DEPARTMENT OF TRANSPORTATION

Modulus and Dynamic Cone Penetrometer Data Collection for Full-Depth Reclamation Projects

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This field study involved falling-weight deflectometer (FWD) and dynamic cone penetrometer (DCP) testing on Minnesota roads using full-depth reclamation (FDR) base layers. The study also included basic backcalculation analysis of collected FWD data using TONN2010. This initial analysis found that FDR layers had an average stiffness, or elastic modulus, of 53.8 ksi and an average DCP Index of 2.81 mm/blow. The report presented these values alongside average DCP indices by location with limited analysis (more advanced analysis being beyond this field study). A more research-oriented review of the FWD and DCP data collected will be required to further verify layer thicknesses and compositions. The results of that review will enable MnDOT to better evaluate the use of DCP indices and the characterization of FDR-composed sublayers in MnPAVE-Flexible.

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MODULUS AND DYNAMIC CONE PENETROMETER DATA COLLECTION FOR FULL-DEPTH RECLAMATION PROJECTS

FINAL REPORT

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The Minnesota Department of Transportation (MnDOT) Office of Materials and Road Research (OMRR) created and maintains the MnPAVE-Flexible (MPF) software for the design of asphalt pavements in Minnesota. MPF relies on sophisticated mechanistic-empirical (M-E) structural models and detailed design parameters to estimate the long-term performance of an asphalt pavement structure. As materials that are used for paving projects change over time, there exists a need to update MnDOT's characterization of these materials for the sake of MPF.

One class of materials that has become increasingly popular in the past few decades is reclaimed materials that result from full-depth reclamation (FDR) paving projects. These materials are composed of a blend of recycled asphalt pavement (i.e., the in-place pavement to be replaced with a new asphalt pavement) and in-place granular base materials (i.e., the base layer under the in-place pavements). Because the composition of reclaimed base materials can vary widely, the resulting field performance of these materials may vary.

To evaluate MPF's treatment of FDR sublayers and assess possible changes to MPF, MnDOT commissioned this field study to perform falling-weight deflectometer (FWD) and dynamic cone penetrometer (DCP) testing on locations using FDR base layers in Minnesota. Engineers in MnDOT OMRR selected field locations of interest. Field tests were performed during fall 2018 and summer 2019. All test data were organized by site and uploaded to the MnDOT Managed File Transfer (MFT) Server for review by MnDOT and possible incorporation into future research involving MPF.

In addition, the project performed basic backcalculation analysis of collected FWD data using TONN2010. This initial analysis found that FDR layers had an average stiffness, or elastic modulus, of 53.8 ksi and an average DCP Index of 2.81 mm/blow. This report presented these values alongside average DCP indices by location with limited analysis (more advanced analysis being beyond this field study).

A more research-oriented review of the FWD and DCP data collected is required to further verify layer thicknesses and compositions. The results of that review will enable MnDOT to better evaluate the use of DCP indices and the characterization of FDR-composed sublayers in MnPAVE-Flexible.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

The Minnesota Department of Transportation (MnDOT) Office of Materials and Road Research (OMRR) created and maintains the MnPAVE-Flexible (MPF) software for the design of asphalt pavements in Minnesota (MnDOT, 2019). MPF relies on sophisticated mechanistic-empirical (M-E) structural models and detailed design parameters to estimate the long-term performance of an asphalt pavement structure. As materials that are used for paving projects change over time, there exists a need to update MnDOT's characterization of these materials for the sake of MPF.

One class of materials that has become increasingly popular in the past few decades is reclaimed materials that result from full-depth reclamation (FDR) paving projects. These materials are composed of a blend of recycled asphalt pavement (i.e., the in-place pavement to be replaced with a new asphalt pavement) and in-place granular base materials (i.e., the base layer under the in-place pavements). Because the composition of reclaimed base materials can vary widely, the resulting field performance of these materials may vary.

To evaluate MPF's treatment of FDR sublayers and assess possible changes to MPF, MnDOT requires field data to consider *in-situ* behavior alongside MPF and its M-E models. One such area of study is evaluating the methods that MPF uses to characterize sublayer properties. These methods include the use of dynamic cone penetrometer (DCP) data (Figure 1), which is the focus of this experimental field study.

1.2 SCOPE AND OBJECTIVES

The main work objective was to provide MnDOT with a database of falling-weight deflectometer (FWD) and dynamic cone penetrometer (DCP) test data for as many FDR locations in Minnesota as feasible under project scheduling and resource limitations. This database was achieved according to the following items in the project work scope.

- Identify field projects involving FDR that can provide useful FWD and DCP data and/or field samples for OMRR laboratory moisture content/gradation tests
- Conduct field tests and collect field samples using a combination of FWD, DCP, and hand auguring
- Analyze data to determine backcalculated layer stiffnesses (i.e., elastic moduli) and average DCP penetration index values (in mm/blow) from different FDR projects across Minnesota
- Produce a report summarizing the project activities

The project team's understanding is that the ultimate objective of MnDOT OMRR – which lies beyond the scope of this project – is a review of MPF use of DCP to characterize FDR sublayers using the DCP and FWD data collected during this project.

1.3 OVERVIEW OF REPORT

This report provides general information on project locations, an overview of the tests performed, a summary of the test results, and observations on the study to assist MnDOT in future work. Appendices to the report include TONN2010 report sheets (from backcalculation analysis) and DCP report sheets by location and test site within each location. All electronic data (including raw FWD basins and scans of field DCP test forms) have been uploaded to MnDOT repositories for review and use in future studies.

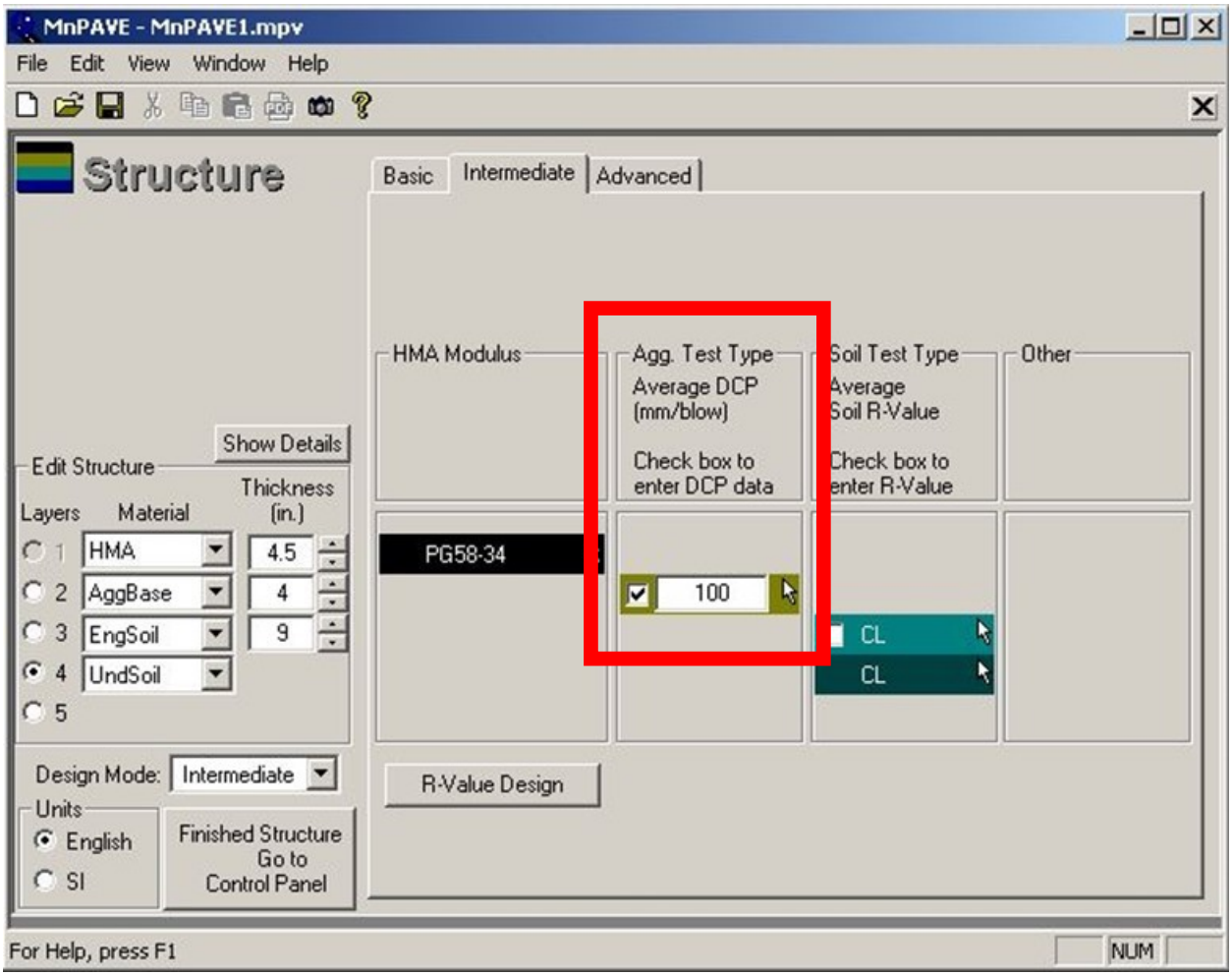

Figure 1. Characterizing sublayers in MPF with average DCP index

CHAPTER 2: TEST LOCATIONS

2.1 TEST LOCATION RESOURCES AND SELECTION CRITERIA

Resources available to the team included summaries of known FDR sections developed by MnDOT Grading and Base engineers. The project team used these summaries to explore MnDOT eDigs Online for construction and design plans and verify the presence of an FDR base layer.

Initially, locations were prioritized by known information (i.e., sections with more comprehensive records were prioritized over those whose records were incomplete). Later reviews and discussions with MnDOT OMRR engineers addressed the need for extensive traffic control on more heavily trafficked roads. To improve field safety conditions for testing, reduce the amount of traffic control required, and narrow the pool of candidate sites, the project team focused on FDR locations with average annual daily traffic (AADT) volumes of less than 1500 vehicles.

Field sites were further evaluated based on proximity to (A) other potential test sites to optimize collected data relative to project resources and scheduling and (B) the Metro district, which is where the project team's field technicians and equipment are located. On the latter point, there was an opportunity to use technicians and equipment from other satellite offices in Minnesota, North Dakota, and South Dakota perform DCP tests on the project team's behalf to limit mobilization costs. Discussions with MnDOT OMRR determined that the best course of action was to use a few experienced technicians for all tests (i.e., those based out of Saint Paul) to ensure consistency and quality in all collected data.

2.2 SELECTED TEST LOCATIONS

After reviewing candidate field locations with MnDOT OMRR engineers, the following final locations (Figure 2), distributed among 4 groups by proximity for test mobilization planning, were selected.

- *North Central.* TH-11 and US-71
- *North West.* TH-1, TH-9, and TH-32
- *Central*. TH-55, TH-238, and US-59
- *South West*. TH-62, TH-83, and TH-109

Table 1 summarizes the project team's understanding of FDR section location details for the purposes of the testing protocol and test data summary conducted during this project. A 3.0-mile stretch of each FDR location was selected for DCP and FWD testing. As noted above, properties reported in Table 1 were determined using publicly available MnDOT records. Test section maps are shown in Appendix A.

Table 1. Test location summary from MnDOT records (uses MnDOT internal data headers)

aux	d	SP	rehab	age	aadt	pcnt_truck	#1 Thickness	#1 Material	#2 Thickness	#2 Material	Note #1
MN1	U	4502-05	28	8	1240	3.8	5	HMA	--	--	9" reclaim
MN1	U	6901-07	28	8	1240	3.8	4	HMA	4.5	Agg. Base	10" reclaim
MN9	U	5408-11	28	4	771	13.2	5	HMA	14	Agg. Base	9" reclaim
MN9	U	6010-12	28	6	662	13.9	4.5	HMA	6	Agg. Base	10" reclaim
MN11	U	3604-26	28	7	580	27.1	6	HMA	14.5	Agg. Base	12" reclaim
MN32	U	6006-13	28	8	1400	12.6	4.5	HMA	--	--	8" reclaim
MN32	U	6006-13	28	8	1400	12.6	4.5	HMA	4	Agg. Base	8" reclaim
MN55	U	6107-03	28	7	670	15.7	5	HMA	6	Agg. Base	5" reclaim
MN62	U	2507-07	28	3	876	14.4	4	HMA	14.75	Agg. Base	10" reclaim
MN83	U	8107-10	28	6	703	13.1	5	HMA	2.5	Agg. Base	12" reclaim & 3.5" soil-cement base
MN83	U	0711-16	28	6	688	13.2	12.5	HMA	2.5	Agg. Base	12" reclaim & 3.5" soil-cement base
MN109	U	2212-11	28	5	814	12.8	3	HMA	18	Agg. Base	*<No note on reclaimed depth>*
MN238	U	0	28	0	1047	3.9	1.5	HMA	2	Agg. Base	*<No note on reclaimed depth, assumed 4" over 8" as 1.5 is too low>*
US59	U	6010-08	28	1	1055	22.7	4.5	HMA	3.25	Agg. Base	10" reclaim
US71	U	3611-15	28	6	670	9.6	5	HMA	9.75	Agg. Base	10" reclaim
US71	U	3611-23	28	12	580	9.8	4.5	HMA	1.5	Agg. Base	8" reclaim

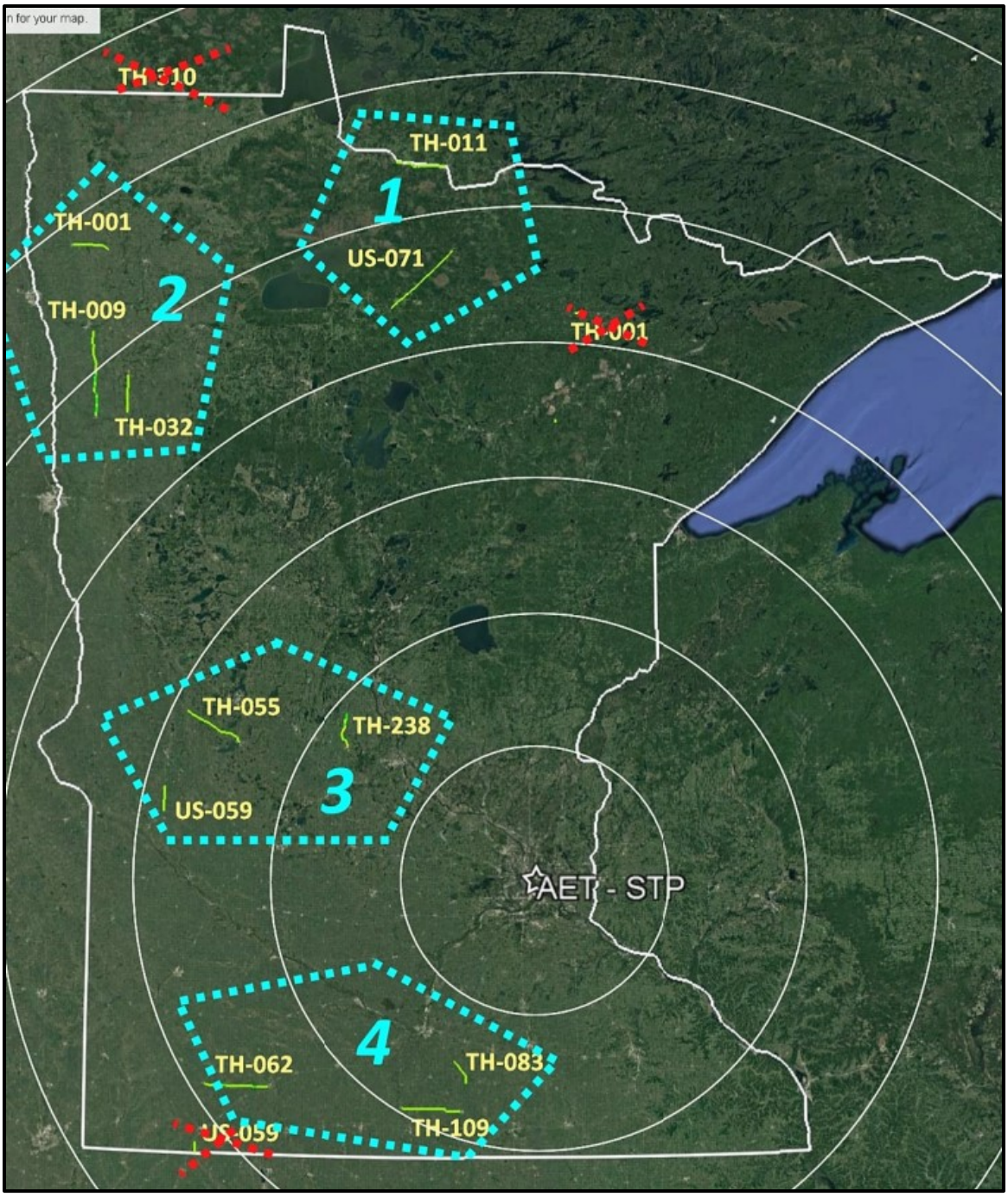

Figure 2. Map of test locations by regional grouping

CHAPTER 3: TESTS PERFORMED

The project team performed tests described in the following sections. Appropriate test standards and resources are cited to provide additional detail. The tests were performed by location as indicated in Table 2. Inclement weather in Fall 2018 and late May/June 2019 delayed the original field testing schedule, however tests of all sections were completed by Fall 2019 without issue. Appendix A illustrates each test section – Table 2 indicates GPS coordinates for termini.

Table 2. Field test dates and termini

Section	Test Date	From		To	
		Lat	Long	Lat	Long
TH001	6/19/2019	48.1952285	-96.7166718	48.1953401	-96.6522469
TH009	6/19/2019	47.7446186	-96.5673442	47.7016399	-96.5678367
TH011	6/20/2019	48.6523774	-94.2500457	48.6485189	-94.1870590
TH032	6/19/2019	47.3693815	-96.2805731	47.4133168	-96.2812268
TH055	10/11/2018	45.7371620	-95.5820284	45.7568934	-95.6386508
TH059	10/12/2018	45.2842571	-95.9120541	45.3333109	-95.9116142
TH062	10/12/2018	43.8623662	-95.5437658	43.8624588	-95.4779318
TH071	6/20/2019	48.0949670	-93.9369857	48.1264640	-93.8900040
TH083	10/13/2018	43.9354219	-93.7023348	43.8904114	-93.6975968
TH109	10/13/2018	43.7605201	-93.9876216	43.7603651	-94.0590845
TH238	10/11/2018	45.7290215	-94.5899511	45.6751551	-94.6036357

3.1 DYNAMIC CONE PENETROMETER AND BASE SAMPLING AND OBSERVATIONS

Field DCP testing followed ASTM D6951, "Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications." DCP tests were performed at five (5) regularly spaced sites within each 3.0-mile FDR location. Field technicians performed the test using a Kessler Soils Engineering (KSE) Dynamic Cone Penetrometer Model K-100A with disposable metal cone tips. The DCP procedure included the following basic steps.

- The asphalt pavement was cored to provide access for the DCP test at the top of the base layer.
- Note: Pavement cores were reserved and later photographed in the lab to verify pavement thickness for later analysis and for MnDOT OMRR records.
- DCP testing was performed to a depth of 18 inches minimum, the depth being measured from the top of the base layer (i.e., the bottom of the pavement core hole). This practice was performed – regardless of the base depth indicated in plans or other MnDOT records – to ensure there is useful DCP data to characterize all base layers tested, including those whose thicknesses may later be found to be inaccurate in MnDOT records.

- DCP testing of other sublayers was not performed as subbase/subgrade characterization was not in the original work scope.
- Disposable metal cone tips were recovered (if possible) or left in-situ.

After DCP tests were complete at a given test site, technicians performed the following steps before proceeding to the next site or location.

- Sampled base materials were stored for possible laboratory tests (e.g. sieve analysis for gradation, chemical extraction or ignition for approximate RAP content).
- Approximately 3-5 pounds of base materials were sampled per site.
- Core holes were backfilled with MnDOT Class 5 aggregate (to replace base materials) and asphalt patching material (to replace the pavement core). As some districts had requested a special patch material (UPM Bituminous Cold Mix #4), this patching material was used at all test sites/locations.

3.2 FALLING WEIGHT DEFLECTOMETER

All FWD tests were performed using either a Dynatest Model 8001 or 8002 FWD test trailer, which includes nine deflectometers. The Dynatest FWD Test System used for all tests performed in this field study meets ASTM D4694, "Standard Test Method for Deflections with a Falling-Weight-Type Impulse Load Device." Technicians performed FWD tests at 0.1-mile intervals within each 3.0-mile test location – that is, a minimum of 30 regularly spaced drops were performed at each location.

3.3 LABORATORY SIEVE ANALYSIS AND CHEMICAL EXTRACTION TESTS OF BASE SAMPLES

Samples of base materials from each road section were blended to form a representative composite base sample for the roadway. Sample collection and volumes are discussed in Section 3.1.2. The composite samples by roadway were tested in the laboratory according to the following procedures from the *MnDOT Materials Laboratory Manual No. 5-695* (MnDOT, 2014).

- MnDOT 1202/1203, "Coarse/Fine Aggregate Sieve Analysis" (MnDOT-modified AASHTO T 27)
- MnDOT 1852, "Quantitative Extraction of Bituminous Mixtures (Centrifuge)" (MnDOT-modified AASHTO T 164, Method A)

The chemical extraction testing made all reasonable efforts to ensure that the level of fines present in the extraction specimen reflected those of the larger composite sample.

3.4 FIELD TESTING NOTES

As the project team regularly conducts pavement field testing, the FWD and DCP tests were largely routine. The primary observation from field testing was the difficulty technicians encountered when attempting to distinguish the base layer from either the subbase or subgrade layer visually (i.e., inspection of core hole) or mechanically (through feedback from DCP testing). For this reason, the DCP

electronic reports and brief TONN2010 analysis that was performed relied on plan thicknesses from MnDOT records.

DCP field test reports included some observations of conditions that temporarily complicated testing. While none of the observations have significant bearing on the final results, they are recorded here for completeness.

- Particles of RAP larger than approximately 1.5 inches (as approximated by technicians) were encountered at sites within some sections (e.g. TH-059, Site 3). These large particles occasionally complicated DCP testing. To proceed with the DCP test, the technician had to remove the oversized aggregate in the path of the cone, then resume the test. Special notes were made in field test files to indicate the complication, however field notes may not be comprehensive.
- The top of inch base was disturbed by coring operations in a few instances (e.g. TH-083, Site 3).
- Geogrid was encountered in a few instances (e.g. TH-011).
- Based on DCP penetration and observations in the core hole, field technicians made a note of layers being apparently separated into a finer upper lift and coarser lower lift in a few instances (e.g. TH-001, Site 3).

No notes on difficulties or special conditions were made during FWD testing.

CHAPTER 4: RESULTS

4.1 PROJECT TESTING FILES

All project files have been uploaded to the MnDOT MFT Server for OMRR use. These files include the following items.

- Scans of DCP field test forms (completed by hand)
- Core and core hole photos from field DCP testing
- Electronic DCP report sheets (entered from field forms)
- FWD raw data
- TONN2010 analysis files of FWD data

Backcalculated results and electronic DCP summaries are included as appendices to this report. Other files, including raw data FWD files, are excluded given their length and the fact that they are immediately available to MnDOT through the MFT Server.

4.1.1 DCP File Description

The DCP reports produced include the original completed field test forms and the formatted electronic files. For MnDOT's convenience and to avoid confusion about which DCP data applies to which location through the sublayer cross-section, the electronic files limit DCP results to those for the thickness indicated in MnDOT records. The scanned field notes can be consulted should MnDOT OMRR learn that plan thicknesses are inaccurate – these field notes contain DCP blow counts and penetration depths for the full test to a minimum depth of 18 inches.

4.2 TEST RESULTS IN SUMMARY

Given that the analysis performed was very limited in scope, that analysis is reported within this subsection, rather than in a conventional chapter dedicated to analysis and/or discussion. All test results are provided in full in the appendices to this report.

- Average DCP results by site and location are reported in Table 3. DCP results by test site are provided in full in Appendix B.
- FWD analysis relating directly to base modulus is summarized in Table 4. Full backcalculated results (including moduli for other layers) by location are provided in Appendix C.
- Results of sieve analysis and chemical extraction tests of base samples are summarized in Table 5 and provided in full in Appendix D.

Backcalculation analysis assumptions about the pavement cross-section were based on MnDOT records. Some adjustment to layer thicknesses were made based on collected cores and field observations. These adjustments are noted in Table 4, which also reports the backcalculated stiffness (with basic statistical analysis) for the base layer alongside the average DCP index for the project team's understanding of the

corresponding base layer thickness. Also included in Table 4 – for discussion only and not for research purposes – are columns that convert the average DCP index to potentially relevant parameters

- An estimated laboratory resilient modulus (MR) using $MR = 78.05 \cdot DPI^{-0.6645}$, which is a relationship established by Chen et al (2005) where DPI is measured in mm per blow and MR is measured in ksi.
- The estimated pavement design MR of $MR = 96.7 \cdot DPI^{-0.717}$ for the AASHTO M-E procedure, based on expressions for CBR (given DPI) and MR (given CBR) in the NCHRP 1-37A final report, where DPI and MR are in mm per blow and ksi, respectively (ERES 2004).

Overall, the average backcalculated stiffnesses for the FDR base layers is 53.8 ksi, which is slightly higher than the value a pavement engineer would expect (i.e., 25-45 ksi) for a given base layer in the State of Minnesota. However, note that the data is skewed by a few sections – the median base modulus for all tested sections is 47.1 ksi, which is closer to expectations but still slightly higher than the expectations described above.

The observed DCP index for FDR base layers was 2.81 mm/blow on average. The fitness of the average DCP indices (in terms of characterizing base properties) is otherwise difficult to gauge given the inherent challenge of DCP interpretation. A first-pass inspection of Table 4 yields a few interesting observations.

- DPI is generally less uniform across all observations by location than the backcalculated base stiffness – that is, the coefficient of variation (the ratio of the standard deviation to the mean, or COV) for DPI by location is 0.44, which is higher than the COV for FWD data by location (0.33).
- One indicator that certain locations may contain data sets with larger variation can be observed by inspection. The FWD data for TH-055 is a clear outlier in terms of variability – its COV is 0.59, nearly twice the average COV for FWD observations. Likewise, the DCP data for TH-083 and TH-001 may be worth additional review, as their COVs were 0.68 and 0.59 respectively.

This first-impression analysis should, of course, be reviewed and replaced (in a research sense) with more in-depth analysis by MnDOT OMRR. There are many MnDOT resources to advise future efforts on how best to account for DCP indices and base stiffness in MPF. Those resources include, but are not limited to Burnham (1997), which established expected DPI limits for paving materials in Minnesota; Dai and Kremer (2005), which elaborated on base characterization using DCP; and Ghasemi et al (2018), which characterized stabilized FDR bases using DCP testing of Minnesota roads. Please note that Ghasemi et al (2018) did not include FWD testing.

Finally, the results of sieve analysis indicate that the particle distribution of the sampled bases from each location is similar. When compared to the current specified gradation for a MnDOT Class 6 base containing 25 percent or more recycled aggregates, as shown in Figure 3, the sampled bases were generally finer than the levels required in MnDOT Table 3138-4, which is reproduced in Figure 4. Some differences between the tested FDR bases and MnDOT recommendations for Class 6 bases containing recycled materials are as follows.

- 21.7 percent of tested FDR base aggregate (on average) was retained on the No. 4 sieve – this is below the MnDOT minimum requirement of 30 percent from MnDOT Table 3138-4
- 33.9 percent of tested FDR base aggregate (on average) was retained on the No. 10 sieve – this is below the MnDOT minimum requirement of 45 percent from MnDOT Table 3138-4
- 7.5 percent of tested FDR bases passed the No. 200 sieve, which is over the required maximum of 7.0 percent in MnDOT Table 3138-4.

These observations regard aged materials and not the base materials immediately after reclamation. While the gradation of the base material may change (become finer) over time, the asphalt content of the RAP in the base material should not. Reported asphalt contents (along with summary sieve analysis) for each roadway are reported in Table 5. On average the samples contained 1.7 percent asphalt binder.

Interpretation of the asphalt binder content – in terms of judging RAP content in the reclaimed blend – varies by roadway and mix design for the original asphalt concrete pavement. A very broad rule to judge extraction results for reclaimed materials is that levels of roughly 2.5 percent asphalt binder content in a blend corresponds to roughly 50 percent RAP content in the blend. The rationale for this rule is based on general expectations of hot-mix asphalt to contain roughly 5.0 percent asphalt binder by weight.

