Highway Data Workshop
March 19, 2019

Karl Vogel, P.E.
New York State Department of Transportation
Pavement Management
What We Will Cover:

- History
- New Changes in Pavement Condition
- What Are The Benefits
- Potential Disadvantages
- Other Changes
- Timeline/Schedule
- Implementation of Changes
- Local Pavement Data
History
Why Do We Collect This Data?

- Identifies Maintenance and Reconstruction Needs
- Gives an Assessment of System Performance and Deterioration
  - NYS Highway Law
  - Federal Law: Highway Performance Monitoring System Reporting (HPMS)
- Helps Determine Financing Requirements
Two Surveys Conducted For Pavement Condition Data (Prior to 2018)

Visual Windshield/E-Score Survey
- Laptop & Software
- State Vehicle & DMI
- Photographic Rated Distress Images

High-Speed Profiler Survey
- Automated Roadway Analyzer (ARAN)
How & When Were They Done?

**Visual Windshield/E-Score Survey**
- Regional-Based (Including NYSTA)
  - 2-Person Crews, Driver and Rater
- Duration of Survey: April to August
- Survey Performed at Posted Speed Limits

**High-Speed Profiler Survey**
- By Contract Through a Vendor
- QA/QC by State Forces
- Duration of Survey: April through November
- Survey Performed at Posted Speed Limits
What was Collected?

Visual Windshield/E-Score Survey

• **Condition Score**: (Frequency & Severity of Cracking)
  Scale: 1 to 10
  (“1” Being Worst; “10” Being Best)

• **Dominant Distresses**
  ✓ Fatigue (Alligator) Cracking
  ✓ Widening Drop-Off
  ✓ Spalling

• **Classification of Dominant Distresses**
  Isolated (i) – Presence is Less than 20% of Segment being scored
  General (g) – Presence is 20% or Greater of the Segment being scored
  Low (l) – Low Severity of the Dominant Distress
  High (h) – High Severity of the Dominant Distress

High-Speed Profiler Survey

• **Roughness (IRI)**

• **Rutting**

• **Faulting/Bump**

• **Geometric**
  ✓ Grade
  ✓ Cross-Slope
  ✓ Roadway Curvature

• **Crack Data** (began in 2016 for federal performance requirements)

• **Roadway Images**
New Changes in Pavement Condition and Score Generation
One Survey For All Pavement Condition Data

Automated Pavement Distress Survey
- Roughness (IRI)
- Rutting
- Faulting/Bump
- Geometric
  - Grade
  - Cross-Slope
  - Roadway Curvature
- Roadway Images
- Crack Data
  - Surface Score Algorithms
  - Dominant Distress Algorithms
- Secondary Asset Collection
Why The Change?

- The E-Score Application was at the end of its useful life
  - The software would require updating or replacement through a contract
  - All of the hardware was old and obsolete and needed replacement

- Department already collects crack data on a large portion of the NYS highway network per the federal requirement 23 CFR Part 490 National Performance Management Measures

- The crack data is objective and can be easily quantified and analyzed

- Department is moving towards a Pavement Condition Index (PCI) based on the multiple distresses and severities, which the crack data allows
Development Phase

- A pilot project was done in 2015 to collect automated distress data
  - Initially, over 280 fields for distress and severity were collected and they were statistically and quantitively analyzed for score and dominant distress development.
  - An initial algorithm was developed

- In 2016, crack data was collected on the entire Touring and Reference Route Systems and ran through the algorithm, then compared to 2016 regional rater scores.

<table>
<thead>
<tr>
<th>CRACK DETECTION ALGORITHM</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS.</td>
</tr>
<tr>
<td>2016 Surface Score Ratings</td>
</tr>
</tbody>
</table>

- Algorithm was further refined to address score differences greater than 1 point

+/- 1 point - 96% Correlation
Again in 2017, we compared regional rater scores to the automated collection scores.

*There was an issue with the way the distress data for concrete was collected.

