I-40 Regional Partnership
11th Annual Meeting

Thursday, Oct. 17, 2019
Hosted by SAS

Coordinated by the Regional Transportation Alliance business coalition in cooperation with the NC Department of Transportation and area partners

Welcome and Introductions

Joe Milazzo II, RTA

Acknowledgements

Geoff Lang, RTA 2019 chair

I-40 Partnership Overview

Meredith McDiarmid
I-40 Regional Partnership Executive
NCDOT

AGENDA

- Active projects - I-40, I-440, I-885
- Upcoming and future projects - I-40, US 70, US 1, I-540
- Innovations and solutions - managed lanes, shoulder use
- Research and learning - safety analysis and freeway modeling

ACTIVE PROJECTS
I-40 and parallel / reliever routes

I-40 active project updates

Boyd Tharrington, NCDOT Div. 5

I-40 Regional Partnership

I-40 Project Updates
Parallel Reliever Route Updates

E. Boyd Tharrington, PE

NCDOT Division 5

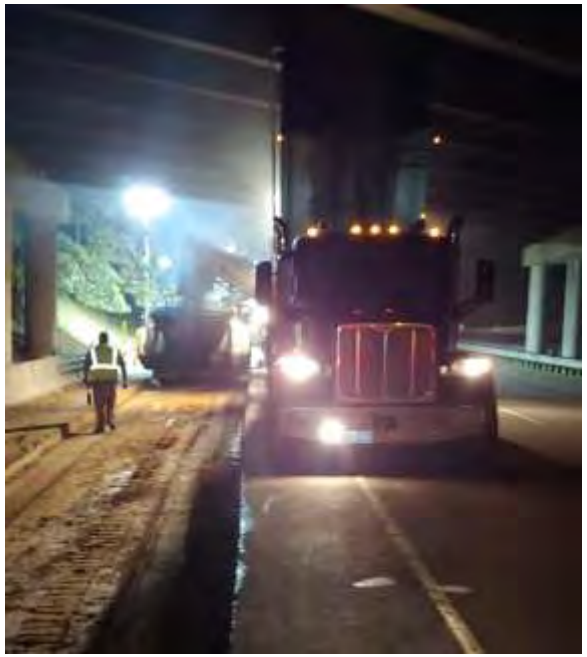
Agenda

- I-40 Widening to Johnston Co
- I-40 Beautify Fortify
- I-440 Widening and Improvements
- I-885 East End Connector
- I-40/NC54 Cary-Raleigh Interchange Improvements
- I-40/Aviation Parkway Interchange Improvements

I-40 to Johnston County
I-5111/I-4739

Project Overview

- Project Limits: I-40/I-440/I-87 Split to Cornwallis Rd in Johnston Co
- Contract Bid Amount: $360,175,000
- Contractor/Designer- S.T. Wooten Corp. with RK&K
- Project Awarded: July 2018
- Completion: June 2022
- All Lanes on I-40 by December 2021 (I-440 to US 70 Bypass)



Project Overview - Continued

- Modify Interchange at I-440
- Replace Bridges at Rock Quarry Rd, US 70 Business, East Garner, White Oak, Swift Creek, NC 42 and Cleveland Rd
- Add two additional lanes in both directions of I-40
- New interchange with Cleveland Rd
- Modify interchange with NC 42
- Collector distributor with NC 42/Cleveland
- Drainage- Rehabilitate or supplement cross lines
- I-87 Signing
- Structures accommodate future managed lane

Construction Status

- I-440 to US 70 Bus-Constructing Widening in Median
  - Median Barrier to Begin Soon
  - Paving Up to Intermediate Course Complete
  - Drainage Complete
  - Working I-440 Ramps and Interior Bents for Flyover
- US 70 Business to Cornwallis Rd-Constructing Outside Widening
  - US 70 Business WB On-Ramp Construction
  - WB On-Ramp Spur
  - US 70 Bus to US 70 Bypass
    - Setting Barrier
    - Clearing and Drainage
- NC 42/Cleveland Rd
  - RW and Utilities
  - Bridge Construction
  - Widening to begin in Spring

Moving Forward

- Complete Median Barrier and Shift Traffic to Outside – I-440 to US 70 Business
  - Early 2020
- Complete Outside Widening US 70 Bus to US 70 Bypass
  - Late Summer/Fall 2020
  - Shift Traffic to Outside
- Continue Bridge Construction Throughout
- Begin Work on NC 42/Cleveland
- Begin Swift Creek Bridges

I-40/I-440/I-87 Interchange

- Construction of new flyover bridge
- Asphalt plant moved to East Garner Rd
- Traffic on EB I-40 Shifted to Outside

I-40/I-440/I-87 Interchange

- Construction of Interior Bents of New Flyover Bridge at I-440

Rock Quarry Rd Overpass

- Rock Quarry Rd. Bridge to be Replaced
- Widening of 0.8 Miles of Rock Quarry Rd
- Old Birch Dr to Sunnybrook Rd

Median Access- I-40 to Swift Creek

- Ramp off Existing Bridge at East Garner Rd (West of US 70 Bus)
- East Garner Rd Re-Opens May 2020
- ST Wooten asphalt plant moved to East Garner Rd
- Quarry site
- 21,375 Loads of Material Delivered Directly to Median

Proposed Median Access Swift Creek to Cornwallis Rd.

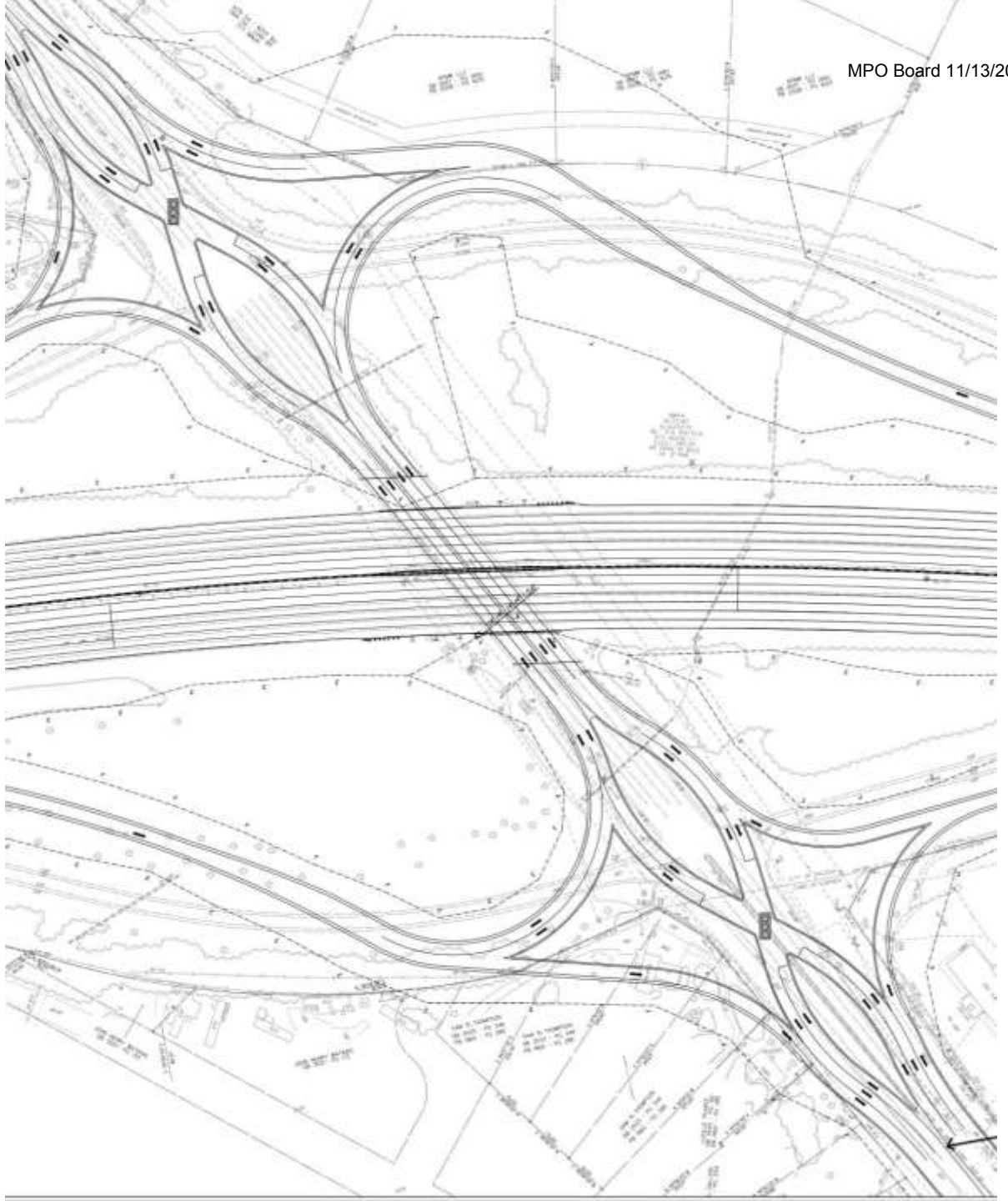
- Near Cleveland Rd interchange
- ST Wooten plant site located off of Cleveland Rd.

Jones Sausage Rd.

- RFP Design Retained Existing Diamond Interchange
- New Amazon Distribution Hub to the West
- Poor LOS

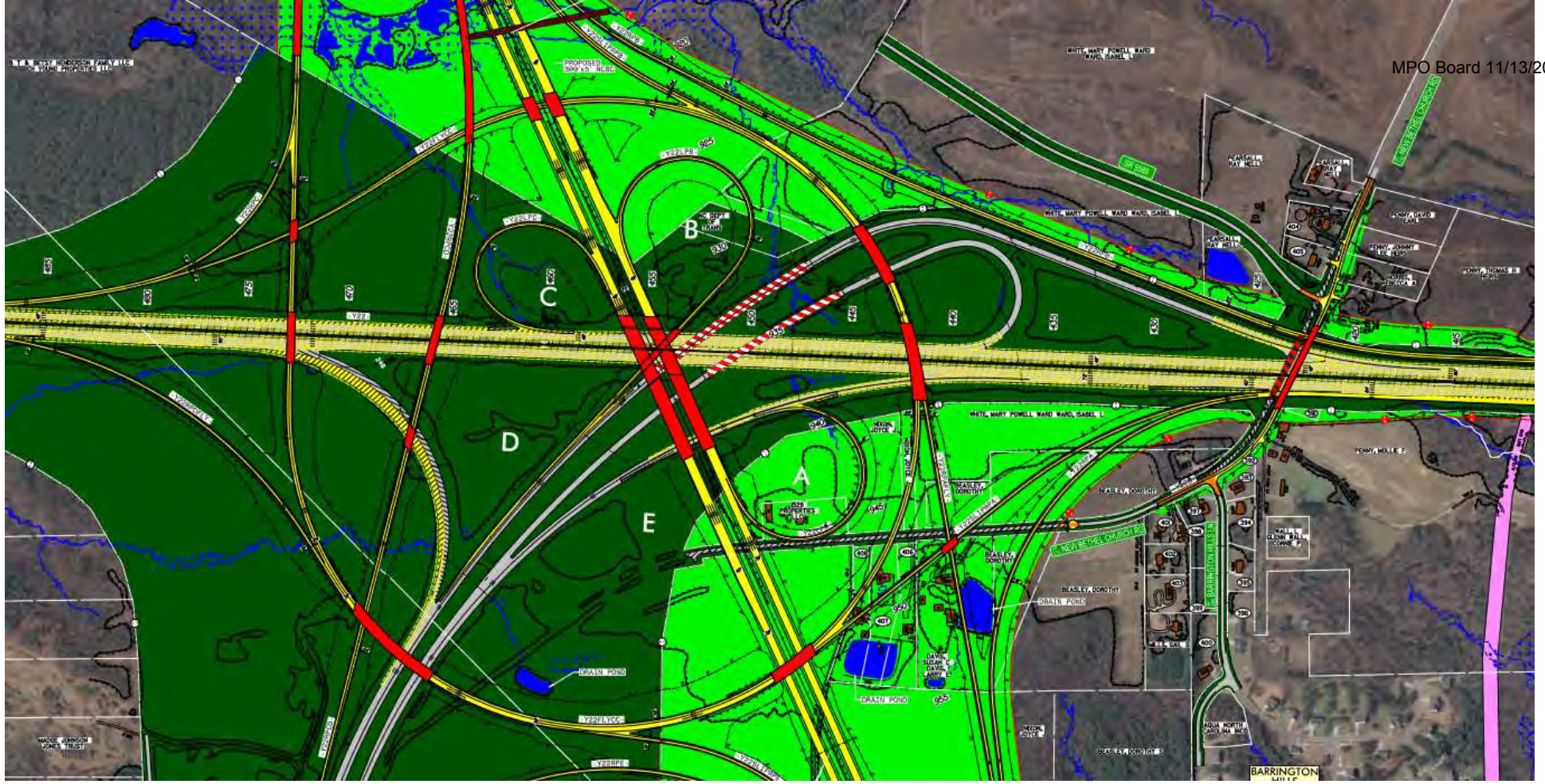
Jones Sausage Rd. Diverging Diamond

- Convert to DDI
- Maintain Existing Structure
- Accommodate current and future traffic
- Coordination with Amazon Improvements on Jones Sausage



NC 42 and Cleveland Rd.

- Continue with R/W and Utility Coordination
- Working at Bridge Sites
- Widening to Begin Spring 2020



Coordination with R-2828 Complete 540

- Multiple bridge bents located in I-40 median
- Coordination with schedule/phasing
- Coordination with permitting and R/W
- Drainage

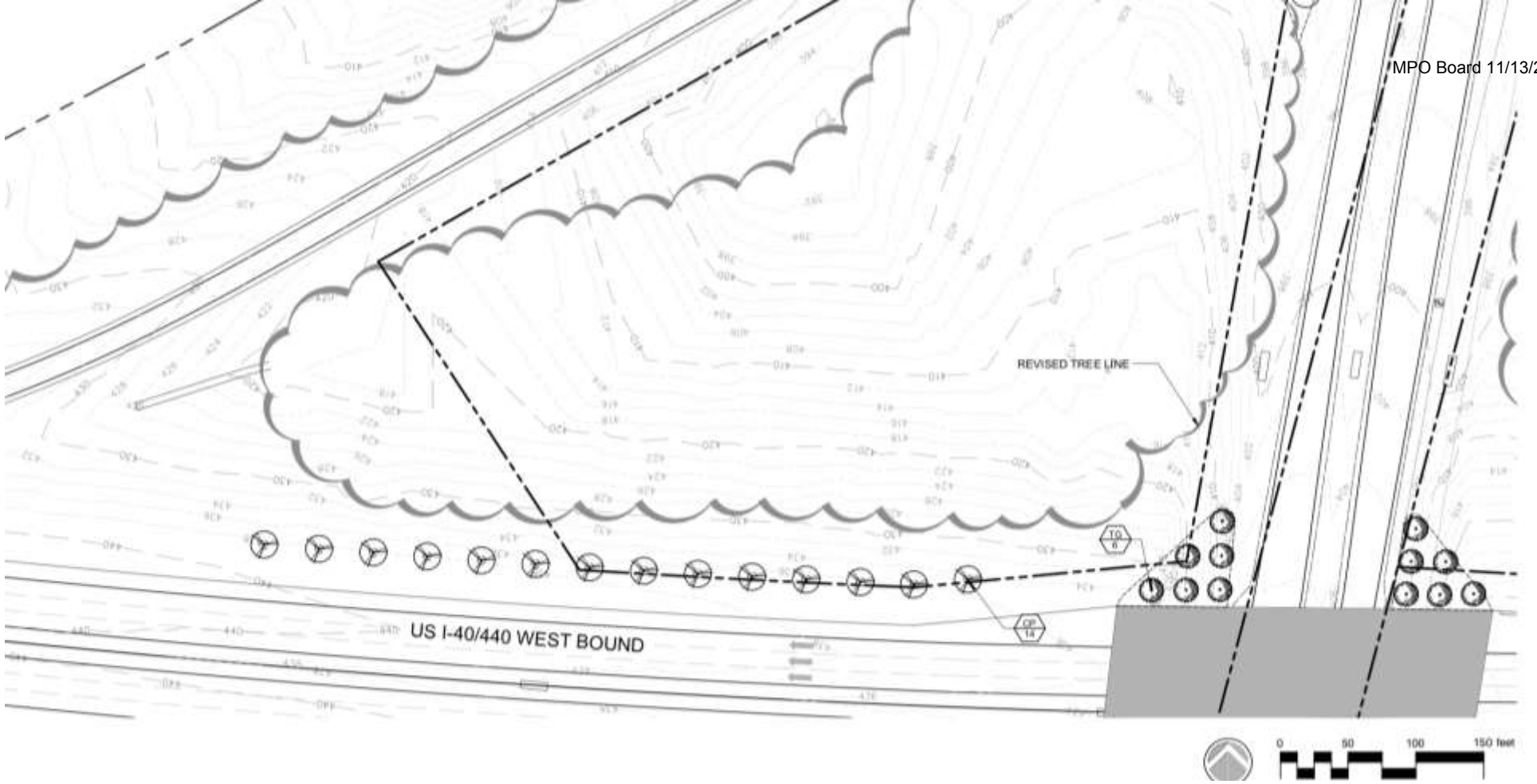
I-40 Beautify Fortify Initiative

Landscape Planning and Design

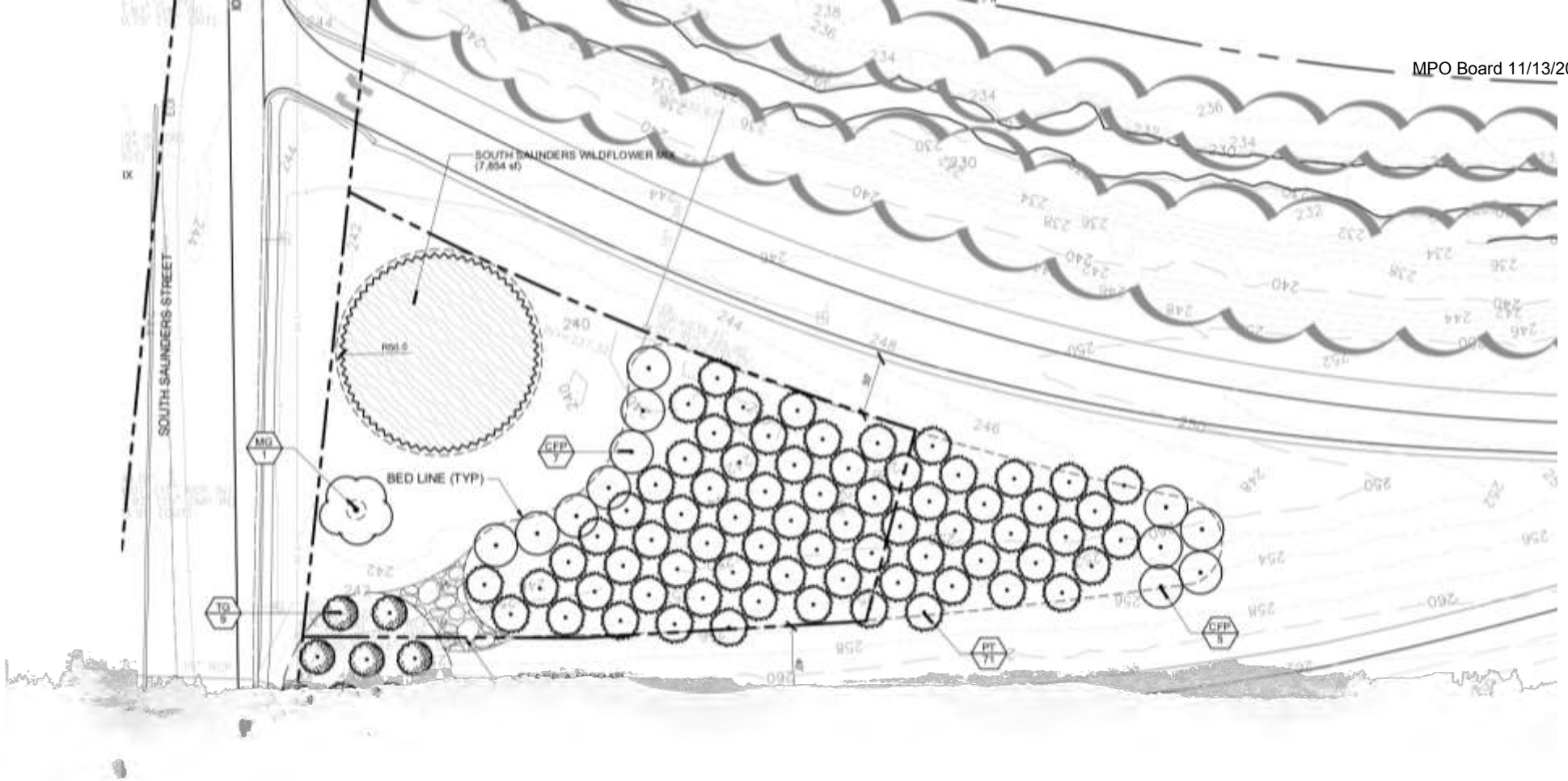
- Funding up to 1% Contract Value Available for Landscape Enhancements(~1.3 MIL)
- Coordination- RTA (Regional Travel Experience Council) and Convention Visitors Bureau with City of Raleigh and NCDOT
- Develop Plans that Maximize Visual Impact at Reasonable Maintenance Cost
- Separate Landscape Contract to Be Awarded This Year
- Begin Work this Planting Season

