1.0 PURPOSE

This standard outlines the minimum requirements for soil surveys used in the design and assessment of highway embankments and pavements. The specific objectives are:

- To provide a standard for the collection of high quality information in a consistent manner for engineering tasks including pavement design, embankment design, borrow evaluation and assessment activities; and
- To provide standard reporting format for ease of use and storage of data.

2.0 SCOPE

This standard covers the methodology for Soil Survey programs conducted for highway embankment design and construction, and for pavement structural design or assessment. It includes the requirements for: coring pavements; drilling boreholes; collecting samples of soils and granular materials; identification of soils and granular materials in the field; laboratory testing; and preparing report including all observations, findings, test results and recommendations.

This standard does not cover investigations for more complex geotechnical problems and studies such as: failures of highway embankments and side slopes, groundwater related issues, and the design high embankments. Nor does this standard apply to geotechnical investigations for culverts (small or large), bridges, water control structures, drains, channels, etc., to soil surveys for airports and marine facilities or to investigate potential granular material and bedrock sources.

The standard outlines the department's minimum requirements for a number of soil survey types. The specific requirements of each project should be reviewed and confirmed with the engineer responsible for the analyses, designs, and/or assessments for which the soil survey information will be used. It is also important that those conducting the soil survey and testing inform the engineer of any unforeseen site, soil or pavement conditions and issues so that any required changes to the investigation and testing can be made.

Soil survey is a valuable investment when the information is accurate, contains well-defined location descriptions, and the information is easy to access and use. The Soil Survey Supervisor should recognize these needs and conduct their activities in a competent technical manner.

3.0 REFERENCE STANDARDS

ASTM Standards

C117 Test Method for Material Finer than 0.075 mm Sieve in Mineral Aggregates by Washing.
C136 Method for Sieve Analysis of Fine and Coarse Aggregates.
D421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.
D422 Method for Particle-Size Analysis of Soils.
D2216 Test Method for Laboratory Determination of Water Content of Soil and Rock.
D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures).
D4318 Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.
D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
D1883 Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.
D4546 Standard Test Methods for One-Dimensional Swell or Collapse of Soils.

AASHTO Standards

M145 The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
T267 Determination of Organic Content in Soils by Loss on Ignition

4.0 SOIL SURVEY METHODOLOGY

The activities under this Standard Practice consists of distinct phases as follows:

- Coring pavements, where applicable
- Borehole drilling
- Standard penetration test, where applicable
- Sampling of soils and pavement materials, as applicable

- Layer/material identification in the field
- Preparation of borehole logs
- Laboratory testing on representative samples
- Evaluation and analysis of field data and test results
- Reporting including geotechnical recommendations

4.1 Borehole Drilling

4.1.1 General Requirements

Core and Borehole Diameters

Core holes through the pavement layer shall be between 150 and 200 mm in diameter. Boreholes into the pavement base and subbase layers, subgrade and natural ground shall be 112 to 150 mm in diameter. On partial depth reconstruction and rehabilitation projects, additional cores of the pavement (100 mm in diameter) shall be drilled at random locations on pavement cracks throughout project area.

Spacing, Depth and Transverse Location

Borehole spacing, depth and transverse location shall meet the requirements as specified in Table 1. Regardless of soil survey type, three (3) boreholes shall be drilled, as a minimum, on each highway or road section of length less than 600 m e.g., where the total length of a highway/road section in a project is less then 600 m or a short section of highway/road has unique construction details than the rest of the project area.

Special considerations shall be given to intersections and roundabouts. The soil survey shall be planned to investigate possible differences in soil types, existing pavement structures and construction types (rehabilitation, reconstruction and new construction). It shall also consider both existing and new alignments in the vicinity of the intersection. For intersections including roundabouts, two (2) boreholes shall be drilled on each leg of the intersection (total 8 boreholes for an intersection with four legs) as a minimum.

