Hard Shoulder Running is a valuable tool

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Dean H. Gustafson, PE, PTOE
State Operations Engineer
VDOT Operations Division

Virginia


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Fredericksburg
Staunton
Waynesboro
Charlottesville
Goshen
Clifton Forge
Covington
Lexington
Scottsville
Columbia
Glasgow
Amherst
Dillwyn
Tuckahoe
Richmond
Bon Air
Highland Springs
Laurel
Glen Allen
Bowling Green
Tappahannock
Warsaw
Montross
Chincoteague
Tangier
Accomac
Bloxom
Melfa
Eastville
Cape Charles
Williamsburg
Hopewell
Colonial Heights
Petersburg
Surry
Poquoson
Hampton
Newport News
Norfolk
Virginia Beach
Chesapeake
Suffolk
Jarratt
Lawrenceville
Alberta
McKenney
Crewe
Burkeville
Pamplin
Appomattox
Lynchburg
Troutville
New Castle
Salem
Roanoke
Bedford
Blacksburg
Christiansburg
Altavista
Rocky Mount
Floyd
Chatham
Halifax
Danville
Clarksville
Virgilina
Martinsville
Stuart
Hillsville
Radford
Tazewell
Pearisburg
Bluefield
Grundy
Haysi
Clintwood
Wise
Lebanon
Pennington Gap
Jonesville
Gate City
Bristol
Damascus
Trout Dale
Independence
Branchville
Newsoms
Interstate Highways
US Highways
Toll Roads
0
50 KM
50 Miles
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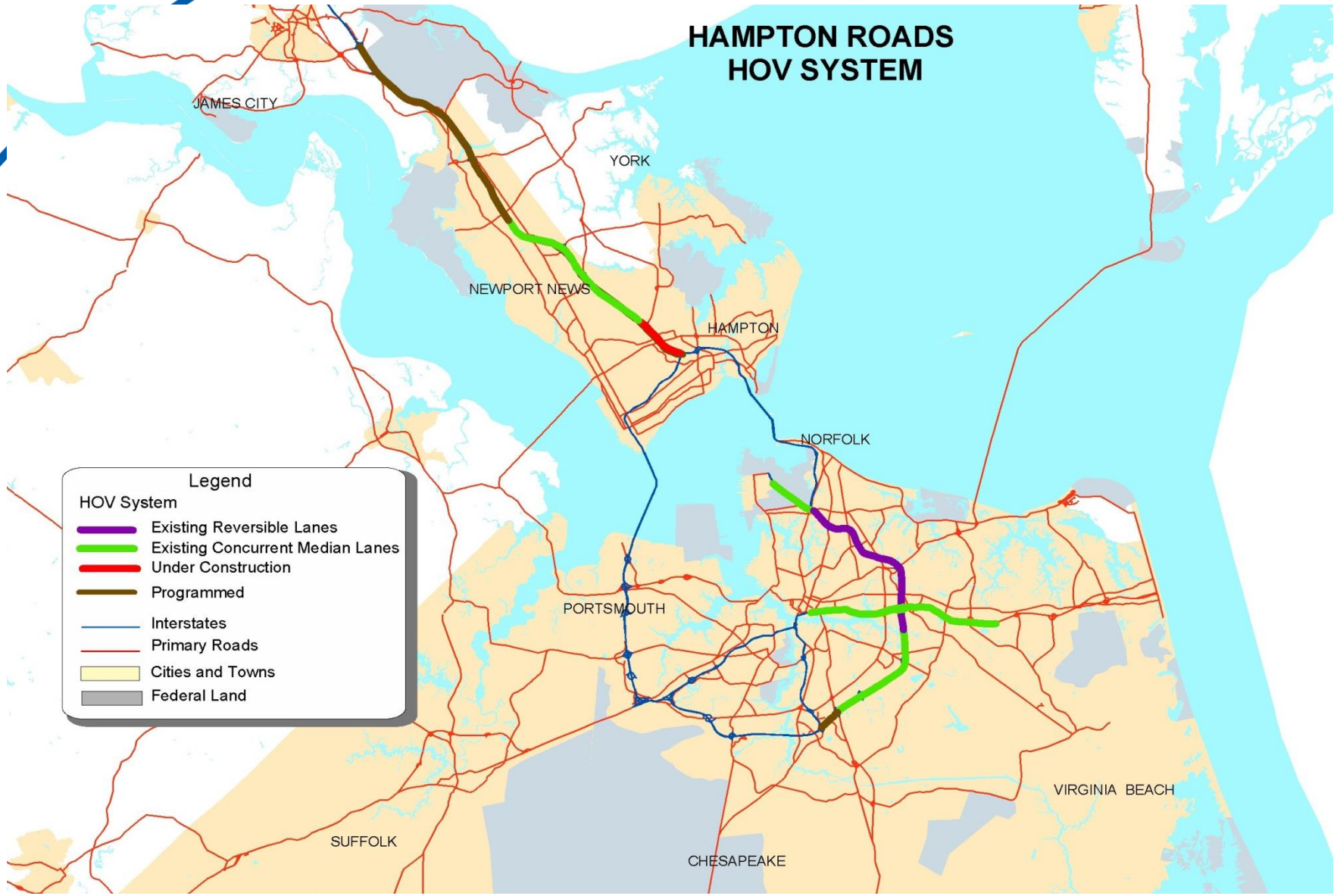
VDOT's Statewide Operations Program
Operations Statistics

