Coordinated Adaptive Ramp Metering

and Its Future in North Carolina

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

April 24, 2019

Agenda

- Phases of ramp metering
- The managed motorways concept
- How does it work
- Why do freeways fail
- Managed motorways down under
- US efforts
- NC Corridors
- Lessons learned

Phases of Ramp Metering Project

- Basic Operation –Pre-Timed, Set Release Rates, and Set Hours of Operations **“I-540 Pilot Project”**
- Local Traffic Responsive –Turns on in response to Mainline Vehicle Detection Data, and Sets Release Rate based on data thresholds
- Coordinated Traffic Responsive –Shares mainline vehicle detection data between a limited number of ramps up and down stream a few ramps; attempts to prevent flow breakdown
- Coordinated Adaptive –Balances traffic demand across a corridor to provide the most equitable wait time for all who utilize the freeway. **“ One Piece of the M1’s Managed Motorway Concept”**

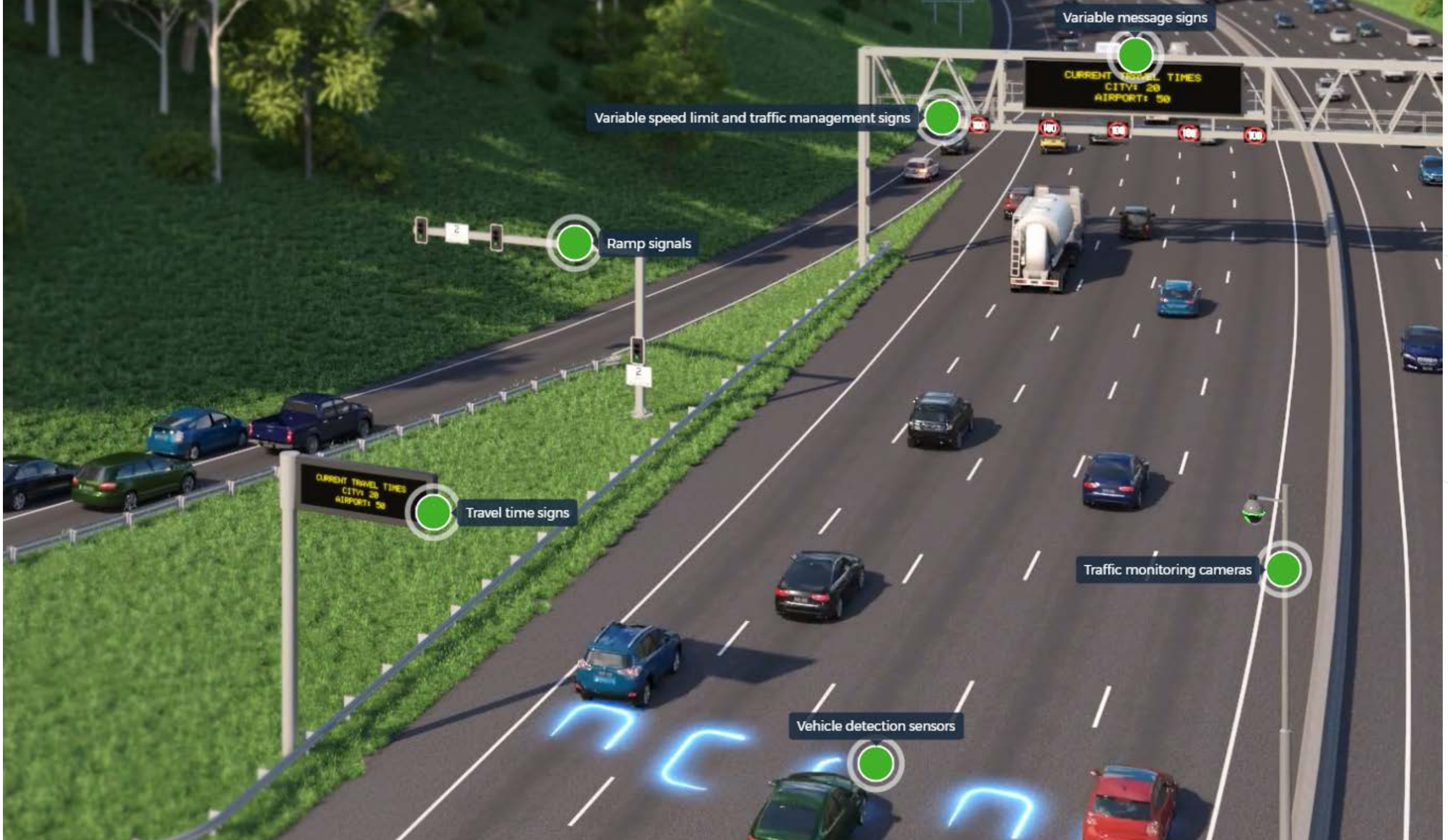
The Managed Motorways Concept

A collection of strategies and technologies that work in concert to provide a holistic approach to managing traffic operations of a freeway. The integration of these systems is critical to the ability of this concept to increase on -road outcomes by:

- Enhancing safety
- Improving reliability
- Reducing congestion
- Providing traveler information
- Improving lane utilization

In Layman's Terms

- A series of coordinated ramp meters
- Integrated sensors along freeway and surface streets collecting high resolution data
- Ramp improvements to handle additional queuing and ramp discharge
- Command and control software
- Human intervention at Traffic Management Center
- Incident detection and CCTV surveillance
- Can include traveler information
- Can include lane management (variable speed limits, lane control, shoulder running, pricing)