Using the general rule described above, the tested road sections contained roughly 35 percent RAP on average. Expectations for RAP content in FDR base materials is anywhere between 30 and 70 percent (based on construction plan review and general experience on Minnesota road design and construction). The reliability of the RAP content estimate from extracted binder content is arguable. As noted in Section 3.1.3, the loss of fines in the extraction specimen may result in underestimation of asphalt content. While the tests were performed in a controlled environment by experienced personnel, fine loss (or rather, a specimen whose gradation may not represent that of the source material) is unavoidable.

Finally, the chemical extraction results were performed to supplement MnDOT's understanding of these road sections – that is, these results are for information only. They do not form a valid basis to infer properties of the reclaimed blend. Additional sampling, testing, and consulting of MnDOT District construction records should be performed to better gauge the amount of RAP present in these FDR bases, particularly as regards associating structural performance with a level of RAP or tested asphalt content.

Table 3. DCP test data by location

ID	Locn	Avg DCI (mm/blow)
01-1	TH 01	2.89
01-2	TH 01	1.88
01-3	TH 01	2.06
01-4	TH 01	2.01
01-5	TH 01	2.86
09-1	TH 09	3.08
09-2	TH 09	1.63
09-3	TH 09	2.00
09-4	TH 09	2.25
09-5	TH 09	1.42
11-1	TH 11	1.95
11-2	TH 11	2.06
11-3	TH 11	2.27
11-4	TH 11	2.21
11-5	TH 11	2.10
32-1	TH 32	2.58
32-2	TH 32	2.29
32-3	TH 32	1.53
32-4	TH 32	2.35
32-5	TH 32	2.40

ID	Locn	Avg DCI (mm/blow)
55-1	TH 55	2.95
55-2	TH 55	4.30
55-3	TH 55	3.16
55-4	TH 55	4.67
55-5	TH 55	2.81
59-1	TH 59	4.06
59-2	TH 59	2.48
59-3	TH 59	3.04
59-4	TH 59	4.21
59-5	TH 59	3.27
62-1	TH 62	2.66
62-2	TH 62	3.19
62-3	TH 62	2.32
62-4	TH 62	2.00
62-5	TH 62	2.84
71-1	TH 71	1.78
71-2	TH 71	2.51
71-3	TH 71	3.33
71-4	TH 71	2.20
71-5	TH 71	2.47

ID	Locn	Avg DCI (mm/blow)
83-1	TH 83	3.40
83-2	TH 83	3.80
83-3	TH 83	5.00
83-4	TH 83	3.51
83-5	TH 83	3.14
109-1	TH 109	3.10
109-2	TH 109	1.33
109-3	TH 109	3.10
109-4	TH 109	7.50
109-5	TH 109	1.92
238-1	TH 238	2.73
238-2	TH 238	3.56
238-3	TH 238	3.45
238-4	TH 238	2.75
238-5	TH 238	2.43

Table 4. FWD analysis by location (with DCP information for comparison)

Section	Layer Thickness		GE [in]		Base Elastic Modulus [ksi]		DPI [mm/blow]		Interpreted MR [ksi] from DPI	
	AC	Base	Avg	SD	Avg	SD	Avg	SD	Lab (Chen)	Design (AASHTO)
TH001	5.0	9.0	25.3	2.0	61.7	18.9	2.3	1.36	44.9	53.2
TH009	4.5	10.0	31.6	3.3	64.2	17.4	2.1	1.02	47.7	56.8
TH011	6.0	12.0	29.5	2.8	32.9	8.1	2.1	0.87	47.7	56.8
TH032	4.5	8.0	19.5	2.3	47.1	11.5	2.2	0.90	46.2	54.9
TH055	5.0	5.0	19.1	2.7	109.7	35.8	3.6	1.33	33.3	38.6
TH059	7.0	10.0	22.3	2.2	61.2	33.0	3.4	1.06	34.6	40.2
TH062	4.0	10.0	17.0	2.0	42.1	12.9	2.6	0.92	41.4	48.7
TH071	4.5	8.0	22.6	2.9	34.5	8.7	2.5	0.79	42.5	50.1
TH083	5.0	15.5	21.8	1.7	34.1	13.2	3.4	2.31	34.6	40.2
TH109	5.0	18.0	19.2	2.2	32.5	10.7	3.8	1.87	32.1	37.1
TH238	4.0	8.0	17.3	2.4	72.1	27.4	3.0	1.36	37.6	44.0

Table 5. Results of chemical extraction tests of base samples with FDR base gradation summary

	TH001	TH009	TH011	TH032	TH055	TH059	TH062	TH071	TH083	TH109	TH238
Retained at ¾" (%)	4.1	0.0	3.2	1.0	0.0	5.7	1.0	0.0	0.0	1.4	0.7
Retained at #4 (%)	21.2	18.9	21.3	22.2	17.1	28.1	15.9	17.7	28.6	23.9	24.3
Passing #200 (%)	6.3	6.0	9.1	6.2	8.1	6.9	7.4	7.1	10.7	8.2	6.5
Asphalt Content (%)	0.9	1.4	2.8	1.5	2.8	0.5	1.7	1.7	0.9	1.7	3.2

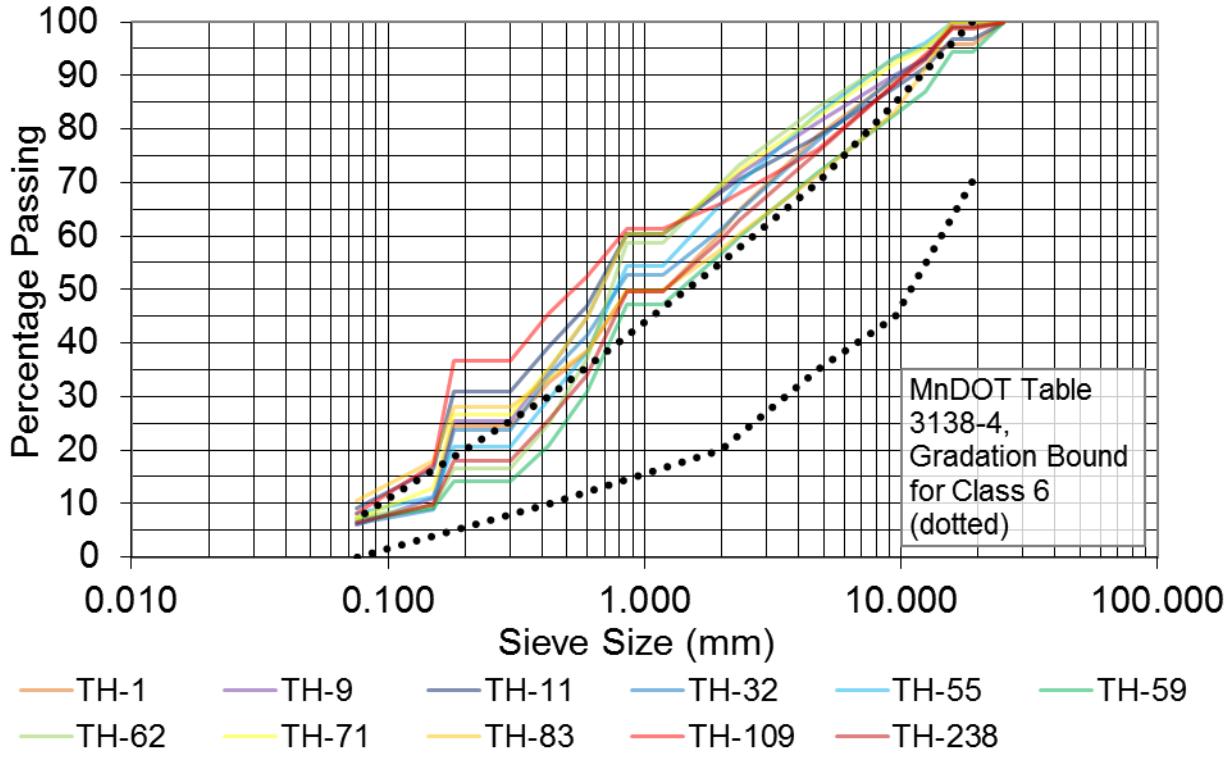

Figure 3. Sieve analysis of composite FDR base samples from each roadway

Table 3138-4
Base and Surfacing Aggregate
(containing 25% or more recycled aggregates & 75% or less recycled concrete)
Total Percent Passing *

Sieve Size	Class 1 (Surfacing £)	Class 3 (Subbase)	Class 4 (Subbase)	Class 5 (Base)	Class 5Q (Base)	Class 6 (Base)
2 in	—	100	100	—	100	—
1½ in	—	—	—	100	—	100
1 in	—	—	—		65 - 95	
¾ in	100	—	—	70 – 100	45 – 85	70 – 100
⅜ in	65 – 95	—	—	45 – 90	35 – 70	45 – 85
No. 4	40 – 85	35 – 100	35 – 100	35 – 80	15 – 45	35 – 70
No. 10	25 – 70	20 – 100	20 – 100	20 – 65	10 – 30	20 – 55
No. 40	10 – 45 † 5 – 45	5 – 50	5 – 35	10 – 35	5 – 25	10 – 30
No. 200	5.0 – 15.0 † 0 – 15.0	0 – 10.0	0 – 10.0	0 – 10.0	0 – 10.0	0 – 7.0

* Add letters in parentheses for each aggregate blend designating the type of recycled products included in the mixture.
(B) = Bituminous, (C) = Concrete, (G) = Glass
(BC) = Bituminous and Concrete, (BG) = Bituminous and Glass
(CG) = Concrete and Glass, (BCG) = Bituminous, Concrete, and Glass
† Note: For Class 1, if the bitumen content is ≥ 1.5%, the gradation requirement is modified to 5 – 45% for the #40 sieve and 0 – 15.0% for the #200 sieve.
£ Recycled concrete is only allowed for shoulders

Figure 4. Gradation requirements of bases containing 25 percent or more recycled materials (MnDOT 3138, "Aggregate for Surface and Base Courses)

CHAPTER 5: CONCLUSIONS

Tests of all FDR locations were successful. All project data were successfully uploaded to the MnDOT MFT Server.

The project team organized collected test data to minimize complications when future studies access the results of this field study. In addition, limited analysis was performed on collected FWD data to provide MnDOT OMRR with a first impression of backcalculated base stiffness relative to DCP indices by location.

Overall, the assembled data provides MnDOT with the ability to assess future research involving (A) the use of DCP by MPF for FDR (or other) sublayers, (B) the characterization and performance of FDR sublayers as modeled by MPF, and/or (C) assumed values of stiffness of FDR base layers for other Minnesota pavement design procedures.

REFERENCES

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ASTM Standard D6951 (2018). Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications. ASTM International, West Conshohocken, PA

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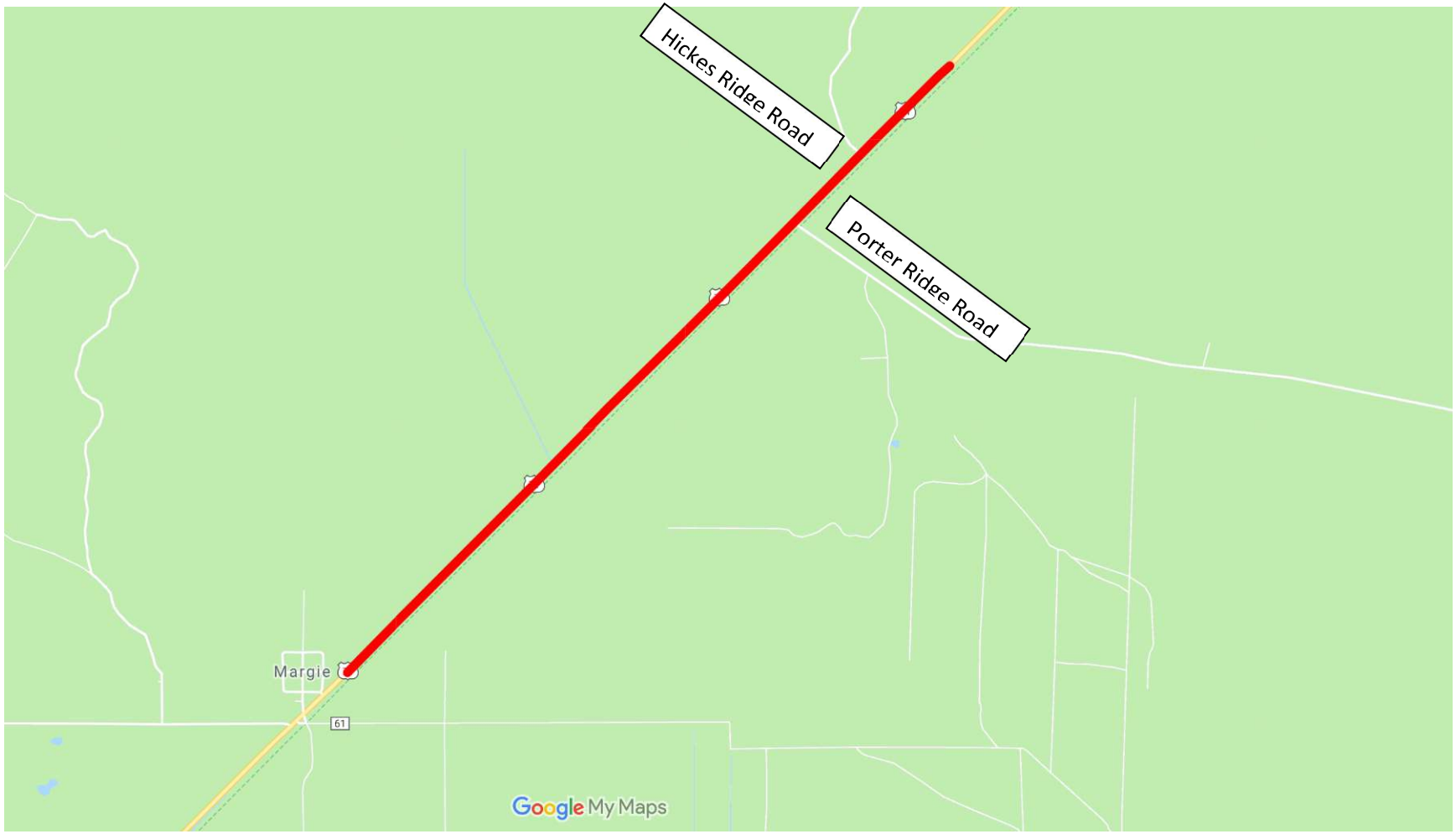
APPENDIX A: TEST LOCATION MAPS


Frontier
Rainy River
Canada
United States
Canada
United States
Rainy River
124
88
124
124
88
4
88
88
4
Google My Maps

TH 11

A-1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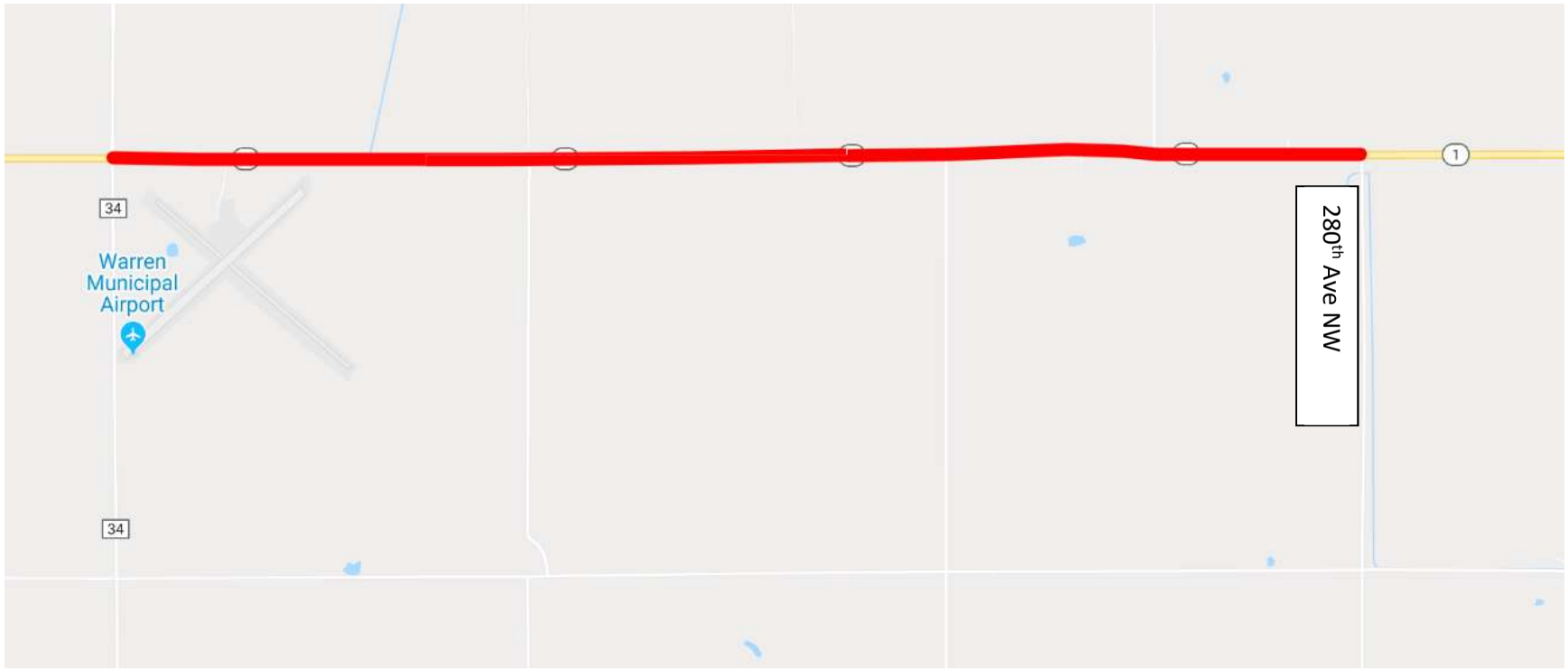
Porter Ridge Road
Margie
61
Google My Maps

US 71



TH 1

A-3


Crookston
Red Lake River
Red Lake River
U.S. Hwy 2
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3rd Ave S
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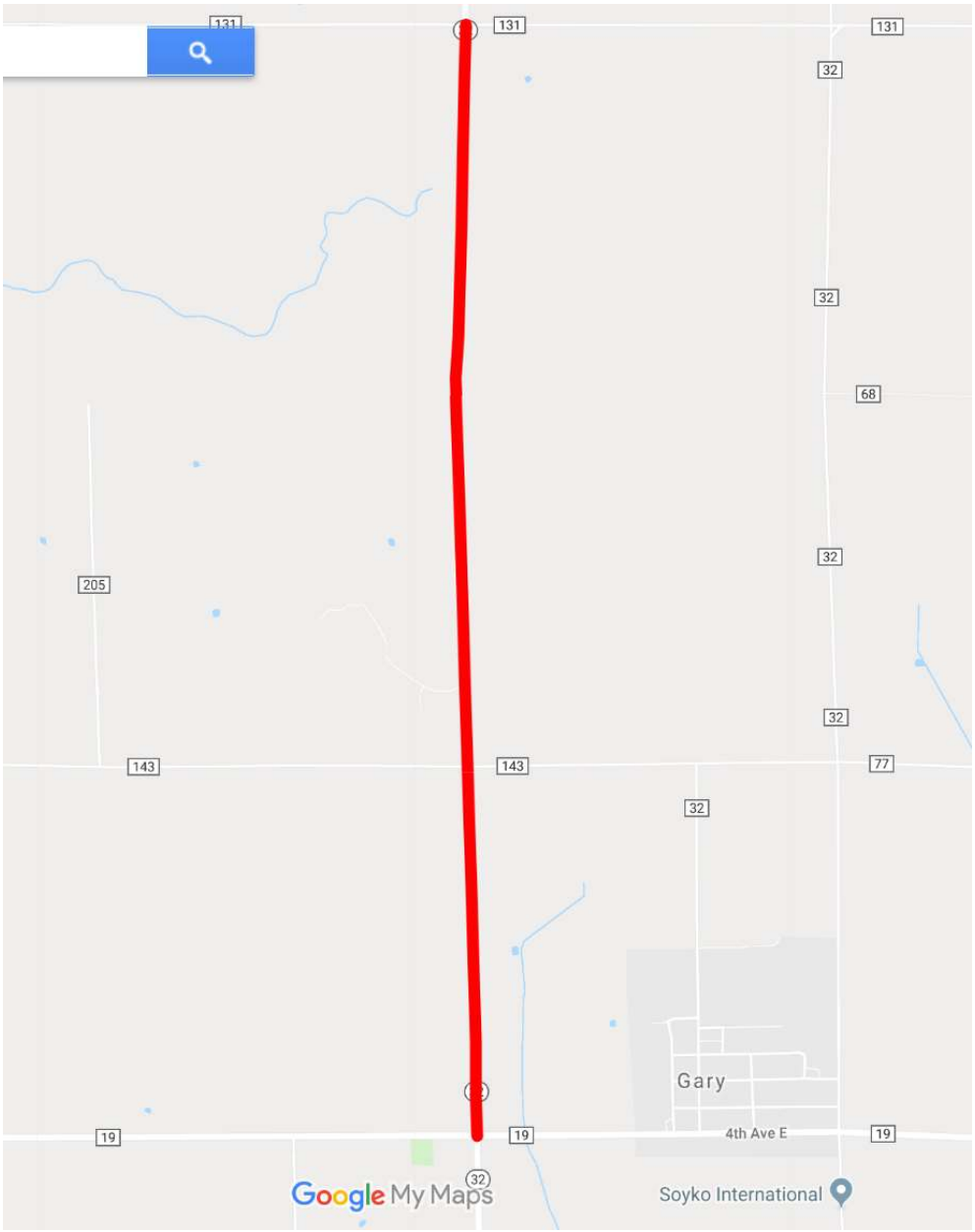
214
9
102
102
214
214
45
45
9
Google My Maps

TH 9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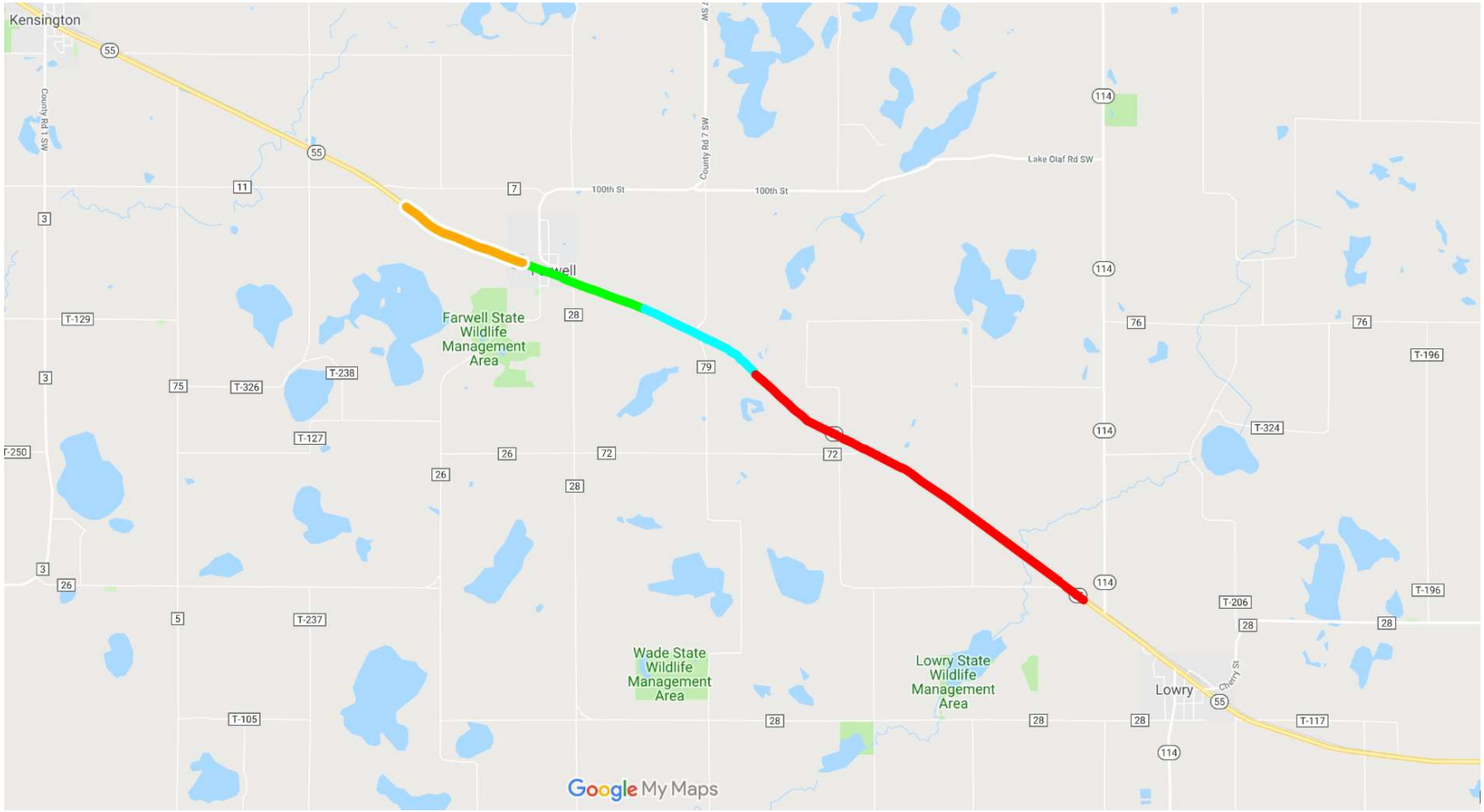
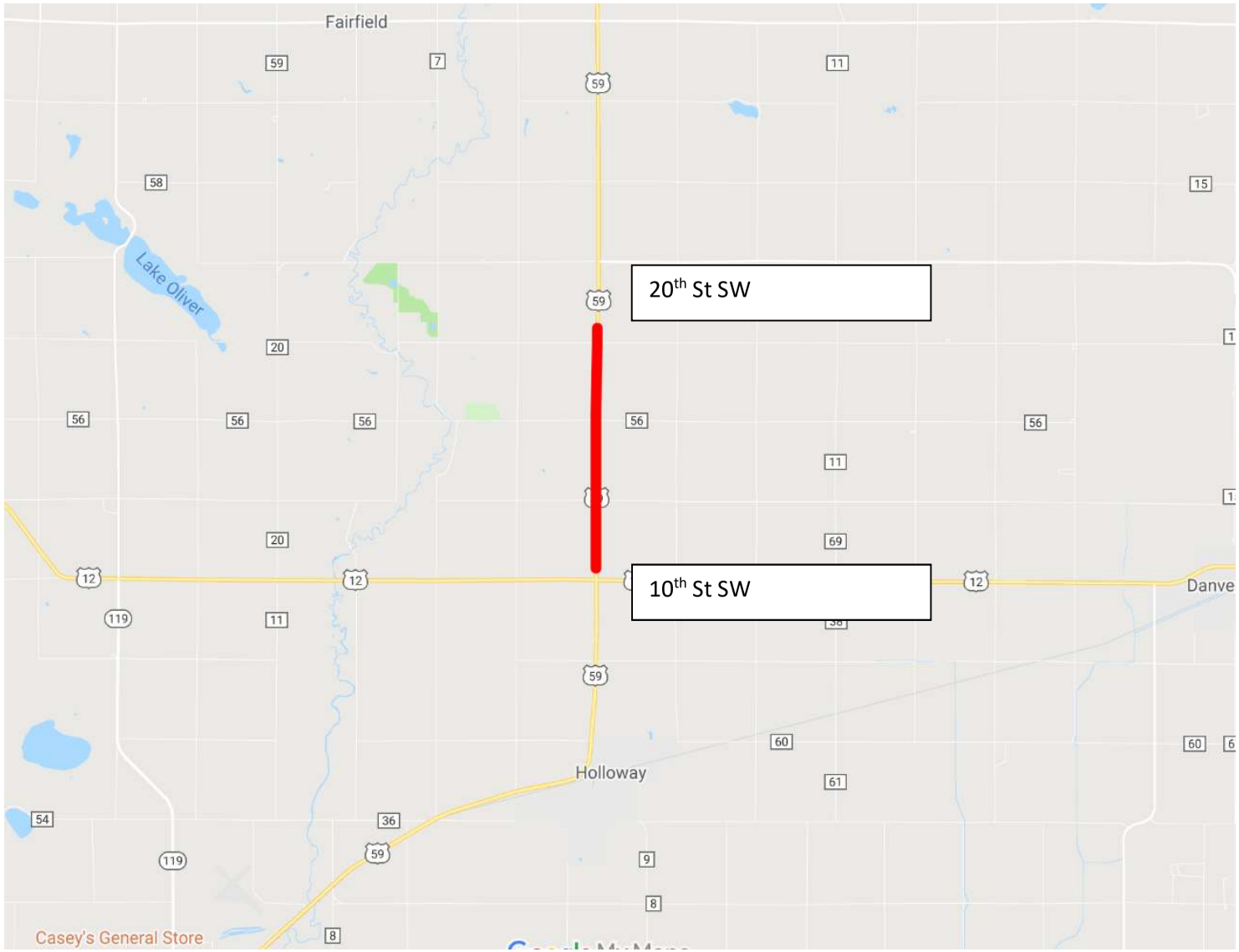
32
Google My Maps
Soyko International