Table 1: Borehole Spacing, Depth and Transverse Location- General Requirements

Survey Type	Maximum Spacing[1, 2,3]	Minimum Depth [4,5]	Transverse Location of Holes	Purpose
Preliminary Grade Survey	Refer to Section 4.1.2	Refer to Section 4.1.2	Refer to Section 4.1.2	To determine subsurface soil types, contents and conditions on a proposed new alignment. Information to be used to estimate sub-cut, topsoil and waste excavations, and to calculate shrinkage factors and provide preliminary designs.
Prairie Survey	200 m	1.50 m	Middle of new grade[7]	To determine soil types, contents and conditions along an existing roadway alignment for grade widening to add a new lane or widen the existing lane or shoulder. Information will be used for preliminary design, estimate topsoil excavation and shrinkage factors.
Borrow Pit Survey[6]	As Required	As Required	Site/pit specific	To determine soil types and contents, their suitability and shrinkage factors for embankment construction. Borrow survey applies to sources both within (including common excavation) and outside the right of way.
Final Grade Survey	200 m	1.50 m	Staggered on the middle of each lane	To determine subsurface soil types and contents in an existing or newly constructed grade with no subbase, base and/or surface layers in place. To be used to provide intermediate/final pavement design.
Existing Pavement-Full Depth Survey	200 m	2.50 m	Outer wheel path of each lane, staggered on adjacent lanes[7]	To determine pavement layer thicknesses, layer materials types and subsurface soil types and contents. To be used to provide pavement design for full depth pavement reconstruction with removal of existing surface, base and subbase layers.
Existing Pavement-Partial Depth Survey	200 m	1.80 m	Outer wheel path of each lane, staggered on adjacent lanes[7]	To determine pavement layer thicknesses, layer materials types and subsurface soil types and contents. To be used to provide pavement design for partial depth pavement reconstruction with mill and relay of chip seal (AST), pulverize and relay of bituminous, full depth reclamation of bituminous, rubblization of concrete, etc. and pavement rehabilitation with new chip seal, bituminous overlay, mill and overlay, cold in-place recycle and overlay, etc..

Existing Pavement-Shoulder Survey	400 m	1.5 m	Middle of each shoulder[8]	To determine layer thicknesses, layer materials types and subsurface soil types and contents. To be used for selecting the shoulder treatment types and the required base for shoulder paving or repaving.
Bedrock and Peat Survey	Refer to Sections 4.1.3 and 4.1.4	Refer to Sections 4.1.3 and 4.1.4	Project specific	To investigate overburden soils, define the bedrock surface topography, and determine the thickness and distribution of peat soils (i.e., muskeg, bogs and swamps).
Special Survey	As Required	As Required	Project specific	To investigate localized pavement failures, depths and types of base and subbase courses, frost heave or swelling issues, subgrade moisture issues, feasibility of subgrade stabilization, etc.

[1] Additional boreholes at closer spacing shall be drilled if significant variations in subsurface conditions (such as changes in layer thickness, soil types or consistency, presence of swamp areas, springs or high water table, etc.) are encountered between two adjacent boreholes to identify the location and extent of the change in conditions.

[2] The borehole pattern and depth shall be revised where there is evidence of changes in subsurface conditions such as at ridges, ravines, sloughs, creeks, etc.

[3] For a short section or small study area, the minimum number of boreholes shall be as per the requirements outlined in this Standard or as specified in the project Request for Quotation (RFQ), Request for Proposal (RFP) or Terms of Reference (TOR).

[4] Unless otherwise instructed, boreholes should be terminated where bedrock is encountered above the specified minimum depth. A ground survey to investigate bedrock topography may be required.

[5] When unsuitable soil or material (e.g., organics, peat, soft/wet soils or silt) is encountered at the bottom of the nominal bore depth, the borehole shall be drilled to a depth of 1.5 m (minimum) below the layer of unsuitable soil or material.

[6] The spacing and number of boreholes to investigate potential embankment fill material shall be determined on a project specific basis. In general, about five (5) boreholes should be drilled for every hectare of borrow area. All bore holes shall be drilled to the potential depth of the borrow pit excavation.

[7] Boreholes shall be spread out onto adjacent lanes of the existing alignment or onto the proposed prairie grade of the existing alignment, as applicable to the project.

[8] The longitudinal location of each shoulder borehole shall closely match with the adjacent borehole on the main lane. The transverse locations shall be in the middle of the shoulder.