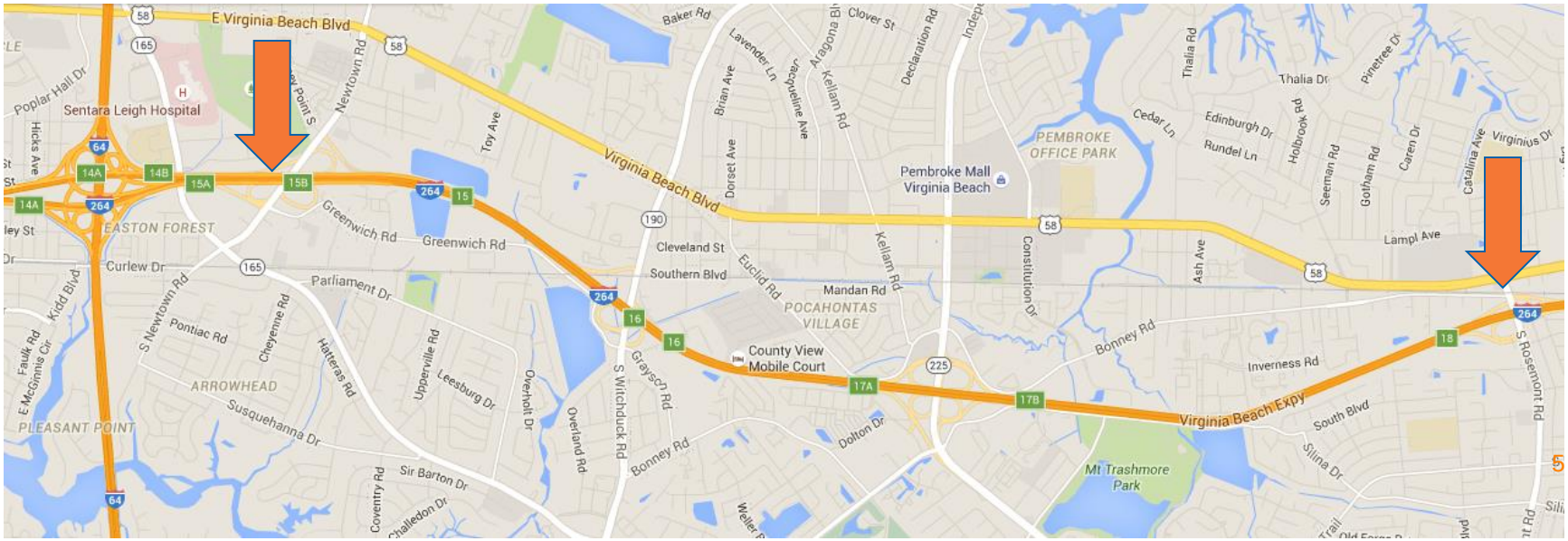
- **System Mileage**
  - **Interstate – 1,120**
  - **Primary – 7,996**
  - **Secondary - 48,809**
- **7 Tunnels**
- **11 Moveable Bridges**
- **3 Ferries**

- Each TOC handles 28 to 151 events every day
- Over 2,700 field devices
- Over 338 miles of VDOT fiber
- 50 SSP patrol routes covering 503 miles of Interstate
- 30 routes/250 miles are 24/7
- 4th Generation Statewide 511 Program
- Phone, Web, Mobile App


HAMPTON ROADS
HOV SYSTEM
JAMES CITY
YORK
NEWPORT NEWS
HAMPTON
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
SUFFOLK
CHESAPEAKE
Legend
HOV System
Existing Reversible Lanes
Existing Concurrent Median Lanes
Under Construction
Programmed
Interstates
Primary Roads
Cities and Towns
Federal Land

I-264 Hard Shoulder Running

- I-264 between Newtown Road and Rosemont Road Interchanges
- Approximately a 4 centerline mile length
- Installed in 1992 when HOV lanes created from GP lanes
- Shoulder/Lane is a 12’-wide full depth shoulder
- Pavement matches GP Lanes
- Emergency Pull-off areas located each ¼ Mile
  - Full width (15’), Length approx. 300’, Includes decel/accel tapers



