

ITS Carolinas Operations Training Program

Program Overview

- 3-Year Program
- 3 Modules Per Year
- 20 Participants
- In-person networking element and hands-on experience

1st Class

- 1st Session will be Summer of 2021 – Integrated Corridor Management
- Additional Upcoming Sessions:
 - Advanced Freeway Operations
 - Regional Operations Academy (Leadership, Systems Engineering, TSMO, and Capability Maturity Model)

2nd Class

- We will start accepting applications prior to next year's annual meeting



NORTH CAROLINA
Department of Transportation



Integrated Corridor Management

ITS Carolinas

March 16th, 2021

Matthew T. Carlisle, PE
State Signal Systems Engineer

Integrated Corridor Management (ICM)

The integrated and proactive management of existing infrastructure along major corridors

Coordination

- Transportation assets
- Stakeholders engaged in Corridor Mobility



Primary Goals

- Faster and better Traveler Information
- Faster and better Stakeholder Coordination
- Faster incident response and clearance
- Dynamically manage network based on demand

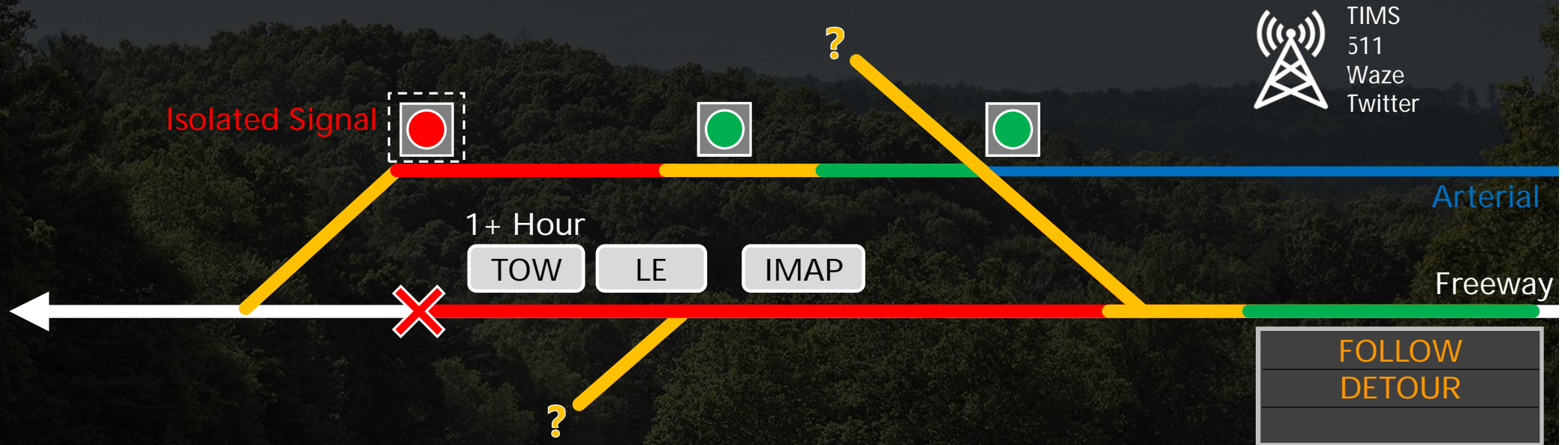


Integrated Corridor Management Tools

Scale Response to Traffic Impacts

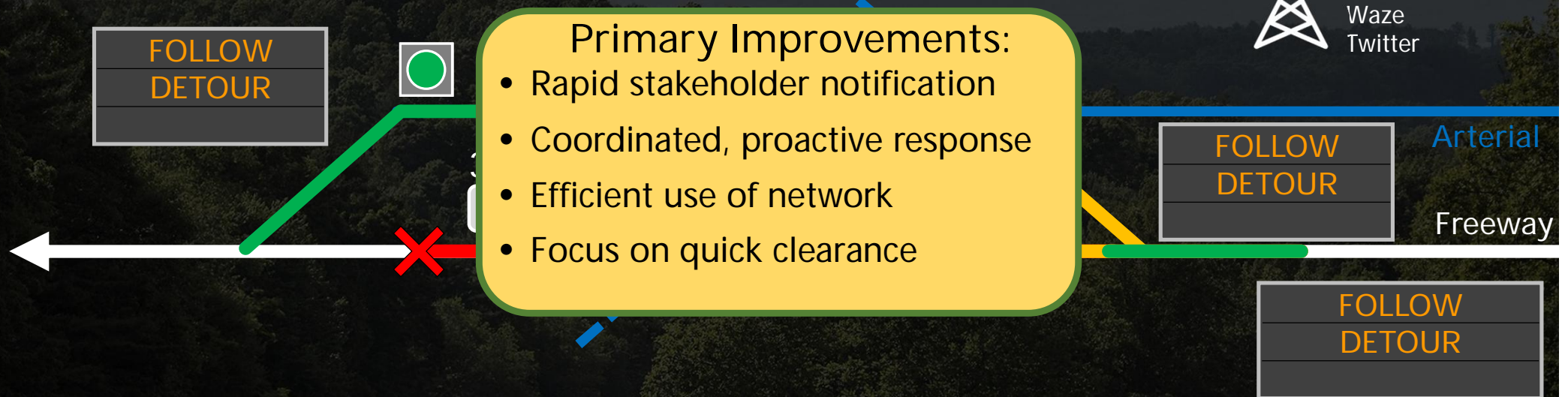


Incident Response – without ICM



1. Incident occurs and congestion builds
2. Congestion grows, law enforcement arrives
3. Law enforcement diverts traffic (*maybe* along a viable detour route) – **SOME RELIEF**
4. TMC learns of incident, deploys IMAP, Traveler Information, and DMS messaging – **SOME RELIEF**
5. TMC plans viable detour, directions along detour often unavailable – **SOME RELIEF**
6. Rotation Wrecker arrives, paid by the hour so removal time is lengthy
7. Where available, Municipal staff reactively adjusts signal timing – **SOME RELIEF**

Incident Response – with ICM



1. Incident occurs and congestion builds
2. Congestion grows, law enforcement arrives and notifies TMC
3. TMC deploys Traveler Information & IMAP – **SOME RELIEF**
4. TMC notifies Contract Wrecker & Municipal Staff
5. TMC executes planned detour, alternate routes, and signal timing – **MORE RELIEF**
6. Contract Wrecker arrives – has financial incentive to remove vehicles quickly

Where is ICM a Good Strategy?

Locations with Reoccurring Congestion

- Vehicle Crashes
- Special Events
- Commuter Routes
- Seasonal Fluctuations
- Construction Projects

Locations with Viable Parallel Routes

Locations Sensitive to Reduced Capacity

- Routes currently operating at or near capacity
- Major routes to tourist destinations



ICM Efforts in North Carolina



— Interstate/US Route

IMPLEMENTED

- Business 40 in Winston-Salem
- I-26, south of Asheville (I-4400)
- I-40, south of Raleigh (I-5111)

IN DESIGN

- I-95, north of Fayetteville (I-5986)
- I-95, south of Fayetteville (I-5987/6064)
- I-85, west of Charlotte (C-5600K)

Accomplishments

Infrastructure

- Three projects implemented
- Over 130 miles of freeway covered
- Over 200 signals upgraded
- Over 50 dynamic trailblazers installed
- Two NCDOT-managed tow contracts

Process

- Project Process Outline
- Decision Matrix Tables
- ICM Response Database
- Standardized Training
- Standardized After Action Reviews

The collage features several screenshots from traffic management software:

- Signal Timing Tables:** Multiple tables showing signal timing parameters for various routes and directions, including AM Peak, PM Peak, and Overnight periods. Columns include Start/End times, Cycle Length, and Signal Phases.
- ICM Route Data:** A table for ICM Route 1-40, showing direction (Eastbound), freeway AADT (116,000), and truck percentages (3%).
- ICM Response Database:** A screenshot of a database interface with columns for ID, Significance, Signal, and Panel, listing various incident response scenarios.
- Project Process Outline Diagram:** A circular flow diagram titled "PROJECT PROCESS OUTLINE" showing the sequence of operations: "Integrated Corridor Management" (top), "Traffic Systems Operations" (right), "Involve Traffic Operators" (bottom), and "Streamline decision-making process" (left).

