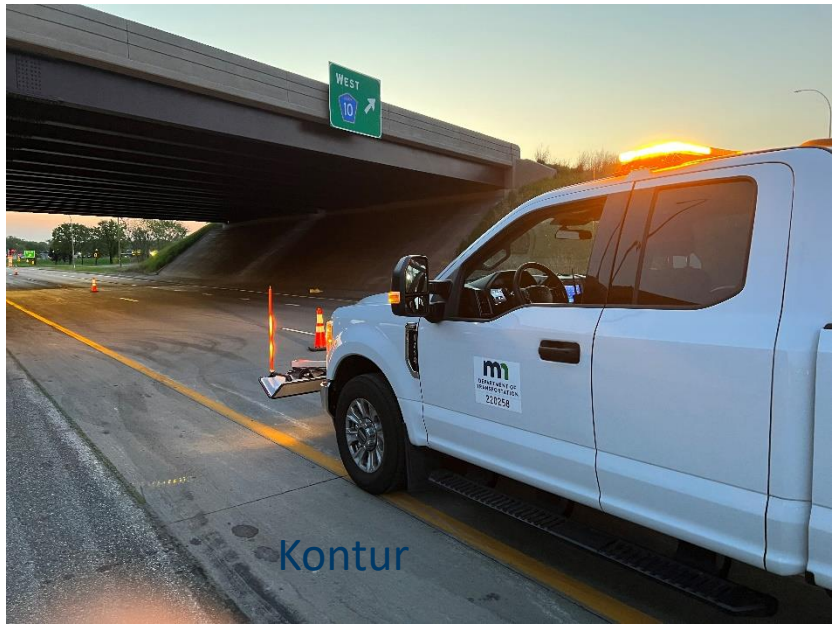


Pavement Density Using Dielectric Mapping

DEPARTMENT OF TRANSPORTATION

Kyle Hoegh, Ph.D., P.E., Research Section

Minnesota Department of Transportation

DPS National Pooled Fund Program

DPS Contacts - Materials & Road Research - MnDOT
www.dot.state.mn.us

Continuous Asphalt Mixture Compaction Assessment Using Density Profiling System (DPS) [TPF-5(443)]

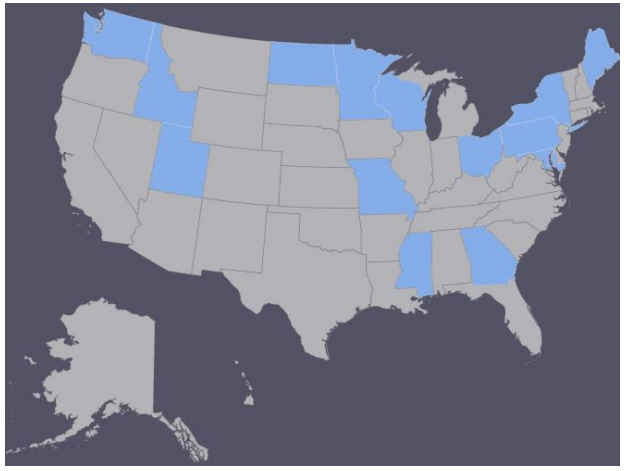
- **Objective:** Use the DPS method to improve asphalt pavement density
  - Increased coverage and comprehensiveness of assessment
  - Timely information to improve construction process
  - Reduce coring
- **Lead Agency:** MnDOT
  - Contact: Kyle Hoegh, kyle.hoegh@state.mn.us (MnDOT)
- **Committed agencies: MN, FHWA, GA, ID, MD, ME, MO, MS, ND, NY, OH, PADOT, UT, WA, WI**
- **100% SP&R Approval:** Approved
- **Commitment level**: $25K/year

U.S. Department of Transportation Federal Highway Administration

+

DEPARTMENT OF TRANSPORTATION

+



TPF - Study Detail
www.pooledfund.org

Official TPF

Density Profiling System - Office of Materials an...
www.dot.state.mn.us

MnDOT TPF

Phase I Task 2: Development of AASHTO Data Collection and Analysis Specifications

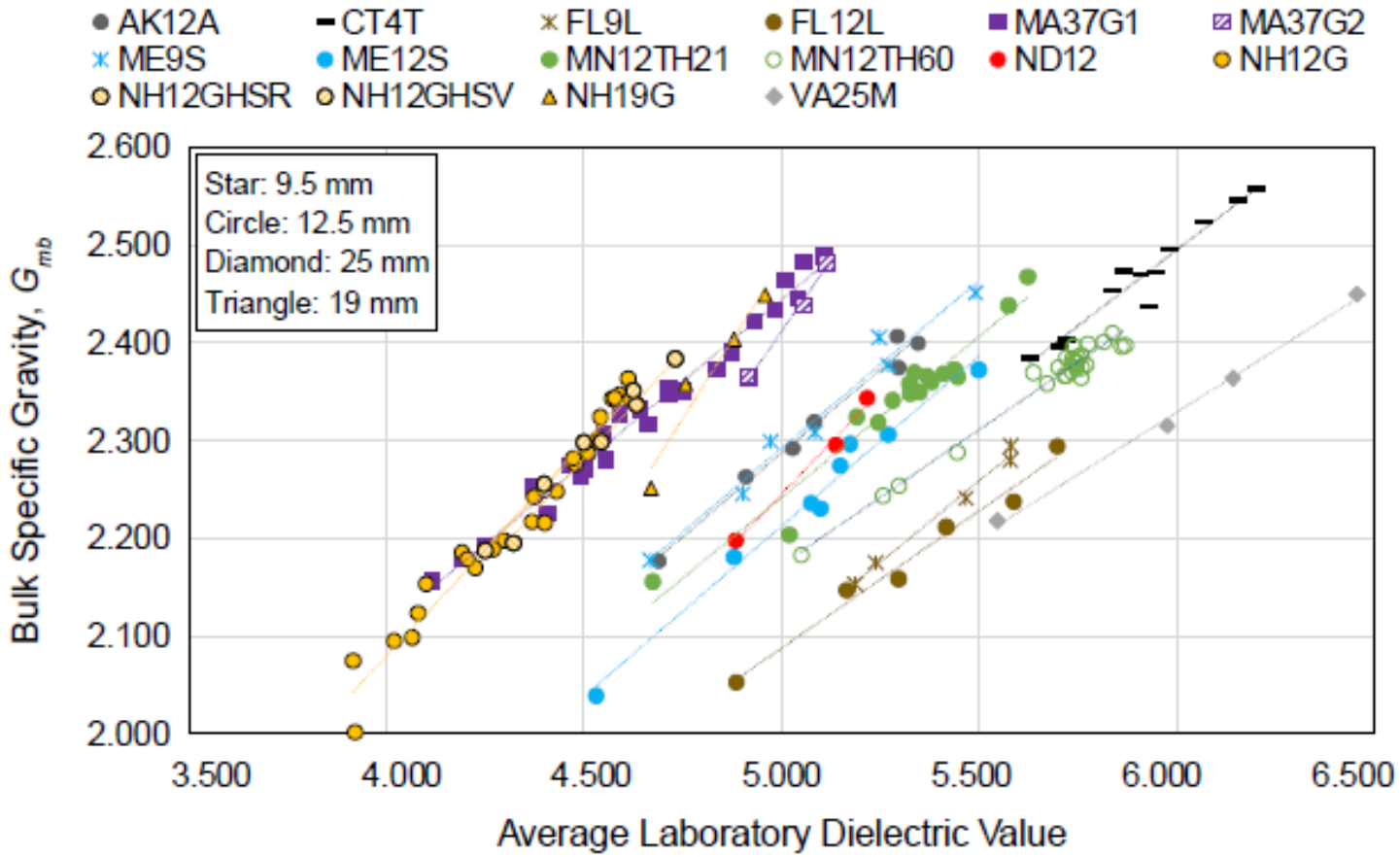


Figure X1.1—Average Dielectric Values for All Compacted Specimens as a Function of Measured Bulk Specific Gravity

Determining the Dielectric Constant of Compacted Asphalt Mixture Specimens

AASHTO Designation: T 414-24[1]

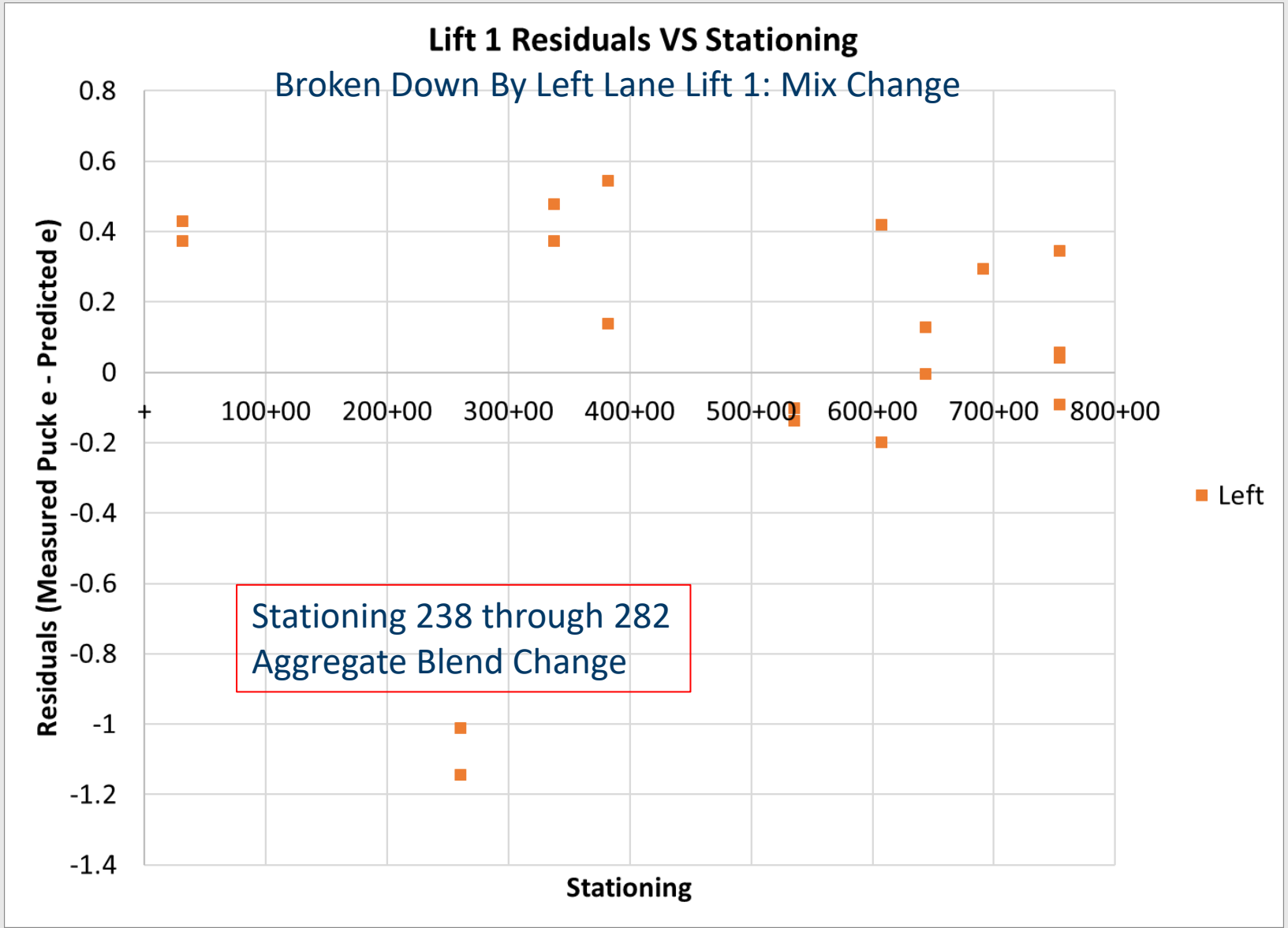
First Published: 2024

Technical Subcommittee: TS 5c, Quality Assurance and Environmental

AASHTO

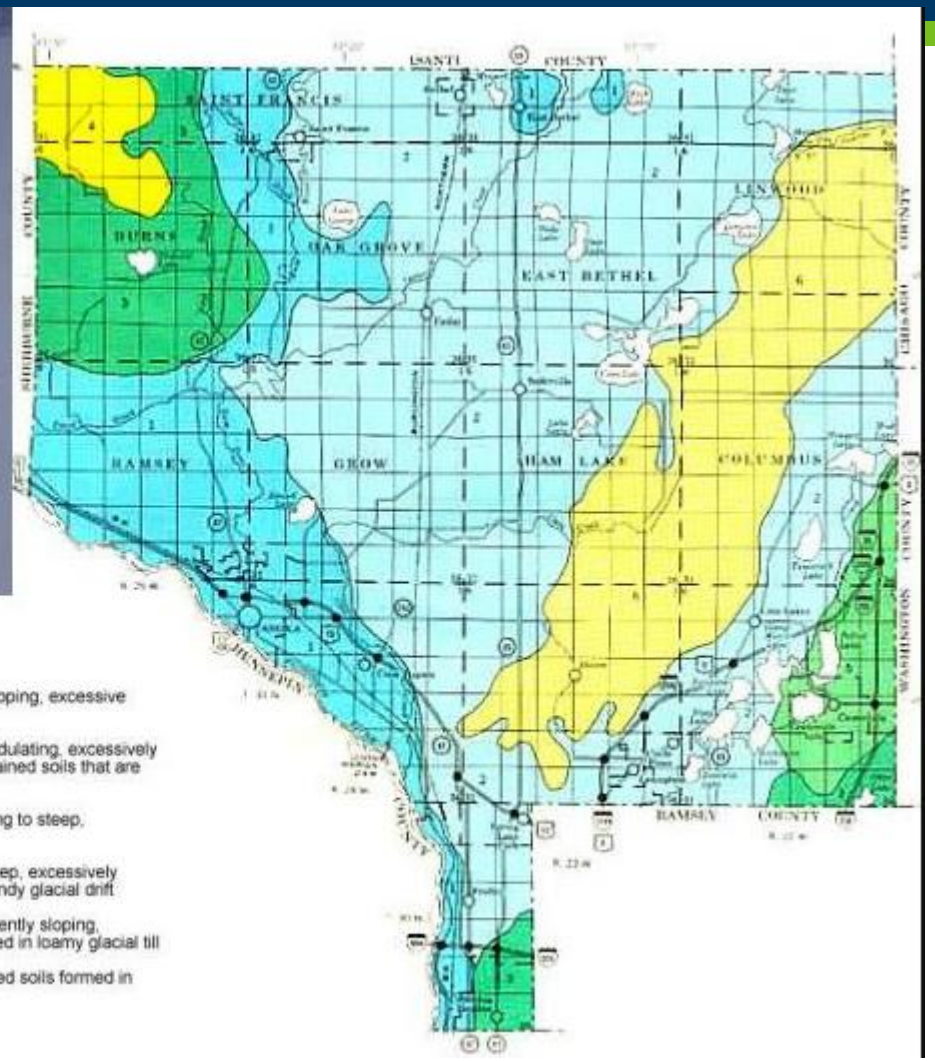
American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004