4.1.2 Borehole Coverage for Preliminary Grade- Nominal Requirements

One borehole shall be drilled every 100 m longitudinally with the location of successive borehole staggered laterally from each borehole up and down chainage in the following manner:

- First borehole at 15 m left of centerline,
- Second borehole at 100 m longitudinally up chainage from the first bore hole and on centerline,
- Third borehole at 100 m longitudinally up chainage from the second borehole and 15 m right of centerline,
- Fourth borehole at 100 m longitudinally up chainage from the third borehole and on centerline, and
- Repeat above sequence for the remaining bore holes at 100 m longitudinal spacing.

The nominal depth of each borehole shall be 1.5 m below existing ground in fill areas.

In cut areas, the borehole depth shall extend a minimum of 2.0 m below the design top of subgrade.

4.1.3 Borehole Coverage in Areas of Bedrock

Ground surveys in areas of shallow or exposed bedrock shall be conducted with the objective of obtaining representative models of the bedrock surface topography. This information is critical for the planning of vertical road profiles and for accurately estimating volumes of costly bedrock excavation on projects in bedrock terrain. In some cases, investigations of bedrock topography can be effectively conducted using an excavator or backhoe to supplement the borehole drilling.

Soil surveys in areas of bedrock should be considered supplemental to the ground surveys for these projects. Ground surveys must accurately and completely record all locations of exposed bedrock to eliminate ambiguity between areas where bedrock is, and is not, exposed.

The following standard methodology may need be supplemented with additional boreholes where needed to obtain overburden thicknesses at a sufficient number of points to define the bedrock surface in sufficient detail:

- The borehole locations and frequency set out in *Section 4.1.2* above (i.e., 100 m longitudinal intervals) shall be followed until the first borehole encounters bedrock at a depth shallower than the specified borehole depth. This location is called the *Initial Rock Chainage*. The following pattern of borehole locations shall be followed in areas of shallow and exposed bedrock:

- At the Initial Rock Chainage, a set of three boreholes shall be drilled (centerline, and 15 m left and 15 m right of centerline).
- Sets of supplemental boreholes shall be drilled at 25 m longitudinal intervals both up and down chainage from the Initial Rock Chainage until bedrock is not encountered in any of the three boreholes at depths shallower than the specified borehole depth.
- Where bedrock is visibly exposed at the surface, topographic survey shots (recorded as bedrock surface) shall be taken at a sufficient density to accurately define the bedrock surface.

- Where bedrock is no longer encountered at depths shallower than the specified depth, the borehole locations and frequency set out in section 4.1.2 shall be followed (i.e., 100 m longitudinal intervals).

4.1.4 Borehole Coverage in Areas of Peat Soils

The borehole pattern outlined in Section 4.1.2 “Borehole Coverage for Preliminary Grade- Nominal Requirements” shall be used in areas containing muskeg.

The limits of peat soils (i.e., limits of peat bogs) shall be accurately delimited in the site topographic survey.

Boreholes shall be drilled to a depth of 1.5 m (minimum) below the bottom of the peat. The drilling may need to be extended deeper to investigate any soft/compressible soils beneath the peat, as directed by the Geotechnical Engineer.

It may be necessary to extend test holes into soft compressible weak soils (such as soft wet clay or silt) present below the peat. If such conditions are encountered, the site conditions should be reviewed with the project Geotechnical and Pavement Engineers to determine the test drilling and sampling requirements for the project.

4.1.5 Extent and Quantity of Unsuitable and Suitable Soils

Based on the soil survey and highway design alignment/profile, quantify potentially unsuitable (topsoil, organics, peat, soft/compressible soils or silt) soils, which can not be used for embankment construction. The quantification shall include the layer thickness, depth and extent of unsuitable soils in existing embankments and proposed alignments, as applicable.

Estimate the quantity of suitable soils that will be available from common excavation within the project for embankment construction and the required quantity of offsite borrow materials.

