

# Short Pump Area Interchange Access Report

May 19, 2023

PREPARED FOR:



PREPARED BY:

**Kimley»Horn**  
Expect More. Experience Better.



## Table of Contents

- ▲ FHWA Interstate Access Policy Points ..... 1
  - Overview ..... 1
  - Policy Point 1 ..... 2
    - Response ..... 2
  - Policy Point 2 ..... 3
    - Response ..... 3
- ▲ Introduction ..... 4
  - Background ..... 4
    - Study Work Group ..... 4
  - Purpose and Need ..... 4
  - Project Location ..... 6
- ▲ Methodology ..... 8
  - Relevant Studies ..... 8
  - Analysis Tools ..... 8
  - Measures of Effectiveness ..... 8
  - Analysis Years ..... 9
  - Alternatives Development, Screening, and Preferred Alternative Selection ..... 9
- ▲ Existing Conditions ..... 9
  - Existing Roadway Network ..... 9
  - Interchanges ..... 10
    - Interchange Spacing ..... 11
  - Land Use ..... 11
  - Alternative Travel Modes ..... 12
  - Existing Traffic Data and Operational Performance ..... 12
    - Existing Traffic Volumes, Peak Hour Factors, and Heavy Vehicle Percentages ..... 12
    - Existing Geometries, Lane Designations, and Speed Data ..... 13
    - Criteria for Evaluating Analysis Results ..... 18
    - Existing Conditions Modeling Assumptions ..... 18
    - Existing Conditions Freeway Analysis Results ..... 18
    - Existing Conditions Intersection Analysis Results ..... 25
  - Existing Safety Data and Identification of Problem Areas ..... 30
    - Existing Mainline Freeway Crash Summary ..... 31

- Existing Intersection Crash Summary ..... 36
- ▲ Alternatives Considered ..... 37
  - No-Build Alternative ..... 37
    - Background Improvements ..... 37
  - Alternatives Development and Screening ..... 38
    - Transportation Management Options ..... 39
    - Subarea Model Scenarios ..... 39
      - Route 288 ..... 41
      - I-64 at US 250 Interchange ..... 41
      - I-64 at I-295 Interchange ..... 43
      - I-64 at US 250 and I-295 Interchanges ..... 44
      - I-64 at N Gayton Road ..... 45
- Build Packages ..... 53
- ▲ Description and Configuration of Interchange Access ..... 54
  - Build Package 1 ..... 54
  - Build Package 2 ..... 54
  - Build Package 3 ..... 55
- ▲ Roadway Geometry ..... 72
  - Description of Proposed Improvements ..... 77
    - Partial Cloverleaf Interchange at I-64 and US 250 ..... 77
    - Route 288 Southbound Auxiliary Lane ..... 77
    - Route 288 Northbound Auxiliary Lane and US 250 Improvements ..... 77
    - US 250 Thru-Cut at Tom Leonard Drive ..... 77
    - Northeastbound I-295 Auxiliary Lane ..... 77
    - I-64 Eastbound Off Ramp Lane Reconfiguration ..... 78
    - Diverging Diamond Interchange at I-64 and N Gayton Road ..... 78
- Geometric Criteria ..... 78
  - Existing Conditions and Proposed Conditions ..... 78
  - Potential Design Exceptions ..... 80
  - Potential Design Waivers ..... 80
  - Access Management ..... 83
  - Proposed Right-of-Way Acquisition Line ..... 83
  - Conceptual Signing Plan ..... 84
  - Pedestrian and Bicycle Facilities ..... 84

- ▲ Forecasted Traffic Volumes and Operations ..... 84
  - No-Build ..... 85
    - No-Build Peak Hour Factors and Heavy Vehicle Percentages..... 85
    - No-Build Modeling Assumptions ..... 85
    - No-Build Conditions Freeway Analysis Results..... 88
    - No-Build Conditions Intersection Analysis Results ..... 100
  - Build ..... 110
    - Build Traffic Volumes ..... 110
    - Build Package 1 ..... 115
    - Build Package 2 ..... 139
    - Build Package 3 ..... 163
    - Build Package Operational Comparison ..... 187
- ▲ Safety Analysis ..... 195
  - Existing Conditions ISATe Analysis ..... 195
  - Build Package Freeway Analysis ..... 196
    - Limitations of ISATe Analysis ..... 198
    - Alternative Analysis Methodologies ..... 198
  - Build Package Arterial Analysis ..... 200
  - Safety Conclusions ..... 200
- ▲ Environmental Considerations ..... 202
  - Methodology ..... 202
  - Environmental Consequences ..... 206
    - No-Build Alternative ..... 206
    - Common Elements in All Build Packages..... 206
    - Restriping for Eastbound I-64 Off-Ramp to I-295 ..... 208
    - Partial Cloverleaf at US 250 Interchange (Build Packages 1 and 3) ..... 209
    - Diverging Diamond Interchange at N Gayton Road (Build Packages 2 and 3) ..... 210
  - Alternatives Matrix ..... 212
  - Project Environmental Review Compliance ..... 215
  - Resources..... 215
- ▲ Planning Level Cost Estimate ..... 217
- ▲ Selection of Preferred Alternative ..... 217
  - Public Involvement ..... 217
  - Matrix ..... 219

Improvement Phasing.....	220
--------------------------	-----

## Table of Figures

Figure 1: Study Area .....	7
Figure 2: Interchange Spacing Measurement.....	11
Figure 3: Existing (2019) Peak Hour Traffic Volumes.....	14
Figure 4: Existing (2019) AM Peak Hour Factor and Heavy Vehicle Percentages.....	15
Figure 5: Existing (2019) PM Peak Hour Factor and Heavy Vehicle Percentages.....	16
Figure 6: Existing (2019) Geometrics and Lane Designations .....	17
Figure 7: Existing (2019) AM Peak Hour Average Densities .....	20
Figure 8: Existing (2019) AM Peak Hour Average Speeds.....	21
Figure 9: Existing (2019) PM Peak Hour Average Densities .....	22
Figure 10: Existing (2019) PM Peak Hour Average Speeds.....	23
Figure 11: Existing (2019) PM Peak Hour Maximum Queue Lengths .....	24
Figure 12: Existing (2019) AM Peak Hour Intersection Delay .....	26
Figure 13: Existing (2019) AM Peak Hour Maximum Queue Length.....	27
Figure 14: Existing (2019) PM Peak Hour Intersection Delay .....	28
Figure 15: Existing (2019) PM Peak Hour Maximum Queue Length.....	29
Figure 16: Freeway Crash Density Summary (2015 – 2019) (1).....	33
Figure 17: Freeway Crash Density Summary (2015 – 2019) (2).....	34
Figure 18: Westbound I-64 at US 250 Interchange Crash Type Summary (2015 – 2019).....	34
Figure 19: Eastbound I-64 at US 250 Interchange Roadway Condition Crash Summary (2015 – 2019).....	35
Figure 20: Route 288 at US 250 Interchange Crash Type Summary (2015 – 2019) .....	35
Figure 21: Proposed Lane Configuration for Auxiliary Lane Concept.....	47
Figure 22: Proposed Lane Configuration for Braided Ramp Concept (1/2).....	47
Figure 23: Proposed Lane Configuration for Braided Ramp Concept (2/2).....	48
Figure 24: Proposed Lane Configuration for C-D Road Concept (1/2).....	48
Figure 25: Proposed Lane Configuration for C-D Road Concept (2/2).....	48
Figure 26: Peak Hour Traffic Volumes and Proposed Lane Configuration for Larger C-D Road Concept (1/2).....	49
Figure 27: Peak Hour Traffic Volumes and Proposed Lane Configuration for Larger C-D Road Concept (2/2).....	50
Figure 28: US 250 at I-64 Partial Cloverleaf Improvement (1).....	56
Figure 29: US 250 at I-64 Partial Cloverleaf Improvement (2).....	57
Figure 30: Route 288 Continuous Auxiliary Lanes to Tuckahoe Creek Parkway .....	58
Figure 31: Route 288 at US 250 Ramp and Ramp Terminal Improvements (1) .....	59
Figure 32: Route 288 at US 250 Ramp and Ramp Terminal Improvements (2) .....	60
Figure 33: Route 288 at US 250 Ramp and Ramp Terminal Improvements (3) .....	61
Figure 34: Route 288 at US 250 Ramp and Ramp Terminal Improvements (4) .....	62
Figure 35: Route 288 at US 250 Ramp and Ramp Terminal Improvements (5) .....	63
Figure 36: US 250 at Tom Leonard Drive Intersection Improvements .....	64
Figure 37: I-295 Continuous Auxiliary Lane from I-64 to Nuckols Road.....	65
Figure 38: I-64 to I-295 Diverge Reconfiguration.....	66
Figure 39: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (1) .....	67
Figure 40: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (2) .....	68
Figure 41: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (3) .....	69

Figure 42: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (4)	70
Figure 43: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (5)	71
Figure 44: No-Build (2026) Peak Hour Traffic Volumes	86
Figure 45: No-Build (2046) Peak Hour Traffic Volumes	87
Figure 46: No-Build (2026) AM Peak Hour Average Density	90
Figure 47: No-Build (2046) AM Peak Hour Average Density	92
Figure 48: No-Build (2046) AM Peak Hour Average Speed	93
Figure 49: No-Build (2046) AM Peak Hour Maximum Queue Length (Depictive)	94
Figure 50: No-Build (2026) PM Peak Hour Average Density	95
Figure 51: No-Build (2026) PM Peak Hour Average Speed	96
Figure 52: No-Build (2046) PM Peak Hour Average Density	97
Figure 53: No-Build (2046) PM Peak Hour Average Speed	98
Figure 54: No-Build (2046) PM Peak Hour Maximum Queue Length (Depictive)	99
Figure 55: No-Build (2026) AM Peak Hour Intersection Delay	102
Figure 56: No-Build (2026) AM Peak Hour Maximum Queue Length	103
Figure 57: No-Build (2046) AM Peak Hour Intersection Delay	104
Figure 58: No-Build (2046) AM Peak Hour Maximum Queue Length	105
Figure 59: No-Build (2026) PM Peak Hour Intersection Delay	106
Figure 60: No-Build (2026) PM Peak Hour Maximum Queue Length	107
Figure 61: No-Build (2046) PM Peak Hour Intersection Delay	108
Figure 62: No-Build (2046) PM Peak Hour Maximum Queue Length	109
Figure 63: AM Traffic Volume Rerouting (2040) in Subarea Model for N Gayton Interchange Scenario	111
Figure 64: PM Traffic Volume Rerouting (2040) in Subarea Model for N Gayton Interchange Scenario	112
Figure 65: Changes in 2046 AM Peak Hour Traffic Volumes from No-Build for Build Packages 2 and 3	112
Figure 66: Changes in 2046 PM Peak Hour Traffic Volumes from No-Build for Build Packages 2 and 3	113
Figure 67: Build (2026) Peak Hour Traffic Volumes for Build Packages 2 and 3	114
Figure 68: Build (2046) Peak Hour Traffic Volumes for Build Packages 2 and 3	115
Figure 69: Build Package 1 (2026) AM Peak Hour Average Density	118
Figure 70: Build Package 1 (2026) AM Peak Hour Average Speed	119
Figure 71: Build Package 1 (2046) AM Peak Hour Average Density	120
Figure 72: Build Package 1 (2046) AM Peak Hour Average Speed	121
Figure 73: Build Package 1 (2026) PM Peak Hour Average Density	122
Figure 74: Build Package 1 (2026) PM Peak Hour Average Speed	123
Figure 75: Build Package 1 (2046) PM Peak Hour Average Density	124
Figure 76: Build Package 1 (2046) PM Peak Hour Average Speed	125
Figure 77: Build Package 1 (2046) AM Peak Hour Maximum Queue Length (Depictive)	126
Figure 78: Build Package 1 (2046) PM Peak Hour Maximum Queue Length (Depictive)	127
Figure 79: Build Package 1 (2046) PM Peak Hour Average Speeds	128
Figure 80: Build Package 1 (2026) AM Peak Hour Intersection Delay	131
Figure 81: Build Package 1 (2026) AM Peak Hour Maximum Queue Length	132
Figure 82: Build Package 1 (2046) AM Peak Hour Intersection Delay	133
Figure 83: Build Package 1 (2046) AM Peak Hour Maximum Queue Length	134
Figure 84: Build Package 1 (2026) PM Peak Hour Intersection Delay	135
Figure 85: Build Package 1 (2026) PM Peak Hour Maximum Queue Length	136
Figure 86: Build Package 1 (2046) PM Peak Hour Intersection Delay	137
Figure 87: Build Package 1 (2046) PM Peak Hour Maximum Queue Length	138

Figure 88: Build Package 2 (2026) AM Peak Hour Average Density .....	142
Figure 89: Build Package 2 (2026) AM Peak Hour Average Speed .....	143
Figure 90: Build Package 2 (2046) AM Peak Hour Average Density .....	144
Figure 91: Build Package 2 (2046) AM Peak Hour Average Speeds .....	145
Figure 92: Build Package 2 (2026) PM Peak Hour Average Density .....	146
Figure 93: Build Package 2 (2026) PM Peak Hour Average Speed .....	147
Figure 94: Build Package 2 (2046) PM Peak Hour Average Density .....	148
Figure 95: Build Package 2 (2046) PM Peak Hour Average Speed .....	149
Figure 96: Build Package 2 (2046) AM Peak Hour Maximum Queue Length (Depictive) .....	150
Figure 97: Build Package 2 (2046) PM Peak Hour Maximum Queue Length (Depictive) .....	151
Figure 98: Build Package 2 (2046) PM Peak Hour Average Speed .....	152
Figure 99: Build Package 2 (2026) AM Peak Hour Intersection Delay .....	155
Figure 100: Build Package 2 (2026) AM Peak Hour Maximum Queue Length .....	156
Figure 101: Build Package 2 (2046) AM Peak Hour Intersection Delay .....	157
Figure 102: Build Package 2 (2046) AM Peak Hour Maximum Queue Length .....	158
Figure 103: Build Package 2 (2026) PM Peak Hour Intersection Delay .....	159
Figure 104: Build Package 2 (2026) PM Peak Hour Maximum Queue Length .....	160
Figure 105: Build Package 2 (2046) PM Peak Hour Intersection Delay .....	161
Figure 106: Build Package 2 (2046) PM Peak Hour Maximum Queue Length .....	162
Figure 107: Build Package 3 (2026) AM Peak Hour Average Density .....	166
Figure 108: Build Package 3 (2026) AM Peak Hour Average Speed .....	167
Figure 109: Build Package 3 (2046) AM Peak Hour Average Density .....	168
Figure 110: Build Package 3 (2046) AM Peak Hour Average Speed .....	169
Figure 111: Build Package 3 (2026) PM Peak Hour Average Density .....	170
Figure 112: Build Package 3 (2026) PM Peak Hour Average Speed .....	171
Figure 113: Build Package 3 (2046) PM Peak Hour Average Density .....	172
Figure 114: Build Package 3 (2046) PM Peak Hour Average Speed .....	173
Figure 115: Build Package 3 (2046) AM Peak Hour Maximum Queue Length (Depictive) .....	174
Figure 116: Build Package 3 (2046) PM Peak Hour Maximum Queue Length (Depictive) .....	175
Figure 117: Build Package 3 (2046) PM Peak Hour Average Speed .....	176
Figure 118: Build Package 3 (2026) AM Peak Hour Intersection Delay .....	179
Figure 119: Build Package 3 (2026) AM Peak Hour Maximum Queue Length .....	180
Figure 120: Build Package 3 (2046) AM Peak Hour Intersection Delay .....	181
Figure 121: Build Package 3 (2046) AM Peak Hour Maximum Queue Length .....	182
Figure 122: Build Package 3 (2026) PM Peak Hour Intersection Delay .....	183
Figure 123: Build Package 3 (2026) PM Peak Hour Maximum Queue Length .....	184
Figure 124: Build Package 3 (2046) PM Peak Hour Intersection Delay .....	185
Figure 125: Build Package 3 (2046) PM Peak Hour Maximum Queue Length .....	186
Figure 126: No-Build (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250 .....	193
Figure 127: Build Package 1 (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250 .....	193
Figure 128: Build Package 2 (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250 .....	193
Figure 129: Build Package 3 (2046) PM Maximum Queue Length (Depictive) – Eastern Intersections on US 250 .....	193
Figure 130: No-Build (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250 .....	194
Figure 131: Build Package 1 (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250 .....	194
Figure 132: Build Package 2 (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250 .....	194
Figure 133: Build Package 3 (2046) PM Maximum Queue Length (Depictive) – Western Intersections on US 250 .....	194

Figure 134: Environmental Features and Proposed Improvement Impact Areas (1) ..... 203  
Figure 135: Environmental Features and Proposed Improvement Impact Areas (2) ..... 204  
Figure 136: Environmental Features and Proposed Improvement Impact Areas (3) ..... 205  
Figure 137: Public Survey Rankings of Priorities within Study Area..... 217  
Figure 138: Public Survey Ratings for Build Options ..... 218

## Table of Tables

Table 1: Summary of Build Package Components .....	2
Table 2: Interchange Spacing .....	11
Table 3: Criteria for Vissim Analyses .....	18
Table 4: Study Area PSI Segments .....	31
Table 5: Freeway Crash Summary by Year (2015 - 2019) .....	32
Table 6: Freeway Crash Summary by Severity (2015 - 2019).....	32
Table 7: Freeway Crash Summary by Crash Type (2015 - 2019).....	32
Table 8: Freeway Crash Summary by Time of Day (2015 - 2019) .....	32
Table 9: Freeway Crash Summary by Weather Condition (2015 - 2019).....	33
Table 10: Intersection Crash Summary by Severity (2015 - 2019).....	36
Table 11: Funded Transportation Projects within the Study Area .....	37
Table 12: Transportation Projects within the Modeling Area .....	38
Table 13: Subarea Model Scenarios.....	39
Table 14: Concepts on Route 288 .....	41
Table 15: Concepts at the I-64 at US 250 Interchange .....	42
Table 16: Concepts at the I-64 at I-295 Interchange .....	44
Table 17: Concepts at the I-64 Interchanges with US 250 and I-295.....	45
Table 18: Percent of Demand Served Comparison .....	50
Table 19: Conflict Point Summary for Mainline Improvement Concepts .....	52
Table 20: Mainline Improvement Concepts for New Interchange at N Gayton Road .....	52
Table 21: Summary of Build Package Components .....	54
Table 22: AASHTO Design Criteria .....	73
Table 23: VDOT Design Criteria .....	75
Table 24: Potential Design Waivers.....	81
Table 25: I-64 AM Peak Hour (2046) Travel Time Comparison (minutes:seconds).....	188
Table 26: US 250 AM Peak Hour (2046) Travel Time Comparison (minutes:seconds).....	188
Table 27: AM Peak Hour (2046) Freeway Demand (Percent Served) .....	189
Table 28: I-64 PM Peak Hour (2046) Travel Time Comparison (minutes:seconds).....	190
Table 29: US 250 PM Peak Hour (2046) Travel Time Comparison (minutes:seconds).....	191
Table 30: PM Peak Hour (2046) Freeway Demand (Percent Served) .....	192
Table 31: Existing Conditions ISATe Analysis Results .....	196
Table 32: Build Package ISATe Freeway Analysis Crash Predictions (2046).....	196
Table 33: Build Package ISATe Freeway Analysis Crash Rate Predictions (2046).....	196
Table 34: Build Package ISATe Ramp Analysis Crash Predictions (2046).....	197
Table 35: Build Package ISATe Ramp Terminal Analysis Crash Predictions (2046).....	198
Table 36: ISATe Crash Predictions on I-64 Between the Two Westbound I-64 Off-Ramps to US 250 (2046).....	198
Table 37: Low-range CMF Estimates for Westbound I-64 at US 250 Interchange .....	199
Table 38: ISATe Crash Predictions per Year.....	199
Table 39: Projected Crash Reduction on Westbound I-64 between the Cox Road Bridge and the Off-Ramp to Westbound US 250 .....	199
Table 40: Projected Crash Reduction on US 250 .....	200
Table 41: Network Safety Summary for Low- and High-Range Projections for Change in Annual Crash Frequency).....	201
Table 42: Previously Recorded Cultural Resources within the Common Elements Study Area .....	207
Table 43: Build Package Environmental Impacts Matrix .....	213

Table 44: Environmental Impacts Matrix Legend..... 214  
Table 45: Planning Level Cost Estimates ..... 217  
Table 46: Build Package Simplified Matrix..... 219  
Table 47: Recommended Improvement Phasing..... 221

## Appendices

Appendix A – Framework Document

Appendix B – Data Collection

Appendix C – Existing Conditions Operational Analysis

Appendix D – Existing Safety Analysis

Appendix E – No-Build Conditions Operational Analysis

Appendix F – Alternatives Development and Screening

Appendix G – Build Conditions Operational Analysis

Appendix H – Preferred Alternative Selection

Appendix I – Public Survey Comments

Appendix J – Letters of Commitment

## ▲ FHWA Interstate Access Policy Points

As detailed in FHWA's *Policy on Access to the Interstate System*, dated May 22, 2017, FHWA's decision to approve new or revised access points to the interstate system is dependent on the proposal satisfying two policy points. The following sections outline an overview of the study and responses to the required policy points.

### OVERVIEW

The objective of this study is to identify the needs and to develop and evaluate potential solutions to address those needs of the transportation network in the Short Pump area (in Henrico County just west of Richmond), which includes sections of I-64, I-295, Route 288, and US 250. The purpose for the project is to address and improve upon the identified needs of the transportation network, which include:

- **Addressing capacity-constrained roadways:** several ramps and roadway segments within the Short Pump area are over capacity or are projected to be over capacity in the future
- **Reducing recurring congestion:** the Short Pump area contains three high-volume freeway networks and a US Route that serves a popular commercial area. This mix leads to recurring congestion on several roadway segments within the study area.
- **Improving safety at hot spots:** the Short Pump area contains several intersections and roadway segments that have been identified as high-ranking areas with potential for safety improvement within VDOT Richmond District

The study team screened individual improvement alternatives to address needs identified throughout the study area and developed three Build packages that included the improvements outlined in *Table 1*. The study team prepared an alternatives comparison matrix to evaluate the differences between the three Build packages and the No-Build scenario using the following criteria. Build Package 3 scored the highest and was selected as the preferred alternative.

- Right-of-way (RW) and utility impacts
- Safety impacts
- Operational impacts
- Bicycle and pedestrian accommodation
- Meets Purpose and Need
- Environmental impacts
- Preliminary cost of construction

Table 1: Summary of Build Package Components

Improvement	Build Package 1	Build Package 2	Build Package 3
Construct a partial cloverleaf interchange (option 3) that removes the on-ramp from eastbound US 250 to westbound I-64. Construct dual westbound right-turn lanes at intersection with westbound I-64 ramps plus contraflow left-turn lanes	✓	✗	✓
Construct a new diverging diamond interchange on I-64 at N Gayton Road	✗	✓	✓
Construct an auxiliary lane on southbound Route 288 between US 250 and Tuckahoe Creek Parkway	✓	✓	✓
Construct an auxiliary lane on northbound Route 288 between Tuckahoe Creek Parkway and US 250. Signalize and add a second lane to serve the right-turn movement on the southbound Route 288 off-ramp to US 250. Add a second lane to serve the right-turn movement on the northbound Route 288 off-ramp to US 250.	✓	✓	✓
Convert the westbound US 250 right-turn lane at Tom Leonard Drive to a shared through/right lane and install a thru-cut	✓	✓	✓
Restrict vehicles on the westbound off-ramp from I-64 to eastbound US 250 from turning left at Dominion Boulevard	✓	✓	✓
Convert the single-lane I-295 on-ramp from westbound I-64 to two lanes. Construct a continuous northbound auxiliary lane from I-64 to Nuckols Road interchange.	✓	✓	✓
Reconfigure the eastbound I-64 ramp diverge at I-295 to create one exit only lane and one choice lane	✓	✗	✗

## POLICY POINT 1

*An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, and ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (Title 23, Code of Federal Regulations (CFR), paragraphs 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, should be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access should include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute, and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request should also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).*

## Response

The study team conducted operational and safety analyses and determined that the preferred alternative addresses the needs of the transportation network, which included addressing capacity-constrained roadways, reducing recurring congestion, and improving safety at hot spots.

The preferred alternative is projected to improve operations at several points in the study area that are over capacity or are projected to be over capacity in the future. The preferred alternative is projected to serve a higher percentage of demand than the No-Build scenario on all roadways as documented in the *Build Package Operational Comparison* section. The improvements are also projected to result in travel times in the study area that are lower or comparable to the No-Build scenario on I-64 and US 250.

Crashes were projected to be added to the network in the vicinity of the new interchange at N Gayton Road since the new interchange adds two new on- and off-ramps to the interstate system and attracts more vehicles to the section of interstate. The goal of the safety analysis was to determine if the projected reduction in crashes at the existing freeway hot spots outweighed the crashes that were projected to be added to the network in the vicinity of the new interchange. The study team determined that the preferred alternative was projected to reduce enough crashes at the existing freeway hotspots to result in an overall safety benefit on the freeway as documented in the *Safety Conclusions* section.

A conceptual signing plan for the preferred alternative is described in the *Conceptual Signing Plan* section and included in *Appendix H*.

## POLICY POINT 2

*The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access, such as managed lanes (e.g., transit or high occupancy vehicle and high occupancy toll lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.*

### Response

The proposed modifications to access in the preferred alternative include new access at the existing grade-separated crossing of N Gayton Road over I-64, which will provide for all traffic movements and connect to a public road only. Additional modifications in access include interchange reconfiguration improvements at US 250, in which the westbound I-64 on-ramp from eastbound US 250 is proposed to be removed. Access will be maintained for vehicles making this movement via a left turn onto the existing westbound I-64 on-ramp from westbound I-64. The preferred alternative was conceptually designed to meet or exceed current design standards except at the locations noted in the *Potential Design Exceptions* and *Potential Design Waivers* sections.

## Introduction

### BACKGROUND

The interstate, interchanges, and arterial network in the Short Pump area have experienced operational and safety challenges and are expected to have significant growth in the coming years. Henrico County is advancing and implementing several improvements in the Short Pump area, but the improvements are not enough to provide relief to the congestion and safety issues.

#### Study Work Group

A study work group (SWG) was formed for the Short Pump Area Interchange Access Report (IAR) project to capture input from local stakeholders through the study process and to shape the development of the preferred alternative. The SWG provided key knowledge of the study area, reviewed study methodologies, provided input on assumptions, and reviewed alternatives developed throughout the study process. The Short Pump IAR SWG included members representing the following organizations:

- Henrico County Department of Transportation
- Goochland County Department of Transportation
- Virginia Department of Transportation (VDOT) – Central Office and Richmond District Office
- Federal Highway Administration (FHWA) – Virginia Division Office
- Kimley-Horn & Associates, Inc. (Henrico County transportation consultant)

### PURPOSE AND NEED

The objective of this study is to identify the needs of the transportation network in the Short Pump area, which includes sections of I-64, I-295, Route 288, and US 250, and to develop and evaluate potential solutions to address those needs. Previous studies and current traffic conditions demonstrate that the highway segments above are experiencing operational and safety challenges and are limited in capacity. The area in the vicinity of Short Pump is expected to have significant growth in the coming years, which will add to the challenges. Henrico County is advancing and implementing a number of multimodal transportation improvements in the Short Pump area, but the improvements are not enough to provide relief to the congestion and safety issues on the interstate.

Key findings from recent studies include the following conclusions:

- The *STARS US 250 (Short Pump) Study* included a high-level analysis of the I-64 /US 250 interchange (Exit 178). Through preliminary alternatives analysis, the study determined that the I-64/US 250 interchange could not be improved enough to accommodate demand on I-64 nor on US 250.
- Another key finding from the *STARS US 250 (Short Pump) Study* was that US 250 could not be improved enough to relieve congestion on the segments between the I-64/US 250 interchange and Pouncey Tract Road, and between N. Gayton Road and Route 288. This congestion is independent of the capacity-constrained congestion on the ramp from the westbound I-64 to westbound US 250.
- A subarea model derived from the Richmond region Travel Demand Model was created by VDOT Transportation Mobility Planning Division (TMPD) with a focus on the Short Pump area. It was calibrated with updated traffic count data and was based on the latest available socioeconomic data in Henrico and Goochland counties. Several potential Build scenarios, which included potential planned improvements in the region, were derived to evaluate the impact(s) each improvement had on Short Pump area traffic independently. Based on the results of the subarea model analysis, an additional interstate connection at N. Gayton Rd was shown to potentially reduce demand at critical, over-capacity interchange ramps, as well as on key sections of major arterials. This reduction in demand would also potentially reduce congestion along sections of I-64, I-295, Route 288 and US 250, and alleviate congestion-related safety issues.

- Another previous study, the *Greater RVA Transit Vision Plan*, determined that increased transportation demand strategies considered for deployment in this area are not expected to address all identified capacity constraints. As such, this study should consider improvements to the existing roadway network and new roadway connections or limited access point connections that may reduce demand on the existing roadway network as potential solutions to address the needs identified in the Short Pump area.

Based on these findings, it was determined that existing and future traffic volumes and travel patterns point to the need to identify long-term solutions to increase capacity and improve safety in the Short Pump area.

The purpose for the project is to address and improve upon the identified needs of the transportation network, which include:

- **Addressing capacity-constrained roadways:** several ramps and roadway segments within the Short Pump area are over capacity or are projected to be over capacity in the future
- **Reducing recurring congestion:** the Short Pump area contains three high-volume freeway networks and a US Route that serves a popular commercial area. This mix leads to recurring congestion on several roadway segments within the study area.
- **Improving safety at hot spots:** the Short Pump area contains several intersections and roadway segments that have been identified as high-ranking areas with potential for safety improvement within VDOT Richmond District

## PROJECT LOCATION

The study area includes the follow corridors, interchange ramps, and intersections as shown in *Figure 1*.

