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**TRB** TRANSPORTATION RESEARCH BOARD

# TRB Webinar: Optimizing Data Quality within Maintenance Management Systems

*November 30, 2023*

*1:00 – 2:30 PM*



# PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at [TRBwebinar@nas.edu](mailto:TRBwebinar@nas.edu)

*The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.*



# AICP Credit Information

1.5 American Institute of Certified Planners Certification  
Maintenance Credits

You must attend the entire webinar

Log into the American Planning Association website to claim your  
credits

Contact AICP, not TRB, with questions

# Purpose Statement

This webinar will explore experiences, challenges, and solutions from North Carolina (NCDOT), Minnesota (MnDOT), and New York (NYSDOT) in optimizing data quality within their maintenance management systems.

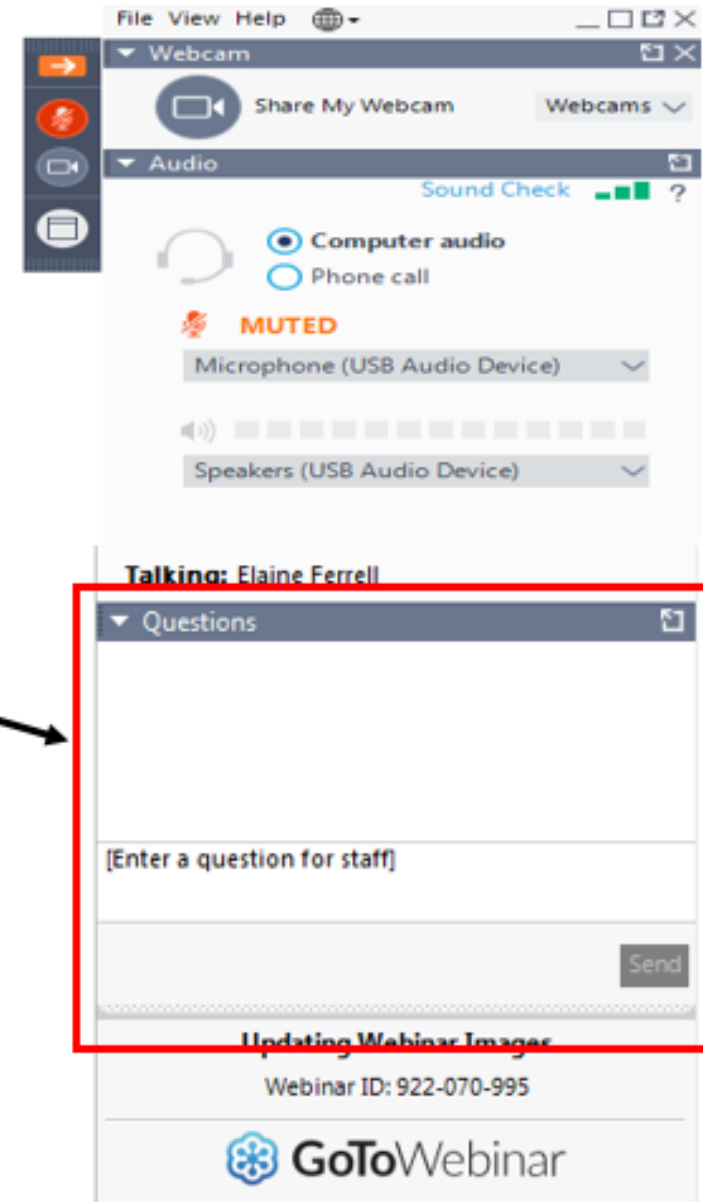
# Learning Objectives

At the end of this webinar, you will be able to:

- Improve maintenance data quality being captured in their maintenance systems
- Understand the systematic approach to identifying areas requiring data validation
- Implement any necessary changes in maintenance management systems

# Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



# Today's Presenters



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# Five W's of Data Quality Management at MnDOT

Douglas Maki - Asset Management & Resiliency Engineer  
Asset Management Program Office

# Agenda

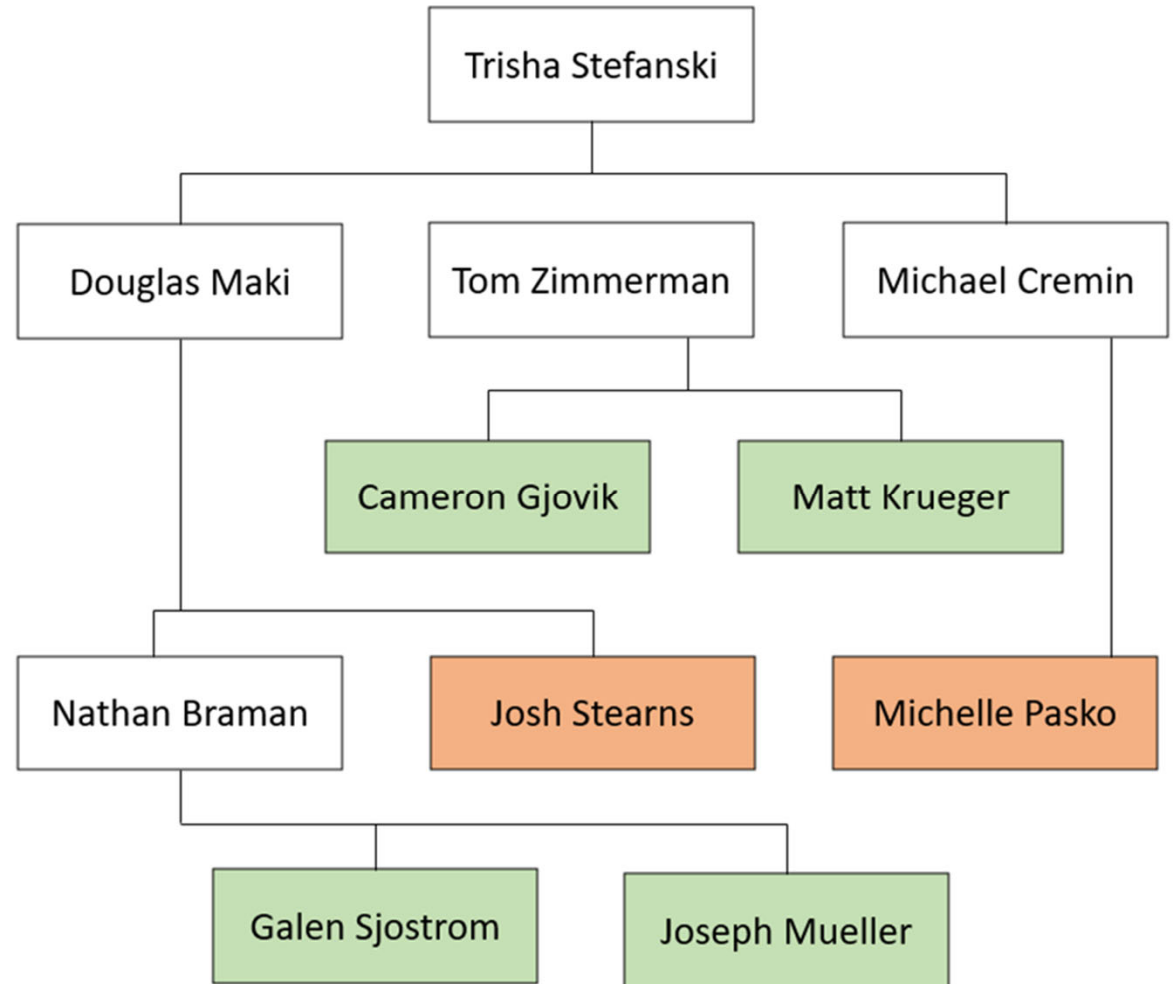
## Topic

- 1 Who is responsible for data quality at MnDOT?
- 2 Where should data quality management take place?
- 3 What constitutes high quality data?
- 4 How do we facilitate high levels of data quality?
- 5 When is data quality managed?
- 6 Why is data quality and its management important?
- 7 Data Quality Management Examples

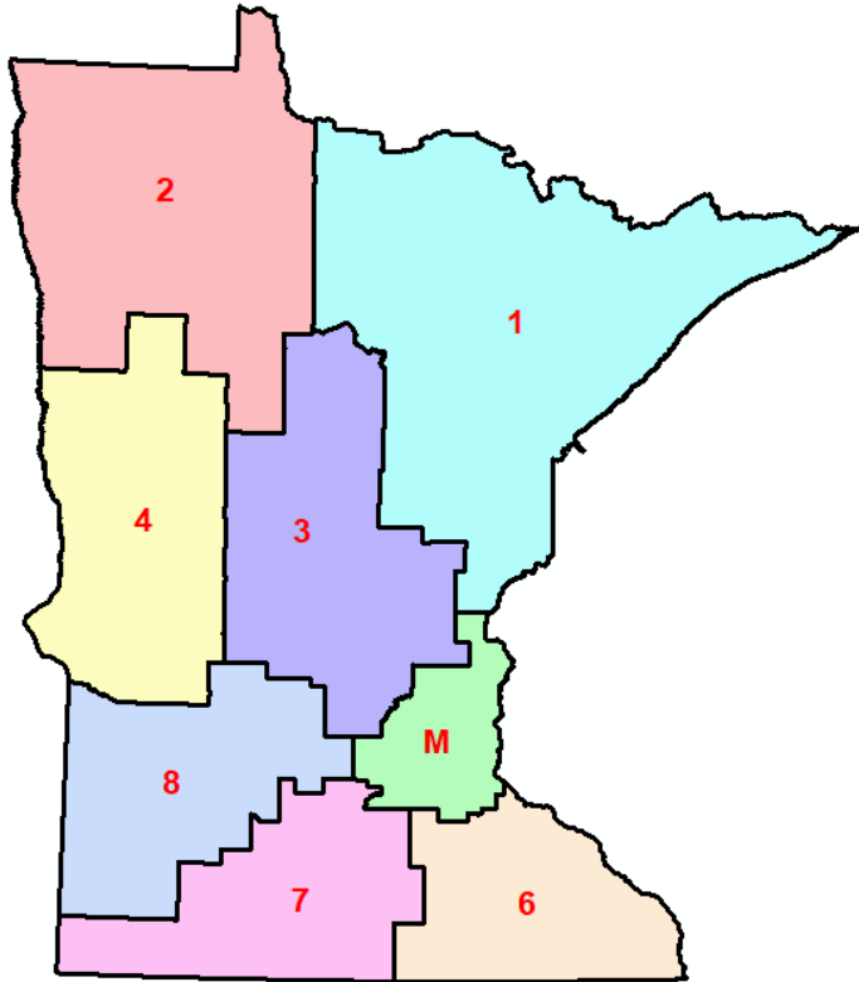


# Who is responsible for data quality at MnDOT?

- The most concise and correct answer is **EVERYBODY!**
- We have staff in the districts and Asset Management Program Office (AMPO) who are tasked with training frontline field staff on how to properly write work orders, inventory records, etc.
- Different functional groups have staff that manages inventory information, inspections, as-builts, planning, etc.



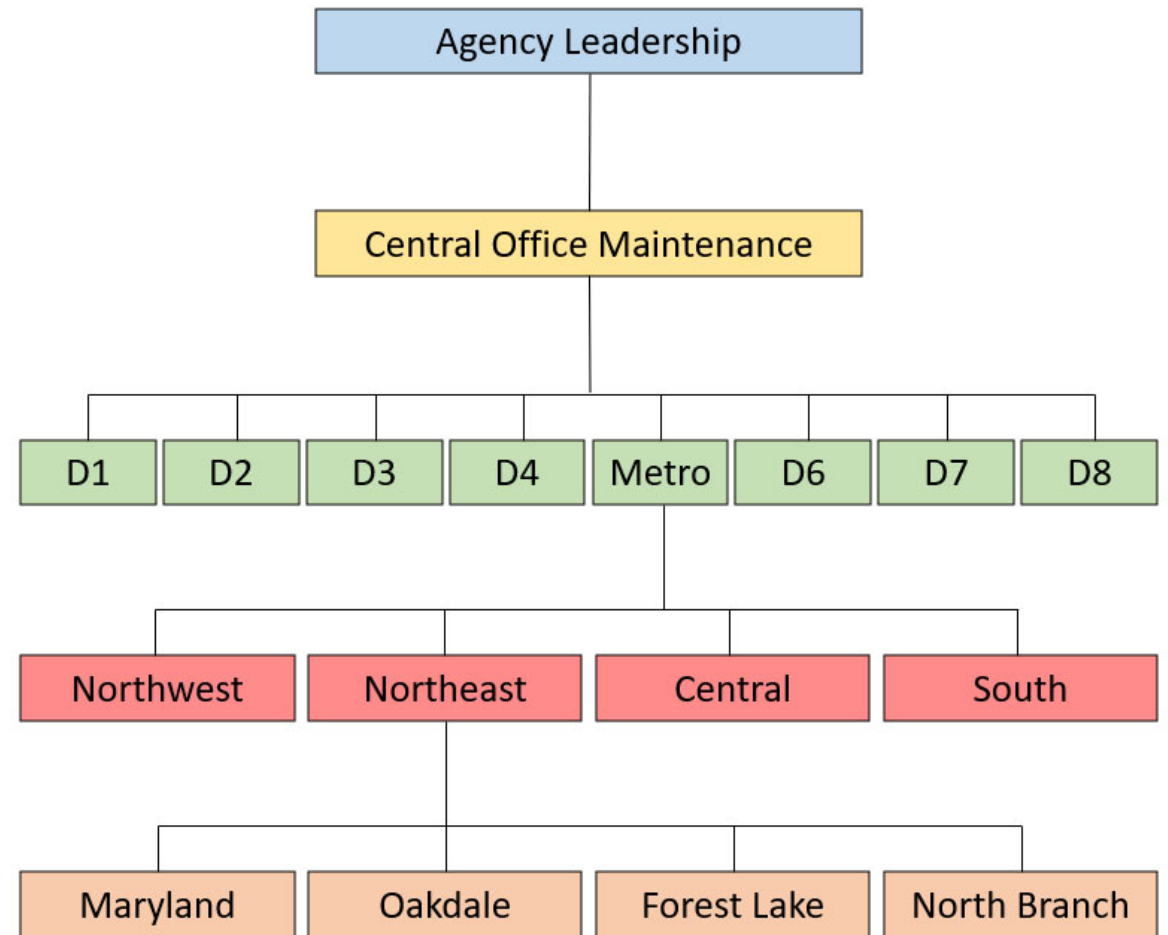
# Who is responsible for data quality at MnDOT?



- The AMPO team also includes data analysts who review submitted records for accuracy and completeness.
- The Metro District has a smaller Asset Management team to help with specific challenges, such as funneling data entry through timekeepers
- The AMPO office will be hiring more permanent support staff to be housed out of each district

# Where should data quality management take place?

- Data quality management takes place at many levels of the agency: front lines, immediate supervisors, district management, statewide management
- We rely on staff closest to the work (maintenance, inventory, inspections) to supply good data and alert us when the inventory data is not accurate
- Because of this bottom-up approach, buy-in from frontline staff is crucial to data quality management



# Where should data quality management take place?

- Historically, districts have had different approaches to recording, storing, and reporting of data, which led to inconsistencies and difficulty when comparing and contrasting
- Adoption of a new transportation asset management system (TAMS), which requires a more consistent approach
- Though front-line crews can still differ in their data entry practices, training is done by a centrally located asset management team, which helps minimize inconsistencies and variability



# What constitutes high quality data?

- Before adoption of our asset management system, our field crews were accustomed to a lower level of detail for their day-to-day work
- Our new maintenance module requires additional info on labor, equipment, material (which can come from a variety of sources), and location/asset data
- This location data specifies the asset being worked on and the amount of work being done

The screenshot displays the AgileAssets software interface. The top navigation bar includes the AgileAssets logo and a user profile icon. The main content area is titled "Maintenance Management > Operations > Work Orders" and features buttons for "Insert", "Insert Like", "Make Daycards", and "Complete Copy". Below this is a "Work Orders" table with columns for Highway, WR #, WO #, Activity, and Description/Comments. The table shows several work orders, with the third one (US169, WO # 264244) highlighted. Below the work orders table is a pagination control showing "3 of 8 total rows".