Landscape Planning and Design- Continued

- Tree Removal to Clear Zone and Removal of Undergrowth at all Wooded Interchanges
- Plant Variety of New Trees to Add Color and Enhance Interchanges
- Unique Designs at Each Interchange
- Incorporates Wildflower Beds
- Incorporate Turf Management of Grass within Quadrants



Landscape Design Elements
Gorman Street

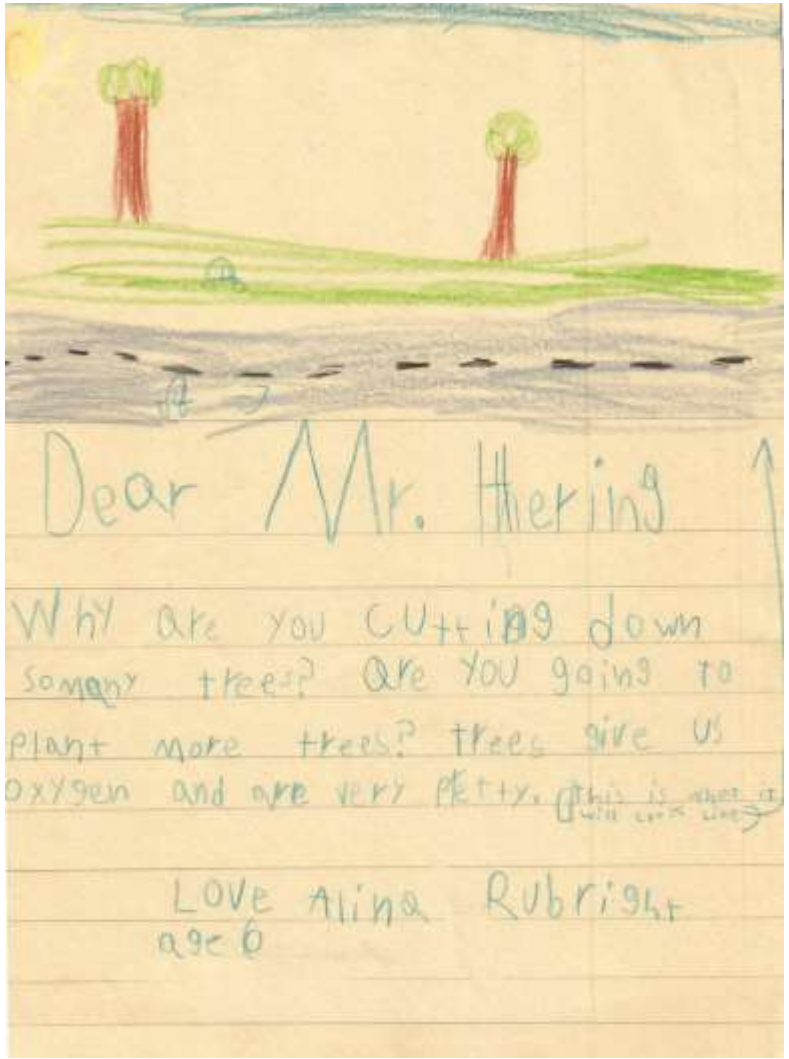


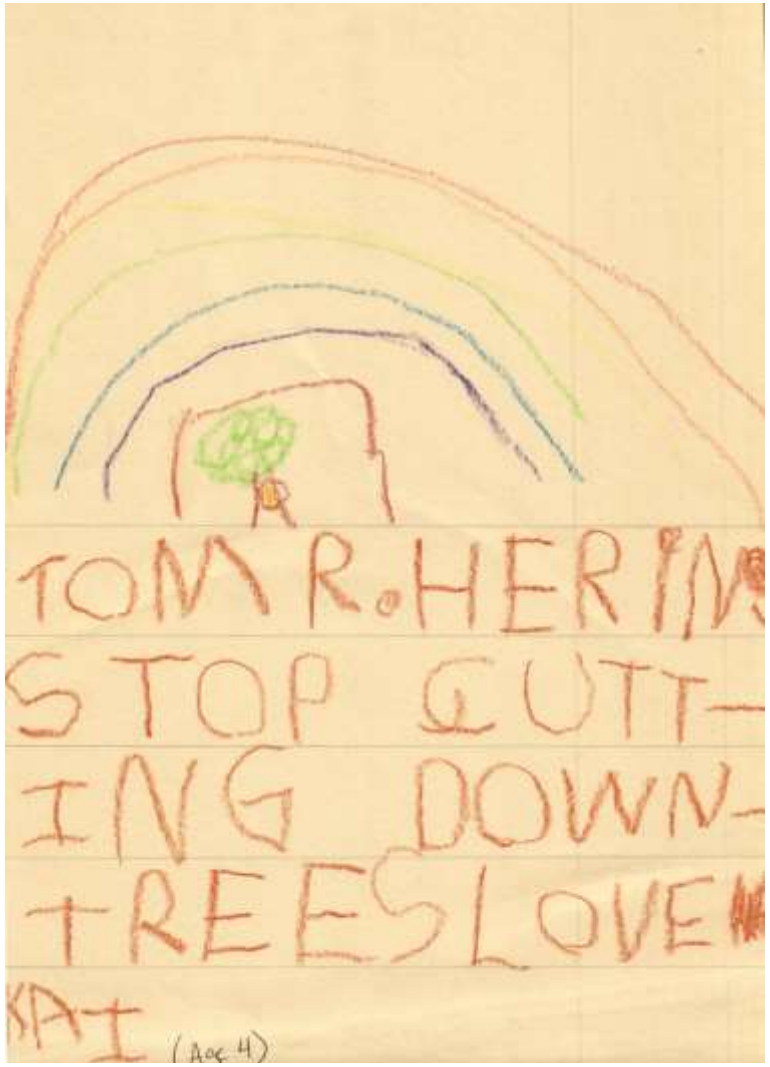
Landscape Design Elements
South Saunders Street

Construction Status

- Removal of Undergrowth and Clear Zone is Underway
- Plantings to be Performed Late Fall/Early Winter
- Begin plantings at Gorman interchange and move east
- Overall completion Spring 2020

Customer Feedback

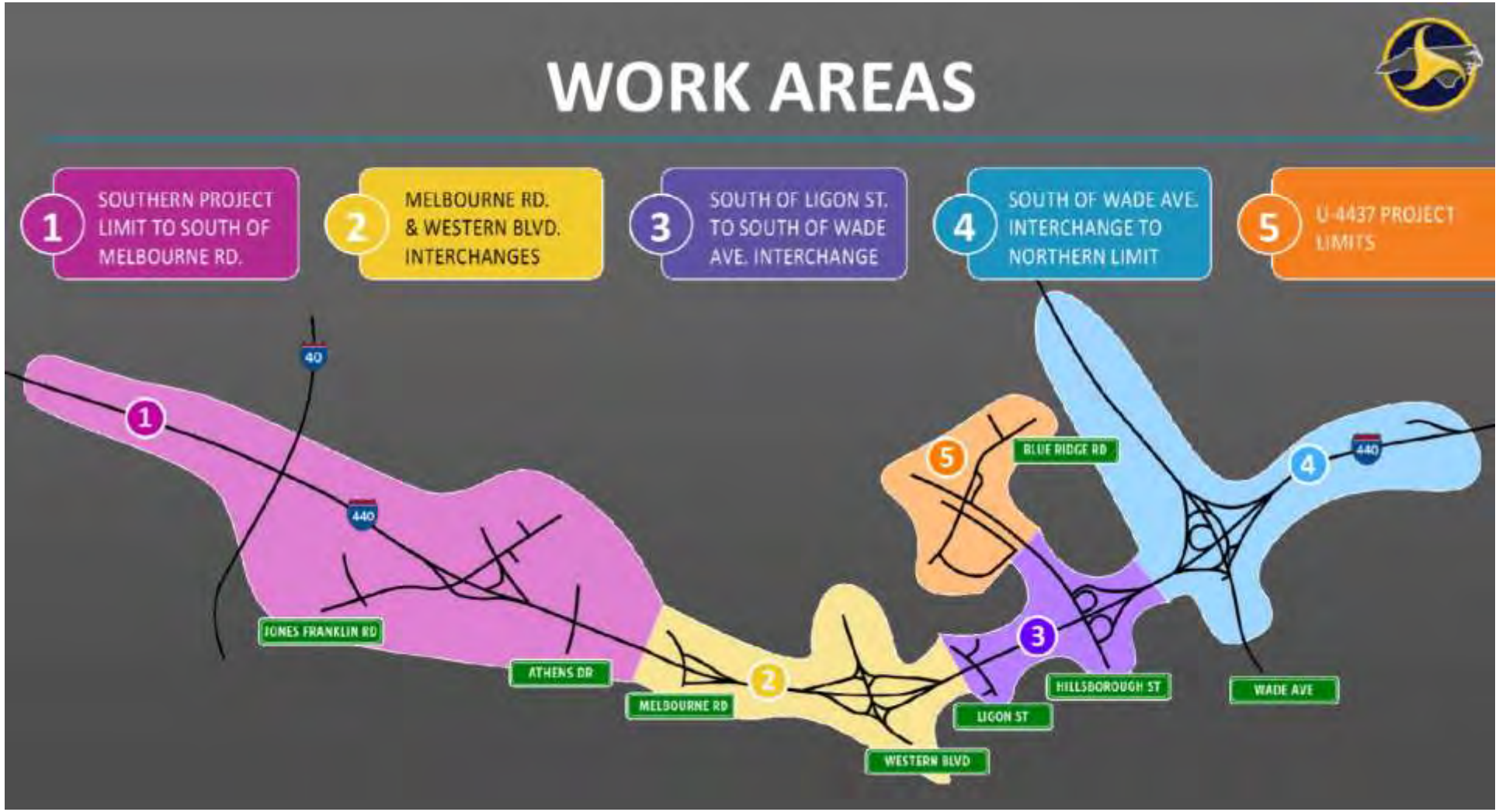




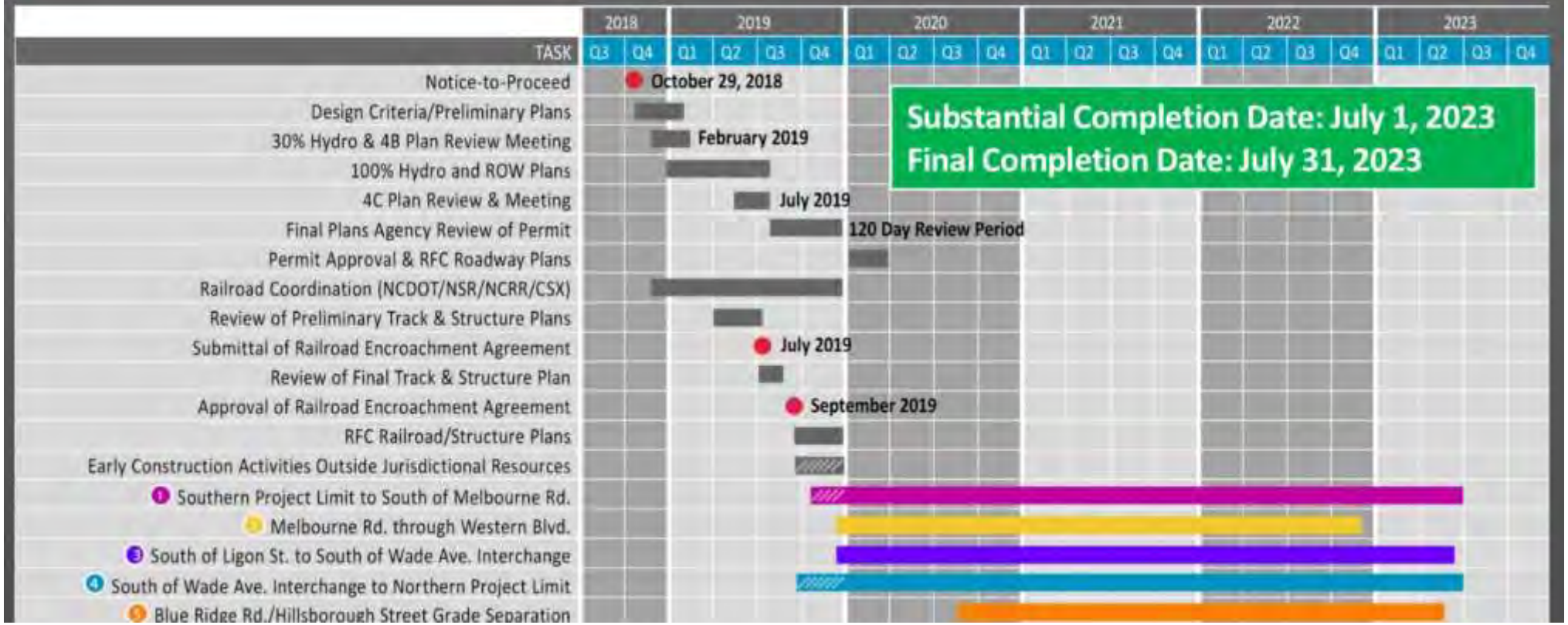
I-440 Widening and Improvements

Project Overview

- Awarded to Lane Construction/HDR Design Build Team in October 2018.
- Work Began in July 2019
- Contract Value of $346 MIL
- Completion Date July 2023
- Add Additional Lane in Each Direction
- Bring up to Current Interstate Standards
- Modify Existing Interchanges


WORK AREAS
1 SOUTHERN PROJECT LIMIT TO SOUTH OF MELBOURNE RD.
2 MELBOURNE RD. & WESTERN BLVD. INTERCHANGES
3 SOUTH OF LIGON ST. TO SOUTH OF WADE AVE. INTERCHANGE
4 SOUTH OF WADE AVE. INTERCHANGE TO NORTHERN LIMIT
5 U-4437 PROJECT LIMITS
40
440
JONES FRANKLIN RD
ATHENS DR
MELBOURNE RD
WESTERN BLVD
LIGON ST
HILLSBOROUGH ST
BLUE RIDGE RD
WADE AVE

SCHEDULE


2018
2019
2020
2021
2022
2023
TASK
Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
Notice-to-Proceed
October 29, 2018
Design Criteria/Preliminary Plans
30% Hydro & 4B Plan Review Meeting
February 2019
100% Hydro and ROW Plans
4C Plan Review & Meeting
July 2019
Final Plans Agency Review of Permit
120 Day Review Period
Permit Approval & RFC Roadway Plans
Railroad Coordination (NCDOT/NSR/NCRR/CSX)
Review of Preliminary Track & Structure Plans
Submittal of Railroad Encroachment Agreement
July 2019
Review of Final Track & Structure Plan
Approval of Railroad Encroachment Agreement
September 2019
RFC Railroad/Structure Plans
Early Construction Activities Outside Jurisdictional Resources
1 Southern Project Limit to South of Melbourne Rd.
2 Melbourne Rd. through Western Blvd.
3 South of Ligon St. to South of Wade Ave. Interchange
4 South of Wade Ave. Interchange to Northern Project Limit
5 Blue Ridge Rd./Hillsborough Street Grade Separation
Substantial Completion Date: July 1, 2023
Final Completion Date: July 31, 2023

Intermediate Contract Times

INTERMEDIATE CONTRACT TIME	DESCRIPTION	SELF-IMPOSED LD
ICT #16	Ligon St. Closure	$2,000/day
ICT #17	Beryl Rd. Closure	$2,000/day

INTERMEDIATE CONTRACT TIME	AVAILABILITY DATE	COMPLETION DATE
ICT #1	December 2, 2021	May 31, 2022
ICT #22	November 1, 2020	August 26, 2021
ICT #23	November 1, 2021	September 27, 2022

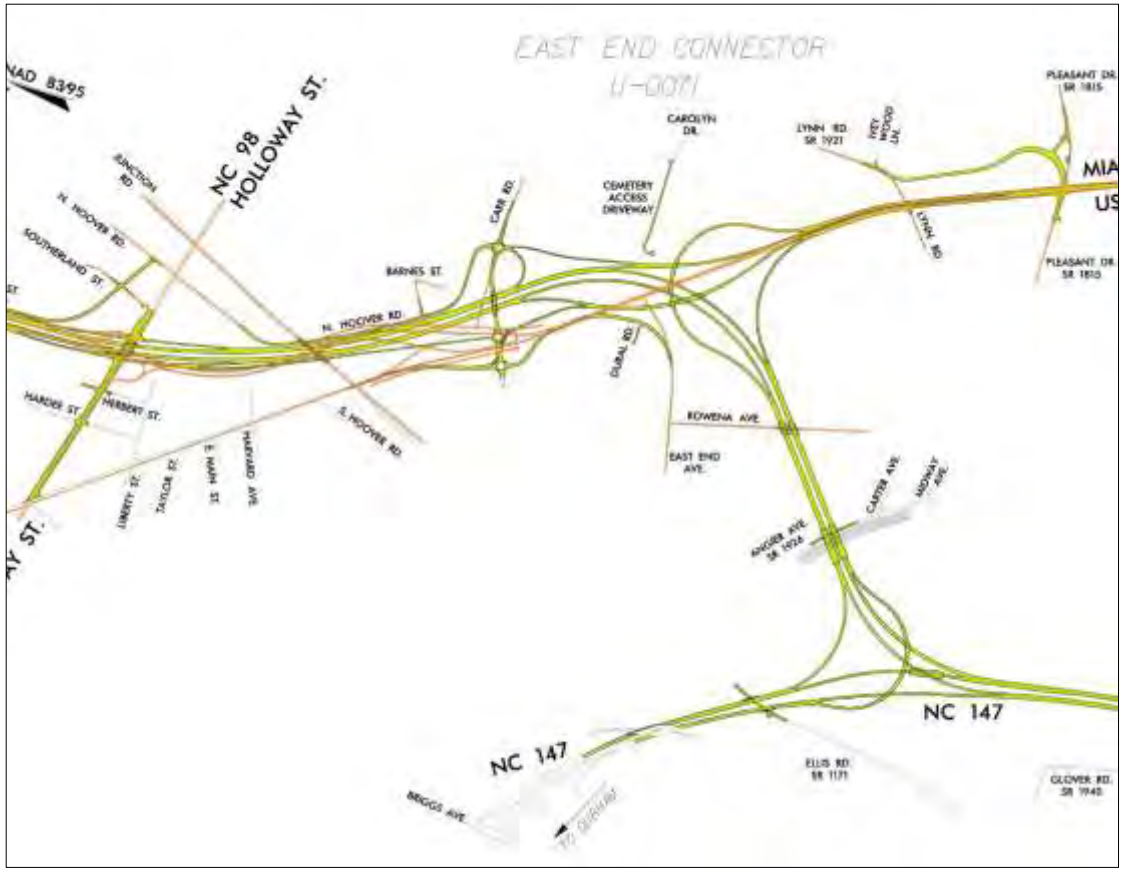
INTERMEDIATE CONTRACT TIME	DESCRIPTION	DURATION
ICT #8	Jones Franklin Rd. Mainline Ramp C	224 hours
ICT #9	Melbourne Rd. Mainline Ramp D	224 hours
ICT #10	Western Blvd. Mainline Ramp C & Ramp D	224 hours (each)
ICT #11	Hillsborough St. Mainline Ramp A	224 hours
ICT #12	Wade Ave. Mainline Loop C	224 hours
ICT #13	Jones Franklin Rd.	56 hours
ICT #14	Athens Dr. Closure (20 days early)	345 days (of 365 allowed)
ICT #15	Melbourne Rd. Closure (14 days early)	351 days (of 365 allowed)
ICT #16	Ligon St. Closure (68 days early)	352 days (of 420 allowed)
ICT #17	Beryl Rd. Closure (33 days early)	512 days (of 545 allowed)
ICT #21	Western Blvd. Interchange Closure	56 hours

