The Evolution of Structures Asset Management in Wisconsin

11th International Bridge and Structure Management Conference
Mesa, Arizona
Wednesday, April 26th, 2017
Introduction

- The bridge management process...

1. Maintain database of structures inventory and condition data
2. Produce recommendations for current and future optimal work actions
3. Develop and delivers structure improvement projects
4. Structures are inspected per FHWA Guidelines and deterioration is recorded
Overview

• MAP-21 definition for asset management:

Asset management is a strategic and systematic process of operating, maintaining, and improving physical assets, with a focus on both engineering and economic analysis based upon quality information, to identify a structured sequence of maintenance, preservation, repair, rehabilitation, and replacement actions that will achieve and sustain a desired state of good repair over the life-cycle of the assets at minimum practicable cost.

“Systematic process”
“Quality information”
Policy
Goals for today

• Share what WisDOT is doing in the field of structures asset management
  • Where we’ve had success
  • Where we...haven’t had as much success
Overview

- WisDOT Bridge Inventory
Overview

- WisDOT Bridge Inventory
- WisDOT Organizational Structure
Overview

- WisDOT Bridge Inventory
- WisDOT Organizational Structure

- Foundation for Asset Management
  - Data Management Tools
  - Bridge Preservation Policy
  - Asset Management Tools
Overview

- WisDOT Bridge Inventory
- WisDOT Organizational Structure
- Foundation for Asset Management
  - Data Management Tools
  - Bridge Preservation Policy
  - Asset Management Tools
- Asset Management at WisDOT
Where is Wisconsin?
WisDOT Bridge Inventory

• Wisconsin at a glance

• Population: 5.7 million
• Top 3 Cities (population):
  • Milwaukee – 595,000 🏈
  • Madison – 233,000 🏈
  • Green Bay – 104,000 🏈

• Also in the top-15:
  • Kenosha
  • Racine
  • Waukesha
  • Janesville
  • West Allis
  • Wauwatosa
WisDOT Bridge Inventory

- 14,116 bridges
  - 5,259 state-owned
  - 8,857 local-owned
WisDOT Bridge Inventory

State Owned Bridges - By Superstructure Type

- Trend is toward PS girder and concrete slab
- Not many new steel structures
WisDOT Bridge Inventory

- Only 2.7% of state inventory > 60 years old
- 20% for local inventory

**Average Age:**
- State: 33 years
- Local: 39 Years
WisDOT Bridge Inventory

Age of Deck Inventory

Average Age:
State: 26 Years  
Local: 36 Years

<table>
<thead>
<tr>
<th>Age</th>
<th>State</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>956</td>
<td>759</td>
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<tr>
<td>11-20</td>
<td>1058</td>
<td>1350</td>
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<tr>
<td>21-30</td>
<td>1000</td>
<td>1641</td>
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<tr>
<td>31-40</td>
<td>606</td>
<td>1112</td>
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<td>41-50</td>
<td>569</td>
<td>724</td>
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<td>51-60</td>
<td>575</td>
<td>597</td>
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<tr>
<td>60+</td>
<td>55</td>
<td>1104</td>
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</table>
WisDOT Bridge Inventory

NBI Condition Rating by # of Bridges State Owned

- 10% for local

Deck Condition Rating by # of Bridges State Owned

- 6% for local
WisDOT Bridge Inventory

- Load posted bridges (excluding SHVs...coming soon)
  - 44 state-owned bridges
    - 0.8% of total state inventory
  - 838 local-owned bridges
    - 9.5% of total local inventory
WisDOT Organizational Structure
Organizational Structure

- 5 regions & central office
- Geography, not by number of bridges or deck area
- Each region:
  - Inspections
  - Project planning
  - Project scoping
  - Project delivery
Organizational Structure

- Allocation of funds is another division
Organizational Structure

- Significance?
- Implementation
  - Need consistent application
- “The most damaging phrase in the language is “We’ve always done it this way!”
  - Grace Hopper
Foundations for Asset Management: WisDOT Data Management Tools
Data Management Tools

• Why do we need data management tools?
  • 54 structures (mostly sign bridges)
Data Management Tools

