SEPA-20-0002 and EM-20-002

Rec'd 5-13-2020

Geotechnical Report

Twin Transit

1820 N. National Avenue
Parcels 005605100003 & 005605100004
Chehalis, Washington 98532

Prepared For:

RB Engineering
PO Box 923
Chehalis, Washington 98532

Prepared By:

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2/14/20

February 14, 2020

PTI Project # 200004

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1.0 INTRODUCTION

Pacific Testing & Inspection, Inc. (PTI) has completed a geotechnical investigation for the planned Twin Transit facility to be located at 1820 N. National Avenue in Chehalis, Washington. See the vicinity map on the following page for a general depiction of the site location.

An initial geotechnical evaluation of the project was conducted by PTI on January 24, 2020. During this site visit, surface and subsurface conditions were assessed. After completion of the field work, laboratory work, and applicable project research, PTI prepared this geotechnical report. At a minimum, this report conforms to the requirements outlined in the International Building Code (IBC) Sections 1603.1.6 and 1803.6.

As presented herein, this report includes information pertaining to the project in this Introduction Section; observations of the property and surrounding terrain in the Surface Conditions Section; field methods and soil descriptions in the Subsurface Investigation Section; and, supporting documentation with relation to the aforesaid IBC sections and project requirements in the Engineering Conclusions and Recommendations Section.

1.1 Project Information

Information pertaining to the planned development of the project was provided by the proponent of the property. The property was formerly developed with a fast food restaurant. The planned development consists of a Twin Transit facility which includes multiple small structures, paved ingress/ egress/ parking, drainage facilities, and other ancillary features.

Approximate existing site conditions and test pit locations are illustrated on the Test Pit Location Plan provided in Appendix A of this report.

1.2 Purpose of Investigation and Scope of Work

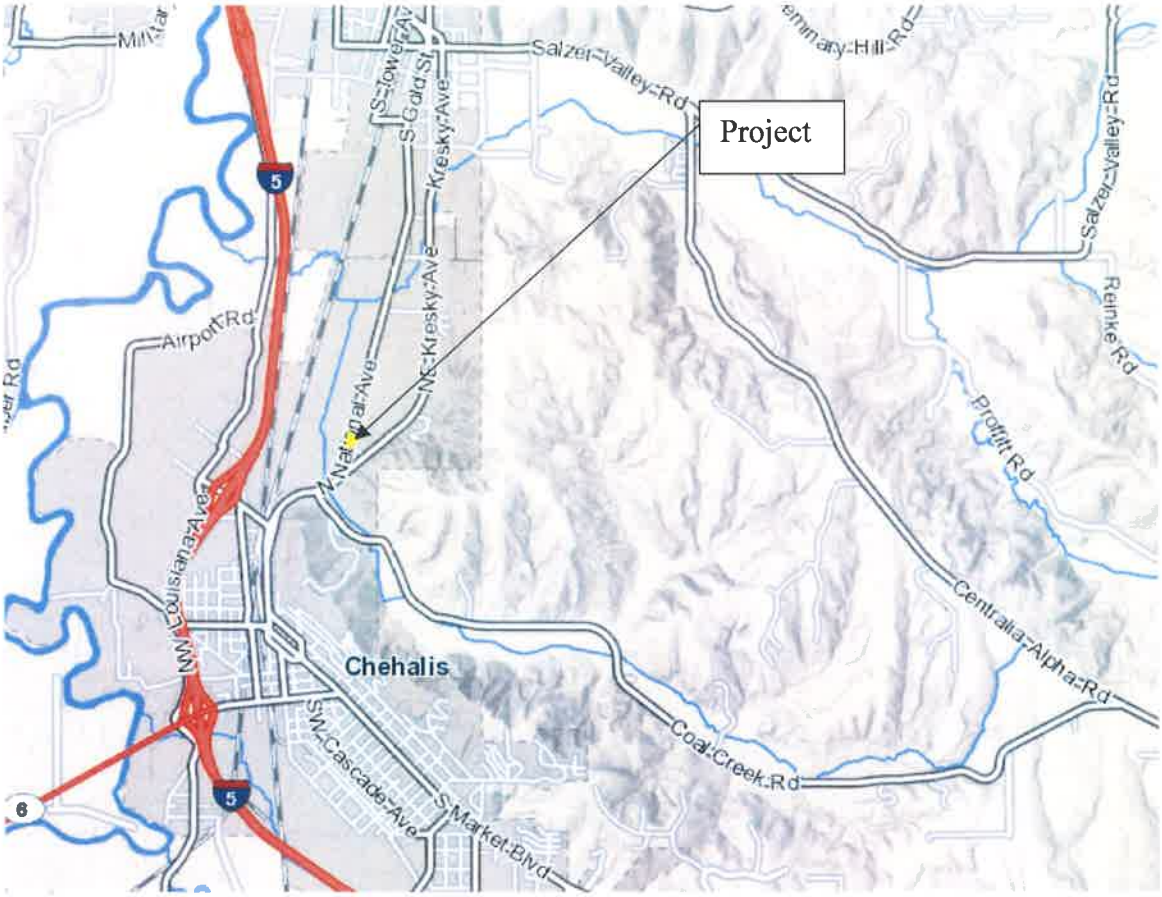
The purpose of this geotechnical investigation is to minimally address the reporting requirements outlined in the IBC, and further evaluate the project as necessary with respect to geotechnical constraints in order to provide recommendations that should be implemented during development.

In order to fulfill the purpose of investigation, the geotechnical program completed for the proposed improvements of the project include:

- Review project information provided by the proponent of the project;
- Conduct a site visit to document the site conditions that may influence the construction and performance of the proposed improvements of the project;
- Define general subsurface conditions of the site by observing subsoils within test pits, review geological and other soil mapping for the general area, research published references concerning earthquake/ slope/ erosion hazards, and review any other pertinent documents near the project;
- Collect bulk samples as necessary, at various depths and locations;
- Perform laboratory testing to determine selected index and/or engineering properties of the site soils;
- Complete an engineering analysis supported by the planned site alterations, and the

surface and subsurface conditions that were identified by the field investigation, soil testing, and applicable project research; and,

- Establish conclusions based on findings, and make recommendations for foundations, drainage, pavements, earthwork construction requirements, and other considerations as outlined in this report.



Vicinity Map from Lewis County Website

2.0 SURFACE CONDITIONS

Information pertaining to the existing surface conditions for the project was gathered on January 24, 2020 by a representative with PTI. During the site visit, the type of geotechnical investigation was assessed, site features were documented that may influence construction, and site features were examined that may be influenced by construction. This Surface Conditions Section provides information on general observations, vegetation, topography, drainage and observed slope/ erosion conditions for the project and surrounding areas that may impact the project.

2.1 General Observations

Currently, the property is vacant with remnants of a pre-existing building, pavement, and sign/ light poles. Vegetation on and near the project consists primarily of grass, weeds, and alders. An aerial photo of the project and immediate vicinity is provided on the following page.

2.2 Topography

The topographic information provided in this section was extrapolated from a public lidar source. Except for the drainage feature near the roadway, the property is relatively flat with a vertical relief of less than 5 feet. Critical slopes were not observed on the property or within 300 feet of the planned project location. Critical slopes are defined as grades exceeding 15% with a vertical relief of at least 10 feet.

2.3 Surface Drainage

Runoff originating upslope of the development is mostly diverted away from the property by upslope development and accommodating topography. Roadside drainage ditches are located within the rights-of-way.

