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**GEOTECHNICAL ENGINEERING REPORT
of
Proposed Commercial Development
180 East Lane South
Ontario, Oregon**

Prepared for:

**Keizer Enterprises, LLC
c/o Dickerhoof Properties
P.O. Box 1583
Corvallis, Oregon 97339**

MTI File Number BIO404g

Mr. Darren Dickerhoof
Keizer Enterprises, LLC
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P.O. box 1583
Corvallis, Oregon 97339
(541) 231-5977

Re: Geotechnical Engineering Report
Proposed Commercial Development
180 East Lane South
Ontario, Oregon

Dear Mr. Dickerhoof:

In compliance with your instructions, we have conducted a soils exploration and foundation evaluation for the above referenced development. Fieldwork for this investigation was conducted on 6 May 2011. Data have been analyzed to evaluate pertinent geotechnical conditions. Results of this investigation, together with our recommendations, are to be found in the following report. We have distributed three copies upon your request.

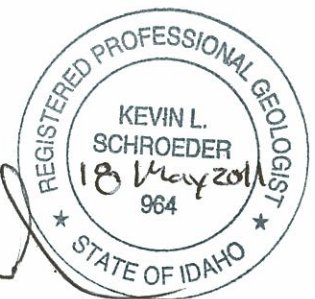
Often questions arise concerning soil conditions because of design and construction details that occur on a project. MTI would be pleased to continue our role as geotechnical engineers during project implementation. Additionally, MTI would be pleased in providing materials testing and special inspection services during construction of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

MTI appreciates this opportunity to be of service to you and looks forward to working with you in the future. If you have questions, please call (208) 376-4748.

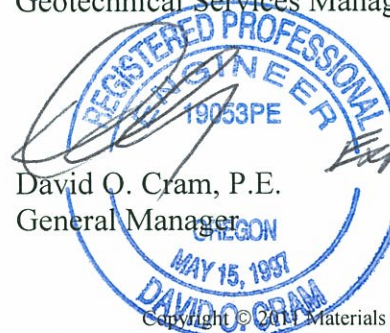
Respectfully Submitted,
Materials Testing & Inspection, Inc.

Elizabeth Brown
Elizabeth Brown, E.I.T.
Staff Engineer

Reviewed by: *[Signature]* Kevin L. Schroeder, P.G.
Geotechnical Services Manager



Reviewed by: *[Signature]* David O. Cram, P.E.
General Manager



cc: Mr. Marc Cross, Rhine Cross Group (2 copies)



TABLE OF CONTENTS

EXECUTIVE SUMMARY	3
INTRODUCTION	5
Project Description	5
Authorization	5
Purpose	5
Scope of Investigation	6
Warranty and Limiting Conditions	6
Exclusive Use	6
Report Recommendation are Limited and Subject to Misinterpretation	6
Environmental Concerns	7
SITE DESCRIPTION	7
Site Access	7
Regional Geology	7
General Site Characteristics	8
Regional Site Climatology and Geochemistry	8
Geoseismic Setting	8
SOILS EXPLORATION	8
Exploration and Sampling Procedures	8
Laboratory Testing Program	9
Soil and Sediment Profile	9
Soils Survey Review	9
Volatile Organic Scan	9
SITE HYDROLOGY	10
Groundwater	10
Soil Infiltration Rates	10
FOUNDATION, SLAB, AND PAVEMENT DISCUSSION AND RECOMMENDATIONS	11
Foundation Design Recommendations	11
Floor Slab-on-Grade	12
Recommended Pavement Sections	12
Flexible Pavement Sections	12
Common Pavement Section Construction Issues	13
CONSTRUCTION CONSIDERATIONS	14
Earthwork	14
Dry Weather	14
Wet Weather	15
Soft Subgrade Soils	15
Frozen Subgrade Soils	15
Structural Fill	16
Backfill of Walls	17
Excavations	17
Groundwater Control	17
GENERAL COMMENTS	18
REFERENCES	19
APPENDICES	20
Acronym List	20
Geotechnical General Notes	21
Geotechnical Investigation Test Pit Log	22
AASHTO Pavement Thickness Design Procedures	26
R-Value Laboratory Test Data	28
Plate 1: Vicinity Map	29
Plate 2: Site Map	30

EXECUTIVE SUMMARY

The following is a brief summary of significant geotechnical issues for the proposed development, presented with conclusions and recommendations. This summary must be read in conjunction with the entire accompanying report for proper interpretation of the overall investigation.

Subsurface Conditions: The profile below represents a generalized interpretation for the project site. Note that on site soils strata, encountered between test pit locations, may vary from the individual soil profiles presented in the logs, which can be found in the **Appendix**.

Below the pavement section and surficial gravel fill materials, native soils are gray brown to light brown, slightly moist to moist, very stiff to hard sandy silts. Underlying the sandy silts poorly graded sands and gravels are present. These sediments are brown to gray, slightly moist to saturated, medium dense to dense, with sand grain sizes varying from fine to coarse, fine to coarse gravels, and 5 inch diameter and smaller cobbles.

Competency of test pit walls varied little across the site. In general, fine grained soils remain stable while more granular sediments readily sloughed. However, moisture contents will also affect wall competency with saturated soils having a tendency to readily slough when under load and unsupported.

Groundwater Conditions: During this field investigation, groundwater was encountered in test pits a depth ranging from 11.1 to 12.6 feet bgs. Actual groundwater depths varied with topography and distance from the Snake River. Soil moistures in the test pits were generally slightly moist to moist within surficial soils. Within the poorly graded sands and gravels, soil moistures graded from slightly moist to saturated as the water table was approached and penetrated.

In the vicinity of the project site, groundwater levels are controlled in large part by the stage and flow of the Snake River. Maximum groundwater elevations likely occur during late spring to early summer runoff season. During previous investigations performed in August and November 2007 within approximately ½-mile to the west of the project site, groundwater was noted within borings and test pits at depths varying between 12.9 to 13.6 feet bgs. Furthermore, according to USGS monitoring well data within approximately ½-mile of the project site, groundwater was measured at depths ranging between 15.3 and 17.3 feet bgs. Based on evidence of this investigation and background knowledge of the area, MTI estimates groundwater depths greater than approximately 10 feet bgs throughout the year.

Building Foundations: Based on data obtained from the site and test results from various laboratory tests performed, MTI recommends following guidelines for the net allowable soils bearing capacity:

Soil Bearing Capacity

Footing Depth	ASTM D 1557 Subgrade Compaction	Net Allowable Soil Bearing Capacity
Footings must bear on competent, native, sandy silt soils or compacted structural fill. Existing fill materials must be completely removed from below foundation elements. ¹ Excavation depths ranging from 1.1 to 2.5 feet bgs should be anticipated to expose proper bearing soils.	Not Required for Native Soil 95% for Structural Fill	2,000 lbs/ft ² A $\frac{1}{3}$ increase is allowable for short-term loading, which is defined by seismic events or designed wind speeds.

¹MTI recommends that a qualified geotechnical engineer or engineering technician verify the bearing soil suitability for each structure at the time of construction.

