



Inspectors Workshop
Advanced Materials and Technology (AMT) Update

Wednesday, February 17 and Tuesday, February 23, 2021

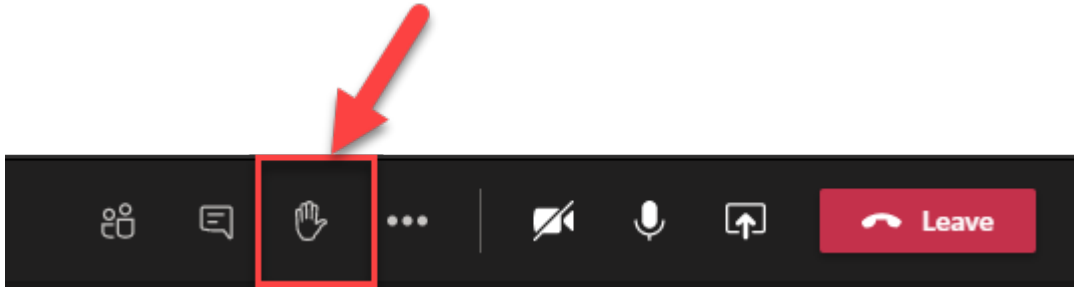
Virtual via Teams

DEPARTMENT OF TRANSPORTATION

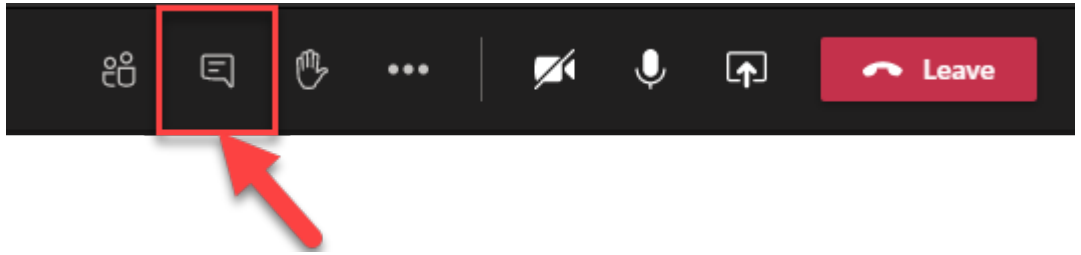
AMT Website | http://www.dot.state.mn.us/materials/amt/index.html

Discussions

- **Slides**
  - Open to Discussion – Interactive
- **Verbal Comments / Questions:**
  - Raise Hand in Microsoft Teams



- **Written Comments**
  - Chat Box



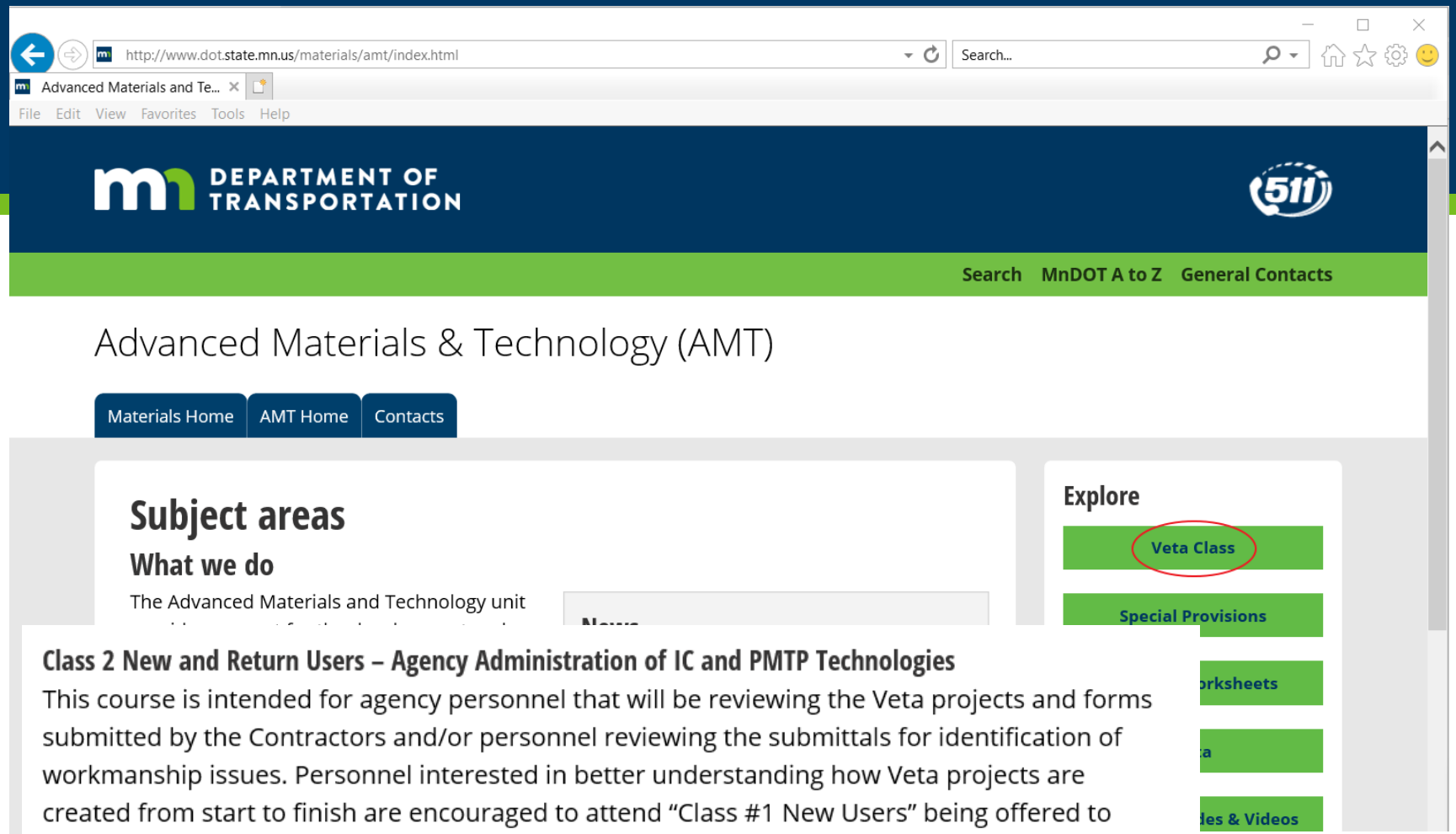
(2016) Quality Management Intelligent Construction Technologies

Michael M Johnson
Assistant Advanced Materials and Technology Engineer

Veta Training

- 2021
  - Not expiring users(Contractors)
  - Users (Contractors) that did not complete 2020 training and plan to create Veta and form submittals in CY2021 must take online class.
  - Agency (District) training will be provided in spring of 2022
- Significant Veta enhancements expected for 2022.
  - Anticipate expiring Users (Contractors) in 2022

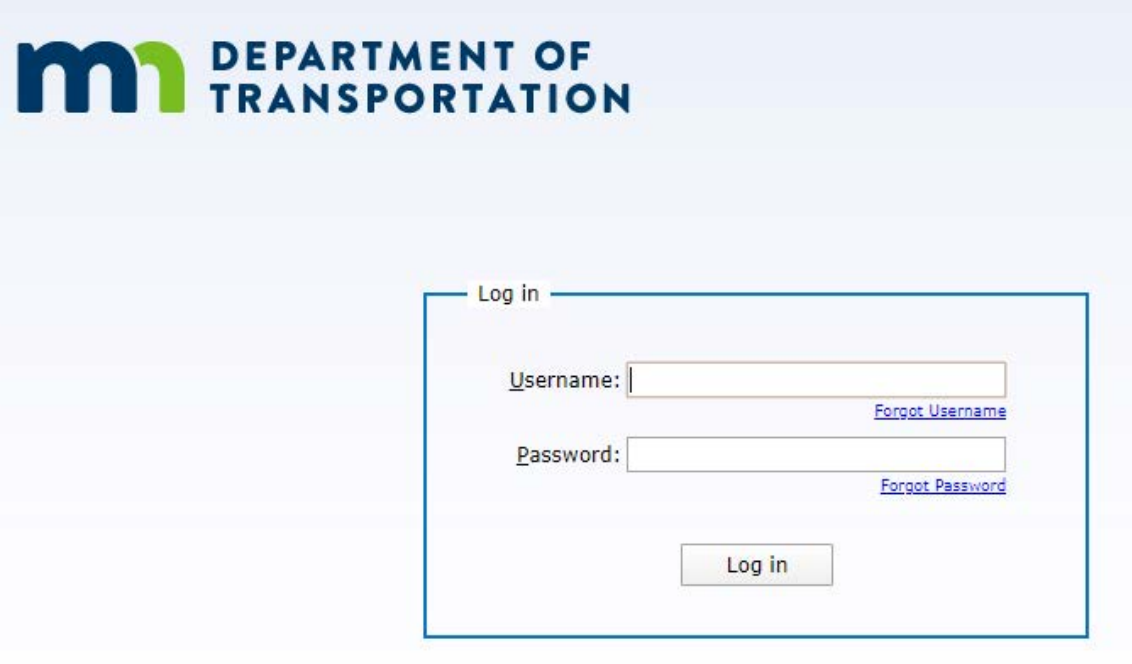
ICT-106 Form



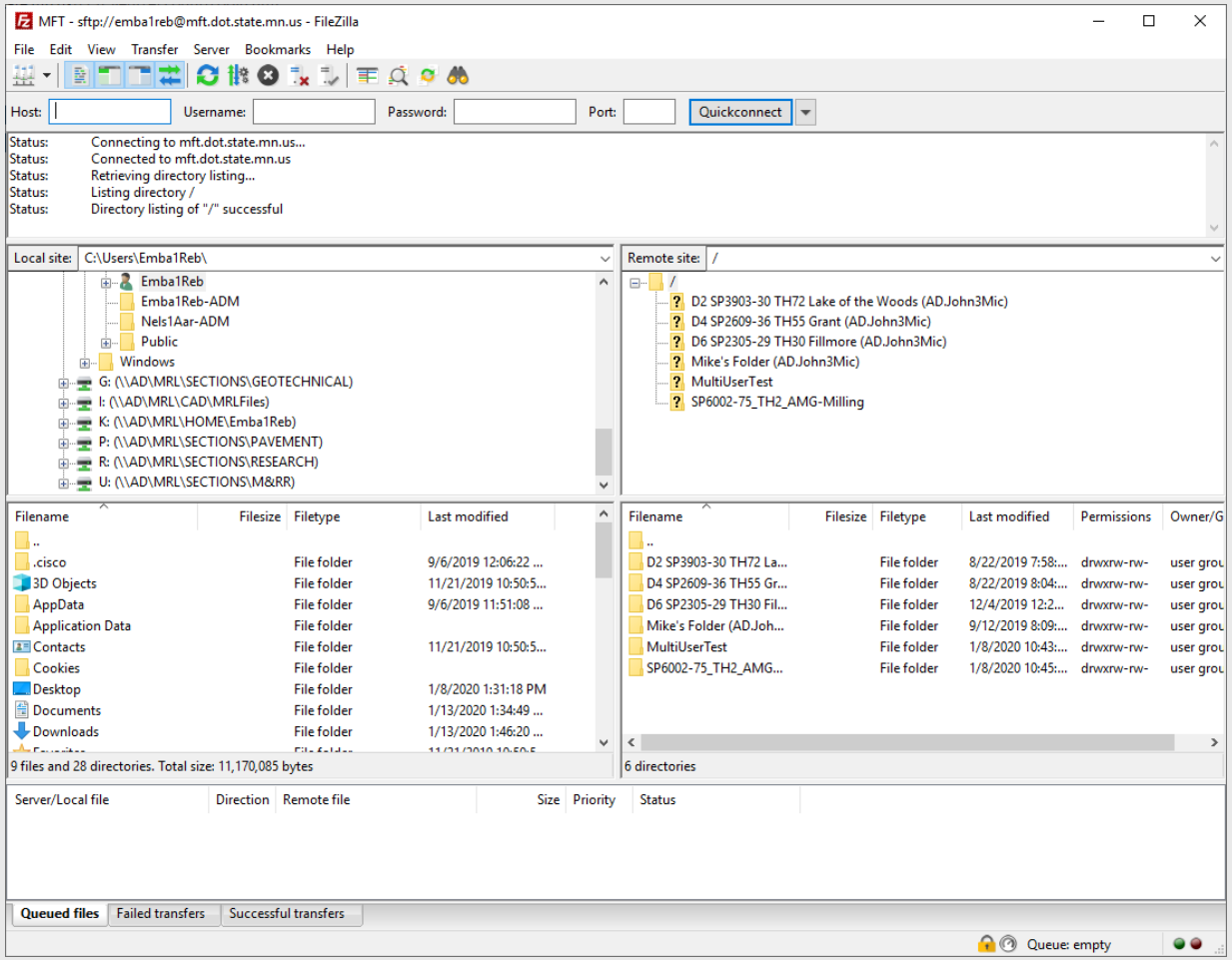
Module	Links	New & Return Users
Class Example File Downloads	**County/Consultants** Contact AMT unit to obtain file downloads. **MnDOT** Download files from iHUB	✓
Module F Complete ICT-106 Form	Module F Video (9 minutes) Module F Workflow (pdf)	✓

File Sharing
MnDOT MFT Site

https://mft.dot.state.mn.us/EFTClient/Account/Login.htm



Larger File Uploads / Downloads: Recommend using SFTP Platform (e.g., Filezilla)



File Sharing on MnDOT MFT Site

Provide AMT unit with name and e-mail address of personnel requiring access to project folders in MFT site.

