I-485 Express Lanes

NC MODEL USER GROUP MEETING

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STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

CLEARBOX

Agenda

- Travel Demand Model (TDM)
  - Limitations
  - TDM and Micro-simulation

- I-485 Express Lanes
  - Volume Development
  - Model Development
  - Measures of Effectiveness (MOE)

- Lessons Learned

Travel Demand Models and its Limitations

- All travel demand models have trade offs between accuracy and precision
- Forcing one can have a negative impact on the other
- Travel demand models do not have all facilities or take in to account all aspects of the road (e.g. exact driveways and locations)
- As such, there are limits to accuracy and precision

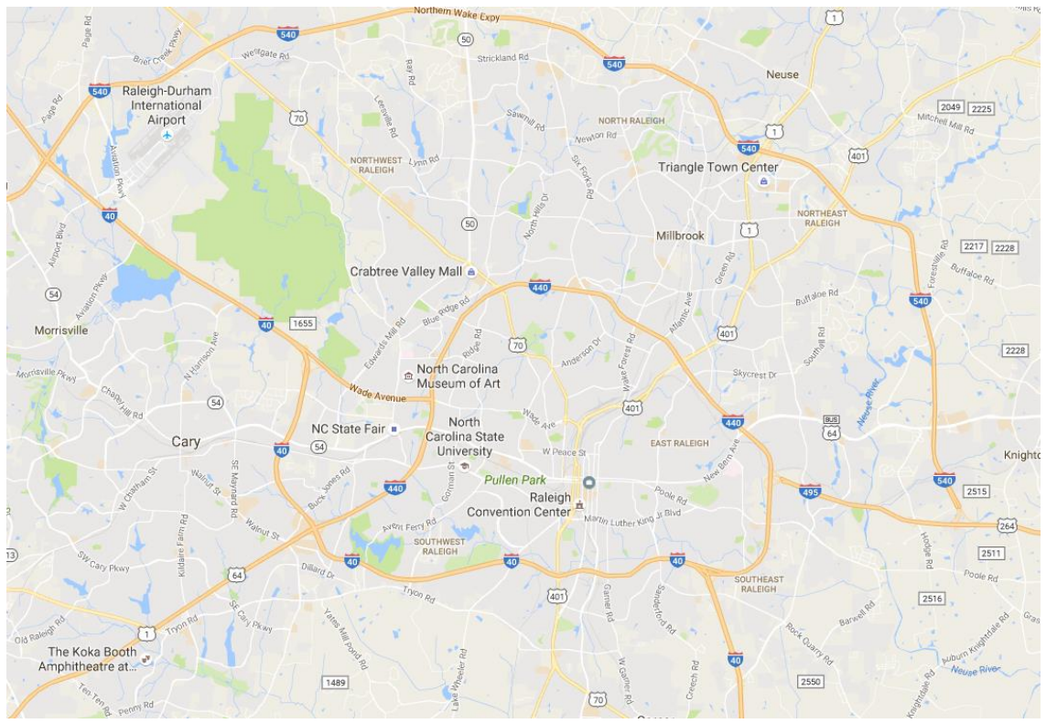
This is why a travel demand model is a tool and applied to field collected data/statistics

Travel Demand Models – TDM vs Micro-simulation

- Each type of model has its own use
- It is important to use the appropriate model for the appropriate task
  - Travel demand models should be used to help inform traffic change (growth, reduction, shift) decisions over large areas.
  - Micro-simulation models should be used to judge operational improvements to specific areas or corridors.

Travel Demand Models – TDM vs Micro-simulation

How do we use each tool well?



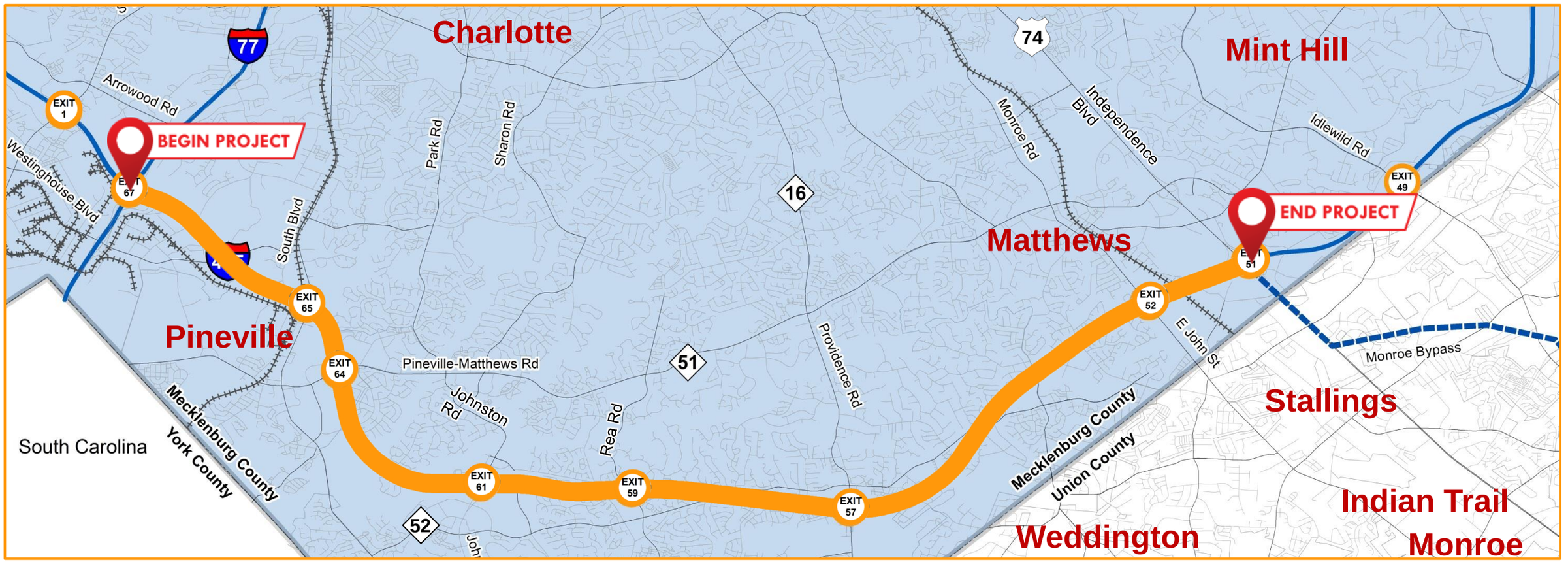
Forecasting vs Capacity Analysis – Process Comparison

New designs strain the linkage between forecasting and capacity analysis

- How do we handle turns on synchronized streets? Other locations access is limited?
- How do we allow for different volumes in the AM and PM peak hour?
- How do we handle the distribution of traffic between a free and managed facility?