I-264 HSR Operations

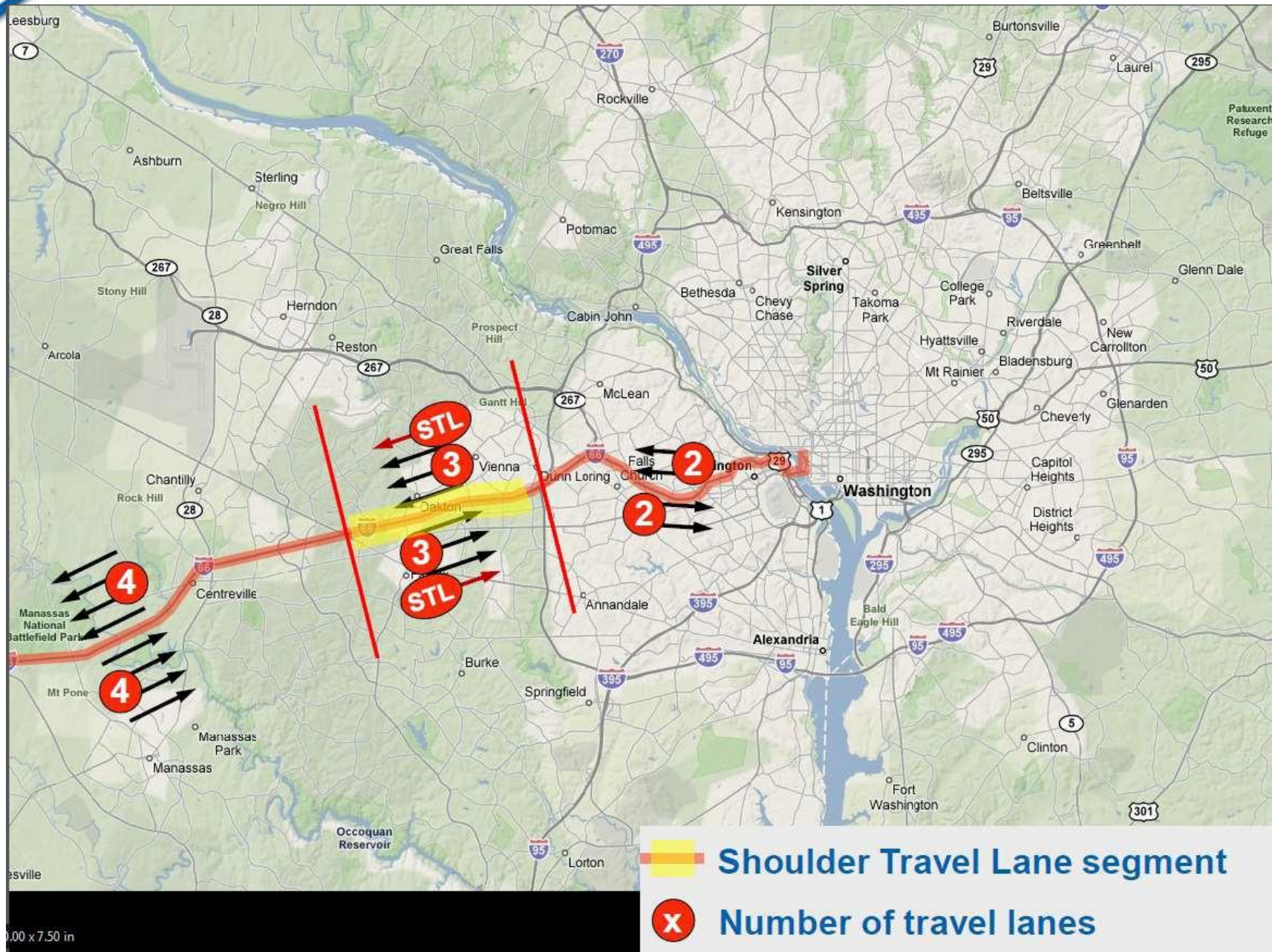
- HSR Operations coincide with HOV Reversible and Concurrent Flow Lanes (HOV 2+) Weekdays Only
  - Westbound 0600 – 0900
  - Eastbound 1500– 1800
  - Closed (Emergency Stopping Only) all other times
- Virginia code allows the lifting of HOV restrictions in Hampton Roads when a general purpose lane is expected to be blocked for 10+ minutes.
  - HSR lane remains open to all traffic
  - Occurs several times per year
- Speed limits are fixed and same as the rest of travel lanes.