Construction Update

- Paving and Barrier for Traffic Shift
- Erosion Control and Clearing Throughout
- Median Work from I-40 to Western Blvd.
  - Drainage and Paving
- Structure Replacement at Melbourne Rd
  - Bridge Demolition Nearly Completed
  - One Year Closure
- Grading Activities at Wade Ave Interchange
  - Temporary Ramp Alignments from Wade Ave
- Utility Coordination

Moving Forward

- Jones Franklin Rd Bridge
  - Begin November
- Western Blvd Drainage Installation
  - Begin in November
- Hillsborough St Bridge
  - Begin work Late 2019
- Wade Ave Flyover and Bridges
  - Begin work Late 2019
- Blue Ridge Grade Separation
  - Begin Work After Fair 2020
  - Utility Relocations Ongoing



I-885 Construction Update East End Connector

- Construction Began March 2015
- Substantial Completion Summer 2020
- Contract Value $141,949,000

Progress

- Holloway St (NC 98)
- Traffic Shifted onto new WB Bridge
- Work to begin on new EB Bridge and Roadway

Progress

- Rail Structures on US 70
- New Rail Bridge Under Construction
- Temporary Rail Bridge in Service

Progress

- Flyover from WB US 70 to I-885

Progress

- I-885 Towards NC 147
- Sound Walls to Begin

Progress

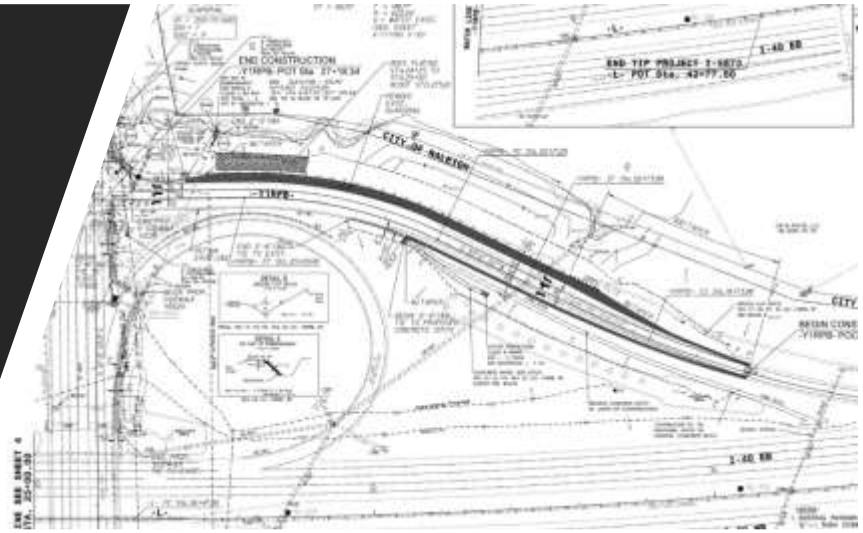
- I-885 to SB NC 147
- Scissor Bridge

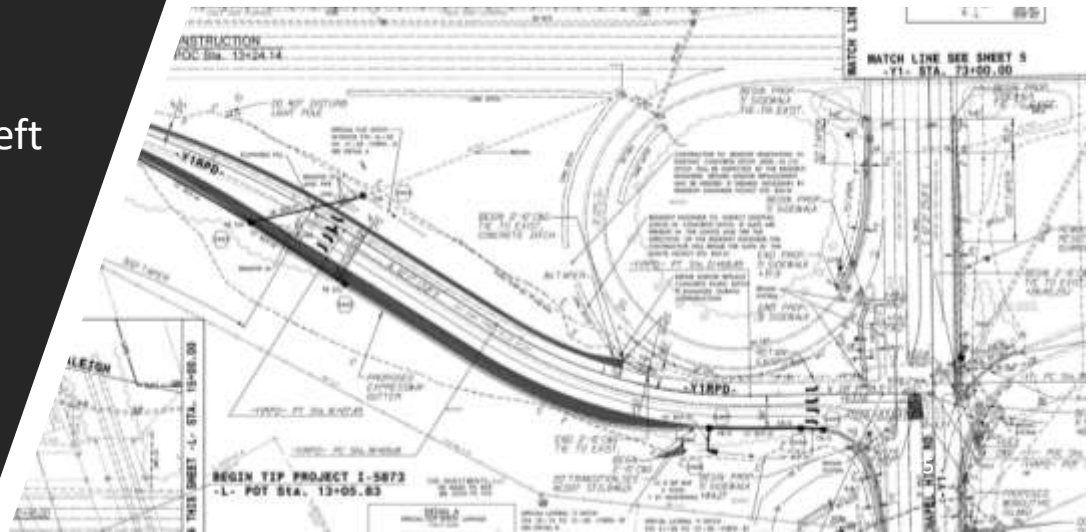
Progress

- NC 147 Looking North to Downtown Durham
- NC 147 Nearing Substantial Completion
- Concrete Repairs and Bridge Rehabilitation Remain

I-40/NC 54 Interchange Improvements
I-5873

- Construction Began Spring 2019
- Substantial Completion October 2019
- Contract Value $2.7 MIL
- Westbound Off-Ramp Includes Dual Left and Right Turn Movements
- Eastbound Off-Ramp Includes Dual Left and Single Right Turn Movements
- Bridge Deck Rehabilitated





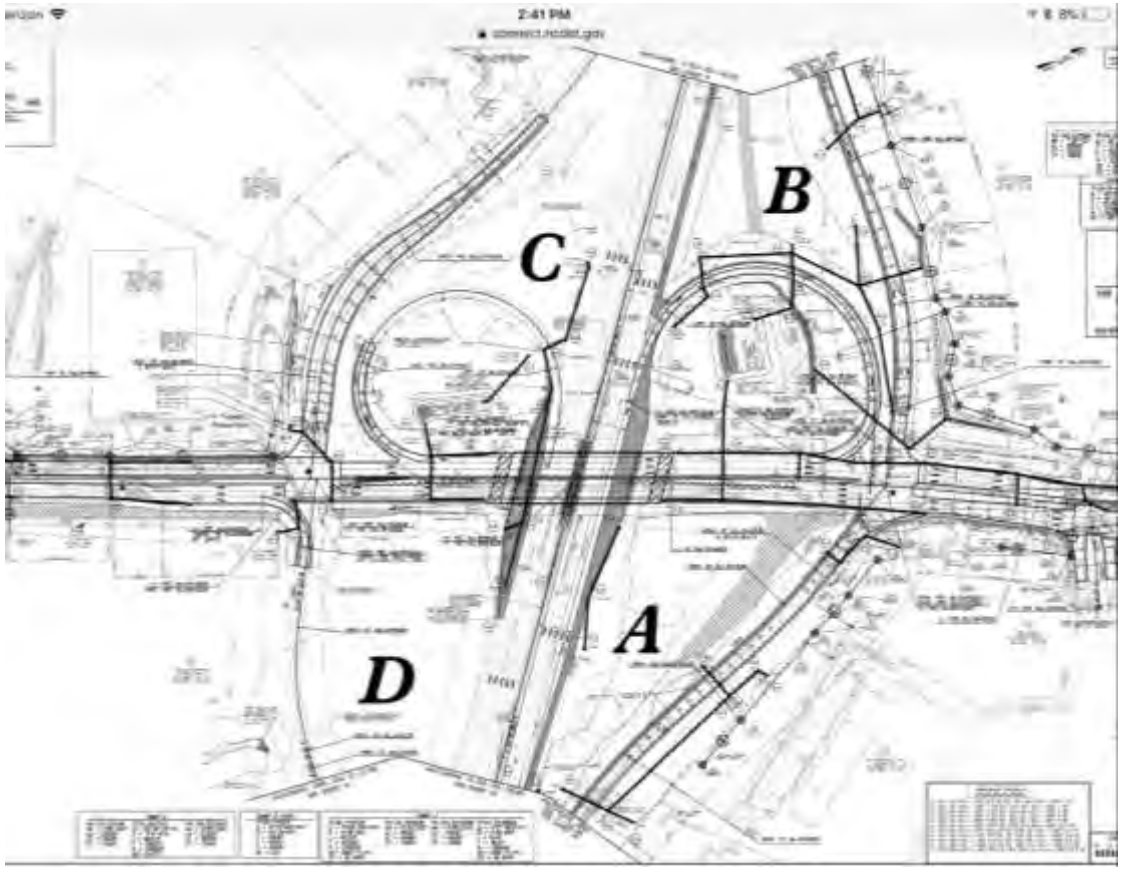
Construction Update

- Substantial Completion in October
- Currently striping final pattern and performing signal work to open all lanes

Aviation Parkway Interchange
I-5506

Project Information

- Contract Value- $21,545,646
- Awarded February 2018 to Flatiron Construction Corp.
- Work Began in April 2018
- Substantial Completion Spring/Summer 2021
- Replace Bridge Over I-40
- Add West Bound Loop for South Bound Aviation
- Widen Aviation to Divided Facility
- Add Auxiliary Lane on WB I-40 to Airport Blvd.



Schedule

- Constructing Phase I of New Bridge over I-40
- WB Auxiliary Lane Complete to Airport Blvd
- Work on Aviation Pkwy Delayed by Utilities
- Substantial Completion in Spring/Summer 2021
- Widening on Aviation Pkwy has Begun

Bridge Construction

- Working on Phase I of Bridge
  - Currently Working on Interior Bent
- Ramp/Loop Closures
  - EB Off-Ramp and On-Loop
  - 60 Day Closure Beginning Late Fall

Questions?

Boyd Tharrington, PE

NCDOT Division 5 Construction Engineer

919-220-4600

btharrington@ncdot.gov

UPCOMING AND FUTURE PROJECTS
I-40 and parallel / reliever routes

Upcoming and future projects

Joey Hopkins, NCDOT Div. 5

NORTH CAROLINA
Department of Transportation

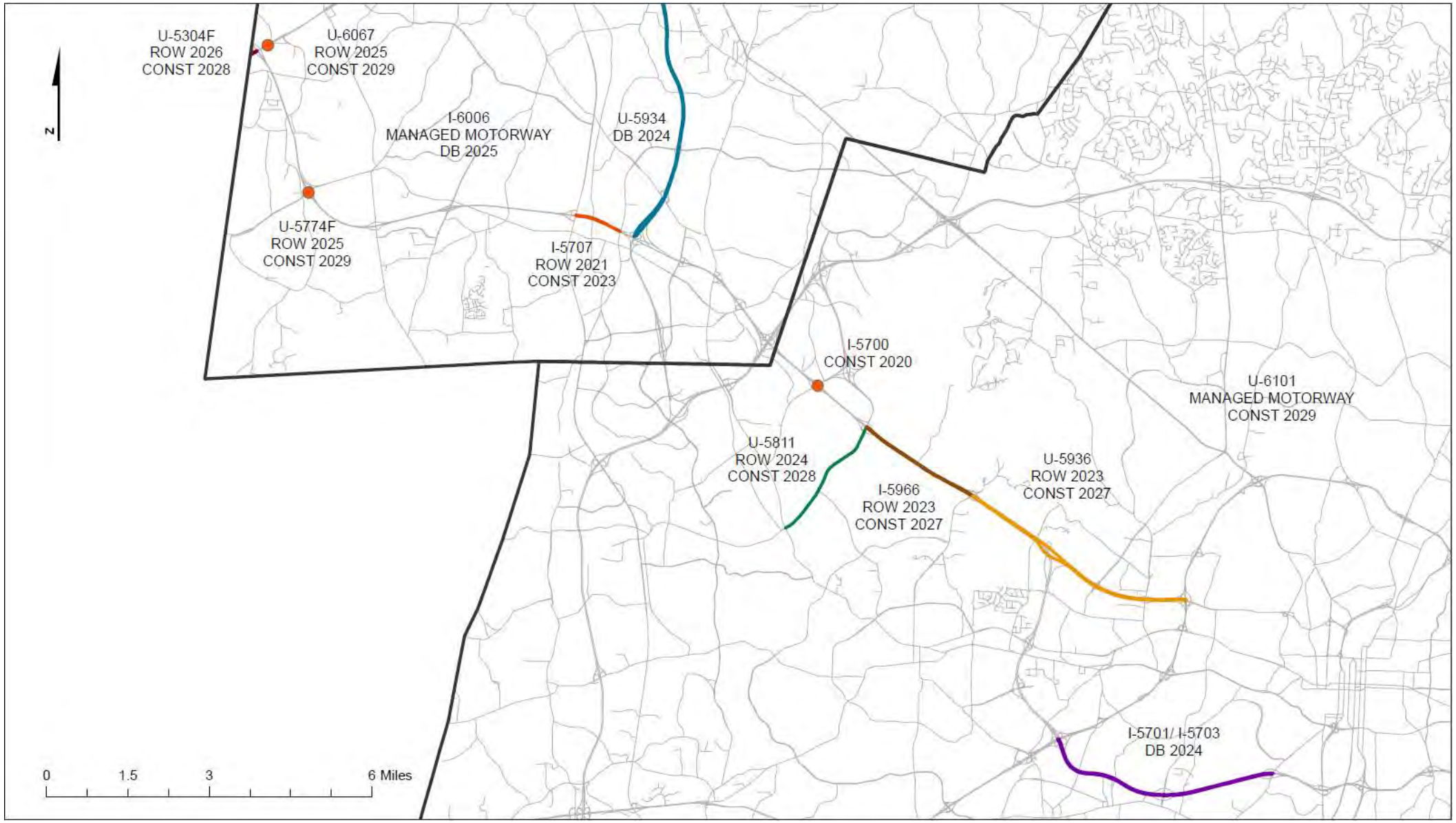
I-40 Partnership – Upcoming Projects

Joey Hopkins, Division Engineer

October 2019

Division 5 Project Highlights

- I-40 / Airport Blvd
- US 70 Improvements
- US 1 Improvements

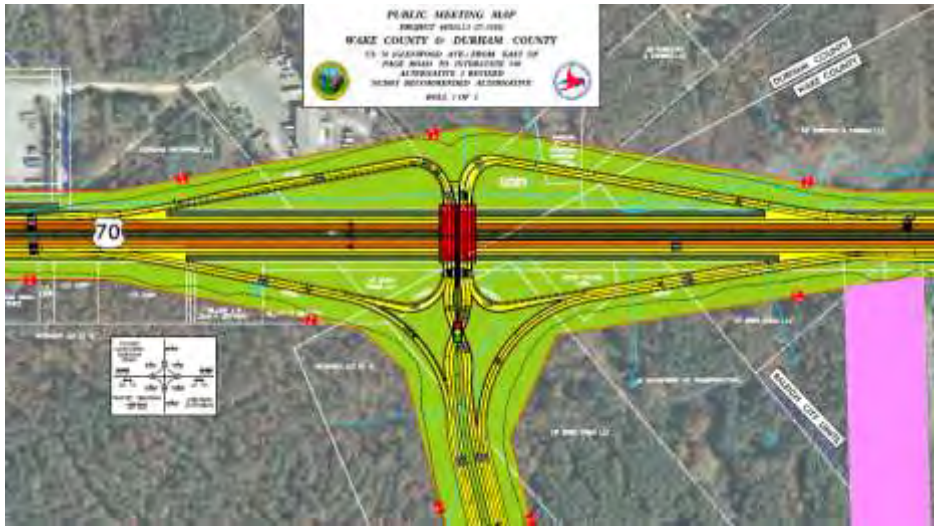

U-5304F
ROW 2026
CONST 2028
U-6067
ROW 2025
CONST 2029
I-6006
MANAGED MOTORWAY
DB 2025
U-5934
DB 2024
U-5774F
ROW 2025
CONST 2029
I-5707
ROW 2021
CONST 2023
I-5700
CONST 2020
U-6101
MANAGED MOTORWAY
CONST 2029
U-5811
ROW 2024
CONST 2028
U-5936
ROW 2023
CONST 2027
I-5966
ROW 2023
CONST 2027
I-5701/ I-5703
DB 2024
N
0
1.5
3
6 Miles

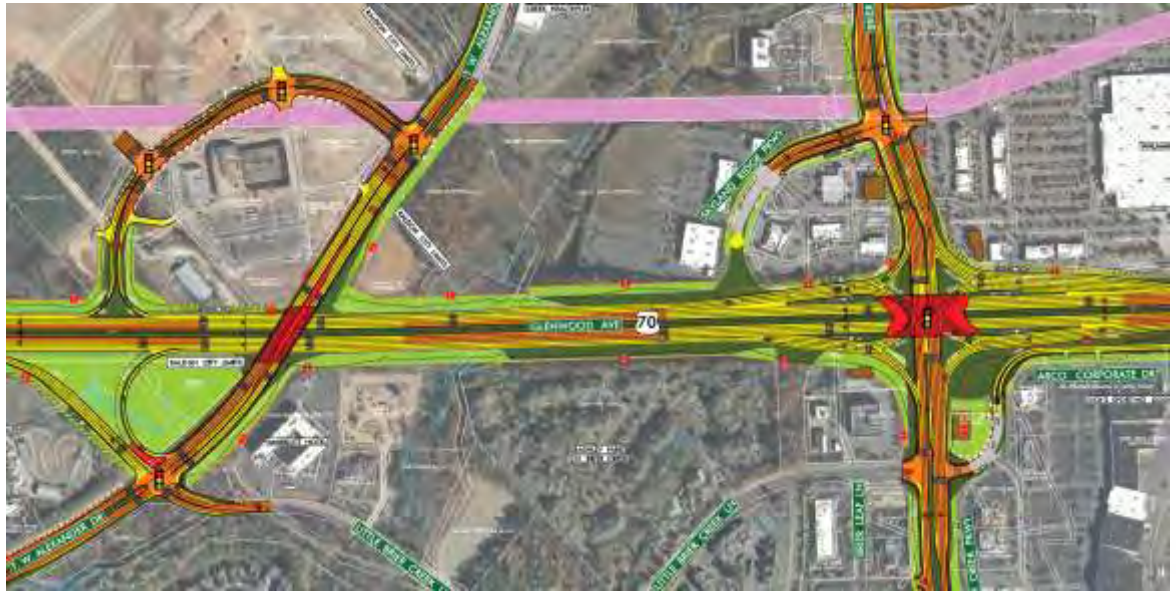
I-40 / Airport Boulevard

- Replace Bridge
- DDI
- Auxiliary Lanes (WB 540 - Airport & EB Airport - Aviation)
- Contract November 2019
- Estimated Cost - $33M
- GARVEE