TH 32



TH 55 (AREA IN RED ONLY)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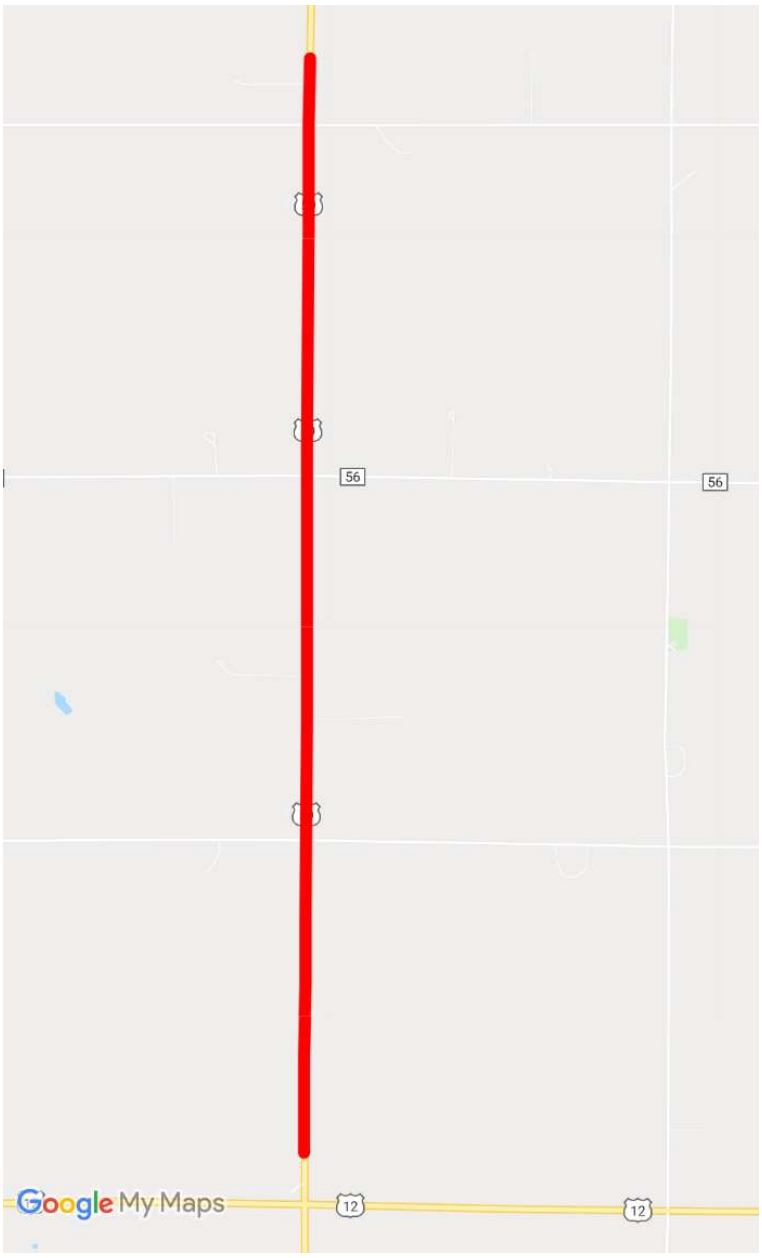
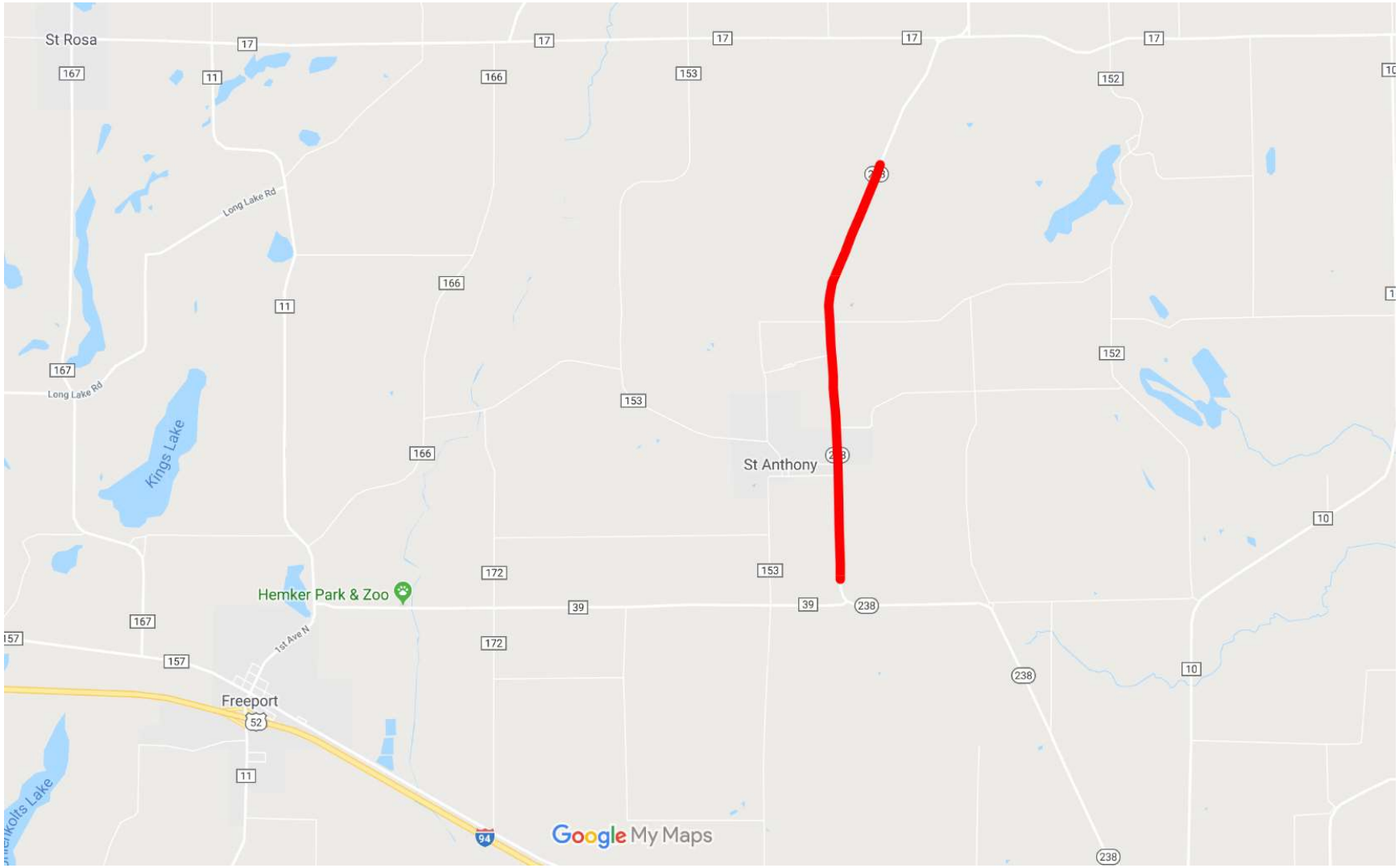
10th St SW
Holloway
Casey's General Store
Danve

US 59



US 59

A-8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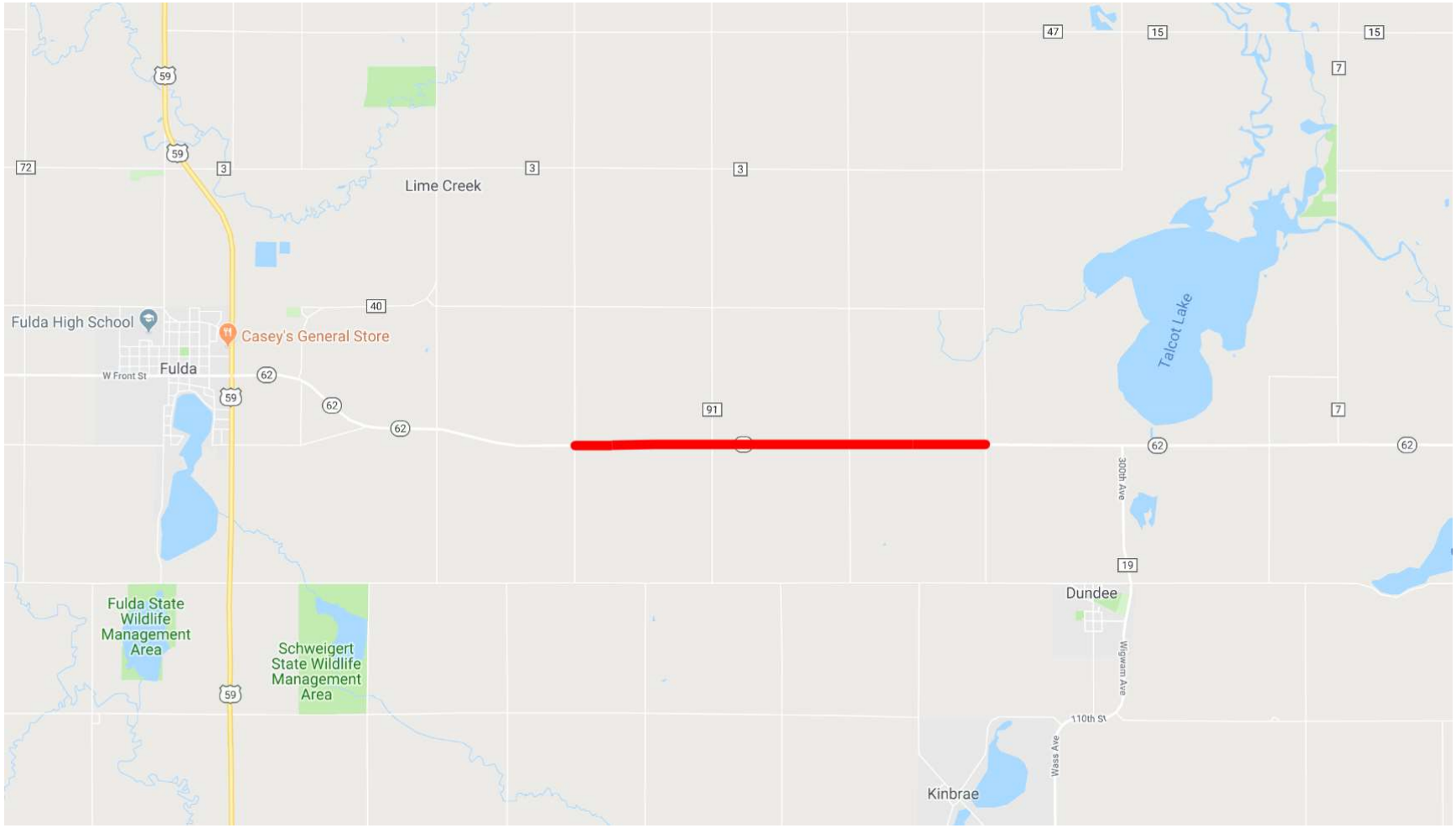
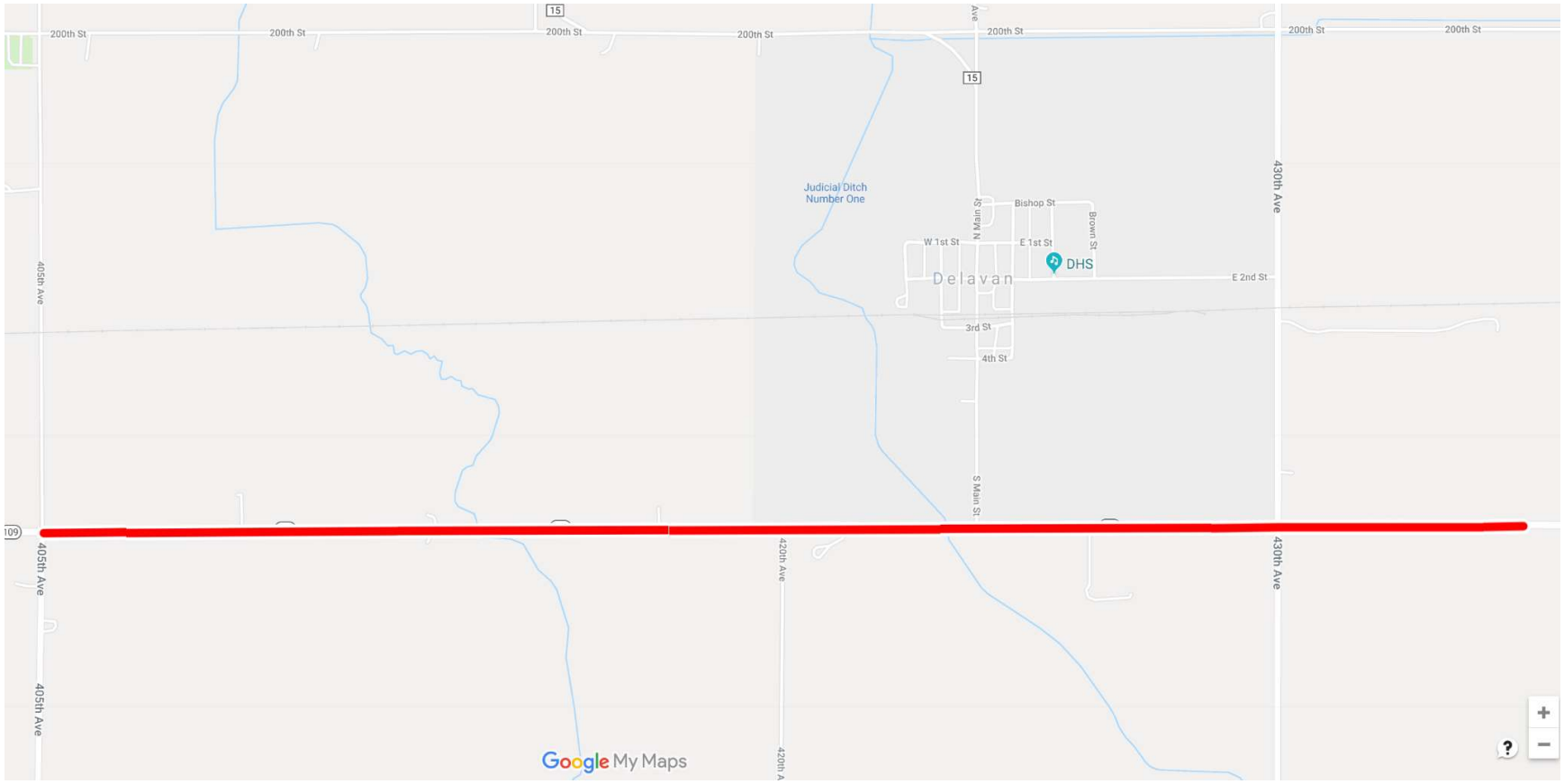
Long Lake Rd
Kings Lake
Hemker Park & Zoo
1st Ave N
Freeport
St Anthony
Google My Maps

TH 238


Lime Creek
Fulda High School
Casey's General Store
Fulda
W Front St
Talcot Lake
Fulda State Wildlife Management Area
Schweigert State Wildlife Management Area
Dundee
300th Ave
Wigwam Ave
110th St
Wass Ave
Kinbrae
59
72
3
40
62
91
47
15
7
19

TH 62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200th St
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200th St
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15
Judicial Ditch
Number One
Bishop St
N Main St
Brown St
W 1st St
E 1st St
DHS
Delavan
E 2nd St
3rd St
4th St
S Main St
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420th Ave
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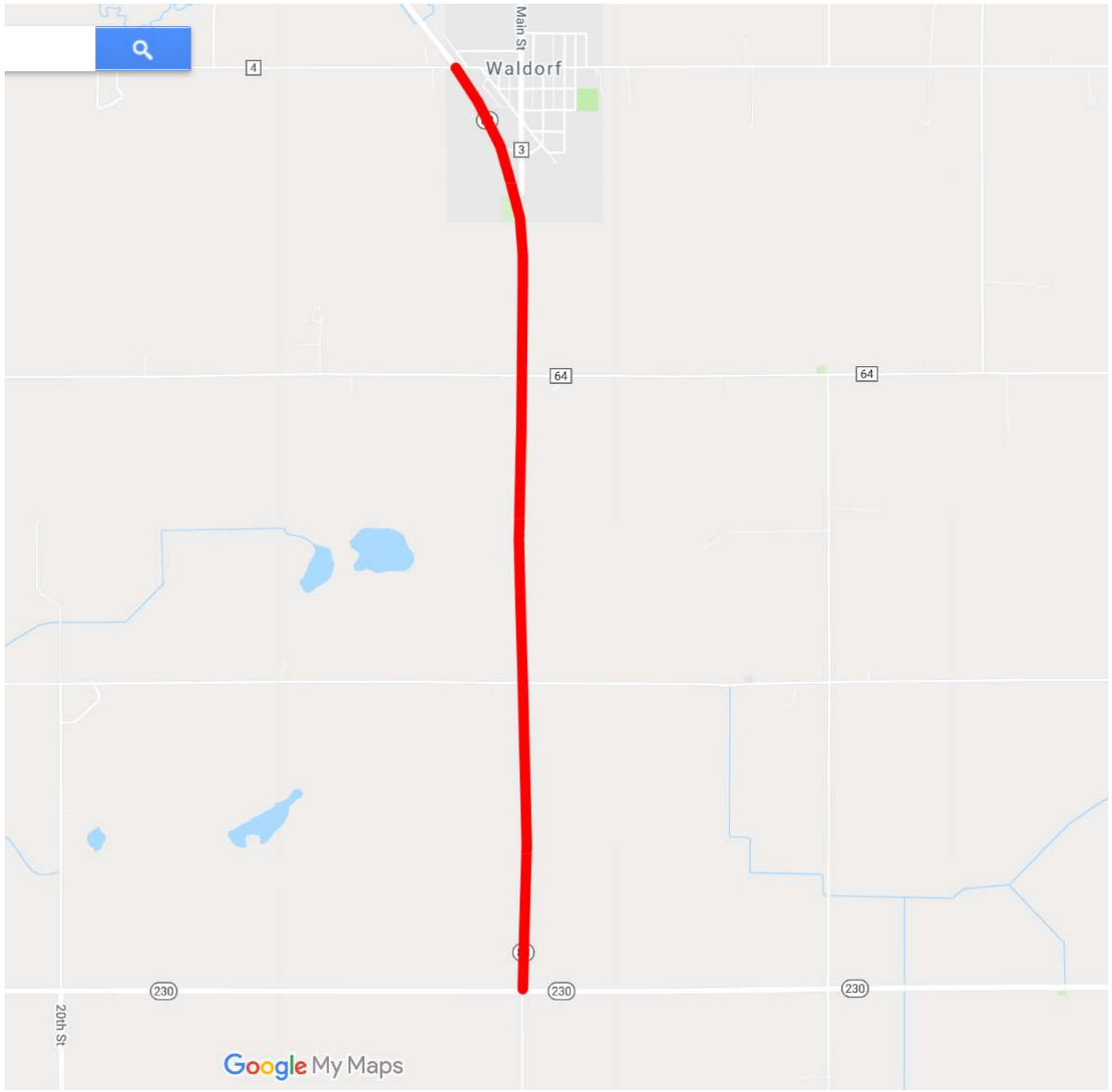
430th Ave
109
Google My Maps

TH 109

A-11



TH 83

APPENDIX B: DCP REPORTS BY TEST SITE

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

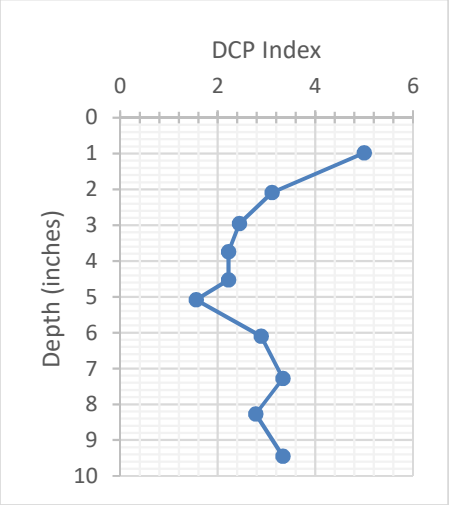
General Information

Road:	TH 01
Test No.	01-1
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	48.195195, -96.708092
Hammer Weight:	17.6 lbs
Weather:	Sunny 70

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	85	10	0.4	
3	100	15	1.0	5.0
9	128	28	2.1	3.1
9	150	22	3.0	2.4
9	170	20	3.7	2.2
9	190	20	4.5	2.2
9	204	14	5.1	1.6
9	230	26	6.1	2.9
9	260	30	7.3	3.3
9	285	25	8.3	2.8
9	315	30	9.4	3.3



Average DCP Index	2.9	mm/blow

Comments

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: Office of Materials and Road Research **CC:**

Project: MnDOT Contract No. 1031051
TH 01 East 1.0 mile #2

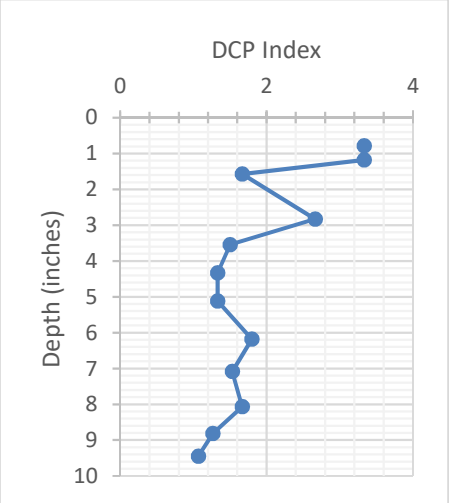
General Information

Road:	TH 01
Test No.	01-2
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	48.1952022, -96.697347
Hammer Weight:	17.6 lbs
Weather:	Sunny 70

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	80	10	0.4	
3	90	10	0.8	3.3
3	100	10	1.2	3.3
6	110	10	1.6	1.7
12	142	32	2.8	2.7
12	160	18	3.5	1.5
15	180	20	4.3	1.3
15	200	20	5.1	1.3
15	227	27	6.2	1.8
15	250	23	7.1	1.5
15	275	25	8.1	1.7
15	294	19	8.8	1.3
15	310	16	9.4	1.1



Average DCP Index	1.9	mm/blow

Comments

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
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Material Test Report

Client: Office of Materials and Road Research **CC:**

Project: MnDOT Contract No. 1031051
TH 01 East 1.5 mile #3

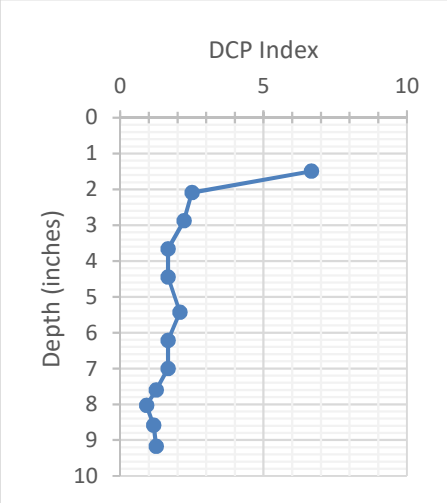
General Information

Road:	TH 01
Test No.	01-3
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	48.1952769, -96.686607
Hammer Weight:	17.6 lbs
Weather:	Sunny 70

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	72			
2	90	18	0.7	
3	110	20	1.5	6.7
6	125	15	2.1	2.5
9	145	20	2.9	2.2
12	165	20	3.7	1.7
12	185	20	4.4	1.7
12	210	25	5.4	2.1
12	230	20	6.2	1.7
12	250	20	7.0	1.7
12	265	15	7.6	1.3
12	276	11	8.0	0.9
12	290	14	8.6	1.2
12	305	15	9.2	1.3



Average DCP Index	2.1	mm/blow

Comments

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Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
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www.amengtest.com

Material Test Report

Client: Office of Materials and Road Research **CC:**

Project: MnDOT Contract No. 1031051
TH 01 East 2.0 mile #4

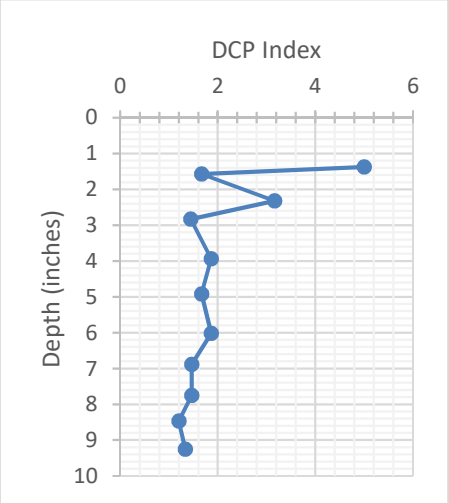
General Information

Road:	TH 01
Test No.	01-4
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	48.1953592, -96.675864
Hammer Weight:	17.6 lbs
Weather:	Sunny 74

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	95	20	0.8	
3	110	15	1.4	5.0
3	115	5	1.6	1.7
6	134	19	2.3	3.2
9	147	13	2.8	1.4
15	175	28	3.9	1.9
15	200	25	4.9	1.7
15	228	28	6.0	1.9
15	250	22	6.9	1.5
15	272	22	7.8	1.5
15	290	18	8.5	1.2
15	310	20	9.3	1.3



Average DCP Index	2.0	mm/blow

Comments

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: Office of Materials and Road Research **CC:**

Project: MnDOT Contract No. 1031051
TH 01 East mile 2.5 #5

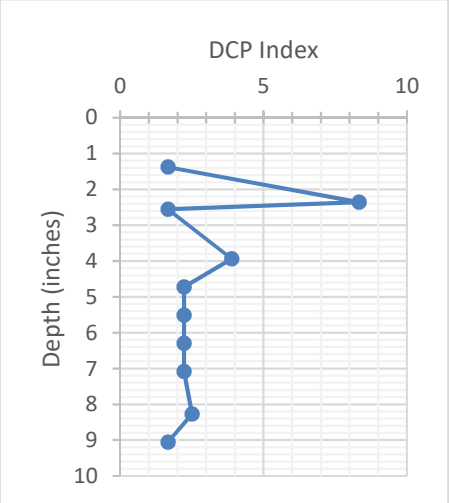
General Information

Road:	TH 01
Test No.	01-5
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	48.1954438, -96.665135
Hammer Weight:	17.6 lbs
Weather:	Sunny 70

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	110	30	1.2	
3	115	5	1.4	1.7
3	140	25	2.4	8.3
3	145	5	2.6	1.7
9	180	35	3.9	3.9
9	200	20	4.7	2.2
9	220	20	5.5	2.2
9	240	20	6.3	2.2
9	260	20	7.1	2.2
12	290	30	8.3	2.5
12	310	20	9.1	1.7



Average DCP Index	2.9	mm/blow

Comments

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: MNDOT
Project: 27-20000
TH 01 East

CC:

Date of issue:
Reviewed By:

General Information

Road:	TH 01
Test No.	
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny 70

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
48.195195, -96.708092	2.9		
48.1952022, -96.697347	1.9		
48.1952769, -96.686607	2.1		
48.1953592, -96.675864	2.0		
48.1954438, -96.665135	2.9		

Average:	2.3
Standard deviation:	0.5
Design:	1.8

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

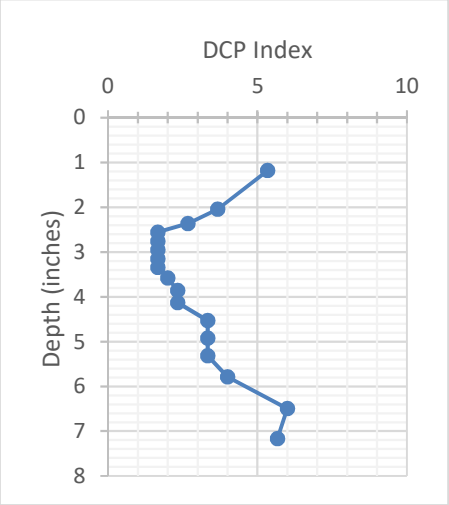
General Information

Road:	TH 09
Test No.	09-1
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	47.7389876, -96.568090
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79 F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	94	14	0.6	
3	110	16	1.2	5.3
6	132	22	2.0	3.7
3	140	8	2.4	2.7
3	145	5	2.6	1.7
3	150	5	2.8	1.7
3	155	5	3.0	1.7
3	160	5	3.1	1.7
3	165	5	3.3	1.7
3	171	6	3.6	2.0
3	178	7	3.9	2.3
3	185	7	4.1	2.3
3	195	10	4.5	3.3
3	205	10	4.9	3.3
3	215	10	5.3	3.3
3	227	12	5.8	4.0
3	245	18	6.5	6.0
3	262	17	7.2	5.7