I-264 Typical Section

Typical Traffic Control Devices

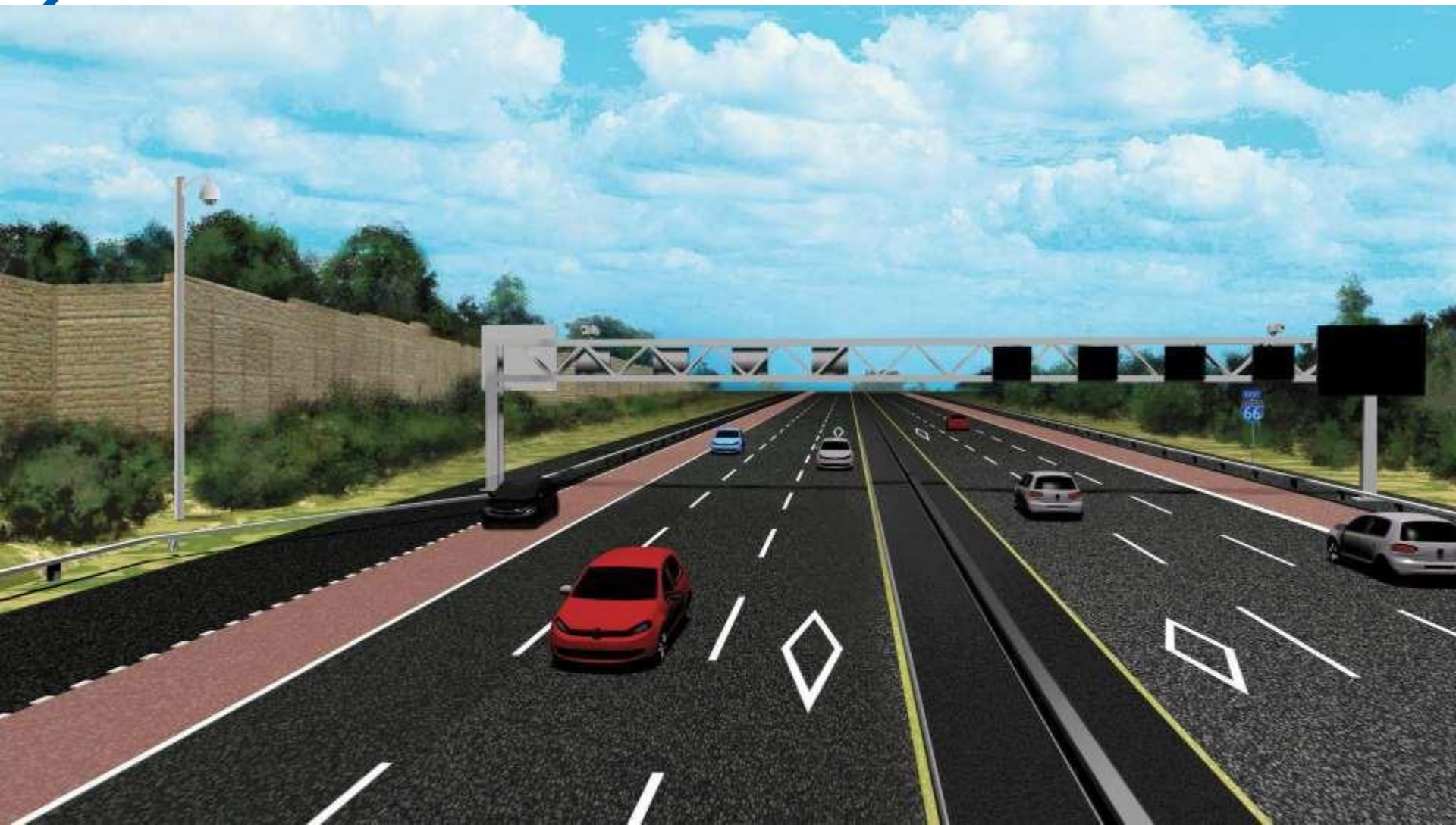
Typical Traffic Control

Interstate 66 corridor



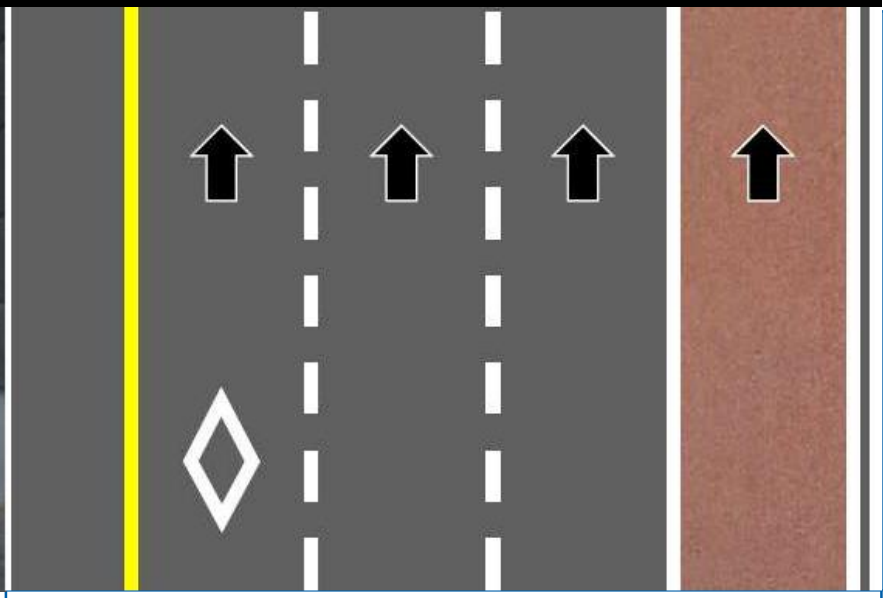
Shoulder Travel Lane History

- 1964: This segment of I-66 first constructed as a 4-lane divided freeway
- April 1993: Widened to 6 lanes. Left lane reserved for HOV-2, shoulder upgraded for use as a travel lane during peak periods.
  - 6:30 – 9:00 AM eastbound
  - 4:00 – 6:30 PM westbound
- August 1993: HOV and Shoulder Lane hours extended:
  - 5:30 – 9:30 AM eastbound
  - 3:00 – 7:00 PM westbound
- 1999: Shoulder Lane hours extended:
  - 5:30 – 10:00 AM eastbound
  - 3:00 – 8:00 PM westbound
- August 2008: Shoulder Lane hours extended and incidents
  - 5:30 – 11:00 AM eastbound
  - 2:00 – 8:00 PM westbound
- HOV Hours remain unchanged since August 1993



Shoulder Lane Control Signs

Shoulder Lane Control Signs



Lane Control Signs

Yellow Merge Arrow: Used to start shifting traffic away from lane when there is debris, stopped vehicle(s), encroachment, or when people are close to edge of travel way

Red X: Used keep traffic away from blocked lane at scene of an incident, debris or encroachment

Green Arrow: Used to signify that the lane is open to traffic beyond a blockage point

Signing for Emergency Pull-Off Areas

Safety Impacts

- Comprehensive study of crash patterns
- Methodology peer-reviewed by TRB and ITE
- No significant difference in crashes when shoulder travel lane is open

Safety Impacts of Freeway Managed-Lane Strategy

Inside Lane for High-Occupancy Vehicle Use and Right Shoulder Lane as Travel Lane During Peak Periods

Jung-Taek Lee, Randy Dittberner, and Hari Sripathi

This paper presents results of a safety analysis of a freeway managed-lane strategy, that is, a time-of-day managed-lane strategy that concurrently allows use of the inner left lanes by high-occupancy vehicles (HOVs) and use of right shoulders as general purpose travel lanes during peak hours. Recent 3-year crash data and corresponding annual average daily traffic (AADT) volumes and lane-type-specific AADT volumes were identified for various lane types, including the inner left lanes for HOV only use during peak hours, general purpose lanes, right shoulder lanes, and all lanes as a whole. Negative binomial regression models were used to estimate the effect of this traffic operations system and other factors relevant to crash frequency. The negative binomial regression model analyses present no evidence that the interest factors, including the managed-lane strategy during peak hours, AADT volumes, merging and diverging influence areas, weather, light conditions, and existence of pull-off areas, affect the crash frequency when aggregated across all lanes. The variable AADT volumes in the specific analysis of general purpose lanes appear to be significant and show about a 2% increase in weekday crashes for each increase of 1,000 vehicles per day in the AADT range of 50,000 to 83,000 vehicles per day. Right shoulder direction on weekdays. The use of the right shoulders for traffic is of particular interest to the agency because a disturbance on the shoulder, such as a collision or a disabled vehicle, significantly affects traffic during peak hours. Allowing traffic to use the right shoulders as travel lanes provides additional capacity to meet peak traffic demand and is a simple and cost-effective congestion mitigation method, but the shoulders become unavailable for other purposes, such as a refuge for disabled vehicles or enforcement activities. Despite the safety implications of the change in shoulder use, the safety effects of the system had not been comprehensively analyzed. This paper addresses the effects of this managed-lane strategy and other factors on lane-specific traffic safety, especially the right shoulders.

