The National Academies of
SCIENCES · ENGINEERING · MEDICINE

TRANSPORTATION RESEARCH BOARD

What's Next for Integrated Corridor Management?

October 7, 2021

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact TRBWebinars@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objective

Design effective ICM deployments

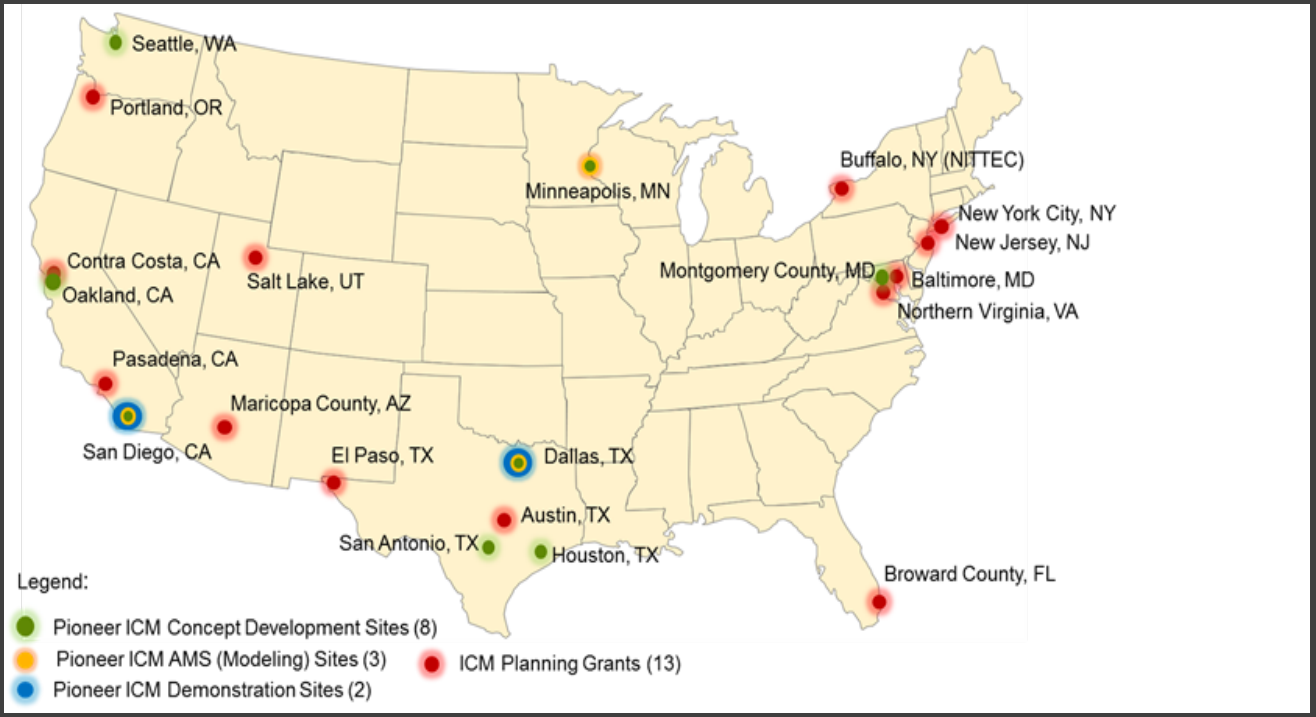
Evolution of Integrated Corridor Management

Dr. Kevin Miller, PE

Director, Solution Consulting

Kapsch TrafficCom

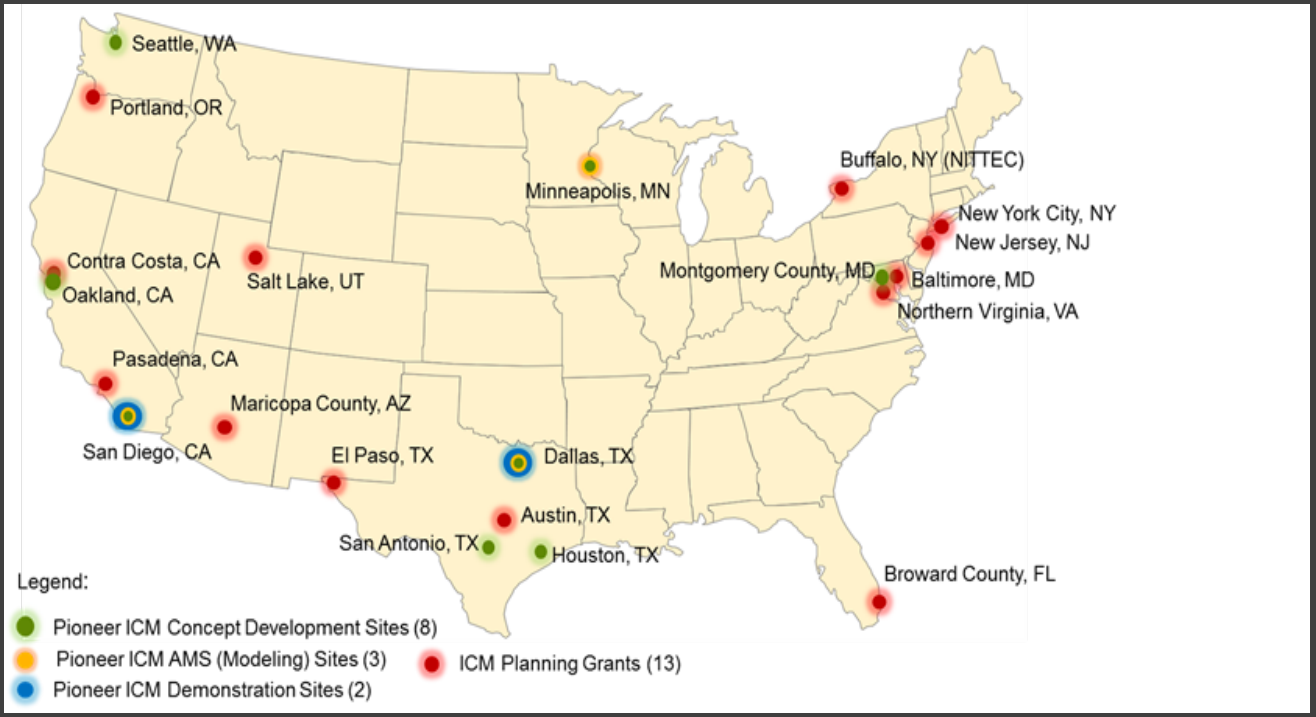
FHWA Program



Began 15 Years Ago as a Research Program

- **8 Pioneer Sites**
- **3 AMS Sites**
- **2 Demonstration Sites**
- **13 ICM Planning Grants**

FHWA Program



2 Goals for Program

- to **demonstrate and evaluate** pro-active **integrated approaches, strategies, and technologies**
- to provide the **institutional guidance, operational capabilities, and ITS technical methods**

Integrated Corridor Management

What is ICM?

1. **Multi-Agency coordination and operation** of a specified corridor within a region
   a) Provides **Multi-modal response** capability;
   b) Provides **Information to the public** to affect their behavior;
   c) Is useful for both **recurrent and non-recurrent congestion.**

Integrated Corridor Management

What is ICM?

2. ICM will help manage congestion by:
   a) **Optimizing e**xisting transportation infrastructure along a corridor;
   b) **Enabling** travelers to make informed travel decisions and dynamically shift mode;
   c) **Reducing** travel times, delays, fuel consumption;
   d) Increasing travel time **reliability and predictability**.

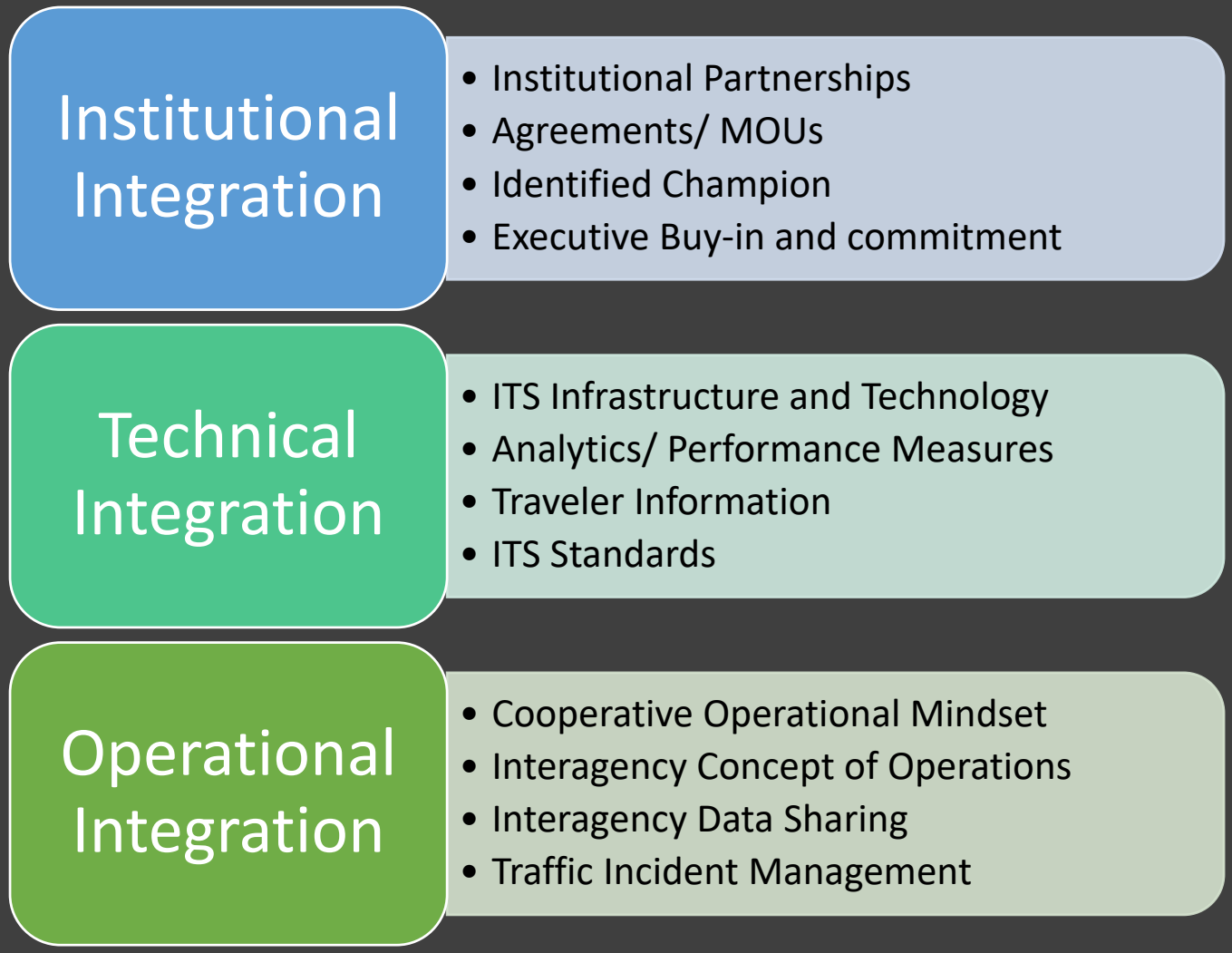
Building Blocks of ICM

1. **Available Capacity** is needed to make ICM effective. Multimodal Capabilities
2. Must be an **Exchange of Data** and information between agencies responding to an event within the managed corridor. Centralized Data Hub.
3. Institutional Cooperation - There must be a **dialogue and agreements among agencies** to operate the assets within the corridor in a cooperative fashion. Stakeholder engagement is needed throughout every phase.

Building Blocks of ICM

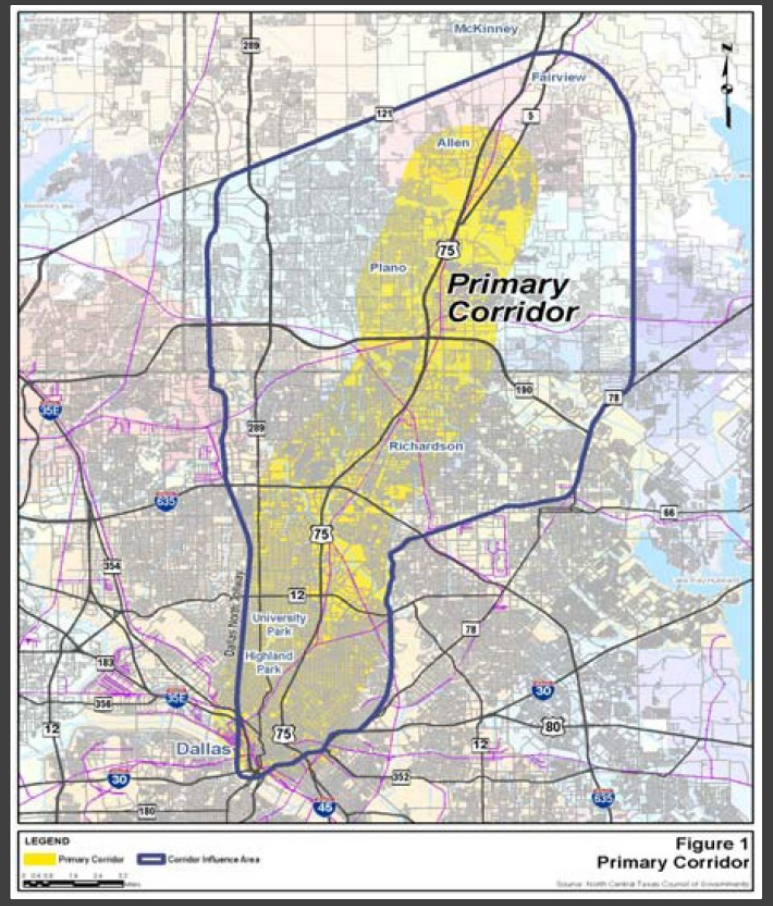
4. **Coordinated Response** - For ICM to function most effectively, all agencies involved with operations of the corridor must coordinate their response to events, including planned events, recurring conditions and non-recurring incidents.
5. **Funding** for initial development and on-going operations needs to be identified.