Three projects being implemented this year

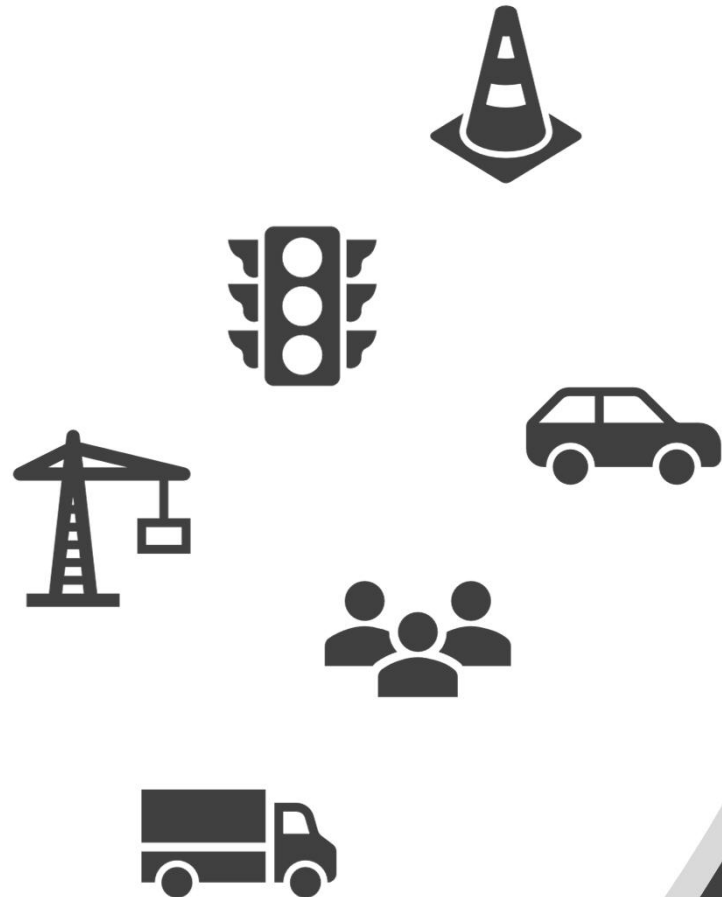
Three Contracts Server-to-Server connected

Continuous Improvements

- Reduce overall timeline
- Refine signal timing process
- Streamline decision-making process
- Involve Traffic Operators



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Integrated Corridor Management

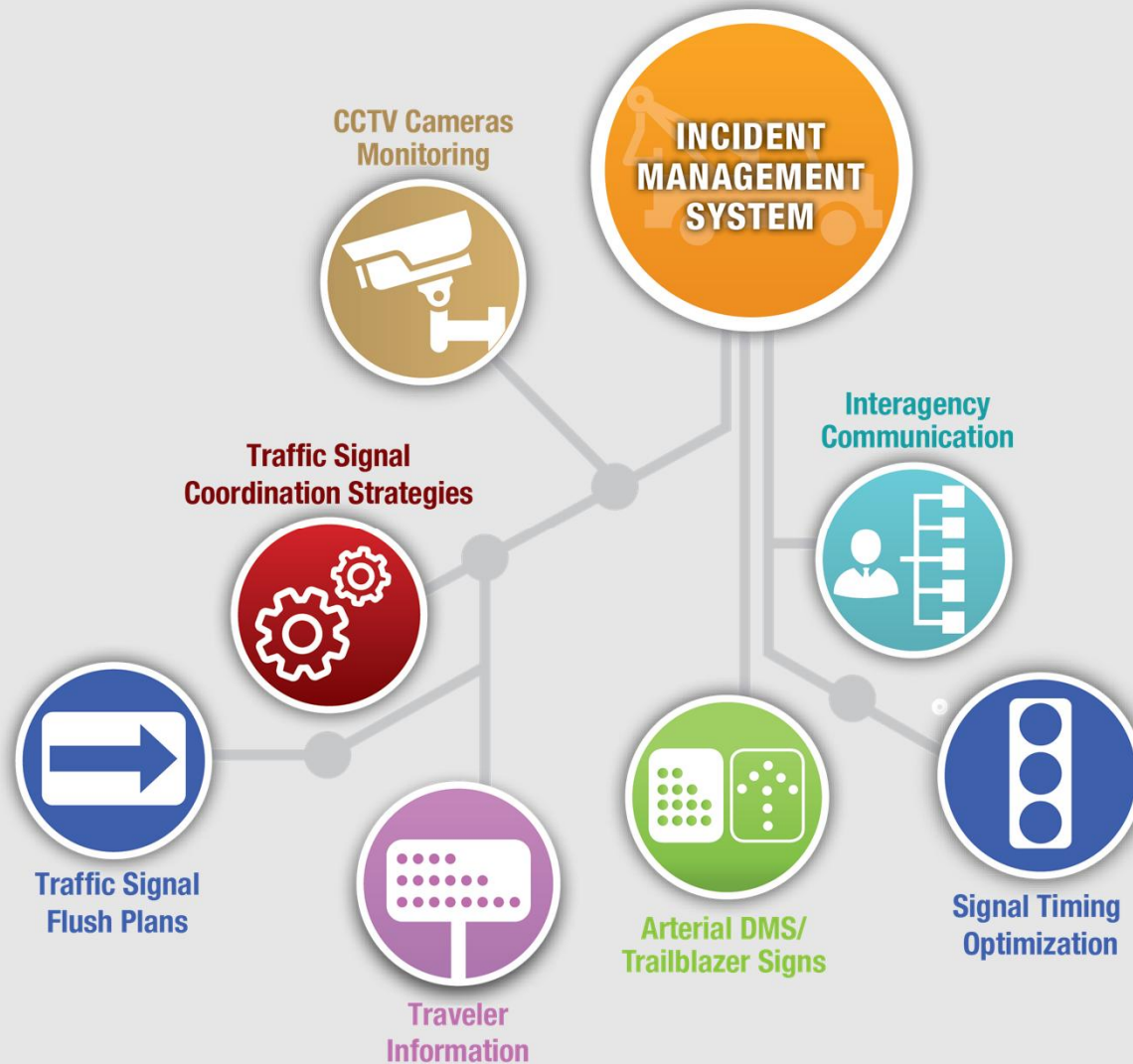
Stakeholders, Communication, and Coordination

Existing Conditions

- 10 Construction Projects Planned in the area:
 - Widening projects
 - Bridge projects
 - Intersection/Pedestrian improvements
 - Streetcar project
- Traffic Signals, CCTV Cameras, DMS
- Coverage by NCSHP, Gastonia PD, Belmont PD
- Existing Incident Scenario-Response Process

ICM System

The integrated and proactive management of existing infrastructure along major corridors



Stakeholders

- NCDOT
- Gastonia
- Charlotte

Stakeholders

Invested Partners

AECOM & Kimley-Horn

NCDOT – Statewide Operations

NCDOT – Signals

Charlotte

Gastonia

Belmont

NCDOT – ITS Design

NCDOT – Division 12 Traffic Engineer

NCDOT – Division 10 Traffic Engineer

MRTMC

STOC

NCDOT – Division 10 RITS Engineer

NCDOT – Program Management Office

NCSHP and Local PD

Contractor

NCDOT – Division 10 Program Delivery

NCDOT – Division 10 PIO

NCDOT – Division 12 PIO

Public

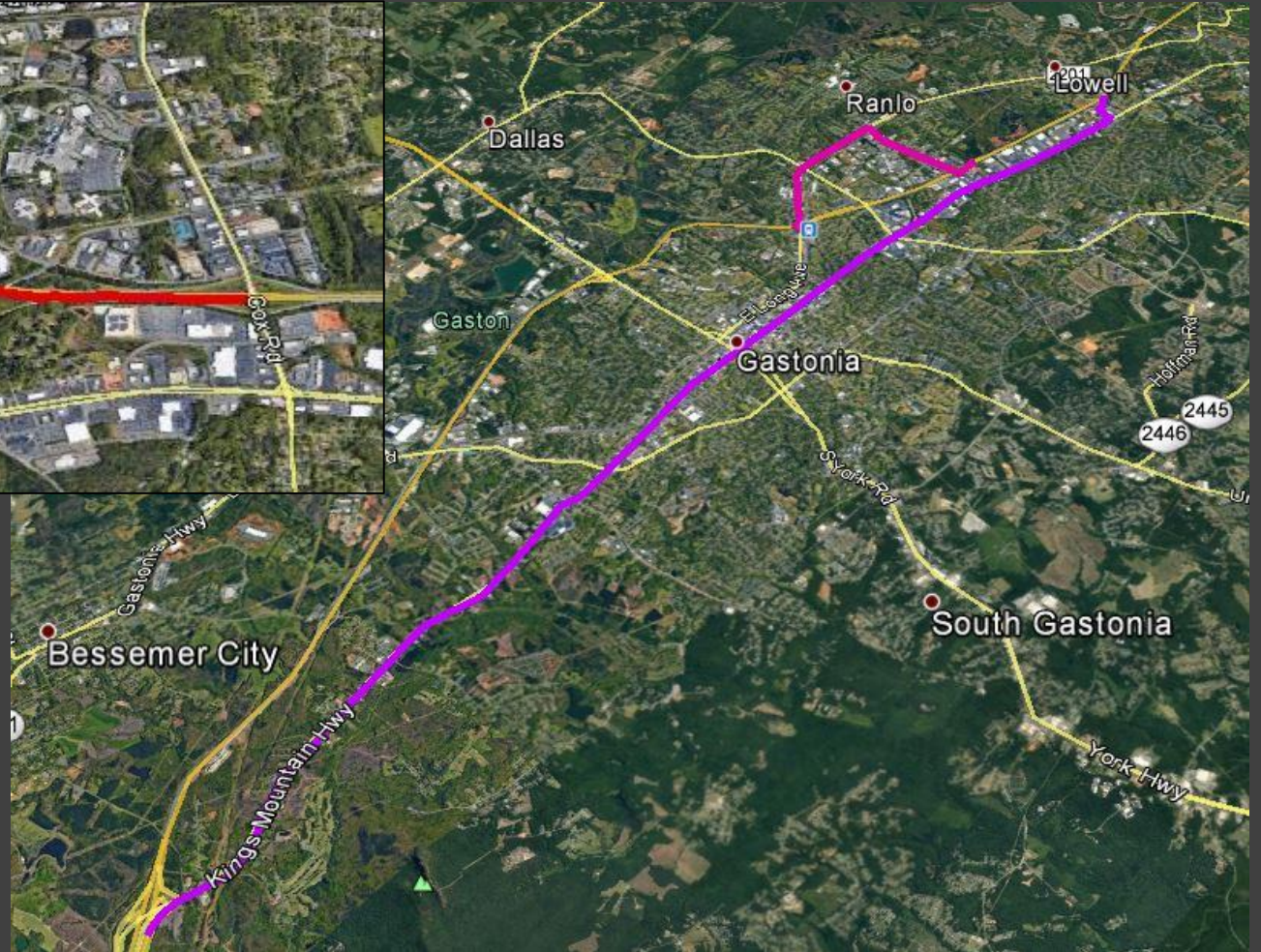
Response Scenario Components

- 20 Response Scenarios
 - Alternate/detour routes
 - Turn-by-turn directions
 - Message sets
 - Signal timing plans
 - Additional details

