARTMENTS	FIGURE NO.: A-8



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT %	LIQUID LIMIT %	PLASTICITY INDEX %	PASSING NO. 200 SIEVE %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
▣	TH-#1	1.5	18.8	17.7	3.8	63.7		ML

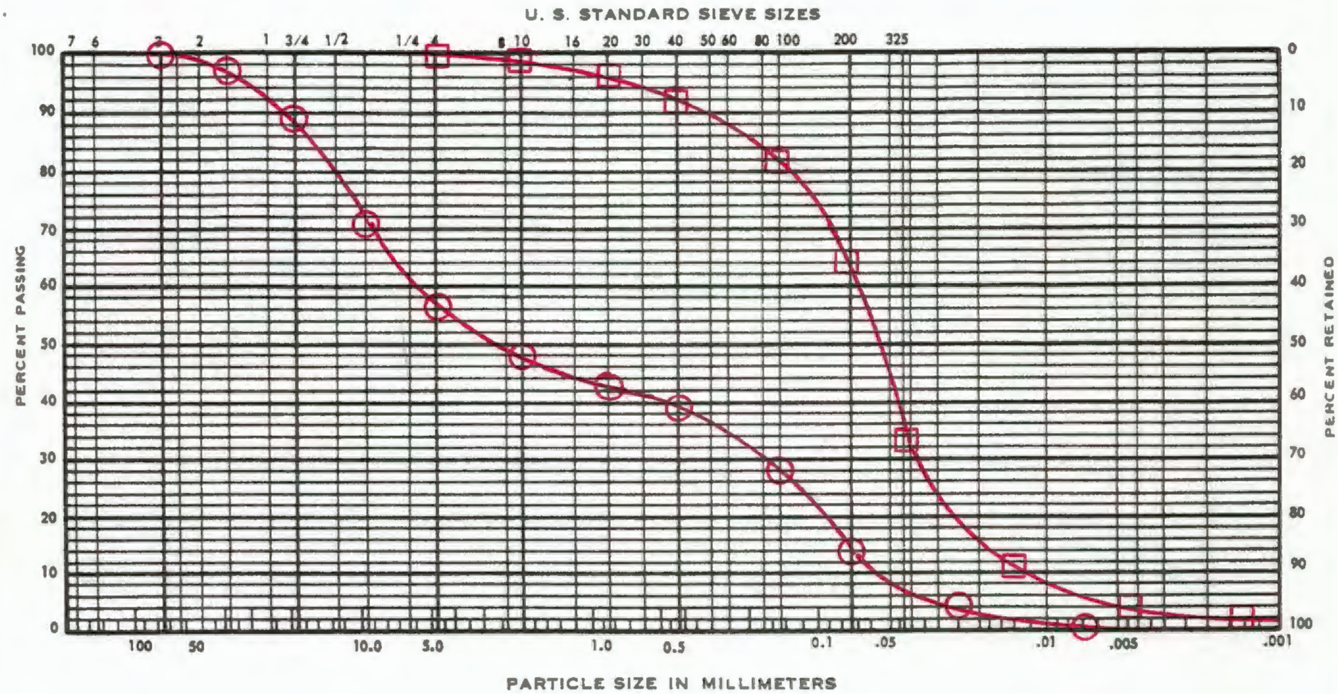
REDMOND GEOTECHNICAL SERVICES

PO Box 20547 • Portland, Oregon 97294

PLASTICITY CHART AND DATA		
23rd STREET APARTMENTS Salem, Oregon		
PROJECT NO.	DATE	Figure A-9
1553.002.G	Nov 1, 2016	

UNIFIED SOIL CLASSIFICATION SYSTEM

(ASTM D 422-72)