4.2 Sampling

A minimum of three representative samples from each granular material type (e.g., Granular A, Granular C, granular fill, GBC-I, GBC-M, GSB-C) shall be collected for laboratory testing (where applicable) from a highway/road section of ≥5.0 km in length. A minimum of two representative samples shall be collected for each material type from a section of ≥2.0 to <5.0 km in length. A minimum of one representative sample shall be collected for each material type from a section of <2.0 km in length. Additional samples shall be required where the existing granular material or aggregate (e.g., gravel, limestone, granite) type change within the project area or between sample locations. Each sample of granular material shall be large enough to conduct all the required tests. In situations where it will be difficult to collect enough quantity of material (e.g. with auger drill), a sampling and pavement structure restoration plan shall be developed.

A minimum of one (1) subgrade soil sample shall be obtained from each test hole. In addition, a sample shall be obtained for each change in soil layer encountered including changes soil type, consistency, colour or moisture content. No sample is required for topsoil. Each soil sample material shall be a minimum one kilogram (1.0 kg). A larger quantity of materials from various representative soils shall be collected to determine the maximum dry density (MDD), optimum moisture content (OMC) and soaked California Bearing Ratio (CBR) values at the specified frequency and/or based on the specified number of tests (refer to Section 4.5). Additional borehole(s) adjacent to a planned borehole location shall be drilled, if required, to collect the required quantity of materials for laboratory testing, especially for the MDD/OMC and CBR tests.

Samples shall also be obtained from all organic layers including peat. When an organic layer is thicker than 0.60 m, a sample shall be obtained at least every 0.60 m depth interval.

Additional boreholes used only to confirm the extent of rock, depth to bedrock or depth of peat do not necessarily need to be sampled. However, samples shall be obtained where changes in soil type, contents or other conditions warrant.

Any variation of soils in shoulders from the main lanes shall be recorded. Representative samples of the varying soils shall be collected and tested in the laboratory.

Each sample shall be double bagged to ensure no loss in moisture and sample tag with sample identification information shall be placed between two bags. Each sample tag shall contain the following information:

- Highway number, identification of borrow pit,
- Control section (C.S.) number or borrow pit location,
- Borehole number,
- Chainage or station

- Field Sample Number, and
- Depth (from……..m to……m)

Each sample bag shall be marked with a brief identification (e.g. C.S. number, borehole number and depth). Samples that appear to contain excessive moisture contents shall be flagged, with orange survey ribbon, for immediate determination of moisture in the laboratory.

4.3 Material and Layer Identification in the Field

The Soil Survey Supervisor shall record the layer material type, consistency and condition on the Standard Template for *Soil Survey Field Log (Borehole Log)* as shown in Appendix A (the template i.e. Form is available online at department's website). Additional notes shall be added to the log to indicate anomalies (coring through pavement crack, crack type, crack widths and progression, stripping, layer delamination, topography changes, etc.).

Soil identification shall be performed in accordance with *ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* and recorded on the Standard Template for *Soil Survey Field Log (Borehole Log),* which include the following:

- Soil visual classification
- Appearance/colour
- Layer density/consistency (hard, stiff, soft, etc.)
- Soil moisture condition (dry, damp, wet, etc.)
- Soil contents (organics, cobbles, rock, etc.)

4.4 Preparation of Borehole Log

The following information shall be logged with applicable description on the department's Standard Template for *Soil Survey Field Log* (Borehole Log) as shown in Appendix A:

- Borehole identification number
- Lane
- Distance (km) from start of Control Section and project chainage, if available
- Centreline offset (m)
- UTM coordinates. A handheld GPS unit may be used for locations on existing pavements. All boreholes not drilled on existing roads, such as boreholes for preliminary grade and prairie surveys, the locations shall be obtained with a survey grade equipment and shall include ground elevations. The field logs shall be accompanied by the UTM coordinates of the borehole and core locations in shape files (ArcGIS) and a KML file (Google).

- Each layer depth (m)
- Each layer thickness (m)
- Field sample number
- Layer material or soil description

When coring through pavement cracks, measurements of the crack width shall be taken at the top, middle and bottom of each surface layer from the extracted cores and recorded.