New questions need new solutions

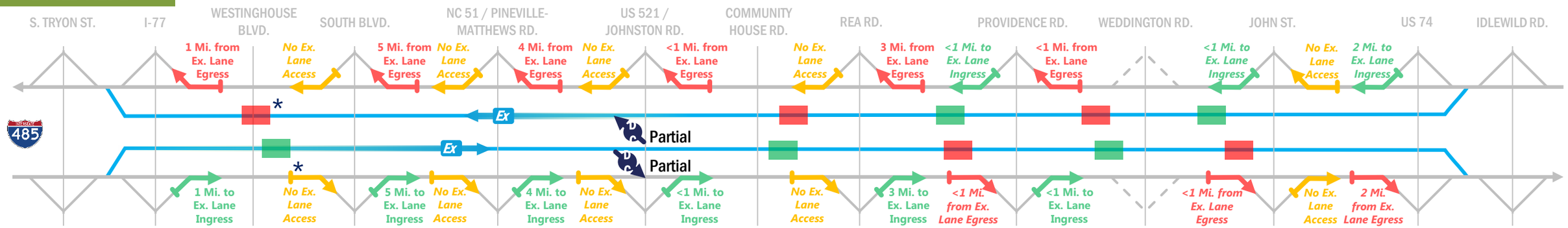
Project Location



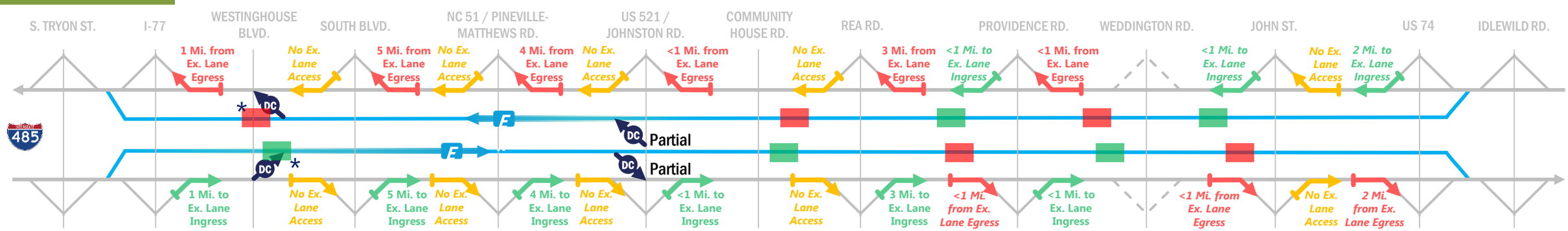
I-485 EXPRESS LANES
MECKLENBURG COUNTY

Alternatives

BUILD ALT 1



BUILD ALT 2



LEGEND

Partial DC — **Partial Direct Connector** *(Access to/from the south side of Johnston Road (but not to the north)*

Ingress Access Point

Egress Access Point

Combined Access Point

Ex — **Express Lanes**

General Purpose Lanes

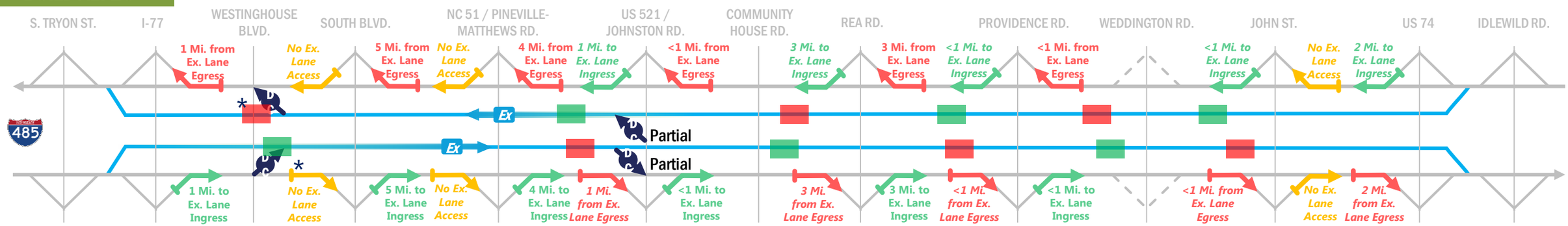
* *Access Points between I-77 and South Boulevard may be relocated to east of Westinghouse Blvd based on traffic operations analysis results.*

NOTE: As traffic operations analysis for the Build Alternatives is performed, the Access Point locations may be further refined/relocated accordingly.

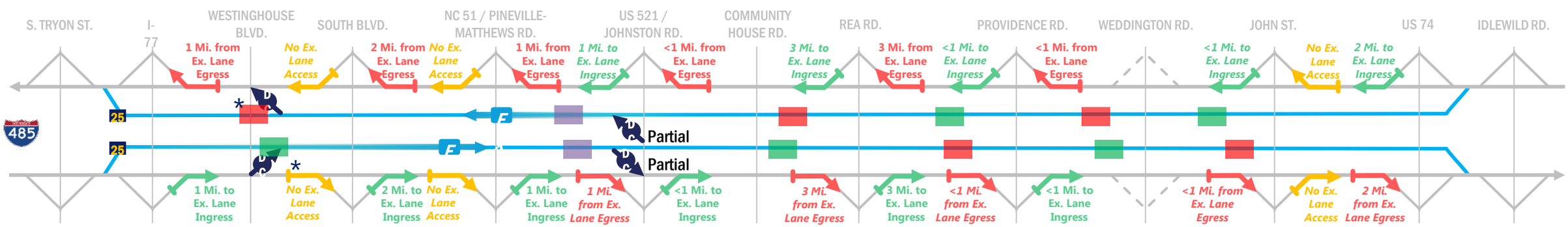
I-485 EXPRESS LANES
MECKLENBURG COUNTY

Alternatives

BUILD ALT 2C



BUILD ALT 2D



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I-485 Simulation Models

- Development of I-485 Simulation can be broadly divided into three (3) steps:
  - Volume Development
  - Model Development
  - Model simulation to obtain Measures of Effectiveness (MOE)

Volume Development

- Peak Period Volumes were developed for the following conditions:
  - 2013 Existing Conditions
  - 2015 Interim Conditions
  - 2040 No Build Conditions
  - 2040 Build Conditions

2040 No-Build Volume Development Steps

2015 NB1

- Includes 2013 Network and GP lanes between I-77 and Rea Road (R-4902)
- 2013 O-D matrices were grown by 5% for all 9 analysis hours
- These 9 matrices were used for the 2015Interim Conditions micro-simulation

2015 NB2

- Includes Weddington Road GP interchange
- TransCAD MRM runs were performed for scenarios with and without the Weddington Road interchange
- 2015 NB 1 hourly O-D matrices (all 9 hours)were adjusted based on travel pattern changes observed from TransCAD MRM runs
- No changes were made to demand

2015 NB3

- Includes lane extensions at Westinghouse Boulevard, South Boulevard, Ballantyne Commons Parkway, and Community House Road
- 2015 NB 2 hourly O-D matrices (all 9 hours) were adjusted based on travel pattern changes observed from TransCAD MRM runs and peak period field traffic counts obtained from Charlotte DOT
- No changes were made to demand
- These 9 matrices served as seed matrices for *2040 NB 3 ODME*

2040 NB3

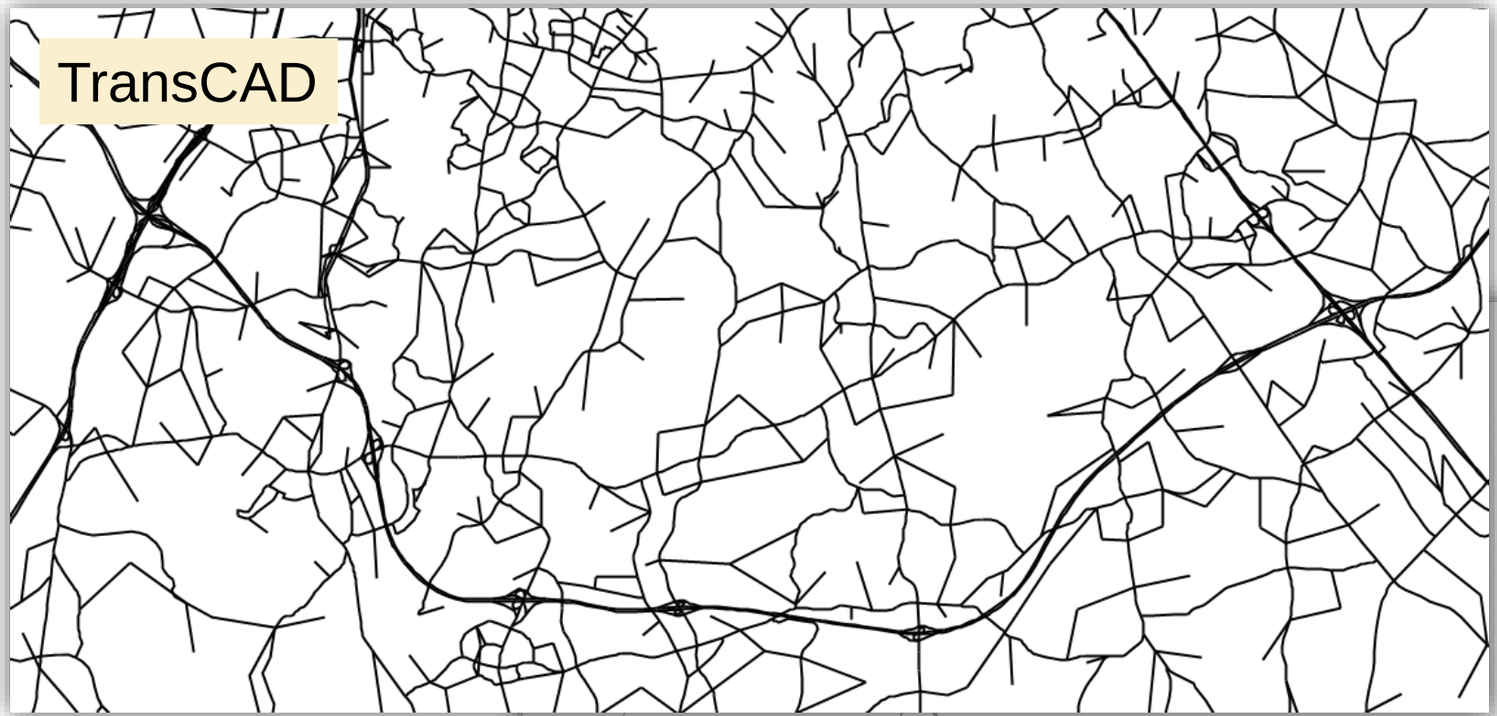
- 2015 NB 3 hourly O-D matrices were input as seed matrices for ODME process
- Peak hour traffic volumes from the 2040 No Build traffic forecasts were balanced and were input as target for ODME process
- The target volumes for all four hours in the AM peak period are the same (AM peak hour) and similarly, the target volumes for all five hours in the PM peak period are the same (PM peak hour).
- 2040 NB 3 hourly O-D matrices (all 9 hours) were estimated using VISUM's ODME process