Excessive scour, erosion or other indications of past drainage problems were not observed within the immediate vicinity of the planned development.

2.4 Slope and Erosion Observations

Slope or erosion instability was not observed during our site visit. In conclusion, indications of past landslides, current unstable slopes, deep-seated slope problems, surficial slope failures, or excessive soil erosion were not observed during the site visit.

Aerial Photo from Lewis County Website

3.0 SUBSURFACE INVESTIGATION

Information on subsurface conditions pertaining to the project was primarily gathered on January 24, 2020 by a representative with PTI. Applicable information on field methods, sampling, field testing, general geologic conditions, specific subsurface conditions, and results from soil testing are presented in this section of the report. Appendix B of this report includes pertinent information on subsurface conditions for the project, such as test pit logs, and other applicable soil information. Applicable test pit locations are depicted on the Test Pit Location Plan provided in the appendix of this report.

3.1 Field Methods, Sampling and Field Testing

Information on subsurface conditions for the project was accomplished by examining soils within 4 test pits extending to depths of up to 7 feet below the existing ground surface. Information on subsurface conditions also included reviewing soil and geological maps representing the general vicinity of the project.

Soil samples were obtained from this project and utilized for laboratory testing as necessary. PTI evaluated the relative density of the near-surface in-situ soils by gauging the resistance of the excavator. Within testing locations, field testing results generally indicated loose to medium dense soils in the upper 2 to 3 feet, and dense soils below.

3.2 General Geologic Conditions

In general, soils at the project are composed of materials from glacial advances. The geologic conditions as presented in the "Geologic Map of Washington," compiled by J. Eric Schuster, 2002 indicates Quaternary sediments, Q_g. Quaternary sediments are generally unconsolidated deposits, and dominantly deposited from glacial drift, including alluvium deposits. This project is located within the Puget Lowland. Typically, "lower tertiary sedimentary rocks unconformably overlie the Crescent Formation." as revealed in the Geologic Map. Initial sedimentary rocks were formed from shales, sandstones and coal deposits from rivers. During the Quaternary period, the Puget Lowland was covered by numerous ice sheets, with the most recent being the Fraser glacier with a peak of approximately 14,000 years ago. Upon the glacial retreat, the landscape was formed by glacial erosion glacial drift deposits. According to the "Interactive Geologic Map, 1:100,000 Quadrangle," as depicted by the Department of Natural Resources, this project area has the following description:

Geologic Unit Label: Qa

Geologic Age: Quaternary

Lithology: Quaternary alluvium

Geologic Unit Description: Quaternary unconsolidated or semiconsolidated alluvial clay, silt, sand, gravel, and (or) cobble deposits; locally includes peat, muck, and diatomite; locally includes beach, dune, lacustrine, estuarine, marsh, landslide, lahar, glacial, or colluvial deposits; locally includes volcaniclastic or tephra deposits; locally includes modified land and artificial fill.

3.3 Soil Profile

The following subsurface conditions are estimated descriptions of the project subgrade utilizing information from the depth of penetration at all testing, sampling, observed and investigated locations. Soils for this project were primarily described utilizing the Unified Soil Classification System (USCS) and the Soil Conservation Service (SCS) descriptions.

Within test pit locations, soils within the upper 12 to 24 inches were generally observed to be organic laden topsoil and fill. Construction debris was found periodically within the fill. Beneath the fill soils to the depth of terminous, native soils were observed to be mostly silty sand and sitly gravel (SM and GM).

The relative densities of the soil within selected test pits are provided above in Section 3.1. Expanded and specific subsurface descriptions, other than what is provided in this section, are provided in the soil logs located in Appendix B of this report.

According to the "Soil Survey of Lewis County," by the United States Department of Agriculture, Soil Conservation Service, the site soils are described as Xerorthents, spoils, 247. The soil designations are depicted in the aerial photograph below, and descriptions are provided in Appendix B of this report.

Soil Survey From USDA Natural Resources Conservation Service

Visual classifications were performed in the field in accordance with the American Standards for Testing and Materials (ASTM) D2488. Laboratory testing was performed in order to further classify soils at selected locations and depths.

The soil samples obtained at the project site during the field investigation were preserved and transported for laboratory testing. The following soil tests were performed in accordance with the American Standards for Testing and Materials (ASTM):

4 Particle Size Analyses (ASTM D422); and,
4 Moisture Contents (ASTM D2216).

The results from the sieve analysis, performed by PTI, are provided in Appendix C of this report. The moisture content tests are shown on our soil logs in Appendix B.

3.3.1 Groundwater

Groundwater was observed to be 5 feet to 6 feet below current grade within all four of our test pits.

3.3.2 Infiltration Rates

Infiltration rates are based on the Soil Grain Size Analysis Method as outlined in the 2012 Stormwater Management Manual for Western Washington. Based on soil characteristics and the aforesaid drainage manual, infiltration was determined to be the following:

$Log_{10}(K_{sat}) = -1.57+1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08f_{fines}$

K_{sat} = saturated hydraulic conductivity, cm/sec
D_{10} = soil sample 10% finer by weight, mm
D_{60} = soil sample 60% finer by weight, mm
D_{90} = soil sample 90% finer by weight, mm
f_{fines} = soil fraction passing #200 seive, by weight, mm

$Log_{10}(K_{sat}) = -1.57+1.90(0.02) + 0.015(0.16) - 0.013(2) - 2.08(0.35) = -2.2836$

- $K_{sat} = 10^{-2.2836} = 0.005204752$ cm/sec = 7.38 in/hr

$K_{sat\ design} = K_{sat} \times CF_T$

$CF_T = CF_V * CF_t * CF_m$

K_{sat} = 7.38 in/hr
CF_V = 1.0 (0.33 to 1.0) site variability and number of test locations
CF_t = 0.4 (0.4) grain size test method
CF_m = 0.9 (0.9) degree of influent control

$K_{sat\ design}$ = 2.7 in/hr

4.0 ENGINEERING CONCLUSIONS & RECOMMENDATIONS

The following section includes slope stability, seismic considerations, erosion, building foundations, earthwork, retaining walls, and drainage recommendations.

4.1 Slope Stability

According to the "Interactive Geologic Map, 1:100,000 Quadrangle," as depicted by the Department of Natural Resources, this project does not have a mapped landslide or liquefaction hazard. Based on the mapped conditions, soil characteristics, minor sloping grades, observed surface conditions, and other pertinent information, it is our opinion that the proposed development is not subject to a landslide hazard, and the development may commence in accordance with the recommendations in this geotechnical report.

4.2 Seismic Considerations and Liquefaction

The nearest Class 'A' or Class 'B' fault to this property is the Olympia Structure, and is over 20 miles from the parcel. This information is based on the USGS Quaternary Fault and Fold Database for the United States with the following description:

Fault Name: Olympia structure (class B)
Fault System: Olympia structure (class B)
Geologic Age (Years):unknown
Geologic Age Description:insufficient data to determine age (class B)
Fault Detection Method:geophysical lineament
Fault Visiblilty:inferred fault trace
Slip Rate (mm per year):--
Fault Description:fault
USGS Fault ID:--
Fault Source URL:--
Fault Source Citation: Brocher, Thomas M.; Parsons, Tom E.; Blakely, Richard J.; Christensen, Nikolas I.; Fisher, Michael A.; Wells, Ray E.; SHIPS Working Group, 2001, Upper crustal structure in Puget Lowland, Washington--Results from the 1998 Seismic Hazards Investigations in Puget Sound: Journal of Geophysical Research, v. 106, no. B7, p. 13,541-13,564.