Pavement surface, base and subbase depths shall be reported to the nearest 0.001 m, 0.01 m and 0.01 m, respectively. The soil layer depths shall be recorded to the nearest 0.10 m.

4.5 Laboratory Testing Requirements

Unless specified otherwise in the project Request For Proposal (RFP), Request For Quotation (RFQ) or Terms of Reference (TOR), soil samples collected from boreholes shall be tested in the laboratory for the properties and classifications listed in Table 2. Ensure that a sufficient number of representative samples are selected for each laboratory testing. No testing is required for topsoil.

Table 2: Required Laboratory Testing and Classification of Soils

Property	Test Standard/ Method	Frequency
Grain size distribution (sieve and hydrometer analysis)	ASTM C136/ ASTM C117/ASTM D421/ ASTM D 422	At least 30% of representative soil samples from all soil samples collected from boreholes
Atterberg limits	ASTM D4318	On the same soil samples that are selected for grain size distribution test
AASHTO soil classification	AASTHO M145	Based on grain size distribution and Atterberg limits
ASTM (Unified) soil classification	ASTM D2487	Based on grain size distribution and Atterberg limits
Moisture content [1]	ASTM D2216	On the same soil samples that are selected for grain size distribution test
Organic content	AASHTO T267	At least 30% of representative soil samples from those selected for grain size distribution test (i.e., approximately 10% of all soil samples collected from

		boreholes), whether a soil layer contains visible organics or not
MDD and OMC	ASTM D698	As specified in the RFP, RFQ or TOR[2]. Each test for the MDD/OMC shall be accompanied by grain size distribution, Atterberg limits, soil classifications, in-situ moisture content and organic content.
Soaked CBR at OMC and 95% of the MDD	ASTM D1883	On the same soil samples that are selected for MDD/OMC test.
Swell	ASTM D4546	As specified in the RFP, RFQ or TOR[2]. On the same soil samples that are selected for MDD/OMC test.

[1] Test shall be conducted during the sampling or as soon as the samples are delivered to the laboratory, preferably within 48 hours of sampling.

[2] In addition to the requirements specified in the RFP, RFQ or TOR, the service provider shall assess the number and frequency of testing based on the site and soil conditions to meet the project requirements.

Each representative sample of granular material (base and subbase) shall be tested for the properties and classification/type listed in Table 3. Unless otherwise specified in the project RFP, RFQ or TOR, the frequency or number of these samples shall be as specified in this Standard.

Table 3: Required Laboratory Testing of Base and Subbase Materials

Property	Test Standard/Method
Gradation	ASTM C136/ASTM C117
Plasticity	ASTM D4318
Moisture content [1]	ASTM D2216
Classification/Type	Material Specification for Aggregate- Granular Course: Department's Specs. 901(I)/ 900
MDD and OMC	ASTM D698
Soaked CBR at OMC and 98% of the MDD	ASTM D1883

[1] Test shall be conducted during the sampling or as soon as the samples are delivered to the laboratory, preferably within 24 hours of sampling.

4.6 Report

The borehole log and results of laboratory tests shall be presented in the *Standard Soil Survey Summary Report* and submitted in digital (pdf and MS Excel) formats, as shown in Appendices B1 and B2. The template (Form) is available online at department's website. Other test results can be presented in separate table(s) or added to Table shown in Appendix B. Details of the soil survey, site inspection, general site, road and pavement conditions, elevation/profile data, field and laboratory assessment, testing and analysis, and geotechnical recommendations shall also be included in the soil survey report.

Appendix A: Standard Template for Soil Survey Field Log (Borehole Log)

MANITOBA TRANSPORTATION AND INFRASTRUCTURE

ENGINEERING SERVICES

Manitoba

SOIL SURVEY FIELD LOG (BOREHOLE LOG)

Client/Region:	Capital	**From (Survey Start):**	PR…	**Survey Purpose:**	Pavement Rehabilitation
Hwy/Sub-Div. No.:	PTH 1	**To (Survey End):**	PTH…	**Driller's Name:**	M. Scharnik
Control Section No.:	01001xxxHA	**Survey Location/Type:**	Existing Pavement	**Supervisor's Name:**	J. Halldorson
Project No.:	C 2038	**UTM Coordinates Recorded (Yes/No):**	Yes	**Survey Date:**	June 11, 2020