Average DCP Index	3.1	mm/blow

Comments

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

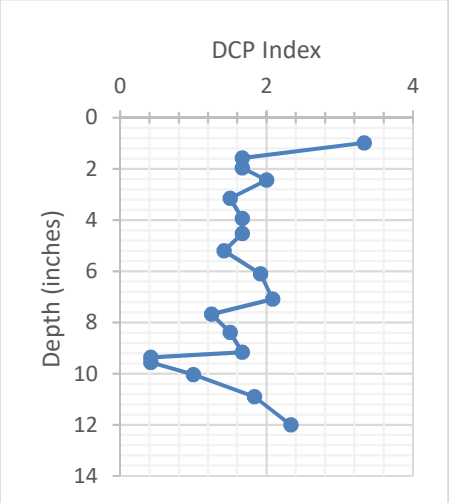
General Information

Road:	TH 09
Test No.	09-2
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	47.7318009, -96.568112
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79 F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	65			
2	80	15	0.6	
3	90	10	1.0	3.3
9	105	15	1.6	1.7
6	115	10	2.0	1.7
6	127	12	2.4	2.0
12	145	18	3.1	1.5
12	165	20	3.9	1.7
9	180	15	4.5	1.7
12	197	17	5.2	1.4
12	220	23	6.1	1.9
12	245	25	7.1	2.1
12	260	15	7.7	1.3
12	278	18	8.4	1.5
12	298	20	9.2	1.7
12	303	5	9.4	0.4
12	308	5	9.6	0.4
12	320	12	10.0	1.0
12	342	22	10.9	1.8
12	370	28	12.0	2.3



Average DCP Index	1.6	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

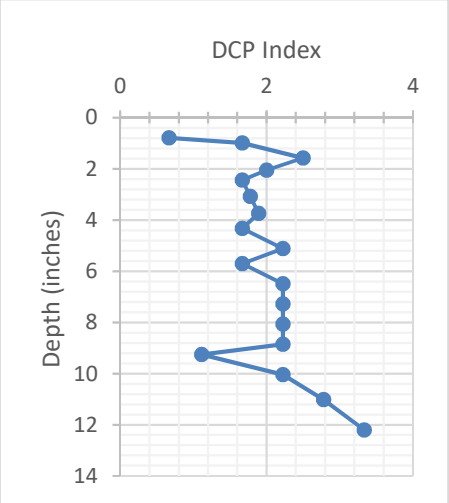
General Information

Road:	TH 09
Test No.	09-3
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	47.7246298, -96.568053
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79 F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	88	18	0.7	
3	90	2	0.8	0.7
3	95	5	1.0	1.7
6	110	15	1.6	2.5
6	122	12	2.0	2.0
6	132	10	2.4	1.7
9	148	16	3.1	1.8
9	165	17	3.7	1.9
9	180	15	4.3	1.7
9	200	20	5.1	2.2
9	215	15	5.7	1.7
9	235	20	6.5	2.2
9	255	20	7.3	2.2
9	275	20	8.1	2.2
9	295	20	8.9	2.2
9	305	10	9.3	1.1
9	325	20	10.0	2.2
9	350	25	11.0	2.8
9	380	30	12.2	3.3



Average DCP Index	2.0	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

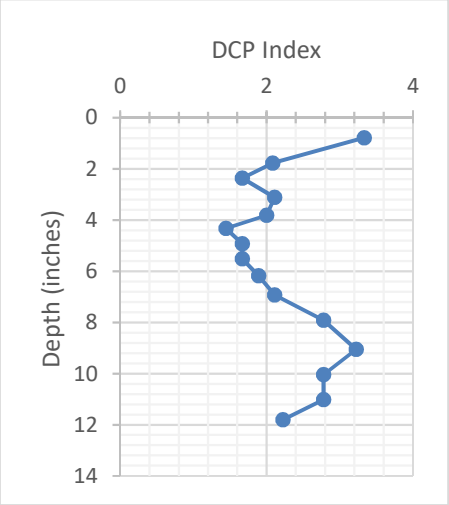
General Information

Road:	TH 09
Test No.	09-4
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	47.7174385, -96.567982
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79 F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	85	10	0.4	
3	95	10	0.8	3.3
12	120	25	1.8	2.1
9	135	15	2.4	1.7
9	154	19	3.1	2.1
9	172	18	3.8	2.0
9	185	13	4.3	1.4
9	200	15	4.9	1.7
9	215	15	5.5	1.7
9	232	17	6.2	1.9
9	251	19	6.9	2.1
9	276	25	7.9	2.8
9	305	29	9.1	3.2
9	330	25	10.0	2.8
9	355	25	11.0	2.8
9	375	20	11.8	2.2



Average DCP Index	2.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

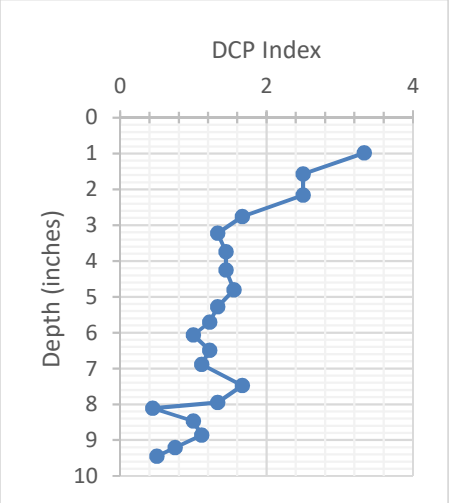
General Information

Road:	TH 09
Test No.	09-5
Date Tested:	7/23/2019

Tested by:	RS
Test Location:	47.7102685, -96.567924
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79 F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	85	15	0.6	
3	95	10	1.0	3.3
6	110	15	1.6	2.5
6	125	15	2.2	2.5
9	140	15	2.8	1.7
9	152	12	3.2	1.3
9	165	13	3.7	1.4
9	178	13	4.3	1.4
9	192	14	4.8	1.6
9	204	12	5.3	1.3
9	215	11	5.7	1.2
9	224	9	6.1	1.0
9	235	11	6.5	1.2
9	245	10	6.9	1.1
9	260	15	7.5	1.7
9	272	12	8.0	1.3
9	276	4	8.1	0.4
9	285	9	8.5	1.0
9	295	10	8.9	1.1
12	304	9	9.2	0.8
12	310	6	9.4	0.5



Average DCP Index	1.4	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 09 South

CC:

Date of issue:
Reviewed By:

General Information

Road:	TH 09
Date Stabilized:	09-1
Date Tested:	7/23/2019
Days after stabilization:	-406

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79 F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
47.7389876, -96.568090	3.078		
47.7318009, -96.568112	1.63		
47.7246298, -96.568053	2.003		
47.7174385, -96.567982	2.25		
47.7102685, -96.567924	1.424		

Average:	2.1
Standard deviation:	0.6
Design:	1.4

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

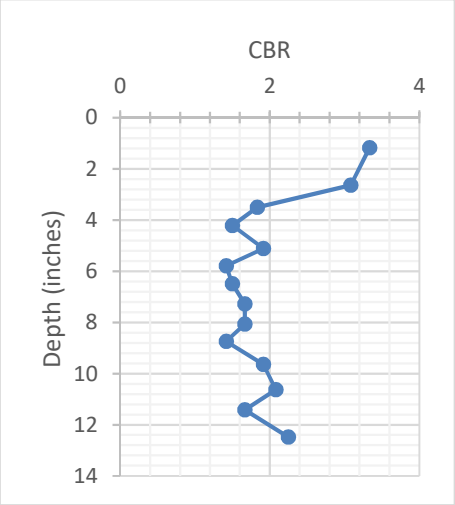
General Information

Road:	TH 11
Test No.	11-1
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.648454, -94.236720
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	95	20	0.8	
3	105	10	1.2	3.3
12	142	37	2.6	3.1
12	164	22	3.5	1.8
12	182	18	4.2	1.5
12	205	23	5.1	1.9
12	222	17	5.8	1.4
12	240	18	6.5	1.5
12	260	20	7.3	1.7
12	280	20	8.1	1.7
12	297	17	8.7	1.4
12	320	23	9.6	1.9
12	345	25	10.6	2.1
12	365	20	11.4	1.7
12	392	27	12.5	2.3



Average DCP Index	1.9	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

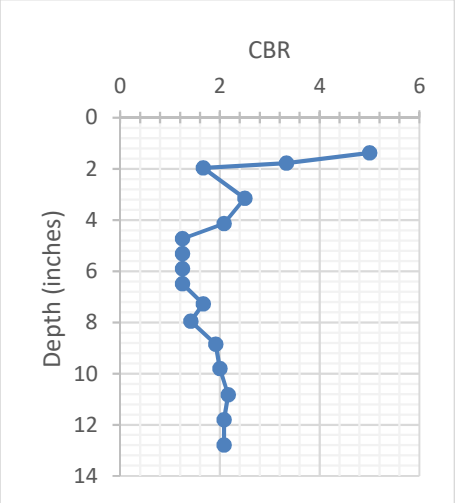
General Information

Road:	TH 11
Test No.	11-2
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.646759, -94.225612
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	85			
2	105	20	0.8	
3	120	15	1.4	5.0
3	130	10	1.8	3.3
3	135	5	2.0	1.7
12	165	30	3.1	2.5
12	190	25	4.1	2.1
12	205	15	4.7	1.3
12	220	15	5.3	1.3
12	235	15	5.9	1.3
12	250	15	6.5	1.3
12	270	20	7.3	1.7
12	287	17	8.0	1.4
12	310	23	8.9	1.9
12	334	24	9.8	2.0
12	360	26	10.8	2.2
12	385	25	11.8	2.1
12	410	25	12.8	2.1



Average DCP Index	2.1	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

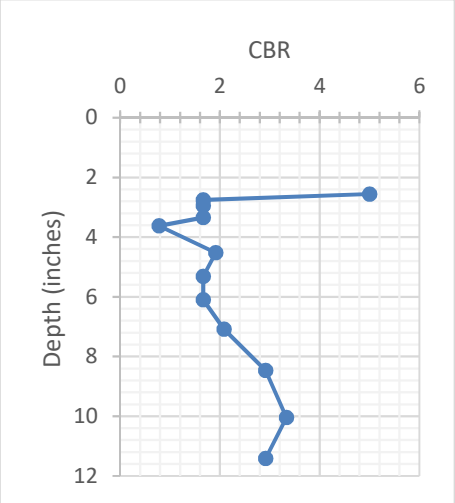
General Information

Road:	TH 11
Test No.	11-3
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.647400, -94.213781
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	120	50	2.0	
3	135	15	2.6	5.0
3	140	5	2.8	1.7
3	145	5	3.0	1.7
6	155	10	3.3	1.7
9	162	7	3.6	0.8
12	185	23	4.5	1.9
12	205	20	5.3	1.7
12	225	20	6.1	1.7
12	250	25	7.1	2.1
12	285	35	8.5	2.9
12	325	40	10.0	3.3
12	360	35	11.4	2.9



Average DCP Index	2.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

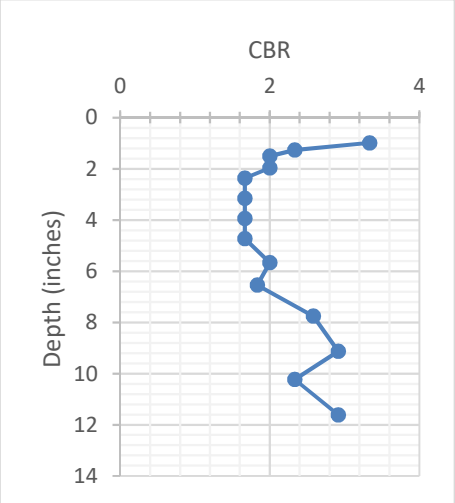
General Information

Road:	TH 11
Test No.	11-4
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.648494, -94.203496
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	90			
2	105	15	0.6	
3	115	10	1.0	3.3
3	122	7	1.3	2.3
3	128	6	1.5	2.0
6	140	12	2.0	2.0
6	150	10	2.4	1.7
12	170	20	3.1	1.7
12	190	20	3.9	1.7
12	210	20	4.7	1.7
12	234	24	5.7	2.0
12	256	22	6.5	1.8
12	287	31	7.8	2.6
12	322	35	9.1	2.9
12	350	28	10.2	2.3
12	385	35	11.6	2.9



Average DCP Index	2.2	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

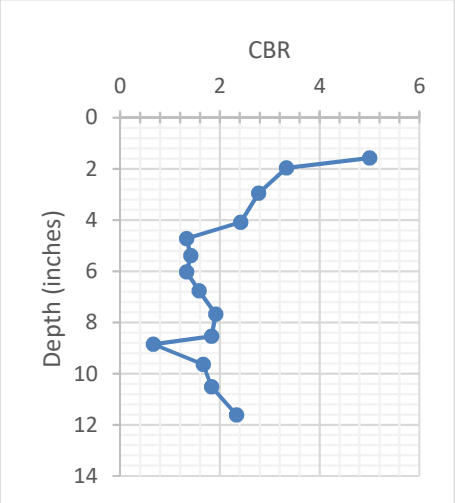
General Information

Road:	TH 11
Test No.	11-5
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.648846, -94.191014
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	85			
2	110	25	1.0	
3	125	15	1.6	5.0
3	135	10	2.0	3.3
9	160	25	3.0	2.8
12	189	29	4.1	2.4
12	205	16	4.7	1.3
12	222	17	5.4	1.4
12	238	16	6.0	1.3
12	257	19	6.8	1.6
12	280	23	7.7	1.9
12	302	22	8.5	1.8
12	310	8	8.9	0.7
12	330	20	9.6	1.7
12	352	22	10.5	1.8
12	380	28	11.6	2.3



Average DCP Index	2.1	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

Date of issue:
Reviewed By:

General Information

Road:	TH 11
Date Stabilized:	11-1
Date Tested:	7/30/2019
Days after stabilization:	-460

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 79F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
48.648454, -94.236720	1.946		
48.646759, -94.225612	2.057		
48.647400, -94.213781	2.273		
48.648494, -94.203496	2.208		
48.648846, -94.191014	2.103		

Average:	2.1
Standard deviation:	0.1
Design:	2.0

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

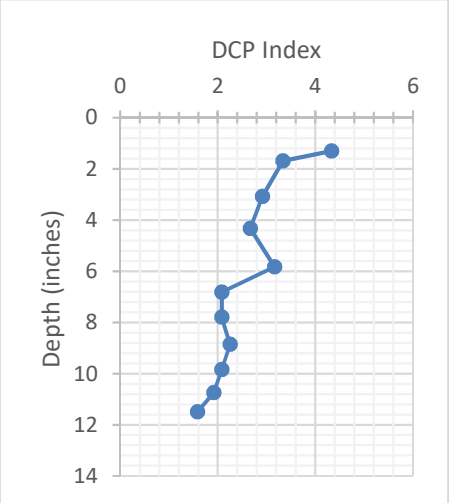
General Information

Road:	TH 32
Test No.	32-1
Date Tested:	7/22/2019

Tested by:	RS
Test Location:	47.3759881, -96.280737
Hammer Weight:	17.6 lbs
Weather:	Sunny, 80F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	72			
2	92	20	0.8	
3	105	13	1.3	4.3
3	115	10	1.7	3.3
12	150	35	3.1	2.9
12	182	32	4.3	2.7
12	220	38	5.8	3.2
12	245	25	6.8	2.1
12	270	25	7.8	2.1
12	297	27	8.9	2.3
12	322	25	9.8	2.1
12	345	23	10.7	1.9
12	364	19	11.5	1.6



Average DCP Index	2.6	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

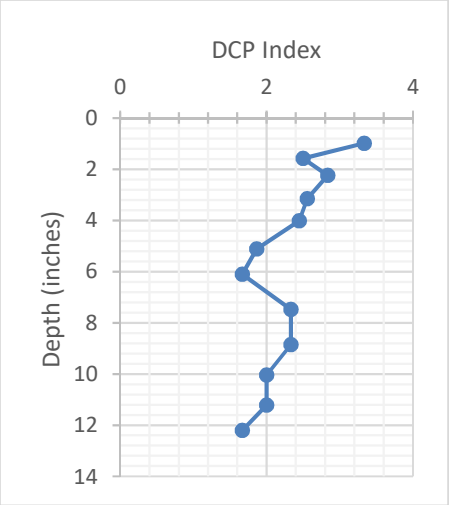
General Information

Road:	TH 32
Test No.	32-2
Date Tested:	7/22/2019

Tested by:	RS
Test Location:	47.3831674, -96.281057
Hammer Weight:	17.6 lbs
Weather:	Sunny, 80F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	90	15	0.6	
3	100	10	1.0	3.3
6	115	15	1.6	2.5
6	132	17	2.2	2.8
9	155	23	3.1	2.6
9	177	22	4.0	2.4
15	205	28	5.1	1.9
15	230	25	6.1	1.7
15	265	35	7.5	2.3
15	300	35	8.9	2.3
15	330	30	10.0	2.0
15	360	30	11.2	2.0
15	385	25	12.2	1.7



Average DCP Index	2.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

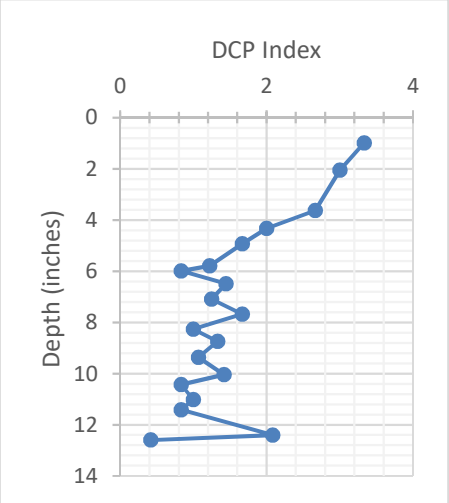
General Information

Road:	TH 32
Test No.	32-3
Date Tested:	7/22/2019

Tested by:	RS
Test Location:	47.390351, -96.281412
Hammer Weight:	17.6 lbs
Weather:	Sunny, 80F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	85	15	0.6	
3	95	10	1.0	3.3
9	122	27	2.0	3.0
15	162	40	3.6	2.7
9	180	18	4.3	2.0
9	195	15	4.9	1.7
18	217	22	5.8	1.2
6	222	5	6.0	0.8
9	235	13	6.5	1.4
12	250	15	7.1	1.3
9	265	15	7.7	1.7
15	280	15	8.3	1.0
9	292	12	8.7	1.3
15	308	16	9.4	1.1
12	325	17	10.0	1.4
12	335	10	10.4	0.8
15	350	15	11.0	1.0
12	360	10	11.4	0.8
12	385	25	12.4	2.1
12	390	5	12.6	0.4



Average DCP Index	1.5	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

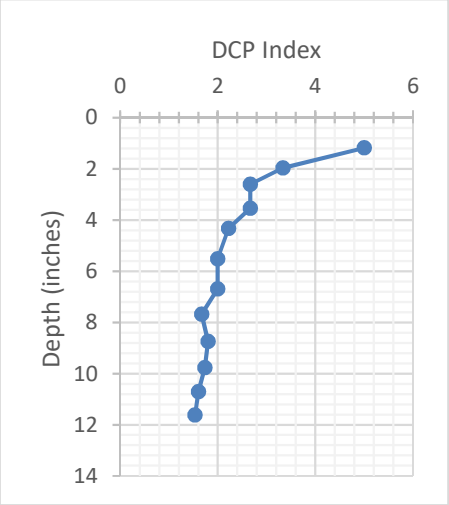
General Information

Road:	TH 32
Test No.	32-4
Date Tested:	7/22/2019

Tested by:	RS
Test Location:	47.3975329, -96.281761
Hammer Weight:	17.6 lbs
Weather:	Sunny, 80F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	85	15	0.6	
3	100	15	1.2	5.0
6	120	20	2.0	3.3
6	136	16	2.6	2.7
9	160	24	3.5	2.7
9	180	20	4.3	2.2
15	210	30	5.5	2.0
15	240	30	6.7	2.0
15	265	25	7.7	1.7
15	292	27	8.7	1.8
15	318	26	9.8	1.7
15	342	24	10.7	1.6
15	365	23	11.6	1.5



Average DCP Index	2.4	mm/blow

Comments

American Engineering Testing, Inc.
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550 Cleveland Ave N
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(651) 659-9001
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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

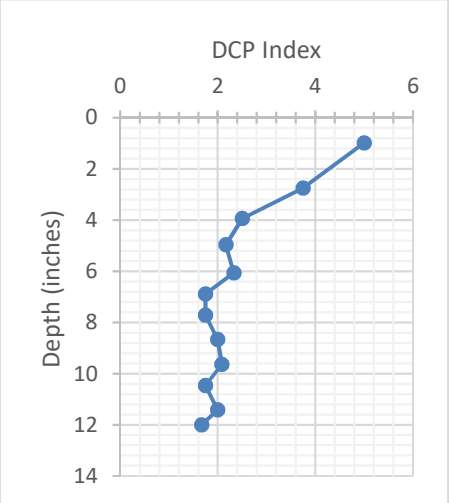
General Information

Road:	TH 32
Test No.	32-5
Date Tested:	7/22/2019

Tested by:	RS
Test Location:	47.4047202, -96.281548
Hammer Weight:	17.6 lbs
Weather:	Sunny, 80F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	80	10	0.4	
3	95	15	1.0	5.0
12	140	45	2.8	3.8
12	170	30	3.9	2.5
12	196	26	5.0	2.2
12	224	28	6.1	2.3
12	245	21	6.9	1.8
12	266	21	7.7	1.8
12	290	24	8.7	2.0
12	315	25	9.6	2.1
12	336	21	10.5	1.8
12	360	24	11.4	2.0
9	375	15	12.0	1.7



Average DCP Index	2.4	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 32 North

CC:

Date of issue:
Reviewed By:

General Information

Road:	TH 32
Date Stabilized:	32-1
Date Tested:	7/22/2019
Days after stabilization:	#VALUE!

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 80F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR		
47.3759881, -96.280737	2.6			Average:	2.2
47.3831674, -96.281057	2.3			Standard deviation:	0.4
47.390351, -96.281412	1.5			Design:	1.8
47.3975329, -96.281761	2.4				
47.4047202, -96.281548	2.4				

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

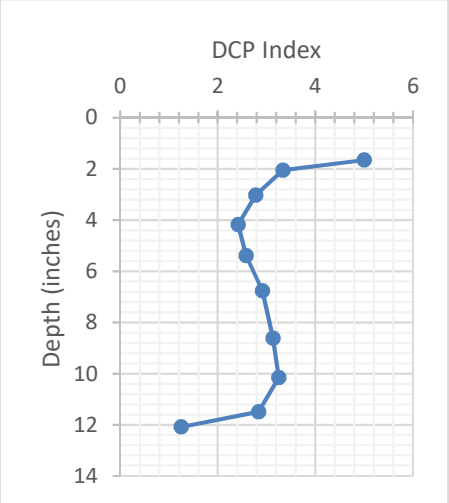
General Information

Road:	TH 55
Test No.	55-1
Date Tested:	7/22/2016

Tested by:	RS
Test Location:	45.7174036, -95.539210
Hammer Weight:	17.6 lbs
Weather:	Sunny, 83F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	68			
2	95	27	1.1	
3	110	15	1.7	5.0
3	120	10	2.0	3.3
9	145	25	3.0	2.8
12	174	29	4.2	2.4
12	205	31	5.4	2.6
12	240	35	6.8	2.9
15	287	47	8.6	3.1
12	326	39	10.2	3.3
12	360	34	11.5	2.8
12	375	15	12.1	1.3
2				



Average DCP Index	2.9	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

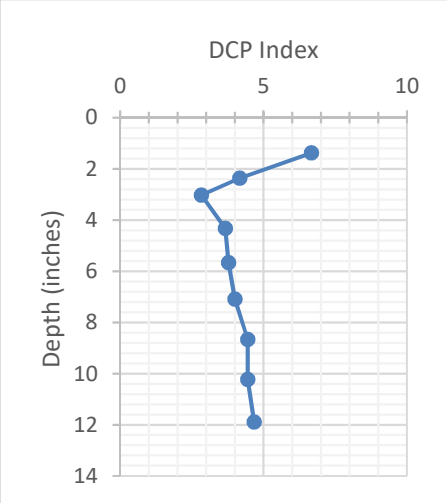
General Information

Road:	TH 55
Test No.	55-2
Date Tested:	7/18/2019

Tested by:	RS
Test Location:	45.7216562, -95.547534
Hammer Weight:	17.6 lbs
Weather:	Sunny, 83F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	95	15	0.6	
3	115	20	1.4	6.7
6	140	25	2.4	4.2
6	157	17	3.0	2.8
9	190	33	4.3	3.7
9	224	34	5.7	3.8
9	260	36	7.1	4.0
9	300	40	8.7	4.4
9	340	40	10.2	4.4
9	382	42	11.9	4.7



Average DCP Index	4.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

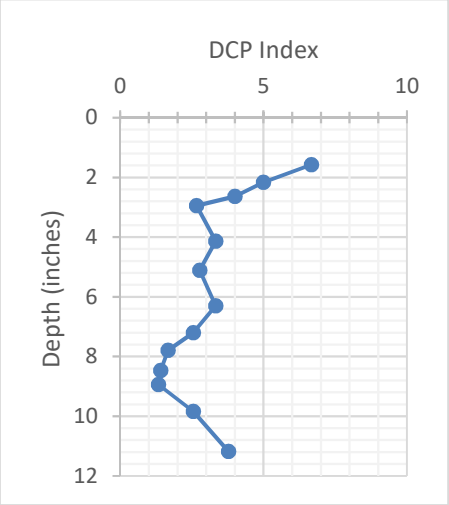
General Information

Road:	TH 55
Test No.	55-3
Date Tested:	7/18/2019

Tested by:	RS
Test Location:	45.7258976, -95.555850
Hammer Weight:	17.6 lbs
Weather:	Sunny, 83F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	90	20	0.8	
3	110	20	1.6	6.7
3	125	15	2.2	5.0
3	137	12	2.6	4.0
3	145	8	3.0	2.7
9	175	30	4.1	3.3
9	200	25	5.1	2.8
9	230	30	6.3	3.3
9	253	23	7.2	2.6
9	268	15	7.8	1.7
12	285	17	8.5	1.4
9	297	12	8.9	1.3
9	320	23	9.8	2.6
9	354	34	11.2	3.8



Average DCP Index	3.2	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

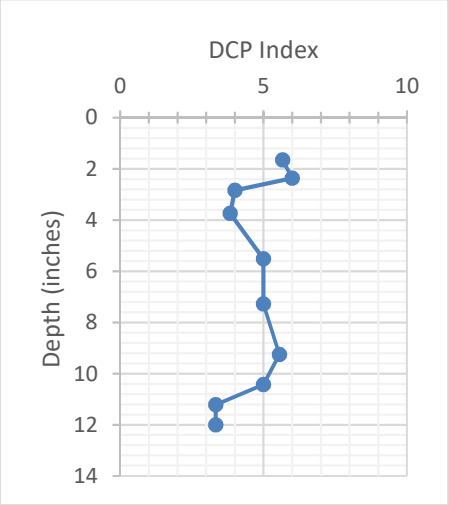
General Information

Road:	TH 55
Test No.	55-4
Date Tested:	7/18/2019

Tested by:	RS
Test Location:	45.7297974, -95.564482
Hammer Weight:	17.6 lbs
Weather:	Sunny, 83F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	95	25	1.0	
3	112	17	1.7	5.7
3	130	18	2.4	6.0
3	142	12	2.8	4.0
6	165	23	3.7	3.8
9	210	45	5.5	5.0
9	255	45	7.3	5.0
9	305	50	9.3	5.6
6	335	30	10.4	5.0
6	355	20	11.2	3.3
6	375	20	12.0	3.3



Average DCP Index	4.7	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

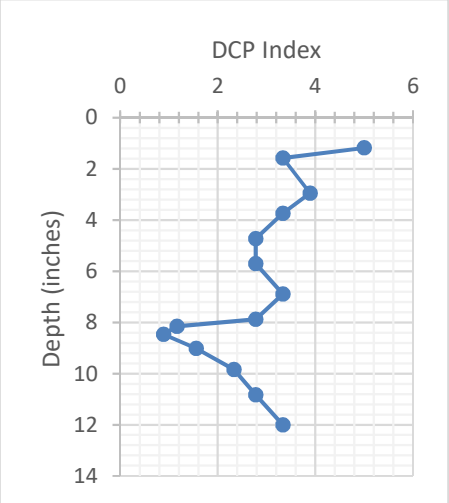
General Information

Road:	TH 55
Test No.	55-5
Date Tested:	7/18/2019

Tested by:	RS
Test Location:	45.7329562, -95.573741
Hammer Weight:	17.6 lbs
Weather:	Sunny, 83F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	90	15	0.6	
3	105	15	1.2	5.0
3	115	10	1.6	3.3
9	150	35	3.0	3.9
6	170	20	3.7	3.3
9	195	25	4.7	2.8
9	220	25	5.7	2.8
9	250	30	6.9	3.3
9	275	25	7.9	2.8
6	282	7	8.1	1.2
9	290	8	8.5	0.9
9	304	14	9.0	1.6
9	325	21	9.8	2.3
9	350	25	10.8	2.8
9	380	30	12.0	3.3



Average DCP Index	2.8	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 55 North

CC:

Date of issue:
Reviewed By:

General Information

Road:	55
Date Stabilized:	55-1
Date Tested:	7/18/2019
Days after stabilization:	#VALUE!