### Corridors

- Eastbound and westbound I-64 between the Route 623 interchange and the Gaskins Road interchange
- Northbound and southbound I-295 between the Nuckols Road interchange and the I-64 interchange
- Northbound and southbound Route 288 between the Tuckahoe Creek Parkway interchange and the I-64 interchange

### Intersections

- N Gayton Road at Blue Ocean Lane
- N Gayton Road at Bacova Drive
- N Gayton Road at Liesfeld Farm Drive
- US 250 at Tom Leonard Drive
- US 250 at Dominion Boulevard
- US 250 at eastbound I-64 on-ramp
- US 250 at northbound Route 288 ramps
- US 250 at southbound Route 288 ramps

### Interchange Ramps

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>■ Eastbound I-64               <ul style="list-style-type: none"> <li>■ Off-ramp to southbound Route 288</li> <li>■ On-ramp from northbound Route 288</li> <li>■ Off-ramp to southbound I-295</li> <li>■ On-ramp from northbound I-295</li> <li>■ Off-ramp to westbound US 250</li> <li>■ Off-ramp to eastbound US 250</li> <li>■ On-ramp from US 250</li> <li>■ Off-ramp to eastbound US 250</li> <li>■ On-ramp from eastbound US 250</li> </ul> </li> <li>■ Westbound I-64               <ul style="list-style-type: none"> <li>■ Off-ramp to eastbound US 250</li> <li>■ On-ramp from eastbound US 250</li> <li>■ Off-ramp to westbound US 250</li> <li>■ On-ramp from westbound US 250</li> <li>■ Off-ramp to southbound I-295</li> <li>■ On-ramp from northbound I-295</li> <li>■ Off-ramp to southbound Route 288</li> <li>■ On-ramp from northbound Route 288</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>■ Northbound Route 288               <ul style="list-style-type: none"> <li>■ Off-ramp to US 250</li> <li>■ On-ramp from US 250</li> </ul> </li> <li>■ Southbound Route 288               <ul style="list-style-type: none"> <li>■ Off-ramp to US 250</li> <li>■ On-ramp from US 250</li> </ul> </li> <li>■ Northbound I-295               <ul style="list-style-type: none"> <li>■ On-ramp from southbound Nuckols Road</li> </ul> </li> <li>■ Southbound I-295               <ul style="list-style-type: none"> <li>■ Off-ramp to southbound Nuckols Road</li> </ul> </li> </ul> |
|--|---|

Figure 1: Study Area



## ▲ Methodology

This IAR was developed according to the applicable VDOT and FHWA interchange access criteria stated in IIM-LD-200.11.

A framework document was developed for this IAR that documented the methodologies and assumptions for this study. The original document was signed on March 24, 2021. The document was revised on October 6, 2021, and was re-signed by Henrico County, VDOT, and FHWA. The revised framework document is attached in [Appendix A](#).

## RELEVANT STUDIES

The *STARS West Broad Street (US 250) Corridor Study* was prepared in December 2018 for VDOT to provide recommendations to improve operations and safety on the US 250 corridor between Glenside Drive and Dominion Boulevard.

The *STARS US 250 (Short Pump Area) Corridor Study* was prepared in December 2020 to provide recommendations to improve operations and safety on the US 250 corridor between the I-64 interchange and Hockett Road/St. Matthews Lane. As documented in the [Purpose and Need](#), this study concluded that further study was needed to address deficiencies on US 250 between the I-64 interchange and Pouncey Tract Road and between the Route 288 interchange and N Gayton Road. It was also determined that the I-64 interchange at US 250 could not be improved enough to accommodate demand on I-64 nor on US 250.

The *I-64 at Parham Road Interchange Modification Report (Parham IMR)* and the *I-64 at Gaskins Road Interchange Modification Report (Gaskins IMR)* were prepared in conjunction with the analysis efforts for the *STARS US 250 (Short Pump Area) Corridor Study*. Traffic modeling and growth rate assumptions are consistent between these two IMRs, the *STARS US 250 (Short Pump Area) Corridor Study*, and this IAR.

## ANALYSIS TOOLS

The traffic operations analysis was conducted in accordance with methodologies from VDOT's *Traffic Operations and Safety Analysis Manual (TOSAM)*, Version 2.0. The following traffic analysis tools were selected for the development of this IAR:

- Vissim 11: freeway and intersection analyses
- Synchro Professional, Version 10: screen intersection and interchange improvements; optimize signal timings for use in Vissim

## MEASURES OF EFFECTIVENESS

The following measures of effectiveness (MOE) were selected to evaluate analysis results:

- Vissim freeway analyses
  - Density, measured in vehicles per lane per mile (veh/ln/mi)
  - Speed, measured in miles per hour (mph)
  - Travel time, measured in minutes (min)
  - Vehicle throughput, measured in vehicles (veh)
- Vissim intersection analyses
  - Delay, measured in seconds per vehicle (sec/veh)
  - Maximum queue length, measured in feet (ft)

- Vehicle throughput, measured in vehicles (veh)
- Synchro screening analyses
  - Control delay, measured in seconds per vehicle (sec/veh)
  - 95<sup>th</sup> percentile queue length, measured in feet (ft)

## ANALYSIS YEARS

The following analysis years were selected and agreed upon by the SWG to evaluate results:

- Existing conditions: 2019
- Opening year: 2026
- Design Year: 2046

## ALTERNATIVES DEVELOPMENT, SCREENING, AND PREFERRED ALTERNATIVE SELECTION

Potential geometric improvements were developed to address existing and projected operational and safety deficiencies described in the Purpose and Need. Improvements that were considered included concepts from previous studies (including concepts screened out and recommended) and new concepts. Seven SWG meetings were held throughout the alternatives development and screening process to present potential solutions and their potential to address the Purpose and Need. Screening matrices were developed to justify advancing an alternative or removing it from consideration in the final Build packages, and ultimately, to select the preferred Build alternative. The screening matrices considered the following criteria:

- Right-of-way (RW) and utility impacts
- Safety impacts
- Operational impacts
- Bicycle and pedestrian accommodation
- Environmental impacts
- Preliminary cost of construction (high-level construction cost estimates categorized into low, medium, and high ranges)

The detailed alternatives development and screening process is documented in the *Alternatives Considered* chapter.

## ▲ Existing Conditions

### EXISTING ROADWAY NETWORK

The roadways within the study area vary from interstates to local facilities as described below:

**Interstate 64:** I-64 is classified as an interstate and intersects with I-295, Route 288, and US 250 within the study area limits. It is a six-lane, divided roadway with three 12-foot lanes in each direction of travel separated by a variable-width, primarily grass median. There is an auxiliary lane in each direction on I-64 between the Route 288 and I-295 interchanges and between the US 250 and I-295 interchanges. I-64 is generally oriented in an east-west direction and has a posted speed limit of 65 mph through the US 250, I-295, and Route 288 interchanges. The posted speed limit on I-64 west of Route 288 is 70 mph. Based on the 2019 traffic data published by VDOT, the annual average daily traffic (AADT) for both directions of I-64 ranges from 57,000 vehicles per day west of the Route 288 interchange to 89,000 vehicles per day east of the US 250 interchange.

**Interstate 295:** I-295 is classified as an interstate and intersects with I-64 and Route 695 (Nuckols Road) within the study area limits. It is a six-lane, divided roadway with three 12-foot lanes in each direction of travel separated by a variable-width grass median. Northbound and southbound I-295 are referred to as southwestbound and northeastbound I-295, respectively, for the remainder of this study due to the directionality of I-295 within the study area. The posted speed limit on I-295 is 70 mph. Based on the 2019 VDOT traffic data, the AADT for both directions of I-295 is 67,000 vehicles per day between the I-64 and Nuckols Road interchanges.

**Route 288:** Route 288 is classified as an other freeway or expressway and intersects with US 250 and I-64 within the study area limits. It is a four-lane, divided roadway with two 12-foot lanes of travel in each direction separated by a variable-width grass median. The posted speed limit on Route 288 in the study area is 65 mph. Based on the 2019 VDOT traffic data, the AADT for both directions of Route 288 ranges from 47,000 vehicles per day north of the US 250 interchange to 54,000 vehicles per day south of the US 250 interchange.

**US 250:** US 250 (West Broad Street) is classified as an other principal arterial. US 250 is a six-lane, divided facility with three 12-foot travel lanes in each direction separated by a curbed, primarily grass median. US 250 is generally oriented in an east-west direction within the study area with a posted speed limit of 45 mph. Based on the 2019 VDOT traffic data, the AADT for both directions of US 250 varies from 32,000 to 76,000 vehicles per day within the study area limits.

**N Gayton Road:** N Gayton Road is classified as a major collector road and intersects US 250, Blue Ocean Lane, Bacova Drive, and Liesfeld Farm Drive within the study area. N Gayton Road is a six-lane, divided roadway with three 12-foot travel lanes in each direction of travel and a 16-foot raised concrete median of within the study area. N Gayton Road is generally oriented in a north-south direction with a posted speed limit of 45 mph. Based on the published 2019 VDOT traffic data, the AADT on N Gayton Road is 7,100 vehicles per day.

## INTERCHANGES

The study area for this IAR includes four full interchanges and one partial interchange, which are described in the following paragraphs.

### ***I-64 at US 250***

I-64 at US 250 is a partial cloverleaf interchange that consists of three loop ramps and four directional ramps. The interchange is bound by commercial and office buildings in the northwest, northeast, and southeast quadrants. It is bound by commercial buildings and multifamily residential complexes in the southwest quadrant.

### ***I-64 at I-295***

The I-64 at I-295 interchange is a three-leg directional interchange that consists of three two-lane directional ramps and one single-lane loop ramp. The interchange is bound by residential neighborhoods in the northwest and northeast quadrants. It is bound by commercial buildings to the south of the interchange.

### ***I-64 at Route 288***

The I-64 at Route 288 interchange is a three-leg directional interchange that consists of four directional ramps. All four ramps at this interchange consist of two 12-foot lanes. The interchange is bound by commercial and multifamily residential buildings in the southeast quadrant and undeveloped land in the southwest quadrant and north of the interchange.

### ***Route 288 at US 250***

The Route 288 at US 250 is a partial cloverleaf interchange that consists of two loop ramps and four directional ramps. The ramp terminal intersections were converted to signalized intersections in fall 2020. The interchange is bound by commercial and residential developments to the east and some undeveloped land to the west.

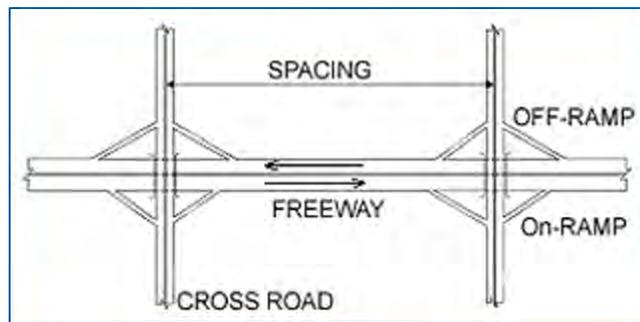
### *I-295 at Nuckols Road*

The I-295 at Nuckols Road interchange is a full cloverleaf interchange that consists of four directional ramps and four loop ramps. The study area for this IAR only includes two directional ramps in the traffic analysis study area: the southwestbound I-295 on-ramp from southbound Nuckols Road and the northeastbound I-295 off-ramp to southbound Nuckols Road.

### Interchange Spacing

According to the American Association of State Highway and Transportation Officials (AASHTO) Green Book, the general guidance for minimum interchange spacing on urban freeways is one mile. The FHWA TechBrief *Safety Assessment of Interchange Spacing on Urban Freeways* (Publication Number FHWA-HRT-07-031), defines interchange spacing as the distance between interchange crossroads as shown in *Figure 2*.

Figure 2: Interchange Spacing Measurement



Source: FHWA Techbrief "Safety Assessment of Interchange Spacing on Urban Freeways" (Publication Number: FHWA-HRT-07-031)

Existing interchange spacing between crossroads in the study area is summarized in *Table 2*. Two locations in the study area do not meet AASHTO's one-mile interchange spacing criterion: I-64 between the US 250 and I-295 interchanges, and Route 288 between the I-64 and US 250 interchanges.

Table 2: Interchange Spacing

From	To	Interchange Spacing (miles)
<b>I-64</b>		
Gaskins Rd	US 250	1.4
US 250	I-295	0.8
I-295	Route 288	2.8
<b>Route 288</b>		
I-64	US 250	0.7
<b>I-295</b>		
I-64	Nuckols Rd	1.7

### LAND USE

The 2010 land use map for Henrico County is provided in *Appendix B*. The map shows that most parcels surrounding US 250 are designated for commercial/retail use. The 2026 land use map from the *Henrico County Vision 2026 Comprehensive Plan* is provided in *Appendix B* and shows additional parcels along the US 250 corridor zoned for commercial and urban mixed use. Much of the area surrounding I-64 in the study area is designated as multi-family or suburban residential on both existing and future maps.

The 2015 zoning use map for Goochland County is provided in [Appendix B](#). The map shows most parcels around Route 288 and I-64 in the study area are designated for agriculture or industry. The 2035 land use map from the *Goochland County 2035 Comprehensive Plan* shows many of these parcels rezoned as commercial or prime economic development to accommodate the expected growth in this area of the county in future years. The future land use map is provided in [Appendix B](#).

## ALTERNATIVE TRAVEL MODES

Greater Richmond Transit Company (GRTC) is the primary transit and bus service provider operating in the study area. GRTC provides local service on US 250 with Route 19, which runs along US 250 from east of the study area limits to Bon Secours Parkway. Route 19 runs every 30 minutes in each direction during the AM and PM peak hours. As part of the *Interstate 64/664 Corridor Improvement Plan*, two additional GRTC express bus routes were funded through the Interstate Operations and Enhancement Program and provide access to Short Pump: one route from downtown Richmond and one route from the Willow Lawn area.

## EXISTING TRAFFIC DATA AND OPERATIONAL PERFORMANCE

Traffic operational analyses were conducted to evaluate the overall performance of the study corridors and intersections under existing AM and PM peak hour conditions. To maintain consistency with the previously completed studies adjacent to the study area, the existing analysis year for this study was 2019. The intent of the existing conditions analysis was to provide a general understanding of the baseline traffic conditions as a starting point for developing future improvement strategies. Existing conditions were modeled using Vissim 11. Existing conditions modeling inputs, assumptions, and results are described in detail in the following sections.

### Existing Traffic Volumes, Peak Hour Factors, and Heavy Vehicle Percentages

Turning movement counts (TMCs) and 48-hour video ramp counts were conducted as a part of the *Gaskins IMR*, *Parham IMR*, and *STARS US 250 Corridor Study*. Additional traffic counts were conducted on April 20, 2021, to supplement the traffic data collected in 2019 for the expanded roadway network used in this study. The additional locations included:

- N Gayton Road at Blue Ocean Lane (TMC)
- N Gayton Road at Bacova Drive (TMC)
- N Gayton Road at Liesfeld Farm Drive (TMC)
- Southwestbound I-295 on-ramp from southbound Nuckols Road (48-hour directional count)
- Northeastbound I-295 off-ramp to southbound Nuckols Road (48-hour directional count)

The raw traffic count data for all study area intersections, ramps and mainline locations can be found in [Appendix B](#).

Based on direction provided in the *TOSAM*, the individual AM and PM peak hours for each intersection and ramp within the study were held constant throughout the analysis. The SWG determined in the framework document that the AM and PM peak hours would stay consistent with the previously completed *STARS US 250 Corridor Study*. The peak hours used for analysis were:

- AM Peak: 7:45 – 8:45 AM
- PM Peak: 5:00 – 6:00 PM

Balanced AM and PM peak hour traffic volumes are illustrated in [Figure 3](#). AM and PM peak hour factors were calculated for each intersection based on guidance provided in the *TOSAM*. The AM and PM peak hour factors are illustrated in [Figure 4](#) and [Figure 5](#), respectively.

All collected intersection, ramp, and mainline count data included vehicle classification information. The vehicle classification data was used to compute heavy vehicle percentages during the peak hours throughout the study area. Heavy vehicle percentages are shown in *Figure 4* and *Figure 5*.

### **Existing Geometries, Lane Designations, and Speed Data**

Existing intersection geometries, turn lane storage lengths, and posted speed limits were all confirmed by the study team on a field visit on April 24, 2019. A summary of the existing lane designations and turn lane storage lengths is illustrated in *Figure 6*. INRIX data provided by VDOT was used to obtain free-flow mainline travel speeds in both directions on I-64. During the field review, free-flow speeds observed in the field were comparable to the INRIX data.



Figure 4: Existing (2019) AM Peak Hour Factor and Heavy Vehicle Percentages

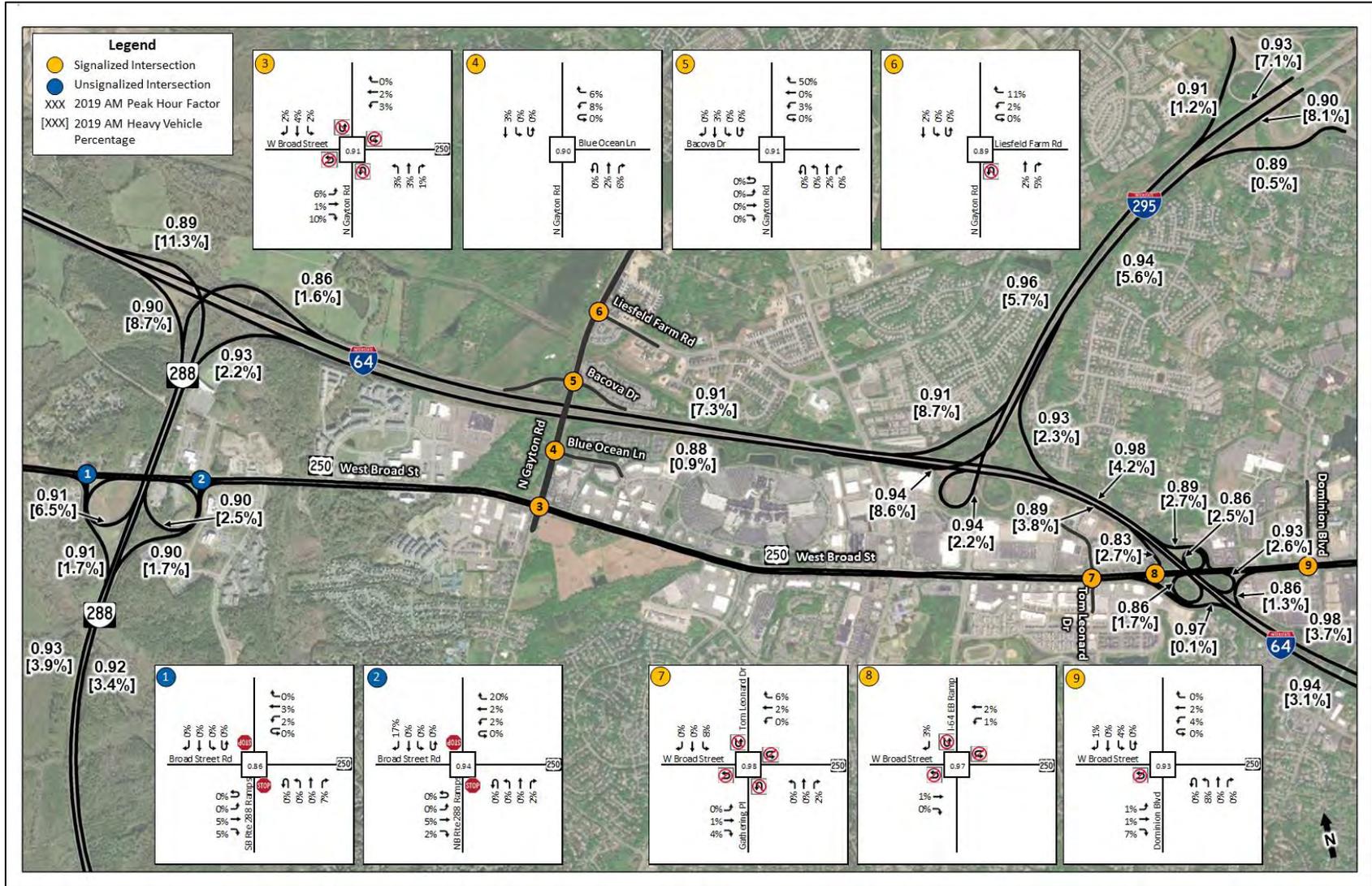


Figure 5: Existing (2019) PM Peak Hour Factor and Heavy Vehicle Percentages

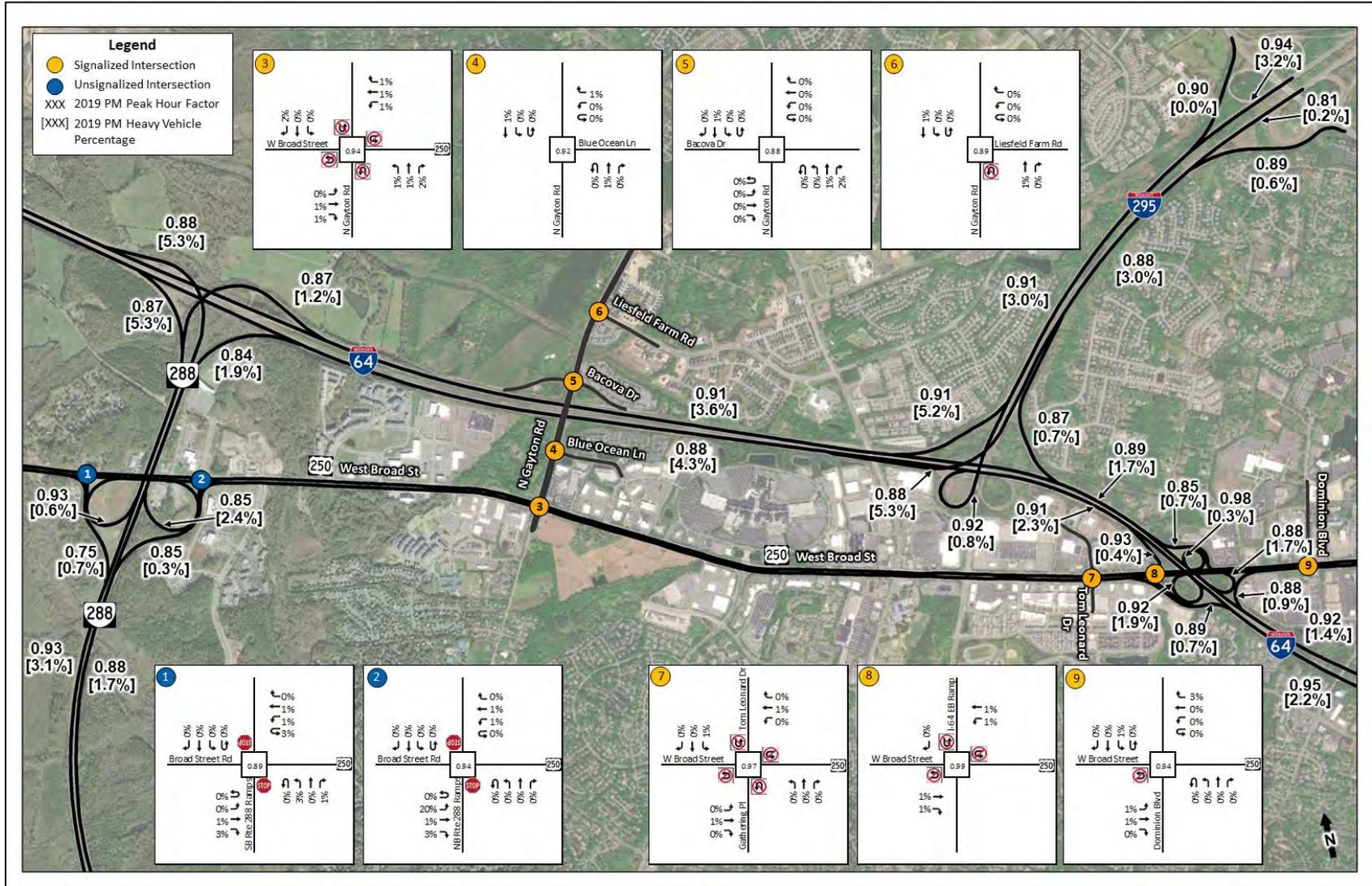


Figure 6: Existing (2019) Geometrics and Lane Designations



## Criteria for Evaluating Analysis Results

The criteria for reporting intersection and segment results for the Vissim analyses shown in *Table 3* were agreed upon for the *Gaskins IMR* and *Parham IMR* and were used for this IAR.

*Table 3: Criteria for Vissim Analyses*

Color Scale	Intersection	Segments	
	Average Delay (sec/veh)	Average Density (veh/ln/mi)	Average Speed (mph)
Green	≤ 10	≤ 18	> 60
Light Green	> 10 - 20	> 18 – 26	> 50 – 60
Yellow	> 20 – 35	> 26 – 35	> 35 – 50
Orange	> 35 – 55	> 35 – 45	> 20 – 35
Red	> 55	> 45	> 20

## Existing Conditions Modeling Assumptions

The existing AM and PM Vissim models were developed based on a combination of collected data and visual observations from field review. Traffic volumes, travel times, and maximum queue lengths were used as calibration measures for this IAR to satisfy *TOSAM* requirements. A detailed summary of Vissim modeling inputs, assumptions, and calibration results is provided in *Appendix C*.

The VDOT Sample Size Determination Tool, Version 2.0 was used to determine the number of traffic simulation runs required to provide the acceptable 95th percentile confidence level for both the AM and PM models. The appropriate sample size for this study was determined using speed results from test locations throughout the study corridors. Based on the results of the Sample Size Determination Tool, the minimum of 10 traffic simulation runs were performed at a 95th percentile confidence level for the AM peak hour traffic simulation model. The PM peak hour model required 19 runs to be performed at a 95th percentile confidence level. The results from the Sample Size Determination Tool and the speed test locations are provided in *Appendix C*.

## Existing Conditions Freeway Analysis Results

The AM and PM peak hour average freeway segment density (vehicle per lane per mile) and speed (mph) are illustrated in *Figure 7* through *Figure 10*. Graphical representation of the freeway results by lane is included in *Appendix C*.

### AM Peak Hour

In the AM peak hour, all eastbound and westbound mainline I-64 segments operate with densities under 26 veh/ln/mi and speeds greater than 50 mph. The southwestbound I-295 off-ramp to eastbound I-64 operates with the worst density at 72 veh/ln/mi due to the demand of 1,814 vehicles in the peak hour on a single-lane loop ramp. The speeds slow to between 35 and 50 mph on southwestbound I-295 approaching I-64 due to the congestion on the single-lane loop ramp. The eastbound I-64 on-ramp from US 250 operates with a density of 58 veh/ln/mi where the ramp merges from two lanes to one lane prior to merging onto the interstate.

### PM Peak Hour

In the PM peak hour, most mainline I-64 segments in both directions operate with densities under 26 veh/ln/mi. Westbound I-64 operates with higher densities and slower speeds within and approaching the weaving segment at the US 250 interchange. The link density within this weaving segment reaches 45.1 veh/ln/mi while the speed slows to 29 mph. The increased density and reduced speed are attributed to congestion in the right through lane (63.6 veh/ln/mi; 23.2 mph)

and the auxiliary lane (69.6 veh/ln/mi; 19.8 mph) that is caused by the high number of vehicles exiting to westbound US 250 and queuing from the signals on westbound US 250 that back up to the interstate as shown in *Figure 11*. The left two lanes on westbound I-64 within the weaving segment operate at 44 mph or higher with densities less than 32 veh/ln/mi. The maximum queue length on westbound I-64 extends approximately 3,500 feet from the gore for the westbound I-64 off-ramp to westbound US 250 to the Cox Road bridge as shown in *Figure 11*.

The southwestbound I-295 off-ramp to eastbound I-64 operates at a density of 54 veh/ln/mi due to the demand of 1,785 vehicles in the peak hour on a single-lane loop ramp. However, the high density and slower speed does not extend north on southwestbound I-295 like the AM peak hour. Southwestbound I-295 between the Nuckols Road interchange and the off-ramp to westbound I-64 operates at speeds above 60 mph.

Higher densities also occur on the following ramps: eastbound I-64 on-ramp from Northbound Route 288, westbound I-64 off-ramp to northeastbound I-295, westbound I-64 on-ramp from westbound US 250, and eastbound I-64 on-ramp from eastbound US 250.