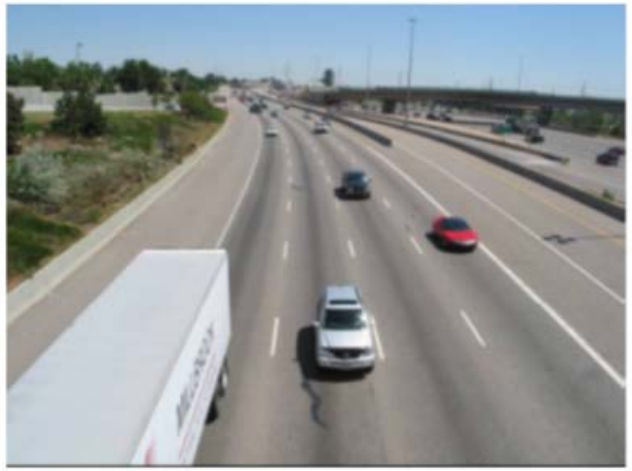

Variable message signs
CURRENT TRAVEL TIMES
CITY: 20
AIRPORT: 50
Variable speed limit and traffic management signs
Ramp signals
CURRENT TRAVEL TIMES
CITY: 20
AIRPORT: 50
Travel time signs
Traffic monitoring cameras
Vehicle detection sensors

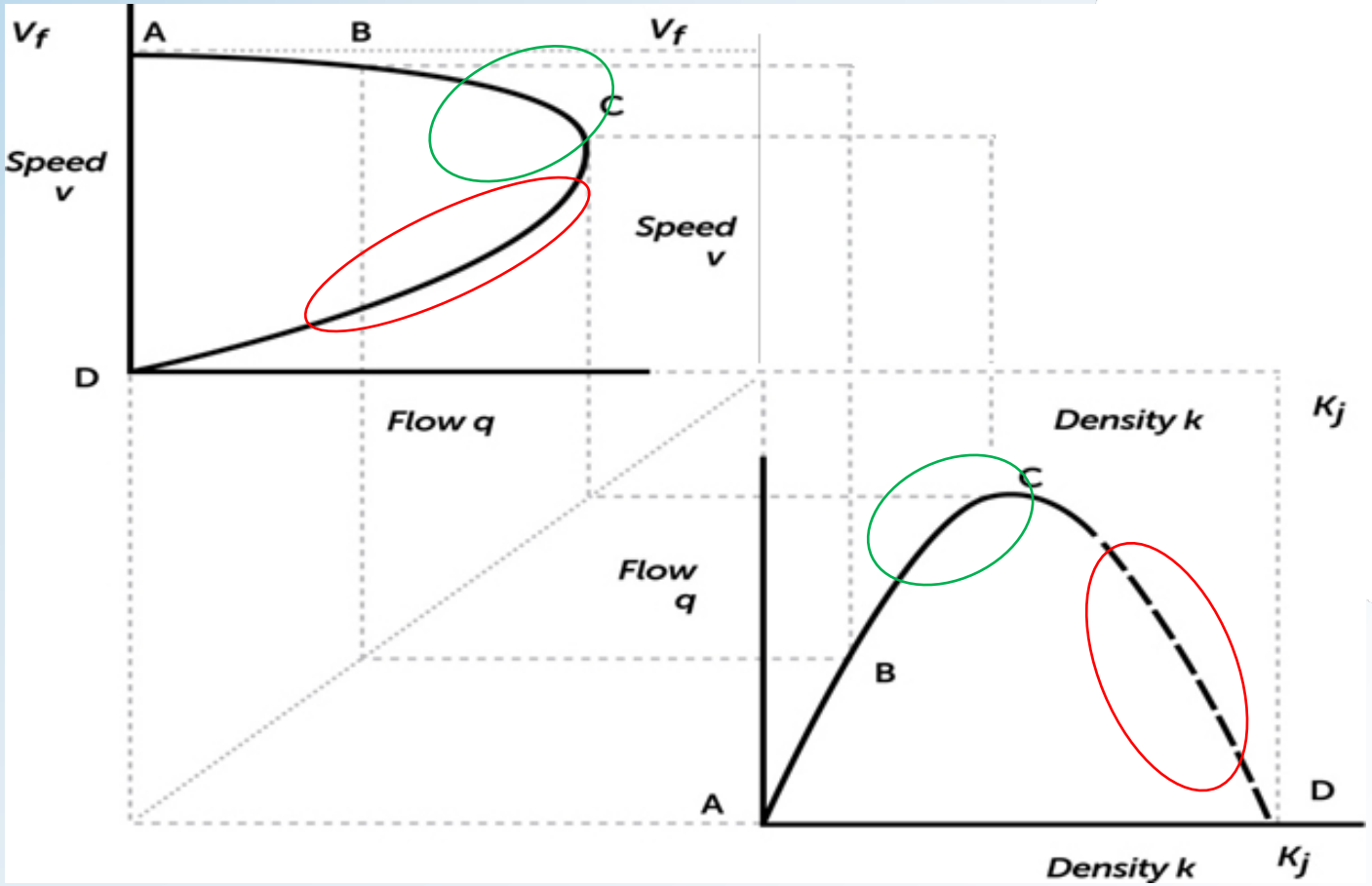
How Does It Work

- Synchronizes flow of vehicles entering a freeway to available capacity on the freeway
- Provides real time demand management (every 20 seconds) to control traffic and optimize overall freeway efficiency
- Interchanges coordinate with one another to prevent excessive wait times and queuing for all interchanges, metering rates differ for each ramp