Below the work orders table is a "Labor" section with tabs for "Equipment", "Material", "Non-Inventoried Material", "Location/Asset", "Direct Costs", and "Contract and PO Cost". The "Employee Day Cards" table is active, showing columns for Approved, Employee, Work Date, Total Hrs, and TRC. The table lists three day cards for August 9, 2023, with employees Becker, Austin William and Donahue, Brianna Marie.

| Highway | WR # | WO #   | * Activity                               | Description/Comments    |
|---------|------|--------|--|-------------------------|
| MN41    |      | 259287 | Mowing for Safety - Top Cuts (Lane Mile) | FY 2024 1 Cut           |
| US169   |      | 263369 | Mowing Guardrail and Bullpens (Each)     | FY 2024                 |
| US169   |      | 264244 | Repair in Kind (Linear Foot)             | 7328-24-0006 (Not done) |
| MN5     |      | 266604 | Mowing for Safety - Top Cuts (Lane Mile) | FY 2024 1 Cut, 2nd time |
| MN25    |      | 269398 | Mowing for Safety - Top Cuts (Lane Mile) | FY 2024 1 Cut, 2nd Time |

| Approved                            | * Employee             | * Work Date | * Total Hrs | * TRC                  |
|-------------------------------------|------------------------|-------------|-------------|------------------------|
| <input checked="" type="checkbox"/> | Becker, Austin William | 8/9/2023    | 3.5         | 01. REG - Base Pay     |
| <input checked="" type="checkbox"/> | Becker, Austin William | 8/9/2023    | 0.5         | 02. OVT - Overtime Pay |
| <input checked="" type="checkbox"/> | Donahue, Brianna Marie | 8/9/2023    | 3.5         | 01. REG - Base Pay     |

# What constitutes high quality data?

- The newly captured location and accomplishment data allows asset managers to determine cost and achievement rates that are essential to effective work planning
- TAMS is written in the linear referencing system (LRS), which differs from the reference post (RP) system that our field crews know and use
- This leads to some challenges when translating location information between the real world and WO location
- LRS and RP are usually close, but not always

The screenshot shows the Minnesota Department of Transportation web application interface. The header includes the logo and navigation options: Identify, Select, Search, Measure, Route Detail, Street View, and Find Me. Below the header, there are tabs for Catalog, Favorites, Visible, and Results. The main content area displays the 'Nearest Route' information for MN 51-I. The data is as follows:

| LRS Version            | Current (1 week old) |
|------------------------|----------------------|
| Route Name:            | MN 51-I              |
| Street Name:           | N Snelling Ave       |
| Route ID:              | 0300000000000051-I   |
| Carto Measure:         | 7.72400000           |
| Reference Post Offset: | 007+00.738           |
| County:                | Ramsey               |

The background shows an aerial view of a road intersection with a red line indicating the route.

The screenshot shows the Minnesota Department of Transportation web application interface. The header includes the logo and navigation options: Identify, Select, Search, Measure, Route Detail, Street View, and Find Me. Below the header, there are tabs for Catalog, Favorites, Visible, and Results. The main content area displays the 'Nearest Route' information for MN 62-I. The data is as follows:

| LRS Version            | Current (1 week old) |
|------------------------|----------------------|
| Route Name:            | MN 62-I              |
| Street Name:           | MNTH 62              |
| Route ID:              | 0300000000000062-I   |
| Carto Measure:         | 144.83800000         |
| Reference Post Offset: | 115+00.351           |
| County:                | Hennepin             |

The background shows an aerial view of a road intersection with a red line indicating the route.

# What constitutes high quality data?

## Common data entry errors

Omitting the asset that was worked on altogether

| Highway | WR # | WO #   | * Activity                           | Description/Comments |
|---------|------|--------|--------------------------------------|----------------------|
| US61    |      | 262361 | Mowing for Weed/Brush Control (Acre) | Brush Mowing on 61   |

| Approved | * Work Date | Asset Name | BMP | End Measure | * Accomplishments |
|----------|-------------|------------|-----|-------------|-------------------|
|          |             |            |     |             |                   |

Choosing the wrong work order activity

Select WO Attributes

Project: Highway Maintenance Safety Barriers

Asset Type: Linear Barriers

Activity: Inspection/Assessment (Hours)

Subactivity: Inspection/Assessment (Hours)

Inv. Elem:

- Inspection/Assessment (Hours)
- Guardrail Mowing (Lane Mile)
- Inspection/Assessment (Hours)
- Repair in Kind (Linear Foot)
- Retention (Each)
- Traffic Barrier Direct Support (Hours)

Leaving the accomplishment value at the default of 1, which is non-sensical for activities such as guardrail repair

| Highway | WR # | WO #   | * Activity                   | Description/Comments                     |
|---------|------|--------|------------------------------|--|
| US52    |      | 269673 | Repair in Kind (Linear Foot) | Cable NB 52 1100 Ft north of Goodwin Ave |

| Approved                            | * Work Date | Asset Name      | BMP      | End Measure | * Accomplishments |
|-------------------------------------|-------------|-----------------|----------|-------------|-------------------|
| <input checked="" type="checkbox"/> | 9/12/2023   | TBL-US52-102-37 | 102.8922 | 102.8922    | 1                 |

Not adjusting the beginning and ending points of the work location

| Highway | WR # | WO #   | * Activity                               | Description/Comments |
|---------|------|--------|--|----------------------|
| MN41    |      | 259287 | Mowing for Safety - Top Cuts (Lane Mile) | FY 2024 1 Cut        |

| Approved                            | * Work Date | Asset Name                        | BMP | End Measure | * Accomplishments |
|-------------------------------------|-------------|-----------------------------------|-----|-------------|-------------------|
| <input checked="" type="checkbox"/> | 7/11/2023   | MN 411.RP.000+00.000 - 009+00.352 | 0   | 9.4088      | 2.4               |

# How do we facilitate high levels of data quality?

- As mentioned earlier, the Central Office Asset Management team conducts training sessions after new software releases and during seasonal changeovers
- Regular reports are run to track how consistently TAMS is being utilized, and to determine data entry accuracy and completion
- When erroneous data is discovered, we work alongside the front-line staff to correct issues, reinforcing the importance of accurate data, and offering tips and tricks to make TAMS more efficient

| Row Labels                                    | Total Entry Count | # Default B/EMP | # Default/No Accompl | # No Asset | # No Material Cost | Good Entries |
|---|-------------------|-----------------|----------------------|------------|--------------------|--------------|
| ⊕ Blow Patching (Lane Mile)                   | 261               | 7               | 173                  | 47         | 64                 | 58           |
| ⊕ Debris Clearance (Hours)                    | 4610              | 752             | 3048                 | 0          | 4602               | 0            |
| ⊕ Fence Repair and Installation (Linear Foot) | 396               | 13              | 113                  | 76         | 67                 | 159          |
| ⊕ Heavy Patching (Lane Mile)                  | 304               | 9               | 228                  | 48         | 86                 | 43           |
| ⊕ Mowing for Safety - Top Cuts (Lane Mile)    | 2660              | 193             | 606                  | 193        | 2660               | 0            |
| ⊕ Repair in Kind (Linear Foot)                | 6268              | 3565            | 1530                 | 505        | 1091               | 1352         |
| ⊕ Wedge Paving - Roadway (Lane Mile)          | 65                | 1               | 39                   | 4          | 6                  | 25           |



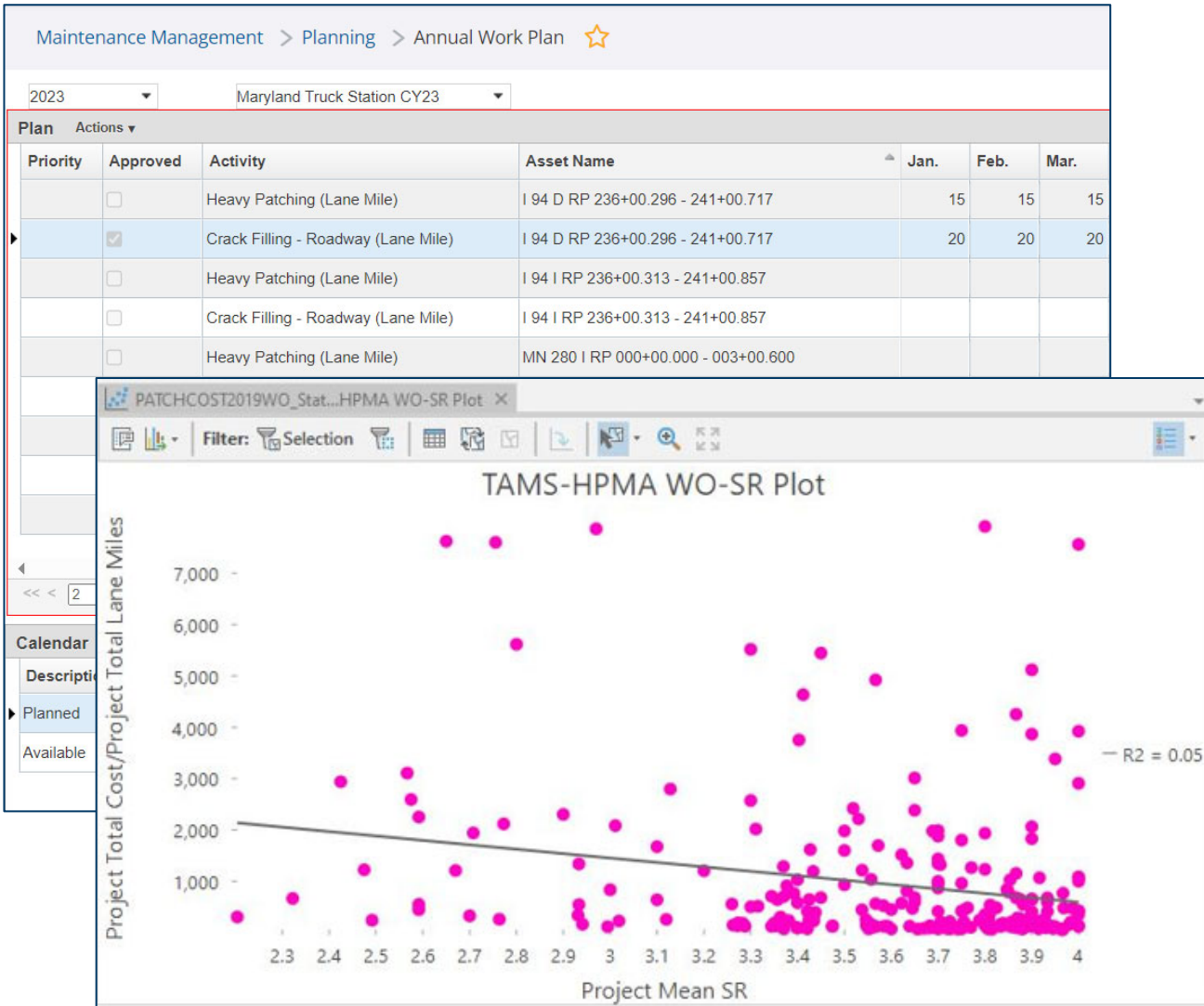
# When is data quality managed?

- Data quality is stressed throughout the process, starting before the work order is written by keeping accurate asset inventories and material lists and costs
- Monthly utilization reports are run to make sure that staff is using TAMS to record their work
- Seasonal reports are run to recap summer or winter work, which replaces similar reports from previous work management systems
- Reports are required when performance measures are calculated, which can be at various times throughout the year

| Row Labels | TAMS Hours | RCA Hours | UTILIZATION |
|------------|------------|-----------|-------------|
| T797312    | 961.5      | 1014.5    | 86.13%      |
| T797314    | 891.25     | 1036.75   | 86.95%      |
| T797315    | 880        | 1114.75   | 81.31%      |
| T797317    | 1165.25    | 1200.75   | 88.59%      |
| T797322    | 1104.5     | 1120.5    | 98.80%      |
| T797324    | 1514.5     | 2076.05   | 76.71%      |
| T797325    | 2261.25    | 2414.75   | 94.66%      |
| T797327    | 1318       | 1491      | 82.82%      |
| T797328    | 1141.25    |           |             |
| T797331    | 1057.75    |           |             |
| T797333    | 1378.25    |           |             |
| T797334    | 1483       |           |             |
| T797336    | 1231       |           |             |
| T797344    | 617.25     |           |             |
| T797361    | 1538.36    |           |             |
| T797363    | 1291.5     |           |             |
| T797364    | 1517.5     |           |             |
| T797373    | 790        |           |             |
| T797375    | 1038       |           |             |
| T797378    | 1548       |           |             |
| T797390    | 1681       |           |             |

| Measures Recently Developed or Modified (MBMT effort) |                           |   |   |
|---|---------------------------|---|---|
| Measure Area  | Activity                  | Asset/Operation                           | Measure Description   |
| NoiseWall Inspection and Maintenance                  | Inspections               | Noisewalls                                | The Percent % of Noisewall Inspections Completed On-Time                                      |
|   | High Priority Maintenance | Noisewalls                                | % completion of Noise Wall High Priority Maintenance Items within 6 months inspection finding |
| Snow and Ice  | Snow and Ice removal      | Pavement                                  | Frequency (%) of meeting bare lane target(s)  |
| Guardrail   | Maintenance               | "Guardrails" Non Functional; High ADT     | % Repairs completed within 10 days  |
|   |                           | "Guardrails" Non Functional; Low ADT      | % Repairs completed within 15 days  |
|   |                           | "Guardrails" Functional; High ADT         | % Repairs completed within 25 days  |
|   |                           | "Guardrails" Functional; Low ADT          | % Repairs completed within 30 days  |
| Cable Median Barrier                                  | Maintenance               | "Cable Barriers" Non Functional; High ADT | % Repairs completed within 10 days  |
|   |                           | "Cable Barriers" Non Functional; Low ADT  | % Repairs completed within 15 days  |
|   |                           | "Cable Barriers" Functional; High ADT     | % Repairs completed within 15 days  |
|   |                           | "Cable Barriers" Functional; Low ADT      | % Repairs completed within 20 days  |

# Why is data quality and its management important?



- Improved data quality helps reinforce public trust in our agency by increasing transparency and accountability
- Better quality data helps managers create more efficient work plans, which helps maximize the effectiveness of our funding
- Enhanced data quality allows for accurate reporting of performance measures and ensures a consistent approach across district boundaries

# Data Quality Management Examples – Utilization Report

| <b>NORTH BRANCH SUB AREA</b> |               |              |              |                   |              |
|------------------------------|---------------|--------------|--------------|-------------------|--------------|
| <b>NAME</b>                  | <b>DEPTID</b> | <b>TAMS</b>  | <b>RCA</b>   | <b>PERCENTAGE</b> | <b>GAP</b>   |
| Anderson,Joseph John         | T797316       | 98           | 98           | 100%              | 0            |
| Blazek,Cody Allen            | T797316       | 97           | 97           | 100%              | 0            |
| Blazek,Jason                 | T797316       | 94.5         | 94.5         | 100%              | 0            |
| Cieluch Jr,Rick Joseph       | T797316       | 108.5        | 108.5        | 100%              | 0            |
| Heimerl,Brian P              | T797316       | 99           | 99           | 100%              | 0            |
| Kvale,Jeffrey A              | T797316       | 96           | 96           | 100%              | 0            |
| Miller,Paul Charles          | T797316       | 90.5         | 90.5         | 100%              | 0            |
| Morrison,Charles H           | T797316       | 125          | 125          | 100%              | 0            |
| Raymond,Dean E               | T797316       | 87.5         | 87.5         | 100%              | 0            |
| Volk,William R               | T797316       | 54           | 54           | 100%              | 0            |
| Wendt,David D                | T797316       | 83           | 83           | 100%              | 0            |
| Moss,Elizabeth               | T797316       | 101.75       | 112.75       | 90%               | 11           |
| Hendrickson,Michael Allen    | T797316       | 64           | 97           | 66%               | 33           |
| Thompson Jr,James W          | T797316       | 0            | 152          | 0%                | 152          |
| <b>Averages</b>              |               | <b>85.63</b> | <b>99.63</b> | <b>90%</b>        | <b>14.00</b> |

