Maryland SHA's Use of Probe Data and Lessons Learned

2015 MWCOG Vehicle Probe Data Users Group

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Why is SHA interested?

- Maryland is home to **6 million people** with lots of geographic and socio-economic diversity
- SHA operates and maintains the numbered, non-toll routes in MD - **17,000 lane-miles** and **2,576 bridges**
- SHA roadways serve **65% of state VMT** and **85% of truck VMT**

- Performance Management & Data driven decisions at all levels
- Business Plan, Performance Measurement & MAP-21
- Increased focus on Operations
- System Efficiency & Reliability key
- Freight movement & Economy
- Communicating Performance

Mobility/ Reliability Performance Management

Mobility & Economy is one of six Key Performance Areas (KPAs) at SHA.

Mobility KPA Goal: *Support Maryland's Economy and Communities through enabling reliable movement of people and goods.*

Objectives, performance measures and strategies have been identified to accomplish the goal.

Travel Reliability, Freight Mobility and Travel Information Dissemination are three objectives that use private sector vehicle probe data.

Vehicle probe data feed various performance metrics

Maryland State Highway Annual Mobility Report

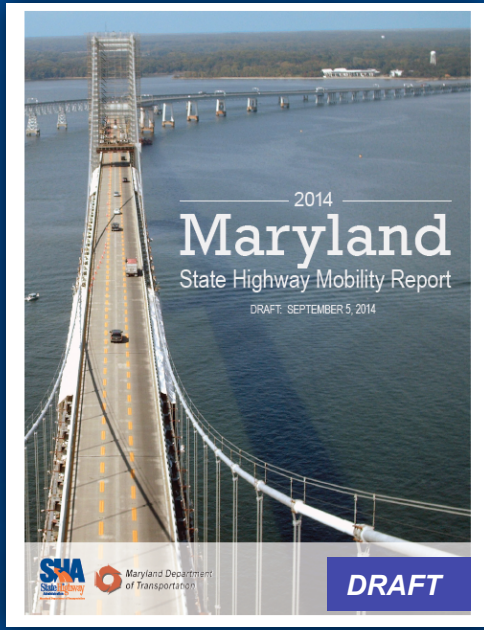
Background

- Developed to document key initiatives at SHA as it relates to Mobility KPA
- Started in 2012…in the third year of publication
- Demonstrates SHA data and performance based decision-making framework
- Built around a theme of:

What's happening?

What is SHA doing?

What is the outcome?



Key Datasets and Applications

Datasets

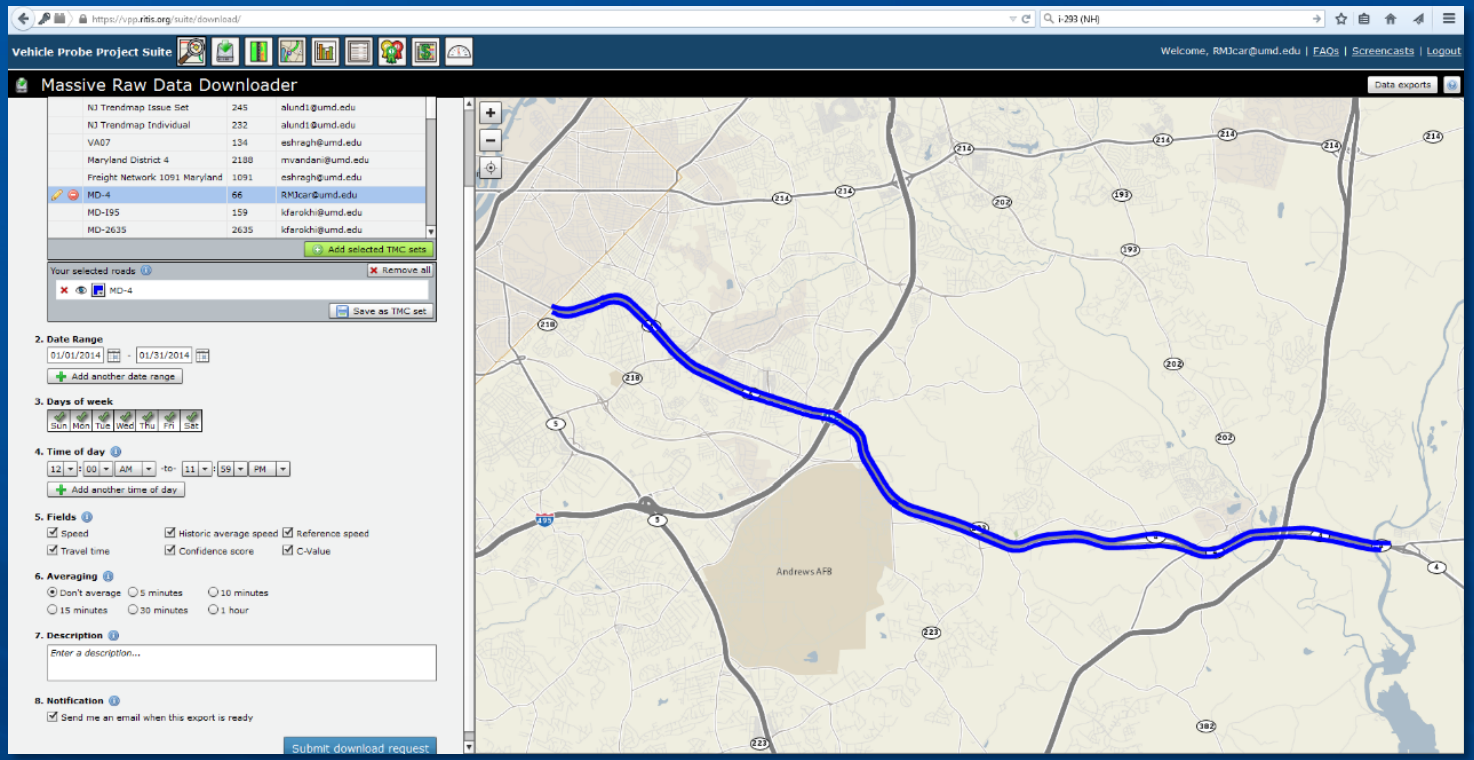
- INRIX Vehicle Probe Data on freeways/expressways
- SHA Traffic Count Data
- SHA Signal System Data
- SHA Construction Project Information

Applications

- UMD CATT Lab Vehicle Probe Project (VPP) Suite
- SHA Traffic Monitoring System Application (I-TMS)
- Traffic Simulation Models and Other GIS Applications

General Data Processing Method

Obtain Data via VPP Massive Raw Data Download → Format Data with MATLAB → Generate PM values with MATLAB → Create Report



Work performed with support from UMD-CATT

Congestion Metrics

Travel Time Index

- AM and PM Peak Hours
- INRIX Data
- Ratio of Peak Hour Travel Time versus Free Flow Travel Time

Reliability Metrics

Planning Time Index

- AM and PM Peak Hours
- INRIX Data
- Amount of Travel Time a Motorist Should Plan on Allowing to Arrive at Destination on Time Taking into Account Potential Impacts