Soils immediately below the expected foundation depth for this project may use the following seismic parameters:

Seismic Site Class: Site class D to E
Seismic Site Class Description: Average shear wave velocity in the upper 100 feet (30 meters) corresponds to a D site class and the mean shear wave velocity minus one standard deviation within the upper 100 feet (30 meters) corresponds to a E site class.
Seismic Design Category Code:D1
Seismic Design Category (SDC): Seismic design category D1
SDC Description: 0.67 < S(DS) <= 0.83, where S(DS) is the 5 percent damped design spectral response acceleration at short periods

Based on observed and known subsurface conditions in the area, the potential for liquefaction is believed to be moderate for this project. According to the Interactive Geological Map of Washington, liquefaction hazards are moderate to high within the vicinity of the property.

4.3 Erosion

Based on the USCS description of the project soils, the surface soils are considered to have a low to moderate erodibility hazard. According to the Resource Map from the Washington State DNR, the project is not within terrain labeled 'highly erodible.'

It is our opinion that standard erosion control per the drainage engineer or agency requirements is sufficient for the development of this project. Extents of temporary erosion control will mostly depend on the timeliness of construction, moisture content of the soil, and amount of rainfall during construction. Soil erosion typical to the existing site conditions and planned disturbance of the project include wind-borne silts during dry weather, and sediment transport during prolonged wet weather. Sediment transport could be from stormwater runoff or tracking off-site with construction equipment.

Erosion control measures during construction may include stockpiling cleared vegetation, silt fencing, intercepting swales, berms, straw bales, plastic cover or other standard controls. Any erosion control should be located down-slope and beyond the limits of construction and clearing of vegetation where surface water is expected to flow. If the loss of sediments appears to be greater than expected, or erosion control measures are not functioning as needed, additional measures must be implemented immediately.

Permanent erosion control will also be necessary if substantial vegetation has not been established within disturbed areas upon completion of the project. Temporary erosion control should remain in place until permanent erosion control has been established. Permanent erosion control may include promoting the growth of vegetation within the exposed areas by mulching, seeding or an equivalent measure. Additional erosion control measures that should be performed include routine maintenance and replacement, when necessary, of permanent erosion control, vegetation, drainage structures and/or features.

4.4 Building Foundation Recommendations

Recommendations provided in this section account for the site development of a typical commercial facility. The recommended allowable bearing capacities and settlements as presented below, consider the probable type of construction as well as the field investigation results by implementing practical engineering judgment within published engineering standards. Evaluations include classifying site soils based on observed field conditions and soil testing for this project. After deriving conservative relative densities, unit weights and angles of internal friction of the in-situ soils, the Terzhagi ultimate bearing capacity equation was utilized for determining foundation width and depth. Foundation parameters provided herein account for typical structural pressures due to the planned type of development. A structural analysis is beyond the scope of a geotechnical report, and a structural engineer may be required to design specific foundations and other structural elements based on the soil investigation.

Stepped foundations are acceptable, if warranted for this project. Continuous, isolated, or stepped foundations shall be horizontally level between the bottom of the foundation and the top of the bearing strata. The frost penetration depth is not expected to extend beyond 12 inches below the ground surface for this project under normal circumstances and anticipated design features.

A modulus of subgrade reaction of no more than 150 pci should be used for the foundation system. Friction between the bottom of the foundation and soil may be utilized to resist lateral loads. A coefficient of friction of 0.5 may be used for this application, and should account for the vertical dead loads only.

Existing in-situ soils for this project indicates that the structure can be established on shallow, continuous or isolated footings. Foundations shall be established on relatively undisturbed native soil that is competent and unyielding. Alternatively, foundations may be constructed on selective re-compacted native soil or compacted engineered fill as described in the Earthwork Construction Recommendations Section of this report.

For a bearing capacity requirement of no more than 1500 psf, a minimum continuous footing width of 15 inches shall be placed at a minimum of 24 inches below the existing ground surface atop prepared subgrade that are firm and unyielding. For a columnar load of no more than 3 tons, a circular or square isolated foundation diameter or width shall be at least 24 inches. Foundations for light posts shall be a minimum of 3 feet below ground with additional depth as required by the structural engineer.

Foundation recommendations are made available based on adherence to the remaining recommendations that are provided in this report. Alterations to the aforementioned foundation recommendations may be completed upon a site inspection by a geotechnical engineer after the foundation excavation is completed.

4.4.1 Settlement

Total and differential settlement that a structure will undergo depends primarily on the subsurface conditions, type of structure, amount and duration of pressure exerted by the structure, reduction of pore water pressure, and in some instances, the infiltration of free moisture. Based on the expected native soil conditions, anticipated development, and construction abides by the recommendations in this report, the assumed foundation system may undergo a maximum of 1.0 inch total settlement, and a maximum differential settlement of 0.75 inch.

4.4.2 Concrete Slabs-on-Grade

Concrete slabs, if utilized, should be supported on a minimum of 4 inches of compacted coarse, granular material (Retained on U.S. Sieve #10 or greater) that is placed over undisturbed, competent native subgrade or engineered fill per the Earthwork Recommendations Section below.

The recommendations for interior concrete slabs-on-grade as presented herein are only relevant for the geotechnical application of this project. Although beyond the scope of this report, concrete slabs should also be designed for structural integrity and

environmental reliability. This includes vapor barriers or moisture control for mitigating excessive moisture in the building.

4.5 Earthwork Construction Recommendations

Founding material for building foundations shall consist of undisturbed native soils to the specified foundation depths. Compacted engineered fill, or selective re-compacted native soils may be used to the extents provided in this Earthwork Construction Recommendations Section. The following recommendations include excavations, subgrade preparation, type of fill, and placement of fill for building foundations.

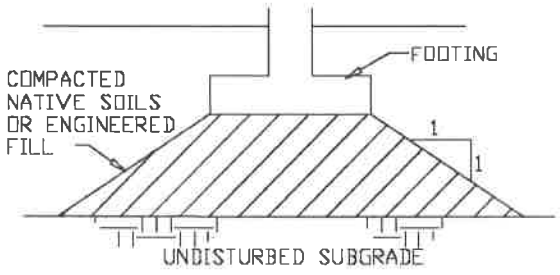
4.5.1 Excavation

Excavation is recommended to remove any excessive organic content or other deleterious material, if present, beneath foundations and to achieve appropriate foundation depth. Additional sub-excavation will be required for this project if the soils below the required foundation depth are loose, saturated, not as described in this report, or otherwise incompetent due to inappropriate land disturbing, or excessive water trapped within foundation excavations prior to foundation construction. All soils below the bottom of the excavation shall be competent, and prepared by proof rolling with a 60K steel drum roller. If these soils are disturbed or deemed incompetent, re-compaction of these soils below the anticipated footing depth is necessary. Excavations shall be completely dewatered, compacted, and suitable before placement of additional native soil, engineered fill or structural concrete. Subgrades shall be prepared for ensuing structural fill, foundations and slabs by proof rolling with a steel drum roller or a hand-held jumping jack.

4.5.2 Placement and Compaction of Native Soils and Engineered Fill

For engineered fill or disturbed native soils that will be utilized as fill material directly beneath foundations, observation and/ or geotechnical testing is required prior to foundation construction. The following placement and compaction requirements are necessary.

For disturbed native soils or engineered fill beneath foundations, limits of compacted or re-compacted fill shall extend laterally from the bottom edge of the foundation at a rate of one horizontal foot for each foot of compacted or re-compacted fill depth beneath the foundation. See the illustration below.



