

# Queue Warning System Pilot Projects – Stevens Point and Edgerton

Erin Schoon - WisDOT Bureau of Traffic Operations  
July 22, 2016



## Overview

- ▶ Wisconsin Background
- ▶ Federal Aid Grant
- ▶ Design and Implementation
- ▶ Edgerton/Rock River and Stevens Point Deployment
- ▶ Lessons Learned



## Background

- ▶ Wisconsin has been looking for a way to increase safety and decrease end-of-queue crashes in work zones
- ▶ Other states saw a safety benefit and reduced crashes with the QWS
- ▶ Wisconsin has implemented a QWS in the Milwaukee and Madison area several years ago that was linked with the STOC.



3

## Federal Aid Grant

- ▶ WisDOT applied for a grant in December 2015 to fund two pilot QWS in the following locations:
  - I-39 near Stevens Point
  - I-39 Rock River Bridge near Edgerton (mega project)
- ▶ Grant was approved in May 2016.
- ▶ Systems were implemented in April and May prior to grant approval, if grant not approved WisDOT was going to fund projects
- ▶ As part of the grant, WisDOT will be submitting a final report to FHWA.



4

## Included in Federal AID Grant Submittal

- ▶ Application
- ▶ Letters of Support for each project
- ▶ Accelerated Innovation Deployment (AID) Demonstration Project Narrative
- ▶ Cost Estimate
- ▶ Project Plans and Special Provisions



5

## Report

- ▶ Crash Analysis with and without QWS (if available)
- ▶ Speed Study – extra sensors deployed to collect
- ▶ Capacity Study
- ▶ Driver Survey
- ▶ Different types of messaging
- ▶ Lessons Learned



6

## Public Outreach

- ▶ WisDOT Radio News Line
- ▶ News Release
- ▶ WisDOT Internal State Notice on Weekly Bulletin



7

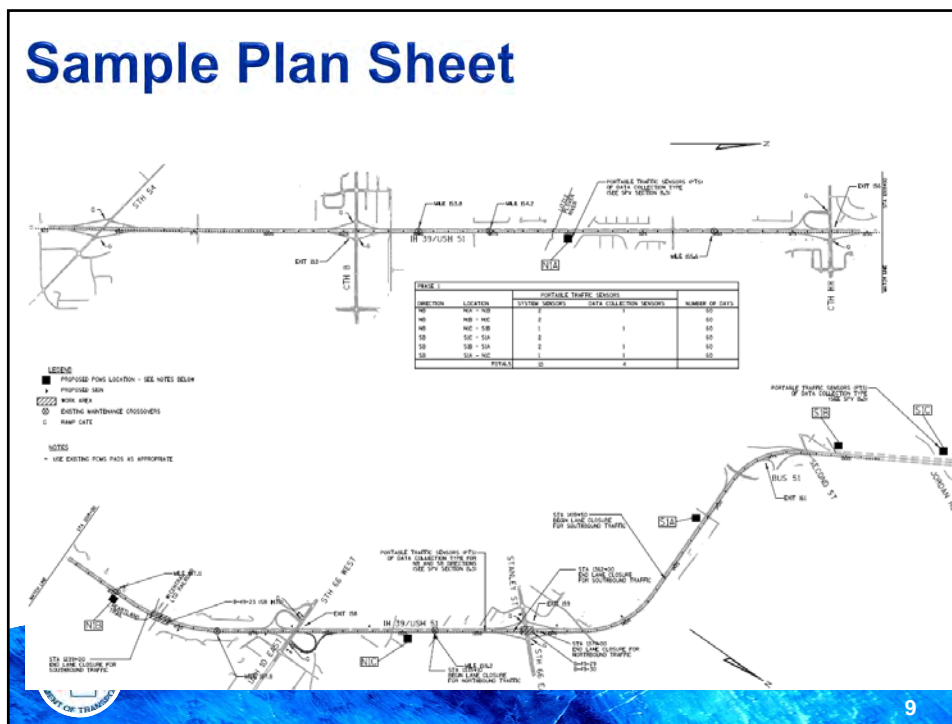
## Implementation and Design

- ▶ WZ ITS Implementation Guide and QWS Research
- ▶ Reached out to the Regions to help determine projects that would be good candidates for a QWS
  - Stevens Point in NC Region
  - Edgerton in SW Region
- ▶ Reviewed TMP Plans
- ▶ Iowa EDC3 Peer Exchange and Smart WZ Vendors
- ▶ Developed Plan Sheets for Projects – in house consultant
- ▶ Developed Cost Estimate
- ▶ Proposed Plan was reviewed by Project teams