2040 NB4

- Includes the proposed express lanes between I-77 and US 74 and additional general purpose lane between Rea Road and Providence Road
- TransCAD MRM runs were performed for scenarios with and without the proposed express lanes and GP lanes
- 2040 NB 3 hourly O-D matrices (all 9 hours) were adjusted based on travel pattern changes and demand changes observed from TransCAD MRM runs
- These 9 matrices were used for the 2040 Build Conditions micro-simulation

Approach Tools

TransCAD

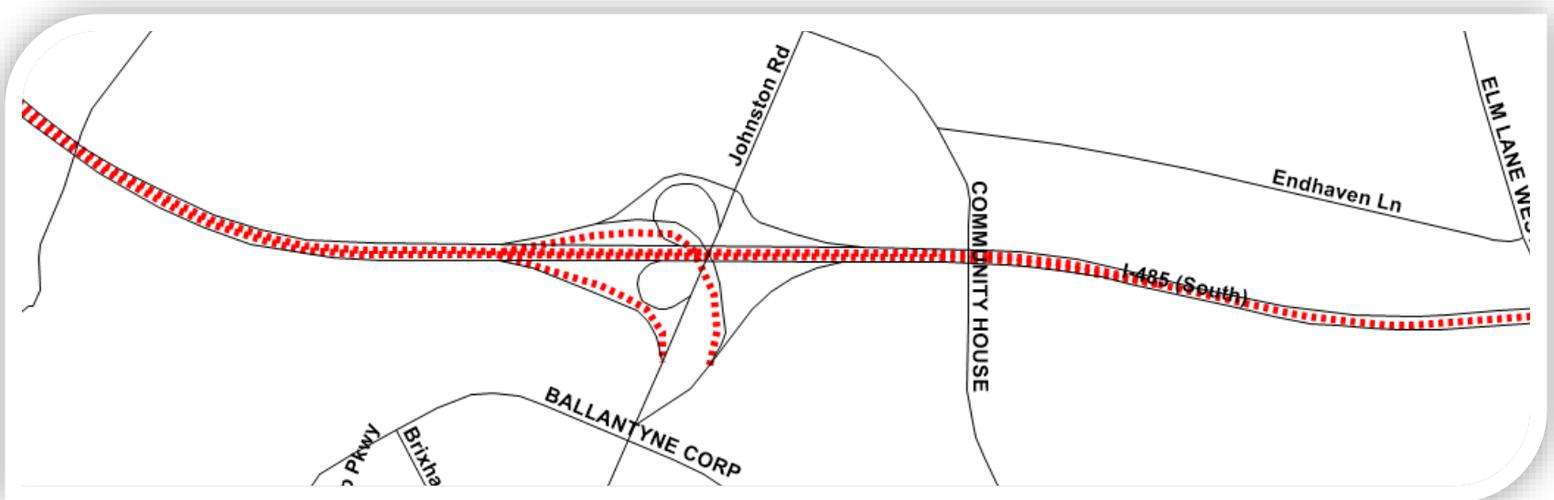


VISUM

TransModeler

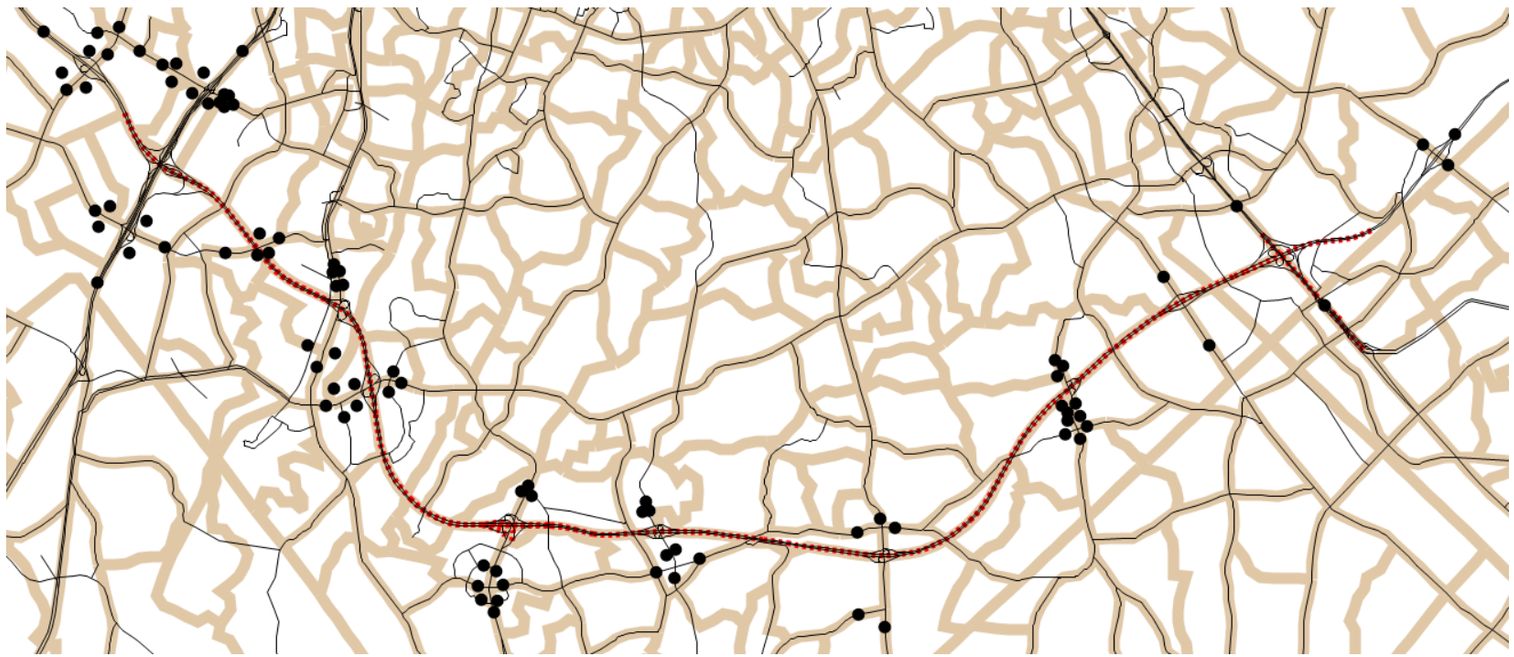
TransCAD Utilization

- TransCAD was utilized to measure overall demand impacts to the study area with the No-Build and Build scenarios
- Use of TransCAD has several benefits:
  - Considers the entire region – are there additional through trips on I-485?
  - Base and future year land use conditions
  - Base and future year transportation system
  - System “equilibrium” - Cascade effect of improvements