The contractor recollected concrete sections in Region 10 using the correct method of collection and the algorithm was further refined for concrete.
How the Algorithm Works

The new pavement scoring algorithm was developed based on the same logic of frequency and severity of surface cracking on the pavement surface.

The algorithm calculates scores and dominant distresses using the same scale and classifications we historically used.
New Score Generation

How Algorithm Uses Crack Data:

- Need to recreate frequency (extent) and severity of cracking
- Need to recreate Dominant Distresses with their classifications
New Score Generation

- Determine frequency (extent) as an area calculation. Build a box around each crack, and express the area in s.f.
  - Lane Width = 12 ft
  - Total Area of Segment (TAS) = 52.8 ft (.01 Mile) * 12 ft = 633.6 sqft.
  - Total Crack Extent Area (TCEA) = 8 sqft + 25 sqft + 18 sqft + 38 sqft + 12 sqft = 101 sqft

- Calculate For Frequency
  - TCEA / TAS * 100 = 101 sqft / 633.6 sqft = 15.94%
## Pavement Surface Rating Based on Frequency and Severity Descriptions

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>SEVERITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Slight</td>
</tr>
<tr>
<td>≤ 5%</td>
<td>None</td>
</tr>
<tr>
<td>≤ 10%</td>
<td>Infrequent</td>
</tr>
<tr>
<td>≤ 15%</td>
<td>Infrequent to Occasional</td>
</tr>
<tr>
<td>≤ 20%</td>
<td>Occasional to Frequent</td>
</tr>
<tr>
<td>≤ 45%</td>
<td>Frequent</td>
</tr>
<tr>
<td>&gt; 45%</td>
<td>Very Frequent</td>
</tr>
</tbody>
</table>

### Definitions
- **Slight**: Cracks are tight, single and only a few feet long. Tight, single longitudinal joint cracks, partial or continuous, are included.
- **Minor**: Cracks are generally < 1/8 inch wide; some with minor secondary cracks, no or very few connected cracks. May have a few small spalls (< 1 ft square).
- **Moderate**: Cracks are generally >1/8 inch wide; secondary cracking is common, some cracks connected; may have some minor popouts or small (1-2 ft) to medium (3-4 ft) patching.
- **Moderate to Severe**: Distresses vary from "Moderate" to "Severe."
- **Severe**: Cracks are wide and/or have extensive interconnected secondary cracking; holes, loose material and/or patching are common, patches may have patches.
- **Very Severe**: Cracks are very wide, holes and/or patching is extensive; patches extend across the full lane or extend several feet along the lane, patches on patches are common.
- **Travel is Impaired**: Holes in pavement are large and/or pavement has so many layers of patches that the section can be traveled only at reduced speed.
- **Impossible**: Travel by ordinary car would risk damage to the vehicle.

**Notes:**
- Ratings in **blue** are the definitions from the original Pavement Rating Manual c 1981.
- "**Very Slight**" from the original Manual = "**Slight**" here.
- "**Slight**" from the original Manual = "**Minor**" here.

3/16/2010
Determine Severity, (Crack Ratio), as follows:

\[ \sum (\text{crack length} \times \text{crack width}) \]

(Total Crack Extent Area)

For all cracks in the tenth mile:

\[
\begin{align*}
(7') \times (0.0208') &= 0.1456 \text{ s.f.} \\
(150') \times (0.0625') &= 9.3750 \text{ s.f.} \\
(47') \times (0.0520') &= 2.4440 \text{ s.f.} \\
(15') \times (0.0316') &= 0.1580 \text{ s.f.} \\
(23') \times (0.0625') &= 1.4375 \text{ s.f.}
\end{align*}
\]

\[= 13.5601 \text{ s.f.} / 101 \text{ s.f.} = 0.13426\]
Pavement Rating Methodology is based on the severity and extent of the pavement distress. Small amounts of severe distress have the same rating as large amounts of minor distress.