Not Long-Term Storage
Non-Carry Over Projects – Deleting March 1

General Special Provision Edits

- ADA Compliance
  - Removed Merged Cells in Tables
  - Removed symbols from general text body
  - Units written in long form (e.g., ft = feet)
  - Complex tables deleted and moved to body of text
    - “Required Instrumented Roller Equipment”
    - “PMTP System Requirements”
- Pay items to use ICT equipment moved from general section to section B “PMTP method” and C “IC Method”

PMTP GNSS Accuracy

- S-xx.3.B.1.a(2)
  - GNSS to capture coordinates of the surface temperature readings. GNSS accuracy is **plus or minus 2 inches** or less in X and Y Directions.

- S-xx.5 Basis of Payment
  - Monetary Adjustments for GNSS Accuracy - Deleted
    - ~~A single lump sum payment of $5,000 will be issued when the thermal profile measurements are collected with an associated GNSS accuracy of ± 2 inches in the X and Y direction.~~

PMTP Method – Thermal Coverage (TC)

- No changes to TC calculation (calculated using total linear length)

- Anticipated 2022 Changes:
  - Calculate per sublot
  - Review 70% TC threshold

Veta Project and Form Submittals

added in fall of 2019 to the special provision...

- S-xx.3.A.1
  - A monetary deduction of $500 per calendar day will be assessed for submitting the final version of the Veta Project(s) and required forms later than 14-calendar days of completion of the ICT method.

Table 2016-11
Partial Payments Schedule

Added 75%
Added Final Approval of Submittals (remaining 25%)

When	Percent of Estimated Quantity Completed	Pay Percent of Lump Sum Item
First Pay Estimate	(Blank)	10
Subsequent Pay Estimate *	5	15
Subsequent Pay Estimate *	15	30
Subsequent Pay Estimate *	50	50
Subsequent Pay Estimate *	75	75
Final Approval of Submittals	100	100

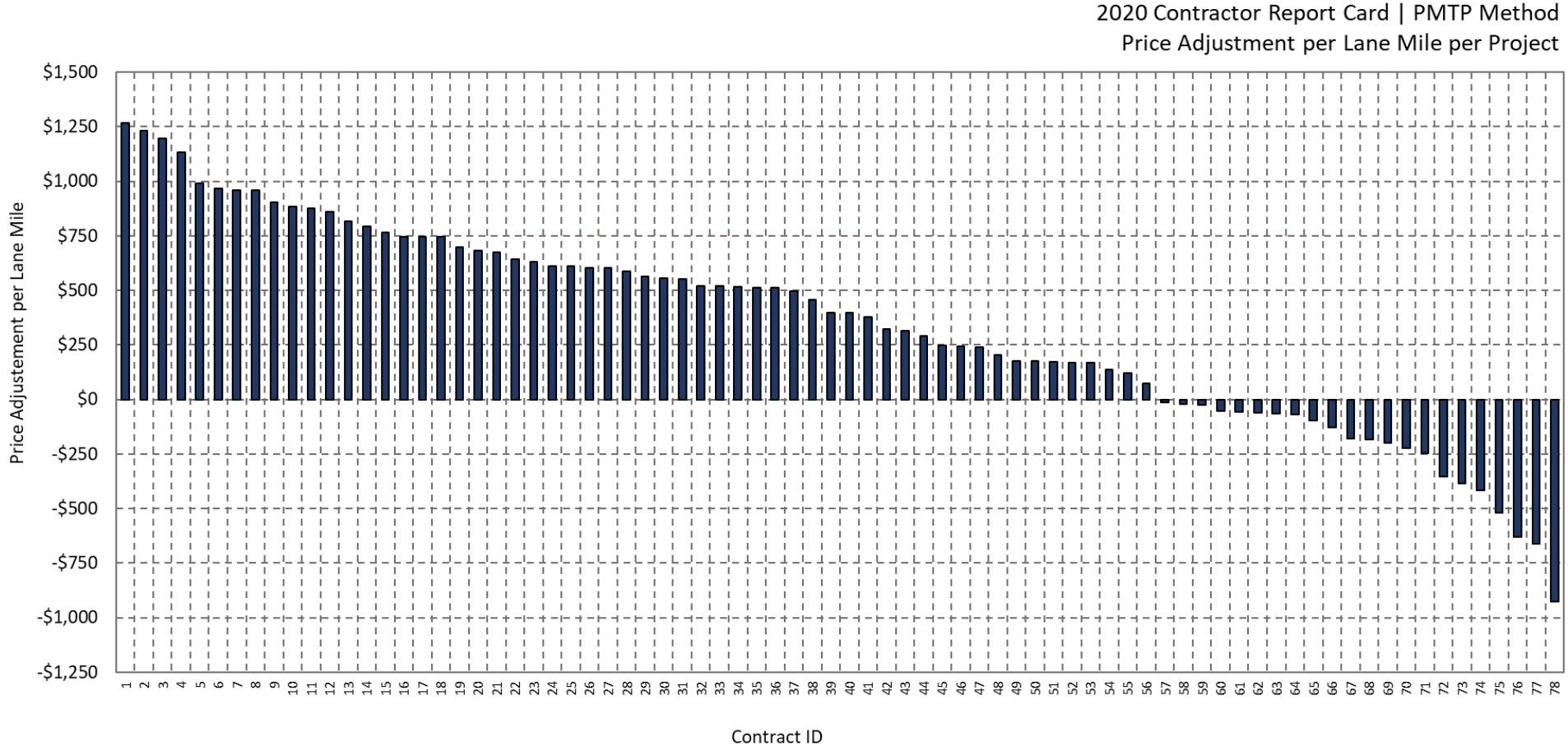
* Percent of Estimated Quantity Completed is based on the pay quantity where the given ICT method is required:
2215.504 Stabilized Full Depth Reclamation
2390.504 CIR – CCPR Bituminous
2353.504 Ultrathin Bonded Wear Course
2360.509 Type SP Wearing Course Mixture
2360.509 Type SP Non-Wearing Course Mixture
2360.504 Type SP Wearing Course Mixture in [mm] Thick
2360.504 Type SP Non-Wearing Course Mixture in [mm] Thick
2365.509 Type SM Wearing Course Mixture