Figure 7: Existing (2019) AM Peak Hour Average Densities

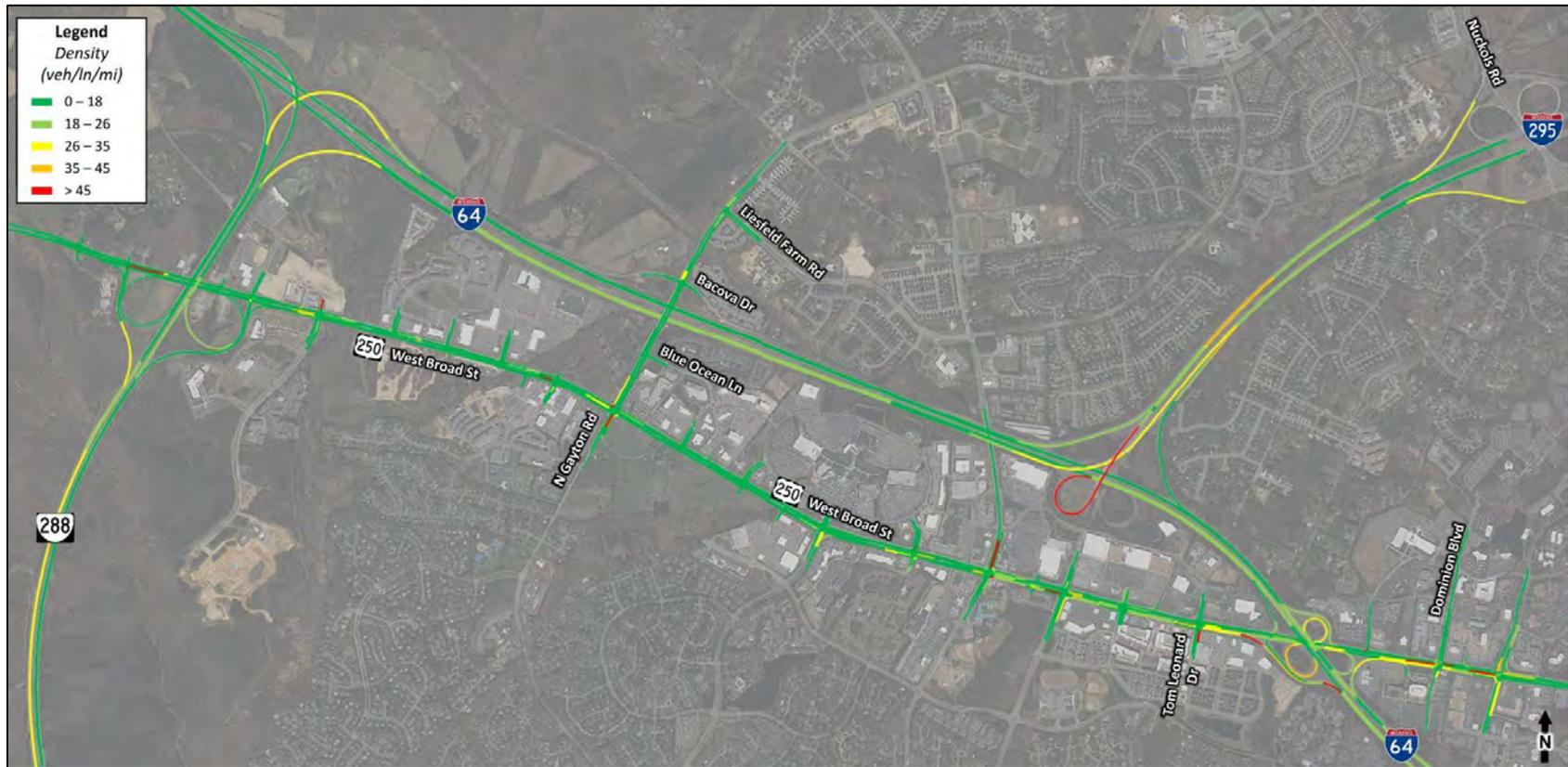


Figure 8: Existing (2019) AM Peak Hour Average Speeds

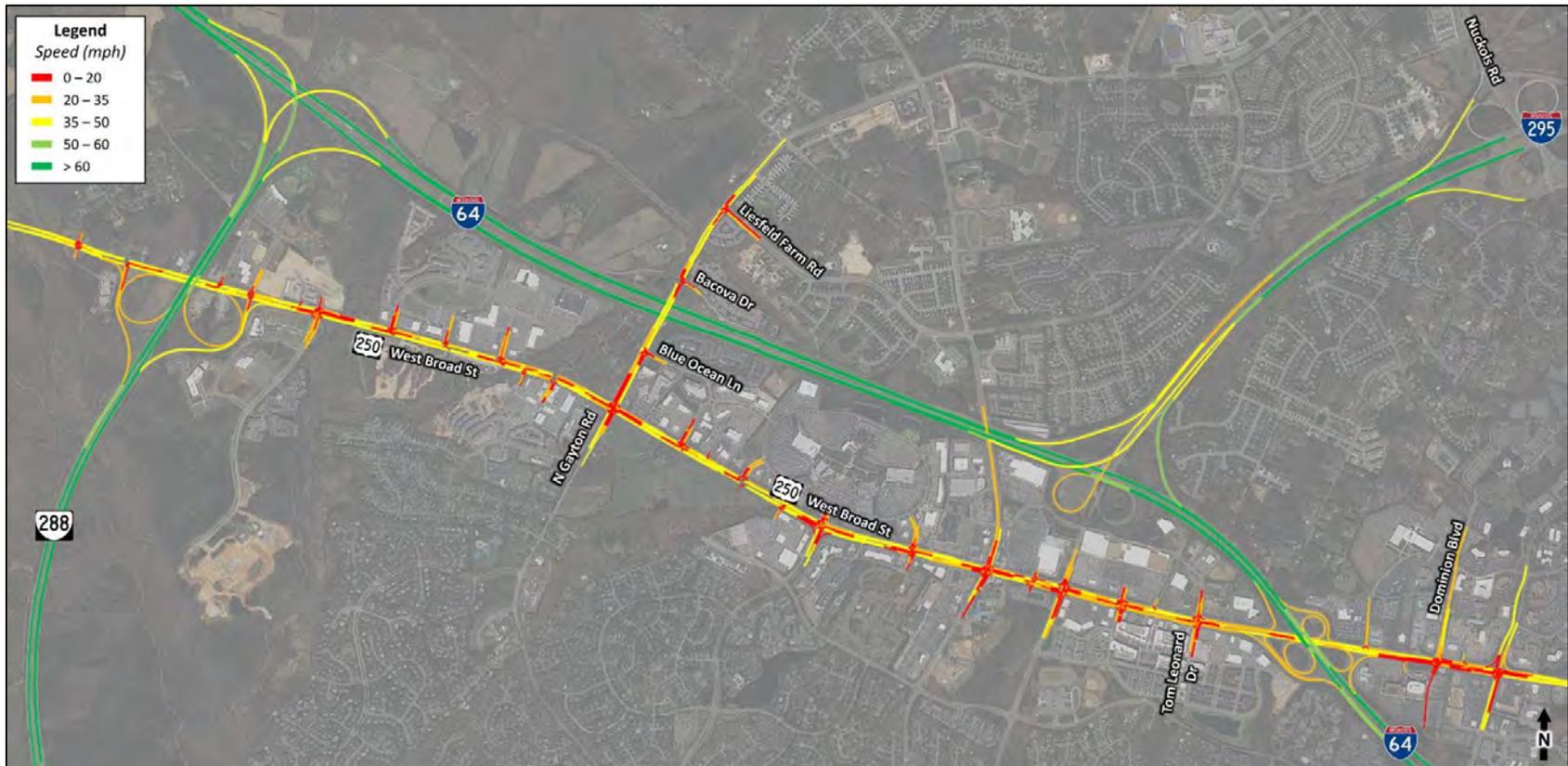


Figure 9: Existing (2019) PM Peak Hour Average Densities

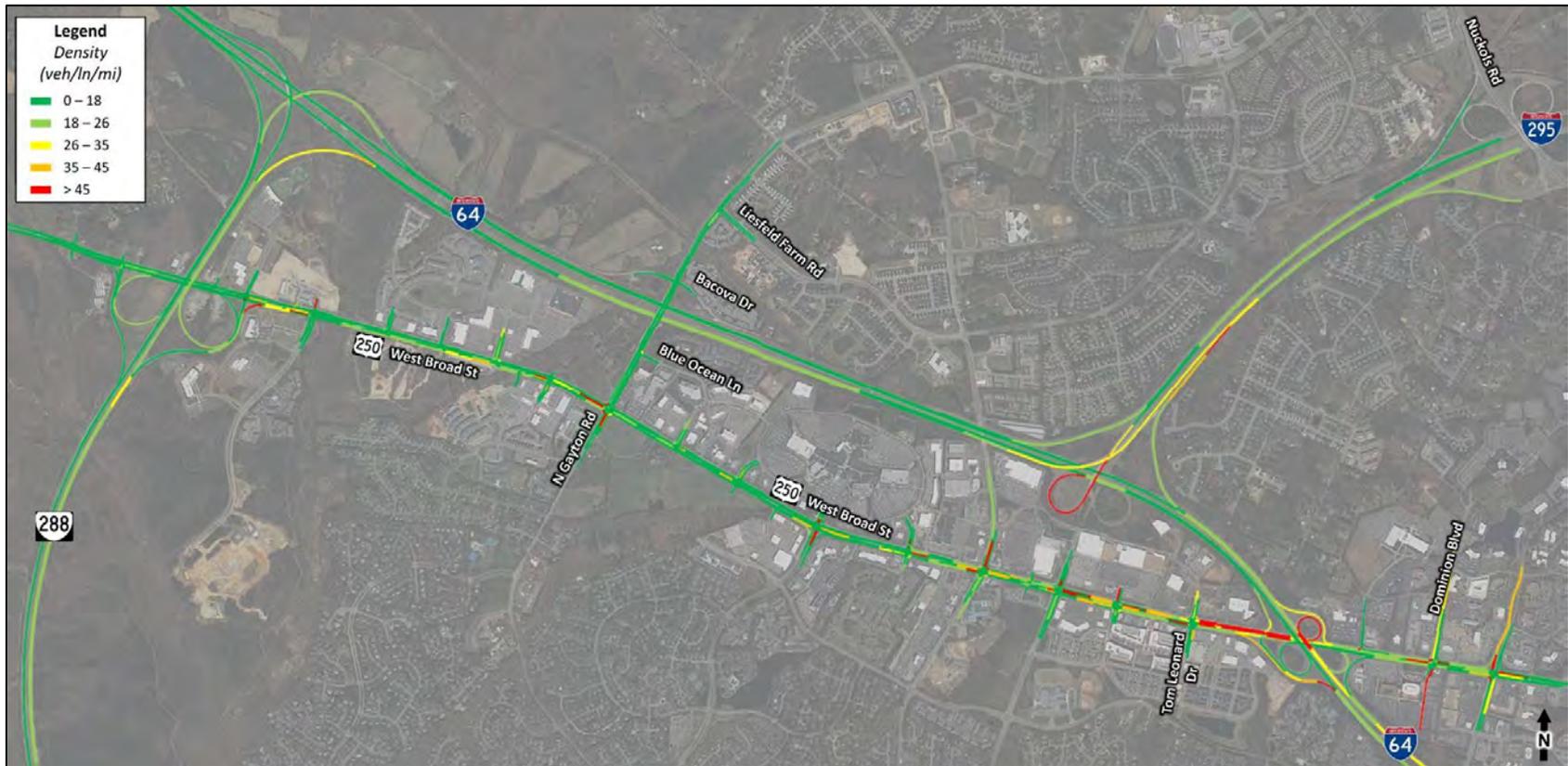


Figure 10: Existing (2019) PM Peak Hour Average Speeds

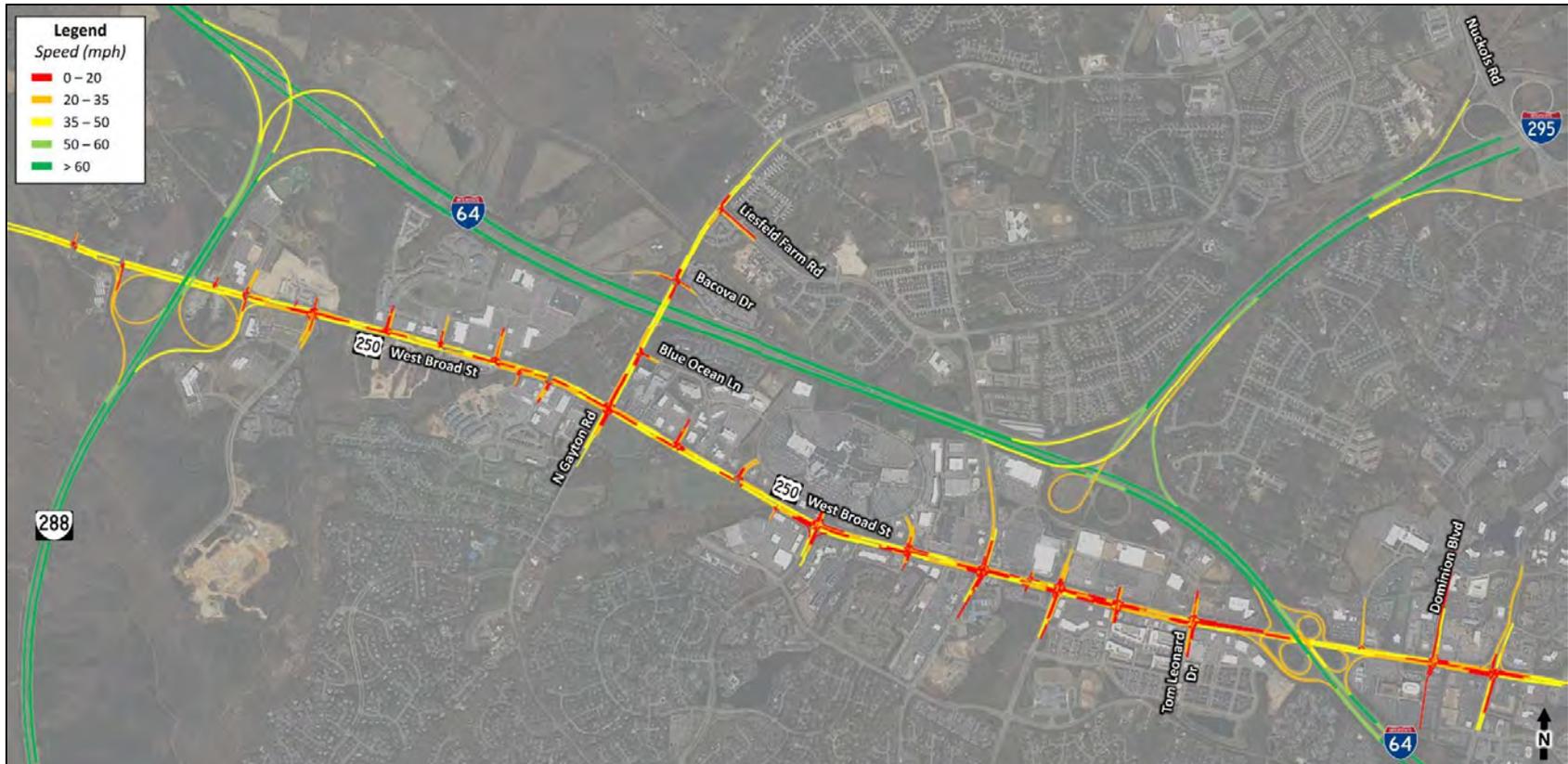
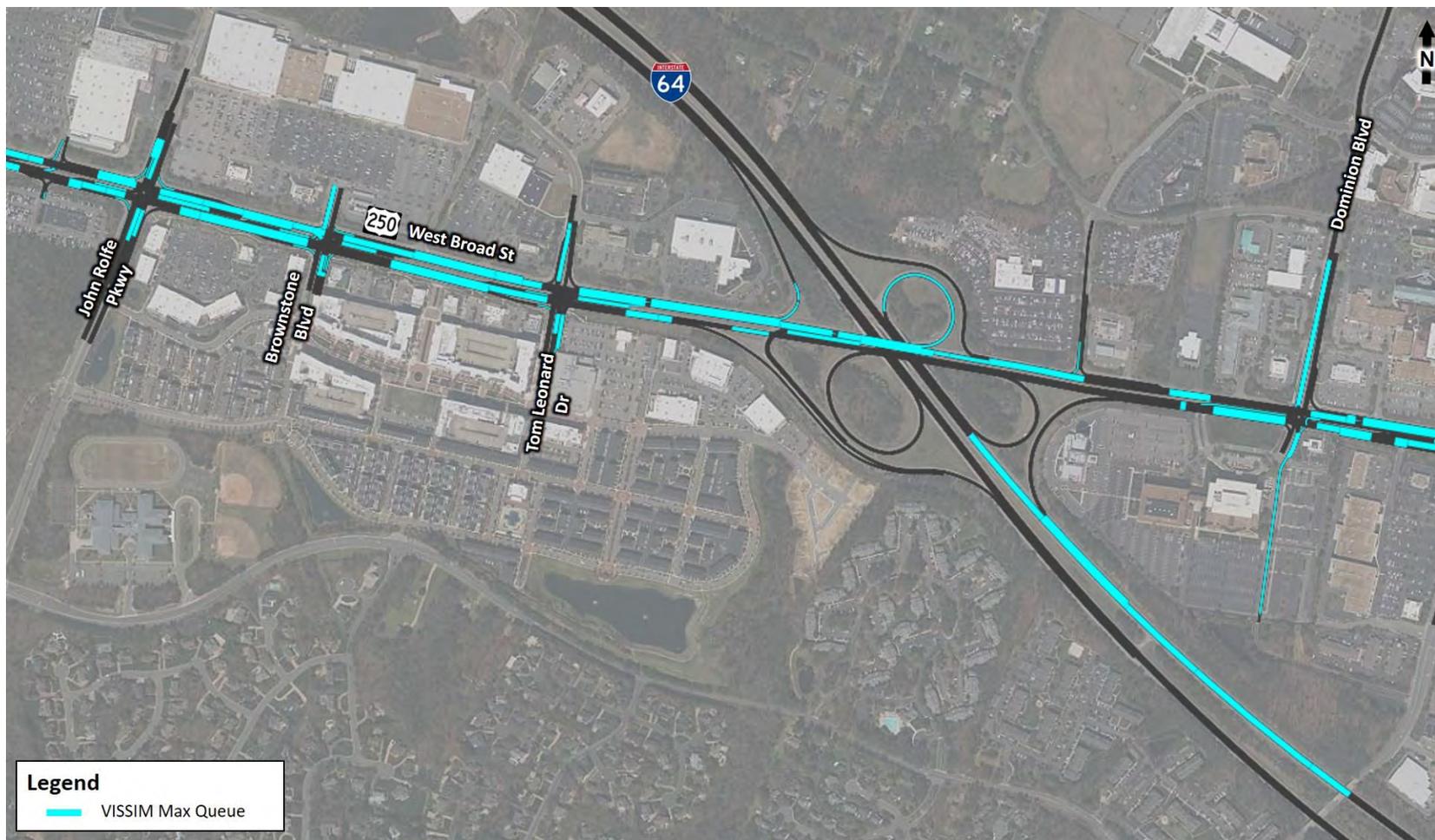


Figure 11: Existing (2019) PM Peak Hour Maximum Queue Lengths



## Existing Conditions Intersection Analysis Results

Graphical representation of the average intersection delay (seconds per vehicle) by movement and maximum queue (feet) by movement are shown in *Figure 12* through *Figure 15*.

### AM Peak Hour

In the AM peak hour, all intersections operate with overall acceptable delays. The intersection of US 250 and Dominion Boulevard operates with the highest overall intersection delay of 31.4 seconds per vehicle. All left turn movements at the intersection operate with delays of 49.9 seconds per vehicle or greater. The maximum queue length for the eastbound left-turn movement extends 1,000 feet, which is beyond the storage capacity of the left-turn lane and past the terminal of the westbound I-64 off-ramp. This queue contributes to slow speeds on the ramp since there is no restriction to vehicles on this off-ramp accessing the left turn.

All left turn movements at the intersection of US 250 and N Gayton Road operate with delays of 57.7 seconds per vehicle or greater, but the total intersection operates with 29.8 seconds per vehicle. At the intersection of US 250 and Tom Leonard Drive, all left-turn movements operate with delays of 53.4 seconds per vehicle or greater. At the unsignalized intersection of US 250 and the southbound Route 288 on-ramp, the westbound left turn queue extends 1,065 feet and spills back into the through lanes on westbound US 250.

### PM Peak Hour

In the PM peak hour, the intersection of US 250 and Dominion Boulevard operates with the highest overall intersection delay of 38.3 seconds per vehicle. The northbound approach, eastbound left-turn movement, and southbound left-turn movement all operate with delays of 71.2 seconds or greater.

The intersection of US 250 and Tom Leonard Drive operates with an overall intersection delay of 30.4 seconds per vehicle. All left-turn movements at the intersection operate with 59.4 seconds of delay or greater. The westbound queues at the intersection extend back to the upstream intersection at the on-ramps to eastbound I-64 and through the I-64 interchange, impacting the operations of the two I-64 off-ramps as shown in *Figure 11*.

At the intersection of US 250 and N Gayton Road, all left-turn movements operate with delays of 64.6 seconds per vehicle or greater. The eastbound left-turn queue extends 685 feet and spills back into the through lanes on eastbound US 250.

Figure 12: Existing (2019) AM Peak Hour Intersection Delay

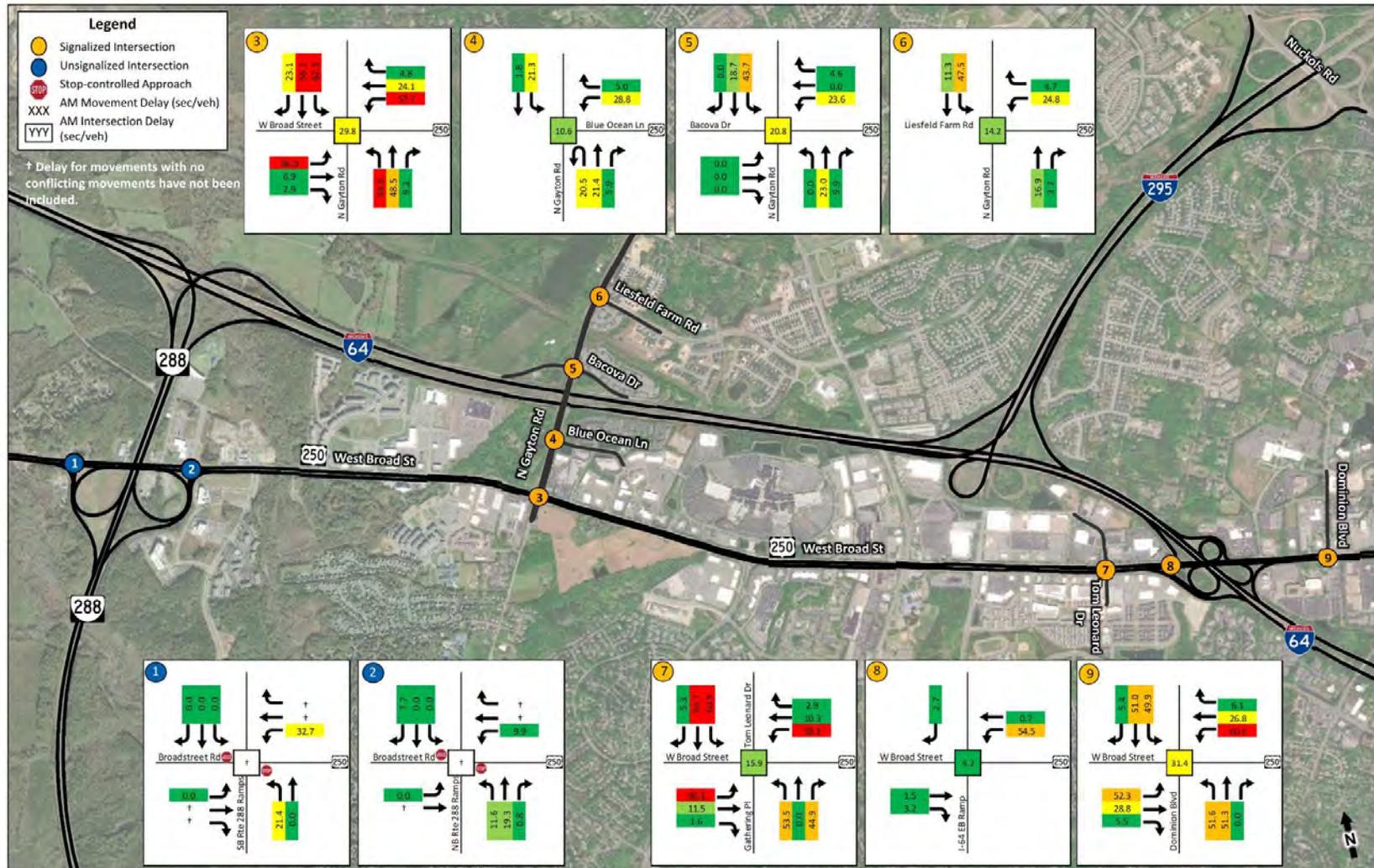
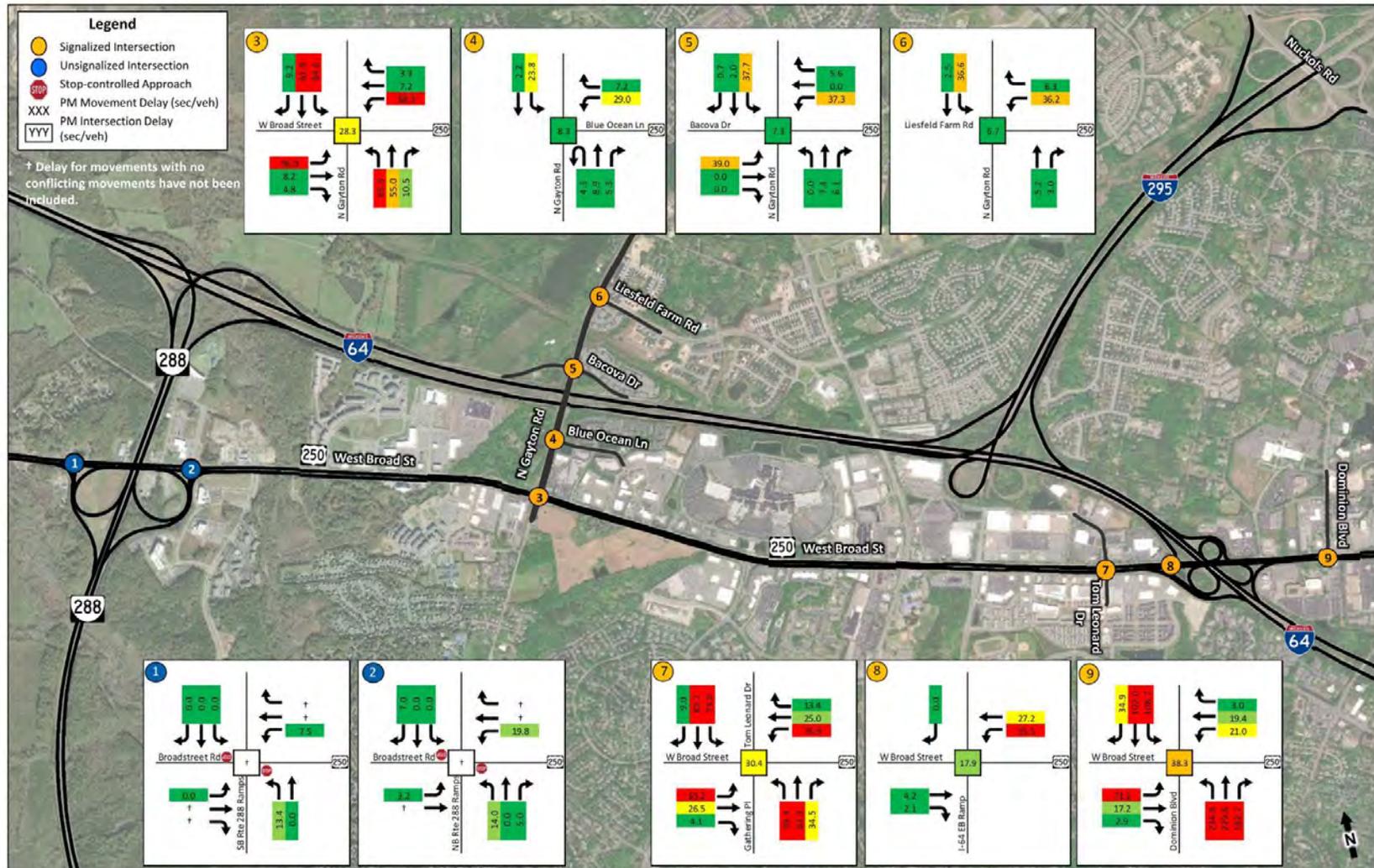




Figure 14: Existing (2019) PM Peak Hour Intersection Delay





## EXISTING SAFETY DATA AND IDENTIFICATION OF PROBLEM AREAS

A crash analysis was conducted to review and document crash patterns and trends within the study area roadway network. To remain consistent with the analysis year for the existing conditions Vissim analyses, the five years of crash data between January 1, 2015, and December 31, 2019, were obtained from the VDOT Traffic Engineering Division (TED) Roadway Network System (RNS) database. The crash analysis was completed at the nine study area intersections and along the following freeway segments:

- Eastbound and westbound I-64 from east of the US 250 interchange to the Ashland Road interchange
- Northbound and southbound Route 288 from the Tuckahoe Creek Parkway interchange to the I-64 interchange
- Northeastbound and southwestbound I-295 from the I-64 interchange to the Nuckols Road interchange

The existing crash analysis did not include any interchange ramps within the study area.

VDOT Traffic Engineering Division (TED) performed a network screening analysis based on *Highway Safety Manual (HSM)* methodology to rank intersection and roadway segments throughout the state based on each site's potential for safety improvement (PSI). PSI is an indication of how much the long-term crash frequency could be reduced at a particular site and is based on Virginia-specific safety performance functions (SPFs). TED releases the ranks for the top 100 VDOT-maintained intersections and the top 100 miles of VDOT-maintained roadway segments within each district.

*Table 4* summarizes the segments within the study area or on US 250 within the modeling area that were in the top 100 miles of segments in Richmond District based on 2016-2020 crash data. Segments are ranked based on the cumulative mileage of segments (e.g., two segments can be ranked in the top mile if the highest-ranking segment is shorter than one mile). None of the study area intersections were ranked in the top 100 within Richmond District. However, the following intersections on US 250 are within the modeling area and rank in the top 100 intersections within Richmond District.