MSHA Definitions of Congestion and Reliability

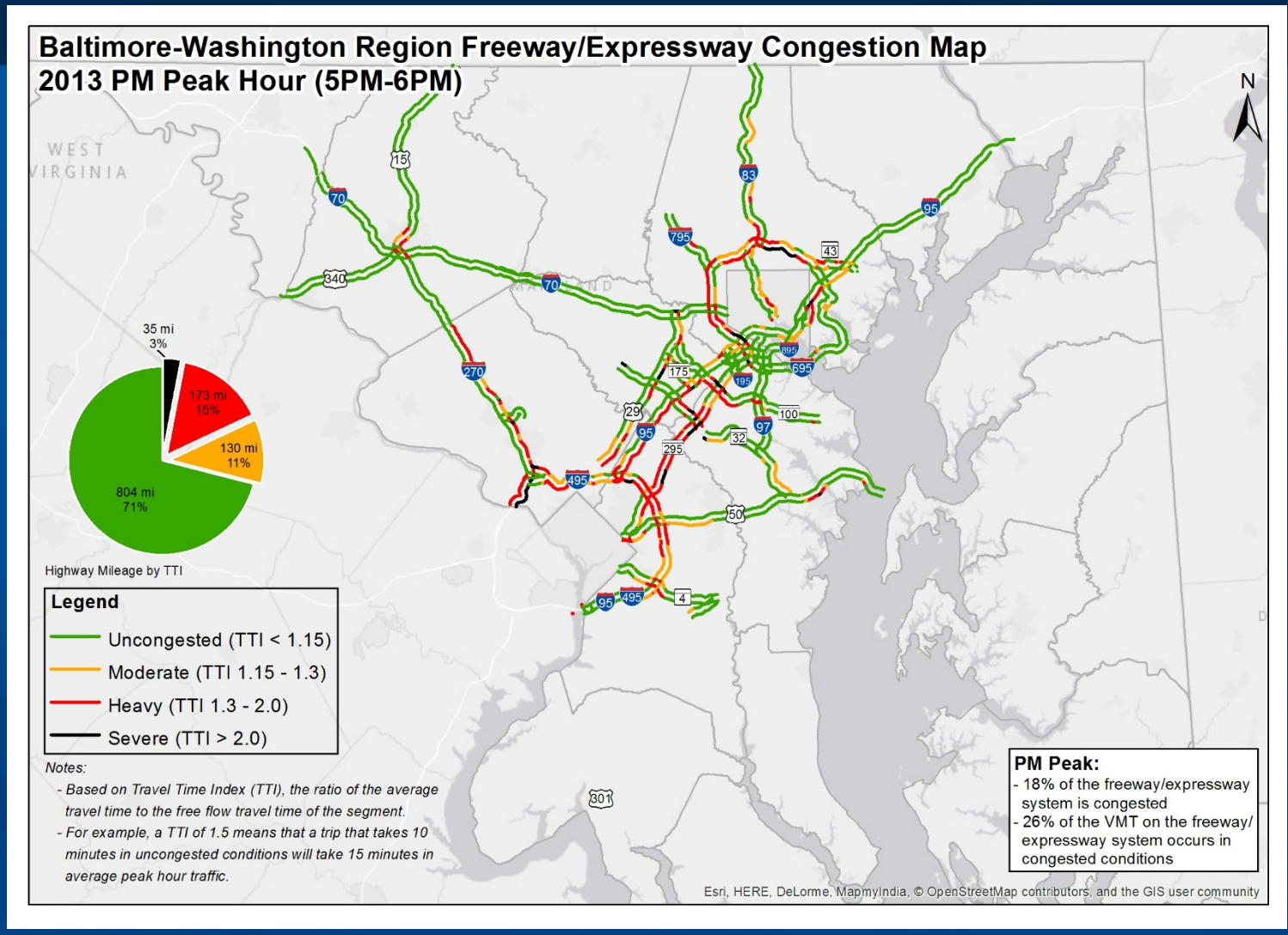
Travel Time Index (TTI): (50th Percentile Travel Time/Free Flow Travel Time)

- Uncongested (TTI < 1.15)
- Moderate (1.15 < TTI < 1.3)
- Heavy (1.3 < TTI < 2.0)
- Severe (TTI > 2.0)

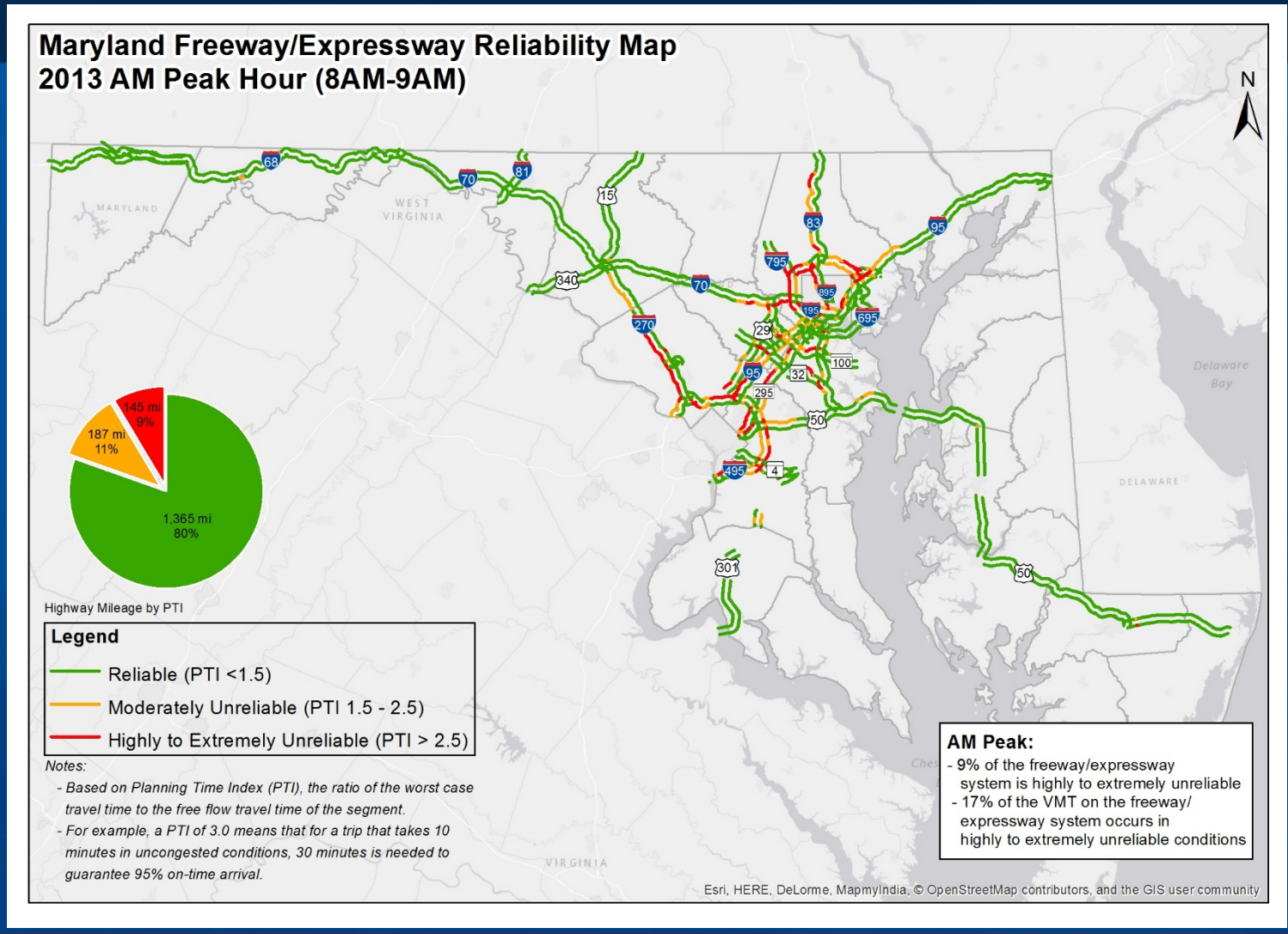
Planning Time Index (PTI): (95th Percentile Travel Time/ Free Flow Travel Time)

- Reliable (PTI < 1.5)
- Moderately Unreliable (1.5 < PTI < 2.5)
- Highly to Extremely Unreliable (PTI > 2.5)