I-85N Incident Between 19-21



* 20 Decision Matrix Sections



* 20 Alternate / Detour Routes

TurnByTurn	Panel1-2	Panel1-3	DayOfWeek	ExpectedDuration	QueueThresh	CTB	Standard Direction	ICM Direction
ts must take Exit 30 (I-485 South). Follow I-485 South and Exit onto US-74 East (Exit 9), th	MAJOR DELAYS	AHEAD	Weekday	>0.5-2< hours		CTB1	Left	Straight
4 East. Continue on US-29/US-74 East and take left onto N Josh Birmingham Pkwy. Cont	AHEAD	FOLLOW DETOUR	Weekday	>0.5-2< hours		CTB2	Left	Straight
ts must take 20 to NC-279 (New Hope Rd). Follow New Hope Rd and take a left onto	MAJOR DELAYS	AHEAD	Weekday	>2 hours		CTB3	Left	Straight
9/US-74 East and take a left onto N Josh Birmingham Pkwy. Follow JB Pkwy North to	AHEAD	FOLLOW DETOUR	Weekend	<0.5 hours		CTB4	Left	Left
ts must take Exit 32 (Little Rock Rd). Follow Little Rock Rd, then take right onto US-7	AHEAD	FOLLOW ALT RO	Weekend	>0.5-2< hours		CTB5	Left	Left
9/US-74 West and take left onto I-485 North. Continue straight to re-access I-85 S	MAJOR DELAYS	AHEAD	Weekend	>2 hours		CTB1	Left	Straight
ts must take Exit 48 to I-485 South. Follow I-485 South to Exit 30 (I-85 South).	NEAR EXIT 17	USE ALT RO	Weekday	<0.5 hours		CTB2	Left	Straight
ts must take Exit 30 (I-485). Follow I-485 South to US-29/US-74 West (Exit 9) a	NEAR EXIT 17	FOLLOW D	Weekday	>0.5-2< hours		CTB3	Left	Straight
ollow US-29/US-74 West and then take right onto Sam Wilson Rd. Continue to	AHEAD	FOLLOW A	Weekday	>2 hours		CTB4	Left	Left
ts must take Exit 29 (Sam Wilson Rd). Follow Sam Wilson Rd South and take	MAJOR DELAYS	AH	Weekend	<0.5 hours		CTB5	Left	Left
US-29/US-74 West then take right onto NC-273 (Park St). Continue to	MAJOR DELAYS	A	Weekend	>0.5-2< hours		CTB8	Left	Left
ts must take Exit 30 (I-485). Follow I-485 South to US-29/US-74 West (CLOSED	NEAR EXIT 19	Weekend	>2 hours		CTB9	Left	Left
ollow US-29/US-74 West and then take right onto NC-273 (Park St). Cont	CLOSED	NEAR EXIT 19	Weekday	<0.5 hours		CTB1	Left	Straight
ts must take Exit 27 (NC-273 South). Follow NC-273 (Park St) and take	AHEAD	FO	Weekday	>0.5-2< ho		CTB2	Left	Straight
9/US-74 West and take right onto NC-7 North. Continue on NC-7	MAJOR DELAYS		Weekday	>0.5-2< h		CTB3	Left	Straight
ts must take Exit 30 (I-485). Follow I-485 South to US-29/US-74 W	MAJOR DELAYS		Weekday	>2 ho		CTB4	Left	Straight
ollow US-29/US-74 West and then take right onto Redbud Dr/S	MAJOR DELAYS		Weekend	<0.5				
ts must take Exit 26 (NC-7 West). Follow NC-7 South and take								
West and then take right onto S Main St. Continue to re-acce								
ts must take Exit 30 (I-485). Follow I-485 South to US-29/US								

Decision Matrix Process

Inputs

- Location
- Time of Day
- Day of Week
- # of Lanes Closed
- Duration of Incident
- Queue Threshold

Outputs

- Alternate/detour route
- Turn-by-turn directions
- Message set
- Signal timing plans

MsgSet	SignalID	System	BeginMM	EndMM
CTB	12-0082	SB	10	13
CTB	12-0151	SB	13	17
CTB	12-0157	SB	17	19
CTB	12-0158	SB	19	21
CTB	12-0561	SB	21	22
CTB	12-0562	SB	22	26
CTB	12-0942	SB	26	27
CTB	12-0985	SB	27	29
CTB	12-1105	SB	29	30
CTB	12-112	SB	30	33
CTB	12-13	SB	30	30
CTB	12-1	SB	30	29
CTB	12-1	SB	29	27
CTB	12-1	SB	3	27
CTB	12-1	SB	3	26
CTB	12-1	SB	3	22
CTB	12-1	SB	3	21
CTB	12-1	SB	3	19
CTB	12-1	SB	3	17
CTB	12-1	SB	3	13
CTB	12-1	SB	3	10



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Summary:

- Multiple Stakeholders
- Fluid Process
- Final ICM Decisions



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Response Plan Development & Trailblazer Design

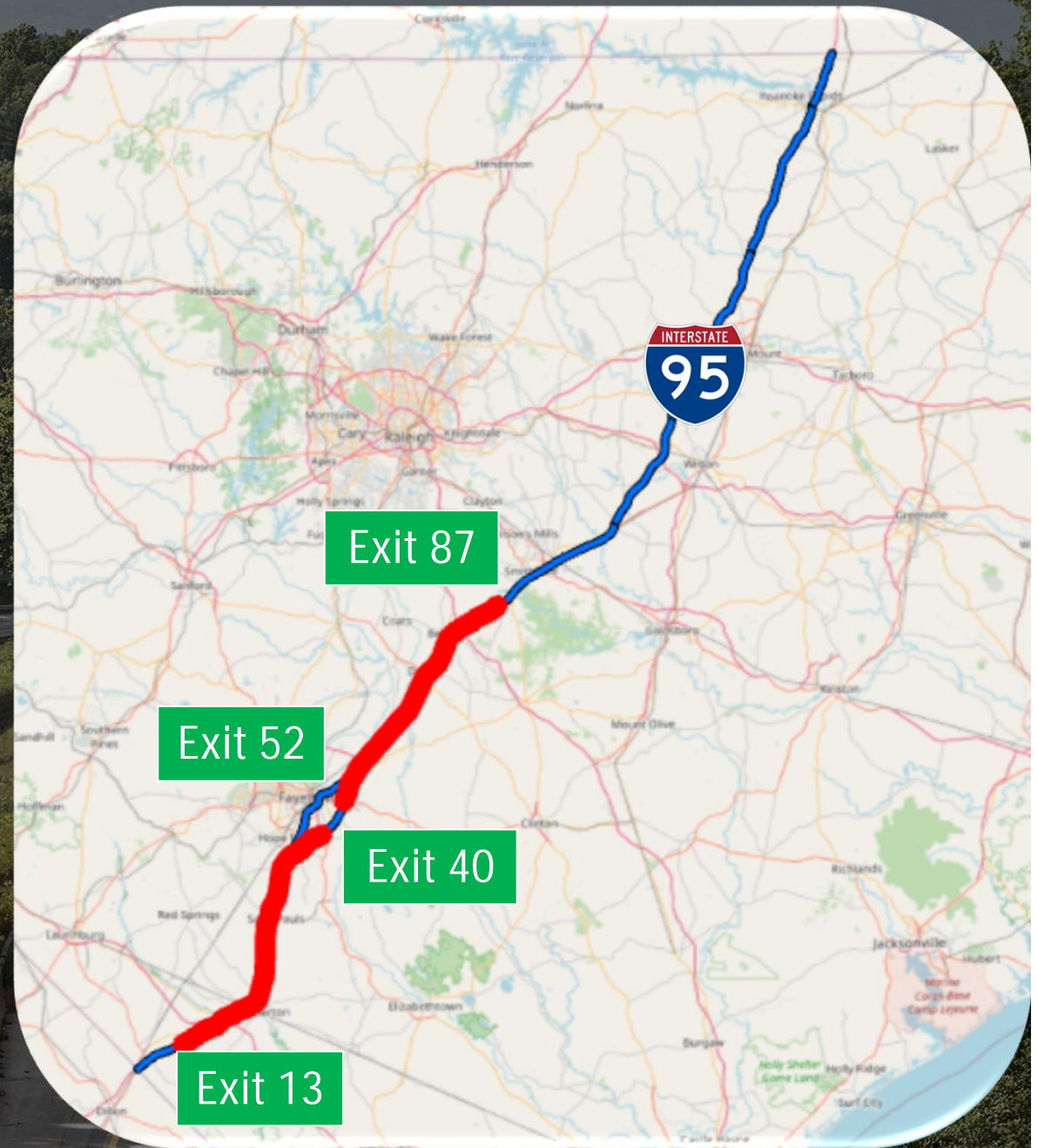
Role in NCDOT's ICM Initiatives

Project Manager:

- Two ICM Projects over four TIP Projects
- Mostly rural ICM

Project Responsibilities:

- Stakeholder coordination
- **Route and Response Plan Development**
- **Trailblazer Design and Implementation Support**
- Tow Contract Support
- Maintenance Planning



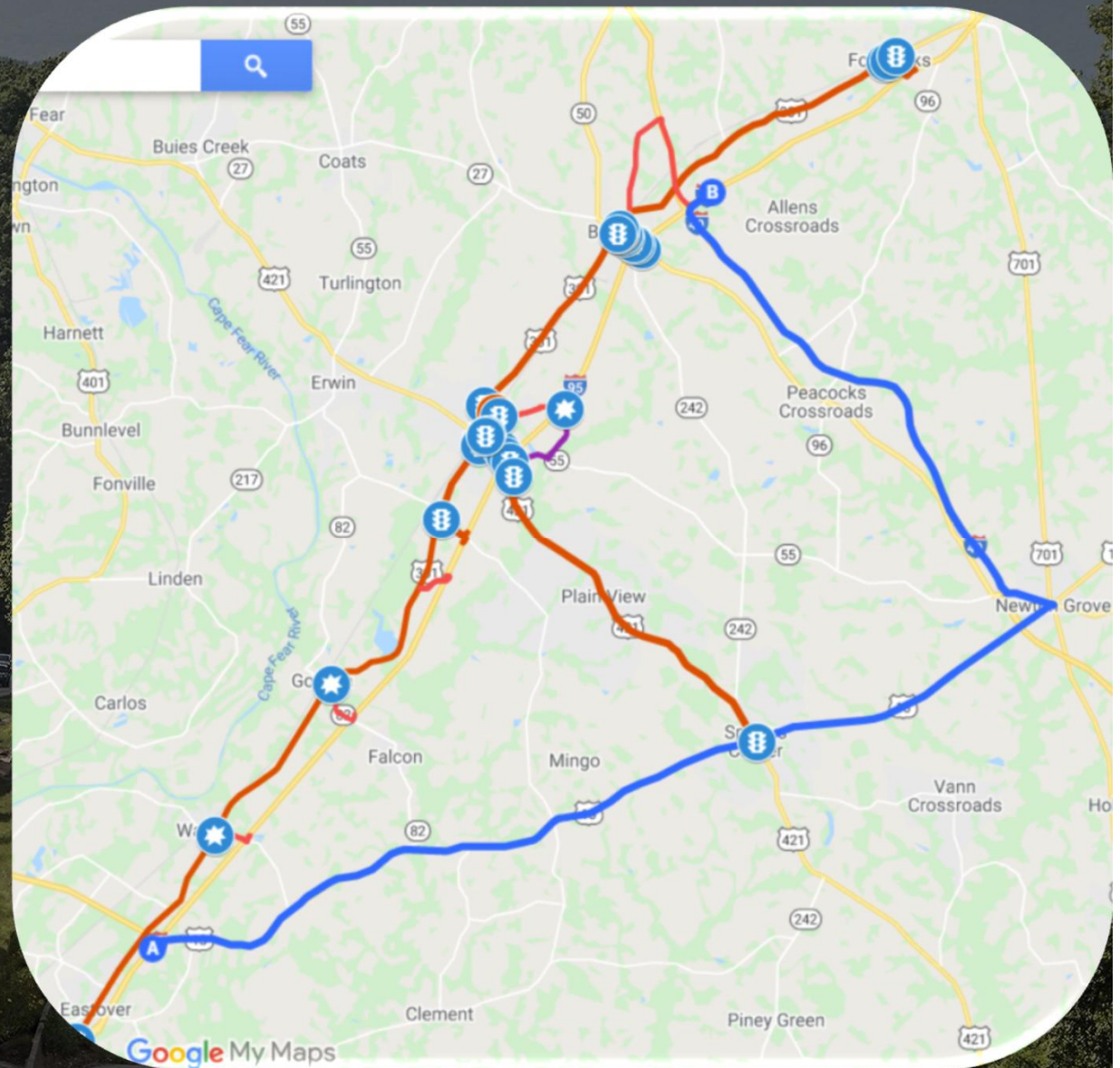
Route and Response Plan Development

Route Development:

- Coordination with STOC Team and Division Staff
- Consider geometry, signals, four-way stops, schools, rail crossings, points of confusion, etc.
- Ride-thru
- Response plan evaluation

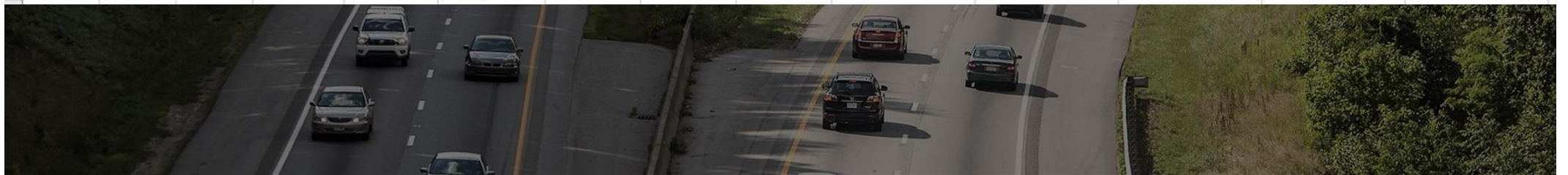
Response Plan Development

- Inputs/Triggers
- Decision Matrix Evaluation



Route and Response Plan Development

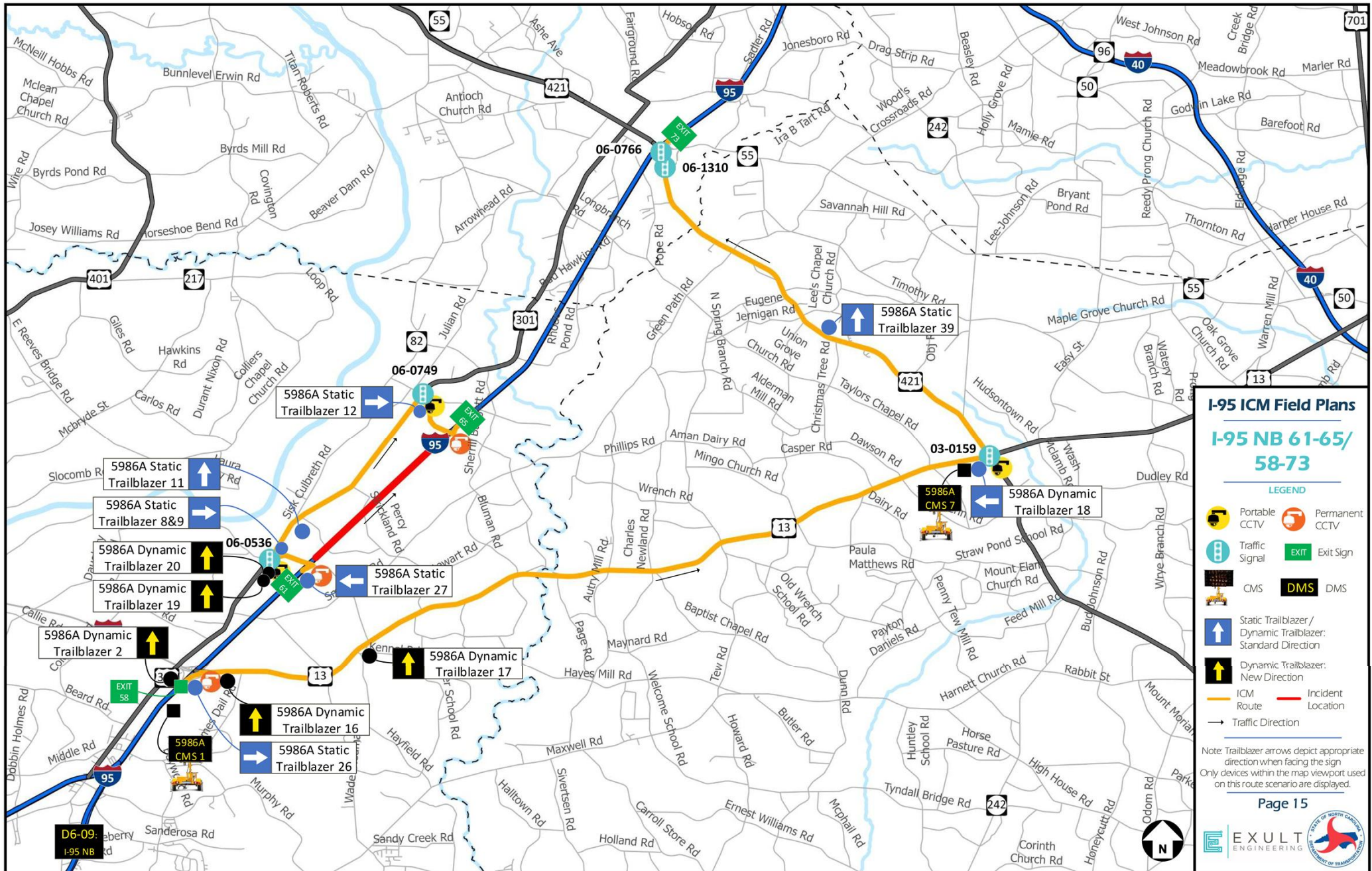
ICM Route		I-95		Diverted Traffic Signal Timing Design Volumes		ICM Route Section		COMPLETE HIGHLIGHTED C					
Direction		Northbound		Moderate	Heavy	Begin MM	End MM						
# of thru Lanes		2				61	65						
Freeway AADT													
% Trucks		14%											
AM Peak		06:00 AM	09:00 AM			Sign Scenarios		Signal Timing Action S					
Lanes Closed	Lanes Open	Day of Week	Expected Duration	Queue Threshold Met?	ICM Route Volumes (vph)	TOD Cycle Length	Moderate Cycle Length	Heavy Cycle Length	Alternate/ Detour Route	"Open" Sign Scenario	"Closed" Sign Scenario	Moderate Signal Timing Action Set	Heavy Signal Timing Action Set
1	1	Weekday	0.5-2 hours	Yes	1,244	0	120	240	I-95N61-65	I-95N61-65Alt		I-95N61-65Mod	
			>2 hours	Yes	1,244	0	120	240	I-95N61-65	I-95N61-65Alt		I-95N61-65Mod	
		Weekend	0.5-2 hours	Yes	1,358	0	120	240	I-95N61-65	I-95N61-65Alt		I-95N61-65Mod	
			>2 hours	Yes	1,358	0	120	240	I-95N61-65	I-95N61-65Alt		I-95N61-65Mod	
2	0	Weekday	0.5-2 hours	No	1,244	0	120	240	I-95N61-65		I-95N61-65Clos		I-95N61-65Heav
				Yes	1,244	0	120	240	I-95N61-65		I-95N61-65Clos		I-95N61-65Heav
			>2 hours	No	1,244	0	120	240	I-95N61-65		I-95N61-65Clos		I-95N61-65Heav
				Yes	1,244	0	120	240	I-95N58-73		I-95N61-65Clos		I-95N61-65Heav
		Weekend	0.5-2 hours	No	1,358	0	120	240	I-95N61-65		I-95N61-65Clos		I-95N61-65Heav
				Yes	1,358	0	120	240	I-95N61-65		I-95N61-65Clos		I-95N61-65Heav
			>2 hours	No	1,358	0	120	240	I-95N58-73		I-95N58-73Clos	I-95N58-73Mod	
				Yes	1,358	0	120	240	I-95N61-65		I-95N61-65Clos		I-95N61-65Heav