### Table: Pavement Surface Rating Based on Frequency and Severity Descriptions

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>SEVERITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 5%</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
</tr>
<tr>
<td></td>
<td>Travel is Impaired</td>
</tr>
<tr>
<td></td>
<td>Impassible</td>
</tr>
<tr>
<td>≤ 10%</td>
<td>Infrequent</td>
</tr>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
</tr>
<tr>
<td></td>
<td>Travel is Impaired</td>
</tr>
<tr>
<td></td>
<td>Impassible</td>
</tr>
<tr>
<td>≤ 15%</td>
<td>Infrequent to Occasional</td>
</tr>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
</tr>
<tr>
<td></td>
<td>Travel is Impaired</td>
</tr>
<tr>
<td></td>
<td>Impassible</td>
</tr>
<tr>
<td>≤ 20%</td>
<td>Occasional to Frequent</td>
</tr>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
</tr>
<tr>
<td></td>
<td>Travel is Impaired</td>
</tr>
<tr>
<td></td>
<td>Impassible</td>
</tr>
<tr>
<td>≤ 45%</td>
<td>Frequent</td>
</tr>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td></td>
<td>Minor</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td></td>
<td>Very Severe</td>
</tr>
<tr>
<td></td>
<td>Travel is Impaired</td>
</tr>
<tr>
<td></td>
<td>Impassible</td>
</tr>
</tbody>
</table>

Notes:
- Ratings in blue are the definitions from the original Pavement Rating Manual c.1981.
- "Very Slight" from the original Manual = "Slight" here.
- "Slight" from the original Manual = "Minor" here.

3/15/2019

- Distresses vary from "Moderate" to "Severe."
- Cracks are wide and/or have extensive interconnected secondary cracking.
- Cracks are very wide; holes and/or patching is extensive; patches extend across the full lane or extend several feet along the lane; patches on patches are common.
- Holes in pavement are large and/or pavement has so many layers of patches that the section can be traveled only at reduced speed.
- Travel by ordinary car would risk damage to the vehicle.
New Dominant Distress Generation

Determine Dominant Distress - Alligator Cracking, as follows:

\[ \sum \frac{\text{Area of Extent Cracking in Zones 2 & 4}}{\text{Total Area of Zones 2 & 4}} \]

(based on HPMS Reporting)

Total Area of Zones 2 & 4:

\[ = 2 \times 0.1 \text{ mile} \times 3.25 \text{ ft.} \times 5,280 \text{ ft./mile} = 343.2 \text{ s.f.} \]

Total Area of Extent Cracking for Zones 2 & 4:

Zone 2 = 58.5 s.f.
Zone 4 = 81.25 s.f.
Zone 2 + Zone 4 = 139.27 s.f.

Percent of Area of Pavement with Fatigue Cracking:

\[ = \frac{139.27 \text{ s.f.}}{343.2 \text{ s.f.}} \times 100 = 40.7\% > 20\% \]

Segment Rating

= Ag → 5 Ag
Benefits of Using New Surface Score

- Historical trend analysis will still be possible

- Minimize Cost By
  - Using data already collected to meet Federal requirements
  - Eliminating regional staff effort, vehicle mileage and equipment needs

- Eliminates subjectivity/Bias. It’s objective and quantifiable

- Provides additional and more detailed data that can be used for other pavement management analysis (i.e., actual measurements of multiple distresses)

- Allows the QA process to become more automated and faster, requiring less manual effort by Main Office staff
Potential Disadvantages

- Distress is collected in one lane in the primary direction. Raters previously rated all lanes.
  *(Highways typically have similar distresses in both directions. This change will have minimal impact)*

- Updating pavement inventory attributes
  *(The Pavement Data collection Contract includes a process to verify and update pavement inventory and secondary asset information on a 4-year cycle)*

- New work and their locations which were previously provided by raters will need to be determined. We are working on a process to gather this information which would include but not limited to:
  - Giving Resident Engineers the ability to enter work information into Agile Asset PMS
  - Requiring the work information to be entered into Site Manager
  - The use of OPPM/PSS data to see what was planned
  - The use of Bid Results for VPP projects
  - Vendor will provide an event in the data that tells whether new pavement is present
Other Changes