# Data Quality Management Examples – Utilization Report

| NORTH BRANCH SUB AREA     |                       |               |                       |                               |                  |
|---------------------------|-----------------------|---------------|-----------------------|-------------------------------|------------------|
| NAME                      | DEPTID                | TAMS          | RCA                   | PERCENTAGE                    | GAP              |
| Anderson,Joseph John      | T707216               | 00            | 00                    | 100%                          | 0                |
| Blazek,Cody Allen         |                       |               |                       |                               |                  |
| Blazek,Jason              |                       |               |                       |                               |                  |
| Cieluch Jr,Rick Joseph    |                       |               |                       |                               |                  |
| Heimerl,Brian P           |                       |               |                       |                               |                  |
| Kvale,Jeffrey A           |                       |               |                       |                               |                  |
| Miller,Paul Charles       |                       |               |                       |                               |                  |
| Morrison,Charles H        |                       |               |                       |                               |                  |
| Raymond,Dean E            |                       |               |                       |                               |                  |
| Volk,William R            |                       |               |                       |                               |                  |
| Wendt,David D             |                       |               |                       |                               |                  |
| Moss,Elizabeth            |                       |               |                       |                               |                  |
| Hendrickson,Michael Allen |                       |               |                       |                               |                  |
| Thompson Jr,James W       |                       |               |                       |                               |                  |
| <b>Averages</b>           |                       |               |                       |                               |                  |
|                           | <b>NAME</b>           | <b>RESULT</b> | <b>SOURCE TYPE CD</b> | <b>SOURCE TYPE DEF</b>        | <b>HOURS SUM</b> |
|                           | Ancheta,Michael Scott | TAMS          | 2144                  | Annual Sign Replacement       | 1                |
|                           | Ancheta,Michael Scott | TAMS          | 2155                  | Signs Direct Support          | 11               |
|                           | Ancheta,Michael Scott | RCA           | 2222                  | Sign/Delineation/Marker Repai | 3                |
|                           | Ancheta,Michael Scott | TAMS          | 2222                  | Sign/Delineation/Marker Repai | 108.5            |
|                           | Ancheta,Michael Scott | TAMS          | 2316                  | Brush & Tree Removal          | 3.5              |
|                           | Ancheta,Michael Scott | TAMS          | 2807                  | Traffic Control               | 3                |
|                           | Anderson,Joseph John  | TAMS          | 2107                  | Mastic Patching Operations    | 72.5             |
|                           | Anderson,Joseph John  | TAMS          | 2210                  | GuardrailInstall/Repair/Maint | 4.5              |
|                           | Anderson,Joseph John  | TAMS          | 2214                  | Debris Clearance              | 15               |
|                           | Anderson,Joseph John  | TAMS          | 2245                  | Guardrail Direct Support      | 6                |
|                           | Anderson,Kyle         | TAMS          | 2101                  | Light Patching                | 2                |
|                           | Anderson,Kyle         | TAMS          | 2103                  | Heavy Patching                | 4.5              |
|                           | Anderson,Kyle         | TAMS          | 2132                  | Milling Surfaces              | 5                |
|                           | Anderson,Kyle         | TAMS          | 2202                  | Ditches/Slopes/PondsClean/Sha | 10               |
|                           | Anderson,Kyle         | TAMS          | 2210                  | GuardrailInstall/Repair/Maint | 54               |

# Data Quality Management Examples – Weekly Accomplishment Verification Report

| Administrative Unit             | Activity                                     | Asset Type | Asset                               | BMP      | EMP      | Accomplishment |
|---------------------------------|--|------------|-------------------------------------|----------|----------|----------------|
| 7312 - Anoka Subarea            | Mowing for Safety - Top Cuts (Lane Mile)     | Section    | MN 101 I RP 036+00.627 - 046+00.499 | 36.2900  | 36.5700  | 1.00           |
| <b>Number of Records 1</b>      |  |            |                                     |          |          |                |
| 7314 - Spring Lake Park Subarea | Brush & Tree Removal (Acre)                  | Section    | MN 610 D RP 000+00.000 - 009+00.408 | 2.0000   | 9.6070   | 1.00           |
| 7314 - Spring Lake Park Subarea | Brush & Tree Removal (Acre)                  | Section    | MN 610 I RP 000+00.000 - 009+00.398 | 2.0000   | 9.9187   | 1.00           |
| 7314 - Spring Lake Park Subarea | Brush & Tree Removal (Acre)                  | Section    | MN 610 I RP 000+00.000 - 009+00.398 | 1.0000   | 9.9187   | 1.00           |
| 7314 - Spring Lake Park Subarea | Gravel Shoulder Restoration (Lane Mile)      | Section    | MN 47 I RP 005+00.370 - 013+00.228  | 5.3980   | 13.4810  | 1.00           |
| <b>Number of Records 4</b>      |  |            |                                     |          |          |                |
| 7315 - Golden Valley Subarea    | Fence Repair and Installation (Linear Foot)  | Section    | MN 100 I RP 000+00.000 - 016+00.116 | .0000    | 15.9080  | 1.00           |
| <b>Number of Records 1</b>      |  |            |                                     |          |          |                |
| 7316 - North Branch Subarea     | Brush & Tree Removal (Acre)                  | Section    | I 35WI I 021+00.473 - 041+00.745    | 21.4850  | 41.7960  | 1.00           |
| 7316 - North Branch Subarea     | Brush & Tree Removal (Acre)                  | Section    | US 169 D RP 084+00.309 - 106+00.437 | 83.5270  | 105.6860 | 1.00           |
| 7316 - North Branch Subarea     | Brush & Tree Removal (Acre)                  | Section    | US 169 D RP 084+00.309 - 106+00.437 | 83.5270  | 105.6860 | 1.00           |
| 7316 - North Branch Subarea     | Brush & Tree Removal (Acre)                  | Section    | US 169 D RP 084+00.309 - 106+00.437 | 83.5270  | 105.6860 | 1.00           |
| 7316 - North Branch Subarea     | Brush & Tree Removal (Acre)                  | Section    | US 169 D RP 084+00.309 - 106+00.437 | 83.5270  | 105.6860 | 1.00           |
| <b>Number of Records 5</b>      |  |            |                                     |          |          |                |
| 7317 - Forest Lake Subarea      | Mowing for Safety - Top Cuts (Lane Mile)     | Section    | I 35 I RP 127+00.426 - 132+00.896   | 132.1070 | 132.4330 | 1.00           |
| 7317 - Forest Lake Subarea      | Mowing for Safety - Top Cuts (Lane Mile)     | Section    | MN 243 I RP 000+00.000 - 001+00.224 | .0000    | 1.2200   | 1.00           |
| 7317 - Forest Lake Subarea      | Pavement Buckle/Blow Up Repair (Square Yard) | Section    | I 35 I RP 127+00.426 - 132+00.896   | 132.5040 | 132.5040 | 1.00           |
| <b>Number of Records 3</b>      |  |            |                                     |          |          |                |
| 7321 - Mendota Heights Subarea  | Roadway Sweeping and Flushing (Lane Mile)    | Section    | I 494 D RP 063+00.493 - 072+01.124  | 63.1910  | 73.2347  | 1.00           |
| <b>Number of Records 1</b>      |  |            |                                     |          |          |                |
| 7328 - Chaska Subarea           | Mowing for Safety - Top Cuts (Lane Mile)     | Section    | MN 5 I RP 026+00.242 - 046+00.129   | 26.4330  | 46.1860  | 1.00           |
| 7328 - Chaska Subarea           | Mowing Guardrail and Bullpens (Each)         | Section    | MN 5 I RP 026+00.242 - 046+00.129   | 26.4330  | 46.1860  | 1.00           |

# Data Quality Management Examples – Asset Inventory Using As-Built Submittals

| Traffic Barrier As-built Survey Data |                    |  |                                      |                                    |   |            |               |             |          |
|--------------------------------------|--------------------|--|--------------------------------------|------------------------------------|---|------------|---------------|-------------|----------|
| Traffic Barrier Identification       |                    |  |                                      |                                    | Coordinates   | Attributes |               |             |          |
| Plan ID                              | Barrier Class Code | Manufacturer or Standard Plan/Plate/Detail*                  | Collect Product line [Category Type] | Collect Product [Subcategory Type] | Linestring (Lat1, Long1; Lat2, Long2; etc)  | Post Type  | Blockout Type | # of cables | Comments |
| Site 1                               | Plate Beam         | 5-297. 696<br>Traffic Barrier Type 31 Low Fill/Long Span *** | W-Beam                               | Type 31 Standard                   | 45.1234, -93.1234;<br>45.3456, -93.3456;<br>45.5678, -93.5678;<br>45.7890, -93.7890;<br>45.9012, -93.9012;<br>45.2345, -93.2345 | Steel      | Steel         |             |          |
| Site 2                               | Cable              | Brifen   | High Tension                         | Brifen                             | 45.1234, -93.1234;<br>45.3456, -93.3456;<br>45.5678, -93.5678;<br>45.7890, -93.7890;<br>45.9012, -93.9012;<br>45.2345, -93.2345 | Steel      | N/A           | 4           |          |
| Site 1                               | End Terminal       | Road Systems, Inc.   | Fleat 350                            | Wood                               | 45.1234, -93.1234;<br>45.3456, -93.3456   | Steel      | Steel         |             |          |
| Site 2                               | Cable Anchor       | HTCB_ANCHOR - Anchorage Assemblies for HTCB                  | End Anchorage                        |                                    | 45.1234, -93.1234   | Steel      | N/A           |             |          |
| Site 5                               | Crash Cushion      | Barrier Systems by Lindsay                                   | Universal TAU                        | TAU-II                             | 45.1234, -93.1234;<br>45.3456, -93.3456   | Steel      | Plastic       |             |          |

# Data Quality Management Examples – Asset Inventory Using Work Manager

AgileAssets Work Manager

← Back Save

Asset NEW (Linear Barriers)


- Linear Barriers Inventory
- Linear Barriers Details**

## Linear Barriers Details

**Location** Remove location

**Route**  
03000000000000055-D

**BMP**  
194.618



**Latitude / Longitude**  
44.9296036 , -93.2253988

**Direction**  
Optional

**Lane**  
Optional

**Offset**  
11.837

AgileAssets Work Manager

← Back

Asset NEW (Linear Barriers)

- Linear Barriers Inventory**
- Linear Barriers Details

## Linear Barriers Inventory

Linear Barriers  
[DM\\_11072023\\_1144](#)

Linear Barriers Status  
[Inplace](#)

Linear Barriers Class Code  
[Plate Beam](#)

Category Type  
[W-Beam](#)

Administrative Unit  
[7363 - Cedar SubArea](#)

Curb Height  
[Greater than 3](#)

# Data Quality Management Examples – Asset Inventory Using LiDAR Data

The screenshot displays a GIS application interface with several key components:

- Map:** An aerial view of a road intersection with various pavement markings overlaid. A red 'X' marks a specific location on the road.
- Legend:** A panel on the left titled "Legend" with two sections:
  - Asset Review:** A list of colored dots representing different review statuses: MnDOT Review (purple), Accepted (green), Rework Completed (yellow), Rework Required (red), and others (grey).
  - Axim:** A section titled "Pavement Markings - Collected" with a table of "Roadway Markings Type/Color Symbology".
- Pavement Markings - Collected Table:** A table listing various pavement marking types and their corresponding colors and line styles.

| Roadway Markings Type/Color Symbology | Color  |
|---------------------------------------|--------|
| Solid                                 | White  |
| Solid                                 | Yellow |
| Dotted                                | White  |
| Broken                                | White  |
| No passing-D                          | Yellow |
| No passing-I                          | Yellow |
| Broken                                | Yellow |
| Double                                | Yellow |
| Double                                | White  |
| Other                                 |        |
- Table of Properties:** A table on the right titled "Pavement Markings - Collected" showing details for a selected feature.

| Property              | Value                 |
|-----------------------|-----------------------|
| Pvmt Stripe ID        | 50838                 |
| Line Type Code        | Solid                 |
| Line Color            | White                 |
| Line Width            | 4                     |
| Miles of Paint        |                       |
| Travel Direction      | D                     |
| Construction District | 7000 - Metro District |
- Oriented Imagery:** A window at the bottom right showing a street-level view of the road from a vehicle's perspective, dated 9/17/2022.
- Map Controls:** Standard GIS navigation tools (zoom, pan, home, etc.) are visible on the left and bottom.



# Data Quality Management Examples – Asset Inventory LiDAR Data Sampling

| ISO 2859 "Sampling procedures for inspection by attributes"      |        |                    |                 | example estimation for Pilot data, corridor hwy 2, sign structures |         |             |  |
|--|--------|--------------------|-----------------|--|---------|-------------|--|
| z  | z2     | population Portion | margin of error | Population size  | n       | n1          |  |
| 1.96   | 3.8416 | 0.95               | 0.05            | 1500   | 72.9904 | 69.64775357 |  |
| c: Confidence Level = .95  |        |                    |                 | Unlimited Population: $n = (z^2 * p * (1-p)) / m^2$                |         |             |  |
| z: z-score = 1.96 (known)  |        |                    |                 |  |         |             |  |
| m: Margin of error = .05   |        |                    |                 | Finite Population: $n1 = n / (1 + ((n-1)/N))$                      |         |             |  |
| N: Population Size (assets per corridor, per delivery)           |        |                    |                 |  |         |             |  |
| p: Population Proportion = use confidence level (worst case: .5) |        |                    |                 |  |         |             |  |

# Data Quality Management Examples – Performance Measures Reporting

High quality pavement maintenance data leads to reliable performance measures, which help determine work plans

| Year of Rehab | Construction_District_Name | Measure_Cat | SUM_In_mi | MEASURE_NAME                | ACTIVITY_LANE_MI | PERCENT_COMPLETE | CURRENT_LOS | TARGET_STATUS |
|---------------|----------------------------|-------------|-----------|-----------------------------|------------------|------------------|-------------|---------------|
| 2016          | D1-DULUTH                  | THICK       | 74.96     | D1-DULUTH THICK 2016        | 3.164            | 4.22%            | < C         | BELOW         |
| 2016          | D1-DULUTH                  | THIN        | 62.898    | D1-DULUTH THIN 2016         | 20.0474          | 31.87%           | < C         | BELOW         |
| 2016          | D2-BEMIDJI                 | NEW         | 2.734     | D2-BEMIDJI NEW 2016         | 0                | 0.00%            | < C         | BELOW         |
| 2016          | D2-BEMIDJI                 | THICK       | 84.752    | D2-BEMIDJI THICK 2016       | 50.7056          | 59.83%           | C           | BELOW         |
| 2016          | D2-BEMIDJI                 | THIN        | 16.724    | D2-BEMIDJI THIN 2016        | 0                | 0.00%            | < C         | BELOW         |
| 2016          | D3-BRAINERD                | NEW         | 19.634    | D3-BRAINERD NEW 2016        | 0                | 0.00%            | < C         | BELOW         |
| 2016          | D3-BRAINERD                | THICK       | 59.514    | D3-BRAINERD THICK 2016      | 9.87             | 16.58%           | < C         | BELOW         |
| 2016          | D3-BRAINERD                | THIN        | 160.04    | D3-BRAINERD THIN 2016       | 25.62            | 16.01%           | < C         | BELOW         |
| 2016          | D4-DETROIT LAKES           | NEW         | 13.756    | D4-DETROIT LAKES NEW 2016   | 4.644            | 33.76%           | < C         | BELOW         |
| 2016          | D4-DETROIT LAKES           | THICK       | 106.328   | D4-DETROIT LAKES THICK 2016 | 18.6144          | 17.51%           | < C         | BELOW         |
| 2016          | D4-DETROIT LAKES           | THIN        | 2.646     | D4-DETROIT LAKES THIN 2016  | 0.732            | 27.66%           | < C         | BELOW         |
| 2016          | D6-ROCHESTER               | NEW         | 1.504     | D6-ROCHESTER NEW 2016       | 0                | 0.00%            | < C         | BELOW         |
| 2016          | D6-ROCHESTER               | THICK       | 49.316    | D6-ROCHESTER THICK 2016     | 1.512            | 3.07%            | < C         | BELOW         |
| 2016          | D6-ROCHESTER               | THIN        | 13.653    | D6-ROCHESTER THIN 2016      | 0                | 0.00%            | < C         | BELOW         |
| 2016          | D7-MANKATO                 | NEW         | 9.066     | D7-MANKATO NEW 2016         | 0                | 0.00%            | < C         | BELOW         |
| 2016          | D7-MANKATO                 | THICK       | 133.422   | D7-MANKATO THICK 2016       | 61.238           | 45.90%           | < C         | BELOW         |
| 2016          | D7-MANKATO                 | THIN        | 14.908    | D7-MANKATO THIN 2016        | 8.144            | 54.63%           | C           | MEETS         |
| 2016          | D8-WILLMAR                 | THICK       | 60.688    | D8-WILLMAR THICK 2016       | 65.992           | 108.74%          | A           | MEETS         |
| 2016          | D8-WILLMAR                 | THIN        | 135.516   | D8-WILLMAR THIN 2016        | 107.897          | 79.62%           | B           | MEETS         |

# Data Quality Management Examples – Performance Measures Reporting

**The information shared is gathered for each district.**

**Make sure the work you perform on the system is reported.**

**TAMS**

**CHIMES**

**HPMA**

# Data Quality Management Examples – Performance Measures Reporting

The in

## DISTRICT 6 Edge Joint Sealing

### Concrete Pavements with Bituminous Shoulders

?? lane miles

### Joint Sealing Performed

?? lane miles

Performance = ??%

Target = 80%

**How can this Performance Measure be documented?**

**There is no activity code established to specifically document this work.**

Make s

TAM

While each of the 5 W's (and 1 H) are important to data quality management, the most important aspect that underpins all of them is clear, concise, documented **COMMUNICATION**.

