I-76 ITS Enhancements ConOps (2016)

Vision and Goals

The traffic and transit operations of the Schuylkill Expressway Corridor will be managed seamlessly across multiple jurisdictional and agency boundaries, with the assistance of advanced technologies and cooperative strategies.

• Project Goals
  – Alleviate persistent recurrent congestion along the corridor
  – Reduce crashes, more specifically those related to rear-end collisions
  – Better manage unbalanced traffic volumes
  – Better incentivize transit, bicycle and pedestrian trips throughout the corridor
## Operational Focus Focus Areas

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<thead>
<tr>
<th>Variable Speed Limits</th>
<th>Queue Warning</th>
<th>Junction Control</th>
<th>Ramp Metering</th>
<th>Part-Time Shoulder Use</th>
<th>Multi-Modal Improvements</th>
<th>Connected Vehicle Applications</th>
<th>Managed Arterials</th>
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</thead>
<tbody>
<tr>
<td>IMPROVE TRAFFIC OPERATIONS</td>
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<td>OPTIMIZE MULTI-MODAL OPTIONS</td>
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Historical Crash Performance

![Bar chart showing total reported crashes on I-76 from 2007 to 2016. The chart indicates a general decrease in crashes except for a peak in 2015. The average reported crashes are also shown.]

Total Reported Crashes 2007-2016

- 2007: 540 crashes
- 2008: 520 crashes
- 2009: 460 crashes
- 2010: 440 crashes
- 2011: 540 crashes
- 2012: 520 crashes
- 2013: 460 crashes
- 2014: 420 crashes
- 2015: 540 crashes
- 2016: 520 crashes

Average reported crashes: 480 crashes
I-76 REPORTED CRASHES BY TYPE

- Rear Ends (65%), 3109
- Hit Fixed Object (20%), 976
- Same Direction Sideswipe (7%), 330
- Angle (3%), 126
- Other (4%), 241
- Rear Ends (65%), 3109
I-76 REPORTED CRASHES BY SEVERITY

- Fatal, 11
- Injury, 2158
- Property Damage Only, 2420
- Unknown, 193
Variable Speed Limit and Queue Warning Early Action

• Primary Goal – Reduce Rear-End Crashes and Harmonize Traffic Flow
• Project Status
  • Construction Start Date – April 2018
  • Construction Complete/Go Live – Spring, 2020
• Project Elements
  • 73 Variable Speed Limit Signs
  • Nine (9) Dynamic Message Signs
  • New ATMS Software Module
Alternatives Analysis

• Report Submitted to PennDOT April, 2019
• Identified Overall Design Criteria
  • Roadway
  • Structures
  • ITS
• Evaluated Options for Flex Lane Limits
  • Traffic and Safety Metrics were Modeled and Analyzed
• Evaluated Options for Highway Widening & associated SWM
• Evaluated Options for Structure Accommodations
• Identified Constraints – Environmental, Socioeconomic, Geotechnical
• Identified Emergency Access Enhancements
Base Model Development

- Import Highway Geometry into IHSDM – InRoads – Assistance from FHWA IHSDM Development Team
- Import Traffic Volumes – Same as used in VISSIM analysis – Hourly/partial counts were aggregated into ADT.
  - Volumes assigned to geometric limits – not continued through interchanges.
  - Generated errors for ADT falling outside of model limits.
- Import existing crash resumes into IHSDM
- Run model and assess results
Base Model Outputs

I-76 Total Reported Crashes 2007-2016 (crashes/year)

- **Reported Crashes**
- **AVG Reported Crashes**
- **IHSDM Predicted (Without Crash Data)**
- **IHSDM Predicted (With Crash Data)**
Flex Lane Limit Alternatives
Flex Lane Limit Alternatives
Widening Alternative – Symmetrical – outside shoulder
Widening Alternative – Directional – Inside Shoulder

INACTIVE OPERATION

ACTIVE OPERATION
Build Models Developed

- Existing Conditions
- No Build Model
- Alternative 1 (symmetrical widening) – Outside Flex Lane
- Alternative 1 (symmetrical widening) – Inside Flex Lane
- Alternative 2 (WB directional widening) – Outside Flex Lane
- Alternative 2 (WB directional widening) – Inside Flex Lane
Adjustments to model flex lane usage

• Assumed operational flex lane from 6:00AM to 8:00 PM
• Use hourly volumes, when available, to determine active/inactive total volume
  • Apply percentage breakdown based on nearest hourly volumes in areas where only ADT data available
• Develop Equivalent ADTs
  • Equivalent Active Period ADT = (Total Active Period Volume) * 24 hours / 14 hours
  • Equivalent Inactive Period ADT = (Total Inactive Period Volume) * 24 hours / 10 hours
• Run IHSDM for each geometry (no-build, alt 1 and alt 2) with inactive and active ADT – 10 model runs total
• Calibrate results to equivalent periods and combine into total crashes for each build scenario.
  • Active Period Predicted Crashes = Active Model Crash Output * 14 hours / 24 hours
  • Inactive Period Predicted Crashes = Inactive Model Crash Output * 10 hours / 24 hours
IHSDM Flex Lane Model Development Skew

- **No-Build Model**
  - Active Time (06:00-20:00): 496
  - Inactive Time (20:00-06:00): 94

- **Existing (24 Hour) Model**
  - Active Time (06:00-20:00): 433
  - Inactive Time (20:00-06:00): 122

  - Active Time (06:00-20:00): 373
  - Inactive Time (20:00-06:00): 107
Build Model Comparative Results Full Limits (crashes/year)

<table>
<thead>
<tr>
<th>Model</th>
<th>Active Time (06:00-20:00)</th>
<th>Inactive Time (20:00-06:00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt 2 Build Model</td>
<td>463</td>
<td>91</td>
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<tr>
<td>Alt 1 Build Model</td>
<td>489</td>
<td>93</td>
</tr>
<tr>
<td>No-Build Model</td>
<td>496</td>
<td>94</td>
</tr>
<tr>
<td>Existing (24 Hour) Model</td>
<td>433</td>
<td>122</td>
</tr>
<tr>
<td>Reported Crashes (2007-2016)</td>
<td>373</td>
<td>107</td>
</tr>
</tbody>
</table>

Reported Crashes (2007-2016):

- Alt 2 Build Model: 463 (Active: 373, Inactive: 91)
- Alt 1 Build Model: 489 (Active: 433, Inactive: 56)
- No-Build Model: 496 (Active: 433, Inactive: 63)
- Existing (24 Hour) Model: 433 (Active: 373, Inactive: 60)
Alternative 1&2 Inside vs. Outside Flex Lane Comparison (US 202 to I-476)

- **Alternative 2 - Inside Flex Lane**: 153 active, 28 inactive
- **Alternative 2 - Outside Flex Lane**: 160 active, 28 inactive
- **Alternative 1 - Inside Flex Lane**: 184 active, 31 inactive
- **Alternative 1 - Outside Flex Lane**: 181 active, 31 inactive

Legend:
- Green: Active Time (06:00-20:00)
- Orange: Inactive Time (20:00-06:00)
Next Steps

- Re-Run symmetrical widening alternatives (Alt. 1) with a slightly wider shoulder (4’ vs. 1.5’)
- New IHSDM version allow CMFs to be applied
  - Lane use control
  - VSL
  - Queue Warning
  - Ramp Metering
- Re-Run analysis on selected alternative with preliminary design geometry
- Develop corridor specific CMF for VSL and Queue Warning.
Questions

www.transform76.com

Twitter @transformi76

Facebook (Transform76)

Brian J. DePan, PE
brian.depan@jacobs.com
267.234.9496