Footings should be proportioned to meet either the stated soil bearing capacity or the 2009 IBC minimum requirements. Total settlement should be limited to approximately 1 inch, and differential settlement should be limited to approximately $\frac{1}{2}$ inch. Objectionable soil types encountered at the bottom of footing excavations should be removed and replaced with structural fill. Excessively loose or soft areas that are encountered in the footing subgrade will require over-excavation and backfilling with structural fill. To minimize the effects of slight differential movement that may occur because of variations in character of supporting soils and seasonal moisture content, MTI recommends continuous footings be suitably reinforced to make them as rigid as possible. For frost protection, the bottom of external footings should be 30 inches below finished grade.

Building Floor Slabs: Fill materials were encountered across the site. MTI recommends that these fill materials be compacted to at least 95% of the maximum dry density as determined by ASTM D-1557 or be excavated to a sufficient depth to expose competent, native soils or to a minimum depth of 1½ feet below finished subgrade. A qualified soils technician should be present during excavation to identify these materials.

Organic, loose, or obviously compressive materials must be removed prior to placement of concrete floors or floor-supporting fill. In addition, the remaining subgrade should be treated in accordance with guidelines presented in the **Earthwork** section. Areas of excessive yielding should be excavated and backfilled with structural fill. Fill used to increase the elevation of the floor slab should meet requirements detailed in the **Structural Fill** section. Fill materials must be compacted to a minimum 95 percent of maximum density as determined by ASTM D 1557.

INTRODUCTION

This report presents results of a geotechnical investigation and analysis in support of data utilized in design of structures as defined in the 2009 International Building Code (IBC). Information in support of groundwater and storm water issues pertinent to the practice of Civil Engineering is included. Observations and recommendations relevant to the earthwork phase of the project are also presented. Revisions in plans or drawings for the proposed development from those enumerated in this report should be brought to the attention of the soils engineer to determine whether changes in foundation recommendations are required. Deviations from noted subsurface conditions, if encountered during construction, should also be brought to the attention of the soils engineer.

Project Description

The proposed development is in the eastern portion of the City of Ontario, Malheur County, Oregon, and occupies a portion of the N½ of Section 11, Township 18 South, Range 47 East, Willamette Meridian. This project will consist of construction of a 22,000 square foot commercial structure to be developed with spread/continuous footings and concrete floor slabs on approximately 6.68 acres. Total settlements are limited to 1 inch. Loads of up to 2,000 pounds per lineal foot for wall footings, and column loads of up to 50,000 pounds were assumed for settlement calculations. Drainage will be directed to below grade seepage beds. Location and size of seepage beds are unknown at this time. Additionally, assumptions have been made for traffic loading of pavements. Retaining walls are not anticipated as part of the project. MTI has not been informed of the proposed grading plan.

Authorization

Authorization to perform this exploration and analysis was given in the form of a written authorization to proceed from Mr. Darren Dickerhoof of Keizer Enterprises, LLC to Elizabeth Brown of Materials Testing and Inspection, Inc. (MTI), on 2 May 2011. Said authorization is subject to terms, conditions, and limitations described in the Professional Services Contract entered into between Keizer Enterprises, LLC and MTI. Our scope of services for the proposed development has been provided in our proposal dated 25 April 2011 and repeated below.

Purpose

The purpose of this Geotechnical Engineering Report is to determine various soil profile components and their engineering characteristics for use by either design engineers or architects in:

- Preparing or verifying suitability of foundation design and placement
- Preparing site drainage designs
- Indicating issues pertaining to earthwork construction
- Preparing light and heavy duty pavement section design requirements

Scope of Investigation

The scope of this investigation included review of geologic literature and existing available geotechnical studies of the area, visual site reconnaissance of the immediate site, subsurface exploration of the site, field and laboratory testing of materials collected, and engineering analysis and evaluation of foundation materials.

Warranty and Limiting Conditions

MTI warrants that findings and conclusions contained herein have been formulated in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology only for the site and project described in this report. These engineering methods have been developed to provide the client with information regarding apparent or potential engineering conditions relating to the site within the scope cited above and are necessarily limited to conditions observed at the time of the site visit and research. Field observations and research reported herein are considered sufficient in detail and scope to form a reasonable basis for the purposes cited above.

Exclusive Use

This report was prepared for exclusive use of the property owner(s), at the time of the report, and their retained design consultants ("Client"). Conclusions and recommendations presented in this report are based on the agreed-upon scope of work outlined in this report together with the Contract for Professional Services between the Client and Materials Testing and Inspection, Inc. ("Consultant"). Use or misuse of this report, or reliance upon findings hereof, by parties other than the Client is at their own risk. Neither Client nor Consultant make representation of warranty to such other parties as to accuracy or completeness of this report or suitability of its use by such other parties for purposes whatsoever, known or unknown, to Client or Consultant. Neither Client nor Consultant shall have liability to indemnify or hold harmless third parties for losses incurred by actual or purported use or misuse of this report. No other warranties are implied or expressed.

Report Recommendation are Limited and Subject to Misinterpretation

There is a distinct possibility that conditions may exist that could not be identified within the scope of the investigation or that were not apparent during our site investigation. Findings of this report are limited to data collected from noted explorations advanced and do not account for unidentified fill zones, unsuitable soil types or conditions, and variability in soil moisture and groundwater conditions. To avoid possible misinterpretations of findings, conclusions, and implications of this report, MTI should be retained to explain the report contents to other design professionals as well as construction professionals.

Since actual subsurface conditions on the site can only be verified by earthwork, note that construction recommendations are based on general assumptions from selective observations and selective field exploratory sampling. Upon commencement of construction, such conditions may be identified that required corrective actions, and these required corrective actions may impact the project budget. Therefore, construction recommendations in this report should be considered preliminary, and MTI should be retained to observe actual subsurface conditions during earthwork construction activities to provide additional construction recommendations as needed.

Since geotechnical reports are subject to misinterpretation, **do not** separate the soil logs from the report. Rather, provide a copy, or authorize for their use, of the complete report to other design professional or contractors.

This report is also limited to information available at the time it was prepared. In the event additional information is provided to MTI following publication of our report, it will be forwarded to the client for evaluation in the form received.

Environmental Concerns

Comments in this report concerning either onsite conditions or observations, including soil appearances and odors, are provided as general information. These comments are not intended to describe, quantify, or evaluate environmental concerns or situations. Since personnel, skills, procedures, standards, and equipment differ, a geotechnical investigation report is not intended to substitute for a geoenvironmental investigation or a Phase II/III Environmental Site Assessment. If the potential for petroleum or hazardous materials contamination or other environmental hazards relating to the site exists, MTI must be informed prior to the commencement of the geotechnical investigation. If environmental services are needed, MTI can provide, via a separate contract, those personnel who are trained to investigate and delineate soil and water contamination.

SITE DESCRIPTION

Site Access

Access to the site may be gained via Interstate 84 to Exit 376B for US-30 E toward Payette. Proceed east on Idaho Avenue approximately 0.3 mile to its intersection with South East Lane. The site occupies the southeast corner of this intersection. Presently the site exists as a vacant commercial structure. The location is depicted on site map plates included in the **Appendix**.