Borehole No.	Lane	C.S. Km/ Chainage/	C/L Offset (m)	Layer Depth		Layer Thickness (m)	Field Sample No.	Layer Material or Soil Descriptions
				From (m)	To (m)			
1	WBTL	0.20	2.9R	0.000	0.125	0.125	FS-001	Bituminous layer, soft, severe moisture damage; transverse crack
1	WBTL	0.20	2.9R	0.125	0.425	0.300	FS-002	Granular A base, limestone, moist
1	WBTL	0.20	2.9R	0.425	0.600	0.175	FS-003	Gray clay with trace silt and sand, very soft, wet, some organics
1	WBTL	0.20	2.9R	0.600	1.100	0.500	FS-004	Brown silty clay with trace sand and gravel, soft, wet, trace organics
1	WBTL	0.20	2.9R	1.100	1.900	0.800	FS-005	Brown clay with trace silt, sand and gravel, stiff, moist
1	WBTL	0.20	2.9R	1.900	2.500	0.600	FS-006	Brown silt and sand with trace gravel, stiff
2	WBPL	0.40	2.9L	0.000	0.125	0.125	FS-007	Bituminous layer, soft, severe moisture damage; transverse crack
2	WBPL	0.40	2.9L	0.125	0.425	0.300	FS-008	Granular A base, limestone, moist
2	WBPL	0.40	2.9L	0.425	0.600	0.175	FS-009	Gray clay with trace silt and sand, very soft, wet, some organics
2	WBPL	0.40	2.9L	0.600	1.100	0.500	FS-010	Brown silty clay with trace sand and gravel, soft, wet, trace organics
2	WBPL	0.40	2.9L	1.100	1.900	0.800	FS-011	Brown clay with trace silt, sand and gravel, stiff, moist
2	WBPL	0.40	2.9L	1.900	2.500	0.600	FS-012	Brown silt and sand with trace gravel, stiff
3	WBTL	0.60	2.9R	0.000	0.125	0.125	FS-013	Bituminous layer, soft, severe moisture damage; transverse crack
3	WBTL	0.60	2.9R	0.125	0.425	0.300	FS-014	Granular A base, limestone, moist
3	WBTL	0.60	2.9R	0.425	0.600	0.175	FS-015	Gray clay with trace silt and sand, very soft, wet, some organics
3	WBTL	0.60	2.9R	0.600	1.100	0.500	FS-016	Brown silty clay with trace sand and gravel, soft, wet, trace organics
3	WBTL	0.60	2.9R	1.100	1.900	0.800	FS-017	Brown clay with trace silt, sand and gravel, stiff, moist
3	WBTL	0.60	2.9R	1.900	2.500	0.600	FS-018	Brown silt and sand with trace gravel, stiff
4	WBPL	0.80	2.9L	0.000	0.125	0.125	FS-019	Bituminous layer, soft, severe moisture damage; transverse crack
4	WBPL	0.80	2.9L	0.125	0.425	0.300	FS-020	Granular A base, limestone, moist
4	WBPL	0.80	2.9L	0.425	0.600	0.175	FS-021	Gray clay with trace silt and sand, very soft, wet, some organics
4	WBPL	0.80	2.9L	0.600	1.100	0.500	FS-022	Brown silty clay with trace sand and gravel, soft, wet, trace organics
4	WBPL	0.80	2.9L	1.100	1.900	0.800	FS-023	Brown clay with trace silt, sand and gravel, stiff, moist
4	WBPL	0.80	2.9L	1.900	2.500	0.600	FS-024	Brown silt and sand with trace gravel, stiff
5	WBTL	1.00	2.9R	0.000	0.125	0.125	FS-025	Bituminous layer, soft, severe moisture damage; transverse crack
5	WBTL	1.00	2.9R	0.125	0.425	0.300	FS-026	Granular A base, limestone, moist
5	WBTL	1.00	2.9R	0.425	0.600	0.175	FS-027	Gray clay with trace silt and sand, very soft, wet, some organics
5	WBTL	1.00	2.9R	0.600	1.100	0.500	FS-028	Brown silty clay with trace sand and gravel, soft, wet, trace organics
5	WBTL	1.00	2.9R	1.100	2.500	1.400	FS-029	Brown clay with trace silt, sand and gravel, stiff, moist