8

## Sample Plan Sheet



## Implementation and Design

- ▶ Queue Warning System was BID separately from the two LET projects
- ▶ RFB was sent out and Street Smart Rentals was selected as vendor along with VerMac and Mega Rentals traffic control contractor as subs.
- ▶ Meetings were held with each project team and Street Smart to go over QWS and placement, some changes were made based on these meetings



## Cost

Project ID: 1005-10-88			
1. Rock River Bridge Project	Project Duration	Street Smart Per day	Total
1 System, 8 PCMS, and 22 sensors	280	\$575.00	\$161,000.00
3 additional data collection sensors	14	\$60.00	\$840.00
Change order of 8 additional PCMS	280	\$150.00	\$42,000.00
		Bid Price	\$161,840.00
		Bid Price + Change Order	\$203,840.00
Project ID: 1166-06-92			
2. Stevens Point Bridge Project	Project Duration	Street Smart Per day	Total
1 System, 6 PCMS, and 14 sensors	120	\$826.00	\$99,120.00
3 additional data collection sensors	14	\$120.00	\$1,680.00
		Bid Price	\$100,800.00
		<b>Bid Price Total Cost</b>	\$262,640.00
		<b>Bid Price Total Cost + Change Order</b>	\$304,640.00
		<b>Decision Support System</b>	\$170,416.00
		<b>Evaluation and Coordination</b>	\$49,990.20

11

## Why were these projects selected?

- ▶ Stevens Point
  - Previous crash history along roadway
  - Area traffic volumes, recreational/tourist traffic during summer months
  - Queue and Delay
  - Roadway geometry – horizontal and vertical curves
  - History of delay and queuing in the area
  - Only one work zone
- ▶ Edgerton
  - Area traffic volumes, recreational/tourist traffic during summer months
  - Initially only one work zone, other projects were advanced after QWS selection
  - Night time work with lane closures
  - Queuing not expected based on analysis

12

## Layout of QWS

- ▶ Stevens Point (Phase 1/Phase 2)
  - 3 PCMS in each direction - Phase 1
  - 4 PCMS in the NB direction - Phase 2
  - 1 PCMS on USH 10 - Phase 1
  - 1-2 mile spacing
  - Doppler Sensors
  - Wavetronix Sensors for data collection
  - 1 camera for verification in Phase 1
- ▶ Edgerton
  - 8 PCMS in each direction
  - 1 mile spacing
  - Doppler Sensors
  - Wavetronix Sensors for data collection