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

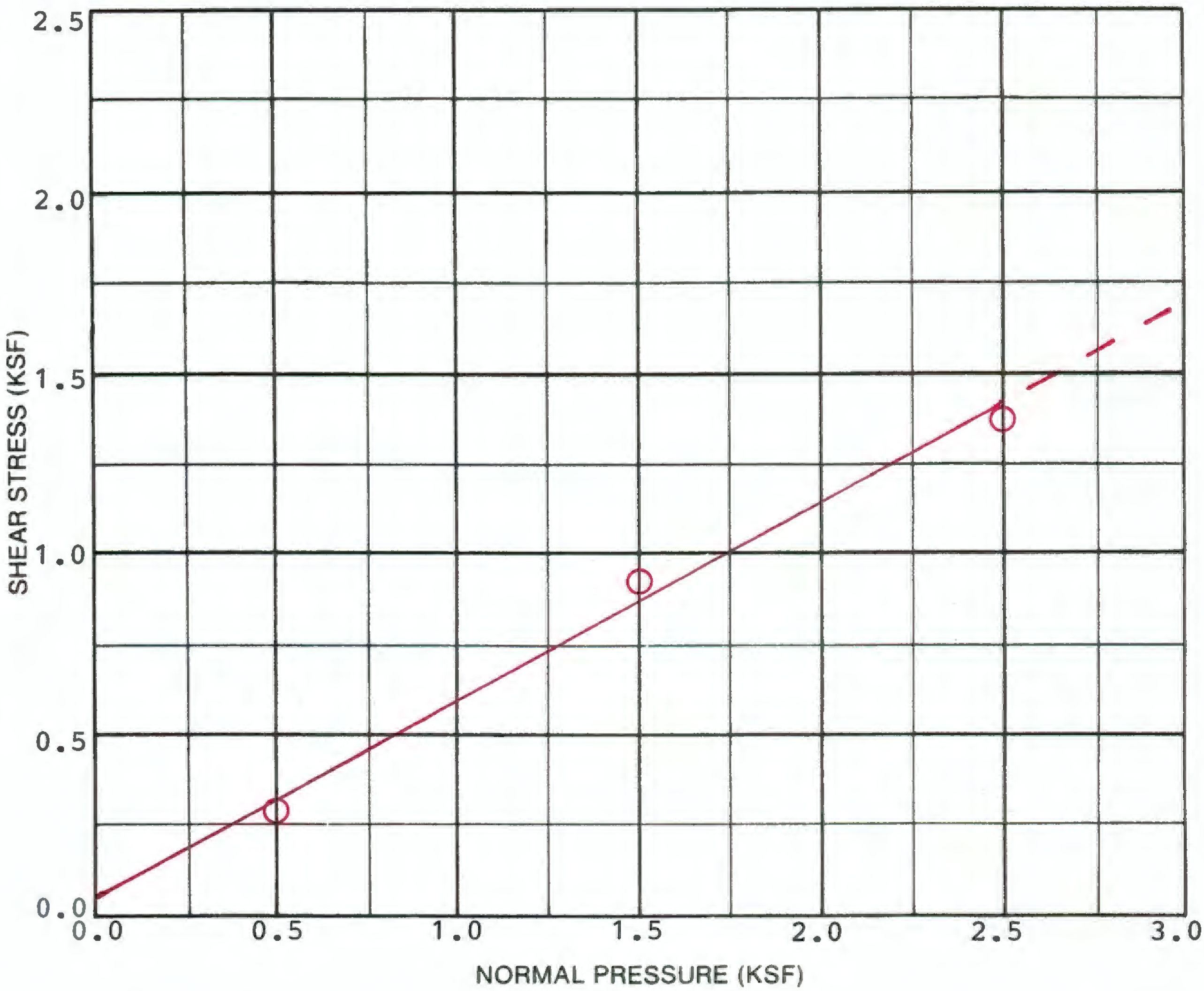
KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	ELEV. (feet)	UNIFIED SOIL CLASSIFICATION SYMBOL	SAMPLE DESCRIPTION
☐	TH-#1	1.5		ML/SM	Dark gray-brown, sandy, clayey SILT
○	TH-#1	3.5		GM	Medium to gray-brown, silty sandy GRAVEL with cobbles

REDMOND GEOTECHNICAL SERVICES
PO Box 20547 • Portland, Oregon 97294

GRADATION TEST DATA

23rd STREET APARTMENTS
Salem, Oregon

PROJECT NO.	DATE	FIGURE
1553.002.G	Nov 1, 2016	A-10



SAMPLE DATA	
DESCRIPTION: Medium to gray-brown, silty, sandy GRAVEL w/cobbles (remolded)	
BORING NO.: TH-#1	
DEPTH (ft.): 3.5	ELEVATION (ft):
TEST RESULTS	
APPARENT COHESION (C): 50 psf	
APPARENT ANGLE OF INTERNAL FRICTION (ϕ): 28°	