ICM Focus Areas



Beginning an ICM Program

1. Broadly Identify the ICM Corridor
   a. Roadways and Transit Systems
   b. Predominant Origin and Destination Points
2. Is ICM a Realistic Solution for the Identified Corridor
   a. Identify Issues Trying to Solve
   b. General Characteristics of Corridor
   c. Prospects for Technical, Operational, and Institutional Integration



Beginning an ICM Program

3. Identify Regional Partners and Stakeholders
   a. Identify Partner Agencies within the Corridor
   b. Identify Champions within Agencies
   c. Identify Roles

Beginning an ICM Program

4. Conduct a Preliminary Maturity Assessment
   a. Identify State of Play
   b. Identify Targeted Capability for ICM Program
   c. Develop High-Level Action Plan
5. Determine Whether to Move Forward
   a. Realistic Approach?
   b. ICM conducive to the problems and characteristics of the corridor

	Level 1 Silo	Level 2 Centralized	Level 3 Partially Integrated	Level 4 Multimodal Integrated	Level 5 Multimodal Optimized
Inter-agency Cooperation	Agencies do not coordinate their operations	Some agencies share data, but operate their networks independently	Agencies share data, and some cooperative responses are done	Agencies share data, and implement multi-modal incident response plans	Operations are centralized for the corridor with personnel operating the corridor cooperatively
Funding	Single Agency	MPO tracks funding	Coordinated funding through MPO	Cooperatively fund deployment projects	Cooperatively fund deployment and operations and maintenance of projects
Traveler Information	Static information on corridor travel modes	Static trip planning with limited real-time alerts	Multimodal trip planning and account based alerts	Location-based, on-journey multimodal information	Location-based, multimodal proactive routing
Data Fusion	Limited or Manual	Near real-time data for multiple modes	Integrated multi-modal data (one-way)	Integrated multi-modal data (two-way)	Multi-source multi-modal data integrated and fused for operations
Performance Measures	Some ad-hoc performance measure based on historic data	Periodic performance measures based on historic data	High-level performance measures using real-time data	Detailed performance measures in real-time for one or more modes	Multi-modal performance measures in real-time
Decision Support System	Manual coordination of response	Pre-agreed incident response plans	Tool selection of pre-agreed plans	Model based selection of pre-agreed plans	Model based creation of incident response plans

Recent Advances

- Changing from a Corridor to a Regional Focus
  - Florida DOT – District 5, Regional ICM System
  - Virginia DOT – RM3P Program
- Begin using new technologies
  - Predictive Analytics
  - Machine Learning
  - Connected Vehicles

Resources to Assist Regions

- FHWA ICM Program: https://ops.fhwa.dot.gov/program_areas/corridor_traffic_mgmt.htm
- NCHRP ICM Scan Tour: http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_12-02.pdf
- NCHRP 03-121 ICM Stakeholders Guidance: http://www.trb.org/Publications/Blurbs/180954.aspx
- NCHRP 03-131 ICM Planning Guidance: http://www.trb.org/main/blurbs/181117.aspx

Innovative ICM Concepts

What's New with Integrated Corridor Management – Next Generation of ICM Deployments

October 14, 2021

Agenda

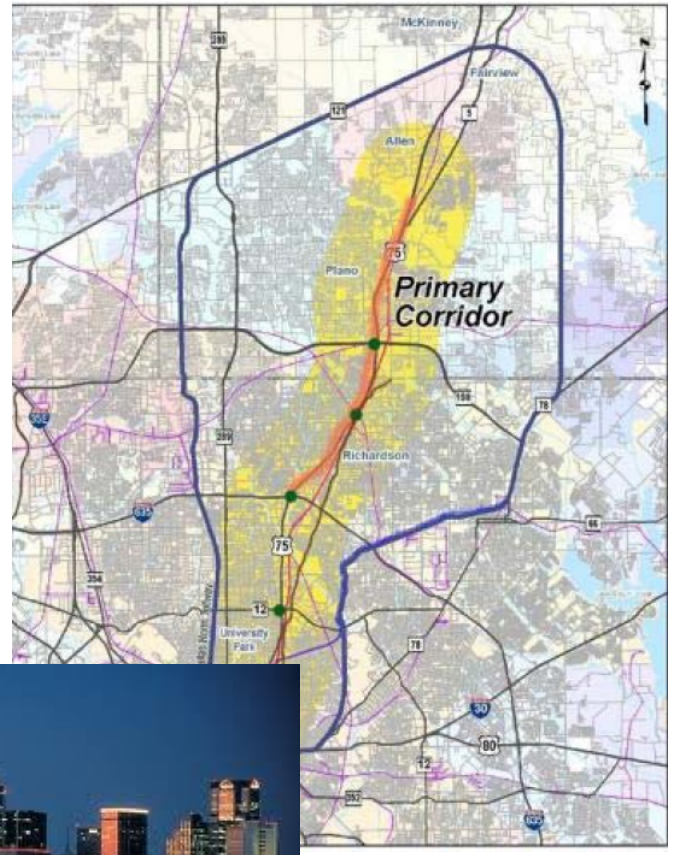
- Initial implementations and demonstrations
- Broadening beyond the demonstrations
- Emerging concepts and trends

Pioneer Demonstration Sites

- USDOT initially identified eight sites
  - Helped to focus the operational concept
    - Manage the corridor as a system rather than individual assets
    - Enable travelers to make informed travel decisions and dynamically shift modes
    - Reduce travel delays, fuel consumption, emissions, and incidents
    - Improve travel time reliability and predictability
    - Optimize existing transportation infrastructure
- Selected 2 corridors for demonstration implementation
  - US 75 in Dallas
  - I-15 in San Diego

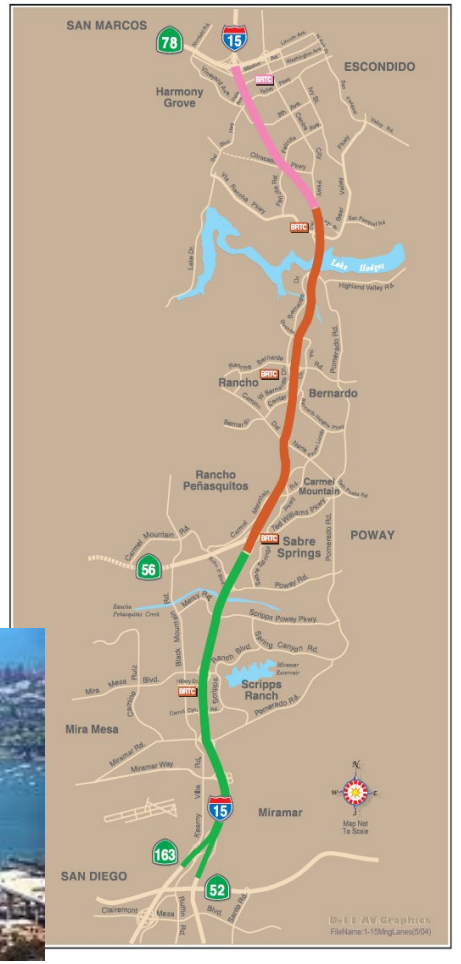
Dallas US-75 ICM

- Freeway with continuous frontage roads
- Managed high occupancy vehicle lanes
- Dallas North Tollway
- Arterials
- Bus Network, Light Rail
- Approx. 900 traffic signals
- Multiple transportation management centers
- Regional 511



SANDAG I-15 ICM

- Primary travel artery from the North to Downtown
- I-15 Managed Lanes System
- Multi Institutional Cooperation/ Partnerships
- Multi-modal Transportation Improvement Strategies and Mode Shift
  - Bus rapid transit
  - Transit signal priority
- 511, including transit information



Demonstration Corridors

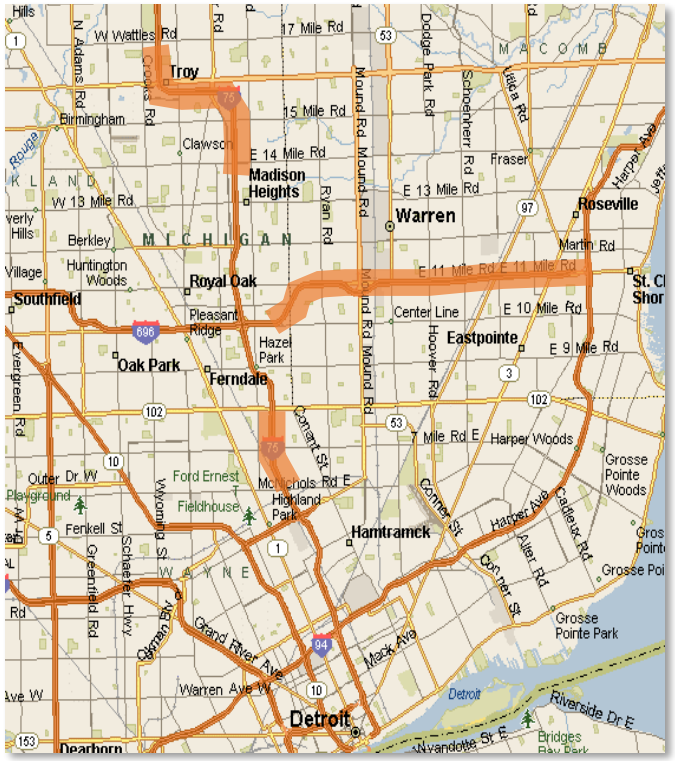
- San Diego and Dallas went “live” in early 2013
- Independent evaluations
- Early lessons:
  - Agreements are tough. Most challenging part of ICM.
  - Data integration from multiple systems and multiple networks
  - Determining mode shift is difficult, working through how to evaluate effectiveness
  - Combinations of strategies also are challenging to evaluate

Beyond the Demonstration Corridors

- Many other agencies have developed ICM programs
- Focus varies
  - Traffic incident/event management only
  - Broader utilization of network on a daily basis
  - Emphasis on demand management concepts vary

Michigan DOT ICM Pilot Corridors

- 2 Pilots on I-75 (Wayne and Oakland Counties); I-696 in Macomb
- Event-based
  - Improve response to major incidents
  - Traffic rerouting on arterials
- ITS equipment upgrades and infill
- Signal timing on alt routes
  - Models show freeway recovery times increasing by 15-30 minutes

