AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

SUMMARY REPORT OF PAVEMENT TESTING AND ANALYSIS

McLeod County CSAH 54 Evaluation

McLeod County, Minnesota

AET Report No. 27-20035

Date:

August 2, 2019

Prepared for:

John Brunkhorst, P.E.
McLeod County Highway Department
1400 Adams Street SE
Hutchinson, MN 55350

www.amengtest.com

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August 2, 2019

John Brunkhorst, P.E.
McLeod County Highway Department
1400 Adams Street SE
Hutchinson, MN 55350

RE: Summary Report of Pavement Testing and Analysis
McLeod County CSAH 54
McLeod County, MN
AET Project No. 27-20035

Dear Mr. Brunkhorst:

American Engineering Testing, Inc. (AET) is pleased to present the results of our pavement testing and analysis services for your referenced project in Mcleod County, Minnesota. These services were performed according to our proposal to you dated April 15, 2019.

We are submitting this digital copy of the report to you. Please let us know if you would like paper copies.

Sincerely,
American Engineering Testing, Inc.

David L. Rettner
President/Principal Engineer
Phone (651)755-5795
drettner@amengtest.com

SIGNATURE PAGE

Prepared for:

John Brunkhorst, P.E.
McLeod County Highway Department
1400 Adams Street SE
Hutchinson, MN 55350

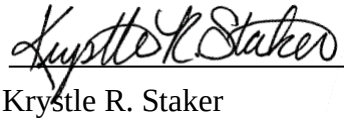
Prepared by:

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, MN 55114

Report Authored By:

David L. Rettner
President, Principal Engineer

Reviewed By:



Krystle R. Staker
Engineering Technician III

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota

Name: David L. Rettner

Date: August 2, 2019 **License #: 20458**

TABLE OF CONTENTS

1.0 INTRODUCTION

It is our understanding that during the summer of 2018, McLeod County (County) contracted to have the section of CSAH 54 (from approximately 400 feet south of Sunset Circle to the junction of CSAH 7) resurfaced (Figure 1). We further understand that the construction was to consist of cement stabilization of the existing gravel roadway surface and subgrade soils to a depth of eight (8) inches. Following the completion of the cement stabilization and a curing period, the roadway was micro-fractured (run over with a vibrating roller to induce minor fracturing of the cement stabilized layer to minimize large thermal cracks). The cement stabilized layer was micro-milled to provide a smooth surface and was provided a chip seal as the final wearing surface, with a second chip seal application to follow in 2019.

We were informed that in the early winter of 2018/2019 some portions of the roadway exhibited debonding of the chipseal surfacing. This surface debonding continued to get worse throughout the winter and by spring 2019, the roadway had lost a significant amount of the chipseal surfacing. The loss of surfacing has continued into the summer of 2019.

To assist in evaluation of the construction and recommend potential repairs and surfacing options, you have authorized American Engineering Testing, Inc. (AET) to perform testing of the roadway. This report discusses our findings.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal to you dated April 15, 2019. The authorized scope consists of the following:

Field

- Perform approximately 60, Dynamic Cone Penetrometer (DCP) tests along the roadway at approximately 1/10th mile intervals for the full depth of the cement stabilized layer.

The DCP tests will be distributed across the roadway (outside wheel paths, between wheel paths, centerline).

- Perform coring of the cement stabilized layer at approximately 10 locations to extract samples for Unconfined Compressive Strength (UCS) testing. The core locations were filled with aggregate base with the upper 2 inches patched with bituminous cold patch.
- Perform Falling Weight Deflectometer (FWD) testing of the roadway in both the NB and SB lanes at approximately 250 foot spacing. The testing will be performed in the outside wheelpath using the Strategic Highway Research Program FWD testing protocol. The tests will be performed at approximately 6,000 lbs. and 9,000 lbs. force.
- Perform a detailed Pavement Condition Index (PCI) assessment of the roadway and use this data for evaluation of the performance of the roadway.
- Perform Ground Penetrating Radar (GPR) survey of the roadway in both the NB and SB lanes in the outside wheel paths. The GPR survey will be used to determine the thickness of the cement stabilized layer.

Laboratory

- Perform UCS testing on the extracted cement stabilized base cores. The cores will be capped with a gypsum capping compound prior to testing.

Report

- Evaluation of construction testing information and daily diaries of McLeod County staff.
- Summary of field and laboratory testing results and data analysis
- Determination of effectiveness of cement stabilization process, including any issues with the upper 1 inch of stabilized layer, where debonding is occurring.
- Recommendations for rehabilitation of the chip seal surfacing (this will be done with cooperation of the County and Astech).

We will also be available to meet with the County as needed and we will co-present with the County at a minimum of one conference and assist in the preparation of a Tech Brief for the MnLTAP to meet the requirements of the Opera Funding grant.

These services are intended for geotechnical purposes only. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or ground water; however, obvious contamination detected by us would be reported to you.

3.0 SUBSURFACE EXPLORATION AND PAVEMENT TESTING

3.1 Pavement Thickness Testing

The pavement thickness testing program conducted for the project consisted of a high speed GPR antenna, collecting the pavement thickness data at a rate of four scans per foot. The data was collected using a 2 GHz antenna, which allows material layer measurements at depths of up to 18 inches with a resolution of less than about 0.5 inch.

The GPR data was collected on May 9, 2019. GPR scanning was performed in both directions of the roadway in the outside wheelpath. GPR scans were collected according to SIR-30 processor settings established by the GSSI RoadScan system. A calibration file, required for data post-processing, was collected prior to testing. The test data and details of the methods used appear in Appendix A.

The GPR interface identification was accomplished using RADAN 7.0, a proprietary software package included with the GSSI RoadScan system. The software includes tools to aid in delineating pavement layer transitions, and automatically calculates their depths from the pavement surface using the calibration file(s) collected prior to testing.

3.2 Pavement Deflection Testing

The FWD testing was performed on May 7, 2019 using a Dynatest 8000 Falling Weight Deflectometer. The FWD testing non-destructively provides data that allows the calculation of roadway load capacity, from which the performance of street pavement can be judged efficiently.

The pavement deflection testing program consisted of FWD testing at approximately 250-foot spacing taken in the outside wheelpath of each driving lane of the roadway. After seating drops, data for four impulse loads (two at 6,000 lbs. nominal load and two at 9,000 lbs. nominal load) were collected at each test point. Nine deflection sensors at offsets consistent with the Long-Term Performance Program (LTPP) configuration were utilized.

The test data and details of the methods used appear in Appendix B of this report. Figure 2 shows the FWD testing locations and the calculated spring load capacity in tons at each location.

3.3 Dynamic Cone Penetration (DCP) Testing

The DCP test provides a measure of a material's in-situ resistance to penetration. The testing was performed in general accordance with ASTM D6951 - Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications. The test is performed by driving a metal cone into the ground by repeatedly striking it with a 17.6 lb (8 Kg) weight dropped from a distance of 2.26 feet (575 mm). The penetration of the cone is measured after each set of blows (1 set = 3 blows) and is recorded to provide a continuous measure of shearing resistance up to 5 feet below the ground surface. Test results can be correlated to California Bearing Ratios, in-situ density, resilient modulus, and bearing capacity.

The DCP testing was performed on May 13 and 14, 2019. The testing locations are shown in Figure 3. The tests were performed at approximately $1/10^{th}$ mile intervals in the outside wheelpath, centerline, and between the wheelpaths. The tests were performed to a depth of

approximately 9 inches at each location, and extended through the stabilized layer. The test results appear in Appendix C.

3.4 Pavement Coring

Coring of the cement stabilized layer was performed at 10 locations along the roadway (Figure 4). Intact cores longer than 4-inches were obtained at seven of the locations, a partial core was extracted at location 6, and two cores shorter than 4-inches were obtained at locations 2 and 10. Photographs of each of the cores appear in Appendix D.

3.5 Pavement Condition Index (PCI) Evaluation

AET performed pavement distress surveys on the roadway at several locations (Figure 5). The condition surveys were performed according to AASHTO standards for bituminous and aggregate surfaced roadways.

4.0 DATA ANALYSIS

4.1 Ground Penetrating Radar (GPR)

An attempt to determine the thickness of the soil cement layer was made by use of GPR. Generally, the bottom of the soil cement layer was clearly identified by the GPR. A summary of the thickness results is shown in Appendix A. The data analysis showed that the depth to the bottom of the NB layer averaged 7.6 inches and the depth to the bottom of the SB layer averaged 7.7 inches. It should be noted that this depth includes the chipseal, if it was still present (at the time of the GPR testing only about 50% of the chipseal remained). It should also be noted that at many locations, the upper portion of the cement stabilized layer had been worn away from traffic after the chipseal had debonded. Therefore, it appears that the 8-inch design thickness was achieved during construction.

Examples of GPR traces are shown as Figure 4.1.

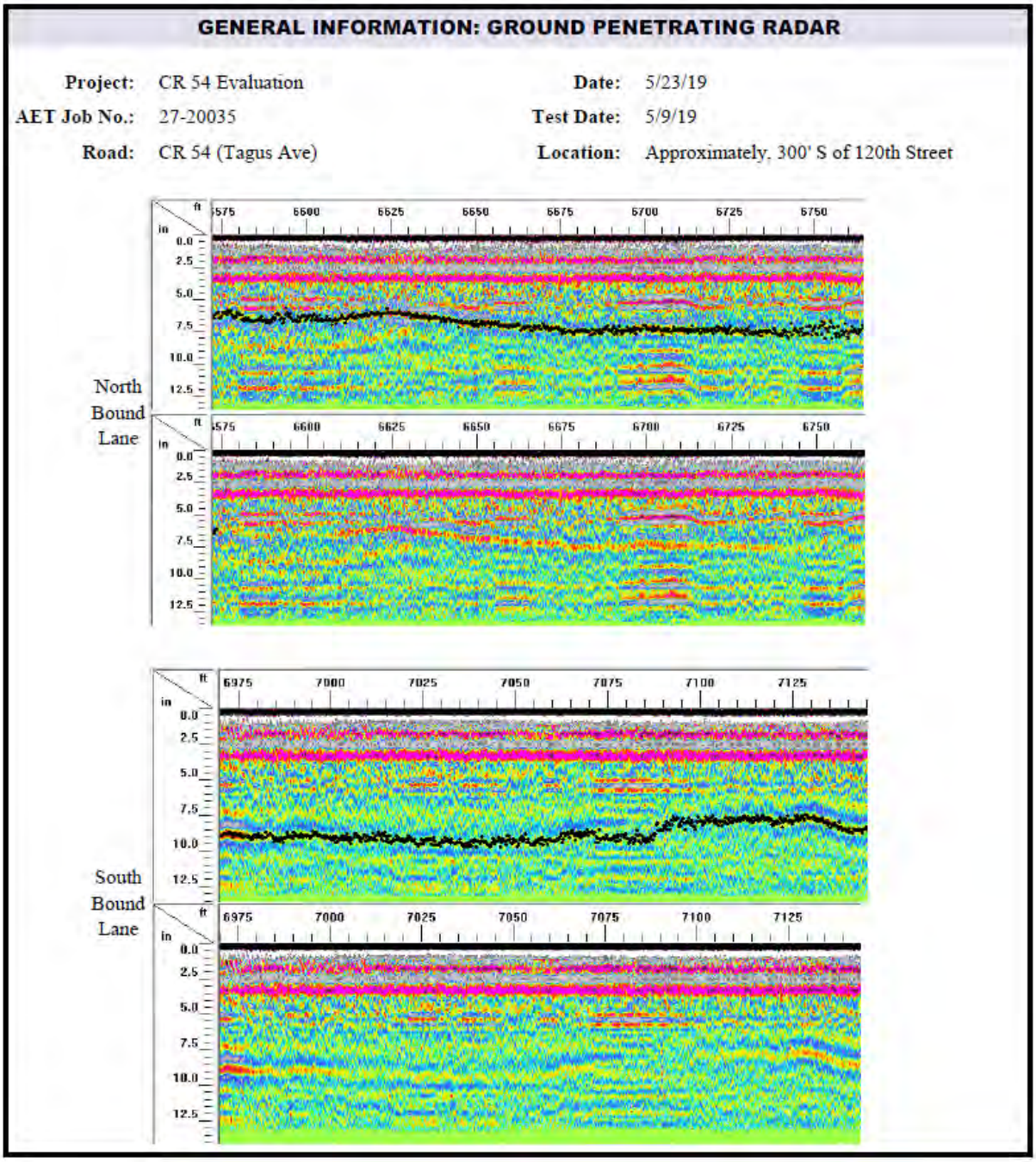


Figure 4.1 –NB and SB GPR Data Traces

4.2 Falling Weight Deflectometer (FWD)

The deflection data were analyzed using the MnDOT TONN2010 method for determining the in-place (effective) subgrade and pavement strength, as well as allowable axle loads for the roadway. The MnDOT TONN2010 methods use the mechanistic and empirical model for estimating the fatigue and rut life of asphalt concrete pavement and shear strength of aggregate base.

The FWD analysis clearly shows that the northern 7,500 feet of the project (north of 135th Street) is significantly stronger than the southern 8,000 feet of the project (south of 135th Street), as can be seen in Table 4.2 below. The northern 7,500 feet has a spring load capacity of 7.1 tons, an effective Granular Equivalent of 22.6 inches, and an effective subgrade R-value of 5.5. The southern 8,000 feet has a spring load capacity of 4.0 tons, an effective Granular Equivalent of 12.5 inches and an effective R-value of 3.9.

	Northern 7,500 Feet			Southern 8,000 Feet		
	Spring Load Capacity (tons)	Effective GE (Inches)	Effective R Value	Spring Load Capacity (tons)	Effective GE (Inches)	Effective R Value
Average	10.4	29.4	7.4	6.1	19.1	5.6
Std. Dev.	3.3	6.9	1.9	2.0	6.6	1.7
Design	7.1	22.6	5.5	4.0	12.5	3.9

Table 4.2 – FWD Analysis Summary

The data analysis of the northern portion of the project indicates that the subgrade soils are stronger and that there is a significantly stronger pavement structure. The cement stabilized material would be expected to have a GE of approximately 1.5 inches per inch of stabilized thickness, therefore the 8-inches of stabilized material should have produced a GE of approximately 12.0. It appears that the northern portion of the roadway exceeded this anticipated

GE. It is also possible that there was additional aggregate surfacing on the northern portion of the roadway, which is now underlying the stabilized layer.

4.3 Dynamic Cone Penetration (DCP)

The DCP testing was performed in general accordance with ASTM D6951 - Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications. In general, the DCP test was performed to a depth of approximately 9 inches so that the average test result for the full depth of the cement stabilization could be calculated. The California Bearing Ratio (CBR) for each test location was calculated using the following equation:

$$CBR = 292/PI^{1.12}$$

PI = Penetration Index (mm/blow)

A calculated CBR over 100 indicates that the material tested is too strong for a valid correlation to be made. It also indicates that the cement stabilization was effective. A typical correlation used for determining whether the as constructed soil cement strength meets the project unconfined compressive strength requirement (in this case 250 psi) is the following equation developed by the University of Illinois for the Illinois DOT:

$$\text{Unconfined Compressive Strength} = 4.5*CBR$$

Therefore, using this equation, it can be assumed that if the CBR exceeds 56% that the unconfined compressive strength exceeds 250 psi. A summary of the results and the results of each test location are contained in Appendix C.

Figure 4.3 below shows the results for Location 13. It can be seen that the average CBR for this location is 48.4%, but that the measured strength is variable with depth. In this case, it is lower near the surface, higher in the middle, and lower in the bottom of the stabilized layer. This type of test result is typical for the majority of the locations tested. Typically, the upper 0.5 to 1.0 inches had a CBR below the design strength (or significantly lower than the underlying stabilized

material), and oftentimes the lower 0.5 to 1.5 inches was also lower than the design strength (or significantly lower than the overlying stabilized material).

Six locations that were tested did not exceed an average CBR of 56%: NB test locations 8 and 13, and SB test locations 34, 51, 54, and 59, with average results of 53.6%, 48.4%, 38.2%, 26.8%, 36.2% and 27.5%, respectively.

AMERICAN ENGINEERING TESTING, INC.

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: McLeod County **CC:** John Brunkhorst
Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:
Reviewed By:

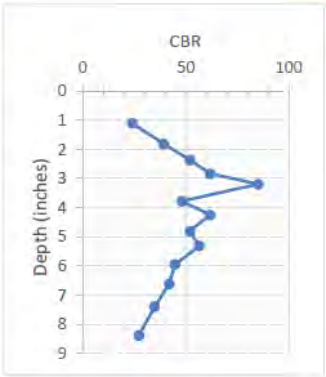
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	13 - Center Line
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)	CBR
	52				
3	80	28	1.1	9.3	23.9
3	98	18	1.8	6.0	39.3
3	112	14	2.4	4.7	52.0
3	124	12	2.8	4.0	61.8
3	133	9	3.2	3.0	85.3
3	148	15	3.8	5.0	48.1
3	160	12	4.3	4.0	61.8
3	174	14	4.8	4.7	52.0
3	187	13	5.3	4.3	56.5
3	203	16	5.9	5.3	44.8
3	220	17	6.6	5.7	41.8
3	240	20	7.4	6.7	34.9
3	265	25	8.4	8.3	27.2



Average CBR:	48.4

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).

Figure 4.3 – Example DCP Test Report – Location 13

4.4 Pavement Coring and Unconfined Compressive Strength (UCS)

Cores were attempted at 10 locations along the roadway. Seven cores with intact sections longer than 4-inches were extracted, a partial core was extracted at one location, and two cores shorter than 4-inches were extracted. One core attempt was made just south of 135th Street but a successful core could not be retrieved. The seven intact cores longer than 4-inches were trimmed, capped, and tested for UCS. The results of the UCS testing are summarized in Table 4.4 below. Photographs of each of the cores as well as the UCS results are in Appendix D. It can be seen from the results that there was a poor correlation between the DCP test results and the UCS test results. It is possible that this is due to some damage that was induced in the material during coring. It is also likely that due to the variability in strength vs. depth, that the UCS is more representative of the weaker layers in the stabilized material, rather than an average strength of the entire layer.

Core	UCS (psi)
C-1	274
C-3	193
C-4	158
C-5	98
C-7	297
C-8	338
C-9	225

Table 4.4 – Core Unconfined Compressive Strength

4.5 Pavement Condition Index (PCI)

Data was collected from the roadway to perform Pavement Condition Index (PCI) calculations. There are standard methods for calculating the PCI of bituminous surfaced roadways and for

aggregate surfaced roadways. Unfortunately, because the most predominate distresses on the roadway were loss of the bituminous chipseal and washboarding of the underlying cement stabilized surface (padfoot roller marks are present), neither evaluation method was applicable since the roadway is neither bituminous nor gravel surfaced (see Figure 4.5.1 and 4.5.2 for examples). We did attempt to use the Wisconsin PASER pavement rating system, which uses a 1-10 scale with 1 being worst. Due to the high density of distresses, the southern 2/3 of the roadway was rated a 1 and the northern 1/3 was rated a 2 (Figure 4.5.3). Both indicate a failed condition for the roadway.

Figure 4.5.1 – CSAH 54 looking South. Loss of Chipseal and Padfoot Roller Marks

Figure 4.5.2 – CSAH 54 Looking North. Almost Total Loss of Chipseal Surfacing in NB Lane.

It can be seen in both Figures 4.5.1 and 4.5.2 that there is a substantially larger amount of chipseal loss in the NB lane than in the SB lane. This phenomenon is generally consistent throughout the project, although the far northern end appears to have better chipseal retention in the NB lane than elsewhere.

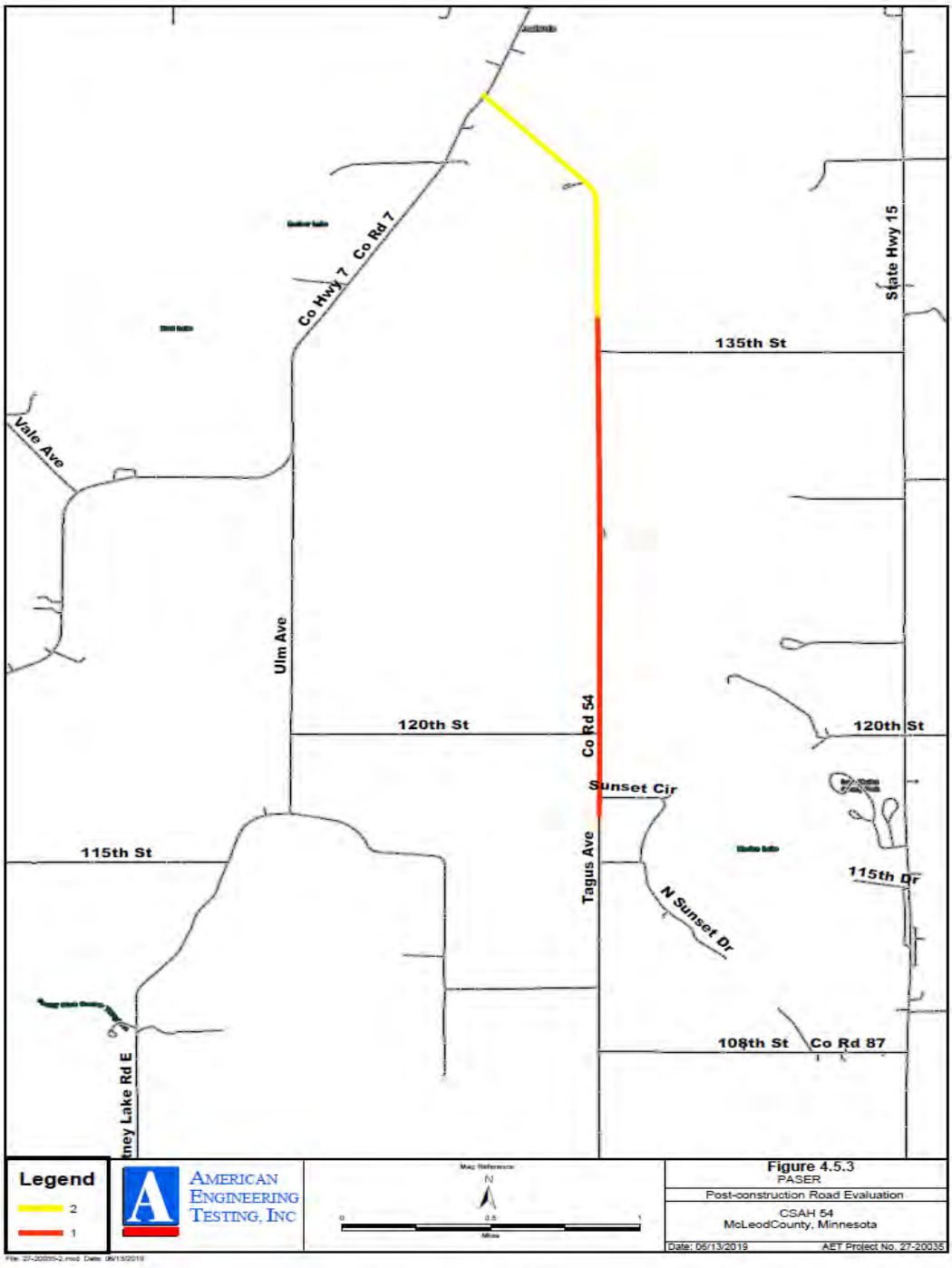


Figure 4.5.3 – PASER Rating

4.6 Construction Diary Review

We reviewed the construction diaries of the McLeod County staff. From the available information, it appears that for the majority of the construction long stretches (1,000 – 2,600 feet) of a roadway section were stabilized in a single reclaimer pass, with the adjacent reclaimer passes following in an east to west sequence (this pattern was not followed on the last day of work). The diaries also indicate that the blade work (bringing the roadway surface to final profile and cross slope) did not start until the completion of the 3rd or 4th pass, and typically, this was 2-3 hours after the reclaiming had started. The final blade work was completed approximately 1 hour after it had begun, and the final compaction was typically completed 3-4 hours after the reclaiming had started.