- State-wide
- 5000+ bridges
Data Management Tools

- Early-2000s: WisDOT initiates an in-house solution for better data management
  - Highway Structures Information System (HSIS)
- Collaboration between WisDOT bridge management engineers and a consultant software programmer
  - Relationship remains intact
Data Management Tools

- **Objective:**
  - Collect and store structures inventory and condition data
  - Data must be accessible and usable
Data Management Tools

- HSIS
Data Management Tools

- HSIS
Data Management Tools

- HSIS
Data Management Tools

- HSIS

<table>
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<tr>
<th>Date</th>
<th>Inspection Type(s)</th>
<th>Agency</th>
<th>Inspector</th>
<th>Activity Type(s)</th>
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<td>Petersen, Dale (4506)</td>
<td>UWP</td>
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</table>
Data Management Tools

• **Features:**
  • **Database structure**
    • Allows for easy storage/manipulation of data
  • **Web-based interface**
    • Allows for easy access anywhere with an internet connection
    • Bridge inspectors able to upload inspections directly to HSI
Data Management Tools

• **Features:**

  • **Compatibility**
    • Interface with other WisDOT systems; OSOW permitting, financial systems, etc.

  • **Access to information**
    • Updates are live, immediately available
    • Easy to query information, write reports
Data Management Tools

- Features:
  - Portal for bridge information
    - Plans, shop drawings, correspondence, etc.
Foundations for Asset Management: WisDOT Bridge Preservation Policy
Bridge Preservation Policy

- WisDOT Bridge Preservation Policy Guide
- Joint effort by:
  - Bureau of Structures
  - Regional maintenance
  - Consultant engineers
Bridge Preservation Policy

Why?

• Looking for better coordination between Bureau of Structures-Regions and among Regions
• Inconsistency in treatments used, timing, etc.
• Create a baseline for the “correct” treatment/timing
Bridge Preservation Policy

- Goals for the document:
  - Create preservation-specific objectives and performance measures
  - Establish a toolbox of preservation activities to consider
  - Identify preservation activities and eligibility to meet objectives
## Bridge Preservation Policy

- Objectives and performance measures

<table>
<thead>
<tr>
<th>Objective</th>
<th>Target/Goals</th>
<th>Performance Measure</th>
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<tbody>
<tr>
<td>Maintain bridges in good or fair condition</td>
<td>95% of bridges</td>
<td>Percentage of bridge in good or fair condition (NBI rating 5 or higher)</td>
</tr>
<tr>
<td>Maintain bridge decks in good or fair condition</td>
<td>95% of bridge decks</td>
<td>Percentage of bridge decks in good or fair condition (NBI Rating 5 or higher)</td>
</tr>
</tbody>
</table>

- Seal concrete decks (NBI rating 6 or higher) with sealant every 4 years
- Seal 25% of concrete decks
- Number of decks sealed (sq. ft of deck area) each year during a 4 year period
### Bridge Preservation Policy

- Preservation activities and expected frequency

<table>
<thead>
<tr>
<th>Bridge Component</th>
<th>Bridge Preservation Type</th>
<th>Activity Description</th>
<th>Preventive Maintenance Type</th>
<th>Action Frequency (years)</th>
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<tbody>
<tr>
<td>All</td>
<td>Preventive Maintenance</td>
<td>Sweeping, power washing, cleaning</td>
<td>Cyclical</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deck washing</td>
<td>Cyclical</td>
<td>1</td>
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<tr>
<td></td>
<td></td>
<td>Deck Sweeping</td>
<td>As needed</td>
<td>As needed</td>
</tr>
<tr>
<td>Deck</td>
<td>Preventive Maintenance</td>
<td>Thin polymer (Epoxy) overlays</td>
<td>Cyclical</td>
<td>4-5</td>
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<tr>
<td></td>
<td></td>
<td>Drainage cleaning/repair</td>
<td>As needed</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint cleaning</td>
<td>As needed</td>
<td>As needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deck Sealing/Crack Sealing</td>
<td>Condition Based</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deck Patching</td>
<td>Condition Based</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chloride extraction</td>
<td>As needed</td>
<td>As needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Asphalt overlay with membrane</td>
<td>Condition Based</td>
<td>12-15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polymer modified Asphalt overlay</td>
<td>Condition Based</td>
<td>6-12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joint seal replacement</td>
<td>Condition Based</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drainage cleaning/repair</td>
<td>Condition Based</td>
<td>1</td>
</tr>
<tr>
<td>Repair or Rehab Element</td>
<td>Preventive Maintenance</td>
<td>Rigid concrete overlays</td>
<td>Condition Based</td>
<td>As needed</td>
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<tr>
<td></td>
<td></td>
<td>Structural Reinforced concrete overlay</td>
<td>Condition Based</td>
<td>As needed</td>
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<tr>
<td></td>
<td></td>
<td>Deck joint replacement</td>
<td>Condition Based</td>
<td>As needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eliminate Joints</td>
<td>Condition Based</td>
<td>As needed</td>
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</table>
## Bridge Preservation Policy