Full Coverage: e to %Gmm – Tracking Mix Changes



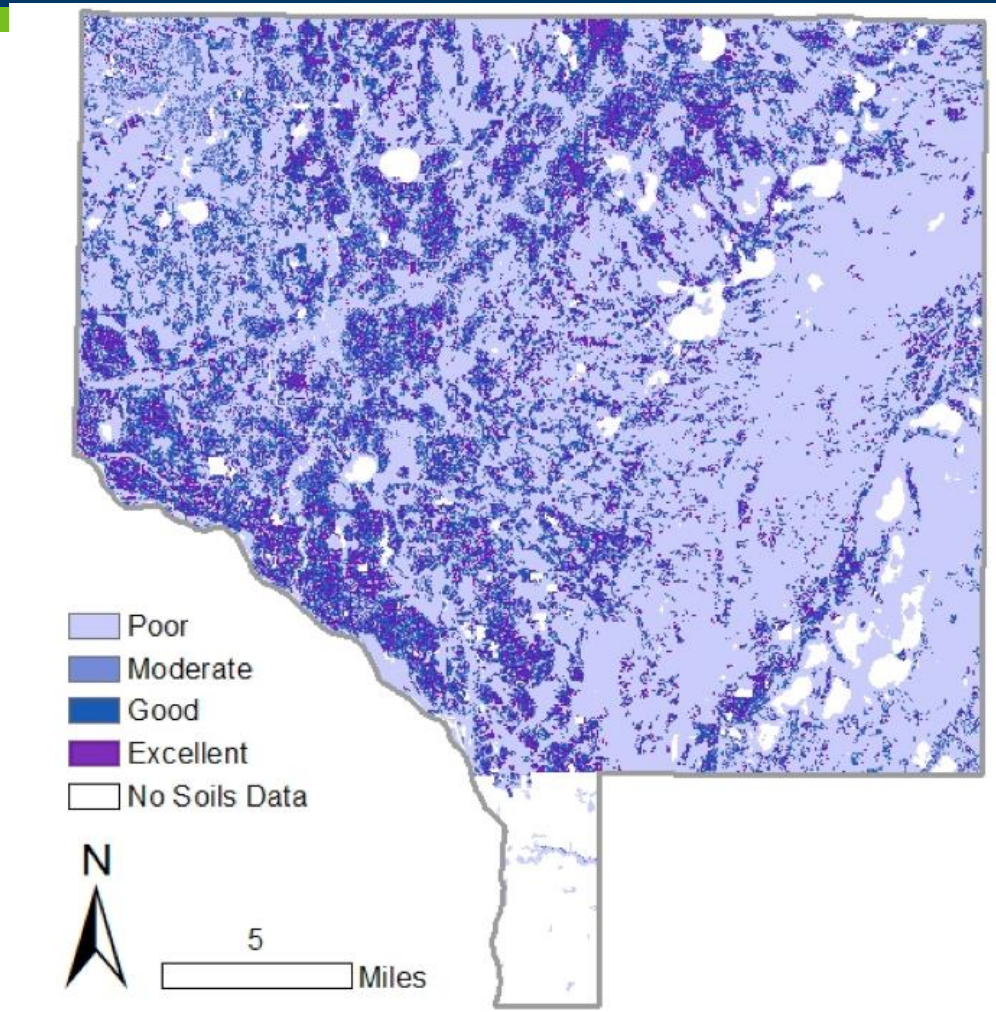
Anoka County MN

Soils Of Anoka County



SOIL ASSOCIATIONS

1. Hubbard-Nymore association: Nearly level to gently sloping, excessive drained soils that are sandy throughout
2. Zimmerman-Isanti-Lino association: Nearly level to undulating, excessively drained, somewhat poorly drained, and very poorly drained soils that are dominated by fine sands throughout
3. Heyder-Kingsley-Hayden association: Gently undulating to steep, well-drained soils formed in loamy glacial till
4. Emmert-Kingsley association: Gently undulating to steep, excessively drained and well drained soils formed in loamy and sandy glacial drift
5. Nessel-Dundas-Webster association: Nearly level to gently sloping, moderatley well drained and poorly drained soils formed in loamy glacial till
6. Rifle-Isanti association: Nearly level, very poorly drained soils formed in organic material and fine sand

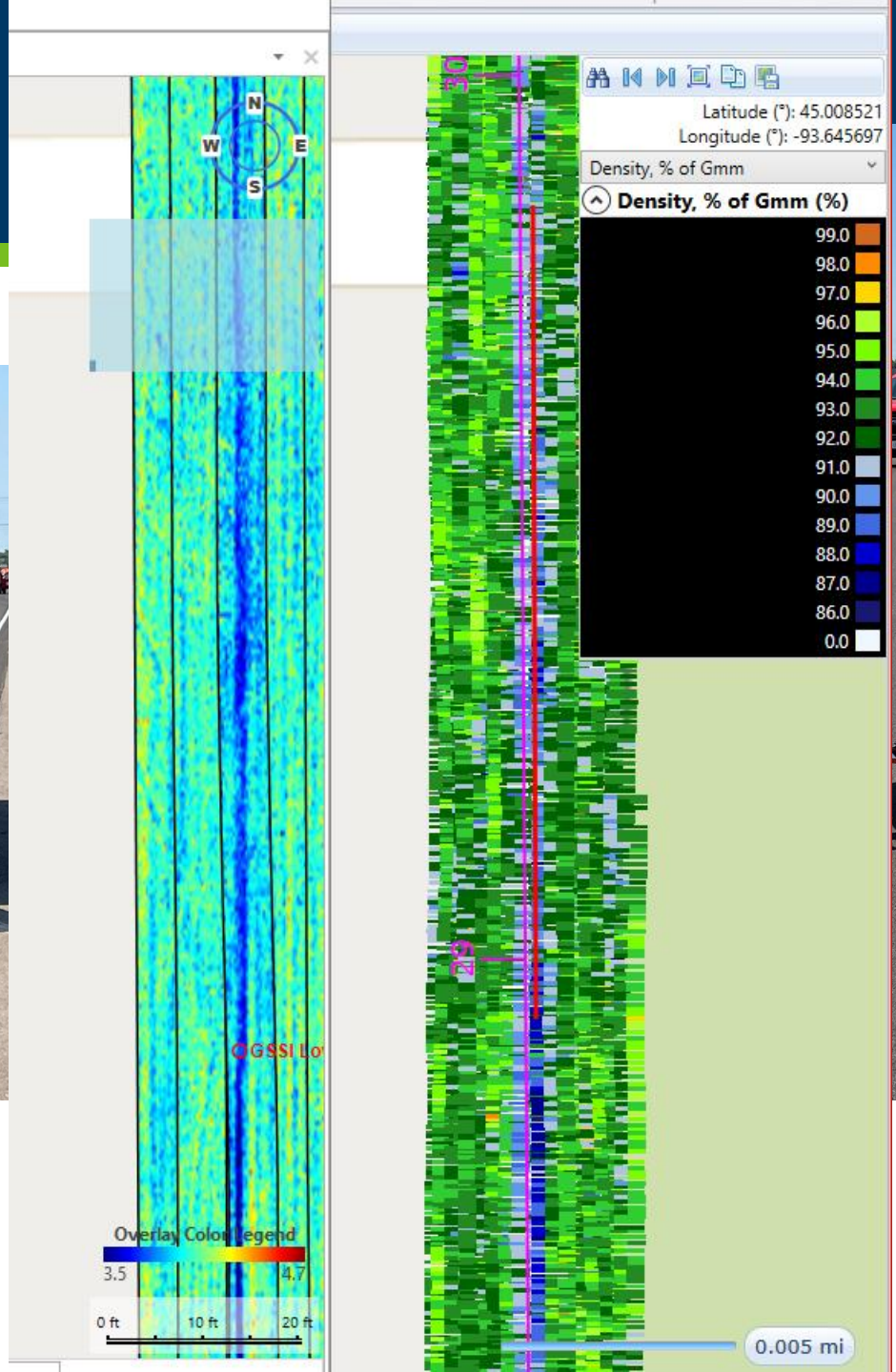


Previous project had issues with settlement during construction and was a “black eye” for MnDOT.

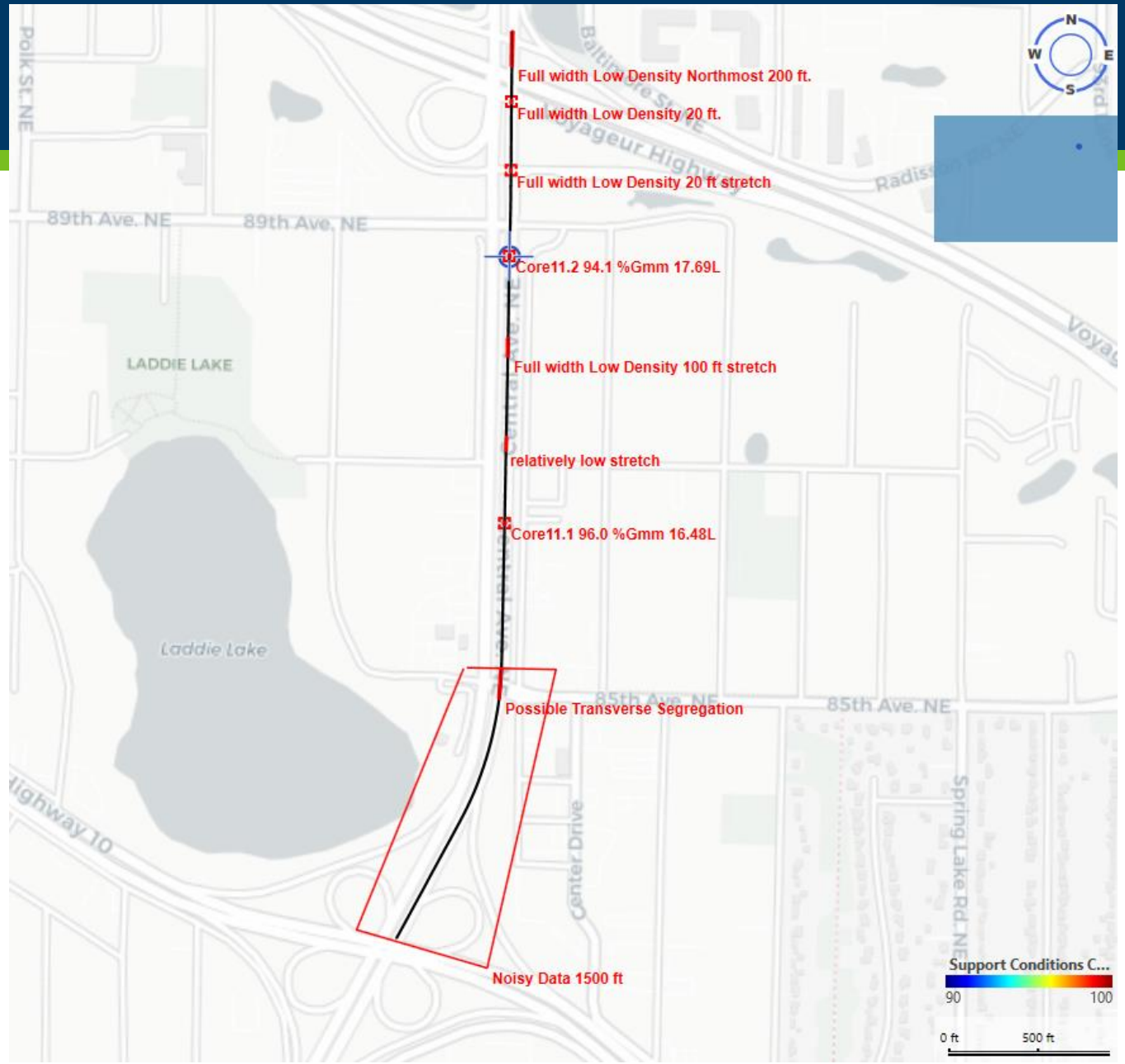
SP 0208-165 TH 65 – Blaine - MPM

Compaction: All Rollers in Static mode, minimum of 5 rollers (2 Steel, 3 Pneumatic)
Density $ disincentives are waived
Agency: 3D DPS to check uniformity of compaction