Both engineered fill and native soils used as compacted fill should be free of roots and other organics, rocks over 6 inches in size, or any other deleterious matter. If import material is utilized as structural fill material for placement in building pad areas, we recommend that it meets the current Washington State Department of Transportation Standard Specification for Road, Bridge and Municipal Construction (WSDOT), Section 9-03(14), for Gravel Borrow. The material should be placed per the recommendation in section 2-06 of WSDOT for sub-grade. Material should be placed in 12 inch vertical lifts and compacted with a vibratory smooth drum roller to achieve 95% of the (ASTM D1557) modified proctor. Each lift surface should be adequately maintained during construction in order to achieve acceptable compaction and inter-lift bonding. Alternative materials may be imported for this project and used for foundation support per the geotechnical engineer.

Temporary earth cuts and temporary fill slopes exceeding 4 feet in height should be limited to a slope of 2:1 (horizontal:vertical). Utility trenches or other confined excavations exceeding 4 feet should conform to OSHA safety regulations. Permanent cut and fill slopes shall be limited to a slope of 2:1, unless otherwise approved by an engineer.

4.6 Surface and Subsurface Drainage

Positive drainage should be provided in the final design for all planned buildings. Drainage shall include sloping the ground surface, driveways and sidewalks away from the project structures.

Shallow infiltration facilities are feasible for this project, and should be located at least 15 feet from any structure. The drainage engineer shall review the groundwater depths provided in this report for adequately determining facility depth. For existing in-situ soils, an infiltration rate of 2.7 in/hr may be used as calculated in the Subsurface Conditions Section in this report.

4.7 Parking and Pavement Analysis

The pavement section design analysis was completed using AASHTO's Guide for Design of Pavement Structures. The AASHTO procedure utilizes a Structural Number (SN) which is used to determine thicknesses of pavement structural sections based on their corresponding structural coefficients. The structural number is determined from a nomograph (Appendix D) utilizing Equivalent Single-Axle Loads (ESALs), Reliability (R%), Serviceability Loss (ΔPSI), Standard Deviation (S_o), and Soil Resilient Modulus (M_R) of the subgrade soil. ESALs were determined by assuming an ADT. This should be confirmed by the owner, and if PTI's assumptions are significantly different, we should be contacted to revise our recommendations.

ESALs = (ADT)(365 days/yr)(N)(DDF)(DLDF)(GR)(PT)(TF)

ADT = 2-way Average Daily Traffic Count
= 300 (assumed)
N = Pavement Design Life
= 20 years
DDF = Direction Distribution Factor
= 50% (50-50 split each direction)

DLDF = Design Lane Distribution Factor
= 100% (one lane in one direction)
GR = Growth Rate
= 0%
PT = Percent Trucks
= 5%
TF = Truck Factor
= 1.7 (common default value)

ESALs = (300)(365)(20)(0.5)(1.0)(.05)(1.7) = 93,075

R% = 80% (Reliability value for local access)
ΔPSI = 2.0 (Serviceability Loss for local access)
S_o = 0.45 (Standard Deviation)
M_R = 1155+555(R Value) = 1155+555(20) = 12,255 psf
where R-Value is interpolated from soil results

The flexible pavement nomograph presented in the AASHTO Guide, was used to calculate the structural number of 2.1. In conjunction with known or assumed pavement layer depths (d_1, etc…), typical published structural coefficients (a_1, etc…), and drainage coefficients (m_1, etc…), as needed, the following formula was used to determine the pavement structural section.

$SN \leq a_1d_1 + a_2d_2m_2 + \ldots. + a_id_im_i + \ldots$

$2.1 \leq (0.42 \times 2 \text{ in}) + (0.14 \times 2 \text{ in}) + (0.14 \times 8.0 \text{ in})$

where a = 0.42 for asphalt concrete (class B)
a = 0.14 for CSTS
a = 0.14 for CSBC

Based on the result of the analysis provided above, PTI recommends that the following pavement elements be utilized at a minimum:

Asphalt concrete	: 2.0 inches
CSTC	: 2.0 inches
CSBC	: 8.0 inches

PTI recommends construction to occur during the dry season (May 1st to October 31st) if at all possible. The upper organic laden soils should be removed beneath proposed roadway sections to a depth so that the necessary fill and/ or pavement structural section is to the desired grade. Upon excavation, the native subgrade should be proof rolled with a 60K steel drum roller to a firm, unyielding condition. If necessary, engineered fill soils should be placed and compacted in order to achieve proper grade. Engineered fill soils should be approved by the geotechnical engineer, and compacted to at least 95% of the modified Proctor.

Upon satisfactory completion of the subgrade preparation and necessary fill, the overlying 8.0 inches Crushed Surfacing Base Course (CSBC), 2.0 inches of Crushed Surfacing Top Course (CSTC) and 2.0 inches asphalt concrete layers may be constructed. New CSB/TC should meet the

requirements of Class B foundation material from the Washington State Department of Transportation Standard Specifications for Road, Bridge and Municipal Construction. Furthermore, the base materials shall be compacted per the (ASTM D1557) modified Proctor. Each lift surface throughout the project should be adequately maintained during construction in order to achieve acceptable compaction and inter-lift bonding.

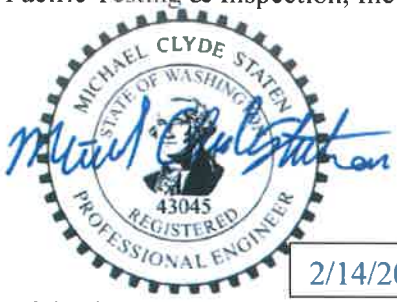
5.0 LIMITATIONS

Due to the inherent natural variations of the soil stratification and the nature of geotechnical subsurface explorations, there is always a possibility that soil conditions encountered during construction are different than those described in this report. Therefore, it is recommended that a qualified engineer observes and documents the construction, or PTI is promptly notified if project and subsurface conditions found on-site are not as presented in this report so that we can re-evaluate our recommendations.

This report presents engineering design guidelines, and is intended only for the owner, or owners' representative, and location of project described herein. This report should not be used to dictate construction procedures or relieve the contractor of his responsibility.

Please contact PTI if you have any questions, comments, or require additional information.