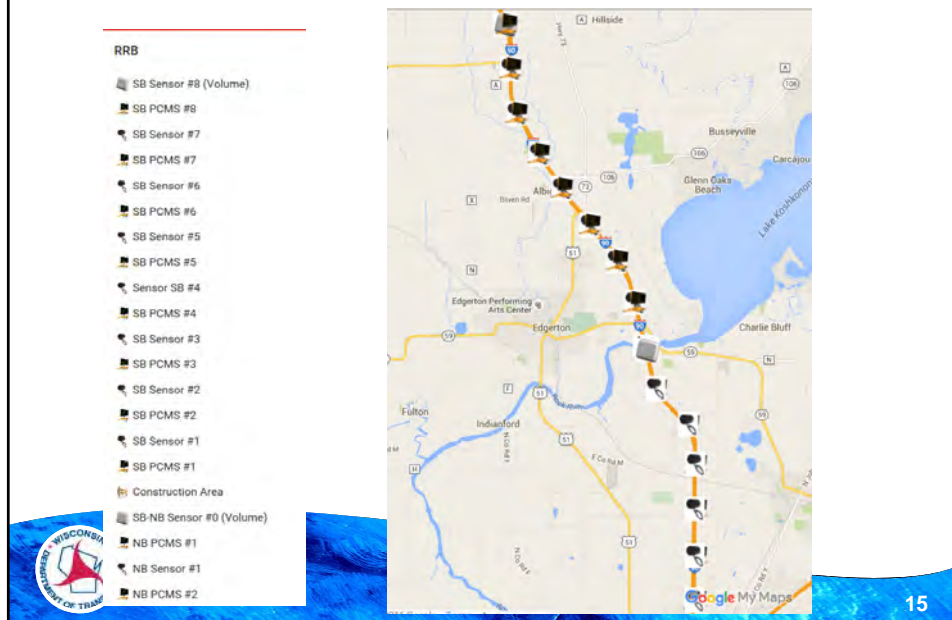
## Stevens Point QWS Layout

### Phase 1

- 1349 SB I-39 PCMS #01 2.25 miles before...
- 3525 4043 SB I-39 PST #02 SB I-39 2.25 m...
- 1427 SB I-39 PCMS #03 1.5 miles before...
- 📍 SB I-39 VDS #03 1.5 miles before Workzon...
- 1423 SB I-39 PCMS #04 0.5 miles before...
- 📍 SB I-39 VDS #04 0.5 miles before Workzon...
- 🚧 SB Lane Closure Start
- 📍 3303 SB I-39 VDS #05 I-39 0.5 into the Wor...
- 🚧 NB End of Lane Closure
- 📍 3529 NB/SB PST #06 0.25 miles South of...
- 🚧 NB Lane Closure
- 1378 NB I-39 PCMS #07 NB I-39 0.5 miles...
- 📍 NB I-39 VDS #07 NB I-39 0.5 miles before...
- 📍 3308 NB/SB VDS #08 0.5 miles South of U...
- 🚧 SB End of Lane Closure
- 1302 NB I-39 PCMS #09 2 miles before Wo...
- 📍 NB I-39 VDS #09 2 miles before Workzone ...
- 📍 3309 NB I-39 VDS #10 3.5 miles before Wo...
- 1827 NB I-39 PCMS #11 4.5 miles before...
- 3532 NB I-39 PST #12 NB I-39 4.5 miles be...
- Full Matrix WB US-10 PCMS #13 1.5 miles...
- 📍 SB I-39 VDS #04B 0.0 mi b4 WZ 3301



## Edgerton QWS Layout



## PCMS Messages

- ▶ **Stevens Point**
  - Free flow speeds in 5 mph increments not to exceed work zone speed limit (55 mph)
  - Phase 1 - minutes to end of road work, speeds ahead
  - Phase 2 – minutes and distance to end of road work and XX mile to road work, speeds ahead
  - Threshold for slow or stopped traffic (39 mph)
- ▶ **Edgerton**
  - Free flow speeds in 5 mph increments up to 59 mph.
  - Anything above 60 mph is in 'free flow' or four corners flashing
  - Threshold for slow or stopped traffic (39 mph)





# Sample Messaging/Logic

## Stevens Point Project – Phase 2

02 PCMS NB I-39 (2.35 b4 WZ) #1827	<b>FREE FLOW</b> Speeds 40+ mph SPEEDS AHEAD XX MPH	<b>SLOW</b> Speeds 15-39 mph SLOW TRAFFIC AHEAD	<b>STOP &amp; GO</b> Speeds 1-14 mph TRAFFIC STOPPED AHEAD	Route: NB02 TT Sensors 01 PST NB I-39 (in WZ) #4007 #3525 #4034 Data Only 01 VDS NB I-39 (1.0 b4 WZ) #1617 on PCMS	Queue & Speed Ahead 01 VDS NB I-39 (1.0 b4 WZ) #1617 on PCMS
	XX MIN TO END OF RDWK	PREPARE TO STOP	PREPARE TO STOP		
03 PCMS NB I-39 (3.8 b4 WZ) #1302 TS	<b>FREE FLOW</b> Speeds 40+ mph SPEEDS AHEAD XX MPH	<b>SLOW</b> Speeds 15-39 mph SLOW TRAFFIC AHEAD	<b>STOP &amp; GO</b> Speeds 1-14 mph TRAFFIC STOPPED AHEAD	Route: NB03 TT Sensors 01 PST NB I-39 (in WZ) #4007 #3525 #4034 Data Only 01 VDS NB I-39 (1.0 b4 WZ) #1617 on PCMS 02 VDS NB I-39 (2.35 b4 WZ) #1827 on PCMS	Queue & Speed Ahead 02 VDS NB I-39 (2.35 b4 WZ) #1827 on PCMS
	XX MIN TO END OF RDWK	PREPARE TO STOP	PREPARE TO STOP		