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 83F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
45.7174036, -95.539210	2.949		
45.7216562, -95.547534	4.296		
45.7258976, -95.555850	3.16		
45.7297974, -95.564482	4.672		
45.7329562, -95.573741	2.806		

Average:	3.6
Standard deviation:	0.8
Design:	2.7

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

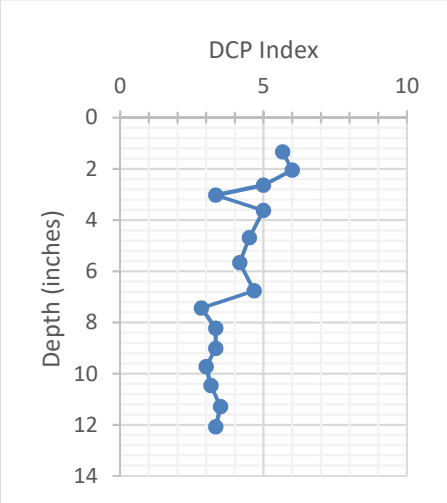
General Information

Road:	TH 59
Test No.	59-1
Date Tested:	7/22/2016

Tested by:	RS
Test Location:	45.2900244, -95.912035
Hammer Weight:	17.6 lbs
Weather:	Sunny, 92F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	78			
2	95	17	0.7	
3	112	17	1.3	5.7
3	130	18	2.0	6.0
3	145	15	2.6	5.0
3	155	10	3.0	3.3
3	170	15	3.6	5.0
6	197	27	4.7	4.5
6	222	25	5.7	4.2
6	250	28	6.8	4.7
6	267	17	7.4	2.8
6	287	20	8.2	3.3
6	307	20	9.0	3.3
6	325	18	9.7	3.0
6	344	19	10.5	3.2
6	365	21	11.3	3.5
6	385	20	12.1	3.3



Average DCP Index	4.1	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

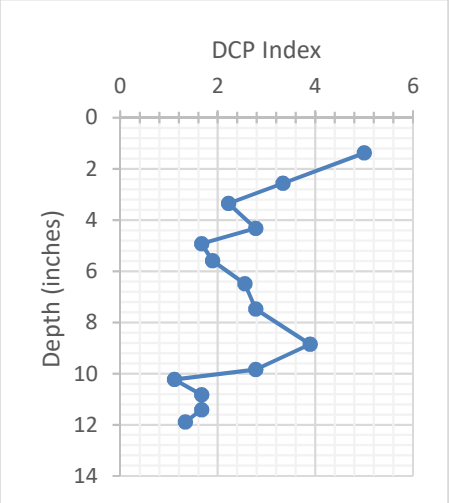
General Information

Road:	TH 59
Test No.	59-2
Date Tested:	7/22/2016

Tested by:	RS
Test Location:	45.2972384, -95.912013
Hammer Weight:	17.6 lbs
Weather:	Sunny, 92F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	100	20	0.8	
3	115	15	1.4	5.0
9	145	30	2.6	3.3
9	165	20	3.3	2.2
9	190	25	4.3	2.8
9	205	15	4.9	1.7
9	222	17	5.6	1.9
9	245	23	6.5	2.6
9	270	25	7.5	2.8
9	305	35	8.9	3.9
9	330	25	9.8	2.8
9	340	10	10.2	1.1
9	355	15	10.8	1.7
9	370	15	11.4	1.7
9	382	12	11.9	1.3



Average DCP Index	2.5	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

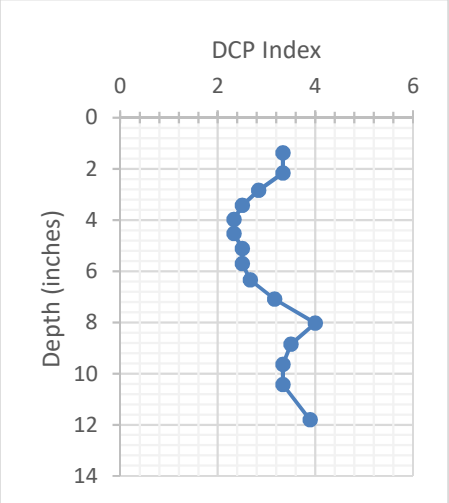
General Information

Road:	TH 59
Test No.	59-3
Date Tested:	7/19/2019

Tested by:	RS
Test Location:	45.304459, -95.911958
Hammer Weight:	17.6 lbs
Weather:	Sunny, 92F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	95	25	1.0	
3	105	10	1.4	3.3
6	125	20	2.2	3.3
6	142	17	2.8	2.8
6	157	15	3.4	2.5
6	171	14	4.0	2.3
6	185	14	4.5	2.3
6	200	15	5.1	2.5
6	215	15	5.7	2.5
6	231	16	6.3	2.7
6	250	19	7.1	3.2
6	274	24	8.0	4.0
6	295	21	8.9	3.5
6	315	20	9.6	3.3
6	335	20	10.4	3.3
9	370	35	11.8	3.9



Average DCP Index	3.0	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

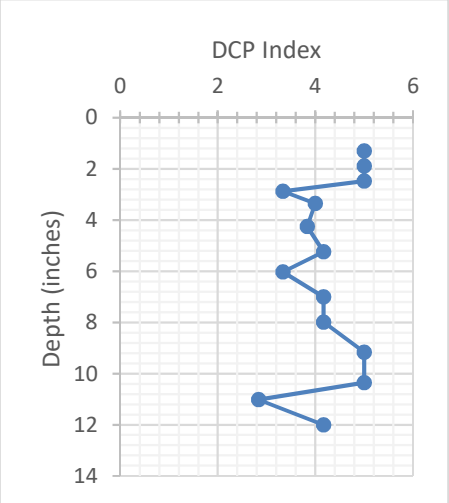
General Information

Road:	TH 59
Test No.	59-4
Date Tested:	7/19/2019

Tested by:	RS
Test Location:	45.3116708, -95911911
Hammer Weight:	17.6 lbs
Weather:	Sunny, 92F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	67			
2	85	18	0.7	
3	100	15	1.3	5.0
3	115	15	1.9	5.0
3	130	15	2.5	5.0
3	140	10	2.9	3.3
3	152	12	3.3	4.0
6	175	23	4.3	3.8
6	200	25	5.2	4.2
6	220	20	6.0	3.3
6	245	25	7.0	4.2
6	270	25	8.0	4.2
6	300	30	9.2	5.0
6	330	30	10.4	5.0
6	347	17	11.0	2.8
6	372	25	12.0	4.2



Average DCP Index	4.2	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

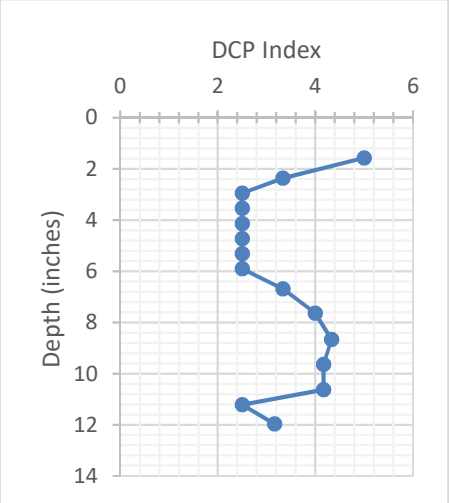
General Information

Road:	TH 59
Test No.	59-5
Date Tested:	7/19/2019

Tested by:	RS
Test Location:	45.3188898, -95.911859
Hammer Weight:	17.6 lbs
Weather:	Sunny, 92F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	95	25	1.0	
3	110	15	1.6	5.0
6	130	20	2.4	3.3
6	145	15	3.0	2.5
6	160	15	3.5	2.5
6	175	15	4.1	2.5
6	190	15	4.7	2.5
6	205	15	5.3	2.5
6	220	15	5.9	2.5
6	240	20	6.7	3.3
6	264	24	7.6	4.0
6	290	26	8.7	4.3
6	315	25	9.6	4.2
6	340	25	10.6	4.2
6	355	15	11.2	2.5
6	374	19	12.0	3.2
6				



Average DCP Index	3.3	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 59 North

CC:

Date of issue:
Reviewed By:

General Information

Road:	TH 59
Date Stabilized:	59-1
Date Tested:	7/18/2019
Days after stabilization:	#VALUE!

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 92F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
45.2900244, -95.912035	4.056		
45.2972384, -95.912013	2.476		
45.304459, -95.911958	3.037		
45.3116708, -95911911	4.214		
45.3188898, -95.911859	3.267		

Average:	3.4
Standard deviation:	0.7
Design:	2.7

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

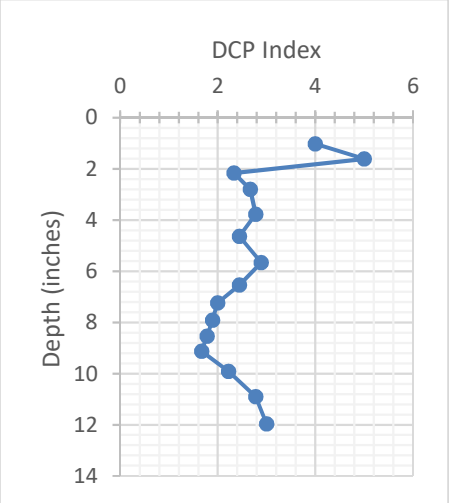
General Information

Road:	TH 62
Test No.	62-1
Date Tested:	7/17/2019

Tested by:	RS
Test Location:	48.8624446, -95.538800
Hammer Weight:	17.6 lbs
Weather:	Rain

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	79			
2	93	14	0.6	
3	105	12	1.0	4.0
3	120	15	1.6	5.0
6	134	14	2.2	2.3
6	150	16	2.8	2.7
9	175	25	3.8	2.8
9	197	22	4.6	2.4
9	223	26	5.7	2.9
9	245	22	6.5	2.4
9	263	18	7.2	2.0
9	280	17	7.9	1.9
9	296	16	8.5	1.8
9	311	15	9.1	1.7
9	331	20	9.9	2.2
9	356	25	10.9	2.8
9	383	27	12.0	3.0



Average DCP Index	2.7	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

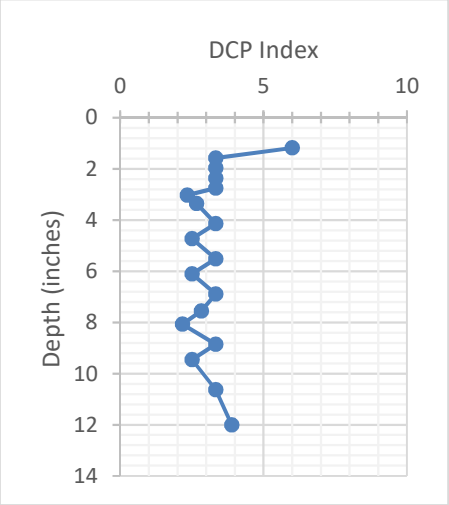
General Information

Road:	TH 62
Test No.	62-2
Date Tested:	7/17/2019

Tested by:	RS
Test Location:	43.8624622, -95.523822
Hammer Weight:	17.6 lbs
Weather:	Rain

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	92	12	0.5	
3	110	18	1.2	6.0
3	120	10	1.6	3.3
3	130	10	2.0	3.3
3	140	10	2.4	3.3
3	150	10	2.8	3.3
3	157	7	3.0	2.3
3	165	8	3.3	2.7
6	185	20	4.1	3.3
6	200	15	4.7	2.5
6	220	20	5.5	3.3
6	235	15	6.1	2.5
6	255	20	6.9	3.3
6	272	17	7.6	2.8
6	285	13	8.1	2.2
6	305	20	8.9	3.3
6	320	15	9.4	2.5
9	350	30	10.6	3.3
9	385	35	12.0	3.9



Average DCP Index	3.2	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

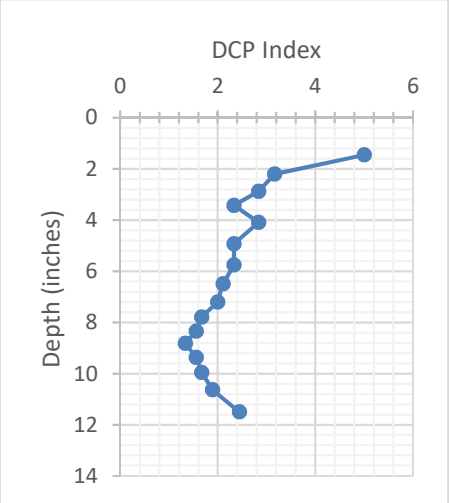
General Information

Road:	TH 62
Test No.	62-3
Date Tested:	7/17/2019

Tested by:	RS
Test Location:	43.8624751, -95.513852
Hammer Weight:	17.6 lbs
Weather:	Rain

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	68			
2	90	22	0.9	
3	105	15	1.5	5.0
6	124	19	2.2	3.2
6	141	17	2.9	2.8
6	155	14	3.4	2.3
6	172	17	4.1	2.8
9	193	21	4.9	2.3
9	214	21	5.7	2.3
9	233	19	6.5	2.1
9	251	18	7.2	2.0
9	266	15	7.8	1.7
9	280	14	8.3	1.6
9	292	12	8.8	1.3
9	306	14	9.4	1.6
9	321	15	10.0	1.7
9	338	17	10.6	1.9
9	360	22	11.5	2.4



Average DCP Index	2.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

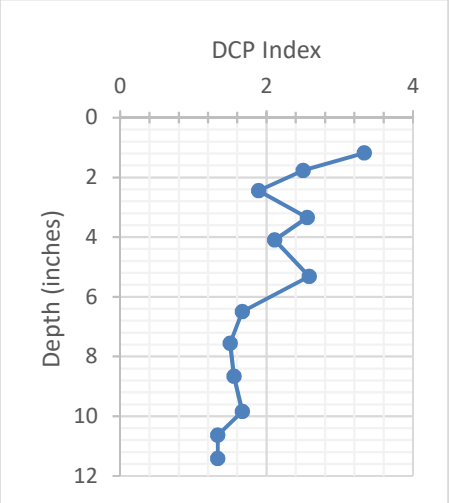
General Information

Road:	TH 62
Test No.	62-4
Date Tested:	7/17/2019

Tested by:	RS
Test Location:	43.8624854, -95.503878
Hammer Weight:	17.6 lbs
Weather:	Rain

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	100	20	0.8	
3	110	10	1.2	3.3
6	125	15	1.8	2.5
9	142	17	2.4	1.9
9	165	23	3.3	2.6
9	184	19	4.1	2.1
12	215	31	5.3	2.6
18	245	30	6.5	1.7
18	272	27	7.6	1.5
18	300	28	8.7	1.6
18	330	30	9.8	1.7
15	350	20	10.6	1.3
15	370	20	11.4	1.3



Average DCP Index	2.0	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

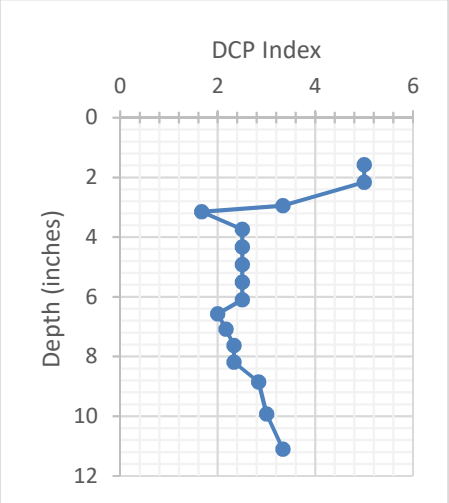
General Information

Road:	TH 62
Test No.	62-5
Date Tested:	7/17/2019

Tested by:	RS
Test Location:	43.8624817, -95.493895
Hammer Weight:	17.6 lbs
Weather:	Rain

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	95	25	1.0	
3	110	15	1.6	5.0
3	125	15	2.2	5.0
6	145	20	3.0	3.3
3	150	5	3.1	1.7
6	165	15	3.7	2.5
6	180	15	4.3	2.5
6	195	15	4.9	2.5
6	210	15	5.5	2.5
6	225	15	6.1	2.5
6	237	12	6.6	2.0
6	250	13	7.1	2.2
6	264	14	7.6	2.3
6	278	14	8.2	2.3
6	295	17	8.9	2.8
9	322	27	9.9	3.0
9	352	30	11.1	3.3



Average DCP Index	2.8	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 62 East

CC:

Date of issue:
Reviewed By:

General Information

Road:	62
Date Stabilized:	62-1
Date Tested:	7/17/2019
Days after stabilization:	#VALUE!

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Rain

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
48.8624446, -95.538800	2.659		
43.8624622, -95.523822	3.188		
43.8624751, -95.513852	2.316		
43.8624854, -95.503878	2.002		
43.8624817, -95.493895	2.844		

Average:	2.6
Standard deviation:	0.5
Design:	2.1

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

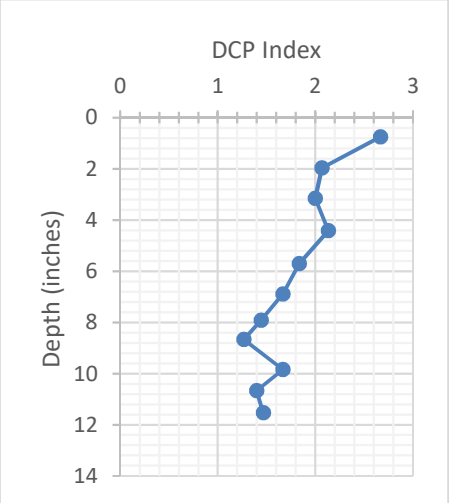
General Information

Road:	TH 71
Test No.	71-1
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.098223, -93.931970
Hammer Weight:	17.6 lbs
Weather:	Sunny, 74F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	86	11	0.4	
3	94	8	0.7	2.7
15	125	31	2.0	2.1
15	155	30	3.1	2.0
15	187	32	4.4	2.1
18	220	33	5.7	1.8
18	250	30	6.9	1.7
18	276	26	7.9	1.4
15	295	19	8.7	1.3
18	325	30	9.8	1.7
15	346	21	10.7	1.4
15	368	22	11.5	1.5



Average DCP Index	1.8	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

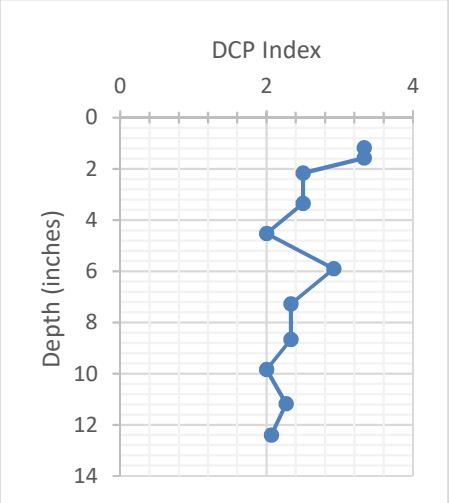
General Information

Road:	TH 71
Test No.	71-2
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.103968, -93925898
Hammer Weight:	17.6 lbs
Weather:	Sunny, 74F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	100	20	0.8	
3	110	10	1.2	3.3
3	120	10	1.6	3.3
6	135	15	2.2	2.5
12	165	30	3.3	2.5
15	195	30	4.5	2.0
12	230	35	5.9	2.9
15	265	35	7.3	2.3
15	300	35	8.7	2.3
15	330	30	9.8	2.0
15	364	34	11.2	2.3
15	395	31	12.4	2.1



Average DCP Index	2.5	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

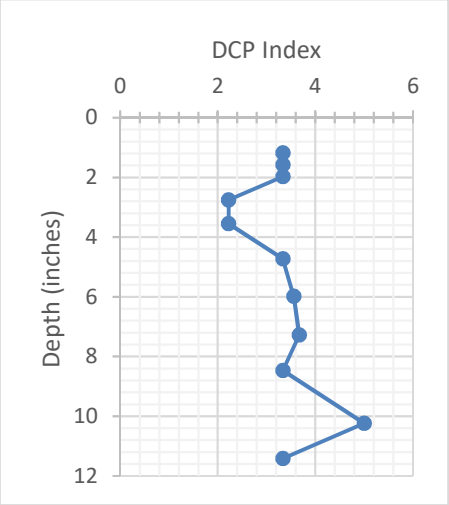
General Information

Road:	TH 71
Test No.	71-3
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.108173, -93.916704
Hammer Weight:	17.6 lbs
Weather:	Sunny, 74F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	95	20	0.8	
3	105	10	1.2	3.3
3	115	10	1.6	3.3
3	125	10	2.0	3.3
9	145	20	2.8	2.2
9	165	20	3.5	2.2
9	195	30	4.7	3.3
9	227	32	6.0	3.6
9	260	33	7.3	3.7
9	290	30	8.5	3.3
9	335	45	10.2	5.0
9	365	30	11.4	3.3



Average DCP Index	3.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

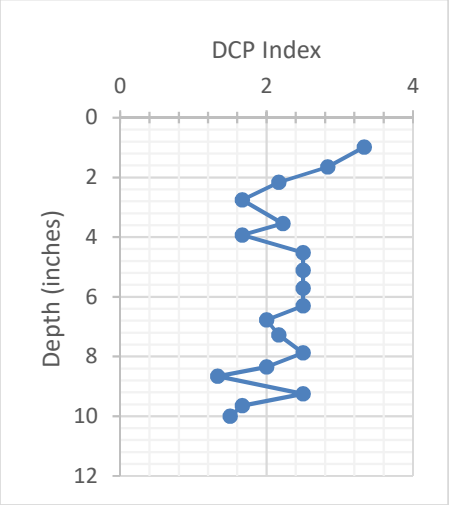
General Information

Road:	TH 71
Test No.	71-4
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.113590, -93909336
Hammer Weight:	17.6 lbs
Weather:	Sunny, 74F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	95	15	0.6	
3	105	10	1.0	3.3
6	122	17	1.7	2.8
6	135	13	2.2	2.2
9	150	15	2.8	1.7
9	170	20	3.5	2.2
6	180	10	3.9	1.7
6	195	15	4.5	2.5
6	210	15	5.1	2.5
6	225	15	5.7	2.5
6	240	15	6.3	2.5
6	252	12	6.8	2.0
6	265	13	7.3	2.2
6	280	15	7.9	2.5
6	292	12	8.3	2.0
6	300	8	8.7	1.3
6	315	15	9.3	2.5
6	325	10	9.6	1.7
6	334	9	10.0	1.5



Average DCP Index	2.2	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

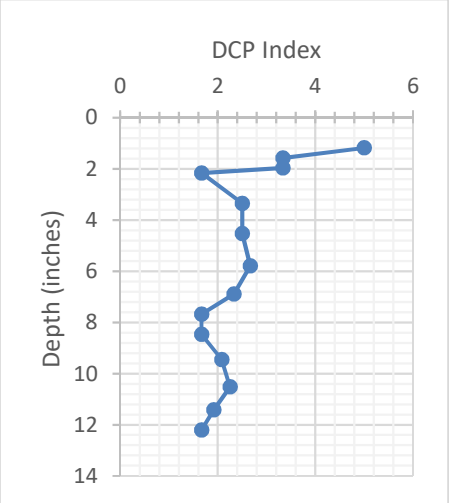
General Information

Road:	TH 71
Test No.	71-5
Date Tested:	7/30/2019

Tested by:	RS
Test Location:	48.118232, -93.899777
Hammer Weight:	17.6 lbs
Weather:	Sunny, 74F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	90	15	0.6	
3	105	15	1.2	5.0
3	115	10	1.6	3.3
3	125	10	2.0	3.3
3	130	5	2.2	1.7
12	160	30	3.3	2.5
12	190	30	4.5	2.5
12	222	32	5.8	2.7
12	250	28	6.9	2.3
12	270	20	7.7	1.7
12	290	20	8.5	1.7
12	315	25	9.4	2.1
12	342	27	10.5	2.3
12	365	23	11.4	1.9
12	385	20	12.2	1.7



Average DCP Index	2.5	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 71 NE

CC:

Date of issue:
Reviewed By:

General Information

Road:	TH 71
Date Stabilized:	71-1
Date Tested:	7/30/2019
Days after stabilization:	#VALUE!

Tested by:	Rel Seykora
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 74F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
48.098223, -93.931970	1.783		
48.103968, -93925898	2.508		
48.108173, -93.916704	3.333		
48.113590, -93909336	2.198		
48.118232, -93.899777	2.47		

Average:	2.5
Standard deviation:	0.6
Design:	1.9

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

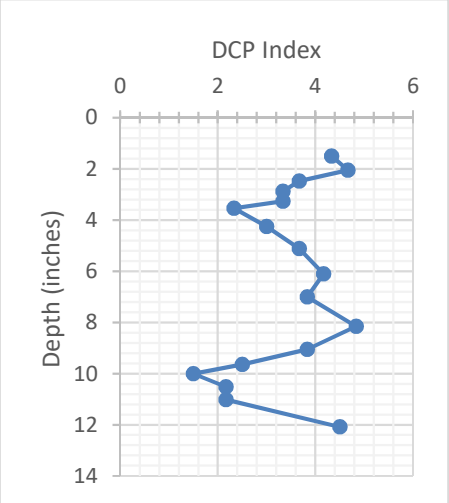
General Information

Road:	TH 83
Test No.	83-1
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.9293175, -93.698210
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	67			
2	92	25	1.0	
3	105	13	1.5	4.3
3	119	14	2.0	4.7
3	130	11	2.5	3.7
3	140	10	2.9	3.3
3	150	10	3.3	3.3
3	157	7	3.5	2.3
6	175	18	4.3	3.0
6	197	22	5.1	3.7
6	222	25	6.1	4.2
6	245	23	7.0	3.8
6	274	29	8.1	4.8
6	297	23	9.1	3.8
6	312	15	9.6	2.5
6	321	9	10.0	1.5
6	334	13	10.5	2.2
6	347	13	11.0	2.2
6	374	27	12.1	4.5



Average DCP Index	3.4	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

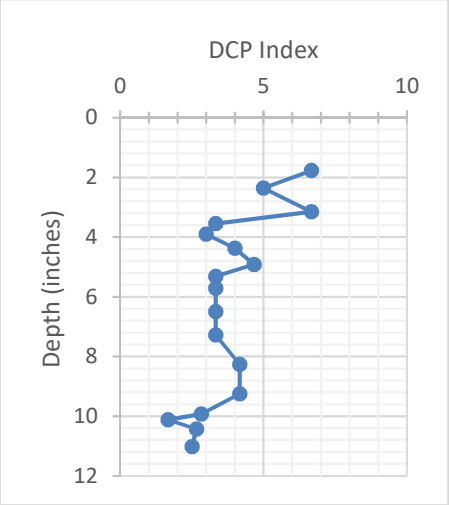
General Information

Road:	TH 83
Test No.	83-2
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.9221416, -93.697599
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	100	25	1.0	
3	120	20	1.8	6.7
3	135	15	2.4	5.0
3	155	20	3.1	6.7
3	165	10	3.5	3.3
3	174	9	3.9	3.0
3	186	12	4.4	4.0
3	200	14	4.9	4.7
3	210	10	5.3	3.3
3	220	10	5.7	3.3
6	240	20	6.5	3.3
6	260	20	7.3	3.3
6	285	25	8.3	4.2
6	310	25	9.3	4.2
6	327	17	9.9	2.8
3	332	5	10.1	1.7
3	340	8	10.4	2.7
6	355	15	11.0	2.5



Average DCP Index	3.8	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

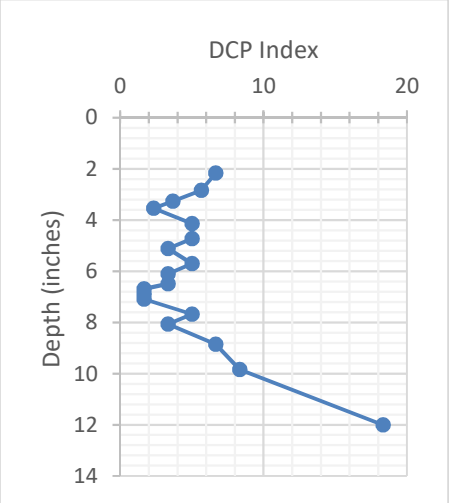
General Information

Road:	TH 83
Test No.	83-3
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.9149320, -93.697750
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	110	35	1.4	
3	130	20	2.2	6.7
3	147	17	2.8	5.7
3	158	11	3.3	3.7
3	165	7	3.5	2.3
3	180	15	4.1	5.0
3	195	15	4.7	5.0
3	205	10	5.1	3.3
3	220	15	5.7	5.0
3	230	10	6.1	3.3
3	240	10	6.5	3.3
3	245	5	6.7	1.7
3	250	5	6.9	1.7
3	255	5	7.1	1.7
3	270	15	7.7	5.0
3	280	10	8.1	3.3
3	300	20	8.9	6.7
3	325	25	9.8	8.3
3	380	55	12.0	18.3



Average DCP Index	5.0	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

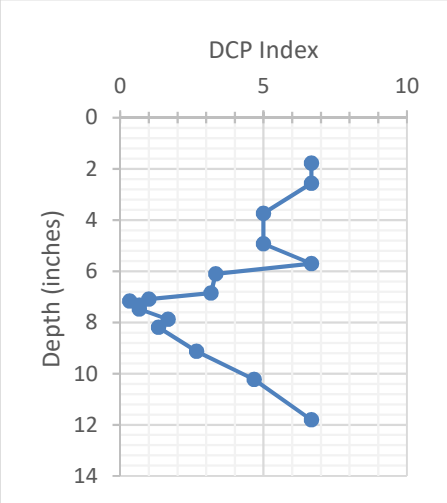
General Information

Road:	TH 83
Test No.	83-4
Date Tested:	7/16/2019

Tested by:	RS
Test Location:	43.9077229, -93.697636
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	95	25	1.0	
3	115	20	1.8	6.7
3	135	20	2.6	6.7
6	165	30	3.7	5.0
6	195	30	4.9	5.0
3	215	20	5.7	6.7
3	225	10	6.1	3.3
6	244	19	6.9	3.2
6	250	6	7.1	1.0
6	252	2	7.2	0.3
6	256	4	7.3	0.7
6	260	4	7.5	0.7
6	270	10	7.9	1.7
6	278	8	8.2	1.3
9	302	24	9.1	2.7
6	330	28	10.2	4.7
6	370	40	11.8	6.7



Average DCP Index	3.5	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

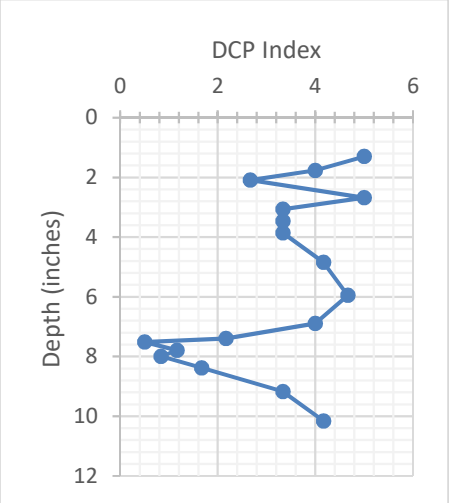
General Information

Road:	TH 83
Test No.	83-5
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.9005092, -93.697411
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	82			
2	100	18	0.7	
3	115	15	1.3	5.0
3	127	12	1.8	4.0
3	135	8	2.1	2.7
3	150	15	2.7	5.0
3	160	10	3.1	3.3
3	170	10	3.5	3.3
3	180	10	3.9	3.3
6	205	25	4.8	4.2
6	233	28	5.9	4.7
6	257	24	6.9	4.0
6	270	13	7.4	2.2
6	273	3	7.5	0.5
6	280	7	7.8	1.2
6	285	5	8.0	0.8
6	295	10	8.4	1.7
6	315	20	9.2	3.3
6	340	25	10.2	4.2



Average DCP Index	3.1	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 83 South

CC:

Date of issue:
Reviewed By:

General Information

Road:	83
Date Stabilized:	83-1
Date Tested:	7/16/2019
Days after stabilization:	#VALUE!