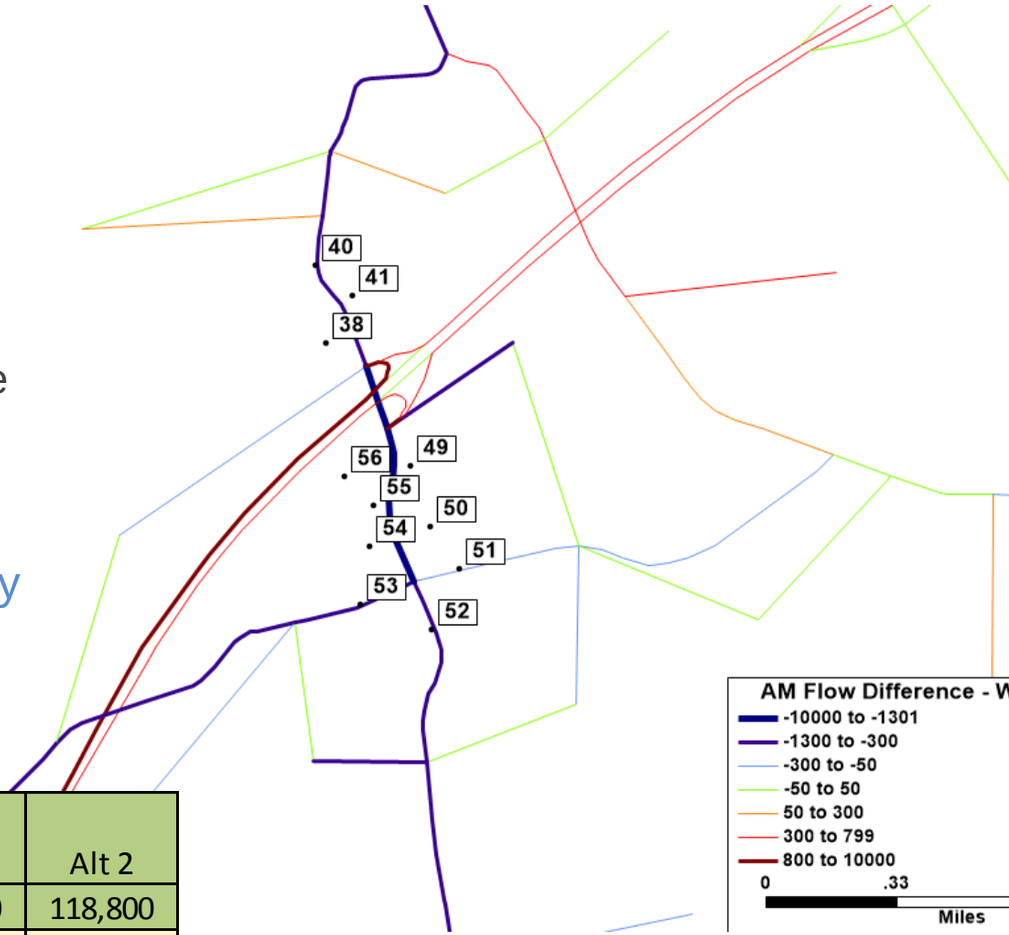
TransCAD Utilization

- Use of TransCAD has several complications:
  - Different scale than transmodeler network (and collected OD data)
  - “Noise” in the model can be larger than actual volume difference
  - Can provide volumes that exceed what is physically possible (esp. left turns)



TransCAD Utilization

- Basic approach for using TransCAD for this study:
  - Several iterations of No-Build
    - Without Weddington Rd Interchange
    - With Weddington Rd interchange
    - With GP Lane widening between Rea Rd and Providence Rd
  - Ran all build alternatives
  - Tested using full feedback versus “fixed” trip table – only small differences in overall demand with different HOT lane configurations



Road	Section	NB2	NB4	Base Fixed	Alt 1	Alt 2
I-485	West of Providence	102,200	113,100	118,700	118,500	118,800
I-485	East of Providence	101,900	104,900	112,800	112,600	112,700
I-485	West of Weddington	101,900	104,900	112,800	112,600	112,700
I-485	East of Weddington	110,400	112,000	119,700	119,400	119,500
I-485	West of John	110,400	112,000	119,700	119,400	119,500

TransCAD Utilization

- Transmodeler OD matrices had to be manually adjusted based on TransCAD results
  - Different scales, some TAZs have multiple driveway OD points
  - Some “noise” had to be eliminated using select link analysis
  - Regional model is peak period, Transmodeler is by hour
- Focus was on development of Transmodeler OD matrices, not link level TransCAD output

			1	2	3	4	5	6
			1	2	3	4	5	6
			1000	1010	1020	1030	1040	3
1	1	1000	0	37	1	1	105	27
2	2	1010	31	0	50	9	287	155
3	3	1020	0	20	0	0	22	8
4	4	1030	1	12	2	0	450	830
5	5	1040	120	130	34	310	0	531
6	6	3	6	287	44	390	369	0
7	7	8	128	1	0	0	2	1
8	8	1050	0	0	0	0	0	0
9	9	1060	11	0	0	0	0	0
10	10	1070	1	1	0	0	0	0
11	11	1080	18	1	0	0	0	1
12	12	1090	1	1	0	0	1	1
13	13	1100	0	0	0	0	0	0

2040 Build Conditions Volume Development

- Once refined future year NB matrices were developed – back to TransCAD
  - Determined that general purpose widening has much more impact on overall 485 flows than the HOT lanes

Road	Section	NB4	Base Fixed	Alt 1	Alt 2	Alt 2c
I-485	West of Providence	113,100	118,700	118,500	118,800	118,800
I-485	East of Providence	104,900	112,800	112,600	112,700	112,800
I-485	West of Weddington	104,900	112,800	112,600	112,700	112,800
I-485	East of Weddington	112,000	119,700	119,400	119,500	119,600
I-485	West of John	112,000	119,700	119,400	119,500	119,600
I-485	East of John	111,500	118,200	117,800	117,800	117,900
I-485	East of US 74	81,600	83,400	83,200	83,400	83,400

  - Developed “Build” matrices that was used for all alternatives

2040 Build Conditions Volume Development

- Transmodeler has 9 individual hours of matrices
- TransCAD has AM, PM, and midday time periods (4 – 6 hours long)
- Had to come up with a process to modify matrices by hour
  - AM and PM peak hour volume differences were manually adjusted in the OD…. very manually!
    - Used select link analysis at different locations along with differences in link flows by time period, factored down to a "peak hour"
  - Hourly traffic count by direction was used to develop peak mixing assumptions
  - Used blend of AM and PM peak hour differences to apply changes to each of the 9 hourly matrices

Hour	AM Peak Difference Weight	PM Peak Difference Weight	Overall Volume Weight	Change in OD Trips
6-7 AM	90%	10%	0.6	497
7-8	100%	0%	1	838
8-9	90%	10%	0.9	765
9-10	80%	20%	0.85	718
10-11	70%	30%	0.8	674
11-12	55%	45%	0.81	685
12-1 PM	50%	50%	0.89	753
1-2	45%	55%	0.94	797
2-3	30%	70%	0.96	816
3-4	20%	80%	1	838
4-5	10%	90%	1	855
5-6	0%	100%	0.97	835
6-7P	10%	90%	0.89	741
7-8P	20%	80%	0.77	641