5.0 CONCLUSIONS

The following conclusions were drawn from our testing and analysis:

1. In general, it appears that the full 8 inches of stabilization that was specified did occur.
2. The majority of the roadway does have a GE of 12 or more over the underlying weak subgrade soils.
3. The construction sequencing appears to have resulted in 3-4 hours between the time the cement stabilization was started and the final compaction was completed. Typically, this work is expected to be completed within 1-2 hours after the start of stabilization to minimize working with hydrating cement. Working with hydrating cement can negatively impact strength gain, as well as workability and compaction of the material.
4. The upper 0.5 to 1.0 inches of the stabilized layer appears to have different characteristics than the lower portion, as evidenced by the loss of the chipseal above the padfoot roller marks as shown in figure 4.5.1. This may be due to the long period of time between the start of stabilization and the final compaction. The padfoot roller marks (dimples) visible on the surface of the roadway (where the chipseal has debonded) indicate that there is a clear difference in the density and strength of the material in the marks compared to that

of the material surrounding the dimples. It is possible that the area rolled by the padfoot was well compacted on the surface, but the blade work loosened hydrating material into the lower portions, and the loose material that filled the dimples was not well compacted by the smooth drum roller due to bridging effects.

5. The reduced strength that was observed by the DCP testing in the lower 1-2 inches of the cement stabilized layer could be due to the delays in performing the compaction of the roadway surface. As cement hydrates and starts gaining strength the cement stabilized material becomes more difficult to compact. Getting compaction energy to the bottom of the stabilized layer becomes more difficult, which can contribute to lower strength. For cement stabilization, density of the final material directly relates to the strength achieved.

6.0 RECOMMENDATIONS

Based on the analysis of the data, it is apparent that the project did not achieve the desired final goals for the roadway. Options for improving the overall condition of the roadway surface for better long term performance include:

Assuming a 20-year design traffic of 200,000 ESAL's (based on an estimate of 25 trucks per day and a growth rate of 1%).

1) Micro-mill followed by a double chip seal. If this approach is considered we recommend consultation with industry regarding the best approach to surface preparation prior to applying the double chipseal. This consultation would include sweeping methods following the micro-milling, the use of a scrub seal, or other recommended best practices.

   It should be noted that micro-milling will reduce the cement stabilization thickness to approximately 7-inches, which further reduces the strength of the roadway. Also, pavement strength will not increase from the use of a double chipseal. If the

improved ride quality of the roadway is achieved, it is likely that this approach will attract traffic to the roadway, which will reduce its life expectancy.

2) Increasing the roadway strength to a 7-ton or 10-ton spring load capacity

The following structure is needed to achieve a 7-ton spring load limit:

Southern 8,000 Feet		Northern 7,500 Feet	
Current Effective GE	12.5 inches	Current Effective GE	22.6 inches
Required GE	14.0 inches	Required GE	14.0 inches
Required Bituminous	1.5 inches	Required Bituminous	1.5 inches
Recommend Structure		Recommended Structure	
1.5 inches SPWEB340C		1.5 inches SPWEB340C	

This structure will likely have transverse cracking spacing of 30-50 feet.

The following structure is needed to achieve a 10-ton spring load limit:

Southern 8,000 Feet		Northern 7,500 Feet	
Current Effective GE	12.5 inches	Current Effective GE	22.6 inches
Required GE	30.0 inches	Required GE	30.0 inches
Recommend Structure		Recommended Structure	
3 inches SPWEB340C		3 inches SPWEB340C	
2 inches SPWEB330B			
6 inches Class 5 Aggregate Base		3 inches Class 5 Aggregate Base	

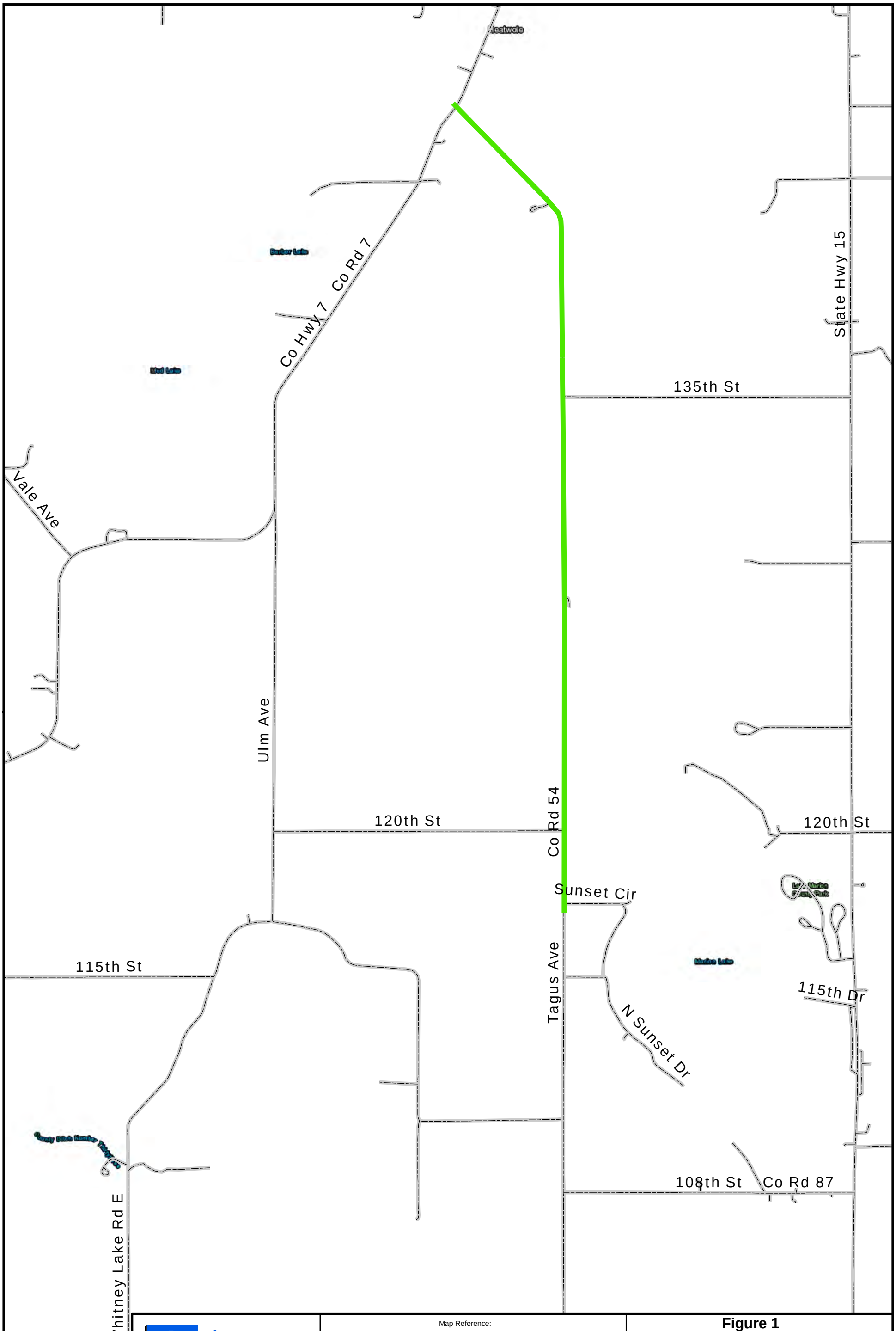
7.0 LIMITATIONS

It should be noted that the greater the number of data points the higher the confidence in the results representing the actual field conditions. Thus, the farther the FWD testing points are spread the likelihood of missing variability in the pavement is increased. AET has considered the approximately 250-foot spacing used in this project as a balance between reasonable confidence in the information and economy. The use of these technologies will keep the number of FWD tests required to the project level while allowing reasonable assessment of the suitability of any pavement to existing traffic loads, as well as assist in recommending repairs of the pavement prior to opening to traffic.

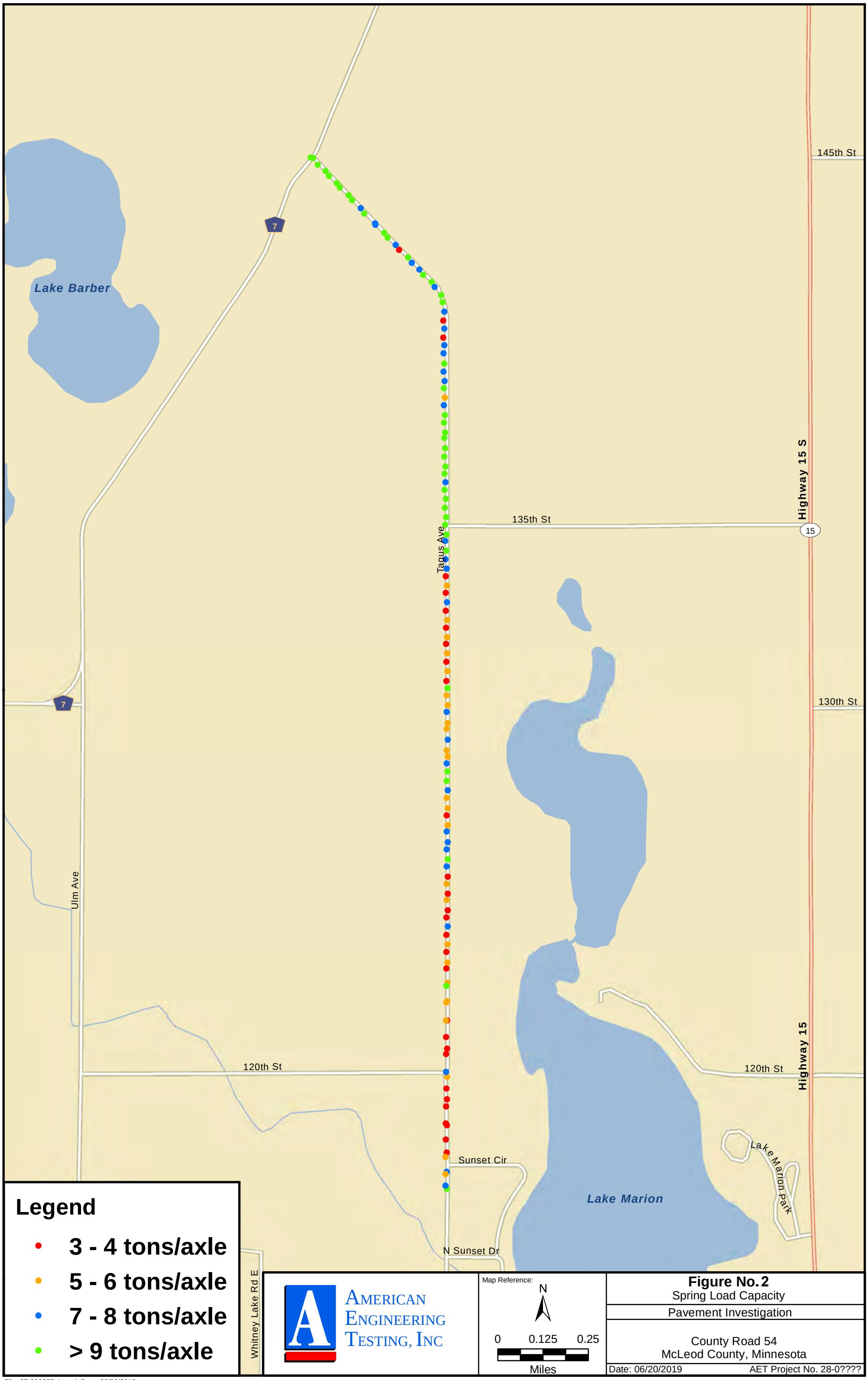
Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix E entitled “Pavement Report Limitations and Guidelines for Use.”

Figures



File: 27-20035-1.mxd Date: 06/13/2019



File: 27-20035P-1.mxd Date: 06/20/2019

Legend

DCP Locations

Test Section

DCP 30
DCP 29
DCP 31
DCP 28
DCP 32
DCP 33
DCP 27
DCP 34
DCP 26
DCP 35
DCP 25
DCP 24
DCP 36
DCP 23
DCP 37
DCP 22
DCP 38
DCP 21
DCP 39
DCP 20
DCP 40
DCP 19
DCP 41
DCP 18
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DCP 16
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DCP 12
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DCP 11
DCP 49
DCP 10
DCP 50
DCP 9
DCP 51
DCP 8
DCP 52
DCP 7
DCP 53
DCP 6
DCP 54
DCP 5
DCP 55
DCP 4
DCP 56
DCP 3
DCP 57
DCP 2
DCP 58
DCP 59
DCP 1
DCP 60

Barber Lake
Co Hwy 7
Co Rd 7
135th St
Ulm Ave
120th St
Lake Rd E
Sunset Cir
54
Marion Lake

AMERICAN ENGINEERING TESTING, INC

Map Reference:

N

0 0.5 1

Miles

Figure 3 DCP Locations

Preconstruction Road Evaluation

CSAH 54
McLeod County, Minnesota

Date: 06/20/2019 AET Project No. 27-20035

File: 27-20035-1-DCP.mxd Date: 06/20/2019

Legend

- Core Locations
- Test Section

Core 6 - Partial Recovery
Core 5
Core 1
Core 7
Core 3
Core 8
Core Attempt, No Recovery
Core 4
Core 9
Core 2
Core 10

Barber Lake
Co Hwy 7
Co Rd 7
Co Rd 54
Tagus Ave
135th St
Ulm Ave
120th St
120th St
Sunset Cir
N Sunset Dr
Lake Rd E
Marion Lake

AMERICAN ENGINEERING TESTING, INC

Map Reference:
N
0 0.5 1
Miles

Figure 4 Core Locations

Preconstruction Road Evaluation

CSAH 54
McLeod County, Minnesota

Date: 06/20/2019 AET Project No. 27-20035

File: 27-20035-1-CORES.mxd Date: 06/20/2019

Legend

- Localized Distress 1
- Localized Distress 2
- Sample 1
- Sample 2
- Sample 3
- Sample 4
- Sample 5
- Sample 6
- Test Section

Sample 1
Co Hwy 7
Co Rd 7
Tagus Ave
Sample 6
Sample 2
135th St
Co Rd 54
Localized Distress 2
Sample 5
Sample 3
Ulm Ave
120th St
120th St
Localized Distress 1
Sample 4
Lake Rd E
N Sunset Dr

AMERICAN ENGINEERING TESTING, INC

Map Reference:
N
0 0.5 1
Miles

Figure 5 PCI Sample Locations

Post construction Road Evaluation

CSAH 54
McLeod County, Minnesota

Date: 06/20/2019 AET Project No. 27-20035

File: 27-20035-1-SAMPLES.mxd Date: 06/20/2019

Appendix A

Ground Penetrating Radar Field Exploration and Testing
Ground Penetrating Radar Summaries

Appendix A
Ground Penetrating Radar Field Exploration and Testing
Report No. 27-20035

A.1 FIELD EXPLORATION

The pavement structural conditions at the site were evaluated nondestructively using Ground Penetrating Radar (GPR). The description of the equipment precedes the GPR Data and Analysis Results in this appendix.

A.2 EQUIPMENT DESCRIPTION

A.2.1 GSSI GPR Test System

The GPR test system owned by AET is a GSSI Roadscan System that consists of a bumper-mounted, 2 GHz air-coupled antenna and a SIR-20 control and data acquisition processor, featuring dual channels. The GPR processor, including a SIR-20 data acquisition system, wheel-mounted DMI (Distance Measuring Instrument), and a tough book with the SIR-20 Field Program constitutes the newest, most sophisticated GSSI Test System, which fulfills or exceeds all requirements to meet ASTM-4748, ASTM D-6087 Standards. Figure A1 provides a view of this equipment.

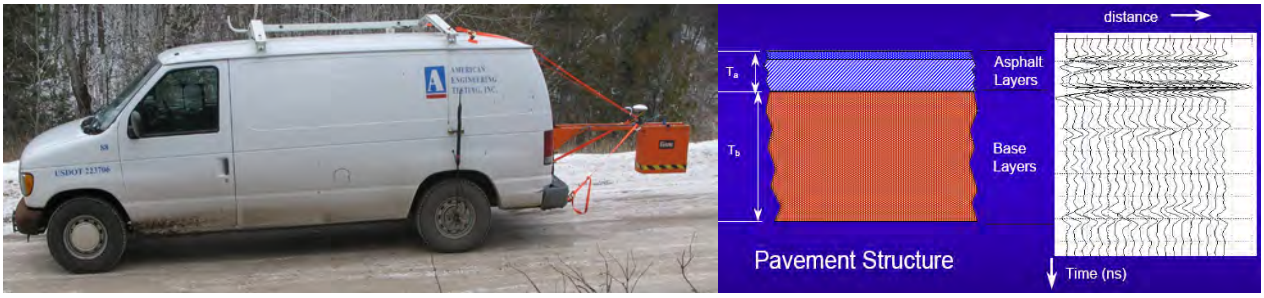


Figure A1 GSSI 2 GHz air-coupled GPR Test System

The GPR antenna emits a high frequency electromagnetic wave into the material under investigation. The reflected energy caused by changes in the electromagnetic properties within the material is detected by a receiver antenna and recorded for subsequent analysis. The 2 GHz air-coupled GPR is capable of collecting radar waveforms at more than 100 signals per second, allows for data to be collected at driving speeds along the longitudinal dimension of the pavements or bridge decks with the antennas fixed at the rear or in front of the vehicle.

The antenna used for Roadscan is the Horn antenna Model 4105 (2 GHz). The 2 GHz antenna is the current antenna of choice for road survey because it combines excellent resolution with reasonable depth penetration (18-24 inches in pavement materials). The data collection is performed at normal driving speeds (45-55 mph), requiring no lane closures nor causing traffic congestion. At this peed the 2 GHz antenna is capable of collecting data at 1-foot interval (1 scan/foot).

The data were collected at a rate of about 1 vertical scans per foot. Each vertical scan consisted of 512 samples and the record length in time of each scan was 12 nanoseconds. Filters used during acquisition were 300 MHz high pass and 5,000 MHz low pass.

In a GPR test, the antenna is moved continuously across the test surface and the control unit collects data at a specified distance increment. In this way, the data collection rate is independent of the scan rate. Alternatively, scanning can be performed at a constant rate of time, regardless of the scan distance. Single point scans can be performed as well. Data is reviewed on-screen and in the field to identify reflections and ensure proper data collection parameters.

Field testing is performed in accordance with the standard ASTM procedures as described in ASTM D 4695-96, “Standard Guide for General Pavement Deflection Measurements”.

A.2.2 System Calibrations

Horn antenna processing is used to get the velocity of the radar energy in the material by comparing the reflection strengths (amplitudes) from a pavement layer interface with a perfect reflector (a metal plate). The calibration scan is obtained with the horn antenna placed over a metal plate at the same elevation as a scan obtained over pavement.

The same setting for data collection is used for metal plate calibration. Fifteen seconds are need for jumping up and down on the vehicle’s bumper to collect the full range of motion for the vehicle’s shocks. The filename of raw calibration file is recorded.

Survey wheel is calibrated by laying out a long distance (> 50 feet) with tape measure.

A.2.3 Linear Distance and Spatial Reference System
Distance measuring instrument (DMI) is a trailer mounted two phase encoder system. When DMI is connected to the SIR-20 it provides for automatic display and recording distance information in both English and metric units with a 1 foot (0.3 meters) resolution and four percent accuracy when calibrated using provided procedure in the Field Program.

Spatial reference system is a Trimble ProXH Global Positioning System (GPS) that consists of fully integrated receiver, antenna and battery unit with Trimble's new H-Star™ technology to provide sub-foot (30 cm) post processed accuracy. The External Patch antenna is added to the ProXH receiver for the position of the loading plate. The External Patch antenna can be conveniently elevated with the optional baseball cap to prevent any signal blockage.

A.2.4 Camera Monitoring System
A battery operated independent DC-1908E multi-functional digital camera with a SD card is used for easy positioning of the loading plate or of the pavement surface condition at the testing locations.

A.3 SAMPLING METHODS
At the project level, the testing interval is set at 12 scans per foot in the Outside Wheel Path (OWP) = 2.5 ft ± 0.25 ft (0.76 m ± 0.08 m) for nominal 12 ft (3.7 m) wide lanes at a survey speed of approximately 10 mph. Where a divided roadbed exists, surveys will be taken in both directions if the project will include improvements in both directions. If there is more than one lane in one direction the surveys will be taken in the outer driving lane (truck lane) versus the passing lane of the highway. GPR tests are performed at a constant lateral offset down the test section. When GPR tests are performed on bridge decks, multiple survey lines are followed transversely at 2-foot spacing between survey lines.

At the network level, GPR tests on one scan per foot are set to be able to collect data on pavements at driving speeds, without statistically compromising the quality of the data collected. If GPR tests are for the in situ characterization of material GPR data will be collected at two scan per foot at slower driving speeds.

A.4 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)
Beside the daily metal plate calibration the DMI is also calibrated monthly by driving the vehicle over a known distance to calculate the distance scale factor. The GPR will be monitored in real time in the data collection vehicle to minimize data errors. The GPR units will be identified with a unique number and that number will accompany all data reported from that unit as required in the QC/QA plan.

Scheduled preventive maintenance ensures proper equipment operation and helps identify potential problems that can be corrected to avoid poor quality or missing data that results if the equipment malfunctions while on site. The routine and major maintenance procedures established by the LTPP are adopted and any maintenance has been done at the end of the day after the testing is complete and become part of the routine performed at the end of each test/travel day and on days when no other work is scheduled.

To insure quality data, the GPR assessments only took place on dry pavement surfaces, and data was collected in each wheel path.

A.5 DATA ANALYSIS METHODS

A.5.1 Data Editing
Field acquisition is seldom so routine that no errors, omissions or data redundancy occur. Data editing encompasses issues such as data re-organization, data file merging, data header or background information updates, repositioning and inclusion of elevation information with the data.

A.5.2 Basic Processing
Basic data processing addresses some of the fundamental manipulations applied to data to make a more acceptable product for initial interpretation and data evaluation. In most instances this type of processing is already applied in real-time to generate the real-time display. The advantage of post survey processing is that the basic processing can be done more systematically and non-causal operators to remove or enhance certain features can be applied.

The Reflection Picking procedure is used to eliminate unwanted noise, detects significant reflections, and records the corresponding time and depth. It uses antenna calibration file data to calculate the radar signal velocity within the pavement.

A.5.3 Advance Processing
Advanced data processing addresses the types of processing which require a certain amount of operator bias to be applied and which will result in data which are significantly different from the raw information which were input to the processing.

A.5.4 Data Interpretation
The EZ Tracker Layer Interpretation procedure uses the output from the first step to map structural layers and calculate the corresponding velocities and depths.

A.6 TEST LIMITATIONS

A.6.1 Test Methods
The data derived through the testing program have been used to develop our opinions about the pavement conditions at your site. However, because no testing program can reveal totally what is in the subsurface, conditions between test locations and at other times, may differ from conditions described in this report. The testing we conducted identified pavement conditions only at those points where we measured pavement thicknesses and observed pavement surface conditions. Depending on the sampling methods and sampling frequency, every location may not be tested, and some anomalies which are present in the pavement may not be noted on the testing results. If conditions encountered during construction differ from those indicated by our testing, it may be necessary to alter our conclusions and recommendations, or to modify construction procedures, and the cost of construction may be affected.

A.6.2 Test Standards
Pavement testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SUPPORTING TEST METHODS

A.7.1 Falling Weight Deflectometer (FWD)
If the pavement layer moduli and subgrade soil strength are desired the deflection data are collected using a Dynatest 8000 FWD Test System that consists of a Dynatest 8002 trailer and a third generation control and data acquisition unit developed in 2003, called the Dynatest Compact15, featuring fifteen (15) deflection channels. The new generation FWD, including a Compact15 System and a standard PC with the FwdWin field Program constitutes the newest, most sophisticated Dynatest FWD Test System, which fulfills or exceeds all requirements to meet ASTM-4694, ASTM D-4695 Standards. The system provides continuous data at pre-set spacing.

A.7.2 Soil Boring/Coring Field Exploration
If both pavement thicknesses and subgrade soil types and conditions are desired the shallow coring/boring and sampling is used. The limited number of coring/boring is necessary to verify the GPR layer thickness data.