Tested by:	Rel Seykora
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
43.9293175, -93.698210	3.402		
43.9221416, -93.697599	3.804		
43.9149320, -93.697750	5		
43.9077229, -93.697636	3.51		
43.9005092, -93.697411	3.137		

Average:	3.8
Standard deviation:	0.7
Design:	3.0

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

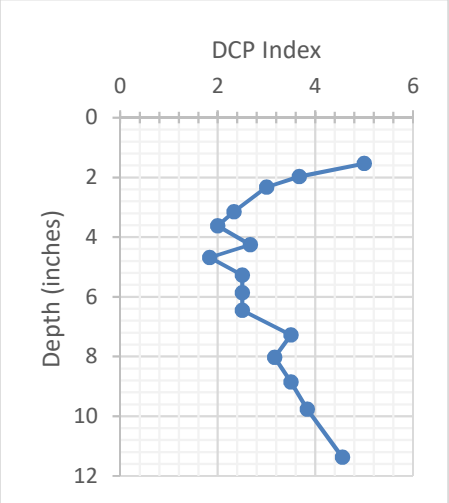
General Information

Road:	TH 109
Test No.	109-1
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.7605718, -93.997369
Hammer Weight:	17.6 lbs
Weather:	Sunny, 75F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	76			
2	100	24	0.9	
3	115	15	1.5	5.0
3	126	11	2.0	3.7
3	135	9	2.3	3.0
9	156	21	3.1	2.3
6	168	12	3.6	2.0
6	184	16	4.3	2.7
6	195	11	4.7	1.8
6	210	15	5.3	2.5
6	225	15	5.9	2.5
6	240	15	6.5	2.5
6	261	21	7.3	3.5
6	280	19	8.0	3.2
6	301	21	8.9	3.5
6	324	23	9.8	3.8
9	365	41	11.4	4.6



Average DCP Index	3.1	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

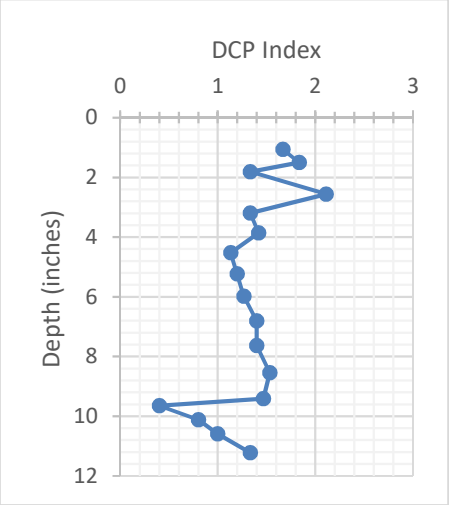
General Information

Road:	TH 109
Test No.	109-2
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.7605414, -94.007325
Hammer Weight:	17.6 lbs
Weather:	Sunny, 75F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	92	22	0.9	
3	97	5	1.1	1.7
6	108	11	1.5	1.8
6	116	8	1.8	1.3
9	135	19	2.6	2.1
12	151	16	3.2	1.3
12	168	17	3.9	1.4
15	185	17	4.5	1.1
15	203	18	5.2	1.2
15	222	19	6.0	1.3
15	243	21	6.8	1.4
15	264	21	7.6	1.4
15	287	23	8.5	1.5
15	309	22	9.4	1.5
15	315	6	9.6	0.4
15	327	12	10.1	0.8
12	339	12	10.6	1.0
12	355	16	11.2	1.3



Average DCP Index	1.3	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

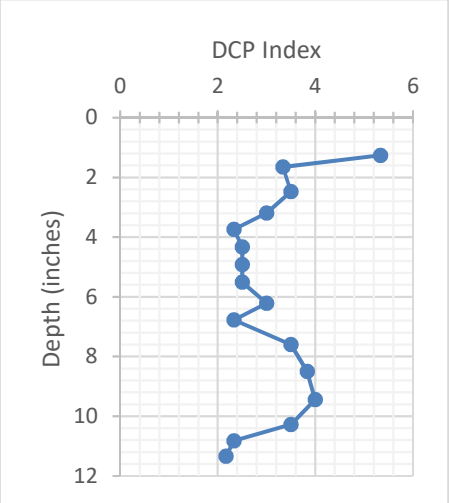
General Information

Road:	TH 109
Test No.	109-3
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.7604880, -94.017292
Hammer Weight:	17.6 lbs
Weather:	Sunny, 75F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	72			
2	88	16	0.6	
3	104	16	1.3	5.3
3	114	10	1.7	3.3
6	135	21	2.5	3.5
6	153	18	3.2	3.0
6	167	14	3.7	2.3
6	182	15	4.3	2.5
6	197	15	4.9	2.5
6	212	15	5.5	2.5
6	230	18	6.2	3.0
6	244	14	6.8	2.3
6	265	21	7.6	3.5
6	288	23	8.5	3.8
6	312	24	9.4	4.0
6	333	21	10.3	3.5
6	347	14	10.8	2.3
6	360	13	11.3	2.2



Average DCP Index	3.1	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

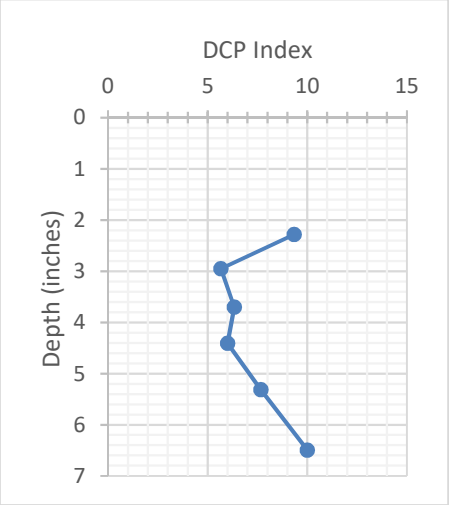
General Information

Road:	TH 109
Test No.	109-4
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.7604950, -94.027231
Hammer Weight:	17.6 lbs
Weather:	Sunny, 75F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	100	30	1.2	
3	128	28	2.3	9.3
3	145	17	3.0	5.7
3	164	19	3.7	6.3
3	182	18	4.4	6.0
3	205	23	5.3	7.7
3	235	30	6.5	10.0



Average DCP Index	7.5	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

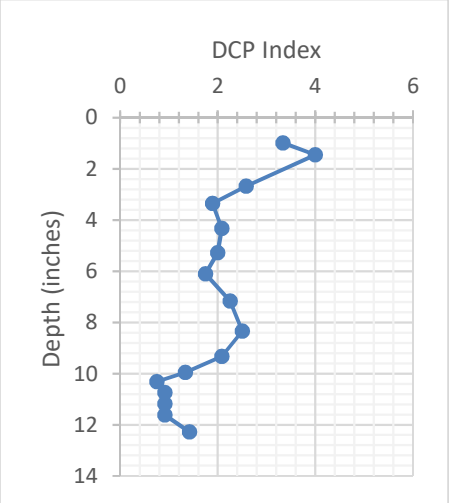
General Information

Road:	TH 109
Test No.	109-5
Date Tested:	7/24/2019

Tested by:	RS
Test Location:	43.7605007, -94.037183
Hammer Weight:	17.6 lbs
Weather:	Sunny, 75F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	70			
2	85	15	0.6	
3	95	10	1.0	3.3
3	107	12	1.5	4.0
12	138	31	2.7	2.6
9	155	17	3.3	1.9
12	180	25	4.3	2.1
12	204	24	5.3	2.0
12	225	21	6.1	1.8
12	252	27	7.2	2.3
12	282	30	8.3	2.5
12	307	25	9.3	2.1
12	323	16	10.0	1.3
12	332	9	10.3	0.8
12	343	11	10.7	0.9
12	354	11	11.2	0.9
12	365	11	11.6	0.9
12	382	17	12.3	1.4



Average DCP Index	1.9	mm/blow

Comments

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Material Test Report

Client: MNDOT
Project: 27-20000
TH 109 West

CC:

Date of issue:
Reviewed By:

General Information

Road:	109
Date Stabilized:	109-1
Date Tested:	7/24/2019
Days after stabilization:	#VALUE!

Tested by:	RS
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Sunny, 75F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
43.7605718, -93.997369	3.104		
43.7605414, -94.007325	1.331		
43.7604880, -94.017292	3.104		
43.7604950, -94.027231	7.5		
43.7605007, -94.037183	1.92		

Average:	3.4
Standard deviation:	2.4
Design:	1.0

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

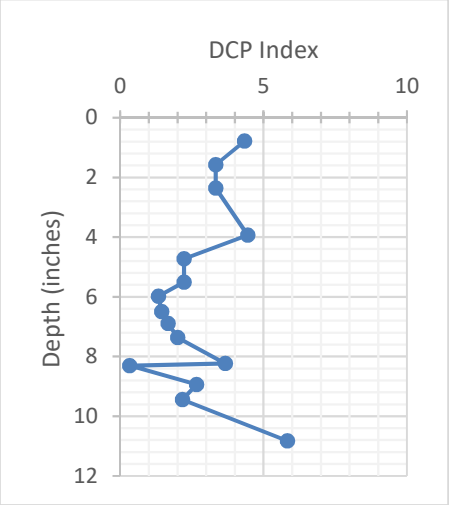
General Information

Road:	TH 238
Test No.	238-1
Date Tested:	7/29/2019

Tested by:	RS
Test Location:	45.7239862, -94.593792
Hammer Weight:	17.6 lbs
Weather:	Overcast, 70F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	85			
2	92	7	0.3	
3	105	13	0.8	4.3
6	125	20	1.6	3.3
6	145	20	2.4	3.3
9	185	40	3.9	4.4
9	205	20	4.7	2.2
9	225	20	5.5	2.2
9	237	12	6.0	1.3
9	250	13	6.5	1.4
6	260	10	6.9	1.7
6	272	12	7.4	2.0
6	294	22	8.2	3.7
6	296	2	8.3	0.3
6	312	16	8.9	2.7
6	325	13	9.4	2.2
6	360	35	10.8	5.8



Average DCP Index	2.7	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

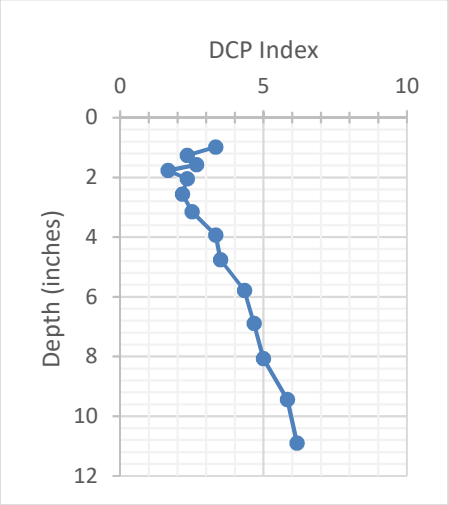
General Information

Road:	TH 238
Test No.	238-2
Date Tested:	7/29/2019

Tested by:	RS
Test Location:	45.709007, -94.602747
Hammer Weight:	17.6 lbs
Weather:	Overcast, 70F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	90			
2	105	15	0.6	
3	115	10	1.0	3.3
3	122	7	1.3	2.3
3	130	8	1.6	2.7
3	135	5	1.8	1.7
3	142	7	2.0	2.3
6	155	13	2.6	2.2
6	170	15	3.1	2.5
6	190	20	3.9	3.3
6	211	21	4.8	3.5
6	237	26	5.8	4.3
6	265	28	6.9	4.7
6	295	30	8.1	5.0
6	330	35	9.4	5.8
6	367	37	10.9	6.2



Average DCP Index	3.6	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

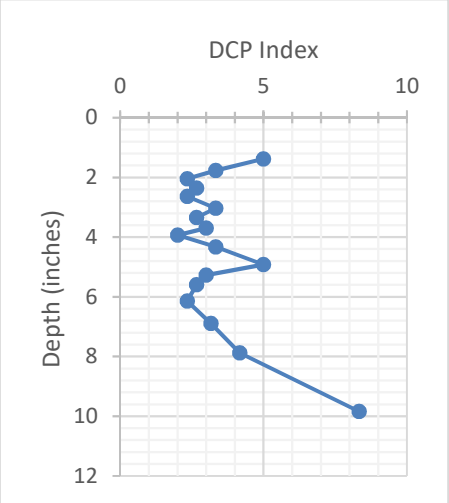
General Information

Road:	TH 238
Test No.	238-3
Date Tested:	7/29/2019

Tested by:	RS
Test Location:	45.700779, -94.605120
Hammer Weight:	17.6 lbs
Weather:	Overcast, 70F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	90			
2	110	20	0.8	
3	125	15	1.4	5.0
3	135	10	1.8	3.3
3	142	7	2.0	2.3
3	150	8	2.4	2.7
3	157	7	2.6	2.3
3	167	10	3.0	3.3
3	175	8	3.3	2.7
3	184	9	3.7	3.0
3	190	6	3.9	2.0
3	200	10	4.3	3.3
3	215	15	4.9	5.0
3	224	9	5.3	3.0
3	232	8	5.6	2.7
6	246	14	6.1	2.3
6	265	19	6.9	3.2
6	290	25	7.9	4.2
6	340	50	9.8	8.3



Average DCP Index	3.5	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

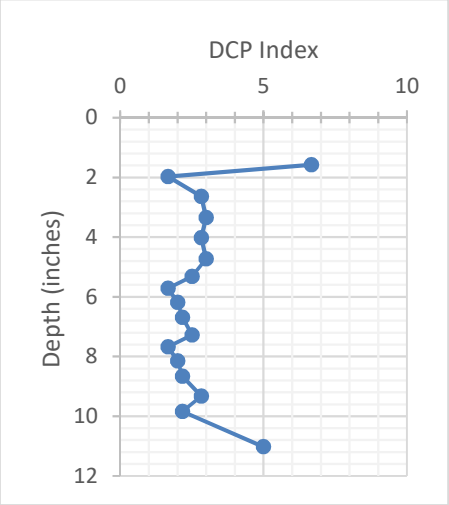
General Information

Road:	TH 238
Test No.	238-4
Date Tested:	7/29/2019

Tested by:	RS
Test Location:	45.688692, -94.604301
Hammer Weight:	17.6 lbs
Weather:	Overcast, 70F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	75			
2	95	20	0.8	
3	115	20	1.6	6.7
6	125	10	2.0	1.7
6	142	17	2.6	2.8
6	160	18	3.3	3.0
6	177	17	4.0	2.8
6	195	18	4.7	3.0
6	210	15	5.3	2.5
6	220	10	5.7	1.7
6	232	12	6.2	2.0
6	245	13	6.7	2.2
6	260	15	7.3	2.5
6	270	10	7.7	1.7
6	282	12	8.1	2.0
6	295	13	8.7	2.2
6	312	17	9.3	2.8
6	325	13	9.8	2.2
6	355	30	11.0	5.0



Average DCP Index	2.7	mm/blow

Comments

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Material Test Report

Client: Office of Materials and Road Research **CC:**
Project: MnDOT Contract No. 1031051

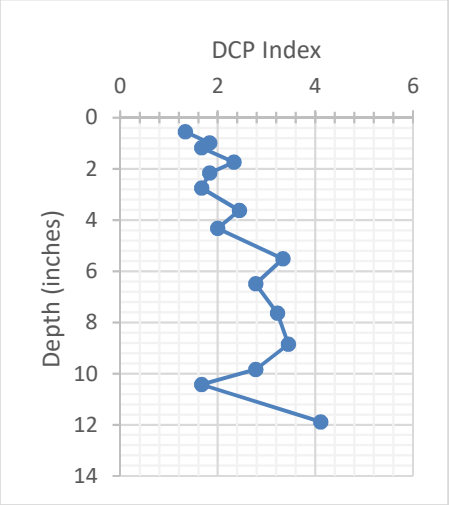
General Information

Road:	TH 238
Test No.	238-5
Date Tested:	7/29/2019

Tested by:	RS
Test Location:	45.681660, -94.603741
Hammer Weight:	17.6 lbs
Weather:	Overcast, 70F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Number of Blows	DCP Readings (mm)	Difference (mm)	Depth (in)	DCP Index (mm/blow)
	80			
2	90	10	0.4	
3	94	4	0.6	1.3
6	105	11	1.0	1.8
3	110	5	1.2	1.7
6	124	14	1.7	2.3
6	135	11	2.2	1.8
9	150	15	2.8	1.7
9	172	22	3.6	2.4
9	190	18	4.3	2.0
9	220	30	5.5	3.3
9	245	25	6.5	2.8
9	274	29	7.6	3.2
9	305	31	8.9	3.4
9	330	25	9.8	2.8
9	345	15	10.4	1.7
9	382	37	11.9	4.1



Average DCP Index	2.4	mm/blow

Comments

American Engineering Testing, Inc.
Saint Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364
www.amengtest.com

Material Test Report

Client: MNDOT
Project: 27-20000
TH 238 North

CC:

Date of issue:
Reviewed By:

General Information

Road:	238
Date Stabilized:	238-1
Date Tested:	7/29/2019
Days after stabilization:	#VALUE!

Tested by:	Rel Seykora
Test Location:	See below
Hammer Weight:	17.6 lbs
Weather:	Overcast, 70F

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
45.7239862, -94.593792	2.733		
45.709007, -94.602747	3.56		
45.700779, -94.605120	3.451		
45.688692, -94.604301	2.745		
45.681660, -94.603741	2.43		

Average:	3.0
Standard deviation:	0.5
Design:	2.5

Comments

For all soils except CL<10 CBR and CH soils, CBR=292/(DPI^1.12). For CL<10, CBR=1/((0.017019*DPI)^2. For CH soils CBR=1/(0.002871*DPI).

APPENDIX C: TONN2010 ANALYSIS SHEETS BY LOCATION

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	57
Min. Temp. °F	61
Avg. Temp. ° F	59

HMA Thickness (inches)

5 Fill

Base Thickness (inches)

9 Fill

Design ESALs

1,000,000 Fill

County

McLeod
Mahnomen
Marshall

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

3 - ADT 1000-3000 HCADT 50-150 Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
6/19/2019				96.8	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
Mn Road	0.100	Aid	Aid	3.100	0	Aid	TH 1 EB	0	Increasing	48.1952, -96.7167	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	23.2	**9.7**	504,872	61,745	**17,173**	14.2	**26**
Average	25.3	10.4	504,872	61,745	17,173	14.2	33
Std. Dev.	2.00	0.68	138,137	18,912	2,522	1.8	6

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.10	5.0	P	3	9.0	1,000,000	22.3	11.3	433,055	65,325	22,567	12	47
0.20	5.0	P	3	9.0	1,000,000	24.3	11.1	382,018	84,509	19,581	13	39
0.32	5.0	P	3	9.0	1,000,000	22.9	10.7	380,485	67,088	19,917	13	40
0.40	5.0	P	3	9.0	1,000,000	23.2	9.9	576,563	25,881	17,562	17	34
0.50	5.0	P	3	9.0	1,000,000	25.3	10.5	631,704	43,436	17,941	14	35
0.61	5.0	P	3	9.0	1,000,000	23.7	10.8	335,517	92,734	17,619	13	34
0.70	5.0	P	3	9.0	1,000,000	22.3	11.1	437,739	63,135	21,810	13	45
0.80	5.0	P	3	9.0	1,000,000	25.3	10.4	649,867	42,129	17,401	14	34
0.90	5.0	P	3	9.0	1,000,000	27.5	10.9	596,155	72,461	16,790	13	32
1.00	5.0	P	3	9.0	1,000,000	27.7	9.9	599,099	53,858	14,202	15	26
1.10	5.0	P	3	9.0	1,000,000	27.7	9.8	539,364	55,477	14,439	15	27
1.20	5.0	P	3	9.0	1,000,000	25.9	11.2	709,309	48,078	19,858	13	40
1.30	5.0	P	3	9.0	1,000,000	29.3	10.4	626,414	69,131	14,434	14	27
1.40	5.0	P	3	9.0	1,000,000	26.1	11.1	727,407	46,948	19,391	13	39
1.50	5.0	P	3	9.0	1,000,000	26.5	10.6	645,274	51,041	17,632	14	34
1.60	5.0	P	3	9.0	1,000,000	26.5	10.9	608,602	66,420	17,287	13	33
1.70	5.0	P	3	9.0	1,000,000	26.9	11.2	625,720	76,735	17,780	12	35
1.80	5.0	P	3	9.0	1,000,000	26.0	9.2	511,747	40,023	13,826	17	25
1.90	5.0	P	3	9.0	1,000,000	27.9	9.7	557,725	55,018	13,530	16	25
2.00	5.0	P	3	9.0	1,000,000	27.8	10.3	609,685	58,742	15,289	14	29
2.10	5.0	P	3	9.0	1,000,000	23.3	10.6	349,461	79,274	18,368	13	36
2.20	5.0	P	3	9.0	1,000,000	25.1	10.0	608,170	33,107	17,001	16	33
2.30	5.0	P	3	9.0	1,000,000	23.5	10.0	325,216	66,398	17,282	15	33
2.40	5.0	P	3	9.0	1,000,000	26.3	10.9	345,068	98,785	17,219	13	33
2.50	5.0	P	3	9.0	1,000,000	23.6	9.6	315,677	60,257	15,683	16	30
2.60	5.0	P	3	9.0	1,000,000	24.0	9.1	268,979	60,662	14,056	18	26
2.70	5.0	P	3	9.0	1,000,000	22.2	11.8	429,998	101,722		10	
2.80	5.0	P	3	9.0	1,000,000	25.1	9.7	279,344	77,358	14,698	16	27
2.90	5.0	P	3	9.0	1,000,000	24.2	10.9	395,411	74,892	19,493	13	39
3.00	5.0	P	3	9.0	1,000,000	23.6	10.7	663,157	29,520	20,032	15	40
3.10	5.0	P	3	9.0	1,000,000	28.1	9.3	487,086	53,957	12,502	17	22

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	57
Min. Temp. °F	61
Avg. Temp. ° F	59

HMA Thickness (inches)

4.5 Fill

Base Thickness (inches)

10 Fill

Design ESALs

1,000,000 Fill

County

Pine
Pipestone
Polk

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

2 - ADT 500-1000 HCADT 25-50 Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
6/19/2019				94.5	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
Mn Roads	0.100	Aid	Aid	3.100	0	Aid	TH 9 SB	0	Increasing	47.7446, -96.5673	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	29.1	**7.4**					**11**
Average	31.6	8.4	729,579	64,176	**7,796**	21.0	13
Std. Dev.	3.32	1.47	363,614	17,408	768	3.2	1

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.10	4.0	P	2	10.0	1,000,000	42.1	15.0					
0.20	4.0	P	2	10.0	1,000,000	34.9	9.5	1,302,809	85,851	8,585	16	14
0.30	4.0	P	2	10.0	1,000,000	33.0	8.2	706,730	72,997	7,300	20	12
0.40	4.0	P	2	10.0	1,000,000	39.7	10.4		73,106	7,311	16	12
0.50	4.0	P	2	10.0	1,000,000	31.6	8.0	1,069,724	48,722	7,629	21	12
0.60	4.0	P	2	10.0	1,000,000	29.5	7.5	653,610	49,363	7,385	23	12
0.70	4.0	P	2	10.0	1,000,000	29.2	7.0	566,260	45,118	6,464	26	10
0.80	4.0	P	2	10.0	1,000,000	28.4	7.6	603,916	50,519	8,134	22	13
0.90	4.0	P	2	10.0	1,000,000	30.9	7.6	1,054,232	39,916	7,110	23	11
1.00	4.0	P	2	10.0	1,000,000	29.8	8.1	595,443	62,741	8,527	20	14
1.10	4.0	P	2	10.0	1,000,000	34.0	8.6	982,788	74,313	7,431	19	12
1.20	4.0	P	2	10.0	1,000,000	33.0	8.5	958,863	68,505	7,588	20	12
1.30	4.0	P	2	10.0	1,000,000	32.0	9.1	612,164	93,522	9,352	17	16
1.40	4.0	P	2	10.0	1,000,000	33.1	8.4	781,661	74,040	7,404	20	12
1.50	4.0	P	2	10.0	1,000,000	24.8	6.3	246,134	40,006	6,974	30	11
1.60	4.0	P	2	10.0	1,000,000	28.3	7.2	355,004	56,050	7,250	25	11
1.70	4.0	P	2	10.0	1,000,000	30.6	7.7	867,670	47,101	7,584	22	12
1.80	4.0	P	2	10.0	1,000,000	31.7	8.1	726,115	64,743	7,633	21	12
1.90	4.0	P	2	10.0	1,000,000	26.3	7.2	427,424	45,097	8,488	24	14
2.00	4.0	P	2	10.0	1,000,000	32.4	9.5	655,270	97,357		16	
2.10	4.0	P	2	10.0	1,000,000	32.8	8.3	2,136,925	21,019	7,481	22	12
2.20	4.0	P	2	10.0	1,000,000	29.7	7.8	349,817	72,787	7,825	22	13
2.30	4.0	P	2	10.0	1,000,000	29.6	7.4	314,741	68,551	7,009	24	11
2.40	4.0	P	2	10.0	1,000,000	31.3	8.4	528,606	77,409	8,551	19	14
2.50	4.0	P	2	10.0	1,000,000	31.6	8.6	522,772	82,822	8,694	19	14
2.60	4.0	P	2	10.0	1,000,000	33.0	8.8	765,293	82,000	8,200	18	13
2.70	4.0	P	2	10.0	1,000,000	29.0	7.8	556,610	56,660	8,477	21	14
2.80	4.0	P	2	10.0	1,000,000	33.5	7.8	815,437	63,919	6,392	23	10
2.90	4.0	P	2	10.0	1,000,000	32.0	8.1	527,981	75,886	7,589	21	12
3.00	4.0	P	2	10.0	1,000,000	31.4	8.2	776,043	62,019	8,127	20	13
3.10	4.0	P	2	10.0	1,000,000	30.8	8.8	697,740	73,131	9,583	18	16