TEST DATA				
TEST NUMBER	1	2	3	4
NORMAL PRESSURE (KSF)	0.5	1.5	2.5	
SHEAR STRENGTH (KSF)	0.3	0.9	1.4	
INITIAL H_2O CONTENT (%)	12.0	12.0	12.0	
FINAL H_2O CONTENT (%)	12.2	10.1	7.7	
INITIAL DRY DENSITY (PCF)	99.0	99.0	99.0	
FINAL DRY DENSITY (PCF)	99.4	102.7	106.1	
STRAIN RATE: 0.02 inches per minute				

REDMOND GEOTECHNICAL SERVICES

PO Box 20547 • Portland, Oregon 97294

DIRECT SHEAR TEST DATA

23rd STREET APARTMENTS
Salem, Oregon

PROJECT NO.	DATE	
1553.002.G	Nov 1, 2016	Figure A-11

RESULTS OF R (RESISTANCE) VALUE TESTS

SAMPLE LOCATION: TH-#1

SAMPLE DEPTH: 1.5 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	219	329	431
Expansion Dial (o.ooo1")	0	0	1
Expansion Pressure (psf)	0	0	3
Moisture Content (%)	20.6	16.4	13.1
Dry Density (pcf)	92.4	96.2	100.6
Resistance Value, "R"	25	37	35
"R"-Value at 300 psi Exudation Pressure = 36			

SAMPLE LOCATION: TH-#3

SAMPLE DEPTH: 2.0 feet bgs

Specimen	A	B	C
Exudation Pressure (psi)	208	326	439
Expansion Dial (0.0001")	0	0	0
Expansion Pressure (psf)	0	0	0
Moisture Content (%)	15.3	12.1	9.7
Dry Density (pcf)	96.9	102.1	107.7
Resistance Value "R"	32	45	53
"R"-Value at 300 psi Exudation Pressure = 44			

Division 004 Appendix C - Infiltration Testing

Location: 23rd Street Apartments	**Date:** September 30, 2016	**Test Hole:** TH-#1
Depth to Bottom of Hole: 2.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC		**Tester's Contact Number:** 503-285-0598

Depth (feet)	Soil Characteristics
0-1.0	FILL: Gray-brown aggregate base rock (GM)
1.0-2.0	Dark gray-brown, clayey, sandy SILT (ML)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
9:00	0	12.00	----		Filled w/12" water
9:20	20	20.67	8.67	26.00	Filled w/12" water
9:40	20	19.67	7.67	23.00	Filled w/12" water
10:00	20	19.17	7.17	21.50	Filled w/12" water
10:20	20	18.67	6.67	20.00	Filled w/12" water
10:40	20	18.33	6.33	19.00	Filled w/12" water
11:00	20	18.13	6.13	18.40	Filled w/12" water
11:20	20	18.11	6.11	18.10	Filled w/12" water
11:40	20	18.00	6.00	18.00	

Infiltration Test Data Table

Division 004 Appendix C - Infiltration Testing

Location: 23rd Street Apartments	**Date:** September 30, 2016	**Test Hole:** TH-#2
Depth to Bottom of Hole: 3.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC		**Tester's Contact Number:** 503-285-0598

Depth (feet)	Soil Characteristics
0-0.5	FILL: Medium brown gravelly SAND (SM)
0.5-1.5	Dark gray-brown, clayey, sandy SILT (ML)
1.5-3.0	Medium to gray-brown, silty, sandy GRAVEL (GM)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
9:10	0	18.00	----		Filled w/18" water
9:30	20	32.67	14.67	44.00	Filled w/18" water
9:50	20	31.00	13.00	39.00	Filled w/18" water
10:10	20	30.00	12.00	36.00	Filled w/18" water
10:30	20	33.33	11.33	34.00	Filled w/12" water
10:50	20	33.00	11.00	33.00	Filled w/12" water
11:10	20	32.88	10.88	32.50	Filled w/12" water
11:30	20	32.73	10.73	32.20	Filled w/12" water
11:50	20	32.67	10.67	32.00	

Infiltration Test Data Table

Division 004 Appendix C - Infiltration Testing

Location: 23rd Street Apartments	**Date:** September 30, 2016	**Test Hole:** TH-#3
Depth to Bottom of Hole: 1.5 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC		**Tester's Contact Number:** 503-285-0598