Regional Geology

The subject site is located within the Western Snake River Flood Plain. Within this region, this geomorphological feature consists of a broad, deeply floored, thick sequence of alluvial silts, clays, sands and gravel. These sediments typically have been deposited on Miocene (24 to 5 million years ago) basalt flows and tuffaceous sediments of the eastern region of the Columbia Plateau. This thick sequence of generally fine-grained sediments, predominately derived from the Idaho Batholith, contains minor intercalated tuffs and basalt flows within the earliest deposits. Most of these sediments were placed during the latter part of the Miocene and are predominately of lacustrine origin. Lakes were created within this area as a result of basalt flow impoundments formed to the west along the ancestral Columbia River. Many of the fossil leaf forms uncovered in these lacustrine plain sediments indicate the presence of a wet tropical climate that prevailed at this time. Early Quaternary age (1.6 million years ago to present) sediments deposited on top of the lacustrine plain were apparently deposited during a time of extremely dry climatic conditions in which little water was present for removal, sorting, and deposition of the debris. With a gradual return to a wetter climate, the surrounding hills again began to erode to their present form. Locally within the City of Ontario, soils generally consist of interbedded clay, silt, sand and gravel. Geologic data for the area indicates bedrock may be encountered at depths of 750 feet or more beneath the soil surface.

General Site Characteristics

This proposed development consists of approximately 6.68 acres of relatively level land. Throughout the majority of the site, surficial soils consist of fine-grained clay-silt mixtures. Vegetation is limited because the majority of the site is paved; however vegetation that does exist primarily consists of bunchgrass, and other native grass varieties typical of arid to semi-arid environments.

Regional drainage is east toward the Snake River. The site has a gentle slope to the east towards the Snake River. Storm water drainage for the site is achieved by both sheet runoff and percolation through surficial soils. Runoff predominates for the paved areas while percolation prevails across the gently sloping and near level areas. Storm water drainage collection and retention systems are not observed on the project site. A swale is located along the northern edge of the property.

Regional Site Climatology and Geochemistry

According to the Western Regional Climate Center (WRCC, 2006) the average precipitation for Treasure Valley is on the order of 10 to 12 inches per year, with an annual snowfall of approximately 20 inches and a range from 3 to 49 inches. The monthly mean daily temperatures range from 21° F to 95° F with daily extremes ranging from -25° F to 111° F. Winds are generally from the northwest or southeast with an annual average wind speed of approximately 9 miles per hour (mph) with a maximum of 62 mph. Soils and sediments in the area are primarily derived from siliceous materials and exhibit low electro-chemical potential for corrosion of metals or concretes. Local aggregates are generally appropriate for Portland cement and lime cement mixtures. Surface waters, groundwaters, and soils in the region typically have pH levels ranging from 7.2 to 8.2 (USGS 2006).

Geoseismic Setting

Soils on site are classed as Site Class D in accordance with Chapter 16 of the 2009 edition of the IBC. Structures constructed on this site should be designed per IBC requirements for such a seismic classification. Our investigation did not reveal hazards resulting from potential earthquake motions including: slope instability, liquefaction, and surface rupture caused by faulting or lateral spreading. Incidence and anticipated acceleration of seismic activity in the area is low.

SOILS EXPLORATION

Exploration and Sampling Procedures

Field exploration conducted to determine engineering characteristics of subsurface materials included a reconnaissance of the project site and investigation by test pit. Test pit sites were located in the field by means of visual approximation from on-site features or known locations and are presumed to be accurate to within a few feet. Upon completion of investigation, each test pit was backfilled with loose excavated materials. Re-excavation and compaction of these test pit areas are required prior to construction of overlying structures.

In addition, samples were obtained from representative soil strata encountered. Samples obtained have been visually classified in the field by professional staff, identified according to test pit number and depth, placed in sealed containers, and transported to our laboratory for additional testing. Subsurface materials have been described in detail on logs provided in the **Appendix**. Results of field and laboratory tests are also presented on these logs. MTI recommends that these logs **not** be used to estimate fill material quantities.

Laboratory Testing Program

Along with our field investigation, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of subsurface materials necessary in an analysis of the anticipated behavior of the proposed structures. Laboratory tests were conducted in accordance with current applicable American Society for Testing and Materials (ASTM) specifications, and results of these tests are to be found on the accompanying logs located in the **Appendix**. The laboratory testing program for this report included: Atterberg Limits Tests - ASTM D 4318, Grain Size Analysis - ASTM C 117/C 136, and Resistance Value (R-Value) and Expansion Pressure of Compacted Soils – Idaho T-8.

Soil and Sediment Profile

The profile below represents a generalized interpretation for the project site. Note that on site soils strata, encountered between test pit locations, may vary from the individual soil profiles presented in the logs, which can be found in the **Appendix**.

Below the pavement section and surficial gravel fill materials, native soils are gray brown to light brown, slightly moist to moist, very stiff to hard sandy silts. Underlying the sandy silts poorly graded sands and gravels are present. These sediments are brown to gray, slightly moist to saturated, medium dense to dense, with sand grain sizes varying from fine to coarse, fine to coarse gravels, and 5 inch diameter and smaller cobbles.

Competency of test pit walls varied little across the site. In general, fine grained soils remain stable while more granular sediments readily sloughed. However, moisture contents will also affect wall competency with saturated soils having a tendency to readily slough when under load and unsupported.

Soils Survey Review

Review of the United States Department of Agriculture (USDA) Soil Conservation Service, Soil Survey of Malheur County Area, Oregon, Northeastern Part, 1980, indicates that the site is underlain by the Umapine silt loam soil type. Specific soils characteristics, as defined by the USDA, are moderately slow permeability, slow runoff and slight hazard of erosion.

Volatile Organic Scan

No environmental concerns were identified prior to commencement of the investigation. Therefore, soils obtained during on-site activities were not assessed for volatile organic compounds by portable photoionization detector. Samples obtained during our exploration activities exhibited no odors or discoloration typically associated with this type contamination. Groundwater encountered did not exhibit obvious signs of contamination.

SITE HYDROLOGY

Existing surface drainage conditions are defined in the **General Site Characteristics** section. Information provided in this section is limited to observations made at the time of the investigation. Either regional or local ordinances may require information beyond the scope of this report.

Groundwater

During this field investigation, groundwater was encountered in test pits a depth ranging from 11.1 to 12.6 feet bgs. Actual groundwater depths varied with topography and distance from the Snake River. Soil moistures in the test pits were generally slightly moist to moist within surficial soils. Within the poorly graded sands and gravels, soil moistures graded from slightly moist to saturated as the water table was approached and penetrated.

In the vicinity of the project site, groundwater levels are controlled in large part by the stage and flow of the Snake River. Maximum groundwater elevations likely occur during late spring to early summer runoff season. During previous investigations performed in August and November 2007 within approximately ½-mile to the west of the project site, groundwater was noted within borings and test pits at depths varying between 12.9 to 13.6 feet bgs. Furthermore, according to USGS monitoring well data within approximately ½-mile of the project site, groundwater was measured at depths ranging between 15.3 and 17.3 feet bgs. Based on evidence of this investigation and background knowledge of the area, MTI estimates groundwater depths greater than approximately 10 feet bgs throughout the year.