YouTube VicRoads –Freeway Management System

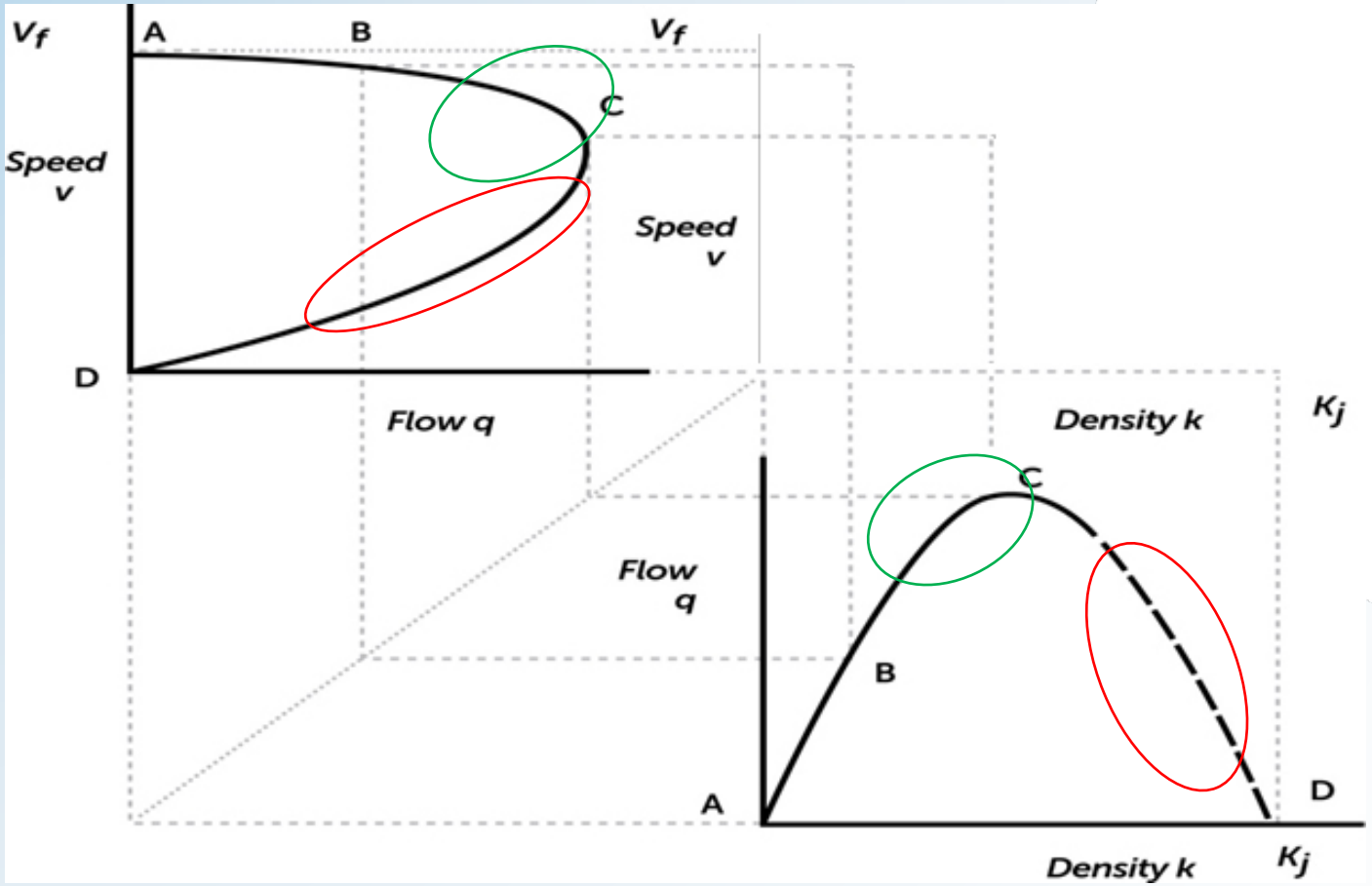
Why Do Freeways Fail





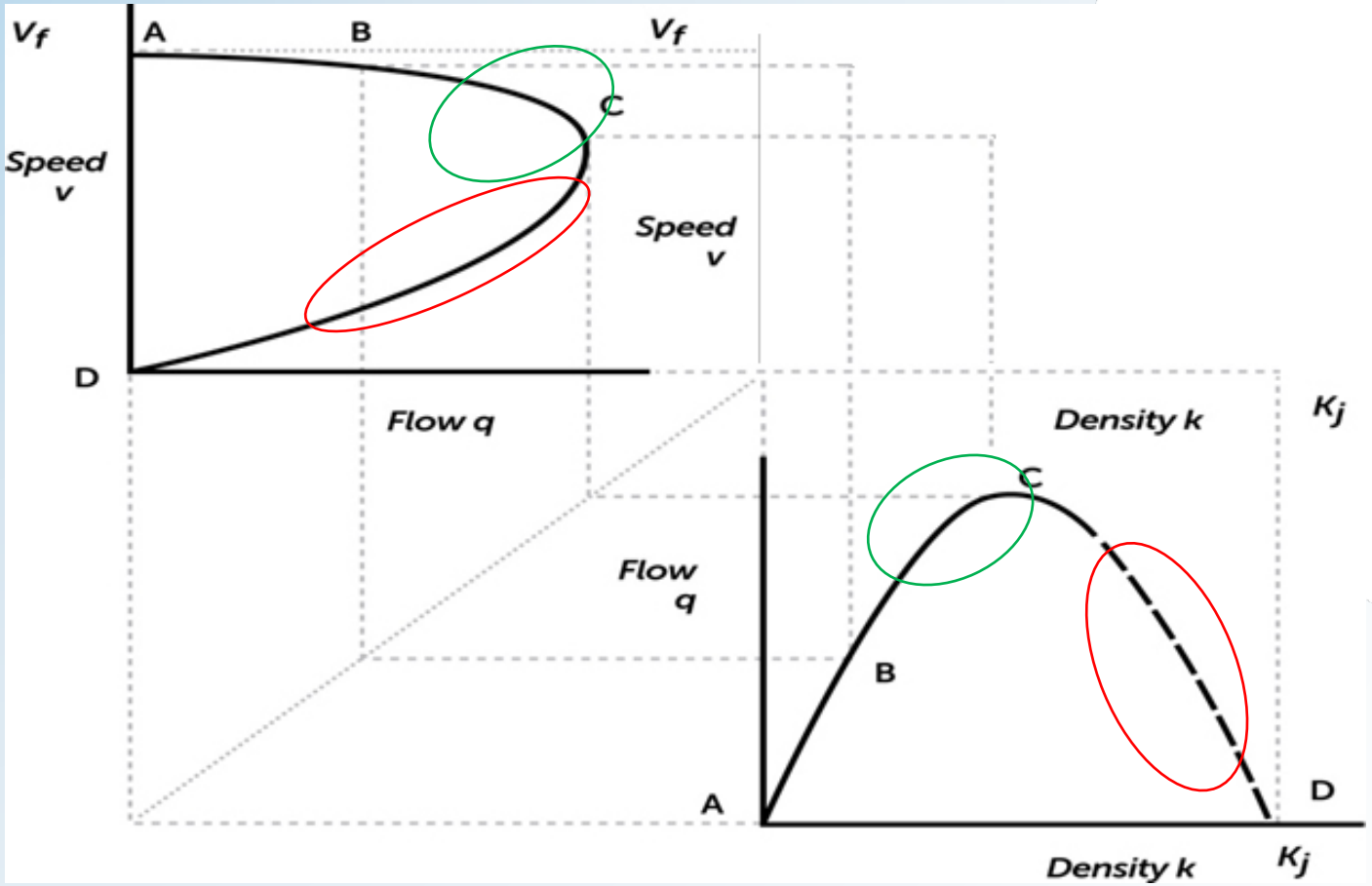
Freeways perform at their worst when they are needed the most.