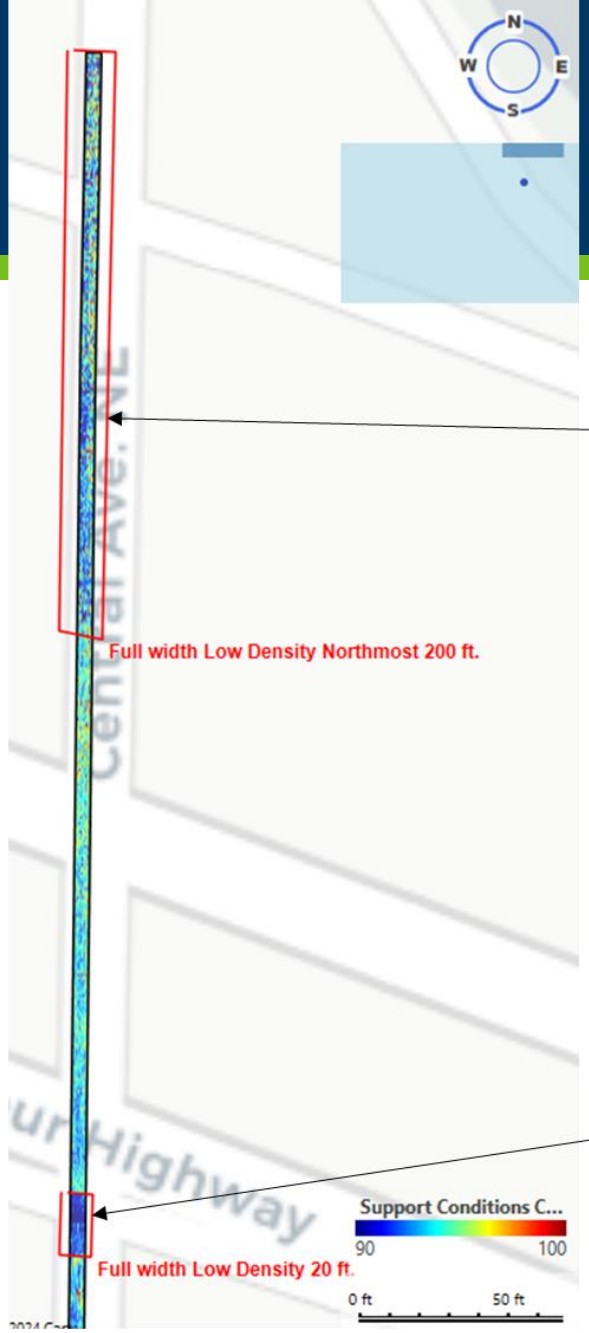
Able to Collect with both one day on Anoka Project