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	64.21
Min. Temp. °F	66.21
Avg. Temp. ° F	65.21

HMA Thickness (inches)

6 Fill

Base Thickness (inches)

12 Fill

Design ESALs

1,000,000 Fill

County

Kandiyohi
Kittson
Koochiching

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

2 - ADT 500-1000 HCADT 25-50

Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
6/20/2019				87.3	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
Mn Road	0.100	Aid	Aid	3.100	0	Aid	TH 11 EB	0	Increasing	48.6524, -94.25	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	26.8	**9.1**	489,371	32,884	**11,057**	16.8	**14**
Average	29.5	10.3					19
Std. Dev.	2.79	1.40	187,874	8,091	2,991	3.4	6

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.10	6.0	P	2	12.0	1,000,000	31.9	10.4	463,467	37,642	9,035	18	15
0.20	6.0	P	2	12.0	1,000,000	29.9	10.1	326,896	42,086	9,321	18	16
0.30	6.0	P	2	12.0	1,000,000	34.2	11.5	633,299	44,509	8,457	16	14
0.40	6.0	P	2	12.0	1,000,000	27.5	9.1	270,136	33,939	8,900	20	15
0.50	6.0	P	2	12.0	1,000,000	25.7	9.7	202,636		5,604	18	8
0.60	6.0	P	2	12.0	1,000,000	30.6	12.3	544,718	52,527	13,671	13	25
0.70	6.0	P	2	12.0	1,000,000	31.5	9.9	523,667	29,611	8,417	18	14
0.80	6.0	P	2	12.0	1,000,000	29.2	9.7	328,339	37,091	9,654	19	16
0.90	6.0	P	2	12.0	1,000,000	26.1	7.7	222,475	22,941	7,925	26	13
1.00	6.0	P	2	12.0	1,000,000	29.5	10.0	345,701	38,701	9,880	18	17
1.10	6.0	P	2	12.0	1,000,000	31.2	9.9	550,617	27,600	9,294	18	16
1.21	6.0	P	2	12.0	1,000,000	26.1	9.5	299,873	33,664	11,629	18	20
1.30	6.0	P	2	12.0	1,000,000	29.9	10.7	790,746	23,195	16,290	13	31
1.40	6.0	P	2	12.0	1,000,000	30.8	14.9	936,706		16,635	9	32
1.50	6.0	P	2	12.0	1,000,000	29.0	11.2	637,954	31,881	16,371	13	31
1.60	6.0	P	2	12.0	1,000,000	29.6	11.2	678,302	31,035	15,937	13	30
1.70	6.0	P	2	12.0	1,000,000	22.8	9.6	244,774	36,596	15,116	16	28
1.80	6.0	P	2	12.0	1,000,000	32.6	11.0	797,071	27,174	12,371	14	22
1.91	6.0	P	2	12.0	1,000,000	31.2	10.6	586,944	31,538	10,895	16	19
2.00	6.0	P	2	12.0	1,000,000	28.8	9.5	491,088	24,153	12,403	17	22
2.10	6.0	P	2	12.0	1,000,000	28.9	9.7	414,862	30,332	10,478	18	18
2.20	6.0	P	2	12.0	1,000,000	30.6	10.9	546,119	36,032	12,447	15	22
2.30	6.0	P	2	12.0	1,000,000	27.6	9.4	494,093	21,939	14,166	16	26
2.40	6.0	P	2	12.0	1,000,000	31.2	11.4	461,085	47,936	11,107	15	19
2.50	6.0	P	2	12.0	1,000,000	33.4	11.3	622,746	39,589	10,135	15	17
2.60	6.0	P	2	12.0	1,000,000	33.0	10.6	506,849	38,763	8,982	17	15
2.70	6.0	P	2	12.0	1,000,000	32.7	11.7	753,120	36,210	12,509	14	22
2.80	6.0	P	2	12.0	1,000,000	22.6	7.7	173,228	29,005	5,617	24	8
2.90	6.0	P	2	12.0	1,000,000	29.8	9.1	464,909	25,024	7,870	20	13
3.00	6.0	P	2	12.0	1,000,000	28.9	9.0	454,684	21,436	11,008	19	19
3.10	6.0	P	2	12.0	1,000,000	28.2	8.7	403,381	21,488	10,650	20	18

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	59.61
Min. Temp. °F	61.61
Avg. Temp. ° F	60.61

HMA Thickness (inches)
4.5 Fill

Base Thickness (inches)
8 Fill

Design ESALs
1,000,000 Fill

County
Nicollet
Nobles
Norman

Run TONN2010

Begin Overlay Design

Soil Type
Plastic Fill

Traffic Category
3 - ADT 1000-3000 HCADT 50-150
Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
6/19/2019				93.7	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
Mn Road	0.040	Aid	Aid	3.100	0	Aid	TH 32 NB	0	Increasing	47.3694, -96.2806	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	17.1	**9.0**	391,231	47,100	**19,094**	16.1	**30**
Average	19.5	9.6	391,231	47,100	19,094	16.1	38
Std. Dev.	2.28	0.66	127,757	11,541	2,936	1.8	7

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.04	4.5	P	3	8.0	1,000,000	16.6	11.4	404,379	49,033		13	
0.10	4.5	P	3	8.0	1,000,000	19.6	10.6	392,992	65,348	22,575	13	47
0.20	4.5	P	3	8.0	1,000,000	19.1	9.7	287,930	57,531	20,047	16	40
0.30	4.5	P	3	8.0	1,000,000	23.2	9.0	537,959	37,156	15,347	18	29
0.40	4.5	P	3	8.0	1,000,000	22.3	8.8	251,859	71,904	13,662	18	25
0.50	4.5	P	3	8.0	1,000,000	21.5	9.3	608,546	24,515	17,044	18	33
0.60	4.5	P	3	8.0	1,000,000	17.9	9.9	399,067	36,743	22,441	16	46
0.70	4.5	P	3	8.0	1,000,000	19.3	9.2	332,775	44,316	18,304	17	36
0.80	4.5	P	3	8.0	1,000,000	22.5	8.4	466,924	32,621	13,474	20	25
0.90	4.5	P	3	8.0	1,000,000	20.0	8.6	232,219	57,407	14,942	19	28
1.00	4.5	P	3	8.0	1,000,000	16.2	10.3	330,658	45,139	24,765	15	52
1.10	4.5	P	3	8.0	1,000,000	24.0	10.0	624,960	52,100	17,255	15	33
1.20	4.5	P	3	8.0	1,000,000	22.9	10.8	631,009	60,576	20,926	13	42
1.30	4.5	P	3	8.0	1,000,000	22.3	10.2	676,066	38,350	19,693	14	39
1.40	4.5	P	3	8.0	1,000,000	17.4	9.4	332,448	39,648	20,360	17	41
1.50	4.5	P	3	8.0	1,000,000	17.3	9.7	272,657	51,273	21,391	16	44
1.60	4.5	P	3	8.0	1,000,000	21.3	9.9	589,706	37,444	19,228	15	38
1.70	4.5	P	3	8.0	1,000,000	21.5	10.0	557,728	46,572	19,236	14	38
1.80	4.5	P	3	8.0	1,000,000	19.2	8.9	283,571	49,309	17,034	18	33
1.90	4.5	P	3	8.0	1,000,000	18.8	9.4	290,293	53,868	18,609	16	37
2.00	4.5	P	3	8.0	1,000,000	19.9	9.7	284,006	71,011	18,482	15	36
2.10	4.5	P	3	8.0	1,000,000	20.3	9.0	261,465	62,065	16,154	17	31
2.20	4.5	P	3	8.0	1,000,000	16.1	9.5	344,452	31,845	21,609	17	44
2.30	4.5	P	3	8.0	1,000,000	16.4	10.0	392,806	34,268	23,253	16	48
2.40	4.5	P	3	8.0	1,000,000	17.0	10.2	366,510	45,610	23,421	15	49
2.50	4.5	P	3	8.0	1,000,000	17.9	9.2	303,443	44,993	18,584	17	37
2.60	4.5	P	3	8.0	1,000,000	18.9	9.1	275,855	51,941	17,943	17	35
2.70	4.5	P	3	8.0	1,000,000	22.2	8.8	450,470	36,802	15,201	18	28
2.80	4.5	P	3	8.0	1,000,000	19.0	9.6	336,153	48,700	20,115	16	40
2.90	4.5	P	3	8.0	1,000,000	17.4	9.4	349,977	34,061	20,546	17	41
3.00	4.5	P	3	8.0	1,000,000	19.4	9.2	322,231	50,861	17,570	16	34
3.10	4.5	P	3	8.0	1,000,000	17.1	9.9	328,275	44,194	22,694	15	47

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	40.05
Min. Temp. °F	42.05
Avg. Temp. ° F	41.05

HMA Thickness (inches)
5 Fill

Base Thickness (inches)
5 Fill

Design ESALs
1,000,000 Fill

County
Pipestone
Polk
Pope

Run TONN2010

Begin Overlay Design

Soil Type
Plastic Fill

Traffic Category
2 - ADT 500-1000 HCADT 25-50
Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
10/11/2018				33.0	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
TH 55 WB right wheel lane	0.000	Aid	Aid	6.400	0	Aid	55 WB beg at hwy	0	Increasing	45.7132, -95.5309	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	16.7	**9.4**					**19**
Average	19.5	10.1	708,504	117,028	**13,493**	13.3	25
Std. Dev.	2.62	0.99	225,644	34,689	2,943	2.5	7

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.00	5.0	P	2	5.0	1,000,000	19.9	10.3	760,290	145,215	14,521	13	27
0.10	5.0	P	2	5.0	1,000,000	18.8	9.9	551,142	129,030	12,903	15	23
0.20	5.0	P	2	5.0	1,000,000	22.5	10.9	1,031,569	117,715	11,772	14	21
0.30	5.0	P	2	5.0	1,000,000	19.7	10.7	859,351	141,714	14,171	12	26
0.40	5.0	P	2	5.0	1,000,000	20.3	9.8	705,100	103,353	10,849	16	19
0.50	5.0	P	2	5.0	1,000,000	18.0	9.7	606,851	161,655	17,857	11	35
0.60	5.0	P	2	5.0	1,000,000	18.1	9.1	561,296	69,975	11,125	17	19
0.70	5.0	P	2	5.0	1,000,000	20.0	8.9	764,044	50,893	9,641	18	16
0.80	5.0	P	2	5.0	1,000,000	23.0	11.2	1,170,669	114,694	12,124	13	22
0.90	5.0	P	2	5.0	1,000,000	19.3	9.9	687,543	158,056	15,806	12	30
1.00	5.0	P	2	5.0	1,000,000	15.8	9.1	421,457	77,754	12,083	16	21
1.10	5.0	P	2	5.0	1,000,000	20.3	10.3	808,882	157,993	15,799	11	30
1.20	5.0	P	2	5.0	1,000,000	19.9	9.5	617,343	101,003	10,602	16	18
1.30	5.0	P	2	5.0	1,000,000	22.1	8.6	837,717	66,627	7,452	19	12
1.40	5.0	P	2	5.0	1,000,000	23.0	9.7	994,794	89,626	8,963	16	15
1.50	5.0	P	2	5.0	1,000,000	22.0	10.5	866,483	115,193	11,519	14	20
1.60	5.0	P	2	5.0	1,000,000	23.4	12.4		169,036	16,904	9	32
1.70	5.0	P	2	5.0	1,000,000	19.7	10.3	627,842	119,991	12,596	14	23
1.80	5.0	P	2	5.0	1,000,000	20.4	10.0	671,316	113,717	11,372	15	20
1.90	5.0	P	2	5.0	1,000,000	22.1	10.9	996,971	150,891	15,089	11	28
2.00	5.0	P	2	5.0	1,000,000	21.3	10.6	807,512	120,918	12,092	14	21
2.10	5.0	P	2	5.0	1,000,000	16.0	9.7	608,970	174,446		9	
2.20	5.0	P	2	5.0	1,000,000	19.7	10.1	689,928	144,129	14,413	13	27
2.30	5.0	P	2	5.0	1,000,000	20.1	10.4	692,483	126,994	12,699	14	23
2.40	5.0	P	2	5.0	1,000,000	21.0	9.4	722,088	93,180	9,781	16	17
2.50	5.0	P	2	5.0	1,000,000	18.5	9.5	613,090	169,676	16,968	11	33
2.60	5.0	P	2	5.0	1,000,000	23.4	12.2		150,887	15,653	9	30
2.70	5.0	P	2	5.0	1,000,000	23.4	12.0	1,357,591	133,071	13,329	11	24
2.80	5.0	P	2	5.0	1,000,000	16.4	10.3	603,165	136,252	20,384	10	41
2.90	5.0	P	2	5.0	1,000,000	18.7	10.2	559,522	117,392	12,968	14	23
3.00	5.0	P	2	5.0	1,000,000	22.5	10.4	969,388	106,381	10,840	14	19
3.10	5.0	P	2	5.0	1,000,000	17.4	10.2	764,540	46,088	14,776	13	27
3.20	5.0	P	2	5.0	1,000,000	20.5	10.8	774,914	126,503	13,279	13	24
3.30	5.0	P	2	5.0	1,000,000	17.7	8.6	344,641	142,377	14,238	15	26
3.40	5.0	P	2	5.0	1,000,000	15.9	10.6	559,823	113,054	19,707	11	39
3.50	5.0	P	2	5.0	1,000,000	14.4	9.4	435,928	150,091		10	
3.60	5.0	P	2	5.0	1,000,000	17.7	9.8	465,984	105,953	13,072	15	24
3.70	5.0	P	2	5.0	1,000,000	16.9	9.4	577,924	178,092	20,759	10	42
3.80	5.0	P	2	5.0	1,000,000	17.9	10.4	536,534	111,372	14,405	14	27
3.90	5.0	P	2	5.0	1,000,000	18.4	9.6	591,119	160,853	16,885	11	32
4.00	5.0	P	2	5.0	1,000,000	16.2	9.0	452,280	70,252	12,140	16	22
4.10	5.0	P	2	5.0	1,000,000	18.5	11.0	803,783	94,227	15,323	12	29
4.20	5.0	P	2	5.0	1,000,000	14.9						
4.30	5.0	P	2	5.0	1,000,000	22.2	9.7	852,410	95,667	9,567	16	16
4.40	5.0	P	2	5.0	1,000,000	17.0	10.1	519,475	115,938	14,482	13	27
4.50	5.0	P	2	5.0	1,000,000	16.9	9.7	449,223	122,619	15,128	13	28
4.60	5.0	P	2	5.0	1,000,000	22.1	11.0	993,381	118,623	12,452	13	22
4.70	5.0	P	2	5.0	1,000,000	18.8	10.1	561,186	105,694	13,040	14	24

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	32
Min. Temp. °F	33.54
Avg. Temp. ° F	32.77

HMA Thickness (inches)

7 Fill

Base Thickness (inches)

10 Fill

Design ESALs

1,000,000 Fill

County

Steele
Stevens
Swift

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

3 - ADT 1000-3000 HCADT 50-150 Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
10/12/2018				40.8	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
27-00000 TH59NB Right wh	0.100	Aid	Aid	3.500	0	Aid	TH59	0	Increasing	45.2843, -95.9121	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	20.7	**11.0**					**15**
Average	22.3	12.1	724,412	61,216	**11,249**	10.3	20
Std. Dev.	2.22	1.28	157,472	32,990	2,473	2.4	5

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.10	7.0	P	3	10.0	1,000,000	24.6	12.0	822,352	75,617	8,763	11	14
0.20	7.0	P	3	10.0	1,000,000	24.8	12.0	705,498	77,806	9,599	11	16
0.30	7.0	P	3	10.0	1,000,000	24.3	12.0	758,576	67,891	9,997	11	17
0.40	7.0	P	3	10.0	1,000,000	24.1	11.7	803,385	46,536	10,428	11	18
0.50	7.0	P	3	10.0	1,000,000	24.4	12.3	816,768	74,642	9,781	10	17
0.60	7.0	P	3	10.0	1,000,000	21.6	12.3	866,872	55,520	11,129	9	19
0.70	7.0	P	3	10.0	1,000,000	21.9	12.3	719,977	46,073	13,378	10	24
0.80	7.0	P	3	10.0	1,000,000	23.7	12.0	820,550	58,926	10,271	10	18
0.90	7.0	P	3	10.0	1,000,000	20.8	12.0	531,099	97,058	10,188	10	17
1.00	7.0	P	3	10.0	1,000,000	22.5	13.2	1,070,814			5	
1.10	7.0	P	3	10.0	1,000,000	25.3	13.8	774,810	122,812	12,892	9	23
1.20	7.0	P	3	10.0	1,000,000	24.8	13.7	765,276	121,924	12,192	9	22
1.30	7.0	P	3	10.0	1,000,000	22.5	11.4	740,894	59,228	8,861	11	15
1.40	7.0	P	3	10.0	1,000,000	22.7	12.5	750,271	68,948	11,817	10	21
1.50	7.0	P	3	10.0	1,000,000	22.9	13.2	671,364	132,350	14,620	8	27
1.60	7.0	P	3	10.0	1,000,000	23.9	13.3	967,238	66,890	12,359	9	22
1.70	7.0	P	3	10.0	1,000,000	22.8	12.6	782,215	65,555	12,111	9	21
1.80	7.0	P	3	10.0	1,000,000	19.6	10.7	416,596	52,975	11,177	12	19
1.90	7.0	P	3	10.0	1,000,000	20.7	13.8	663,630	110,189	17,884	8	35
2.00	7.0	P	3	10.0	1,000,000	18.1	14.2	805,164	120,767		6	
2.10	7.0	P	3	10.0	1,000,000	21.7	10.5	657,812	39,906	8,647	12	14
2.20	7.0	P	3	10.0	1,000,000	21.8	11.9	716,930	23,325	13,346	11	24
2.30	7.0	P	3	10.0	1,000,000	18.3	8.8	343,429	9,083	9,083	19	15
2.40	7.0	P	3	10.0	1,000,000	21.5	9.1	558,734	20,276	7,004	15	11
2.50	7.0	P	3	10.0	1,000,000	23.0	11.1	875,498	12,073	8,943	12	15
2.60	7.0	P	3	10.0	1,000,000	24.2	12.1	794,648	85,134	8,513	10	14
2.70	7.0	P	3	10.0	1,000,000	24.2	12.6	795,155	64,692	12,063	10	21
2.80	7.0	P	3	10.0	1,000,000	17.5	11.9	455,577	46,955	16,221	10	31
2.90	7.0	P	3	10.0	1,000,000	21.9	10.1	523,441	35,830	9,327	13	16
3.00	7.0	P	3	10.0	1,000,000	22.1	12.9	839,539	26,362	15,086	10	28
3.10	7.0	P	3	10.0	1,000,000	23.5	11.0	710,149	58,393	8,158	11	13
3.20	7.0	P	3	10.0	1,000,000	16.1	14.4	588,238	25,279		8	
3.30	7.0	P	3	10.0	1,000,000	24.2	12.2	898,733	43,544	11,333	10	20
3.40	7.0	P	3	10.0	1,000,000	22.5	12.1	851,299	20,666	12,503	10	22
3.50	7.0	P	3	10.0	1,000,000	21.1	11.1	491,876	48,125	12,299	12	22

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	33.07
Min. Temp. °F	35.07
Avg. Temp. ° F	34.07

HMA Thickness (inches)

4 Fill

Base Thickness (inches)

10 Fill

Design ESALs

1,000,000 Fill

County

Morrison
Mower
Murray

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

2 - ADT 500-1000 HCADT 25-50 Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
10/12/2018				41.8	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
27-20000 TH 62 EB Right wh	0.000	Aid	Aid	3.300	0	Aid	TH62	0	Increasing	43.8624, -95.5438	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	15.5	**7.9**					**19**
Average	17.0	8.6	716,832	42,086	**12,854**	16.3	23
Std. Dev.	2.05	0.73	148,644	12,939	2,246	2.2	5

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.00	4.0	P	2	10.0	1,000,000	15.5	8.6	732,395	24,862	15,349	17	29
0.10	4.0	P	2	10.0	1,000,000	11.2	8.0	354,847	31,891	15,237	19	29
0.20	4.0	P	2	10.0	1,000,000	16.6	9.4	1,007,944	16,768	16,761	16	32
0.30	4.0	P	2	10.0	1,000,000	11.4	9.9	394,306	67,377		13	
0.40	4.0	P	2	10.0	1,000,000	18.5	9.4	912,781	48,822	15,226	14	29
0.50	4.0	P	2	10.0	1,000,000	16.3	8.2	659,097	43,839	11,475	16	20
0.60	4.0	P	2	10.0	1,000,000	16.7	7.4	640,463	29,381	10,150	20	17
0.70	4.0	P	2	10.0	1,000,000	16.5	7.4	574,001	30,811	10,644	20	18
0.80	4.0	P	2	10.0	1,000,000	16.6	8.7	570,977	62,400	11,856	15	21
0.90	4.0	P	2	10.0	1,000,000	16.8	7.6	562,528	35,934	10,940	19	19
1.00	4.0	P	2	10.0	1,000,000	18.7	7.7	660,003	39,204	9,849	19	17
1.10	4.0	P	2	10.0	1,000,000	20.2	8.2	767,094	55,631	9,496	17	16
1.20	4.0	P	2	10.0	1,000,000	19.2	8.8	931,125	47,043	12,396	15	22
1.30	4.0	P	2	10.0	1,000,000	18.9	8.4	841,944	38,831	12,112	16	21
1.40	4.0	P	2	10.0	1,000,000	19.8	8.6	746,232	59,969	10,453	16	18
1.50	4.0	P	2	10.0	1,000,000	18.0	9.5	792,682	56,875	15,287	14	29
1.60	4.0	P	2	10.0	1,000,000	19.6	8.7	991,921	37,714	12,318	16	22
1.70	4.0	P	2	10.0	1,000,000	18.7	8.7	702,848	53,045	12,291	16	22
1.80	4.0	P	2	10.0	1,000,000	18.7	8.5	633,996	55,557	11,600	16	20
1.90	4.0	P	2	10.0	1,000,000	15.8	9.4	640,738	55,656	15,958	14	30
2.00	4.0	P	2	10.0	1,000,000	16.6	10.1	896,299	46,193		12	
2.10	4.0	P	2	10.0	1,000,000	14.7	9.7	722,895	45,668	18,863	13	37
2.20	4.0	P	2	10.0	1,000,000	16.6	8.2	665,974	34,166	12,735	17	23
2.30	4.0	P	2	10.0	1,000,000	17.5	8.0	653,048	37,322	11,675	18	21
2.40	4.0	P	2	10.0	1,000,000	19.0	8.9	688,886	58,831	12,413	15	22
2.50	4.0	P	2	10.0	1,000,000	19.3	9.3	872,538	55,452	13,671	14	25
2.60	4.0	P	2	10.0	1,000,000	17.8	8.7	767,447	42,249	13,411	15	24
2.70	4.0	P	2	10.0	1,000,000	16.7	9.3	878,061	33,454	16,506	14	32
2.80	4.0	P	2	10.0	1,000,000	15.5	7.9	628,587	27,367	12,663	18	23
2.90	4.0	P	2	10.0	1,000,000	15.2	7.9	563,265	40,070	11,442	17	20
3.00	4.0	P	2	10.0	1,000,000	17.1	7.9	774,964	23,648	12,044	18	21
3.10	4.0	P	2	10.0	1,000,000	15.9	7.5	696,730	18,800	11,388	20	20
3.20	4.0	P	2	10.0	1,000,000	17.0	8.7	777,021	38,881	13,833	15	25
3.30	4.0	P	2	10.0	1,000,000	16.2	7.9	668,639	37,199	11,294	17	20

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	57.03
Min. Temp. °F	59.03
Avg. Temp. ° F	58.03

HMA Thickness (inches)
4.5 Fill

Base Thickness (inches)
8 Fill

Design ESALs
1,000,000 Fill

County
Kandiyohi
Kittson
Koochiching

Run TONN2010

Begin Overlay Design

Soil Type
Plastic Fill

Traffic Category
2 - ADT 500-1000 HCADT 25-50
Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
6/20/2019				100.4	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
MN Road	0.100	Aid	Aid	3.200	0	Aid	US 71 NE	0	Increasing	48.095, -93.937	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	21.0	**8.5**					**23**
Average	22.6	9.9	591,379	34,543	**15,337**	17.5	29
Std. Dev.	2.85	1.40	154,305	8,718	2,536	3.2	6

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.10	4.5	P	2	8.0	1,000,000	23.3	9.9	747,911	18,508	16,750	18	32
0.20	4.5	P	2	8.0	1,000,000	22.9	9.2	541,580	30,110	15,462	19	29
0.30	4.5	P	2	8.0	1,000,000	17.8	13.2	696,054	34,415		12	
0.40	4.5	P	2	8.0	1,000,000	14.4	13.4	542,219	39,158		11	
0.50	4.5	P	2	8.0	1,000,000	16.7	13.6	699,876	37,065		11	
0.60	4.5	P	2	8.0	1,000,000	23.2	9.4	523,922	37,890	15,650	18	30
0.70	4.5	P	2	8.0	1,000,000	15.8	9.7	393,655	20,560	20,560	19	41
0.80	4.5	P	2	8.0	1,000,000	22.5	9.1	543,450	29,351	15,072	19	28
0.90	4.5	P	2	8.0	1,000,000	20.9	9.8	374,935	52,202	18,034	16	35
1.01	4.5	P	2	8.0	1,000,000	24.3	9.7	650,014	37,872	15,483	17	29
1.10	4.5	P	2	8.0	1,000,000	21.9	9.2	285,090		14,861	18	28
1.20	4.5	P	2	8.0	1,000,000	22.1	8.4	477,905	25,600	13,146	22	24
1.30	4.5	P	2	8.0	1,000,000	21.0	8.5	258,506	51,118	13,305	20	24
1.40	4.5	P	2	8.0	1,000,000	23.6	8.7	603,189	23,774	12,858	22	23
1.50	4.5	P	2	8.0	1,000,000	23.2	8.5	468,040	30,710	12,951	21	23
1.60	4.5	P	2	8.0	1,000,000	23.7	8.4	594,921	23,034	11,828	23	21
1.70	4.5	P	2	8.0	1,000,000	22.7	8.3	472,454	27,116	12,182	23	22
1.80	4.5	P	2	8.0	1,000,000	23.8	8.4	532,081	27,846	12,126	22	22
1.90	4.5	P	2	8.0	1,000,000	26.8	9.1	623,618	46,816	12,185	19	22
2.00	4.5	P	2	8.0	1,000,000	24.9	9.3	657,085	34,320	13,820	19	25
2.10	4.5	P	2	8.0	1,000,000	25.1	9.4	667,039	36,941	14,097	18	26
2.20	4.5	P	2	8.0	1,000,000	25.5	9.5	747,095	33,614	13,884	18	25
2.30	4.5	P	2	8.0	1,000,000	22.7	9.8	607,094	33,421	17,162	17	33
2.40	4.5	P	2	8.0	1,000,000	23.5	9.5	636,991	31,059	15,359	18	29
2.50	4.5	P	2	8.0	1,000,000	24.9	10.4	864,941	33,294	17,097	16	33
2.60	4.5	P	2	8.0	1,000,000	23.9	10.2	704,422	35,935	17,278	16	33
2.70	4.5	P	2	8.0	1,000,000	22.4	10.0	300,225		16,108	15	31
2.80	4.5	P	2	8.0	1,000,000	25.1	10.4	783,877	41,122	17,162	15	33
2.90	4.5	P	2	8.0	1,000,000	26.6	10.0	706,988	53,484	14,784	16	27
3.00	4.5	P	2	8.0	1,000,000	22.8	11.4	804,570	41,337	22,028	13	45
3.11	4.5	P	2	8.0	1,000,000	22.0	11.3	764,209	33,182		14	
3.20	4.5	P	2	8.0	1,000,000	23.1	10.2	650,161	35,439	18,198	16	36

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	32.41
Min. Temp. °F	32.41
Avg. Temp. ° F	32.41

