Using GIS/LRS to Develop Transportation Management Plan (TMP) Decision Support Capabilities

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March 21, 2018 - Little Rock, AR
Presentation Outline

- Some Terminology
- WisTMP QWS DSS Overview
- QWS DSS Data Integration
- QWS DSS Reporting System
- Status & Timeline
QWS DSS Overview – Some Terminology

- SWZ – Smarter Work Zones
- TMP – Transportation Management Plan
- QWS – Queue Warning System
- DSS – Decision Support System
- STN – WisDOT State Trunk Network
- LRS – Linear Referencing System
Wisconsin TMP Overview

- **Wisconsin TMP Process**
  - Coordinated strategies to manage the work zone impacts of a road project
  - FHWA Final Rule on Work Zone Safety and Mobility (2004); implementation details left to states
  - WisDOT Facilities Development Manual (FDM 11-50)
  - Required on all LET construction projects

- **Wisconsin TMP System (WisTMP)**
  - Centralized workflow management system
  - Team editing, routing, and approval
  - Searchable online archive repository
  - All new TMPs required through system since January 2015
  - Over 1,000 TMPs available at various levels of preparation and approval
WisTMP Overview, Cont.

Wisconsin Transportation Management Plan (WisTMP) System

WisTMP Search Interface

WisTMP View Interface
### WisTMP Overview, Cont.

#### 16. Check mitigation strategies planned

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Public information campaigns</td>
<td></td>
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<tr>
<td>Off-peak lane closures</td>
<td>All lane closures will be limited to overnight and off peak hours</td>
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<tr>
<td>Temporary widening to maintain traffic lanes</td>
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<tr>
<td>Changeable message signs (PCMS)</td>
<td>PCMS signs will be utilized to inform the public of upcoming lane and ramp closures.</td>
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<tr>
<td>Ramp closures</td>
<td>Ramp closures will be required for the single lane ramps to provide a safe work zone. Work zones for the individual structures will be combined by the contractor to minimize closures.</td>
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<tr>
<td>Temporary signals/timing revisions</td>
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<tr>
<td>Coordination with adjacent projects</td>
<td>This project will be coordinated with the I-94 North/South projects and any improvements along the STH 38 corridor.</td>
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<tr>
<td>Innovative contracting, (lane rental, A+B, etc)</td>
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<td>Temporary Emergency Pullouts</td>
<td></td>
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<tr>
<td>Motorist service patrols</td>
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<tr>
<td>Nighttime Work</td>
<td>All work will be done during the night time hours.</td>
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<td>Enhanced Traffic control devices (Wet reflective pavement marking, temp concrete barrier, etc)</td>
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<tr>
<td>Reduced regulatory speed limit (requires declaration approved by Regional Traffic Engineer, &amp; by BTO if 65-mph hwy or higher speed facility.)</td>
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Expanded WisTMP Section 16 listing various ITS and other mitigation strategies to address work zone safety and mobility concerns.
Wisconsin QWS Overview

- Used in work zones to alert drivers of upcoming traffic conditions (e.g. stopped traffic, slowing traffic)
- Has the potential to reduce the number of rear-end crashes by 18-45% (TxDOT Study)
- Typically consists of PCMS and traffic sensors upstream of a work zone.
- Sensors detect slow or stopped traffic ahead which triggers a PCMS message alerting drivers
Wisconsin QWS Overview, Cont.

- Real-time doppler sensors to detect vehicle speeds
- PCMS activated based on thresholds:
  - Stopped (0 mph – 19 mph)
  - Slow (20 mph – 39 mph)
- Sensors / PCMS spaced every 1 mile upstream of the work zone to the maximum queue that the traffic analysis showed.