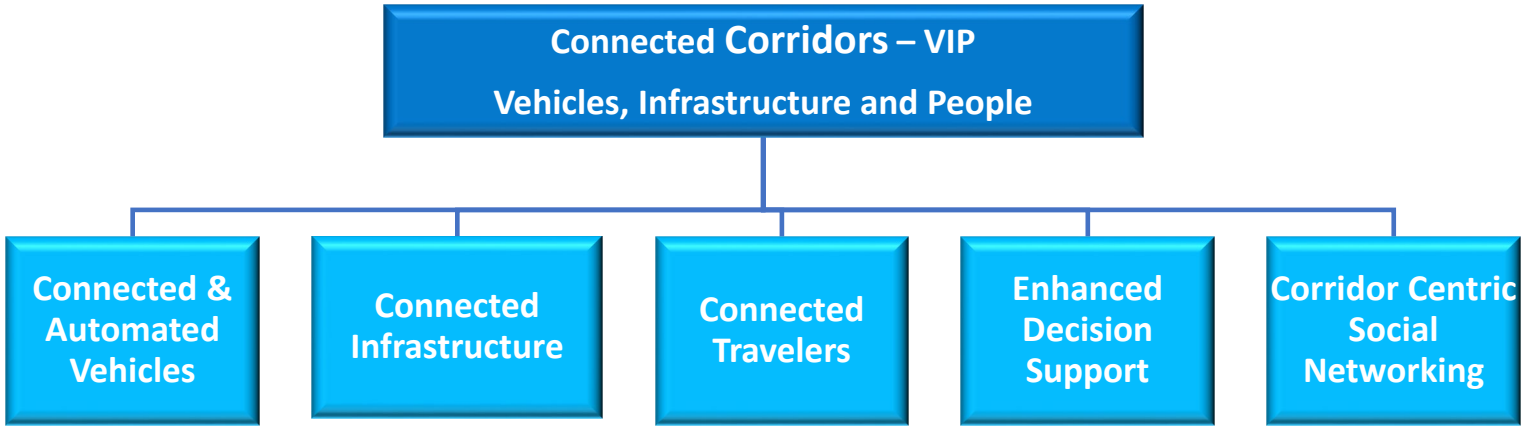


I-80 Smart Corridor

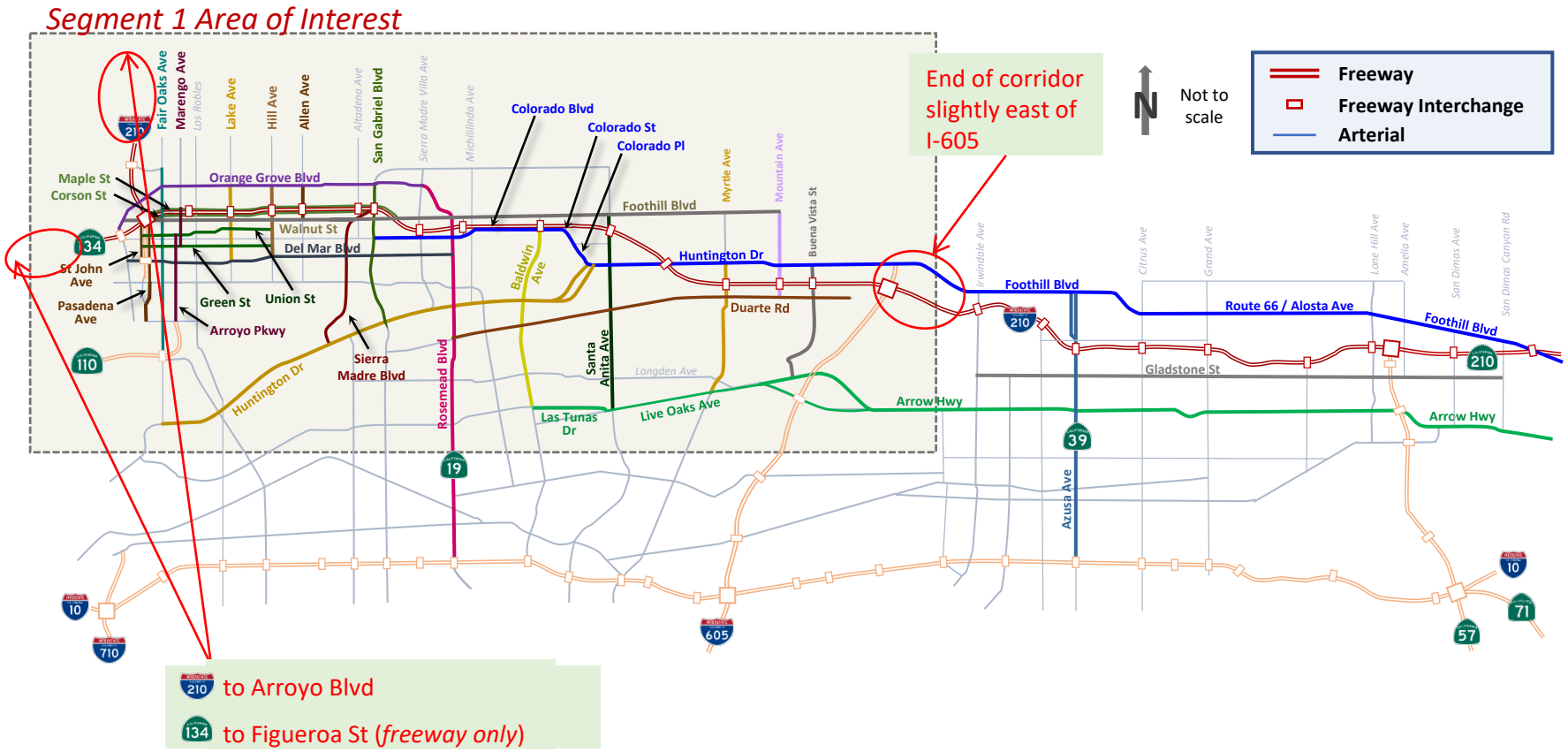
- 20 mile segment of I-80
- Led by Alameda County Transportation Commission (CTC)
  - Caltrans
  - Metropolitan Transportation Commission
  - Local Counties and Cities
- Adaptive ramp metering, incident management, active traffic management (variable speed signs, lane use signs)
- Improvements to arterials
- Operations & Maintenance Memorandum of Understanding with
  - Alameda CTC
  - Caltrans
  - Contra Costa Transportation Authority
  - 9 cities
  - 2 transit agencies

California Connected Corridors

- Initiated in 2011 – Statewide Framework
- Focus on planning, implementation, O&M
  - Implement TSM&O on their most congested corridors (50)
  - Evolve Caltrans to real-time operations and management
  - Enhance partnerships
  - Optimize infrastructure and capacity
  - Improve overall corridor performance



I-210 Project Corridor (Pilot)



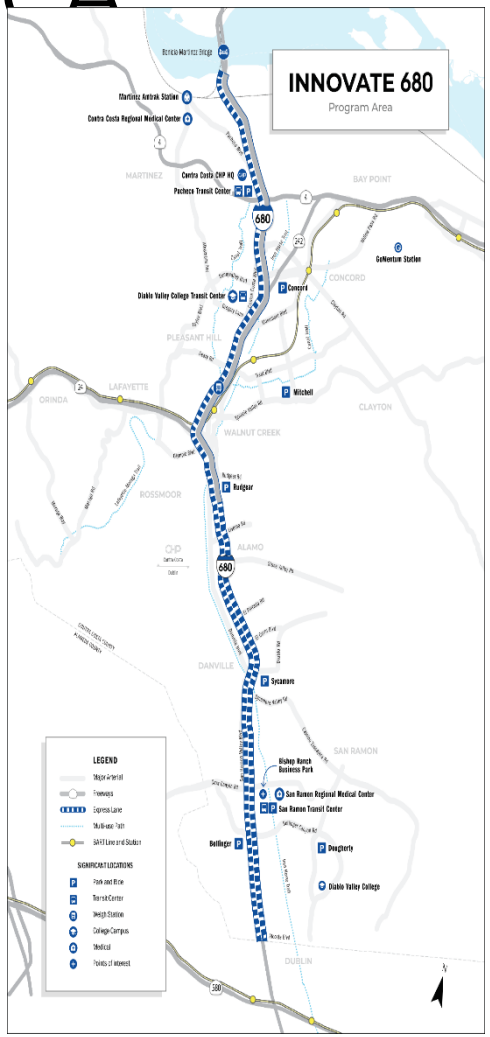
Emerging Concepts and Trends

- Broader set of strategies
  - Automated shuttles
  - Role of connected vehicles
  - Shared mobility
  - Mobility on Demand
- Broad stakeholder involvement
- Importance of partnerships
- Advanced technologies
- Rural applications

Innovate 680 – Contra Costa County, CA

- Aim is to Address growth in the corridor
  - Without significant infrastructure expansion
- Collaborative stakeholder process
- Decision-making structure similar Des Moines
  - From the program level ConOps
- Robust set of concepts

INNOVATE 680
IMAGINE THE POSSIBILITIES

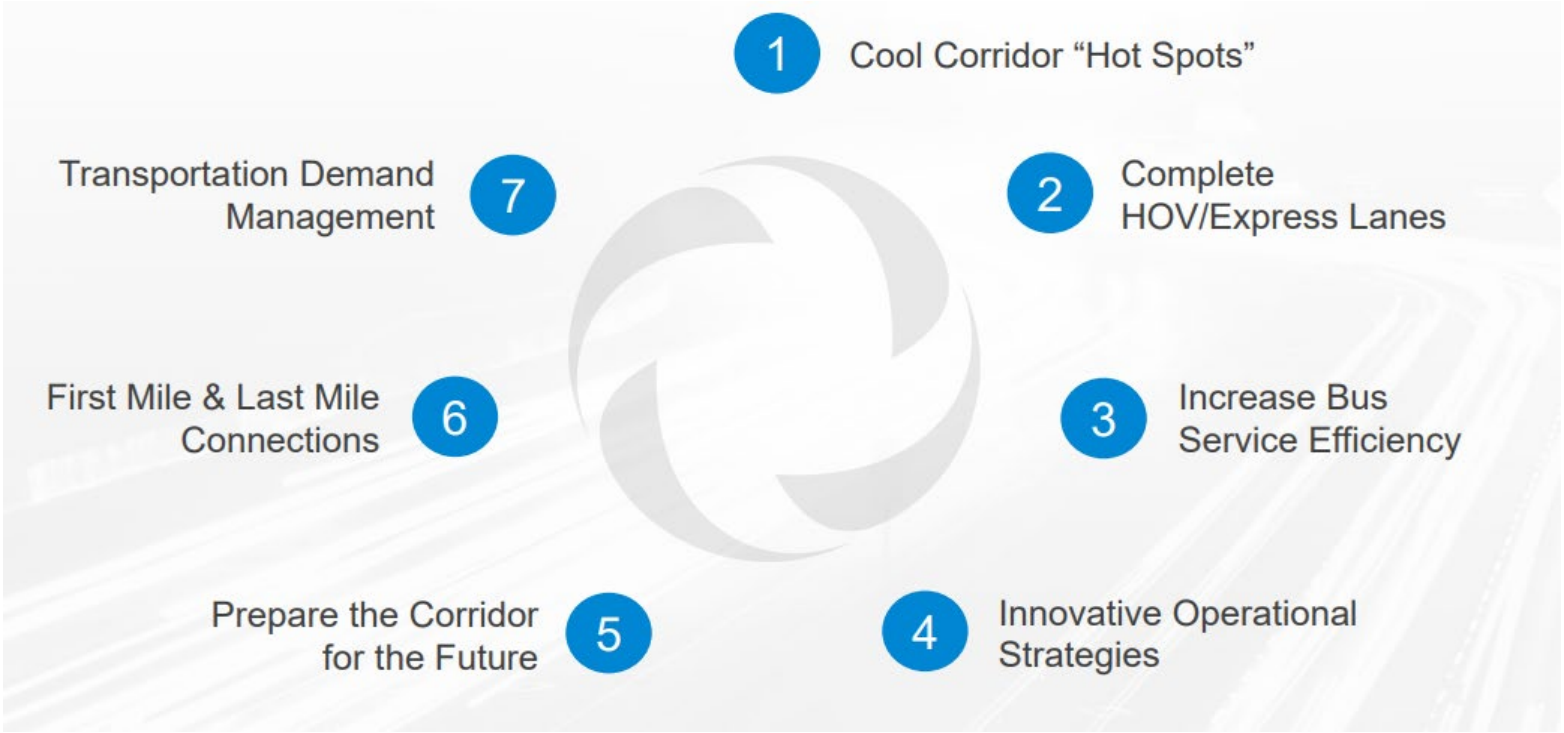


Innovate 680 Goals

- **Improve safety, efficiency and reliability**
- **Prepare the corridor for the future**
- Enhance the ability for people to **shift travel modes**
- **Improve connectivity and services** among mobility options.
- **Provide mobility options**
- **Improve air quality**.
- **Promote equity and provide access to transportation services**

INNOVATE 680
IMAGINE THE POSSIBILITIES

Innovate 680 Initial Strategies



INNOVATE 680
IMAGINE THE POSSIBILITIES

Innovate 680 Current Projects

- Advanced Technologies
  - Decision support system
  - Connected data center
  - Coordinated adaptive ramp metering
- Mobility on demand
  - Traveler-oriented mobility-as-a-service platform
  - Personalized mobility options
- Shared mobility hub
  - Multimodal transportation nodes
  - Interface for micro-mobility and transit
- Part-time transit lane
- Automated driving systems
  - First/last mile, automated shuttle service, connected vehicle technology
- Complete Express Lane system

INNOVATE 680
IMAGINE THE POSSIBILITIES

Rural ICM

- I-80 – Nebraska, Wyoming and Utah
  - Road weather management
  - Improve corridor-wide information, including traveler info
  - Improve agency information sharing and responses
  - Freight needs: truck parking
- I-70 West Mountain Corridor (Colorado)
  - Heavily traveled corridor linking Denver with recreational areas to the west
  - Heavy traffic demand in winter and summer alike
  - Improve corridor mobility
  - Improve corridor safety
  - Improve reliability

I-70 West Mountain Corridor Scope of Problem – Summer

Westbound – Saturday 7/18/2015

Hour	Average Travel Time (Min)	Free Flow Travel Time (Min)	Delay (Min)
6:00 AM	80	79	1
7:00 AM	80	79	1
8:00 AM	80	79	1
9:00 AM	85	79	6
10:00 AM	96	79	17
11:00 AM	104	79	25
12:00 PM	108	79	29
1:00 PM	110	79	31
2:00 PM	112	79	33
3:00 PM	106	79	27
4:00 PM	93	79	14

Eastbound – Sunday 7/19/2015

Hour	Average Travel Time (Min)	Free Flow Travel Time (Min)	Delay (Min)
9:00 AM	79	78	1
10:00 AM	80	78	2
11:00 AM	94	78	16
12:00 PM	125	78	47
1:00 PM	141	78	63
2:00 PM	162	78	84
3:00 PM	152	78	74
4:00 PM	146	78	68
5:00 PM	137	78	59
6:00 PM	120	78	42
7:00 PM	105	78	27
8:00 PM	98	78	20

I-70 West Mountain Corridor Scope of Problem – Winter

Westbound – Saturday 1/23/2016

Hour	Average Travel Time (Min)	Free Flow Travel Time (Min)	Delay (Min)
6:00 AM	93	79	14
7:00 AM	121	79	42
8:00 AM	141	79	62
9:00 AM	137	79	58
10:00 AM	119	79	40
11:00 AM	103	79	24
12:00 PM	88	79	9
1:00 PM	82	79	3
2:00 PM	81	79	2
3:00 PM	80	79	1
4:00 PM	81	79	2

Eastbound – Sunday 1/24/2016

Hour	Average Travel Time (Min)	Free Flow Travel Time (Min)	Delay (Min)
9:00 AM	79	78	1
10:00 AM	79	78	1
11:00 AM	81	78	3
12:00 PM	79	78	1
1:00 PM	78	78	0
2:00 PM	80	78	2
3:00 PM	81	78	3
4:00 PM	86	78	8
5:00 PM	93	78	15
6:00 PM	94	78	16
7:00 PM	92	78	14
8:00 PM	92	78	14

I-70 West Mountain Corridor - Stakeholders

- Agency stakeholders
  - CDOT
  - FHWA
  - DRCOG
  - RTD
  - CSP
- I-70 Coalition – advocates for improvement
  - Adjacent land owners
  - Business owners

I-70 West Mountain Corridor

- Considered wide range of strategies
  - Priced managed lanes
  - Congestion pricing
  - Mobile apps to provide real-time data
  - Connected vehicle applications
  - Variable speed limits
  - Dynamic shoulder use
  - Demand management
  - Transit and carpooling options
- 135 unique strategies considered

I-70 West Mountain Corridor – Notable Implementations

- Mountain Express Lane (MEXL)
  - Priced dynamic shoulder
    - Eastbound opened in 2015
  - Dynamic pricing
  - Shoulder open to traffic when needed
    - Generally Sundays, holidays, and special events
- Travel Demand Management
  - Incentives to travel outside peak travel hours
    - Offered by resorts and business owners
    - Price reductions for staying over Sunday nights
  - Train, bus, and vanpool options targeted to mountain recreation areas

Thank You!