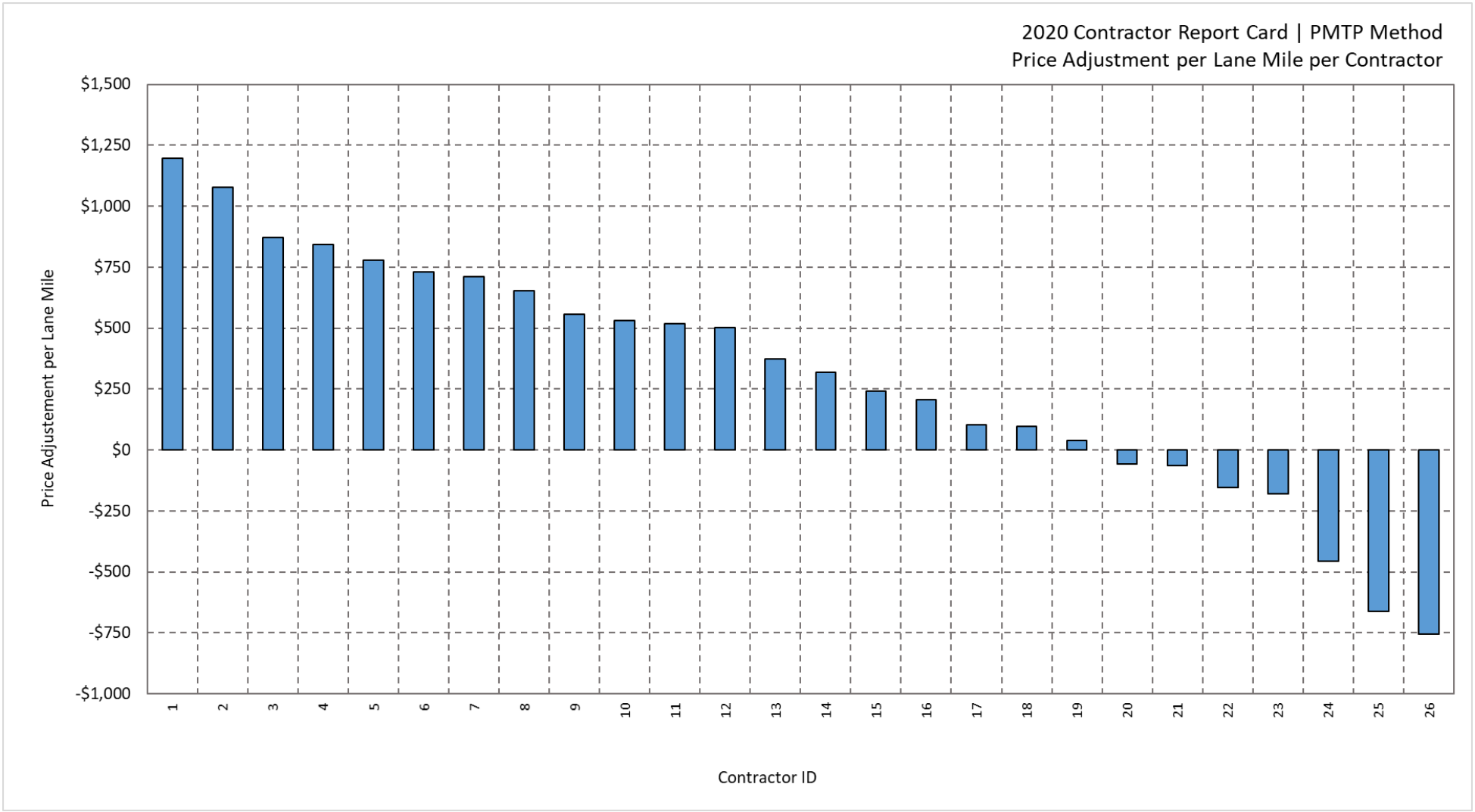
S-xx.5 Basis of Payment
New Pay Items

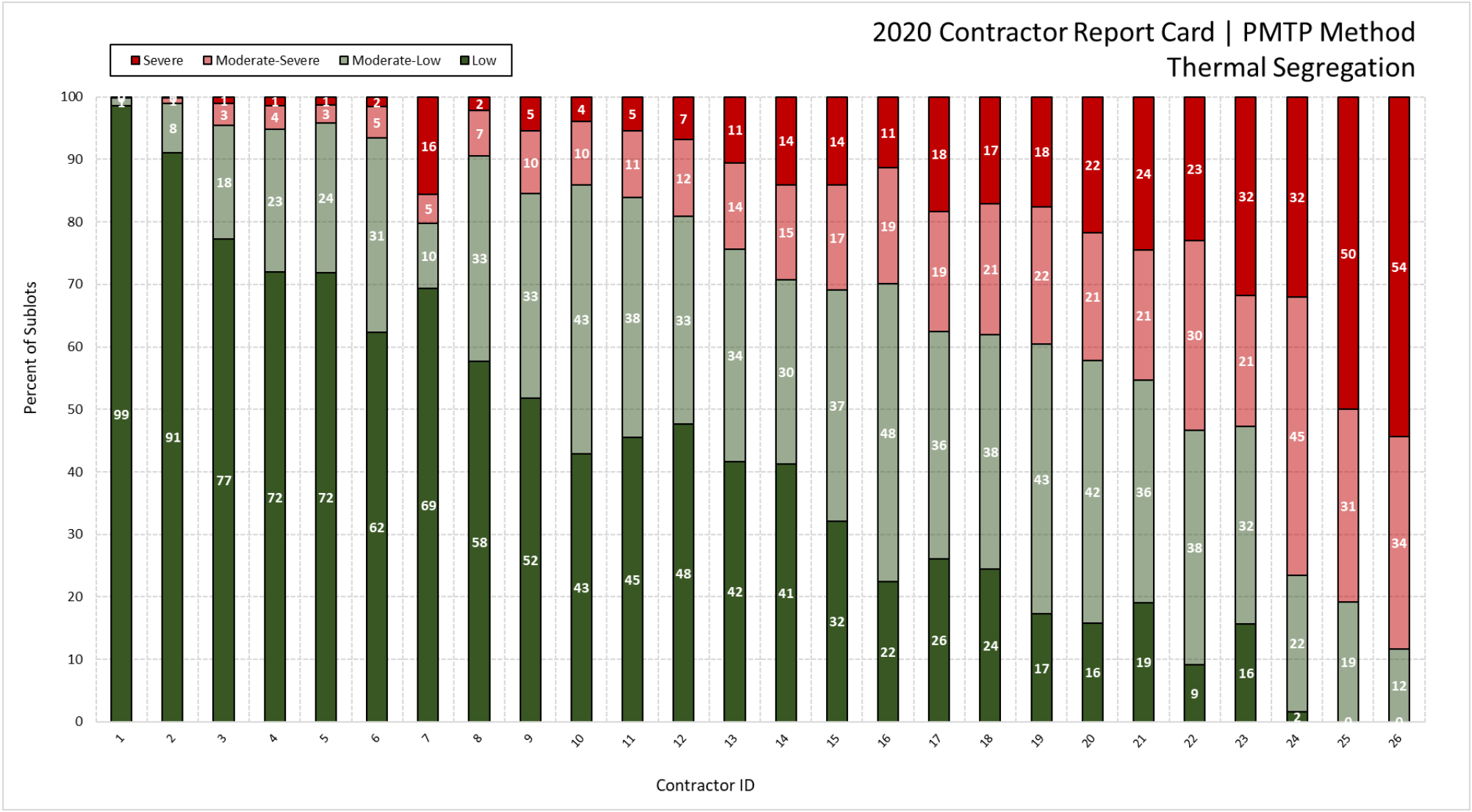
- Contract Lump Sum
  - 2016.601 Quality Management – Thermal Profiling…… Lump Sum
  - 2016.601 Quality Management – Intelligent Compaction…….. Lump Sum

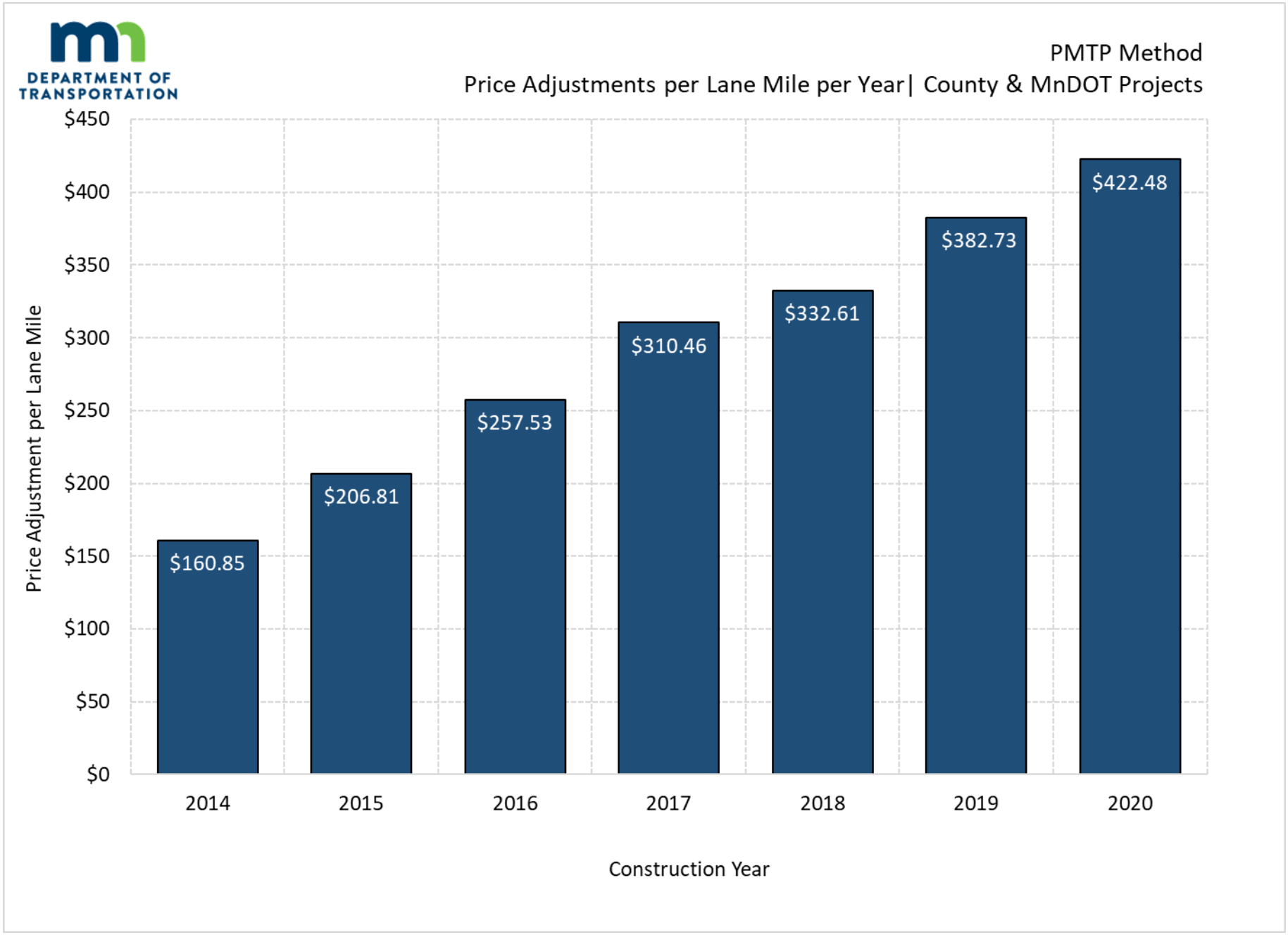
- Setup of cloud storage and computing
- Conversion of design files
- Site calibration
- Instrumentation of equipment with ICT system
- ICT system and software setup
- Equipment setup for satellite corrections
- Data lot establishment
- System monitoring
- Remote server storage
- Cloud-based software accessibility
- Data package plans
- Analysis and organization of ICT measurements in Veta
- Completion of ICT submittal forms