- Reported data will only be data collected at time of the survey, late season paving will not be included
  - This will eliminate work not completed and/or its inaccurate location.
  - It will also relieve M.O. staff and regional staff of extensive effort to identify and verify the work

- Pavements will not be given an automatic score of 10 for new pavement. If a pavement has any distress at time of collection, it will be rated accordingly
  - A score of 10 will signify new pavement and no distress, so a pavement will not have a score of 10 for more than two years

- The previous practice of limiting the maximum score for certain work types will be eliminated
Timeline/Schedule

Data Collection by Vendor
- May to August – Statewide Pavement Condition Survey
- Mid-September – Delivery of Final Data in Required Format

Pavement Data Services
- Mid-September
  - Loads the contractor data into Agile Assets Pavement Management System (PMS)
  - Agile Assets PMS algorithm calculates pavement scores
- Mid-September Through November – QAs the data from contractor to ensure it is complete without any systemic errors (ex. Data handling and processing errors)
- Before December 1 – Notifies Pavement Management Group that data QA is complete

Pavement Management Group
- December Through January
  - Compiles Network Level Data
  - QA of Calculated Scores
  - Approves Final Scores
  - Region Agile Assets PMS Analysts can begin using for planning purposes
- February
  - Create Pavement Data Extract and Pavement Data Report
  - Draft Pavement Condition Report for Executive review and approval
- March – Post approved Pavement Condition and Pavement Data Reports to NYSDOT website
Implementation of the Process

- The 2018 Pavement Condition Data will be the first year that the new score process will be implemented.

- We were not able to meet the Timeline/Schedule as shown for the 2018 Pavement Condition Data due to the Department’s Development and implementation of its new Enterprise Asset Management System (EAMS).

- Currently, Pavement Management, with help from Pavement Data Services, are in the QA process of the data as shown under the Pavement Management Group.
Local Pavement Data

• Starting in 2018, the Department expanded its collection of local data to include all federal aid eligible roads on a 2-year cycle in addition to the current local pavement data collected as part of the MAP 21 and HPMS requirements.

• The Highway Data Services Bureau, Pavement Data Services anticipates disseminating local pavement distress data to local agencies, as follows:
  • Disseminate data in response to individual requests
  • Disseminate data only after Department performs its required QA/QC functions
  • Disseminated data shall consist of roadway identification (GIS_ID), location, pavement scores and dominant distresses. It will be based on a 1/100th of a mile segmentation.

• Data will be provided as a CSV file generated by the Department’s Pavement Management System (PMS) and will be consistent with the Department’s Local Highway Inventory (LHI).
Local Pavement Data

- Proposed fields below:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td></td>
</tr>
<tr>
<td>Route (GIS ID)</td>
<td>GIS ID</td>
</tr>
<tr>
<td>Travel Direction</td>
<td></td>
</tr>
<tr>
<td>Begin MP</td>
<td>Begin Mile Point</td>
</tr>
<tr>
<td>End MP</td>
<td>End Mile Point</td>
</tr>
<tr>
<td>Roadway Type</td>
<td>Road/Route/Ramp</td>
</tr>
<tr>
<td>NYS Route</td>
<td>Shield Number</td>
</tr>
<tr>
<td>County Order</td>
<td></td>
</tr>
<tr>
<td>Region</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td></td>
</tr>
<tr>
<td>Residency</td>
<td></td>
</tr>
<tr>
<td>Construction Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>New Pavement Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>Crack Seal Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>Lane Dev Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>Bridge Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>Railroad Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>Stop Flag</td>
<td>Flagged if this event was present during collection</td>
</tr>
<tr>
<td>Observed Pavement Type</td>
<td></td>
</tr>
<tr>
<td>Surface Score</td>
<td></td>
</tr>
<tr>
<td>Dominant Distress</td>
<td></td>
</tr>
</tbody>
</table>
Questions???