- Les Jacobson
  les.jacobson@wsp.com

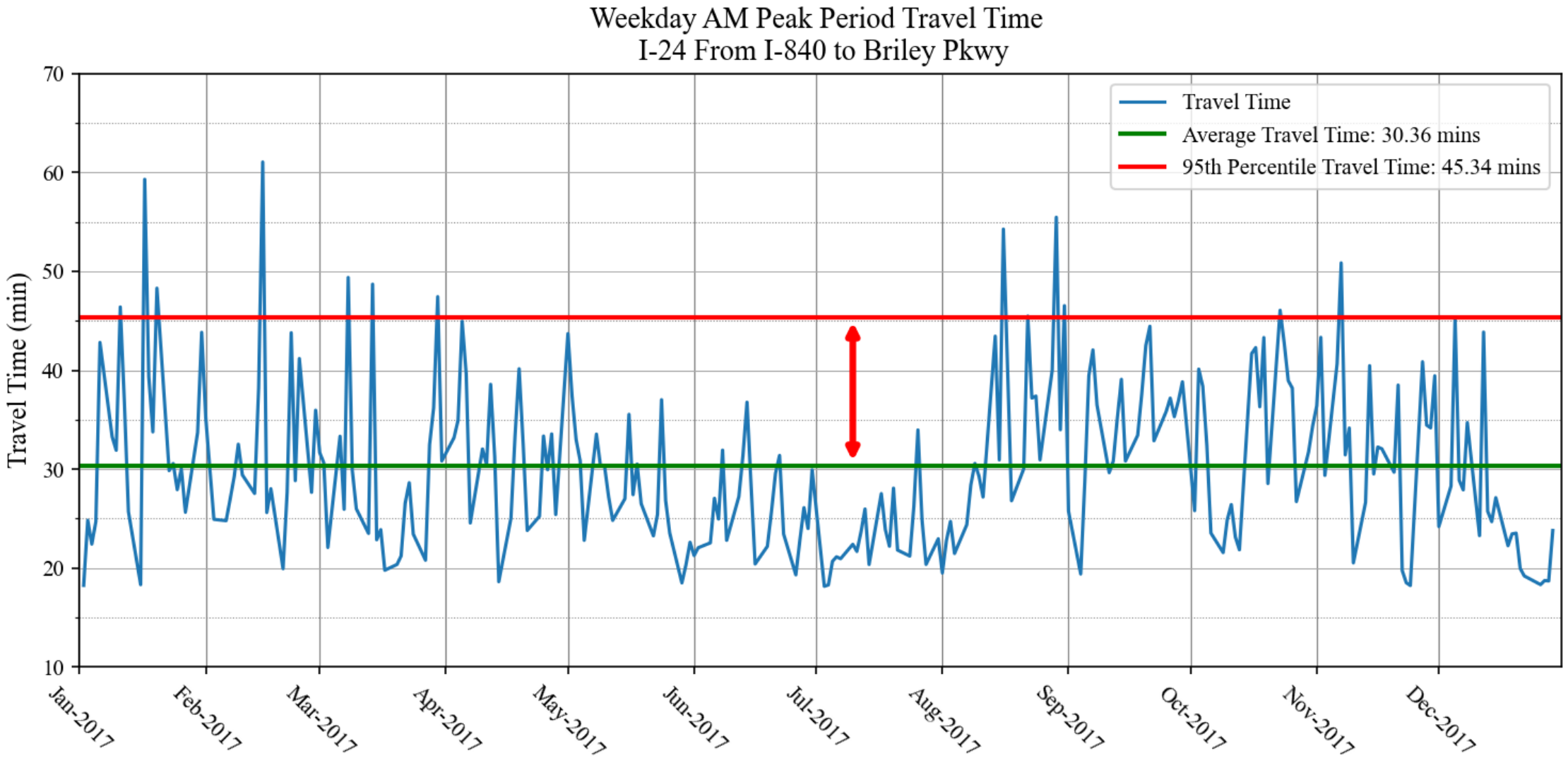
I-24 Smart Corridor: ICM in Tennessee

Brad Freeze, Traffic Operations Division, Tennessee DOT

10.07.2021

Outline

- Mission & Goals
- Purpose & Need
- Our Solution: I-24 Smart Corridor
- Short-Term, Intermediate, and Long-Term Deployments
- Project Schedule & Status
- Operations & Maintenance
- Local Agency Operations Support
- ATCMTD Grant Program for ICM DSS
- Public Outreach for Project


Weekday AM Peak Period Travel Time
I-24 From I-840 to Briley Pkwy
Travel Time (min)
70
60
50
40
30
20
10
Jan-2017
Feb-2017
Mar-2017
Apr-2017
May-2017
Jun-2017
Jul-2017
Aug-2017
Sep-2017
Oct-2017
Nov-2017
Dec-2017
Travel Time
Average Travel Time: 30.36 mins
95th Percentile Travel Time: 45.34 mins

Mission & Goals

TDOT Mission:

*To provide a **safe and reliable transportation system** that supports economic growth and quality of life.*

I-24 Smart Corridor Mission:

*To improve the **safety and reliability of all travel** along the corridor through the proactive management of intelligent and connected infrastructure, and the formation of strong operational partnerships between local and state agency stakeholders.*

I-24 Smart Corridor Goals:

Goal 1: Increase Travel Time Reliability

Goal 2: Increase Mobility of all Modes

Goal 3: Reduce the Concentration of Crashes

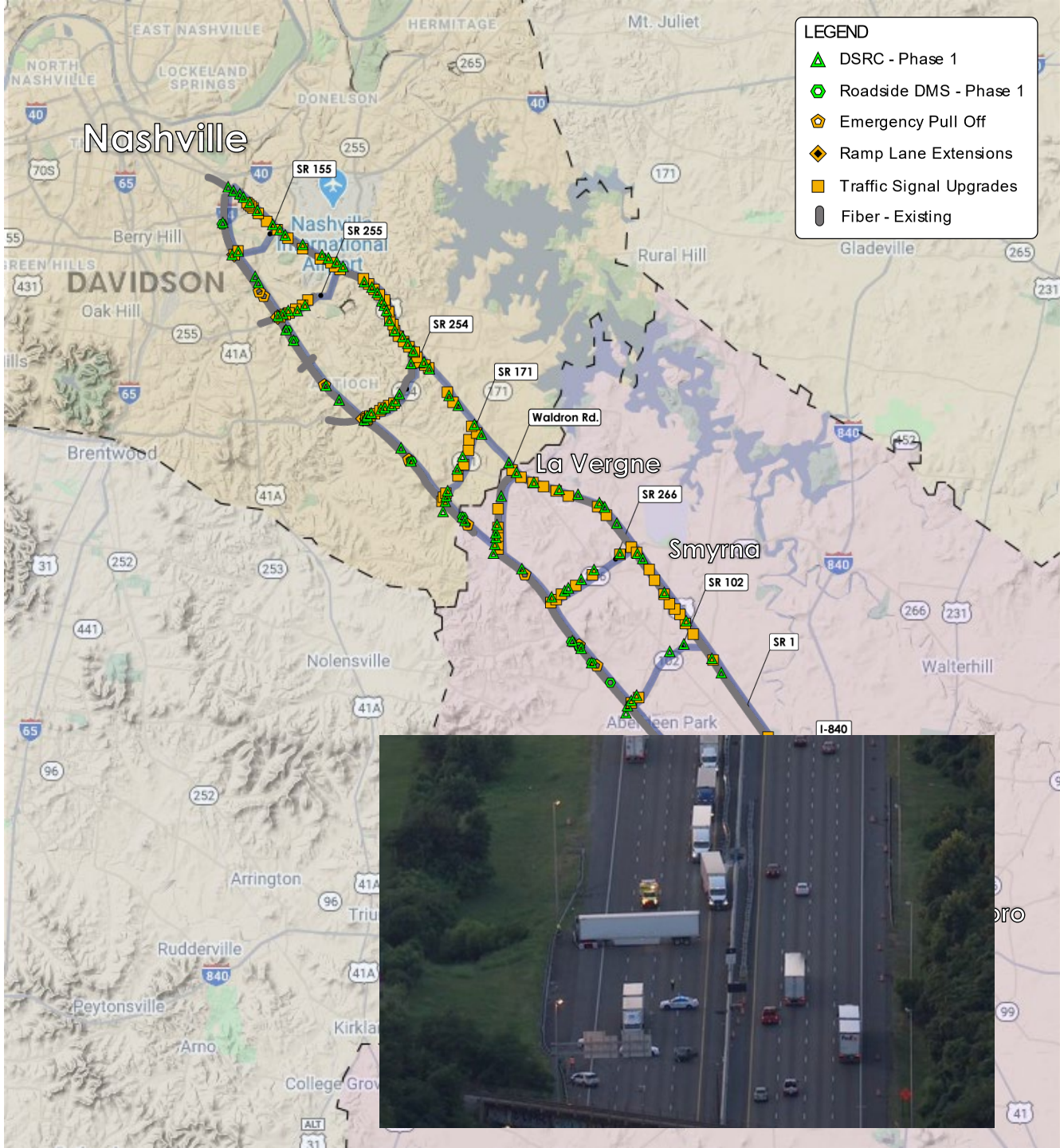
Goal 4: Develop Agency Coordination

Short-Term Deployments

Physical improvements to be deployed with

I-24 Smart Corridor Phase 1 (CNS300)