- US 250 at Brownstone Boulevard (1)
- US 250 at Pouncey Tract Road (9)
- US 250 at Cox Road (83)
- US 250 at Lauderdale Road (98)

Table 4: Study Area PSI Segments

Location	Length (mi)	2016-2020 PSI Rank*
Westbound I-64 between the off-ramp to eastbound US 250 and the on-ramp from westbound US 250	0.34	7
Eastbound I-64 at the acceleration lane for the on-ramp from US 250	0.172	53
Northbound Route 288 between the off-ramp to US 250 and the on-ramp from US 250	0.22	100
US 250 between Mills Road and the northbound Route 288 ramps	0.57	43
US 250 between Wilkes Ridge Parkway and Robert Attack Way	0.43	16
US 250 between Robert Attack Way and Cabela Drive	0.16	75
US 250 between Cabela Drive and N Gayton Road	0.37	26
US 250 between N Gayton Road and Towne Center West Boulevard	0.23	56
US 250 between Towne Center West Boulevard and private driveway	0.14	78
US 250 between private driveway and Lauderdale Drive	0.35	46
US 250 between Westgate Parkway and Spring Oak Drive	0.15	30
US 250 between Spring Oak Drive and Pouncey Tract Road	0.24	8
US 250 between Pouncey Tract Road and John Rolfe Parkway	0.24	1
US 250 between John Rolfe Parkway and Brownstone Boulevard	0.18	2
US 250 between Brownstone Boulevard and Tom Leonard Drive	0.21	2
US 250 between Tom Leonard Drive and the eastbound US 250 ramp to eastbound I-64	0.21	3
US 250 between the eastbound US 250 ramp to eastbound I-64 and the eastbound US 250 ramp to westbound I-64	0.29	3
US 250 between the eastbound US 250 ramp to westbound I-64 and Dominion Boulevard	0.25	7
US 250 between Dominion Boulevard and Cox Road	0.21	14

\*Mile rank for VDOT-maintained roads within Richmond District

### Existing Mainline Freeway Crash Summary

Over the five-year crash period, there were 579 crashes on the freeways in the study area. Of the reported crashes on the freeways, there were 2 fatal injury crashes, 162 injury crashes, and 415 crashes involving property damage only. [Table 5](#) through [Table 9](#) provide summaries of the crashes on freeways in the study area by year, severity, crash type, time of day, and weather condition. Crash severity is coded using the KABCO scale, which is defined using the following classifications:

- K – Fatal Injury
- A – Suspected Serious Injury
- B – Suspected Minor Injury
- C – Possible Injury
- PDO – Property Damage Only

Crashes were fairly evenly distributed across the five-year period, except for a decrease in crashes in 2017. Generally, crashes on westbound I-64 were higher in 2015 and 2016, while crashes on southwestbound I-295 and southbound Route 288 were higher in 2017 through 2019. Rear end crashes constitute 48 percent of all freeway crashes within the study area, but only 23 percent of all crashes on eastbound I-64. The lower percentage of rear end crashes on eastbound I-64 is likely because there is no significant bottleneck on eastbound I-64 within the study area. Conversely, the percentage of rear end crashes on westbound I-64 (59 percent), southwestbound I-95 (56 percent), and northbound Route 288 (69 percent) all exceed 50 percent rear end crashes.

Table 5: Freeway Crash Summary by Year (2015 - 2019)

Route	Number of Crashes					
	2015	2016	2017	2018	2019	Total
Eastbound I-64	31	39	25	25	42	162
Westbound I-64	65	58	41	49	36	249
Southwestbound I-295	7	7	10	15	15	54
Northeastbound I-295	9	2	2	9	4	26
Northbound Route 288	5	10	9	7	14	45
Southbound Route 288	3	4	12	13	11	43
<b>Total</b>	<b>120</b>	<b>120</b>	<b>99</b>	<b>118</b>	<b>122</b>	<b>579</b>

Table 6: Freeway Crash Summary by Severity (2015 - 2019)

Route	Number of Crashes					
	K	A	B	C	PDO	Total
Eastbound I-64	1	11	31	0	119	162
Westbound I-64	1	10	54	12	172	249
Southwestbound I-295	0	2	10	1	41	54
Northeastbound I-295	0	3	5	2	16	26
Northbound Route 288	0	2	7	1	35	45
Southbound Route 288	0	1	8	2	32	43
<b>Total</b>	<b>2</b>	<b>29</b>	<b>115</b>	<b>18</b>	<b>415</b>	<b>579</b>

Table 7: Freeway Crash Summary by Crash Type (2015 - 2019)

Route	Number of Crashes						
	Rear End	Angle	Sideswipe	Fixed Object	Deer	Other	Total
Eastbound I-64	37	14	17	70	4	20	162
Westbound I-64	147	16	24	51	3	8	249
Southwestbound I-295	30	2	9	10	2	1	54
Northeastbound I-295	13	0	2	7	1	3	26
Northbound Route 288	31	3	2	7	2	0	45
Southbound Route 288	19	1	2	15	6	0	43
<b>Total</b>	<b>277</b>	<b>36</b>	<b>56</b>	<b>160</b>	<b>18</b>	<b>32</b>	<b>579</b>

Table 8: Freeway Crash Summary by Time of Day (2015 - 2019)

Route	Number of Crashes			
	AM Peak Period (6-10 AM)	PM Peak Period (3-7 PM)	Off Peak	Total
Eastbound I-64	47	35	80	162
Westbound I-64	40	104	105	249
Southwestbound I-295	16	23	15	54
Northeastbound I-295	12	7	7	26
Northbound Route 288	12	26	7	45
Southbound Route 288	17	10	16	43
<b>Total</b>	<b>144</b>	<b>205</b>	<b>230</b>	<b>579</b>

Table 9: Freeway Crash Summary by Weather Condition (2015 - 2019)

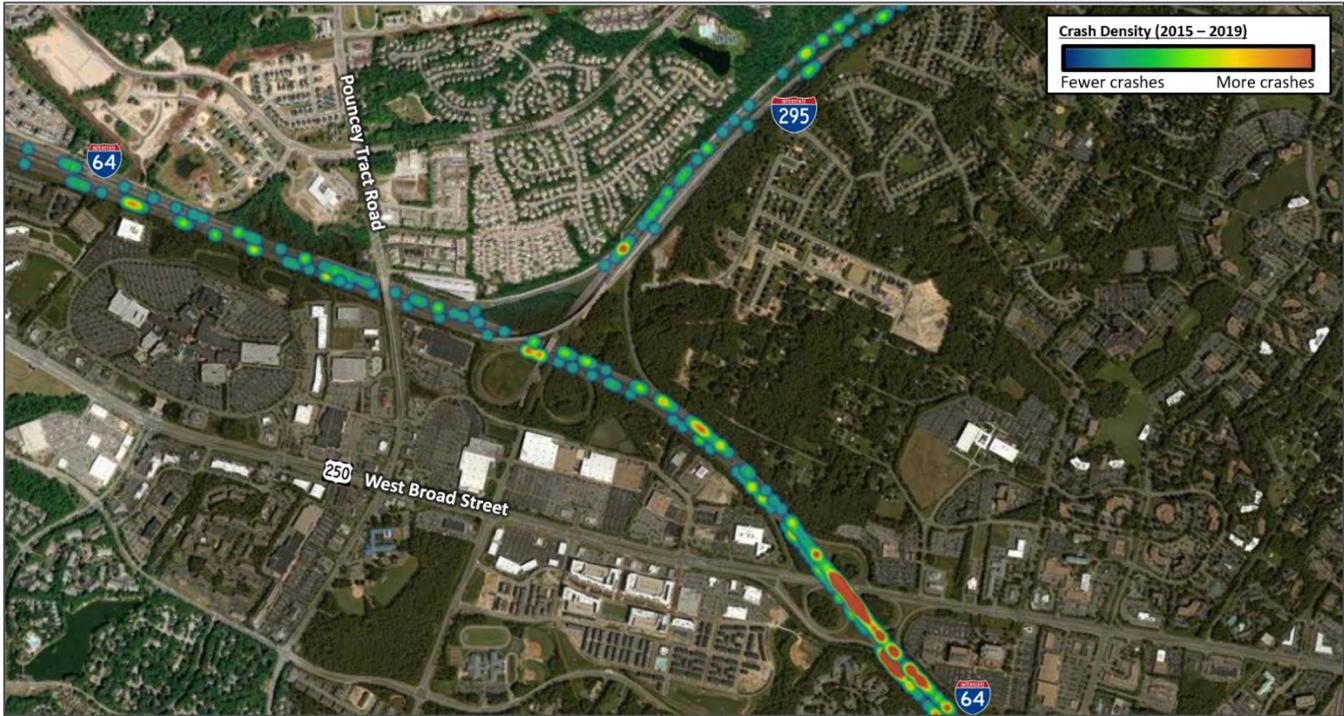
Route	Number of Crashes						Total
	Clear/Cloudy	Fog	Mist	Rain	Snow	Sleet/Hail	
Eastbound I-64	104	3	2	47	3	3	162
Westbound I-64	185	0	2	52	9	1	249
Southwestbound I-295	43	0	0	9	2	0	54
Northeastbound I-295	19	0	0	5	1	1	26
Northbound Route 288	39	1	1	4	0	0	45
Southbound Route 288	29	0	1	13	0	0	43
<b>Total</b>	<b>419</b>	<b>4</b>	<b>6</b>	<b>130</b>	<b>15</b>	<b>5</b>	<b>579</b>

Figure 16 and Figure 17 show the density of total crashes along the corridors for 2015-2019. The following paragraphs document crash trends for the hot spots identified in the density maps, which correlate with the PSI segments identified in Table 4 that were based 2016-2020 data.

Figure 16: Freeway Crash Density Summary (2015 – 2019) (1)



Figure 17: Freeway Crash Density Summary (2015 – 2019) (2)



**Westbound I-64 Within and Approaching the US 250 Interchange**

Westbound I-64 within the US 250 interchange was identified as the highest freeway crash density location within the study area. This segment ranks in the top 7 miles of VDOT-maintained roadways in Richmond District for PSI as shown in [Table 4](#). Crashes in this location are mostly congestion-related and are attributed to the queuing on the interstate during the PM peak period. The existing maximum queue length in 2019 extends approximately 3,500 feet from the gore for the westbound I-64 off-ramp to westbound US 250 to the Cox Road bridge. This queue is caused by congestion on westbound US 250 that backs up to the interstate and friction associated with vehicles weaving and changing lanes in advance of the freeway weaving segment.

Between 2015 and 2019, 155 crashes occurred on westbound I-64 over the limits of the PM maximum queue. The crashes were much more predominant in the afternoon as 57 percent of crashes occurred between 3:00 and 7:00 PM and 26 percent occurred during the PM peak hour between 5:00 and 6:00 PM. Both percentages are higher than the average for urban interstates

Figure 18: Westbound I-64 at US 250 Interchange Crash Type Summary (2015 – 2019)



throughout the state for the same years: 42 percent from 3:00 to 7:00 PM and 9 percent from 5:00 to 6:00 PM. The crashes were also predominantly rear ends as 84 percent of all crashes, 92 percent of crashes from 3:00 to 7:00 PM and 100 percent of crashes from 5:00 to 6:00 PM were rear ends. *Figure 18* illustrates the number of rear end crashes for this section of westbound I-64. The high percentage of rear end crashes point to the safety hot spot being attributable to the bottleneck in this area.

### Eastbound I-64 On-Ramp from US 250

Eastbound I-64 at the on-ramp from US 250 ranks in the top 53 miles of VDOT-maintained roadways in Richmond District for PSI as shown in *Table 4*. Crashes in this area predominantly occur in wet or icy conditions and most involve a roadway departure. Of the 31 crashes between 2015 and 2019 shown in *Figure 19*, 77 percent occurred in wet or icy conditions and 74 percent involved a roadway departure.

### Northbound Route 288 within US 250 Interchange

Northbound Route 288 within the US 250 interchange ranks in the top 100 miles of VDOT-maintained roadways in Richmond District for PSI as shown in *Table 4*. Crashes in this location are mostly congestion-related and attributed to slower speeds on Route 288 during the PM peak period as vehicles preposition in the right lane in advance of the exit to eastbound I-64. Between 2015 and 2019, 23 crashes occurred over the 1,500 feet between the off-ramp to US 250 and the on-ramp from US 250 as shown in *Figure 20*. Rear end crashes constituted 74 percent of crashes in this area. Rear end crashes between 5:00 and 6:00 PM constituted 39 percent of crashes in this area.

Figure 19: Eastbound I-64 at US 250 Interchange Roadway Condition Crash Summary (2015 – 2019)



Figure 20: Route 288 at US 250 Interchange Crash Type Summary (2015 – 2019)



### Existing Intersection Crash Summary

Over the five-year crash period, 626 crashes occurred within the influence areas of the nine study area intersections. The influence area for each intersection generally extended to the back of tapers for turn lanes on each approach. The study team reviewed crash descriptions for those crashes outside the original influence area and extended the influence area as necessary to include additional intersection-related crashes (e.g., to capture a pattern of rear end crashes that extended beyond the back of taper).

Approximately seventy percent of all intersection crashes that occurred at the study area intersections resulted in property damage only. One fatal crash occurred at an intersection in the study area during the analysis period, at the intersection of US 250 and the southbound Route 288 ramps. This fatal crash was an angle crash that occurred in 2019. A traffic signal was installed at this intersection and the intersection of US 250 and the northbound Route 288 ramps in 2020. *Table 10* summarizes 2015-2019 crashes by severity at each study area intersection. The signalized intersections on US 250 at Tom Leonard Drive, Dominion Boulevard, and the eastbound I-64 on-ramp had the most crashes in the five-year analysis period.

Table 10: Intersection Crash Summary by Severity (2015 - 2019)

Intersection	Number of Crashes by Severity					
	K	A	B	C	PDO	Total
US 250 at Dominion Boulevard	0	4	27	4	58	93
US 250 at Eastbound I-64 On-Ramp	0	2	22	4	62	90
US 250 at Tom Leonard Drive	0	0	48	10	211	269
US 250 at N Gayton Road	0	1	11	1	35	48
N Gayton Road at Blue Ocean Road	0	0	0	0	9	9
N Gayton Road at Bacova Drive	0	0	5	0	6	11
N Gayton Road at Liesfeld Farm Road*	0	0	0	0	2	2
US 250 at Northbound Route 288 Ramps	0	4	8	8	18	38
US 250 at Southbound Route 288 Ramps	1	6	7	18	16	48
<b>Total</b>	<b>1</b>	<b>17</b>	<b>128</b>	<b>45</b>	<b>417</b>	<b>608</b>

\*The intersection of N Gayton Road and Liesfeld Farm Road was constructed as an unsignalized intersection in 2016. It was converted to a signalized intersection in 2017.

The predominant crash type at study area intersections was rear ends, which accounted for 57 percent of all crashes at intersections. Rear end crashes constituted 77 percent of all crashes at the intersection of US 250 and Tom Leonard Drive and over 40 percent of the rear end crashes occurred between 3:00 and 7:00 PM. The pattern of rear end crashes during the PM peak period can be attributed to the congestion and queuing at this intersection. Angle crashes were the second most-frequent crash type, accounting for 26 percent of all crashes at intersections. However, 40 percent of all angle crashes occurred at the US 250 intersections with the northbound or southbound Route 288 ramps. Both intersections were signalized in 2020, which should mitigate the number of angle crashes in future years. One crash involving a pedestrian occurred in the study area during the five-year analysis period at the intersection of US 250 and Dominion Boulevard. A summary of the crash types at each intersection can be found in *Appendix D*.

## ▲ Alternatives Considered

### NO-BUILD ALTERNATIVE

Traffic operational and safety analyses were conducted to evaluate the overall performance of the study area using forecasted traffic volumes in the opening and design years. The development of future traffic volumes used in the No-Build analyses can be found in the *Forecasted Traffic Volumes and Operations* section of the report.

#### Background Improvements

Funded transportation projects within the study area were included in the No-Build models provided that the improvements were projected to open before the analysis year. All known funded transportation projects in the study area were projected to open by 2026, so all improvements were included in both the 2026 and 2046 No-Build analyses.

*Table 11* summarizes the location, improvement, and expected opening year of the funded transportation projects that were included in the No-Build models. A few of the improvements are outside of the study area for this IAR but are within the limits of the Vissim models and were included as background improvements.

*Table 11: Funded Transportation Projects within the Study Area*

Location	Improvements	Opening Year
Northbound Route 288 Ramps at US 250	<ul style="list-style-type: none"> <li>■ Convert to signalized intersection</li> <li>■ Construct dual westbound left-turn lanes</li> <li>■ Relocate eastbound right turn to main intersection</li> </ul>	2020
Southbound Route 288 Ramps at US 250	<ul style="list-style-type: none"> <li>■ Convert to signalized intersection</li> <li>■ Construct dual westbound left-turn lanes</li> </ul>	2020
Dominion Boulevard at US 250	<ul style="list-style-type: none"> <li>■ Construct dual southbound right-turn lanes</li> </ul>	2020
Dominion Boulevard at US 250	<ul style="list-style-type: none"> <li>■ Construct dual eastbound left-turn lanes</li> </ul>	2025
I-64 at Parham Road Interchange	<ul style="list-style-type: none"> <li>■ Convert intersection with westbound ramp to signalized intersection</li> <li>■ Construct dual left-turn lanes on eastbound off-ramp</li> </ul>	2026
Cabela Drive at US 250	<ul style="list-style-type: none"> <li>■ Construct northbound leg of intersection and upgrade traffic signal</li> </ul>	2021
Gaskins Road at Three Chopt Road	<ul style="list-style-type: none"> <li>■ Construct dual left-turn lanes on all approaches</li> <li>■ Widen Three Chopt Road to provide one additional through lane in each direction</li> </ul>	2024
Ashland Road at US 250	<ul style="list-style-type: none"> <li>■ Realign Hockett Road to create fourth leg of intersection</li> </ul>	2026

Additional uncommitted projects outside of the study area, but within the modeling area, were included in the No-Build models to prevent bottlenecks outside of the study area from severely limiting the projected demand from entering the study area. These projects do not fully address all bottlenecks outside of the study area but allow for a higher percentage of the demand to enter the study area, which allows for a better comparison of No-Build and Build alternatives for this IAR. The additional projects are documented in *Table 12*.

Table 12: Transportation Projects within the Modeling Area

Location	Improvements
Glenside Drive at Westbound I-64 Ramp	<ul style="list-style-type: none"> <li>Convert ramp terminal to signalized intersection</li> </ul>
Westbound I-64 Between Staples Mill Road and Glenside Drive	<ul style="list-style-type: none"> <li>Construct continuous auxiliary lane on westbound I-64 between interchanges</li> </ul>
Westbound I-64 Between Glenside Drive and Parham Road	<ul style="list-style-type: none"> <li>Construct continuous auxiliary lane on westbound I-64 between interchanges</li> </ul>
I-64 between Parham Road and Gaskins Road	<ul style="list-style-type: none"> <li>Construct continuous auxiliary lanes in both direction on I-64 between interchanges</li> </ul>

## ALTERNATIVES DEVELOPMENT AND SCREENING

Potential geometric improvements were developed to address existing and projected operational and safety deficiencies identified in the existing and No-Build conditions analysis. Improvements that were considered included concepts from previous studies (including concepts screened out and recommended) and new concepts. The following SWG meetings were held throughout the concept screening and alternatives development process:

- June 17, 2021 – presented results for the existing conditions analysis and discussed travel demand model results for the subarea model scenarios
- August 2, 2021 – presented concepts from previous studies and initial new concepts that did not include a new access point; discussed screening-level results for those concepts considered in previous studies; advanced concepts to screening-level analysis in Vissim
- October 14, 2021 – presented screening-level Vissim results and preliminary sketches for concepts that did not include a new access point; introduced preliminary results for a concept that included a new interchange at N Gayton Road; advanced one package of alternatives to Build analysis
- December 15, 2021 – presented screening-level Vissim results for mainline concepts for the new interchange at N Gayton Road and screening-level Synchro results for interchange concepts
- February 10, 2022 – presented preliminary safety analysis results and signing options for mainline concepts for the new interchange at N Gayton Road
- April 22, 2022 – presented updated safety analysis and screening-level Vissim results for mainline concepts for the new interchange at N Gayton Road; advanced one package of alternatives to Build analysis
- June 24, 2022 – presented Vissim and safety analysis results, preliminary concept sketches, and cost estimates for the Build alternative packages

A screening-level analysis was performed in Vissim for the 2046 peak hours for all concepts that were not screened out at the August 2021 meeting based on findings from previous studies. Additionally, screening matrices were compiled to summarize the concepts based on the following criteria:

- Right-of-way (RW) and utility impacts
- Safety impacts
- Operational impacts
- Bicycle and pedestrian accommodation
- Environmental impacts

- Preliminary cost of construction (high-level construction cost estimates categorized into low, medium, and high ranges)

The screening matrices used to establish the three Build alternative packages are provided in *Appendix F*. The following sections document the concepts considered, the level of analysis completed, and the justification for either advancing the alternative or removing it from consideration.

### Transportation Management Options

The *RVA Transit Vision Plan* determined that increased transportation demand management strategies considered for deployment in the area are not expected to address all capacity constraints identified in previous studies.

### Subarea Model Scenarios

As part of the *STARS US 250 Corridor Study*, VDOT TMPD created a subarea model from the Richmond/Tri-Cities regional travel demand model and calibrated it with updated traffic count and socioeconomic data in Henrico and Goochland counties. VDOT TMPD evaluated several Build scenarios for potential roadway widenings or new roadway connections in the region using the subarea model to determine the potential benefits to roadways within the study area.

The scenarios described in *Table 13* do not include any geometric improvements that specifically target the capacity, congestion, and safety issues identified as part of the existing and No-Build analyses. As such, any potential benefit to the issues identified within the study area would be attributed to a change in demand on the study area roadways resulting from a change in traffic patterns from a specific improvement. Results showing the projected change in demand throughout the Short Pump area for each Build scenario are provided in *Appendix F*. The new interchange on I-64 at N Gayton Road had the potential to significantly reduce demand on key study area roadways (e.g., the westbound I-64 off-ramp to westbound US 250) and was advanced to a more detailed analysis and design. The SWG reached a consensus that the changes in demand on study area roadways in other scenarios did not rise to the level that a notable benefit would be shown in a detailed Vissim analysis. Therefore, these scenarios were screened out and were not advanced to a more detailed analysis and design.

Several of the scenarios have standalone project benefits and are supported by Henrico or Goochland County. This study does not draw any conclusions regarding the localized benefits and potential funding for the scenarios that do not have the potential to address the issues identified in the existing and No-Build analyses.

Table 13: Subarea Model Scenarios

Improvement Description	Findings	Recommendation
Construct a new interchange on I-64 at N Gayton Road	Projected to reduce demand on the following study area roadways that are over capacity or have congestion-related issues: westbound I-64 off-ramp to westbound US 250, eastbound I-64 on-ramp from US 250, eastbound I-64 on-ramp from I-295, US 250 between Lauderdale Drive and I-64.	Advanced to a more detailed screening-level operations analysis in Vissim

Improvement Description	Findings	Recommendation
Widen Pouncey Tract Road from two to four lanes between Twin Hickory Lake Drive and Nuckols Road	Projected to provide arterial operational benefits to N Gayton Road by reducing demand in AM and PM peak hours; however, demand on Pouncey Tract Road increases. No notable benefits to critical locations in the study area beyond the margin of error.	Recommended as standalone project outside of the IAR. Included in DRAFT ConnectRVA 2045 CLRP and supported by Henrico County. Projected to provide some arterial benefits but doesn't address purpose and need. Will likely happen as future development occurs.
Extend Three Chopt Road in Henrico County to N Gayton Road	Projected to provide arterial operational benefits to US 250 between N Gayton Road and Lauderdale Drive by shifting traffic to Three Chopt Road. No notable benefits to critical locations in the study area beyond the margin of error.	Recommended as standalone project outside of the IAR. Supported by Henrico County. Anticipated to be constructed as part of future development. Projected to provide some arterial benefits but doesn't address purpose and need.
Connect Three Chopt Road in Goochland via an underpass to US 250	Primarily projected to benefit eastbound US 250 in the AM peak hour between Ashland Road and Route 288 interchange. No notable benefits to critical locations in the study area beyond the margin of error.	Recommended as standalone project outside of the IAR pending demonstration of higher need as development occurs. Included in DRAFT ConnectRVA 2045 CLRP and supported by Goochland County. Doesn't address purpose and need.
Connect Wilkes Ridge Parkway and Tuckahoe Creek Parkway	Projected to improve traffic operations on southbound Route 288 in the AM peak hour and northbound Route 288 in the PM peak hour. No notable benefits to other critical locations in study area.	Recommended as standalone project outside of the IAR. Supported by Goochland County. Anticipated to be constructed as part of future development.
Extend Bacova Drive to connect N Gayton Road and Ashland Road	No notable benefits to critical locations in the study area beyond the margin of error.	Considered recommending pending demonstration of higher need as development occurs; however, doesn't address purpose and need.
Construct a new interchange on Route 288 between US 250 and Tuckahoe Creek Parkway and connect Wilkes Ridge Parkway and Hockett Road	Projected to improve traffic operations on southbound Route 288 in the AM peak hour and both directions of Route 288 in the PM peak hour. No other notable benefits to critical locations in study area. Further study needed to understand impacts of new interchange.	Separate study underway by others. Requires separate IAR for new access on 288.
Provide partial access from I-295 to John Rolfe Parkway at the interchange with I-64	Projected to reduce demand on the following study area roadways that are over capacity or have congestion-related issues: eastbound and westbound I-64 on-ramps from I-295.	Not recommended to provide access to US 250 from a system-to-system interchange. Additionally, Henrico County vacated John Rolfe Parkway north of US 250 in 1997 so new partial access violates FHWA policy for connection to public roads only.

Improvement Description	Findings	Recommendation
Provide full access to/from I-295 and John Rolfe Parkway at the interchange with I-64	Projected to reduce demand on the following study area roadways that are over capacity or have congestion-related issues: eastbound and westbound I-64 on-ramps from I-295, eastbound and westbound I-64 off-ramps to I-295, westbound I-64 between US 250 and I-295.	Not recommended to provide access to US 250 from a system-to-system interchange. Additionally, Henrico County vacated John Rolfe Parkway north of US 250 in 1997.

### Route 288

*Table 14* outlines the concepts that were considered to address the capacity, congestion, and safety issues identified on Route 288 and at Route 288 interchanges. No concepts were analyzed to address the capacity issues on northbound Route 288 between the on-ramp from US 250 and the off-ramps to I-64.

*Table 14: Concepts on Route 288*

Improvement Description	Analysis Tool	Findings	Recommendation
Construct auxiliary lane on southbound Route 288 between US 250 and Tuckahoe Creek Parkway	Vissim	Improvement is projected to decrease congestion and improve speeds on southbound Route 288. This improvement is projected to prevent the queue from affecting upstream operations on westbound I-64.	Advanced to both Build alternatives at October 2021 meeting
Construct auxiliary lane on northbound Route 288 between Tuckahoe Creek Parkway and US 250. Signalize and add a second lane to serve the right-turn movement on the southbound Route 288 off-ramp to US 250. Add a second lane to serve the right-turn movement on the northbound Route 288 off-ramp to US 250. [From <i>STARS US 250 Corridor Study</i> ]	Vissim	Improvement is projected to increase speeds and decrease queuing on northbound Route 288 and increase throughput on northbound Route 288 and eastbound US 250	Advanced to both Build alternatives at October 2021 meeting

### I-64 at US 250 Interchange

*Table 15* outlines the concepts that were considered to address the capacity, congestion, and safety issues identified on I-64 at the interchange with US 250. Additional improvements that spanned the I-64 interchanges with US 250 and I-295 are outlined in the *I-64 at US 250 and I-295 Interchanges* section.

Table 15: Concepts at the I-64 at US 250 Interchange

Improvement Description	Analysis Tool	Findings	Recommendation
Construct a partial cloverleaf interchange that removes the westbound I-64 off-ramp to westbound US 250 [From <i>STARS US 250 Corridor Study</i> ]	Synchro	Preliminary Synchro analysis from <i>STARS US 250 Corridor Study</i> showed that three left-turn lanes were required to serve the new movement on the westbound I-64 off-ramp but queuing and delay concerns persisted on the off-ramp. Modifications to the off-ramp would significantly impact the parcel in the southeast quadrant of the interchange.	Screened out at August 2021 meeting
Construct a diverging diamond interchange (DDI) [From <i>STARS US 250 Corridor Study</i> ]	Synchro	Preliminary Synchro analysis from <i>STARS US 250 Corridor Study</i> showed that three left-turn lanes were required to serve the new movement on the westbound I-64 off-ramp but queuing and delay concerns persisted on the off-ramp.	Screened out at August 2021 meeting
Construct a single point urban interchange (SPUI) [From <i>STARS US 250 Corridor Study</i> ]	Synchro	Preliminary Synchro analysis from <i>STARS US 250 Corridor Study</i> showed that three left-turn lanes were required to serve the new movement on the westbound I-64 off-ramp but queuing and delay concerns persisted on the off-ramp.	Screened out at August 2021 meeting
Construct a flyover ramp from westbound I-64 to westbound US 250 [From <i>STARS US 250 Corridor Study</i> ]	N/A	Flyover ramp would require modifications to inter-parcel connections on north side of US 250 and may require relocation of the US 250 intersection with Tom Leonard Drive.	Screened out at August 2021 meeting
Construct a partial cloverleaf interchange (option 1) that removes the westbound I-64 on-ramp from eastbound US 250. Construct three westbound through lanes at intersection with westbound I-64 ramps. [Revised from <i>STARS US 250 Corridor Study</i> ]	Vissim	The partial cloverleaf interchange is projected to reduce congestion and congestion-related crashes on westbound I-64 approaching the US 250 interchange. The projected queues on westbound US 250 approaching the new signal were longer than the other partial cloverleaf concepts.	Screened out at October 2021 meeting
Construct a partial cloverleaf interchange (option 2) that removes the westbound I-64 on-ramp from eastbound US 250.	Vissim	The partial cloverleaf interchange is projected to reduce congestion and congestion-related crashes on westbound I-64 approaching the US	Screened out at October 2021 meeting

Improvement Description	Analysis Tool	Findings	Recommendation
Construct dual westbound right-turn lanes at intersection with westbound I-64 ramps. [Revised from <i>STARS US 250 Corridor Study</i> ]		250 interchange. The projected queues on westbound US 250 approaching the new signal were shorter than the first partial cloverleaf option.	
Construct a partial cloverleaf interchange (option 3) that removes the westbound I-64 on-ramp from eastbound US 250. Construct dual westbound right-turn lanes at intersection with westbound I-64 ramps plus contraflow left-turn lanes. [Revised from <i>STARS US 250 Corridor Study</i> ]	Vissim	The partial cloverleaf interchange is projected to reduce congestion and congestion-related crashes on westbound I-64 approaching the US 250 interchange. The contraflow left-turn lanes provide additional storage for left-turning vehicles on US 250 and queues were projected to be contained within the contraflow left-turn lanes. This concept was preferred over the other partial cloverleaf concepts.	Advanced to one Build alternative at October 2021 meeting
Convert westbound US 250 right-turn lane to a shared through/right lane and install thru-cut at Tom Leonard Drive [From <i>STARS US 250 Corridor Study</i> ]	Vissim	Improvements are projected to reduce queuing on westbound US 250 approaching Tom Leonard Drive by increasing the capacity of the through movement and reducing the number of signal phases. These improvements are projected to prevent the queue from impacting the interchange ramps at the interchange with I-64.	Advanced to both Build alternatives at October 2021 meeting
Restrict vehicles on westbound I-64 off-ramp to eastbound US 250 from turning left at Dominion Boulevard	Vissim	Improvement is projected to reduce queuing on eastbound US 250 between the I-64 interchange and Dominion Boulevard and has the potential to reduce the number of angle and sideswipe crashes	Advanced to both Build alternatives at October 2021 meeting

### I-64 at I-295 Interchange

*Table 16* outlines the concepts that were considered to address the capacity, congestion, and safety issues identified on I-64 at the interchange with US 250. Additional improvements that spanned the I-64 interchanges with US 250 and I-295 are outlined in the *I-64 at US 250 and I-295 Interchanges* section. At the October 2021 SWG meeting, the study team presented two options for Build alternative packages: one set of Build alternative packages that sought to address capacity, congestion, and safety issues on I-64 and Route 288 and a second set of Build alternative packages that sought to address capacity, congestion, and safety issues on I-64, I-295, and Route 288. The SWG decided that the Build alternative packages should focus on addressing issues on I-64 and Route 288, but that further improvements should be considered for I-295 in the future. As such, any improvements (e.g., converting the on-ramp from I-295 to eastbound I-64 to two lanes) where the main focus was to address issues on solely on I-295, including capacity, congestion, and safety, were screened out. Some improvements to I-295 (e.g., auxiliary lane between I-64 and Nuckols Road) were advanced to a Build alternative package since the primary benefits of the improvement were to I-64.