A.7.3 Pavement Surface Condition Survey
The type and severity of pavement distress influence the deflection response for a pavement. Therefore, GPR operators record any distress located from about 1 ft (0.3 m) in front of vehicle to about 30 ft (9 m) ahead. This information is recorded in the FWD file using the comment line in the field program immediately following the test

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, Minnesota 55114
Phone: (651) 659-9001
Fax: (651) 659-1379

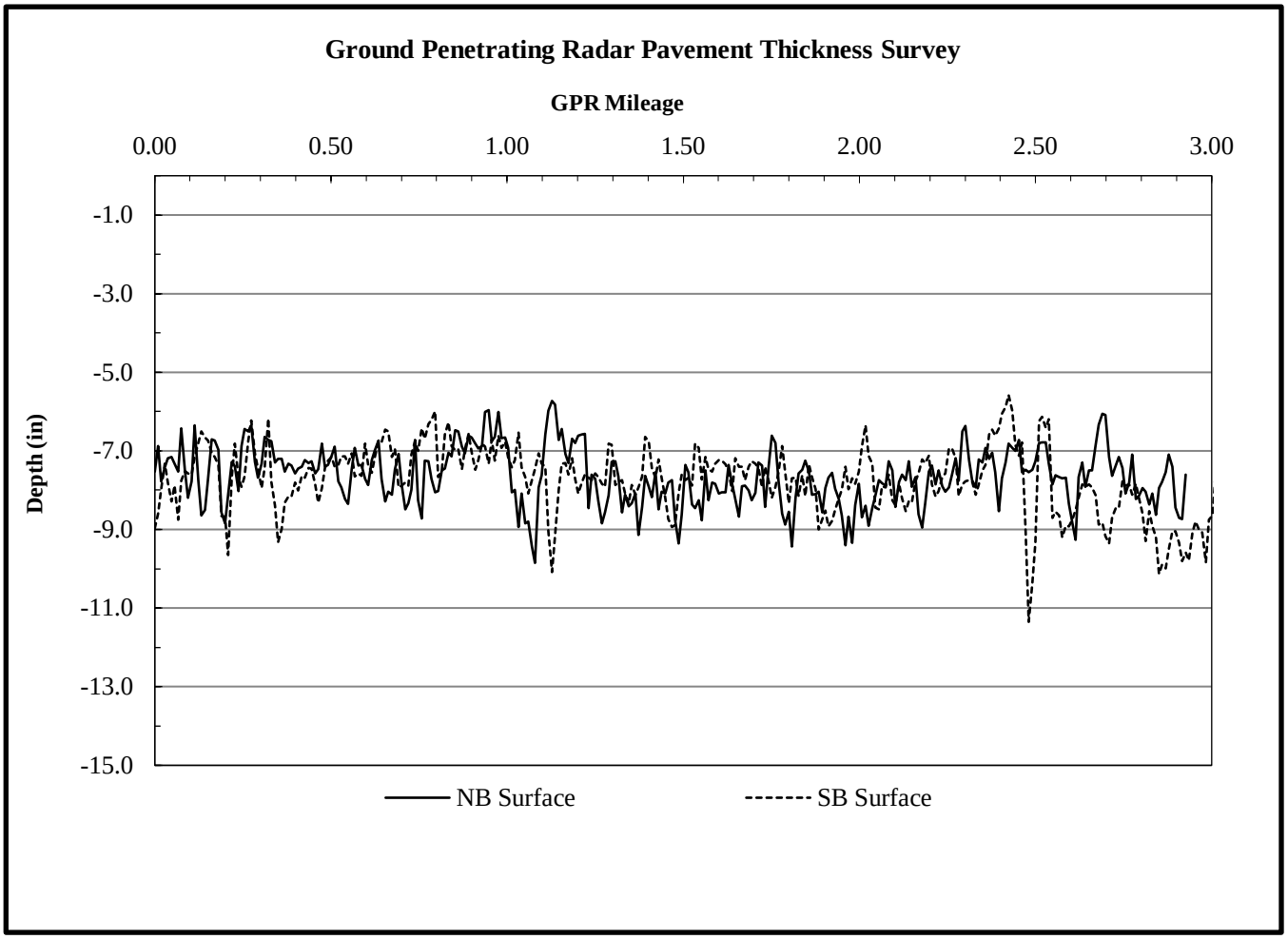
GENERAL INFORMATION: GROUND PENETRATING RADAR

Project:	CR 54 Evaluation	**Date:**	5/23/19
AET Job No.:	27-20035	**Test Date:**	5/9/19
Road:	CR 54 (Tagus Ave)	**Section/Grid:**	01
From:	~350' S of Sunrise Circle	**To:**	CR 7

SUMMARY STATISTICS

Units: inches

	NB				SB			
Layer	**Average**	**CV**	**15th**	**Min.**	**Average**	**CV**	**15th**	**Min.**
Surface	7.6	10%	6.8	5.7	7.7	11%	6.9	5.6



Appendix B

Falling Weight Deflectometer Field Exploration and Testing

FWD Test Results Summary

Appendix B
Falling Weight Deflectometer Field Exploration and Testing
AET Project No. 27-20035

B.1 PAVEMENT TESTING

The pavement structural conditions at the site were evaluated nondestructively using Falling Weight Deflectometer (FWD). The description of the equipment precedes the Deflection Data and Analysis Results in this appendix.

B.2 EQUIPMENT DESCRIPTION

B.2.1 Dynatest 8000 FWD Test System

The FWD owned by AET is a Dynatest 8000 FWD Test System that consists of a Dynatest 8002 trailer and a third generation control and data acquisition unit developed in 2003, called the Dynatest Compact15, featuring fifteen (15) deflection channels. The new generation FWD, including a Compact15 System and a standard PC with the FwdWin Field Program constitutes the newest, most sophisticated Dynatest FWD Test System, which fulfills or exceeds all requirements to meet ASTM-4694 Standards. Figure B1 provides a view of this equipment.

Figure B1 Dynatest 8002 FWD Test System

The FWD imposes a dynamic impulse load onto the pavement surface through a load plate. Total pulse is an approximately half sine shape with a total duration typically between 25 to 30 ms. The FWD is capable of applying a variety of loads to the pavement ranging from 1,500 lbf (7 kN) to 27,000 ibf (120 kN) by dropping a variable weight mass from different heights to a standard, 11.8-inch (300-mm) diameter rigid plate.

The drop weights and the buffers are constructed so that the falling weight buffer subassembly may be quickly and conveniently changed between falling masses of 440 lbm (200 kg) for highways and 770 lbm (350 kg) for airports. With the 440 lbm (200 kg) package for highways three drop heights are used with the target load of 6,000 lbf (27 kN) at drop height 1, 9,000 lbf (40 kN) at drop height 2, and 12,000 lbf at drop height 3 (53 kN). The drop sequence consists of two seating drops from drop height 3 and 2 repeat measurements at drop height 1 and 1 measurement at drop height 2 for flexible pavements and 2 repeat measurements at drop height 2 and 1 measurement at drop height 3 for rigid pavements. The data from the seating drops is not stored.

The FWD is equipped with a load cell to measure the applied forces and nine geophones or deflectors to measure deflections up to 100 mils (2.5 mm). The load cell is capable of accurately measuring the force that is applied perpendicular to the loading plate with a resolution of 0.15 psi (1 kPa) or better. The force is expressed in terms of pressure, as a function of loading plate size.

Nine deflectors at the offsets listed in the following table in the Long Term Performance Program (LTPP) configuration are capable of measuring electronically discrete deflections per test, together with nine (9) separate deflection measuring channels for recording of the data. One (1) of the deflectors measures the deflection of the pavement surface through the center of the loading plate, while seven (7) deflectors are capable of being positioned behind the loading plate along the housing bar, up to a distance of 5 ft (2.5 m) from the center of the loading plate and one (1) being positioned in front of the loading plate along the bar.

Deflector	**D9**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**
Offset (in.)	-12	0	8	12	18	24	36	48	60

Field testing is performed in accordance with the standard ASTM procedures as described in ASTM D 4695-96, "Standard Guide for General Pavement Deflection Measurements" and the calibration of our equipment is verified each year at the Long Term Pavement Performance Calibration Center in Maplewood, MN.

B.2.2 Linear Distance and Spatial Reference System
Distance measuring instrument (DMI) is a trailer mounted two phase encoder system. When DMI is connected to the Compact15 it provides for automatic display and recording distance information in both English and metric units with a 1 foot (0.3 meters) resolution and four percent accuracy when calibrated using the provided procedure in the Field Program.

Spatial reference system is a Trimble ProXH Global Positioning System (GPS) that consists of fully integrated receiver, antenna and battery unit with Trimble's new H-Star™ technology to provide subfoot (30 cm) post-processed accuracy. The External Patch antenna is added to the ProXH receiver for the position of the loading plate. The External Patch antenna can be conveniently elevated with the optional baseball cap to prevent any signal blockage.

B.2.3 Air and Pavement Temperature Measuring System
A temperature monitoring probe, for automatic recording of air temperature, is an electronic (integrated circuit) sensing element in a stainless steel probe. The probe mounts on the FWD unit in a special holder with air circulation and connects to the Compact15. A non-contact Infra-Red (IR) Temperature Transmitter, for automatic recording of pavement surface temperature only, features an integrated IR-detector and digital electronics in a weather proof enclosure. The IR transmitter mounts on the FWD unit in a special holder with air circulation and connects to the Compact15. Both probe and IR transmitter have a resolution of 0.9 ºF (0.5 ºC) and accuracy within ± 1.8ºF (1 ºC) in the 0 to 158 ºF (-18 to +70ºC) range when calibrated using the provided procedure.

B.2.4 Camera Monitoring System
A battery operated independent DC-1908E multi-functional digital camera with a SD card is used for easy positioning of the loading plate or recording of the pavement surface condition at the testing locations.

B.3 SAMPLING METHODS
At the project level, the testing interval is set at 0.1 mi. (maximum) or 10 locations per uniform section in the Outside Wheel Path (OWP) = 2.5 ft ± 0.25 ft (0.76 m ± 0.08 m) for nominal 12 ft (3.7 m) wide lanes. Where a divided roadbed exists, surveys will be taken in both directions if the project will include improvements in both directions. If there is more than one lane in one direction the surveys will be taken in the outer driving lane versus the passing lane of the highway. FWD tests are performed at a constant lateral offset down the test section.

B.4 QUALITY CONTROL (QC) AND QUALITY ASSURANCE (QA)
In addition to the annual reference calibration, the relative calibration of the FWD deflection sensors is conducted monthly but not to exceed 6 weeks during the months in which the FWD unit is continually testing. The DMI is also calibrated monthly by driving the vehicle over a known distance to calculate the distance scale factor. The accuracy of the FWD air temperature and infra-red (IR) sensors are checked on a monthly basis or more frequently if the FWD operator observes "suspicious" temperature readings.

Some care in the placement of the load plate and sensors is taken by the survey crew, especially where the highway surface is rutted or cracked, to ensure that the load plate lays on a flat surface and that the load plate and all geophones lie on the same side of any visible cracks. Liberal use of comments placed in the FWD data file at the time of data collection is required. Comments pertaining to proximity to reference markers, bridge abutments, patches, cracks, etc., are all important documentation for the individual evaluating the data.

Scheduled preventive maintenance ensures proper equipment operation and helps identify potential problems that can be corrected to avoid poor quality or missing data that results if the equipment malfunctions while on site. The routine and major maintenance procedures established by the LTPP are adopted and any maintenance has been done at the end of the day after the testing is complete and become part of the routine performed at the end of each test/travel day and on days when no other work is scheduled.

B.5 DATA ANALYSIS METHODS

B.5.1 Inputs

The two-way AADT and HCADT are required to calculate the ESALs. The state average truck percent and truck type distribution are used when HCADT is not provided. The as-built pavement information (layer type, thickness, and construction year) are required and if not provided, GPR and/or coring and boring is needed.

B.5.2 Adjustments

Temperature adjustment to the deflections measured on bituminous pavements is determined from the temperature predicted at the middle depth of the pavement using the LTPP BELLS3 model that uses the pavement surface temperature and previous day mean air temperature. The predicted middle depth temperature and the standard temperature of 80 degrees Fahrenheit are used to calculate the temperature adjustment factor for deflection data analysis. Seasonal adjustment developed by Mn/DOT is also used.

B.5.3 Methods

For bituminous pavements, the deflection data were analyzed using the Mn/DOT method for determining the in-place (effective) subgrade and pavement strength, as well as allowable axle loads for a roadway (Investigation 603) revised in 1983 and automated with spreadsheet format in 2008. The Mn/DOT method uses Hogg Model for estimating the subgrade modulus and the Effective GE Equation (Investigation 603) for estimating the effective GE of pavements. The Mn/DOT method also uses the TONN method for estimating Spring Load Capacity and Required Overlay, as described in the Mn/DOT publication "Estimated Spring Load-Carrying Capacity".

For gravel roads, the deflection data were analyzed using the American Association of State Highway and Transportation Officials' (AASHTO) method for determining the in-place (effective) subgrade and pavement strength, as well as allowable axle loads for a roadway as in the AASHTO Guide for Design of Pavement Structures, 1993.

For concrete pavements, the deflection data were analyzed using the FAA methods for determining the modulus of subgrade reaction (k-value), effective elastic modulus of concrete slabs, load transfer efficiency (LTE) on approach and leave slabs of a joint, slab support conditions (void analysis) and impulse stiffness modulus ratio (durability analysis) as in the FAA AC 150/5370-11A, Use of Nondestructive Testing Devices in the Evaluation of Airport Pavement, 2004.

B.6 TEST LIMITATIONS

B.6.1 Test Methods

The data derived through the testing program have been used to develop our opinions about the pavement conditions at your site. However, because no testing program can reveal totally what is in the subsurface, conditions between test locations and at other times, may differ from conditions described in this report. The testing we conducted identified pavement conditions only at those points where we measured pavement surface temperature, deflections, and observed pavement surface conditions. Depending on the sampling methods and sampling frequency, every location may not be tested, and some anomalies which are present in the pavement may not be noted on the testing results. If conditions encountered during construction differ from those indicated by our testing, it may be necessary to alter our conclusions and recommendations, or to modify construction procedures, and the cost of construction may be affected.

B.6.2 Test Standards

Pavement testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

Roadway	From Station	State	State	To Statiion	District	TONN ANALYSIS				State	Control Section	Lane	Direction	Lat. and Long.
McLeod County	22.000	Aid	Aid	31052.000	0	Calculated	Reported			Aid	CR 54	0	Increasing	44.7858, -94.3962

DEPARTMENT OF TRANSPORTATION

	Capacity, Tons		Overlay, in.	Life, ESALs	R-value	GE	Capacity, Tons	Moduli Statistics			#1 Defl.
								HMA (72° F)	Base	Subgrade	(mils)
85% Percentile	4.6		6.7	28,099	4.5	14.5	**4.4**				
Average	8.0		3.2	308,601	6.4	23.7	8.3	128,601	10,185	**4,383**	54.8
Std. Dev.	3.45		2.92	453,848	1.99	8.46	3.57	118,739	10,366	1,566	24.9