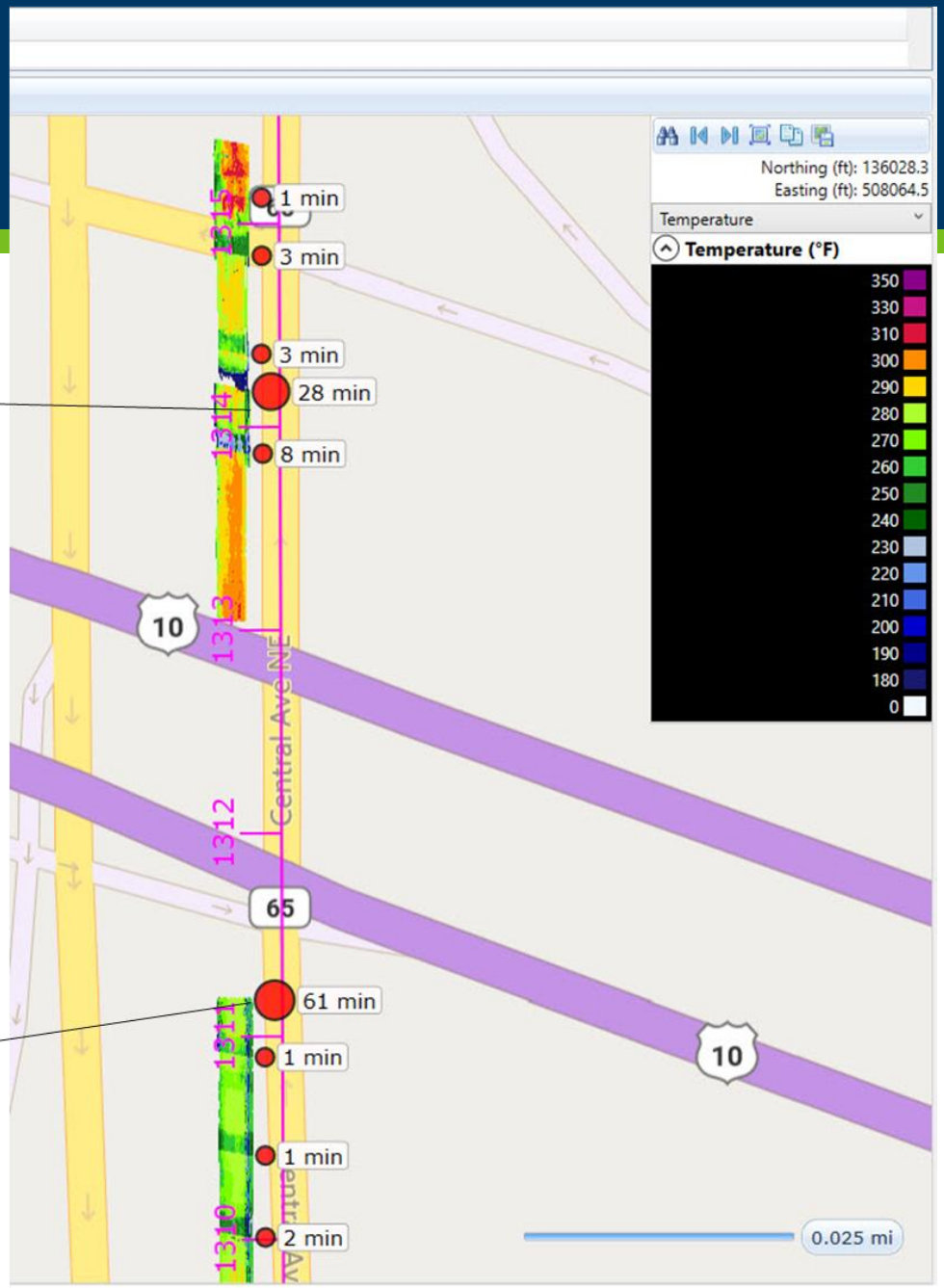
Initial Use of Kontur 3D DPS



Initial Use of Kontur 3D DPS

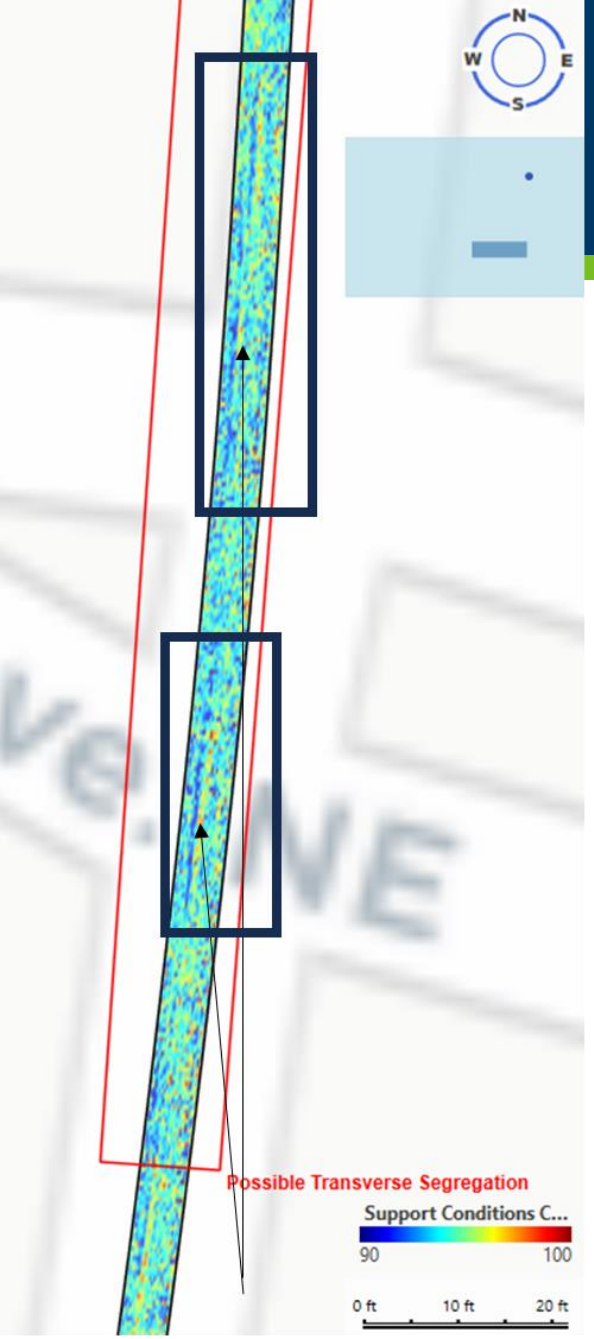


A. DPS with 20 ft. low spot and 200 ft. low spot

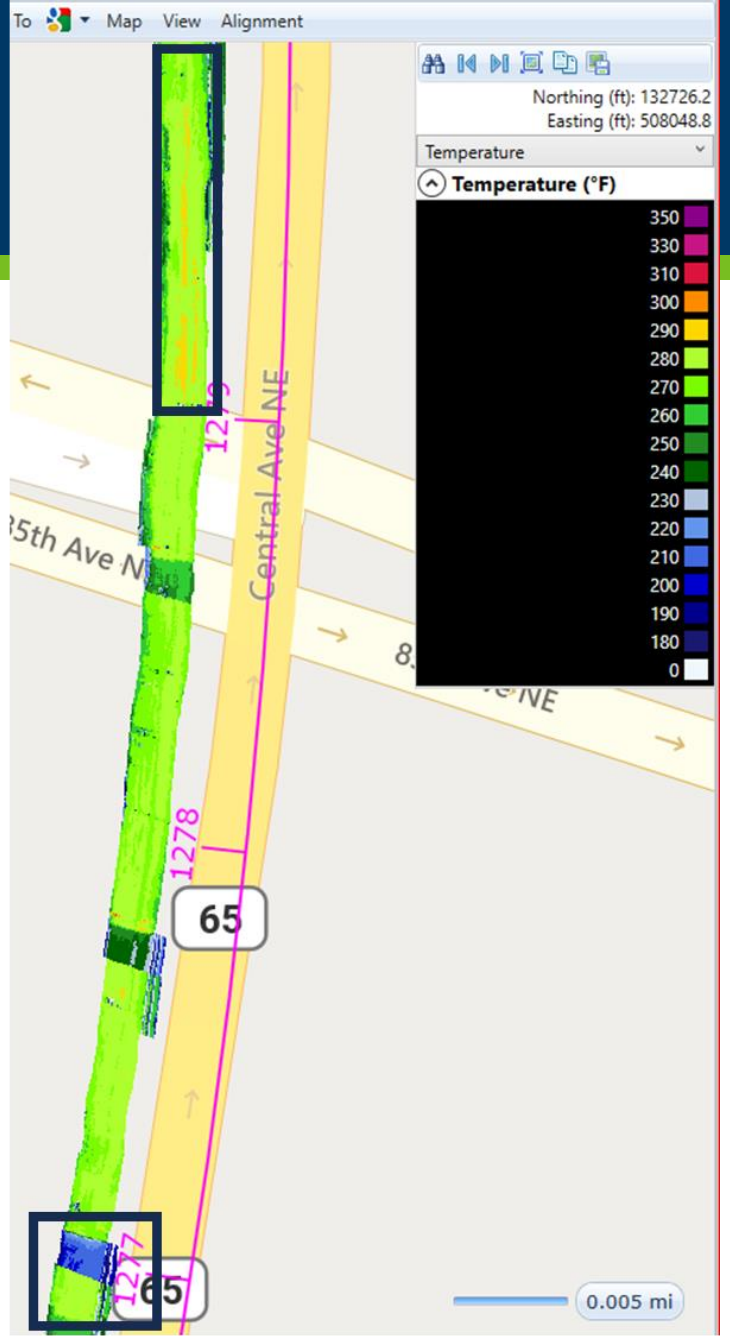


B. PMTP showing paver stops causing low density

Initial Use of Kontur 3D DPS



a. DPS %Gmm Data

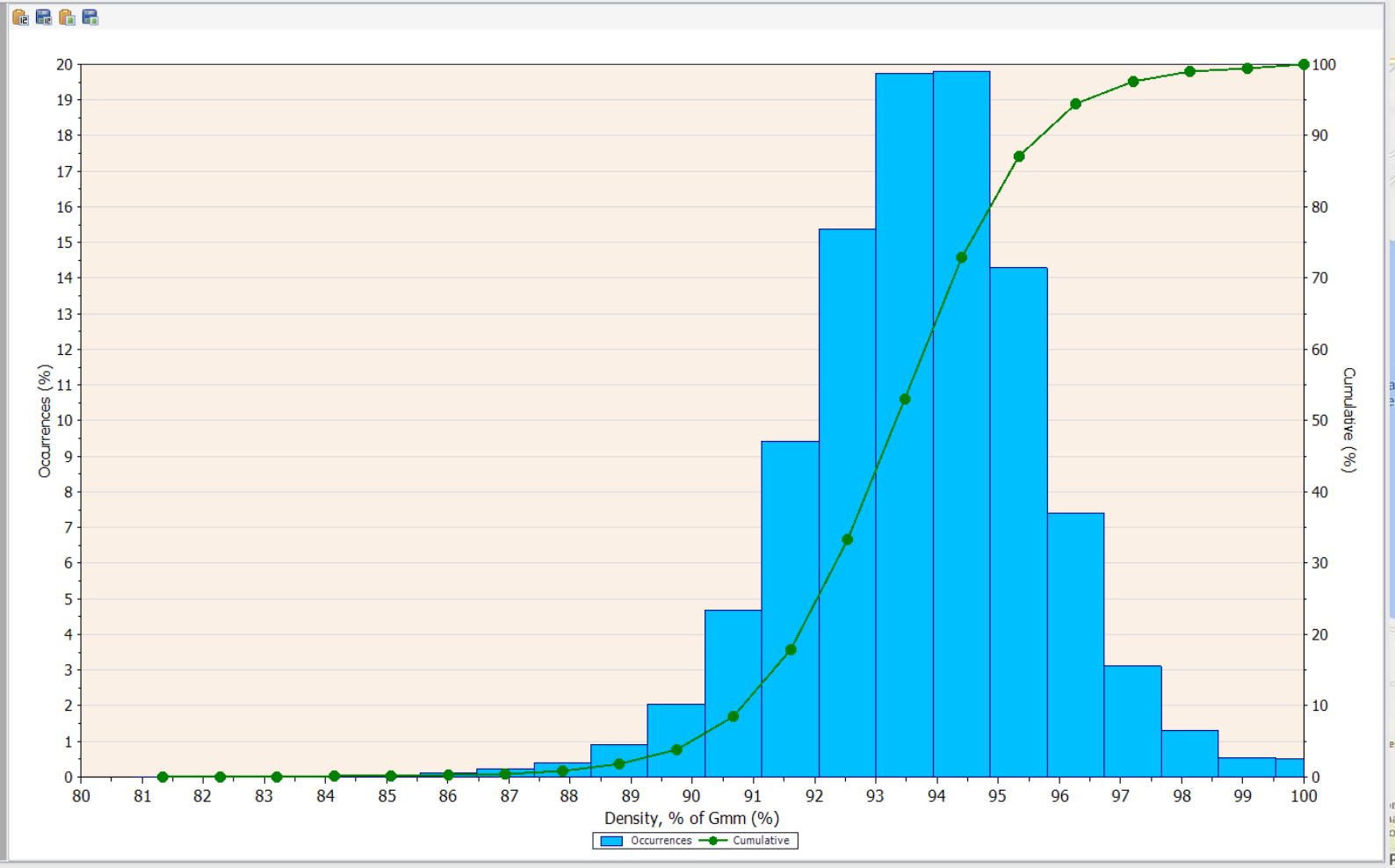


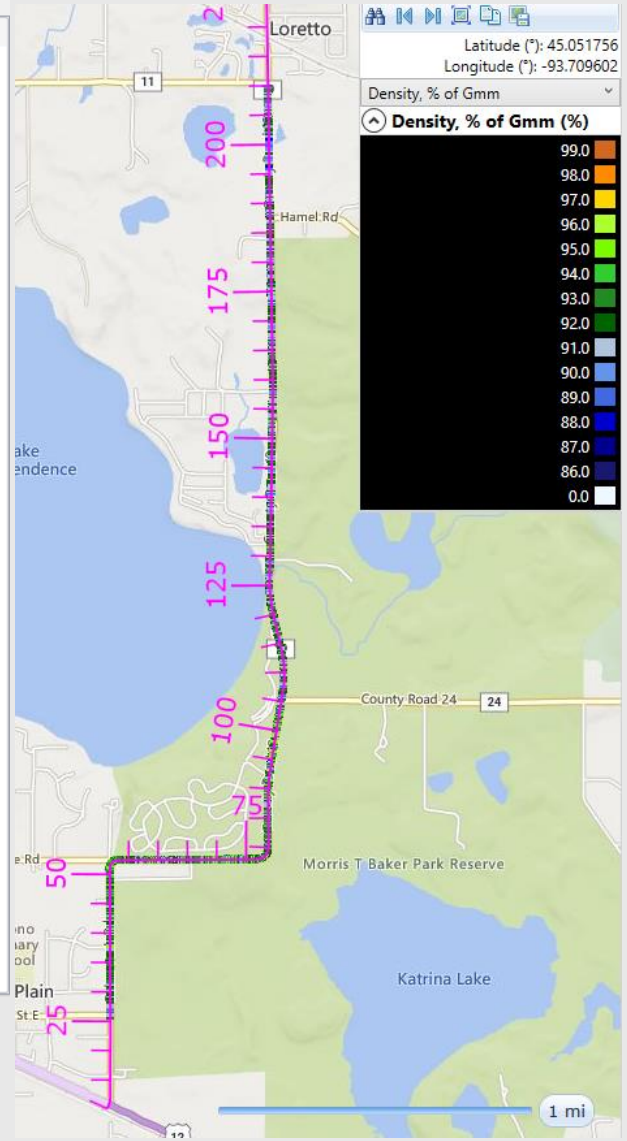
b. PMTP Thermal Data

2024 CY – CSAH19 Overview

Distribution

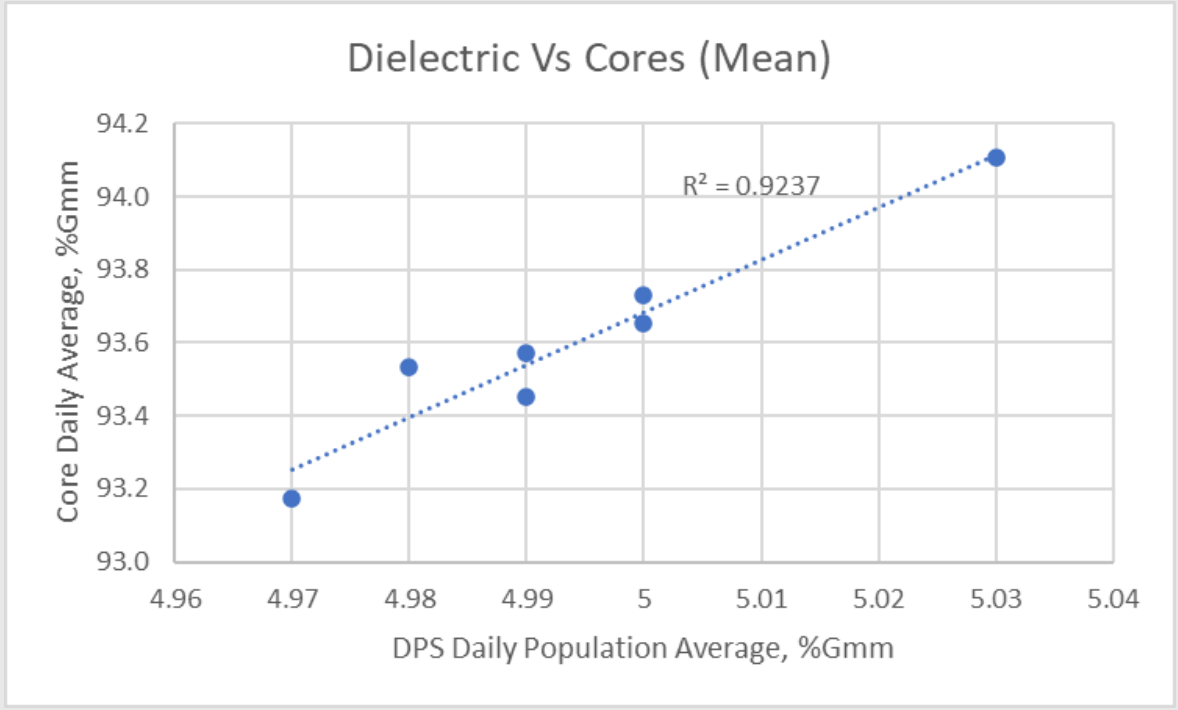
Statistic	Value
Mean (%)	93.3
Standard Deviation (%)	2.0
CoV (%)	2
Variance	3.94
Min (%)	81.3
Max (%)	100.0
Sample Size	967,359
Acceptance	Passed
Acceptance (%)	94.67