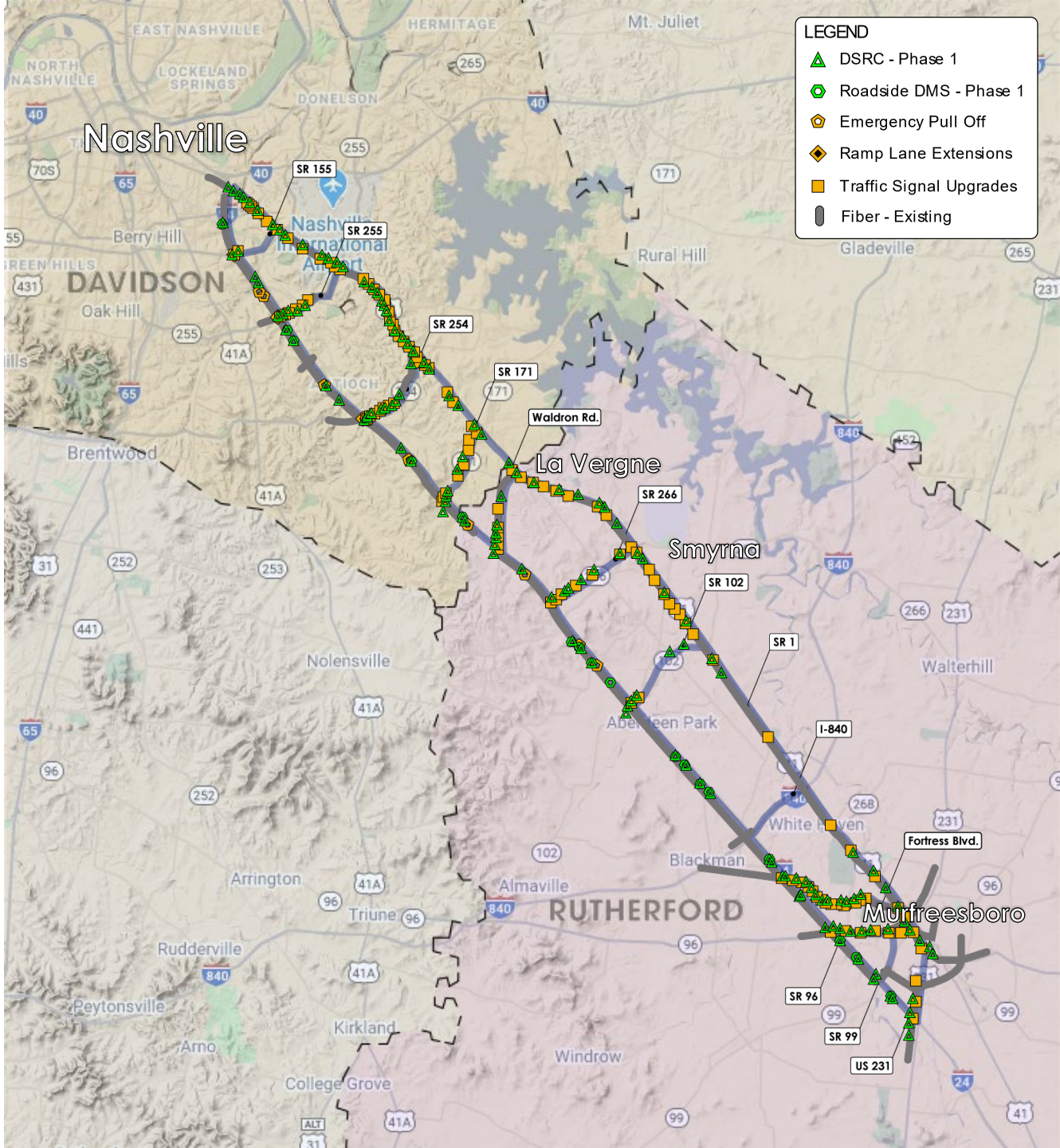
- Communication Network Improvements (Strategic Gap Closures)
- Dedicated Short Range Communications (DSRC)
- Interstate Roadside Dynamic Message Signs (I-24)
- Interstate Ramp Lane Extensions
- Interstate Emergency Pull-offs
- Arterial Signal System Upgrade (Controller Upgrades)



Short-Term Deployments

Operational Improvements

- Signal Timing Optimization
- Update TDOT TMC Procedures
- Improve Operational Coordination for Incident Management
- MOEs, Bluetooth, Centracs tools for active arterial management

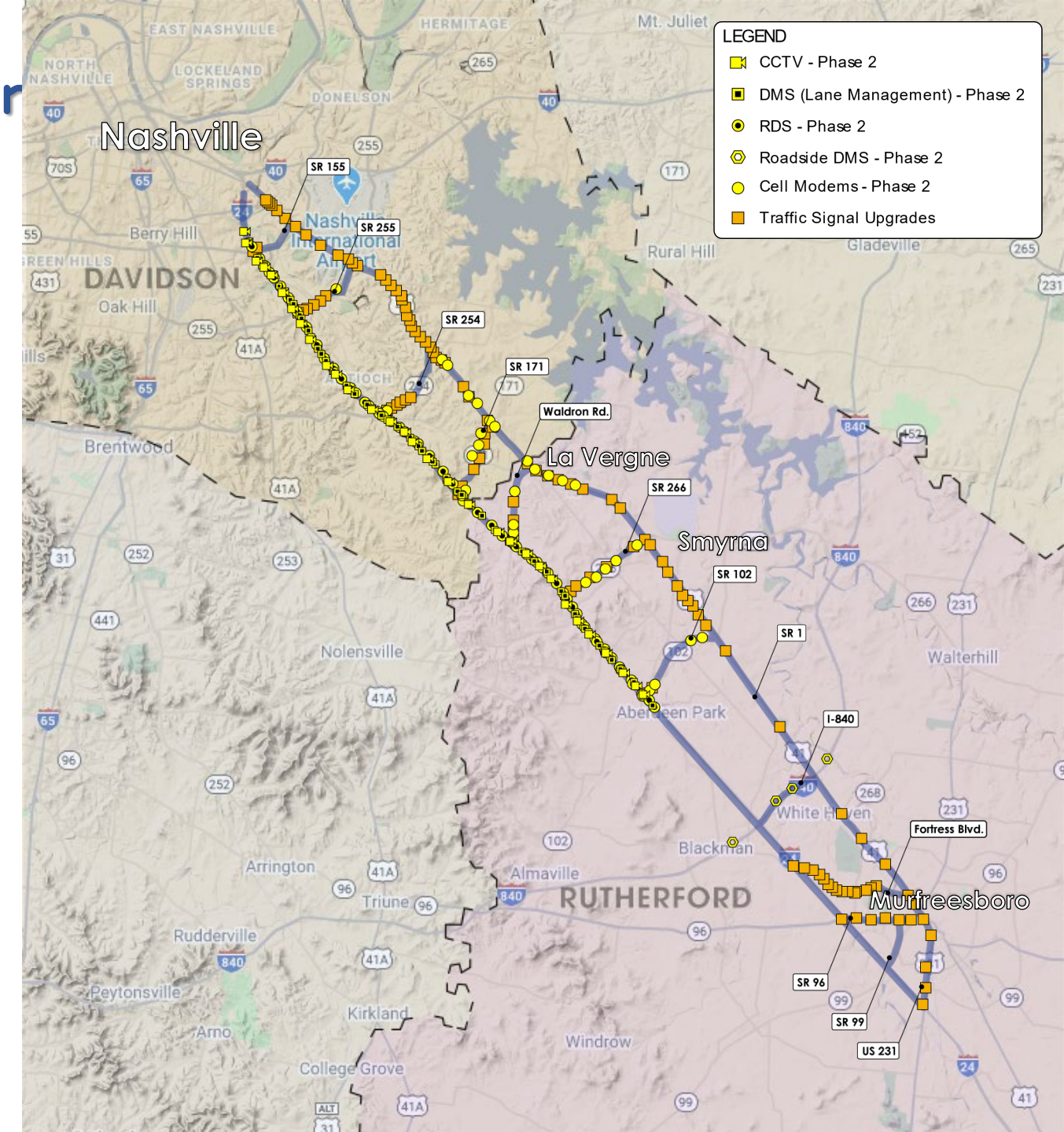


Intermediate-Term Deploymer

Physical improvements to be deployed with

I-24 Smart Corridor Phase 2 (CNT356)

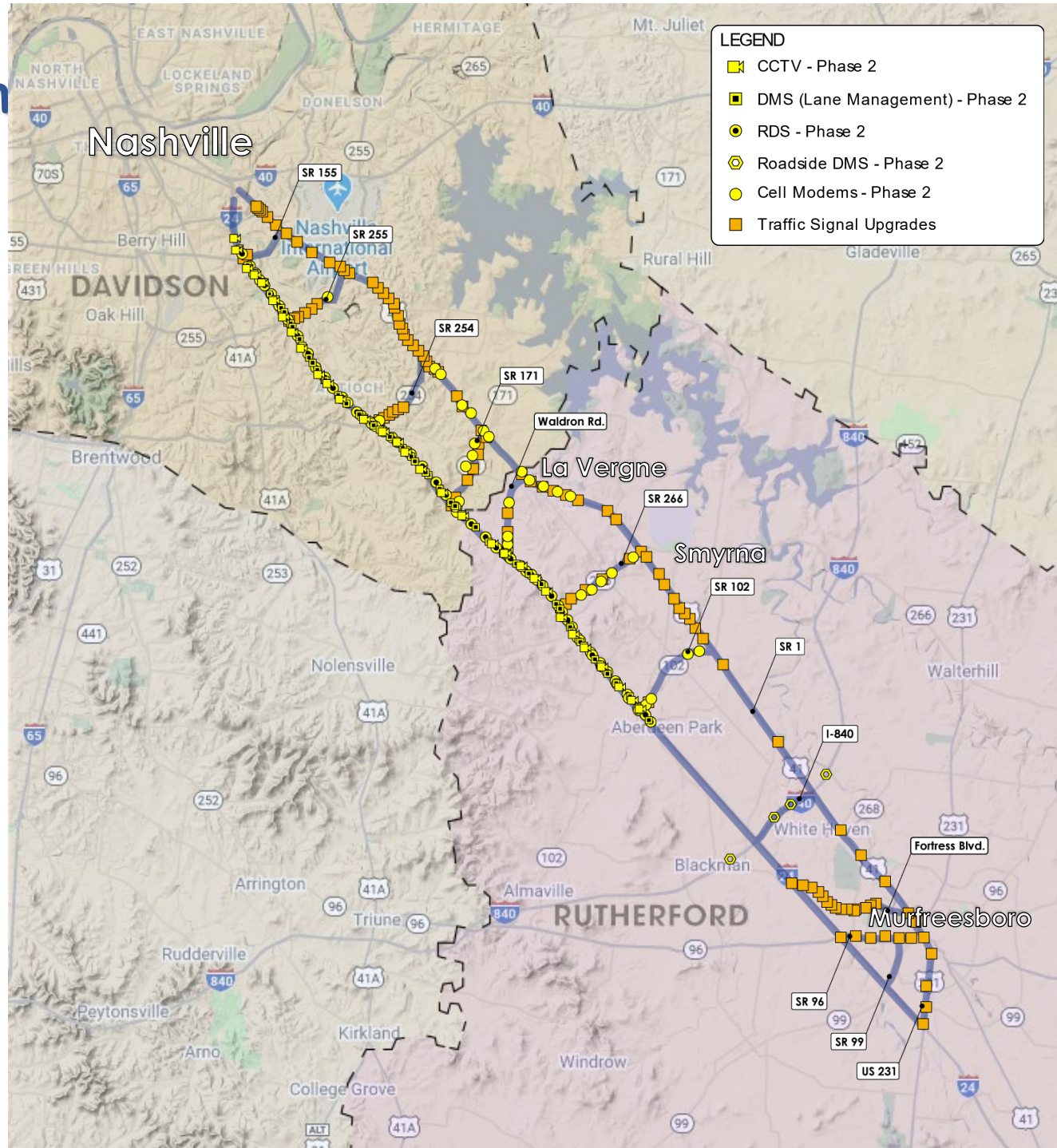
- Communication Network Improvements (Added Capacity to the I-24 Trunk Line)
- Interstate Overhead/Over Lane DMS for Active Traffic Management (Dynamic Lane Management and Speed Harmonization)
- Interstate Sensor Upgrades (CCTV, VDS, and RDS) for Active Traffic Management 14.
- Interstate Roadside Dynamic Message Signs (I-840), Arterial Signal System Upgrade (Detection Upgrades)
- **Contract was awarded October 2019 ($45,778,075.30)**
  - **The project is currently on schedule for conditional acceptance in Winter of 2022.**



Intermediate-Term Deploymen

Operational Improvements

- Update Interstate Incident Management Response Plans
- Develop Active Lane Management Procedures
- Develop Arterial Flush Plans



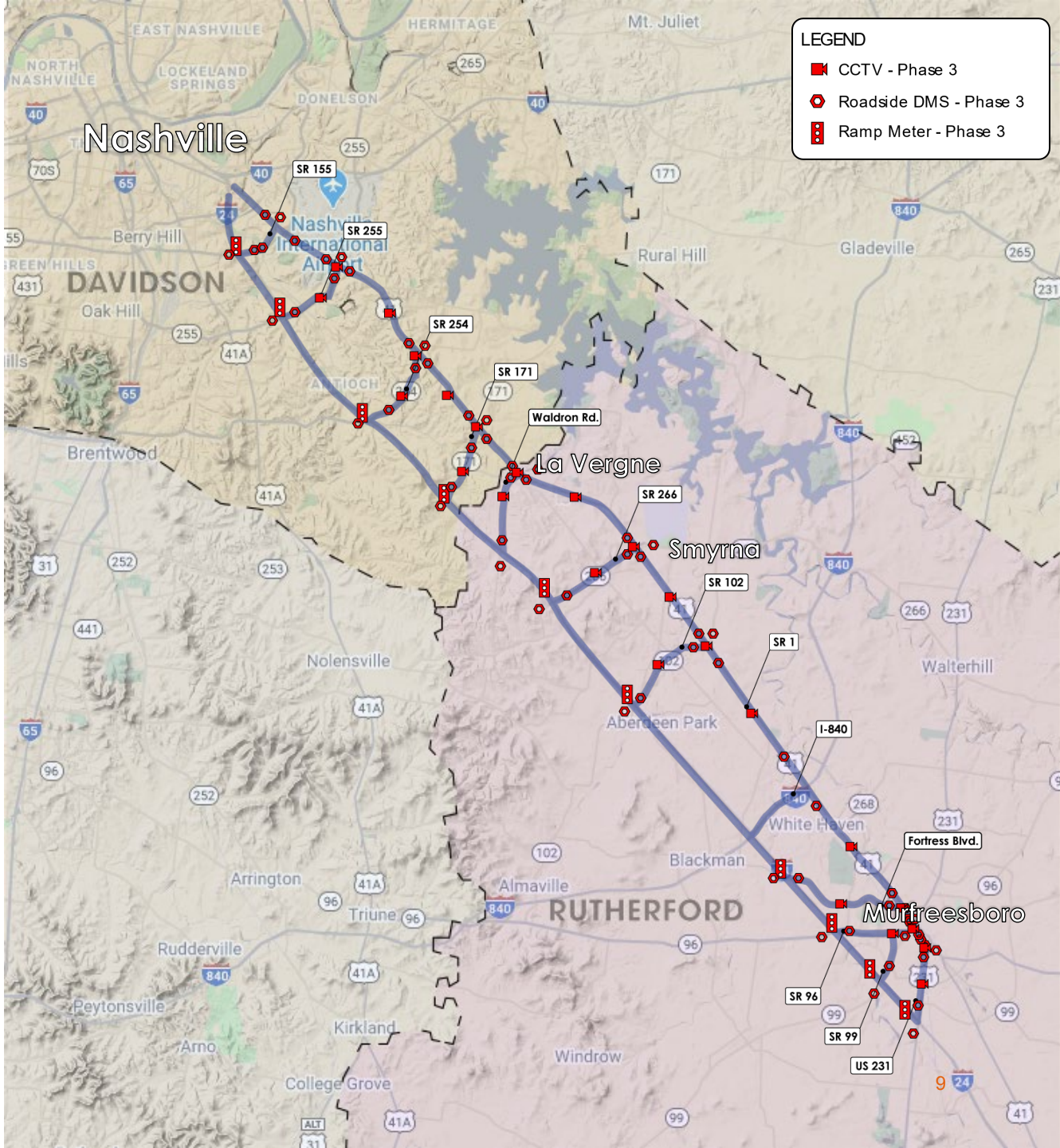
Long-Term Deployments

Proposed physical improvements (Phase 3)