Soil Infiltration Rates

Soil permeability, which is a measure of the ability of a soil to transmit a fluid, was tested in the field for the poorly graded sands. Given the absence of direct measurements for the other soils types onsite, for this report an estimation of infiltration is presented using generally recognized values for each soil type and gradation. Of soils comprising the generalized soil profile for this study, sandy silt soils will commonly exhibit infiltration rates from 2 to 4 inches per hour. Poorly graded sand and gravel sediments typically exhibit infiltration values in excess of 12 inches per hour. Infiltration testing is generally not required within these sediments because of their free-draining nature. However, 5 gallons of water was added at 10 feet bgs in test pit 1 and readily infiltrated.

It is recommended that infiltration facilities constructed on the site be extended into native poorly graded sand or gravel sediments. Excavation depths of approximately 9.5 to 12.0 feet bgs should be anticipated to expose these sand or gravel sediments. Because of the high soil permeability, ASTM C 33 filter sand, or equivalent, should be incorporated into design of infiltration facilities. An infiltration rate of 8 inches per hour should be used in design.

FOUNDATION, SLAB, AND PAVEMENT DISCUSSION AND RECOMMENDATIONS

Various foundation types have been considered for support of the proposed structure. Two requirements must be met in the design of foundations. First, the applied bearing stress must be less than the ultimate bearing capacity of foundation soils to maintain stability. Second, total and differential settlement must not exceed an amount that will produce an adverse behavior of the superstructure. Allowable settlement is usually exceeded before bearing capacity considerations become important; thus, allowable bearing pressure is normally controlled by settlement considerations.

Considering subsurface conditions and the proposed construction, it is recommended that the structure be founded upon conventional spread footings and continuous wall footings. Total settlements should not exceed 1 inch if the following design and construction recommendations are observed.

Foundation Design Recommendations

Based on data obtained from the site and test results from various laboratory tests performed, MTI recommends following guidelines for the net allowable soils bearing capacity:

Soil Bearing Capacity

Footing Depth	ASTM D 1557 Subgrade Compaction	Net Allowable Soil Bearing Capacity
Footings must bear on competent, native, sandy silt soils or compacted structural fill. Existing fill materials must be completely removed from below foundation elements. ¹ Excavation depths ranging from 1.1 to 2.5 feet bgs should be anticipated to expose proper bearing soils.	Not Required for Native Soil 95% for Structural Fill	2,000 lbs/ft ² A $\frac{1}{3}$ increase is allowable for short-term loading, which is defined by seismic events or designed wind speeds.

¹MTI recommends that a qualified geotechnical engineer or engineering technician verify the bearing soil suitability for each structure at the time of construction.

Footings should be proportioned to meet either the stated soil bearing capacity or the 2009 IBC minimum requirements. Total settlement should be limited to approximately 1 inch, and differential settlement should be limited to approximately $\frac{1}{2}$ inch. Objectionable soil types encountered at the bottom of footing excavations should be removed and replaced with structural fill. Excessively loose or soft areas that are encountered in the footing subgrade will require over-excavation and backfilling with structural fill. To minimize the effects of slight differential movement that may occur because of variations in character of supporting soils and seasonal moisture content, MTI recommends continuous footings be suitably reinforced to make them as rigid as possible. For frost protection, the bottom of external footings should be 30 inches below finished grade.

Floor Slab-on-Grade

Fill materials were encountered across the site. MTI recommends that these fill materials be compacted to at least 95% of the maximum dry density as determined by ASTM D-1557 or be excavated to a sufficient depth to expose competent, native soils or to a minimum depth of 1½ feet below finished subgrade. A qualified soils technician should be present during excavation to identify these materials.

Organic, loose, or obviously compressive materials must be removed prior to placement of concrete floors or floor-supporting fill. In addition, the remaining subgrade should be treated in accordance with guidelines presented in the **Earthwork** section. Areas of excessive yielding should be excavated and backfilled with structural fill. Fill used to increase the elevation of the floor slab should meet requirements detailed in the **Structural Fill** section. Fill materials must be compacted to a minimum 95 percent of maximum density as determined by ASTM D 1557.

A free-draining granular mat (drainage fill course) should be provided below slabs-on-grade. This should be a minimum of 4 inches in thickness and properly compacted. The mat should consist of a sand and gravel mixture, complying with Idaho Standards for Public Works Construction (ISPWC) specifications for ¾-inch (Type 1) crushed aggregate. A moisture-retarder should be placed beneath floor slabs to minimize potential ground moisture effects on moisture-sensitive floor coverings. The moisture-retarder should be at least 15-mil in thickness and have a permeance of less than 0.3 US perms as determined by ASTM E 96. Placement of the moisture-retarder will require special consideration with regard to effects on the slab-on-grade. The granular mat should be compacted to no less than 95 percent of maximum density as determined by ASTM D 1557. Upon request, MTI can provide further consultation regarding installation

Recommended Pavement Sections

MTI has made assumptions for traffic loading variables based on the character of the proposed construction. The Client should review these assumptions to make sure they reflect intended use and loading of pavements both now and in the future. MTI collected a sample of near-surface soils for Resistance Value (R-value) testing representative of soils to depths of 3 feet bgs. This sample, consisting of sandy silt collected from test pit 3, yielded a R-value of 11. The R-value was converted to a CBR of 4.8 for design calculations. The following are minimum thickness requirements for assured pavement function. Depending on site conditions, additional work, e.g. soil preparation, may be required to support construction equipment. These have been listed within the **Soft Subgrade Soils** subsection. Results of the test are graphically depicted in the **Appendix**.

Flexible Pavement Sections

The AASHTO design method has been used to calculate the following pavement sections. Calculation sheets provided in the **Appendix** indicate the soils constant, traffic loading, traffic projections, and material constants used to calculate the pavement sections. MTI recommends that materials used in the construction of asphaltic concrete pavements meet requirements of the State of Oregon Department of Transportation (ODOT) Standard Specification for Highway Construction. Construction of the pavement section should be in accordance with these specifications and should adhere to guidelines recommended in the section on **Construction Considerations**.

AASHTO Flexible Pavement Specifications

*Pavement Section Component	Driveways and Parking No Truck Access	Driveways and Parking Truck Access
Asphaltic Concrete	2.5 Inches	3.0 Inches
Crushed Aggregate Base	4.0 Inches	6.0 Inches
Structural Subbase	8.0 Inches	12.0 Inches
**Compacted Subgrade	Not Required	Not Required

*MTI recommends that a qualified geotechnical engineer or engineering technician verify subgrade competency at the time of construction.

** If existing fill materials are left in place they must be compacted to at least 95% of the maximum dry density as determined by ASTM D-698.

Asphaltic Concrete: Asphalt mix design shall meet the requirements of ODOT Class III plant mix. Materials shall be placed in accordance with ODOT Standard Specifications for Highway Construction.

Aggregate Base: Material complying with ODOT Standard Specifications for Highway Construction.