- **Activities and eligibility**

<table>
<thead>
<tr>
<th>Concrete Deck/Slab</th>
<th>NBI Item 50</th>
<th>Deck Distress Area (%)</th>
<th>Preservation Activity</th>
<th>Benefit to Deck from Action</th>
<th>Application Frequency (in years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>=6</td>
<td>&lt;20%</td>
<td>Deck Sweeping/Washing</td>
<td>Extend Service Life</td>
<td>1 to 2</td>
<td></td>
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<tr>
<td>&gt;5% (&lt;2)</td>
<td>&lt;20%</td>
<td>Crack Sealing</td>
<td>Extend Service Life</td>
<td>3 to 5</td>
<td></td>
</tr>
<tr>
<td>&gt;5% (&lt;10)</td>
<td>&lt;20%</td>
<td>Deck Sealing</td>
<td>Service life extended</td>
<td>3 to 5</td>
<td></td>
</tr>
<tr>
<td>&gt;5% (&lt;5)</td>
<td>&lt;5%</td>
<td>Deck Patching</td>
<td>Service life maintained</td>
<td>As needed</td>
<td></td>
</tr>
<tr>
<td>&gt;5% (&lt;15)</td>
<td>&lt;5%</td>
<td>Deck Patching, Cathodic Protection</td>
<td>Extend Service Life</td>
<td>As needed</td>
<td></td>
</tr>
<tr>
<td>&gt;5% (&lt;10)</td>
<td>&lt;10%</td>
<td>HMA w/ membrane</td>
<td>Improve NBI (58) ≥ 7</td>
<td>8 to 12</td>
<td></td>
</tr>
<tr>
<td>&gt;5% (&lt;20)</td>
<td>&lt;20%</td>
<td>Polymer Modified Asphalt Overlay</td>
<td>Improve NBI (58) ≥ 7</td>
<td>12 to 15</td>
<td></td>
</tr>
<tr>
<td>&gt;5% (&lt;20)</td>
<td>&lt;20%</td>
<td>Concrete Overlay</td>
<td>Improve NBI (58) ≥ 7</td>
<td>12 to 30</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Consult 805 - not for deck girder bridges.
- Consider remaining bridge conditions to determine if activity is desirable and cost effective.
## Bridge Preservation Policy

- **Activities and eligibility**

<table>
<thead>
<tr>
<th>Steel Elements</th>
<th>N/A</th>
<th>Superstructure Washing/Cleaning</th>
<th>N/A</th>
<th>1 to 2</th>
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<tbody>
<tr>
<td>Item 59 ≥ 5</td>
<td>3440</td>
<td>CS2 + CS3 Area &gt; 5% <strong>(6)</strong></td>
<td>Painting - Spot</td>
<td>CS1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CS3 Area ≤ 25% <strong>(5)</strong></td>
<td>Painting - Zone</td>
<td>CS1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CS3 Area ≥ 25% <strong>(5)</strong></td>
<td>Painting - Complete</td>
<td>CS1</td>
</tr>
<tr>
<td>Item 59 ≥ 4</td>
<td></td>
<td>CS2, CS3, or CS4</td>
<td>Superstructure Restoration <strong>(3)</strong></td>
<td>NBI ≥ 7</td>
</tr>
</tbody>
</table>

| Bearings       |     | CS3 or CS4                      | Bearing Reset/Repair | CS1 or CS2 | 1 to 5 |
| Item 59 ≥ 5    |     | CS2 or CS3                      | Bearing Cleaning/Painting | CS1 or CS2 | 5 to 7 |
|                |     | CS3 or CS4                      | Bearing Replacement | CS1 or CS2 | 10 to 15 |