US 70 from I-540 to T.W. Alexander

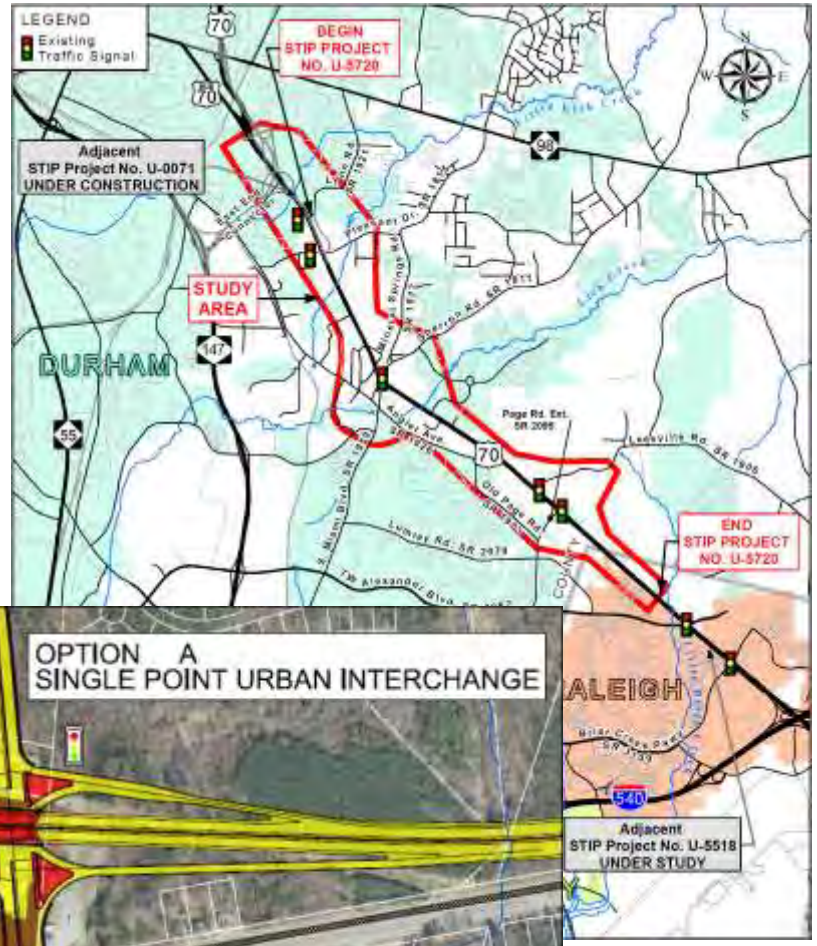
- Upgrade US 70 to a controlled-access facility from I-540 to west of TW Alexander Dr in Raleigh
- New Interchange at Brier Creek Pkwy
- Partial Interchange at T. W. Alexander
- New Interchange west of T. W. Alexander
- R/W & Construction January 2021
- Estimated Cost - $159M
- GARVEE





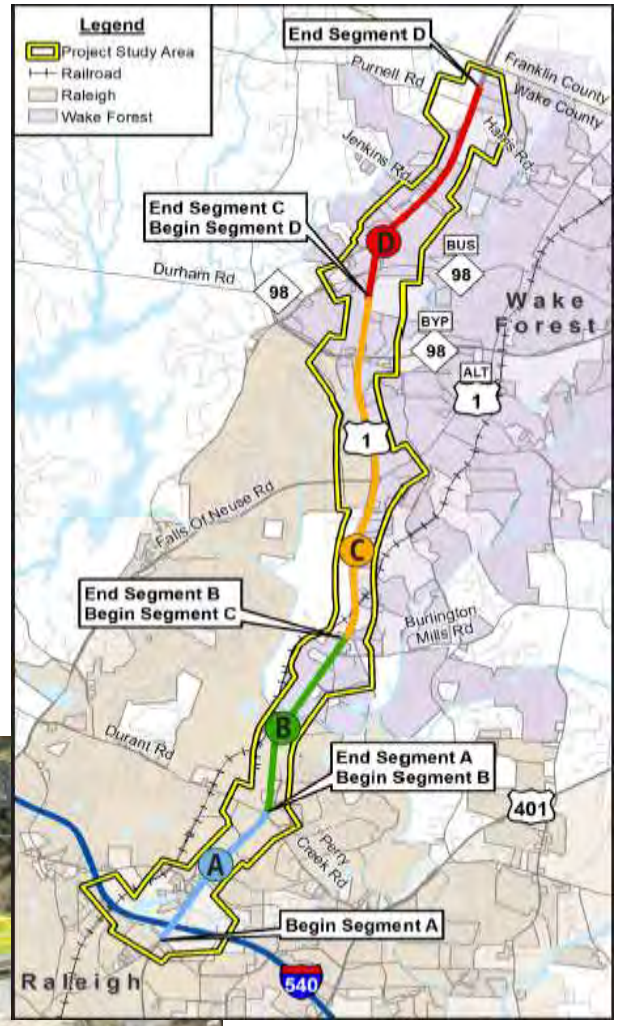
US 70 from Lynn Road to west of T.W. Alexander

- Upgrade US 70 to a controlled-access facility from Lynn Rd in Durham (East End Connector) to west of TW Alexander Dr in Raleigh
- Convert the at-grade intersection of US 70 with Mineral Springs Rd / Sherron Rd / South Miami Blvd to an interchange
- Access to US 70 will be provided at interchange locations
- R/W – 2024
- Construction – 2027
- Estimated Cost - $193M



US 1 From I-540 to Harris/Purnell Roads

- Widen and Upgrade US 1 to a controlled-access facility from I-540 to Harris/Purnell Road
- Access to US 1 will be provided at interchange locations – Perry Creek/Durant; Burlington Mills; US 1A/Falls of Neuse; Harris/Purnell Road
- R/W & Construction – 2022 (Durant/ Perry Creek)
- R/W – 2021 / Construction – 2024 (Burlington Mills/NC 98)
- R/W – 2025 / Construction – 2028 (Harris/Purnell)
- Estimated Cost - $327M



THANK YOU!

I-40 widening in Orange County

Laura Sutton and Gene Tarascio
NCDOT Project Management

NORTH CAROLINA
Department of Transportation

I-40 Widening in Orange County Update

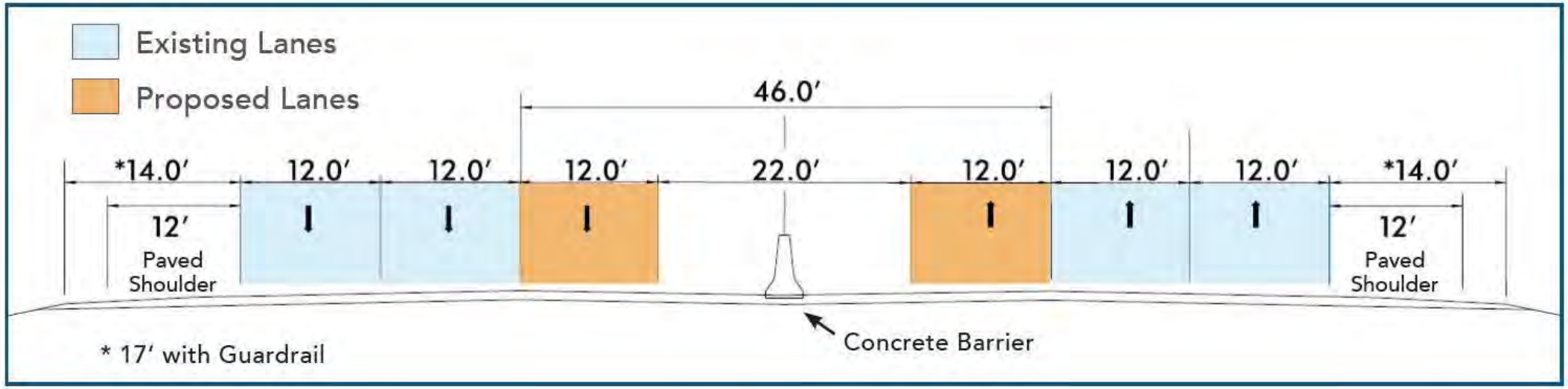
Laura Sutton, P.E. & Eugene Tarascio
NCDOT Project Management Unit

October 17, 2019

Vicinity Map

- I-3306A
  I-40 Widening from I-85 to Durham County Line
- I-3306AA
  I-40 Widening from I-85 to NC 86
- I-3306AB
  I-40 Widening from NC 86 to Durham County Line
- I-3306AC
  NC 86 Interchange Improvements

I-40 Proposed Improvements



- Widen predominantly into median, adding one additional travel lane in each direction, bringing total number of travel lanes from four to six.
- Reduce existing 46-foot median to 22-feet in order to accommodate the additional lanes and a concrete median barrier.
- Replace existing 10-foot paved outside shoulders with 12-foot paved full depth shoulders.
- Replace westbound bridge over Old NC 86 and eastbound bridge over Norfolk Southern Railroad and Millhouse Road.

Proposed Interchange Improvements

Project Benefits

- Reduce traffic congestion and minimize traffic delays, especially during peak rush hours.
- Alleviate the existing bottlenecking that occurs on westbound I-40 near US 15-501 by continuing the inside lane.

Project Benefits

- Improve lane continuity between the eight-lane section at I-85 and the six-lane section at US 15-501 and eliminate the last remaining four-lane section of I-40 in the area.
- Bus On Shoulder System (BOSS) will be able to take advantage of the proposed 12-foot full depth shoulders.
- Improve EMS and Fire Department response times.

Current Schedules

Segment	Right-of-Way	Construction
I-3306AA	FY 2020	FY 2023
I-3306AB	FY 2020	FY 2022
I-3306AC	FY 2020	FY 2022

Based on the current 2020-2029 STIP

Current Status

- Majority of the planning work for I-3306A has been completed, including the Categorical Exclusion.
- Design work has started on the AB segment and will continue to follow the current STIP schedule. The design work for AB includes the widening of I-40 in this section and all the ramp work for the NC 86 interchange but does not include the Reduced Conflict Intersection (RCI) work on NC 86.
- At the request of the Town of Chapel Hill, construction of the RCI work on NC 86 between the I-40 eastbound ramp termini and Perkins Drive, will be delayed. The STIP will be amended at a later date, once the design details are further refined.

QUESTIONS?

I-540 on-ramp signals

Jennifer Portanova, NCDOT Mobility and Safety

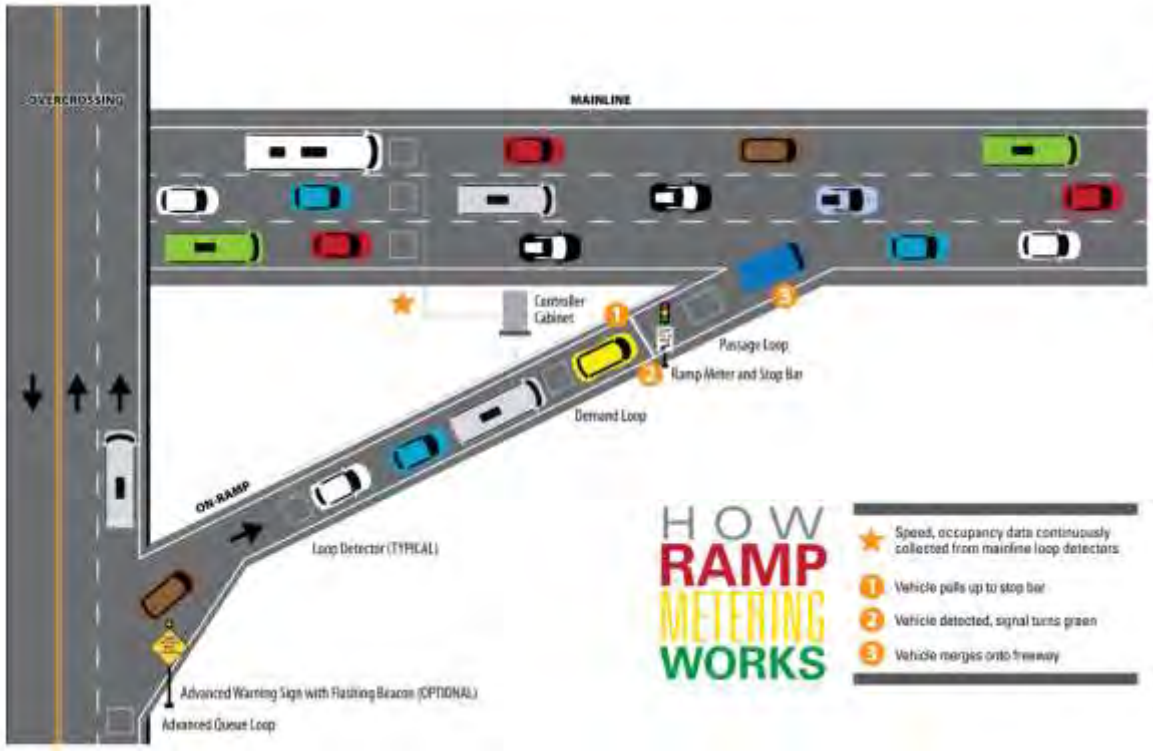
North Carolina
DEPARTMENT OF TRANSPORTATION

NCDOT I-540 Ramp Metering in Raleigh, Lessons Learned

Jennifer Portanova, PE, CPM
State Systems Operations Engineer
NCDOT Transportation Mobility and Safety Division
October 17, 2019

What is Ramp Metering?

- Traffic signals on freeway on-ramp
- Controls flow and promotes safe merging
- Benefits:
  - Reduce Congestion
  - Safety



Source: FHWA

NCDOT I-540 On-ramp Signals Project

- First in NC
- 4 on-ramp signals
- Intelight software
- STOC managed
- Fixed flowrates Sept. 27, 2017
- Traffic responsive Dec. 13, 2017

Exhibit 1 First Four I-540 Westbound Ramp Meter Locations

Source: NCDOT, 2016

Operational Performance

- Overall increase in driver volumes
- 84% of commuters experienced shorter drive times
- Up to 2 minutes (7.3%) decrease in drive time per day for a commuter
- 9% decrease in reoccurring congestion
- $38/year in delay savings for average daily commuter vehicle, expected over 10 years
- $9.6 million in driver delay savings expected over 10 years

ITRE Final Evaluation Report
(Feb. 2019)

Key Takeaways from ITRE Evaluation

- Before Data Collection is Important!
- Use Same data Collection Methods After
- Defined Optimal collection Locations and Timeframes for data source:
  - Probe travel times
  - On-ramp signal detector data
  - Radar-based traffic counts
  - Average Annual Daily Traffic (AADT)
  - Bluetooth Travel Times
  - Traffic Monitoring Video
  - Probe Origin-Destination (OD) Data

RESEARCH & DEVELOPMENT

Planning Level Evaluation of the Effects of Ramp Metering on North Carolina Freeways Final Report

Institute for Transportation Research & Education, North Carolina State University:
Joy Davis
Thomas Chase
Behzad Aghdashi
Chris Cunningham
Weston Head
James Poslusny
Terry Karlson

NCDOT Project 2018-19
FHWA/NC/2018-19
February 2019

Key Lessons Learned: 2 years experience

- Involve Operations during Design
- Clear about role of software vendor:
  - Who will design and maintain the metering plans and software settings
  - Who will do the day-to-day operation?
- Clear expectations: mainline improvements vs added side street congestion

NCDOT Statewide Traffic Control Center, Raleigh

Next Steps

- Consider other freeway corridors in NC for Ramp Metering
- Triangle Region Managed Motorways
- Charlotte I-77 Ramp Meters in the TIP

RTA-NCDOT INNOVATIONS AND SOLUTIONS

I-40 managed freeway

David Keilson, NCDOT Division 5

Coordinated Adaptive Ramp Metering

in North Carolina

David Keilson – NCDOT
Chris Lukasina – CAMPO
Will Letchworth - WSP

October 17, 2019

Agenda

- Types
- Concept
- How
- Why
- Australia, US, NC

Types of Ramp Metering

- Basic Operation
- Local Traffic Responsive
- Coordinated Traffic Responsive
- Coordinated Adaptive

Concept

A collection of strategies:

- Safety
- Reliability
- Congestion
- Traveler information

What's Included

- Coordinated ramp meters
- Sensors
- Ramp improvements
- Command and control software
- Human intervention at Traffic Management Center
- Incident detection and CCTV surveillance
- Traveler information
- Can include lane management

How Does It Work

- Synchronize entry flow
- Optimize efficiency
- Coordination

VicRoads

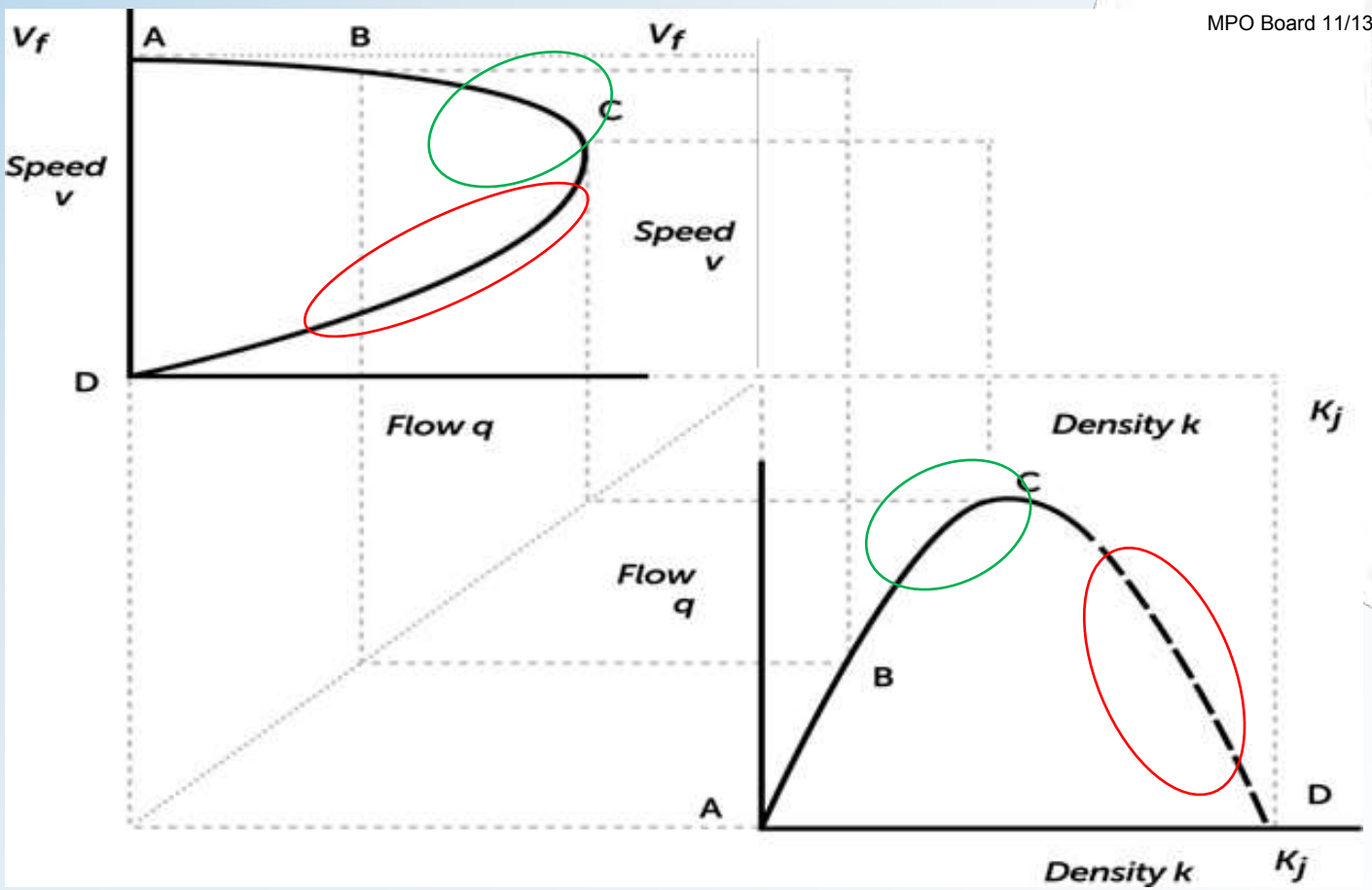
Freeway Management System

M1 Case Study

VICTORIA State Government

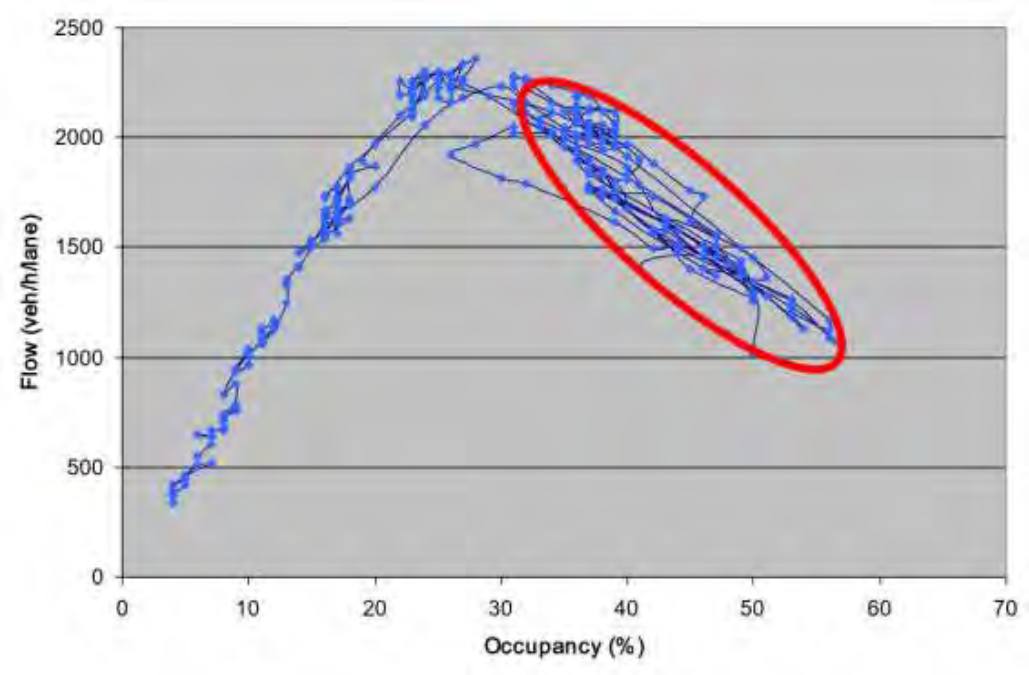
YouTube **VicRoads – Freeway Management System**