Structural Subbase: Material should comply with the requirements detailed in the **Structural Fill** section of this report except that the maximum material diameter is no more than $\frac{2}{3}$ the component thickness.

Common Pavement Section Construction Issues

The subgrade upon which above pavement sections are to be constructed must be properly stripped, compacted (if indicated), inspected, and proof-rolled. Proof rolling of subgrade soils should be accomplished using a heavy rubber-tired, fully loaded, tandem-axle dump truck or equivalent. Verification of subgrade competence by a qualified geotechnical engineer or engineering technician at the time of construction is recommended. Fill materials on the site must demonstrate the indicated compaction prior to placing material in support of the pavement section. MTI anticipates that pavement areas will be subjected to moderate traffic. MTI does not anticipate pumping material to become evident during compaction, but subgrade silts near and above optimum moisture contents may tend to pump. Pumping or soft areas must be removed and replaced with structural fill.

Fill material and aggregates in support of the pavement section must be compacted to no less than 95 percent of the maximum dry density as determined by ASTM D 698 for flexible pavements and by ASTM D 1557 for rigid pavements. If a material placed as a pavement section component cannot be tested by usual compaction testing methods, then compaction of that material must be approved by observed proof rolling. Minor deflections from proof rolling for flexible pavements are allowable. Deflections from proof rolling of rigid pavement support courses should not be visually detectable.

MTI recommends that rigid concrete pavement be provided for heavy garbage receptacles. This will eliminate damage caused by the considerable loading transferred through the small steel wheels onto asphaltic concrete. Rigid concrete pavement should consist of Portland Cement Concrete Pavement (PCCP) generally adhering to ITD specifications for Urban Concrete. PCCP should be 6 inches thick on a 4-inch drainage fill course (see **Floor Slab-on-Grade** section), and should be reinforced with welded wire fabric. Control joints must be on 12-foot centers or less.

CONSTRUCTION CONSIDERATIONS

Recommendations in this report are based upon structural elements of the project being founded on competent sandy silt soils or compacted structural fill. Structural areas should be stripped to an elevation that exposes these soil types.

Earthwork

Excessively organic soils, deleterious materials, or disturbed soils generally undergo high volume changes when subjected to loads, which is detrimental to subgrade behavior in the area of pavements, floor slabs, structural fills, and foundations. Brush, and thick grasses with associated root systems were noted at the time of our investigation. It is recommended that organic or disturbed soils, if encountered, be removed to depths of 1 foot (minimum), and wasted or stockpiled for later use. Stripping depths should be adjusted in the field to assure that the entire root zone or disturbed zone or topsoil are removed prior to placement and compaction of structural fill materials. Exact removal depths should be determined during grading operations by a qualified geotechnical representative, and should be based upon subgrade soil type, composition, and firmness or soil stability. If underground storage tanks (USTs), underground utilities, wells, or septic systems are discovered during construction activities, they must be decommissioned then removed or abandoned in accordance with governing Federal, State, and local agencies. Excavations developed as the result of such removal must be backfilled with structural fill materials as defined in the **Structural Fill** section.

MTI should oversee subgrade conditions (i.e., moisture content) as well as placement and compaction of new fill (if required) after native soils are excavated to design grade. Recommendations for structural fill presented in this report can be used to minimize volume changes and differential settlements that are detrimental to the behavior of footings, pavements, and floor slabs. Sufficient density tests should be performed to properly monitor compaction. For structural fill beneath building structures, one in-place density test per lift for every 5,000 square feet is recommended. In parking and driveway areas, this can be decreased to one test per lift for every 10,000 square feet.

Dry Weather

If construction is to be conducted during dry seasonal conditions, many problems associated with soft soils may be avoided. However, some rutting of subgrade soils may be induced by shallow groundwater conditions related to springtime runoff or irrigation activities during late summer through early fall. Solutions to problems associated with soft subgrade soils are outlined in the **Soft Subgrade Soils** section. Problems may also arise because of lack of moisture in native and fill soils at time of placement. This will require the addition of water to achieve near-optimum moisture levels. Low-cohesion soils exposed in excavations may become friable, increasing chances of sloughing or caving. Measures to control excessive dust should be considered as part of the overall health and safety management plan.

Wet Weather

If construction is to be conducted during wet seasonal conditions (commonly from mid-November through May), problems associated with soft soils must be considered as part of the construction plan. During this time of year, fine-grained soils such as silts and clays will become unstable with increased moisture content, and eventually deform or rut. Additionally, constant low temperatures reduce the possibility of drying soils to near optimum conditions.

Soft Subgrade Soils

Shallow fine-grained subgrade soils that are high in moisture content should be expected to pump and rut under construction traffic. During periods of wet weather, construction may become very difficult if not impossible. The following recommendations and options have been included for dealing with soft subgrade conditions:

- Track-mounted vehicles should be used to strip the subgrade of root matter and other deleterious debris. Heavy rubber-tired equipment should be prohibited from operating directly on the native subgrade and areas in which structural fill materials have been placed. Construction traffic should be restricted to designated roadways that do not cross, or cross on a limited basis, proposed roadway or parking areas.
- Construction roadways on soft subgrade soils should consist of a minimum 2-foot thickness of large cobbles of 4 to 6 inches in diameter with sufficient sand and fines to fill voids. Construction entrances should consist of a 6-inch thickness of clean, 2-inch minimum, angular drain-rock and must be a minimum of 10 feet wide and 30 to 50 feet long. During the construction process, top dressing of the entrance may be required for maintenance.
- Scarification and aeration of subgrade soils can be employed to reduce the moisture content of wet subgrade soils. After stripping is complete, the exposed subgrade should be ripped or disked to a depth of 1½ feet and allowed to air dry for 2 to 4 weeks. Further disking should be performed on a weekly basis to aid the aeration process.
- Alternative soil stabilization methods include use of geotextiles, lime, and cement stabilization. MTI is available to provide recommendations and guidelines at your request.

Frozen Subgrade Soils

Prior to placement of structural fill materials or foundation elements, frozen subgrade soils must either be allowed to thaw or be stripped to depths that expose non-frozen soils and wasted or stockpiled for later use. Stockpiled materials must be allowed to thaw and return to near-optimal conditions prior to use as structural fill.

Structural Fill

Soils recommended for use as structural fill are those classified as GW, GP, SW, and SP in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487). Use of silty soils (USCS designation of GM, SM, and ML) as structural fill may be acceptable. However, use of silty soils (GM, SM, and ML) as structural fill below footings is prohibited. These materials require very high moisture contents for compaction and require a long time to dry out if natural moisture contents are too high and may also be susceptible to frost heave under certain conditions. Therefore these materials can be quite difficult to work with as moisture content, lift thickness, and compactive effort becomes difficult to control. If silty soil is used for structural fill, lift thicknesses should not exceed 6 inches (loose), and fill material moisture must be closely monitored at both the working elevation and the elevations of materials already placed. Following placement, silty soils must be protected from degradation resulting from construction traffic or subsequent construction.