Why Do Freeways Fail



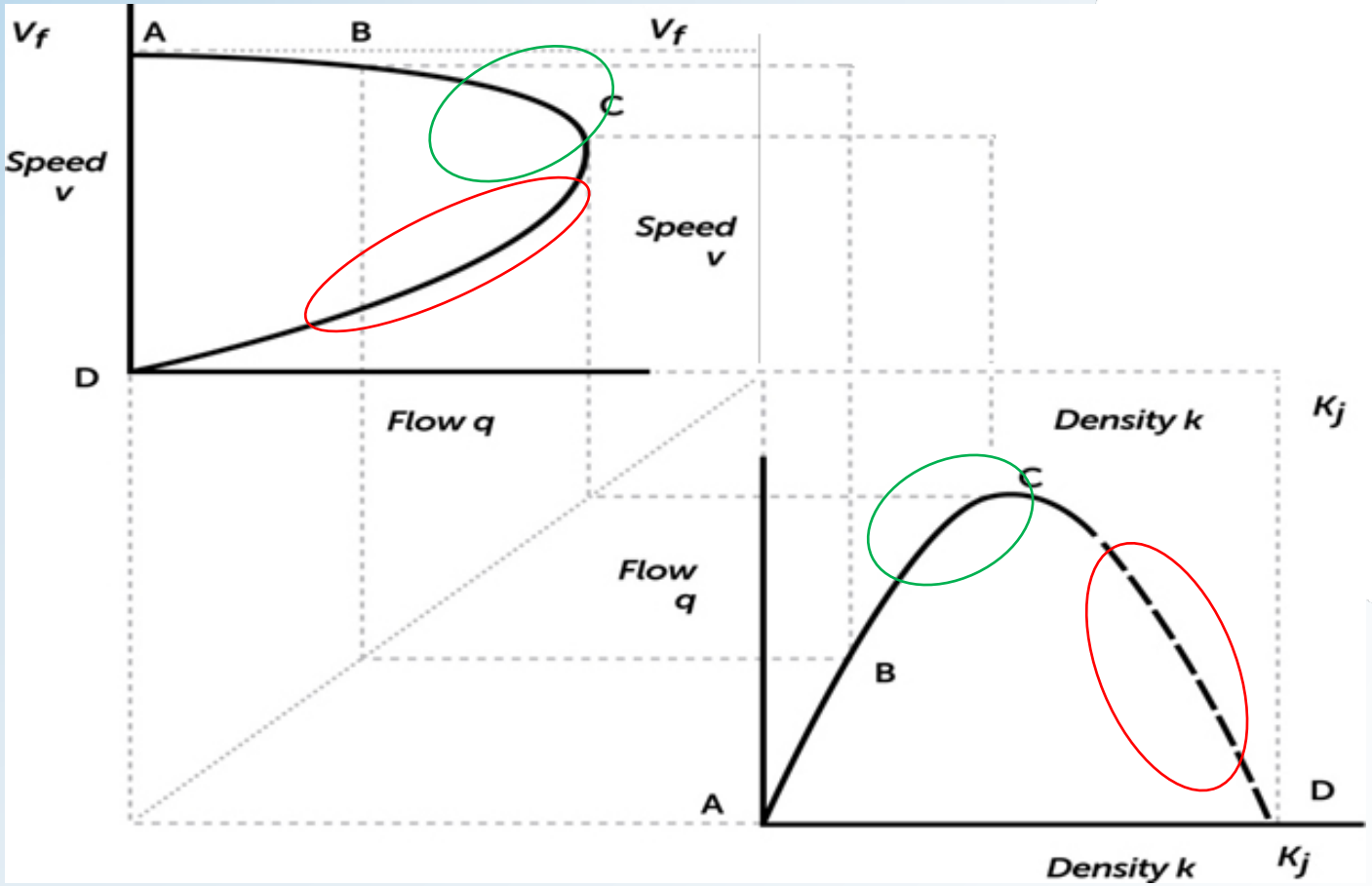
Freeways perform at their worst when they are needed the most.