## Communication regarding:

- Who is responsible for recording data
- What data should they be recording (e.g. labor, equipment, material)
- When should the data be recorded (and reported upon)
- Where data should be recorded (front lines, office staff, contractors)
- Why accurate data recording is crucial (helps with buy-in)
- How the data should be recorded (tools, methods, etc.)

# Thank You!

**Douglas Maki**

*douglas.maki@state.mn.us*

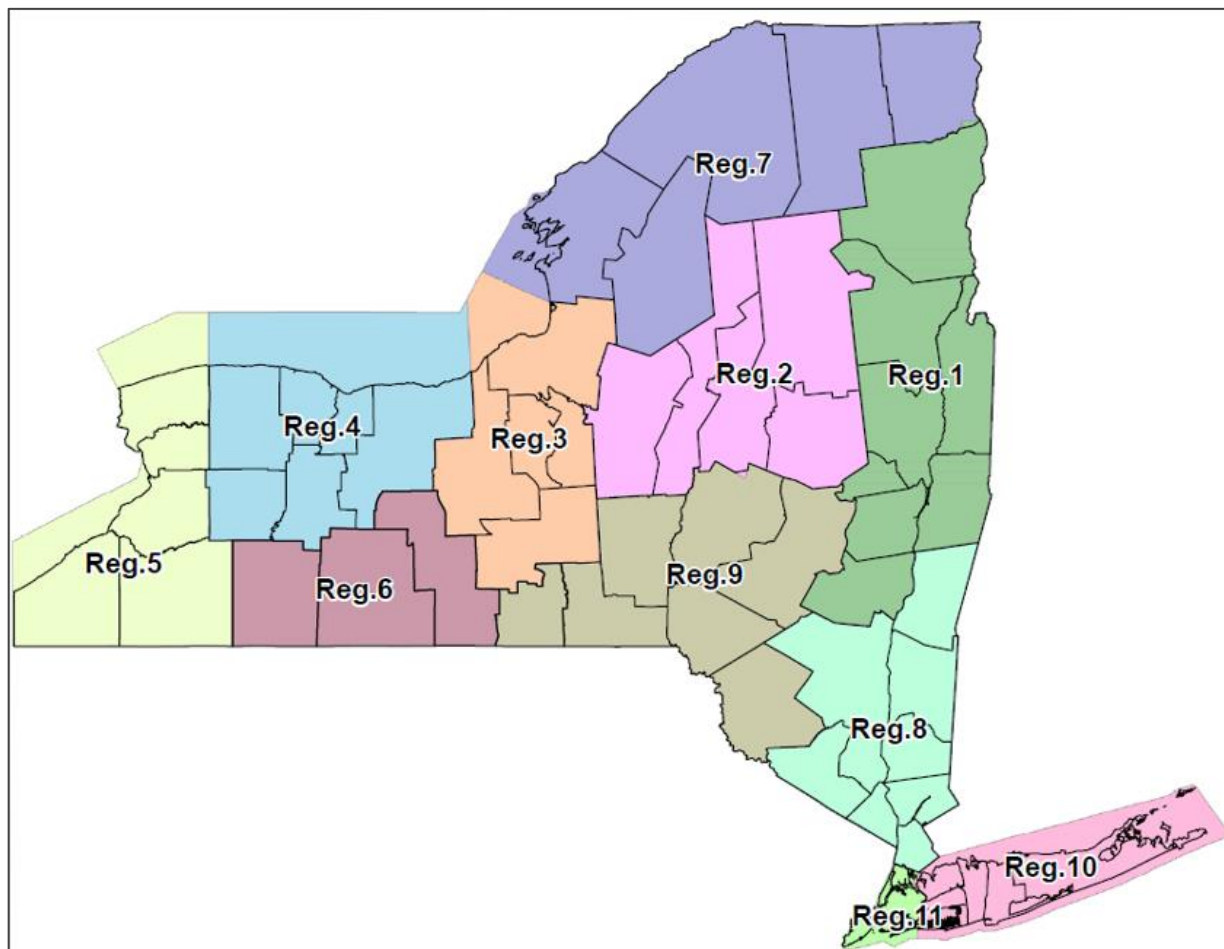
651-234-7044



**Department of  
Transportation**

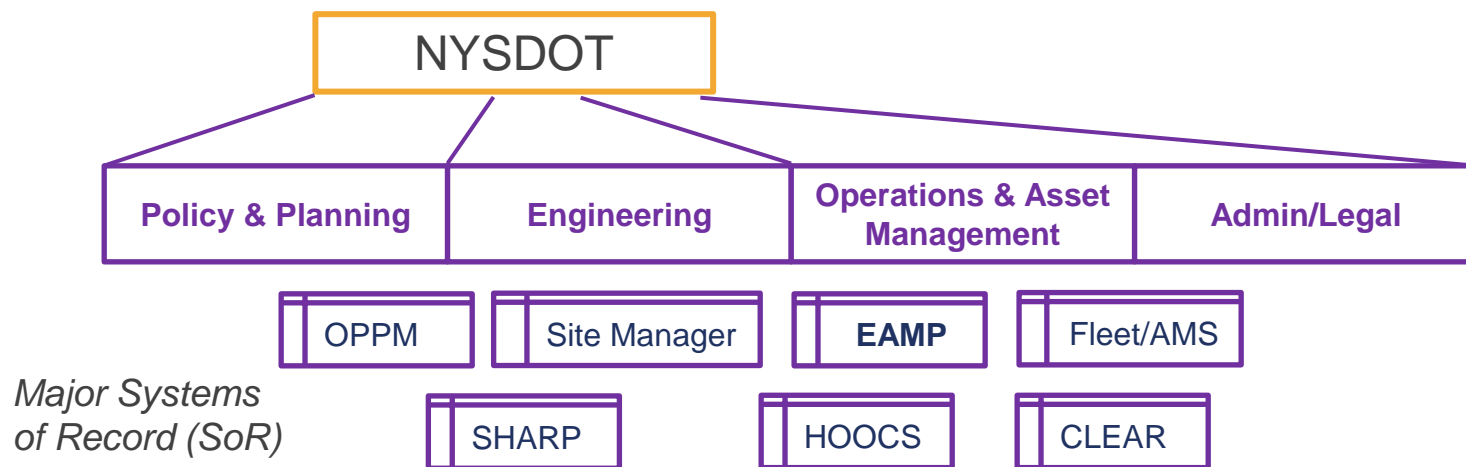
# ***Data Improvement in NYSDOT's Maintenance Management System***

# New York State Department of Transportation

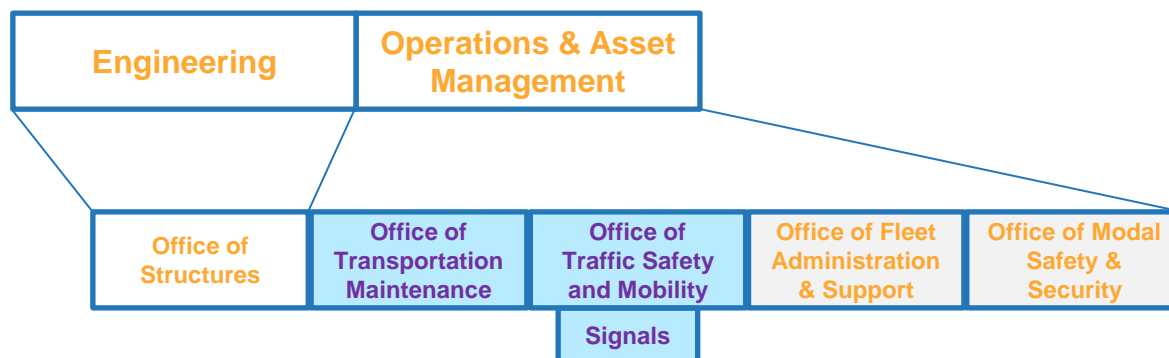




# Enterprise Asset Management Program (EAMP)



# Enterprise Asset Management Program (EAMP)



- Snow and Ice Control
- System Preservation and Repair
- Facilities Operations and Management
- Fiscal and Program Management
- Contract Management
- Training
- Personnel Management and Hiring
- Performance and Asset Management

|      |
|------|
| EAMP |
|------|

# NYSDOT Maintenance Management Systems

## 2006 - 2021

**MAMIS - Daily Work Report - [ 01-MAY-2003 11:18:21 ]**

Field Operations Work Management Reports Special Programs Planning Tables Admin Print Screen Mainforms Exit Window Help

Organization Unit: 999 - test area 999 Region: ONE Date: THURSDAY - MAY 01, 2003 Report Number:

Sub-Organization Unit: 10201-AIKEN - ADMINISTRATION Task:  N Myr Loc: AIKEN Residency of Work: AIKEN Work Order Number:

Asset Group:  Route:  Asset:

Touring Route:  Begin Reference Marker:  End Reference Marker:  Length:  Off System Description:  Accident:

Labor:  Equipment:  Material:  Total \$:   Link Work Res  Comments

**Performance**

Accomplishment Unit:

Units of Accomplishment:

Unit Cost:

DWR Cost:

**Historical Averages**

| Sub Org              | Residency            | Region               | State                | Period Covered             |
|----------------------|----------------------|----------------------|----------------------|----------------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | From: <input type="text"/> |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | To: <input type="text"/>   |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |                            |

# Maintenance Tasks

| Task                              | Task Code | Unit of Measure | Description  |
|-----------------------------------|-----------|-----------------|--|
| Sweeping                          | C64       | Miles           | Sweeping performed by self-propelled pick up sweeper, drawn broom, or manual removal of debris from shoulders, curb side, and gutters adjacent to the roadway. Report manual sweeping as 0.1 mile per location.  |
| Grade Material Behind Shoulders   | D01       | Shoulder Miles  | Grading and removing excess material including vegetation and gravel to reestablish drainage. This includes grading of unstabilized shoulders to reestablish drainage (see D31 for work under guide rail).   |
| Remove Material Under Guiderail   | D31       | Feet            | Mechanical or manual removal of vegetation and soil under guide rail and re-establishment of drainage.   |
| Clean Culverts & Pipes            | G01       | Feet            | Cleaning any culverts or pipes, including driveway pipes, cross culverts and closed drainage systems. Any inlet and/or outlet sumps required for this task are reported under G61. Large culverts, through which a bulldozer might pass, should be reported under G61. |
| Repair Concrete Culvert           | G04       | Cubic Feet      | Repair damaged or deteriorated concrete culvert elements, other than the invert. Includes removal of existing materials, placement of new materials and other related work, as required.   |
| Sliplining or lining Culvert/Pipe | G05       | Feet            | Any culvert or pipe repair, which includes the installation of a new liner pipe or liner system, is reported to this code.   |

# NYS DOT Maintenance Management Systems

## 2021 - Present

Maintenance Manager > Operations > Work Orders > Create New / In Progress Save Reload

**Work Orders** Actions

| WR# | Project/Contract (Description) | WO#     | Activity                      | Job | Primary Owner      | Responsibl... | Asset Type    | Status | * Estimated Star... | * Estimate |
|-----|--------------------------------|---------|-------------------------------|-----|--------------------|---------------|---------------|--------|---------------------|------------|
|     | 23/24 Planned Drainage         | 1719907 | 4G18-Mnt,Repl,Inst Dr Basins  |     | 424001 - LAKEVILLE |               | Small Culvert | Active | 7/20/23             | 8/2/2      |
|     | 23/24 Planned Drainage         | 1718271 | 4G18-Mnt,Repl,Inst Dr Basins  |     | 424001 - LAKEVILLE |               | Small Culvert | Active | 7/17/23             | 7/19/2     |
|     | 23/24 Planned Patching/Repairs | 1712742 | 4B31-Pothole Repair           |     | 424001 - LAKEVILLE |               | Section       | Active | 7/6/23              | 7/19/2     |
|     | 23/24 Planned Patching/Repairs | 1719886 | 4B31-Pothole Repair           |     | 424001 - LAKEVILLE |               | Section       | Active | 7/20/23             | 8/2/2      |
|     | 23/24 Planned Patching/Repairs | 1731907 | 4B20-Cold Milling             |     | 424001 - LAKEVILLE |               | Bridges       | Active | 8/3/23              | 8/16/2     |
|     | 23/24 Planned Patching/Repairs | 1730488 | 4B31-Pothole Repair           |     | 424001 - LAKEVILLE |               | Section       | Active | 8/3/23              | 8/16/2     |
|     | 23/24 Planned Sign Work        | 1719892 | 4X11-Maint Ground Mount Signs |     | 424001 - LAKEVILLE |               | Sign Assembly | Active | 7/20/23             | 8/2/2      |
|     | 23/24 Planned Sign Work        | 1712747 | 4X11-Maint Ground Mount Signs |     | 424001 - LAKEVILLE |               | Sign Assembly | Active | 7/6/23              | 7/19/2     |
|     | 23/24 Planned Sign Work        | 1730493 | 4X11-Maint Ground Mount Signs |     | 424001 - LAKEVILLE |               | Sign Assembly | Active | 8/3/23              | 8/16/2     |

<< < 32 of 74 total rows >>

**Labor** **Equipment** **Material** **Accomplishments** Location/Asset **Time Entry**

**Work Target** Actions

| Structure ID | Approved                            | * Work Date | Region | Residency                  | Begin RM: Line 1 | Begin RM: Line 2 | Begin RM: Line 3 | "+" Ft. fr... | RM: Tra... | End RM: Line 1 | End F |
|--------------|-------------------------------------|-------------|--------|----------------------------|------------------|------------------|------------------|---------------|------------|----------------|-------|
|              | <input checked="" type="checkbox"/> | 7/6/23      |        |                            | 20A              | 4203             | 1084             | 31.68         | All        | 20A            | 4203  |
|              | <input checked="" type="checkbox"/> | 7/6/23      |        |                            | 39               | 4206             | 1174             | 448.8         | All        | 39             | 4206  |
|              | <input checked="" type="checkbox"/> | 7/14/23     | 04     | 424 - LIVINGSTON RESIDENCY | 436              | 4202             | 1012             | 0             | Ascending  | 436            | 4202  |
|              | <input checked="" type="checkbox"/> | 7/17/23     | 04     | 424 - LIVINGSTON RESIDENCY | 5                | 4204             | 1026             | 0             | Ascending  | 5              | 4204  |
|              | <input checked="" type="checkbox"/> | 7/17/23     |        |                            | 36               | 4202             | 1173             | 332.64        | All        | 36             | 4202  |