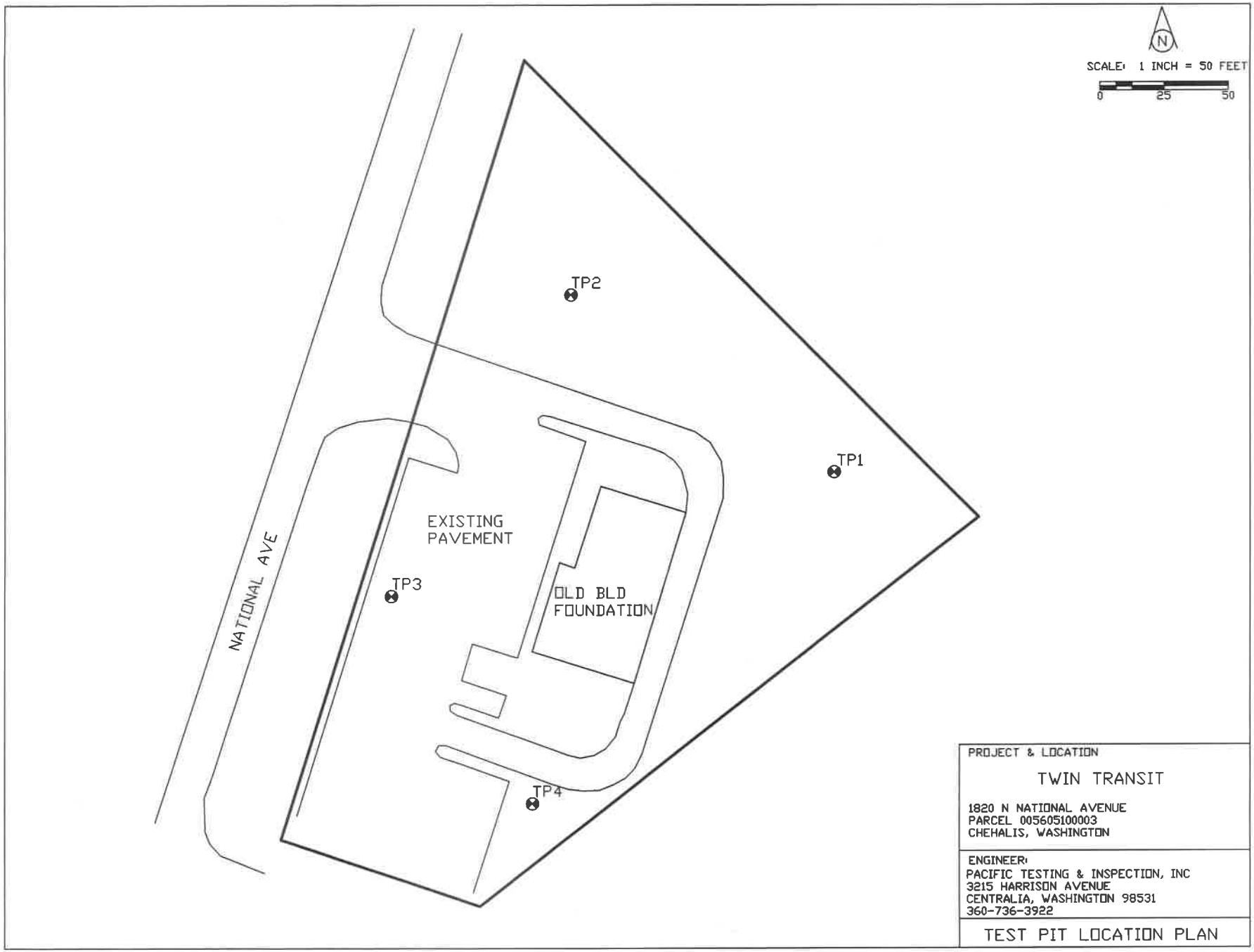
Sincerely,
Pacific Testing & Inspection, Inc.



Michael Staten, P.E.
Engineer

APPENDIX A

TEST PIT LOCATION PLAN



PROJECT & LOCATION

TWIN TRANSIT

1820 N NATIONAL AVENUE
PARCEL 005605100003
CHEHALIS, WASHINGTON

ENGINEER:
PACIFIC TESTING & INSPECTION, INC
3215 HARRISON AVENUE
CENTRALIA, WASHINGTON 98531
360-736-3922

TEST PIT LOCATION PLAN

APPENDIX B

TEST PIT LOGS &
SOIL INFORMATION

Pacific Testing & Inspection Inc.

3215 Harrison Avenue, Centralia, WA 98531
Phone (360) 736-3922 Fax (360) 807-6002

LOG OF TEST PIT

Project No.:	Project Name:	Client:	Date:
200004	Twin Transit Geo	RB Engineering	1-24-2020

Test Pit No.:	Location: NE end	Diameter:	
1	See plan		

Logged By:	Depth of Water:	Date Checked:	Depth of Caving:
MH	5'		

Elev. Or Depth	Lab #	USCS	Description	Remarks	Moisture (%)
Surface			Surface cover consisted of moss, weeds, sub rounded gravels and sitting water at surface About 1' of gravel borrow before native appears	Dewatering of old building pad. At 4' water made its way into the hole with some pressure. Water entered from SW corner	
1	20-014	GM	10YR4/2 Dark greyish brown. Fine – coarse sand with round gravel, ≤3/8", 2"-4" cobbles, traces of silts. Very wet, moderate plasticity.	Mottling present. Did not encounter geo fabric.	13.9
3	20-015	SM	10YR5/6 Yellowish brown. Fine-very fine sand with silts, some traces of gravel ≤3/8", round – sub round. Damp, high plasticity, dense.	Mottling present.	24.5
6		GP	10YR4/2 Dark greyish Brown. Coarse sand with gravel, ≤3/8" and cobbles. Very wet.	Ended at 6'	

Reported by: Mario Hernandez, Field Technician	Reviewed by: **Michael Staten, PE**

Pacific Testing & Inspection Inc.

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LOG OF TEST PIT

Project No.:	Project Name:	Client:	Date:
200004	Twin Transit Geo	RB Engineering	1-24-2020

Test Pit No.:	Location: NW end	Diameter:	
2	See plan		

Logged By:	Depth of Water:	Date Checked:	Depth of Caving:
MH	5'		

Elev. Or Depth	Lab #	USCS	Description	Remarks	Moisture (%)
Surface			Surface consisted of sub rounded gravels and weeds. About a thin lift (2") of top course with a foot of gravel borrow below it.	Geo fabric separate the foot of borrow with the native.	
2		SM	10YR3/1 Very dark grey. Very fine – fine sand with silts. Traces of gravel, ≤3/8", Damp, dense, moderate plasticity.	Some traces of organics. Silica found in samples.	
5		SM	10YR5/1 Grey. Fine sand with silts. Very wet, dense, moderate plasticity.	Ended at 5'	

Reported by: Mario Hernandez, Field Technician	Reviewed by: **Michael Staten, PE**

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LOG OF TEST PIT

Project No.:	Project Name:	Client:	Date:
200004	Twin Transit Geo	RB Engineering	1-24-2020

Test Pit No.:	Location: SW end	Diameter:	
3	See plan		

Logged By:	Depth of Water:	Date Checked:	Depth of Caving:
MH	6'		

Elev. Or Depth	Lab #	USCS	Description	Remarks	Moisture (%)
Surface			About an inch of top course followed by 2' of gravel borrow.	Removed asphalt first. Geo fabric below borrow.	
1		OL	10YR4/2 Dark greyish brown. Fine – coarse sand with gravel ≤3/8" round cobbles 2" – 6", non-plastic, traces of silt.	Wood debris present.	
3	20-016	OL	10YR5/1 Grey. Fine – coarse sand, traces of gravel, ≤3/8", Wet, dense, moderate plasticity.	Mottling present. Silica visible	23.9
5		SM	10YR5/1 Grey. Fine sand with silts. Very wet, dense, moderate plasticity.	No sample – same as TP 2 at 5'	
6				Ended @ 6'	

Reported by: Mario Hernandez, Field Technician	Reviewed by: **Michael Staten, PE**

Pacific Testing & Inspection Inc.