Depth (feet)	Soil Characteristics
0-0.5	FILL: Medium brown gravelly SAND (SM)
0.5-1.5	Dark gray-brown, clayey, sandy SILT (ML)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
9:20	0	6.00	----		Filled w/12" water
9:40	20	14.67	8.67	26.00	Filled w/12" water
10:00	20	13.67	7.67	23.00	Filled w/12" water
10:20	20	13.17	7.17	21.50	Filled w/12" water
10:40	20	12.67	6.67	20.00	Filled w/12" water
11:00	20	12.33	6.33	19.00	Filled w/12" water
11:20	20	12.13	6.13	18.40	Filled w/12" water
11:40	20	12.11	6.11	18.10	Filled w/12" water
12:00	20	12.00	6.00	18.00	

Infiltration Test Data Table

Division 004 Appendix C - Infiltration Testing

Location: 23rd Street Apartments	**Date:** September 30, 2016	**Test Hole:** TH-#4
Depth to Bottom of Hole: 3.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC		**Tester's Contact Number:** 503-285-0598

Depth (feet)	**Soil Characteristics**
0-0.5	FILL: Medium brown gravelly SAND (SM)
0.5-1.0	Dark gray-brown, clayey, sandy SILT (ML)
1.0-3.0	Medium to gray-brown, silty, sandy GRAVEL (GM)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
9:30	0	18.00	----		Filled w/18" water
9:50	20	32.67	14.67	44.00	Filled w/18" water
10:10	20	31.00	13.00	39.00	Filled w/18" water
10:30	20	30.00	12.00	36.00	Filled w/18" water
10:50	20	33.33	11.33	34.00	Filled w/12" water
11:10	20	33.00	11.00	33.00	Filled w/12" water
11:30	20	32.88	10.88	32.50	Filled w/12" water
11:50	20	32.73	10.73	32.20	Filled w/12" water
12:10	20	32.67	10.67	32.00	

Infiltration Test Data Table

Division 004 Appendix C - Infiltration Testing

Location: 23rd Street Apartments	**Date:** September 30, 2016	**Test Hole:** TH-#5
Depth to Bottom of Hole: 3.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC	**Tester's Contact Number:** 503-285-0598	

Depth (feet)	**Soil Characteristics**
0-0.5	FILL: Medium brown gravelly SAND (SM)
0.5-1.0	Dark gray-brown, clayey, sandy SILT (ML)
1.0-3.0	Medium to gray-brown, silty, sandy GRAVEL (GM)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
9:40	0	18.00	----		Filled w/18" water
10:00	20	32.67	14.67	44.00	Filled w/18" water
10:20	20	31.00	13.00	39.00	Filled w/18" water
10:40	20	30.00	12.00	36.00	Filled w/18" water
11:00	20	33.33	11.33	34.00	Filled w/12" water
11:20	20	33.00	11.00	33.00	Filled w/12" water
11:40	20	32.88	10.88	32.50	Filled w/12" water
12:00	20	32.73	10.73	32.20	Filled w/12" water
12:20	20	32.67	10.67	32.00	

Infiltration Test Data Table

Division 004 Appendix C - Infiltration Testing

Location: 23rd Street Apartments	**Date:** September 30, 2016	**Test Hole:** TH-#6
Depth to Bottom of Hole: 4.0 feet	**Hole Diameter:** 6 inches	**Test Method:** Encased Falling Head
Tester's Name: Daniel M. Redmond, P.E., G.E. **Tester's Company:** Redmond Geotechnical Services, LLC	**Tester's Contact Number:** 503-285-0598	

Depth (feet)	Soil Characteristics
0-1.0	FILL: Gray-brown, aggregate base rock (GM)
1.0-1.5	Dark gray-brown, clayey, sandy SILT (ML)
1.5-4.0	Medium to gray-brown, silty, sandy GRAVEL (GM)

Time	Time Interval (Minutes)	Measurement (inches)	Drop in Water (inches)	Infiltration Rate (inches/hour)	Remarks
9:40	0	30.00	----		Filled w/18" water
10:00	20	45.00	15.00	45.00	Filled w/18" water
10:20	20	43.33	13.33	40.00	Filled w/18" water
10:40	20	42.00	12.00	36.00	Filled w/18" water
11:00	20	47.33	11.33	34.00	Filled w/12" water
11:20	20	47.00	11.00	33.00	Filled w/12" water
11:40	20	46.88	10.88	32.50	Filled w/12" water
12:00	20	46.73	10.73	32.20	Filled w/12" water
12:20	20	46.67	10.67	32.00	

Infiltration Test Data Table