# Maintenance Tasks

System > Setup > Asset Activity ☆ Save Reload

**Asset Types** Actions ▾

- Section
- Equipment
- Audible Roadway Delineator
- Beat
- Employee
- Facilities
- Guide Rail**
- Linear Drainage
- Point Drainage
- Sidewalk
- Sidewalk Ramp
- Sign Assembly
- Signals
- Site

**Selected Activities** Actions ▾ ☰ ☲

- Activity
- ▶ 0636-Accident Damage Recovery
- 4D31-Rem. Mat Under Guiderail
- 4F62-Maintain Cable Guide Rail
- 4F63-Maintain Cable Guide Rail

| Asset Type    | Table Name              | User Update | Date Updated |
|---------------|-------------------------|-------------|--------------|
| Small Culvert | SMALL_CULVERT_INVENTORY | SYSTEM      | 11/3/2011    |
| ▶ Guide Rail  | GUIDERAIL_INVENTORY     | SYSTEM      | 8/16/2011    |

System > Setup > Activities ☆

**Activity Tree** Actions ▾ ☲

- [-]  Activities
  - [-]  Common Activities
    - 4A82-Receive Training
    - 4A83-Provide Training
    - 4A11-Manage Field Operations
  - [+]  MMS Activities
  - [+]  OSS Activities
  - [-]  Overhead Activities
    - 0130-Meetings and Conferences
    - 0138-Employee Donations
    - 0190-Witness for Dept. Hearing
    - 0191-Internal Affairs of Union
    - 0193-Investigate Disciplinary Grievance
    - 0194-Investigate Process Grievance
    - 0195-Labor and Management Meeting

**Activity** Actions ▾

- \* Activity
- ▶ 0110-General Administration
- 0114-Project Management
- 0121-General Office Services
- 0130-Meetings and Conferences
- 0138-Employee Donations
- 0190-Witness for Dept. Hearing
- 0191-Internal Affairs of Union
- 0193-Investigate Disciplinary Grievance
- 0194-Investigate Process Grievance
- 0195-Labor and Management Meeting

# Data Validation

- On time entry data

Resources > Operations > Time & Attendance > Time Entry Save Reload

Date: 10/26/23 Admin Unit: 174001 - WARRENSBUR

| Employee               | Actions | Admin Unit           | Employee Name            |
|------------------------|---------|----------------------|--------------------------|
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BAGWELL, DONALD M-67301  |
| ▶ 174001 - WARRENSB... |         | 174001 - WARRENSB... | BAKER, STEPHEN -67078    |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BELDEN, DARREN -67132    |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BENNETT, SCOTT A-67067   |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BLAIR, JAMES -67146      |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BLANCHARD, LARRY -67148  |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BRADWAY, REBECCA -67021  |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BRAMER, DEAN C-67053     |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BRENNER, GEORGE -66031   |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BROWN, AARON -67109      |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BROWN, JUSTIN -67363     |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | BUCKOWSKI, TREVOR -67134 |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | COOPER, KYLE -67145      |
| 174001 - WARRENSB...   |         | 174001 - WARRENSB... | DACHEL, BRYAN K-60050    |

| Start Time       | Lunch Start Time | Lunch End Time   | End Time         | Scheduled Hours | Present | Absent | Over Time | OT |
|------------------|------------------|------------------|------------------|-----------------|---------|--------|-----------|----|
| 10/26/2023 13:00 | 10/26/2023 17:00 | 10/26/2023 17:30 | 10/26/2023 21:30 | 8               | 0       | 0      | 0         | 0  |

<< 1 of 1 total rows >>

| * WO# - Supervisor - Activity             | * Start Time     | * End Time       | Recall                              | Comment | LATS Error        |
|---|------------------|------------------|-------------------------------------|---------|-------------------|
| ▶ 1771895 - - 4F63-Maint W Beam Guiderail | 10/26/2023 13:00 | 10/26/2023 14:00 | <input checked="" type="checkbox"/> |         | EmployeeID: 66070 |

<< 1 of 1 total rows >>

| * Start Time | * End Time |
|--------------|------------|
|              |            |

| Unschedu... | Leave Category Id | * Leave Type Id | * Leave Durati |
|-------------|-------------------|-----------------|----------------|
|             |                   |                 |                |

# Data Validation

- On data entry

Salt Rate (Pounds/Lane Mile) values must be between 0 and 1000.0

Salt Rate = 2000.0.

These columns appear to have exact same values. Please review and edit if needed

row 1:

Dry Material Quantity (Tons) (24C) = 5

Liquid Material Quantity (Gals) = null

Total spread miles for all lanes = 5

OK

Work Order Equipment Log (Plow Entry)

Plow Entry Actions ▼

|                                       |                                     |                            |
|---------------------------------------|-------------------------------------|----------------------------|
| * Work Date<br>6/20/23                | * WO#<br>1611768                    | * Equipment<br>225060P - P |
| * Loading Point<br>514001 - SALAMANCA | Reload Point                        | Off Load Point             |
| * Operator From<br>514001 - SALAMANCA | * Operator<br>FRENTZ, DAVID P-60404 | Assistant Operator From    |

<< < 1 of 1 total rows >>

---

\* Equipment Trip Details Actions ▼

|   |                                  |  |
|---|----------------------------------|--|
| * End Time (20)<br>6/20/23, 13:00:00    | Trip Duration<br>8               | * Odometer Start (22A)<br>200            |
| * Odometer End (22B)<br>250             | Trip Miles<br>50                 | * Dry Material (23)<br>106 - Salt - Bulk |
| * Dry Material Stock<br>Bulk Salt       | * Dry Material Start (24A)<br>10 | * Dry Material End (24B)<br>15           |
| Dry Material Quantity (Tons) (24C)<br>5 | Reload Pt. Dry Mat. Qty (Tons)   | * Spread Mile Start (27A)<br>200         |
| * Spread Mile End (27B)                 | Number of Lanes Spread (28A)     | Total Spread Miles for All Lanes         |

<< < 1 of 1 total rows >>

Ok Cancel



# Data Validation

## Maintenance Core Work Summary- Statewide Bi-Weekly Report, PP # 14 (9/28/2023 - 10/11/2023)

A summary of Core Infrastructure Maintenance and Repair done by Maintenance Forces during the previous Pay Period; does not include all work done

### Program: Pavement Maintenance & Preservation

| Work Category                   | Accomplishment | UNIT       | Material Costs | Labor Hours - Total |
|---------------------------------|----------------|------------|----------------|---------------------|
| Paving                          | 6              | Lane Miles | \$0            | 1,838               |
| Patch & Shim                    | 4740           | Tons       | \$147,005      | 22,508              |
| Conc Pav Blowups & Joint Repair | 103            | Each       | \$600          | 1,998               |
| Pavement Milling                | 14             | Lane Miles | \$3,000        | 3,312               |
| Crack Sealing                   | 2              | Lane Miles | \$0            | 119                 |
| Shoulder Grading                | 103            | Lane Miles | \$7,541        | 5,531               |

### Program: Safety

| Work Category                    | Accomplishment | UNIT  | Material Costs | Labor Hours - Total |
|----------------------------------|----------------|-------|----------------|---------------------|
| Guide Rail Repair                | 3              | Miles | \$92,168       | 7,739               |
| Bridge Rail Repaired             | 293            | Feet  | \$205          | 795                 |
| Traffic Signs Installed/Repaired | 3199           | Each  | \$151,099      | 7,918               |



# Data Validation

The image is a composite of four panels illustrating data validation in a fleet management system:

- Top Left:** A dashboard interface for "e099 assets". It includes a search bar, filters for "Tags", "Attributes", and "More", and a "Sort" dropdown. A list of assets is shown with details such as ID (e.g., 005510), location (e.g., 30 Flat Rock Road, 6.2 mi WSW Plattsburgh, Clinton County, NY, 12962), and speed (e.g., 25 MPH).
- Top Center:** A map of the Northeast United States (New York, Vermont, New Hampshire, Massachusetts, Connecticut, Rhode Island, Pennsylvania) with numerous circular markers representing vehicle locations. The markers are color-coded and numbered.
- Top Right:** A detailed map view of a specific route in Vermont. The route is highlighted in blue. A data panel on the left shows trip statistics: 9520h, 208,560 mi, 100% completion, 12.7 V, and 157 °F.
- Bottom Left:** A first-person perspective view from the driver's seat of a truck, showing a snowy road and the truck's hood and mirrors.
- Bottom Center:** A "Trip History" panel with a "Newest → Oldest" dropdown. It lists two trips: "Lowville Residency 10:00 AM (1h 36m) 54.0 mi" and "Lowville Residency Nov 6, 8:23 AM" with "Driver: Unassigned". A "Show trip images" link is visible.

# Maintenance Work Orders

**Maintenance Work Order Viewer**

Street Address, BIN, Ref M:

Map showing Maintenance Work Orders in New York State, overlaid on a geographic map. The work orders are represented by colored lines (green, yellow, red, blue) across the state. Major cities and regions are labeled, including Toronto, Kingston, Albany, and New York City.

**Layer List**

Layers

- Bridge Maint Work Orders
- Drainage Maint Work Orders
- Guiderrail Maint Work Orders
- Pavement Work Orders
- Roadside Env Work Orders
- Signs Work Orders
- Snow & Ice Control Work Orders
- Traffic & Pvmt Marking Work Orders
- Other Work Orders
- All Work Orders \*\*for use with filters\*\*
- Last 3 Months
- Bridges
- Large Culverts

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**NORTH CAROLINA**  
Department of Transportation

# Data Validations in Asset Management

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## Operations Program Management

*8/30/2023*

Connecting people, products and places safely and efficiently with customer focus, accountability and environmental sensitivity to enhance the economy and vitality of North Carolina



# OUR VISION

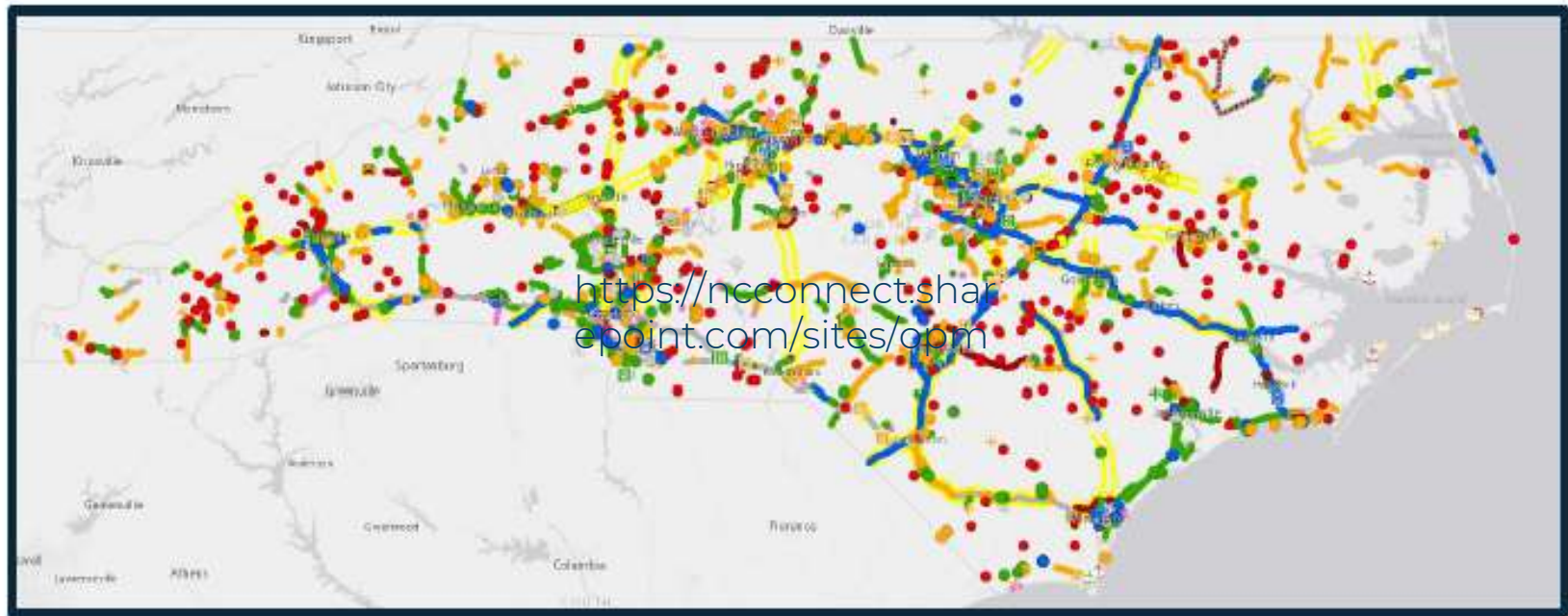
A global leader in providing innovative transportation solutions



## Agenda

- Background on Maintenance Data at NCDOT
- AMS (Asset Management System) / SAP Data Validations
  - Work Activity Unit of Measure - Max Threshold Validation
  - Project ArTEMIS - Required Location Granularity
  - Location Validation - SAP Table / System Error Message
- PMS (Pavement Management System) / PCS Data Validations
  - 2021 Pavement Condition Survey Observations
  - Analysis / Results / Conclusion
  - New data validations built into data collection process for FY 2022
- AIC (Asset Inventory Collection) Data Validations
  - Pipe Inventory
  - Multi-Barrel Pipe Review – Pop-up Errors and SQL scripts
  - Rater Report Cards

## How and where is money being spent?



STI-funded Projects: \$2.2 billion

Clearly connects \$'s planned and performed to locations



## How and where is money being spent?

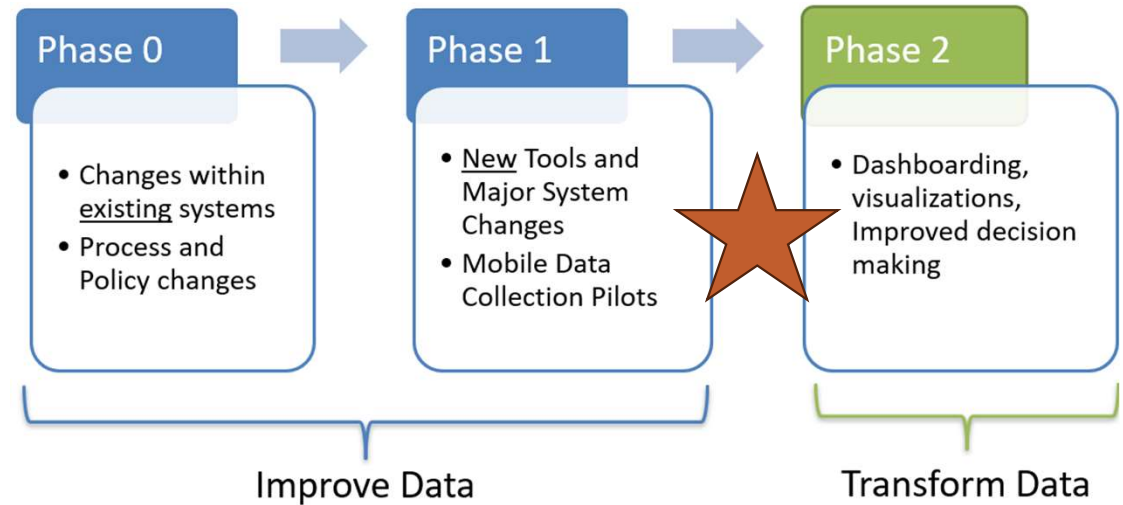


Maintenance Efforts: \$1.95 billion  
(GMR, BPR, CR, PP, BP, RE)

How and where is money being spent?

our **A**dvancing  
**T**ransportation  
**E**cosystem through  
**M**aintenance  
**I**ntelligence  
**S**olutions

Data Validations in Asset Management




# AMS / SAP Data Validations

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## Work Activity Unit of Measure – Max Threshold / High Limit

- High Limits for common work functions are maintained in a table within our SAP financial system
- This limits the work accomplished values that can be entered when recording work activities
- Helps to eliminate typographical errors and mistakes made from extra keystrokes when entering data