Why Do Freeways Fail



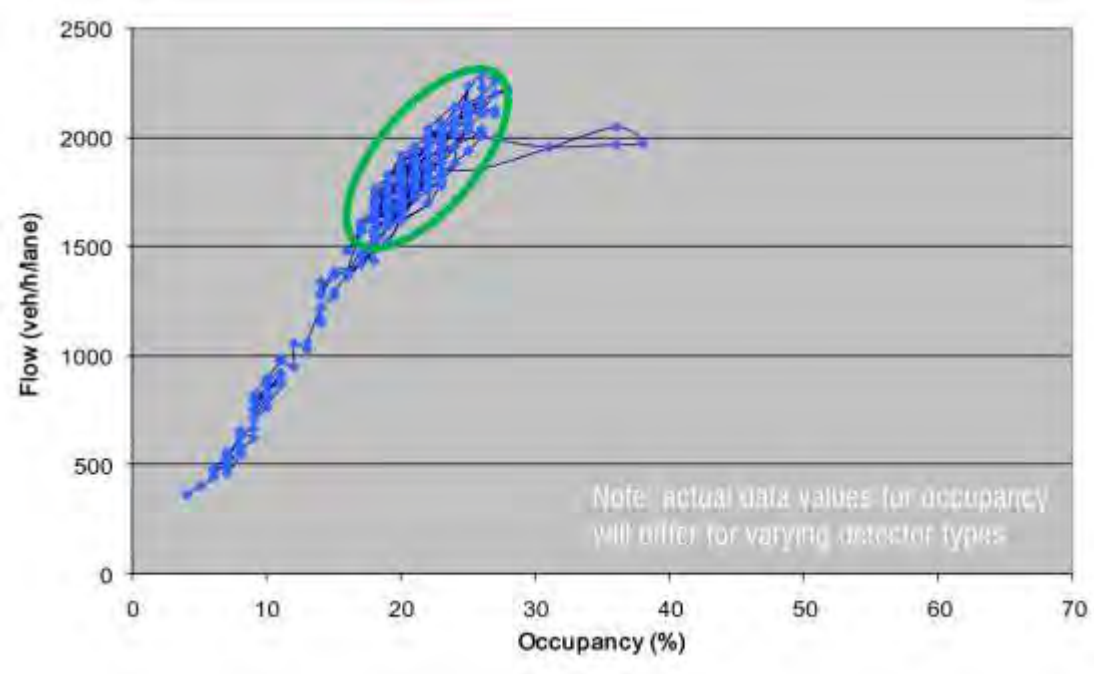
Freeways perform at their <u>worst</u> when they are needed the <u>most.</u>

Unmanaged vs Managed

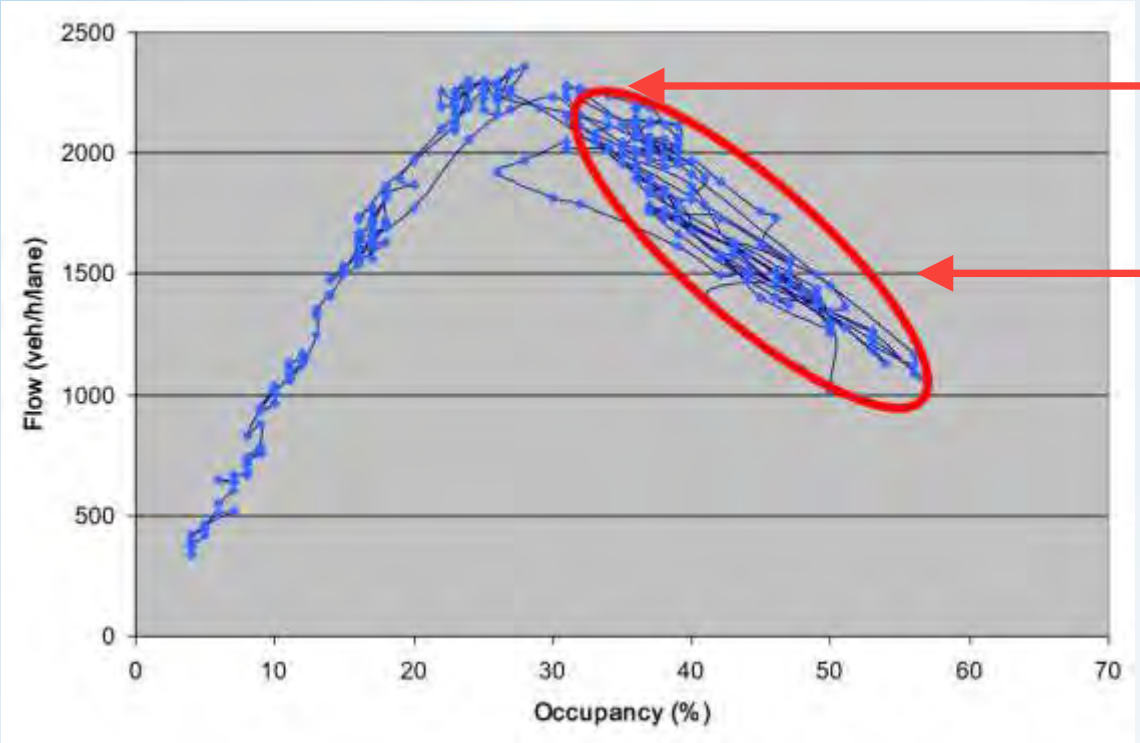


Unmanaged

Managed



Unmanaged vs Managed

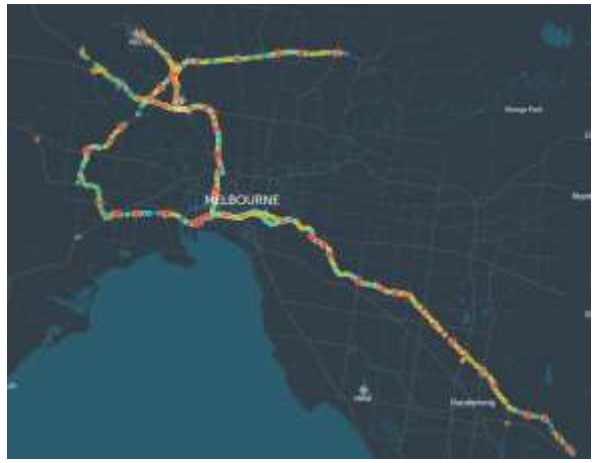


2,300

1,500

4 lanes @ 2,000 = 8,000
4 lanes @ 1,500 = 6,000
8,000-6,000 = 2,000

Managed Motorways in Australia



- Melbourne 2009, M1 Freeway
- 47 miles, >160,000 AADT
- 1,100+ devices
- CARM, 62 locations
- 30 ramp improvements
- Ramp bypass lanes

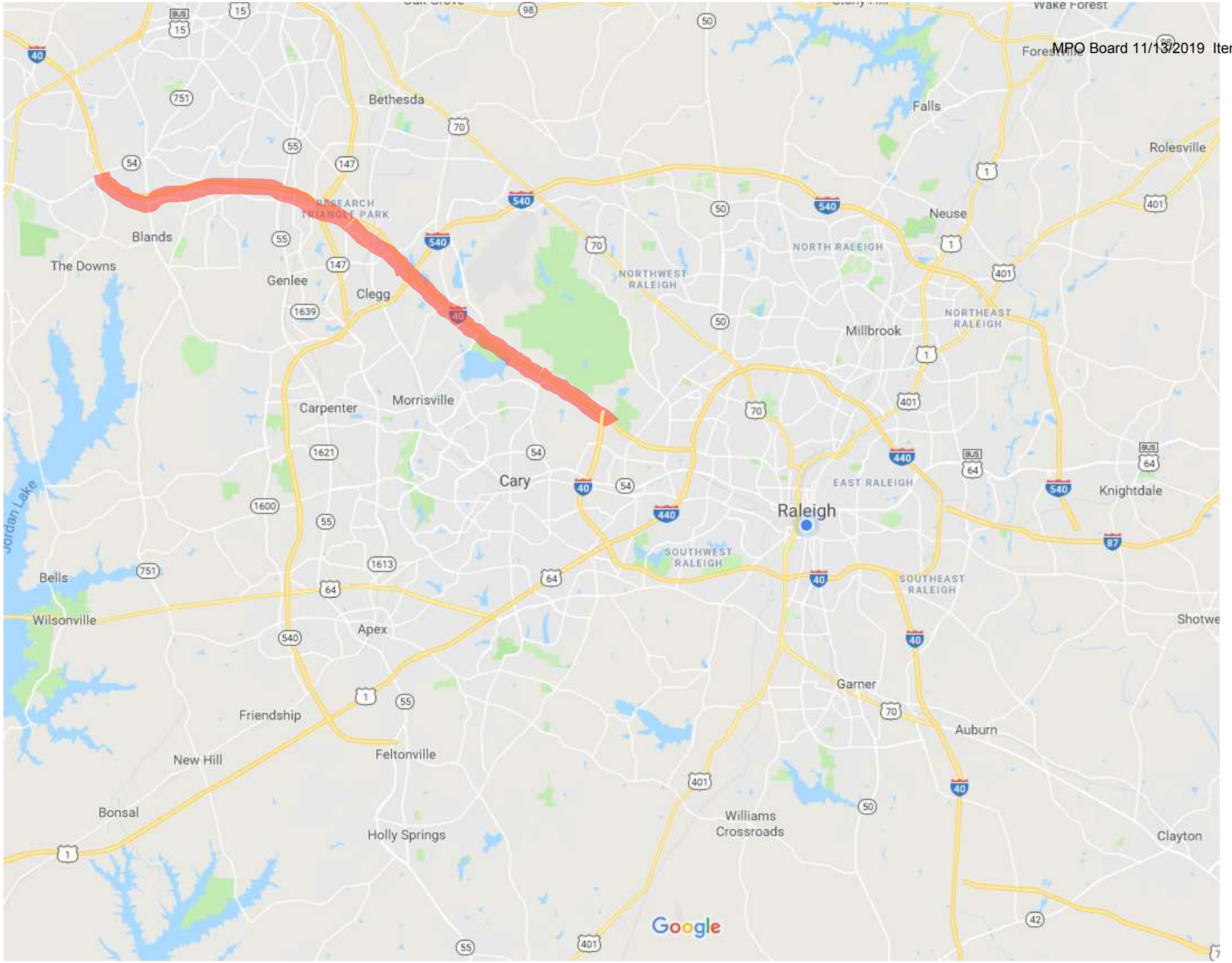
Managed Motorways Australia

- 5% peak flow, 25% overall
- Sustained
- Speeds up 35% to 60% (peak)
- Crash rates

North American Efforts

- Arizona
- California
- Colorado
- Georgia
- North Carolina
- Utah
- Ontario

I-40 in Triangle Region – Wade to NC 54



I-40 in Triangle Region – Wade to NC 54

- I-40, NC 54 to Wade Avenue
- Committed
- Why I-40
  - Congestion
  - Safety
  - No plans for more GP through lanes
  - Cost effective

I-40 Triangle Region, Wade to NC 54, I-6006

- Feasibility study under way
- Other local projects
- I-85 Charlotte

Technology Changes - Managed Roadways

Image courtesy of VicRoads

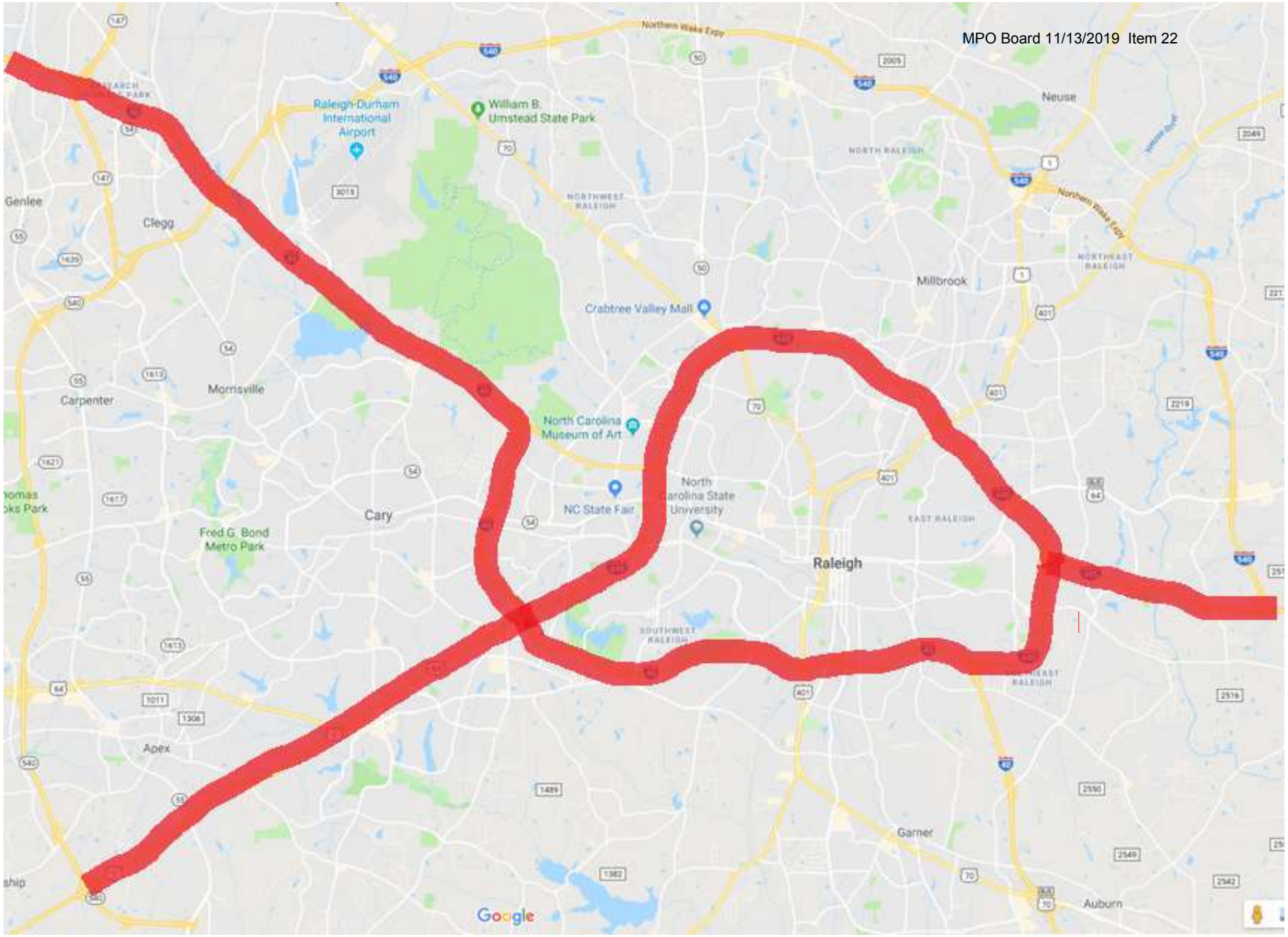
- Synchronizes flow of vehicles entering a freeway to available capacity on the freeway
- Provides real time demand management to manage traffic
- Interchanges coordinate with one another to prevent excessive wait times and queuing for all interchanges, metering rates differ for each ramp
- Future infrastructure to vehicle communications

Image courtesy of Transport UK

Image courtesy of VicRoads

Triangle Region - Managed Roadways Phase 1

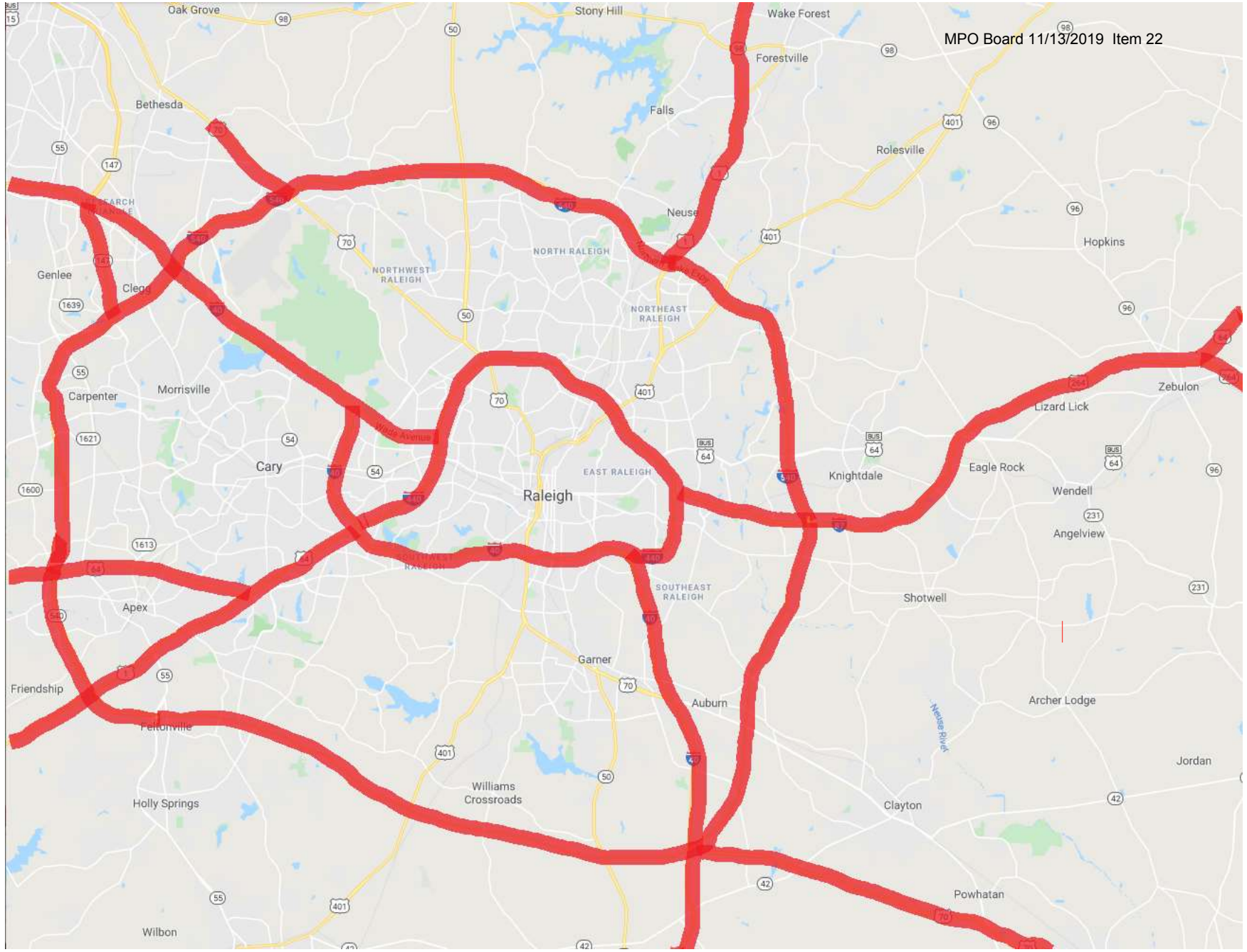
Project	ROW	CON
I-6006	2025	2025
U-6101	2026	2029