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LOG OF TEST PIT

Project No.:	Project Name:	Client:	Date:
200004	Twin Transit Geo	RB Engineering	1-24-2020

Test Pit No.:	Location: SE end	Diameter:	
4	See plan		

Logged By:	Depth of Water:	Date Checked:	Depth of Caving:
MH	6'		

Elev. Or Depth	Lab #	USCS	Description	Remarks	Moisture (%)
Surface			Surface covered with weeds, topsoil for approx. 1 ft..	Roots and old construction debris found at all depths.	
2		SM	10YR3/1 Very dark grey. Fine – coarse sand with gravel ≤3/8", cobbles 2" – 6", some boulders, traces of silt. Very wet, non-plastic.	Small roots	
5	20-017	SM	10YR2/2 Very dark brown. Very fine – fine sand with silts, traces of gravel ≤3/8". Wet, dense, moderate plasticity.	Mottling present.	20.1
7		SM	10YR5/1 Grey. Very fine - fine sand with silts. Wet, dense, moderate plasticity.	Mottling present	
				Ended @ 7'	

Reported by: Mario Hernandez, Field Technician	Reviewed by: **Michael Staten, PE**

Lewis County Area, Washington

247—Xerorthents, spoils

Map Unit Setting

National map unit symbol: 2hf7
Elevation: 100 to 690 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 degrees F
Frost-free period: 150 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Xerorthents and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerorthents

Setting

Landform: Hills

Typical profile

H1 - 0 to 6 inches: silty clay loam
H2 - 6 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Data Source Information

Soil Survey Area: Lewis County Area, Washington
Survey Area Data: Version 19, Sep 16, 2019

APPENDIX C

LABORATORY TESTING RESULTS

Pacific Testing Inspection Inc.

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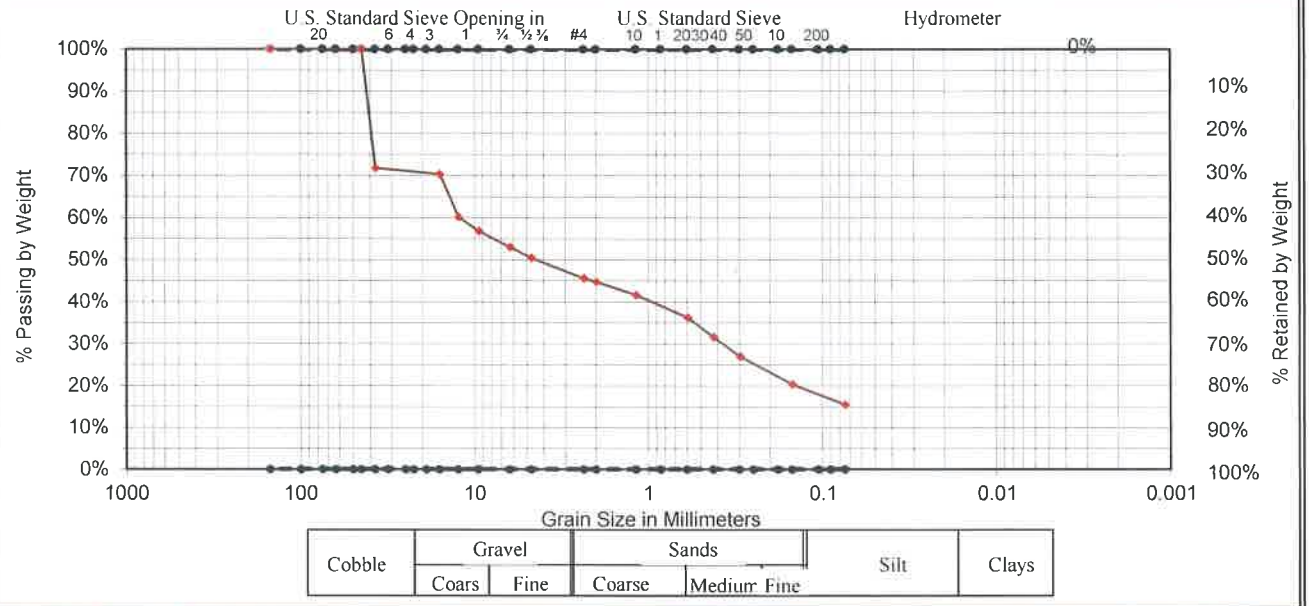
ASTM C-136 **Sieve Report** **ASTM D-4318**



Date :	1/24/2020	D_{10} = 0.05	**USCS Classification**	% Gravel	% Sand
Sample #:	20-014	D_{30} = 0.38	GM, Silty Gravel with Sand	49.5%	35.0%
Source:	TP #1 @ 1'	D_{60} = 12.31	**Specifications**	Color:	
Project #:	200004	C_C = 0.24	**No Specs**	10YR3/4 Yellowish brown	
Project:	Twin Transit Geo	C_U = 254.85	Sample Meets Specs	% Silt & Clay	
Client:	RB Engineering	Liquid Limit= n/a	n/a	15.5%	
Tested By:	AT	Plastic Limit= n/a	Fineness Modulus		
Date Tested:	1/27/2020	Plasticity Index= n/a	4.79		

Coarse Section		Actual Cumulative	Interpolated Cumulative		
Sieve Size US	Metric	Percent Passing	Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%		
4.00"	100.00		100%		
3.00"	75.00		100%		
2.50"	63.00		100%		
2.00"	50.00		100%		
1.75"	45.00	100%	100%		
1.50"	37.50	72%	72%		
1.25"	31.50		71%		
1.00"	25.00		71%		
7/8"	22.40		71%		
3/4"	19.00		71%		
5/8"	16.00	70%	70%		
1/2"	12.50	60%	60%		
3/8"	9.50	57%	57%		
1/4"	6.30	53%	53%		
#4	4.75	51%	51%		

Fines Section		Actual Cumulative	Interpolated Cumulative		
Sieve Size US	Metric	Percent Passing	Percent Passing	Specs Max	Specs Min
#4	4.750	51%	51%		
#8	2.360	46%	46%		
#10	2.000	45%	45%		
#16	1.180	42%	42%		
#20	0.850		39%		
#30	0.600	36%	36%		
#40	0.425	32%	32%		
#50	0.300	27%	27%		
#60	0.250		25%		
#80	0.180		22%		
#100	0.150	20%	20%		
#140	0.106		18%		
#170	0.090		16%		
#200	0.075	15.5%	15.5%		
#270	0.053				

Comments: Moisture content - 13.9%

Reviewed by: Tim Barney

Pacific Testing Inspection Inc.

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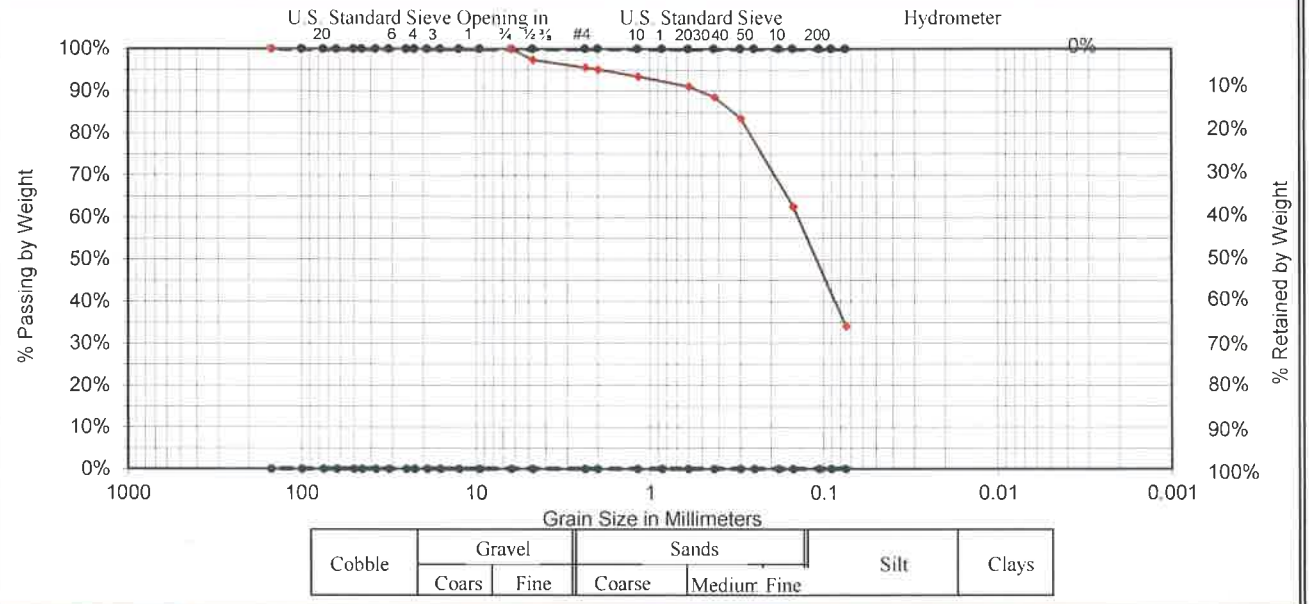
ASTM C-136 **Sieve Report** **ASTM D-4318**