Table 16: Concepts at the I-64 at I-295 Interchange

Improvement Description	Analysis Tool	Findings	Recommendation
Convert I-295 on-ramp from westbound I-64 to two lanes. Construct continuous auxiliary lane to Nuckols Road interchange.	Vissim	Improvement is projected to reduce queuing on westbound I-64 approaching the I-295 interchange and to provide additional capacity on I-295. Improvements at the US 250 interchange should be packaged with this improvement to best mitigate queuing on westbound I-64.	Advanced to both Build alternatives at October 2021 meeting
Convert eastbound I-64 on-ramp from I-295 to a two-lane loop ramp	Vissim	Improvement is projected to increase throughput on southwestbound I-295 but creates a new bottleneck on eastbound I-64 at the US 250 interchange and should not be recommended without an improvement that helps release the new bottleneck	Screened out at October 2021 meeting
Convert eastbound I-64 on-ramp from I-295 to a two-lane directional ramp	Vissim	Improvement is projected to increase throughput on southwestbound I-295 but creates a new bottleneck on eastbound I-64 at the US 250 interchange and should not be recommended without an improvement that helps release the new bottleneck	Screened out at October 2021 meeting
Reconfigure eastbound I-64 diverge to I-295 to create one exit only lane and one choice lane	Vissim	Improvement is projected to help address imbalanced lane utilization that causes slow speeds after the merge from northbound Route 288 to eastbound I-64	Advanced to one Build alternative at October 2021 meeting

### I-64 at US 250 and I-295 Interchanges

Table 17 outlines the concepts that were considered to address the capacity, congestion, and safety issues identified on I-64 at the interchanges with US 250 and I-295. At the October 2021 SWG meeting, the study team presented two options for Build alternative packages: one set of Build alternative packages that sought to address capacity, congestion, and safety issues on I-64 and Route 288 and a second set of Build alternative packages that sought to address capacity, congestion, and safety issues on I-64, I-295, and Route 288. The SWG decided that the Build alternative packages should focus on addressing issues on I-64 and Route 288, but that further improvements should be considered for I-295 in the future. As such, any improvements (e.g., converting the eastbound I-64 on-ramp from I-295 to two lanes) where the main focus was to address capacity, congestion, and safety issues on I-295 were screened out.

Table 17: Concepts at the I-64 Interchanges with US 250 and I-295

Improvement Description	Analysis Tool	Findings	Recommendation
Construct a partial C-D road on westbound I-64 between US 250 and I-295	Vissim	Improvement is projected to decrease queuing and congestion on westbound I-64 at the US 250 interchange, which improves speeds and throughput at and approaching the interchange in the PM peak hour. The improvement improves safety on westbound I-64 by removing two weaves. The improvement has similar benefits to the partial cloverleaf at US 250 but does not address operational issues on eastbound US 250 or eastbound I-64 in the AM peak hour.	Screened out at October 2021 meeting
Convert eastbound I-64 on-ramp from I-295 to a two-lane directional ramp and construct a full access C-D road on eastbound I-64 between I-295 and US 250 (option 1)	Vissim	Improvement is projected to increase throughput and reduce congestion on southwestbound I-295 but does not address operational issues on eastbound US 250 and eastbound I-64 at the interchange. The increased throughput is projected to result in additional queuing on US 250 that backs up to and degrades operations on the C-D road.	Screened out at October 2021 meeting
Convert eastbound I-64 on-ramp from I-295 to a two-lane directional ramp and construct a partial access C-D road on eastbound I-64 between I-295 and US 250 (option 2)	Vissim	Improvement is projected to increase throughput and reduce congestion on southwestbound I-295 but does not address operational issues on eastbound US 250 and eastbound I-64 at the interchange. The increased throughput is projected to result in additional queuing on US 250 that backs up to and degrades operations on eastbound I-64.	Screened out at October 2021 meeting

### I-64 at N Gayton Road

A new interchange at N Gayton Road was included in the constrained project list in *ConnectRVA 2045*, which was developed by the Richmond Regional Transportation Planning Organization and supported by PlanRVA. This plan was adopted in 2021. The SWG agreed to advance the scenario that included a new interchange on I-64 at N Gayton Road to further screening-level operations analysis in Vissim and preliminary safety analysis as documented in the *Subarea Model Scenarios* section. The goal of the screening-level analysis was to determine how well the changing traffic patterns attributed to the new interchange improved operations and safety on other study area roadways with capacity, congestion, and safety issues.

New traffic volumes for the N Gayton Road interchange concept were developed for the study area by applying the projected percent change in traffic volumes from the subarea travel demand model to the forecasted No-Build traffic volumes as described in the **Build Traffic Volumes** section.

A preliminary Vissim model was created to test the N Gayton Road interchange concept using the new traffic volumes. The preliminary interchange configuration assumed a diamond interchange with additional improvements on mainline I-64 as needed to accommodate the new interchange traffic. The screening-level analysis results showed that the new interchange at N Gayton Road was projected to address several of the congestion and safety issues identified in throughout the study area, particularly the congestion on westbound I-64 approaching the US 250 interchange. The SWG determined at the October 2021 meeting to advance the new interchange at N Gayton Road, along with several of the improvement concepts previously discussed, to one of the Build alternative packages provided that additional screening is performed to refine the alternative. The following sections document the approach, findings, and recommendations for further analysis that identified the appropriate interchange configuration and any necessary improvements on N Gayton Road or mainline I-64 to accommodate the new interchange:

### **Mainline Improvement Screening**

Various concepts were considered on mainline I-64 between Route 288 and I-295 to accommodate the proposed interchange at N Gayton Road. The preliminary Vissim model used to screen the mainline improvement concepts assumed a traditional diamond interchange at N Gayton Road and included the following improvements that were advanced to both Build alternative packages at the October 2021 meeting.

- Construct a new diverging diamond interchange on I-64 at N Gayton Road
- Construct an auxiliary lane on southbound Route 288 between US 250 and Tuckahoe Creek Parkway
- Construct an auxiliary lane on northbound Route 288 between Tuckahoe Creek Parkway and US 250. Signalize and add a second lane to serve the right-turn movement on the northbound Route 288 off-ramp to US 250.
- Convert the westbound US 250 right-turn lane to a shared through/right lane and install thru-cut at Tom Leonard Drive
- Restrict vehicles on the off-ramp from westbound I-64 to eastbound US 250 from turning left at the downstream intersection with Dominion Boulevard
- Convert the single-lane on-ramp from westbound I-64 to I-295 to two lanes. Construct a continuous northbound auxiliary lane between I-64 and Nuckols Road interchange.

The following mainline improvement concepts were developed and screened in Vissim. The screening-level analysis used to identify the preferred mainline alternative assumed a traditional diamond interchange at N Gayton Road with sufficient capacity at the ramp terminals to prevent any queues from impacting freeway operations. Interchange configuration screening is documented in the *Interchange Configuration Screening* section and the preferred interchange configuration was incorporated into Vissim for the Build alternative packages.

- Auxiliary lanes: construct auxiliary lanes in both directions on I-64 between the new interchange at N Gayton Road and the interchanges with Route 288 and I-295. Construct choice lanes for the eastbound I-64 off-ramp to I-295 and the westbound I-64 off-ramps to N Gayton Road and Route 288. The proposed lane configuration diagram is shown in *Figure 21*. Conceptual line diagrams are included in *Appendix F*.
- Braided ramps: construct auxiliary lanes on eastbound I-64 between Route 288 and N Gayton Road and on westbound I-64 between I-295 and N Gayton Road. Construct braided ramps on eastbound I-64 between N Gayton Road and I-295 so that the off-ramp to I-295 diverges from I-64 prior to and crosses the on-ramp from N Gayton Road. Construct braided ramps on westbound I-64 between N Gayton Road and Route 288 so that the off-ramp to Route 288 diverges from I-64 prior to and cross the on-ramp from N Gayton Road. The proposed lane

configuration diagrams are shown in *Figure 22* and *Figure 23*. Conceptual line diagrams are included in *Appendix F*.

- Collector-distributor (C-D) roads: construct a C-D road on eastbound I-64 that starts prior to the on-ramp from Route 288, ends with the off-ramp to I-295, and has slip ramps to and from I-64 throughout. Construct a C-D road on westbound I-64 that starts prior to the on-ramp from I-295, ends with the off-ramp to Route 288, and has slip ramps to and from I-64 throughout. The proposed lane configuration diagrams are shown in *Figure 24* and *Figure 25*. Conceptual line diagrams are included in *Appendix F*.

Figure 21: Proposed Lane Configuration for Auxiliary Lane Concept

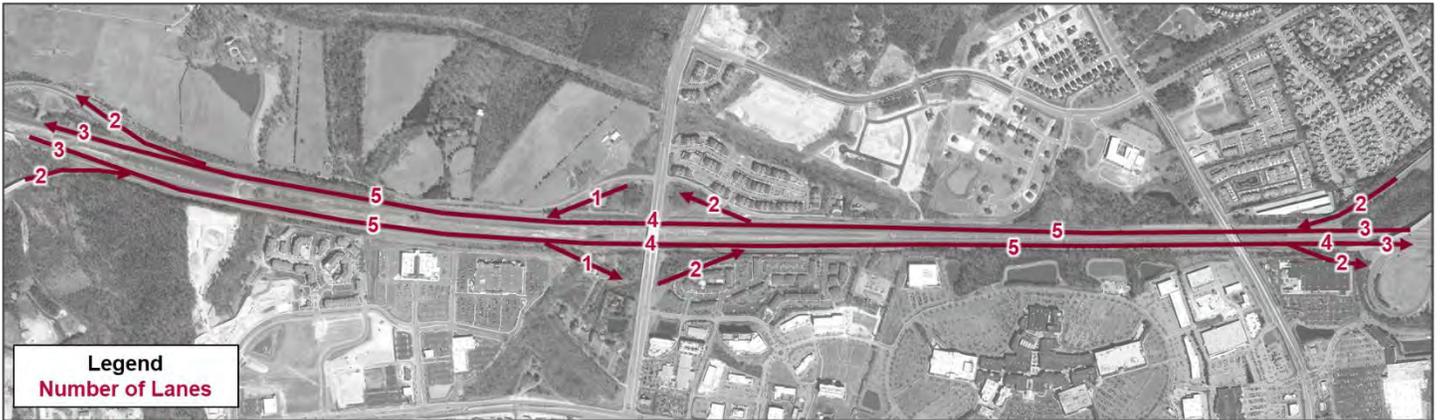


Figure 22: Proposed Lane Configuration for Braided Ramp Concept (1/2)

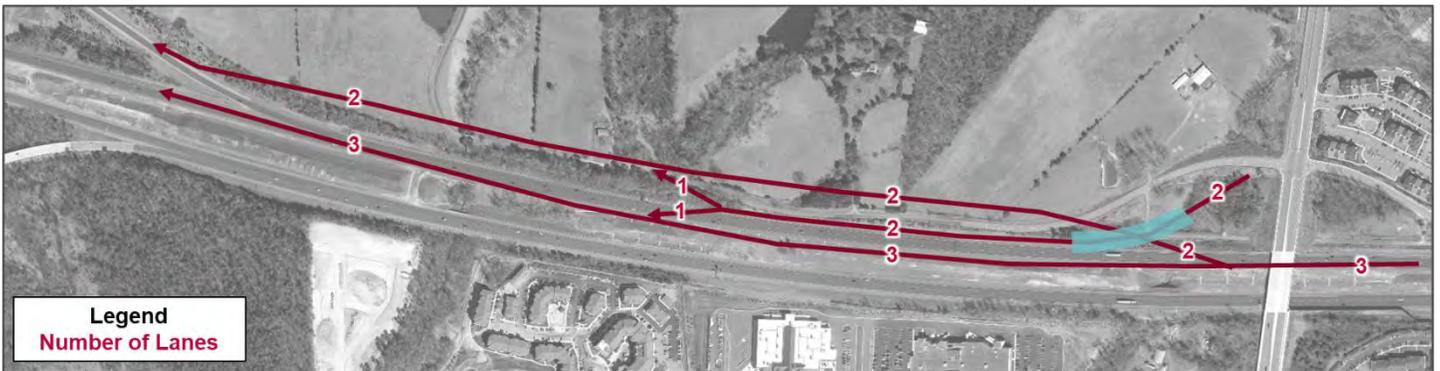


Figure 23: Proposed Lane Configuration for Braided Ramp Concept (2/2)

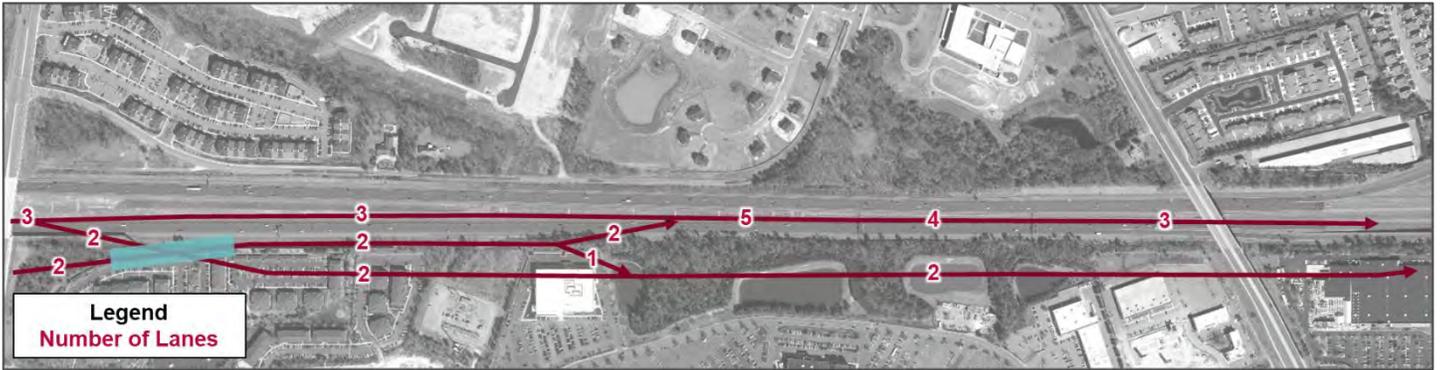


Figure 24: Proposed Lane Configuration for C-D Road Concept (1/2)

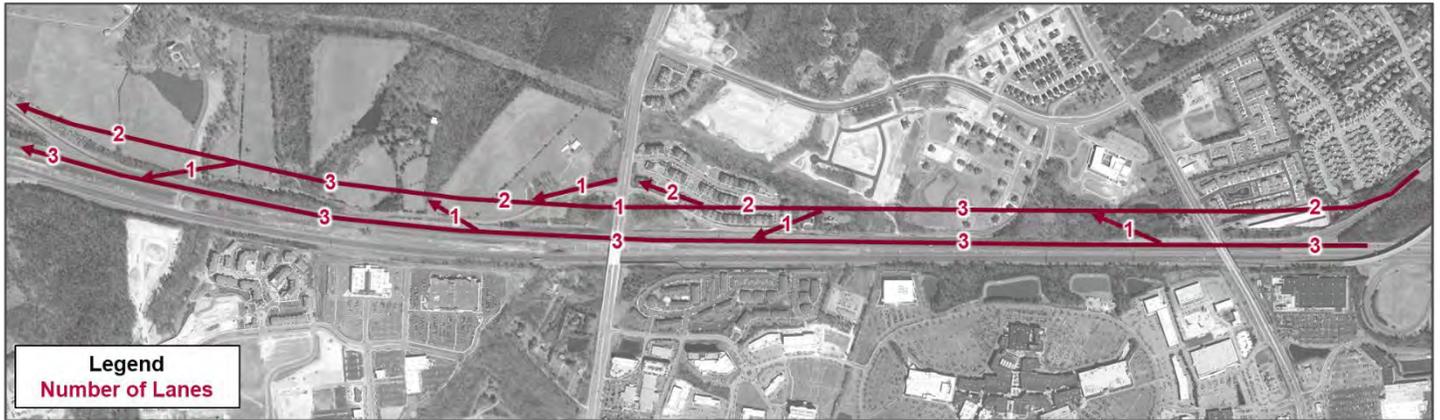
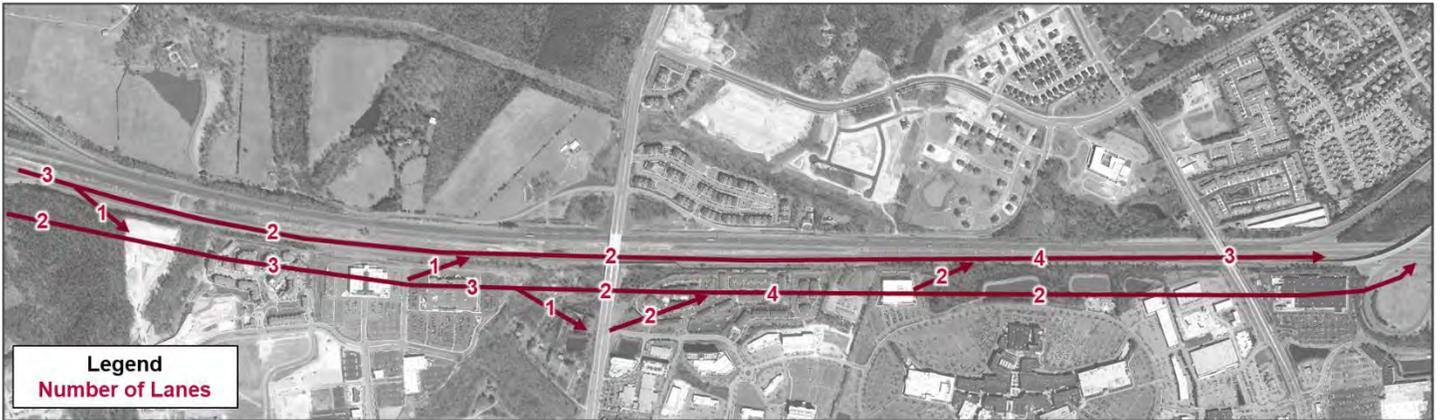


Figure 25: Proposed Lane Configuration for C-D Road Concept (2/2)



Larger C-D road concepts were discussed with the SWG but were screened out without more detailed analysis or design due to geometric concerns. These concepts included a C-D road that spanned from west of the Route 288 interchange through the US 250 interchange and a C-D road similar to the concept shown in *Figure 24* and *Figure 25* without the slip ramps to and from I-64 throughout the C-D road. *Figure 26* and *Figure 27* document the projected AM and PM peak hour

traffic volumes on mainline I-64 and the C-D roads for the concept without the slip ramps to and from I-64. *Figure 26* and *Figure 27* also display the proposed lane configurations for mainline I-64 and the C-D roads that were developed to maintain lane balance while accommodating the projected peak hour traffic volumes. This C-D road concept was projected to carry up to five times more vehicles on the C-D road than on mainline I-64 and would require five lanes for the eastbound C-D road segment between N Gayton Road and I-295. Building this C-D road concept with the proposed lane configurations was projected to have the following right-of-way and cost impacts.

- The Pouncey Tract Road bridge over I-64 would need to be rebuilt
- Larger footprint of C-D road would potentially require total property takes of residential properties and possibly require some takes along adjacent commercial properties
- Additional measures such as retaining walls would be necessary to avoid impacts to stormwater management basins north of the Short Pump mall

A larger C-D road that spanned from west of the Route 288 interchange through the US 250 interchange would have similar impacts plus the following additional impacts:

- The eastbound I-64 ramps to and from I-295 would need to be rebuilt and the westbound I-64 ramps to and from I-295 would need to be realigned
- All ramps at the I-64 at Route 288 interchange would need to be rebuilt or realigned
- All ramps at the I-64 at US 250 interchange would need to be rebuilt or realigned
- The C-D road would require additional bridges over Little Tuckahoe Creek to carry the C-D roads west of the Route 288 interchange
- The larger footprint of C-D road would require additional total property takes of residential and commercial businesses

Since the C-D road concept shown in *Figure 24* and *Figure 25* better distributed traffic volumes between mainline I-64 and the C-D road and was projected to have fewer right-of-way and environmental impacts at a cheaper cost, the two larger C-D road concepts were screened out.

*Figure 26: Peak Hour Traffic Volumes and Proposed Lane Configuration for Larger C-D Road Concept (1/2)*

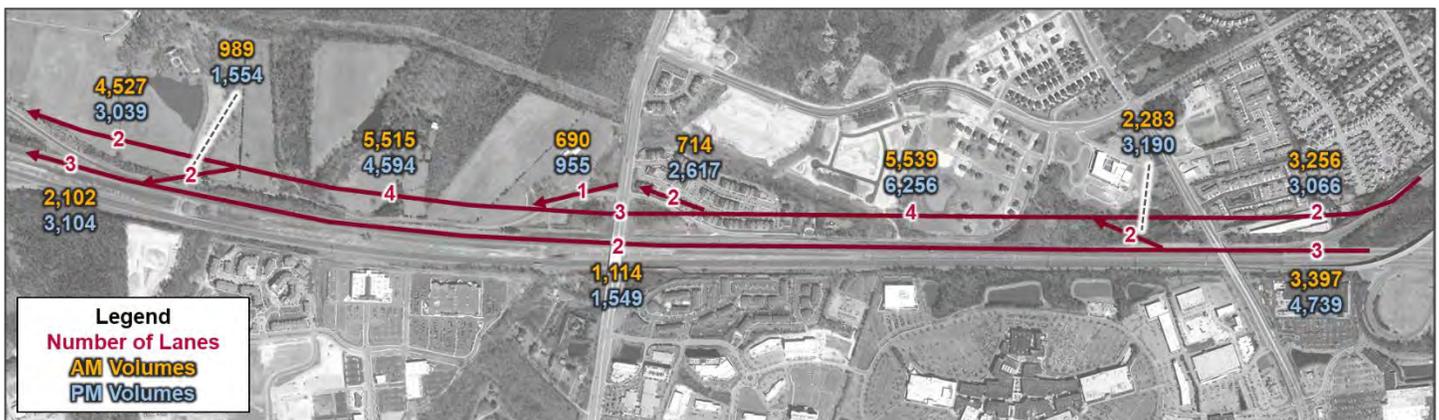


Figure 27: Peak Hour Traffic Volumes and Proposed Lane Configuration for Larger C-D Road Concept (2/2)



**Operational Screening Results**

Screening-level operational results were reviewed for the section of I-64 between Route 288 and I-295 to compare the three mainline improvement concepts using speed, density, travel time index, travel time, and throughput. Operations outside this section of I-64 were not projected to be significantly different due to the changes in geometry and access within this section.

There was little differentiation in throughput, shown as the percent of demand served in *Table 18*, between the three mainline improvement concepts in the AM and PM peak hour. Similarly, I-64 was projected to operate at or near the speed limit during both peak hours. The C-D road was projected to operate below the 45-mph speed limit in both peak hours, with a minimum projected speed of 37 mph for the eastbound C-D road between Route 288 and N Gayton Road in the AM peak hour. The screening-level operational results figures are included in *Appendix F*.

Table 18: Percent of Demand Served Comparison

Mainline Improvement Concept	Eastbound I-64		Westbound I-64	
	Between Route 288 and N Gayton Road	Between N Gayton Road and I-295	Between I-295 and N Gayton Road	Between N Gayton Road and Route 288
AM Percent of Demand Served				
Auxiliary Lanes	100	98	86	87
Braided Ramps	99	96	86	87
C-D Roads*	96	98	86	87
PM Percent of Demand Served				
Auxiliary Lanes	91	89	91	91
Braided Ramps	91	90	91	90
C-D Roads*	90	94	90	90

\*Percent of demand served considers the demand on mainline I-64 and the C-D road

As shown in *Table 18*, demand was not fully served on I-64 near the N Gayton interchange in the Vissim screening analyses. This was attributed to bottlenecks on I-295 and Route 288 that are not fully addressed with the improvements that were advanced to the Build alternative package in the October 2021 meeting. A sensitivity test was performed to evaluate how the three mainline improvement concepts would operate if future projects were to recommend

improvements that addressed these bottlenecks so that a higher percentage of the demand on I-64 between Route 288 and I-295 would be served. The sensitivity testing resulted in a 30-mph decrease in speed on westbound I-64 approaching the off-ramp to Route 288 in the AM peak hour in the braided ramp scenario. This decrease in speed can be attributed to the additional vehicles prepositioning in the right lanes in advance of the braided ramp as other vehicles preposition to exit to N Gayton Road. While this behavior occurs without the release of the bottleneck from I-295, the level of demand served is not projected to be high enough to impact operations. The sensitivity testing also resulted in a 5-mph decrease in speed on the westbound C-D road between I-295 and N Gayton Road in the AM peak hour and the eastbound C-D road between Route 288 and N Gayton Road in the PM peak hour. No decreases in speed were projected in the auxiliary lane concept with the release of the bottlenecks, which indicates that the auxiliary lane concept is less susceptible to break down if all demand in the study area could be served.

### Safety Screening Results

The new interchange at N Gayton Road is projected to increase traffic volume on I-64 between Route 288 and I-295 due to vehicles entering or exiting I-64 at the new interchange instead of an existing interchange. The additional traffic volume on this section of I-64 increases the risk of crashes; however, the new interchange has the potential to reduce crashes at other interchanges where traffic volumes are projected to decrease since many vehicles are projected to be rerouted to the new interchange. To determine if the potential increase in crashes between Route 288 and I-295 outweighed the potential decrease in crashes elsewhere in the study area, the auxiliary lane concept was evaluated using the Enhanced Interchange Safety Analysis Tool (ISATe) and other predictive methods. This analysis was originally conducted assuming a traditional diamond for the new interchange with two two-lane ramps on the eastern side of the interchange and two one-lane ramps on the western side of the interchange. The study team concluded that the auxiliary lane concept was projected to have either fewer or a comparable number of crashes on mainline I-64 than the No-Build scenario. The preliminary analysis was refined after the screening stage; the refined analysis is detailed in the *Safety Analysis* section.

The study team also conducted a preliminary analysis of the braided ramp alternative in the westbound direction to determine if the projected increase in crashes on westbound I-64 outweighed the projected increase in crashes on the braided ramp facility. This analysis was also conducted assuming a traditional diamond for the new interchange. The study team concluded that the projected increase in crashes on the proposed braided ramp facility outweighed the projected decrease in crashes on westbound I-64. The study team could not conduct a similar test for the proposed C-D road alternative since crash prediction methodologies are only available for one- and two-lane ramps; the proposed C-D road, which is considered a ramp in ISATe, contains more than two lanes for almost all segments.

The three mainline improvement concepts were qualitatively compared by considering the number of conflict points on I-64. *Table 19* documents the number of diverging, merging, and weaving conflict points associated with each concept. A weaving conflict point was defined as a location where two vehicles must make lane changes in opposite directions to complete their desired origin-destination movements. The analysis assumed that vehicles are prepositioned on ramps to make the fewest number of lane changes to complete their desired origin-destination movement and that vehicles will choose the least severe conflict (e.g., will choose to merge instead of weave). While the auxiliary lane concept contained the most diverging and merging conflict points, it did not have any weaving conflicts since the concept included choice lanes at the eastbound I-64 off-ramp to I-295 and the westbound I-64 off-ramps to N Gayton Road and Route 288.

Table 19: Conflict Point Summary for Mainline Improvement Concepts

Improvement Concept	Weaving Speed	Eastbound			Westbound		
		Diverges	Merges	Weaves	Diverges	Merges	Weaves
Auxiliary Lanes	65 mph	6	6	0	5	5	0
Braided Ramps	65 mph	2	3	1	2	2	1
C-D Roads	45 mph	2	3	3	3	3	2

### Mainline Improvement Selection

A matrix was prepared to compare each of the three mainline improvement concepts using all criteria listed in the *Alternatives Development and Screening* section, except for bicycle and pedestrian accommodation, which had no bearing on the mainline improvement concepts. Each criterion was assigned an equal weight in the scoring process for preliminary screening. The concepts were then ranked relative to each other based on total score. *Table 20* documents the high-level findings and recommendations for the three mainline improvement concepts. The complete matrix that summarizes the score by criteria, criteria weight, and cumulative scores and ranks is provided in *Appendix F*. The auxiliary lane concept scored the highest and was advanced to a Build alternative package at the April 2022 meeting.