Recommended granular structural fill materials, those classified as GW, GP, SW, and SP, should consist of a 6-inch minus select, clean, granular soil with no more than 50 percent oversize (greater than 3/4-inch) material and no more than 12 percent fines (passing No. 200 sieve). These fill materials should be placed in layers not to exceed 12 inches in loose thickness. Prior to placement of structural fill materials, surfaces must be prepared as outlined in the **Construction Considerations** section. Structural fill material should be moisture-conditioned to achieve optimum moisture content prior to compaction. For structural fill below footings, areas of compacted backfill must extend outside the perimeter of the footing for a distance equal to the thickness of fill between the bottom of foundation and underlying soils, or 5 feet, whichever is less.

Each layer of structural fill must be compacted, as outlined below:

- Below Structures and Rigid Pavements: A minimum of 95 percent of the maximum dry density as determined by ASTM D 1557.
- Below Flexible Pavements: A minimum of 92 percent of the maximum dry density as determined by ASTM D 1557 or 95 percent of the maximum dry density as determined by ASTM D 698.

The ASTM D 1557 test method must be used for samples containing up to 40 percent oversize (greater than 3/4-inch) particles. If material contains more than 40 percent but less than 50 percent oversize particles, compaction of fill must be confirmed by proof rolling each lift with a 10-ton vibratory roller (or equivalent) until the maximum density has been achieved. Density testing must be performed after each proof rolling pass until the in-place density test results indicate a drop (or no increase) in the dry density, defined as the maximum density or "break over" point. The number of required passes should be used as the requirement on the remainder of fill placement. Material should contain sufficient fines to fill void spaces, and must not contain more than 50 percent oversize particles.

Backfill of Walls

Backfill materials must conform to the requirements of structural fill, as defined in this report. For wall heights greater than 2.5 feet, the maximum material size should not exceed 4 inches in diameter. Placing oversized material against rigid surfaces interferes with proper compaction, and can induce excessive point loads on walls. Backfill shall not commence until the wall has gained sufficient strength to resist placement and compaction forces. Further, retaining walls above 2.5 feet in height shall be backfilled in a manner that will limit the potential for damage from compaction methods and/or equipment. It is recommended that only small hand-operated compaction equipment be used for compaction of backfill within a horizontal distance equal to the height of the wall, measured from the back face of the wall.

Backfill should be compacted in accordance with the specifications for structural fill, except in those areas where it is determined that future settlement is not a concern, such as planter areas. In nonstructural areas, backfill must be compacted to a firm and unyielding condition.

Excavations

Shallow excavations that do not exceed 4 feet in depth may be constructed with side slopes approaching vertical. Below this depth, it is recommended that slopes be constructed in accordance with Occupational Safety and Health Administration (OSHA) regulations, section 1926, subpart P. Based on these regulations, on-site soils are classified as type "C" soil, and as such, excavations within these soils should be constructed at a maximum slope of 1½ foot horizontal to 1 foot vertical (1½H:1V) for excavations up to 20 feet in height. Excavations in excess of 20 feet will require additional analysis. Note that these slope angles are considered stable for short-term conditions only, and will not be stable for long-term conditions.

During our subsurface exploration, test pit sidewalls generally exhibited little indication of collapse; however, sloughing of native granular sediments from test pit sidewalls was observed, particularly after penetration of the water table. For deep excavations, native granular sediments cannot be expected to remain in position. These materials are prone to failure and may collapse, thereby, undermining upper soils layers. This is especially true when excavations approach depths near the water table. Care must be taken to ensure that excavations are properly backfilled in accordance with procedures outlined in this report.

Groundwater Control

Groundwater was encountered during the investigation but is anticipated to be below the depth of most construction. If recommended, excavations below the water table will require a dewatering program. Dewatering will be required prior to placement of fill materials. Placement of concrete can be accomplished through water by the use of a tremie. It may be possible to discharge dewatering effluent to remote portions of the site, to a sump, or to a pit. This will essentially recycle effluent, thus eliminating the need to enter into agreements with local drainage authorities. Should the scope of the proposed project change, MTI should be contacted to provide more detailed groundwater control measures.



Special precautions may be required for control of surface runoff and subsurface seepage. It is recommended that runoff be directed away from open excavations. Silty soils may become soft and pump if subjected to excessive traffic during time of surface runoff. Ponded water in construction areas should be drained through methods such as trenching, sloping, crowning grades, nightly smooth drum rolling, or installing a French drain system. Additionally, temporary or permanent driveway sections should be constructed if extended wet weather is forecasted.

GENERAL COMMENTS

When plans and specifications are complete, or if significant changes are made in the character or location of the proposed development, consultation with MTI should be arranged as supplementary recommendations may be required. It is recommended that suitability of subgrade soils and compaction of structural fill materials be verified prior to placement of structural elements. Additionally, monitoring and testing should be performed to verify that suitable materials are used for structural fill and that proper placement and compaction techniques are utilized.

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APPENDICES

ACRONYM LIST

AASHTO:	American Association of State Highway and Transportation Officials
ACCP:	Asphalt Cement Concrete Pavement
ACHD:	Ada County Highway District
ASTM:	American Society for Testing and Materials
AU:	Auger sample
bgs:	below ground surface
CB:	Carbide bit
CBR:	California Bearing Ratio
D:	natural dry unit weight, pcf
DB:	diamond bit
DM:	Dames & Moore sampling tube
GS:	grab sample
IBC:	International Building Code
ISPWC:	Idaho Standards for Public Works Construction
LL:	Liquid Limit
M:	water content
MSL:	mean sea level
N:	Standard "N" penetration: blows per foot, Standard Penetration Test
NP:	nonplastic
PCCP:	Portland Cement Concrete Pavement
PERM:	vapor permeability
PI:	Plasticity Index
PID:	photoionization detector
PVC:	polyvinyl chloride
Qc:	cone penetrometer value, unconfined compressive strength, psi
ODOT:	Oregon Department of Transportation
Qp:	Penetrometer value, unconfined compressive strength, tsf
Qu:	Unconfined compressive strength, tsf
SPT:	Standard Penetration Test (140:pound hammer falling 30 in. on a 2:in. split spoon)
SS:	split spoon (13/8:in. inside diameter, 2:in. outside diameter, except where noted)
ST:	shelby tube (3:in. outside diameter, except where noted)
USCS:	Unified Soil Classification System
USDA:	United States Department of Agriculture
UST:	underground storage tank
V:	vane value, ultimate shearing strength, tsf
WT:	apparent groundwater level



GEOTECHNICAL GENERAL NOTES

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION			
Coarse-Grained Soils	SPT Blow Counts (N)	Fine-Grained Soils	SPT Blow Counts (N)
Very Loose:	< 4	Very Soft:	< 2
Loose:	4-10	Soft:	2-4
Medium Dense:	10-30	Medium Stiff:	4-8
Dense:	30-50	Stiff:	8-15
Very Dense:	>50	Very Stiff:	15-30
		Hard:	>30

Moisture Content	
Description	Field Test
Dry	Absence of moisture, dusty, dry to touch
Moist	Damp but not visible moisture
Wet	Visible free water, usually soil is below water table

Cementation	
Description	Field Test
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

