



NORTH CAROLINA
Department of Transportation



Exploratory Modeling Analysis of Socio-Economic Impacts

John Burris, PTP and Brian Wert, PE

November, 2018

Agenda

- Why did we explore this topic?
- Methodology
- Analysis Results
- Potential Next Steps

Thanks!

- First a note of thanks to:
 - Amar Pillai
 - Matt Quesenberry
 - Craig Gresham
-
- All contributed vital model runs and information to this process and this would not be possible without their help

Why did we explore this topic

- The issue of land use and transportation is coming up more often.
 - Need to understand true “build” and “no-build”
 - Recent court rulings
 - Recent publications (NCHRP 765, etc.)
- Arose during Complete 540
 - Uncertainty on the impact of the project on SE projections
 - Took significant effort to address
 - Wanted something that could be screened earlier
 - Desired to have some sensitivity testing

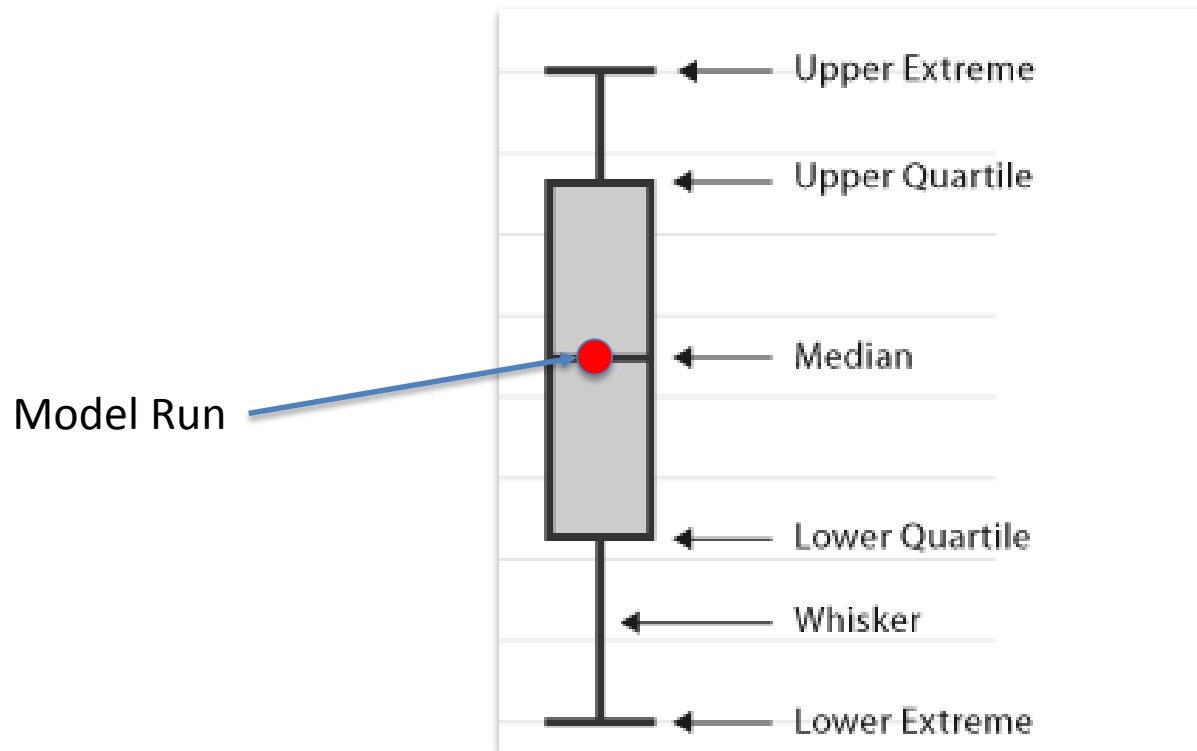
Methodology

- How was the methodology developed?
 - Wanted a simple test (speed was important)
 - Wanted something that could potentially be done early in a project
 - Wanted to test various SE data alternatives
 - Wanted something that could be easily replicated
 - Review of ICEs showed a typical effect of ~3-5%