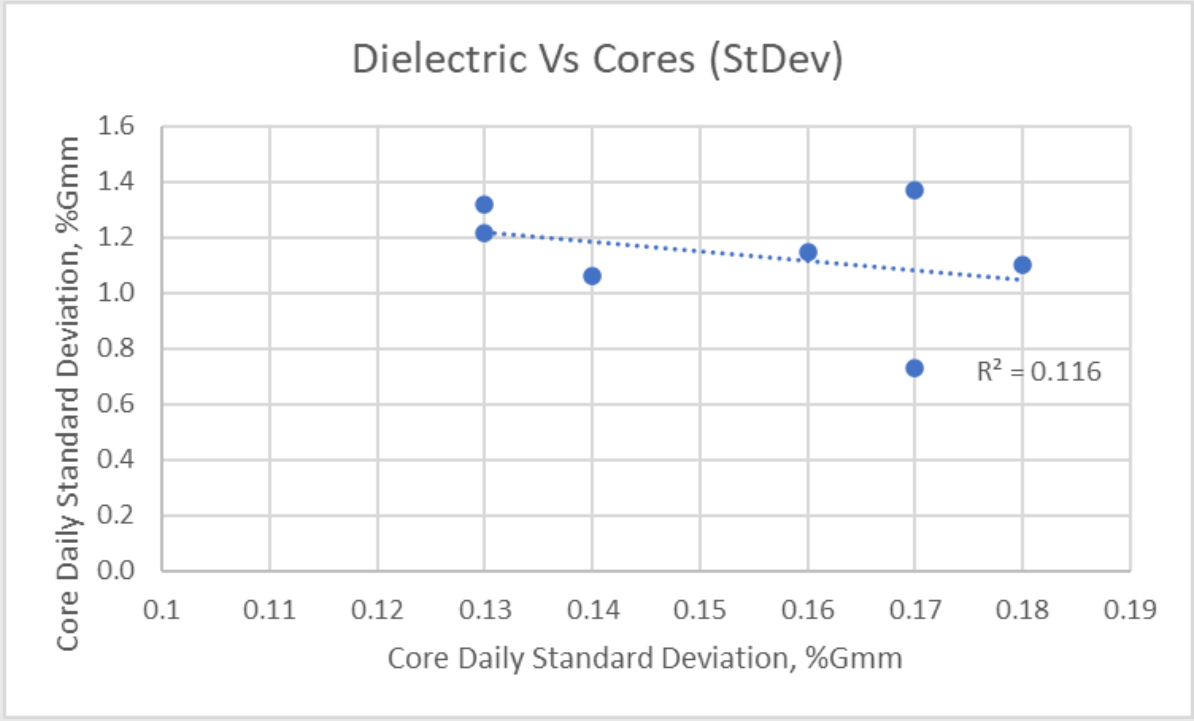


2024 CY – CSAH19 Daily Comparison

Cores are adequate for characterizing daily average density

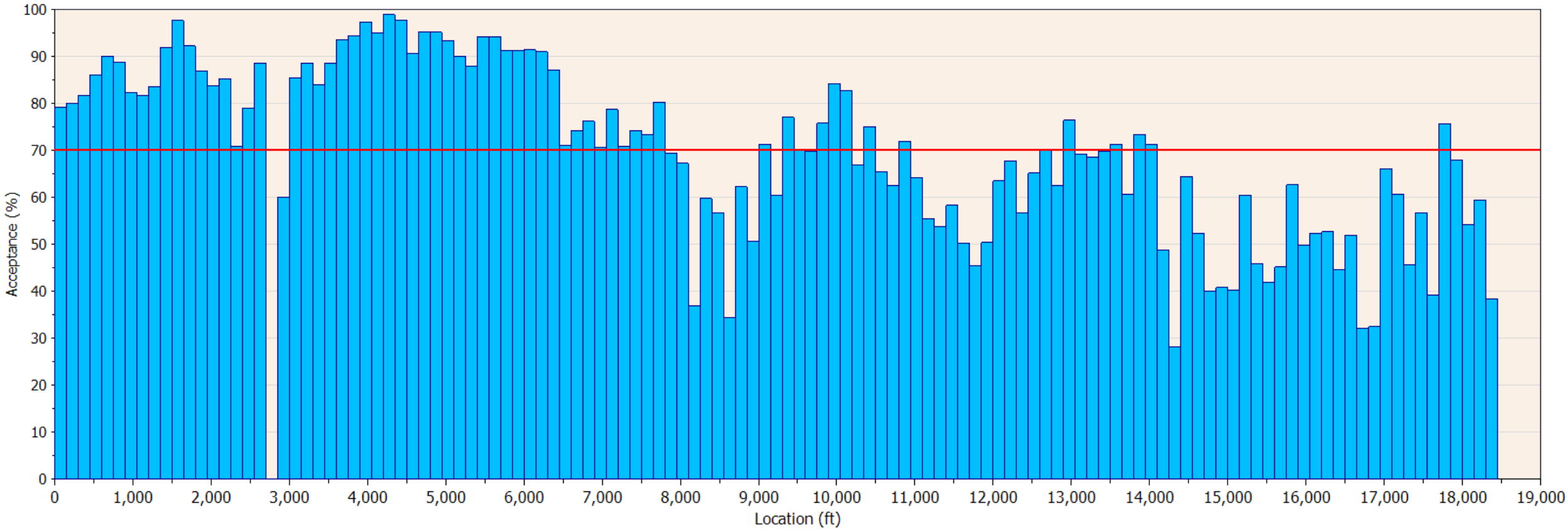


Cores struggle to characterize variability



2024 CY – CSAH19 Overview

Coreless Variability Acceptance L1 RL Mat



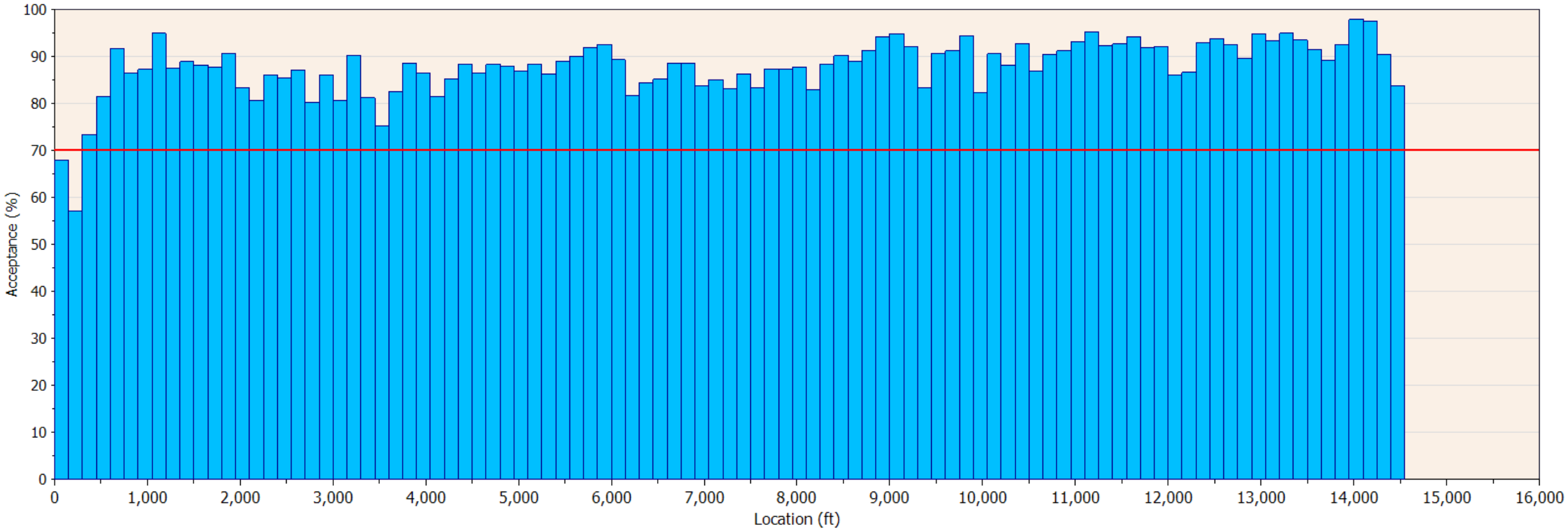
[Excel: Project Incentive/Disincentive]

			$(300.00)	$ (50.00)	0	50	100		
			0	2	16	88	13	119	$/150 ft.
			0	30	50	70	90	100	$ 5,600.00	$ 47.06
Location(f	Length(ft)	Acceptance (%)		<30%	30 to 50%	50 to 70%	70 to 90%	>90%	Payout	
0	150	71.52659		0	0	0	1	0	$ 50.00	
150	150	77.71429		0	0	0	1	0	$ 50.00	

[PPT: Project Incentive/Disincentive]

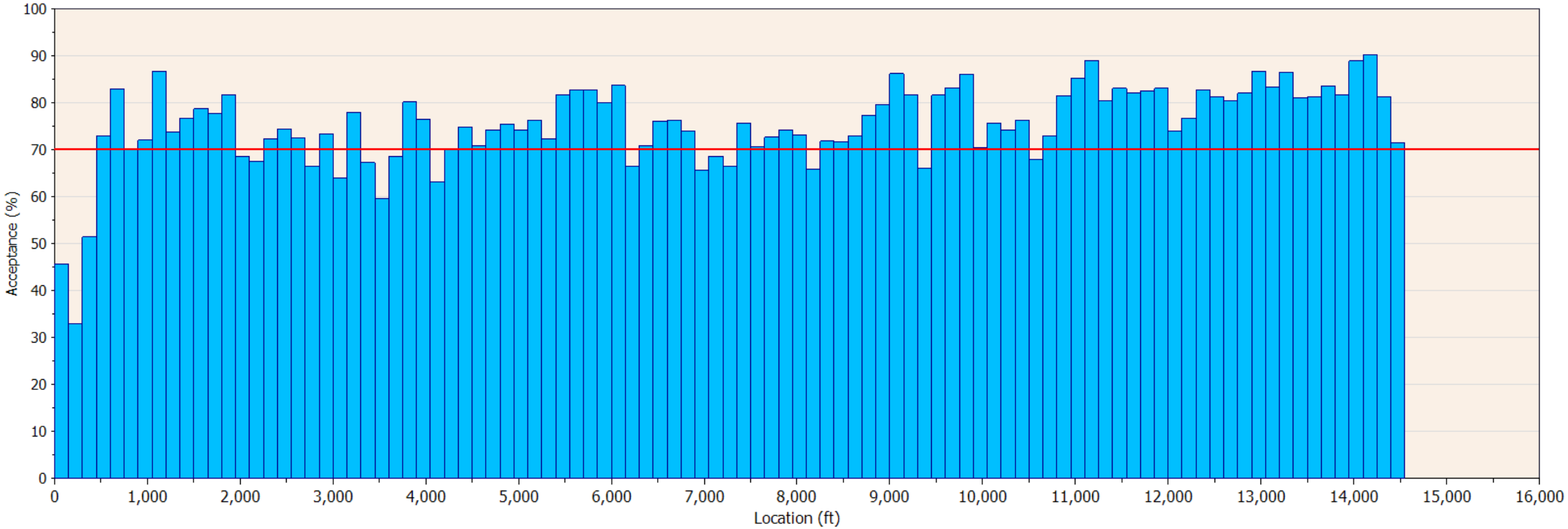
2024 CY – GSSI DPS on Anoka Project

Percent Below Limit (92%Gmm): With Population Field Core Data Available



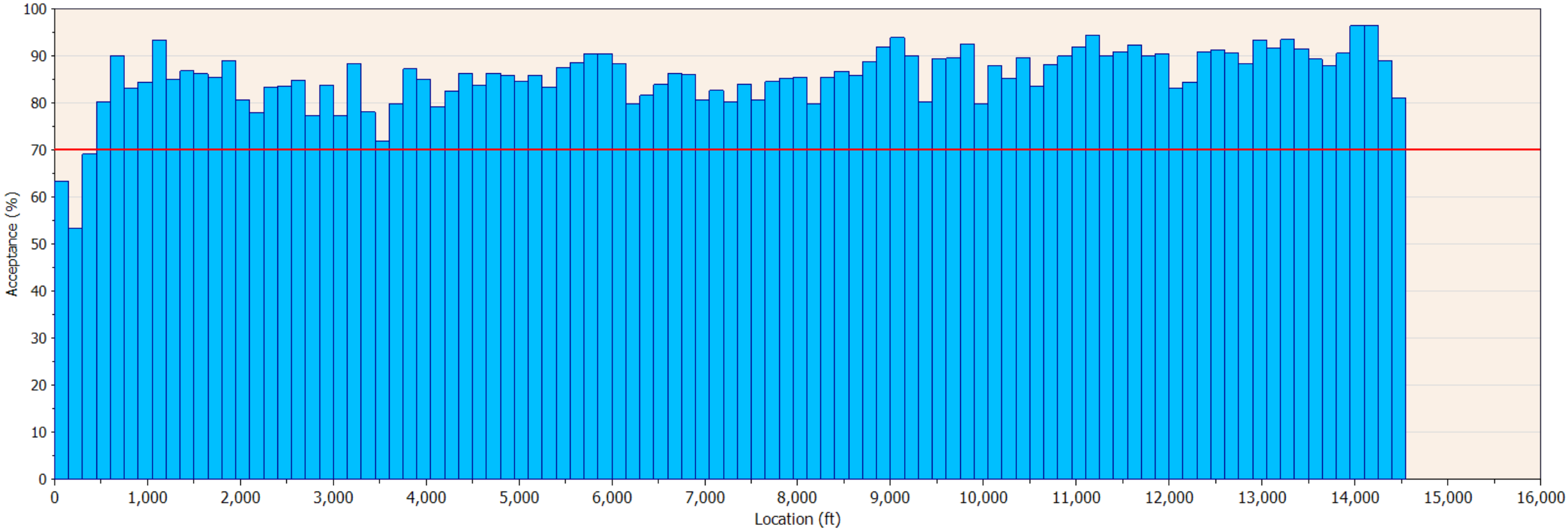
2024 CY – GSSI DPS on Anoka Project

Percent Below Limit (92%Gmm): Hypothetical with No Field Core Data Available



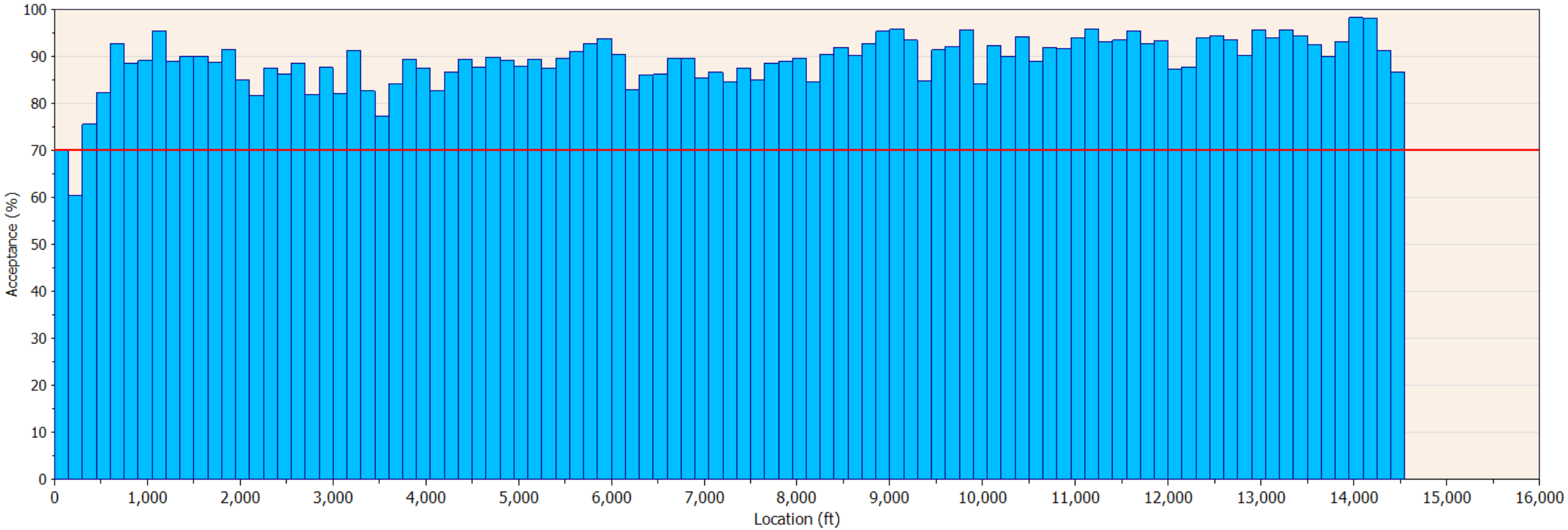
2024 CY – GSSI DPS on Anoka Project

Variability Below Limit: With Population Field Core Data Available



2024 CY – GSSI DPS on Anoka Project

Variability Below Limit: Hypothetical with No Field Core Data Available



Phase II Priorities

RESEARCH TRACK

R1. Field, lab and simulation research of critical factors to develop best and worst use conditions for DPS