**Display View "NCDOT FR-1101 Work Accomplishd Units"**

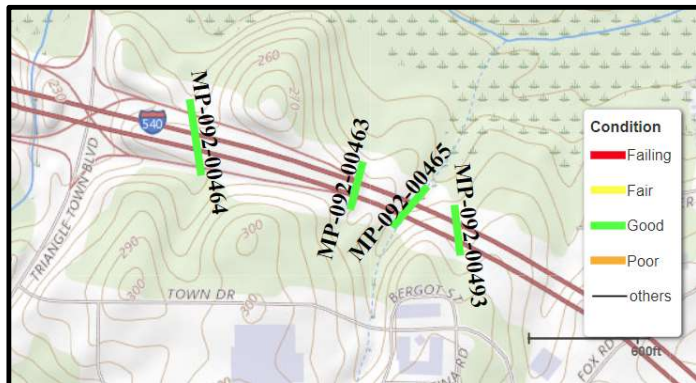


NCDOT FR-1101 Work Accomplishd Units of Measure (Act Type)

| Functional Area | UM  | High limit |
|-----------------|-----|------------|
| 3103            | HR  | 16         |
| 3103C           | HR  | 16         |
| 3104            | SHM | 15         |
| 3104C           | SHM | 15         |
| 3105            | EA  | 0          |
| 3106            | EA  | 0          |
| 3106C           | EA  | 0          |
| 3107            | SFT | 750        |
| 3107C           | SFT | 750        |
| 3108            | SHM | 10         |

## Work Activity Required Location Granularity

- Short list of critical work functions sent to all Division Offices Statewide
- Field crews are required to task these activities within AMS system
- Required level of granularity is listed as a minimum requirement when using these work functions



| ArTEMIS Work Function List |  | <b>ArTEMIS</b> →          |
|----------------------------|--|---------------------------|
| Functional Area            | Functional Area Name                                   | ArTEMIS (Granularity)     |
| 2817                       | Mechanical Asphalt Patching (TON)                      | Y (Route)                 |
| 2817C                      | Mechanical Asphalt Patching (TON)                      | Y (Route)                 |
| 2818                       | Full / Partial Depth Asphalt Pavement Repair (TON)     | Y (Route)                 |
| 2818C                      | Full / Partial Depth Asphalt Pavement Repair (TON)     | Y (Route)                 |
| 2908                       | Brush and Tree Control /Herbicides (SHM)               | Y (Route)                 |
| 2911                       | Manual Brush and Tree Control (SF)                     | Y (Route)                 |
| 2912                       | Mechanical Brush and Tree Control (SHM)                | Y (Route)                 |
| 3108                       | Drainage Ditch Maintenance (SHM)                       | Y (Route)                 |
| 3109                       | Maintenance of Shoulders AND Ditches (SHM)             | Y (Route)                 |
| 3111                       | Minor Shoulder and Drainage Ditch Maintenance (LF)     | Y (Route)                 |
| 3112                       | Shoulder Maintenance / Reconstruction (SHM)            | Y (Route)                 |
| 3115                       | Slope Repair (EA)                                      | Y (Route-MP)              |
| 3115C                      | Slope Repair (EA)                                      | Y (Route-MP)              |
| 3120C                      | Install / Repair / Maintain Barriers (LF)              | Y (Route-MP)              |
| 3122C                      | Maintenance Repair and Replacement of Attenuators (EA) | Y (Route-MP)              |
| 3126                       | Install Pipes (48" or Less) (LFT)                      | Y (Inventory or Route-MP) |
| 3126C                      | Install Pipes (48" or Less) (LFT)                      | Y (Inventory or Route-MP) |

## Work Activity Location Validation - SAP Table

- Short list of critical work functions maintained in a table in our SAP financial system
- "Check Area" field denotes whether the data check is performed during Time Entries or Service Entries
- "Check Attribute" field denotes that the system is checking that the entry has a Task (Work Order) associated with it

**Change View "Work functions to be validated for task"**

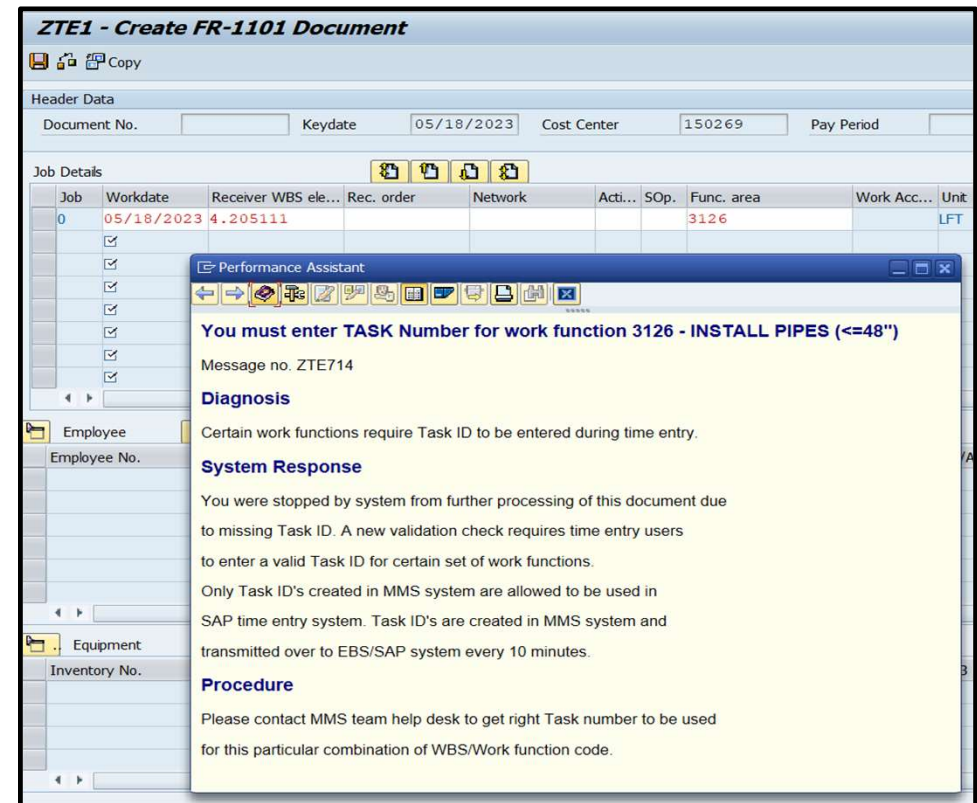
Expand <-> Collapse New Entries Delimit

Work functions to be validated for task route bridge signal

| Functional Area | Check area | Check att | Start Date | End Date   |
|-----------------|------------|-----------|------------|------------|
| 2817            | SE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2817            | TE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2817C           | SE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2817C           | TE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2818            | SE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2818            | TE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2818C           | SE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2818C           | TE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2908            | SE         | TASK      | 11/15/2021 | 12/31/9999 |
| 2908            | TE         | TASK      | 11/15/2021 | 12/31/9999 |

## Work Activity Location Validation - System Error Message

- Error message generated if conditions for entry are not met
- Text box pop-up explains to field user that certain work functions require a Task ID (Work Order) to be entered
- Response / Procedure is conveyed to the users so that the error can be fixed
- This "hard-stop" ensures that charges to certain work activities are tied to a mappable location



# PMS / PCS Data Validations

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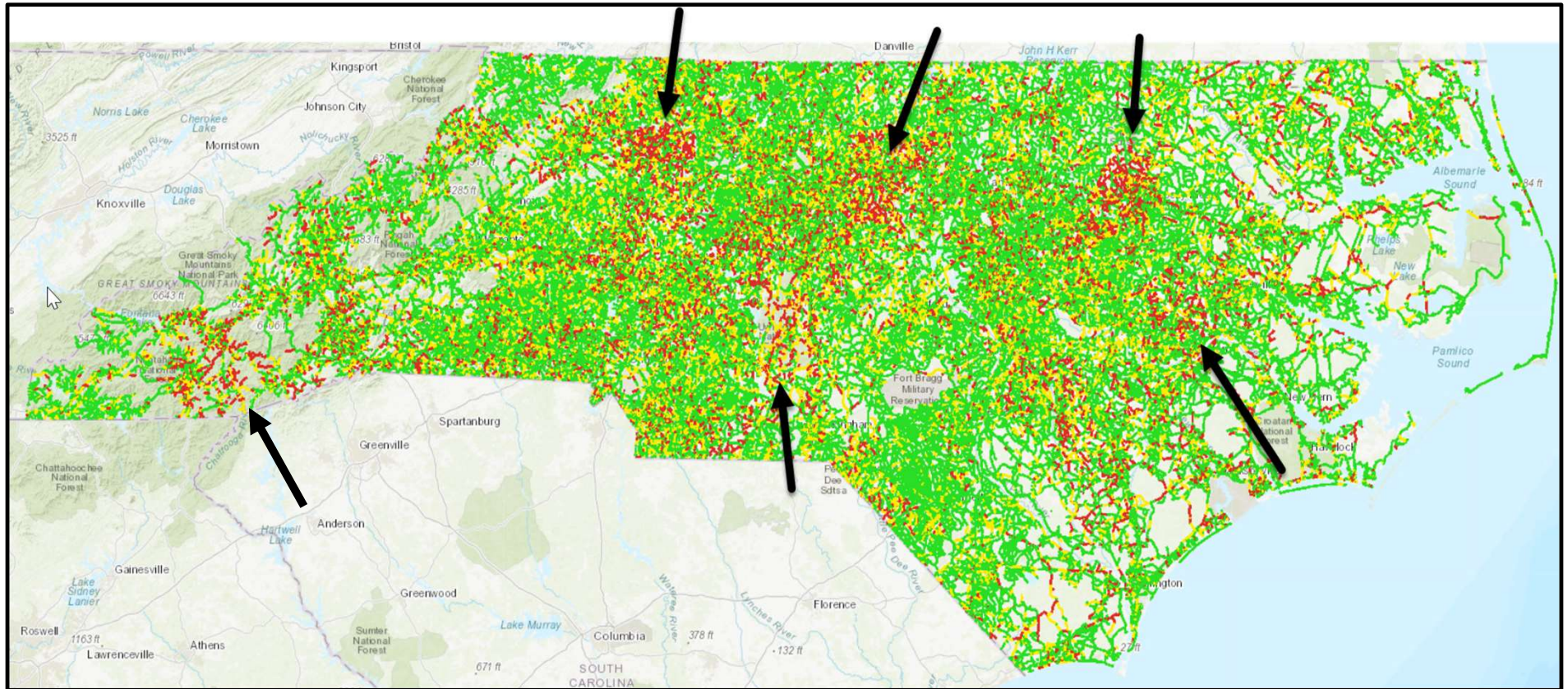


## Importance of Secondary Pavement Condition Data

- Used for multi-level reporting across the department
- TAMP – Federal Report that uses the entire Secondary System condition data
- HPMS – Federal Report due yearly, impacts the federal funding state receives
- HMIP – 5-yr resurfacing and preservation plan due to the NC Legislature yearly
- Pavement Performance Analysis and Resurfacing Funding Needs Legislative Report based on the condition data that is collected during the survey
- High dollar decisions are being made with this data!



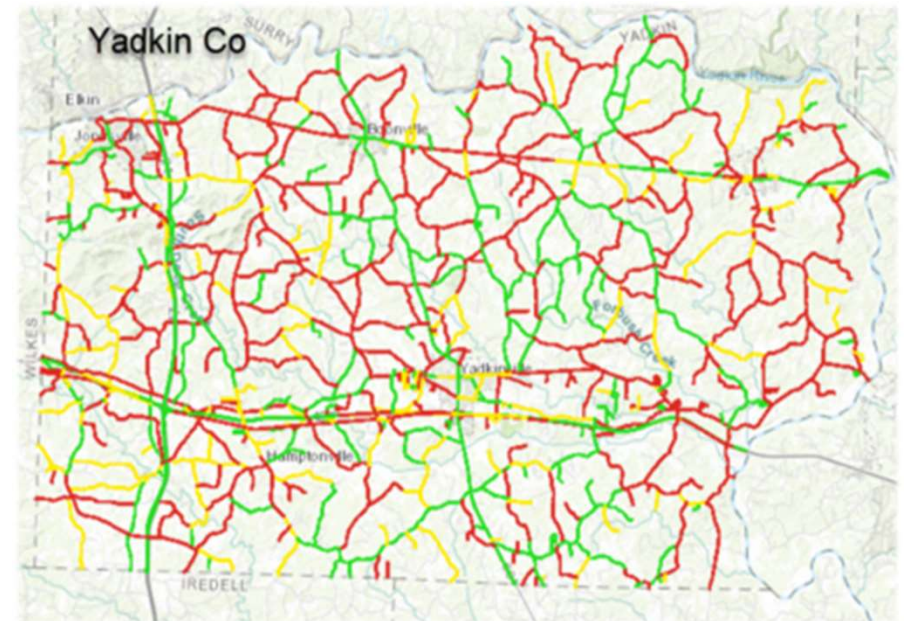
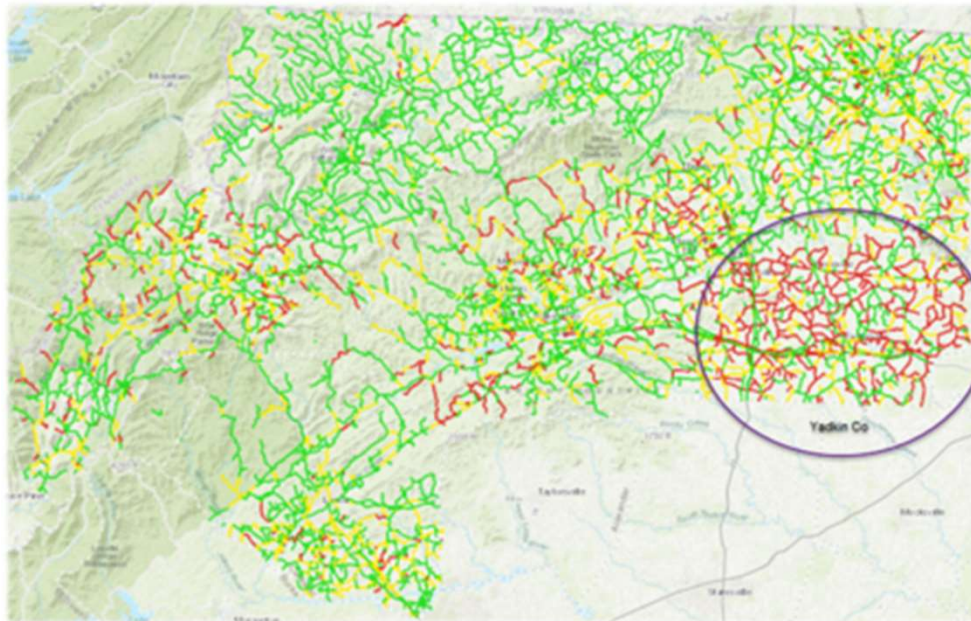
## NCDOT 2021 Secondary Pavement Condition Survey Observations