Why Do Freeways Fail



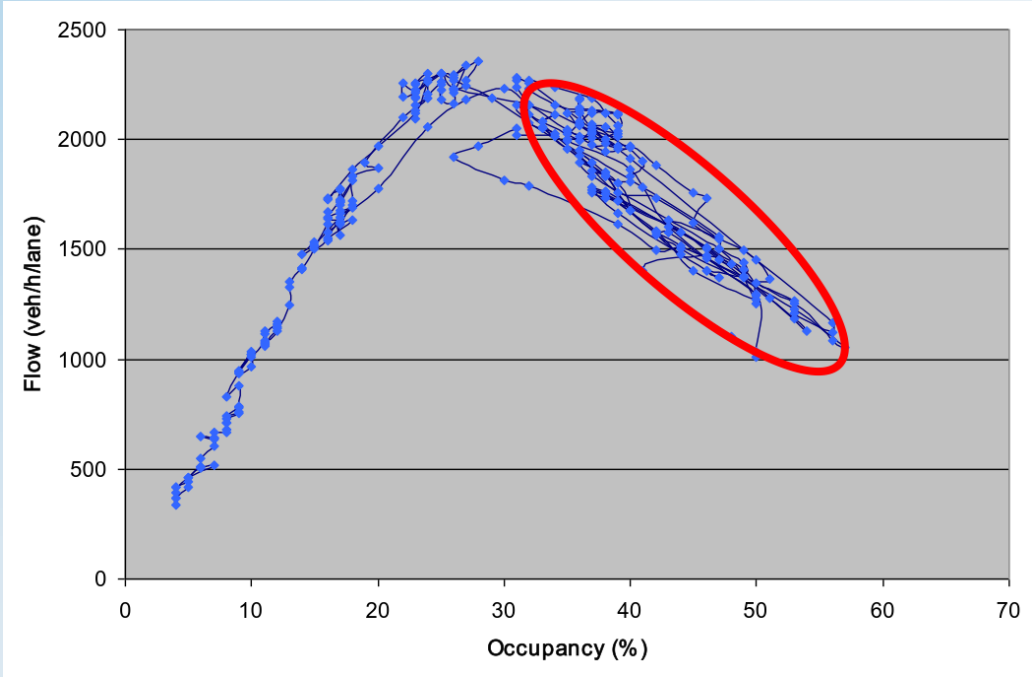
Freeways perform at their worst when they are needed the most.

Why Do Freeways Fail



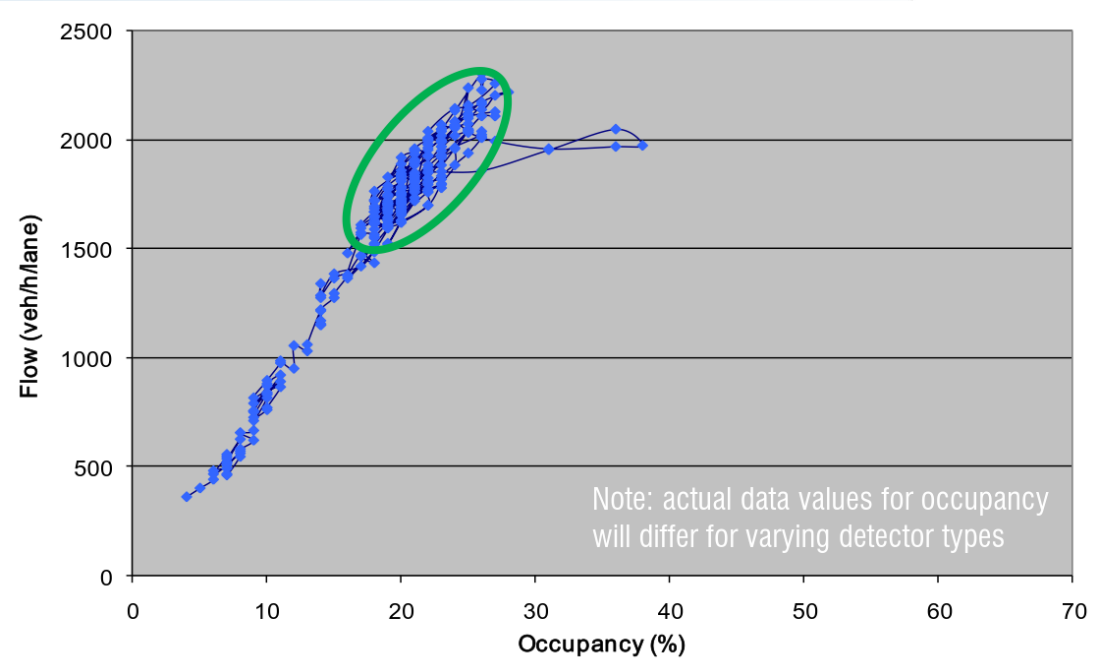
Freeways perform at their worst when they are needed the most.