LITERATURE REVIEW

Traffic operational success of HOV lanes and relevant safety issues are well documented by many transportation agencies and transpor-

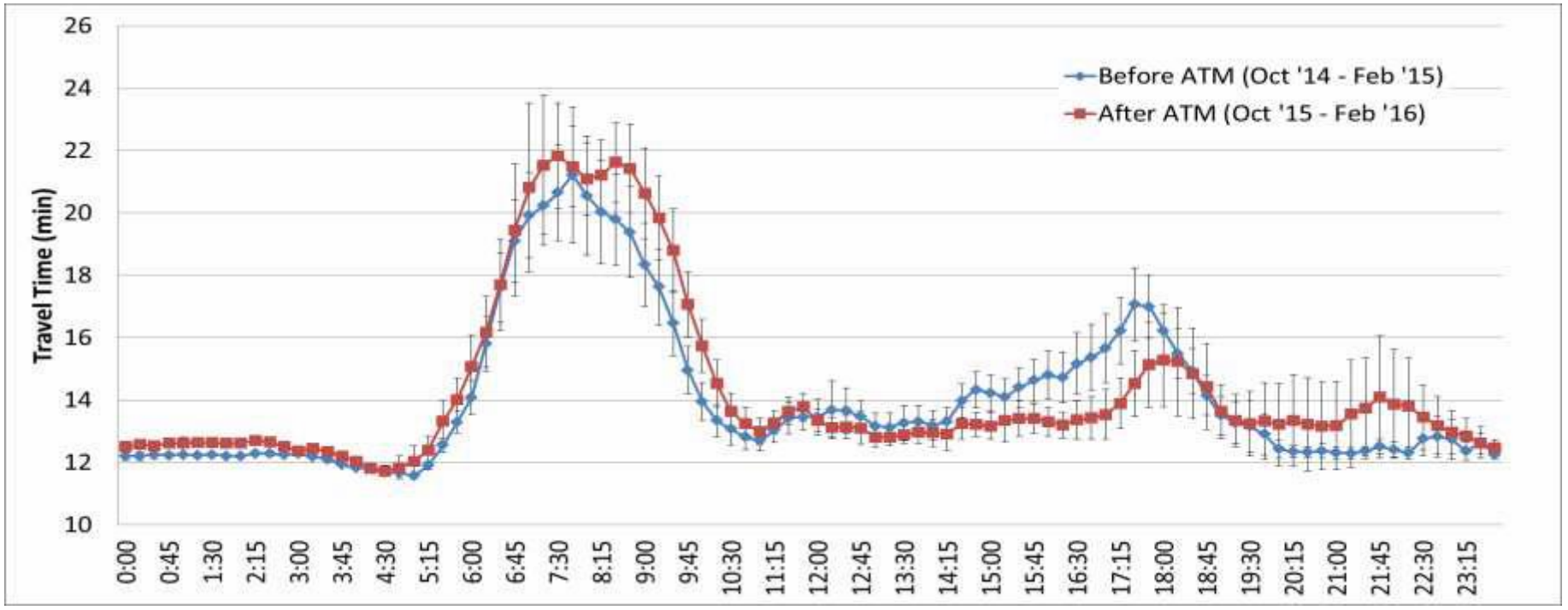
Hard Shoulder Running Usage

- **Before ATM, shoulders on I-66 from US 50 to I-495 were open to travel on a fixed schedule:**
  - **EB: 5:30-11:00 AM weekdays only**
  - **WB: 2:00-8:00 PM weekdays only**
- **After ATM, shoulders were also opened as needed based on traffic congestion.**
- **Average daily duration of shoulder lane sign activation from 9/15 to 2/16:**