Station	HMA Thickness	Soil Type	Traffic Cat.	Base Thickness	ESALs	Calculated Capacity, Tons	N2010 subgrade ksi for cha	Overlay, in.	Life, ESALs	R-value	GE	TONN2010 Capacity, Tons	Moduli HMA (72° F)	Moduli Base	Moduli Subgrade	#1 Defl. (mils)
22.00	7.6	P	1	3.0	100,000	9.4	8	0.5	292,791	12.3	19.9	9.2	70,642	7,672	7,672	38
249.00	7.6	P	1	3.0	100,000	7.6	6	2.4	144,307	8.5	19.5	7.8	57,486	7,782	6,323	48
505.00	7.6	P	1	3.0	100,000	4.8	4	6.4	31,962	6.0	12.4	4.5	34,736	3,809	3,809	80
750.60	7.6	P	1	3.0	100,000	4.2	3	7.5	21,162	4.9	12.1	4.1	31,436	3,411	3,411	89
998.80	7.6	P	1	3.0	100,000	4.6	4	6.6	29,139	4.6	15.5	4.4	36,070	3,535	3,535	81
1258.50	7.6	P	1	3.0	100,000	6.5	4	3.7	89,482	6.1	20.7	7.7	44,770	35,870	3,765	57
1505.80	7.6	P	1	3.0	100,000	4.9	4	6.1	35,906	5.5	14.6	4.8	37,647	3,977	3,977	77
1777.20	7.6	P	1	3.0	100,000	4.8	3	6.2	33,920	5.7	13.5	4.8	28,279	16,787	2,703	78
2021.60	7.6	P	1	3.0	100,000	6.3	4	4.0	77,920	5.2	22.0	6.1	74,082	3,955	3,596	59
2266.00	7.6	P	1	3.0	100,000	6.1	4	4.3	70,941	5.5	20.4	7.4	42,293	25,567	4,117	61
2511.60	7.6	P	1	3.0	100,000	6.6	4	3.5	93,847	5.1	23.9	8.1	55,160	38,821	3,882	56
2749.40	7.6	P	1	3.0	100,000	6.8	4	3.3	102,519	4.3	27.0	7.6	110,204	5,352	3,631	54
3027.40	7.6	P	1	3.0	100,000	7.4	4	2.6	132,837	5.1	26.7	8.1	109,564	5,555	4,195	50
3259.30	7.6	P	1	3.0	100,000	3.3	2	9.4	10,063	4.0	8.8	2.8	23,536	2,181	2,181	114
3505.80	7.6	P	1	3.0	100,000	4.8	4	6.3	33,096	5.1	15.2	4.6	35,685	3,821	3,821	78
3751.50	7.6	P	1	3.0	100,000	4.8	3	6.3	32,591	4.0	18.6	5.7	33,425	19,603	3,156	80
4004.60	7.6	P	1	3.0	100,000	9.0	4	0.9	251,388	5.4	31.1	10.6	185,679	6,201	4,208	40
4254.00	7.6	P	1	3.0	100,000	7.2	4	2.8	125,060	5.1	26.1	7.8	101,554	4,566	4,349	51
4502.50	7.6	P	1	3.0	100,000	6.3	4	4.0	78,289	4.4	24.4	6.5	89,077	3,513	3,513	59
4751.50	7.6	P	1	3.0	100,000	6.6	4	3.6	92,465	5.3	23.1	6.8	81,296	4,122	4,122	56
5013.70	7.6	P	1	3.0	100,000	8.6	5	1.3	217,949	8.2	23.6	8.2	69,712		4,825	42
5290.10	7.6	P	1	3.0	100,000	14.6	8	0.0	1,219,074	10.3	34.5	15.3	341,554	7,990	7,797	23
5502.90	7.6	P	1	3.0	100,000	6.9	5	3.1	108,526	8.3	17.6	6.6	52,889	5,412	5,412	53
5749.80	7.6	P	1	3.0	100,000	7.2	4	2.8	123,052	8.1	19.0	7.6	51,236	32,022	3,537	51
5995.50	7.6	P	1	3.0	100,000	6.0	5	4.4	67,342	5.9	18.8	6.0	52,651	4,607	4,607	62
6258.50	7.6	P	1	3.0	100,000	6.2	4	4.1	76,085	5.2	21.7	6.2	72,839	4,190	3,726	60
6506.20	7.6	P	1	3.0	100,000	9.1	5	0.8	264,035	5.5	31.4	11.0	192,468	5,638	4,513	39
6756.50	7.6	P	1	3.0	100,000	5.6	3	5.0	52,957	4.8	20.0	6.6	41,211	29,406	3,087	67
7018.30	7.6	P	1	3.0	100,000	5.0	4	6.0	36,822	5.2	15.5	4.8	39,432	5,160	3,501	75
7248.20	7.6	P	1	3.0	100,000	5.7	3	4.8	57,762	4.9	20.4	6.8	42,776	29,882	3,137	65
7498.80	7.6	P	1	3.0	100,000	5.9	5	4.5	64,980	6.8	16.3	5.9	46,257	4,881	4,881	63
7764.80	7.6	P	1	3.0	100,000	7.3	2	2.7	127,455	5.1	26.2	7.4	108,320	21,495	2,256	50
8005.00	7.6	P	1	3.0	100,000	5.5	3	5.1	51,832	5.0	19.0	6.6	38,683	29,950	3,144	67
8251.50	7.6	P	1	3.0	100,000	7.8	5	2.2	156,834	6.8	23.7	7.8	94,278	5,407	4,508	46
8520.80	7.6	P	1	3.0	100,000	9.6	5	0.3	316,695	6.3	30.7	11.1	149,734	24,736	4,958	37
8751.10	7.6	P	1	3.0	100,000	13.5	5	0.0	937,541	8.5	35.2	13.6	354,750	12,967	5,174	25
9003.80	7.6	P	1	3.0	100,000	15.7	7	0.0	1,545,162	9.1	38.5	13.3	462,319		6,784	21
9277.60	7.6	P	1	3.0	100,000	16.2	8	0.0	1,708,267	9.8	38.1	17.0		7,542	7,542	20
9519.10	7.6	P	1	3.0	100,000	8.9	5	1.0	240,418	7.5	25.8	9.1	112,502	6,723	5,077	41
9750.20	7.6	P	1	3.0	100,000	10.2	4	0.0	380,028	5.4	34.7	11.4	211,932	41,823	4,390	34
10017.00	7.6	P	1	3.0	100,000	18.5	8	0.0	2,650,128	10.2	41.1	13.8			7,585	17
10249.40	7.6	P	1	3.0	100,000	11.3	7	0.0	523,395	10.0	27.9	12.3	147,365	9,133	7,459	31
10507.50	7.6	P	1	3.0	100,000	10.7	5	0.0	440,109	6.6	32.8	12.2	227,997	6,630	5,306	33
10759.40	7.6	P	1	3.0	100,000	6.3	4	4.0	77,496	5.3	21.6	6.1	72,754	3,719	3,719	58
11005.40	7.6	P	1	3.0	100,000	7.3	4	2.7	128,451	6.0	23.9	7.5	90,741	6,147	4,171	50
11262.30	7.6	P	1	3.0	100,000	12.2	4	0.0	685,180	7.1	35.3	12.9	365,235	12,453	4,275	28
11525.30	7.6	P	1	3.0	100,000	8.3	5	1.6	195,878	6.6	26.0	8.6	103,982	5,170	5,170	43
11770.60	7.6	P	1	3.0	100,000	7.1	4	2.9	117,106	6.0	23.1	7.2	83,512	6,061	4,113	52
12019.50	7.6	P	1	3.0	100,000	8.0	5	1.9	170,631	6.6	24.9	8.3	99,821	5,035	5,035	46
12270.60	7.6	P	1	3.0	100,000	11.4	5	0.0	539,025	6.5	34.6	12.7	257,273	25,289	5,105	31
12505.00	7.6	P	1	3.0	100,000	15.0	6	0.0	1,331,800	7.6	40.0	14.3		41,184	5,754	22
12761.40	7.6	P	1	3.0	100,000	8.3	5	1.6	193,106	6.3	26.6	8.7	117,128	4,855	4,855	43
12998.80	7.6	P	1	3.0	100,000	9.9	4	0.1	345,907	5.4	33.7	11.5	213,085	23,226	4,413	35
13266.80	7.6	P	1	3.0	100,000	7.3	4	2.8	125,767	6.0	23.8	8.3	61,607	39,894	4,188	51
13508.30	7.6	P	1	3.0	100,000	9.1	5	0.9	258,358	7.0	27.5	10.0	129,247	7,632	5,268	39
13700.90	7.6	P	1	3.0	100,000	7.3	5	2.7	126,778	8.3	19.0	7.0	61,234	5,434	5,434	50
14000.90	7.6	P	1	3.0	100,000	7.5	4	2.5	138,010	7.4	21.4	6.7	82,860	5,425	3,681	49
14263.10	7.6	P	1	3.0	100,000	10.0	6	0.0	353,355	9.2	25.8	10.4	121,595	8,810	5,979	36
14510.40	7.6	P	1	3.0	100,000	14.6	7	0.0	1,225,605	9.1	36.4	15.5	432,732	6,501	6,501	23
14752.70	7.6	P	1	3.0	100,000	14.9	8	0.0	1,311,528	11.2	33.9	15.2	336,191	11,098	7,795	22
15005.00	7.6	P	1	3.0	100,000	10.1	4	0.0	368,784	5.8	33.2	11.3	265,068	9,103	3,760	35
15256.10	7.6	P	1	3.0	100,000	9.6	5	0.4	309,094	6.9	29.1	10.8	167,066	5,268	5,268	37
15396.70	7.6	P	1	3.0	100,000	15.3	6	0.0	1,422,042	8.6	38.5	13.0	457,552		6,385	21
15640.70	7.6	P	1	3.0	100,000	13.9	7	0.0	1,028,668	10.2	33.3	14.5	309,457	10,463	7,100	24
15866.00	7.6	P	1	3.0	100,000	15.1	7	0.0	1,360,023	10.0	35.9	13.5	361,558	33,436	7,324	22
16129.90	7.6	P	1	3.0	100,000	9.7	4	0.3	319,944	6.9	29.5	10.6	179,750	6,428	4,362	36
16396.70	7.6	P	1	3.0	100,000	10.5	6	0.0	423,958	7.6	30.4	12.1	189,052	6,070	6,070	33
16628.30	7.6	P	1	3.0	100,000	8.3	5	1.6	194,488	6.5	26.1	8.8	114,097	5,058	5,058	43
16885.50	7.6	P	1	3.0	100,000	11.2	7	0.0	516,296	9.9	27.9	12.4	150,569	10,887	7,387	31
17133.70	7.6	P	1	3.0	100,000	4.0	2	7.9	17,588	4.6	11.5	3.7	27,070	7,718	2,291	95
17397.10	7.6	P	1	3.0	100,000	8.5	5	1.4	208,080	6.9	25.9	8.3	77,294		5,047	43
17638.60	7.6	P	1	3.0	100,000	13.0	5	0.0	832,445	7.0	37.2	14.3	378,802	26,889	5,417	26
17886.40	7.6	P	1	3.0	100,000	8.6	4	1.3	221,589	5.0	31.3	10.7	187,812	8,062	4,140	42
18130.30	7.6	P	1	3.0	100,000	9.6	4	0.4	309,734	4.5	35.8	12.0	326,430	3,662	3,662	37
18401.30	7.6	P	1	3.0	100,000	4.5	2	6.8	27,548	5.0	13.9	4.4	31,434	18,677	1,961	83
18651.50	7.6	P	1	3.0	100,000	4.4	3	7.0	24,888	4.1	16.0	4.3	39,437	3,246	3,246	86
18873.50	7.6	P	1	3.0	100,000	7.3	4	2.7	126,212	5.8	24.3	7.4	104,850	3,970	3,970	50
19147.40	7.6	P	1	3.0	100,000	7.6	5	2.4	145,542	8.5	19.8	8.3	65,881	12,853	5,309	48
19396.30	7.6	P	1	3.0	100,000	9.8	6	0.2	329,934	7.6	28.2	11.0	148,993	6,040	6,038	36
19641.50	7.6	P	1	3.0	100,000	7.3	6	2.7	126,032	8.7	18.2	7.2	59,880	5,666	5,666	50
19895.10	7.6	P	1	3.0	100,000	15.1	7	0.0	1,355,025	10.0	35.9	14.8	372,954	21,495	7,425	22
20121.20	7.6	P	1	3.0	100,000	10.2	5	0.0	381,452	6.6	31.5	11.6	207,780	7,180	4,954	35
20389.30	7.6	P	1	3.0	100,000	12.4	1	0.0	723,132	7.4	35.3	9.7	484,809	2,702	1,476	28
20642.40	7.6	P	1	3.0	100,000	11.9	6	0.0	635,742	8.3	32.4	11.0	191,831	42,295	6,328	29
20883.00	7.6	P	1	3.0	100,000	15.4	8	0.0	1,450,721	10.9	35.1	16.0	409,751	7,622	7,622	21
21140.70	7.6	P	1	3.0	100,000	11.3	4	0.0	531,634	5.0	38.6	13.7	473,816	3,929	3,929	31
21381.40	7.6	P	1	3.0	100,000	16.2	9	0.0	1,701,066	11.9	35.1	16.7	406,426	8,804	8,804	20
21626.60	7.6	P	1	3.0	100,000	7.5	5	2.4	143,015	5.8	25.2	8.0	96,667	4,847	4,847	48
21895.10	7.6	P	1	3.0	100,000	8.8	5	1.1	235,334	6.5	27.8	9.9	140,770	5,260	5,260	41
22143.60	7.6	P	1	3.0	100,000	4.8	4	6.3	33,278	5.1	15.1	4.6	41,288	3,516	3,516	78
22377.70	7.6	P	1	3.0	100,000	4.4	2	7.1	24,203	3.6	17.8	3.7	55,328	1,942	1,942	85
22646.10	7.6	P	1	3.0	100,000	4.6	4	6.6	28,927	5.3	13.5	4.4	36,024	3,561	3,561	82
22892.60	7.6	P	1	3.0	100,000	4.1	2	7.7	19,336	3.7	15.7	3.4	45,095	1,992	1,992	92
23126.60	7.6	P	1	3.0	100,000	3.3	2	9.6	9,493	3.6	10.1	2.7	29,063	1,880	1,880	115
23388.00	7.6	P	1	3.0	100,000	3.6	2	8.8	12,605	3.3	13.6	2.9	39,568	1,652	1,652	105
23674.80	7.6	P	1	3.0	100,000	4.8	3	6.4	31,853	4.2	17.9	5.7	37,000	25,058	2,630	80
23880.60	7.6	P	1	3.0	100,000	6.3	4	3.9	80,862	4.9	23.2	6.9	83,107	4,798	4,000	59
24126.60	7.6	P	1	3.0	100,000	7.4	5	2.6	132,029	6.6	22.8	7.6	93,576	4,616	4,504	50
24374.80	7.6	P	1	3.0	100,000	6.7	3	3.4	98,501	6.4	20.8	6.2	86,264	4,493	3,156	55
24685.60	7.6	P	1	3.0	100,000	5.1	3	5.8	39,681	4.8	17.4	4.4	58,413	2,565	2,565	74
24869.80	7.6	P	1	3.0	100,000	7.8	4	2.2	156,410	7.4	22.5	7.4	109,845	5,108	3,520	47
25130.40	7.6	P	1	3.0	100,000	10.0	6	0.0	356,340	9.8	25.1	8.5	93,944		5,720	35
25378.90	7.6	P	1	3.0	100,000	6.9	5	3.1	108,962	8.2	17.8	7.0	54,061	7,694	5,311	53
25634.50	7.6	P	1	3.0	100,000	4.6	2	6.7	28,282	4.4	15.9	4.7	33,848	18,303	2,133	82
25873.50	7.6	P	1	3.0	100,000	8.2	5	1.8	183,695	6.1	26.7	8.9	125,368	4,718	4,718	44
26134.10	7.6	P	1	3.0	100,000	8.1	4	1.8	177,770	5.1	29.1	9.2	167,801	5,181	3,516	45
26387.20	7.6	P	1	3.0	100,000	8.5	3	1.3	214,374	4.4	32.9	10.7	242,293	3,471	3,471	42
26643.70	7.6	P	1	3.0	100,000	6.0	3	4.4	66,333	4.2	24.0	6.3	90,835	3,337	3,337	63
26878.50	7.6	P	1	3.0	100,000	5.9	3	4.5	65,609	4.8	21.7	5.9	75,879	3,491	3,406	62
27125.00	7.6	P	1	3.0	100,000	3.2	2	9.7	8,950	3.4	10.5	2.5	31,298	1,527	1,527	117
27378.50	7.6	P	1	3.0	100,000	3.2	3	9.8	8,728	3.9	8.2	3.1	25,793	2,528	2,528	119
27627.50	7.6	P	1	3.0	100,000	4.5	3	6.8	26,714	4.2	16.1	4.5	41,871	3,346	3,346	84
27880.20	7.6	P	1	3.0	100,000	3.4	3	9.3	10,550	3.8	10.2	3.2	25,899	2,532	2,532	113
28125.80	7.6	P	1	3.0	100,000	9.1	4	0.8	266,084	4.9	33.2	11.2	257,205	7,232	3,714	39
28375.60	7.6	P	1	3.0	100,000	6.1	4	4.2	71,541	4.5	23.4	6.3	82,107	3,630	3,630	61
28637.80	7.6	P	1	3.0	100,000	6.1	3	4.2	73,080	5.6	20.2	7.6	49,398	33,058	3,470	61
28876.90	7.6	P	1	3.0	100,000	3.7	3	8.6	13,947	5.4	7.0	3.1	26,372	2,518	2,518	103
29128.70	7.6	P	1	3.0	100,000	3.7	3	8.5	14,065	6.3	4.8	3.5	28,936	2,784	2,784	104
29386.40	7.6	P	1	3.0	100,000	8.6	6	1.3	220,064	9.1	22.2	10.2	78,206	18,507	6,393	42
29629.60	7.6	P	1	3.0	100,000	4.5	3	6.9	25,786	5.7	11.3	3.9	33,299	3,053	3,053	85
29893.00	7.6	P	1	3.0	100,000	4.2	3	7.5	20,698	4.8	11.9	4.0	32,949	3,230	3,230	91
30139.50	7.6	P	1	3.0	100,000	4.2	3	7.4	21,438	5.1	11.5	4.1	32,731	3,295	3,295	91
30376.00	7.6	P	1	3.0	100,000	3.5	2	9.0	11,630	4.5	8.2	2.9	25,451	2,304	2,304	109
30625.80	7.6	P	1	3.0	100,000	5.2	4	5.7	41,372	5.3	16.5	5.5	42,830	5,857	4,082	73
30876.40	7.6	P	1	3.0	100,000	6.0	5	4.4	67,645	7.9	14.3	6.1	50,150	4,846	4,846	62
31052.00	7.6	P	1	3.0	100,000	8.0	4	1.9	172,759	7.7	22.6	7.8	105,490	7,315	3,756	45

Appendix C

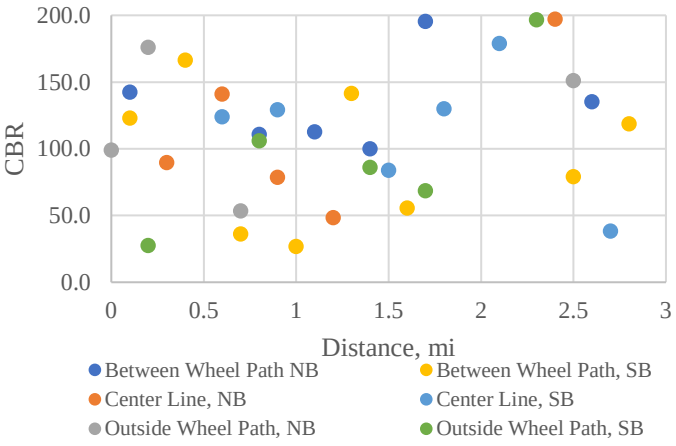
DCP Test Results

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, Minnesota 55114
Phone: (651) 659-9001
Fax: (651) 659-1379

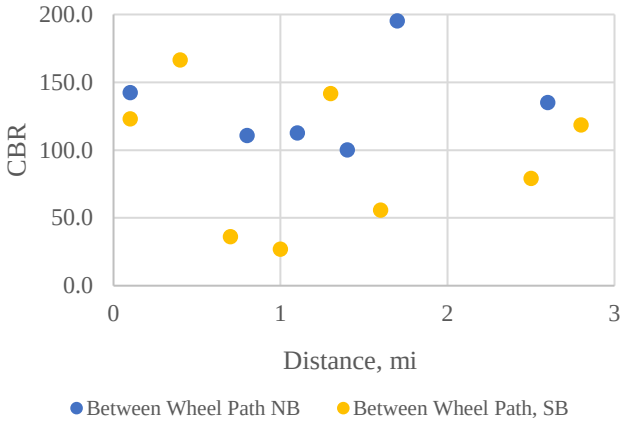
GENERAL INFORMATION: DCP Testing Plots

Project:	CR 54 Evaluation	**Test Date:**	5/13/19
AET Job No.:	27-20035		5/14/19
Road:	CR 54 (Tagus Ave)	**Section/Grid:**	01
From:	~350' S of Sunrise Circle	**To:**	CR 7

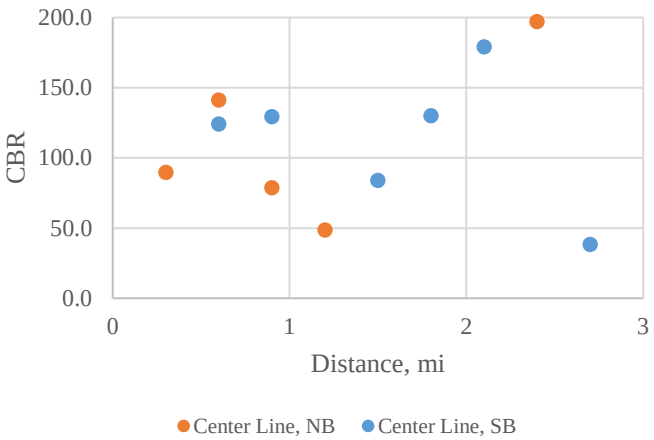
All Locations



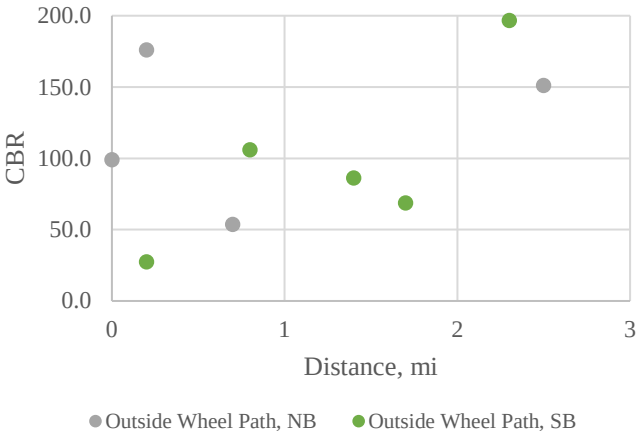
Between Wheel Paths



Center Line



Outside Wheel Path



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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	See below and Figure 3; North Bound
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
1 - Outside Wheel Path	99.0	24 - Between Wheel Paths	383.5
2 - Between Wheel Paths	142.4	25 - Center Line	197.1
3 - Outside Wheel Path	176.0	26 - Outside Wheel Path	151.0
4 - Center Line	89.7	27 - Between Wheel Paths	135.1
5 - Outside Wheel Path	328.7	28 - Center Line	427.6
6 - Between Wheel Paths	583.9	29 - Outside Wheel Path	780.8
7 - Center Line	141.1	30 - Between Wheel Paths	506.2
8 - Outside Wheel Paths	53.6		
9 - Between Wheel Paths	110.7		
10 - Center Line	78.5		
11 - Outside Wheel Path	629.5		
12 - Between Wheel Paths	112.7		
13 - Center Line	48.4		
14 - Outside Wheel Path	262.7		
15 - Between Wheel Paths	100.0		
16 - Center Line	315.7		
17 - Outside Wheel Path	391.4		
18 - Between Wheel Paths	195.3		
19 - Center Line*	2193.5		
20 - Outside Wheel Path*	3750.3		
21 - Between Wheel Paths	223.7		
22 - Center Line	333.9		
23 - Outside Wheel Path	408.4		

Average:	445.0
Standard deviation:	740.0
Design:	######

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

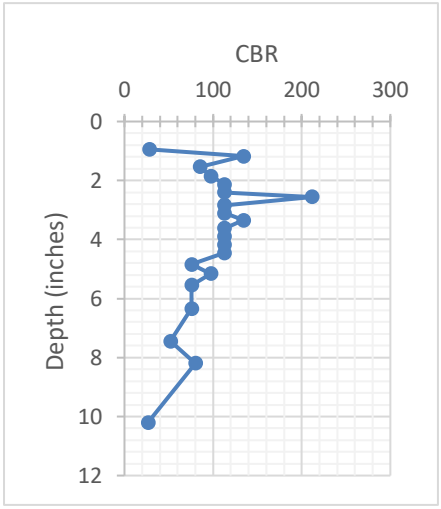
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	1 - Outside Wheel Path
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)	CBR
	51				
3	75	24	0.9	8.0	28.4
3	81	6	1.2	2.0	134.3
3	90	9	1.5	3.0	85.3
3	98	8	1.9	2.7	97.3
3	105	7	2.1	2.3	113.0
3	112	7	2.4	2.3	113.0
3	116	4	2.6	1.3	211.6
3	123	7	2.8	2.3	113.0
3	130	7	3.1	2.3	113.0
3	136	6	3.3	2.0	134.3
3	143	7	3.6	2.3	113.0
3	150	7	3.9	2.3	113.0
3	157	7	4.2	2.3	113.0
3	164	7	4.4	2.3	113.0
3	174	10	4.8	3.3	75.8
3	182	8	5.2	2.7	97.3
3	192	10	5.6	3.3	75.8
6	212	20	6.3	3.3	75.8
6	240	28	7.4	4.7	52.0
6	259	19	8.2	3.2	80.3
6	310	51	10.2	8.5	26.6



Average CBR:	99.0

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

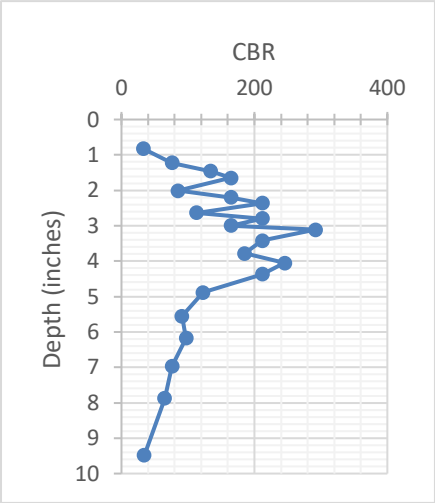
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	2 - Between Wheel Paths
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)	CBR
	53				
3	74	21	0.8	7.0	33.0
3	84	10	1.2	3.3	75.8
3	90	6	1.5	2.0	134.3
3	95	5	1.7	1.7	164.8
3	104	9	2.0	3.0	85.3
3	109	5	2.2	1.7	164.8
3	113	4	2.4	1.3	211.6
3	120	7	2.6	2.3	113.0
3	124	4	2.8	1.3	211.6
3	129	5	3.0	1.7	164.8
3	132	3	3.1	1.0	292.0
6	140	8	3.4	1.3	211.6
6	149	9	3.8	1.5	185.4
6	156	7	4.1	1.2	245.7
6	164	8	4.4	1.3	211.6
6	177	13	4.9	2.2	122.8
6	194	17	5.6	2.8	91.0
6	210	16	6.2	2.7	97.3
6	230	20	7.0	3.3	75.8
6	253	23	7.9	3.8	64.8
6	294	41	9.5	6.8	33.9



Average CBR:	142.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

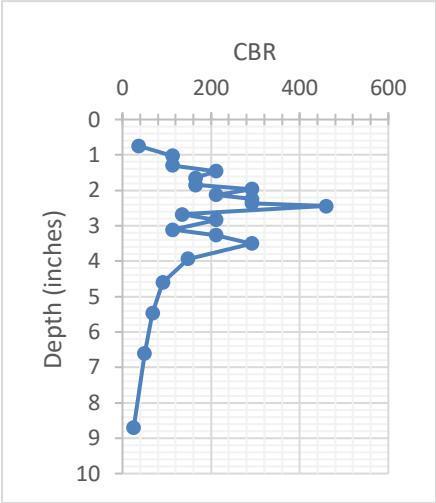
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	3 - Outside Wheel Path
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)	CBR
	53				
3	72	19	0.7	6.3	36.9
3	79	7	1.0	2.3	113.0
3	86	7	1.3	2.3	113.0
3	90	4	1.5	1.3	211.6
3	95	5	1.7	1.7	164.8
3	100	5	1.9	1.7	164.8
3	103	3	2.0	1.0	292.0
3	107	4	2.1	1.3	211.6
3	110	3	2.2	1.0	292.0
3	113	3	2.4	1.0	292.0
3	115	2	2.4	0.7	459.8
3	121	6	2.7	2.0	134.3
3	125	4	2.8	1.3	211.6
3	132	7	3.1	2.3	113.0
3	136	4	3.3	1.3	211.6
6	142	6	3.5	1.0	292.0
6	153	11	3.9	1.8	148.1
6	170	17	4.6	2.8	91.0
6	192	22	5.5	3.7	68.1
6	221	29	6.6	4.8	50.0
6	274	53	8.7	8.8	25.5



Average CBR:	176.0

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

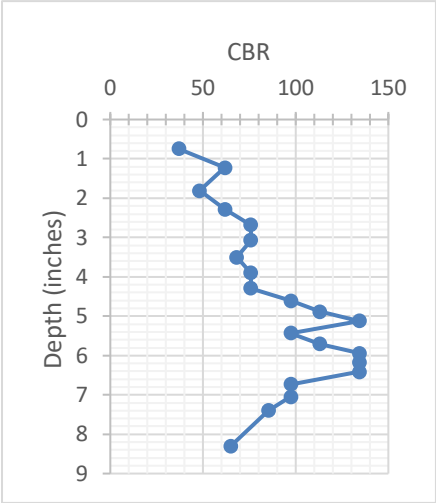
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	4 - Center Line
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)	CBR
	54				
3	73	19	0.7	6.3	36.9
3	85	12	1.2	4.0	61.8
3	100	15	1.8	5.0	48.1
3	112	12	2.3	4.0	61.8
3	122	10	2.7	3.3	75.8
3	132	10	3.1	3.3	75.8
3	143	11	3.5	3.7	68.1
3	153	10	3.9	3.3	75.8
3	163	10	4.3	3.3	75.8
3	171	8	4.6	2.7	97.3
3	178	7	4.9	2.3	113.0
3	184	6	5.1	2.0	134.3
3	192	8	5.4	2.7	97.3
3	199	7	5.7	2.3	113.0
3	205	6	5.9	2.0	134.3
3	211	6	6.2	2.0	134.3
3	217	6	6.4	2.0	134.3
3	225	8	6.7	2.7	97.3
3	233	8	7.0	2.7	97.3
3	242	9	7.4	3.0	85.3
6	265	23	8.3	3.8	64.8



Average CBR:	89.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

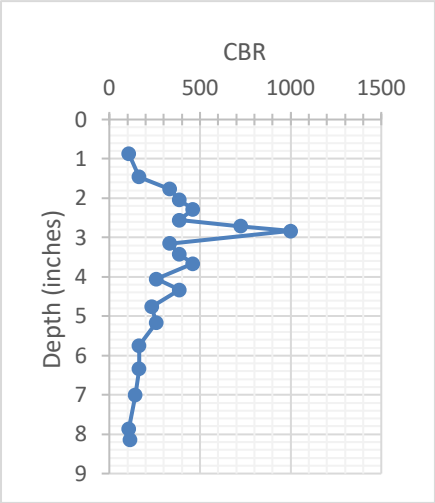
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	5 - Outside Wheel Path
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)	CBR
	53				
9	75	22	0.9	2.4	107.3
9	90	15	1.5	1.7	164.8
9	98	8	1.8	0.9	333.2
9	105	7	2.0	0.8	386.9
9	111	6	2.3	0.7	459.8
9	118	7	2.6	0.8	386.9
9	122	4	2.7	0.4	724.1
9	125	3	2.8	0.3	999.4
9	133	8	3.1	0.9	333.2
9	140	7	3.4	0.8	386.9
9	146	6	3.7	0.7	459.8
9	156	10	4.1	1.1	259.5
9	163	7	4.3	0.8	386.9
9	174	11	4.8	1.2	233.2
9	184	10	5.2	1.1	259.5
9	199	15	5.7	1.7	164.8
9	214	15	6.3	1.7	164.8
9	231	17	7.0	1.9	143.2
9	253	22	7.9	2.4	107.3
3	260	7	8.1	2.3	113.0