R2. Evaluation of improved data collection methods

R3. Benefit-cost analysis of DPS compared with other density measurements

R4. Development of advanced analysis techniques

R5. Identification of uses of dielectric data without converting to density

Presented by GSSI at our DPS Pooled Fund Technical Working Group 3/11/24

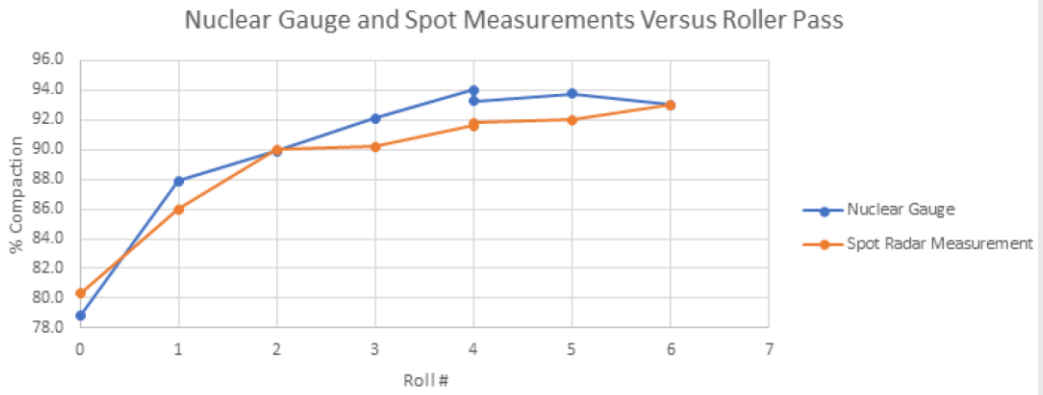
Presented by GSSI at our DPS Pooled Fund Technical Working Group 3/11/24

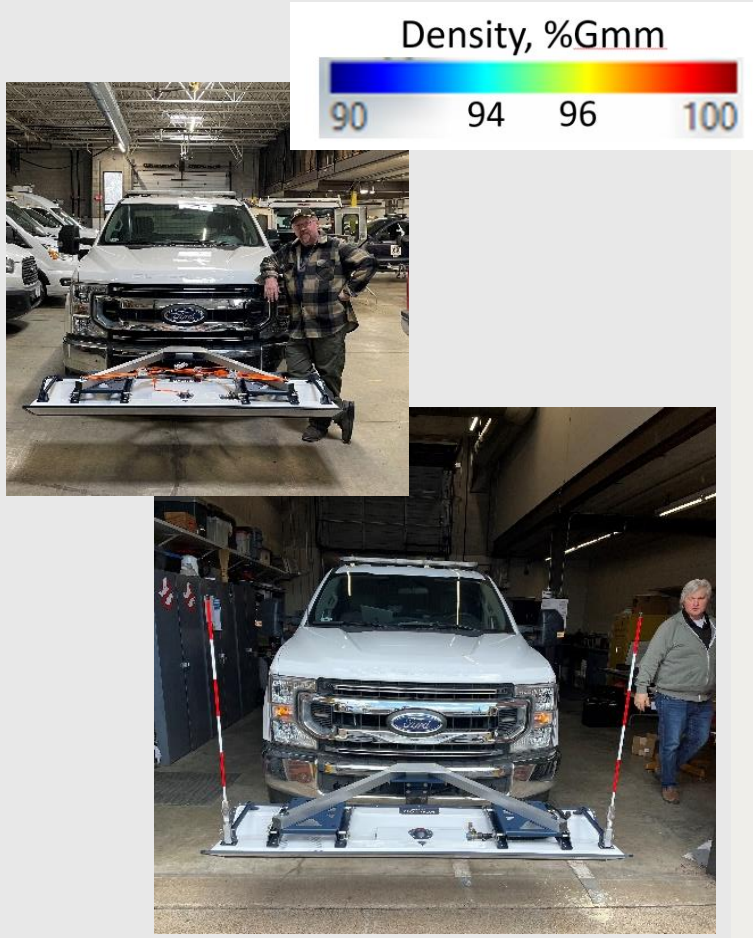
DPS for Quality Management and DPS Incentive/Disincentive

Presented by GSSI at our DPS Pooled Fund Technical Working Group 3/11/24

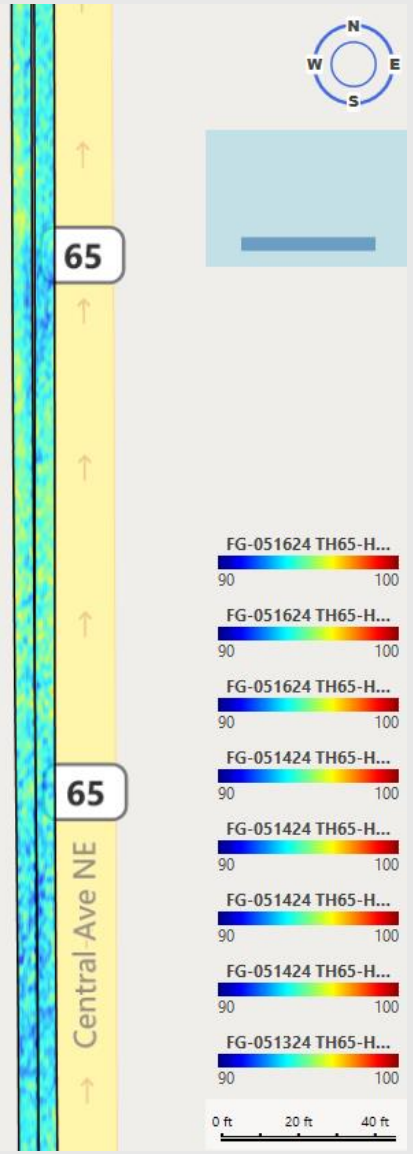
Real-Time Accurate Information

Point Testing at single locations





2024
2nd 3D-Ground
Penetrating Radar Unit



Phase II Priorities

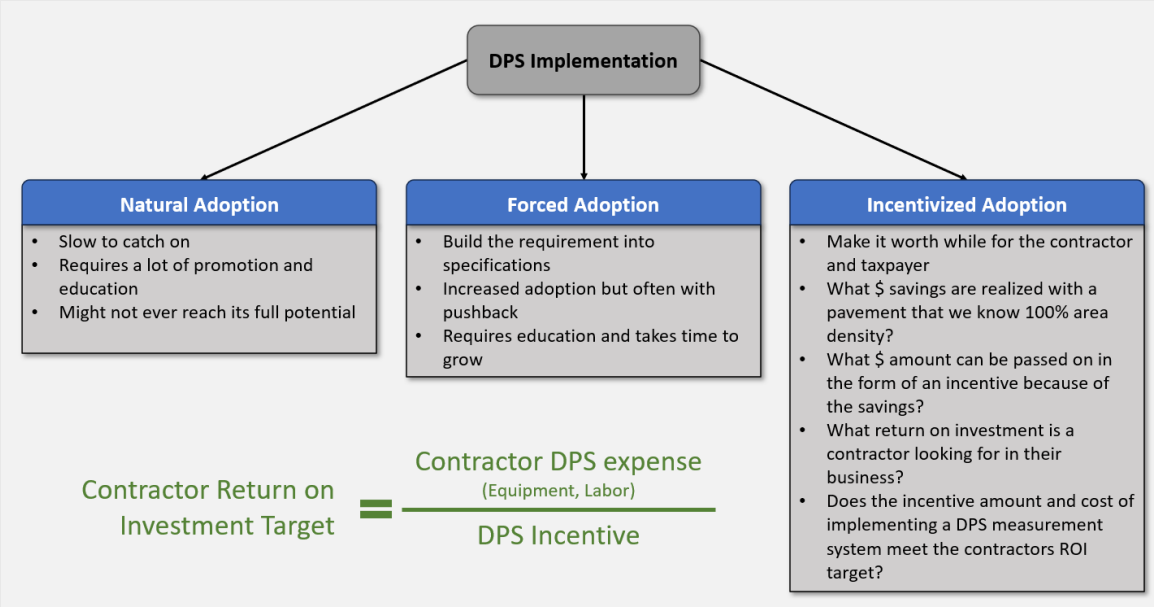
IMPLEMENTATION TRACK

- **I1. Development of training materials, personnel, demonstrations and pilot projects**
- **I2. Updating American Association of State Highway and Transportation Officials (AASHTO) specifications and ghost implementation protocols**
- **I3. Support of national pilot project ghost implementations**
- **I4. Development of a DPS certification center**

MARKETING AND COMMUNICATIONS TRACK

- **M1. Support of communication**
- **M2. Continued training and technical assistance**
- **M3. Continued promotion of the technology**

Presented by CAT at our November 2023 DPS Pooled fund Peer Exchange/Project Update



Thank You!
Questions?

Kyle Hoegh

Kyle.hoegh@state.mn.us

DPS National Pooled Fund Program

DPS Contacts - Materials & Road Research - MnDOT
www.dot.state.mn.us

Informational Materials

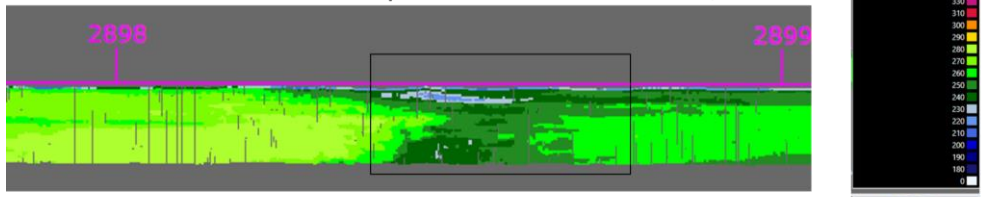
CONTRACTORS ROUTINELY cut cores from the roadway after construction to verify the pavement meets minimum density requirements. These singular random coring locations are used as the basis for acceptance of a larger portion of the pavement. The density results affect contractors and owners alike; for owners such as transportation agencies, a good core result can foretell the road's long-term durability, while contractors often have conditional financial incentives

By rolling a DPS unit over the newly paved roadway, crews measured the pavement's density in real time.

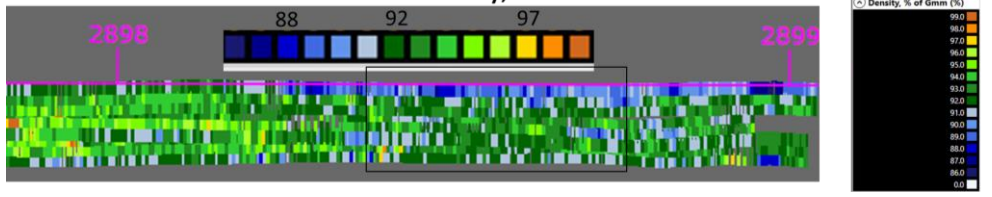
Training/Peer Exchange Opportunities

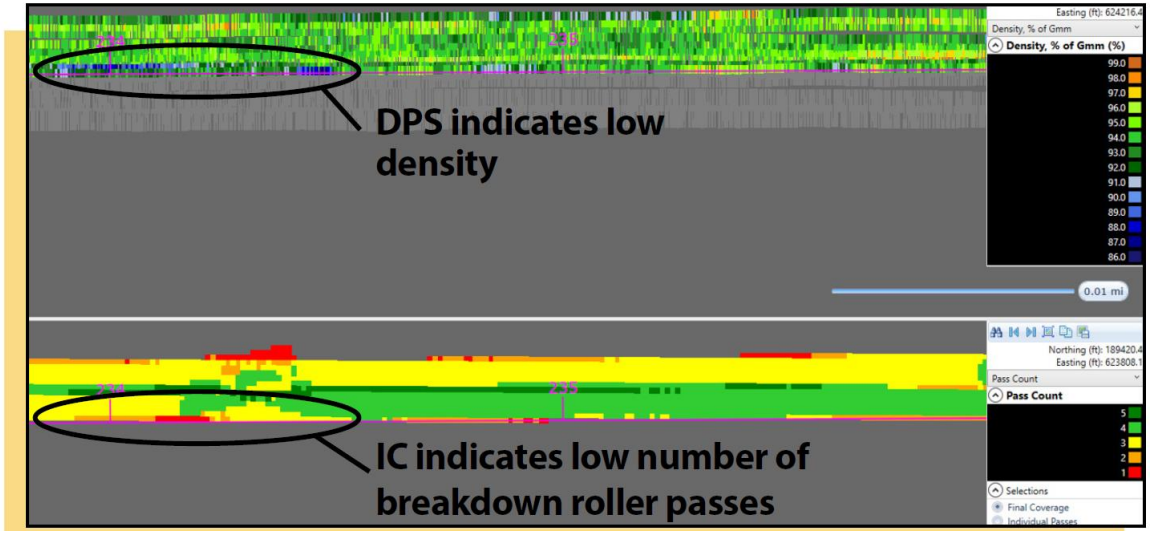
Process Improvement: Leveraging ICT technologies