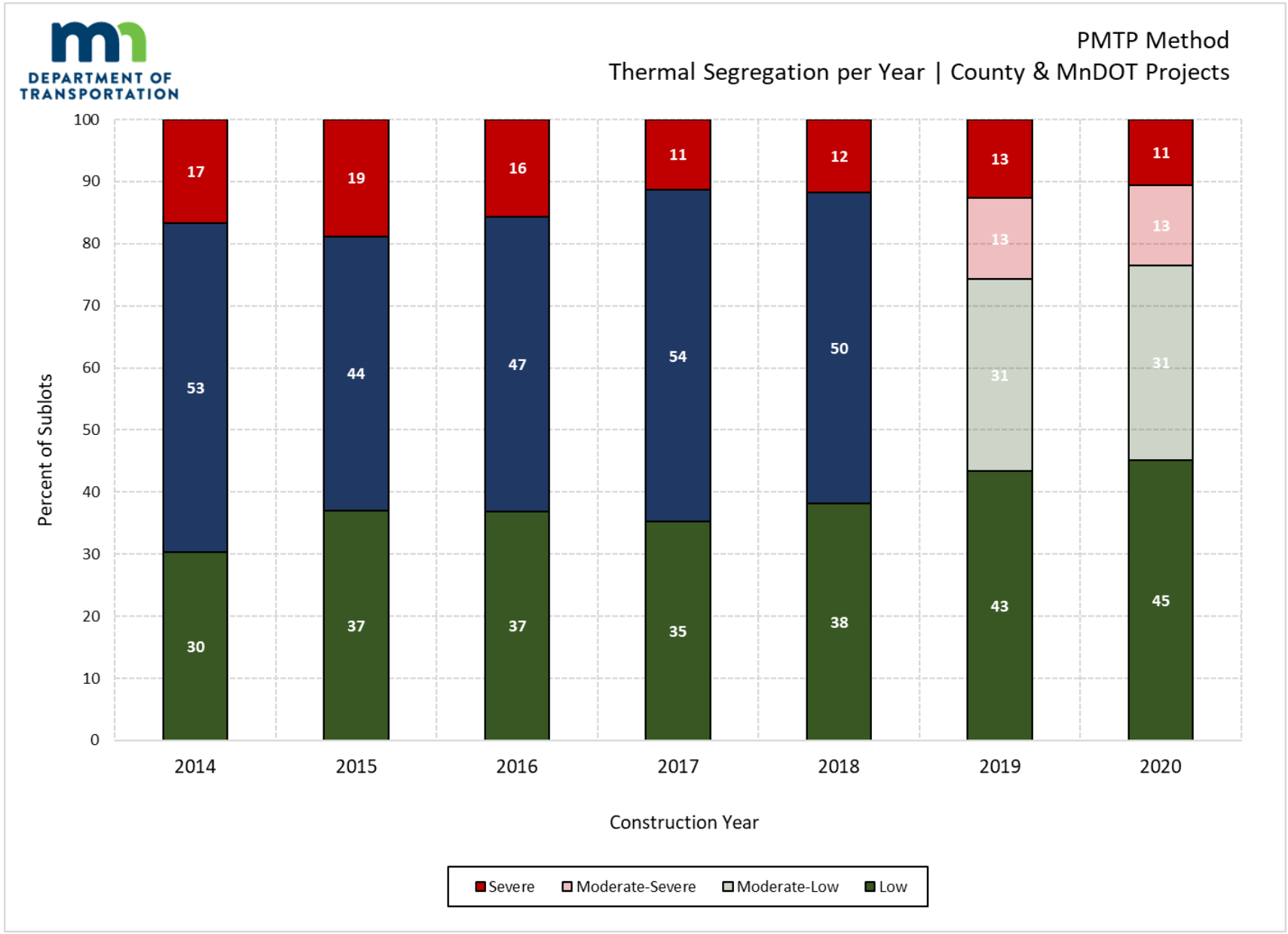
(2016) Quality Management Report Cards

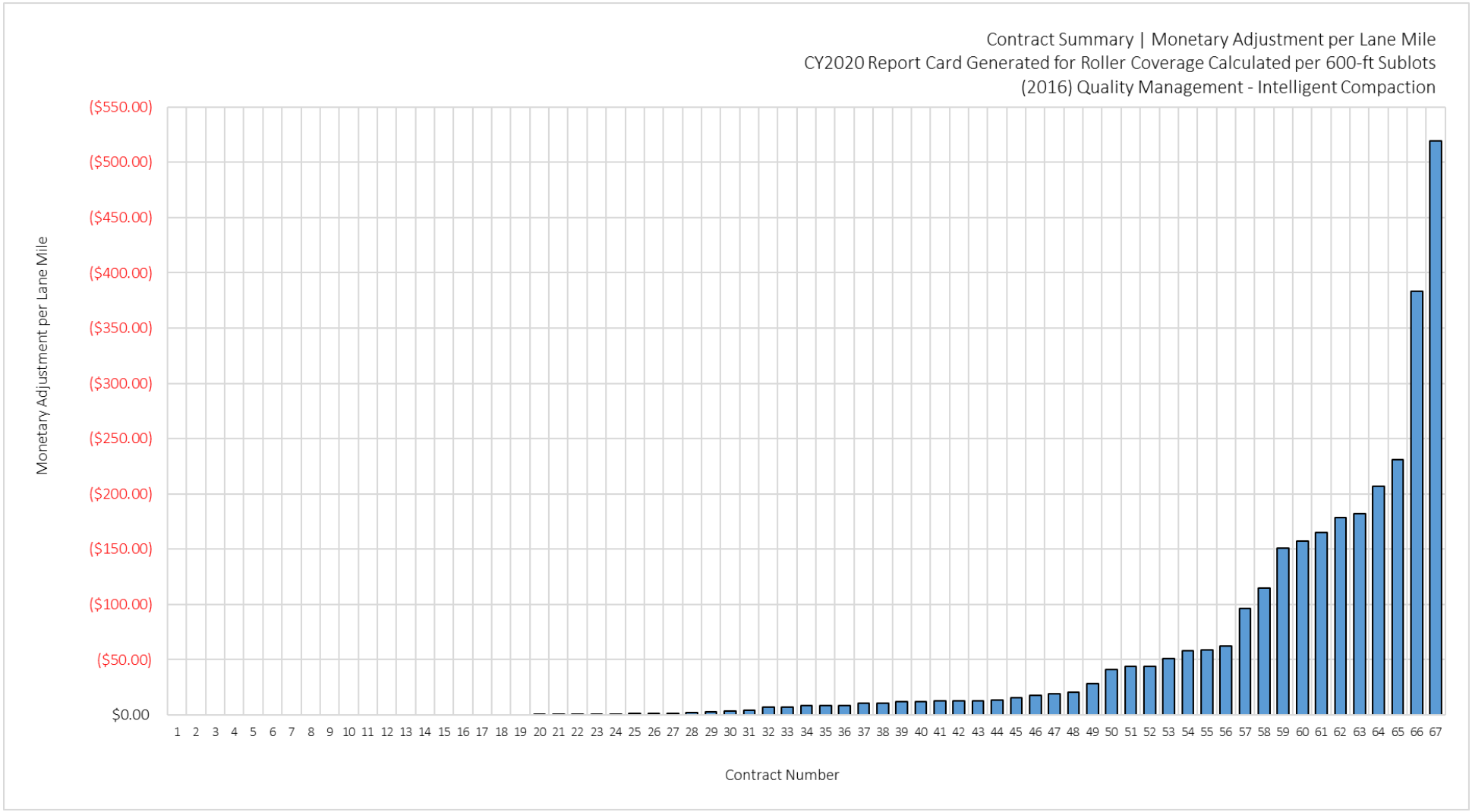

2020 Contractor Report Card | PMTP Method
Price Adjustment per Lane Mile per Project
Price Adjustement per Lane Mile
$1,500
$1,250
$1,000
$750
$500
$250
$0
-$250
-$500
-$750
-$1,000
-$1,250
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78
Contract ID

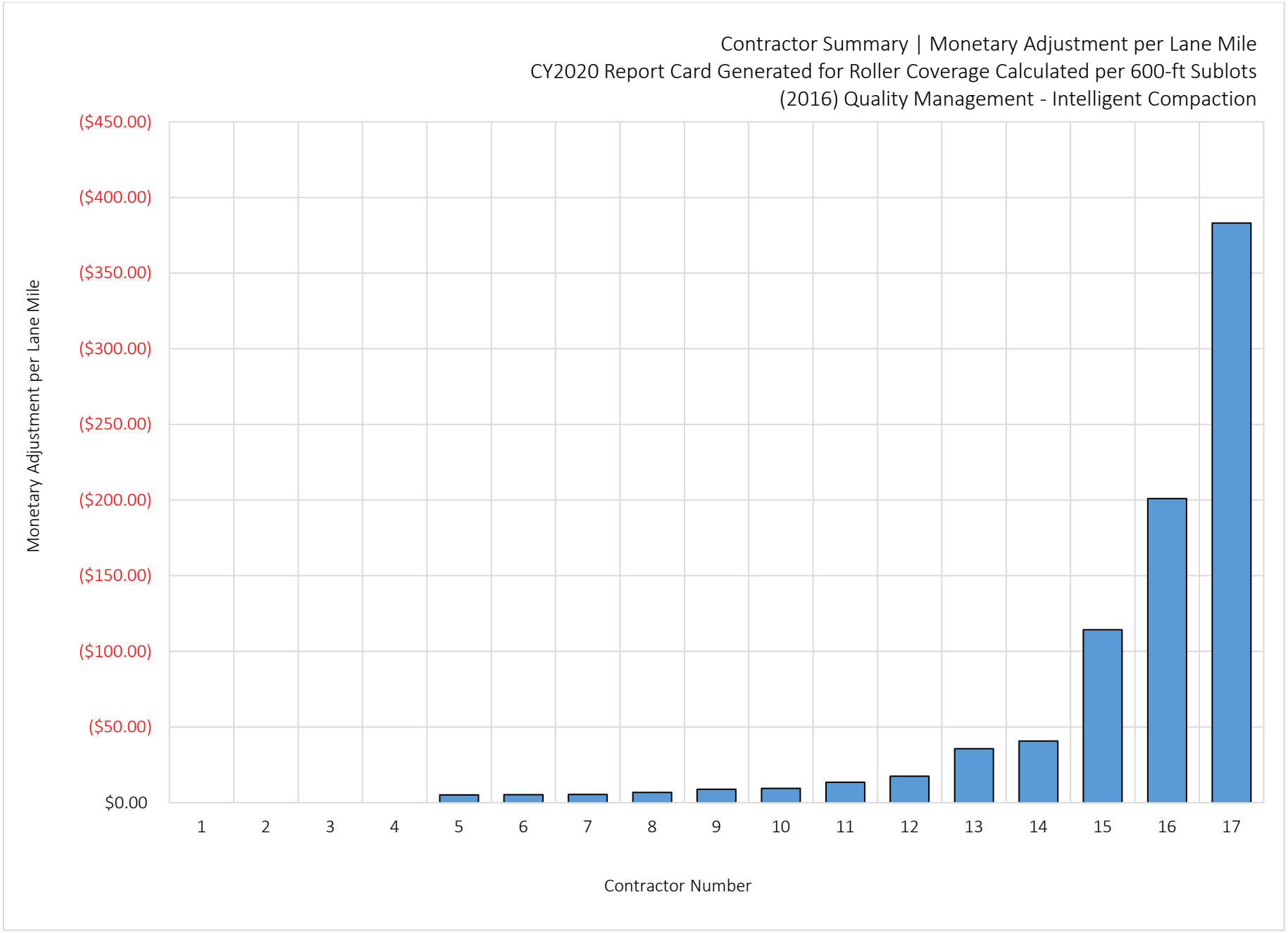

2020 Contractor Report Card | PMTP Method
Price Adjustment per Lane Mile per Contractor
Price Adjustement per Lane Mile
$1,500
$1,250
$1,000
$750
$500
$250
$0
-$250
-$500
-$750
-$1,000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
Contractor ID

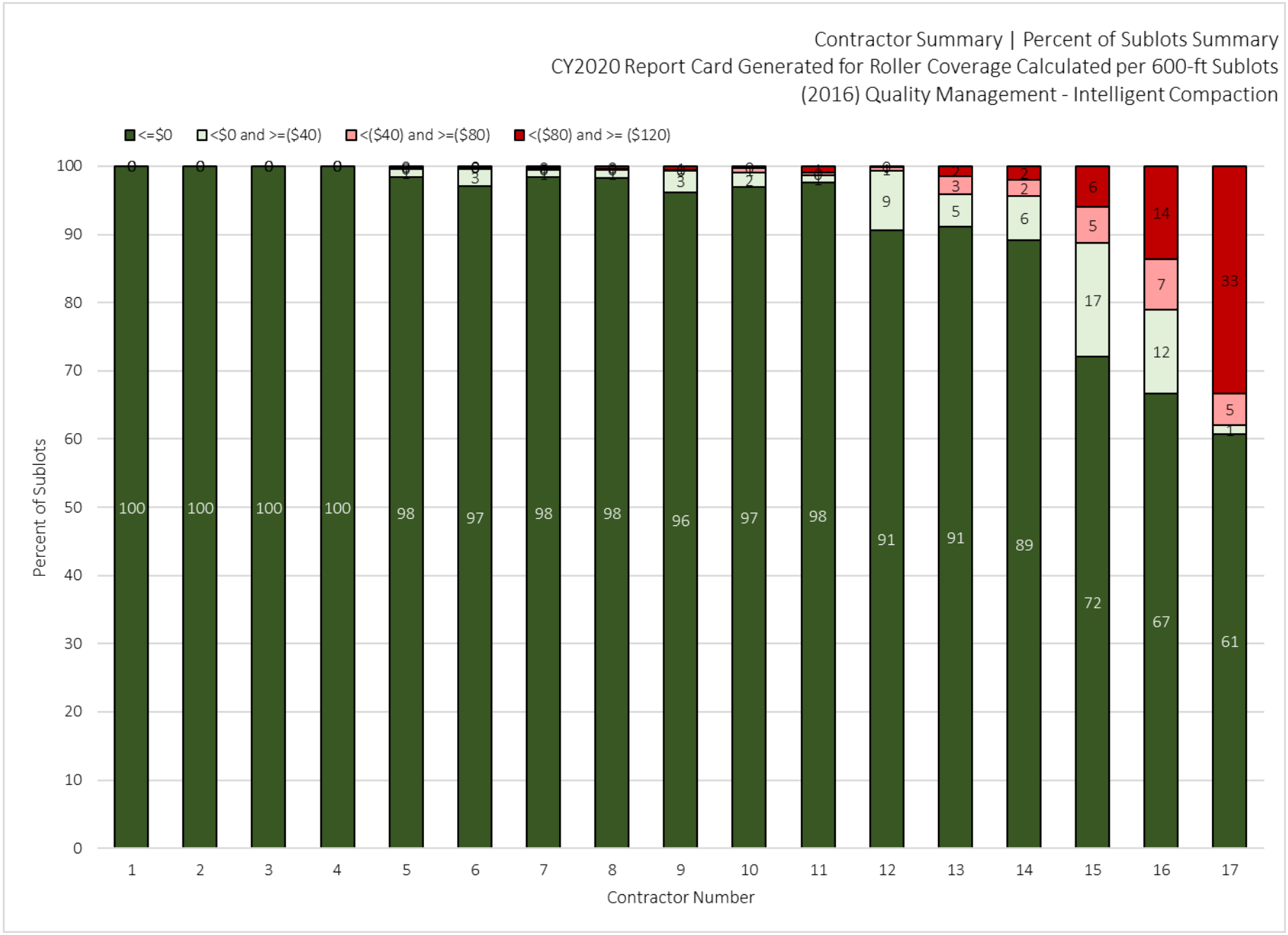

2020 Contractor Report Card | PMTP Method
Thermal Segregation
Severe
Moderate-Severe
Moderate-Low
Low
Percent of Sublots
Contractor ID
0
10
20
30
40
50
60
70
80
90
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
99 91 77 72 72 62 69 58 52 43 45 48 42 41 32 22 26 24 17 16 19 9 16 2 0 0
1 8 18 23 24 31 10 33 33 43 38 33 34 30 37 48 36 38 43 42 36 38 32 22 19 12
1 3 4 3 5 10 5 7 10 10 11 12 14 15 17 19 19 21 22 21 21 30 21 45 31 34
1 1 1 1 1 2 16 2 5 4 5 7 11 14 14 11 18 17 18 22 24 23 32 32 50 54