Table 20: Mainline Improvement Concepts for New Interchange at N Gayton Road

Mainline Improvement Concept	Analysis Tool	Findings	Recommendation
Auxiliary Lanes	Vissim	This concept was preferred because it had fewer right-of-way, utility, and environmental impacts than the other two concepts and it was less susceptible to break down if demand were to be fully served in the study area.	Advanced to one Build alternative at April 2022 meeting
Braided Ramps	Vissim	This concept had more right-of-way, utility, and environmental impacts than the auxiliary lane concept. I-64 was projected to operate at or near the speed limit, but westbound I-64 was susceptible to break down if the demand were to be fully served in the study area.	Screened out at April 2022 meeting
C-D Roads	Vissim	This concept had the most significant right-of-way, utility, and environmental impacts. I-64 was projected to operate at or near the speed limit, but the C-D road was projected to operate below the speed limit and was susceptible to break down if the demand were to be fully served in the study area. Crashes were projected to be reduced on mainline I-64 but weaving conflict points were introduced on the C-D roads, which carried more volume than mainline I-64 in several sections.	Screened out at April 2022 meeting

### Interchange Configuration Screening

Initial interchange configuration screening was performed at the potential N Gayton Road interchange as proposed in Build Package 2 using the VDOT Junction Screening Tool (VJuST). VJuST is a planning-level tool that helps transportation engineers and planners screen innovative intersection and interchange configurations based on operations,

safety, and pedestrian accommodation, and that helps identify potential configurations that could effectively satisfy the purpose and need and thus advance to more detailed analysis and design. The VJuST results for the N Gayton Road interchange are provided in *Appendix F*. The following interchange configurations were screened out based on the VJuST results, since these configurations were not projected to accommodate the projected traffic volumes at an acceptable volume-to-capacity (V/C) ratio.

- Single Roundabout
- Contraflow Left Turn
- Michigan Urban Diamond

Although the projected V/C ratio for the double roundabout configuration was higher than those of the contraflow left turn and Michigan urban diamond interchange configurations, it advanced to further screening analysis in SIDRA Intersection since it could likely be constructed using the existing bridge over I-64 without requiring new structures. The following interchange configurations were analyzed in Synchro 10 for signalized intersection concepts and SIDRA Intersection 9 for roundabout concepts. Delay (seconds per vehicle) and level of service (LOS) were used to compare projected operations for the interchange configurations. Weighted conflict points from VJuST were used to compare the safety impacts of each interchange configuration.

- Traditional Diamond
- Displaced Left Turn
- Diverging Diamond Interchange (DDI)
- Single Point Urban Interchange (SPUI)
- Double Roundabout
- Partial Cloverleaf

A matrix was prepared to compare each of the six interchange configuration concepts using the criteria listed in the *Alternatives Development and Screening* section. Each criterion was assigned an equal weight in the scoring process for preliminary screening. The SWG discussed multiple variations of category weights based on different priorities at the April 2022 meeting and agreed to increase the weights for three categories: safety, operations, and pedestrian/bike accommodations. The concepts were then ranked relative to each other based on total score. A summary of the score by criteria, criteria weight, and cumulative scores and ranks is provided in *Appendix F*. With the revised category weighting, the DDI scored the highest.

An additional matrix, provided in *Appendix F*, was prepared to document any potential challenges with constructability of an interchange configuration alternative with any mainline I-64 alternative. The DDI was not projected to have any major constructability issues with the preferred mainline alternative of continuous auxiliary lanes and was advanced to a Build alternative package.

## BUILD PACKAGES

*Table 21* shows a summary of the improvements from the screening process that were advanced to each Build alternative package, based on input and consensus from the SWG during the alternative development process. The reconfiguration of the eastbound I-64 ramp diverge at I-295 was not included in Build Packages 2 or 3 since both packages include an auxiliary lane between the N Gayton Road and I-295 interchanges. Neither package has a lane configuration that contributes to upstream imbalances in lane distribution and this improvement was deemed unnecessary.

Table 21: Summary of Build Package Components

Improvement	Build Package 1	Build Package 2	Build Package 3
Construct a partial cloverleaf interchange (option 3) that removes the on-ramp from eastbound US 250 to westbound I-64. Construct dual westbound right-turn lanes at intersection with westbound I-64 ramps plus contraflow left-turn lanes	✓	✗	✓
Construct a new diverging diamond interchange on I-64 at N Gayton Road	✗	✓	✓
Construct an auxiliary lane on southbound Route 288 between US 250 and Tuckahoe Creek Parkway	✓	✓	✓
Construct an auxiliary lane on northbound Route 288 between Tuckahoe Creek Parkway and US 250. Signalize and add a second lane to serve the right-turn movement on the southbound Route 288 off-ramp to US 250. Add a second lane to serve the right-turn movement on the northbound Route 288 off-ramp to US 250.	✓	✓	✓
Convert the westbound US 250 right-turn lane at Tom Leonard Drive to a shared through/right lane and install a thru-cut	✓	✓	✓
Restrict vehicles on the westbound off-ramp from I-64 to eastbound US 250 from turning left at Dominion Boulevard	✓	✓	✓
Convert the single-lane I-295 on-ramp from westbound I-64 to two lanes. Construct a continuous northbound auxiliary lane from I-64 to Nuckols Road interchange.	✓	✓	✓
Reconfigure the eastbound I-64 ramp diverge at I-295 to create one exit only lane and one choice lane	✓	✗	✗

## ▲ Description and Configuration of Interchange Access

### BUILD PACKAGE 1

As shown in *Table 21*, Build Package 1 includes seven different improvements throughout the study area roadway network. *Figure 28* through *Figure 38* show conceptual roadway sketches of the geometric changes that are part of these seven improvements in Build Package 1.

### BUILD PACKAGE 2

As shown in *Table 21*, Build Package 2 includes six different improvements throughout the study area roadway network. Five improvements are the same as those included in Build Package 1 and are shown in *Figure 30* through *Figure 37*.

Additionally, Build Package 2 includes the proposed new interchange at N Gayton Road and additional mainline improvements on I-64, shown in *Figure 39* through *Figure 43*. In addition to the construction of the diverging diamond ramp terminals on N Gayton Road, modifications and improvements at existing intersections were proposed. The proposed changes at the existing signalized intersection of Blue Ocean Lane at N Gayton Road include converting the intersection to right-in only to allow space for the DDI signalized crossover intersection. Additionally, the proposed design involves the removal of the signalized intersection of N Gayton Road and Bacova Drive and realignment/reconfiguration of Bacova Drive, with the roadway terminating at Marshall Run Circle east of N Gayton Road. Residents of the Marshall Springs townhomes would have access maintained on N Gayton Road at Marshall Run Circle, which current operates as right-in/right-out access, as well as access from Marshall Run Circle to Liesfeld Farm Drive via Bacova Drive. To the west

of N Gayton Road, Bacova Drive would be reconstructed either as a fourth leg of the intersection with Liesfeld Farm Drive, or as a right-in/right-out access road south of Liesfeld Farm Drive, in coordination with a proposed site development plan for the area in the northwest quadrant of the proposed interchange.

New traffic volumes for the N Gayton Road interchange concept were developed for the study area by applying the projected percent change in traffic volumes from the subarea travel demand model to the forecasted No-Build traffic volumes as described in the *Build Traffic Volumes* section. This section also documents how vehicles were rerouted based on the proposed changes in access on N Gayton Road.

### BUILD PACKAGE 3

As shown in *Table 21*, Build Package 3 includes the partial cloverleaf interchange at US 250 from Build Package 1, the proposed new interchange at N Gayton Road from Build Package 2, and five additional improvements throughout the study area roadway network. *Figure 28* through *Figure 37* and *Figure 39* through *Figure 43* show conceptual roadway sketches of the geometric changes that are part of these seven improvements in Build Package 3.

A sensitivity test was performed using Build Package 3 to evaluate how the proposed DDI would operate if future projects were to be implemented that addressed the remaining bottlenecks on I-295 and Route 288 and provided additional benefit to US 250. While no improvements were identified during the alternatives development and screening process that addressed these issues without negatively impacting I-64, the SWG determined it was important to understand the potential impacts if future projects were identified and implemented. This sensitivity test showed that the original ramp configuration proposed for the eastbound I-64 off-ramp at the DDI could result in queues that back up to the freeway once the bottleneck on northbound Route 288 was released. To account for this, the study team revised the design of the DDI to add a second right-turn lane on this ramp. This change was also made in Build Package 2 and is reflected in *Figure 41*.

Figure 28: US 250 at I-64 Partial Cloverleaf Improvement (1)



Figure 29: US 250 at I-64 Partial Cloverleaf Improvement (2)

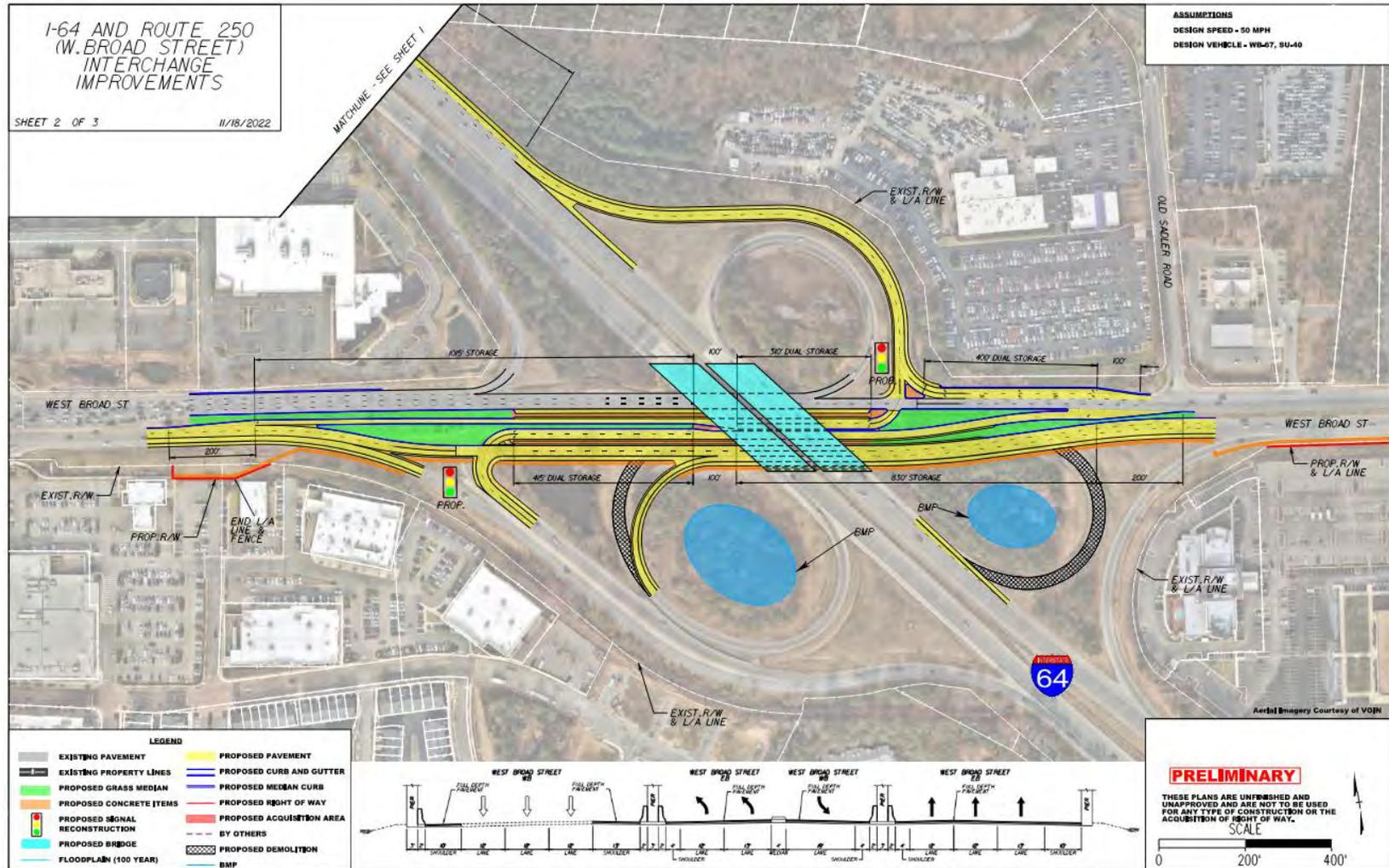




Figure 31: Route 288 at US 250 Ramp and Ramp Terminal Improvements (1)

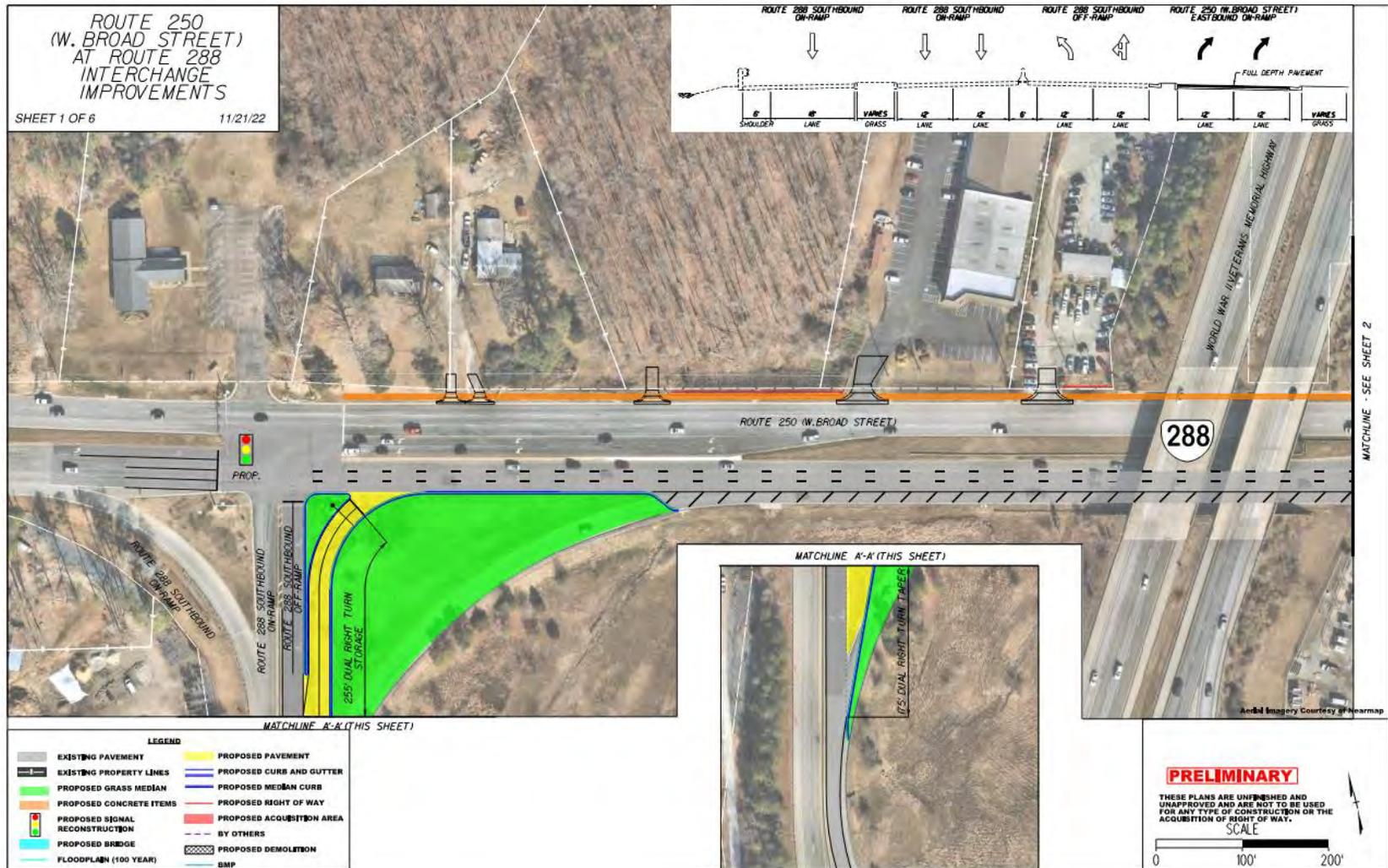


Figure 32: Route 288 at US 250 Ramp and Ramp Terminal Improvements (2)

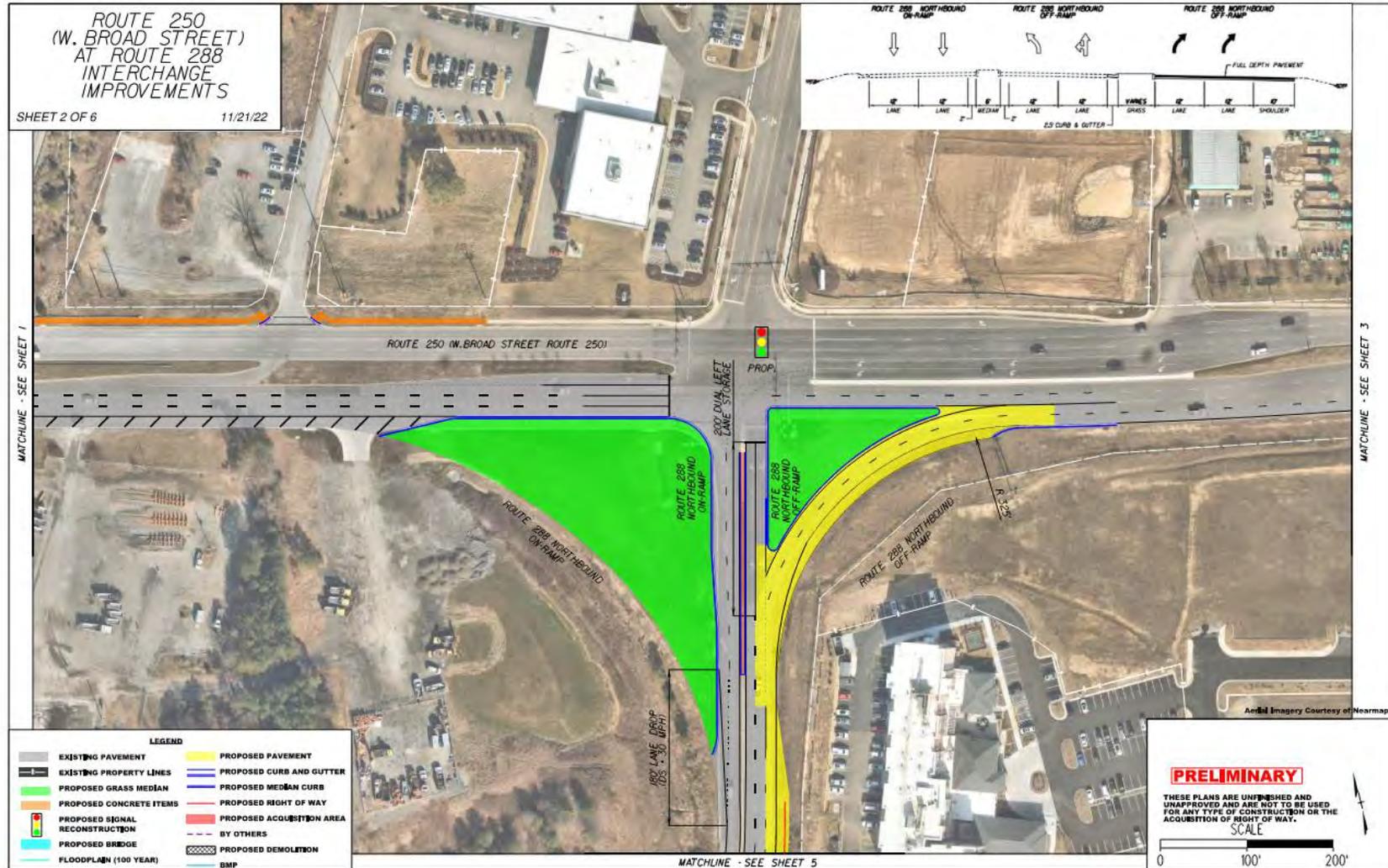


Figure 33: Route 288 at US 250 Ramp and Ramp Terminal Improvements (3)

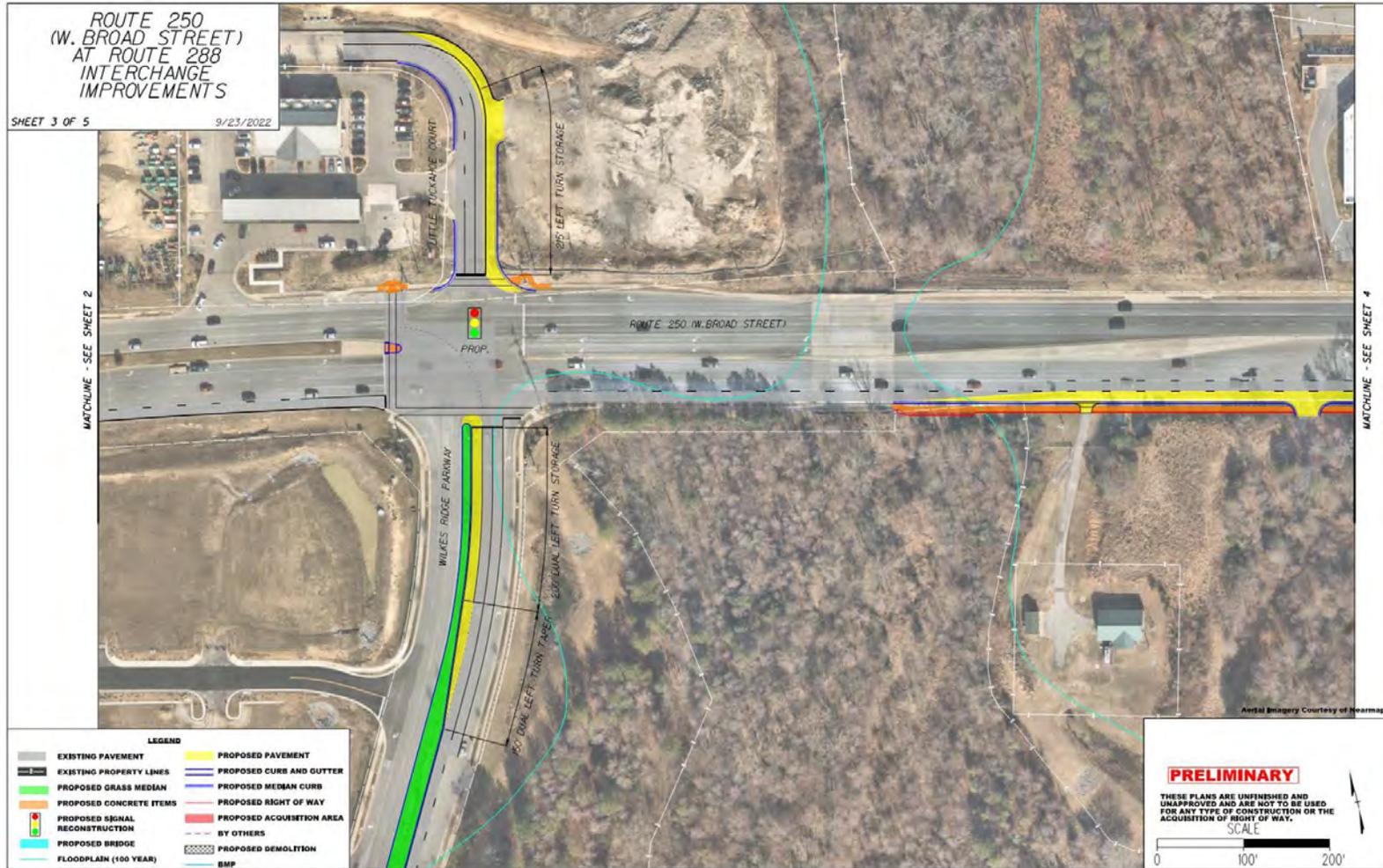




Figure 35: Route 288 at US 250 Ramp and Ramp Terminal Improvements (5)