Triangle Region - Managed Roadways Future Phases

Project	ROW	CON
I-6006	2025	2025
U-6101	2026	2029

- Full freeway network coverage
- Coordinate with community ITS projects
- CV/AV compatibility
- Interoperability with neighboring regions



Questions?

dpkeilson@NCDOT.gov
Chris.Lukasina@campo-nc.us
Will.Letchworth@wsp.com

I-40, I-540 Bus On Shoulder System (BOSS)

Pat Stephens, GoTriangle

I-40 Regional Partnership Meeting

Overview of Bus On Shoulder System Use by Public Transit Buses

October 17, 2019

Introduction

- History of the Bus on Shoulder System (BOSS)
- What are the Benefits of BOSS
- Use of BOSS in the Triangle
- Future expansion of BOSS in the region

History of Bus on Shoulders

- Concept originated in Minneapolis in May 1991
- Major flooding forced the closure of the I-35W Bridge for repairs
- Governor called for strategies for increasing throughput on adjacent bridges
- Decision was made to allow buses to travel on the shoulders to relieve traffic congestion
- Program resulted in a bus travel time savings of 5 to 15 minutes

History of Bus on Shoulders

- The immediate success of the strategy prompted the testing in other area of the Twin Cities.
- Minneapolis now has nearly 300 miles for BOSS and is often used as a key component in traffic management strategy.
- BOSS has been implemented in at least 13 U.S. metropolitan areas and other countries

Benefits of BOSS

- Low-cost operational treatment for buses to bypass freeway congestion
- Promotes inter-agency cooperation
- Provides time savings and travel reliability for transit passengers
- Increase transit vehicle productivity and reliability for Transit
- Expands public support for transit

History of BOSS in the Triangle

- Started in 2012 with pilot on I-40 in Durham County
- Initiative launch coordinated by NCDOT, GoTriangle, and RTA business coalition via I-40 Regional Partnership BOSS team
- Over 60 shoulder miles authorized on portions of I-40 and Wade Avenue Extension freeways
- N.C. Implementation and Operations Plan (IOP) created
- Goal was established to create a regional bus on shoulder system

Public Transit Use of Freeway Shoulders

Pictured:

I-40 Bus on Shoulder

Public Transit Use of Freeway Shoulders

Emergency use remains primary purpose of shoulder

N.C. Operational Guidelines

- Right shoulder use only
- Bus use only when freeway speeds less than 35 mph
- Bus speed limit of 35 mph
- No more than 15 mph faster than traffic in adjacent lane
- Buses must yield to everything in the shoulder
- Governed by State Law

Future of Triangle Region Bus on Shoulder

- Authorized under the NC General Statutes
- Must be initiated at the local/regional level and developed by the regional transportation partners
- Currently exploring potential for BOSS on I-540 and other freeways in Triangle

Thank You!

Questions?

I-40, I-540 shoulder managed lanes and other operations

Chris Werner, NCDOT

NORTH CAROLINA
Department of Transportation

I-40 & I-540 Operational Analyses Feasibility Study

Chris Werner, PE
Director of Technical Services

October 17, 2019
I-40 Regional Partnership
Annual Meeting

Study Parameters

Feasibility study looking at two segments:

- ❑ I-40 from NC 54 (Exit 273) to Airport Blvd.
- ❑ I-540 from I-40 to US 401

Purpose:

Review existing and future operational issues to identify short-term and long-term solutions.

Short-term Analyses

Evaluation of existing conditions to identify historical issues and better understand root cause:

- ❑ crash data
- ❑ traffic data
- ❑ NCDOT Statewide Traffic Operations Center
- ❑ roadway data (lane adds/drops, ramp lengths, etc.)
- ❑ signing and marking

Short-term Analyses

Criteria for potential solutions:

- ❑ simple, low-cost
- ❑ high cost/benefit ratio
- ❑ implementation within 5 years or less
- ❑ compatible with programmed projects
- ❑ compatible with long-term regional plans
- ❑ previously demonstrated success

Short-term Analyses

Examples of potential solutions:

- ❑ improved signing
- ❑ improved pavement markings
- ❑ improved Intelligent Transportation Systems (ITS)
- ❑ variable speed limits
- ❑ extending acceleration/deceleration lengths for ramps
- ❑ temporary use of shoulders during peak hours
- ❑ addition of auxiliary lanes

Long-term Analyses

Examples of potential solutions:

- managed motorways
- managed lanes
- peak period shoulder lanes
- interchange reconfiguration
- interchange consolidation

Note: these potential solutions (if regionally adopted) would be considered as a part of overall regional transportation plans to address long-term transportation needs.

Ideas Gathered from Previous I-40 Corridor Brainstorm Sessions are Under Consideration

RTA Leadership Team - Nov. 8, 2018
Ways to make I-40 work better

COMMENTS FROM RTA LEADERSHIP TEAM DURING BRAINSTORMING EXERCISE

Group 1

- Toll express lanes on I-40
- Bikeway parallel along I-40
- VMT tax to make up for fuel tax loss
- Making parking more expensive
- Technology
- Good connection from the airport to US 70

Group 2

- Advance the commuter rail project – a traffic reduction tool for I-40
- Reduce the toll on I-540 – take some of the project money for I-40 to off-set the loss of toll revenue
- Add managed lanes to I-40
- Upgrade US 70 and NC 54 corridors to freeway or high capacity corridors

Group 3

- Variable direction through lanes that shift direction based on peak flow direction
- Use variable message signs to redirect traffic to alternate routes until I-40 is widened
- Widen Wade Ave. between I-40 and I-440 to improve capacity on this critical link
- Add flexible delineators for left lane of I-40 west and I-40 east to make left lane dedicated through traffic between Wade and 147 -- effectively making an 8-mile collector-distributor lane

Group 4

- Consider creating an I-40 commuter van/bus that would allow drivers to park at one of two major parking lots (e.g. PNC Arena) in the morning and then take the free van/bus to major RTP employers. Then the van/bus would return late afternoon during rush hour. These vans/buses should be allowed to use the shoulders. These vehicles could be dedicated to individual RTP companies maybe.
- Somehow fix the merge from the Durham Freeway to I-40 during rush hour – maybe a ramp meter? Alternately, we could shift traffic on eastbound I-40 before the merger from the far left lane so merging cars can get onto I-40 safely.

Group 5

- I-40 and Wade Ave. merge:
  - re-engineer the approach lanes on to I-40 westbound to avoid bottle-neck at this merge point
  - provide improved signage on I-40 W to keep through lanes to left providing better flow at the Wade Ave. merge

(continued)

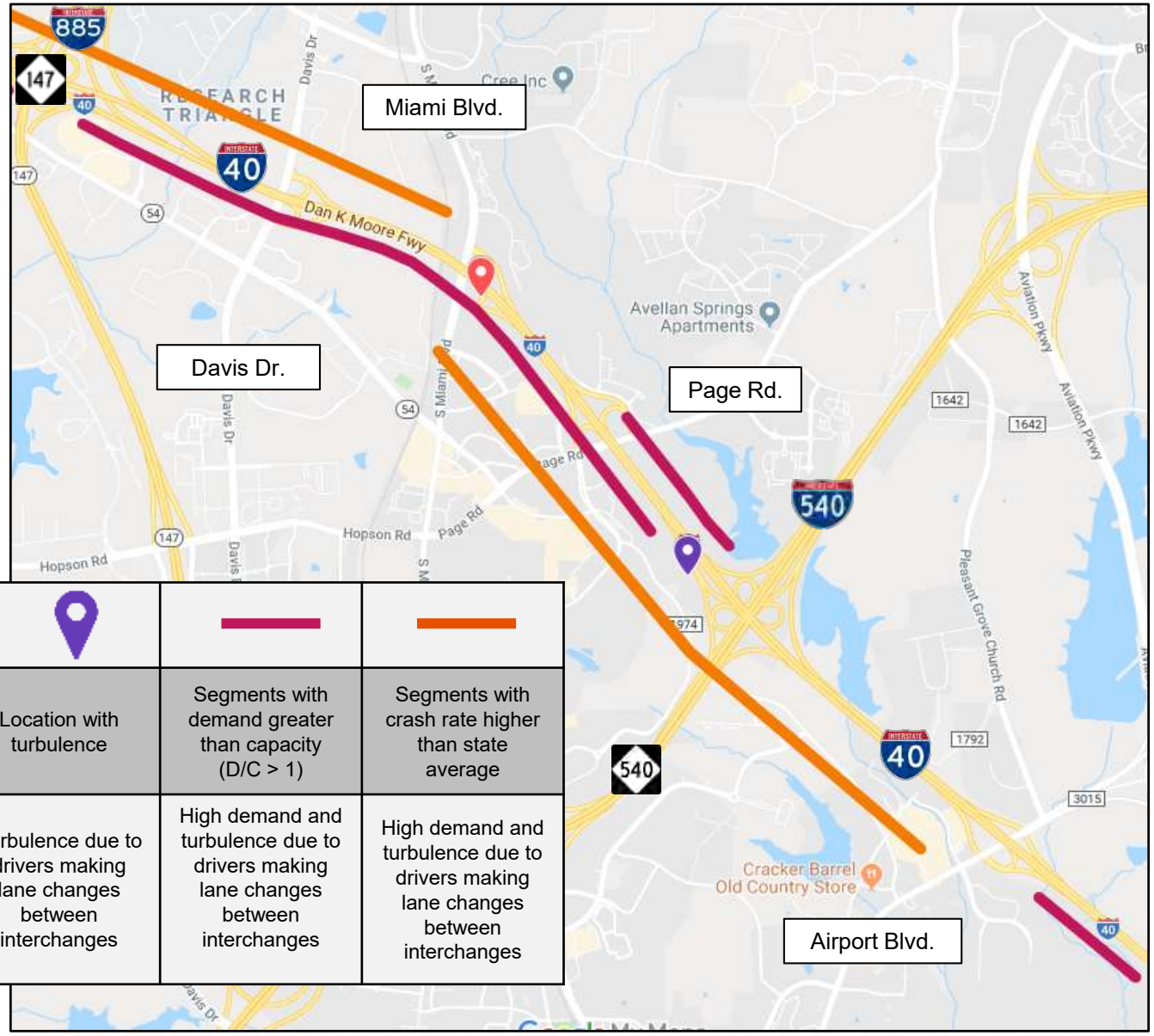
Adjacent Projects

Project (Construction Year)	Project Extent & Description
U-5774F (2029)	I-40 / NC 54 (Exit 273) Interchange Improvements
I-6006 (2025)	I-40 from NC 54 (Exit 273) to Wade Ave (Exit 289) Managed Freeway with Ramp Metering & Additional ATM / ITS
I-5707 (2023)	I-40 from NC 55 (Exit 278) to NC 147 (Exit 279) Westbound Auxiliary Lane
W-5705M (2020)	NC 147 Westbound (Exit 279) Signing and Pavement Marking Improvements
U-5934 (2024)	NC 147 (Exit 279) from I-40 to Future I-885 (East End Connector) Add Lanes
I-5700 (2020)	I-40 / Airport Blvd (Exit 284) Interchange Revision Eastbound Auxiliary Lane (I-540 to Airport Blvd to Aviation Pkwy)
I-5506 (Under Construction)	I-40 / Aviation Pkwy (Exit 285) Interchange Improvements Westbound Auxiliary Lane (Airport Blvd to Aviation Pkwy)

I-40 Short-term Analyses: 54 to 55

Symbol	Description	Potential Short/Medium Term Solution
	Segments with demand greater than capacity (D/C > 1)	Auxiliary lanes within existing pavement, add option lanes to high volume weaving off-ramps
	Segments with crash rate higher than state average for facility type	Variable speed limits, better exit loop ramp signing, ATDM

I-40 Short-term Analyses: 885 147 to Airport Blvd.

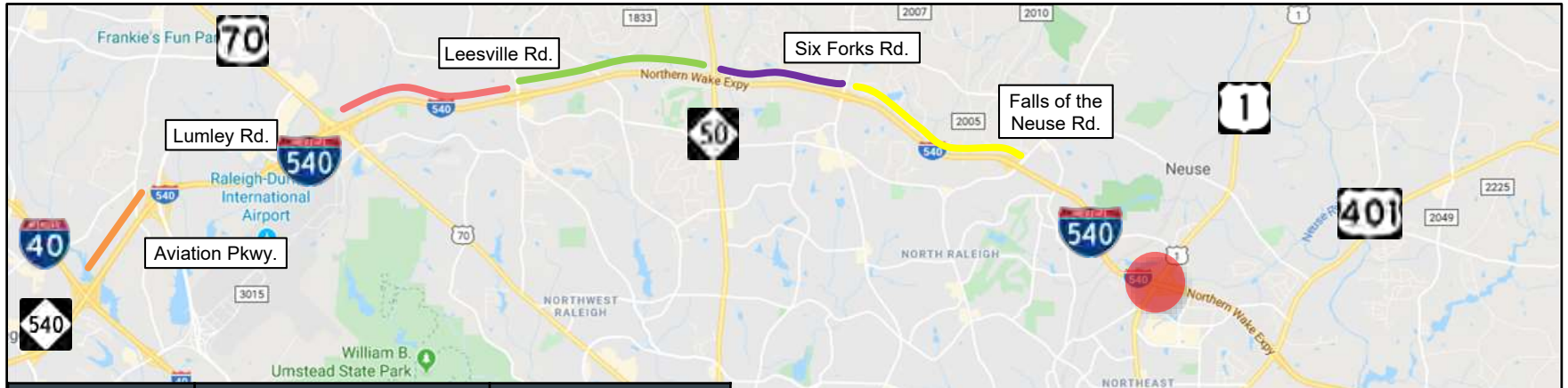


Symbol				
Observation	Frequent crash location	Location with turbulence	Segments with demand greater than capacity (D/C > 1)	Segments with crash rate higher than state average
Potential Cause	Excessive speeds, last minute lane-changes	Turbulence due to drivers making lane changes between interchanges	High demand and turbulence due to drivers making lane changes between interchanges	High demand and turbulence due to drivers making lane changes between interchanges

I-540 EB Short-term Analyses: 40 540 to 87

Symbol	Observation	Potential Cause
	Speed reduction on I-540 between I-40 and Aviation Parkway weaving segment	Congestion on I-540 and weaving from ramps
	Speed reduction on I-540 through Lumley Rd. interchange to US 70	Congestion on I-540 due to backup from US 70; various lane drops
	Speed reduction on I-540 from US 70 on-ramp to Leesville Road	Congestion on I-540 and weaving from on and off-ramps; merge area
	Speed reduction on I-540 from on-ramp at Leesville Rd to NC 50	Congestion on I-540 and weaving from on and off-ramps
	Speed reduction on I-540 from on-ramp at NC 50 to Six Forks Road	Congestion on I-540 and weaving from on and off-ramps
	Speed reduction on I-540 from on-ramp at Six Forks Road to west of Falls of Neuse Road	Congestion on I-540 and weaving from on-ramp
	Speed reduction on I-540 west of I-87 before the exit loop to I-87 NB	Congestion due to late merging traffic exiting to I-87 NB

I-540 WB Short-term Analyses: 87 to 40 540



Symbol	Observation	Potential Cause
	Speed reduction on off-ramp at I-40 WB	Congestion on I-40; turbulence from Aviation Parkway interchange
	Speed reduction on on-ramp at Leesville Road	Congestion on I-540.
	Speed reduction on I-540 and on-ramp at NC 50	Congestion on I-540.
	Speed reduction on I-540 and on-ramp at Six Forks Road	Congestion on I-540.
	Speed reduction on I-540 and on-ramp at Falls of Neuse Road	Congestion on I-540.
	Speed reduction on I-540 from US 1 Interchange to Town Center Blvd Interchange	Congestion on I-540 through 2 lane section

Signing / Marking | Capacity / Operations | Safety / Incidents | ITS | Travel Demand | Roadway Design

Potential improvements under consideration:

- Auxiliary lanes: add Exit Only signs, wider mini-skip lines, and additional marking symbols
- Arrow-per-lane signs to maximize option lane capacity
- In-pavement route shields at system interchanges
- Enhanced mile markers every 0.2 miles to aid incident response

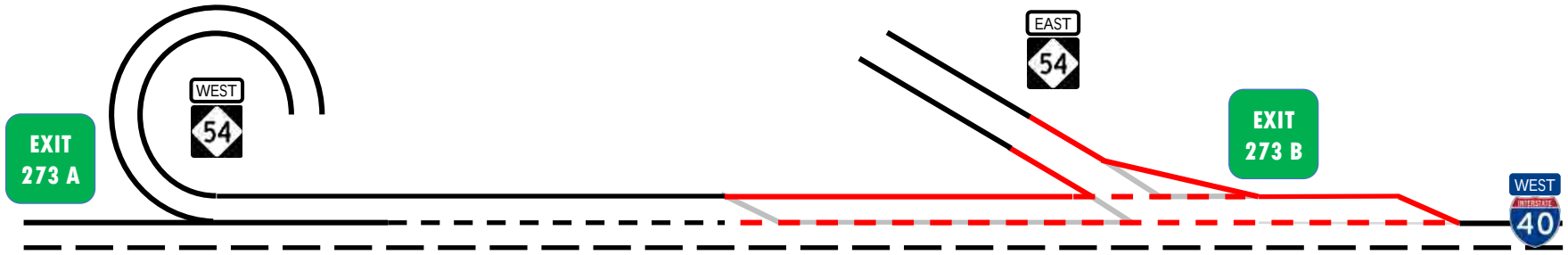
Example: Arrow-per-lane sign for I-40 EB off-ramp to I-540

Example: Interstate route shield pavement markings

Signing / Marking | **Capacity / Operations** | Safety / Incidents | ITS | Travel Demand | Roadway Design

Potential improvements under consideration:

- ❑ Constructing auxiliary lanes as warranted by volume and spacing
- ❑ Adding option lanes to high-volume weaving segment off-ramps
- ❑ Extending acceleration / deceleration lanes
- ❑ Converting low-volume off-ramps to option / taper exits to better facilitate hard shoulder and auxiliary lane applications