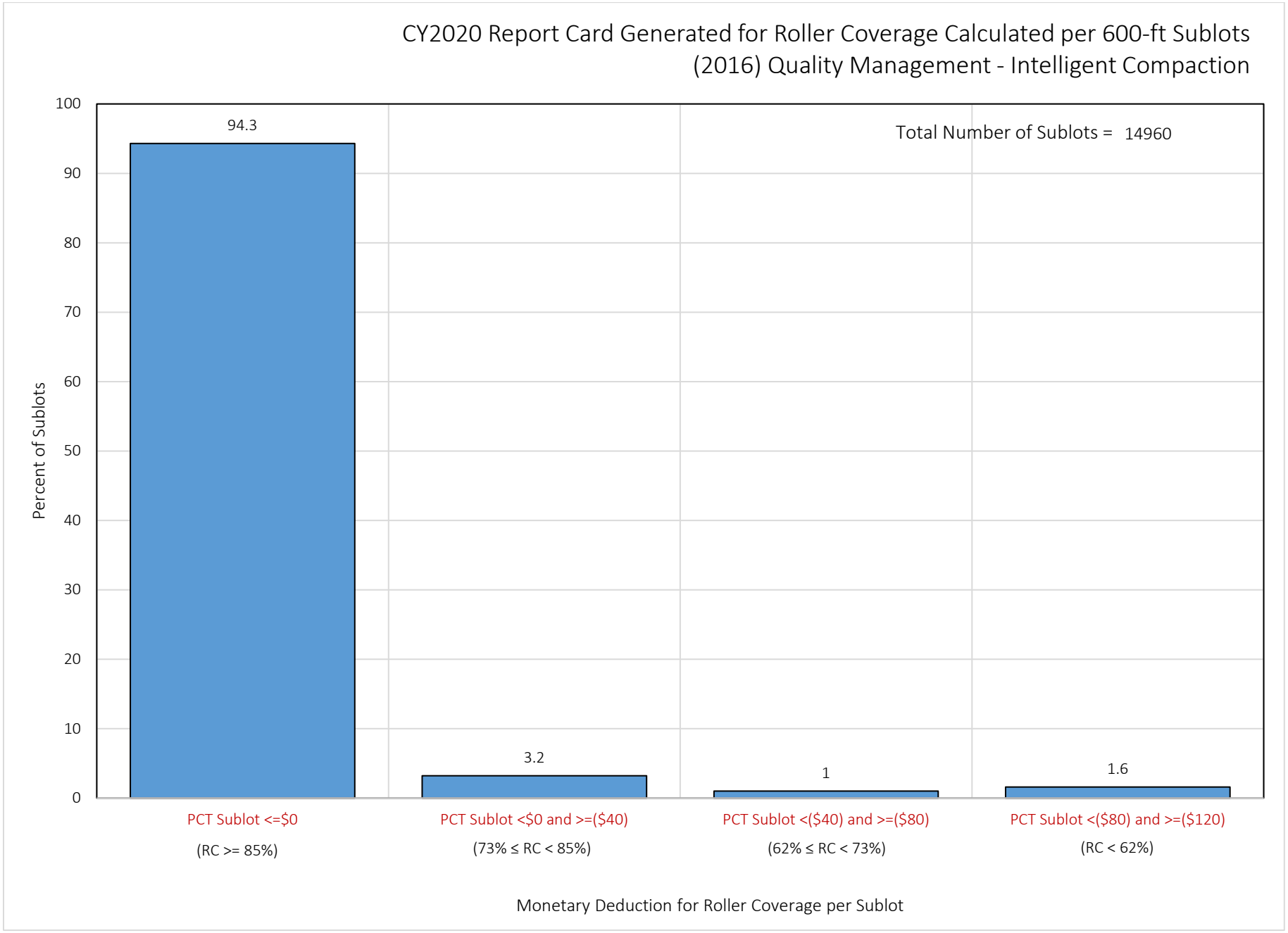

DEPARTMENT OF TRANSPORTATION
PMTP Method
Price Adjustments per Lane Mile per Year| County & MnDOT Projects
Price Adjustment per Lane Mile
$450
$400
$350
$300
$250
$200
$150
$100
$50
$0
$160.85
$206.81
$257.53
$310.46
$332.61
$382.73
$422.48
2014
2015
2016
2017
2018
2019
2020
Construction Year

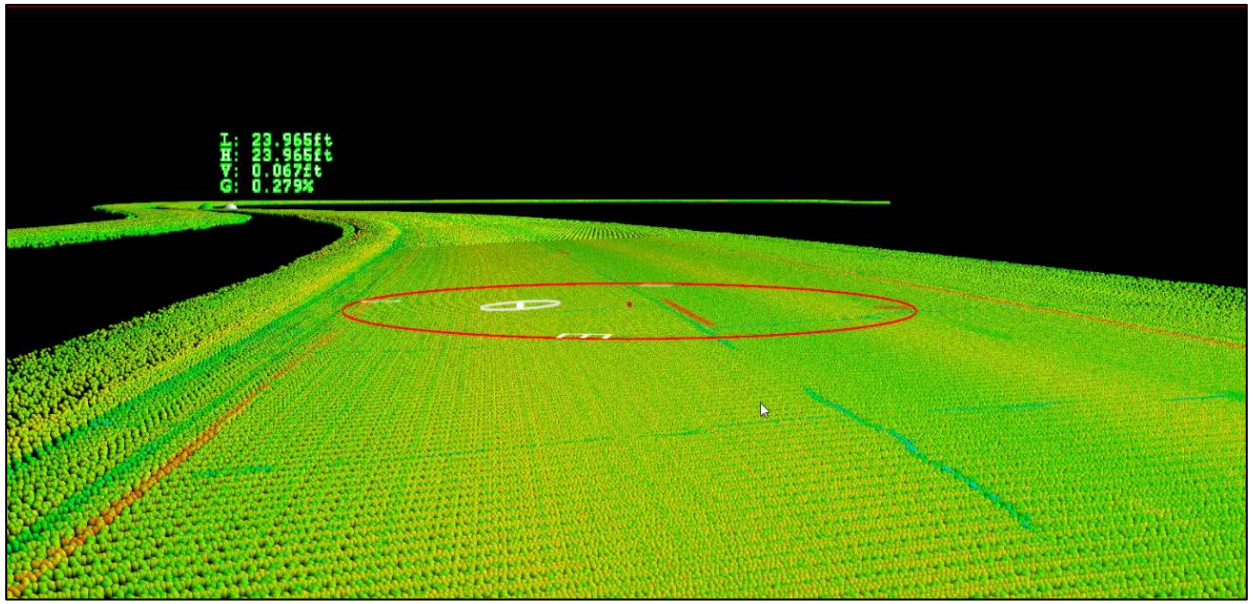

DEPARTMENT OF TRANSPORTATION
PMTP Method
Thermal Segregation per Year | County & MnDOT Projects
Percent of Sublots
100
90
80
70
60
50
40
30
20
10
0
17
53
30
19
44
37
16
47
37
11
54
35
12
50
38
13
13
31
43
11
13
31
45
2014
2015
2016
2017
2018
2019
2020
Construction Year
Severe
Moderate-Severe
Moderate-Low
Low

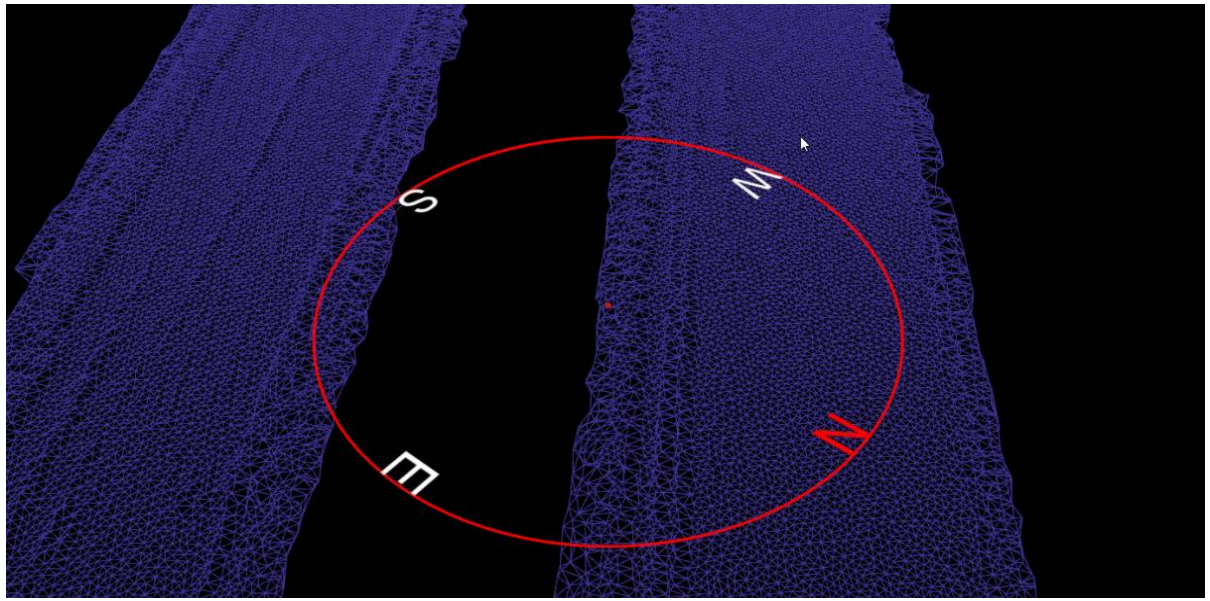

Contract Summary | Monetary Adjustment per Lane Mile
CY2020 Report Card Generated for Roller Coverage Calculated per 600-ft Sublots
(2016) Quality Management - Intelligent Compaction
Monetary Adjustment per Lane Mile
($550.00)
($500.00)
($450.00)
($400.00)
($350.00)
($300.00)
($250.00)
($200.00)
($150.00)
($100.00)
($50.00)
$0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67
Contract Number


Contractor Summary | Monetary Adjustment per Lane Mile
CY2020 Report Card Generated for Roller Coverage Calculated per 600-ft Sublots
(2016) Quality Management - Intelligent Compaction
($450.00)
($400.00)
($350.00)
($300.00)
($250.00)
($200.00)
($150.00)
($100.00)
($50.00)
$0.00
Monetary Adjustment per Lane Mile
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
Contractor Number


Contractor Summary | Percent of Sublots Summary
CY2020 Report Card Generated for Roller Coverage Calculated per 600-ft Sublots
(2016) Quality Management - Intelligent Compaction
<=$0
<$0 and >=($40)
<($40) and >=($80)
<($80) and >= ($120)
Percent of Sublots
Contractor Number
0
10
20
30
40
50
60
70
80
90
100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
100 100 100 100 98 97 98 98 96 97 98 91 91 89 72 67 61
0 0 0 0 1 3 1 1 3 2 1 9 5 6 17 12 5
0 0 0 0 1 0 1 1 1 0 1 1 3 2 5 7 33
0 0 0 0 0 0 0 0 0 0 0 0 2 2 6 14 1


CY2020 Report Card Generated for Roller Coverage Calculated per 600-ft Sublots
(2016) Quality Management - Intelligent Compaction
Total Number of Sublots = 14960
Percent of Sublots
100
90
80
70
60
50
40
30
20
10
0
94.3
3.2
1
1.6
PCT Sublot <=$0
(RC >= 85%)
PCT Sublot <$0 and >=($40)
(73% ≤ RC < 85%)
PCT Sublot <($40) and >=($80)
(62% ≤ RC < 73%)
PCT Sublot <($80) and >=($120)
(RC < 62%)
Monetary Deduction for Roller Coverage per Sublot





2232 Mill Pavement Surface – Relative AMG Milling Method

Relative Milling

- Recommended for use when milling an existing asphalt surface for a
  - Mill and Overlay
  - Thinlay
  - Reclamation (e.g., FDR, SFDR, CIR, CCPR)
- Roadmap
  - Piloting Technology on Select Projects
  - Determining model creation workflow, model review checks, ride reviews, etc.
  - Develop Deployment Roadmap

Variable Depth Milling

This solution uses variable depth milling to achieve a smoothed proposed surface with cross slope corrections.

Relative Milling

Technology uses the existing surface at a given location to mill to a proposed surface using delta depths vs. absolute elevations.

Technology can use both side gates or side gate- cross slope.