PARTICLE SIZE					
Boulders:	>12 in.	Coarse-Grained Sand:	5 to 0.6 mm	Silts:	0.075 to 0.005 mm
Cobbles:	12 to 3 in.	Medium-Grained Sand:	0.6 to 0.2 mm	Clays:	<0.005 mm
Gravel:	3 in. to 5 mm	Fine-Grained Sand:	0.2 to 0.075 mm		

UNIFIED SOIL CLASSIFICATION SYSTEM			
Major Divisions		Symbol	Soil Descriptions
Coarse-Grained Soils <50% passes No.200 sieve	Gravel & Gravelly Soils <50% coarse fraction passes No.4 sieve	GW	Well-graded gravels; gravel/sand mixtures with little or no fines
		GP	Poorly-graded gravels; gravel/sand mixtures with little or no fines
		GM	Silty gravels; poorly-graded gravel/sand/silt mixtures
		GC	Clayey gravels; poorly-graded gravel/sand/clay mixtures
	Sand & Sandy Soils >50% coarse fraction passes No.4 sieve	SW	Well-graded sands; gravelly sands with little or no fines
		SP	Poorly-graded sands; gravelly sands with little or no fines
		SM	Silty sands; poorly-graded sand/gravel/silt mixtures
		SC	Clayey sands; poorly-graded sand/gravel/clay mixtures
Fine Grained Soils >50% passes No.200 sieve	Silts & Clays LL < 50	ML	Inorganic silts; sandy, gravelly or clayey silts
		CL	Lean clays; inorganic, gravelly, sandy, or silty, low to medium-plasticity clays
		OL	Organic, low-plasticity clays and silts
	Silts & Clays LL > 50	MH	Inorganic, elastic silts; sandy, gravelly or clayey elastic silts
		CH	Fat clays; high-plasticity, inorganic clays
		OH	Organic, medium to high-plasticity clays and silts
Highly Organic Soils		PT	Peat, humus, hydric soils with high organic content

GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: **TP-1** Date Advanced: **05/06/2011** Logged by: **Elizabeth Brown, E.I.T.**

Excavated by: **Struckman's Backhoe Service**

Location: **See Site Map Plates**

Depth to Water Table: **12.6 Feet bgs**

Total Depth: **15.2 Feet bgs**

Notes: **5 gallons of water readily infiltrated at 10 feet bgs**

Depth (Feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (Feet bgs)	Qp	Lab Test ID
0.0-0.25	Asphaltic Concrete				
0.25-2.2	Poorly Graded Sandy Gravel Fill (GP-FILL): <i>Brown, slightly moist, medium dense, fine grained sand, 4 inch minus cobbles.</i>				
2.2-9.5	Sandy Silt (ML): <i>Gray brown to light brown, slightly moist, very stiff to hard, fine grained sand.</i> <i>~Color changed from gray brown to light brown at 4.3 feet bgs.</i>			4.0-4.5	
9.5-15.2	Poorly Graded Sand (SP): <i>Brown to gray, slightly moist to saturated, medium dense, fine to medium grained sand, some silt.</i>				



GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: **TP-2** Date Advanced: **05/06/2011** Logged by: **Elizabeth Brown, E.I.T.**

Excavated by: **Struckman's Backhoe Service**

Location: **See Site Map Plates**

Depth to Water Table: **12.4 Feet bgs**

Total Depth: **13.4 Feet bgs**

Depth (Feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (Feet bgs)	Qp	Lab Test ID
0.0-0.08	Asphaltic Concrete				
0.08-2.5	Poorly Graded Sandy Gravel Fill (GP-FILL): <i>Brown, slightly moist, medium dense, fine to medium grained sand, 4 inch minus cobbles.</i>				
2.5-12.0	Sandy Silt (ML): <i>Gray brown to light brown, slightly moist to moist, very stiff to hard, fine grained sand.</i> <i>~Color changed from gray brown to light brown at 4.0 feet bgs.</i> <i>~Sand content began to increase at 8.5 feet bgs.</i>			4.0-4.5	
12.0-13.4	Poorly Graded Sandy Gravel (GP): <i>Brown, wet to saturated, medium dense to dense, fine grained sand, 6 inch minus cobbles.</i>				



GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: **TP-3** Date Advanced: **05/06/2011** Logged by: **Elizabeth Brown, E.I.T.**

Excavated by: **Struckman's Backhoe Service**

Location: **See Site Map Plates**

Depth to Water Table: **12.0 Feet bgs**

Total Depth: **13.4 Feet bgs**

Depth (Feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (Feet bgs)	Qp	Lab Test ID
0.0-2.0	Poorly Graded Sandy Gravel Fill (GP-FILL): Brown, slightly moist, medium dense, fine to medium grained sand, 3 inch minus cobbles.				
2.0-10.0	Sandy Silt (ML): Brown, slightly moist, very stiff to hard, fine grained sand.	GS Bulk	2.5-3.0	4.0-4.5	A R-value
10.0-11.5	Poorly Graded Sand (SP): Brown to gray, slightly moist to moist, medium dense, fine to medium grained sand, some silt.				
11.5-13.4	Poorly Graded Sandy Gravel (GP): Gray, wet to saturated, medium dense to dense, fine to coarse grained sand, fine to coarse gravel, 5 inch minus cobbles.				

Lab Test ID	M	LL	PI	Sieve Analysis				
-	%	-	-	#4	#10	#40	#100	#200
A	36	NP	NP	100	100	91	79	67



GEOTECHNICAL INVESTIGATION TEST PIT LOG

Test Pit Log #: **TP-4** Date Advanced: **05/06/2011** Logged by: **Elizabeth Brown, E.I.T.**

Excavated by: **Struckman's Backhoe Service**

Location: **See Site Map Plates**

Depth to Water Table: **11.1 Feet bgs**

Total Depth: **12.3 Feet bgs**

Depth (Feet bgs)	Field Description and USCS Soil and Sediment Classification	Sample Type	Sample Depth (Feet bgs)	Qp	Lab Test ID
0.0-1.1	Poorly Graded Sandy Gravel Fill (GP-FILL): Brown, slightly moist, medium dense, fine to medium grained sand, 1 inch minus gravels.				
1.1-10.8	Sandy Silt (ML): Brown, slightly moist to moist, very stiff to hard, fine grained sand. ~Sand content increased with depth.			4.0-4.5	
10.8-12.3	Poorly Graded Sandy Gravel (GP): Gray, moist to saturated, medium dense to dense, fine to coarse grained sand, fine to coarse gravel, 5 inch minus cobbles.				