Unmanaged vs Managed

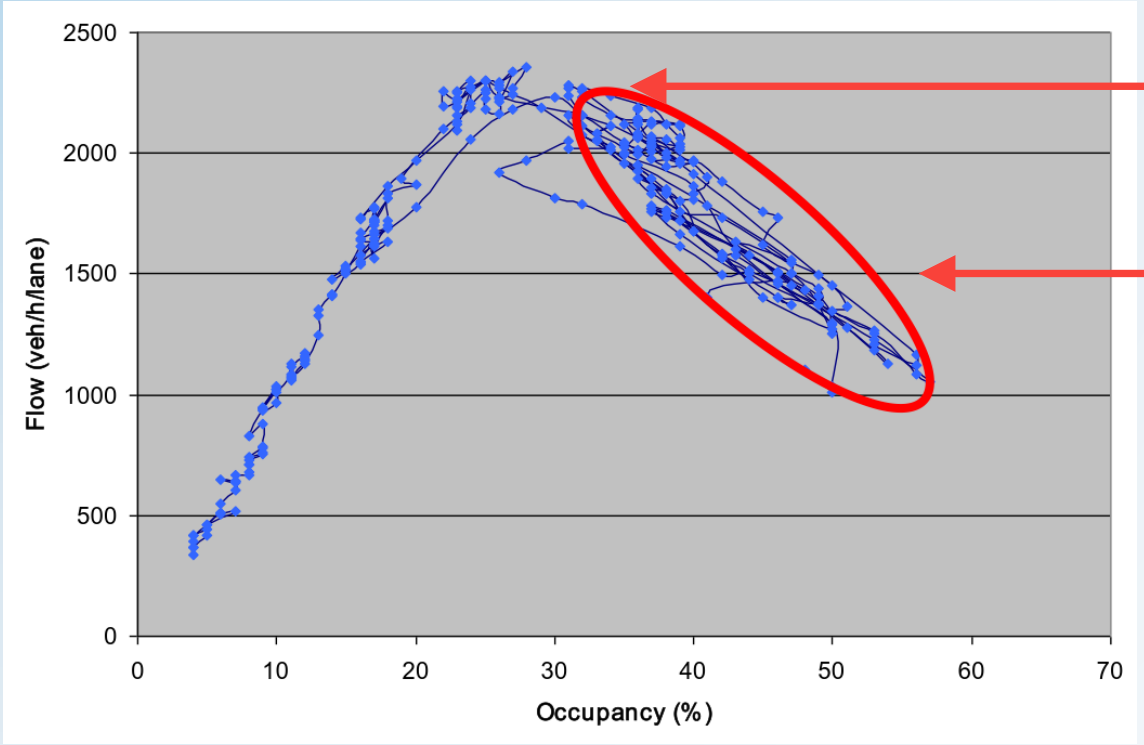


Unmanaged

Managed

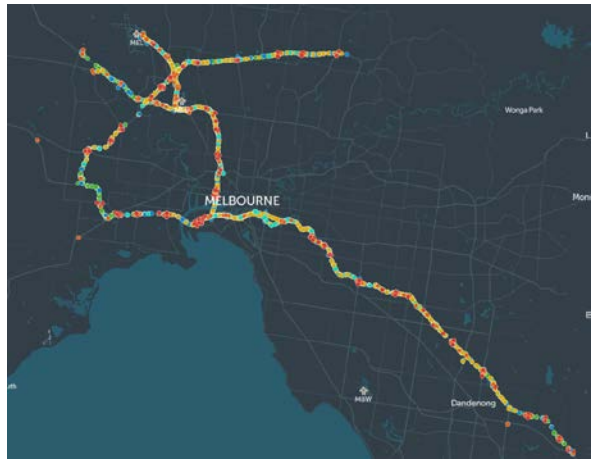


Unmanaged vs Managed



4 lanes @ 2,300 = 9,200
4 lanes @ 1,500 = 6,000
9,200 -6,000 = 3,200
More than a lane worth of capacity!

Managed Motorways Down Under



- First deployed in Melbourne in 2009 on the M1 Freeway
- 47 miles, carrying over 160,000 vpd
- 1,100+ detection, signal, and communication devices
- Coordinated adaptive metering at 62 locations
- Ramp improvements at 30 locations
- Priority ramp bypass for transit, HOV, and trucks at ramp locations

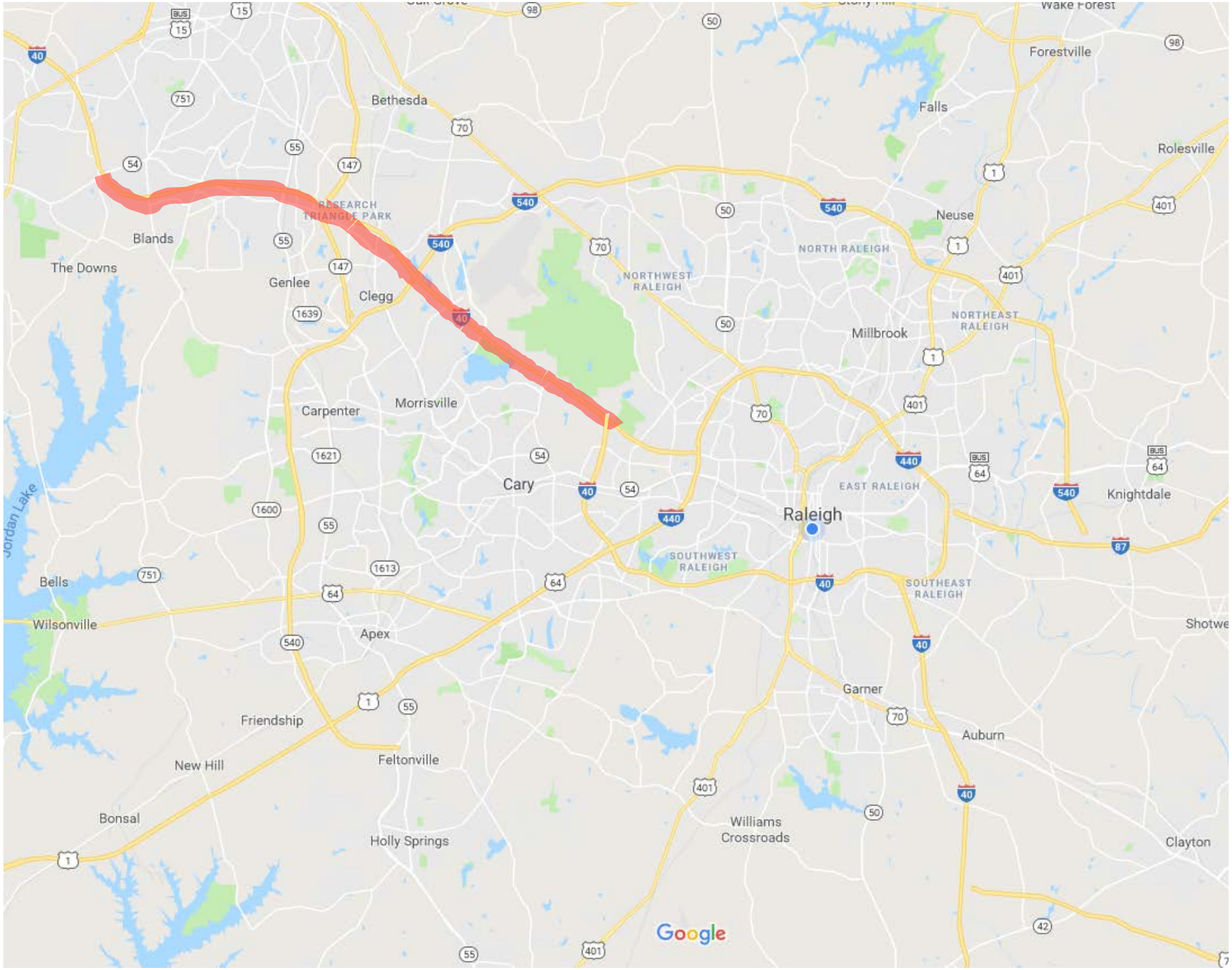
Managed Motorways Down Under

- 5% increase in peak traffic flow rate, 25% in overall flow
- Flow rate is now sustained throughout peak periods
- Traffic speeds improved between 35% and 60% during peak periods
- Decreased crash rates while other Melbourne freeways generally increased