Components

GNSS Receivers: used to track horizontal position

YO-YO Sensor or Sonic Trackers to provide vertical precision

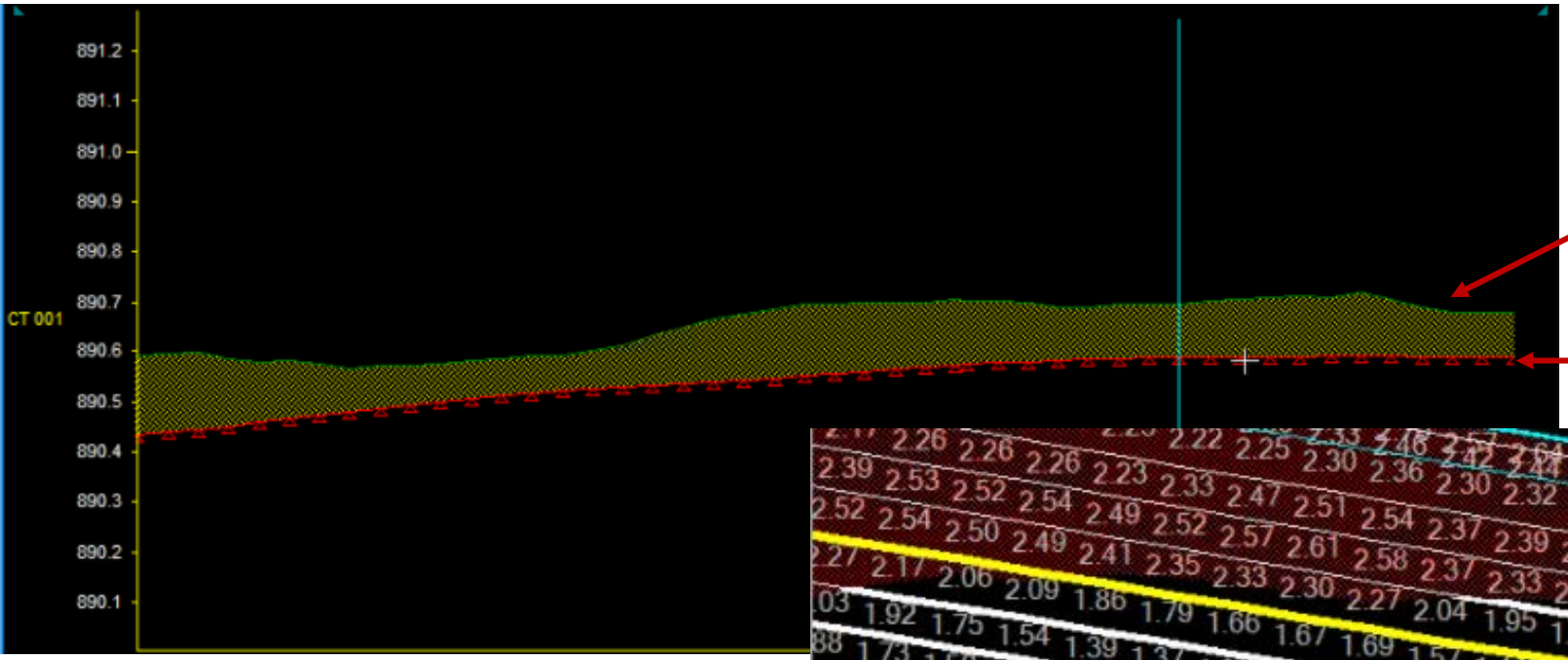
Ski provides 4 ft to average out irregularities.

Down Facing Lidar Scanner

Existing in-place road is scanned to create proposed smoothed milling surface. This surface is also loaded on the milling machine and used as the reference surface during the milling operation.

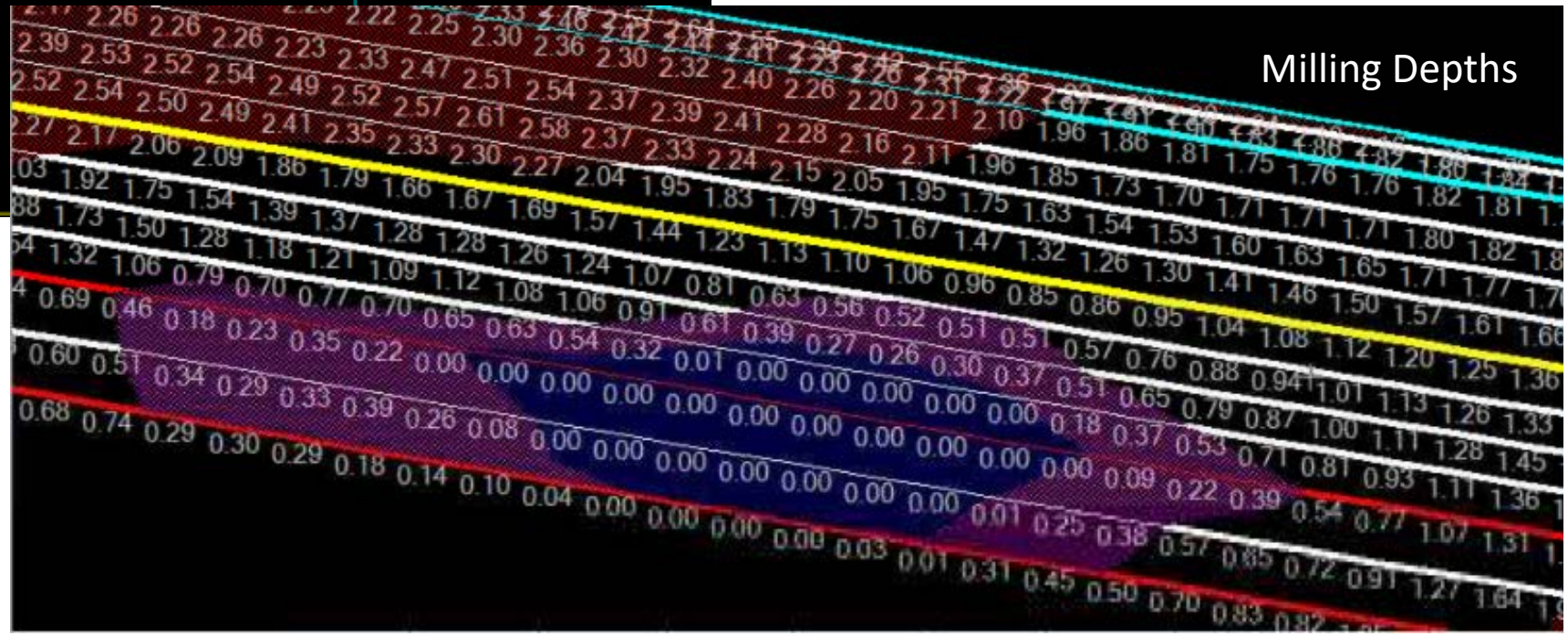
Lidar Scan

Design



Existing Surface

Design



Technology ties into the machine telematics

Onboard Display

The operator can view the real time station, proposed cross slope, milling depth and the machine correction factors.

Continuous Quality Control Checks By Contractor

Quality Assurance By Agency

Solution is in the Milled Surface

Smoothing and cross slope corrections occur during the milling process resulting in conventional (depth) paving to maintain the proposed surface corrections.

Questions

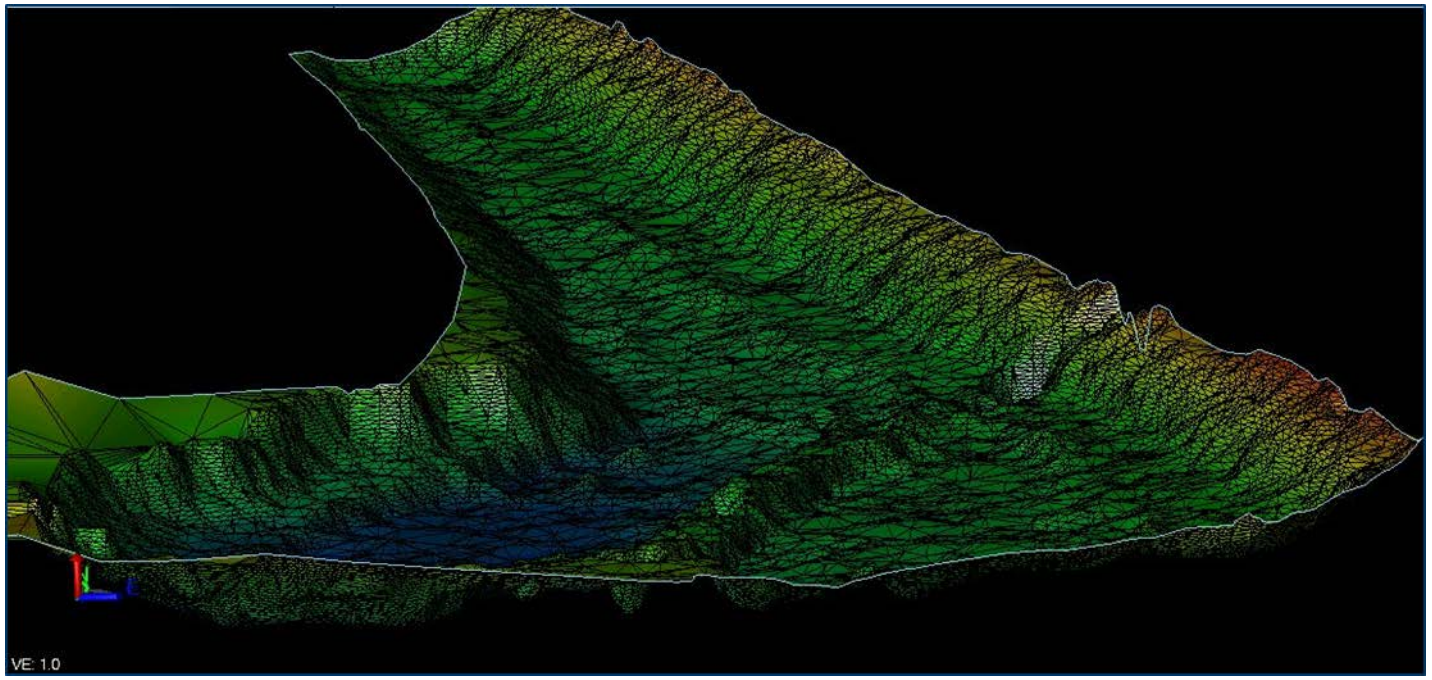
DEPARTMENT OF TRANSPORTATION

AMG-Milling Method – Robotic Total Stations

(2232) Milling Pavement Surface – Automated Machine Guidance – Milling Method Using Robotic Total Stations
(2011) Construction Surveying – Automated Machine Guidance – Milling Method Using Robotic Total Stations

AMG-Milling with Robotic Total Stations

Use when placing whitetopping and unbonded concrete overlays on top of a milled asphalt pavement.



DEPARTMENT OF TRANSPORTATION

Automated Machine Guidance – Muck Excavation Method

(2011) Construction Surveying – Automated Machine Guidance – Muck Excavation Method

Digital Surface Model Method Using the Automated Machine Guidance – Excavation System

- Description
  - Use AMG
    - → continually monitor and record muck excavation operations
    - → create Digital Surface Model for quantification of excavated volumes
- Recommended
  - Muck Excavation Quantities ≥ 30,000 cy, or
  - Muck Excavation activities anticipated to be under water (consider size &/or depth of activities)

Enhancing Highway Foundation Resilience: Intelligent Compaction Applied to Stabilized FDR

Inspector's Workshop OMRR Update
February 23, 2021

John Siekmeier P.E. M.ASCE
MnDOT Advanced Materials and Technology
Maplewood, Minnesota

Reminder

Good inspection may add several
"hundred"-thousand dollars to the value of the
road without adding materially to its cost.