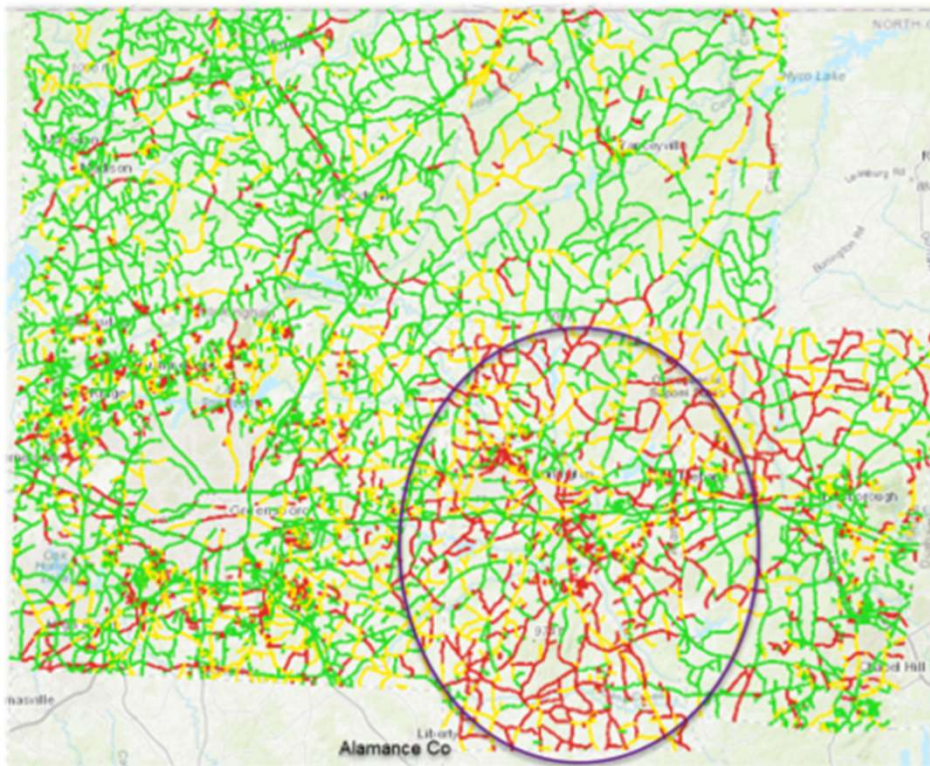
**ncdot.gov**

Data Validations in Asset Management

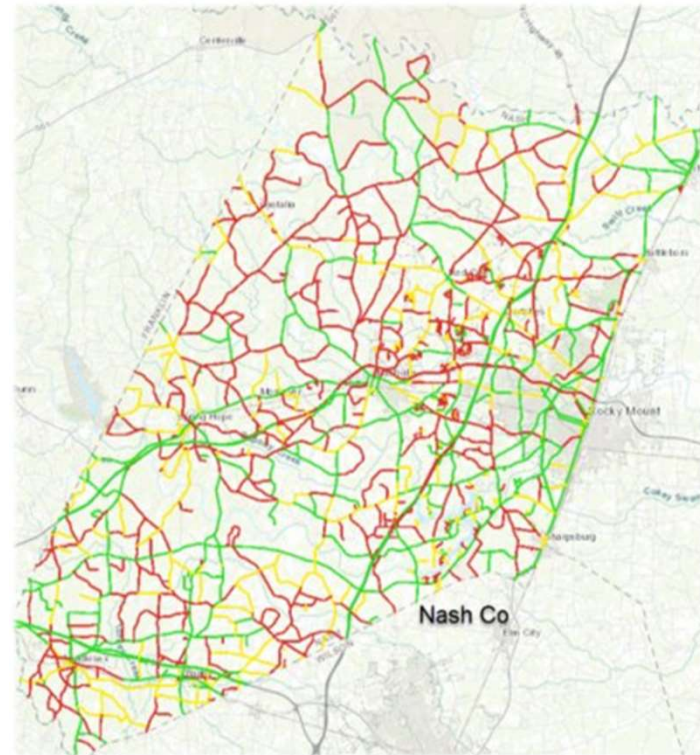
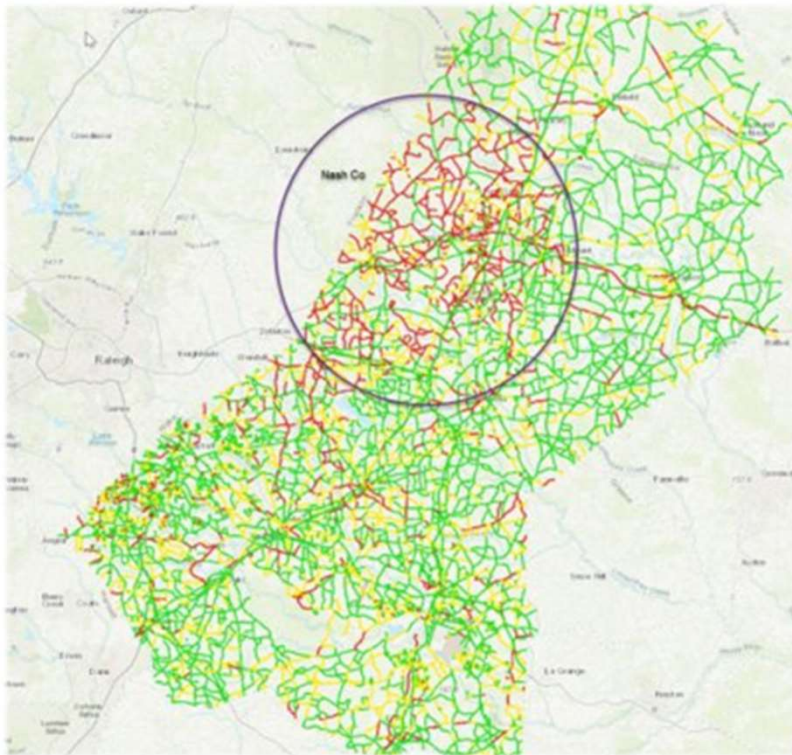
## Division 11 – Yadkin County



## Division 7 – Alamance County



## Division 4 – Nash County



## County List – All affected counties had the same rater team in 2021

| Div. | County          | 2017<br>Avg. Rating | 2021<br>Avg. Rating |
|------|-----------------|---------------------|---------------------|
| 2    | Greene (40)     | 76                  | 60                  |
| 4    | Nash (64)       | 79                  | 59                  |
| 7    | Alamance (1)    | 73                  | 64                  |
| 8    | Montgomery (62) | 87                  | 61                  |
| 9    | Davie (30)      | 82                  | 68                  |
| 11   | Yadkin (99)     | 77                  | 60                  |
| 14   | Jackson (50)    | 71                  | 58                  |

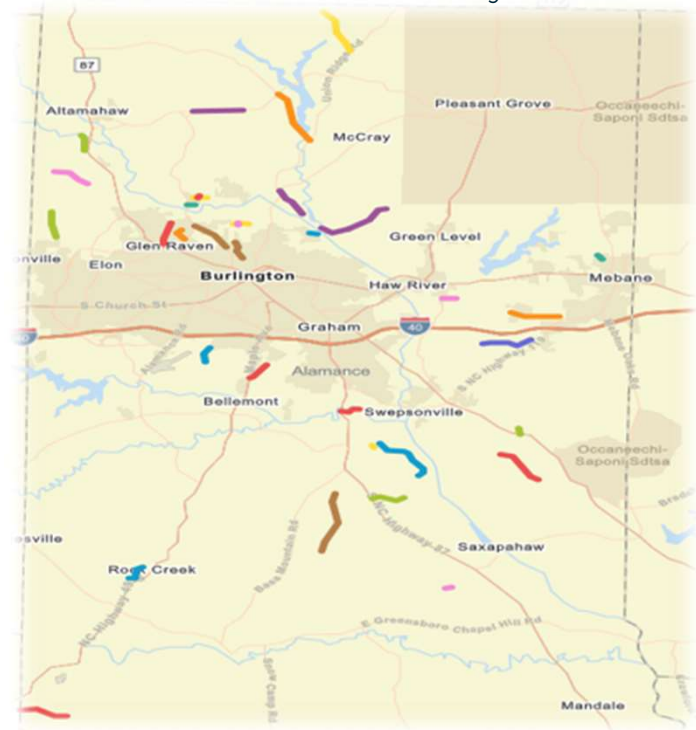
## Site Visits by PMS Engineer

Nash County



24 sections reviewed

Alamance County



24 sections reviewed

## PCS Rating of “0”... But why, the road looks good right?

- Sections rated as overall rating of “0” (rated as 85 from site visit)





## Transverse Cracking and Bleeding

- BST Pavement rated as “**Moderate**” for both types (treated in 2018)

|       | Alligator<br>N L M S | Trans    | Rut      | Rav | Oxi | Bleed    | Ride | Patch | PCR         |
|-------|----------------------|----------|----------|-----|-----|----------|------|-------|-------------|
| Hist  | 8 2 0 0              | L        | L        | L   | N   | M        | L    | N     | 61.4        |
| Rater | 4 4 2 0              | <b>M</b> | <b>L</b> | L   | N   | <b>M</b> | L    | N     | <b>29.8</b> |
| QA    | 7 3 0 0              | L        | L        | L   | N   | L        | L    | N     | 68.1        |
| PMS   | 7 3 0 0              | N        | N        | L   | N   | L        | L    | N     | 78.1        |



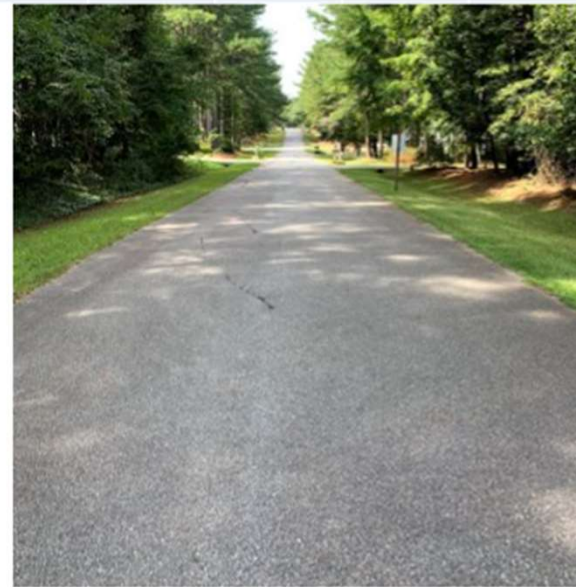
# Oxidation

|       | Alligator<br>N L M S | Trans | Rut | Rav | Oxi | Bleed | Ride | Patch | PCR  |
|-------|----------------------|-------|-----|-----|-----|-------|------|-------|------|
| Hist  | 7 2 1 0              | N     | N   | M   | N   | N     | L    | N     | 75.9 |
| Rater | 3 3 3 1              | M     | M   | N   | S   | N     | L    | N     | 25.0 |
| QA    |                      |       |     |     |     |       |      |       |      |
| PMS   | 7 2 1 0              | N     | N   | N   | N   | N     | L    | N     | 85.9 |

- Plant mix pavement rated as “Severe” but does not show any signs of oxidation (no pitting)



Nash Co.  
SR 2319



# Rutting

- Plant mix pavement rated as “Moderate” rutting

|       | Alligator<br>N L M S | Trans    | Rut      | Rav | Oxi | Bleed    | Ride | Patch | PCR         |
|-------|----------------------|----------|----------|-----|-----|----------|------|-------|-------------|
| Hist  | 4 3 3 0              | M        | N        | N   | N   | N        | L    | N     | 52.6        |
| Rater | 3 3 3 <b>1</b>       | <b>M</b> | <b>M</b> | N   | N   | <b>L</b> | L    | N     | <b>20.0</b> |
| QA    | 3 3 3 <b>1</b>       | <b>M</b> | <b>M</b> | N   | N   | N        | L    | N     | 30.0        |
| PMS   | 6 2 2 0              | L        | N        | N   | N   | N        | L    | N     | 73.4        |



## Conclusion and Resolution

Small errors when rating individual distresses can have a major impact on the final score

2021 Rater overrated most distress types

Primary Contractor & QA/QC Contractor

- Re-rate 8 counties ~4,000 miles
- Consider not using teams 7 / 13 in future years
- Improve communication between raters/QA teams
- Implement better data validations during collection

| Nash County      |                  |                     |
|------------------|------------------|---------------------|
| 2017 Avg. Rating | 2021 Avg. Rating | Survey Avg. Rating* |
| 79               | 35               | 82                  |

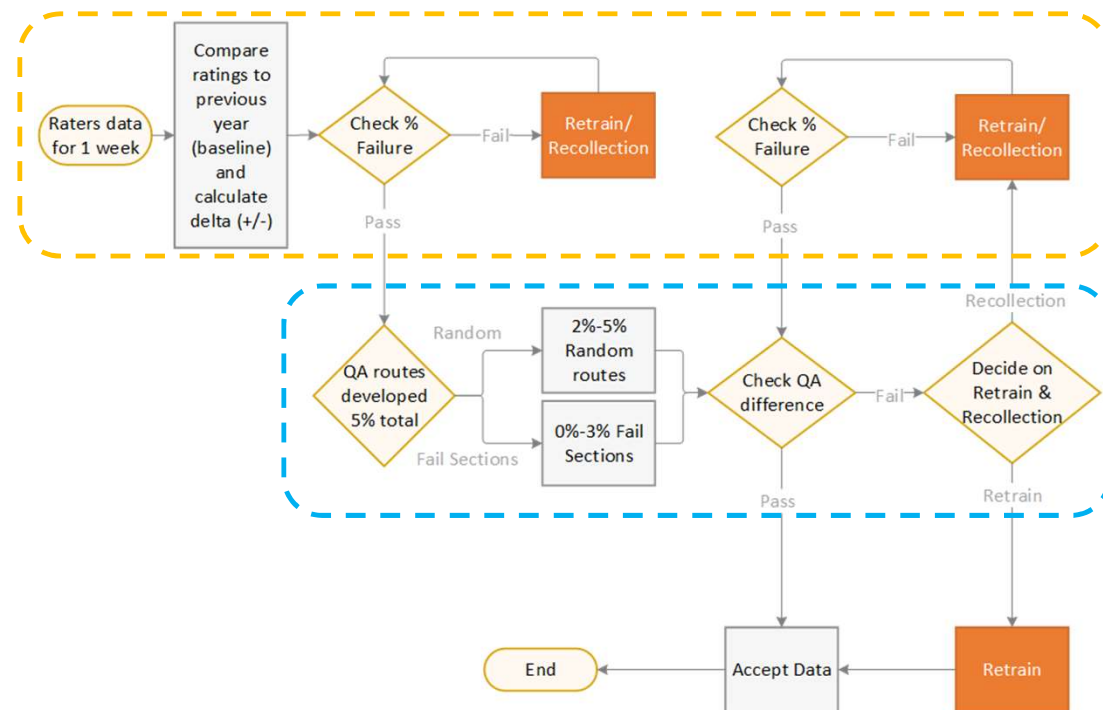
  

| Alamance County  |                  |                     |
|------------------|------------------|---------------------|
| 2017 Avg. Rating | 2021 Avg. Rating | Survey Avg. Rating* |
| 71               | 52               | 80                  |

\*Ratings based on OPM engineers' survey

## Pavement Condition Survey – Data Validation Flowchart

- **Phase 1 Validation** – Compares new rater data to previous year, 60% of the data must be within 15 points of historical values to pass
- **Phase 2 Validation** – 5% of the newly rated mileage (up to 3% failed sections remainder random) is re-assessed by QA teams
- During QA data validation phase, distress rating differences are analyzed to determine data quality before it is accepted



# Rater Report Card Dashboard for monitoring statewide consistency

NCDOT PCS Report Card Dashboard

QA User  
Select QA
Rater  
Choose Raters

QA Sections

# 4,903

Rater: 84,580

Overall Grade

# 91.1%

Avg. Difference from QA PCR

# 5

Avg Dif.