Average CBR:	328.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

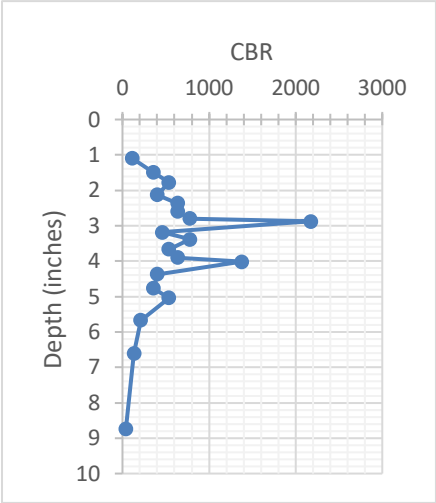
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	6 - Between Wheel Paths
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)	CBR
	52				
12	80	28	1.1	2.3	113.0
12	90	10	1.5	0.8	358.2
12	97	7	1.8	0.6	534.0
12	106	9	2.1	0.8	403.0
12	112	6	2.4	0.5	634.7
12	118	6	2.6	0.5	634.7
12	123	5	2.8	0.4	778.4
12	125	2	2.9	0.2	2172.3
12	133	8	3.2	0.7	459.8
12	138	5	3.4	0.4	778.4
12	145	7	3.7	0.6	534.0
12	151	6	3.9	0.5	634.7
12	154	3	4.0	0.3	1379.4
12	163	9	4.4	0.8	403.0
12	173	10	4.8	0.8	358.2
12	180	7	5.0	0.6	534.0
12	196	16	5.7	1.3	211.6
12	220	24	6.6	2.0	134.3
9	274	54	8.7	6.0	39.3



Average CBR:	583.9

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

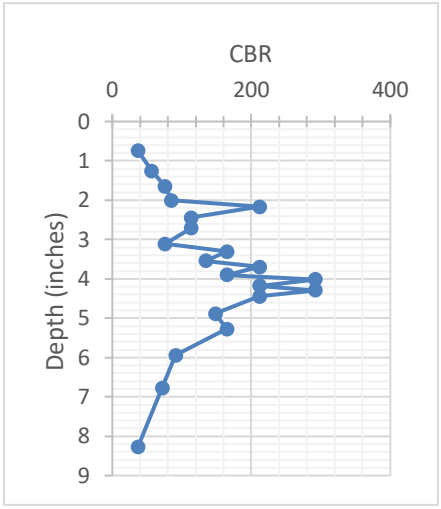
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	7 - Center Line
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)	CBR
	51				
3	70	19	0.7	6.3	36.9
3	83	13	1.3	4.3	56.5
3	93	10	1.7	3.3	75.8
3	102	9	2.0	3.0	85.3
3	106	4	2.2	1.3	211.6
3	113	7	2.4	2.3	113.0
3	120	7	2.7	2.3	113.0
3	130	10	3.1	3.3	75.8
3	135	5	3.3	1.7	164.8
3	141	6	3.5	2.0	134.3
3	145	4	3.7	1.3	211.6
3	150	5	3.9	1.7	164.8
3	153	3	4.0	1.0	292.0
3	157	4	4.2	1.3	211.6
3	160	3	4.3	1.0	292.0
3	164	4	4.4	1.3	211.6
6	175	11	4.9	1.8	148.1
6	185	10	5.3	1.7	164.8
6	202	17	5.9	2.8	91.0
6	223	21	6.8	3.5	71.8
6	261	38	8.3	6.3	36.9



Average CBR:	141.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

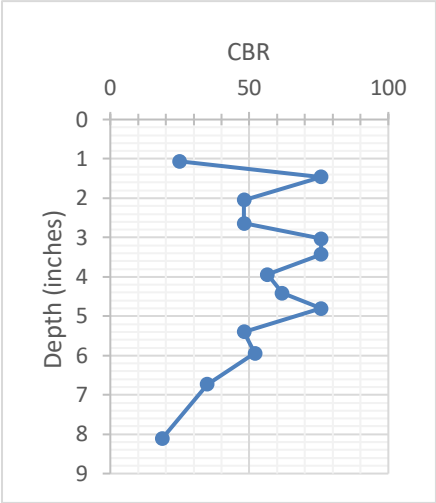
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	8 - Outside Wheel Paths
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)	CBR
	53				
3	80	27	1.1	9.0	24.9
3	90	10	1.5	3.3	75.8
3	105	15	2.0	5.0	48.1
3	120	15	2.6	5.0	48.1
3	130	10	3.0	3.3	75.8
3	140	10	3.4	3.3	75.8
3	153	13	3.9	4.3	56.5
3	165	12	4.4	4.0	61.8
3	175	10	4.8	3.3	75.8
3	190	15	5.4	5.0	48.1
3	204	14	5.9	4.7	52.0
3	224	20	6.7	6.7	34.9
3	259	35	8.1	11.7	18.6



Average CBR:	53.6

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

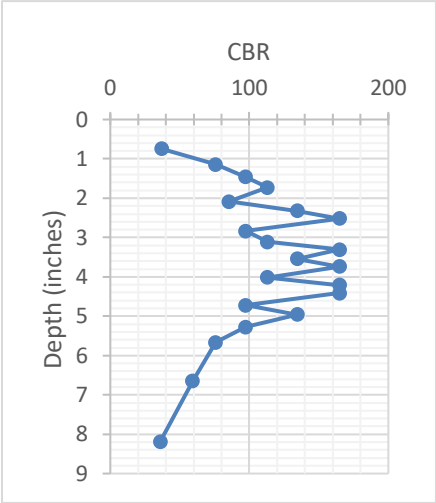
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	9 - Between Wheel Paths
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)	CBR
	51				
3	70	19	0.7	6.3	36.9
3	80	10	1.1	3.3	75.8
3	88	8	1.5	2.7	97.3
3	95	7	1.7	2.3	113.0
3	104	9	2.1	3.0	85.3
3	110	6	2.3	2.0	134.3
3	115	5	2.5	1.7	164.8
3	123	8	2.8	2.7	97.3
3	130	7	3.1	2.3	113.0
3	135	5	3.3	1.7	164.8
3	141	6	3.5	2.0	134.3
3	146	5	3.7	1.7	164.8
3	153	7	4.0	2.3	113.0
3	158	5	4.2	1.7	164.8
3	163	5	4.4	1.7	164.8
3	171	8	4.7	2.7	97.3
3	177	6	5.0	2.0	134.3
3	185	8	5.3	2.7	97.3
3	195	10	5.7	3.3	75.8
6	220	25	6.7	4.2	59.0
6	259	39	8.2	6.5	35.9



Average CBR:	110.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

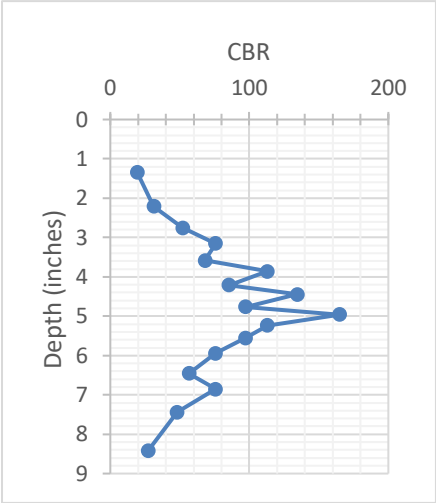
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	10 - Center Line
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)	CBR
	51				
3	85	34	1.3	11.3	19.3
3	107	22	2.2	7.3	31.4
3	121	14	2.8	4.7	52.0
3	131	10	3.1	3.3	75.8
3	142	11	3.6	3.7	68.1
3	149	7	3.9	2.3	113.0
3	158	9	4.2	3.0	85.3
3	164	6	4.4	2.0	134.3
3	172	8	4.8	2.7	97.3
3	177	5	5.0	1.7	164.8
3	184	7	5.2	2.3	113.0
3	192	8	5.6	2.7	97.3
3	202	10	5.9	3.3	75.8
3	215	13	6.5	4.3	56.5
3	225	10	6.9	3.3	75.8
3	240	15	7.4	5.0	48.1
3	265	25	8.4	8.3	27.2



Average CBR:	78.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

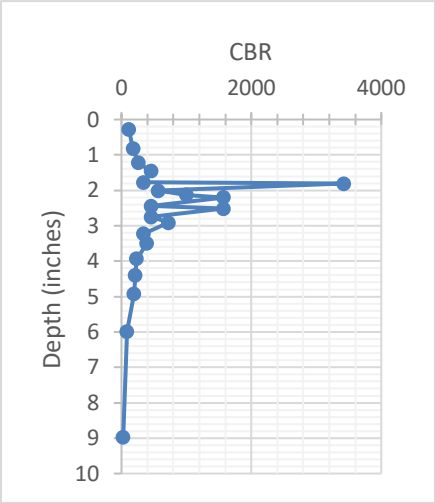
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	11 - Outside Wheel Path
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)	CBR
	59				
3	66	7	0.3	2.3	113.0
9	80	14	0.8	1.6	178.0
9	90	10	1.2	1.1	259.5
9	96	6	1.5	0.7	459.8
9	104	8	1.8	0.9	333.2
9	105	1	1.8	0.1	3420.9
9	110	5	2.0	0.6	564.0
9	113	3	2.1	0.3	999.4
9	115	2	2.2	0.2	1573.9
9	121	6	2.4	0.7	459.8
9	123	2	2.5	0.2	1573.9
9	129	6	2.8	0.7	459.8
9	133	4	2.9	0.4	724.1
9	141	8	3.2	0.9	333.2
9	148	7	3.5	0.8	386.9
9	159	11	3.9	1.2	233.2
9	171	12	4.4	1.3	211.6
9	184	13	4.9	1.4	193.4
9	211	27	6.0	3.0	85.3
9	287	76	9.0	8.4	26.8



Average CBR:	629.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

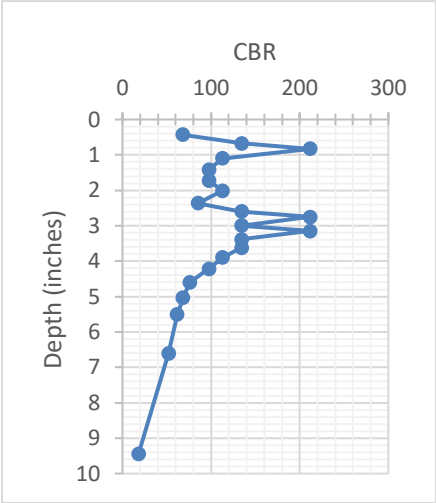
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	12 - Between Wheel Paths
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)	CBR
	55				
3	66	11	0.4	3.7	68.1
3	72	6	0.7	2.0	134.3
3	76	4	0.8	1.3	211.6
3	83	7	1.1	2.3	113.0
3	91	8	1.4	2.7	97.3
3	99	8	1.7	2.7	97.3
3	106	7	2.0	2.3	113.0
3	115	9	2.4	3.0	85.3
3	121	6	2.6	2.0	134.3
3	125	4	2.8	1.3	211.6
3	131	6	3.0	2.0	134.3
3	135	4	3.1	1.3	211.6
3	141	6	3.4	2.0	134.3
3	147	6	3.6	2.0	134.3
3	154	7	3.9	2.3	113.0
3	162	8	4.2	2.7	97.3
3	172	10	4.6	3.3	75.8
3	183	11	5.0	3.7	68.1
3	195	12	5.5	4.0	61.8
6	223	28	6.6	4.7	52.0
6	295	72	9.4	12.0	18.1



Average CBR:	112.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

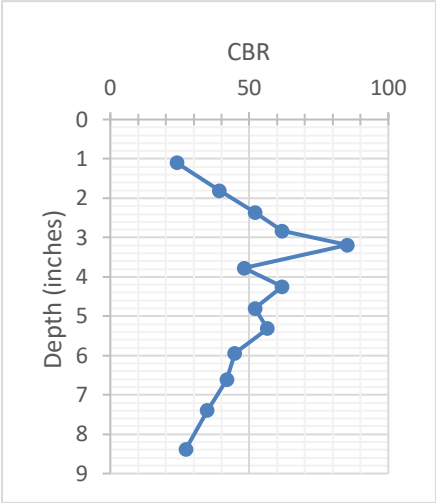
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	13 - Center Line
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)	CBR
	52				
3	80	28	1.1	9.3	23.9
3	98	18	1.8	6.0	39.3
3	112	14	2.4	4.7	52.0
3	124	12	2.8	4.0	61.8
3	133	9	3.2	3.0	85.3
3	148	15	3.8	5.0	48.1
3	160	12	4.3	4.0	61.8
3	174	14	4.8	4.7	52.0
3	187	13	5.3	4.3	56.5
3	203	16	5.9	5.3	44.8
3	220	17	6.6	5.7	41.8
3	240	20	7.4	6.7	34.9
3	265	25	8.4	8.3	27.2



Average CBR:	48.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

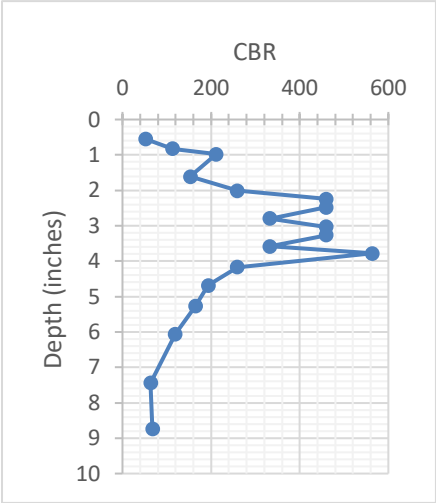
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	14 - Outside Wheel Path
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)	CBR
	51				
3	65	14	0.6	4.7	52.0
3	72	7	0.8	2.3	113.0
3	76	4	1.0	1.3	211.6
9	92	16	1.6	1.8	153.3
9	102	10	2.0	1.1	259.5
9	108	6	2.2	0.7	459.8
9	114	6	2.5	0.7	459.8
9	122	8	2.8	0.9	333.2
9	128	6	3.0	0.7	459.8
9	134	6	3.3	0.7	459.8
9	142	8	3.6	0.9	333.2
9	147	5	3.8	0.6	564.0
9	157	10	4.2	1.1	259.5
9	170	13	4.7	1.4	193.4
9	185	15	5.3	1.7	164.8
9	205	20	6.1	2.2	119.4
9	240	35	7.4	3.9	63.8
9	273	33	8.7	3.7	68.1



Average CBR:	262.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

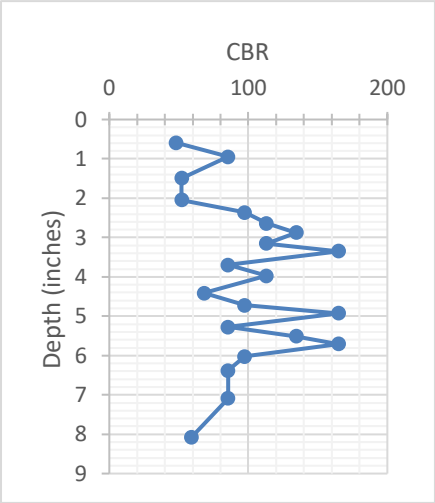
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	15 - Between Wheel Paths
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)	CBR
	50				
3	65	15	0.6	5.0	48.1
3	74	9	0.9	3.0	85.3
3	88	14	1.5	4.7	52.0
3	102	14	2.0	4.7	52.0
3	110	8	2.4	2.7	97.3
3	117	7	2.6	2.3	113.0
3	123	6	2.9	2.0	134.3
3	130	7	3.1	2.3	113.0
3	135	5	3.3	1.7	164.8
3	144	9	3.7	3.0	85.3
3	151	7	4.0	2.3	113.0
3	162	11	4.4	3.7	68.1
3	170	8	4.7	2.7	97.3
3	175	5	4.9	1.7	164.8
3	184	9	5.3	3.0	85.3
3	190	6	5.5	2.0	134.3
3	195	5	5.7	1.7	164.8
3	203	8	6.0	2.7	97.3
3	212	9	6.4	3.0	85.3
6	230	18	7.1	3.0	85.3
6	255	25	8.1	4.2	59.0



Average CBR:	100.0

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

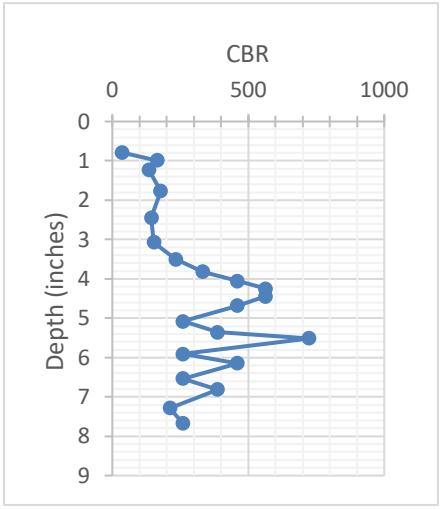
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	16 - Center Line
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)	CBR
	55				
3	75	20	0.8	6.7	34.9
3	80	5	1.0	1.7	164.8
3	86	6	1.2	2.0	134.3
9	100	14	1.8	1.6	178.0
9	117	17	2.4	1.9	143.2
9	133	16	3.1	1.8	153.3
9	144	11	3.5	1.2	233.2
9	152	8	3.8	0.9	333.2
9	158	6	4.1	0.7	459.8
9	163	5	4.3	0.6	564.0
9	168	5	4.4	0.6	564.0
9	174	6	4.7	0.7	459.8
9	184	10	5.1	1.1	259.5
9	191	7	5.4	0.8	386.9
9	195	4	5.5	0.4	724.1
9	205	10	5.9	1.1	259.5
9	211	6	6.1	0.7	459.8
9	221	10	6.5	1.1	259.5
9	228	7	6.8	0.8	386.9
9	240	12	7.3	1.3	211.6
9	250	10	7.7	1.1	259.5



Average CBR:	315.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

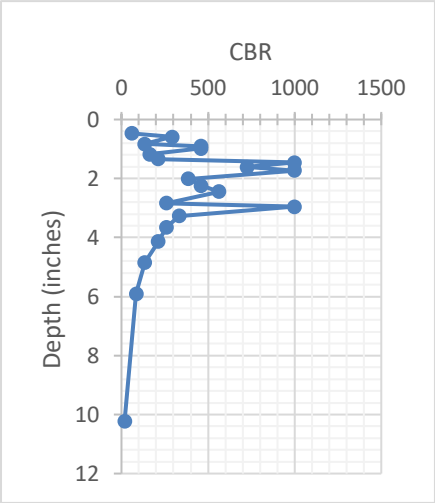
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	17 - Outside Wheel Path
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)	CBR
	50				
3	62	12	0.5	4.0	61.8
3	65	3	0.6	1.0	292.0
3	71	6	0.8	2.0	134.3
3	73	2	0.9	0.7	459.8
3	75	2	1.0	0.7	459.8
3	80	5	1.2	1.7	164.8
3	84	4	1.3	1.3	211.6
9	87	3	1.5	0.3	999.4
9	91	4	1.6	0.4	724.1
9	94	3	1.7	0.3	999.4
9	101	7	2.0	0.8	386.9
9	107	6	2.2	0.7	459.8
9	112	5	2.4	0.6	564.0
9	122	10	2.8	1.1	259.5
9	125	3	3.0	0.3	999.4
9	133	8	3.3	0.9	333.2
9	143	10	3.7	1.1	259.5
9	155	12	4.1	1.3	211.6
9	173	18	4.8	2.0	134.3
9	200	27	5.9	3.0	85.3
9	310	110	10.2	12.2	17.7



Average CBR:	391.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

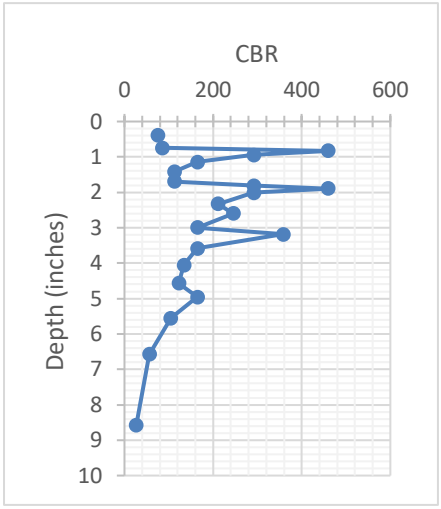
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	18 - Between Wheel Paths
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)	CBR
	54				
3	64	10	0.4	3.3	75.8
3	73	9	0.7	3.0	85.3
3	75	2	0.8	0.7	459.8
3	78	3	0.9	1.0	292.0
3	83	5	1.1	1.7	164.8
3	90	7	1.4	2.3	113.0
3	97	7	1.7	2.3	113.0
3	100	3	1.8	1.0	292.0
3	102	2	1.9	0.7	459.8
3	105	3	2.0	1.0	292.0
6	113	8	2.3	1.3	211.6
6	120	7	2.6	1.2	245.7
6	130	10	3.0	1.7	164.8
6	135	5	3.2	0.8	358.2
6	145	10	3.6	1.7	164.8
6	157	12	4.1	2.0	134.3
6	170	13	4.6	2.2	122.8
6	180	10	5.0	1.7	164.8
6	195	15	5.6	2.5	104.6
6	221	26	6.6	4.3	56.5
6	272	51	8.6	8.5	26.6



Average CBR:	195.3

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

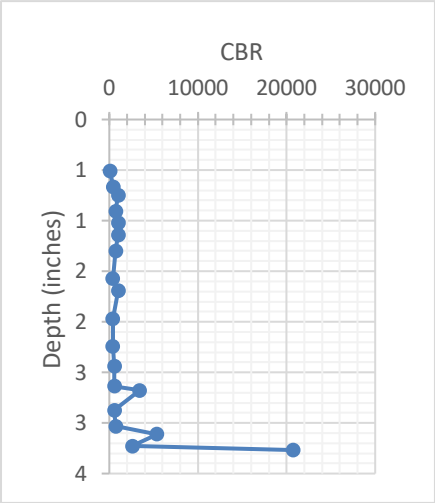
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	19 - Center Line*
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)	CBR
	53				
3	66	13	0.5	4.3	56.5
6	70	4	0.7	0.7	459.8
6	72	2	0.7	0.3	999.4
9	76	4	0.9	0.4	724.1
9	79	3	1.0	0.3	999.4
9	82	3	1.1	0.3	999.4
9	86	4	1.3	0.4	724.1
9	93	7	1.6	0.8	386.9
9	96	3	1.7	0.3	999.4
9	103	7	2.0	0.8	386.9
9	110	7	2.2	0.8	386.9
9	115	5	2.4	0.6	564.0
9	120	5	2.6	0.6	564.0
9	121	1	2.7	0.1	3420.9
9	126	5	2.9	0.6	564.0
9	130	4	3.0	0.4	724.1
27	132	2	3.1	0.1	5387.1
21	135	3	3.2	0.1	2581.6
45	136	1	3.3	0.0	20748.2



Average CBR:	2193.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

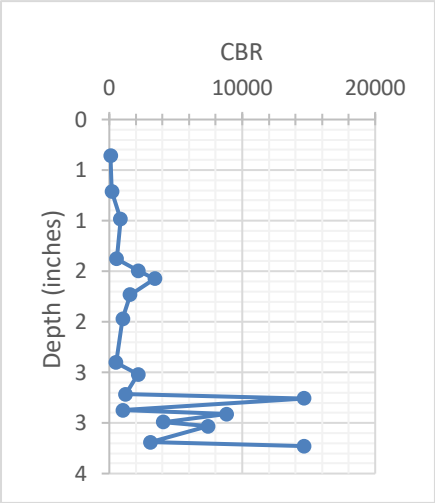
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	20 - Outside Wheel Path*
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)	CBR
	53				
3	62	9	0.4	3.0	85.3
6	71	9	0.7	1.5	185.4
18	78	7	1.0	0.4	841.0
18	88	10	1.4	0.6	564.0
18	91	3	1.5	0.2	2172.3
18	93	2	1.6	0.1	3420.9
18	97	4	1.7	0.2	1573.9
18	103	6	2.0	0.3	999.4
18	114	11	2.4	0.6	506.9
18	117	3	2.5	0.2	2172.3
18	122	5	2.7	0.3	1225.9
33	123	1	2.8	0.0	14659.5
9	126	3	2.9	0.3	999.4
21	127	1	2.9	0.0	8836.3
21	129	2	3.0	0.1	4065.5
18	130	1	3.0	0.1	7435.1
33	134	4	3.2	0.1	3103.2
33	135	1	3.2	0.0	14659.5