Minnesota Highway Department Construction Manual, 1925

Opportunity to Eliminate Unsafe Testing

Opportunity to Implement Performance Tests

Density Does Not Determine Strength
Full Coverage Testing is Important

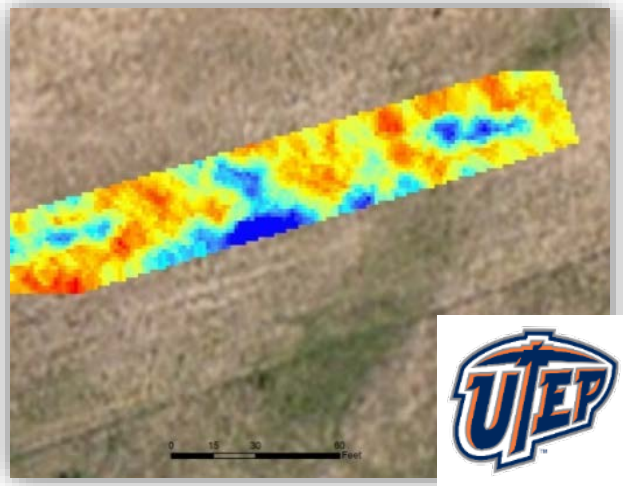
Opportunity to Improve Compaction

Operator Screen

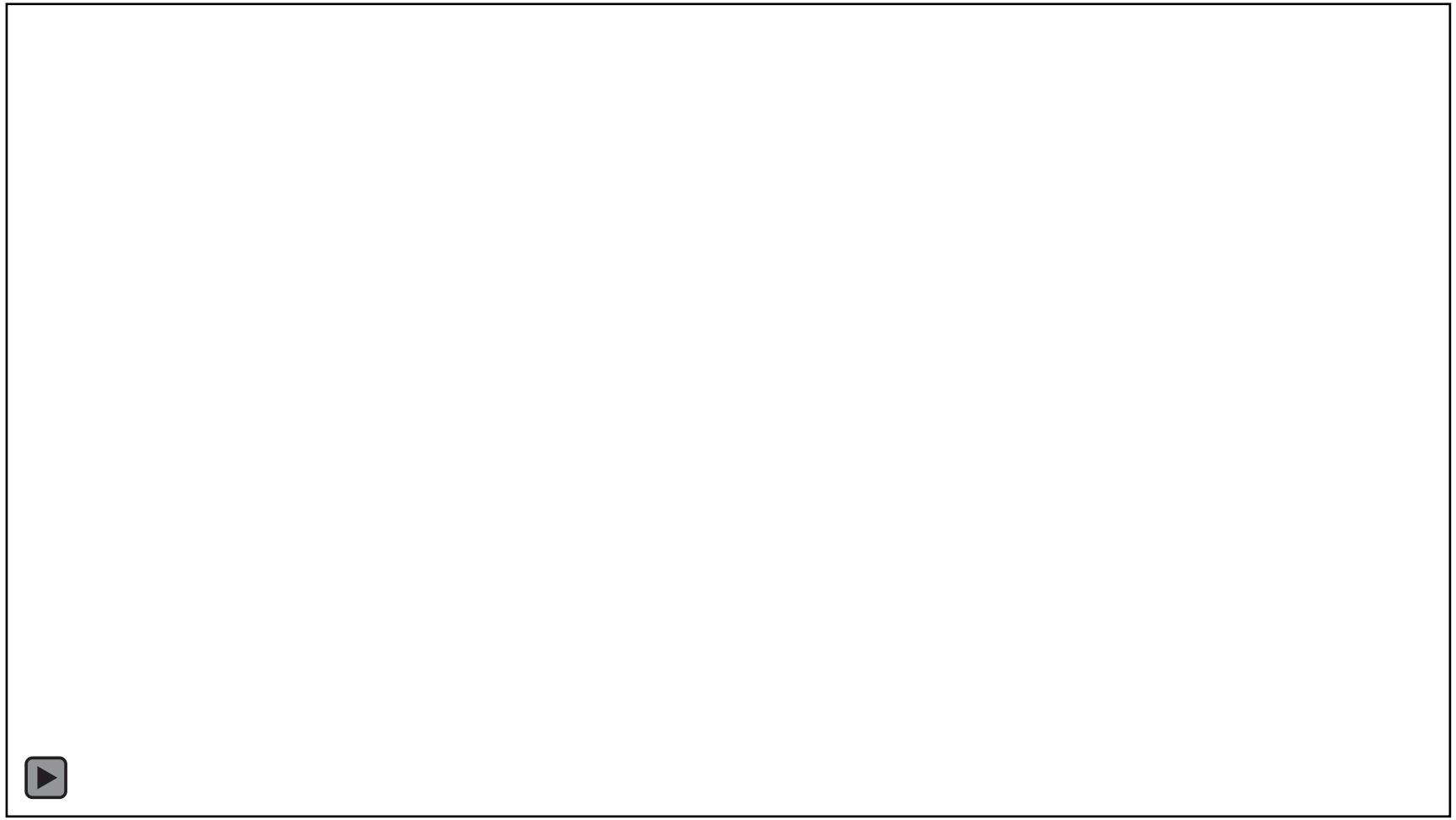
Location

Drum Movement

Compaction Map



Stabilized FDR TH15 2019



Video Courtesy of John Bormann

Roller #1 CP56B

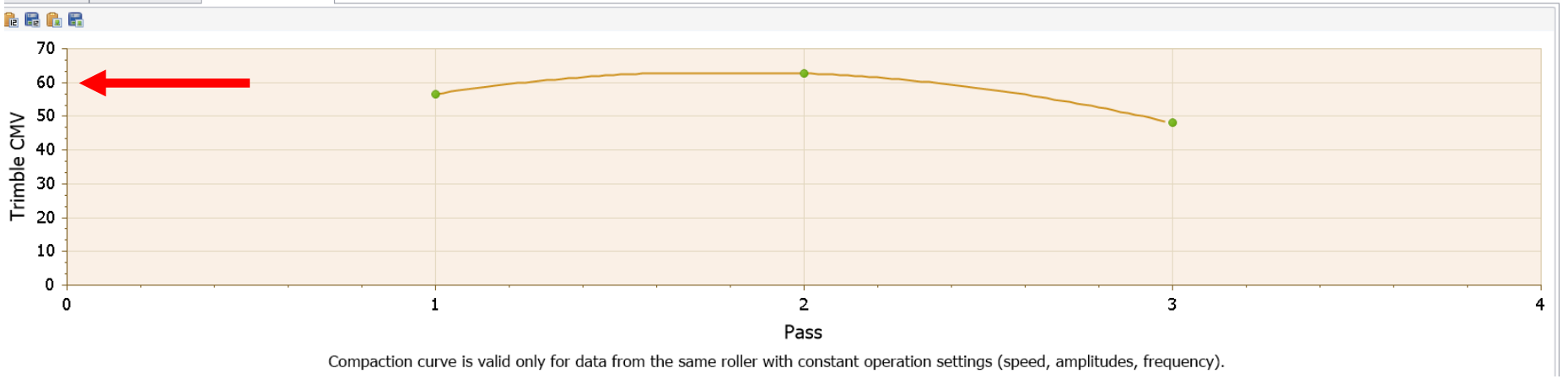
Photo courtesy of Caterpillar

Compaction Curve (high CMV)

Select an item in the table to view details.

.ocation (ft)	Length (ft)	Pass Count	Covered (%)	Speed (kph)	Frequency (Hz)	Amplitude (mm)	Trimble CMV
850.00	25.00	4	100.0	10.5	27	2.30	36.02
875.00	25.00	4	100.0	10.3	26	2.34	40.27
900.00	25.00	5	100.0	8.1	24	2.20	33.52
925.00	25.00	5	100.0	10.3	27	2.44	58.69
950.00	25.00	4	100.0	10.3	27	2.44	59.16
975.00	25.00	4	92.1	9.3	26	2.22	37.87
1,000.00	25.00	5	96.2	9.5	25	2.15	30.14
1,025.00	25.00	4	100.0	10.8	26	2.12	16.18
1,050.00	25.00	4	100.0	10.3	27	2.09	15.83
1,075.00	25.00	6	100.0	9.0	24	2.11	29.58
1,100.00	25.00	4	100.0	10.8	26	2.25	37.43
1,125.00	25.00	4	100.0	10.6	27	2.27	35.45
1,150.00	25.00	4	96.6	10.5	27	2.23	38.55
1,175.00	25.00	4	92.1	10.8	26	2.31	52.26
1,200.00	25.00	4	100.0	7.8	23	2.27	63.75
1,225.00	25.00	4	100.0	9.8	25	2.23	27.05

Distribution | Semivariogram | Compaction Curve

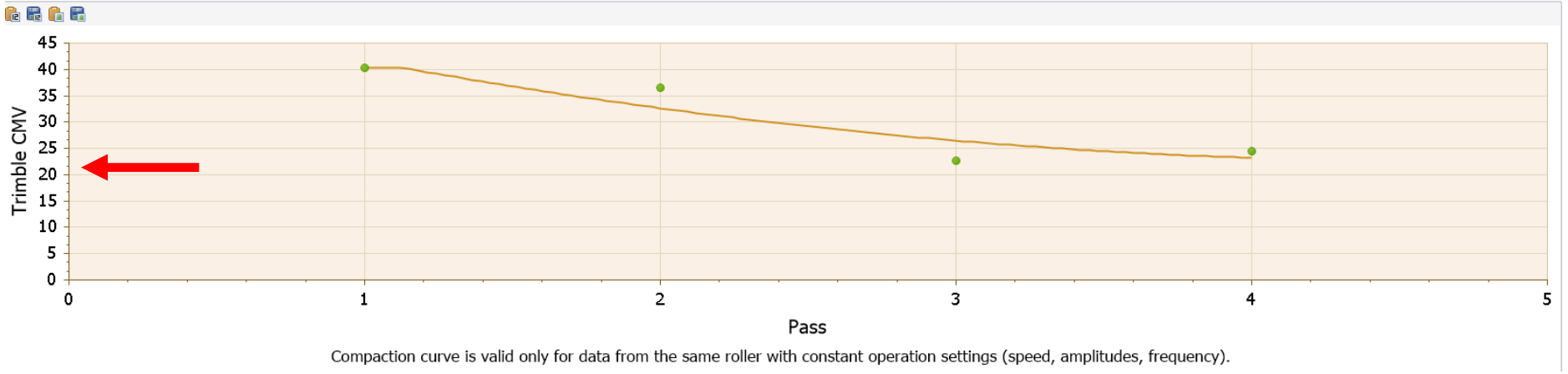


Compaction curve is valid only for data from the same roller with constant operation settings (speed, amplitudes, frequency).

Compaction Curve (low CMV)

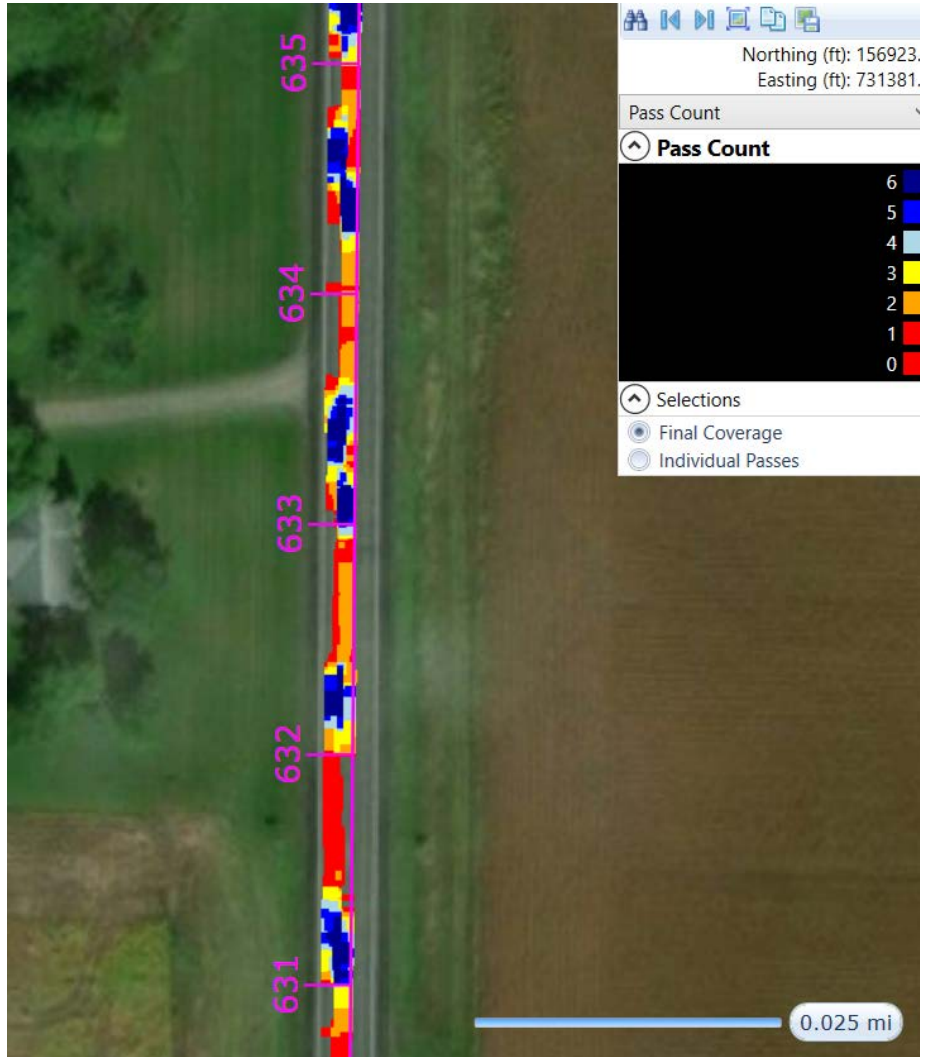
ocation (ft)	Length (ft)	Pass Count	Covered (%)	Speed (kph)	Frequency (Hz)	Amplitude (mm)	Trimble CMV	Impacts per foot
9,075.00	25.00	5	95.8	13.4	24	2.23	25.87	2.9
9,100.00	25.00	4	91.3	11.1	26	2.37	45.87	2.7
9,125.00	25.00	4	95.4	12.0	27	2.17	36.57	2.6
9,150.00	25.00	5	91.2	10.1	27	2.14	29.95	2.7
9,175.00	25.00	5	95.4	9.3	25	2.23	31.88	2.8
9,200.00	25.00	5	97.5	9.4	26	2.06	44.75	2.8
9,225.00	25.00	4	100.0	10.6	[illegible]	[illegible]	20.30	2.8
9,250.00	25.00	4	100.0	10.6	26	2.13	31.62	2.8
9,275.00	25.00	4	100.0	8.8	25	2.39	54.86	2.8
9,300.00	25.00	4	100.0	10.6	26	2.26	44.08	2.8
9,325.00	25.00	4	100.0	10.6	27	2.19	34.46	2.8
9,350.00	25.00	4	100.0	10.5	27	2.28	47.94	2.8
9,375.00	25.00	4	100.0	10.5	27	2.19	28.81	2.8
9,400.00	25.00	4	100.0	10.5	27	2.22	29.51	2.8
9,425.00	25.00	4	100.0	10.5	27	2.17	28.72	2.8
9,450.00	25.00	4	100.0	10.6	27	2.20	39.41	2.8