Inventory Fields

Pavement Type  
**98.2%**

Pavement Width  
**98.8%**

Number of Lanes  
**99.9%**

Curb and Gutter

Assessment Fields

Alligator (None)  
**86.5%**

Alligator (Low)  
**87.5%**

Alligator (Moderate)  
**95%**

Alligator (Severe)  
**99.5%**

Transverse Cracking  
**81.9%**

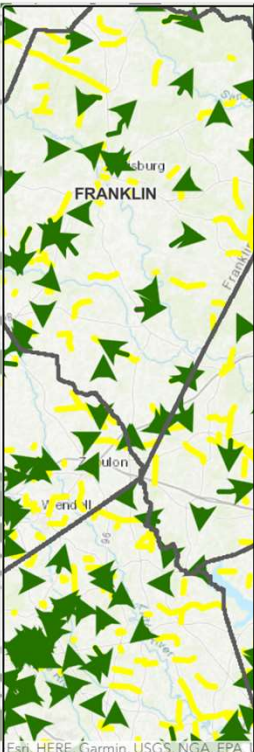
Rutting  
**91.9%**

QA Week Start: 7/5/2023

Overall Score: **87.6** (7 sections)

Breakdown:

| Avg Difference from QA PCR | 7.6 pts       |
|----------------------------|---------------|
| % Higher / Lower           | 100.0% / 0.0% |
| Pavement Type              | 100.0%        |
| Pavement Width             | 100.0%        |
| Number of Lanes            | 100.0%        |
| Curb and Gutter            | 100.0%        |
| Shoulder Type              | 100.0%        |
| Subdivision/Rural          | 100.0%        |
| Cracking (None)            | 85.7%         |
| Cracking (Low)             | 85.7%         |
| Cracking (Moderate)        | 85.7%         |
| Cracking (Severe)          | 100.0%        |
| Transverse Cracking        | 85.7%         |
| Rutting                    | 85.7%         |
| Raveling                   | 85.7%         |
| Oxidation                  | 100.0%        |
| Bleeding                   | 85.7%         |
| Patching                   | 100.0%        |
| Ride Quality               | 85.7%         |



# AIC Data Validations

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## Importance of AIC Pipe Inventory Data

### Non-NBIS Pipes

- Second largest class of NCDOT pipes
- Pipes (round) > 48 inches and culverts; less than 20 feet along the centerline of the road
- Most daylight on both ends
- 27,000+ in inventory

### Maintenance Pipes

- Pipes (round)  $\leq$  48 inches
- Most daylight on both ends
- Does not include driveway pipes
- 350,000+ in inventory

### Storm Drainage Pipes

- Most are maintenance-sized pipes
- Pipes that are part of a closed system (connected to a drainage box on both ends)
- Limited inventory information collected
- Very limited inventory presently (< 15,000)



ArcGIS Online:  
NCDOT pipes



## AIC Process

- Pipes are re-inspected every 5 years
- Collect inventory, condition data and photos
- Program also includes statewide inventory of inlets, retaining walls and noise walls
- Larger pipes are part of NCDOT Structures Management data and are excluded from AIC (> 5,000 NBI-sized pipes and culverts)



## Data Validations in Asset Management

Pipe Type

Coating

Barrel Width Inches

Barrel Height Inches

Barrel Count

Hydraulic Opening Square Feet

Barrel Spacing Inches

Inlet Headwalls

Outlet Headwalls

Length Feet

## Rater Report Cards

- Quality Assurance teams follow behind raters and check for errors
- Report cards inform us on the quality of the data raters are collecting and where there might be issues with the data
- Incorrectly reporting some attributes or missing some condition failures could result in dismissal of the Rater Team

| NON-NBIS PIPES:            | TEAM        | QA          | PASS/FAIL |
|----------------------------|-------------|-------------|-----------|
| PIPE MATERIAL              | CIP CONCRET | CIP CONCRET | PASS      |
| PIPE SHAPE                 | BOX CULVERT | BOX CULVERT | PASS      |
| PIPE LINER                 | NONE        | NONE        | PASS      |
| BARREL WIDTH INCHES        | 42          | 48          | FAIL      |
| BARREL HEIGHT INCHES       | 42          | 48          | FAIL      |
| BARREL COUNT               | 1           | 1           | PASS      |
| BARREL SPACING INCHES      | 0           |             | PASS      |
| INLET HEADWALL TYPE        | HEADWALLS   | HEADWALLS   | PASS      |
| INLET HEADWALL MATERIAL    | CONCRETE    | CONCRETE    | PASS      |
| OUTLET HEADWALL TYPE       | HEADWALLS   | NONE        | FAIL      |
| OUTLET HEADWALL MATERIAL   | CONCRETE    | N/A         | FAIL      |
| INLET CROWN TO BED FEET    | 7           | 8           | PASS      |
| OUTLET CROWN TO BED FEET   | 7           | 5           | PASS      |
| STRUCTURE FAILURE          | NO          | NO          | PASS      |
| EXTERNAL OBSTRUCTION %     | 0%          | 0%          | PASS      |
| INTERNAL OBSTRUCTION %     | 0%          | 20%         | FAIL      |
| SEDIMENT DEPTH INCHES 1ST  | 0           | 11          | FAIL      |
| SEDIMENT DEPTH INCHES 2ND  | 0           | 0           | PASS      |
| INLET SCOUR LENGTH INCHES  | 0           | 0           | PASS      |
| INLET SCOUR DEPTH INCHES   | 0           | 0           | PASS      |
| OUTLET SCOUR LENGTH INCHES | 0           | 0           | PASS      |
| OUTLET SCOUR DEPTH INCHES  | 0           | 0           | PASS      |
| OUTLET PERCH INCHES        | 0           | 0           | PASS      |
| HEADWALL DAMAGE            | GOOD        | GOOD        | PASS      |
| DISTORTION FAILURE         | NO          | NO          | PASS      |
| CRACKING FAILURE           | NO          | NO          | PASS      |
| SPALLING FAILURE           | NO          | NO          | PASS      |
| JOINT FAILURE              | NO          | NO          | PASS      |
| CORROSION FAILURE          | N/A         | YES         | FAIL      |
| ROADWAY SETTLEMENT         | GOOD        | GOOD        | PASS      |
| SHOULDER DAMAGE            | GOOD        | FAIR        | PASS      |
| INLET PICTURE              | GOOD        | POOR        | FAIL      |
| OUTLET PICTURE             | GOOD        | POOR        | FAIL      |
| FAILURE PICTURE            | N/A         | GOOD        | FAIL      |

| MAINTENANCE PIPES:         | TEAM     | QA       | PASS/FAIL |
|----------------------------|----------|----------|-----------|
| PIPE TYPE                  | CONCRETE | CONCRETE | PASS      |
| PIPE SIZE INCHES           | 18"      | 18"      | PASS      |
| BARREL COUNT               | 1        | 1        | PASS      |
| INLET HEADWALLS            | NONE     | NONE     | PASS      |
| OUTLET HEADWALLS           | NONE     | NONE     | PASS      |
| STRUCTURE FAILURE          | YES      | YES      | PASS      |
| PERCENT BLOCKED            | 0%       | 0%       | PASS      |
| EROSION FAILURE            | NO       | YES      | FAIL      |
| CRACKING FAILURE           | YES      | YES      | PASS      |
| JOINT FAILURE              | YES      | YES      | PASS      |
| CRUSHED FAILURE            | N/A      | N/A      | N/A       |
| METAL SECTION LOSS FAILURE | N/A      | N/A      | N/A       |
| PAVEMENT FAILURE           | NO       | NO       | PASS      |
| FAILURE PICTURE            | NO       | YES      | FAIL      |

| INLETS:                | TEAM       | QA       | PASS/FAIL |
|------------------------|------------|----------|-----------|
| INLET TYPE             | DROP       | DROP     | PASS      |
| GRATE COUNT            | 1          | 1        | PASS      |
| GRATE TYPE             | FABRICATED | FABRICAT | PASS      |
| GRATE STD NUMBER       |            |          | N/A       |
| LID LENGTH FEET        |            |          | N/A       |
| LID WIDTH FEET         |            |          | N/A       |
| DEPTH FEET             | < 5 FEET   | < 5 FEET | PASS      |
| BOX TYPE               | CIP        | MASONRY  | FAIL      |
| INVERT COUNT           | 2          | 2        | PASS      |
| STRUCTURE FAILURE      | NO         | NO       | PASS      |
| GRATE/LID FAILURE      | NO         | NO       | PASS      |
| GRATE/LID MISSING      | NO         | NO       | PASS      |
| BLOCKED FAILURE        | NO         | NO       | PASS      |
| APRON FAILURE          | NO         | NO       | PASS      |
| CRACKING/JOINT FAILURE | NO         | NO       | PASS      |
| EROSION FAILURE        | NO         | NO       | PASS      |
| BOX FAILURE            | NO         | YES      | FAIL      |
| INVERT BLOCKED FAILURE | NO         | NO       | PASS      |
| FAILURE PIC            | NO         | YES      | FAIL      |

## Automated Multi-Barrel Data Validation



(2 of 3)

BP-023-0147

|             |              |
|-------------|--------------|
| Pipe ID     | BP-023-0147  |
| County Name | Cleveland    |
| Status      | Not Reviewed |

- 1 Wide Spacing
- 2 Zero Spacing
- 3 Single Barrel with Spacing
- 4 Culvert with Spacing      Culvert with Barrel Spacing
- 5 Large Size with Multi Barrels

Comments 1

Comments 2

[Zoom to](#) [Edit](#) [Get Directions](#)



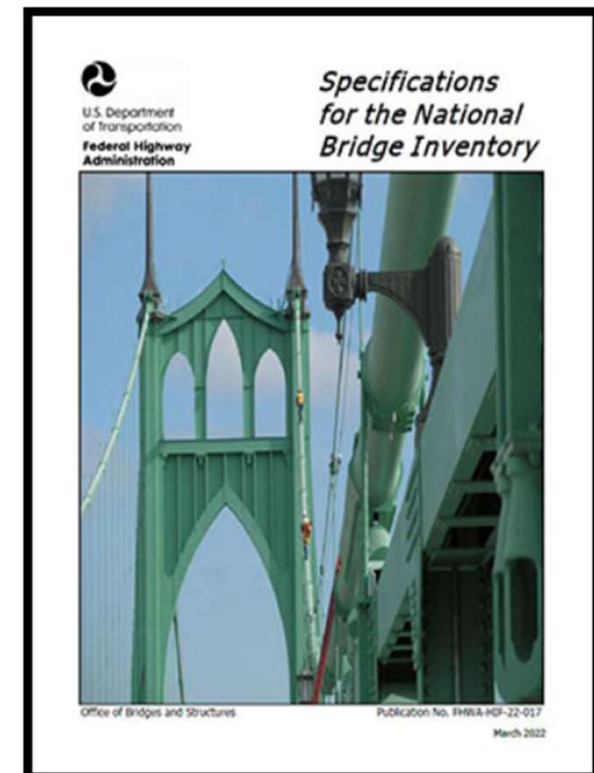
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Data Validations in Asset Management

## **Multi-Barrell Review – Process/Outcome**

- Many data errors were found and corrected
- After field review, some drainage features are sent to Structures Management Unit for evaluation to be classified as an NBI structure
- 42 structures so far have been taken over by SMU into our NBI inventory through this effort

### National Bridge Inventory – Based on the SNBI



**Thanks for your time!**



# Contact Us

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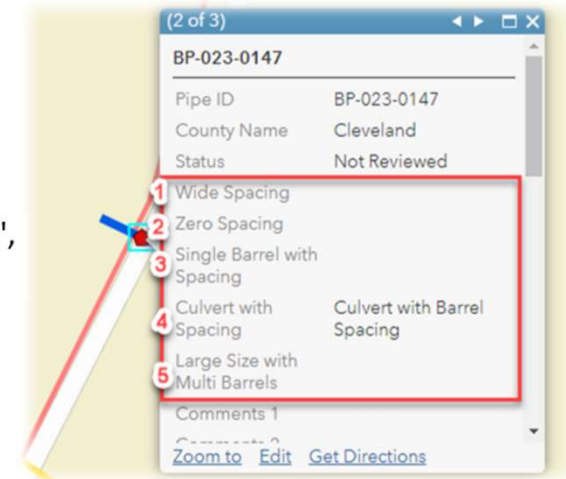
## Multi-Barrell Review – Data Errors

BrlCount IN ('2','3','4','5','6') AND BrlWidth >= 120

PipeType IN ('Aluminum Box Culvert', 'RCBC', 'Precast RCBC') AND BrlSpacing <> 0

BrlCount IN ('2','3','4','5','6') AND BrlSpacing = 0 AND PipeType IN ('Aluminum Pipe', 'CMP-Round', 'Concrete Pipe', 'Concrete Arch', 'Other', 'Pipe Arch-CM', 'Skipped', 'Steel Plate Arch')

BrlSpacing > (BrlWidth / 2)                      BrlCount = '1' AND BrlSpacing > 0



# Today's Presenters



Charles Pilson  
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*Mott MacDonald*



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**January 7-11, 2024**

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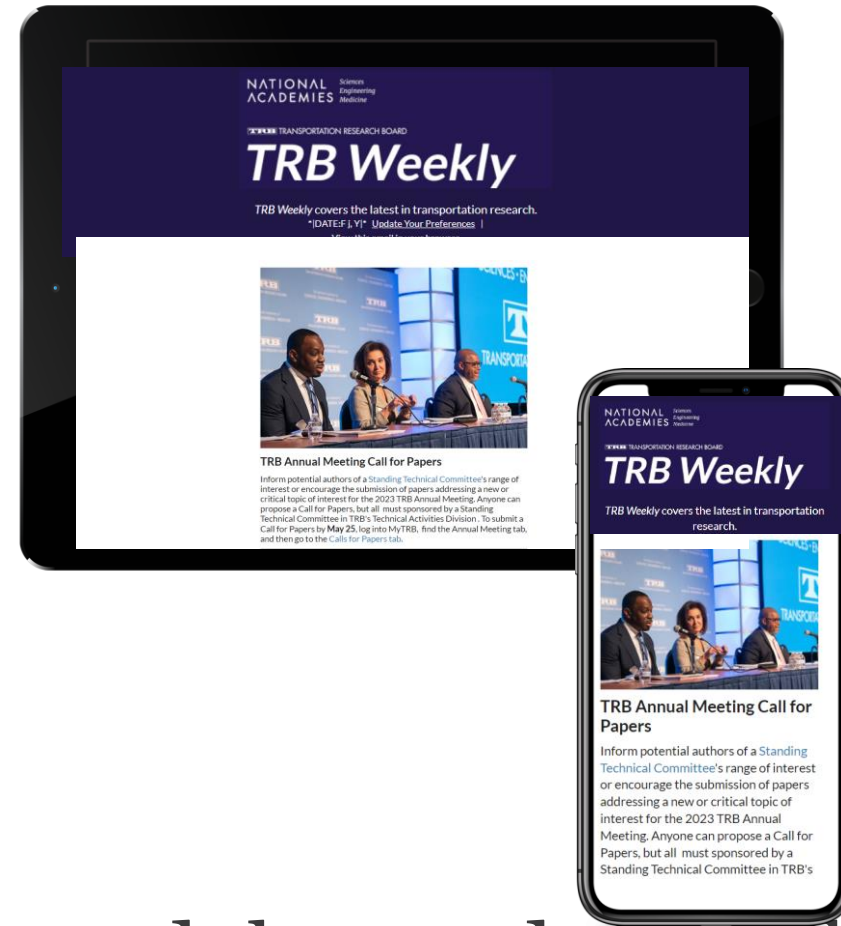


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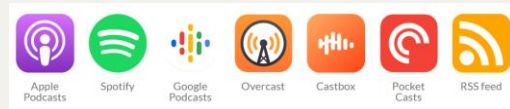
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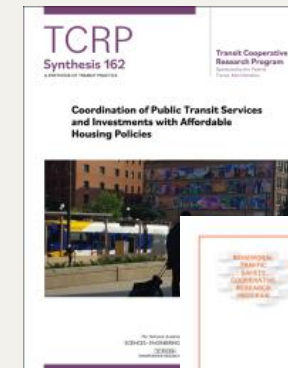
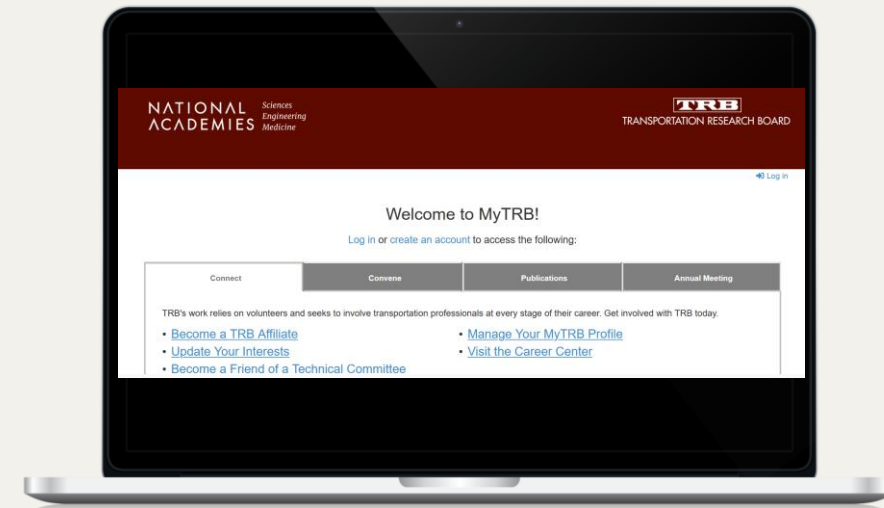
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