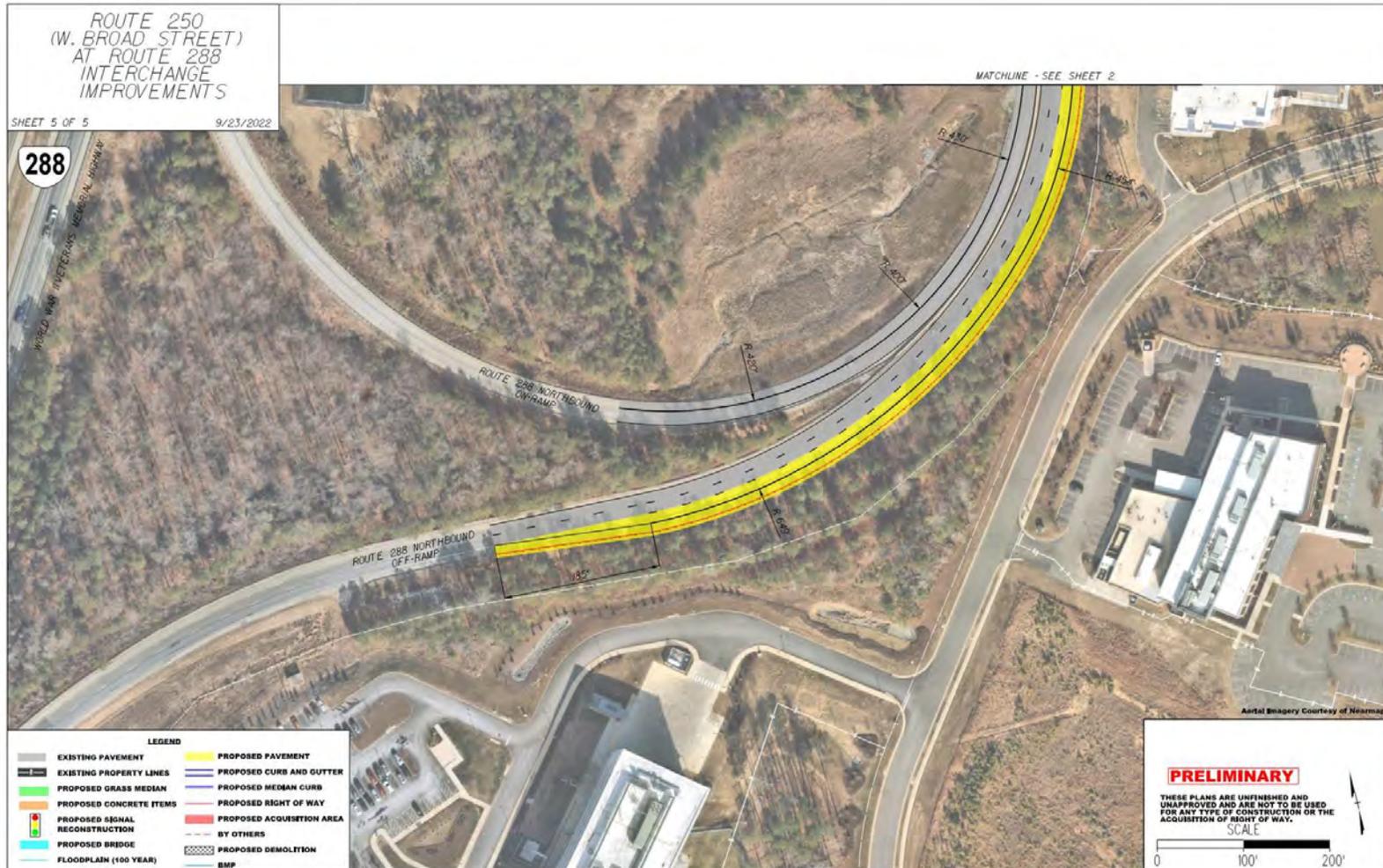


Figure 36: US 250 at Tom Leonard Drive Intersection Improvements

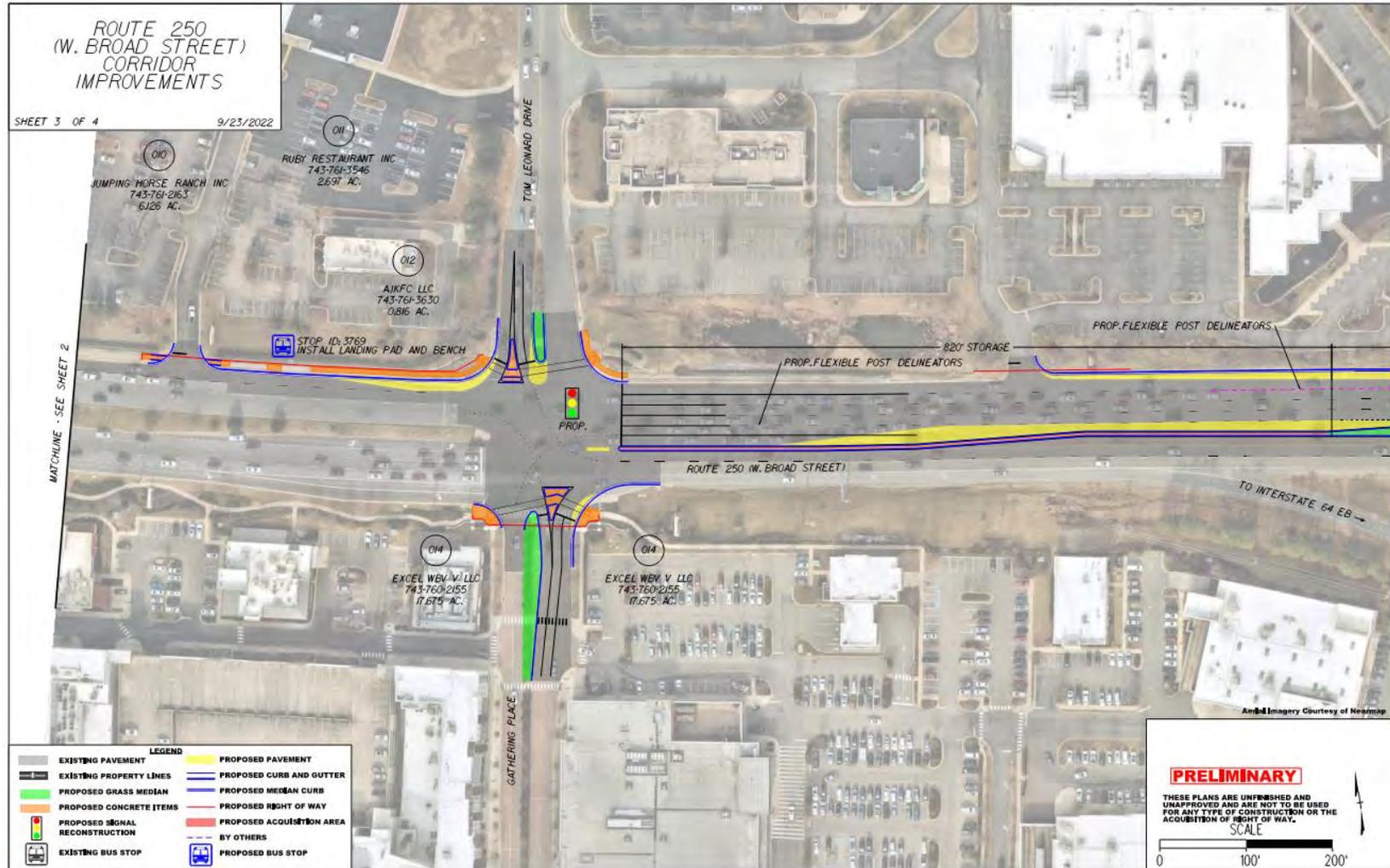


Figure 37: I-295 Continuous Auxiliary Lane from I-64 to Nuckols Road

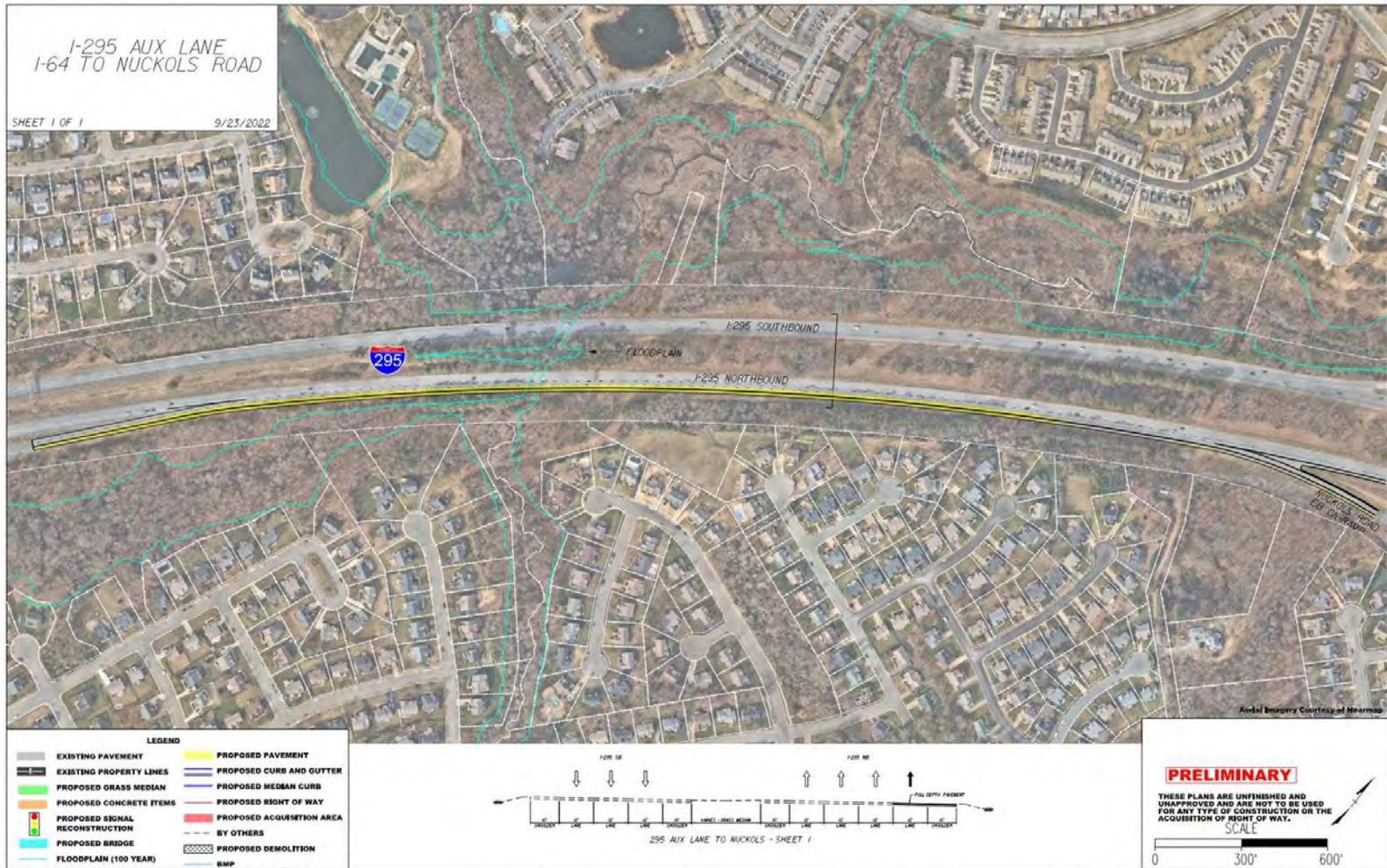


Figure 38: I-64 to I-295 Diverge Reconfiguration



Figure 39: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (1)

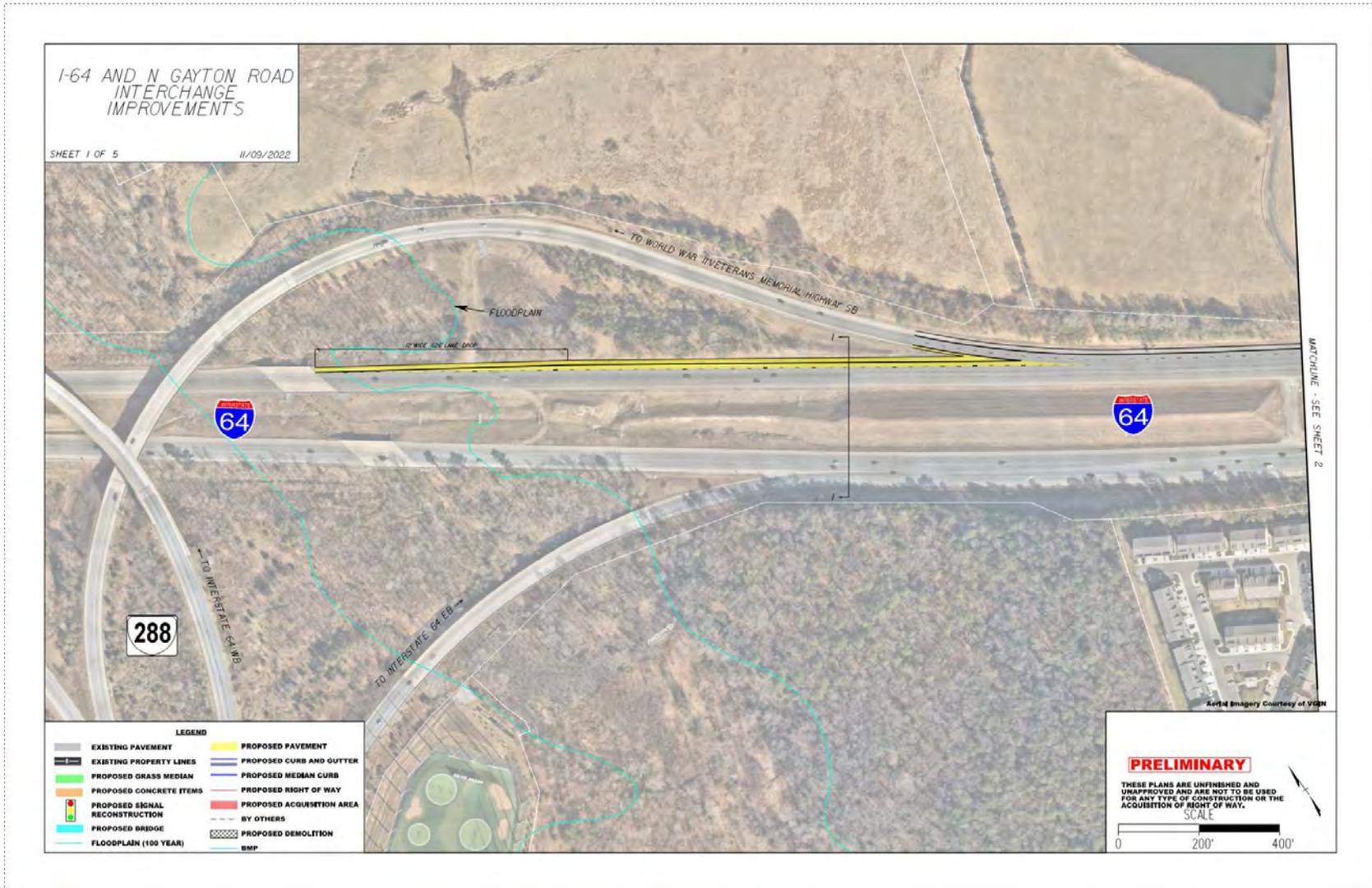


Figure 40: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (2)

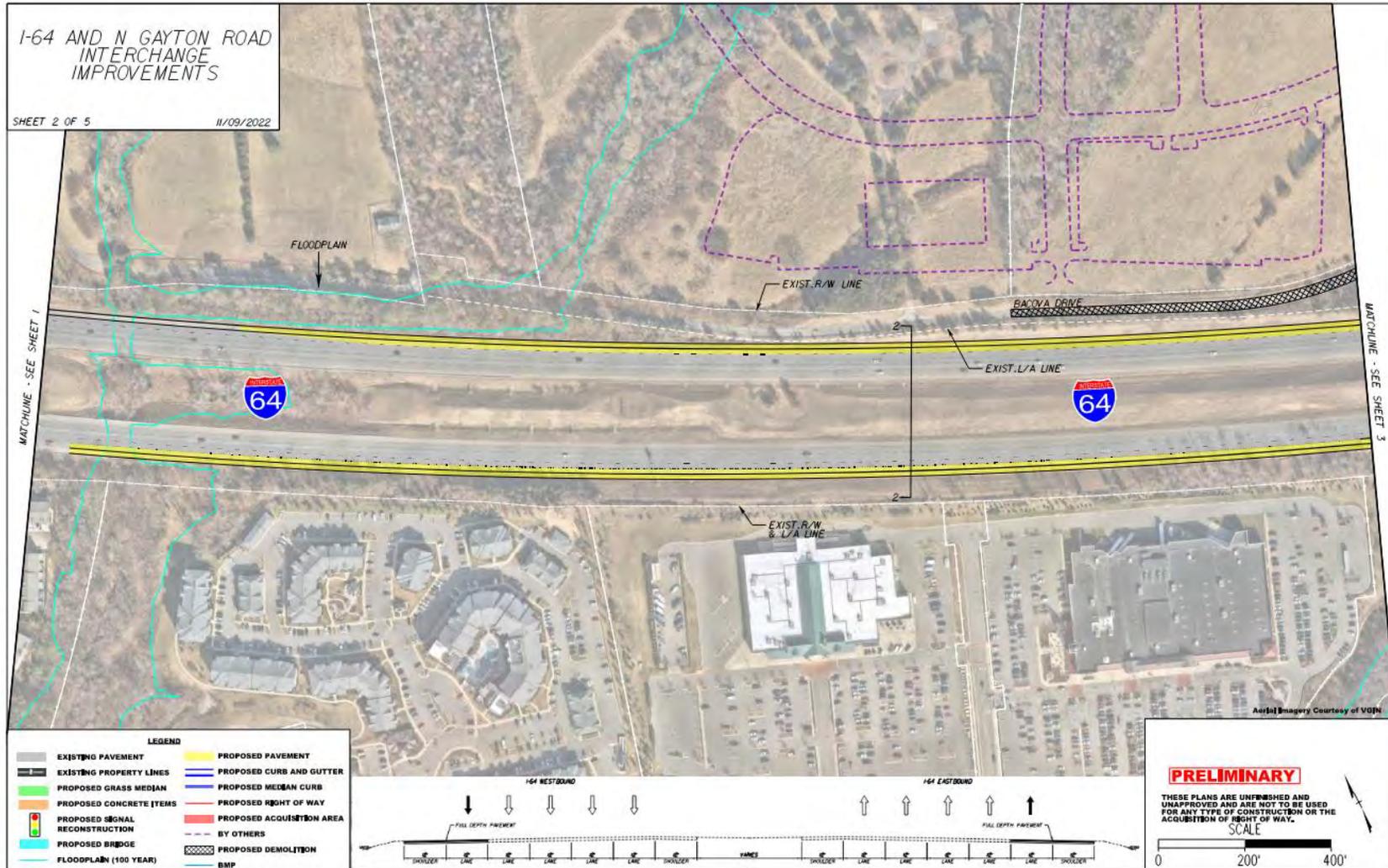


Figure 41: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (3)

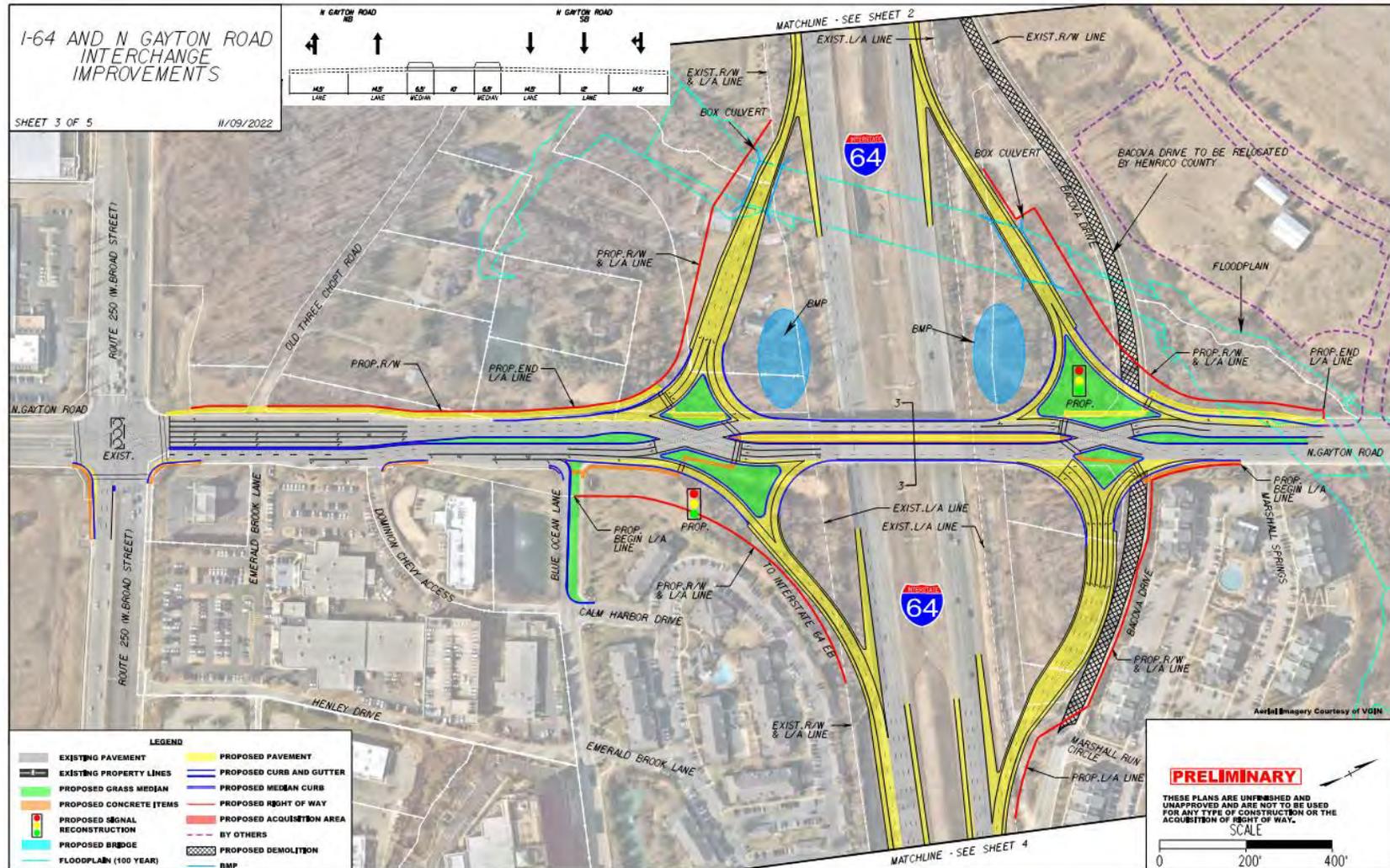


Figure 42: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (4)

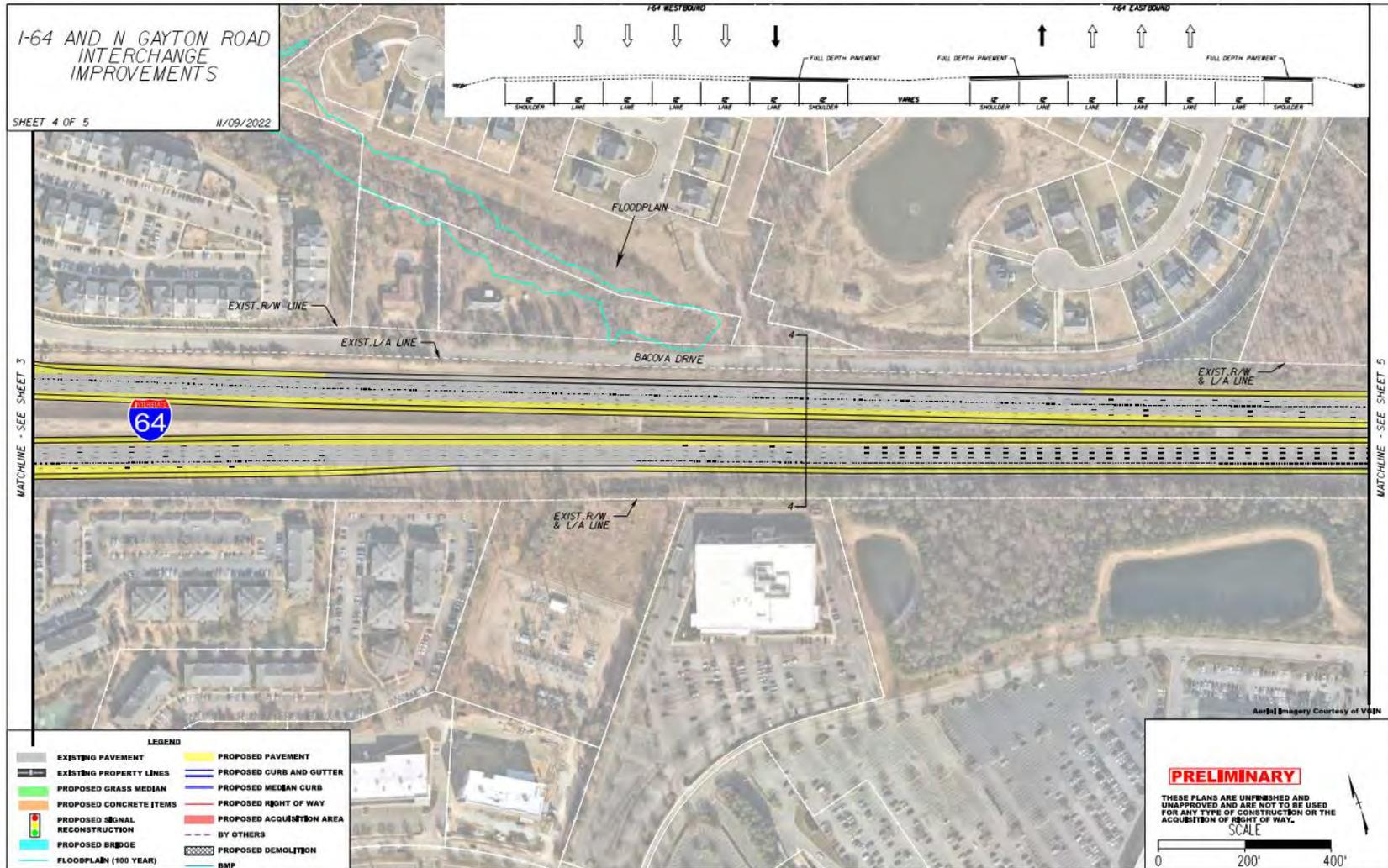
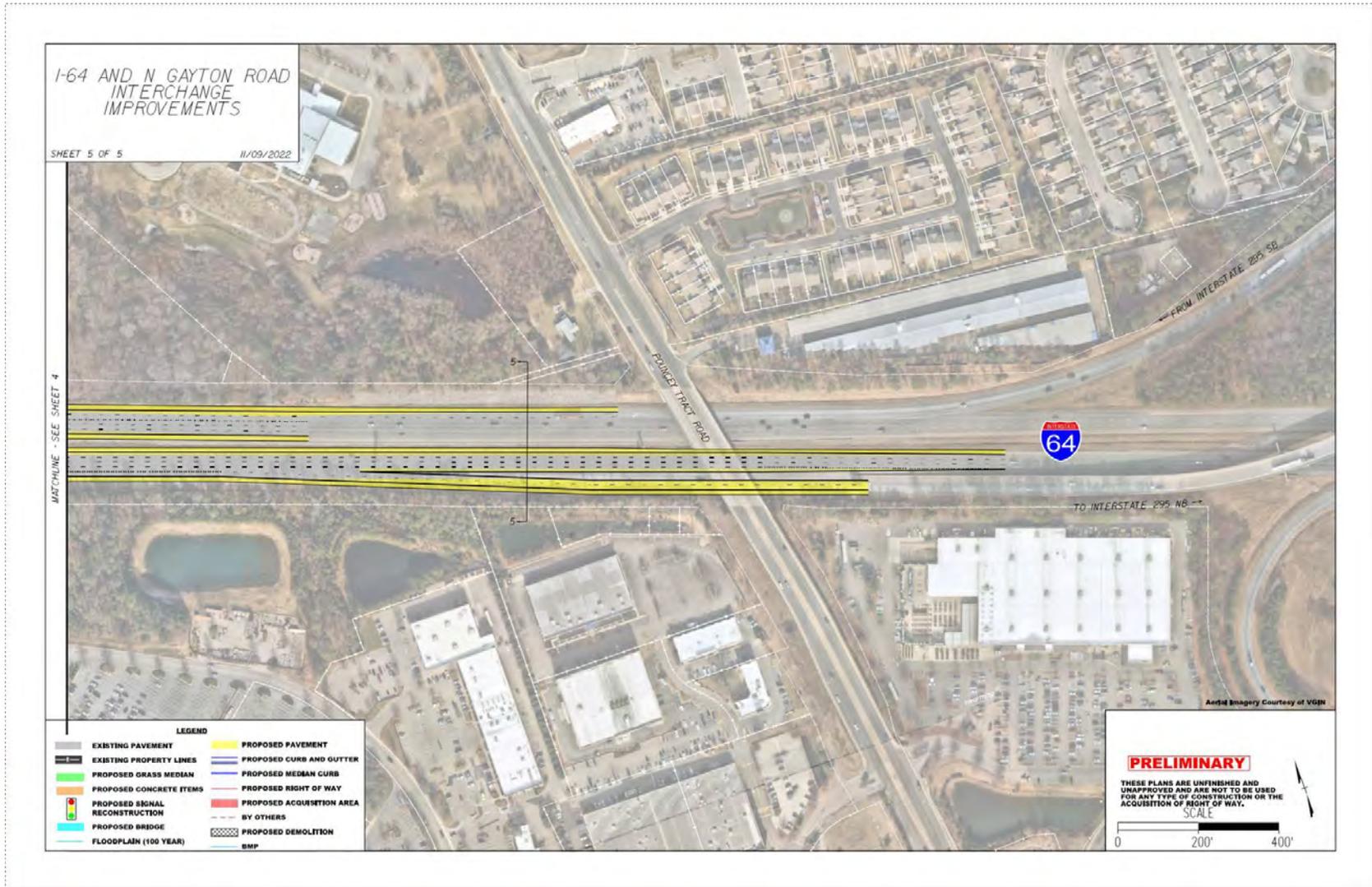


Figure 43: I-64 at N Gayton Road Interchange and Continuous Auxiliary Lanes (5)



## ▲ Roadway Geometry

Conceptual design plans were developed for the improvements included in the three Build packages. Conceptual design plans were developed in accordance with the following applicable guidelines:

- Policy on Geometric Design of Highways and Streets (AASHTO 2018)
- A Policy on Design Standards – Interstate System (AASHTO 2016)
- VDOT Road Design Manual (Issued January 2005, Revised July 2017)
- VDOT Road and Bridge Standards (VDOT 2016, latest revisions)
- Manual on Uniform Traffic Control Devices (MUTCD 2009)
- 2011 Virginia Supplement to the MUTCD

Design criteria and guidance from these documents were applied to roadways within the project limits based on functional classification and roadway design speeds. The proposed design assumes a WB-67 as the design vehicle to determine the design impacts of the turning radius. *Table 22* summarizes the AASHTO design criteria for each roadway within the project limits. *Table 23* summarizes the VDOT design criteria for each roadway within the project limits.

Table 22: AASHTO Design Criteria

Criteria	I-64	Route 288	I-295	N Gayton Road	US 250	Interchange Ramps	Interchange Loop Ramps	References or Remarks
Functional Classification	Interstate	Interstate	Interstate	Urban Major Collector	Urban Principal Arterial	Interchange Ramp	Interchange Ramp	
Terrain	Rolling	Rolling	Rolling	Rolling	Rolling	Rolling	Rolling	--
Design Speed	70 mph	70 mph	75 mph	45 mph	50 mph	35 mph	20 mph	AASHTO Green Book (2018), Section 2.3.6 (page 2-21), Table 10-1 (page 10-105), Section 10.9.6.2.4 (page 10-106)
Posted Speed	65 mph	65 mph	70 mph	45 mph	45 mph	--	--	--
Number of Lanes	3 each direction	2 each direction	2 each direction	3 each direction	3 each direction	1	1	--
Minimum Width, Travel Lane	12'	12'	12'	11'	11'	14'	14'-16'	AASHTO Green Book (2018), Sections 6.3.2.1 (page 6-16), Sections 7.3.3.2 (page 7-39), 8.2.4 (page 8-3), Table 3-27 (page 3-109)
Minimum Width, Vehicle/Bike Shared Lane	--	--	--	14'	14'	--	--	AASHTO Guide for the Development of Bicycle Facilities, Section 4.3.1
Paved Shoulder Widths	LT: 10' RT: 10'	LT: 10' RT: 10'	LT: 10' RT: 10'			LT: 2' RT: 8'	LT: 2' RT: 8'	AASHTO Green Book (2018), Table 6-5 (page 6-6) Table 7-3 (page 7-7), Sections 8.2.4 (page 8-3), 10.9.6 (page 10-102),
Total Shoulder Widths	LT: 10' RT: 10'	LT: 10' RT: 10'	LT: 10' RT: 10'			LT: 4' RT: 10'	LT: 4' RT: 10'	AASHTO Green Book (2018), Table 6-5 (page 6-6) Table 7-3 (page 7-7), Sections 8.2.4 (page 8-3), 10.9.6 (page 10-102),
Normal Cross Slope	2%	2%	2%	2%	2%	2%	2%	AASHTO Green Book (2018), Table 4-1 (page 4-7), Section 6.3.1.6 (page 6-15), Section 7.3.2.8 (page 7-38), 10.9.6.2.14 (page 10-111)
Minimum Radius	1810'	1810'	1810'	711'	926'	314'	76'	AASHTO Green Book (2018), Table 3-7 (page 3-34)
Maximum Superelevation	8%	8%	8%	4%	4%	8%	8%	AASHTO Green Book (2018), Section 3.3.3.2 (page 3-31)
Minimum Stopping Sight Distance on Level Roadways	730'	730'	820'	360'	425'	250'	115'	AASHTO Green Book (2018), Table 3-1 (page 3-4)
Maximum Grade	4%	4%	4%	9%	7%	4 to 6%	6 to 8%	AASHTO Green Book (2018), Section 6.3.1.5 (page 6-14), Table 7-4a (page 7-38), Table 8-1 (page 8-5), Table 10-2 (page 10-110)

Criteria	I-64	Route 288	I-295	N Gayton Road	US 250	Interchange Ramps	Interchange Loop Ramps	References or Remarks
Functional Classification	Interstate	Interstate	Interstate	Urban Major Collector	Urban Principal Arterial	Interchange Ramp	Interchange Ramp	
Minimum Crest K Value (based on SSD)	247	247	312	61	84	29	7	AASHTO Green Book (2018), Table 3-35 (page 3-170)
Minimum Sag K Value	181	181	206	79	96	49	17	AASHTO Green Book (2018), Table 3-37 (page 3-176)
Minimum Median Width	22'	22'	22'	4'	4'	--	--	AASHTO Green Book (2018), Section 6.3.2.4 (page 6-17), Section 7.3.3.5 (page 7-41), Sections 8.4.2 (page 8-13)
Clear Zone	38'	38'	38'	24'	14'	16'	16'	AASHTO Roadside Design Guide, Table 3-1 (page 3-3)
Minimum Vertical Clearance	16'	16'	16'	14'	14'	16'	16'	AASHTO Green Book (2018), Section 6.3.3.2 (page 6-20), Section 7.3.5.2 (page 7-51), Sections 8.2.9 (page 8-5)
Sidewalk Width	--	--	--	5'	5'	--	--	AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, Section 3.2.3
Sidewalk Buffer Width*	--	--	--	2' to 4'	2' to 4'	--	--	AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, Section 3.2.4
Access Management Spacing/Limits of Limited Access	--	--	--	--	--	--	--	TRB Access Management Manual Table 9-14 (page 160)
Ramp Terminal Spacing	EX-EX; EN-EN = 1000' EX-EN = 500' TURNING ROAD = 800' EN-EX = 1600' EN-EX (WEAVING) SYSTEM TO SERVICE INTERCHANGE = 2000'	EX-EX; EN-EN = 1000' EX-EN = 500' TURNING ROAD = 800' EN-EX = 1600' EN-EX (WEAVING) SYSTEM TO SERVICE INTERCHANGE = 2000'	EX-EX; EN-EN = 1000' EX-EN = 500' TURNING ROAD = 800' EN-EX = 1600' EN-EX (WEAVING) SYSTEM TO SERVICE INTERCHANGE = 2000'	--	--	--	--	AASHTO Green Book (2018), Figure 10-70 (page 10-127) *Assumed full freeway & service interchange