Average CBR:	3750.3

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

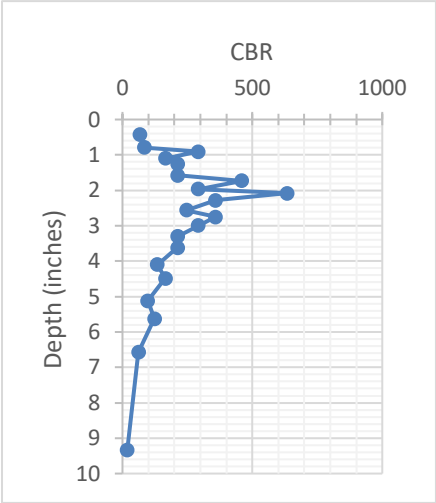
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	21 - Between Wheel Paths
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)	CBR
	53				
3	64	11	0.4	3.7	68.1
3	73	9	0.8	3.0	85.3
3	76	3	0.9	1.0	292.0
3	81	5	1.1	1.7	164.8
3	85	4	1.3	1.3	211.6
6	93	8	1.6	1.3	211.6
6	97	4	1.7	0.7	459.8
6	103	6	2.0	1.0	292.0
6	106	3	2.1	0.5	634.7
6	111	5	2.3	0.8	358.2
6	118	7	2.6	1.2	245.7
6	123	5	2.8	0.8	358.2
6	129	6	3.0	1.0	292.0
6	137	8	3.3	1.3	211.6
6	145	8	3.6	1.3	211.6
6	157	12	4.1	2.0	134.3
6	167	10	4.5	1.7	164.8
6	183	16	5.1	2.7	97.3
6	196	13	5.6	2.2	122.8
6	220	24	6.6	4.0	61.8
6	290	70	9.3	11.7	18.6



Average CBR:	223.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

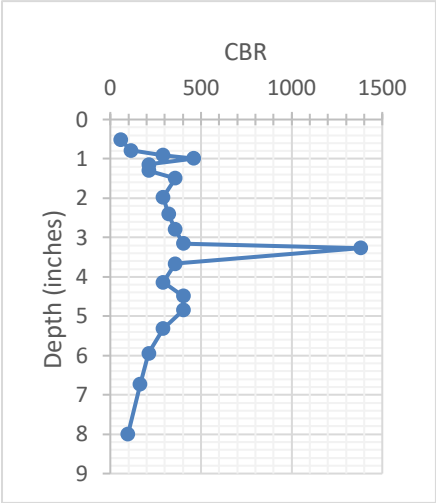
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	22 - Center Line
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)	CBR
	52				
3	65	13	0.5	4.3	56.5
3	72	7	0.8	2.3	113.0
3	75	3	0.9	1.0	292.0
3	77	2	1.0	0.7	459.8
3	81	4	1.1	1.3	211.6
3	85	4	1.3	1.3	211.6
6	90	5	1.5	0.8	358.2
12	102	12	2.0	1.0	292.0
12	113	11	2.4	0.9	321.9
12	123	10	2.8	0.8	358.2
12	132	9	3.1	0.8	403.0
12	135	3	3.3	0.3	1379.4
12	145	10	3.7	0.8	358.2
12	157	12	4.1	1.0	292.0
12	166	9	4.5	0.8	403.0
12	175	9	4.8	0.8	403.0
12	187	12	5.3	1.0	292.0
12	203	16	5.9	1.3	211.6
12	223	20	6.7	1.7	164.8
12	255	32	8.0	2.7	97.3



Average CBR:	333.9

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

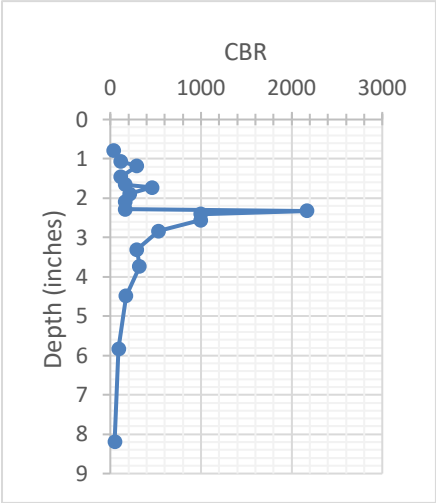
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	23 - Outside Wheel Path
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)	CBR
	50				
3	70	20	0.8	6.7	34.9
3	77	7	1.1	2.3	113.0
3	80	3	1.2	1.0	292.0
3	87	7	1.5	2.3	113.0
3	92	5	1.7	1.7	164.8
3	94	2	1.7	0.7	459.8
3	98	4	1.9	1.3	211.6
3	103	5	2.1	1.7	164.8
3	108	5	2.3	1.7	164.8
6	109	1	2.3	0.2	2172.3
6	111	2	2.4	0.3	999.4
12	115	4	2.6	0.3	999.4
12	122	7	2.8	0.6	534.0
12	134	12	3.3	1.0	292.0
12	145	11	3.7	0.9	321.9
12	164	19	4.5	1.6	174.5
12	198	34	5.8	2.8	91.0
12	258	60	8.2	5.0	48.1



Average CBR:	408.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

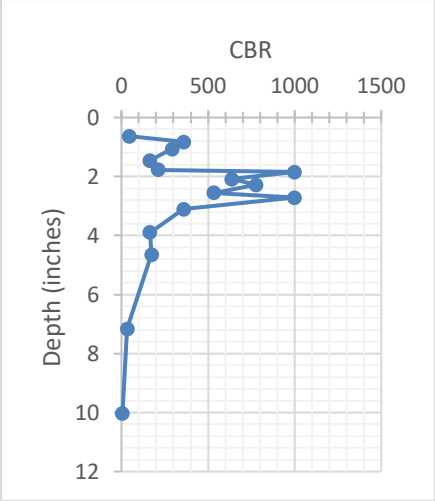
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	24 - Between Wheel Paths
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)	CBR
	55				
3	71	16	0.6	5.3	44.8
6	76	5	0.8	0.8	358.2
6	82	6	1.1	1.0	292.0
6	92	10	1.5	1.7	164.8
6	100	8	1.8	1.3	211.6
6	102	2	1.9	0.3	999.4
12	108	6	2.1	0.5	634.7
12	113	5	2.3	0.4	778.4
12	120	7	2.6	0.6	534.0
12	124	4	2.7	0.3	999.4
12	134	10	3.1	0.8	358.2
12	154	20	3.9	1.7	164.8
12	173	19	4.6	1.6	174.5
9	237	64	7.2	7.1	32.4
3	310	73	10.0	24.3	5.8



Average CBR:	383.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

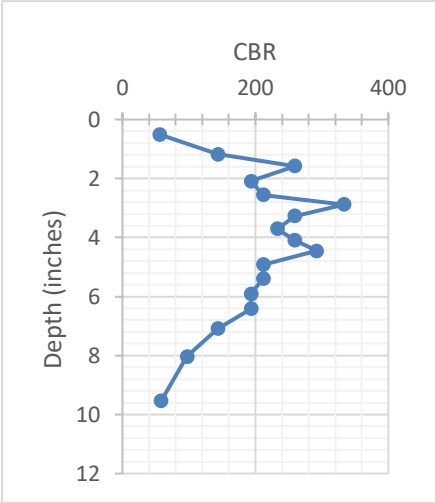
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	25 - Center Line
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)	CBR
	57				
3	70	13	0.5	4.3	56.5
9	87	17	1.2	1.9	143.2
9	97	10	1.6	1.1	259.5
9	110	13	2.1	1.4	193.4
9	122	12	2.6	1.3	211.6
9	130	8	2.9	0.9	333.2
9	140	10	3.3	1.1	259.5
9	151	11	3.7	1.2	233.2
9	161	10	4.1	1.1	259.5
9	170	9	4.4	1.0	292.0
9	182	12	4.9	1.3	211.6
9	194	12	5.4	1.3	211.6
9	207	13	5.9	1.4	193.4
9	220	13	6.4	1.4	193.4
9	237	17	7.1	1.9	143.2
9	261	24	8.0	2.7	97.3
9	299	38	9.5	4.2	58.2



Average CBR:	197.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

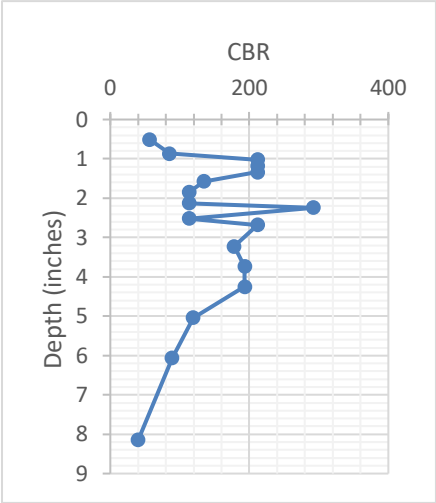
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	26 - Outside Wheel Path
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)	CBR
	53				
3	66	13	0.5	4.3	56.5
3	75	9	0.9	3.0	85.3
3	79	4	1.0	1.3	211.6
3	83	4	1.2	1.3	211.6
3	87	4	1.3	1.3	211.6
3	93	6	1.6	2.0	134.3
3	100	7	1.9	2.3	113.0
3	107	7	2.1	2.3	113.0
3	110	3	2.2	1.0	292.0
3	117	7	2.5	2.3	113.0
3	121	4	2.7	1.3	211.6
9	135	14	3.2	1.6	178.0
9	148	13	3.7	1.4	193.4
9	161	13	4.3	1.4	193.4
9	181	20	5.0	2.2	119.4
9	207	26	6.1	2.9	89.0
9	260	53	8.1	5.9	40.1



Average CBR:	151.0

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

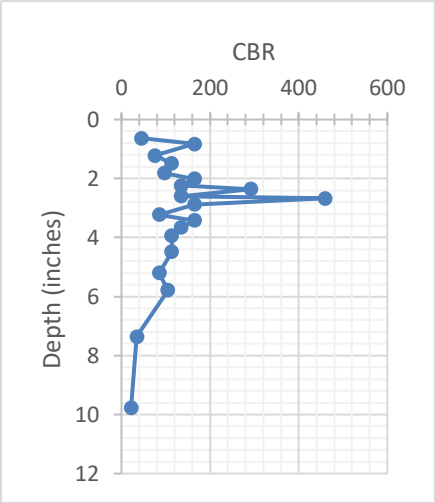
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	27 - Between Wheel Paths
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)	CBR
	54				
3	70	16	0.6	5.3	44.8
3	75	5	0.8	1.7	164.8
3	85	10	1.2	3.3	75.8
3	92	7	1.5	2.3	113.0
3	100	8	1.8	2.7	97.3
3	105	5	2.0	1.7	164.8
3	111	6	2.2	2.0	134.3
3	114	3	2.4	1.0	292.0
3	120	6	2.6	2.0	134.3
3	122	2	2.7	0.7	459.8
3	127	5	2.9	1.7	164.8
3	136	9	3.2	3.0	85.3
3	141	5	3.4	1.7	164.8
3	147	6	3.7	2.0	134.3
3	154	7	3.9	2.3	113.0
6	168	14	4.5	2.3	113.0
6	186	18	5.2	3.0	85.3
6	201	15	5.8	2.5	104.6
6	241	40	7.4	6.7	34.9
6	302	61	9.8	10.2	21.7



Average CBR:	135.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

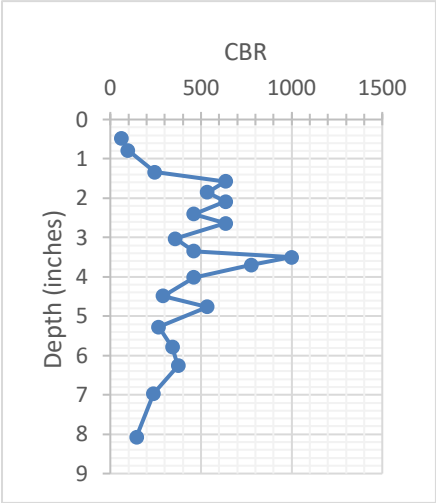
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	28 - Center Line
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)	CBR
	50				
3	62	12	0.5	4.0	61.8
3	70	8	0.8	2.7	97.3
12	84	14	1.3	1.2	245.7
12	90	6	1.6	0.5	634.7
12	97	7	1.9	0.6	534.0
12	103	6	2.1	0.5	634.7
12	111	8	2.4	0.7	459.8
12	117	6	2.6	0.5	634.7
12	127	10	3.0	0.8	358.2
12	135	8	3.3	0.7	459.8
12	139	4	3.5	0.3	999.4
12	144	5	3.7	0.4	778.4
12	152	8	4.0	0.7	459.8
12	164	12	4.5	1.0	292.0
12	171	7	4.8	0.6	534.0
12	184	13	5.3	1.1	267.0
15	197	13	5.8	0.9	342.8
15	209	12	6.3	0.8	374.9
15	227	18	7.0	1.2	238.1
15	255	28	8.1	1.9	145.1



Average CBR:	427.6

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

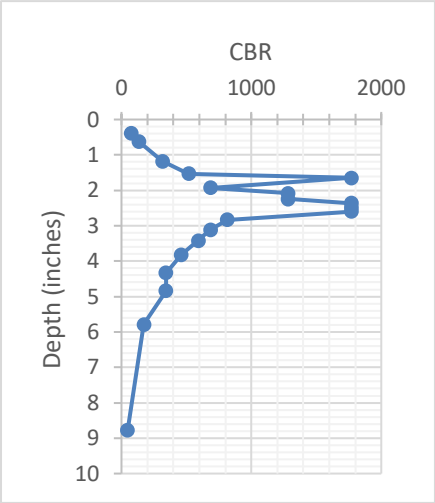
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	41580

Tested by:	K. Boks/L. McLaughlin
Test Location:	29 - Outside Wheel Path
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)	CBR
	51				
3	61	10	0.4	3.3	75.8
3	67	6	0.6	2.0	134.3
15	81	14	1.2	0.9	315.5
15	90	9	1.5	0.6	517.4
15	93	3	1.7	0.2	1771.0
15	100	7	1.9	0.5	685.6
15	104	4	2.1	0.3	1283.2
15	108	4	2.2	0.3	1283.2
15	111	3	2.4	0.2	1771.0
15	114	3	2.5	0.2	1771.0
15	117	3	2.6	0.2	1771.0
15	123	6	2.8	0.4	814.8
15	130	7	3.1	0.5	685.6
15	138	8	3.4	0.5	590.4
15	148	10	3.8	0.7	459.8
15	161	13	4.3	0.9	342.8
15	174	13	4.8	0.9	342.8
15	198	24	5.8	1.6	172.5
15	274	76	8.8	5.1	47.4



Average CBR:	780.8

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - NB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

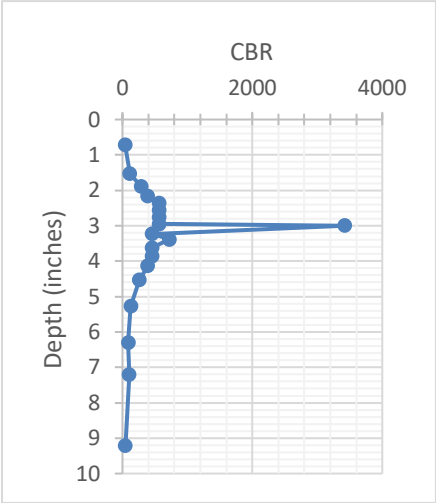
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/13/2019
Days after stabilization:	41580

Tested by:	K. Boks/L. McLaughlin
Test Location:	30 - Between Wheel Paths
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)	CBR
	50				
3	68	18	0.7	6.0	39.3
9	89	21	1.5	2.3	113.0
9	98	9	1.9	1.0	292.0
9	105	7	2.2	0.8	386.9
9	110	5	2.4	0.6	564.0
9	115	5	2.6	0.6	564.0
9	120	5	2.8	0.6	564.0
9	125	5	3.0	0.6	564.0
9	126	1	3.0	0.1	3420.9
9	132	6	3.2	0.7	459.8
9	136	4	3.4	0.4	724.1
9	142	6	3.6	0.7	459.8
9	148	6	3.9	0.7	459.8
9	155	7	4.1	0.8	386.9
9	165	10	4.5	1.1	259.5
9	184	19	5.3	2.1	126.5
9	210	26	6.3	2.9	89.0
9	233	23	7.2	2.6	102.1
9	284	51	9.2	5.7	41.8



Average CBR:	506.2

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	See below and Figure 3; South Bound
Hammer Weight:	17.6 lbs
Weather:	Sunny

Dynamic Cone Penetrometer Testing (ASTM: D6951)

Test Location	CBR	Test Location	CBR
31 - Center Line	884.1	54 - Between Wheel Paths	36.2
32 - Outside Wheel Path	311.6	55 - Center Line	124.1
33 - Between Wheel Paths	118.6	56 - Outside Wheel Path	207.5
34 - Center Line	38.2	57 - Between Wheel Paths	166.4
35 - Outside Wheel Path	439.7	58 - Center Line	345.7
36 - Between Wheel Paths	79.1	59 - Outside Wheel Path	27.5
37 - Center Line	3238.5	60 - Between Wheel Paths	123.1
38 - Outside Wheel Path	196.6		
39 - Between Wheel Paths	275.4		
40 - Center Line	179.0		
41 - Outside Wheel Path	287.5		
42 - Between Wheel Paths	410.0		
43 - Center Line	129.9		
44 - Outside Wheel Path	68.7		
45 - Between Wheel Paths	55.7		
46 - Center Line	83.9		
47 - Outside Wheel Path	86.1		
48 - Between Wheel Paths	141.6		
49 - Center Line	230.4		
50 - Outside Wheel Path	357.3		
51 - Between Wheel Paths	26.8		
52 - Center Line	129.2		
53 - Outside Wheel Path	106.1		

Average:	296.8
Standard deviation:	582.1
Design:	######

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

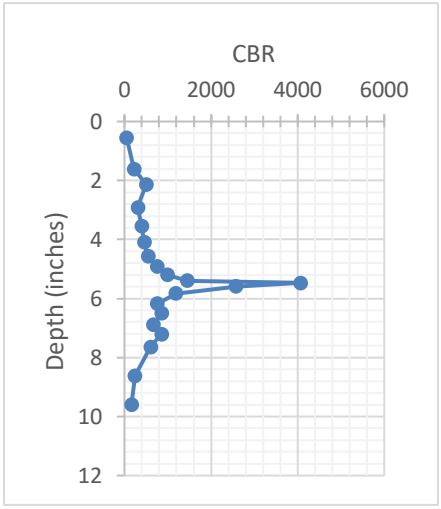
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	31 - Center Line
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)	CBR
	51				
3	65	14	0.6	4.7	52.0
21	92	27	1.6	1.3	220.4
21	105	13	2.1	0.6	499.6
21	125	20	2.9	1.0	308.4
21	141	16	3.5	0.8	396.0
21	155	14	4.1	0.7	459.8
21	167	12	4.6	0.6	546.5
21	176	9	4.9	0.4	754.3
21	183	7	5.2	0.3	999.4
21	188	5	5.4	0.2	1456.9
21	190	2	5.5	0.1	4065.5
21	193	3	5.6	0.1	2581.6
21	199	6	5.8	0.3	1187.8
21	208	9	6.2	0.4	754.3
21	216	8	6.5	0.4	860.6
21	226	10	6.9	0.5	670.3
21	234	8	7.2	0.4	860.6
21	245	11	7.6	0.5	602.4
21	270	25	8.6	1.2	240.2
15	295	25	9.6	1.7	164.8



Average CBR:	884.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

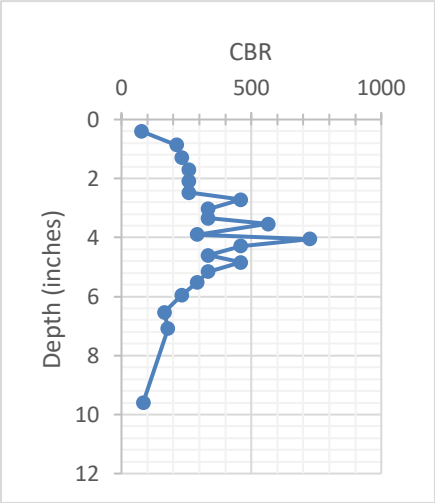
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	32 - Outside Wheel Path
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)	CBR
	54				
3	64	10	0.4	3.3	75.8
9	76	12	0.9	1.3	211.6
9	87	11	1.3	1.2	233.2
9	97	10	1.7	1.1	259.5
9	107	10	2.1	1.1	259.5
9	117	10	2.5	1.1	259.5
9	123	6	2.7	0.7	459.8
9	131	8	3.0	0.9	333.2
9	139	8	3.3	0.9	333.2
9	144	5	3.5	0.6	564.0
9	153	9	3.9	1.0	292.0
9	157	4	4.1	0.4	724.1
9	163	6	4.3	0.7	459.8
9	171	8	4.6	0.9	333.2
9	177	6	4.8	0.7	459.8
9	185	8	5.2	0.9	333.2
9	194	9	5.5	1.0	292.0
9	205	11	5.9	1.2	233.2
9	220	15	6.5	1.7	164.8
9	234	14	7.1	1.6	178.0
21	298	64	9.6	3.0	83.8



Average CBR:	311.6

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

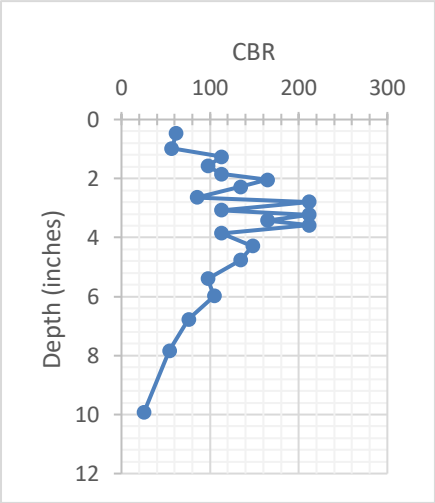
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	33 - Between Wheel Paths
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)	CBR
	53				
3	65	12	0.5	4.0	61.8
3	78	13	1.0	4.3	56.5
3	85	7	1.3	2.3	113.0
3	93	8	1.6	2.7	97.3
3	100	7	1.9	2.3	113.0
3	105	5	2.0	1.7	164.8
3	111	6	2.3	2.0	134.3
3	120	9	2.6	3.0	85.3
3	124	4	2.8	1.3	211.6
3	131	7	3.1	2.3	113.0
3	135	4	3.2	1.3	211.6
3	140	5	3.4	1.7	164.8
3	144	4	3.6	1.3	211.6
3	151	7	3.9	2.3	113.0
6	162	11	4.3	1.8	148.1
6	174	12	4.8	2.0	134.3
6	190	16	5.4	2.7	97.3
6	205	15	6.0	2.5	104.6
6	225	20	6.8	3.3	75.8
6	252	27	7.8	4.5	54.2
6	305	53	9.9	8.8	25.5



Average CBR:	118.6

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

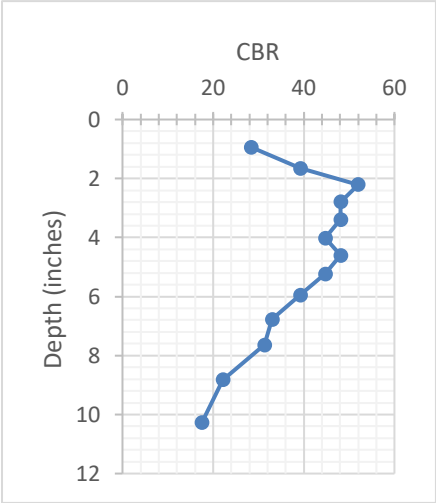
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	34 - Center Line
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)	CBR
	51				
3	75	24	0.9	8.0	28.4
3	93	18	1.7	6.0	39.3
3	107	14	2.2	4.7	52.0
3	122	15	2.8	5.0	48.1
3	137	15	3.4	5.0	48.1
3	153	16	4.0	5.3	44.8
3	168	15	4.6	5.0	48.1
3	184	16	5.2	5.3	44.8
3	202	18	5.9	6.0	39.3
3	223	21	6.8	7.0	33.0
3	245	22	7.6	7.3	31.4
3	275	30	8.8	10.0	22.2
3	312	37	10.3	12.3	17.5