Direction	Weekdays	Weekends
EB	8.0 hours	2.4 hours
WB	5.9 hours	2.0 hours

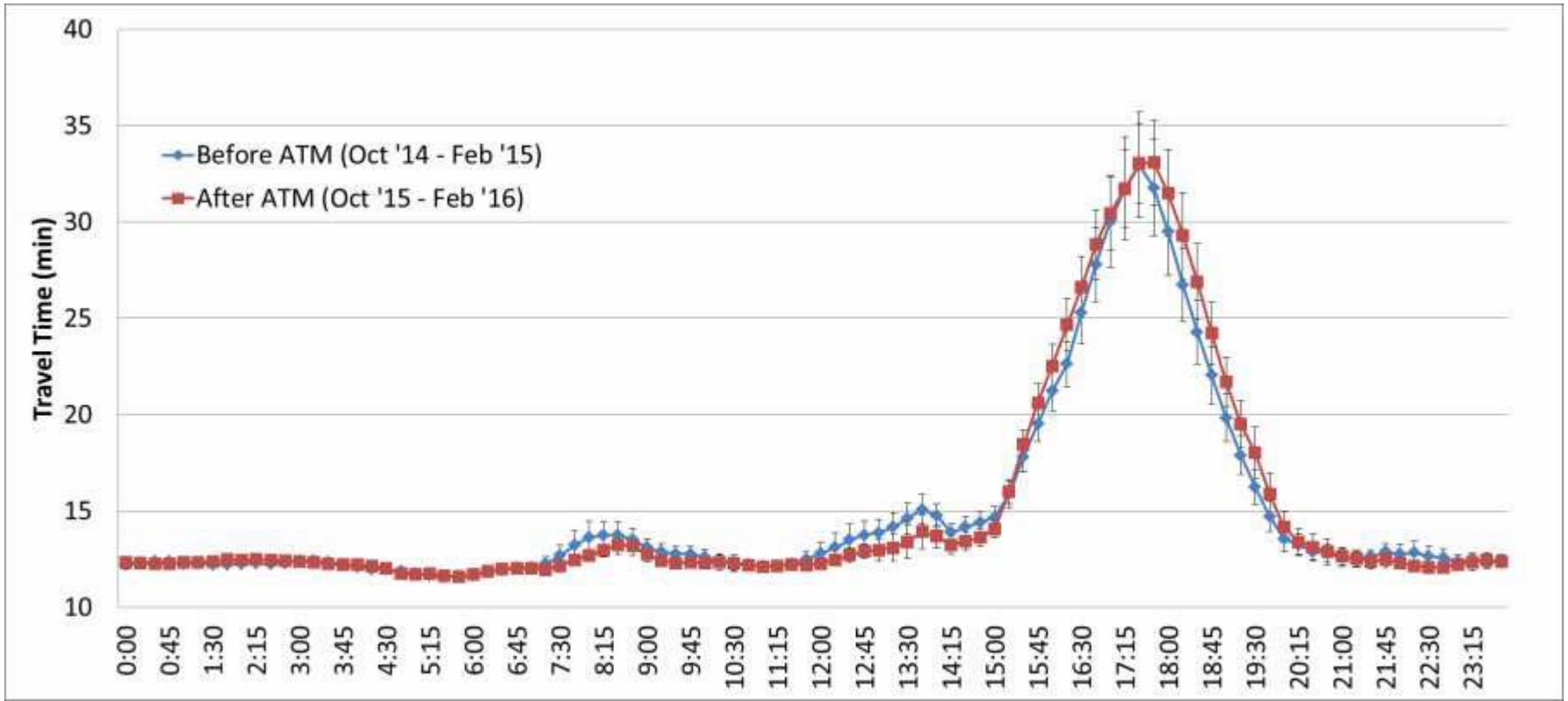
2014-2015 vs. 2015-2016 Average EB Weekday Travel Times

Time Period	Oct 2014 - Feb 2015	Oct 2015 - Feb 2016	Change	Statistically Significant?
AM Peak (5:30 - 11AM)	17.0 min	18.2 min	+1.2 (+7%)	Yes
Midday (11AM - 2PM)	13.3 min	13.2 min	-0.1 (-1%)	Yes
PM Peak (2PM - 8PM)	14.7 min	13.7 min	-1.0 (-6%)	Yes



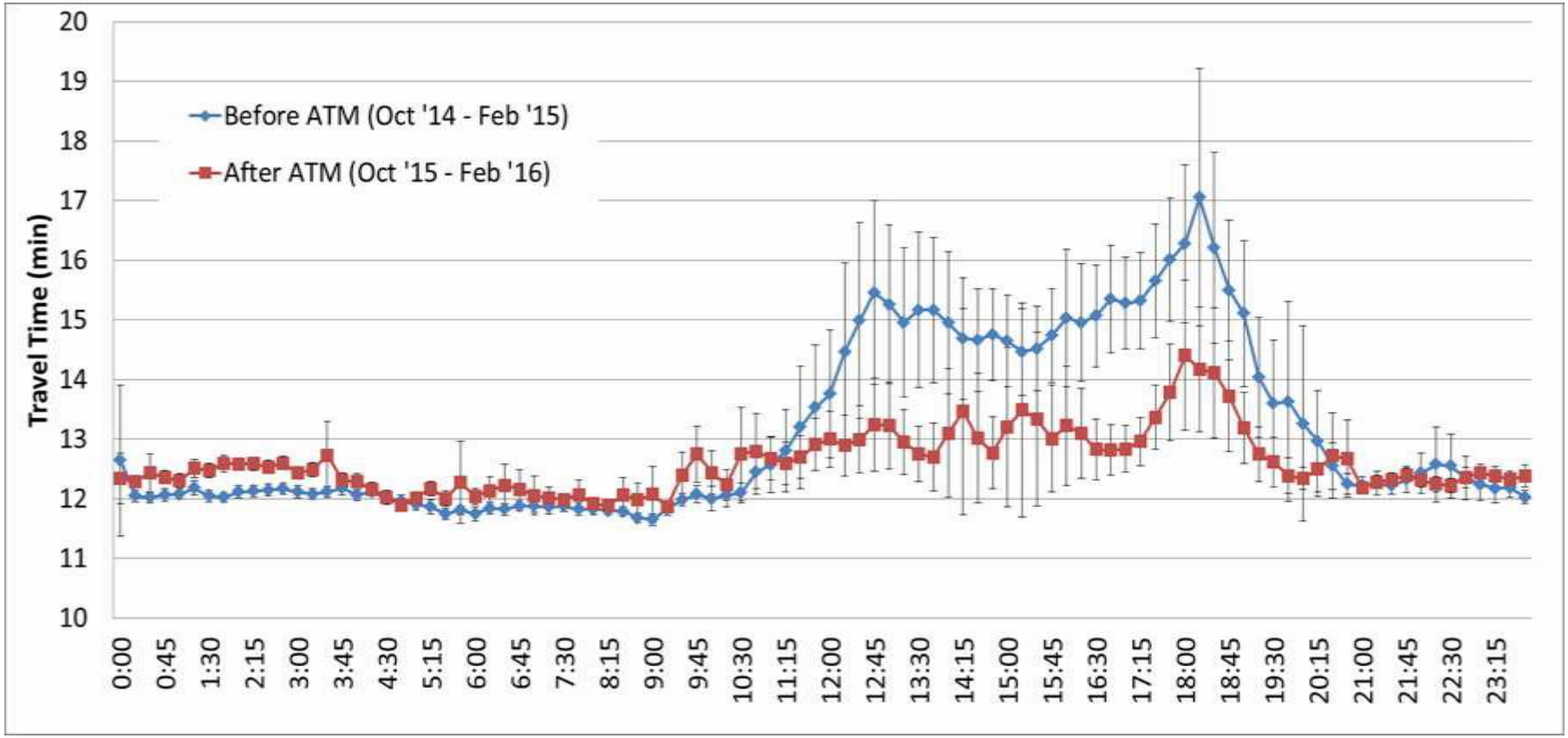
2014-2015 vs. 2015-2016 Average WB Weekday Travel Times