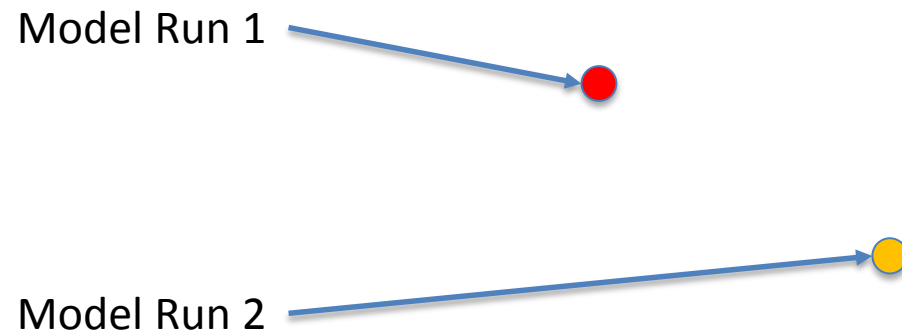
Box Plot Example



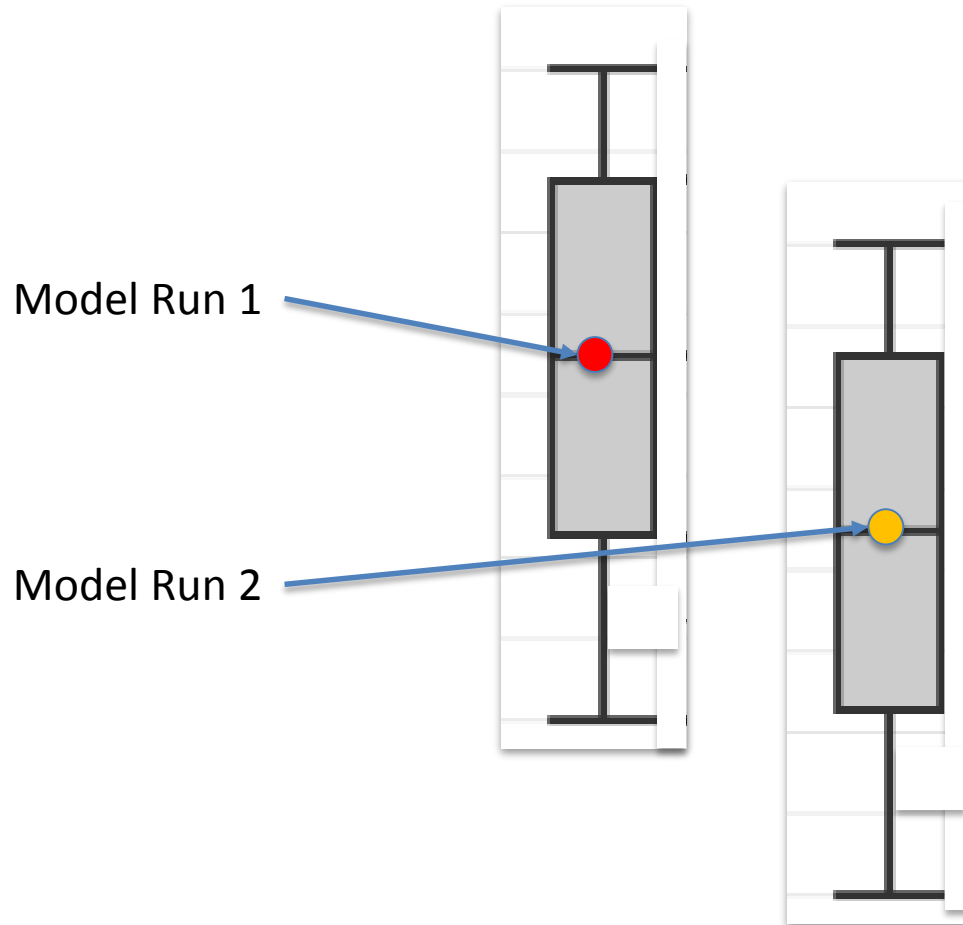
Box Plot Example



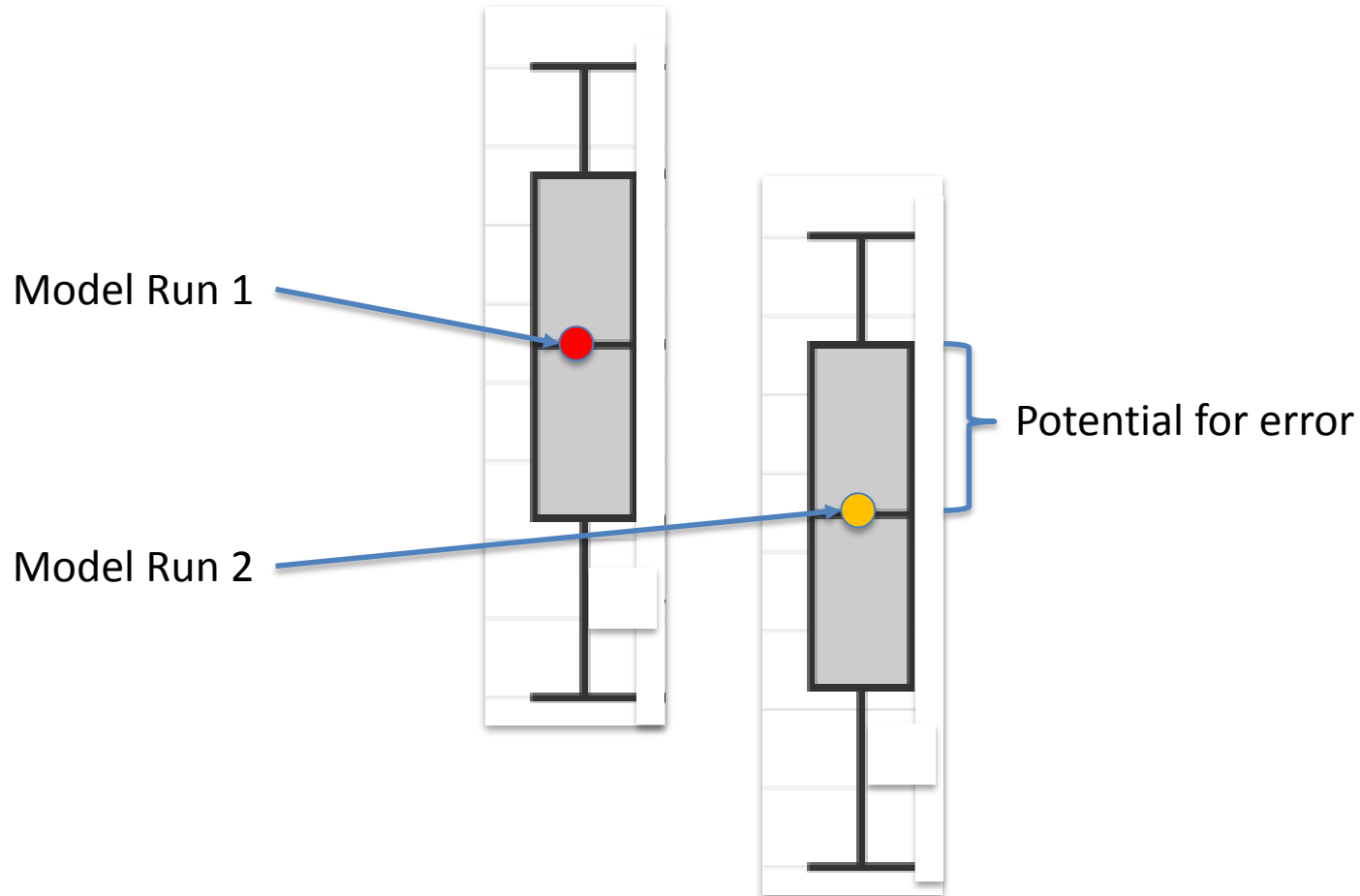
Box Plot Example



Box Plot Example



Box Plot Example



Methodology

- What is the methodology?
 - Verify the adopted SE data is based on a project being built
 - Run adopted SE data with the build transportation network
 - Run the adopted SE data with the no-build transportation network
 - Reduce growth in the FLUSA by 10%