Route and Response Plan Development



Route and Response Plan Development



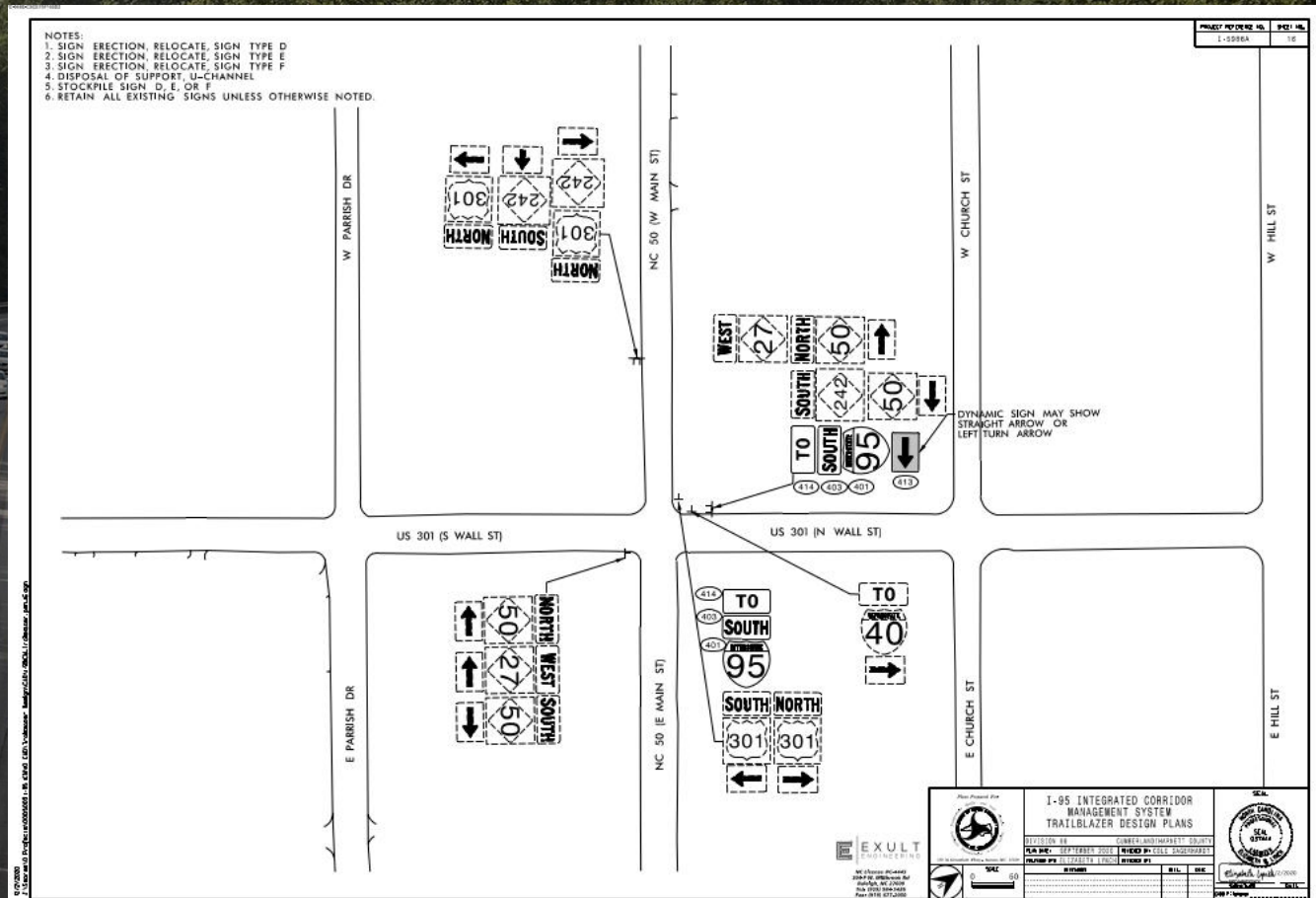
Trailblazer Design and Implementation Support

Trailblazer Design

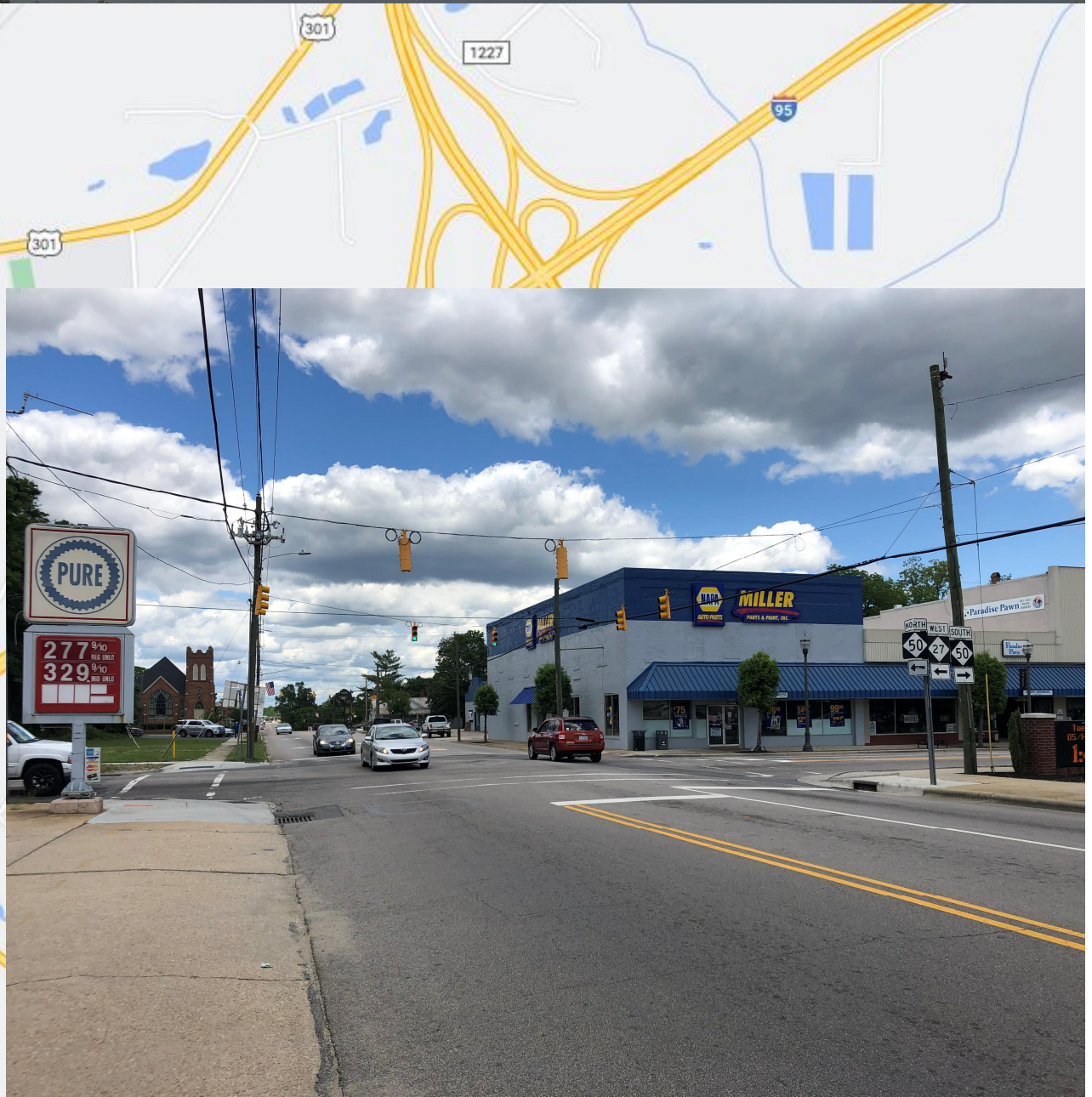
- Dynamic Trailblazers
- Static Trailblazers
- Coordination with Sign Vendors