Time Period	Oct 2014 - Feb 2015	Oct 2015 - Feb 2016	Change	Statistically Significant?
AM Peak (5:30AM - 11AM)	12.6 min	12.3 min	-0.3 (-2%)	Yes
Midday (11AM - 2PM)	13.3 min	12.7 min	-0.6 (-5%)	Yes
PM Peak (2PM - 8PM)	21.7 min	22.5 min	+0.8 (+4%)	Yes



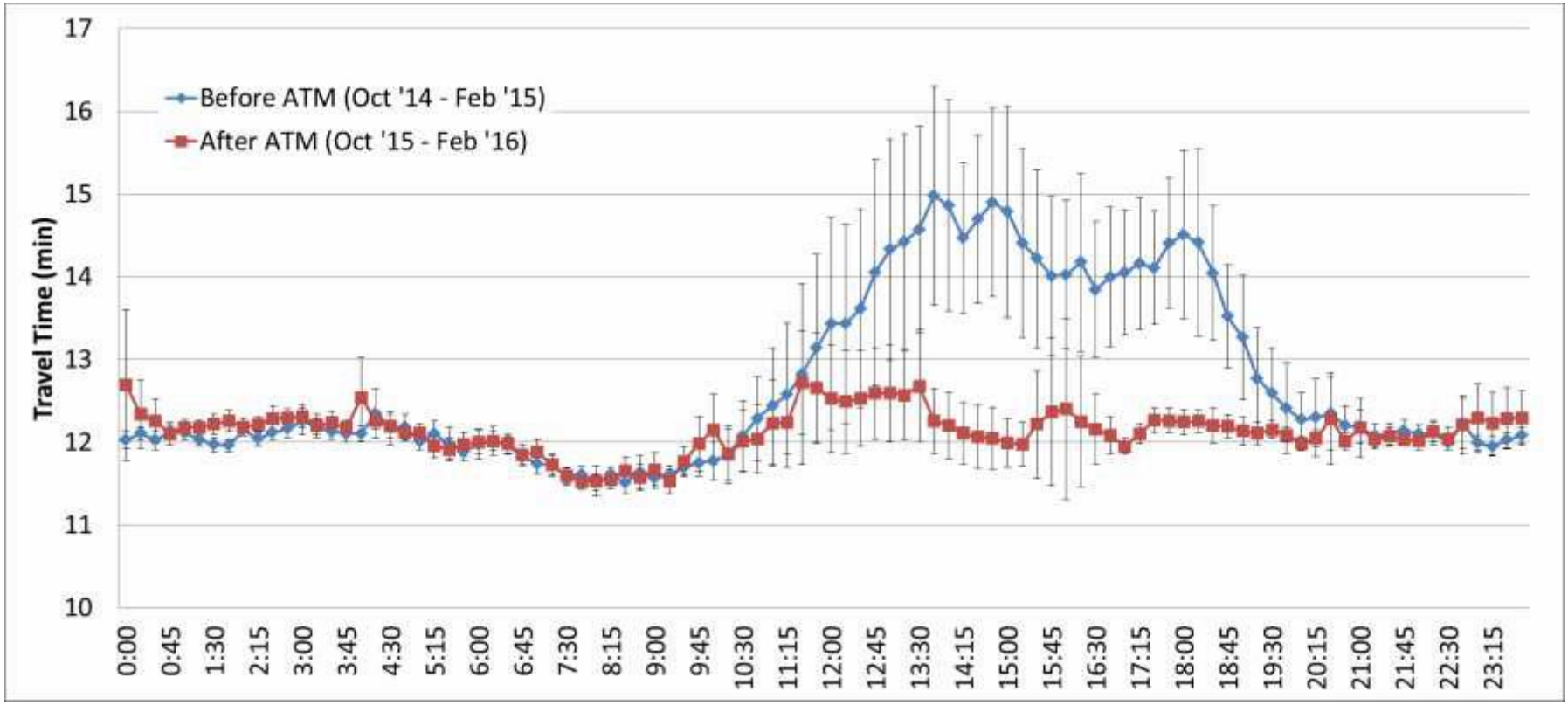
2014-2015 vs. 2015-2016 Average EB Weekend Travel Times

Time Period	Oct 2014 - Feb 2015	Oct 2015 - Feb 2016	Change	Statistically Significant?
Daytime Peak (10AM - 8PM)	14.5 min	13.1 min	-1.4 (-10%)	Yes