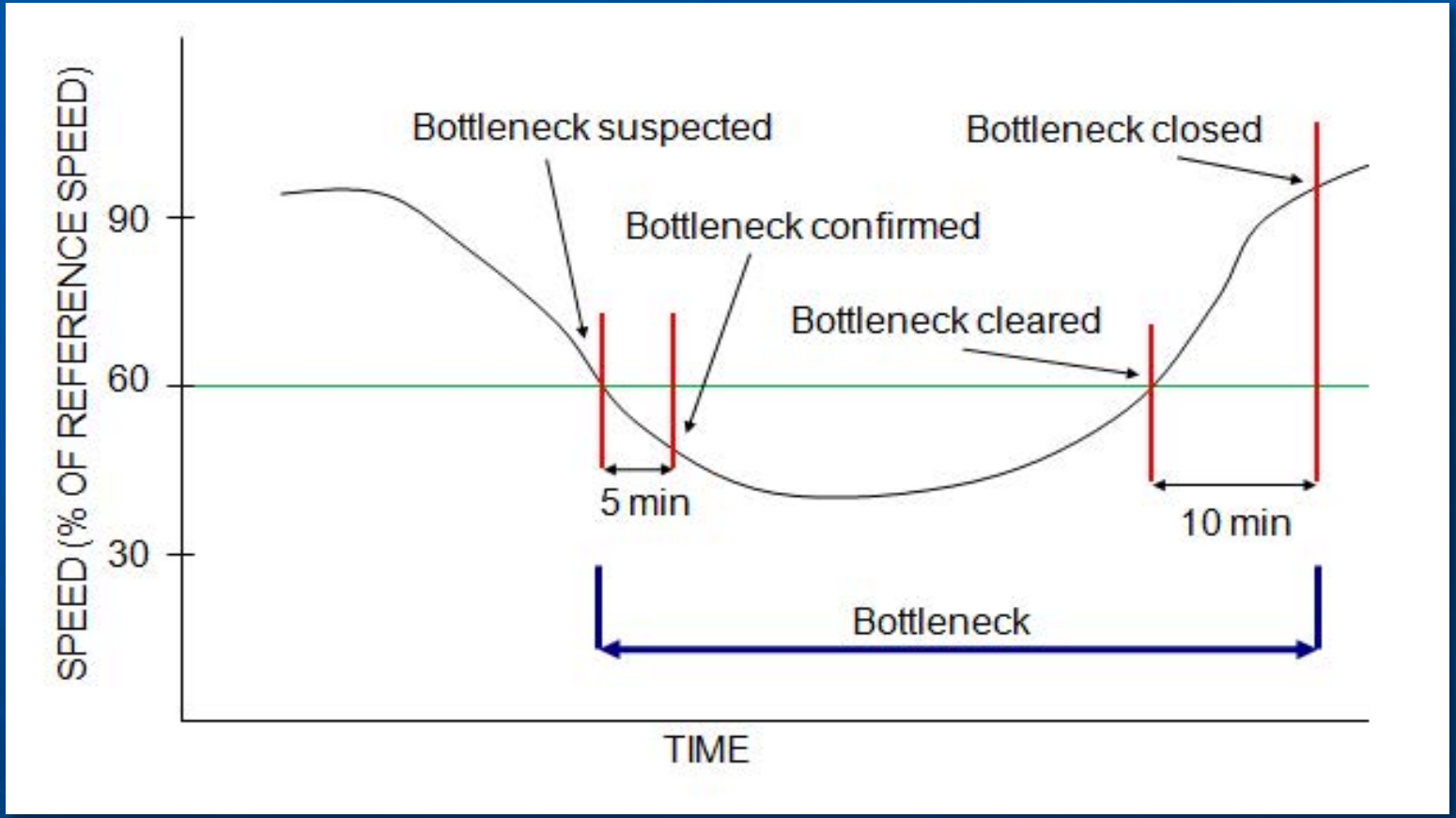
2013 Congestion Map



2013 Reliability Map



Bottlenecks



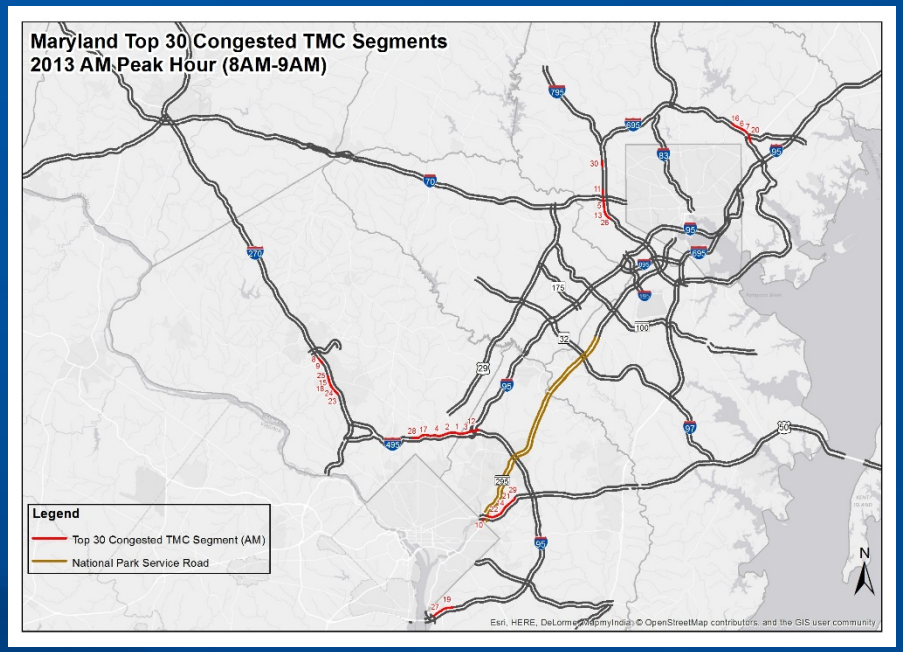
Bottlenecks

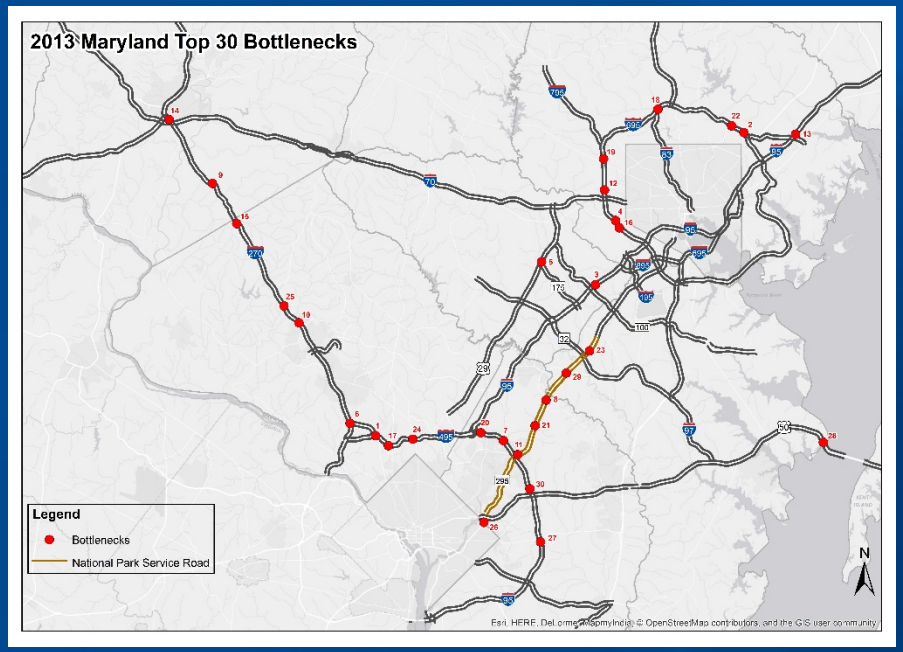
Impact Factor

- Based on traffic throughout the entire day
- Number of Occurrences per quarter
- Average Duration per quarter
- Average Queue Length per quarter

Average Duration	Average Max Length	Impact Factor
185.5	13.86	1993724
165.25	10.58	712794
122.5	10.53	699231
128	8.43	696761
139.5	8.84	617074
100.75	7.32	589191
133	10.8	515630

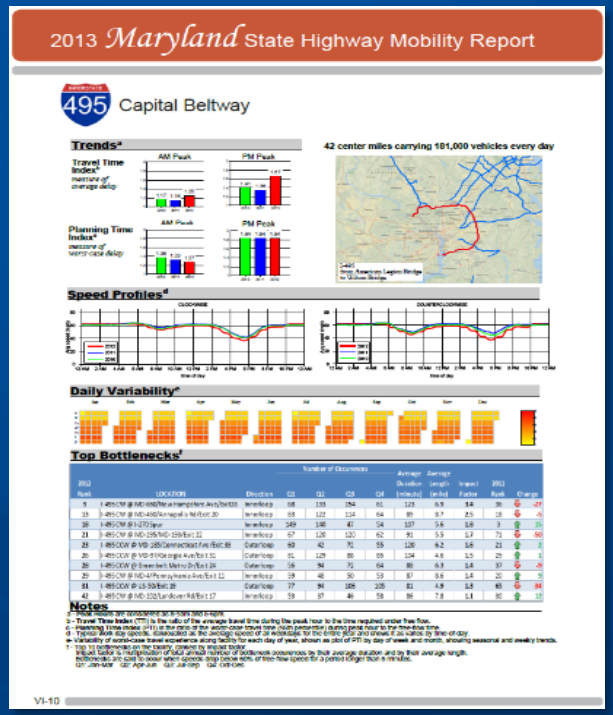
Top 30 Locations

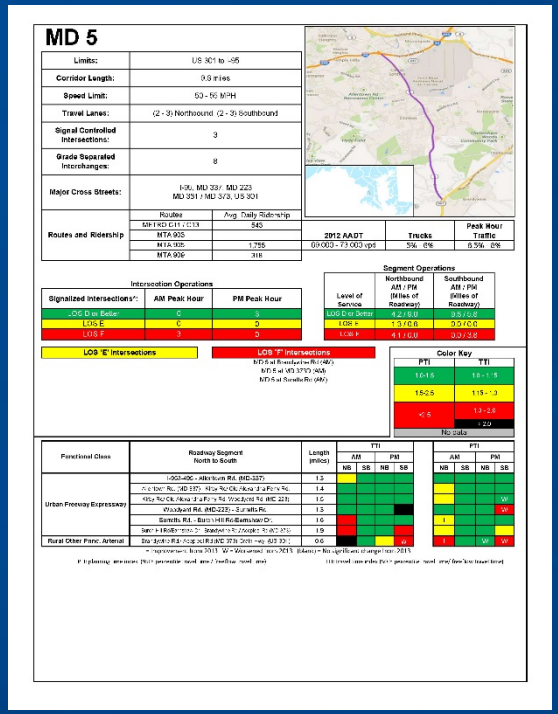




SHA Mobility Report

- Regionally Significant Corridor Performance
  - Freeways (INRIX speed data)
  - Arterials (added since 2014)