# Sample Messaging/Logic

## Edgerton

SB I-39 PCMS 07 (7.0 b4 WZ)	<b>FREE FLOW</b> Speeds 40+ mph SPEED AHEAD XX MPH	<b>SLOW</b> Speeds 40-39 mph SPEED AHEAD XX MPH	<b>SLOWER</b> Speeds 20-39 mph SLOW TRAFFIC AHEAD	<b>STOP &amp; GO</b> Speeds 1-20 mph TRAFFIC STOPPED AHEAD	Speed Ahead Sensors SB I-39 VDS 06 (6.0 b4 WZ)	PTS Sensors SB I-39 VDS 05 (5.0 b4 WZ) SB I-39 VDS 06 (6.0 b4 WZ)
		REDUCE SPEED	PREPARE TO STOP	PREPARE TO STOP		
SB I-39 PCMS 08 (8.0 b4 WZ)	<b>FREE FLOW</b> Speeds 40+ mph SPEED AHEAD XX MPH	<b>SLOW</b> Speeds 40-39 mph SPEED AHEAD XX MPH	<b>SLOWER</b> Speeds 20-39 mph SLOW TRAFFIC AHEAD	<b>STOP &amp; GO</b> Speeds 1-20 mph TRAFFIC STOPPED AHEAD	Speed Ahead Sensors SB I-39 VDS 07 (7.0 b4 WZ)	PTS Sensors SB I-39 VDS 06 (6.0 b4 WZ) SB I-39 VDS 07 (7.0 b4 WZ)
		REDUCE SPEED	PREPARE TO STOP	PREPARE TO STOP		

- Notes:**
- 1 SLOW: XX MPH = Even 5 MPH Increments Rounded Down for Only the NEXT sensor downstream
  - 2 SLOWER & STOP-GO Conditions: Use Next 2 Sensors Downstream
  - 3 Comm Loss = PCMS with Four Corners Flashing
  - 4 Quick In/Slow Out Logic: 1 sample period to move to more congested condition and 2 periods to move to less congested condition.
  - 5 One minute periods with < 8 vehicles or 7% occupancy (microwave) will be ignored by logic.



## System Logic

- ▶ Stevens Point
  - 1 minute period, 3 minute period – latency to trigger system
  - Any sensor downstream dictates what is on PCMS upstream – worst case speed
- ▶ Edgerton
  - 1 minute period, 3 minute period – latency to trigger system
  - 8 vehicles/min and 7% occupancy for Edgerton Project – construction vehicles
  - Two sensors downstream dictates what is on PCMS – worst case speed

Quick In/Slow Out Logic. 1 sample period to move to more congested condition and 3 periods to move to less congested condition.



19

## Jam Logic

- ▶ Information to be used from Jam Logic
  - Occupancy
  - Speed
  - Device malfunction
  - Duration of messages
  - Vehicle Counts
  - Vehicle Classification



20

# Jam Logic

The screenshot displays the Jam Logic software interface. On the left, a 'Device List' table shows various radar and camera units. The selected device is 'NB I-39 VDS 02 (2.0 b4 WZ) 1679 TS Radar', which is highlighted in blue. The detailed view on the right shows the device's status, including 'Speed' at 72 mph and 'Voltage' at 12.86 V. Below the device list, there is a circular logo for the University of Wisconsin - Institute of Transportation Studies.

Type	Status	Name	Value	Voltage	Image
Work Area					
		NB I-39 VDS 01 (1.0 b4 WZ) 1926**	73 mph	13.23 V	
		NB I-39 PCMS 01 (1.0 b4 WZ) 1936		13.25 V	
		NB I-39 PCMS 02 (2.0 b4 WZ) 1679 TS		13.19 V	
		NB I-39 VDS 02 (2.0 b4 WZ) 1679 TS Radar	72 mph	12.86 V	
		NB I-39 VDS 03 (3.0 b4 WZ) 1307 TS Radar	71 mph	12.81 V	
		NB I-39 PCMS 03 (3.0 b4 WZ) 1307 TS		13.25 V	
		NB I-39 PCMS 04 (4.0 b4 WZ) 1903 TS		13.29 V	
		NB I-39 VDS 04 (4.0 b4 WZ) 1903 TS Radar	71 mph	12.78 V	
		NB I-39 PCMS 05 (5.0 b4 WZ) 1378 TS		13.37 V	
		NB I-39 VDS 05 (5.0 b4 WZ) 1378 TS Radar	74 mph	13.29 V	

# Alert/Notification Options

- ▶ Text Alerts
- ▶ Email Alerts
- ▶ Queue Thresholds
- ▶ Speed Thresholds

The screenshot shows the 'Alert/Notification Options' menu in the Jam Logic software. The menu items are: Text Alerts, Email Alerts, Queue Thresholds, and Speed Thresholds. Below the menu, there is a circular logo for the University of Wisconsin - Institute of Transportation Studies.