**Notes:**
- **(6)** Includes but is not limited to seal joints and parking block replacement.
- **(5)** Must bring rating to current standards or have an approved exception to standards.
- **(3)** Includes expansion joints and bridge systems.
- **(4)** Provide 10-year measurements after repairing any other substructure defects.
Bridge Preservation Policy

• Objective:
  • Get everyone on the same page and get the most life out of our bridge inventory
Foundations for Asset Management:
WisDOT Asset Management Tools
Asset Management Tools

• Objective:
  • Provide recommendations for structures work, near-term and long-term
Asset Management Tools

• Why?
  • Help WisDOT financial body set a baseline for required funding levels
  • Provide guidance for Regions in programming optimal bridge work
  • Provide long-term projections on system needs and condition at various funding levels
Asset Management Tools

• How?
  • Apply a logic to inventory and condition data to determine current work needs
  • Project future condition and repeat process for future needs
Asset Management Tools

- Wisconsin Structures Asset Management System – WiSAMS
- Software application developed in-house
Asset Management Tools

• WiSAMS:
  • Pulls inventory and inspection data
  • Data management tool – HSIS
  • Process a set of “rules” – if/then statements for given work actions
  • Policy – WisDOT Bridge Preservation Policy Guide
• Deterioration curves to project future condition
  • Based on historic WisDOT NBI data (mostly)
Asset Management Tools

• WiSAMS logic

WiSAMS Rule #1:

- If the all of the following criteria are met...
  - The current NBI rating for substructure is less than or equal to 3, and;
  - The structure is scour critical;
- ...then the recommended work action is “REPLACE STRUCTURE.”

WiSAMS Rule #10:

- If the all of the following criteria are met...
  - The current NBI rating for superstructure is less than or equal to 3, and;
  - The structure is > 50 years old, and;
  - The superstructure is fracture critical;
- ...then the recommended work action is “REPLACE STRUCTURE.”
WiSAMS logic

WiSAMS Rule #32:

- If all of the following criteria are met...
  - The number of previous overlays (concrete or asphalt) is less than 4, and;
  - The current NBI rating for deck is greater than or equal to 6, and;
  - The total quantity of deck area in CS-2, CS-3, and CS-4 for defect 1080 (delaminations, spalls, and patches) is less than 5% of the total deck area, and;
  - The total quantity of deck area in CS-2, CS-3, and CS-4 for defect 3210 (debonding, spalls, patched area, pothole – wearing surface) is greater than 20% of the total deck area, or;
  - The total quantity of deck area in CS-2, CS-3, and CS-4 for defect 3220 (crack – wearing surface) is greater than 50% of the total deck area, or;
  - The total quantity of deck area in CS-3 and CS-4 for defect 8911 (abrasion, wear, rutting, or loss of friction – wearing surface) is greater than 20% of the total deck area;
- ...then the recommended work action is “CONCRETE OVERLAY.”
### Asset Management Tools