Average CBR:	38.2

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

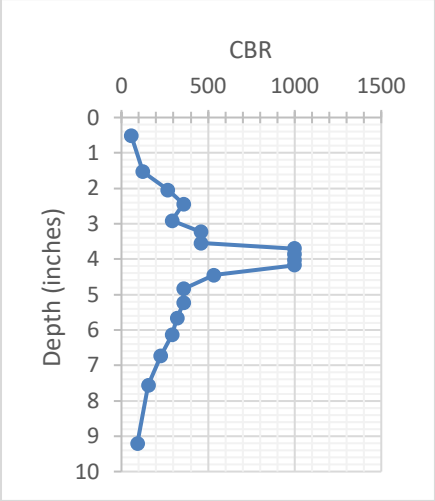
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	35 - Outside Wheel Path
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)	CBR
	51				
3	64	13	0.5	4.3	56.5
12	90	26	1.5	2.2	122.8
12	103	13	2.0	1.1	267.0
12	113	10	2.4	0.8	358.2
12	125	12	2.9	1.0	292.0
12	133	8	3.2	0.7	459.8
12	141	8	3.5	0.7	459.8
12	145	4	3.7	0.3	999.4
12	149	4	3.9	0.3	999.4
12	153	4	4.0	0.3	999.4
12	157	4	4.2	0.3	999.4
12	164	7	4.4	0.6	534.0
12	174	10	4.8	0.8	358.2
12	184	10	5.2	0.8	358.2
12	195	11	5.7	0.9	321.9
12	207	12	6.1	1.0	292.0
12	222	15	6.7	1.3	227.4
12	243	21	7.6	1.8	156.0
15	285	42	9.2	2.8	92.2



Average CBR:	439.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

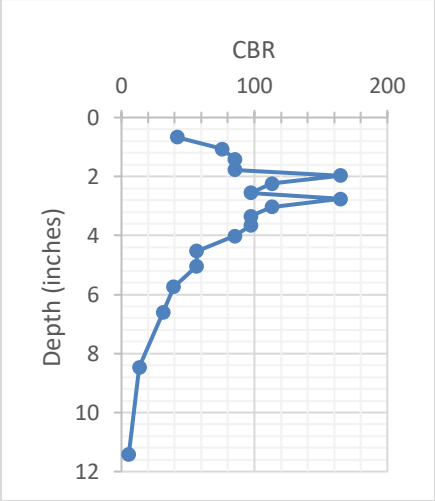
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	36 - Between Wheel Paths
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)	CBR
	55				
3	72	17	0.7	5.7	41.8
3	82	10	1.1	3.3	75.8
3	91	9	1.4	3.0	85.3
3	100	9	1.8	3.0	85.3
3	105	5	2.0	1.7	164.8
3	112	7	2.2	2.3	113.0
3	120	8	2.6	2.7	97.3
3	125	5	2.8	1.7	164.8
3	132	7	3.0	2.3	113.0
3	140	8	3.3	2.7	97.3
3	148	8	3.7	2.7	97.3
3	157	9	4.0	3.0	85.3
3	170	13	4.5	4.3	56.5
3	183	13	5.0	4.3	56.5
3	201	18	5.7	6.0	39.3
3	223	22	6.6	7.3	31.4
3	270	47	8.5	15.7	13.4
3	345	75	11.4	25.0	5.5



Average CBR:	79.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

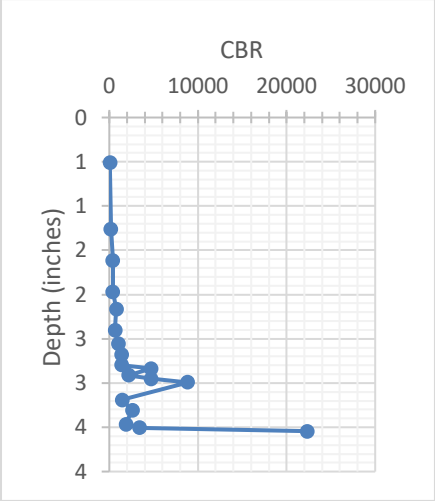
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	37 - Center Line
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)	CBR
	49				
3	62	13	0.5	4.3	56.5
12	81	19	1.3	1.6	174.5
12	90	9	1.6	0.8	403.0
12	99	9	2.0	0.8	403.0
12	104	5	2.2	0.4	778.4
12	110	6	2.4	0.5	634.7
12	114	4	2.6	0.3	999.4
12	117	3	2.7	0.3	1379.4
12	120	3	2.8	0.3	1379.4
12	121	1	2.8	0.1	4721.3
12	123	2	2.9	0.2	2172.3
12	124	1	3.0	0.1	4721.3
21	125	1	3.0	0.0	8836.3
21	130	5	3.2	0.2	1456.9
21	133	3	3.3	0.1	2581.6
21	137	4	3.5	0.2	1870.5
9	138	1	3.5	0.1	3420.9
48	139	1	3.5	0.0	22303.5



Average CBR:	3238.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

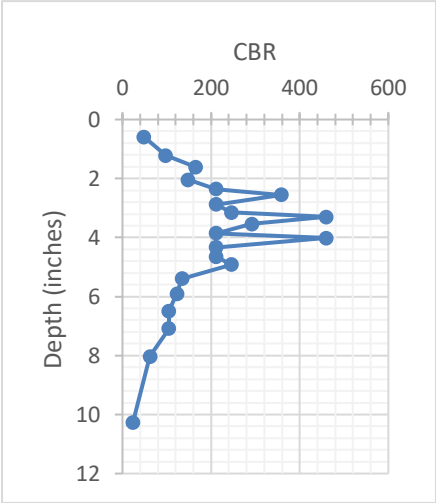
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	38 - Outside Wheel Path
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)	CBR
	50				
3	65	15	0.6	5.0	48.1
6	81	16	1.2	2.7	97.3
6	91	10	1.6	1.7	164.8
6	102	11	2.0	1.8	148.1
6	110	8	2.4	1.3	211.6
6	115	5	2.6	0.8	358.2
6	123	8	2.9	1.3	211.6
6	130	7	3.1	1.2	245.7
6	134	4	3.3	0.7	459.8
6	140	6	3.5	1.0	292.0
6	148	8	3.9	1.3	211.6
6	152	4	4.0	0.7	459.8
6	160	8	4.3	1.3	211.6
6	168	8	4.6	1.3	211.6
6	175	7	4.9	1.2	245.7
6	187	12	5.4	2.0	134.3
6	200	13	5.9	2.2	122.8
6	215	15	6.5	2.5	104.6
6	230	15	7.1	2.5	104.6
6	254	24	8.0	4.0	61.8
6	311	57	10.3	9.5	23.5



Average CBR:	196.6

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

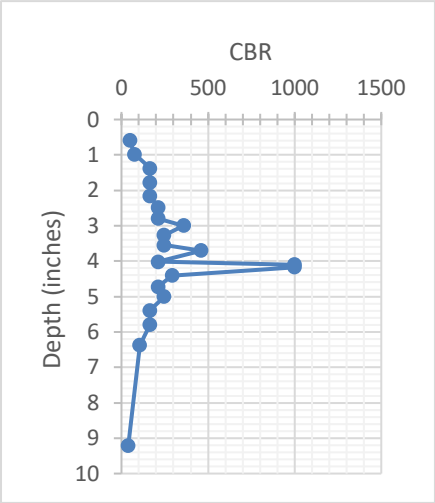
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	39 - Between Wheel Paths
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)	CBR
	50				
3	65	15	0.6	5.0	48.1
3	75	10	1.0	3.3	75.8
6	85	10	1.4	1.7	164.8
6	95	10	1.8	1.7	164.8
6	105	10	2.2	1.7	164.8
6	113	8	2.5	1.3	211.6
6	121	8	2.8	1.3	211.6
6	126	5	3.0	0.8	358.2
6	133	7	3.3	1.2	245.7
6	140	7	3.5	1.2	245.7
6	144	4	3.7	0.7	459.8
6	152	8	4.0	1.3	211.6
6	154	2	4.1	0.3	999.4
6	156	2	4.2	0.3	999.4
6	162	6	4.4	1.0	292.0
6	170	8	4.7	1.3	211.6
6	177	7	5.0	1.2	245.7
6	187	10	5.4	1.7	164.8
6	197	10	5.8	1.7	164.8
6	212	15	6.4	2.5	104.6
12	284	72	9.2	6.0	39.3



Average CBR:	275.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

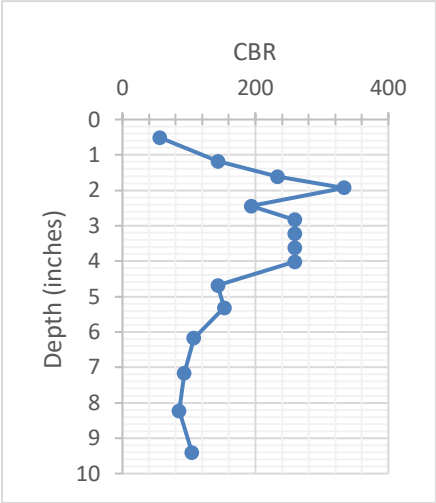
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	40 - Center Line
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)	CBR
	53				
3	66	13	0.5	4.3	56.5
9	83	17	1.2	1.9	143.2
9	94	11	1.6	1.2	233.2
9	102	8	1.9	0.9	333.2
9	115	13	2.4	1.4	193.4
9	125	10	2.8	1.1	259.5
9	135	10	3.2	1.1	259.5
9	145	10	3.6	1.1	259.5
9	155	10	4.0	1.1	259.5
9	172	17	4.7	1.9	143.2
9	188	16	5.3	1.8	153.3
9	210	22	6.2	2.4	107.3
9	235	25	7.2	2.8	93.0
9	262	27	8.2	3.0	85.3
12	292	30	9.4	2.5	104.6



Average CBR:	179.0

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

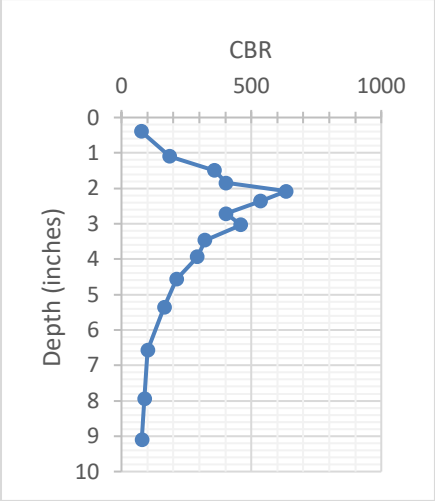
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	41 - Outside Wheel Path
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)	CBR
	52				
3	62	10	0.4	3.3	75.8
12	80	18	1.1	1.5	185.4
12	90	10	1.5	0.8	358.2
12	99	9	1.9	0.8	403.0
12	105	6	2.1	0.5	634.7
12	112	7	2.4	0.6	534.0
12	121	9	2.7	0.8	403.0
12	129	8	3.0	0.7	459.8
12	140	11	3.5	0.9	321.9
12	152	12	3.9	1.0	292.0
12	168	16	4.6	1.3	211.6
12	188	20	5.4	1.7	164.8
12	219	31	6.6	2.6	100.9
12	254	35	8.0	2.9	88.0
9	283	29	9.1	3.2	78.7



Average CBR:	287.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

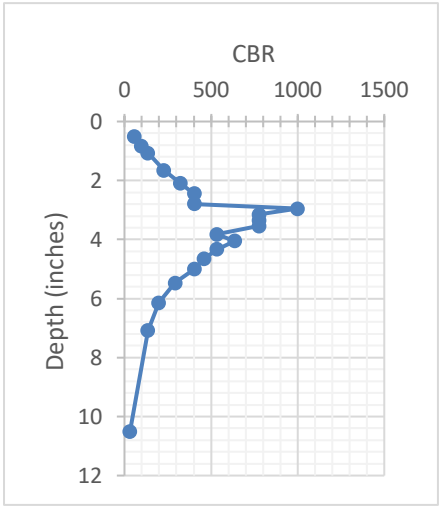
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	42 - Between Wheel Paths
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)	CBR
	53				
3	66	13	0.5	4.3	56.5
3	74	8	0.8	2.7	97.3
3	80	6	1.1	2.0	134.3
12	95	15	1.7	1.3	227.4
12	106	11	2.1	0.9	321.9
12	115	9	2.4	0.8	403.0
12	124	9	2.8	0.8	403.0
12	128	4	3.0	0.3	999.4
12	133	5	3.1	0.4	778.4
12	138	5	3.3	0.4	778.4
12	143	5	3.5	0.4	778.4
12	150	7	3.8	0.6	534.0
12	156	6	4.1	0.5	634.7
12	163	7	4.3	0.6	534.0
12	171	8	4.6	0.7	459.8
12	180	9	5.0	0.8	403.0
12	192	12	5.5	1.0	292.0
12	209	17	6.1	1.4	197.7
12	233	24	7.1	2.0	134.3
12	320	87	10.5	7.3	31.8



Average CBR:	410.0

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

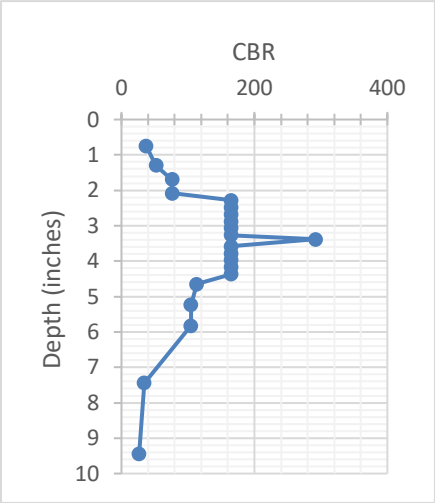
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	43 - Center Line
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)	CBR
	54				
3	73	19	0.7	6.3	36.9
3	87	14	1.3	4.7	52.0
3	97	10	1.7	3.3	75.8
3	107	10	2.1	3.3	75.8
3	112	5	2.3	1.7	164.8
3	117	5	2.5	1.7	164.8
3	122	5	2.7	1.7	164.8
3	127	5	2.9	1.7	164.8
3	132	5	3.1	1.7	164.8
3	137	5	3.3	1.7	164.8
3	140	3	3.4	1.0	292.0
3	145	5	3.6	1.7	164.8
3	150	5	3.8	1.7	164.8
3	155	5	4.0	1.7	164.8
3	160	5	4.2	1.7	164.8
3	165	5	4.4	1.7	164.8
3	172	7	4.6	2.3	113.0
6	187	15	5.2	2.5	104.6
6	202	15	5.8	2.5	104.6
6	243	41	7.4	6.8	33.9
6	294	51	9.4	8.5	26.6



Average CBR:	129.9

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

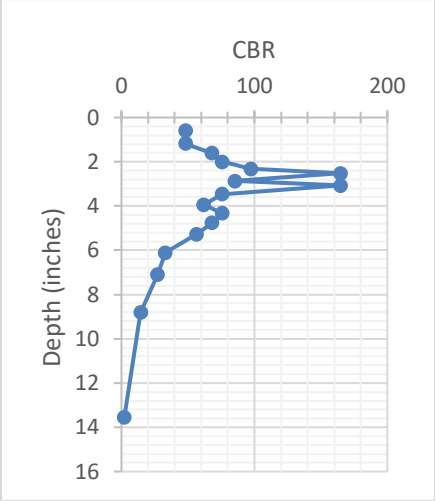
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	44 - Outside Wheel Path
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)	CBR
	60				
3	75	15	0.6	5.0	48.1
3	90	15	1.2	5.0	48.1
3	101	11	1.6	3.7	68.1
3	111	10	2.0	3.3	75.8
3	119	8	2.3	2.7	97.3
3	124	5	2.5	1.7	164.8
3	133	9	2.9	3.0	85.3
3	138	5	3.1	1.7	164.8
3	148	10	3.5	3.3	75.8
3	160	12	3.9	4.0	61.8
3	170	10	4.3	3.3	75.8
3	181	11	4.8	3.7	68.1
3	194	13	5.3	4.3	56.5
3	215	21	6.1	7.0	33.0
3	240	25	7.1	8.3	27.2
3	284	44	8.8	14.7	14.4
3	404	120	13.5	40.0	2.2



Average CBR:	68.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

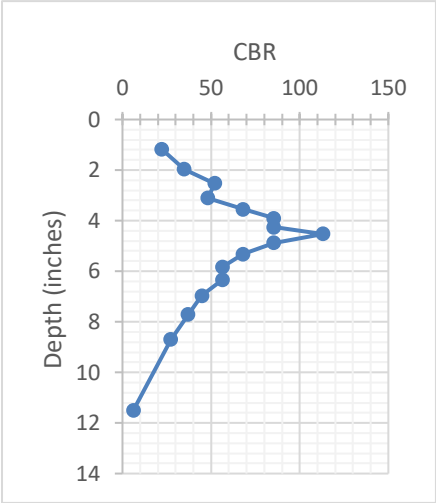
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	45 - Between Wheel Paths
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)	CBR
	60				
3	90	30	1.2	10.0	22.2
3	110	20	2.0	6.7	34.9
3	124	14	2.5	4.7	52.0
3	139	15	3.1	5.0	48.1
3	150	11	3.5	3.7	68.1
3	159	9	3.9	3.0	85.3
3	168	9	4.3	3.0	85.3
3	175	7	4.5	2.3	113.0
3	184	9	4.9	3.0	85.3
3	195	11	5.3	3.7	68.1
3	208	13	5.8	4.3	56.5
3	221	13	6.3	4.3	56.5
3	237	16	7.0	5.3	44.8
3	256	19	7.7	6.3	36.9
3	281	25	8.7	8.3	27.2
3	352	71	11.5	23.7	6.2



Average CBR:	55.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

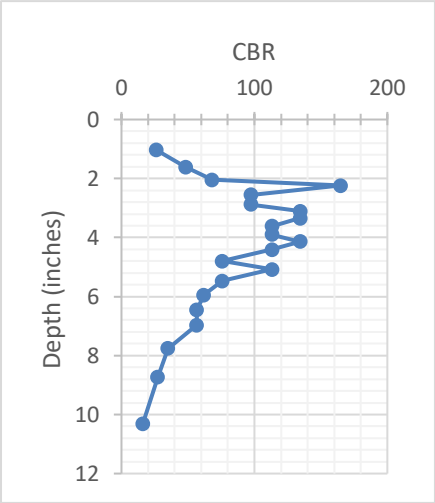
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	46 - Center Line
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)	CBR
	58				
3	84	26	1.0	8.7	26.0
3	99	15	1.6	5.0	48.1
3	110	11	2.0	3.7	68.1
3	115	5	2.2	1.7	164.8
3	123	8	2.6	2.7	97.3
3	131	8	2.9	2.7	97.3
3	137	6	3.1	2.0	134.3
3	143	6	3.3	2.0	134.3
3	150	7	3.6	2.3	113.0
3	157	7	3.9	2.3	113.0
3	163	6	4.1	2.0	134.3
3	170	7	4.4	2.3	113.0
3	180	10	4.8	3.3	75.8
3	187	7	5.1	2.3	113.0
3	197	10	5.5	3.3	75.8
3	209	12	5.9	4.0	61.8
3	222	13	6.5	4.3	56.5
3	235	13	7.0	4.3	56.5
3	255	20	7.8	6.7	34.9
3	280	25	8.7	8.3	27.2
3	320	40	10.3	13.3	16.0



Average CBR:	83.9

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

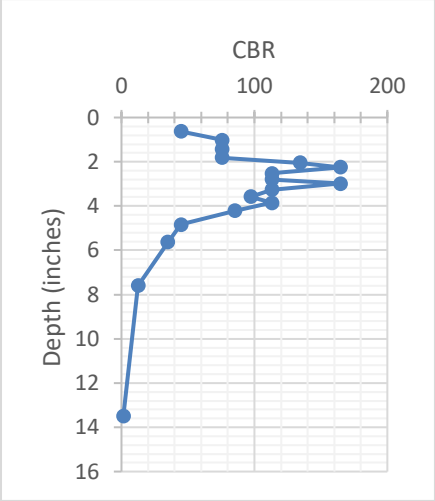
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	47 - Outside Wheel Path
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)	CBR
	57				
3	73	16	0.6	5.3	44.8
3	83	10	1.0	3.3	75.8
3	93	10	1.4	3.3	75.8
3	103	10	1.8	3.3	75.8
3	109	6	2.0	2.0	134.3
3	114	5	2.2	1.7	164.8
3	121	7	2.5	2.3	113.0
3	128	7	2.8	2.3	113.0
3	133	5	3.0	1.7	164.8
3	140	7	3.3	2.3	113.0
3	148	8	3.6	2.7	97.3
3	155	7	3.9	2.3	113.0
3	164	9	4.2	3.0	85.3
3	180	16	4.8	5.3	44.8
3	200	20	5.6	6.7	34.9
3	250	50	7.6	16.7	12.5
3	400	150	13.5	50.0	1.4



Average CBR:	86.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

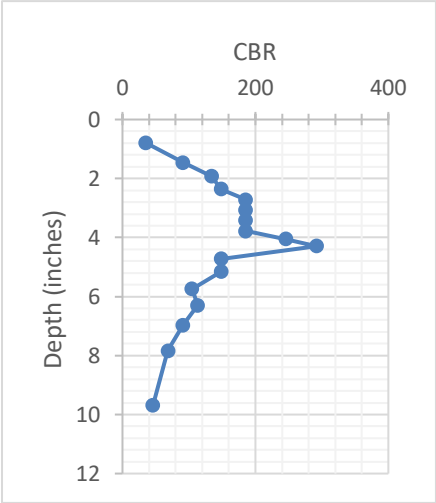
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	48 - Between Wheel Paths
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)	CBR
	54				
3	74	20	0.8	6.7	34.9
6	91	17	1.5	2.8	91.0
6	103	12	1.9	2.0	134.3
6	114	11	2.4	1.8	148.1
6	123	9	2.7	1.5	185.4
6	132	9	3.1	1.5	185.4
6	141	9	3.4	1.5	185.4
6	150	9	3.8	1.5	185.4
6	157	7	4.1	1.2	245.7
6	163	6	4.3	1.0	292.0
6	174	11	4.7	1.8	148.1
6	185	11	5.2	1.8	148.1
6	200	15	5.7	2.5	104.6
6	214	14	6.3	2.3	113.0
6	231	17	7.0	2.8	91.0
6	253	22	7.8	3.7	68.1
9	300	47	9.7	5.2	45.9



Average CBR:	141.6

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

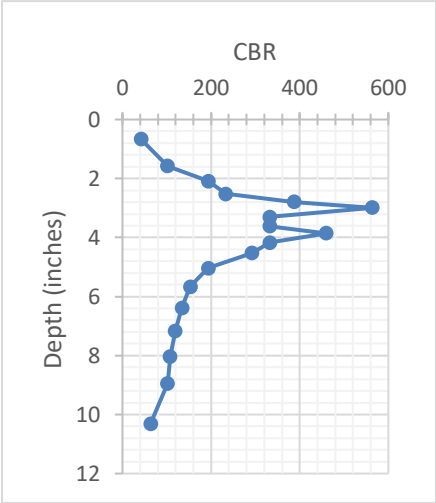
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	49 - Center Line
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)	CBR
	58				
3	75	17	0.7	5.7	41.8
9	98	23	1.6	2.6	102.1
9	111	13	2.1	1.4	193.4
9	122	11	2.5	1.2	233.2
9	129	7	2.8	0.8	386.9
9	134	5	3.0	0.6	564.0
9	142	8	3.3	0.9	333.2
9	150	8	3.6	0.9	333.2
9	156	6	3.9	0.7	459.8
9	164	8	4.2	0.9	333.2
9	173	9	4.5	1.0	292.0
9	186	13	5.0	1.4	193.4
9	202	16	5.7	1.8	153.3
9	220	18	6.4	2.0	134.3
9	240	20	7.2	2.2	119.4
9	262	22	8.0	2.4	107.3
9	285	23	8.9	2.6	102.1
9	320	35	10.3	3.9	63.8