 - Run reduced SE data with no-build network
 - Compare transportation network from previous run to initial run
 - If reduced SE data performs better than build run then reduce growth by 5% and re-run
 - If reduced SE data performs worse than build run then reduce growth by 20% and re-run
 - Add additional scenarios as needed/desired

Project Selection

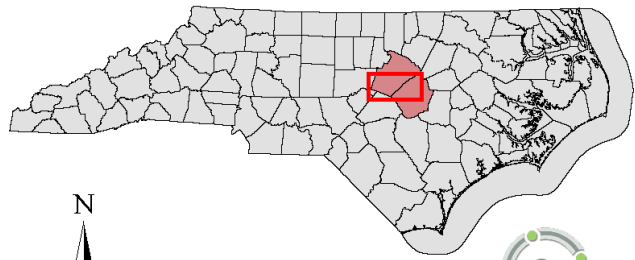
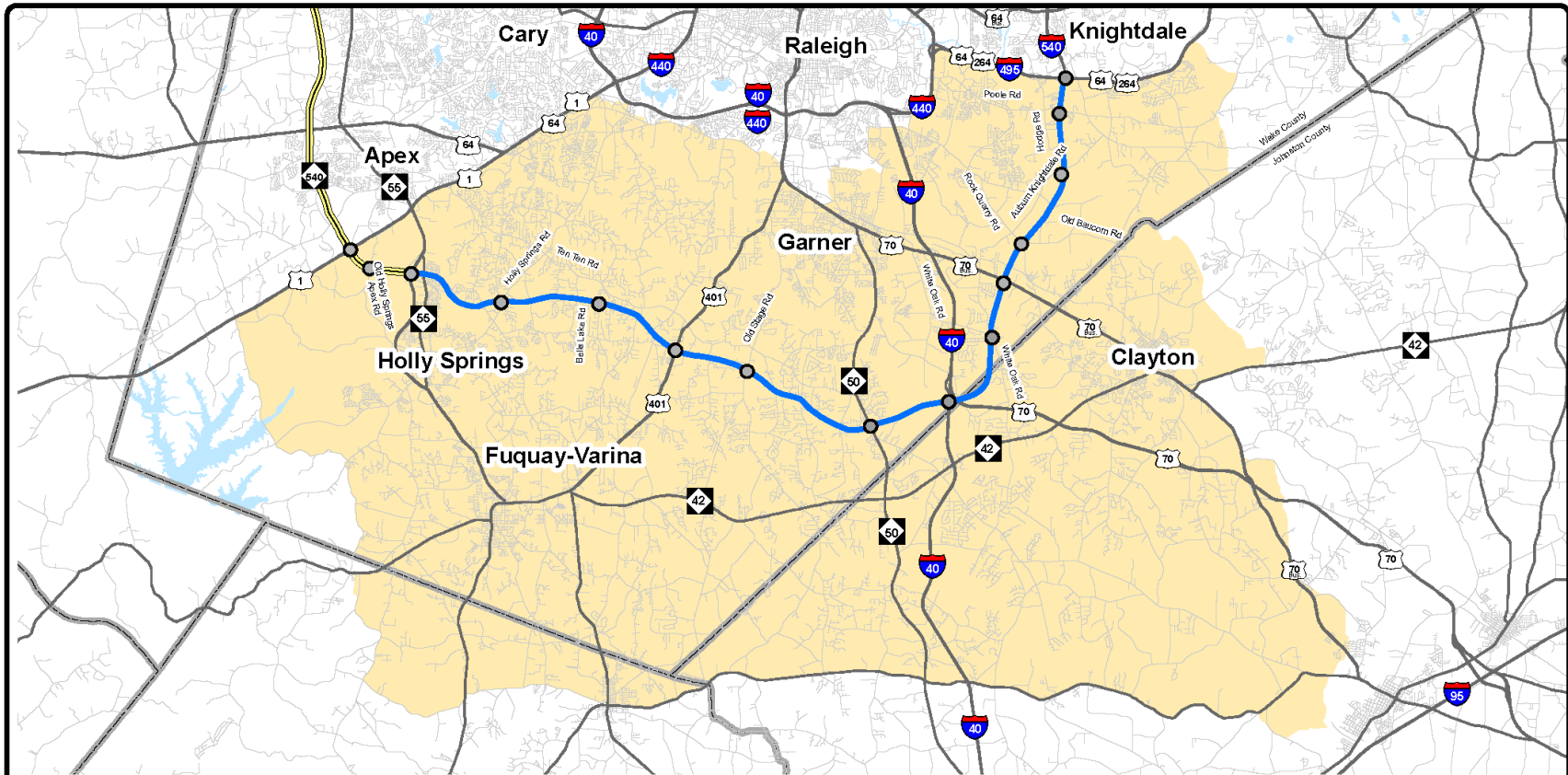
Three Projects Selected:

1. Complete 540
2. Winston-Salem Beltway
3. Monroe Expressway

- Projects selected have already gone through the NEPA process
 - ICE already completed
- Three largest metropolitan areas in NC
 - Similar regional travel demand models
 - Triangle Regional Model
 - Piedmont Triad Regional Model
 - Metrolina Regional Model
- Major projects that impact the entire metro area
 - Easier to analyze MOE changes to entire region as result of the project

Complete 540 Background Information

- STIP Projects R-2721, R-2828, and R-2829
- Construction programmed to begin in FY 2019
- Proposal is to build a multi-lane freeway (toll road) that loops around the southern and eastern portions of the Raleigh area and complete the 540 Outer Loop
- Expected to help alleviate congestion on I-440, I-40, NC 42, NC 55, and Ten Ten Road
- Approximately 30 miles in length



Complete 540 FLUSA Study Area

Legend	
	FLUSA Boundary
	Triangle Expressway
	Complete 540
	Interchanges
	Major Roads
	Counties

STIP: R-2721, R-2828, R-2829	WBS: 37673.1.TA2, 35516.1.TA2, 35517.1.TA1
COUNTY: Wake/Johnston	DIVISION: 5/4
DATE: July 2018	
PREPARED BY: HNTB North Carolina, P.C. 343 E. Six Forks Rd, Suite 200 Raleigh, NC 27609	
LOCATION: NC 55 Bypass (Holly Springs) to I-495 / US 64 Bypass / US 264 (Knightdale)	
PROJECT: Complete 540 Triangle Expressway Southeast Extension	Figure 1

Complete 540 FLUSA 2040 Projections

- FLUSA covers approximately 280,000 acres
- Contains 1,268 roadway miles, 16% of entire TRM network
- Includes:
 - 250,940 households (22% of all households)
 - 174,815 employees (13% of all employees)

Complete 540 VMT & VHT Results

Table 1: 2040 Average Daily VMT and VHT Comparisons

Alternative Scenario	Region Wide				FLUSA			
	VMT (miles)	VHT (hours)	VMT Change	VHT Change	VMT (miles)	VHT (hours)	VMT Change	VHT Change
No-Build	87,365,432	2,268,263	-	-	17,201,378	478,802	-	-
Build	87,872,949	2,243,677	0.58%	-1.08%	17,825,280	465,091	3.63%	-2.86%
No-Build 5% Reduction	87,005,198	2,251,581	-0.41%	-0.74%	16,957,846	467,660	-1.42%	-2.33%
No-Build 10% Reduction	86,633,622	2,235,394	-0.84%	-1.45%	16,710,427	456,786	-2.85%	-4.60%
No-Build 15% Reduction	86,262,456	2,219,280	-1.26%	-2.16%	16,460,888	445,993	-4.30%	-6.85%
No-Build 20% Reduction	85,896,672	2,204,017	-1.68%	-2.83%	16,215,253	435,550	-5.73%	-9.03%