- **WiSAMS output**

<table>
<thead>
<tr>
<th>B400067</th>
<th>Corridor: Not 208 Corridor</th>
<th>YEAR</th>
<th>AGE</th>
<th>NO ACTION TAKEN</th>
<th>OPTIMAL IMPROVEMENT SCENARIO</th>
<th>CAI</th>
<th>PRIMARY WORK ACTION</th>
<th>CAI</th>
<th>COST: PRIMARY WORK ACTION</th>
<th>EST. LIFE EXTENSION [YRS]</th>
<th>INCIDENTAL WORK ACTIONS</th>
<th>PROGRAMMED WORK ACTION</th>
<th>CAI</th>
<th>COST [W/O DEL]</th>
<th>FOS PROJ ID</th>
<th>PROJ CONCEPT</th>
<th>DOT PROGRAM</th>
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<tbody>
<tr>
<td>FEAT ON/UNDER:</td>
<td>RAMP HAMPTON AVE-WI-826</td>
<td>2018</td>
<td>56</td>
<td>34</td>
<td>(06) REPLACE DECK</td>
<td>60.7</td>
<td>$797,683</td>
<td>40</td>
<td>(72) REPLACE DECK - THIN POLYMER; (42) REPLACE BEARINGS; (72) REPLACE OR REPAIR WINGWALLS; (11) REPLACE RAISING OR PARAPET; (10) WIDEN BRIDGE</td>
<td>34</td>
<td>5.0</td>
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<td>STRUCTURE TYPE:</td>
<td>DECK GRD BRK</td>
<td>2019</td>
<td>57</td>
<td>58.5</td>
<td>50</td>
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<td>0</td>
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<td>MATERIAL:</td>
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<td>TOT LENGTH (FT):</td>
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<td>60</td>
<td>54</td>
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<td>INVENTORY RATINGS:</td>
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<td>61</td>
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<td>OPERATING RATINGS:</td>
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<td>2024</td>
<td>62</td>
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<td>47.1</td>
<td>50</td>
<td>0</td>
<td>(96) REPLACE STRUCTURE 100</td>
<td>5,750,000</td>
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<td>LOAD POSTING:</td>
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<td>63</td>
<td>18.1</td>
<td>41.3</td>
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<td>97.8</td>
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<td>LAST INSPECTION:</td>
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<td>64</td>
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<td>CONSTR HIST:</td>
<td>[1962] NEW STRUCTURE; [1983] OVERLAY - CONCRETE; [2002] OVERLAY - BITUMINOUS</td>
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## Asset Management Tools

### Structure Information

<table>
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<tr>
<th>B400067</th>
<th>Corridor: Not 2030 Corridor</th>
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<tbody>
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</tbody>
</table>

### Details

- **Feation/Under:** RAMP HAMPTON AVE-IH 43SB over MILWAUKEE RIVER
- **Year:** 2018
- **Age:** 56

- **Structure Type:** DECK GIRDER
- **Material:** PREST CONCRETE
- **Num Spans:** 6
- **Tot Length (FT):** 370
- **Inventory Rating:** HS17
- **Operating Rating:** HS26
- **Load Posting:** None
- **Last Inspection:** 3/9/2017
- **Constr Hist:**
  - 1962 | NEW STRUCTURE
  - 1983 | OVERLAY - CONCRETE
  - 2002 | OVERLAY - BITUMINOUS
- **Year:** 2027
- **Age:** 65
## Asset Management Tools

- **Condition Assessment Index**
- **Cost estimates**

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<th>Optimal Improvement Scenario</th>
<th>CAI</th>
<th>Primary Work Action</th>
<th>CAI</th>
<th>Cost: Primary Work Action</th>
<th>Est. Life Extension (Yrs)</th>
<th>Incidental Work Actions</th>
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<td>(77) Overlay Deck - Thin Polymer; (42) Replace Bearings; (72) Replace or Repair Wingwalls; (11) Replace Railing or Parapet; (02) Widen Bridge;</td>
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**Asset Management Tools**

- Information from WisDOT financial system

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<th>FIIPS PROGRAM</th>
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Asset Management Tools

- WiSAMS output
Asset Management Tools

- Advantages:
  - Wisconsin-specific
  - Flexibility to quickly change/modify to improve the application or correct errors
  - Can shape the output to serve WisDOT business needs
  - Compatibility with other WisDOT systems
Asset Management at WisDOT
Asset Management at WisDOT

• Progression...
  • Needed tools to effectively collect/store/manage data – HSIS
  • Define state-wide policy for preserving bridges – Bridge Preservation Policy Guide
  • Develop tools to provide recommendations for future bridge rehab/replacement needs – WiSAMS
Asset Management at WisDOT

• WiSAMS is a tool...and just a tool
• Goal is not to provide a finalized work plan
• Provide recommendations and work with Regions to make good decisions
Asset Management Tools

• Next steps?
  • Fostering relationships, become a known resource
  • Attending planning/scoping meeting
  • De-coupling inspection from planning
  • Move toward element-based deterioration curves
  • Refine WiSAMS rules for better projections
  • Prioritization
  • Better quantify risk
Questions?

Josh Dietsche – WisDOT Bridge Rating and Management Unit
joshua.dietsche@dot.wi.gov
608-266-8353