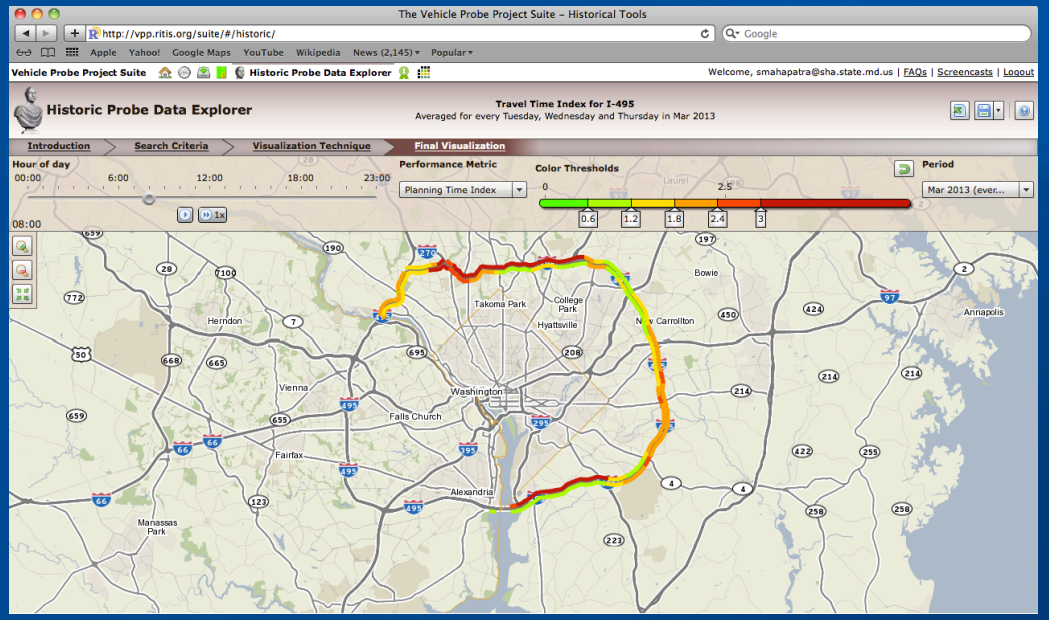
Lessons Learned

Data Considerations/Model Calibration

- Short Segment Lengths
- Lane Use Variations
- Variable Roadway Functions
- Work Zones
- Weather
- Uphill Segments

Use of Vehicle Probe Data for Project Planning and Design Studies

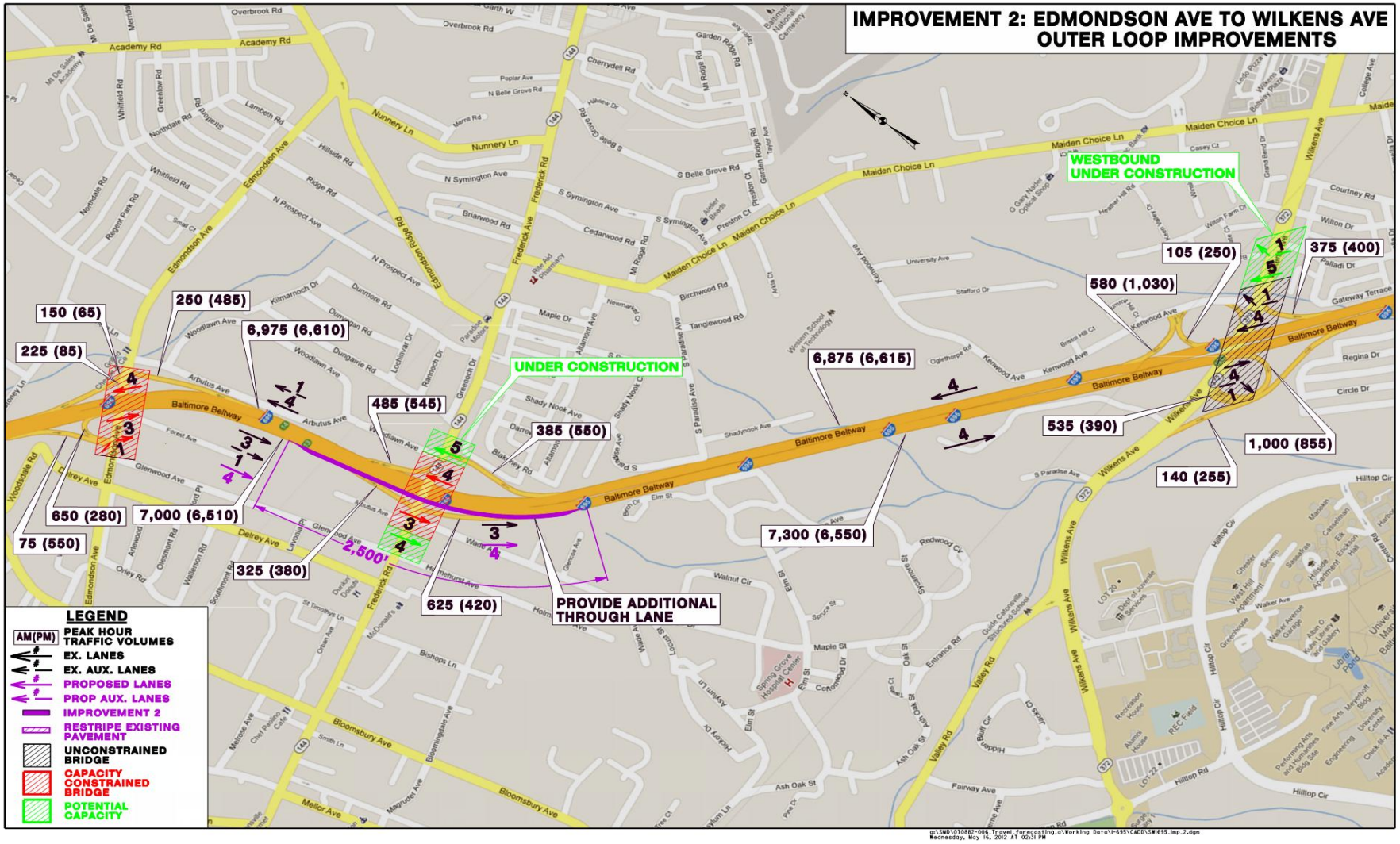
- Use Peak Period INRIX Data
- Identify Congestion Hotspots and Sources
- Develop Traffic Simulation Models – Calibrate with probe speeds
- Evaluate Low Cost Short Term Improvements in a Benefit/Cost Context



Source: UMD CATT Vehicle Probe Project Suite

Process has been implemented on all major freeways of Maryland – I-695, I-495, I-270, I-95, I-70 – Ongoing Congestion Management Program

I-695 Study Example @ MD 144



I-695 Study Example @ MD 144

Project Name:

I-695, Baltimore Beltway

Location of Project:

I-695 Outer Loop: MD 144 (Edmonson Avenue) on ramp continuing to MD 372 (Wilkens Avenue)

Description:

Provide additional through lane from on ramp at Edmonson Avenue to end of acceleration lane from Edmonson Avenue. Project includes widening and restriping of I-695 Outer Loop and removal and placement of retaining wall. Total project length is 2,500 feet.