Complete 540

VMT & VHT Results – Example

Build scenario produces VHT benefits equivalent to No-Build scenario with 5% to 10% SE Data Reduction

Table 1: 2040 Average Daily VMT and VHT Comparisons

Alternative Scenario	Region Wide				FLUSA			
	VMT (miles)	VHT (hours)	VMT Change	VHT Change	VMT (miles)	VHT (hours)	VMT Change	VHT Change
No-Build	87,365,432	2,268,263	-	-	17,201,378	478,802	-	-
Build	87,872,949	2,243,677	0.58%	-1.08%	17,825,280	465,091	3.63%	-2.86%
No-Build 5% Reduction	87,005,198	2,251,581	-0.41%	-0.74%	16,957,846	467,660	-1.42%	-2.33%
No-Build 10% Reduction	86,633,622	2,235,394	-0.84%	-1.45%	16,710,427	456,786	-2.85%	-4.60%
No-Build 15% Reduction	86,262,456	2,219,280	-1.26%	-2.16%	16,460,888	445,993	-4.30%	-6.85%
No-Build 20% Reduction	85,896,672	2,204,017	-1.68%	-2.83%	16,215,253	435,550	-5.73%	-9.03%

Analysis Results

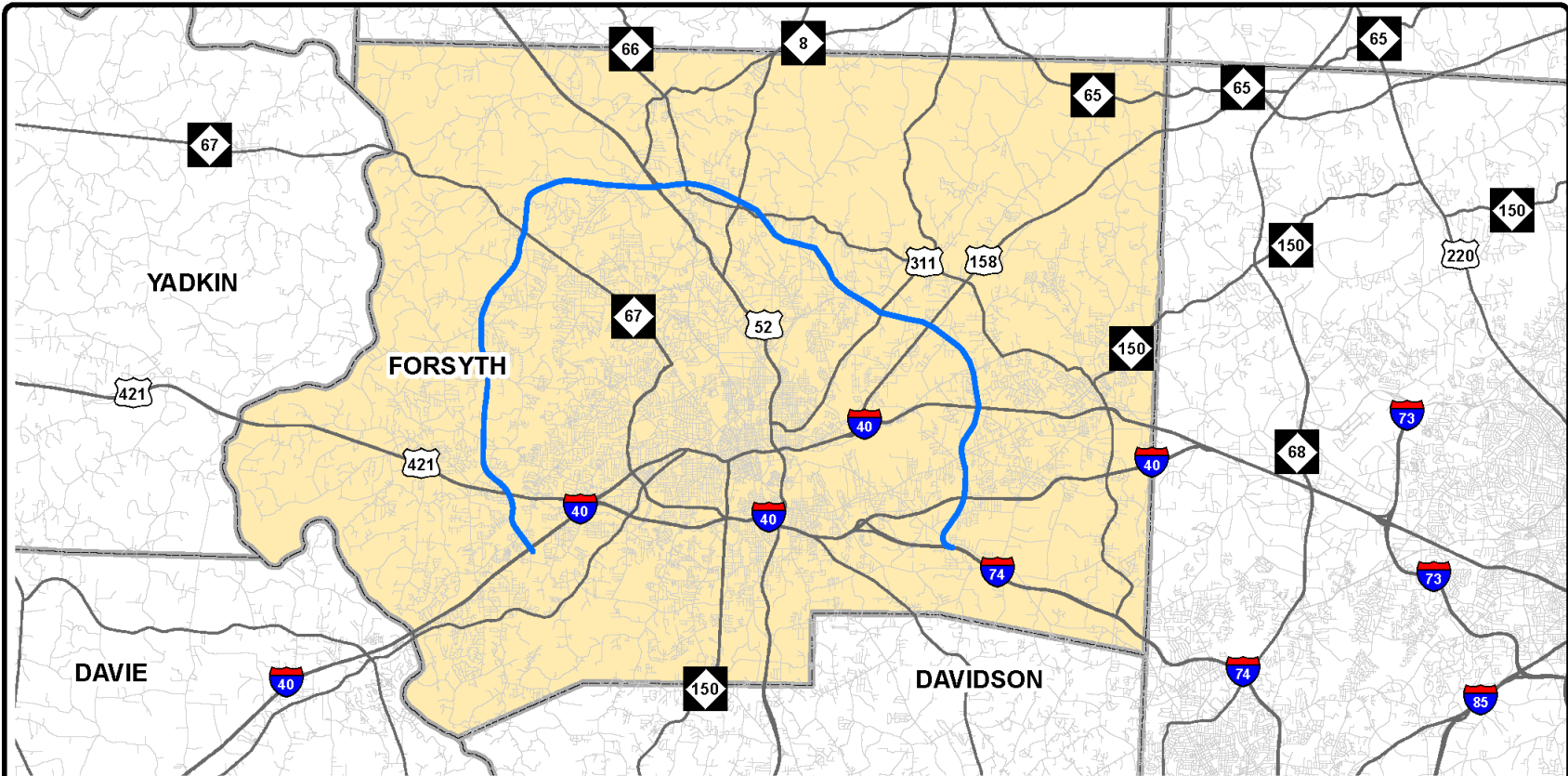
Table 2: SE Data Percent Reduction Level to Attain MOE Benefit of Build Scenario