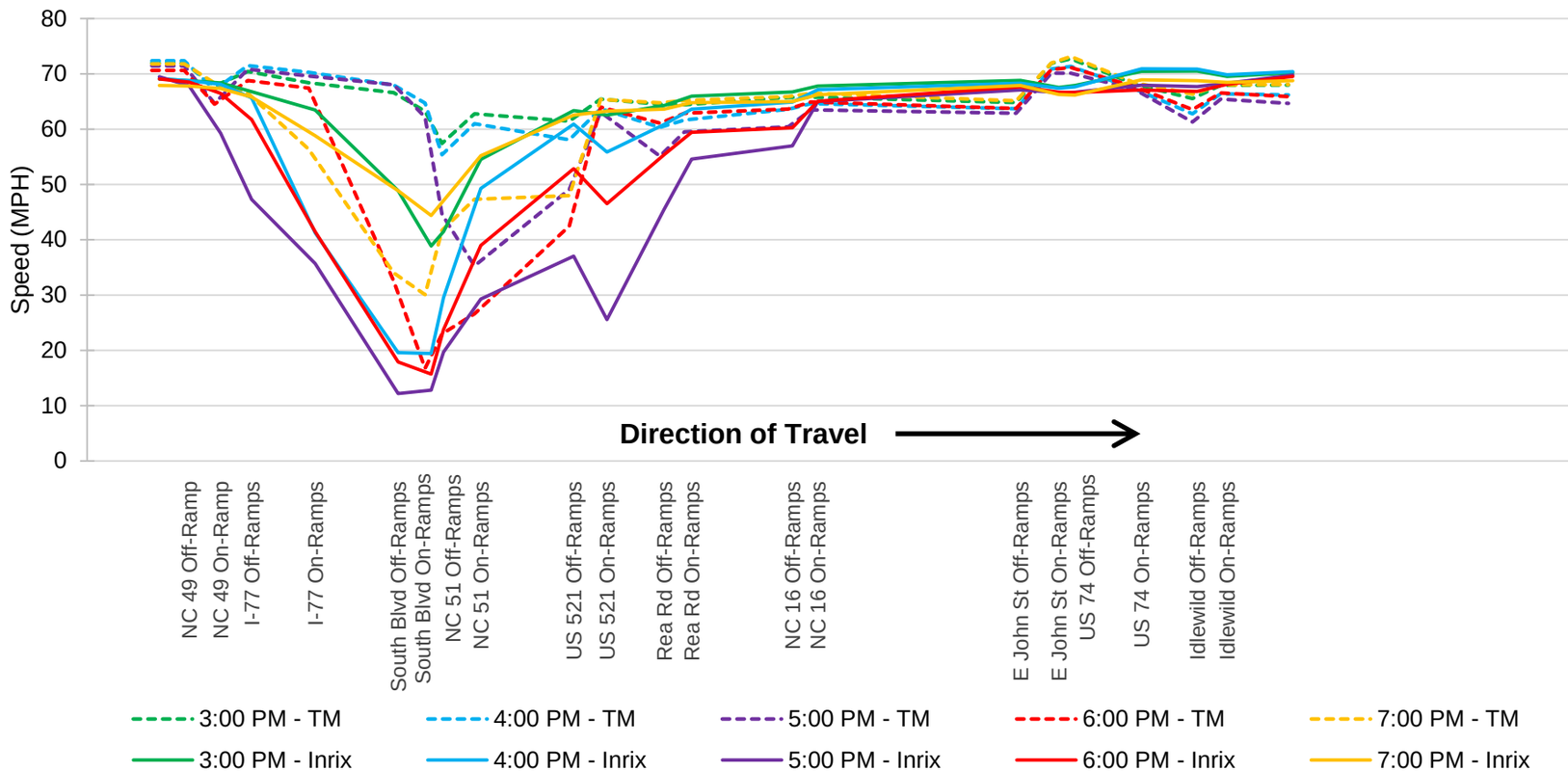
Simulation Model Development

- Simulation Models were developed for the following conditions:
  - 2013 Existing Conditions
    - Calibrated to 2013 INRIX Data
  - 2015 Interim Conditions
  - 2040 No Build Conditions
  - 2040 Build Conditions
    - Alternative 2 analysis in progress

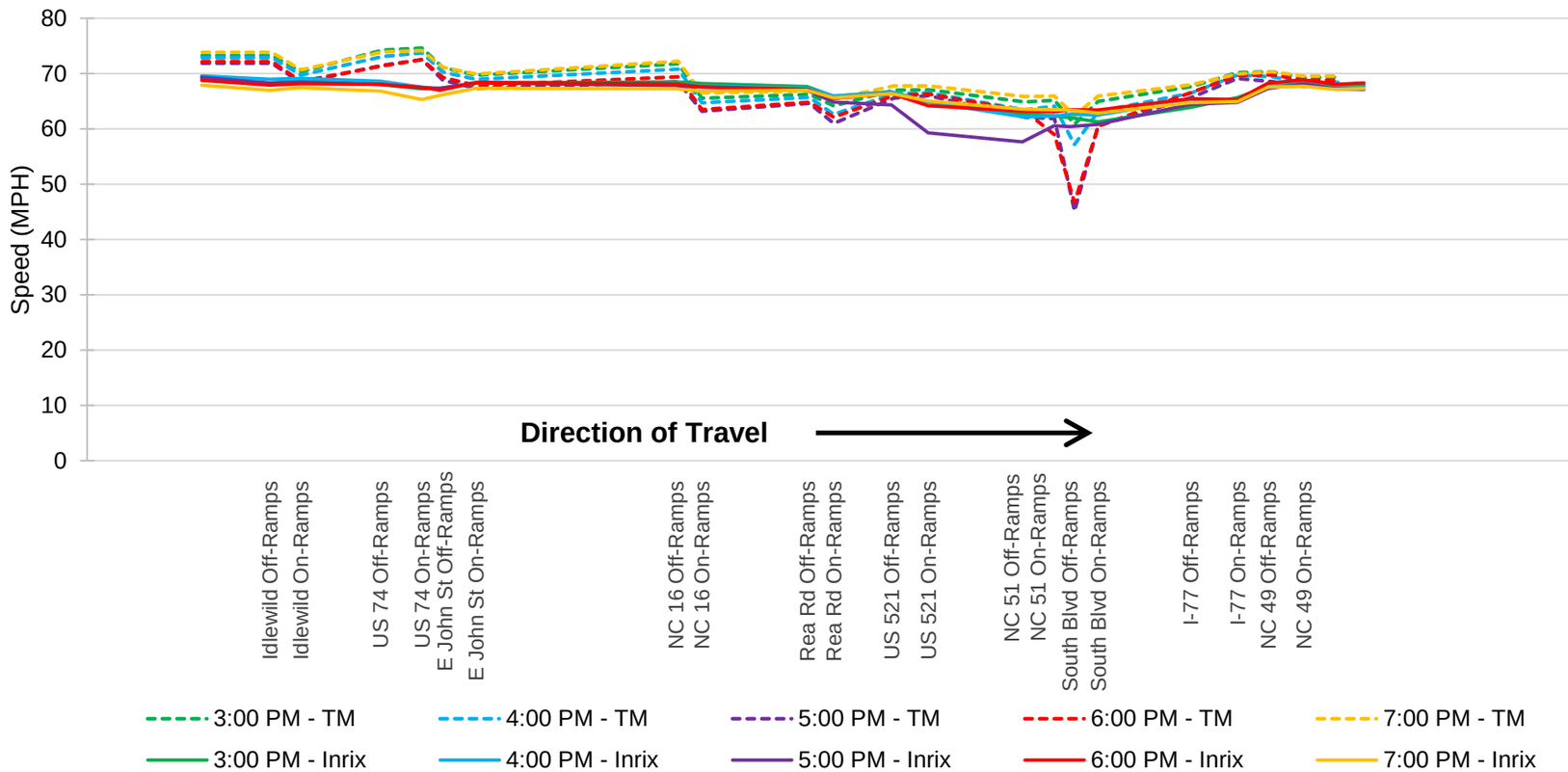
Measures of Effectiveness

- Several Measures of Effectiveness were obtained for comparison
  - Network Delay, Vehicle Miles Travelled (VMT), Vehicle Hours Travelled (VHT)
  - Travel Times
  - Volume Profiles
  - Speed Profiles
  - Speed Heat Maps