Implementation Support

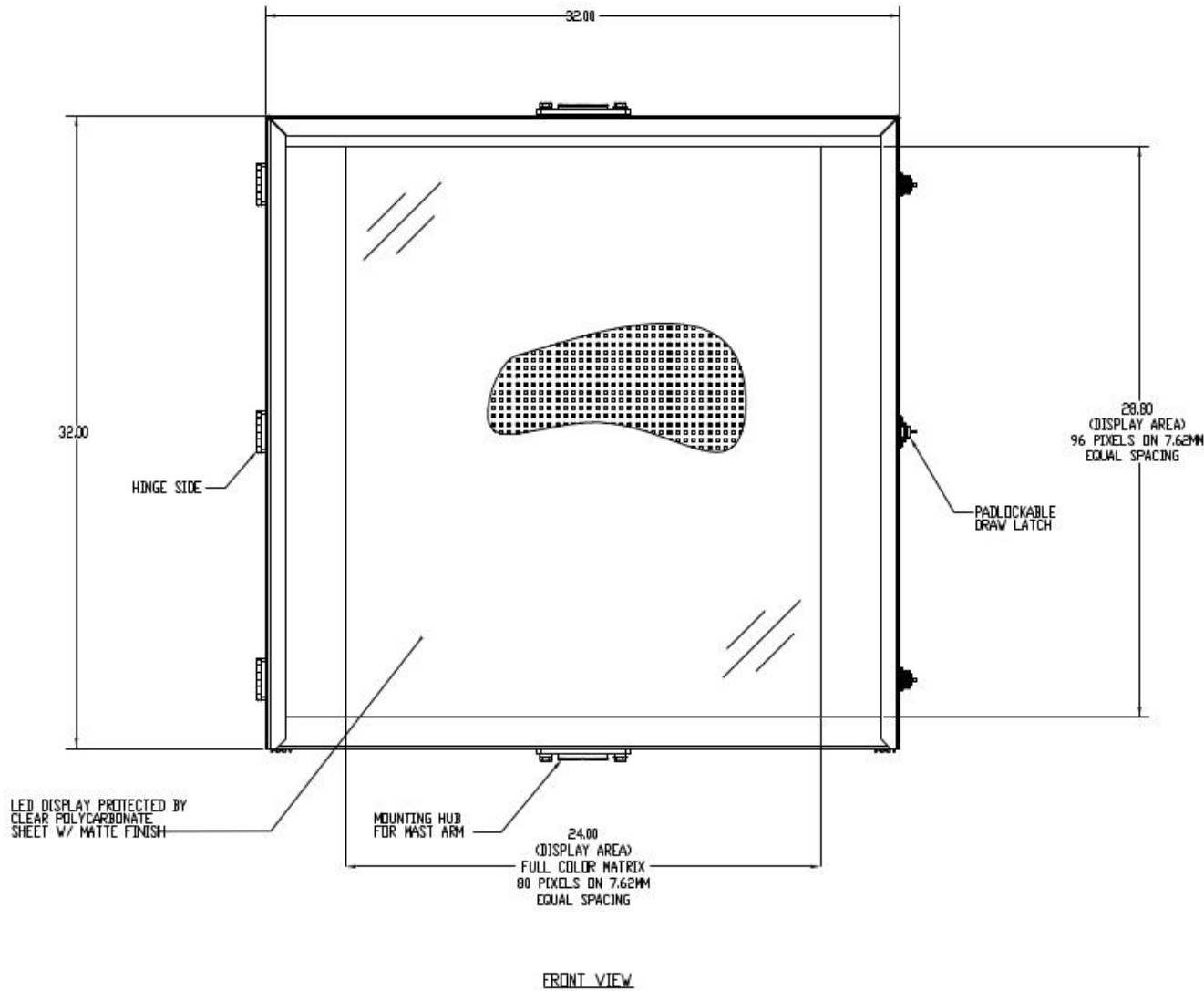
- Division Procurement
- Division Implementation



Biggest Challenges/Lessons Learned



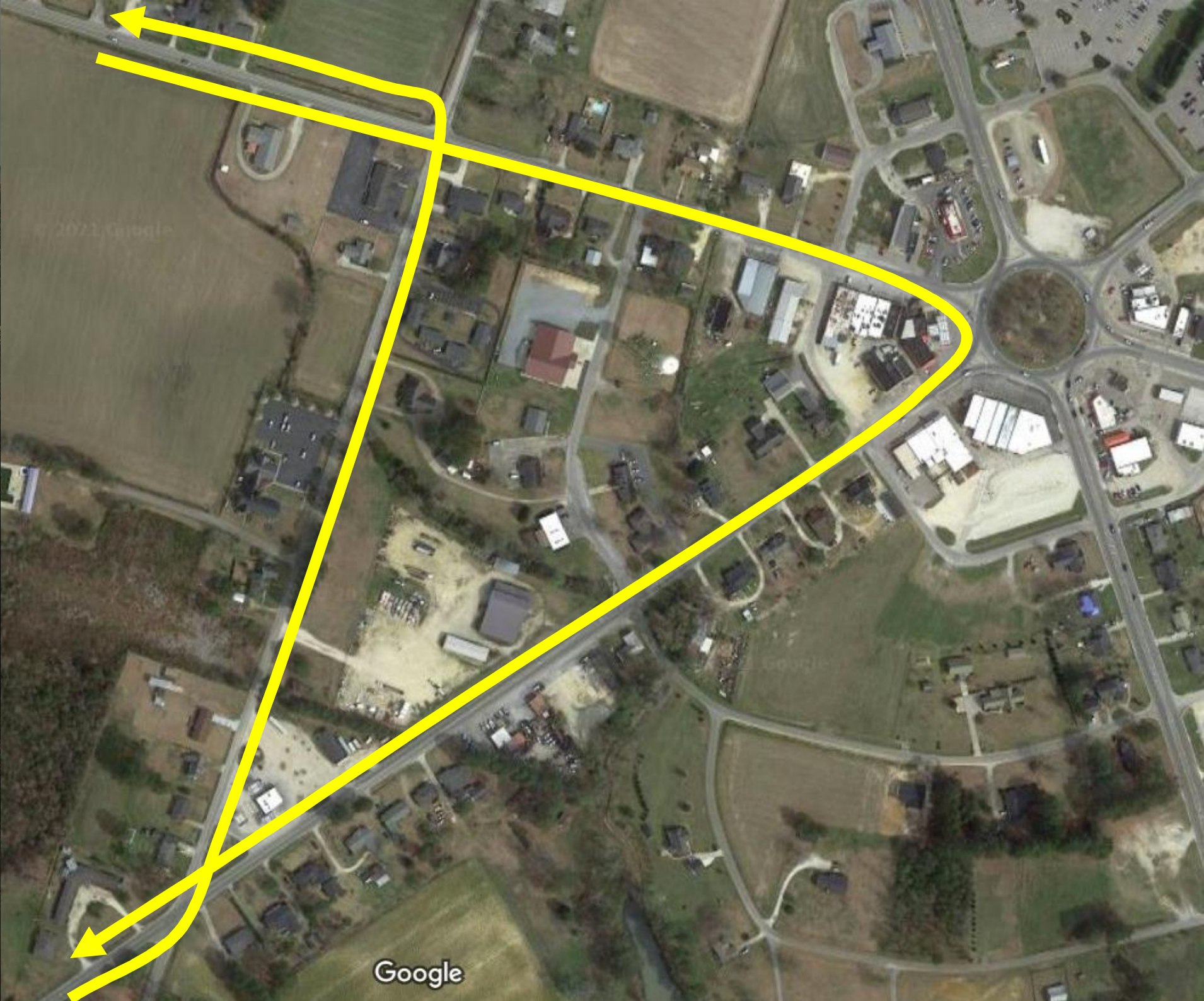
Biggest Challenges/Lessons Learned





Google





Google

Most Memorable Aspects of ICM

An aerial photograph of a multi-lane highway winding through a lush, green forested area. The road is filled with various vehicles, including cars and a large white truck. The surrounding landscape is hilly and densely wooded, with a clear sky in the background.