MOE	Complete 540	
	Regionwide	FLUSA
Average Daily VMT	Build is highest	Build is highest
Average Daily VHT	5% to 10%	5% to 10%
Average Daily Congested VMT	10% to 15%	>20%
Average Daily Congested VHT	10% to 15%	15% to 20%
Average Daily Speed	>20%	>20%
Average PM Peak Speed	>20%	>20%
Daily Congested Roadway Mileage	10% to 15%	15% to 20%
PM Peak Congested Roadway Mileage	10% to 15%	10% to 15%

- Dark Green = over 20 percent SE Data Reduction
- Light Green = 5 percent to 20 percent SE Data Reduction
- Orange = SE Data reduction up to 5%
- Red = No MOE benefit from No-Build scenario to Build scenario

Winston-Salem Beltway Background Information

- STIP Projects U-2579 and R-2247
- Currently under construction from I-40 BUS to US 311
- Proposal is to build a multi-lane freeway that loops around the western, northern, and eastern portions of Winston-Salem
- Expected to help alleviate congestion and improve safety along heavily traveled routes such as I-40 BUS and US 52
- Approximately 34.5 miles in length



Winston-Salem Beltway Study Area

Legend

- FLUSA Boundary
- Winston-Salem Beltway
- Major Roads
- Counties

STIP: U-2579 & R-2247

WBS: 34839.1.1

COUNTY: Forsyth

DIVISION: 9

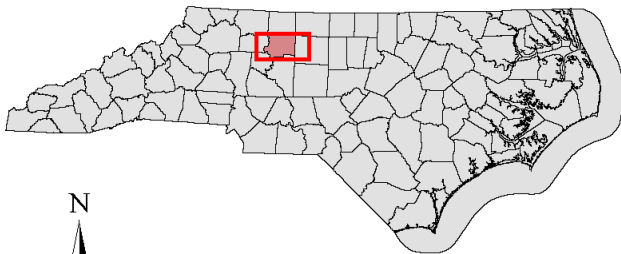
DATE: July 2018

PREPARED BY: HNTB North Carolina, P.C.
343 E. Six Forks Rd, Suite 200
Raleigh, NC 27609

LOCATION: NC 55 Bypass (Holly Springs) to I-495 / US 64 Bypass / US 264 (Knightdale)

PROJECT: Winston-Salem Beltway

Figure 2



Winston-Salem Beltway FLUSA 2040 Projections

- FLUSA covers approximately 264,000 acres
- Contains 1,587 roadway miles, 24% of entire PTRM network
- Includes:
 - 183,886 households (29% of all households)
 - 245,530 employees (30% of all employees)

Winston-Salem Beltway VMT & VHT Results

Table 3: 2040 Average Daily VMT and VHT Comparisons

Alternative Concept	Region Wide				FLUSA			
	VMT (miles)	VHT (hours)	VMT Change	VHT Change	VMT (miles)	VHT (hours)	VMT Change	VHT Change
No-Build	51,837,385	1,230,616	-	-	13,462,253	325,172	-	-
Build	51,631,330	1,213,710	-0.40%	-1.37%	13,405,297	311,178	-0.42%	-4.30%
No-Build 5% Reduction	51,667,240	1,226,549	-0.33%	-0.33%	13,364,883	321,882	-0.72%	-1.01%
No-Build 10% Reduction	51,655,547	1,225,292	-0.35%	-0.43%	13,258,310	318,170	-1.51%	-2.15%
No-Build 15% Reduction	51,500,144	1,220,288	-0.65%	-0.84%	13,178,212	315,760	-2.11%	-2.89%
No-Build 20% Reduction	51,252,484	1,212,258	-1.13%	-1.49%	13,019,569	310,155	-3.29%	-4.62%