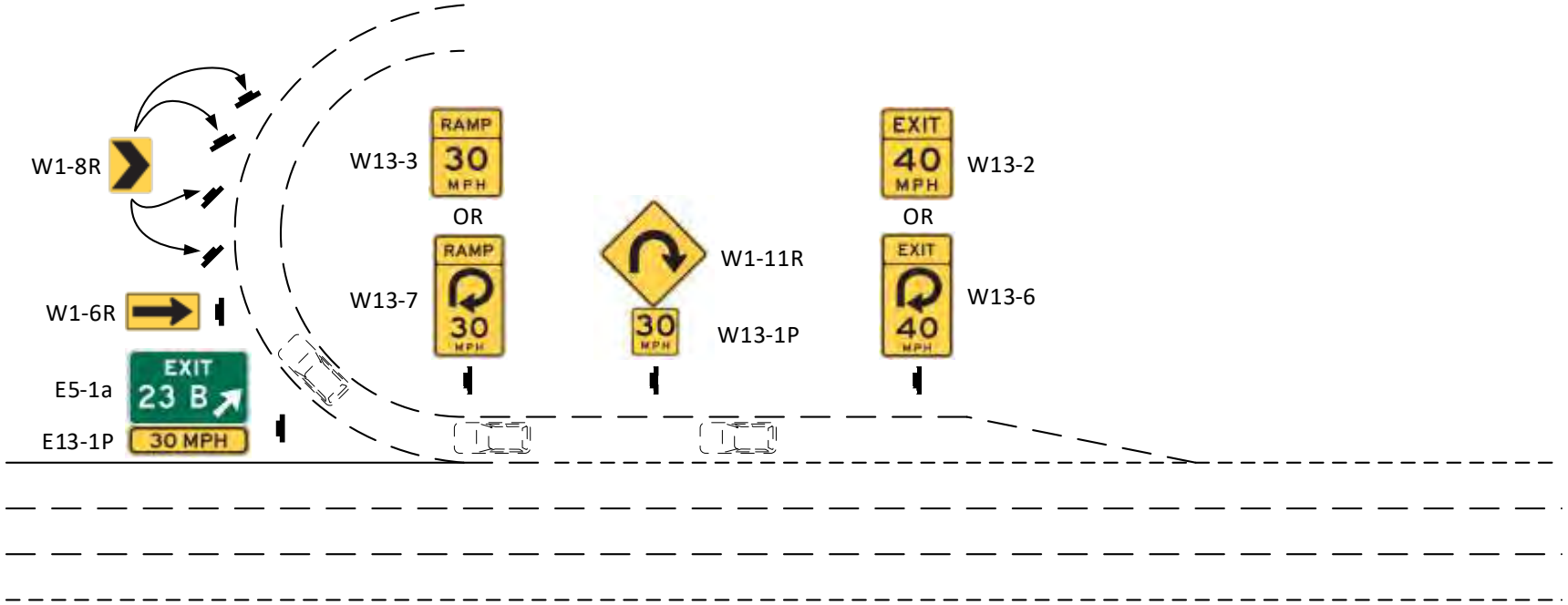


Example: Converting low-volume off-ramp to a taper exit to extend decel lane for high-volume off-ramp

Signing / Marking | Capacity / Operations | **Safety / Incidents** | ITS | Travel Demand | Roadway Design

Potential improvements under consideration:

- ❑ Improving signing and marking at identified loop ramps
- ❑ Bringing other loop ramps up to current standards

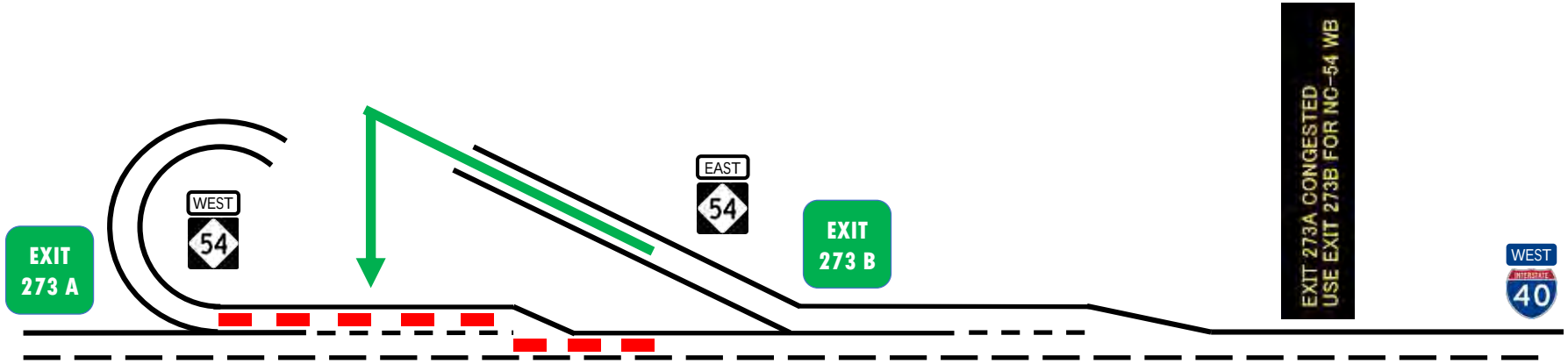


Example: Advisory Speed Signing for an Exit Loop Ramp

Signing / Marking | Capacity / Operations | Safety / Incidents | **ITS** | Travel Demand | Roadway Design

Potential improvements under consideration:

- ❑ Dynamic curve warning system for high crash locations
- ❑ "Queue ahead" warning system; or variable speed limit signing
- ❑ Crowdsourced secure incident data sharing platform
- ❑ Additional traveler information devices (e.g. DMS westbound)
- ❑ Exit diversion system (NC-54 WB; Toll NC-147 SB)



Example: DMS-driven exit diversion system I-40 WB to NC 54 WB

Next Steps

- ❑ continued work with stakeholders
- ❑ complete short-term analysis of existing conditions
- ❑ evaluate potential options
- ❑ prepare cost estimate (by location)
- ❑ develop benefit/cost factors
- ❑ incorporate into existing maintenance or TIP projects?
  - ❑ If not, determine funding options or submit through the normal process
- ❑ Transition to long-term solutions analyses and sync with other on-going studies

Questions?

Chris Werner, PE
Director of Technical Services
cmwerner@ncdot.gov

Derrick Lewis, PE
Manager, Feasibility Studies Unit
dlewis@ncdot.gov

FREEWAY RESEARCH AND LEARNING

I-40 crashes and safety pilot analysis

Drew Draper, Wetherill Engineering

Regional Transportation Alliance
Business Leadership

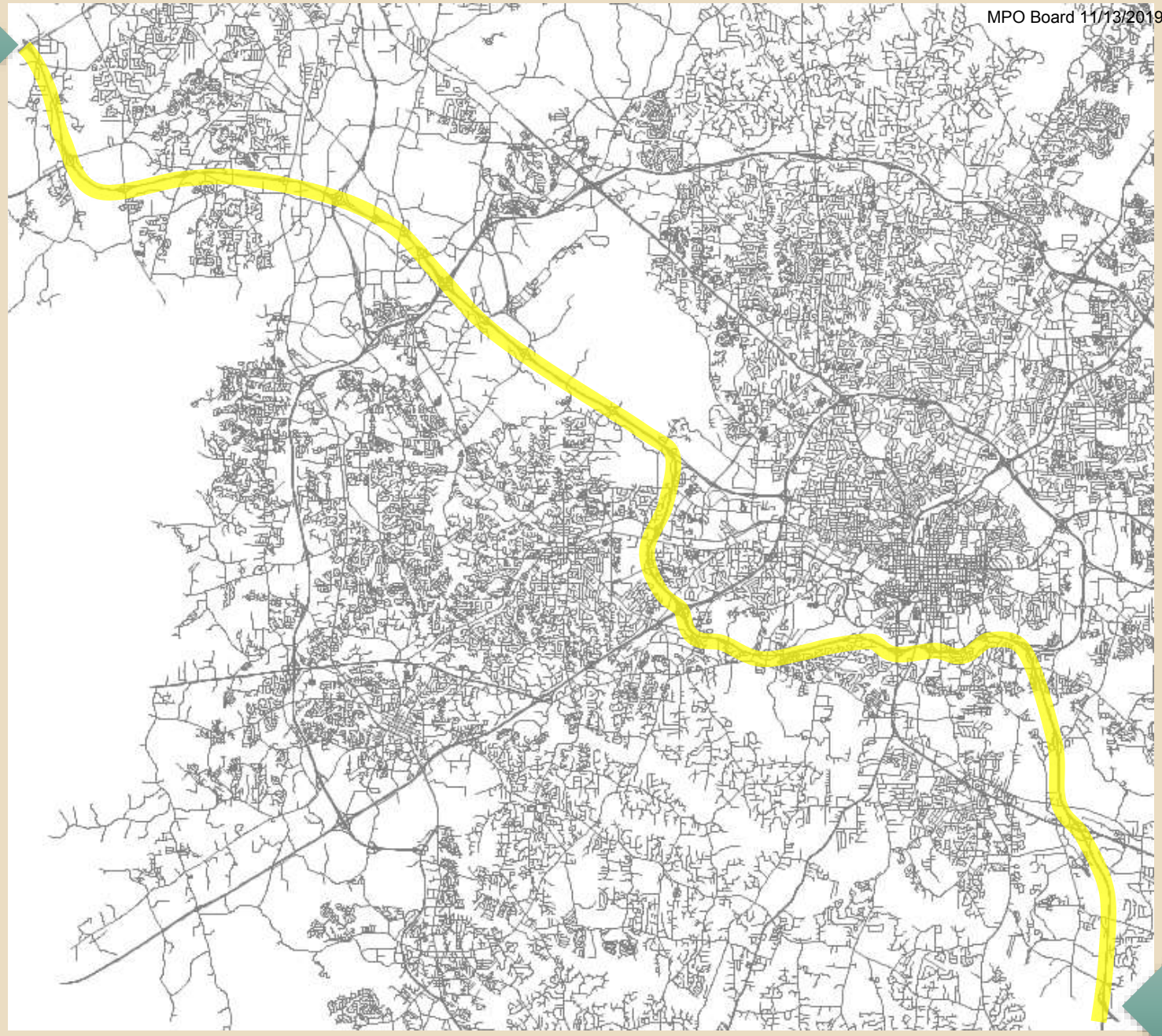
I-40 CRASH ANALYSIS

From Watkins Road at Orange County Line through Durham and Wake Counties to US 70 Bypass at Johnston County Line

WETHERILL ENGINEERING

The Data

- Crash history from 2000 to 2018, including severity
- AADT volumes from 2002 to 2018
- Crash and volume by segment on I-40 and I-540



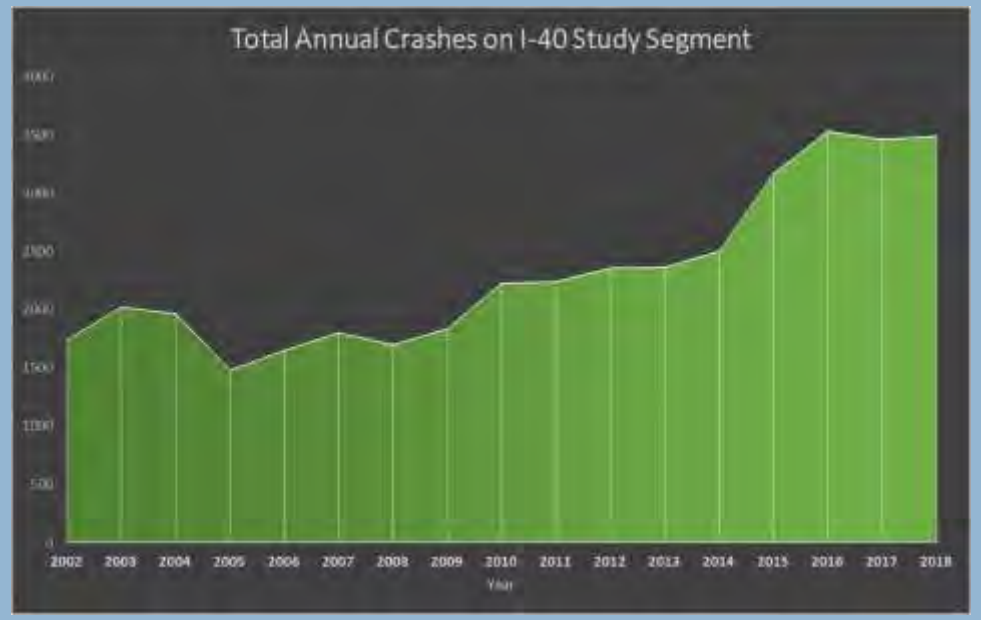
The Hypotheses

- As traffic volumes increase, crash frequency and rates also increase.
- The number of crashes hit a threshold in comparison to volume/capacity where they begin to rise exponentially.
- Widespread cell phone use has led to an increase in crash frequency and rates.
- Construction causes an increase in the number of crashes. Is there a correlation with severity?

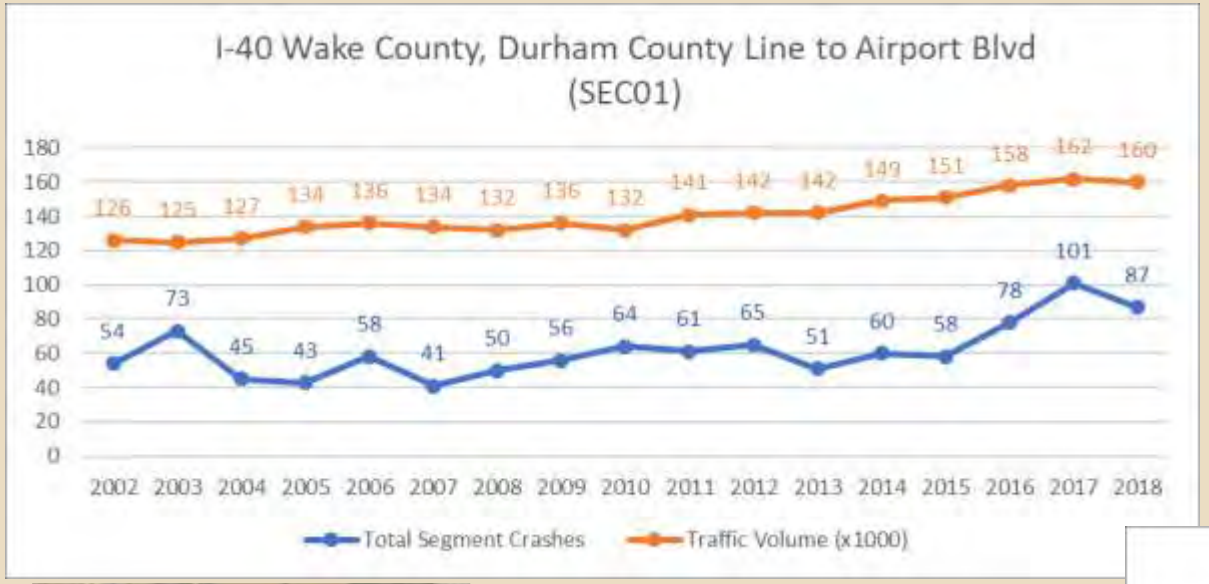
I-40 Crash Heat Map 2002-2018

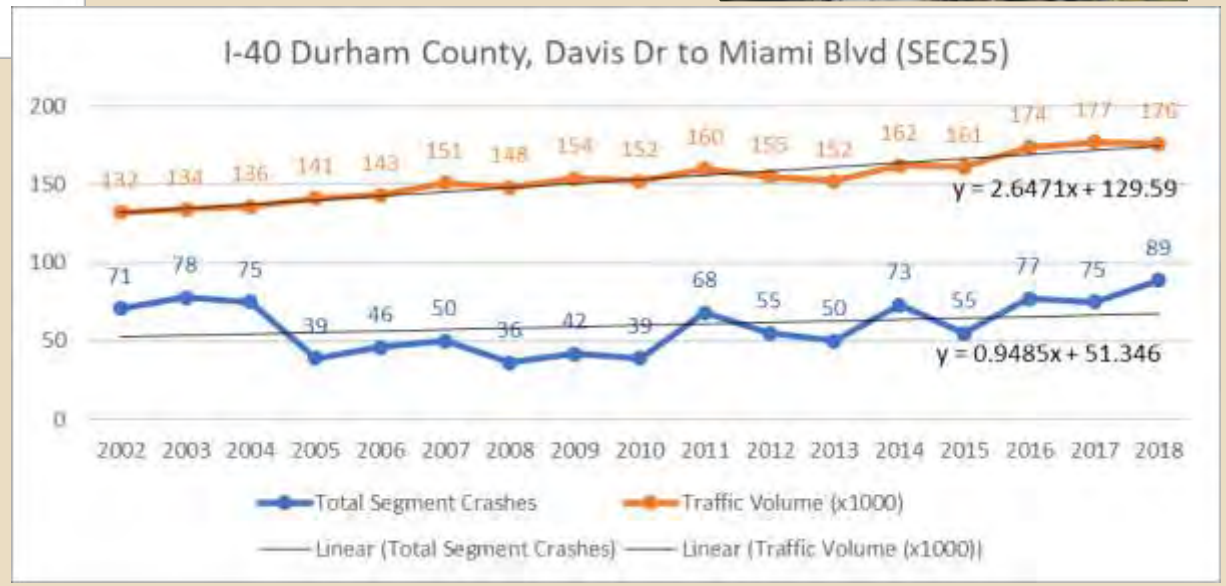
Within the study area over 17 years:

- 90 Fatal Crashes
- 8,512 Injury Crashes
- 31,032 Property Damage Only Crashes
- **39,634 TOTAL CRASHES**

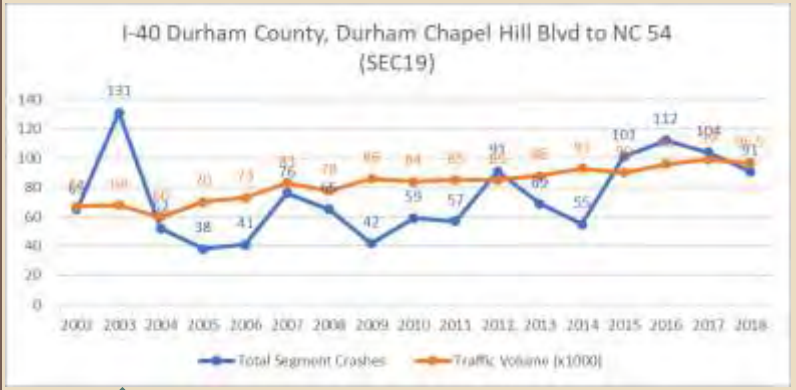


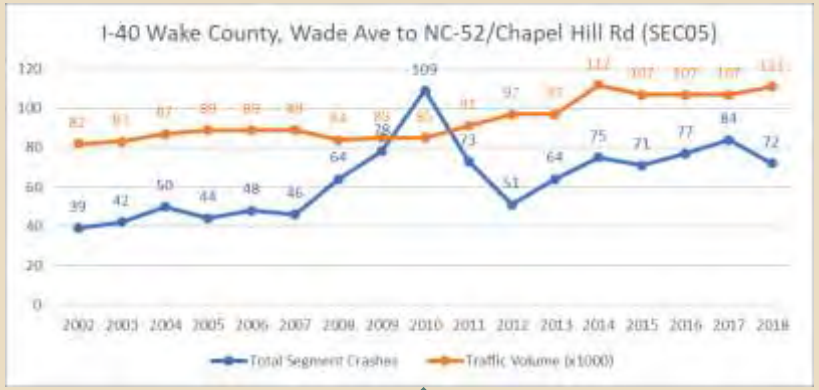
General Expectation

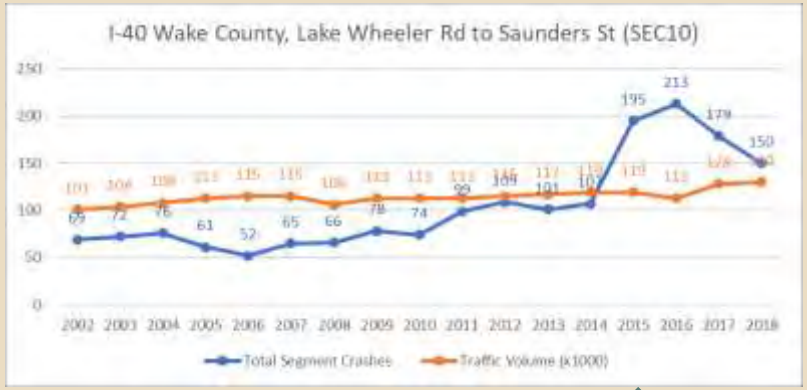




But…
Construction Happens







2003
Widening from 4 to 6 lanes
Exit 270 to Exit 279

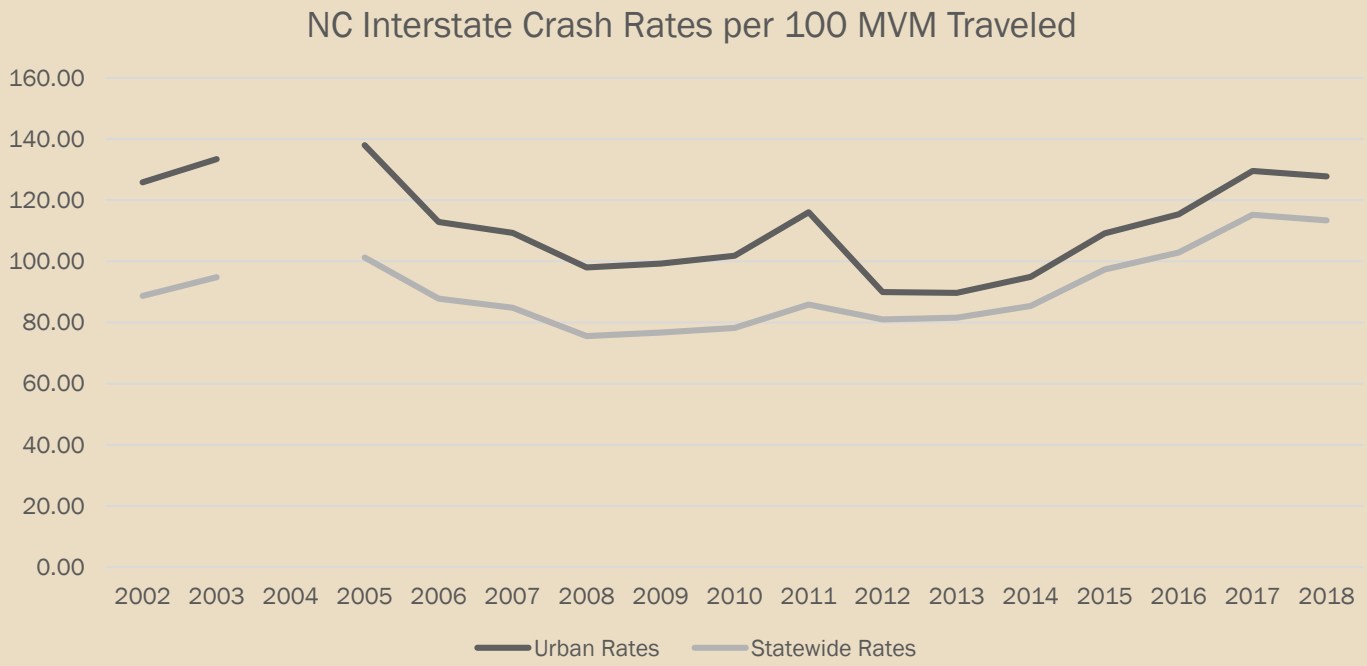
2010
Widening from 4 to 6 lanes
Exit 287 to Exit 295