Total User Cost Savings over 10 Years:

Delay Cost Savings $ ('000)			Fuel Cost Savings $ ('000)	Reliability Savings $ ('000)	Safety Savings $ ('000)	Total Savings
Auto	Truck	Total Auto/Truck				
11,427	2,722	14,149	1,415	10,612	989	Approx. $27.2 Million

Total Cost:

$ 18.2 Million (in 2011 Dollars)

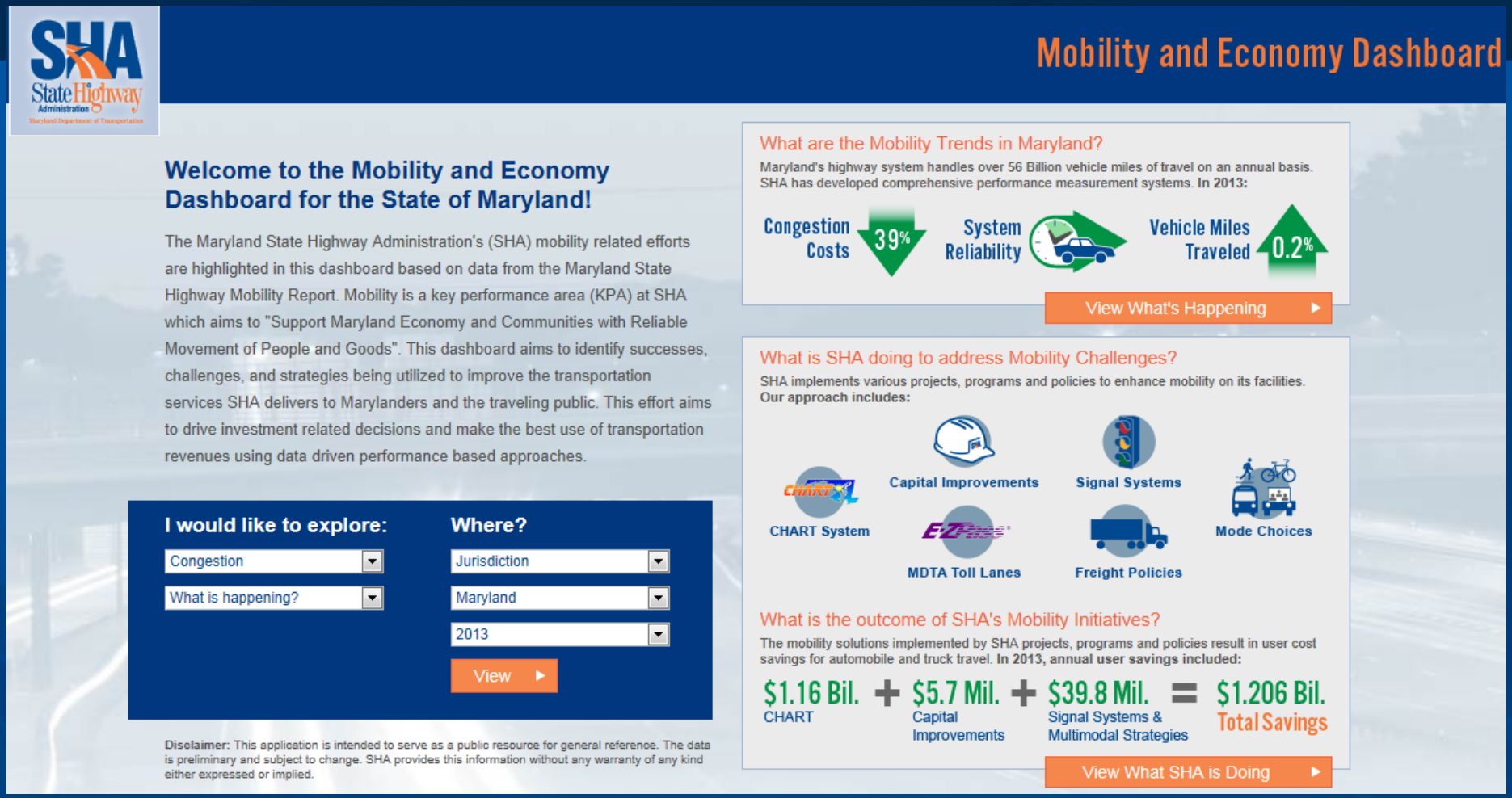
Project Ranking:

I-695 Study Example @ MD 147

- Maryland Mobility Report Results
- VISSIM Modeling
- Highway Safety Manual
- Alternative Development ($ 2 million)