AASHTO PAVEMENT THICKNESS DESIGN PROCEDURES

Pavement Section Design Location: Commercial Development, No Truck Access

Average Daily Traffic Count:	500	All Lanes & Both Directions
Design Life:	20	Years
Percent of Traffic in Design Lane:	100%	
Terminal Serviceability Index (Pt):	2.5	
Level of Reliability:	95	
Subgrade CBR Value:	4.8	Subgrade Mr: 7,200

Calculation of Design-18 kip ESALs

	Daily Traffic	Growth Rate	Load Factors	Design ESALs
Passenger Cars:	199	2.0%	0.0008	1,412
Buses:	0	2.0%	0.6806	0
Panel & Pickup Trucks:	40	2.0%	0.0122	4,328
2-Axle, 6-Tire Trucks:	10	2.0%	0.1890	16,762
Emergency Vehicle:	1.0	2.0%	4.4800	39,731
Dump Trucks:	0	2.0%	3.6300	0
Tractor Semi Trailer Trucks:	0	2.0%	2.3719	0
Double Trailer Trucks:	0	2.0%	2.3187	0
Heavy Tractor Trailer Combo Trucks:	0	2.0%	2.9760	0
Average Daily Traffic in Design Lane:	250			

Total Design Life 18-kip ESALs: 62,232

Actual Log (ESALs): 4.794

Trial SN: 2.38

Trial Log (ESALs): 4.805 This number must be equal to or greater than the Actual Log.

Pavement Section Design SN: 2.41 This number must be equal to or greater than the Trial SN.

	Design Depth Inches	Structural Coefficient	Drainage Coefficient
Asphaltic Concrete:	2.50	0.42	n/a
Asphalt-Treated Base:	0.00	0.25	n/a
Cement-Treated Base:	0.00	0.17	n/a
Crushed Aggregate Base:	4.00	0.14	1.0
Pit Run Aggregate Subgrade:	8.00	0.10	1.0
Special Aggregate Subgrade:	0.00	0.09	0.9



AASHTO PAVEMENT THICKNESS DESIGN PROCEDURES

Pavement Section Design Location: Commercial Development, Truck Access

Average Daily Traffic Count:	500	All Lanes & Both Directions
Design Life:	20	Years
Percent of Traffic in Design Lane:	100%	
Terminal Serviceability Index (Pt):	2.5	
Level of Reliability:	95	
Subgrade CBR Value:	4.8	Subgrade Mr: 7,200

Calculation of Design-18 kip ESALs

	Daily Traffic	Growth Rate	Load Factors	Design ESALs
Passenger Cars:	150	2.0%	0.0008	1,064
Buses:	4	2.0%	0.6806	24,144
Panel & Pickup Trucks:	60	2.0%	0.0122	6,492
2-Axle, 6-Tire Trucks:	20	2.0%	0.1890	33,523
Emergency Vehicles:	2.0	2.0%	4.4800	79,462
Dump Trucks:	2	2.0%	3.6300	64,386
Tractor Semi Trailer Trucks:	10	2.0%	2.3719	210,353
Double Trailer Trucks:	2	2.0%	2.3187	41,127
Heavy Tractor Trailer Combo Trucks:	0	2.0%	2.9760	0
Average Daily Traffic in Design Lane:	250			

Total Design Life 18-kip ESALs: 460,550

Actual Log (ESALs): 5.663

Trial SN: 3.30

Trial Log (ESALs): 5.663 This number must be equal to or greater than the Actual Log.

Pavement Section Design SN: 3.30 This number must be equal to or greater than the Trial SN.

	Design Depth Inches	Structural Coefficient	Drainage Coefficient
Asphaltic Concrete:	3.00	0.42	n/a
Asphalt-Treated Base:	0.00	0.25	n/a
Cement-Treated Base:	0.00	0.17	n/a
Crushed Aggregate Base:	6.00	0.14	1.0
Pit Run Aggregate Subgrade:	12.00	0.10	1.0
Special Aggregate Subgrade:	0.00	0.09	0.9

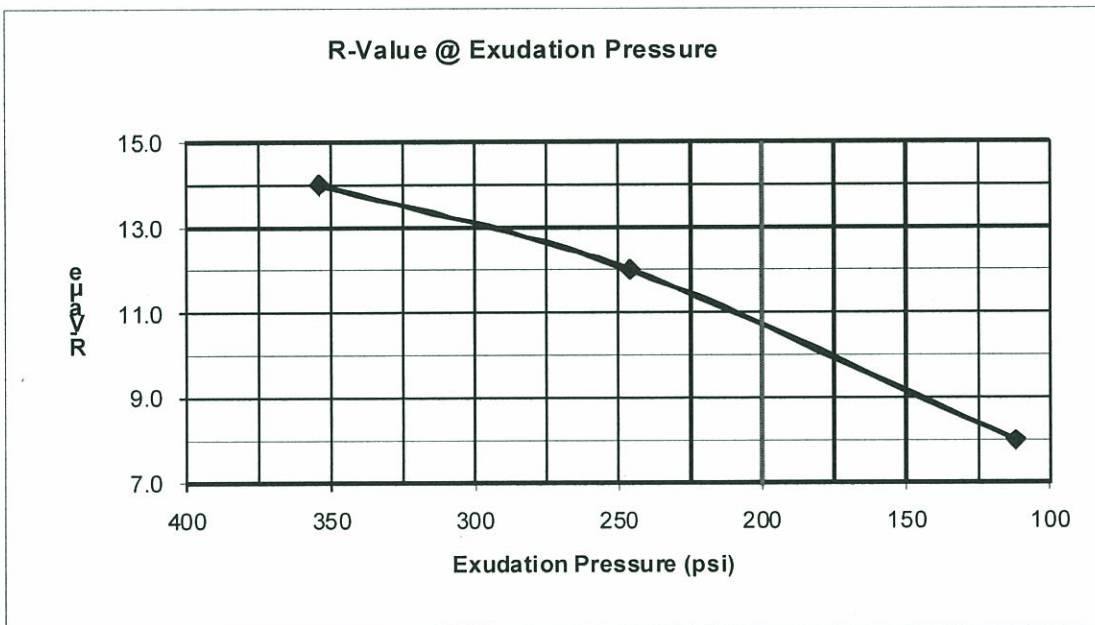


R-VALUE LABORATORY TEST DATA

Source and Description:	TP-3, 2.5'-3.0' – Silt						
Date Obtained:	May 6, 2011						
Sample ID:	112697						
Sampling and Preparation:	ASTM D75:		AASHTO T2:	X	ASTM D421:		AASHTO T87: X
Test Standard:	ASTM D2844:		AASHTO T190:		Idaho T8:	X	

Sample	A	B	C
Dry Density (lb/ft ³)	93.8	93.3	90.9
Moisture Content (%)	15.3	17.2	19.2
Expansion Pressure (psi)	0.21	0.09	0.00
Exudation Pressure (psi)	354	246	112
R-Value	14	12	8

R-Value @ 200 psi Exudation Pressure = 11



MAP NOTES:

- Delorme Street Atlas
- Not to Scale

LEGEND

Approximate Site
Location

Commercial Development

180 East South Lane
Ontario, OR

Modified from Delorme by: EB

17 May 2011

Drawing: B10404g



MATERIALS TESTING & INSPECTION

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HOME DEPOT

SUPER WAL-MART

EAST IDAHO AVENUE (US HWY 30)

MCDONALD'S

30' 30'

EAST LANE SOUTH

KMART

DOLLAR TREE

Phase II



NOTES:

- Not to Scale

LEGEND

Approximate Site Boundary

Approximate MTI Test Pit Location



Commercial Development

180 East Lane South
Ontario, OR

Modified from Rhine Cross Group by: EB
17 May 2011
Drawing: B10404g



**MATERIALS
TESTING &
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