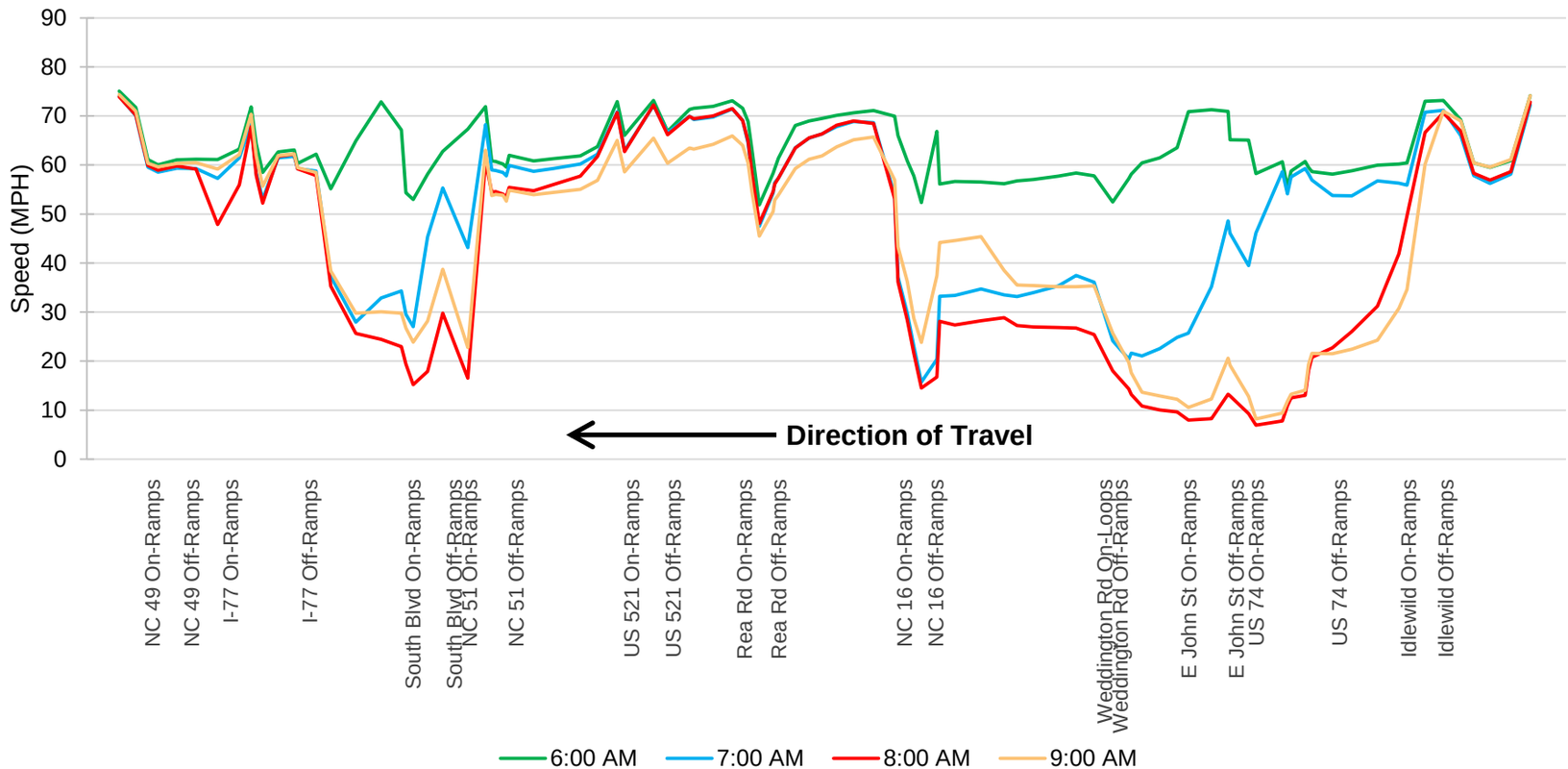
2013 Speed Profiles – Eastbound PM



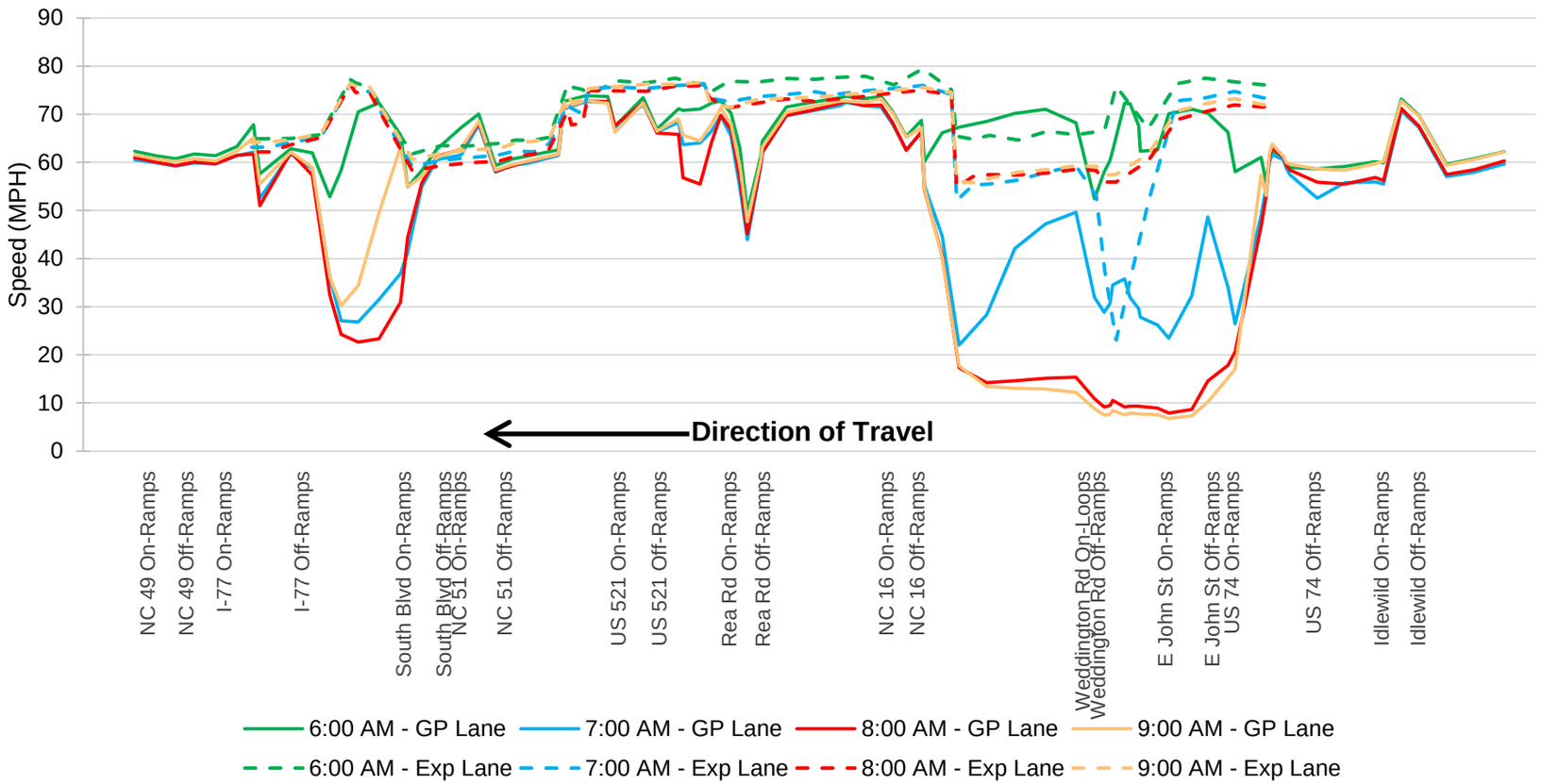
2013 Speed Profiles – Westbound PM



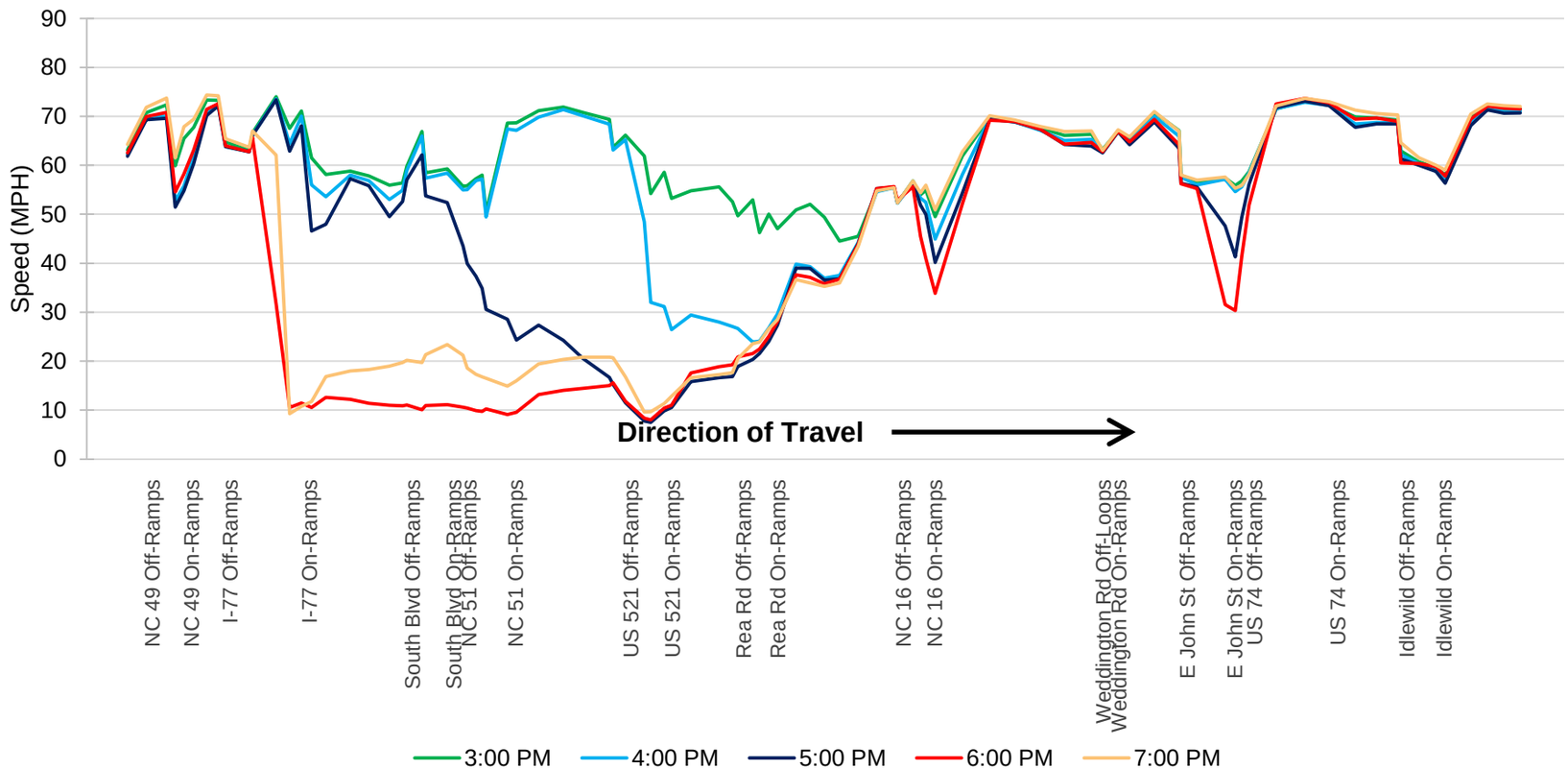
Speed Profiles: No Build – AM Westbound



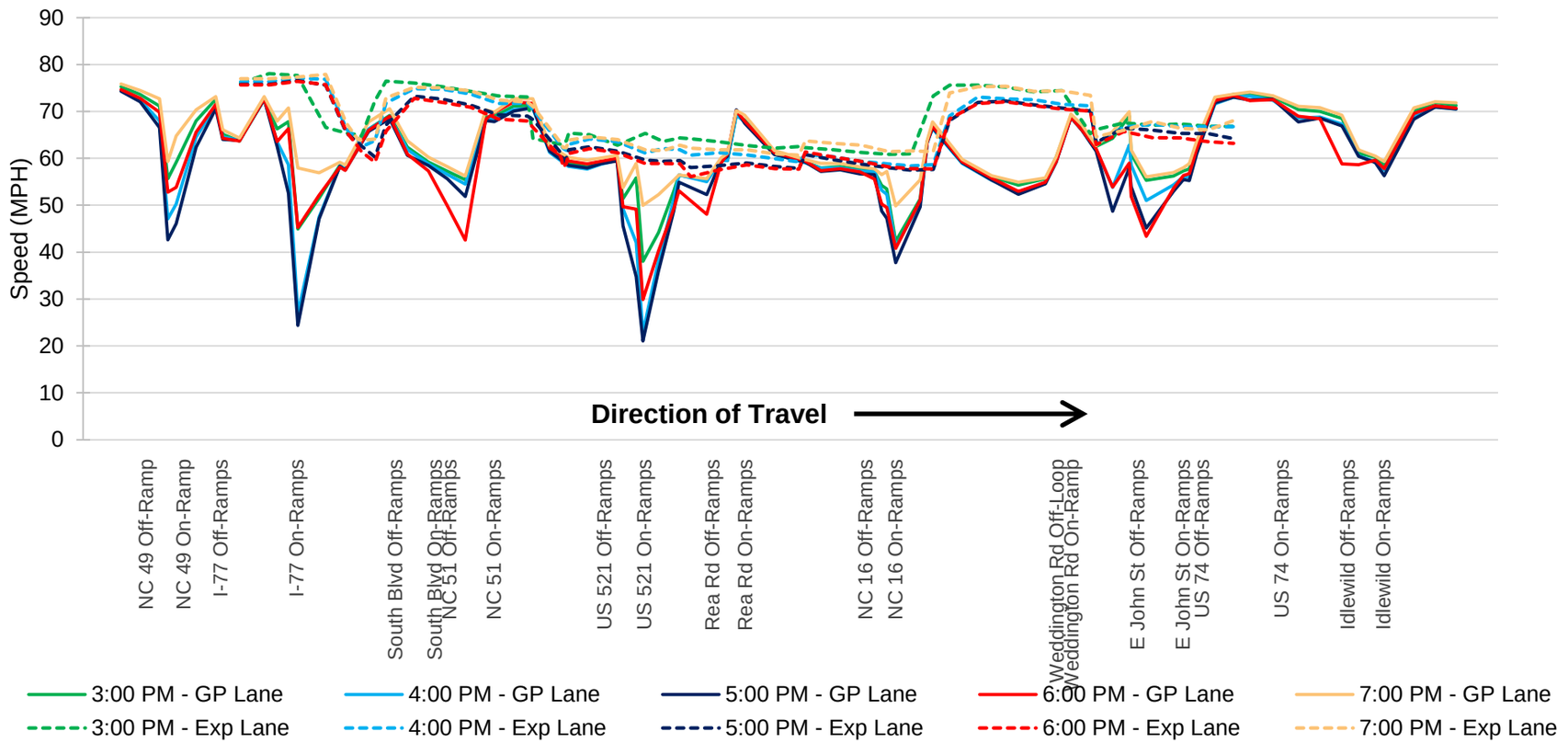
Speed Profiles: Build – AM Westbound



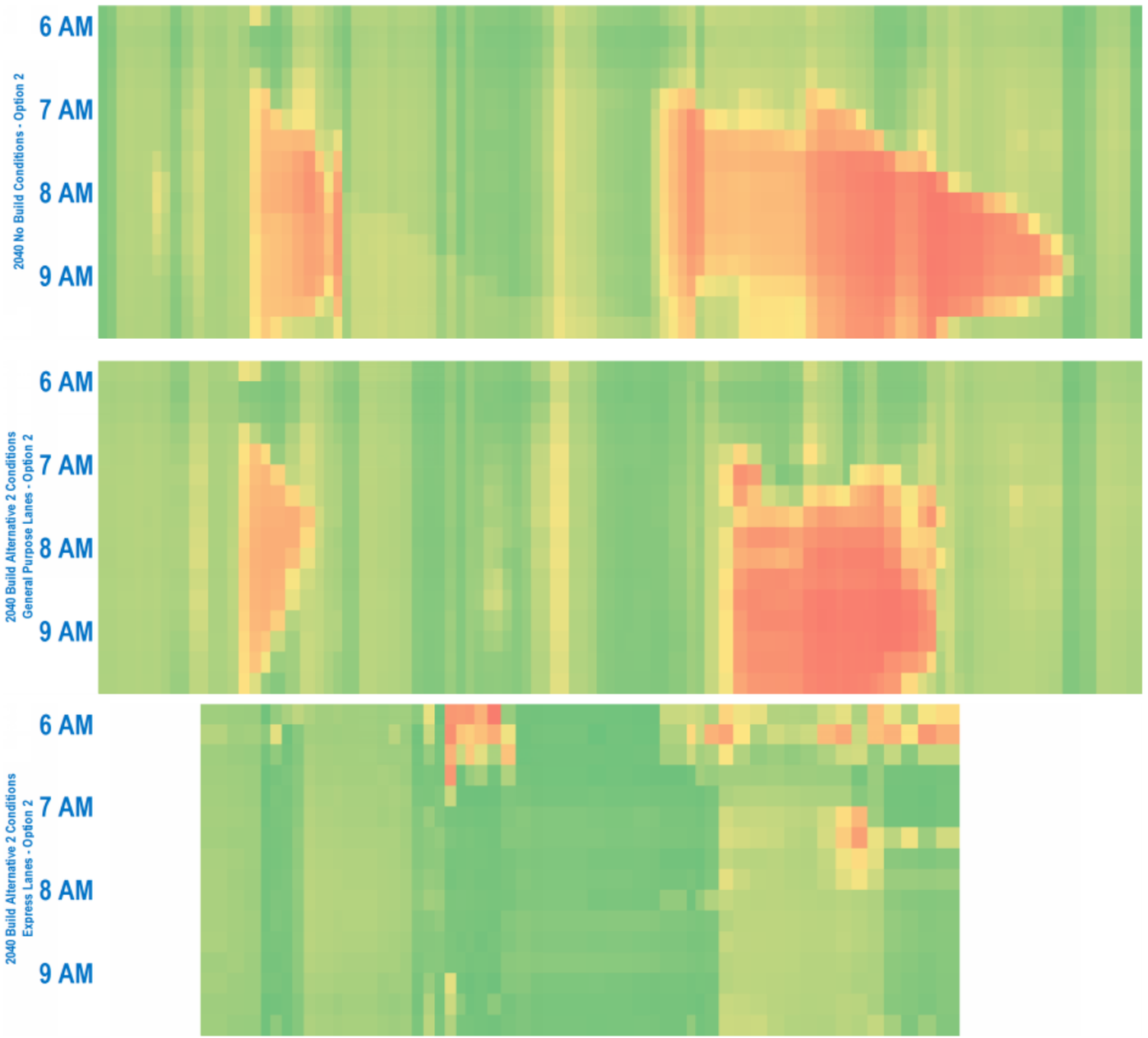
Speed Profiles: No Build – PM Eastbound



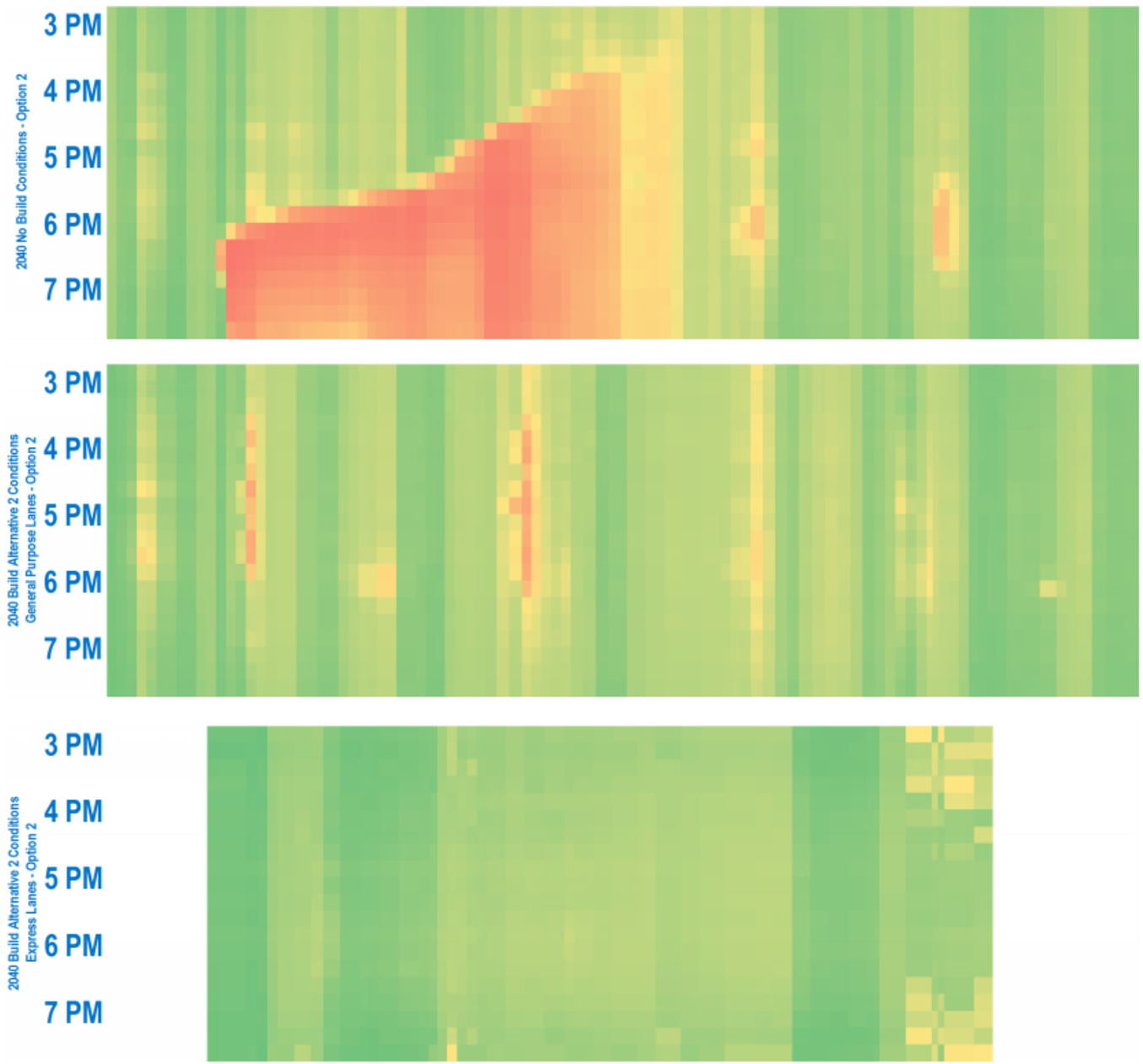
Speed Profiles: Build – PM Eastbound



Speed Heat Maps: No Build vs Build



Speed Heat Maps: No Build vs Build



Lessons Learned

- Extensive need for Data
  - Counts performed in 2013; Analysis began in 2015
- First Express Lane Project in TransModeler in North Carolina
  - Analysis methodologies were yet to be defined
  - Scale of data needed changed due to project requirements
- Close coordination between TransCAD and TransModeler staff
  - Initally Clearbox was scoped for Traffic Forecasting tasks but ended up being closely involved in Traffic Operations Tasks as well
- Aligning Transmodeler boundaries more closely with TransCAD zones could have helped with OD matrix analysis
- When appropriate, fixed trip tables for TransCAD assignment eliminates noise

Lessons Learned

- Strive for a “repeatable” process – but the reality is that manual adjustments may be required because of the difference in model resolutions

- Accelerated Schedule
  - Project is expected to go to DB next year. Let in 2017 and construction to begin in May 2018

Thank You!