PMTP Measured Temperature at Placement, °F



DPS Measured Density, %Gmm



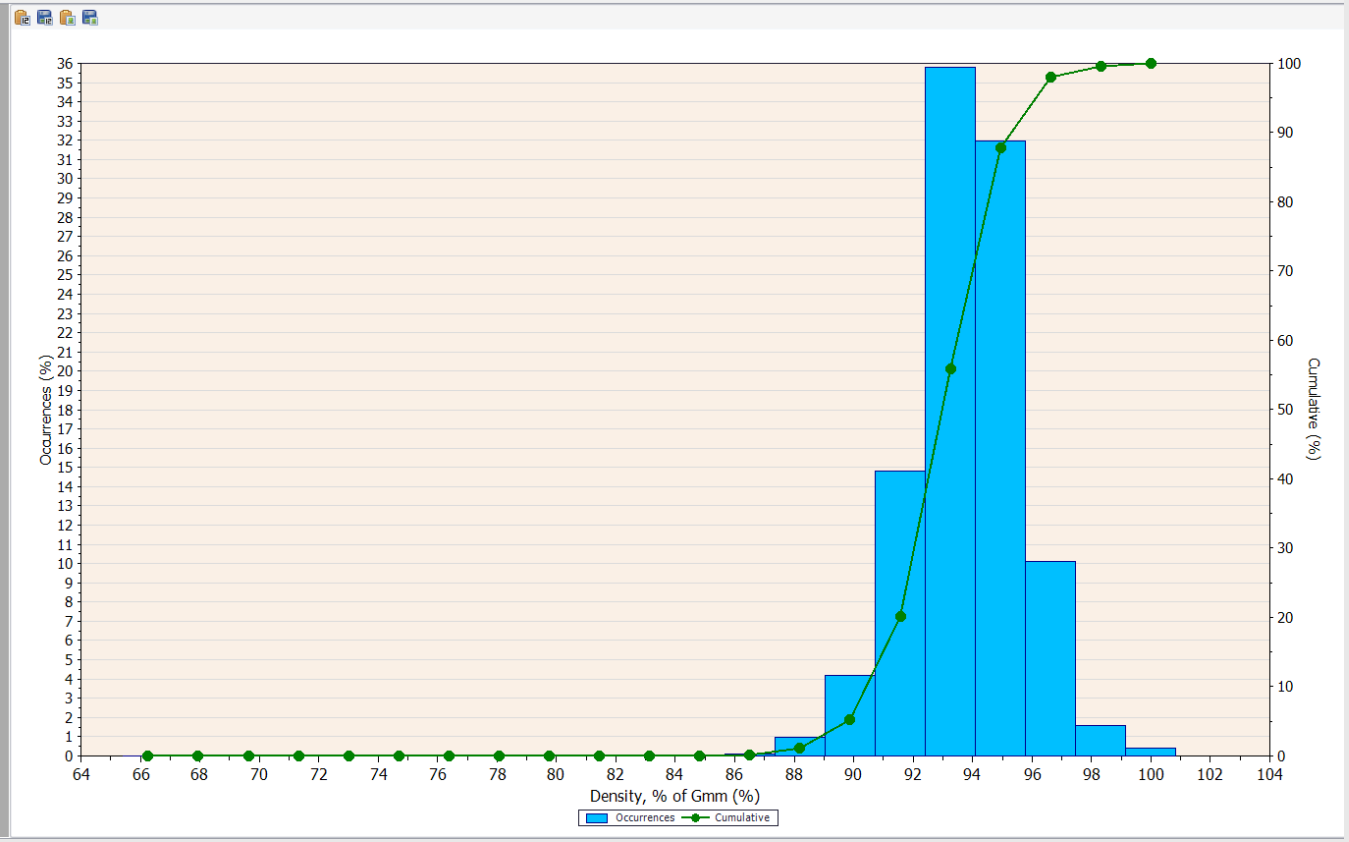


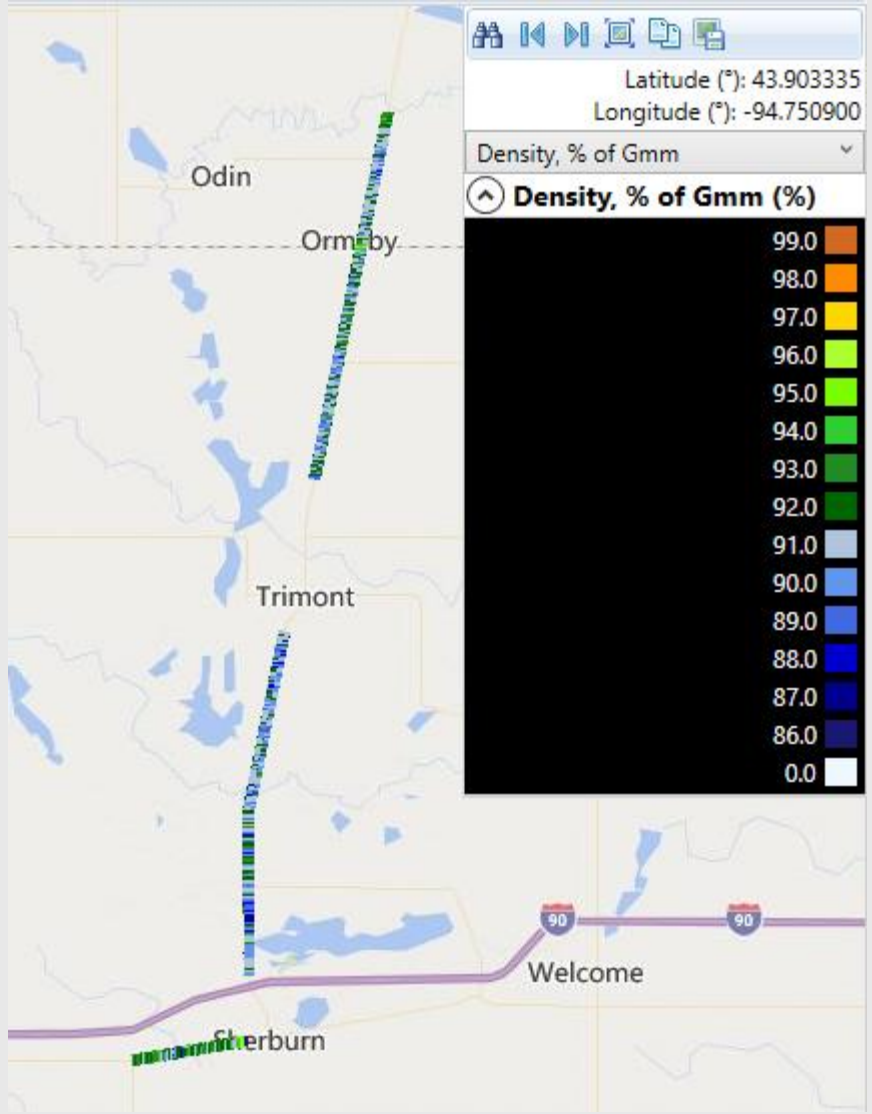
2024 CY – TH4 Overview

Coverage: Raw Data

Distribution

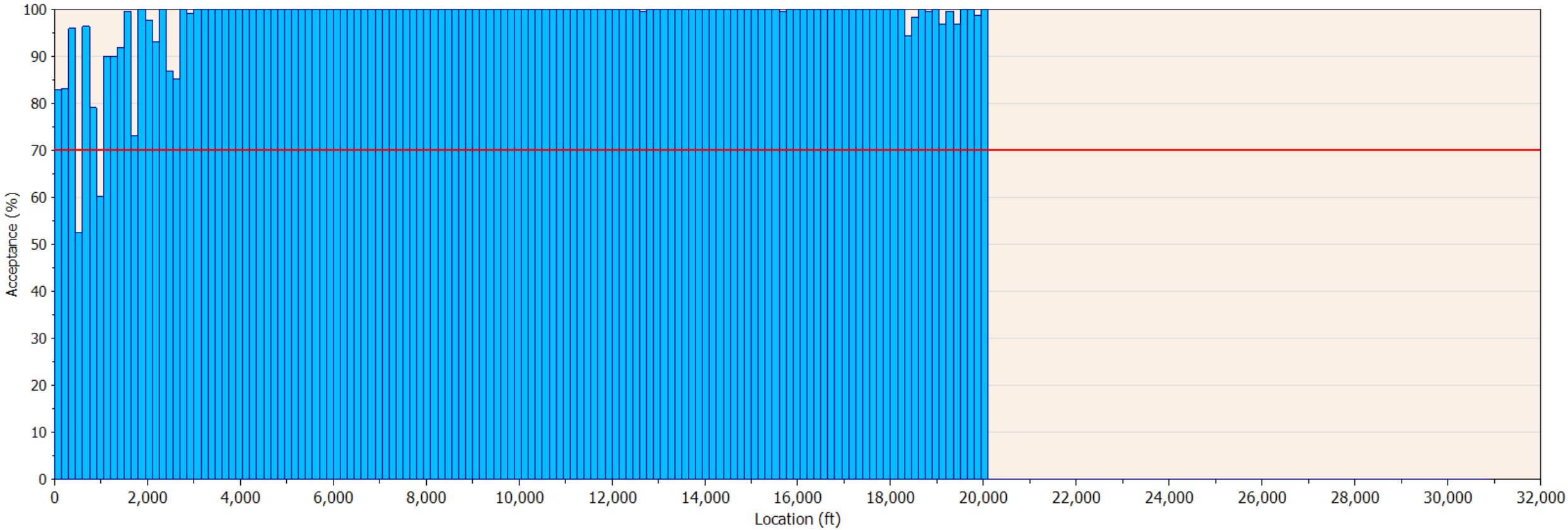
Statistic	Value
Mean (%)	92.9
Standard Deviation (%)	1.8
CoV (%)	2
Variance	3.36
Min (%)	66.3
Max (%)	100.0
Sample Size	2,083,560



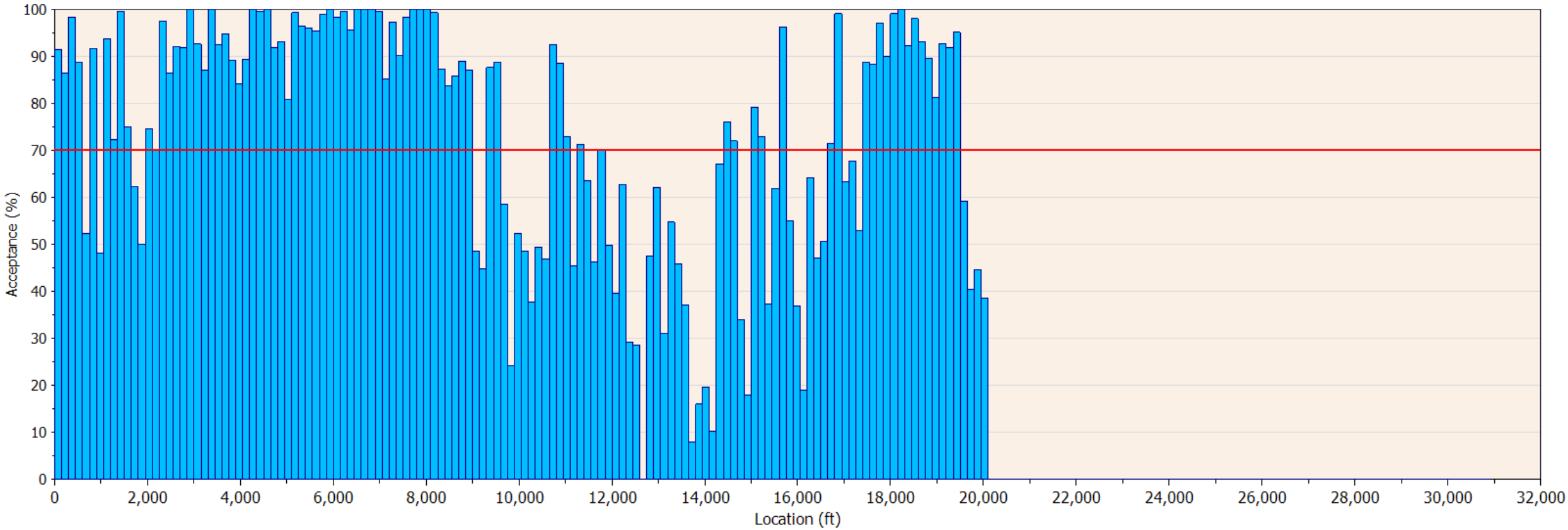


[TH4 Results]

RL CL L1


100
90
80
70
60
50
40
30
20
10
0
Acceptance (%)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
26,000
28,000
30,000
32,000
Location (ft)