- Communication Network Improvements (Complete Regional Network)
- Interstate Ramp Metering
- Arterial CCTVs, Arterial DMS
- Arterial Operational Improvements (Including ADA accommodations)
- **Phase 3 is projected to let in Fall of 2022**

Proposed operational improvements

- Develop Decision Support System (ATCMTD Grant)
- Interstate Bus on Shoulder (BOS)
- Integrate Staffing, Maintenance, and Operations Plan
- Provide Network Interface Enhancements



Project Schedule - overall

Phase 1 *(CNS 300)*

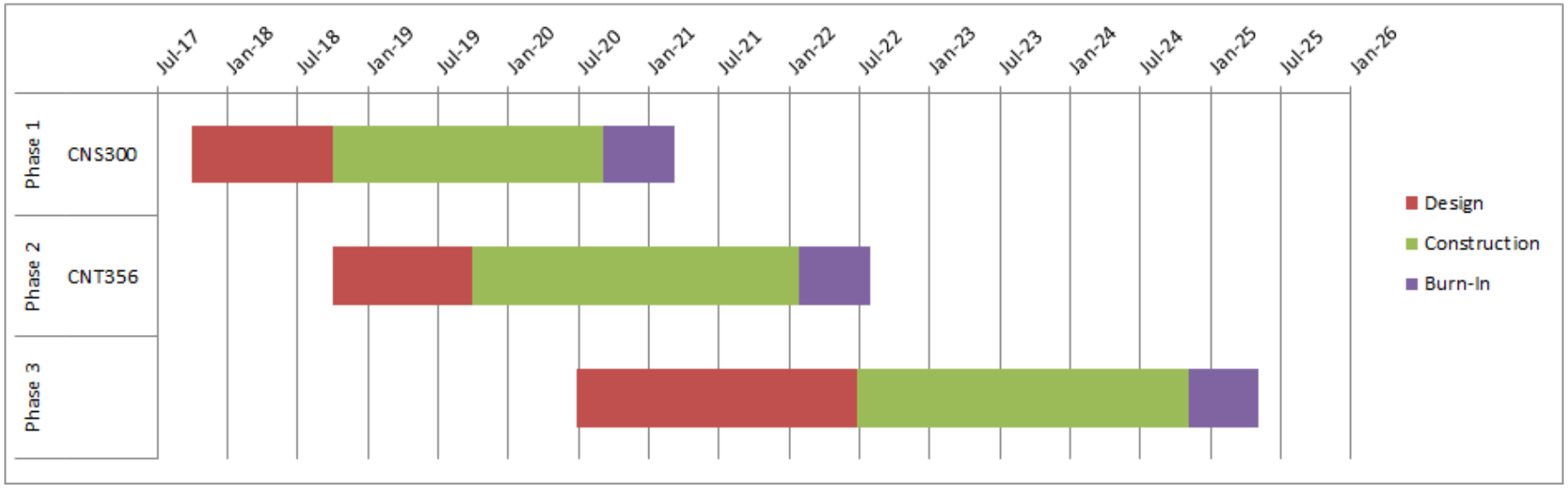
- Contract was awarded October 30, 2018 ($18,688,440.80)
- The project is currently on schedule for conditional acceptance in Spring of 2021

Phase 2 *(CNT 356)*

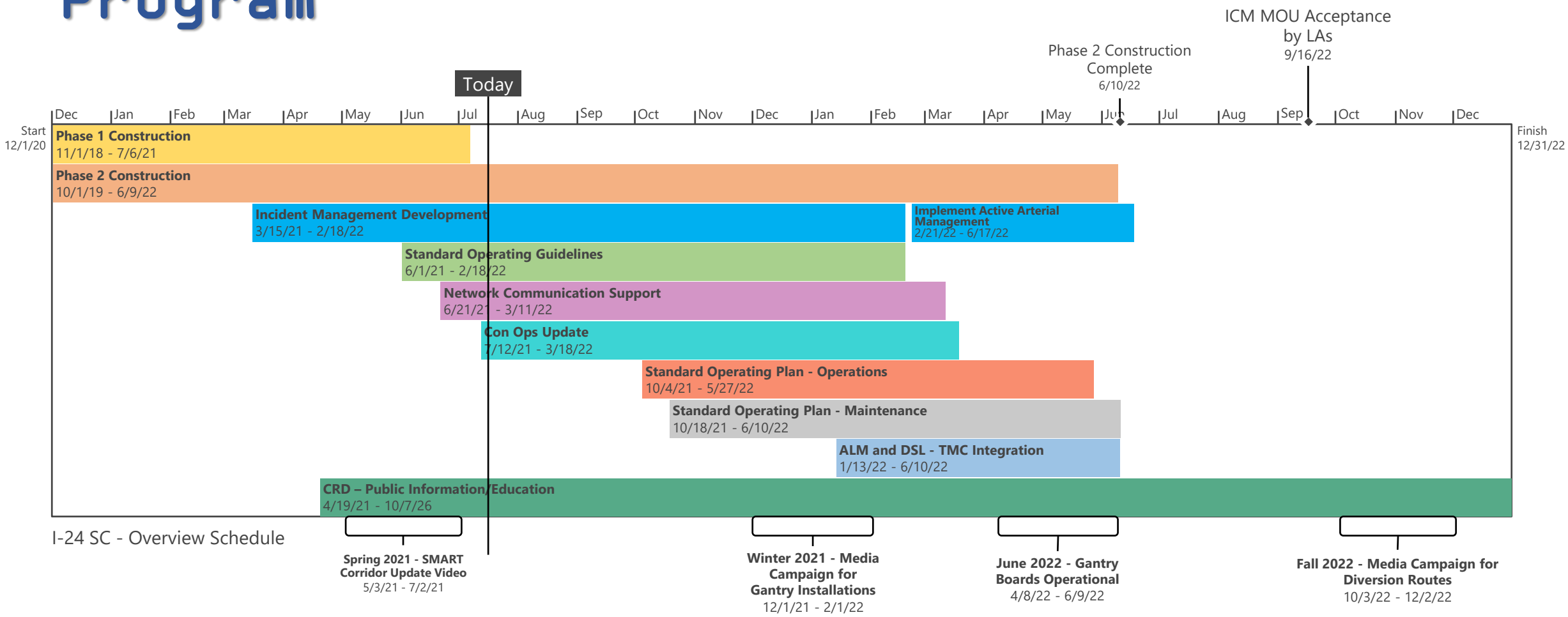
- October 2019 Letting
- Construction award: $45,778,075.30

Phase 3

- Projected Letting for Fall of 2022



Project Schedule - O&M Program

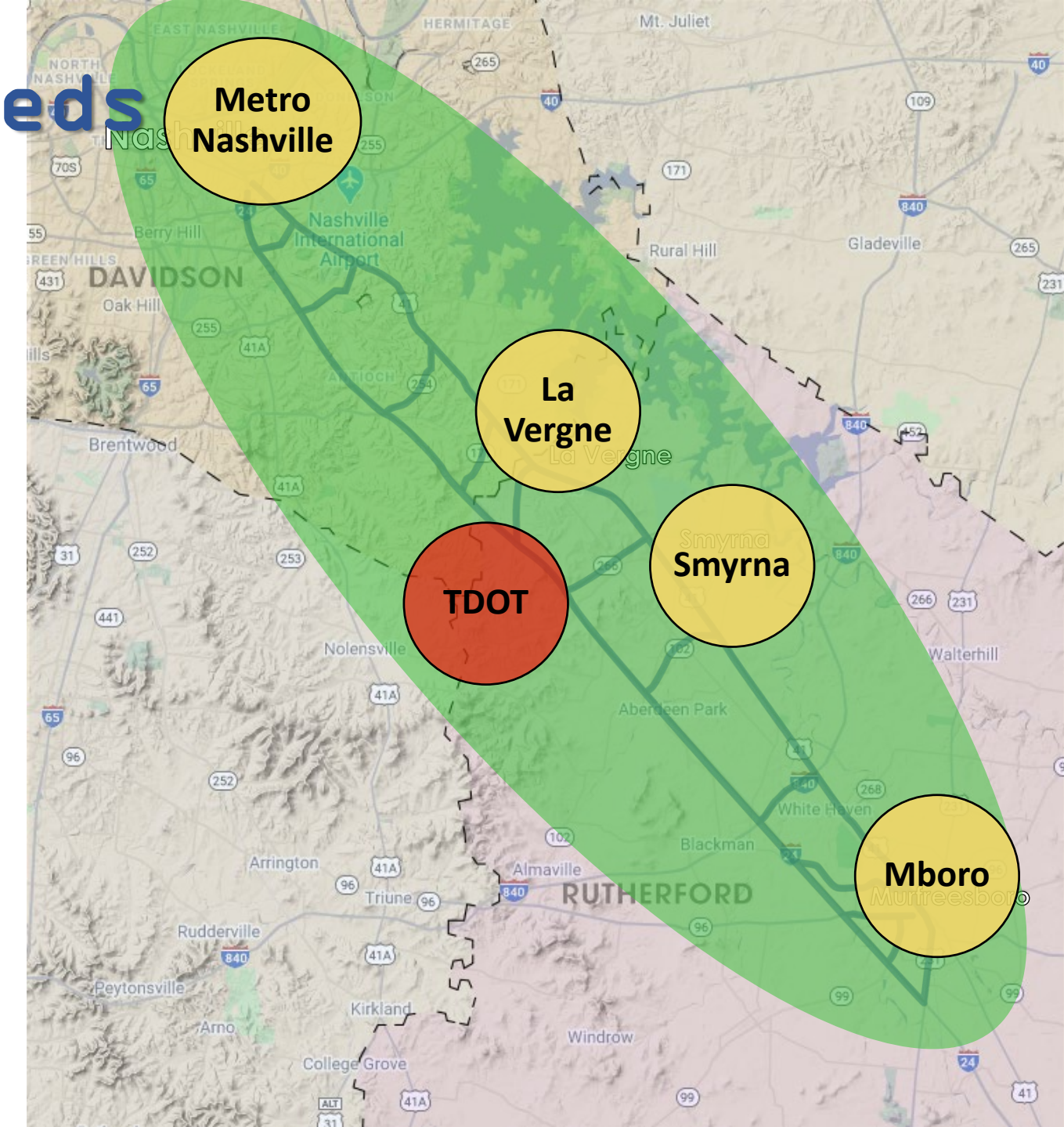


Initial ICM Operation and Maintenance Needs

- ICM Coordinator Roles
  - Defines and coordinate training needs
  - Support the TMC on active freeway and arterial management strategies
  - Support DSS Development based on lessons learned and TDOT SOPs
  - Define rules for implementation of diversion scenario plans
  - Coordinates with Local Agencies on the implementation of an incident management signal timing plans.
  - Corridor Specific TIM Coordination

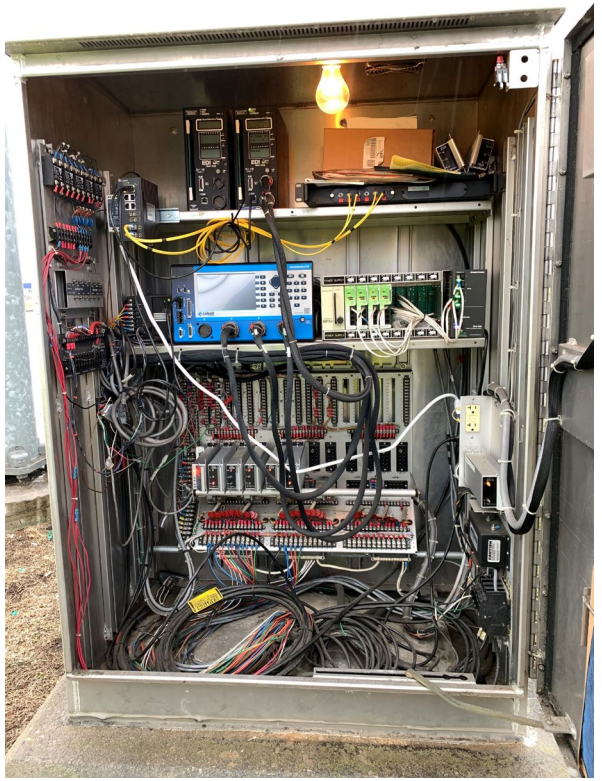
Initial ICM O&M Needs

- Local Agency Operations Support
  - Assists and trains Local Agencies on active arterial operation.
  - Assists local agencies in planning and execution of ICM strategies.
  - Assists and trains staff in maintenance of ICM components within their jurisdictions.
  - Provide supplemental TOC support.