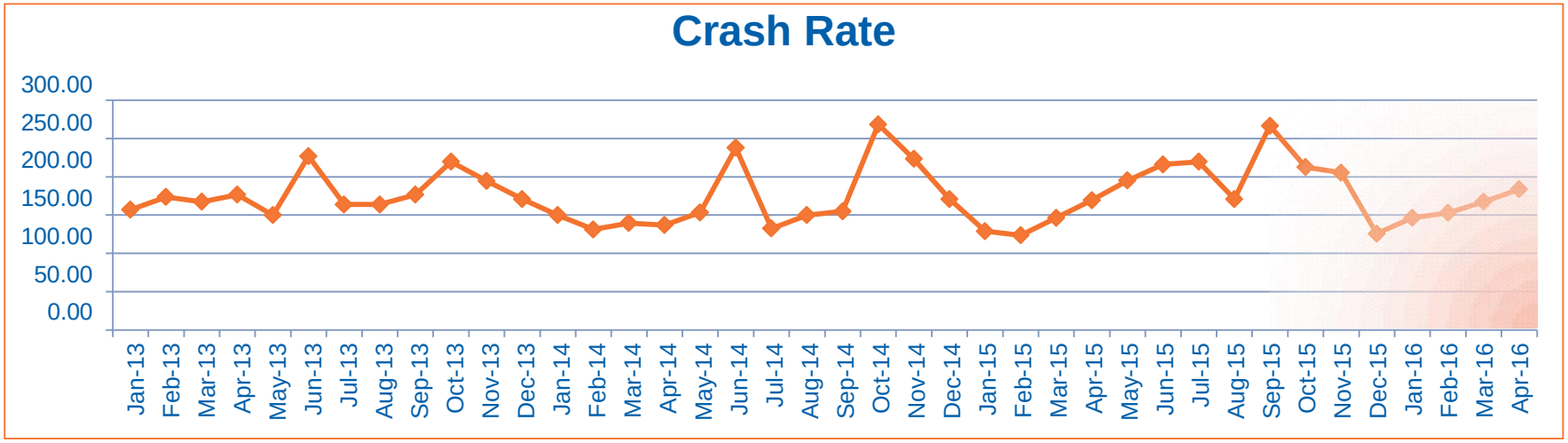


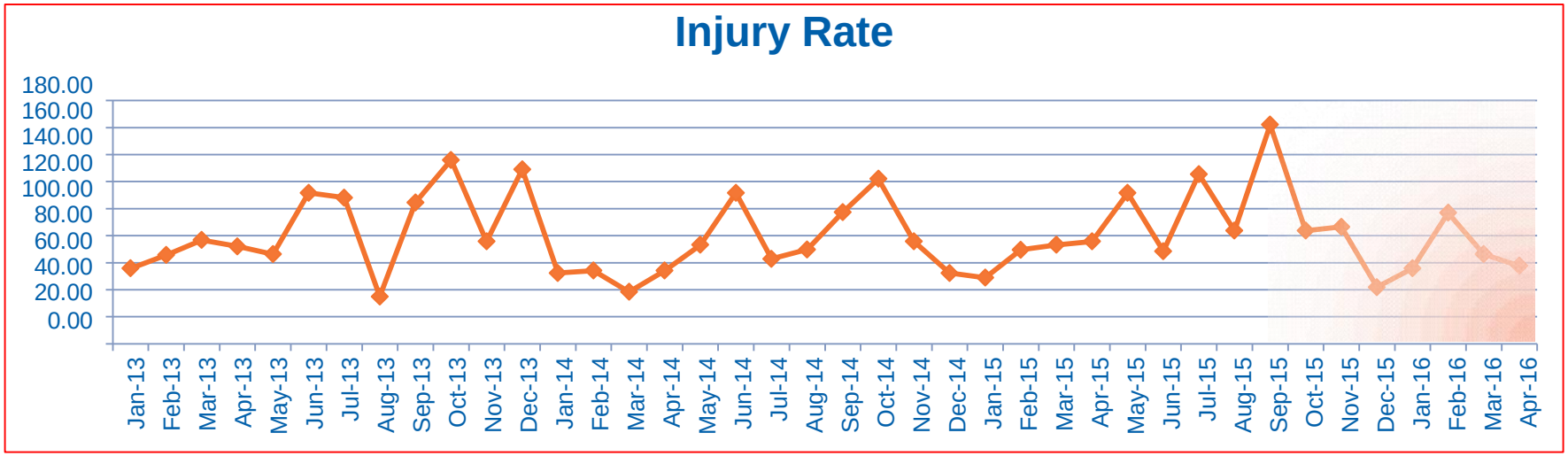
2014-2015 vs. 2015-2016 Average WB Weekend Travel Times

Time Period	Oct 2014 - Feb 2015	Oct 2015 - Feb 2016	Change	Statistically Significant?
Daytime Peak (10AM - 8PM)	13.7 min	12.2 min	-1.5 (-11%)	Yes



Crash and Injury Rate Trend





Initial before/after Study Finding

- The ATM system had minimal effect on travel times during weekday peak periods, same shoulders use before ATM.
- Small benefits were observed in the off peak direction and during midday periods during the week.
- Flow improved substantially during the weekends. Both mean travel time and travel time reliability improved by a statistically significant amount.
- Most improvements appear to be attributable to shoulder lane usage.
- Currently examining crash data, but early results appear to show some reductions in crashes.

Impact, Issues, and Public Perception

- Reduced congestion.
- Safety issues: No major safety issues. No adverse impact on traffic safety.
- Motorists have generally favorable views due to reduction of congestion.
- Enforcement issues - motorists using lane during non-usage times.
- Incident management is difficult when shoulder lane is open to traffic, quick clearance is required.
- Lesson Learned: Start with better lane control and other signs, provide information to motorists through overhead DMS.
- Colored pavements really help public discern special facility, especially around interchanges.

Thank you!

Please email me with questions:

Dean.Gustafson@vdot.virginia.gov