US Efforts

- Colorado – Currently under construction
  - 14 miles, 14 interchanges,
  - 18 meters, 7 ramp improvements
  - Includes freeway to freeway interchanges
- Utah – Feasibility study on I -15 in Salt Lake City completed. Design steps being developed
- Arizona – High level feasibility study complete
- Georgia – Identified a pilot corridor, developed mainline/interchange/arterial vehicle detection templates, performed testing to implement coordinated traffic responsive application, Procuring new ATMS with a CARM application

I-40 in Triangle Region – Wade to NC 54



I-40 in Triangle Region – Wade to NC 54

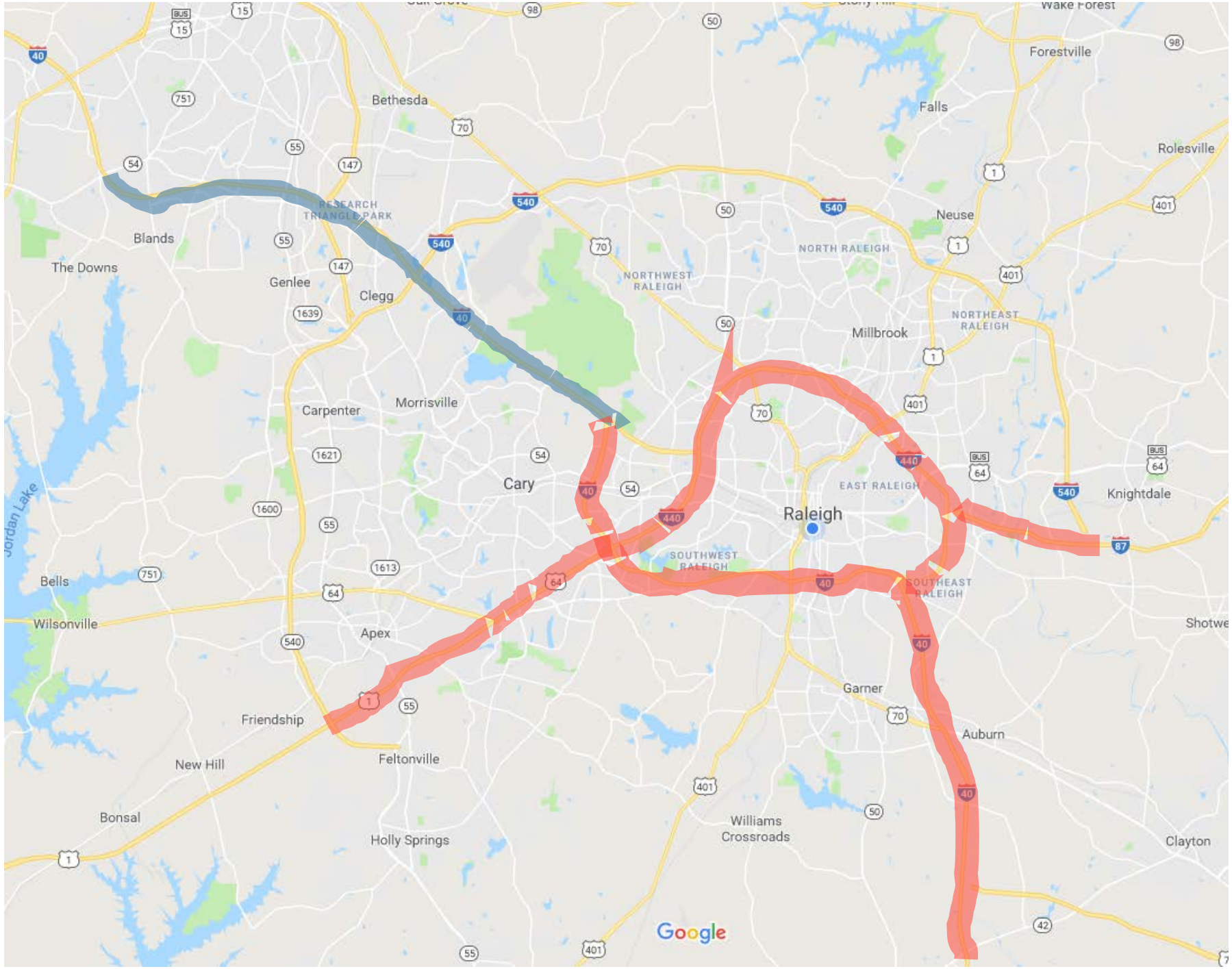
- TIP #I-6006 for I 40 from NC 54 to Wade Avenue ROW and construction in FY 25
- Why I-40 project made sense for this application for the department
  - Recurring congestion
  - Safety concerns
  - No plans for adding GP through lanes
  - Cost effective treatment
  - Funded in STIP

I-40 in Triangle Region – Wade to NC 54

- Feasibility study under way, completion in June
  - Preliminary screening
  - Analysis of required storage
  - Analysis of Ramp Discharge Capacity
  - Detection requirements, including detection templates for various interchange types
  - High level cost estimates and environmental analysis
- Have completed traffic counts and analyzed ramp capacities, bottlenecks, and detection requirements
- Working on software/IT concerns
- Beginning to develop ramp designs