RL Sh L1

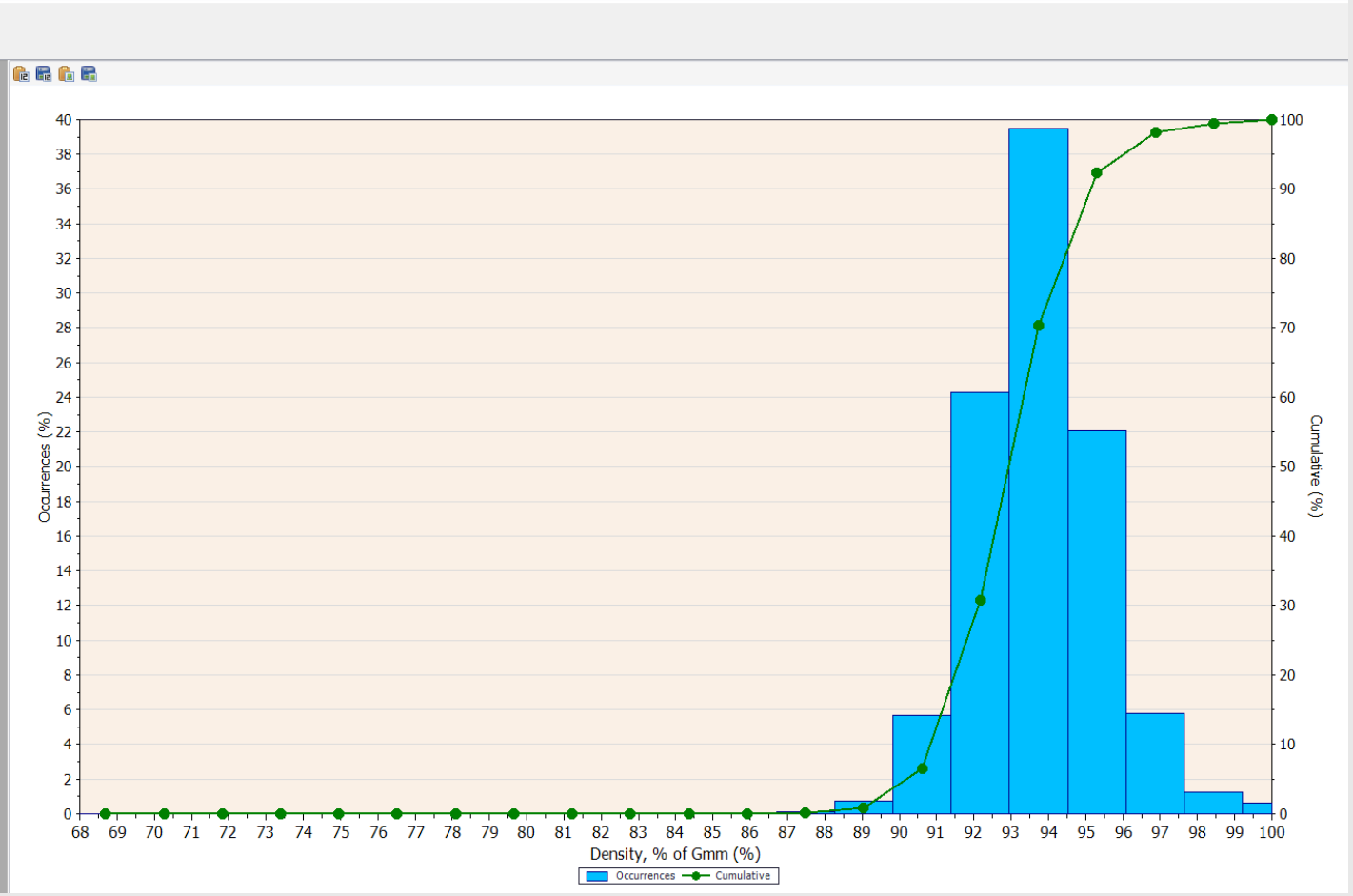

Acceptance (%)
100
90
80
70
60
50
40
30
20
10
0
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
26,000
28,000
30,000
32,000
Location (ft)

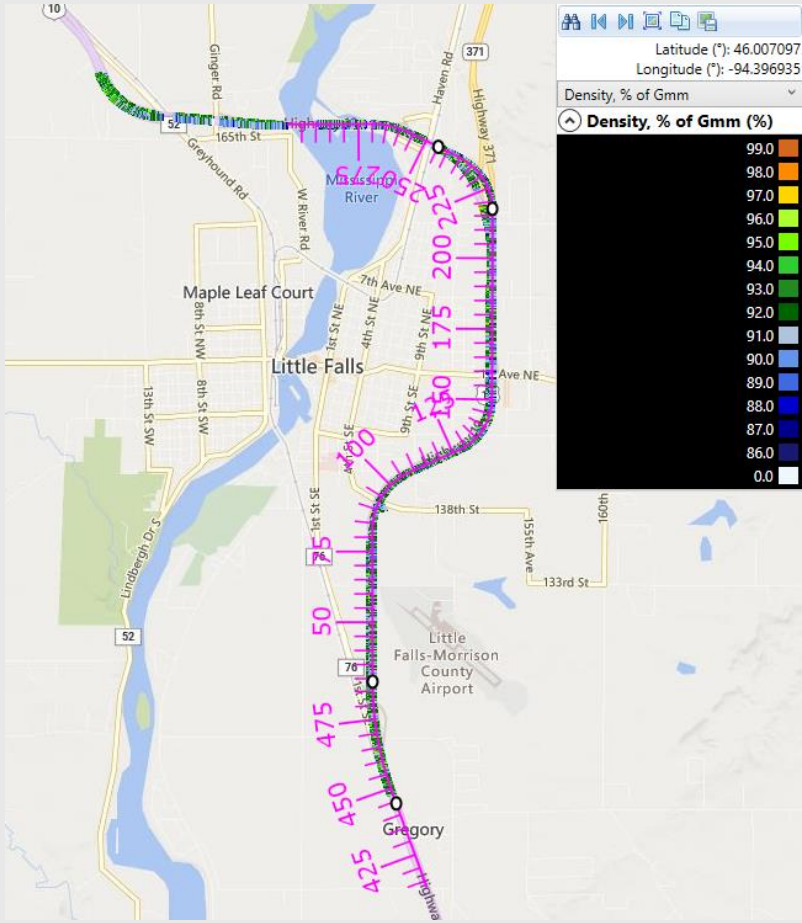
2024 CY – TH10 Overview

Coverage: Raw Data

Distribution

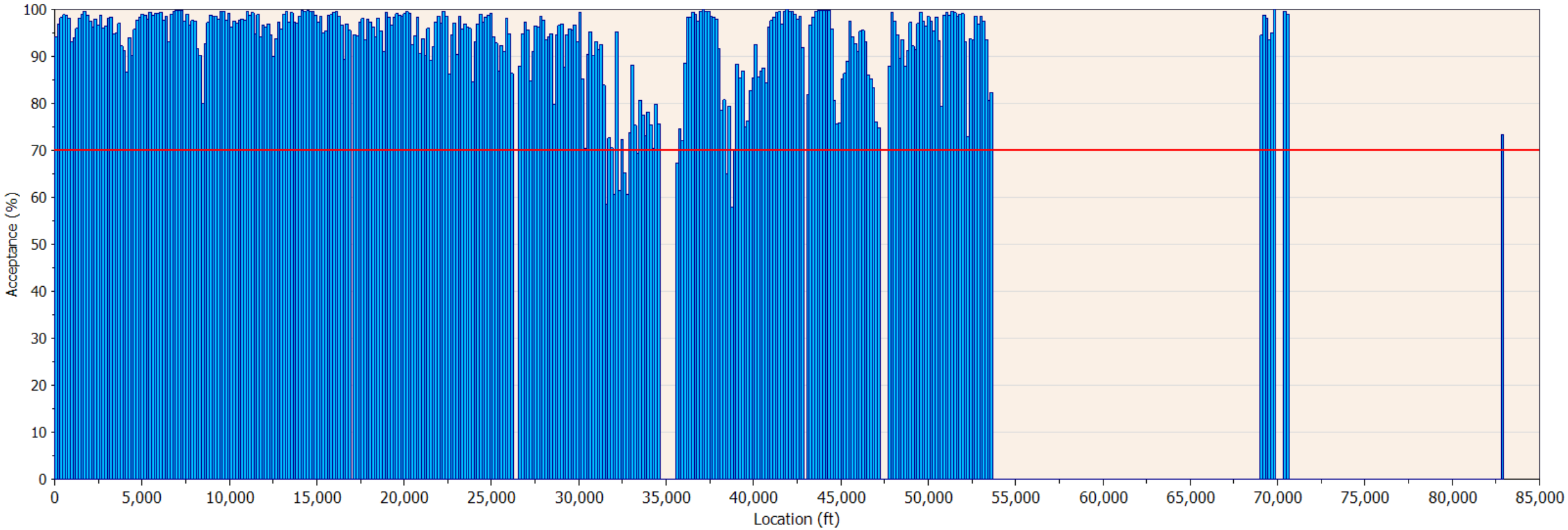
Statistic	Value
Mean (%)	93.0
Standard Deviation (%)	1.7
CoV (%)	2
Variance	2.83
Min (%)	68.7
Max (%)	100.0
Sample Size	1,373,326
Acceptance	Passed
Acceptance (%)	89.36



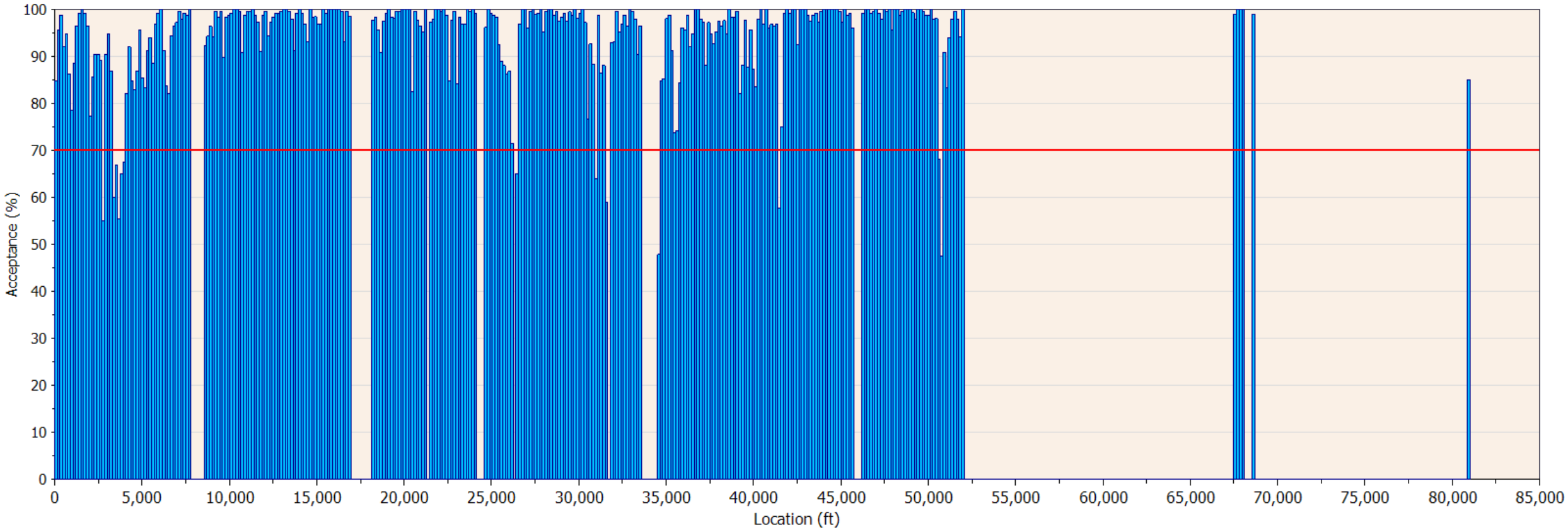


[TH10 Results]

WB RL Mat

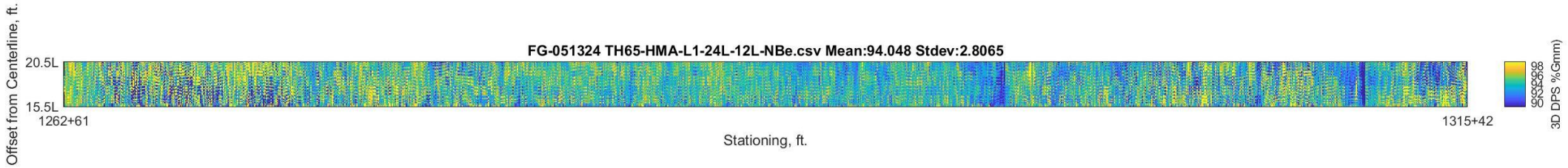

Acceptance (%)
100
90
80
70
60
50
40
30
20
10
0
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
75,000
80,000
85,000
Location (ft)

WB RL CL

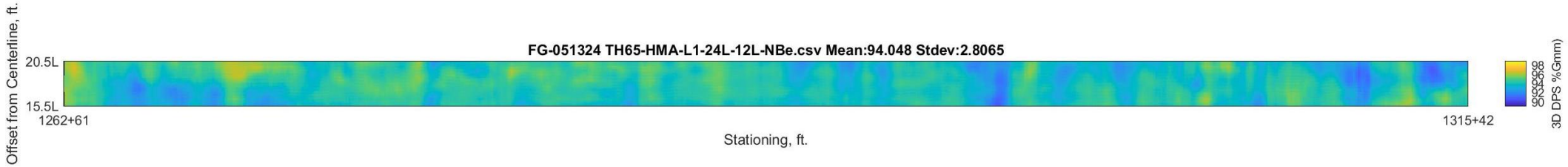

Acceptance (%)
100
90
80
70
60
50
40
30
20
10
0
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
50,000
55,000
60,000
65,000
70,000
75,000
80,000
85,000
Location (ft)

Initial Use of Kontur 3D DPS

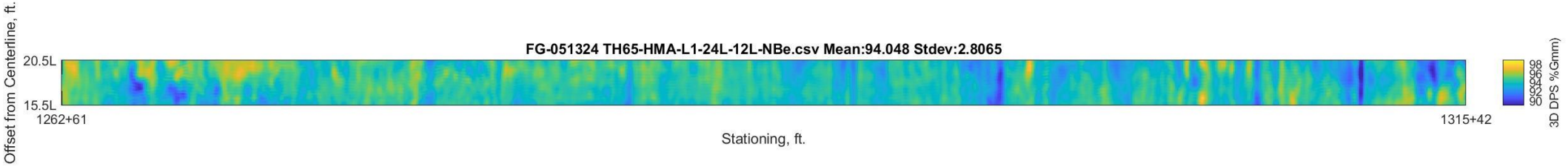
None



movmean



rloess



Phase II Priorities

RESEARCH TRACK

R1. Field, lab and simulation research of critical factors to develop best and worst use conditions for DPS

R2. Evaluation of improved data collection methods

R3. Benefit-cost analysis of DPS compared with other density measurements

R4. Development of advanced analysis techniques

R5. Identification of uses of dielectric data without converting to density