General Description of Site and Road Conditions:

Appendix B1: Standard Soil Summary Survey Report (Cover Page)

MANITOBA TRANSPORTATION AND INFRASTRUCTURE

ENGINEERING SERVICES

SOIL SURVEY SUMMARY REPORT

Field Book No.:	G2020-001		
Client/Region:	Capital	**From:**	PR…
Highway/Subdiv. No.:	PTH 1	**To:**	PTH…
Control Section:	01001xxxHA	**Survey Location/Type:**	Existing Pavement
Project No.:	C 2038	**Survey Purpose:**	Pavement Rehabilitation
Soil Survey No.:	SS2020-001	**Driller's Name:**	M. Scharnik
Internal Order No.:	1232456789	**Supervisor's Name:**	J. Halldorson
Contract No.:	SS2020-P001	**Dated Sampled:**	June 11, 2020

Field Book Notes:

Appendix B2: Standard Soil Summary Survey Report (Survey and Testing Data Sheet)

MANITOBA TRANSPORTATION AND INFRASTRUCTURE
ENGINEERING SERVICES

SOIL SURVEY SUMMARY REPORT (Survey and Testing Data Sheet)

Field Book No.:	G2020-001	From:	PR…	Report To:	Note:
Client/Region:	Capital	To:	PTH…	Date Requisitioned:	Particle Size Analysis is Based on Passing 75 mm Material
Highway/Sub-div. No.:	PTH 1	Contract No.:	SS2020-P001	Date Reported:	
Control Section:	01001xxxHA	Survey Location/Type:	Existing Pavement	Tested By:	Oversize (Ret. on 75mm) Particles (%):
Project No.:	C 2038	Survey Purpose:	Pavement Rehabilitation	Reviewed By:	
Soil Survey No.:	SS2020-001	Supervisor's Name:	J. Halldorson		
Internal Order No.:	1232456789	Date Sampled:	June 11, 2020	Is Files With UTM Coordinates Available (Yes/No)?: Yes	Sheet No.: 1 of 4

Required Additional Information and Tests for Geotechnical Investigation Projects