HMA Thickness (inches)
5 Fill

Base Thickness (inches)
15.5 Fill

Design ESALs
1,000,000 Fill

County
Wabasha
Wadena
Waseca

Run TONN2010

Begin Overlay Design

Soil Type
Plastic Fill

Traffic Category
2 - ADT 500-1000 HCADT 25-50
Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
10/13/2018				35.8	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
TH83SB Waldorf	0.030	Aid	Aid	3.200	0	Aid	TH83	0	Increasing	43.9354, -93.7023	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	20.0	**10.1**					**14**
Average	21.8	11.6	1,358,484	34,095	**11,108**	11.0	19
Std. Dev.	1.67	1.49	265,780	13,232	2,492	1.9	5

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.03	5.0	P	2	15.5	1,000,000	24.4	12.8	1,688,979		13,069	8	24
0.10	5.0	P	2	15.5	1,000,000	22.8	13.2	1,238,329	50,419	9,556	11	16
0.20	5.0	P	2	15.5	1,000,000	24.8	13.8	1,887,483		12,564	8	22
0.30	5.0	P	2	15.5	1,000,000	22.4	10.4	1,268,604	24,949	9,536	13	16
0.40	5.0	P	2	15.5	1,000,000	20.7	10.7	1,277,383	26,116	13,201	11	24
0.50	5.0	P	2	15.5	1,000,000	22.2	12.7	1,207,388	77,640	9,050	9	15
0.60	5.0	P	2	15.5	1,000,000	23.2	12.5	1,529,093	37,225	9,881	11	17
0.70	5.0	P	2	15.5	1,000,000	23.1	12.1	1,590,304	32,989	11,576	11	20
0.80	5.0	P	2	15.5	1,000,000	24.7	14.5	1,590,258	56,749	10,294	10	18
0.90	5.0	P	2	15.5	1,000,000	24.3	13.0	1,843,581		11,851	7	21
1.00	5.0	P	2	15.5	1,000,000	21.3	12.7	1,698,773	35,715	16,390	9	31
1.10	5.0	P	2	15.5	1,000,000	21.1	13.6	1,734,056	43,617	12,563	9	22
1.20	5.0	P	2	15.5	1,000,000	19.7	11.8	1,309,018	34,360	16,728	9	32
1.30	5.0	P	2	15.5	1,000,000	21.0	10.6	1,397,793	24,125	12,388	11	22
1.40	5.0	P	2	15.5	1,000,000	20.1	9.8	1,398,764	18,928	14,442	11	27
1.50	5.0	P	2	15.5	1,000,000	21.3	13.1	1,252,126	49,032	9,674	10	16
1.60	5.0	P	2	15.5	1,000,000	21.1	11.2	1,420,210	27,786	14,010	10	26
1.70	5.0	P	2	15.5	1,000,000	22.3	12.8	1,256,241	46,072	8,047	11	13
1.80	5.0	P	2	15.5	1,000,000	21.2	10.6	1,391,681	24,283	9,448	12	16
1.90	5.0	P	2	15.5	1,000,000	20.7	11.6	1,091,473	37,724	8,939	12	15
2.00	5.0	P	2	15.5	1,000,000	21.7	11.3	1,567,930	26,492	13,690	10	25
2.10	5.0	P	2	15.5	1,000,000	19.7	10.3	1,122,342	26,065	10,012	12	17
2.20	5.0	P	2	15.5	1,000,000	22.3	12.8	1,438,323	41,043	13,128	10	24
2.30	5.0	P	2	15.5	1,000,000	20.6	9.1	1,066,299	18,535	9,518	14	16
2.40	5.0	P	2	15.5	1,000,000	20.3	10.2	999,233	27,281	8,260	14	13
2.50	5.0	P	2	15.5	1,000,000	22.1	10.8	1,596,848	22,702	13,339	11	24
2.60	5.0	P	2	15.5	1,000,000	22.2	11.6	1,073,211	38,733	6,780	14	11
2.70	5.0	P	2	15.5	1,000,000	19.5	8.9	930,747	19,468	8,151	15	13
2.80	5.0	P	2	15.5	1,000,000	19.0	9.3	873,053	22,541	12,358	14	22
2.90	5.0	P	2	15.5	1,000,000	21.9	11.8	1,293,919	35,588	8,594	12	14
3.00	5.0	P	2	15.5	1,000,000	19.7	9.4	929,004	22,512	11,939	14	21
3.10	5.0	P	2	15.5	1,000,000	22.6	12.7	1,504,296	40,070	9,242	11	15
3.20	5.0	P	2	15.5	1,000,000	25.6	12.9	1,363,241		8,361	10	14

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	34.33
Min. Temp. °F	36.33
Avg. Temp. ° F	35.33

HMA Thickness (inches)

5 Fill

Base Thickness (inches)

18 Fill

Design ESALs

1,000,000 Fill

County

Dodge
Douglas
Faribault

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

2 - ADT 500-1000 HCADT 25-50

Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
10/13/2018				44.8	*1*

Roadway	From Station	State	State	To Statiion	District	State	Control Section	Lane	Direction	Lat. and Long.	State
TH109 WB Delavan	0.010	Aid	Aid	3.600	0	Aid	TH109	0	Increasing	43.7605, -93.9876	Aid

DEPARTMENT OF TRANSPORTATION

	GE	Capacity, Tons	Moduli Statistics			#1 Defl.	R-value
			HMA (72° F)	Base	Subgrade	(mils)	
85% Percentile	17.4	**8.6**					**13**
Average	19.2	10.1	692,195	32,466	**10,476**	14.4	18
Std. Dev.	2.23	1.50	207,093	10,721	3,091	3.1	6

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.01	5.0	P	2	18.0	1,000,000	16.4	10.4	414,239	45,528	13,222	14	24
0.10	5.0	P	2	18.0	1,000,000	21.4	12.5		39,610	14,289	10	26
0.20	5.0	P	2	18.0	1,000,000	23.1	12.9		40,560	9,849	11	17
0.30	5.0	P	2	18.0	1,000,000	20.7	12.8	916,045	54,401	10,369	11	18
0.40	5.0	P	2	18.0	1,000,000	19.1	9.6	752,426	26,494	12,641	14	23
0.50	5.0	P	2	18.0	1,000,000	17.4	8.8	608,013	24,041	11,898	15	21
0.60	5.0	P	2	18.0	1,000,000	19.4	10.6	844,739	32,581	13,855	12	25
0.70	5.0	P	2	18.0	1,000,000	17.0	9.8	580,888	32,403	12,864	13	23
0.80	5.0	P	2	18.0	1,000,000	14.4	8.0	296,489	27,158	9,243	19	15
0.90	5.0	P	2	18.0	1,000,000	20.0	10.9	585,279	42,493	10,780	14	19
1.00	5.0	P	2	18.0	1,000,000	19.0	12.2	870,928	46,717	17,333	10	34
1.10	5.0	P	2	18.0	1,000,000	18.1	9.2	517,054	29,434	9,728	16	16
1.20	5.0	P	2	18.0	1,000,000	20.2	8.7	819,923	19,206	10,548	16	18
1.30	5.0	P	2	18.0	1,000,000	21.1	9.9	800,893	27,850	8,975	15	15
1.40	5.0	P	2	18.0	1,000,000	20.1	8.5	752,689	18,784	9,562	17	16
1.50	5.0	P	2	18.0	1,000,000	22.8	13.0	944,979	52,255	7,943	12	13
1.60	5.0	P	2	18.0	1,000,000	15.5	9.0	219,639	48,807	9,230	16	15
1.70	5.0	P	2	18.0	1,000,000	17.4	8.0	554,841	19,826	10,127	17	17
1.80	5.0	P	2	18.0	1,000,000	19.6	10.0	714,915	30,697	10,605	14	18
1.90	5.0	P	2	18.0	1,000,000	20.3	10.9	687,775	39,666	8,097	14	13
2.00	5.0	P	2	18.0	1,000,000	22.1	11.2	987,107	34,276	10,011	13	17
2.10	5.0	P	2	18.0	1,000,000	19.4	9.0	769,295	22,242	8,646	16	14
2.20	5.0	P	2	18.0	1,000,000	18.9	9.5	690,306	26,835	9,007	15	15
2.30	5.0	P	2	18.0	1,000,000	17.9	8.4	581,609	21,424	3,451	19	5
2.40	5.0	P	2	18.0	1,000,000	22.6	10.5	1,034,789	28,026	6,998	15	11
2.50	5.0	P	2	18.0	1,000,000	22.0	9.9	949,751	25,100	6,877	16	11
2.60	5.0	P	2	18.0	1,000,000	13.2	6.8	251,407	19,759	2,850	27	4
2.70	5.0	P	2	18.0	1,000,000	20.8	8.5	1,017,359	15,546	11,846	15	21
2.80	5.0	P	2	18.0	1,000,000	18.6	9.5	697,858	27,050	12,786	14	23
2.90	5.0	P	2	18.0	1,000,000	21.0	10.4	842,454	31,197	8,120	14	13
3.00	5.0	P	2	18.0	1,000,000	18.2	9.8	600,927	31,965	11,635	14	20
3.10	5.0	P	2	18.0	1,000,000	19.2	11.5	619,540	47,980	9,518	12	16
3.20	5.0	P	2	18.0	1,000,000	20.3	9.4	887,814	22,739	10,956	14	19
3.31	5.0	P	2	18.0	1,000,000	19.3	9.1	620,236	25,843	9,084	16	15
3.40	5.0	P	2	18.0	1,000,000	18.2	11.3	631,518		16,137	10	31
3.50	5.0	P	2	18.0	1,000,000	17.7	11.8	678,226	49,320	17,038	10	33
3.60	5.0	P	2	18.0	1,000,000	17.6	10.3	484,869	40,948	11,495	14	20

Version TONN2010 - 1.06

Get FWD Data

Previous Day's

Max. Temp. °F	34
Min. Temp. °F	38
Avg. Temp. ° F	36

HMA Thickness (inches)

4 Fill

Base Thickness (inches)

8 Fill

Design ESALs

1,000,000 Fill

County

St. Louis
Stearns
Steele

Run TONN2010

Begin Overlay Design

Soil Type

Plastic Fill

Traffic Category

3 - ADT 1000-3000 HCADT 50-150 Fill

Conv/Full Depth Conventional

HIDE STATE AID

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Estimate Number of ESALs for 10-Ton Rating

This button will estimate the number of ESALs that will result in a rating of 10-tons.

Make KML File

Test Date				Pave. Temp.	*Segments (20 max)*
10/11/2018				30.2	

Roadway	From Station	State	State	To Statiion	District
238 SB right wheel	lane 0.100	Aid	Aid	4.000	0

State		ane	Direction	Lat. and Long.	State
	238 SB beg at hwy	0	Increasing	45.729, -94.59	Aid

GE		Moduli Statistics			#1 Defl.	R-value
15.1	**8.6**					**18**
17.3	9.5	783,007	72,120	**13,636**	14.6	25
2.37	1.03	198,984	27,391	2,442	2.0	6

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)	S.A. R-Value
0.10	4.0	P	3	8.0	1,000,000	22.2	13.4			18,704		37
0.20	4.0	P	3	8.0	1,000,000	17.3	9.2	1,043,730	37,451	14,713	14	27
0.30	4.0	P	3	8.0	1,000,000	17.1	10.6	1,008,897	85,574	16,937	11	33
0.40	4.0	P	3	8.0	1,000,000	16.2	10.3	818,438	84,587	16,758	12	32
0.50	4.0	P	3	8.0	1,000,000	17.6	9.0	883,418	50,839	13,232	15	24
0.60	4.0	P	3	8.0	1,000,000	16.2	11.3	931,539		19,417		39
0.70	4.0	P	3	8.0	1,000,000	18.8	9.5	883,576	103,425	10,369	14	18
0.80	4.0	P	3	8.0	1,000,000	15.1	7.9	759,882	18,001	12,426	19	22
0.90	4.0	P	3	8.0	1,000,000	16.7	7.9	681,353	59,206	9,082	18	15
1.00	4.0	P	3	8.0	1,000,000	14.0	8.8	720,619	28,696	15,925	16	30
1.10	4.0	P	3	8.0	1,000,000	15.1	8.6	700,552	45,711	13,570	16	25
1.20	4.0	P	3	8.0	1,000,000	15.7	9.1	838,126	37,792	15,610	15	29
1.30	4.0	P	3	8.0	1,000,000	15.0	8.6	746,728	38,669	13,934	16	26
1.40	4.0	P	3	8.0	1,000,000	18.7	10.1	917,238	90,089	14,447	13	27
1.50	4.0	P	3	8.0	1,000,000	19.0	9.3	904,482	97,769	9,777	14	17
1.60	4.0	P	3	8.0	1,000,000	18.6	9.3	1,168,207	53,439	12,949	14	23
1.70	4.0	P	3	8.0	1,000,000	18.5	10.1	1,256,945	62,414	14,800	12	28
1.80	4.0	P	3	8.0	1,000,000	17.0	9.3	810,518	65,681	13,414	14	24
1.90	4.0	P	3	8.0	1,000,000	17.5	10.7	1,202,454	72,654	17,329	11	33
2.00	4.0	P	3	8.0	1,000,000	15.9	9.0	735,325	67,982	12,501	14	22
2.10	4.0	P	3	8.0	1,000,000	20.3	10.2		60,303	13,811	12	25
2.20	4.0	P	3	8.0	1,000,000	17.5	9.2	847,299	57,010	13,808	15	25
2.30	4.0	P	3	8.0	1,000,000	16.7	8.3	673,554	50,080	11,789	17	21
2.40	4.0	P	3	8.0	1,000,000	14.8	8.8	409,163	81,897	12,577	16	23
2.50	4.0	P	3	8.0	1,000,000	10.2	10.5	340,690	94,099		12	
2.60	4.0	P	3	8.0	1,000,000	15.9	10.1	686,064	86,690	16,136	13	31
2.70	4.0	P	3	8.0	1,000,000	15.9	9.8	741,443	73,969	15,525	13	29
2.80	4.0	P	3	8.0	1,000,000	16.5	10.4	600,121	116,565	15,476	12	29
2.90	4.0	P	3	8.0	1,000,000	19.6	10.5	753,715	128,884	13,354	13	24
3.00	4.0	P	3	8.0	1,000,000	21.2	10.2	864,600	121,645	12,164	14	22
3.10	4.0	P	3	8.0	1,000,000	17.0	9.0	619,230	72,656	12,648	16	23
3.20	4.0	P	3	8.0	1,000,000	18.8	9.5	850,666	79,133	13,004	14	23
3.30	4.0	P	3	8.0	1,000,000	15.2	8.7	760,743	40,683	14,133	15	26
3.40	4.0	P	3	8.0	1,000,000	17.3	8.3	502,753	74,702	10,265	18	18
3.50	4.0	P	3	8.0	1,000,000	18.9	8.9	613,941	92,405	10,564	16	18
3.60	4.0	P	3	8.0	1,000,000	19.6	9.2	605,445	106,385	10,639	16	18
3.70	4.0	P	3	8.0	1,000,000	23.3	9.3	988,967	96,955	9,695	16	16
3.80	4.0	P	3	8.0	1,000,000	18.2	9.1	599,896	89,233	11,808	16	21
3.90	4.0	P	3	8.0	1,000,000	17.0	9.7	610,802	91,265	14,241	14	26
4.00	4.0	P	3	8.0	1,000,000	14.2	8.3	673,147	26,023	14,267	17	26

APPENDIX D: SIEVE ANALYSIS AND CHEMICAL EXTRACTION

American Engineering Testing, Inc.
St. Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364

Albertville
5548 Barthel Ind Dr, Ste 500
Albertville, MN 55301
(763) 428-5573
www.amengtest.com

Material Test Report

Report No: MAT:20-11563-S1

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S1
Field Sample ID	TH01
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/17/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	0.9	

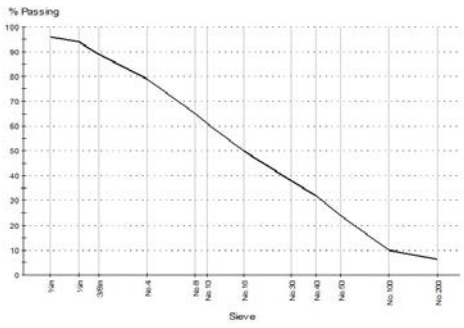
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	96	
½in (12.5mm)	94	
3/8in (9.5mm)	89	
No.4 (4.75mm)	79	
No.8 (2.36mm)	65	
No.10 (2.0mm)	61	
No.16 (1.18mm)	50	
No.30 (600µm)	38	
No.40 (425µm)	32	
No.50 (300µm)	24	
No.100 (150µm)	10	
No.200 (75µm)	6.3	

Chart



Comments

N/A

D-1

American Engineering Testing, Inc.
St. Paul
550 Cleveland Ave N
St. Paul, MN 55114
(651) 659-9001
Toll Free: (800) 972-6364

Albertville
5548 Barthel Ind Dr, Ste 500
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www.amengtest.com

Material Test Report

Report No: MAT:20-11563-S2

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S2
Field Sample ID	TH09
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/17/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	1.4	

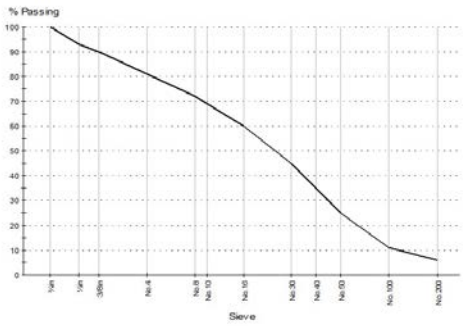
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	93	
3/8in (9.5mm)	90	
No.4 (4.75mm)	81	
No.8 (2.36mm)	72	
No.10 (2.0mm)	69	
No.16 (1.18mm)	60	
No.30 (600µm)	45	
No.40 (425µm)	35	
No.50 (300µm)	25	
No.100 (150µm)	11	
No.200 (75µm)	6.0	

Chart



Comments

N/A

D-2

American Engineering Testing, Inc.
St. Paul
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Toll Free: (800) 972-6364

Albertville
5548 Barthel Ind Dr, Ste 500
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Material Test Report

Report No: MAT:20-11563-S3

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S3
Field Sample ID	TH11
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/17/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	2.8	

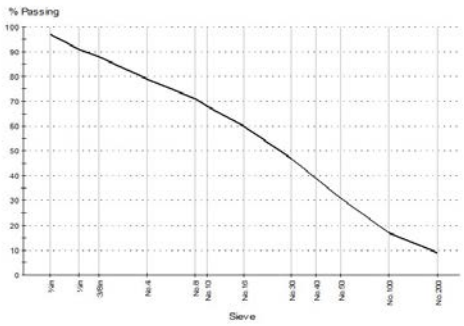
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	97	
½in (12.5mm)	91	
3/8in (9.5mm)	88	
No.4 (4.75mm)	79	
No.8 (2.36mm)	71	
No.10 (2.0mm)	68	
No.16 (1.18mm)	60	
No.30 (600µm)	47	
No.40 (425µm)	39	
No.50 (300µm)	31	
No.100 (150µm)	17	
No.200 (75µm)	9.1	

Chart



Comments

N/A

D-3

American Engineering Testing, Inc.
St. Paul
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Albertville
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Material Test Report

Report No: MAT:20-11563-S4

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S4
Field Sample ID	TH32
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/17/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	1.5	

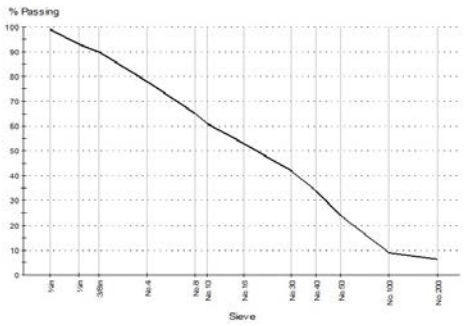
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	99	
½in (12.5mm)	93	
3/8in (9.5mm)	90	
No.4 (4.75mm)	78	
No.8 (2.36mm)	65	
No.10 (2.0mm)	61	
No.16 (1.18mm)	53	
No.30 (600µm)	42	
No.40 (425µm)	34	
No.50 (300µm)	24	
No.100 (150µm)	9	
No.200 (75µm)	6.2	

Chart



Comments

N/A

D-4

American Engineering Testing, Inc.
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Toll Free: (800) 972-6364

Albertville
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Material Test Report

Report No: MAT:20-11563-S5

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S5
Field Sample ID	TH55
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/17/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	2.8	

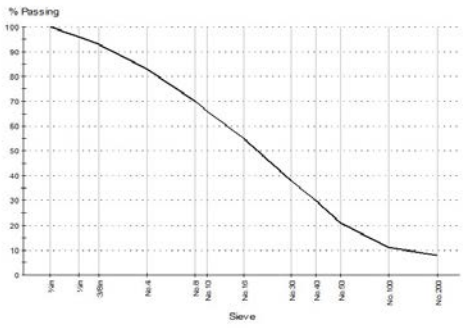
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	96	
3/8in (9.5mm)	93	
No.4 (4.75mm)	83	
No.8 (2.36mm)	70	
No.10 (2.0mm)	66	
No.16 (1.18mm)	55	
No.30 (600µm)	38	
No.40 (425µm)	30	
No.50 (300µm)	21	
No.100 (150µm)	11	
No.200 (75µm)	8.1	

Chart



Comments

N/A

D-5

American Engineering Testing, Inc.
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Material Test Report

Report No: MAT:20-11563-S6

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S6
Field Sample ID	TH59
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/17/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	0.5	

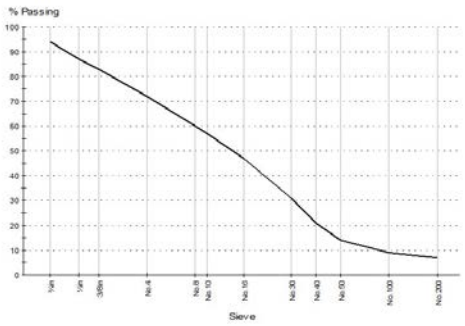
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	94	
½in (12.5mm)	87	
3/8in (9.5mm)	83	
No.4 (4.75mm)	72	
No.8 (2.36mm)	60	
No.10 (2.0mm)	57	
No.16 (1.18mm)	47	
No.30 (600µm)	31	
No.40 (425µm)	21	
No.50 (300µm)	14	
No.100 (150µm)	9	
No.200 (75µm)	6.9	

Chart



Comments

N/A

D-6

American Engineering Testing, Inc.
St. Paul
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Albertville
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Material Test Report

Report No: MAT:20-11563-S7

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S7
Field Sample ID	TH62
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/18/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	1.7	

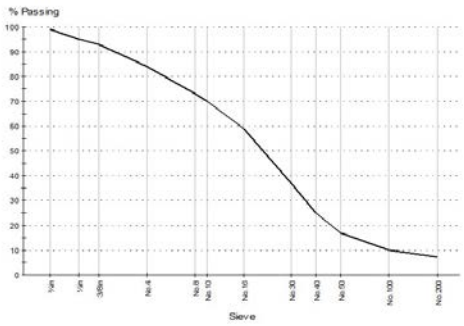
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	99	
½in (12.5mm)	95	
3/8in (9.5mm)	93	
No.4 (4.75mm)	84	
No.8 (2.36mm)	73	
No.10 (2.0mm)	70	
No.16 (1.18mm)	59	
No.30 (600µm)	37	
No.40 (425µm)	25	
No.50 (300µm)	17	
No.100 (150µm)	10	
No.200 (75µm)	7.4	

Chart



Comments

N/A

American Engineering Testing, Inc.
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Albertville
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Material Test Report

Report No: MAT:20-11563-S8

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S8
Field Sample ID	TH71
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/18/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	1.7	

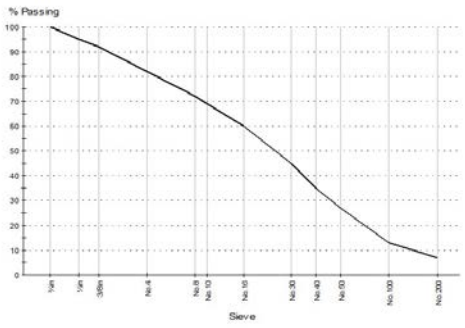
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	95	
3/8in (9.5mm)	92	
No.4 (4.75mm)	82	
No.8 (2.36mm)	72	
No.10 (2.0mm)	69	
No.16 (1.18mm)	60	
No.30 (600µm)	45	
No.40 (425µm)	35	
No.50 (300µm)	27	
No.100 (150µm)	13	
No.200 (75µm)	7.1	

Chart



Comments

N/A

D-8

American Engineering Testing, Inc.
St. Paul
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Albertville
5548 Barthel Ind Dr, Ste 500
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Material Test Report

Report No: MAT:20-11563-S9

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S9
Field Sample ID	TH83
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/18/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	0.9	

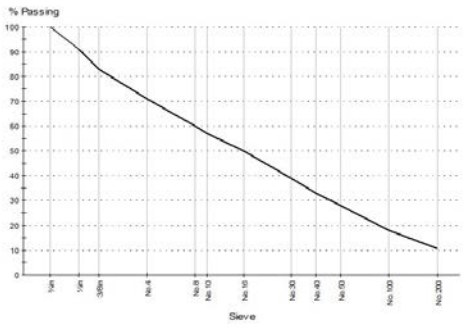
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	100	
½in (12.5mm)	91	
3/8in (9.5mm)	83	
No.4 (4.75mm)	71	
No.8 (2.36mm)	60	
No.10 (2.0mm)	57	
No.16 (1.18mm)	50	
No.30 (600µm)	39	
No.40 (425µm)	33	
No.50 (300µm)	28	
No.100 (150µm)	18	
No.200 (75µm)	10.7	

Chart



Comments

N/A

American Engineering Testing, Inc.
St. Paul
550 Cleveland Ave N
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Albertville
5548 Barthel Ind Dr, Ste 500
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Material Test Report

Report No: MAT:20-11563-S10

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S10
Field Sample ID	TH109
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/18/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	1.7	

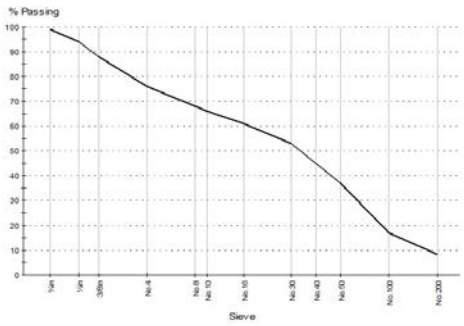
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	99	
½in (12.5mm)	94	
3/8in (9.5mm)	88	
No.4 (4.75mm)	76	
No.8 (2.36mm)	68	
No.10 (2.0mm)	66	
No.16 (1.18mm)	61	
No.30 (600µm)	53	
No.40 (425µm)	45	
No.50 (300µm)	37	
No.100 (150µm)	17	
No.200 (75µm)	8.2	

Chart



Comments

N/A

American Engineering Testing, Inc.
St. Paul
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(651) 659-9001
Toll Free: (800) 972-6364

Albertville
5548 Barthel Ind Dr, Ste 500
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Material Test Report

Report No: MAT:20-11563-S11

Client: MINNESOTA DEPT OF TRANSPORTATION
CC:

Project: DCP FDR Tests

St. Paul MN
Job No: 27-20000

Draft Report - Subject to change pending final review

Date of Issue: 6/18/2020

Sample Details

Sample ID	20-11563-S11
Field Sample ID	TH238
Date Sampled	
Source	
Material	
Specification	Gradation
Sampling Method	
Location	
Date Submitted	6/18/2020

Other Test Results

Description	Method	Result	Limits
Granular Ratio	MnDOT 1202, MnDOT 1203		
Asphalt Content (of Total Sample) (%)	MnDOT 1852	3.2	

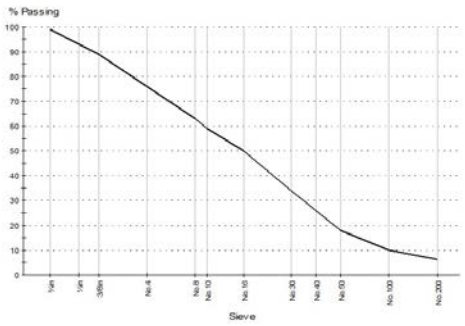
Particle Size Distribution

Method: MnDOT 1202, MnDOT 1203

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
¾in (19.0mm)	99	
½in (12.5mm)	93	
3/8in (9.5mm)	89	
No.4 (4.75mm)	76	
No.8 (2.36mm)	63	
No.10 (2.0mm)	59	
No.16 (1.18mm)	50	
No.30 (600µm)	34	
No.40 (425µm)	26	
No.50 (300µm)	18	
No.100 (150µm)	10	
No.200 (75µm)	6.5	

Chart



Comments

N/A

D-11