## Sample Weekly Report



23

## Lessons Learned Roundtable

- ▶ Construction vehicle activity triggering the system
- ▶ Type of detection – Doppler vs microwave
- ▶ Field staff availability to assist in placement of devices
- ▶ Working within multiple construction zones
- ▶ Mega projects
- ▶ Spacing of PCMS and Sensors
- ▶ Truck percentages
- ▶ Verifying/reviewing vendor input and logic
- ▶ Field adjustments built into contract
- ▶ Latency of system
- ▶ Don't move the PCMS boards to quickly near start of project
- ▶ Latency concerns



24

## Future of QWS

- ▶ If projects are successful, WisDOT would like to implement QWS on more projects throughout the state.
- ▶ Working on a Decision Support tool to help identify future projects.



25

## QWS Decision Support System

Brian Sippel – BTO Work Zones  
7/22/2016



## Overview of presentation

- ▶ Background
- ▶ System logic and overview
- ▶ Future Strategy



27

## Background

- ▶ Challenges identifying pilot projects
  - Heavy reliance on regional resources
- ▶ Lessons learned from Iowa's Traffic Critical Projects program
- ▶ Working with the University of Wisconsin Traffic Operations and Safety Laboratory (UW-TOPS LAB)



28

## Decision Support System - Overview

- ▶ Leveraging existing resources
  - Online WisTMP
  - SSA Crash Map tool (under development)
  - Meta Manager data
- ▶ Possible criteria used to flag potential projects
  - AADT
  - Delay and Queuing
  - Roadway Geometry



29

## WisTMP User Inputs

- ▶ Specific Project AADT
- ▶ Queue Analysis
- ▶ Delay Analysis

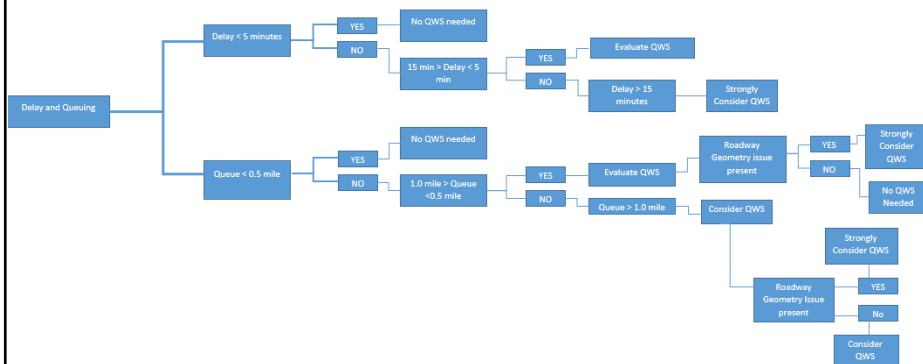
## System Inputs

- ▶ Meta Manager AADT for State Trunk Network
- ▶ Geometric Deficiencies – Horizontal and Vertical



30

## Decision Support System - Logic



31

## Decision Support System – Outputs

- ▶ Query of Potential Projects by:
  - AADT (high level map overview)
  - Geometric Issues (map overview)
  - Queue and Delay – if available at time of query
  - Project Information such as year, type, region, etc.
  
- ▶ Online WisTMP output
  - Mitigation Strategy



32



## Decision Support System - Status

- ▶ Estimated cost - \$170,000
- ▶ Concept plan vetted
- ▶ Scoping with UWTOPS Lab



33

## Future Strategy

- ▶ Identify projects early in the scoping phase so funding is available
- ▶ Supports potential for larger scale deployment



34

## Questions?

- ▶ Contact Information
  - Erin Schoon  
[Erin.schoon@dot.wi.gov](mailto:Erin.schoon@dot.wi.gov)  
414-220-6803
  - Brian Sippel  
[Brian.Sippel@dot.wi.gov](mailto:Brian.Sippel@dot.wi.gov)  
414-531-9279