It's All About People – Decision Matrix Review Meetings

- STOC Team
- Division
- Operations Leadership
- D-B Team

Real Impacts

- Congestion reduction
- Safety enhancement

Signal Timing Data Collection

Signal Timing Project

ICM

Goals

Varies

Throughput

Plan Verification

Same

Same



Signal Timing Volumes

Signal Timing Project

ICM

Types of Traffic

Regular network traffic

Regular and Detour traffic

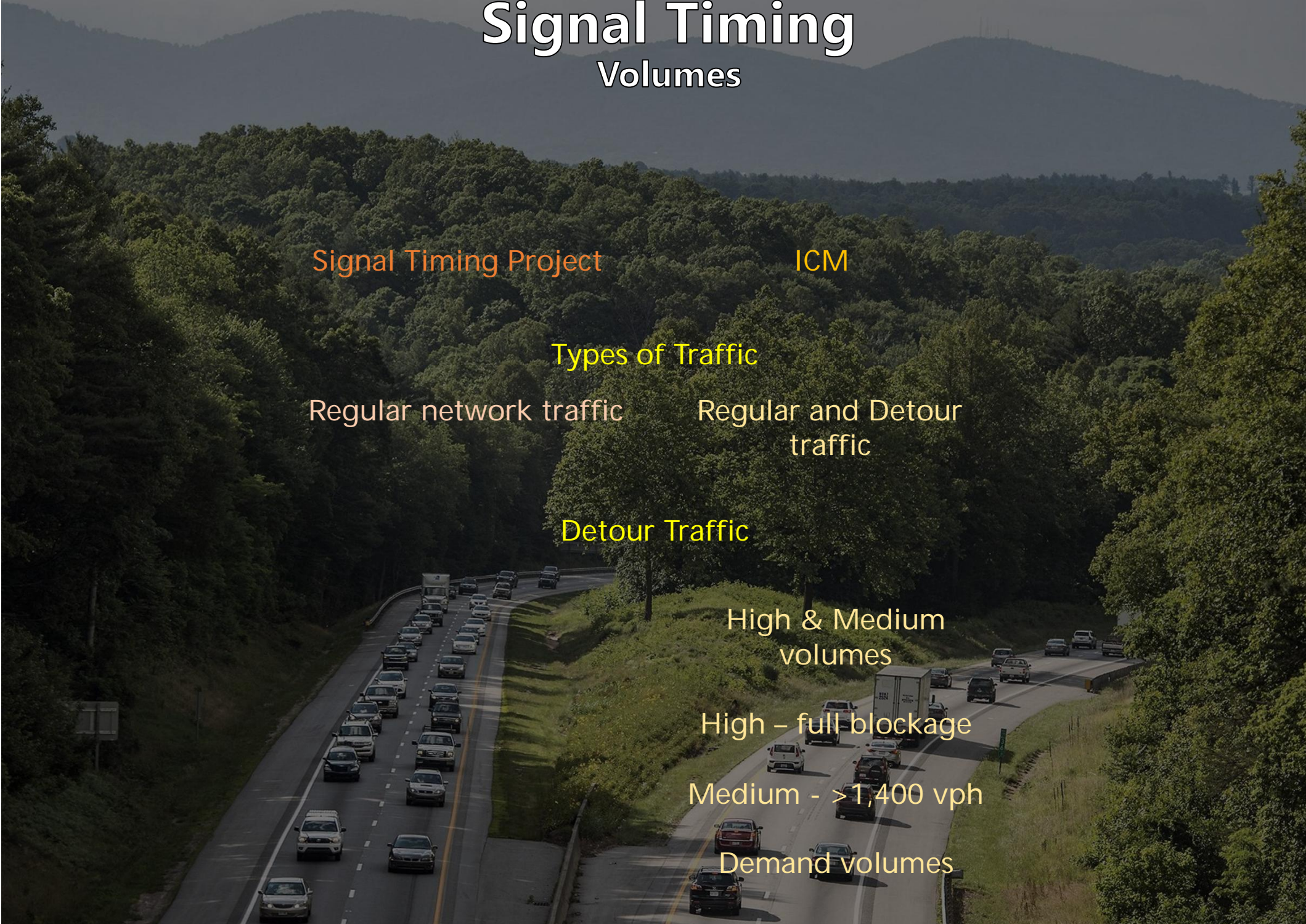
Detour Traffic

High & Medium volumes

High - full blockage

Medium - >1,400 vph

Demand volumes



Signal Timing Volumes

Signal Timing Project

ICM

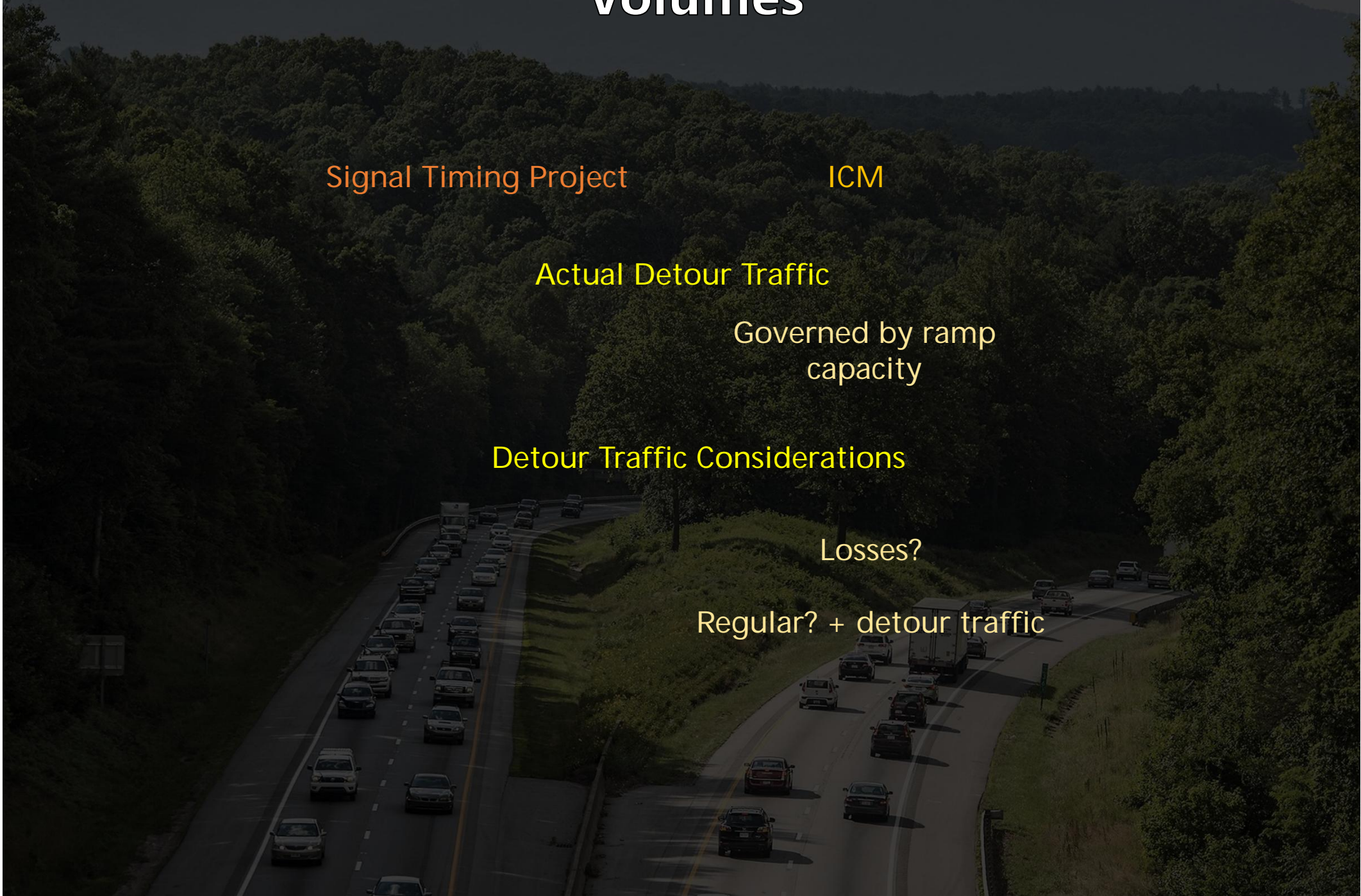
Actual Detour Traffic

Governed by ramp
capacity

Detour Traffic Considerations

Losses?