Sample Data									Particle Size Analysis of Minus 75mm Material, % Passing or Smaller										Soil Index Properties and Classification							Other Physical Properties					Reactivity, Strength and Conductivity Parameters									
Borehole No.	Lane	C.S. km/ Station	Centerline Offset (m)	From Depth (m)	To Depth (m)	Layer Thickness (m)	Field Sample No.	Field Description	Lab. Sample Number	19.0mm	9.5mm	4.75mm	2.00mm	0.425mm	0.180mm	0.075mm	0.05mm	0.02mm	0.005mm	0.002mm	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	AASHTO Group Index	AASHTO Class	Unified (ASTM) Class	Soil Class Description as per Unified System	Moisture Content (%)	Frost Susceptibility Class	Organic Content (%)	Maximum Density (kg/m^3)	Optimum Moisture (%)	Reactivity with HCl *	Field SPT (N)	Field PP (kpa)	Field Torvane Value (kpa)	Unconfined qu (kpa)	Bulk Dry Density (kg/cu.m	Direct Shear Performed	Consolidation Performed	Permeability Performed
1	WBTL	0.20	2.9R	0.000	0.125	0.125	FS-001	Bituminous layer, soft, severe moisture damage; transverse crack	WGT185534																														
1	WBTL	0.20	2.9R	0.125	0.425	0.300	FS-002	Granular A base, limestone, moist	WGT185535																																
1	WBTL	0.20	2.9R	0.425	0.600	0.175	FS-003	Gray clay with trace silt and sand, very soft, wet, some organics	WGT185536																																
1	WBTL	0.20	2.9R	0.600	1.100	0.500	FS-004	Brown silty clay with trace sand and gravel, soft, wet, trace organic	WGT185537																																
1	WBTL	0.20	2.9R	1.100	1.900	0.800	FS-005	Brown clay with trace silt, sand and gravel, stiff, moist	WGT185538																																
1	WBTL	0.20	2.9R	1.900	2.500	0.600	FS-006	Brown silt and sand with trace gravel, stiff	WGT185539																																
2	WBPL	0.40	2.9L	0.000	0.125	0.125	FS-007	Bituminous layer, soft, severe moisture damage; transverse crack	WGT185540																																
2	WBPL	0.40	2.9L	0.125	0.425	0.300	FS-008	Granular A base, limestone, moist	WGT185541																																
2	WBPL	0.40	2.9L	0.425	0.600	0.175	FS-009	Gray clay with trace silt and sand, very soft, wet, some organics	WGT185542																																
2	WBPL	0.40	2.9L	0.600	1.100	0.500	FS-010	Brown silty clay with trace sand and gravel, soft, wet, trace organic	WGT185543																																
2	WBPL	0.40	2.9L	1.100	1.900	0.800	FS-011	Brown clay with trace silt, sand and gravel, stiff, moist	WGT185544																																
2	WBPL	0.40	2.9L	1.900	2.500	0.600	FS-012	Brown silt and sand with trace gravel, stiff	WGT185545																																
3	WBTL	0.60	2.9R	0.000	0.125	0.125	FS-013	Bituminous layer, soft, severe moisture damage; transverse crack	WGT185546																																
3	WBTL	0.60	2.9R	0.125	0.425	0.300	FS-014	Granular A base, limestone, moist	WGT185547																																
3	WBTL	0.60	2.9R	0.425	0.600	0.175	FS-015	Gray clay with trace silt and sand, very soft, wet, some organics	WGT185548																																
3	WBTL	0.60	2.9R	0.600	1.100	0.500	FS-016	Brown silty clay with trace sand and gravel, soft, wet, trace organic	WGT185549																																
3	WBTL	0.60	2.9R	1.100	1.900	0.800	FS-017	Brown clay with trace silt, sand and gravel, stiff, moist	WGT185550																																
3	WBTL	0.60	2.9R	1.900	2.500	0.600	FS-018	Brown silt and sand with trace gravel, stiff	WGT185551																																
4	WBPL	0.80	2.9L	0.000	0.125	0.125	FS-019	Bituminous layer, soft, severe moisture damage; transverse crack	WGT185552																																
4	WBPL	0.80	2.9L	0.125	0.425	0.300	FS-020	Granular A base, limestone, moist	WGT185553																																
4	WBPL	0.80	2.9L	0.425	0.600	0.175	FS-021	Gray clay with trace silt and sand, very soft, wet, some organics	WGT185554																																
4	WBPL	0.80	2.9L	0.600	1.100	0.500	FS-022	Brown silty clay with trace sand and gravel, soft, wet, trace organic	WGT185555																																
4	WBPL	0.80	2.9L	1.100	1.900	0.800	FS-023	Brown clay with trace silt, sand and gravel, stiff, moist	WGT185556																																
4	WBPL	0.80	2.9L	1.900	2.500	0.600	FS-024	Brown silt and sand with trace gravel, stiff	WGT185557																																
5	WBTL	1.00	2.9R	0.000	0.125	0.125	FS-025	Bituminous layer, soft, severe moisture damage; transverse crack	WGT185558																																
5	WBTL	1.00	2.9R	0.125	0.425	0.300	FS-026	Granular A base, limestone, moist	WGT185559																																
5	WBTL	1.00	2.9R	0.425	0.600	0.175	FS-027	Gray clay with trace silt and sand, very soft, wet, some organics	WGT185560																																
5	WBTL	1.00	2.9R	0.600	1.100	0.500	FS-028	Brown silty clay with trace sand and gravel, soft, wet, trace organic	WGT185561																																
5	WBTL	1.00	2.9R	1.100	2.500	1.400	FS-029	Brown clay with trace silt, sand and gravel, stiff, moist	WGT185562																																

Field Book information is represented by the shaded area NS - Not Sampled NT - Not Tested (Not Applicable)