Analysis Results

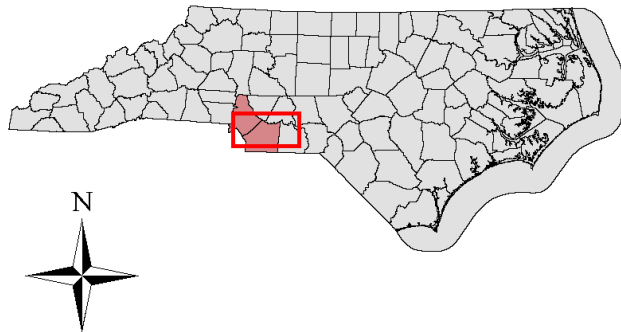
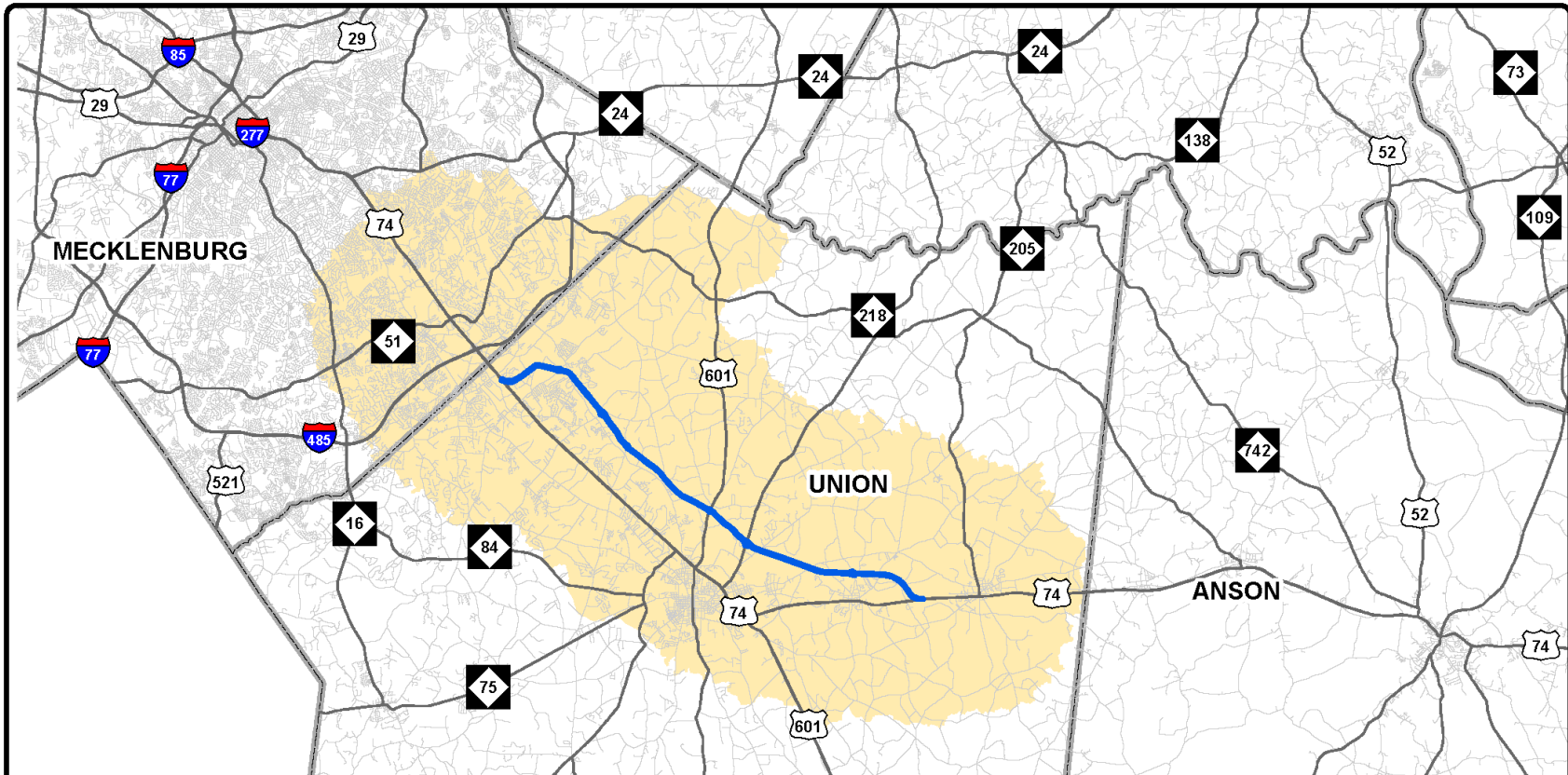
Table 4: SE Data Percent Reduction Level to Attain MOE Benefit of Build Scenario

MOE	Winston-Salem Beltway	
	Regionwide	FLUSA
Average Daily VMT	10% to 15%	<5%
Average Daily VHT	15% to 20%	15% to 20%
Average Daily Congested VMT	>20%	>20%
Average Daily Congested VHT	>20%	>20%
Average Daily Speed	>20%	>20%
Average PM Peak Speed	>20%	>20%
Daily Congested Roadway Mileage	>20%	>20%
PM Peak Congested Roadway Mileage	>20%	>20%

- Dark Green = over 20 percent SE Data Reduction
- Light Green = 5 percent to 20 percent SE Data Reduction
- Orange = SE Data reduction up to 5%
- Red = No MOE benefit from No-Build scenario to Build scenario

Monroe Expressway Background Information

- STIP Projects R-2559 and R-3329
- Currently under construction
- Will be a tolled facility
- Proposal is to bypass the City of Monroe and provide an important parallel alternative for commuters to existing US 74
- Nearly 20 miles in length



Monroe Expressway Study Area

Legend

- FLUSA Boundary
- Monroe Expressway
- Major Roads
- Counties

STIP: R-2559 & R-3329

COUNTY: Union & Mecklenburg

DIVISION: 10

DATE: July 2018

PREPARED BY: HNTB North Carolina, P.C.
343 E. Six Forks Rd, Suite 200
Raleigh, NC 27609