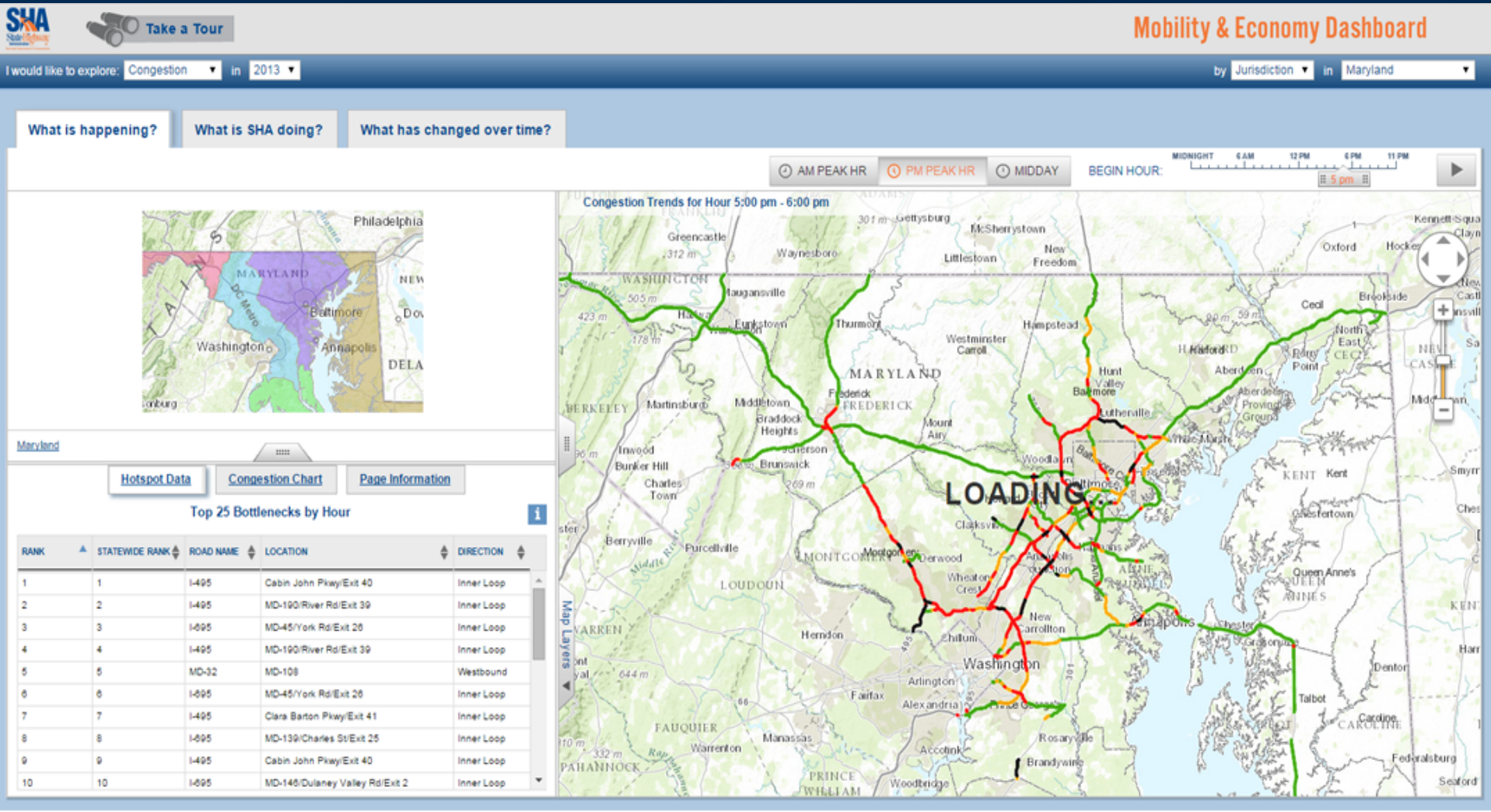
Mobility Dashboard Features

Mobility & Economy Dashboard – Early 2015 Release



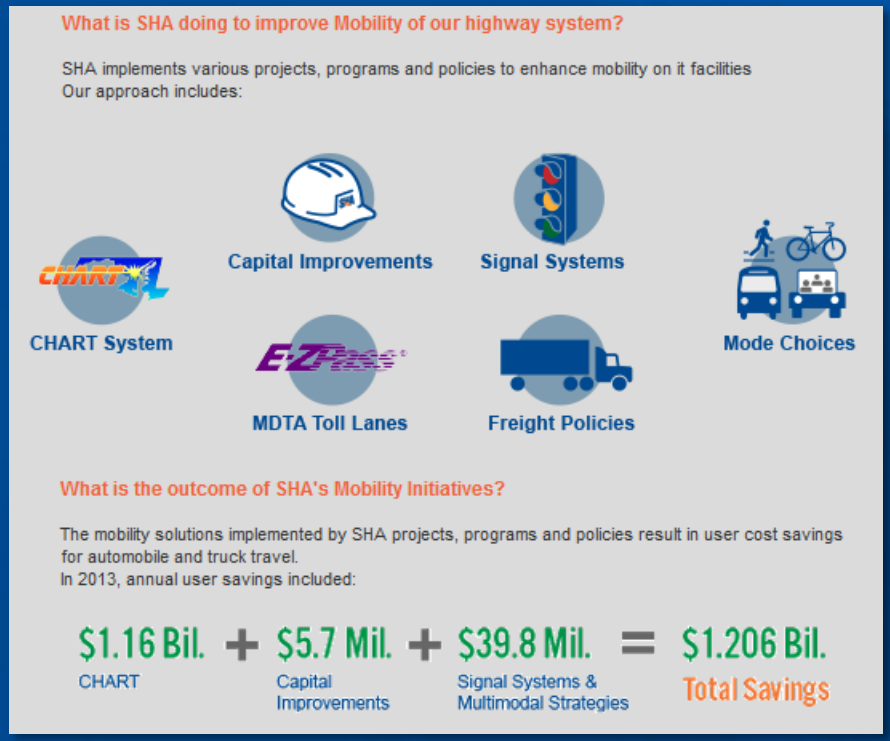
- Web-based Solution
- Increase Transparency
- Performance Based Approach

Dashboard: What is Happening?



Dashboard: What is SHA doing? What is the OUTCOME?

- Projects
  - Major and Minor Projects
- Programs
  - Signal retiming
  - CHART/Incident Management
  - ITS/511
- Policies
  - Park N Ride
  - HOV Users
  - Reversible Lanes
  - Bicycle & Pedestrian
  - Transit Oriented Development
  - MDTA Managed Lanes



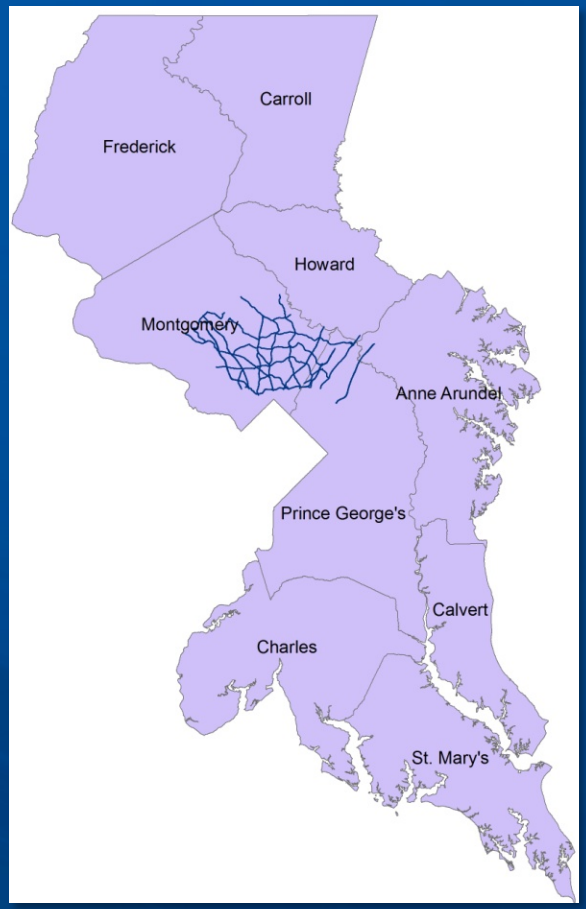
Use of Probe Data in Before/ After Studies

- Vehicle probe data has been instrumental in before/ after studies for major projects/ programs
- Study area network evaluated before/ during and after the project/ strategy is implemented
- Evaluation done with various performance metrics:

Spatial Extent of Congestion: *Percent of Congested Route-Miles*
Intensity of Congestion: *Travel Time Index*
Reliability of Travel: *Planning Time Index*

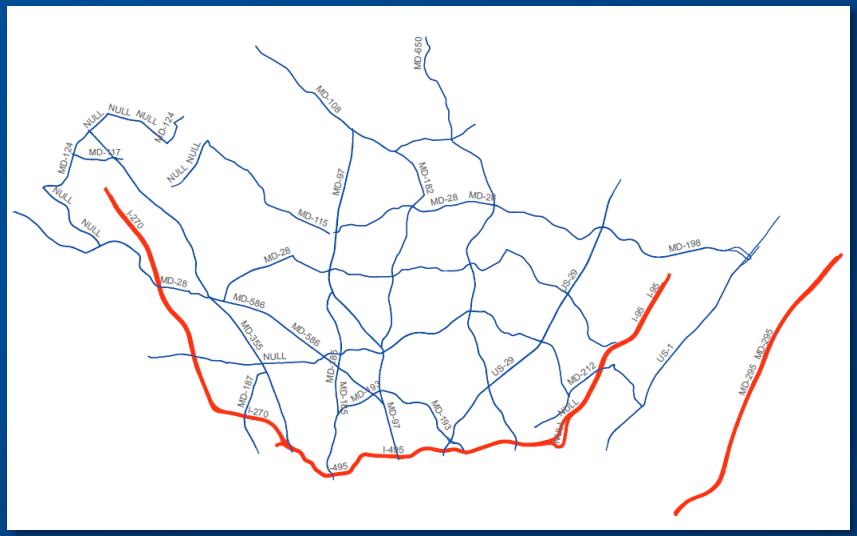
SHA/ MWCOG ICC Before/ After Study is a great demonstration of the usage of vehicle probe data for performance evaluation

ICC Study Area



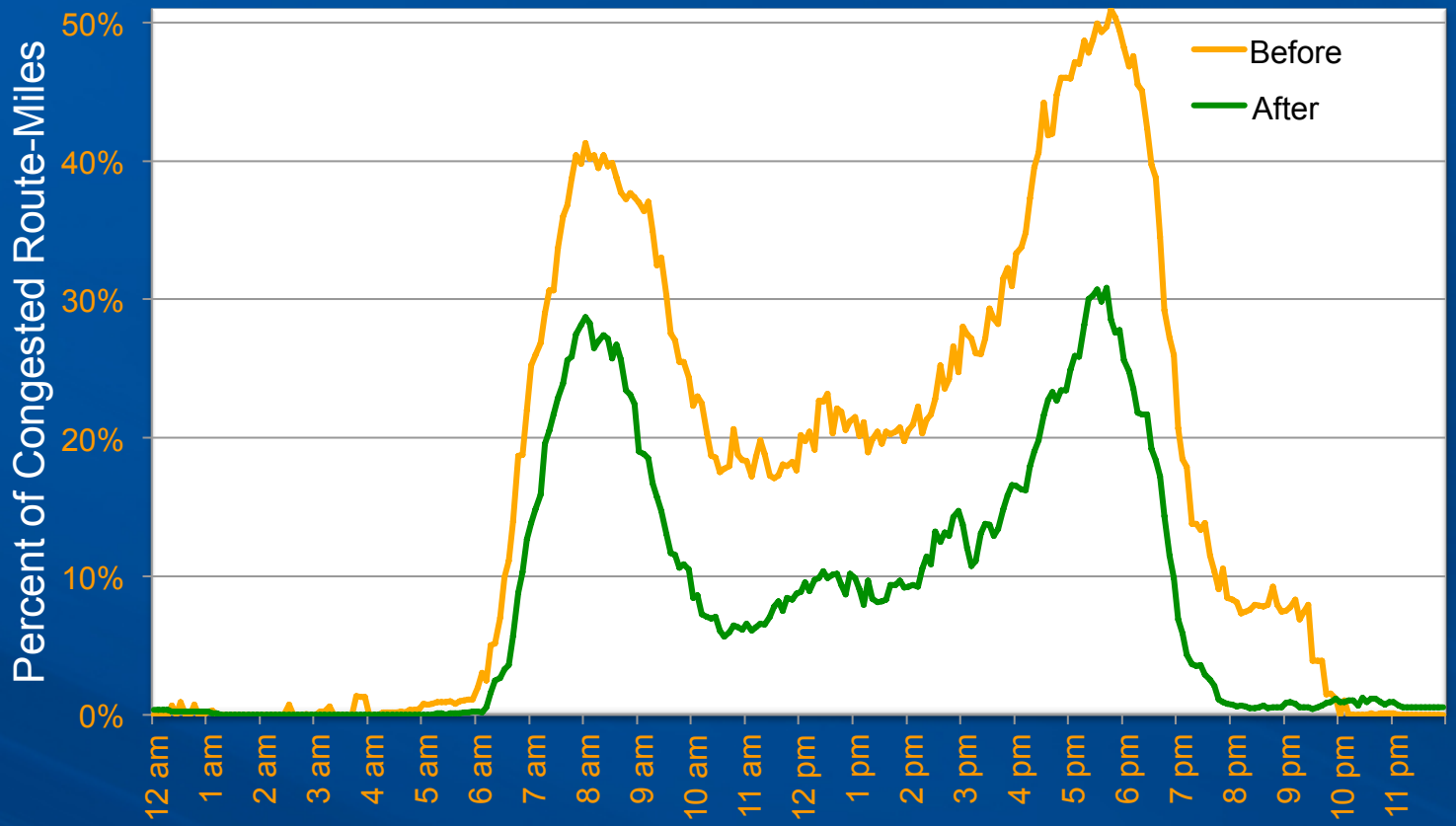
Roadway Segments Studied & Data Coverage:

- 21 Corridors (INRIX data cover all corridors)
- 790 segments (INRIX data provide segment speeds in 5-minute increments
- 422 directional miles



Spatial Extent of Congestion

Study Area (Typical Weekday)



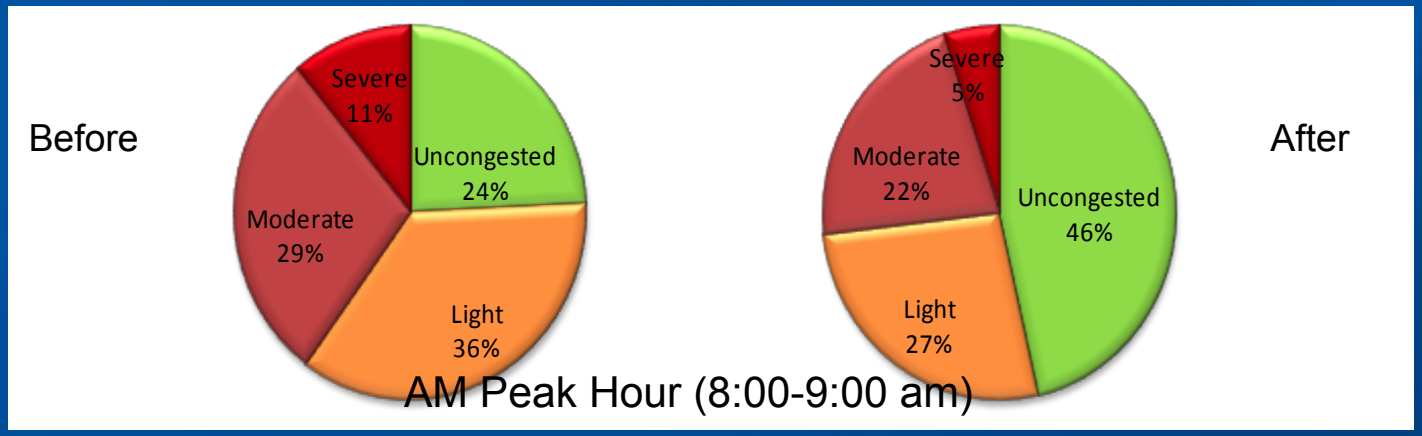
Notes:

Total route-miles (directional): 422

Congestion determination: Travel Time Index (TTI) >= 1.3

Spatial Extent of Congestion

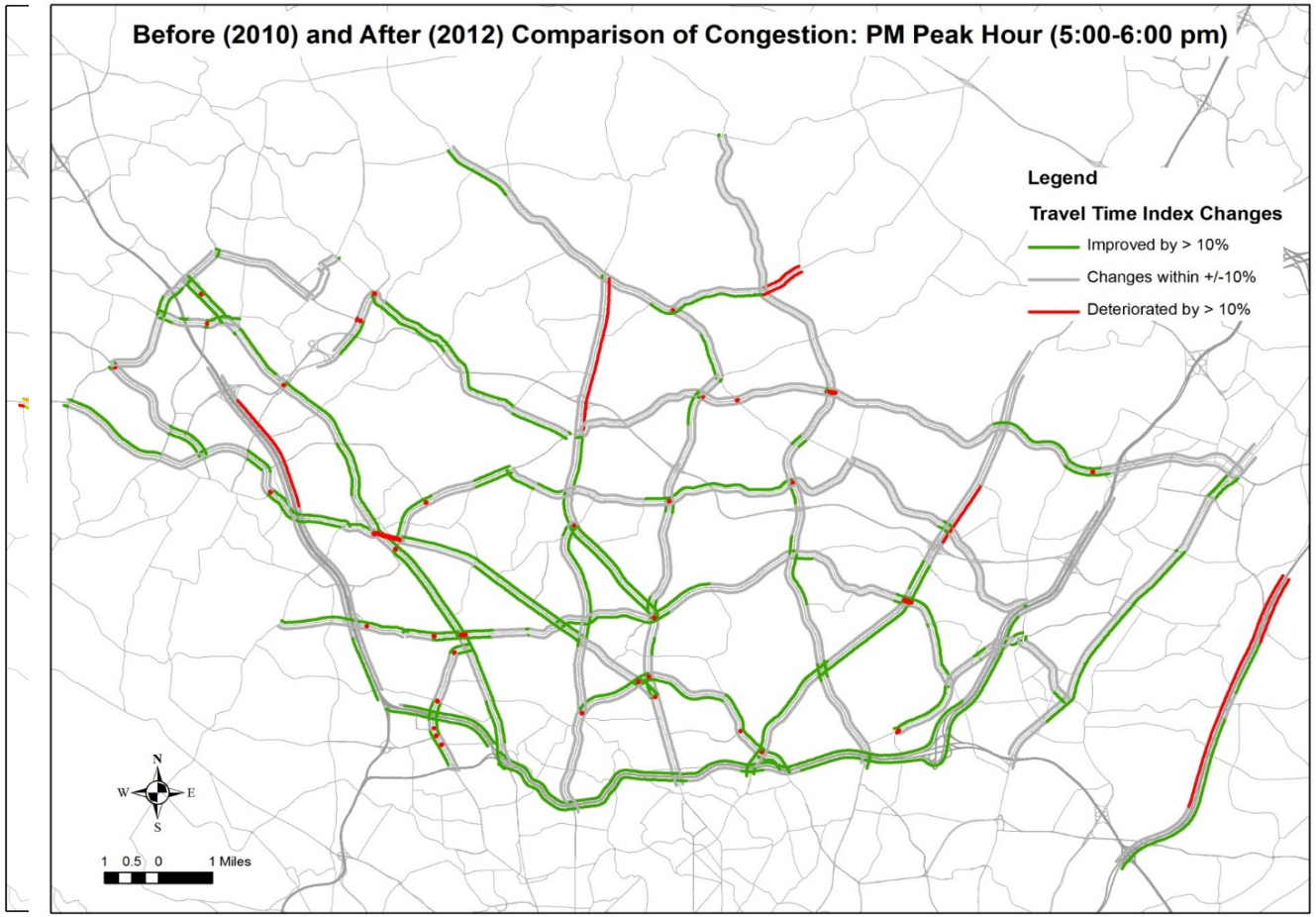
Percent of Route-Miles by Congestion Level (Study Area)



Levels of Congestion:

Uncongested: TTI< 1.15; Light: 1.15<TTI<1.30; Moderate: 1.30<TTI< 2.00; Severe: TTI>2.00

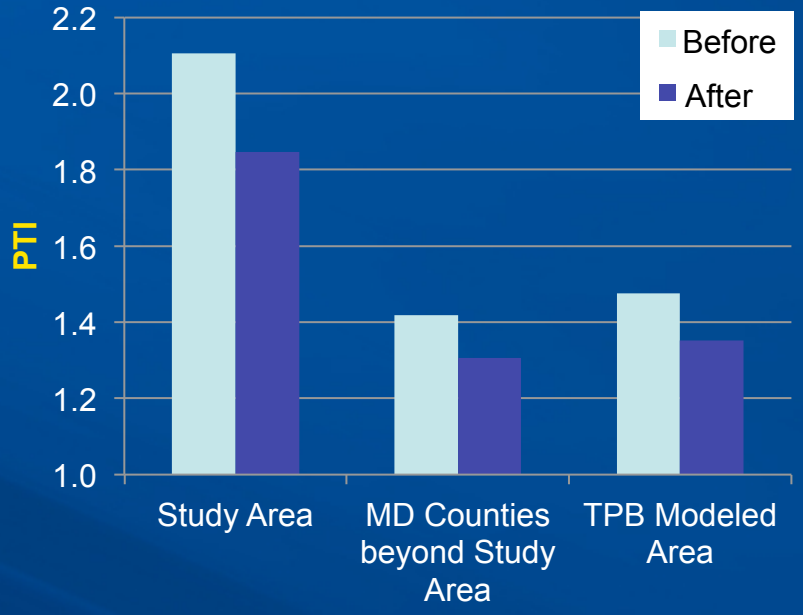
ICC Before/After Study – PM Peak Hour Speed Comparison