Date:	1/24/2020	D_{10} = 0.02	**USCS Classification**	% Gravel	% Sand
Sample #:	20-015	D_{30} = 0.07	OL, Sandy Organic Silt	2.6%	63.3%
Source:	TP #1 @ 3'	D_{60} = 0.14	**Specifications**	Color:	
Project #:	200004	C_C = 1.38	No Specs	10YR4/4 Dark yellowish brown	
Project:	Twin Transit Geo	C_U = 6.52	Sample Meets Specs	% Silt & Clay	
Client:	RB Engineering	Liquid Limit= 0.0%	n/a	34.1%	
Tested By:	AT	Plastic Limit= 0.0%	Fineness Modulus		
Date Tested:	1/27/2020	Plasticity Index= 0.0%	0.76		

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%		
4.00"	100.00		100%		
3.00"	75.00		100%		
2.50"	63.00		100%		
2.00"	50.00		100%		
1.75"	45.00		100%		
1.50"	37.50		100%		
1.25"	31.50		100%		
1.00"	25.00		100%		
7/8"	22.40		100%		
3/4"	19.00		100%		
5/8"	16.00		100%		
1/2"	12.50		100%		
3/8"	9.50		100%		
1/4"	6.30	100%	100%		
#4	4.75	97%	97%		

Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	97%	97%		
#8	2.360	96%	96%		
#10	2.000	95%	95%		
#16	1.180	93%	93%		
#20	0.850		92%		
#30	0.600	91%	91%		
#40	0.425	89%	89%		
#50	0.300	84%	84%		
#60	0.250		77%		
#80	0.180		67%		
#100	0.150	63%	63%		
#140	0.106		46%		
#170	0.090		40%		
#200	0.075	34.1%	34.1%		
#270	0.053				

Comments: Moisture content - 24.5%

Reviewed by: Tim Barney

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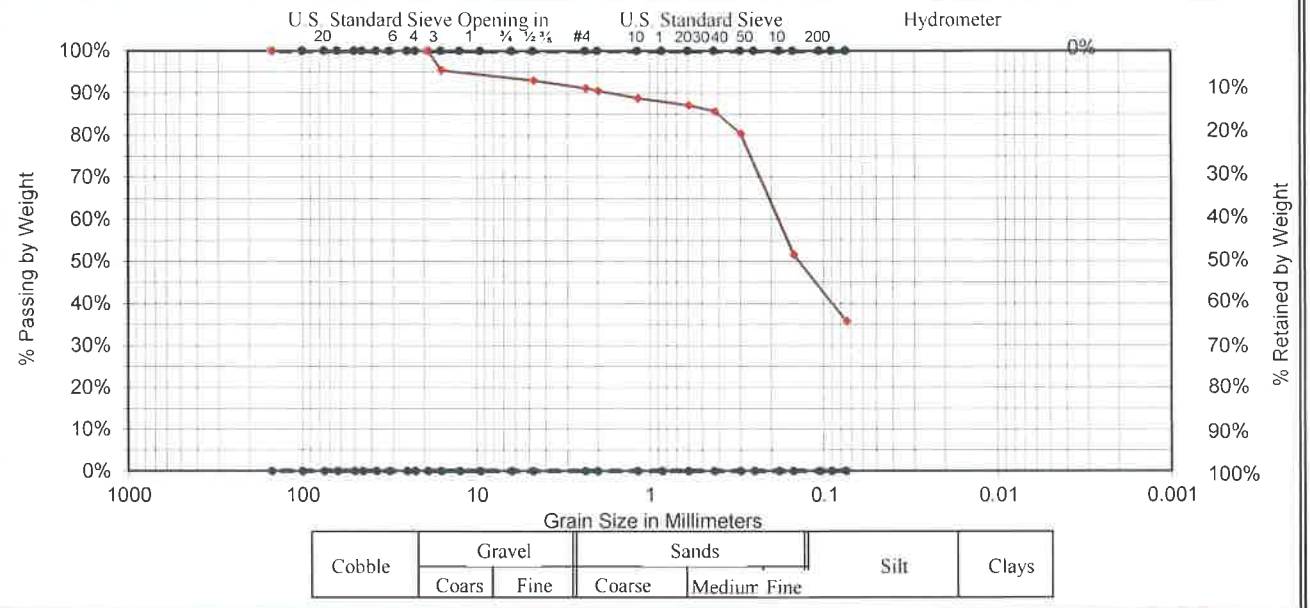
ASTM C-136 **Sieve Report** **ASTM D-4318**



Date:	1/24/2020	D_{10} = 0.02	**USCS Classification**	% Gravel	% Sand
Sample #:	20-016	D_{30} = 0.06	SM, Silty Sand	7.0%	57.2%
Source:	TP #3 @ 3'	D_{60} = 0.19	**Specifications**	Color:	
Project #:	200004	C_C = 0.97	No Specs	10YR4/2 Dark greyish brown	
Project:	Twin Transit Geo	C_U = 9.25	Sample Meets Specs	% Silt & Clay	
Client:	RB Engineering	Liquid Limit= 0.0%	n/a	35.8%	
Tested By:	AT	Plastic Limit= 0.0%	Fineness Modulus		
Date Tested:	1/27/2020	Plasticity Index= 0.0%	1.14		

Coarse Section		Actual Cumulative	Interpolated Cumulative		
Sieve Size US	Metric	Percent Passing	Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%		
4.00"	100.00		100%		
3.00"	75.00		100%		
2.50"	63.00		100%		
2.00"	50.00		100%		
1.75"	45.00		100%		
1.50"	37.50		100%		
1.25"	31.50		100%		
1.00"	25.00		100%		
7/8"	22.40		100%		
3/4"	19.00	100%	100%		
5/8"	16.00	95%	95%		
1/2"	12.50		95%		
3/8"	9.50		94%		
1/4"	6.30		93%		
#4	4.75	93%	93%		

Fines Section		Actual Cumulative	Interpolated Cumulative		
Sieve Size US	Metric	Percent Passing	Percent Passing	Specs Max	Specs Min
#4	4.750	93%	93%		
#8	2.360	91%	91%		
#10	2.000	91%	91%		
#16	1.180	89%	89%		
#20	0.850		88%		
#30	0.600	87%	87%		
#40	0.425	86%	86%		
#50	0.300	80%	80%		
#60	0.250		71%		
#80	0.180		57%		
#100	0.150	52%	52%		
#140	0.106		42%		
#170	0.090		39%		
#200	0.075	35.8%	35.8%		
#270	0.053				