Average CBR:	230.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

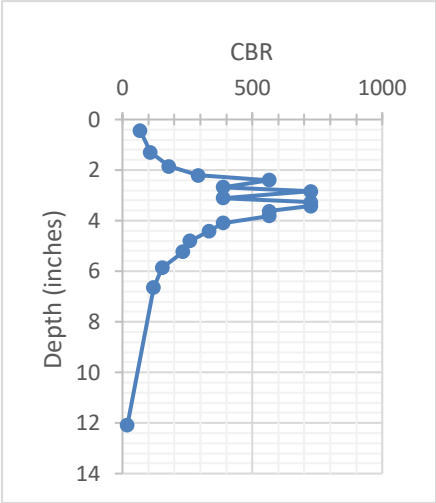
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	50 - Outside Wheel Path
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)	CBR
	54				
3	65	11	0.4	3.7	68.1
9	87	22	1.3	2.4	107.3
9	101	14	1.9	1.6	178.0
9	110	9	2.2	1.0	292.0
9	115	5	2.4	0.6	564.0
9	122	7	2.7	0.8	386.9
9	126	4	2.8	0.4	724.1
9	133	7	3.1	0.8	386.9
9	137	4	3.3	0.4	724.1
9	141	4	3.4	0.4	724.1
9	146	5	3.6	0.6	564.0
9	151	5	3.8	0.6	564.0
9	158	7	4.1	0.8	386.9
9	166	8	4.4	0.9	333.2
9	176	10	4.8	1.1	259.5
9	187	11	5.2	1.2	233.2
9	203	16	5.9	1.8	153.3
9	223	20	6.7	2.2	119.4
12	361	138	12.1	11.5	18.9



Average CBR:	357.3

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

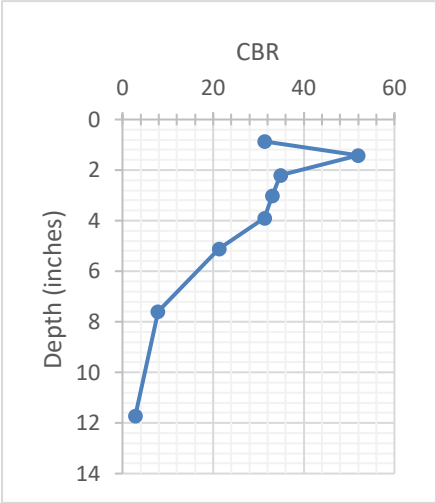
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	51 - Between Wheel Paths
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)	CBR
	54				
3	76	22	0.9	7.3	31.4
3	90	14	1.4	4.7	52.0
3	110	20	2.2	6.7	34.9
3	131	21	3.0	7.0	33.0
3	153	22	3.9	7.3	31.4
3	184	31	5.1	10.3	21.4
3	247	63	7.6	21.0	7.8
3	352	105	11.7	35.0	2.8



Average CBR:	26.8

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

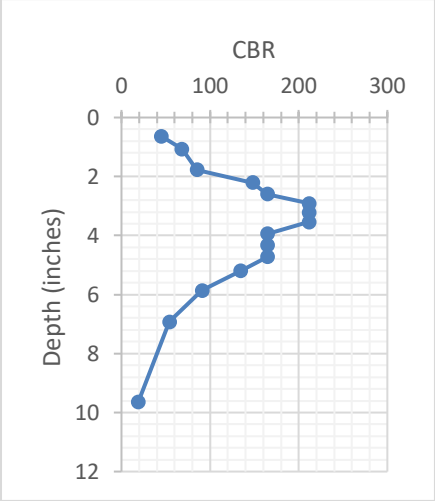
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	52 - Center Line
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)	CBR
	55				
3	71	16	0.6	5.3	44.8
3	82	11	1.1	3.7	68.1
6	100	18	1.8	3.0	85.3
6	111	11	2.2	1.8	148.1
6	121	10	2.6	1.7	164.8
6	129	8	2.9	1.3	211.6
6	137	8	3.2	1.3	211.6
6	145	8	3.5	1.3	211.6
6	155	10	3.9	1.7	164.8
6	165	10	4.3	1.7	164.8
6	175	10	4.7	1.7	164.8
6	187	12	5.2	2.0	134.3
6	204	17	5.9	2.8	91.0
6	231	27	6.9	4.5	54.2
6	300	69	9.6	11.5	18.9



Average CBR:	129.2

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

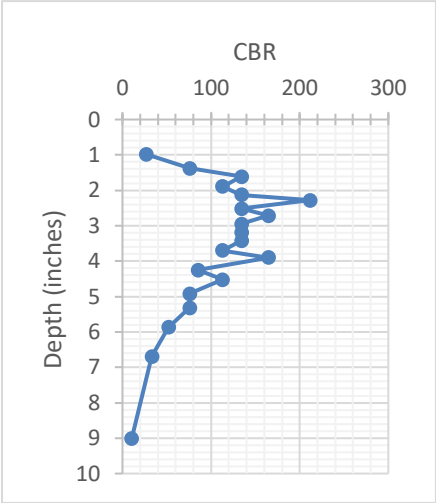
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	53 - Outside Wheel Path
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)	CBR
	55				
3	80	25	1.0	8.3	27.2
3	90	10	1.4	3.3	75.8
3	96	6	1.6	2.0	134.3
3	103	7	1.9	2.3	113.0
3	109	6	2.1	2.0	134.3
3	113	4	2.3	1.3	211.6
3	119	6	2.5	2.0	134.3
3	124	5	2.7	1.7	164.8
3	130	6	3.0	2.0	134.3
3	136	6	3.2	2.0	134.3
3	142	6	3.4	2.0	134.3
3	149	7	3.7	2.3	113.0
3	154	5	3.9	1.7	164.8
3	163	9	4.3	3.0	85.3
3	170	7	4.5	2.3	113.0
3	180	10	4.9	3.3	75.8
3	190	10	5.3	3.3	75.8
3	204	14	5.9	4.7	52.0
3	225	21	6.7	7.0	33.0
3	284	59	9.0	19.7	10.4



Average CBR:	106.1

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: McLeod County
CC: John Brunkhorst
Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:
Reviewed By:

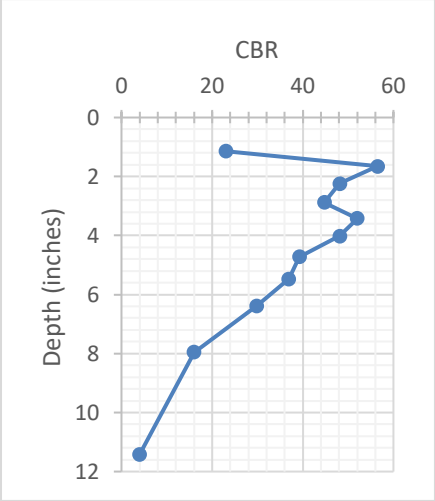
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	54 - Between Wheel Paths
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)	CBR
	55				
3	84	29	1.1	9.7	23.0
3	97	13	1.7	4.3	56.5
3	112	15	2.2	5.0	48.1
3	128	16	2.9	5.3	44.8
3	142	14	3.4	4.7	52.0
3	157	15	4.0	5.0	48.1
3	175	18	4.7	6.0	39.3
3	194	19	5.5	6.3	36.9
3	217	23	6.4	7.7	29.8
3	257	40	8.0	13.3	16.0
3	345	88	11.4	29.3	4.0



Average CBR:	36.2

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

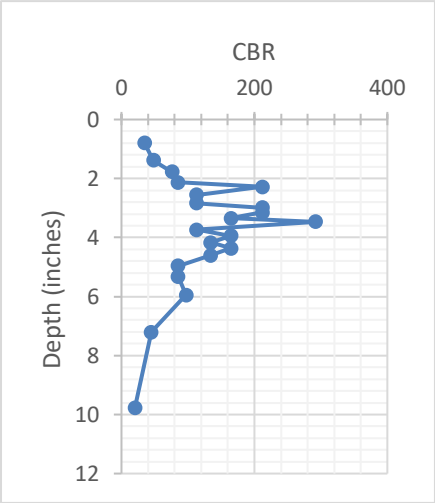
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	55 - Center Line
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)	CBR
	57				
3	77	20	0.8	6.7	34.9
3	92	15	1.4	5.0	48.1
3	102	10	1.8	3.3	75.8
3	111	9	2.1	3.0	85.3
3	115	4	2.3	1.3	211.6
3	122	7	2.6	2.3	113.0
3	129	7	2.8	2.3	113.0
3	133	4	3.0	1.3	211.6
3	137	4	3.1	1.3	211.6
3	142	5	3.3	1.7	164.8
3	145	3	3.5	1.0	292.0
3	152	7	3.7	2.3	113.0
3	157	5	3.9	1.7	164.8
3	163	6	4.2	2.0	134.3
3	168	5	4.4	1.7	164.8
3	174	6	4.6	2.0	134.3
3	183	9	5.0	3.0	85.3
3	192	9	5.3	3.0	85.3
6	208	16	5.9	2.7	97.3
6	240	32	7.2	5.3	44.8
6	305	65	9.8	10.8	20.3



Average CBR:	124.1

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

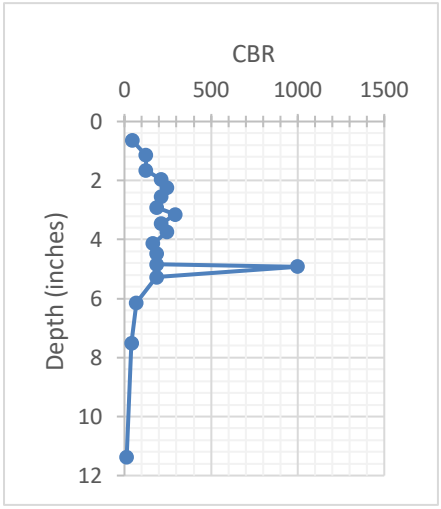
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	56 - Outside Wheel Path
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)	CBR
	56				
3	72	16	0.6	5.3	44.8
6	85	13	1.1	2.2	122.8
6	98	13	1.7	2.2	122.8
6	106	8	2.0	1.3	211.6
6	113	7	2.2	1.2	245.7
6	121	8	2.6	1.3	211.6
6	130	9	2.9	1.5	185.4
6	136	6	3.1	1.0	292.0
6	144	8	3.5	1.3	211.6
6	151	7	3.7	1.2	245.7
6	161	10	4.1	1.7	164.8
6	170	9	4.5	1.5	185.4
6	179	9	4.8	1.5	185.4
6	181	2	4.9	0.3	999.4
6	190	9	5.3	1.5	185.4
6	212	22	6.1	3.7	68.1
6	247	35	7.5	5.8	40.5
6	345	98	11.4	16.3	12.8



Average CBR:	207.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

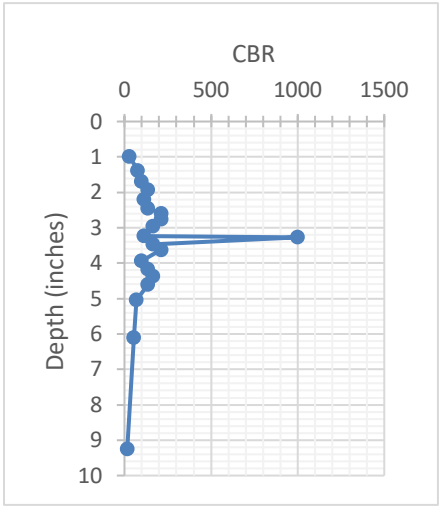
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	57 - Between Wheel Paths
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)	CBR
	55				
3	80	25	1.0	8.3	27.2
3	90	10	1.4	3.3	75.8
3	98	8	1.7	2.7	97.3
3	104	6	1.9	2.0	134.3
3	111	7	2.2	2.3	113.0
3	117	6	2.4	2.0	134.3
3	121	4	2.6	1.3	211.6
3	125	4	2.8	1.3	211.6
3	130	5	3.0	1.7	164.8
3	137	7	3.2	2.3	113.0
3	138	1	3.3	0.3	999.4
3	143	5	3.5	1.7	164.8
3	147	4	3.6	1.3	211.6
3	155	8	3.9	2.7	97.3
3	161	6	4.2	2.0	134.3
3	166	5	4.4	1.7	164.8
3	172	6	4.6	2.0	134.3
3	183	11	5.0	3.7	68.1
6	210	27	6.1	4.5	54.2
6	290	80	9.3	13.3	16.0



Average CBR:	166.4

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

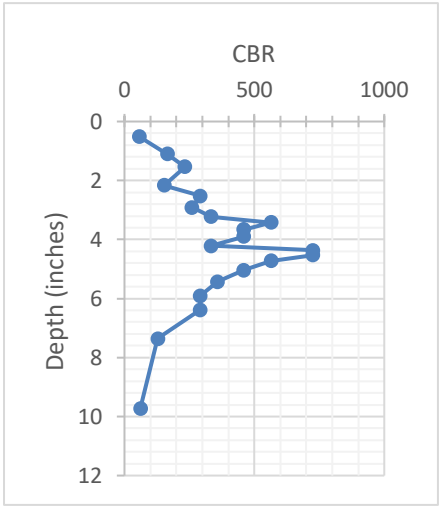
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	58 - Center Line
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)	CBR
	53				
3	66	13	0.5	4.3	56.5
9	81	15	1.1	1.7	164.8
9	92	11	1.5	1.2	233.2
9	108	16	2.2	1.8	153.3
9	117	9	2.5	1.0	292.0
9	127	10	2.9	1.1	259.5
9	135	8	3.2	0.9	333.2
9	140	5	3.4	0.6	564.0
9	146	6	3.7	0.7	459.8
9	152	6	3.9	0.7	459.8
9	160	8	4.2	0.9	333.2
9	164	4	4.4	0.4	724.1
9	168	4	4.5	0.4	724.1
9	173	5	4.7	0.6	564.0
12	181	8	5.0	0.7	459.8
12	191	10	5.4	0.8	358.2
12	203	12	5.9	1.0	292.0
12	215	12	6.4	1.0	292.0
12	240	25	7.4	2.1	128.3
15	300	60	9.7	4.0	61.8



Average CBR:	345.7

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: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

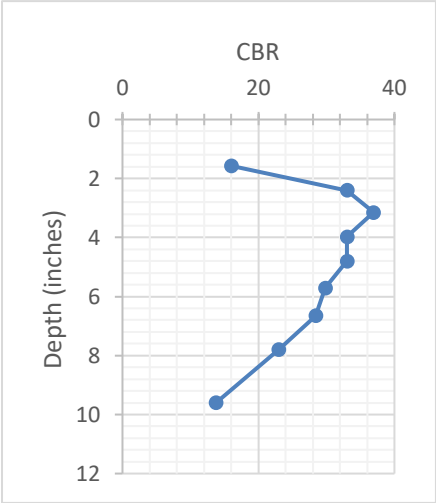
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	59 - Outside Wheel Path
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)	CBR
	61				
3	101	40	1.6	13.3	16.0
3	122	21	2.4	7.0	33.0
3	141	19	3.1	6.3	36.9
3	162	21	4.0	7.0	33.0
3	183	21	4.8	7.0	33.0
3	206	23	5.7	7.7	29.8
3	230	24	6.7	8.0	28.4
3	259	29	7.8	9.7	23.0
3	305	46	9.6	15.3	13.7



Average CBR:	27.5

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).

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Material Test Report

Client: McLeod County **CC:** John Brunkhorst

Project: CR 54 Pavement Evaluation - SB
McLeod County, MN
AET Project No. 27-20035

Date of Issue:

Reviewed By:

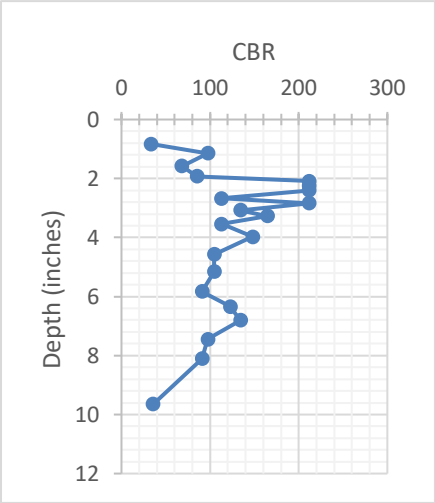
General Information

Road:	CR 54
Date Stabilized:	2018
Date Tested:	5/14/2019
Days after stabilization:	

Tested by:	K. Boks/L. McLaughlin
Test Location:	60 - Between Wheel Paths
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)	CBR
	54				
3	75	21	0.8	7.0	33.0
3	83	8	1.1	2.7	97.3
3	94	11	1.6	3.7	68.1
3	103	9	1.9	3.0	85.3
3	107	4	2.1	1.3	211.6
3	111	4	2.2	1.3	211.6
3	115	4	2.4	1.3	211.6
3	122	7	2.7	2.3	113.0
3	126	4	2.8	1.3	211.6
3	132	6	3.1	2.0	134.3
3	137	5	3.3	1.7	164.8
3	144	7	3.5	2.3	113.0
6	155	11	4.0	1.8	148.1
6	170	15	4.6	2.5	104.6
6	185	15	5.2	2.5	104.6
6	202	17	5.8	2.8	91.0
6	215	13	6.3	2.2	122.8
6	227	12	6.8	2.0	134.3
6	243	16	7.4	2.7	97.3
6	260	17	8.1	2.8	91.0
6	299	39	9.6	6.5	35.9



Average CBR:	123.1

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).

Appendix D

Pavement Core Logs and UCS Results

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· MATERIALS
· FORENSICS

CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-1	**Core Diameter:**	4”
Date Cored:	5/13/2019	**Recovered:**	5”
GPS Coordinates:	44.82102920, -94.39615278	**Trimmed Length:**	4.2”
Location:	NB Lane, Wheel Path		
Unconfined Compressive Strength:	274 psi		

Figure 1. Recovered Core

Figure 2. Trimmed Core

Figure 3. Trimmed & Gypsum Capped Core, Before Testing

Figure 4. Tested Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-2	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	Pieces
GPS Coordinates:	44.79368936, -94.39609932		
Location:	NB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	Not Tested		

Figure 1. Recovered Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-3	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	8”
GPS Coordinates:	44.81204833, -94.39607245	**Trimmed Length:**	6.7”
Location:	NB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	193 psi		

Figure 1. Recovered Core

Figure 2. Trimmed Core


Figure 3. Trimmed & Gypsum Capped Core, Before Testing


Figure 4. Tested Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-4	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	6.5”
GPS Coordinates:	44.79989772, -94.39605237	**Trimmed Length:**	4.4”
Location:	NB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	158 psi		

Figure 1. Recovered Core

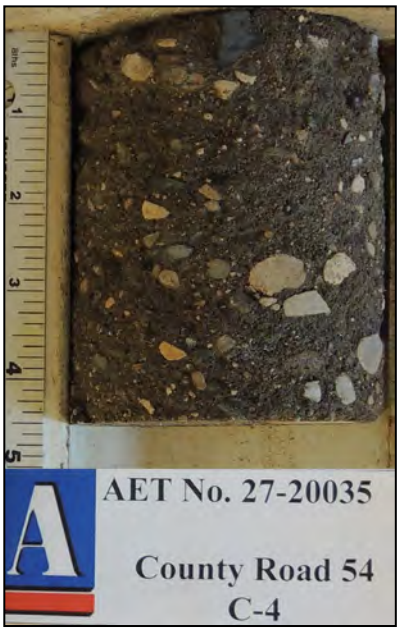

Figure 2. Trimmed Core

Figure 3. Trimmed & Gypsum Capped Core, Before Testing

Figure 4. Tested Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-5	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	6”
GPS Coordinates:	44.82532060, -94.40135352	**Trimmed Length:**	3.8”
Location:	NB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	98.3 psi		

Figure 1. Recovered Core

Figure 2. Trimmed Core

Figure 3. Trimmed & Gypsum Capped Core, Before Testing

Figure 4. Tested Core

CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-6	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	Pieces
GPS Coordinates:	44.82662274, -94.40315159		
Location:	SB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	Not Tested		

Figure 1. Recovered Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-7	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	7.5”
GPS Coordinates:	44.81956466, -94.39615427	**Trimmed Length:**	5.9”
Location:	SB Lane, Between Wheel Paths		

Unconfined Compressive Strength: 296.8 psi

Figure 2. Recovered Core

Figure 1. Trimmed Core

Figure 3. Trimmed & Gypsum Capped Core, Before Testing

Figure 4. Tested Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-8	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	8”
GPS Coordinates:	44.81105278, -94.39606907	**Trimmed Length:**	6.5”
Location:	SB Lane, Between Wheel Paths		

Unconfined Compressive Strength: 338 psi

Figure 2. Recovered Core

Figure 1. Trimmed Core

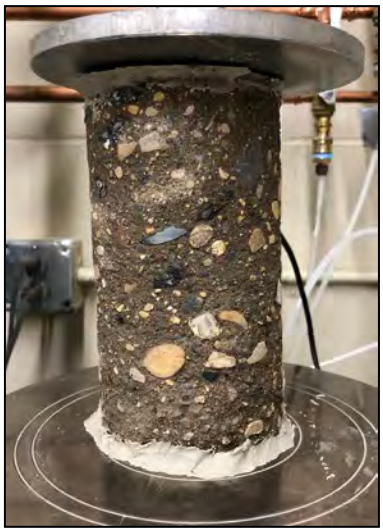

Figure 3. Trimmed & Gypsum Capped Core, Before Testing

Figure 4. Tested Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-9	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	4.5”
GPS Coordinates:	44.79867623, -94.39608288	**Trimmed Length:**	3.1”
Location:	SB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	225 psi		

Figure 2. Recovered Core

Figure 1. Trimmed Core

Figure 3. Trimmed & Gypsum Capped Core, Before Testing

Figure 4. Tested Core

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CR 54 Pavement Investigation
McLeod County, MN
AET Project Number: 27-20035

Core:	C-10	**Core Diameter:**	4”
Date Cored:	5/14/2019	**Recovered:**	2.5”
GPS Coordinates:	44.78813302, -94.39616148		
Location:	SB Lane, Between Wheel Paths		
Unconfined Compressive Strength:	Not Tested		

Figure 1. Recovered Core

Appendix E

Pavement Report Limitations and Guidelines for Use

Appendix E
Pavement Report Limitations and Guidelines for Use
Report No. 27-20035

E.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

E.2 RISK MANAGEMENT INFORMATION

E.2.1 Pavement Services are Performed for Specific Purposes, Persons, and Projects

Pavement engineers structure their services to meet the specific needs of their clients. A pavement engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each pavement engineering study is unique, each pavement engineering report is unique, prepared solely for the client. No one except you should rely on your pavement engineering report without first conferring with the pavement engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

E.2.2 Read the Full Report

Serious problems have occurred because those relying on a pavement engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

E.2.3 A Pavement Engineering Report is Based on A Unique Set of Project-Specific Factors

Pavement engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the pavement engineer who conducted the study specifically indicates otherwise, do not rely on a pavement engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing pavement engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your pavement engineer of project changes, even minor ones, and request an assessment of their impact. Pavement engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

E.2.4 Subsurface Conditions Can Change

A pavement engineering report is based on conditions that existed at the time the study was performed. Do not rely on a pavement engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the pavement engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

1 ASFE, 8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733: www.asfe.org

E.2.5 Most Pavement Findings Are Professional Opinions
Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Pavement engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in your report. Retaining the pavement engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

E.2.6 A Report's Recommendations Are Not Final
Do not over rely on the construction recommendations included in your report. Those recommendations are not final, because pavement engineers develop them principally from judgment and opinion. Pavement engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The pavement engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

E.2.7 A Pavement Engineering Report Is Subject to Misinterpretation
Other design team members' misinterpretation of pavement engineering reports has resulted in costly problems. Lower that risk by having your pavement engineer confer with appropriate members of the design team after submitting the report. Also retain your pavement engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a pavement engineering report. Reduce that risk by having your pavement engineer participate in prebid and preconstruction conferences, and by providing construction observation.

E.2.8 Do Not Redraw the Engineer's Logs
Pavement engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a pavement engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

E.2.9 Give Contractors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete pavement engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the pavement engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

E.2.10 Read Responsibility Provisions Closely
Some clients, design professionals, and contractors do not recognize that pavement engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, pavement engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where pavement engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your pavement engineer should respond fully and frankly.

E.2.11 Geoenvironmental Concerns Are Not Covered
The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a pavement study. For that reason, a pavement engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your pavement consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.