Triangle Area Corridors

Project	ROW	CON
I-6006	2025	2025
I-6101	2026	2028



Other Triangle Area Corridors

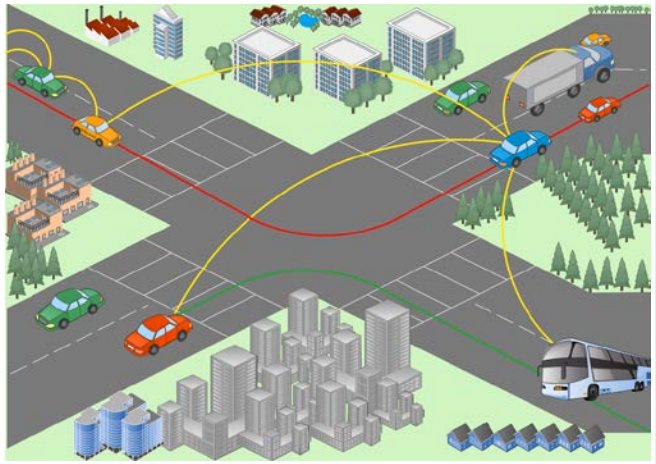
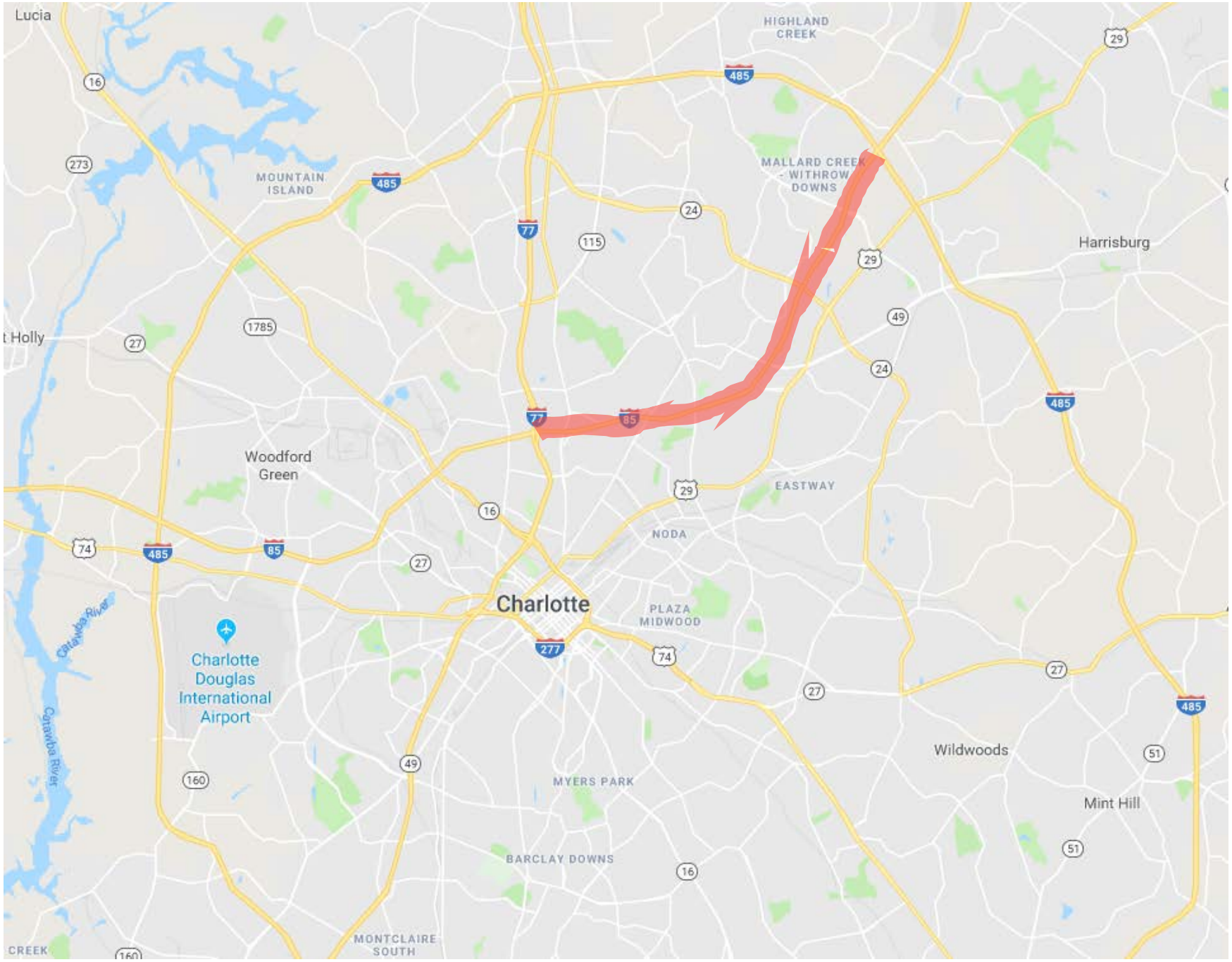


Image by conceptdraw.com

- How managed motorways fits into the regional vision:
  - Part of a larger regional investment in ITS
  - Integrated community signal systems
  - Connected vehicle investments
    - Infrastructure to vehicle
    - Vehicle to vehicle
  - Evolving investment approach
    - Backbone/nervous system investments now

I-85 in Charlotte – I-77 to I -485



Lessons Learned

- Managed motorways is a multi -faceted solution that involves new skill sets, communications systems, control engineering and systems, and optimization strategies
- It is important to control all access points
- Can significantly reduce delay and increase reliability
- Much cheaper than adding an additional lane
- Can be used in conjunction with managed lanes, toll facilities, and future widening

Questions?

Will.Letchworth@WSP.com
919-805-4900

DPKeilson@NCDOT.gov
919-220-4600

Chris.Lukasina@CAMPO-NC.us
919-996-4402