WisDOT PCMS with a “Stopped or Slow Traffic” message, part of a Zipper Merge/Dynamic Late Merge System deployment which also includes back of queue detection.
Wisconsin QWS DSS Project

- FHWA grant under the Every Day Counts (EDC-3) Smarter Work Zone initiative
- WisDOT piloted two QWS deployments; found significant benefits for overall and injury crash reduction
- Working with UW-Madison TOPS Lab to develop a decision support tool to help identify future candidate work zones for QWS deployment
  - Leverage the WisTMP system to develop a data driven analysis tool that is tied to the work zone planning and approval process
QWS DSS Data Integration & Analysis

QWS DSS Input
- Project Limits
- Queue & Delay
- Roadway Curvature
- Crash History

QWS DSS Data Integration & Analysis

QWS DSS Results
- QWS Project Ranking
- Mapping & Analysis Details

STN LRS
**QWS DSS – STN Integration**

- WisDOT’s State Trunk Network (STN) Linear Referencing System (LRS) is used for the underlying data integration and analysis.
- STN roadway routes (highways) are modeled in terms of sequences of links along the roadway network.
- Business data are located per various linear referencing methods (LRM) to STN link IDs and link-offsets.
QWS DSS – STN Integration, Cont.

- For QWS DSS, STN link locations are converted to cumulative mileage values to simplify the integration and analysis steps.
- Additional technical considerations for divided vs. undivided highways, concurrent routes.
- Need to account for STN version changes.
- Processing is done at the relational database level.
Example work zone planned for I-39 SB / I-90 EB / I-94 EB in Dane County. For QWS DSS integration and analysis, STN link and offset values are converted to cumulative mileages per highway for the begin- and end- locations of the work zone and for all crashes upstream and within the work zone.
The key to QWS DSS analysis is to combine the four data elements onto the STN network:

- Project Limits – New mapping interface in WisTMP
- Queue and Delay – User entered into WisTMP
- Horizontal / Vertical Curvature – External dataset
- Crash History – External dataset
**QWS DSS – TMP Work Zone Mapping**

- Per begin- and end- locations of the Work Area
- Discontiguous work areas modeled separately
- QWS DSS estimates the upstream area of impact
QWS DSS – TMP Work Zone Mapping

- WisTMP Interface based on Google Maps API
  - Familiar, detailed
  - Distinct from STN
- Google Maps locations translated to STN link / offsets:
  - STN Highway List
  - Fixed STN Landmarks
  - Offsets to Landmarks
    - Distance
    - Upstream / Downstream Direction
The WisTMP Form Section 11 was expanded to include a table for anticipated delay and queue estimates per each work area mapped in Section 1. The updates were rolled out January 1, 2018.
Crash History

- Highway crashes are mapped by WisDOT staff using STN “Reference Points” (RP) for the linear referencing method.
- The TOPS Lab maintains an archive of WisDOT crash data in its WisTransPortal system.
- QWS DSS crashes are pulled from the last three years of final (year-end) crash data
- Crashes are taken per work area from 1 mile upstream of the queue to the end of the work area
- QWS DSS crashes are processed nightly for all relevant TMPs.
**QWS DSS – Linked Datasets**

- **Roadway Curvature**
  - Horizontal and vertical curvature data is translated from the WisDOT Photolog to the STN link network
  - WisDOT maintains a Photolog to STN translation table
  - Curve data is modeled per MIRE definitions:
    - Horizontal Curve Degree and Direction
    - Vertical Percent of Gradient
  - This dataset is still under development; will be processed nightly per similar rules to the crash data
The TMP QWS DSS Reporting System search interface provides a list of TMPs per user defined criteria (transportation region, TMP status, LET date, etc.), ordered by analysis score (not shown). A summary list may be downloaded and/or individual TMPs may be selected for further viewing and analysis.
The TMP QWS DSS Results Interface provides an interactive map of TMP work zone project limits, crash history, and vertical and horizontal curvature locations (not shown). Expandable sections provide details regarding the TMP QWS DSS analysis and weighting, expected queue and delay, crash history, and roadway geometry.
Individual crashes may be selected directly from the map or from the tabular list. The Wisconsin police crash report (DT4000) may be downloaded from the crash point info window.
QWS DSS Project Status & Timeline

- WisTMP Section 1 (Mapping) and Section 11 (Queue/Delay) form enhancements – January 2018
  - All new TMPs based on the new sections
- WisTMP QWS DSS Reporting System – June 2018
  - Initial System available to WisTMP administrator roles
  - QWS DSS Project Ranking List to be reviewed internally
- WisTMP Section 16 (Mitigation Strategies) enhancements & redesign – December 2018
  - Methodology applicable to general SWZ ITS planning
Questions?

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The QWS DSS Project is sponsored by the Wisconsin Department of Transportation (WisDOT) Bureau of Traffic Operations (BTO).