Comments: Moisture content - 23.9%

Reviewed by: Tim Barney

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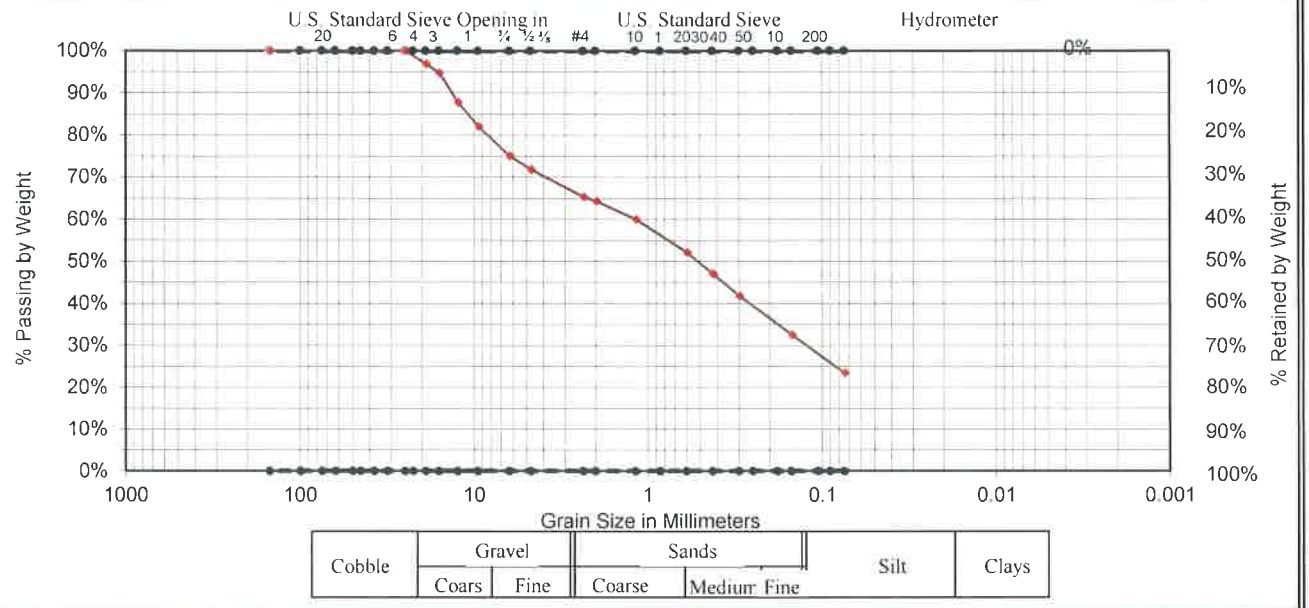
ASTM C-136 **Sieve Report** **ASTM D-4318**



Date : 1/24/2020	D_{10} = 0.03	**USCS Classification**	% Gravel	% Sand
Sample #: 20-017	D_{30} = 0.13	SM, Silty Sand with Gravel	28.1%	48.4%
Source: TP #4 @ 5'	D_{60} = 1.17	**Specifications**	Color:	
Project #: 200004	C_C = 0.44	No Specs	10YR2/1 Black	
Project: Twin Transit Geo	C_U = 36.66	Sample Meets Specs	% Silt & Clay	
Client: RB Engineering	Liquid Limit= 0.0%	n/a	23.4%	
Tested By: AT	Plastic Limit= 0.0%	Fineness Modulus		
Date Tested: 1/27/2020	Plasticity Index= 0.0%	2.97		

Coarse Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%		
4.00"	100.00		100%		
3.00"	75.00		100%		
2.50"	63.00		100%		
2.00"	50.00		100%		
1.75"	45.00		100%		
1.50"	37.50		100%		
1.25"	31.50		100%		
1.00"	25.00	100%	100%		
7/8"	22.40		99%		
3/4"	19.00	97%	97%		
5/8"	16.00	95%	95%		
1/2"	12.50	88%	88%		
3/8"	9.50	82%	82%		
1/4"	6.30	75%	75%		
#4	4.75	72%	72%		

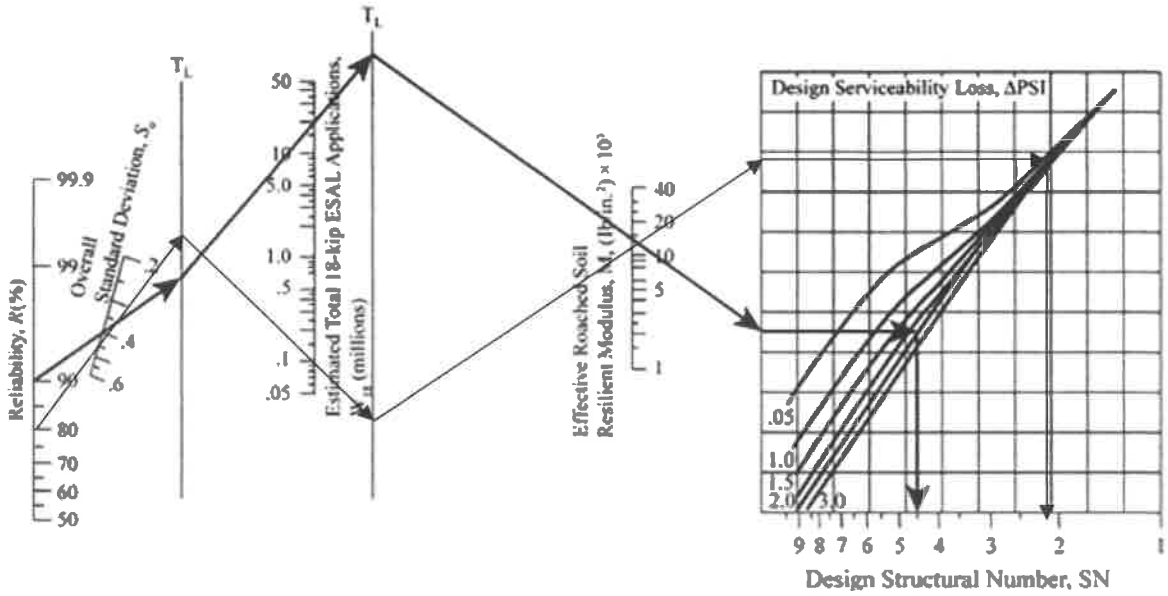
Fines Section Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.750	72%	72%		
#8	2.360	65%	65%		
#10	2.000	64%	64%		
#16	1.180	60%	60%		
#20	0.850		56%		
#30	0.600	52%	52%		
#40	0.425	47%	47%		
#50	0.300	42%	42%		
#60	0.250		39%		
#80	0.180		34%		
#100	0.150	33%	33%		
#140	0.106		27%		
#170	0.090		25%		
#200	0.075	23.4%	23.4%		
#270	0.053				

Comments: Moisture content - 20.1%

Reviewed by: Tim Barney

APPENDIX D

NOMOGRAPH


Reliability, R(%)
99.9
99
95
90
80
70
60
50
Overall Standard Deviation, S_o
.3
.4
.6
T_L
T_L
Estimated Total 18-kip ESAL Applications, W_{18} (millions)
50
10
5.0
1.0
.5
.1
.05
T_L
Effective Roached Soil Resilient Modulus, M_r (lb/in.^{2}) × 10^3
40
20
10
5
1
Design Serviceability Loss, ΔPSI
.05
1.0
1.5
2.0
3.0
9 8 7 6 5 4 3 2 1
Design Structural Number, SN