LOCATION: US 74 Northwest of Monroe to
US 74 East of Monroe

PROJECT: Monroe Expressway

Figure 3

Monroe Expressway FLUSA 2040 Projections

- FLUSA covers approximately 200,000 acres
- Contains 965 roadway miles, 10% of entire MRM network
- Includes:
 - 138,704 households (10% of all households)
 - 185,630 employees (10% of all employees)

Monroe Expressway VMT & VHT Results

Table 5: 2040 Average Daily VMT and VHT Comparisons

Alternative Concept	Region Wide				FLUSA			
	VMT (miles)	VHT (hours)	VMT Change	VHT Change	VMT (miles)	VHT (hours)	VMT Change	VHT Change
No-Build	116,065,516	3,743,718	-	-	11,289,357	407,508	-	-
Build	116,167,974	3,723,216	0.09%	-0.55%	11,724,389	402,581	3.85%	-1.21%
No-Build 5% Reduction	115,473,507	3,707,383	-0.51%	-0.97%	10,975,485	387,974	-2.78%	-4.79%
No-Build 10% Reduction	115,051,753	3,682,818	-0.87%	-1.63%	10,651,616	368,755	-5.65%	-9.51%
No-Build 15% Reduction	114,691,655	3,661,251	-1.18%	-2.20%	10,338,645	351,303	-8.42%	-13.79%
No-Build 20% Reduction	114,240,294	3,636,822	-1.57%	-2.86%	11,724,389	333,193	3.85%	-18.24%

Analysis Results

Table 6: SE Data Percent Reduction Level to Attain MOE Benefit of Build Scenario

MOE	Monroe Expressway	
	Regionwide	FLUSA
Average Daily VMT	Build is highest	Build is highest
Average Daily VHT	<5%	<5%
Average Daily Congested VMT	5% to 10%	5% to 10%
Average Daily Congested VHT	<5%	5% to 10%
Average Daily Speed	5% to 10%	10% to 15%
Average PM Peak Speed	5% to 10%	10% to 15%
Daily Congested Roadway Mileage	5% to 10%	5% to 10%
PM Peak Congested Roadway Mileage	5% to 10%	<5%

- Dark Green = over 20 percent SE Data Reduction
- Light Green = 5 percent to 20 percent SE Data Reduction
- Orange = SE Data reduction up to 5%
- Red = No MOE benefit from No-Build scenario to Build scenario

Analysis Summary – All Projects

- At least a 5 percent SE data reduction will be required to match the MOE benefits of building the analyzed transportation project for the majority of MOEs considered.
- As expected, new location facilities lead to an increase in average daily VMT for the Monroe Expressway and Complete 540.
- Average daily congested VMT and all other MOEs improve at varying levels for the three projects summarized.
- In many instances, it would take over 20 percent SE data reduction to achieve the same MOE benefits as a scenario where the project is built and the SE data is unchanged.

Analysis Results – All Projects

Table 7: SE Data Percent Reduction Level to Attain MOE Benefit of Build Scenario

MOE	Complete 540		Winston-Salem Beltway		Monroe Expressway	
	Regionwide	FLUSA	Regionwide	FLUSA	Regionwide	FLUSA
Average Daily VMT	Build is highest	Build is highest	10% to 15%	<5%	Build is highest	Build is highest
Average Daily VHT	5% to 10%	5% to 10%	15% to 20%	15% to 20%	<5%	<5%
Average Daily Congested VMT	10% to 15%	>20%	>20%	>20%	5% to 10%	5% to 10%
Average Daily Congested VHT	10% to 15%	15% to 20%	>20%	>20%	<5%	5% to 10%
Average Daily Speed	>20%	>20%	>20%	>20%	5% to 10%	10% to 15%
Average PM Peak Speed	>20%	>20%	>20%	>20%	5% to 10%	10% to 15%
Daily Congested Roadway Mileage	10% to 15%	15% to 20%	>20%	>20%	5% to 10%	5% to 10%
PM Peak Congested Roadway Mileage	10% to 15%	10% to 15%	>20%	>20%	5% to 10%	<5%

- Dark Green = over 20 percent SE Data Reduction
- Light Green = 5 percent to 20 percent SE Data Reduction
- Orange = SE Data reduction up to 5%
- Red = No MOE benefit from No-Build scenario to Build scenario

Potential Next Steps

- Expand to additional projects
 - Cape Fear Crossing
 - Asheboro Bypass
 - I-2513
- Expand to additional areas
 - Other areas of NC (Wilmington, Asheville, Greenville, others)
 - Outside of NC (Florida, Arizona, others)
- Use as a screening for NEPA analysis
 - Provide information to NEPA team about confluence of traffic and land use early in the process
- Use to drive Planning and Environmental Linkages
 - Analyze, document, and eliminate alternatives

Question and Answer Portion

Contacts Information

- John Burris:
 - John Burris, PTP, jburris@hntb.com, 919-424-0483
- Brian Wert:
 - Brian Wert, PE, bmwert@ncdot.gov, 919-707-0974