Regular? + detour traffic



Signal Timing Modeling

Signal Timing Project

ICM

Existing Model

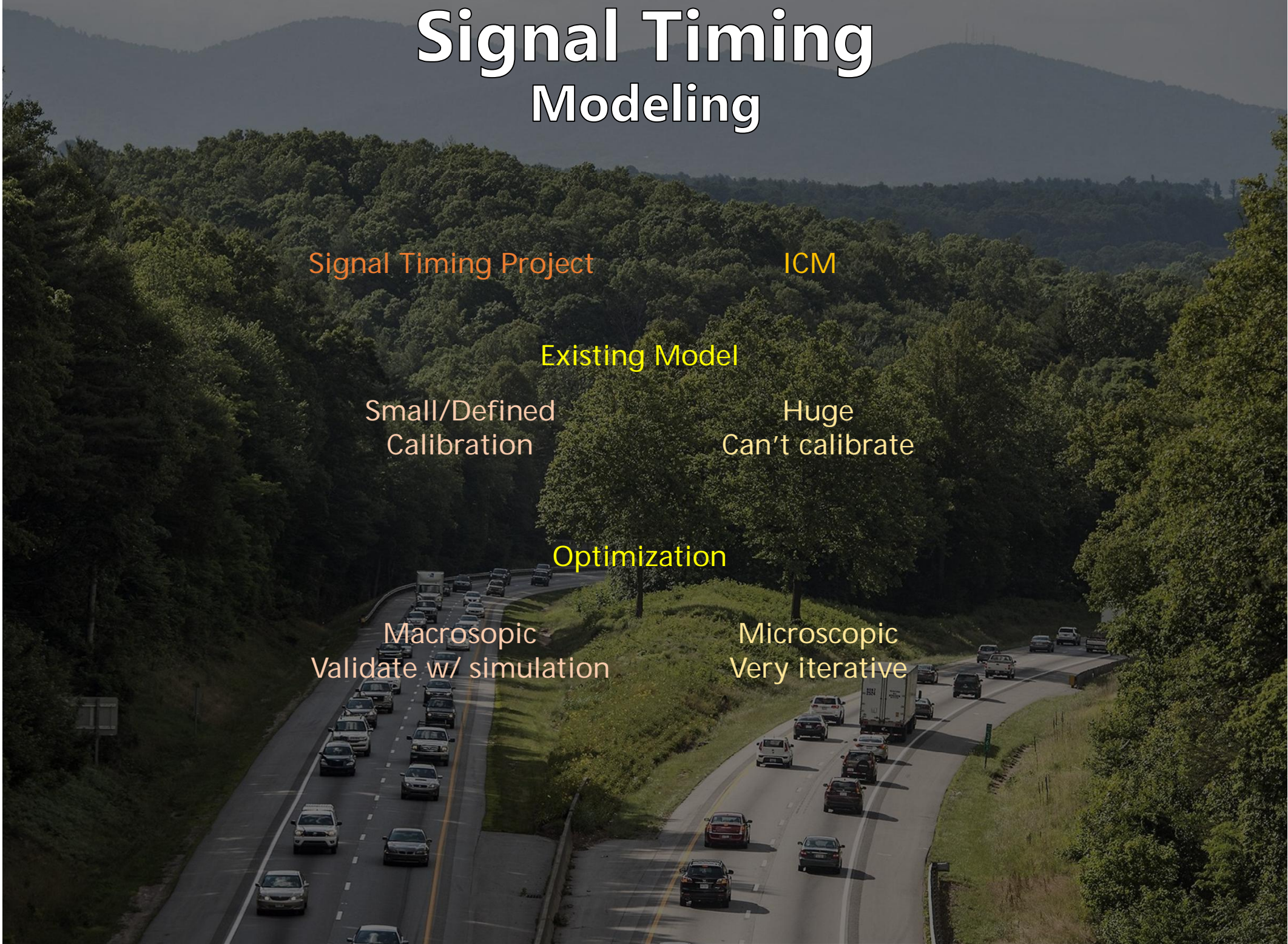
Small/Defined
Calibration

Huge
Can't calibrate

Optimization

Macroscopic
Validate w/ simulation

Microscopic
Very iterative



Signal Timing

Timing Entry Prep

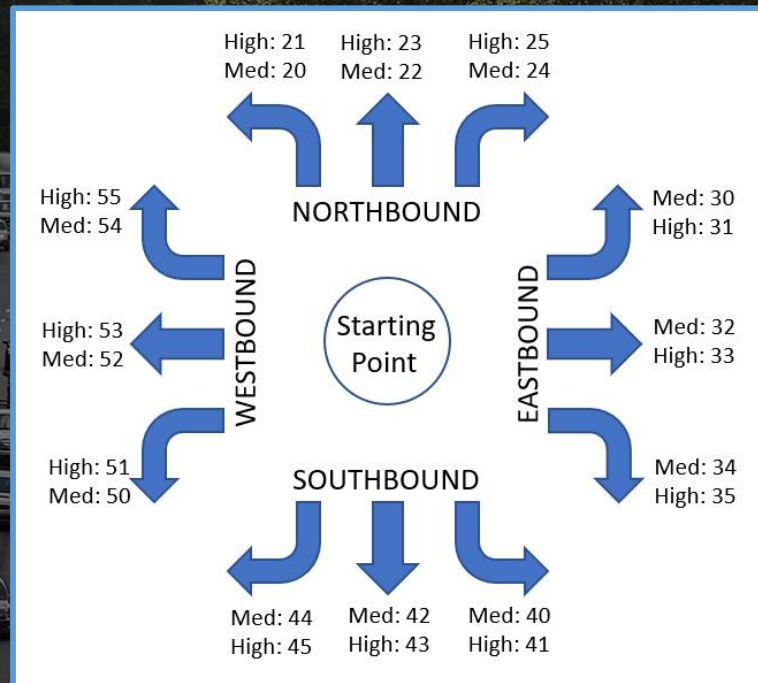
Signal Timing Project

ICM

Easy-peasy
Plan 1 thru 10

End user in mind

Indicate direction &
level



Signal Timing Implementation/Fine-Tuning

Signal Timing Project

ICM

Implementation

Street corner

"Office"

Fine-tuning

Observe - Adjust

After-Action Reviews

Questions or Crickets?





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Integrated Corridor Management

TMC Control Room Perspective

TMC is where “the rubber meets the road”

TMC Operators...

- Gather the details that go into the ICM Database
- Activate ICM scenarios for DMS/CMS and Traffic Signals
- Coordinate with DOT, IMAP, and other field responders
- Capture response times to help manage Tow Contracts



**...and many
other
response
tasks!**

Primary Benefit = Faster Response Time

(from TMC perspective)

Example: Activating multiple signs with specific detour info

I-26 EAST TRAFFIC
ROAD CLOSED
NEAR EXIT 33

Panel 1

DETOUR
USE EX 47 NC 191 S
TO I-26 EAST

Panel 2

Plan detour & get approved

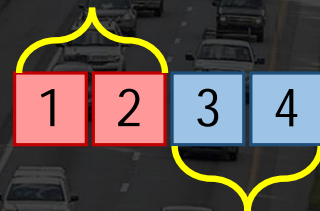
Manually activate each sign

Manual
(No ICM)



Query ICM DB

Automated
(w/ ICM)



Run ICM Sign Plan

~4 minutes
vs. ~20?
WOW!

TMC Challenges with ICM

Training

- Lots of people to train
- ICM is new – processes are still evolving



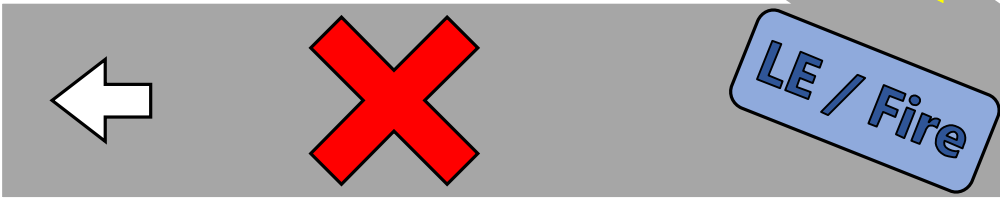
STOC = 24 employees
Each TMC = 7+ employees

TMC Challenges with ICM

Field Response \neq ICM Plan
sometimes

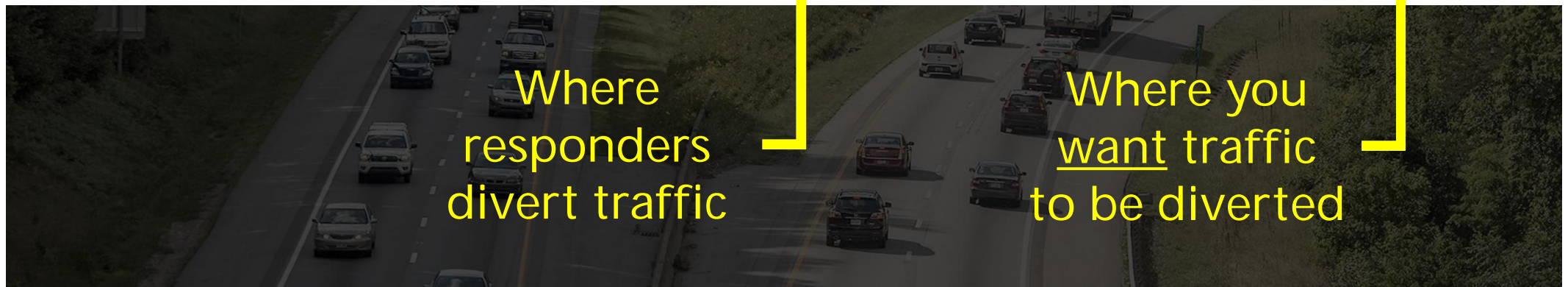
← **Not so good detour**

← **Good, ICM detour**



Where responders divert traffic

Where you want traffic to be diverted





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Summary

- TMCs make ICM happen
- ICM is working
- ICM is still evolving & getting better

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