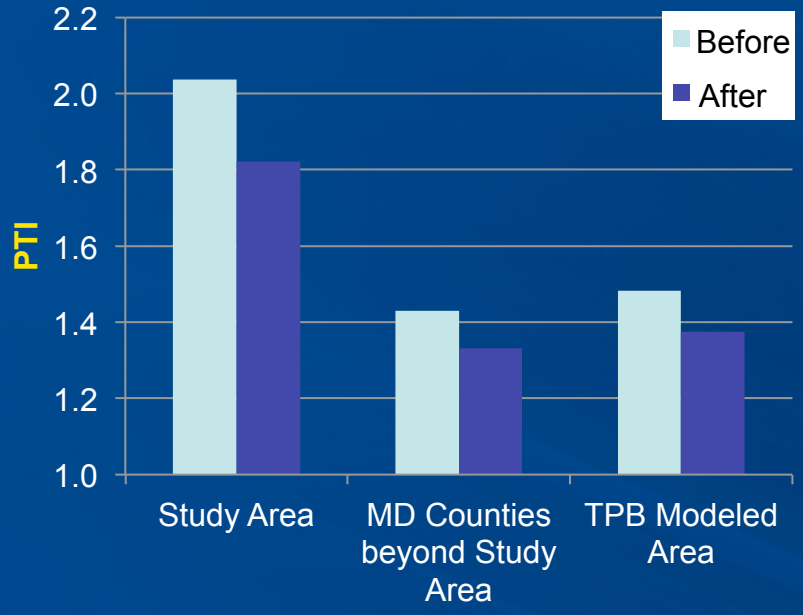
Reliability of Travel (95%)

Planning Time Index (PTI): Reliable Travel Time[2] / Free Flow Travel Time

AM Peak Hour (8:00-9:00 am)



PM Peak Hour (5:00-6:00 pm)



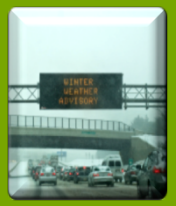
Note:

[2] Reliable Travel Time here is defined as the travel time that ensures **95% chance of arriving on time**

Reliability Data & Analysis Tools

CAUSES OF UNRELIABILITY

Inclement Weather

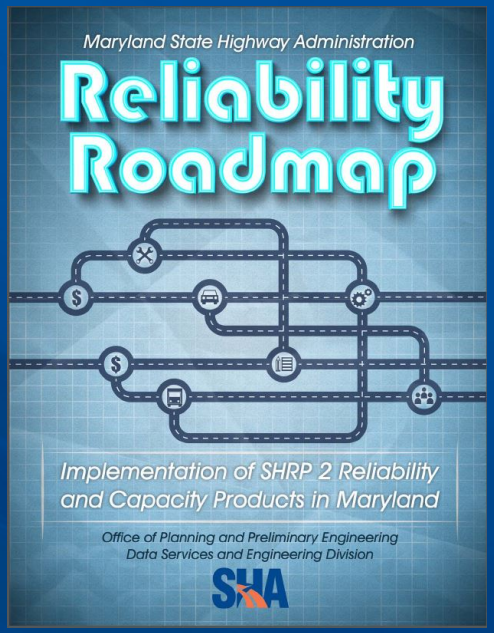


Fluctuations in Demand

Crashes

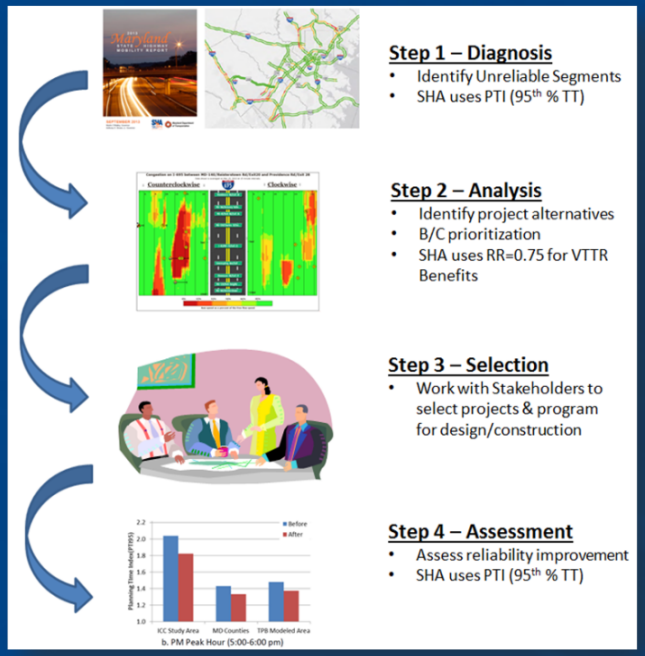
Work Zones

Poorly Timed Traffic Signals



SHA will implement a four step process:

- Diagnosis
- Analysis
- Selection
- Assessment



Phase 1 of Reliability Roadmap Efforts will be implemented under SHRP2 L38

Application of Probe Data in Advanced Travel Analysis Tools

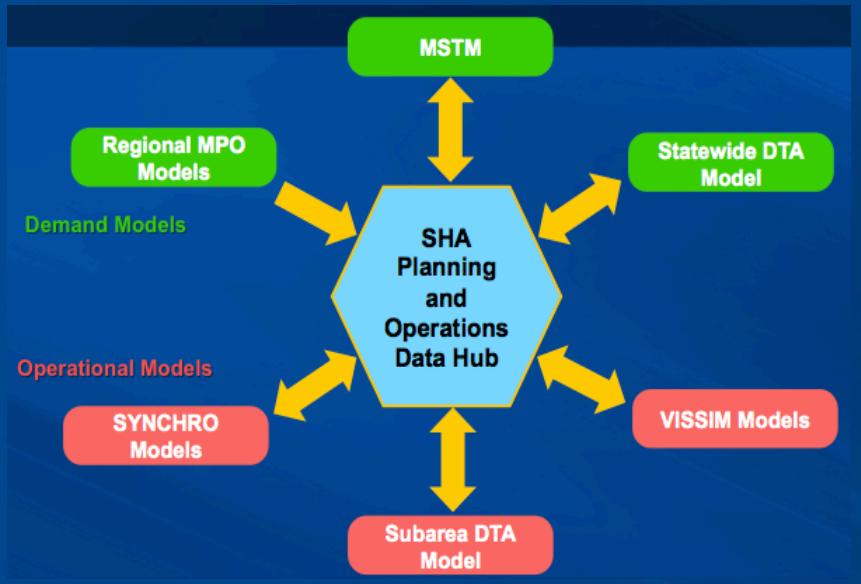
SHA will develop multi-resolution and time-dependent travel demand models for integrated planning and operations.

MITAMS
Maryland Integrated Travel Analysis Modeling System

KEY FEATURES

- Data Hub
- Multi-resolution network
- Statewide Model/DTA
- Corridor/Sub-area AgBM/DTA
- ABM/DTA Integration

Traffic and Demand Management
Non-recurrent Congestion Management
Performance Analysis & Reporting
Planning and Prioritization



How has Vehicle Probe Data shaped Performance Analysis and Decision-Making?

- Great step demonstrating Performance based Planning and Data Driven Decision-making
- Leads to funding decisions – *multiple low cost short term improvements have been identified and implemented*
- Multiple Mid term/ Long term corridor studies have been re-evaluated and initiated
- Better prepared to account for Freight and Reliability
- Helps us communicate our performance and tell our story

Challenges and Opportunities with Vehicle Probe Data

- Trip and tour based congestion and reliability metrics (Origin to Destination) for people and goods movement
- Lane based performance metrics (HOV lane or, ETL running next to a general travel lane)
- Lane based usage (disproportional use of some lanes over others) to understand operations better
- Fusing datasets with other data sources like land use, traffic counts, detectors etc. - Interfacing of navigation networks with state LRS
- Insights on markets and trip O/Ds
- Multi-modal and multi-resolution networks that can meet both performance management, travel modeling and analysis needs

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