Distribution | Semivariogram | Compaction Curve

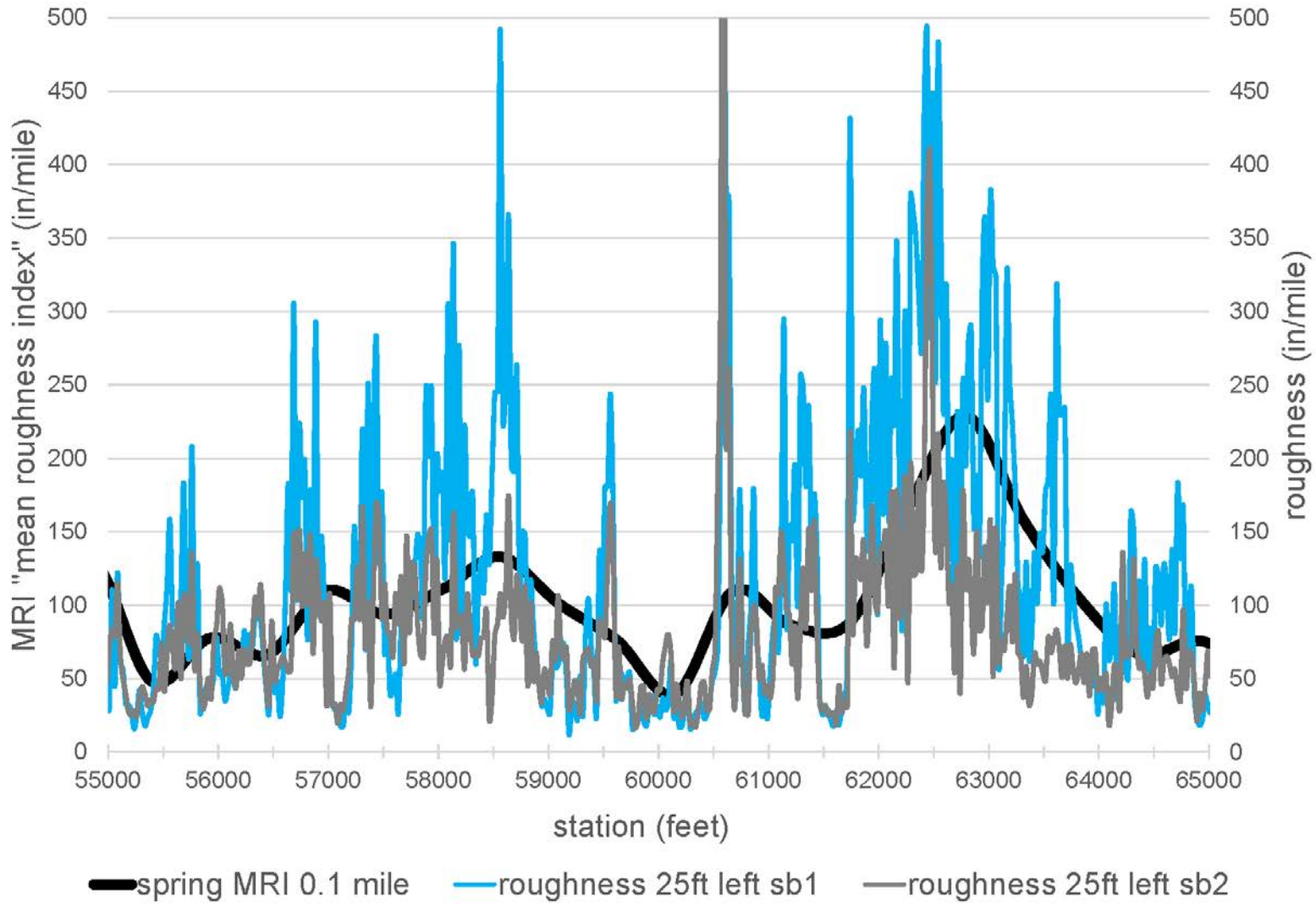


Compaction curve is valid only for data from the same roller with constant operation settings (speed, amplitudes, frequency).

Vibration and Static Compaction

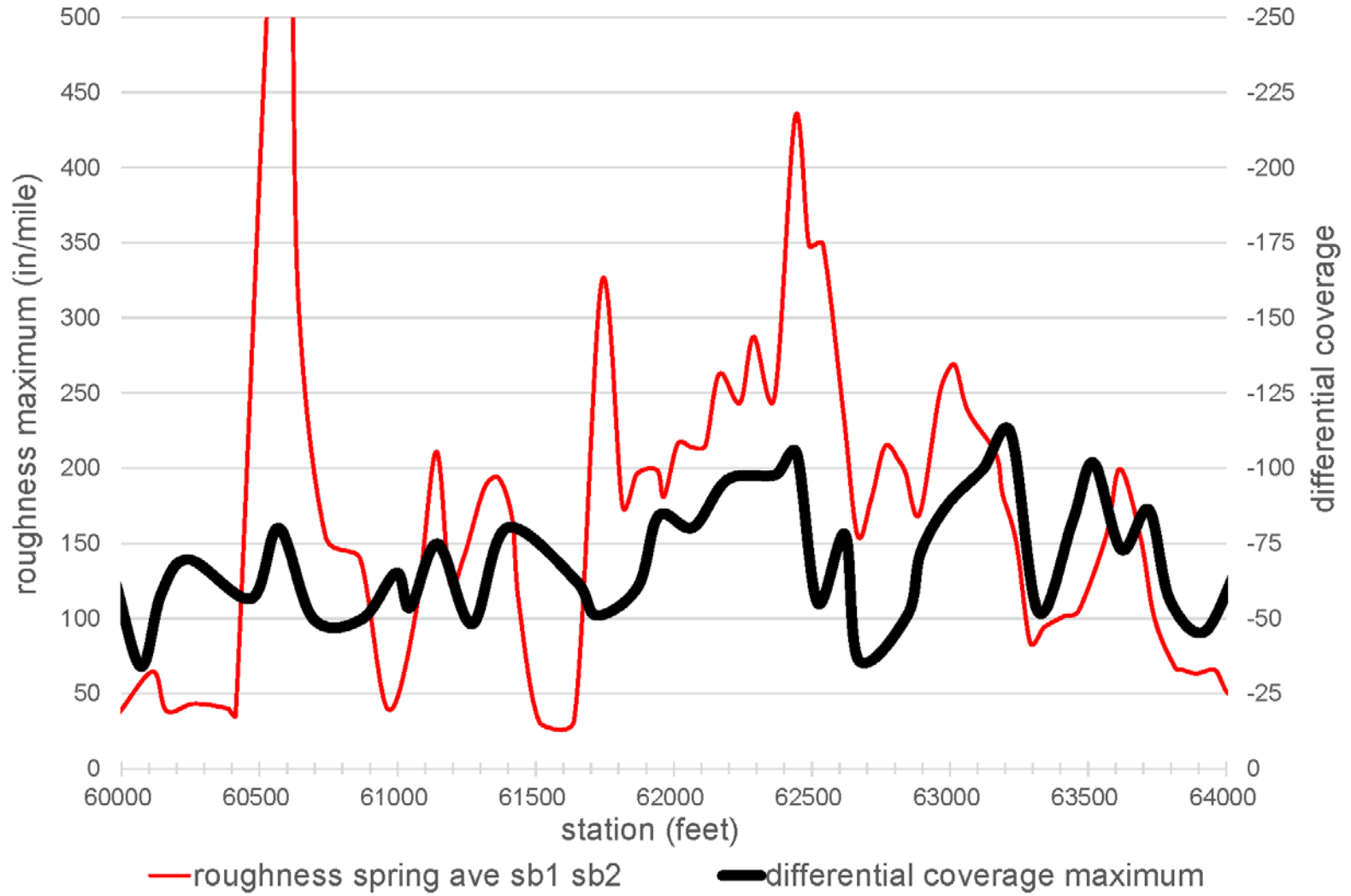


Spring Roughness

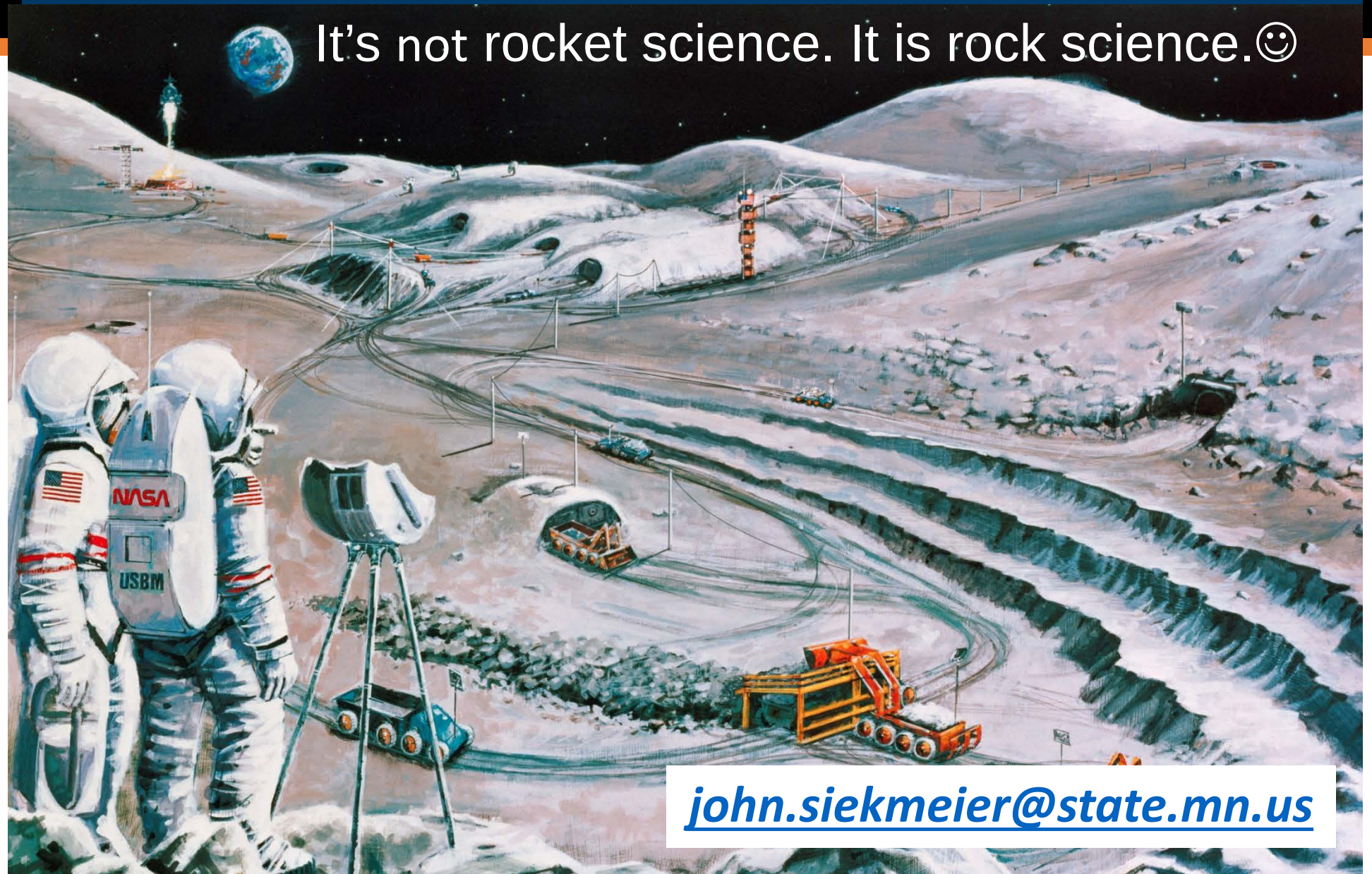


Roughness and Differential Coverage Maximum

Roughness greater than 10 in/mile and differential coverage greater than 25%.



Thanks for Listening. Please ask questions



john.siekmeier@state.mn.us