2015
Project “Fortify” Rebuild
Exit 293 to Exit 301

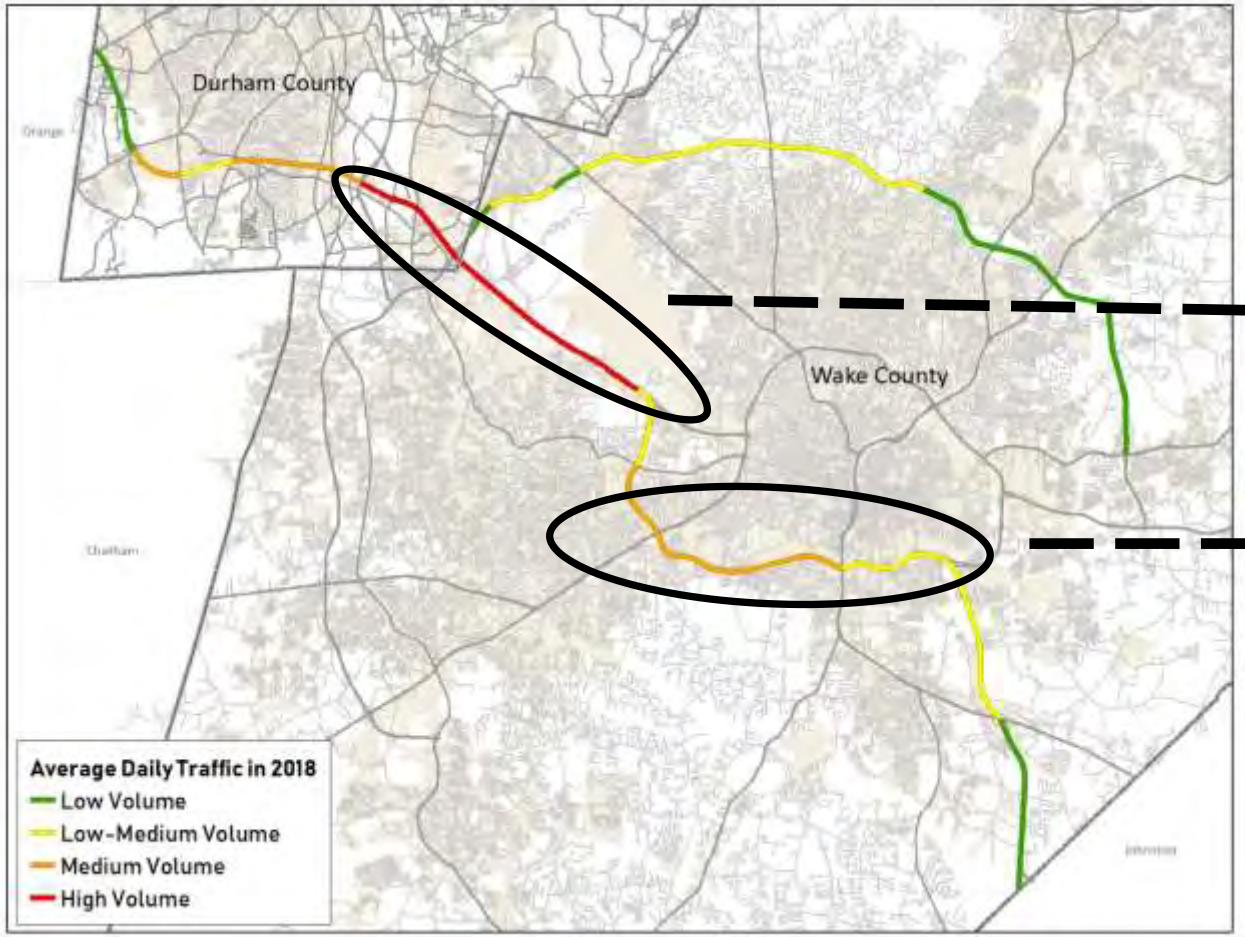
NC Interstate Crash Rates

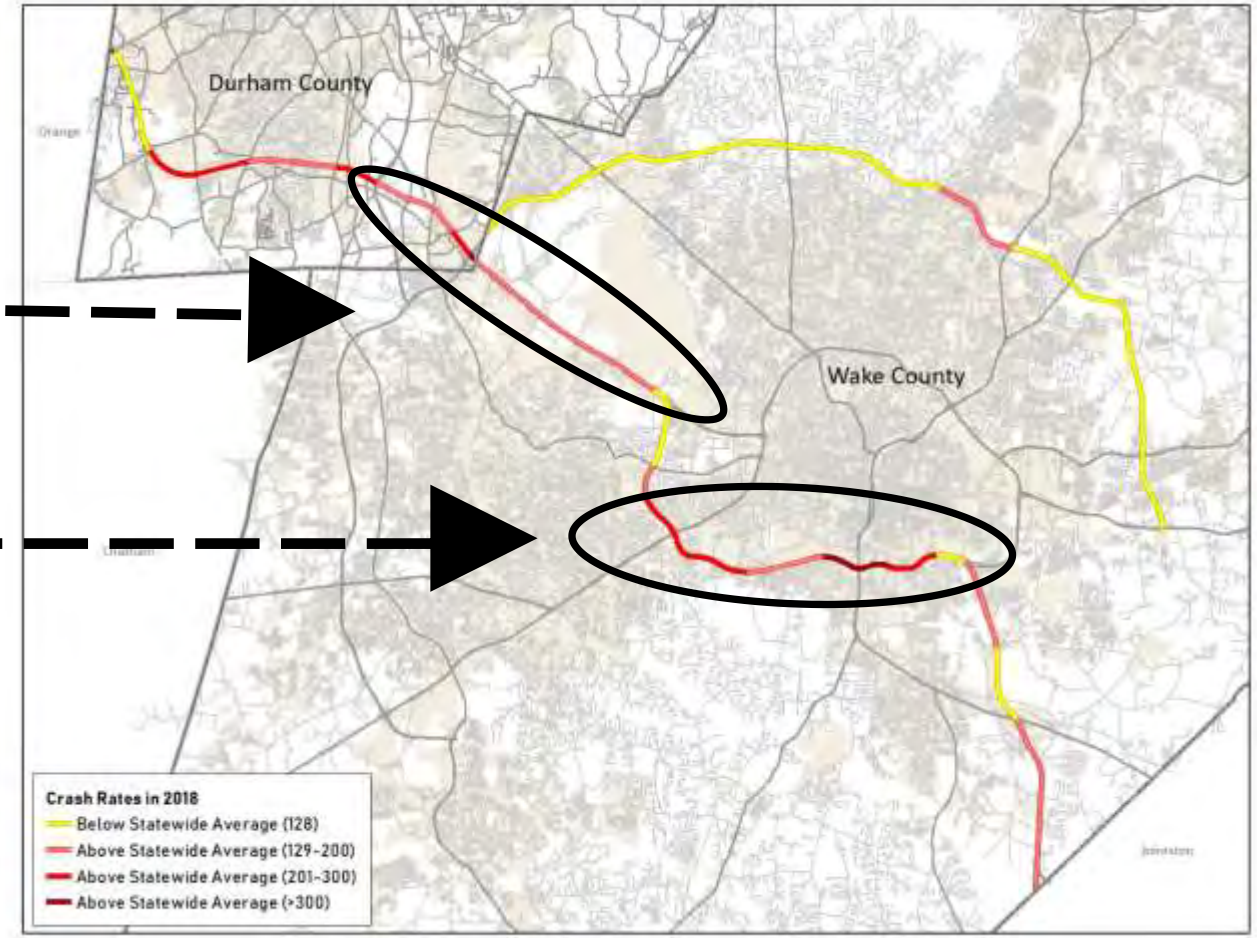
Urban Crash Rates range from 89 to 138 crashes per 100 million vehicle miles traveled

Statewide rates are lower: from 75 to 116 crashes per 100 million vehicle miles traveled



Volumes vs Crash Rates





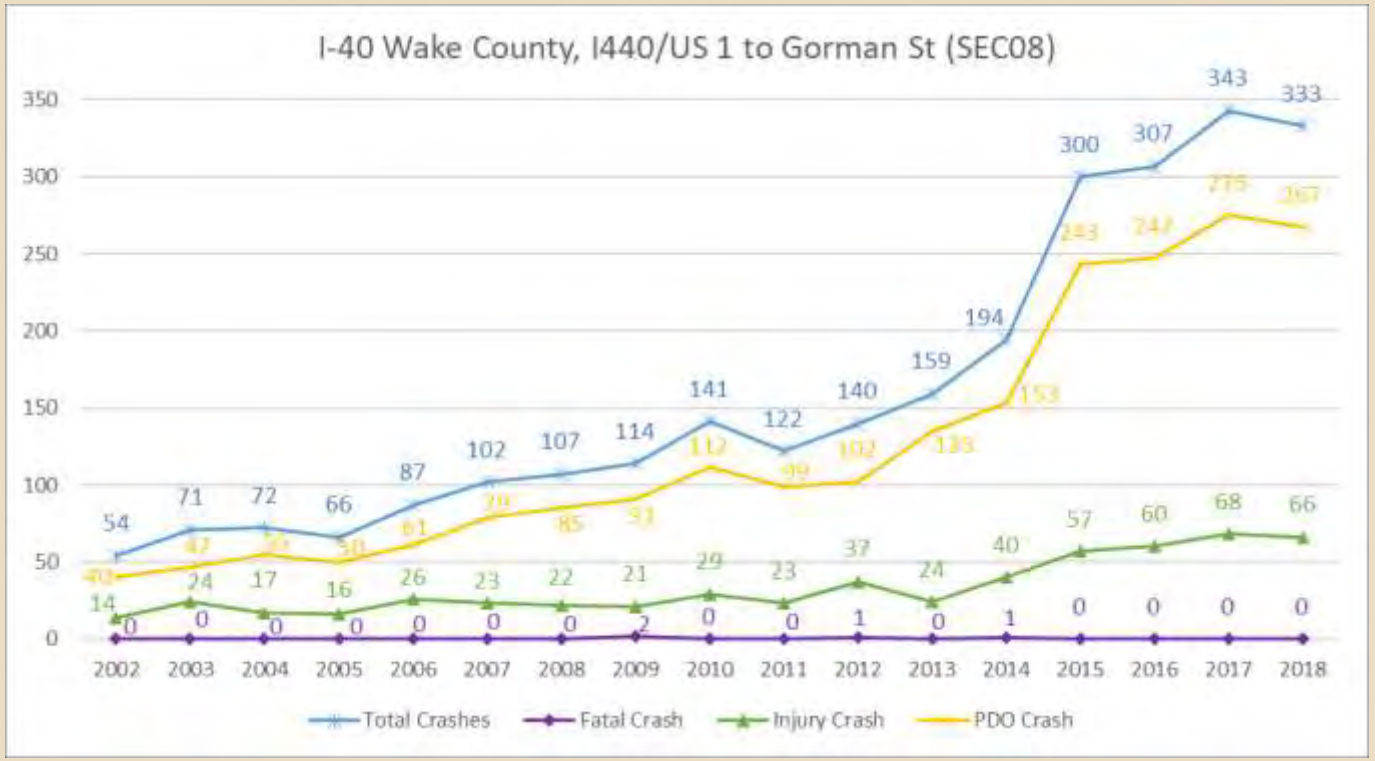
Daily Traffic

Crash Rates

Crash Severity

In this example, construction begins in 2015:

- Total crashes increase
- Property damage only (PDO) crashes increase proportionately
- Injury crashes increase, but by a slightly lower percentage
- Fatal crashes appear unaffected by construction.



Cell Phones (Distracted Driving)

- 1990s – mobile phones disconnect from the car and become more portable
- 2000s – evolution of 3G technology & cell phones become accessories
- 2007 – Apple iPhone debut
- 2013 – Global smartphone sales surpass other types of cell phones

Email, text, social media, & phone conversations are all available in an instant.

Is there increased pressure to remain connected to work / friends / family?

Is there more pressure to multi-task?

In Summary

- High volume does not always correlate to high crash rates.
- “Mid-level” volume segments experience higher crash rates.
- Did not correlate V/C thresholds to an exponential increase in crashes.
- Widespread cell phone use has contributed to crashes and rates.
- Construction is shown to increase crashes by 100%. PDO may slightly outpace injuries over construction duration.

Regional Transportation Alliance
Business Leadership

QUESTIONS?

Special Thanks:

Brian Murphy, PE
Safety Planning Engineer
NCDOT Traffic Safety Unit

Joseph E. Hummer, PhD, PE
State Traffic Management Engineer
NCDOT Mobility and Safety Division

WETHERILL ENGINEERING

FREEVAL-NC advanced freeway model

Mike Reese, NCDOT Mobility and Safety

Behzad Aghdashi, ITRE

FREEVAL-NC

Advanced Freeway Model

I-40 Regional Partnership 11th Annual Meeting
Oct 17, 2019

Mike Reese, PE (NCDOT)
Behzad Aghdashi, PhD, PMP (ITRE/NCSU)

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

ITRE Institute for Transportation Research and Education

KITTELSON & ASSOCIATES

What is FREEVAL?

- It is the official computational engine of HCM to perform freeway analyses.
- It encompasses all freeway segment methods (basic, merge, diverge, and weave) as well as managed lanes, work zone, reliability and other analyses.
- It is able to model oversaturated conditions, queue formation, and dissipation over time and space.
- There has been a number of recent updates to the tool for different purposes (e.g., FREEVAL-2015e, FREEVAL-WZ, etc.)

FREEVAL-NC Overview

- Developed in 2019 by ITRE/NCSU and Kittelson and Associates under a Research Project funded by NCDOT
- Enables **quick** (minutes!) assessment of freeways with and without work zones (*http://freeval.org*)
- Includes all existing NC interstate and non-interstate freeways, key features:
  - 6,723 segment and 3,963 miles directional freeways
  - Geometric (Segment Lengths, types, # of lanes, etc.)
  - Demand (AADT, Percent Trucks, Reliability Demand Multipliers)
  - Safety (Crash Data)
  - Weather Data (Likelihoods of rains, snow, etc. for **65** airports in NC)
  - Standard NCDOT PDF Reports (Key inputs and outputs)

FREEVAL-NC DEMO

Oct 17, 2019

FREEVAL NC

Freeway Analysis Tool

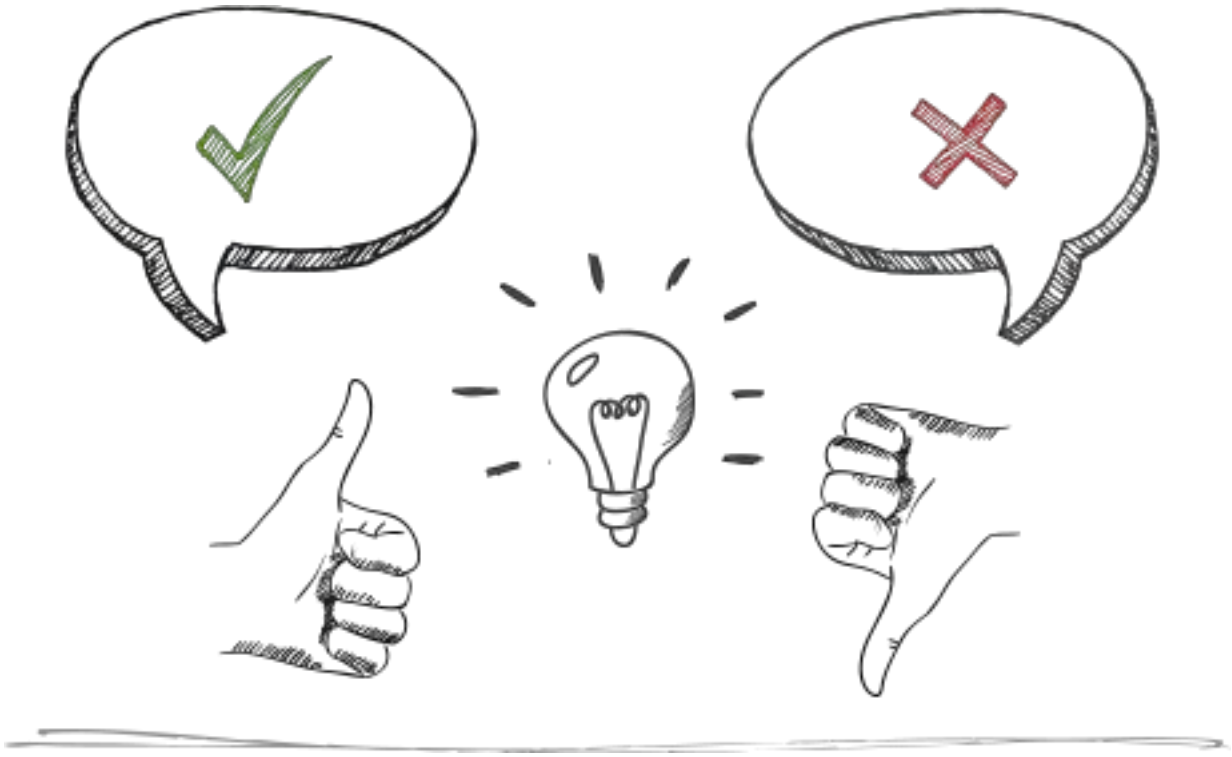
ITRE
Institute for Transportation Research and Education

KITTELSON & ASSOCIATES

FREEVAL-NC Resources

- http://freeval.org
  - Download the latest version of FREEVAL-NC.
  - Download the user guide.
  - Access the segmentation database.
- FREEVAL-NC User Guide
  - Detailed descriptions of FREEVAL-NC's features and functions help you operate the tool.
- YouTube Videos (http://go.ncsu.edu/freeval)
  - Short videos give you a big-picture idea on what different FREEVAL analyses are about.
- Already 76 people trained in full day hands-on workshops across NC (contact saghdas@ncsu.edu for class information)

Feedback



FINAL REMARKS

I-40 Regional Partnership
11th Annual Meeting

Thursday, Oct. 17, 2019
Hosted by SAS

Coordinated by the Regional Transportation Alliance business coalition in cooperation with the NC Department of Transportation and area partners