Initial ICM Operation and Maintenance Needs

- ICM Maintenance Expectations
  - Set maintenance goals and expectations for the local agencies
    - Identify critical field assets
    - Define KPIs such as percent uptime
    - Establish expected repair times
  - Establish maintenance budgets
  - TDOT's role if local agency cannot repair critical asset within accepted duration
  - Paradigm Shift for Traffic Signal O&M in TN
    - TSM&M



Artificial Intelligence for Transportation Management

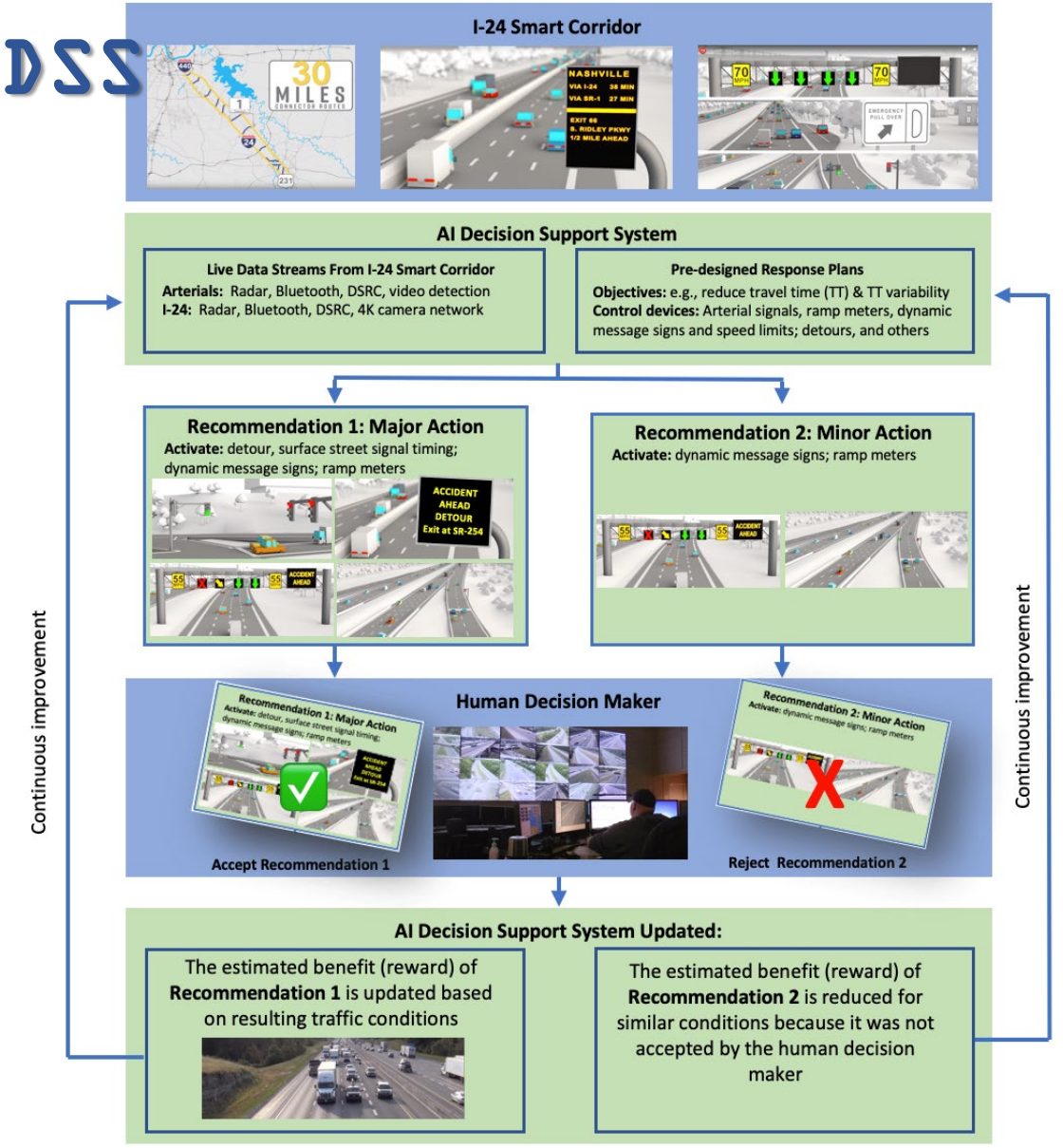
ATCMTD Grant Project ICM DSS

Artificial Intelligence-powered decision support tools for Integrated Corridor Management

- Total Project Cost: $5,235,306.31
- Total Award Request: $2,617,653.16

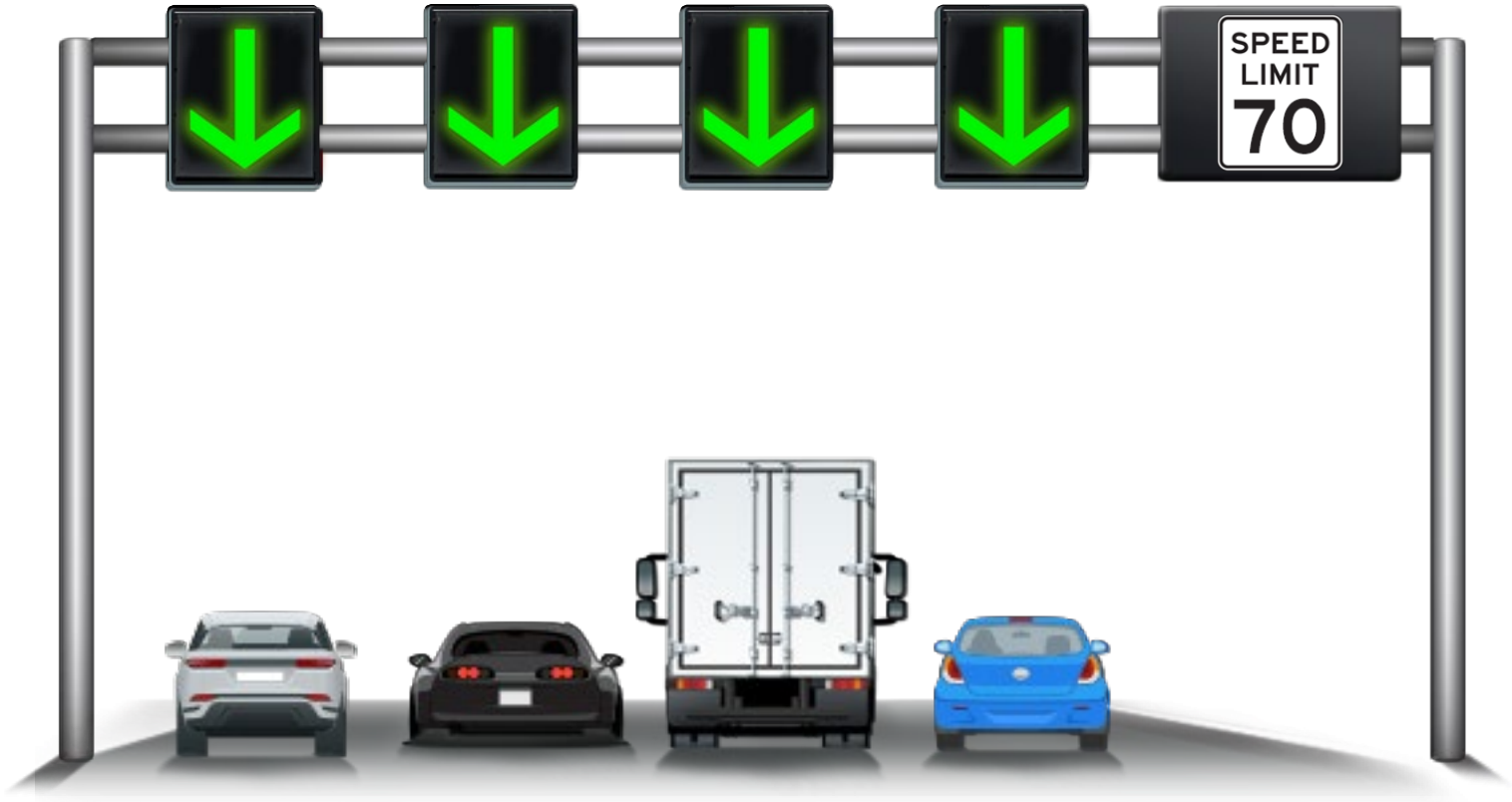
Tools includes:

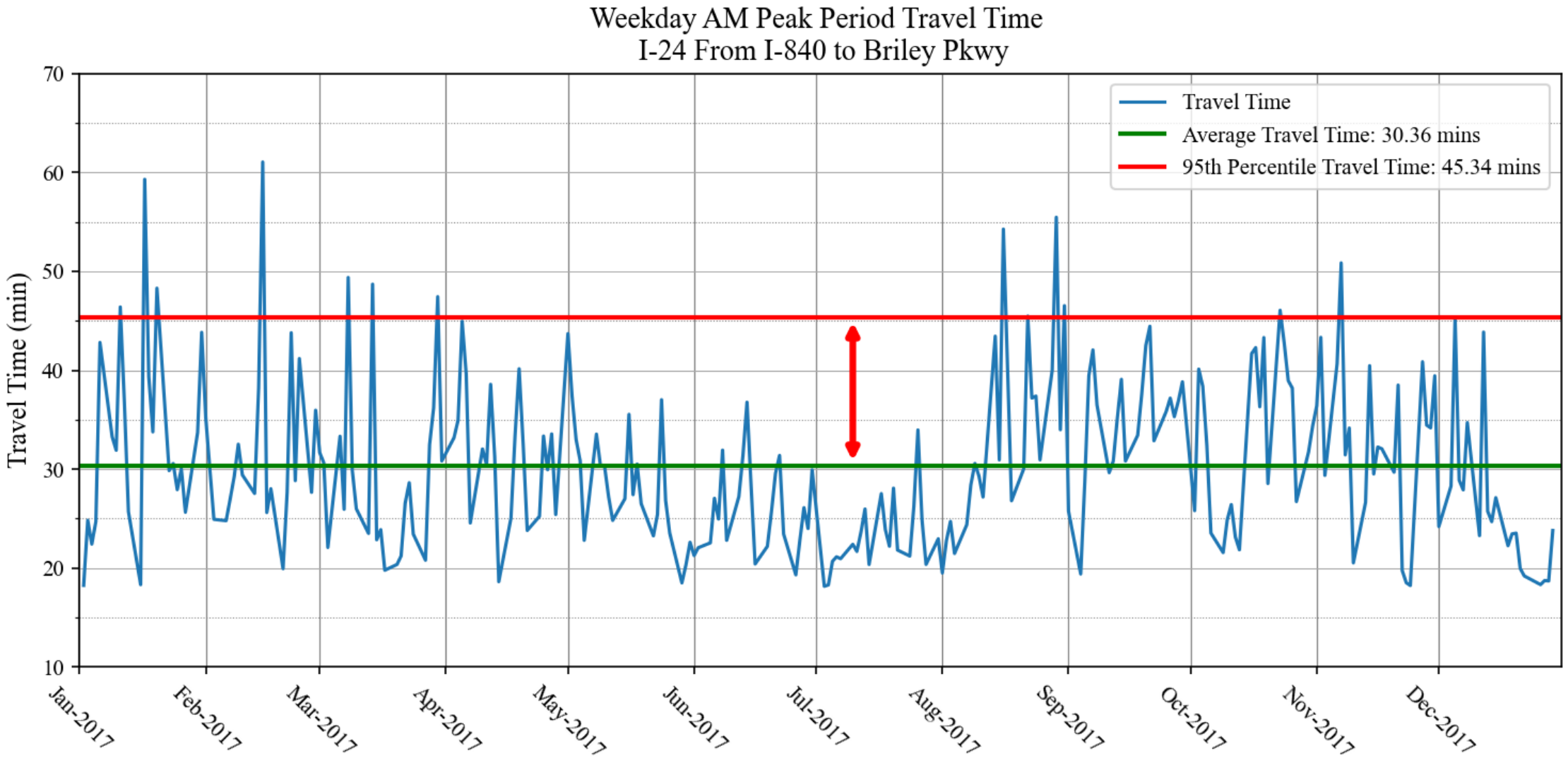
- Artificial Intelligence-based ICM Decision Support System
- Web interface for ICM partners
- Traffic Management Center ICM software integration

