I-35 Queue Detection Warning System

TxDOT Short Course
October 15, 2013

Andy Petter, P.E.
Deputy District Engineer (Waco)
Texas Department of Transportation

Christopher Poe, Ph.D., P.E.
Assistant Agency Director
Texas A&M Transportation Institute
I-35 Expansion Project

TxDOT is committed to finishing the widening of Main Street Texas (I-35) to six lanes from San Antonio to Hillsboro.
Highlights

- 14 segments/17 projects
- 55,000–111,000 vehicles/day
- 25–30% trucks

Total Cost Approx. $2.1B

- Construction: $1.6B
- Right-of-Way: $410M
- Utilities: $110M
• Complete: 1A, 3C, 6A, 6B
• Nearly complete: 5C
• Active today: 1B, 1C, 2B, 3A1, 3B, BRB, 5A, 5B, Hill Co. rest areas
• Complete in early 2017
Construction Impact to Central Texas

I-35 Miles Under Construction

- Today: 60
- 2012: 64
- 2013: 64
- 2014: 64
- 2015: 43
- 2016: 32
- 2017: 6
I-35 Construction in Belton, TX
Construction Requirements

- Lane closures limited to evenings
  - Sun 10:00pm - Mon 7:00am
  - Mon - Fri, 7:00pm - 7:00am
- Lane rental fees
- Lane closure blackout dates
- Advance notifications
- 6-day work week
- Incentives for completing ahead of schedule
Challenges with Work Zones

Congestion

• Causes of Work Zone Queues
  – Geometric constraints
  – High demand
  – Lane closures in the construction area
  – Incidents

• Queues are dynamic
  – Extent and intensity changes from hour to hour

• Queues can exceed the project limits
End of Queue Warning Systems

- Automated monitoring near a work zone
- Warning of slow speeds
- Warning location of stop and go traffic
- Additional use of rumble strips
Challenges with Smart Work Zone

- Changing phases of constructions
- Queues can exceed the limits of the Smart Work Zone
Innovations on I-35

• Modified Smart Work Zone Specification for Nightly Deployment
Estimating Construction Traffic Delay

- Use of TTI research to estimate delay, queue length and duration
Innovations on I-35 (cont.)

- Smart Work Zone Deployed based on predicted queue
- Plan 1 and Plan 2

<table>
<thead>
<tr>
<th>Plan \ Project</th>
<th>1A</th>
<th>1B</th>
<th>1C</th>
<th>2A</th>
<th>2B</th>
<th>3A-1</th>
<th>3A-2</th>
<th>3B</th>
<th>3C</th>
<th>4</th>
<th>4A</th>
<th>BRB</th>
<th>5A</th>
<th>5B</th>
<th>5C</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
Innovations on I-35 (cont.):
Plan 1 vs. Plan 2
End of Queue System Summary

- 91 deployments to date
  - Plan 1 = 67
  - Plan 2 = 24

- March = 5
- April = 9
- May = 22
- June = 16
- July = 12
- Aug = 14
- Sept = 13
Innovations on I-35 (cont.)

• Full Corridor Monitoring with Bluetooth Readers
  – Warning of travel time delays in advance of work zones
Innovations on I-35 (cont.)

- Maximum Motorist Delay Rule of Thumb

### Expected Delay Summary (in minutes)

<table>
<thead>
<tr>
<th>Northbound</th>
<th>1A</th>
<th>1B</th>
<th>1C</th>
<th>2A</th>
<th>2B</th>
<th>3A-1</th>
<th>3A-2</th>
<th>3B</th>
<th>3C</th>
<th>4</th>
<th>4A</th>
<th>BRB</th>
<th>5A</th>
<th>5B</th>
<th>5C</th>
<th>Total Delay</th>
<th>Total Travel Time</th>
<th>% Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 PM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.4</td>
<td>104.4</td>
<td>4.4</td>
</tr>
<tr>
<td>8 PM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.4</td>
<td>104.4</td>
<td>4.4</td>
</tr>
<tr>
<td>9 PM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.2</td>
<td>103.2</td>
<td>3.2</td>
</tr>
<tr>
<td>10 PM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>11 PM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>12 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>1 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>2 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>3 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>4 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>5 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>6 AM</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10.1</td>
<td>110.1</td>
<td>10.1</td>
</tr>
</tbody>
</table>
Innovations on I-35 (cont.)

I-35 NB Full Closure Impact
Night of 8/20/2013

Max. Delay = 33 min

Queue Length from iTribe Data
Innovations on I-35 (cont.)

• Social Media / Twitter