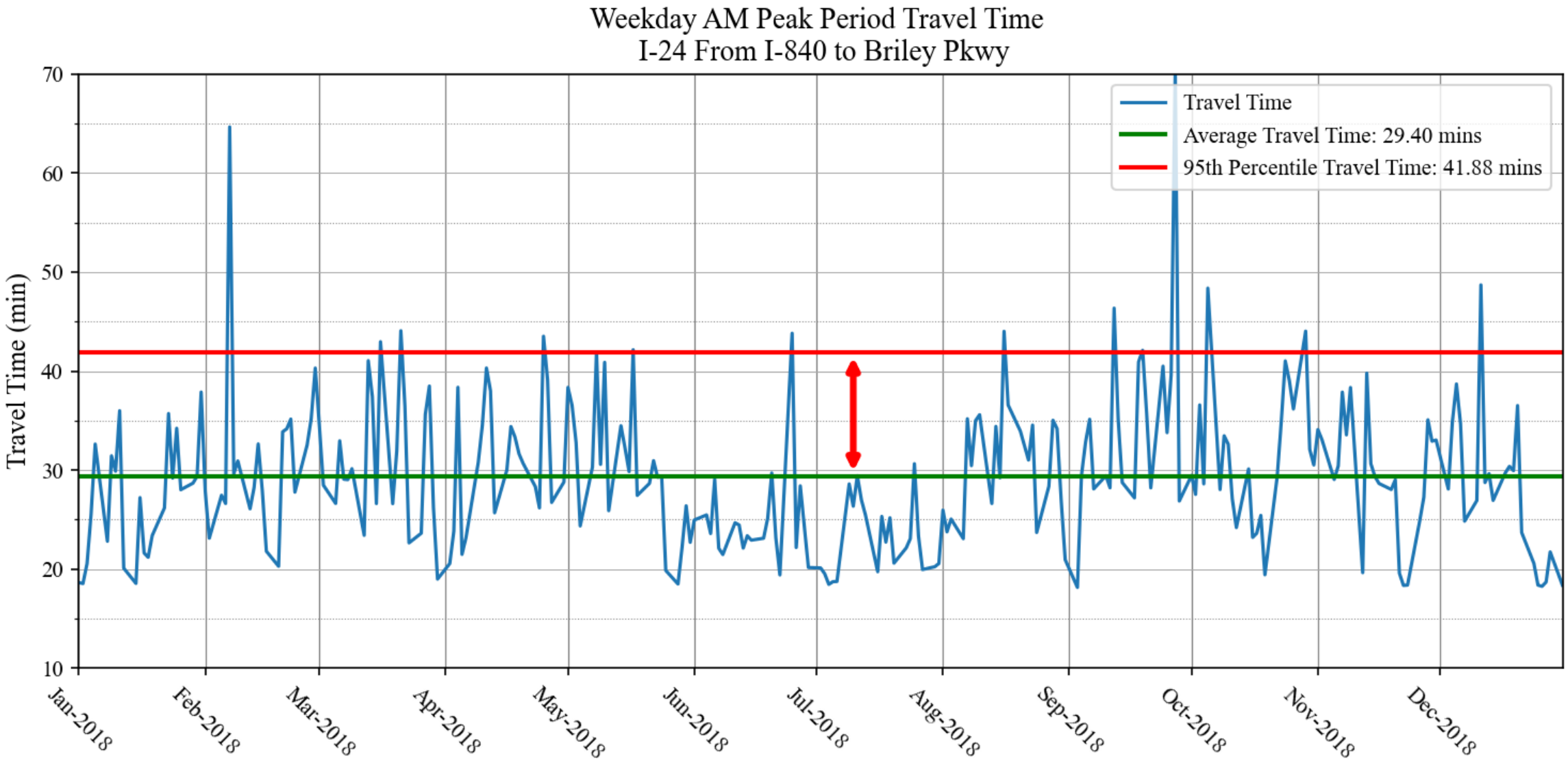


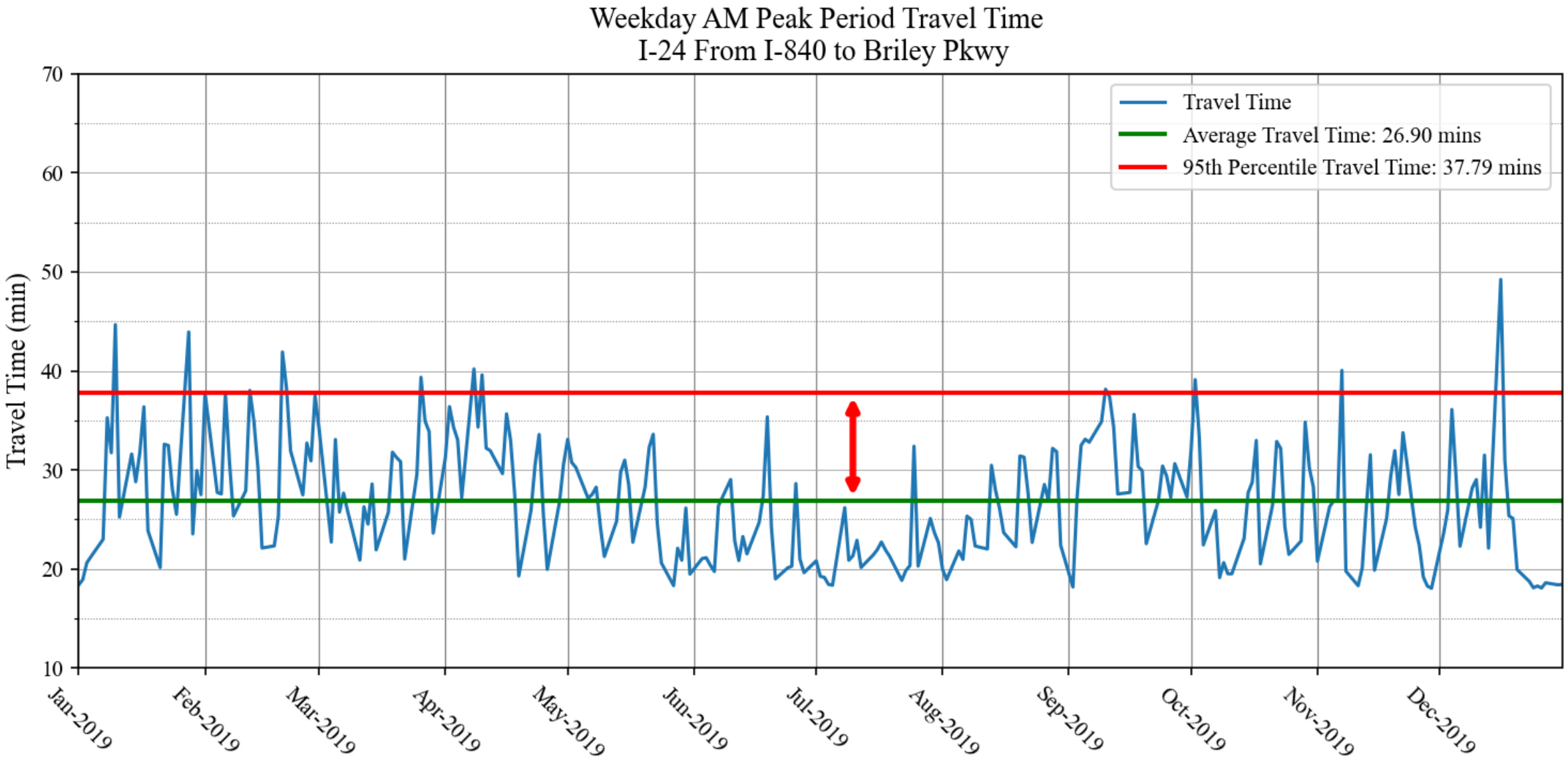
Public Information

- Providing relevant and timely information to the public is critical to this project's success
  - Media campaigns in advance of project milestones
  - Update of the project website as well as Social Media Outlets.




Weekday AM Peak Period Travel Time
I-24 From I-840 to Briley Pkwy
Travel Time (min)
70
60
50
40
30
20
10
Jan-2017
Feb-2017
Mar-2017
Apr-2017
May-2017
Jun-2017
Jul-2017
Aug-2017
Sep-2017
Oct-2017
Nov-2017
Dec-2017
Travel Time
Average Travel Time: 30.36 mins
95th Percentile Travel Time: 45.34 mins


Weekday AM Peak Period Travel Time
I-24 From I-840 to Briley Pkwy
Travel Time (min)
70
60
50
40
30
20
10
Travel Time
Average Travel Time: 29.40 mins
95th Percentile Travel Time: 41.88 mins
Jan-2018
Feb-2018
Mar-2018
Apr-2018
May-2018
Jun-2018
Jul-2018
Aug-2018
Sep-2018
Oct-2018
Nov-2018
Dec-2018


Weekday AM Peak Period Travel Time
I-24 From I-840 to Briley Pkwy
Travel Time (min)
70
60
50
40
30
20
10
Jan-2019
Feb-2019
Mar-2019
Apr-2019
May-2019
Jun-2019
Jul-2019
Aug-2019
Sep-2019
Oct-2019
Nov-2019
Dec-2019
Travel Time
Average Travel Time: 26.90 mins
95th Percentile Travel Time: 37.79 mins

Today's Panelists

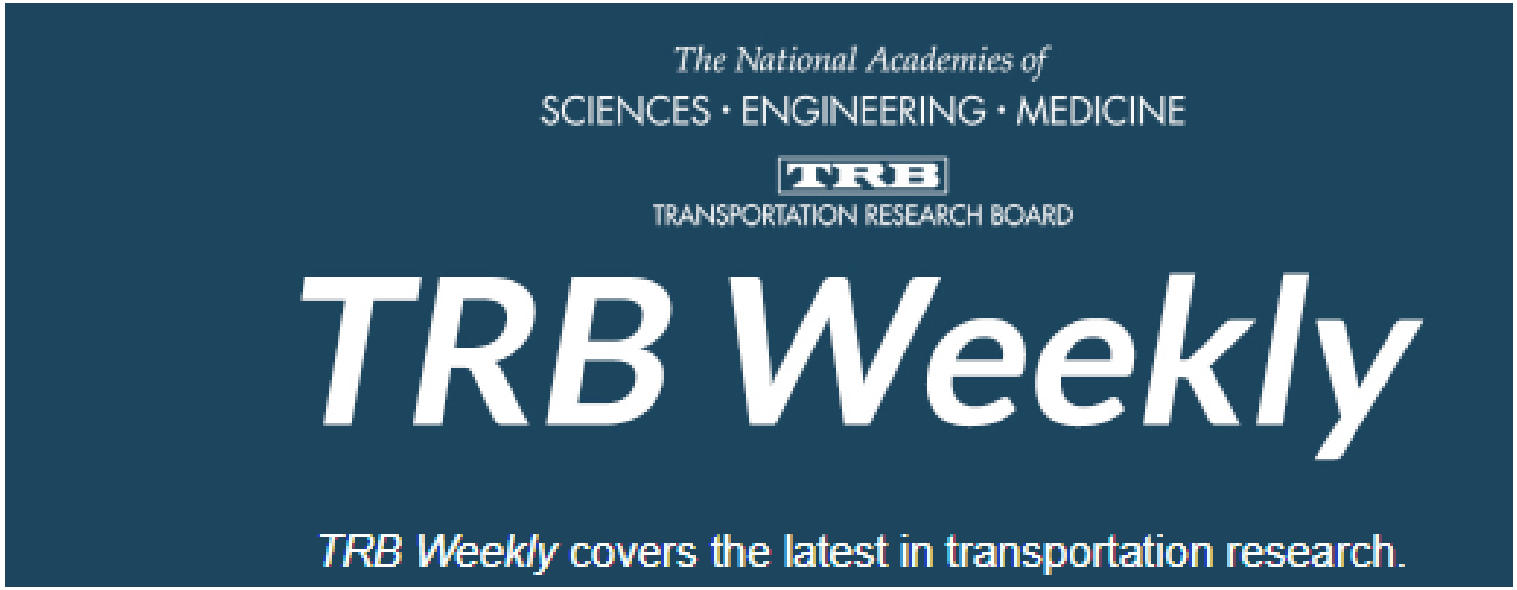
Moderator:
Cathy McGhee,
Virginia DOT

Les Jacobsen,
WSP

Kevin Miller,
kapsch >>>

Brad Freeze,
TN TDOT Department of Transportation

#TRBwebinar



- Subscribe to the newsletter for the most recent TRB news & research!

https://bit.ly/ResubscribeTRBWeekly

TRB's New Podcast!

- Have you heard that we have a new podcast, TRB's Transportation Explorers?
- Listen on our website or subscribe wherever you listen to podcasts!

#TRBExplorers

Get involved with TRB

- Receive emails about upcoming webinars:

https://mailchi.mp/nas.edu/trbwebinars

- Find upcoming conferences:
  http://www.trb.org/Calendar

#TRBWebinars

Get Involved with TRB

#TRBwebinar

@NASEMTRB

@NASEMTRB

Transportation Research Board

Getting involved is free!

Be a Friend of a Committee bit.ly/TRBcommittees

- Networking opportunities
- May provide a path to Standing Committee membership

Join a Standing Committee bit.ly/TRBstandingcommittee

Work with CRP https://bit.ly/TRB-crp

Update your information www.mytrb.org