Table 23: VDOT Design Criteria

Criteria	I-64	Route 288	I-295	N Gayton Road	US 250	Interchange Ramps	Interchange Loop Ramps	References or Remarks
Functional Classification	Interstate	Interstate	Interstate	Urban Major Collector	Urban Principal Arterial	Interchange Ramp	Interchange Ramp	
VDOT Standard	GS-INT	GS-INT	GS-INT	GS-7	GS-7	GS-R	GS-R	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Terrain	Rolling	Rolling	Rolling	Rolling	Rolling	Rolling	Rolling	--
Design Speed	70 mph	70 mph	75 mph	45 mph	45 mph	35 mph	20 mph	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Posted Speed	65 mph	65 mph	70 mph	45 mph	45 mph	--	--	--
Number of Lanes	3 each direction	2 each direction	2 each direction	3 each direction	3 each direction	1	1	--
Minimum Width, Travel Lane	12'	12'	12'	11'	11'	16'	18'	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Minimum Width, Vehicle/Bike Shared Lane	--	--	--	17'	17'	--	--	VDOT Road Design Manual, Appendix A(1), Page A(1)-15
Paved Shoulder Widths	LT: 10' RT: 10'	LT: 10' RT: 10'	LT: 10' RT: 10'	LT: 4' RT: 8'	LT: 4' RT: 8'	LT: 4' RT: 8'	LT: 4' RT: 8'	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Total Shoulder Widths	LT: 12' RT: 12'	LT: 12' RT: 12'	LT: 12' RT: 12'	LT: 6' RT: 10'	LT: 6' RT: 10'	LT: 6' RT: 10'	LT: 6' RT: 10'	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Normal Cross Slope	2%	2%	2%	2%	2%	2%	2%	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Minimum Radius	1821'	1821'	1821'	713'	713'	316'	77'	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Maximum Superelevation	8%	8%	8%	4%	4%	8%	8%	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Minimum Stopping Sight Distance on Level Roadways	730'	730'	730'	360'	360'	250'	125'	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22
Maximum Grade	4%	4%	4%	8%	8%	4 to 6%	6 to 8%	VDOT Road Design Manual, Appendix A, Pages A-12, A-18, A-19 and A-22; AASHTO Green Book (2018), Section 6.3.1.5 (page 6-14), Table 7-4a (page 7-38), Table 8-1 (page 8-5), Table 10-2 (page 10-110)

Criteria	I-64	Route 288	I-295	N Gayton Road	US 250	Interchange Ramps	Interchange Loop Ramps	References or Remarks
Functional Classification	Interstate	Interstate	Interstate	Urban Major Collector	Urban Principal Arterial	Interchange Ramp	Interchange Ramp	
Minimum Crest K Value (based on SSD)	247	247	247	61	61	29	7	AASHTO Green Book (2018), Table 3-35 (page 3-170)
Minimum Sag K Value	181	181	181	79	79	49	17	AASHTO Green Book (2018), Table 3-37 (page 3-176)
Minimum Median Width	40'	40'	40'	4'	4'	--	--	VDOT Road Design Manual, Section 2E-3, Pages 2E-9, 2E-10
Clear Zone	38'	38'	38'	24'	24'	16'	16'	VDOT Road Design Manual, Appendix A, Table A-2-1, Pg. A-29
Minimum Vertical Clearance	16.5'	16.5'	16.5'	14.5**	14.5**	14.5**	14.5**	VDOT Manual of the Structure and Bridge Division - Volume V - Part 2 Design Aids - Chapter 6
Sidewalk Width	--	--	--	5'	5'	--	--	VDOT Road Design Manual, Appendix A(1), Page A(1)-71
Sidewalk Buffer Width	--	--	--	4'	4'	--	--	VDOT Road Design Manual, Appendix A(1), Page A(1)-69
Access Management Spacing/Limits of Limited Access	--	--	--	X = 750'; Y = 1320'; M = 990'	X = 750'; Y = 1320'; M = 990'	--	--	VDOT Road Design Manual, Appendix F, Page F-30, Table 2-3, Figure 2-9 X = Distance to first entrance on the right from end of off-ramp terminal; right in/right out only Y = Distance to first four-legged intersection measured from the end of the off-ramp terminal M = Distance to first directional median crossover from off-ramp terminal
Ramp Terminal Spacing	EX-EX; EN-EN = 1000' EX-EN = 500' TURNING ROAD = 800' EN-EX = 1600'	EX-EX; EN-EN = 1000' EX-EN = 500' TURNING ROAD = 800' EN-EX = 1600'	EX-EX; EN-EN = 1000' EX-EN = 500' TURNING ROAD = 800' EN-EX = 1600'	--	--	--	--	AASHTO Green Book (2018), Figure 10-70 (page 10-127) *Assumed full freeway & service interchange

## DESCRIPTION OF PROPOSED IMPROVEMENTS

### Partial Cloverleaf Interchange at I-64 and US 250

A conceptual roadway sketch of the improvement is provided in *Figure 28* and *Figure 29*. This improvement consists of the following components:

- Construct an auxiliary lane on westbound I-64 between the US 250 and I-295 interchanges
- Reconstruct US 250 between Tom Leonard Drive and Dominion Boulevard by constructing contraflow left turns to the eastbound and westbound I-64 on ramps
- Construct a traffic signal for the eastbound US 250 left turns onto the westbound I-64 on-ramp.
- Construct sidewalk along eastbound US 250 from West Broad Village to connect to the existing sidewalk east of the interchange
- Eliminate the existing loop ramp from eastbound US 250 to westbound I-64
- Widen the westbound I-64 on-ramp from US 250 to two lanes
- Reconstruct I-64, including new bridges over US 250, to accommodate the widening of US 250
- Reconfigure the eastbound I-64 to eastbound US 250 loop ramp

### Route 288 Southbound Auxiliary Lane

A conceptual roadway sketch of the improvement is provided in *Figure 30*. This improvement consists of the following components:

- Construct an auxiliary lane on southbound Route 288 between the US 250 and Tuckahoe Creek Parkway interchanges

### Route 288 Northbound Auxiliary Lane and US 250 Improvements

A conceptual roadway sketch of the improvement is provided in *Figure 30* through *Figure 35*. This improvement consists of the following components:

- Construct an auxiliary lane on northbound Route 288 between the US 250 and I-295 interchanges
- Construct dual northbound right-turn lanes at the US 250 intersection with the southbound Route 288 ramps
- Widen the northbound Route 288 off-ramp to two lanes
- Restripe the eastbound approach at Wilkes Ridges Parkway from a right-turn only lane to a shared through/right lane and construct side street intersection improvements
- Extend the fourth eastbound through lane east of Bon Secours Parkway intersection

### US 250 Thru-Cut at Tom Leonard Drive

A conceptual roadway sketch of the improvement is provided in *Figure 36*. This improvement consists of the following components:

- Install barrier to restrict vehicles weaving from the eastbound I-64 off-ramp to turn left into Gathering Place
- Convert the westbound US 250 right turn lane into a shared through/right lane at Tom Leonard Drive
- Construct a thru-cut intersection at Tom Leonard Drive

### Northeastbound I-295 Auxiliary Lane

A conceptual roadway sketch of the improvement is provided in *Figure 37*. This improvement consists of the following components:

- Construct an auxiliary lane on northeastbound I-295 between the I-64 and Nuckols Road interchanges

### I-64 Eastbound Off Ramp Lane Reconfiguration

A conceptual roadway sketch of the improvement is provided in *Figure 38*. This improvement consists of the following components:

- Restripe the eastbound I-64 ramp diverge at I-295 to create one exit only lane and one choice lane

### Diverging Diamond Interchange at I-64 and N Gayton Road

A conceptual roadway sketch of the improvement is provided in *Figure 39* through *Figure 43*. This improvement consists of the following components:

- Construct a diverging diamond interchange at I-64 and N Gayton Road
- Construct an auxiliary lane on westbound I-64 between the I-295 interchange and the proposed N Gayton Road interchange
- Construct an auxiliary lane on westbound I-64 between the proposed N Gayton Road interchange and the I-288 interchange
- Construct an auxiliary lane on eastbound I-64 between the I-288 interchange and the proposed N Gayton Road interchange
- Construct an auxiliary lane on eastbound I-64 between the proposed N Gayton Road interchange and the I-295 interchange
- Reconstruct N Gayton Road to accommodate the diverging diamond interchange
- Construct a shared-use path along southbound N Gayton Road from US 250 to the existing shared-use path
- Construct traffic signals at the proposed intersections of N Gayton Road and the I-64 ramps
- Eliminate Bacova Drive from Marshall Run Circle to approximately 1,500 linear feet west of N Gayton Road
- Construct triple southbound left-turn lanes at the intersection of N Gayton Road and US 250
- Reconstruct Blue Ocean Lane to right-in only from N Gayton Road to Calm Harbor Drive

## GEOMETRIC CRITERIA

The improvements were developed to follow the design criteria listed in *Table 22* and *Table 23*. For all improvements, the horizontal and vertical alignment, design speeds, sight distance, and access requirements have been reviewed to confirm that the AASHTO and VDOT standards are met for the respective roadway classifications. There are no known sight distance issues. The preferred alternative access change meets AASHTO route continuity and lane balance standards. The design speeds of the ramps proposed to be modified are at least 50 percent of the mainline design speed and the acceleration and deceleration lengths for ramps meet AASHTO and VDOT standards considering truck traffic.

### Existing Conditions and Proposed Conditions

The existing conditions and proposed conditions have been reviewed to highlight the geometric improvements for all roadway improvements. Typical sections for the proposed improvements are shown on *Figure 28* through *Figure 43* where appropriate.

- **Partial Cloverleaf Interchange at I-64 and US 250**
  - **Existing**
    - The existing interchange consists of a partial cloverleaf interchange that consists of two loop ramps and four directional ramps. US 250 (W Broad Street) consists of a six-lane divided arterial with 11-foot travel lanes and a closed median and a combination of curb and gutter and two-foot outside shoulder. US 250 passes underneath I-64 via a tangent section with a consistent vertical alignment. I-64 consists of a six-lane interstate with 12-foot travel lanes and 12-foot left and right shoulders for eastbound and westbound. I-64 passes over US 250 via a tangent section with a consistent vertical alignment. The I-64 on and off-ramps consist of 16-foot travel lanes with 2-foot left shoulders and 6-foot right shoulders for the single

lane ramps and 12-foot travel lanes with 10-foot left shoulders and 2-foot right shoulders for the dual lane directional ramps.

- **Proposed**

- The proposed interchange consists of a partial cloverleaf interchange that consists of three loop ramps and four directional ramps. US 250 (W Broad Street) consists of a six-lane divided arterial with 11-foot travel lanes and a closed median and a combination of curb and gutter and two-foot outside shoulder. I-64 consists of a six-lane interstate with 12-foot travel lanes and 12-foot left and right shoulders for eastbound and westbound. The I-64 on and off-ramps consist of 16-foot travel lanes with 2-foot left shoulders and 6-foot right shoulders for the single lane ramps and 12-foot travel lanes with 4-foot left shoulders and 8-foot right shoulders for the dual lane directional ramps.

- **Route 288 Southbound Auxiliary Lane**

- **Existing**

- The existing condition of Southbound Route 288 consists of two 12-foot travel lanes with a 12-foot right shoulder and a 10-foot left shoulder.

- **Proposed**

- The proposed condition of Southbound Route 288 consists of two-12 foot travel lanes and a proposed 12-foot auxiliary lane with 12-foot right shoulder and a 10-foot left shoulder.

- **Route 288 Northbound Auxiliary Lane and US 250 Interchange**

- **Existing**

- The existing condition of Northbound Route 288 off-ramp consists of two 11-foot travel lanes with a 10-foot right shoulder and a 4-foot left shoulder. US 250 (W Broad Street) consists of a six-lane divided arterial with 11-foot travel lanes and a closed median and combination of curb and gutter.

- **Proposed**

- The proposed condition of Northbound Route 288 off-ramp consists of three 11-foot travel lanes with a 10-foot right shoulder and a 4-foot left shoulder. US 250 (W Broad Street) consists of a six-lane divided arterial with 11-foot travel lanes and a closed median and curb and gutter.

- **US 250 Thru-Cut at Tom Leonard Drive**

- **Existing**

- The existing condition of US 250 (W Broad Street) consists of a six-lane divided arterial with 11-foot travel lanes and a 24-foot grass median and curb and gutter.

- **Proposed**

- The proposed condition of US 250 (W Broad Street) consists of a six-lane divided arterial with 11-foot travel lanes and a 4-foot concrete median and curb and gutter.

- **Northeastbound I-295 Auxiliary Lane**

- **Existing**

- The existing condition of Northbound I-295 consists of three 12-foot travel lanes with a 12-foot right shoulder and a 12-foot left shoulder.

- **Proposed**

- The proposed condition of Northbound I-295 consists of three-12 foot travel lanes and a proposed 12-foot auxiliary lane with 12-foot right shoulder and a 10-foot left shoulder.

- **Diverging Diamond Interchange at I-64 and N Gayton Road**

- **Existing**

- The existing interchange of N Gayton Road consists of a six-lane divided arterial with 12-foot travel lanes and a closed median and curb and gutter. I-64 consists of a six-lane interstate with 12-foot travel lanes and 12-foot left and right shoulders for eastbound and westbound. I-64 currently passes underneath

N Gayton Road via a tangent section with a consistent vertical alignment. N Gayton Road currently passes over I-64 via a tangent section with a crest vertical alignment.

- **Proposed**

- The proposed interchange consists of a diverging diamond interchange. N Gayton Road consists of a six-lane divided arterial with 12-foot travel lanes and a closed median and curb and gutter. I-64 consists of a six-lane interstate with 12-foot travel lanes and 12-foot left and right shoulders for eastbound and westbound. The I-64 on and off-ramps consist of 16-foot travel lanes with 4-foot left shoulders and 8-foot right shoulders.

### Potential Design Exceptions

Based on a review of the conceptual design for all improvements and the constraints of the corridor, it is anticipated that the following design exceptions may be required for the design of the project:

- Left shoulder width along I-64
  - A potential design exception would be required for the inside widening of eastbound I-64 at the Pouncey Tract Road overpass. The proposed widening will utilize a portion of the existing 12-foot inside shoulder for the travel lane thus reducing the proposed left shoulder to approximately 6 feet adjacent to the bridge pier protection system for Pouncey Tract Road overpass. The potential design exception would only be required in this localized area and this design decision would avoid impacts to the Pouncey Tract Road overpass.

### Potential Design Waivers

Based on a review of the preferred alternative limits and constraints of the corridor, it is anticipated that the following design waivers may be required for the design of the project:

- Right shoulder widths along I-64, I-295, and Route 288
  - The conceptual design of the proposed improvements includes widening to the outside for the auxiliary lanes along I-64, I-295, and Route 288. In an effort to avoid impacting multiple structures – the existing Route 288 bridge over Tuckahoe Creek, the existing N Gayton Road bridge over I-64, and the existing Pouncey Tract Road bridge over I-64 – the proposed shoulder width may be reduced to 8 feet. The VDOT standard right shoulder width required is 10 feet. The existing 10-foot-wide right shoulder is adjacent to a through lane, but the reduced shoulder for the proposed improvements would be adjacent to an auxiliary lane. Approval of this design waiver would concentrate the improvement footprints and minimize the need to impact the existing right-of-way and limited access line with proposed slope limits and/or stormwater management basins.
- Use of existing drainage culvert under I-64, I-295, and Route 288 (hydraulic adequacy in existing and proposed condition has not yet been analyzed)
  - The conceptual design of the proposed improvements, specifically the I-64, I-295, and Route 288 auxiliary lanes, will impact and may require the extension of multiple culverts along I-64, I-295, and Route 288 that do not see a significant increase in drainage due to the project. These drainage appurtenances may or may not be adequate in the existing condition and require extension. If that is the case, a design waiver will be required to not upgrade the unaffected capacity deficiency and extend the pipe or culvert.

*Table 24* summarizes the potential design waivers associated with the proposed improvements.

Table 24: Potential Design Waivers

To Be Obtained By	DE or DW	Item	Location	Design Feature	Proposed Design	Min AASHTO (for DE) and VDOT (For DW) Standards Required	Remarks	Required for Standard to be Fully Met
VDOT	DW	Reduced Right Shoulder Width for Auxiliary Lane	I-64	Shoulder Width	8' Shoulder	10' Paved Shoulder	This design waiver would be for the localized reduction in shoulder width due to avoiding impacts to the Pouncey Tract Road and N Gayton Road overpasses	Full rebuild of the Pouncey Tract Road and N Gayton Road overpasses
VDOT	DW	Reduced Right Shoulder Width for Auxiliary Lane	I-295	Shoulder Width	8' Shoulder	10' Paved Shoulder	This design waiver would be for the localized reduction in shoulder width to avoid the extension of an existing culvert	Multi-cell box culvert extension and additional floodplain impacts
VDOT	DW	Reduced Right Shoulder Width for Auxiliary Lane	Route 288	Shoulder Width	8' Shoulder	10' Paved Shoulder	This design waiver would be for the localized reduction in shoulder width due to avoiding widening of the Tuckahoe Creek bridge	Widening of the Route 288 bridge over Tuckahoe Creek
VDOT	DW	Reduced Left Shoulder Width Along I-64	I-64	Shoulder Width	Varies (0-4')	4' Paved Shoulder	This design waiver would be for the localized reduction in shoulder width due to avoiding impacts to the Pouncey Tract Road and N Gayton Road overpasses	Full rebuild of the Pouncey Tract Road and N Gayton Road overpasses
VDOT	DW	Hydraulic Capacity of Existing Culvert	I-64	Hydraulic Capacity	Culvert Extension	Meeting Minimum Freeboard	This design waiver would be a culvert extension that would not upgrade the unaffected capacity of the existing culvert	Full rebuild of multiple culverts across the I-64 corridor

To Be Obtained By	DE or DW	Item	Location	Design Feature	Proposed Design	Min AASHTO (for DE) and VDOT (For DW) Standards Required	Remarks	Required for Standard to be Fully Met
VDOT	DW	Hydraulic Capacity of Existing Culvert	I-295	Hydraulic Capacity	Culvert Extension	Meeting Minimum Freeboard	This design waiver would be a culvert extension that would not upgrade the unaffected capacity of the existing culvert	Full rebuild of one culvert along the I-295 corridor
VDOT	DW	Hydraulic Capacity of Existing Culvert	Route 288	Hydraulic Capacity	Culvert Extension	Meeting Minimum Freeboard	This design waiver would be a culvert extension that would not upgrade the unaffected capacity of the existing culvert	Full rebuild of multiple culverts across the Route 288 corridor

## Access Management

Key distances between access points along N Gayton Road and US 250 were identified during the geometric review of the proposed improvements based on standards in the Transportation Research Board's (TRB) *Access Management Manual*. The following locations were identified as areas where recommended TRB *Access Management Manual* dimensions could not be accommodated with the least impactful proposed improvements:

- **Partial Cloverleaf Interchange at I-64 and US 250**
  - Minimum spacing standards from the end of ramp terminal to partial access/full access intersections along US 250
  - Minimum spacing between traffic signals along US 250 at the proposed signal at the westbound I-64 ramps and the eastbound I-64 ramps
- **Route 288 Northbound Auxiliary Lane and US 250 Improvements**
  - Minimum commercial entrance spacing standards along US 250 between the southbound Route 288 ramps and Robert Attack Way
- **US 250 Thru-Cut at Tom Leonard Drive**
  - Minimum commercial entrance spacing standards along US 250 between Brownstone Boulevard and the eastbound I-64 ramps
- **Diverging Diamond Interchange at I-64 and N Gayton Road**
  - Minimum spacing standards from the end of ramp terminal to partial access/full access intersections along N Gayton Road
  - Minimum commercial entrance spacing standards along N Gayton Road between US 250 and Liesfeld Farm Drive
  - Minimum spacing between traffic signals along N Gayton Road at the proposed intersections with the westbound and eastbound I-64 ramps

## Proposed Right-of-Way Acquisition Line

Proposed right-of-way, easements, and an adjustment to the existing limited access line is anticipated for the proposed improvements on I-64, Route 288, US 250, and N Gayton Road. The following locations were identified for each improvement:

- **Partial Cloverleaf Interchange at I-64 and US 250**
  - Proposed right-of-way impacts are anticipated for properties within the vicinity of the proposed sidewalk along eastbound US 250. Temporary construction and private utility easements are also anticipated near the proposed sidewalk.
- **Route 288 Northbound Auxiliary Lane and US 250 Improvements**
  - Proposed right-of-way impacts are anticipated for properties within the vicinity of the northbound Route 288 off-ramp widening and the proposed sidewalk along eastbound and westbound US 250. Temporary construction and private utility easements are also anticipated near the proposed sidewalk improvements.
- **US 250 Thru Cut at Tom Leonard Drive**
  - Proposed right-of-way impacts are anticipated for properties within the vicinity of the shared through-right lane and proposed sidewalk along westbound US 250. Temporary construction and private utility easements are also anticipated near the proposed sidewalk.

### ■ Diverging Diamond Interchange at I-64 and N Gayton Road

- Proposed right-of-way and limited access changes are anticipated for properties within the vicinity of the proposed ramps from I-64 to N Gayton Road. Temporary construction and private utility easements are also anticipated near these ramps. Utility, right-of-way, and limited access line impacts are anticipated for the auxiliary lane improvements between Route 288 and I-295. The preferred alternative will include the pavement needed for the auxiliary lanes and potential sound walls.

### Conceptual Signing Plan

The study team developed a conceptual signing plan for the preferred alternative (see the *Selection of Preferred Alternative* section), which is included in *Appendix H*. The conceptual signing plan is in accordance with the guidance provided in the *MUTCD*. Due to interchange spacing, the advanced guide signs for the new interchange at N Gayton Road were only placed ½ mile and 1 mile in advance of the exits. Similarly, the advanced guide signs for the westbound I-64 off-ramp to Route 288 and the eastbound I-64 off-ramp to I-295 were only placed ½ mile and 1 mile in advance of the exits.

Interchange sequence signing should be evaluated for potential inclusion in the signing plan during the design phase. Interchange sequence signs can be used to supplement advance guide signs in urban areas with closely spaced interchanges.

### Pedestrian and Bicycle Facilities

Proposed pedestrian and bicycle accommodations are provided throughout the proposed improvements. The partial cloverleaf interchange at the I-64 interchange with US 250 will include pedestrian improvements along eastbound US 250 to tie to existing pedestrian features along US 250. The northbound Route 288 auxiliary lane and improvements on US 250 will include pedestrian improvements along eastbound and westbound US 250 to tie to existing pedestrian features along US 250. The US 250 thru-cut at Tom Leonard Drive will include pedestrian improvements along westbound US 250 to tie to existing pedestrian features. The new diverging diamond interchange on I-64 at N Gayton Road will include a shared-use path along southbound N Gayton Road and sidewalk improvements within the corridor to tie to existing bicycle and pedestrian features along N Gayton Road.

## ▲ Forecasted Traffic Volumes and Operations

As part of the *STARS US 250 Corridor Study*, VDOT TMPD created a subarea model from the Richmond/Tri-Cities regional travel demand model, calibrated it with updated traffic count and socioeconomic data in Henrico and Goochland counties, and developed linear growth rates. The SWG for the *STARS US 250 Corridor Study* agreed to apply the linear growth rates developed from the subarea travel demand model except where recent VDOT-approved growth rates existed (e.g., US 250 east of I-64, Route 288 south of US 250). For this IAR, the SWG reached consensus to apply the following growth rates from the *STARS US 250 Corridor Study*:

- I-64
  - 1.50 percent linear growth rate west of Route 288
  - 2.00 percent linear growth rate between Route 288 and I-295
  - 1.75 percent linear growth rate between I-295 and US 250
  - 1.06 percent linear growth rate east of US 250
- I-295
  - 1.67 percent linear growth rate

- Route 288
  - 2.25 percent linear growth rate between I-64 and US 250
  - 2.50 percent linear growth rate south of US 250
- US 250
  - 2.50 percent linear growth rate between Hockett Road and Route 288
  - 2.25 percent linear growth rate between Route 288 and N Gayton Road
  - 1.25 percent linear growth rate between N Gayton Road and Lauderdale Drive
  - 0.75 percent linear growth rate between Lauderdale Drive and I-64
  - 0.70 percent linear growth rate east of I-64
- N Gayton Road
  - 2.25 percent linear growth rate

Linear traffic growth rates were applied to the 2019 existing traffic volumes to generate projected 2026 and 2046 traffic volumes for the No-Build option. Ramp growth was balanced between the arterial and freeway growth rates, which resulted in a blended growth rate for each ramp. The projected 2026 and 2046 AM and PM peak hour traffic volumes for the No-Build option are summarized in *Figure 44* and *Figure 45*.

## NO-BUILD

### No-Build Peak Hour Factors and Heavy Vehicle Percentages

Heavy vehicle traffic was anticipated to grow at a similar rate to passenger vehicles. Therefore, heavy vehicle percentages were assumed to remain unchanged when compared to existing conditions for all study area roadways in the No-Build option.

Peak hour factors were updated in the No-Build Synchro networks based on the guidance provided in the *TOSAM* for the optimization of future conditions traffic signals. Peak hour factors were not used for the No-Build Vissim analyses because 15-minute traffic volumes were coded for the vehicle inputs.

### No-Build Modeling Assumptions

The background improvements discussed in the *Alternatives Considered* chapter were coded into the calibrated existing AM and PM Vissim models to develop the 2026 and 2046 No-Build models. The background improvements were coded separately into each peak period model to maintain the existing calibration adjustments. A detailed summary of the No-Build Vissim modeling inputs is provided in *Appendix E*.

The VDOT Sample Size Determination Tool, Version 2.0 was used to determine the number of traffic simulation runs required to provide the acceptable 95th percentile confidence level for the 2026 and 2046 No-Build models. Ten simulation runs were conducted for all models using different random seeds and the average of these runs was reported. The VDOT Sample Size Determination Tool summary sheets are provided in *Appendix E*.

Figure 44: No-Build (2026) Peak Hour Traffic Volumes

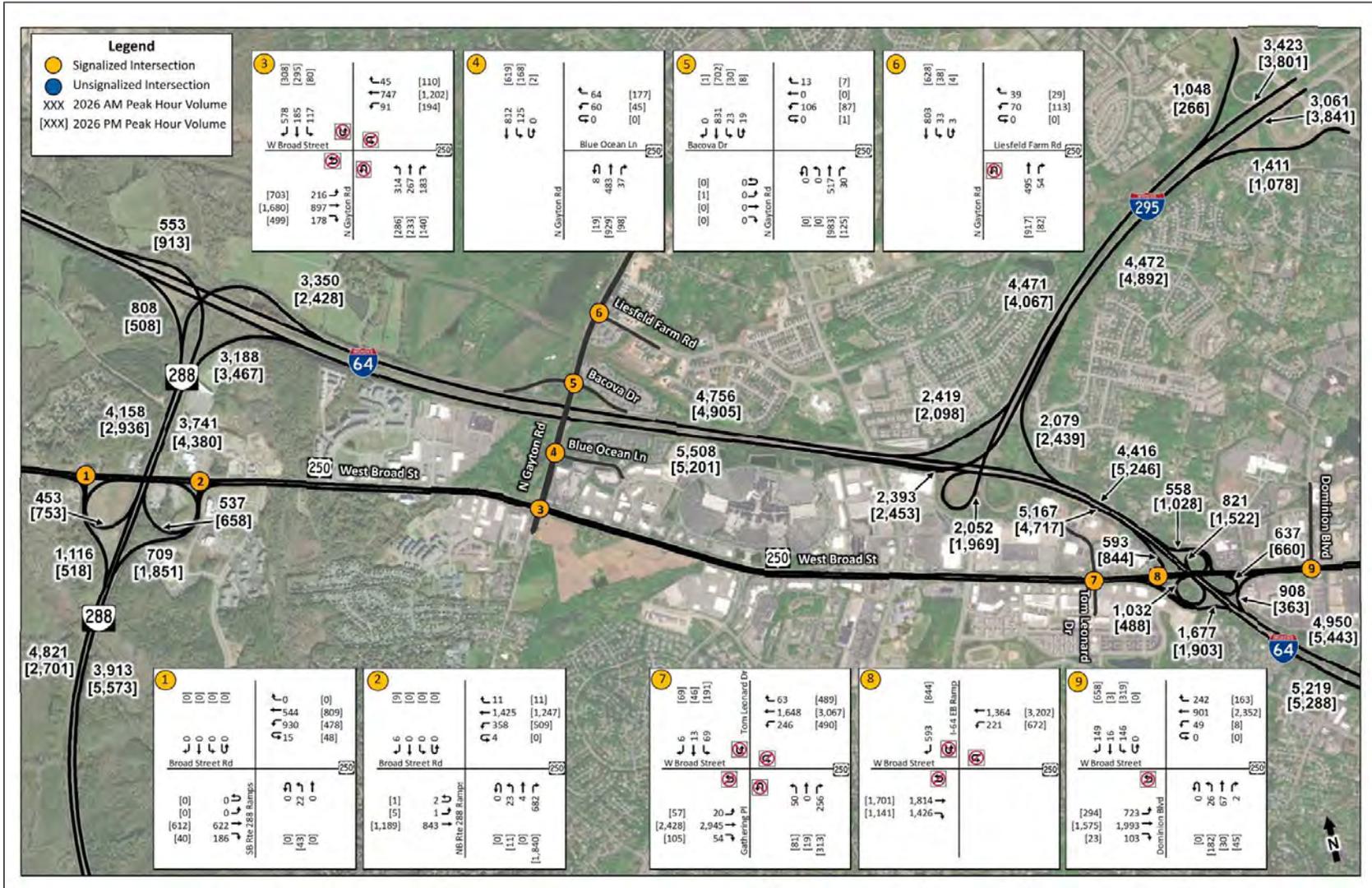
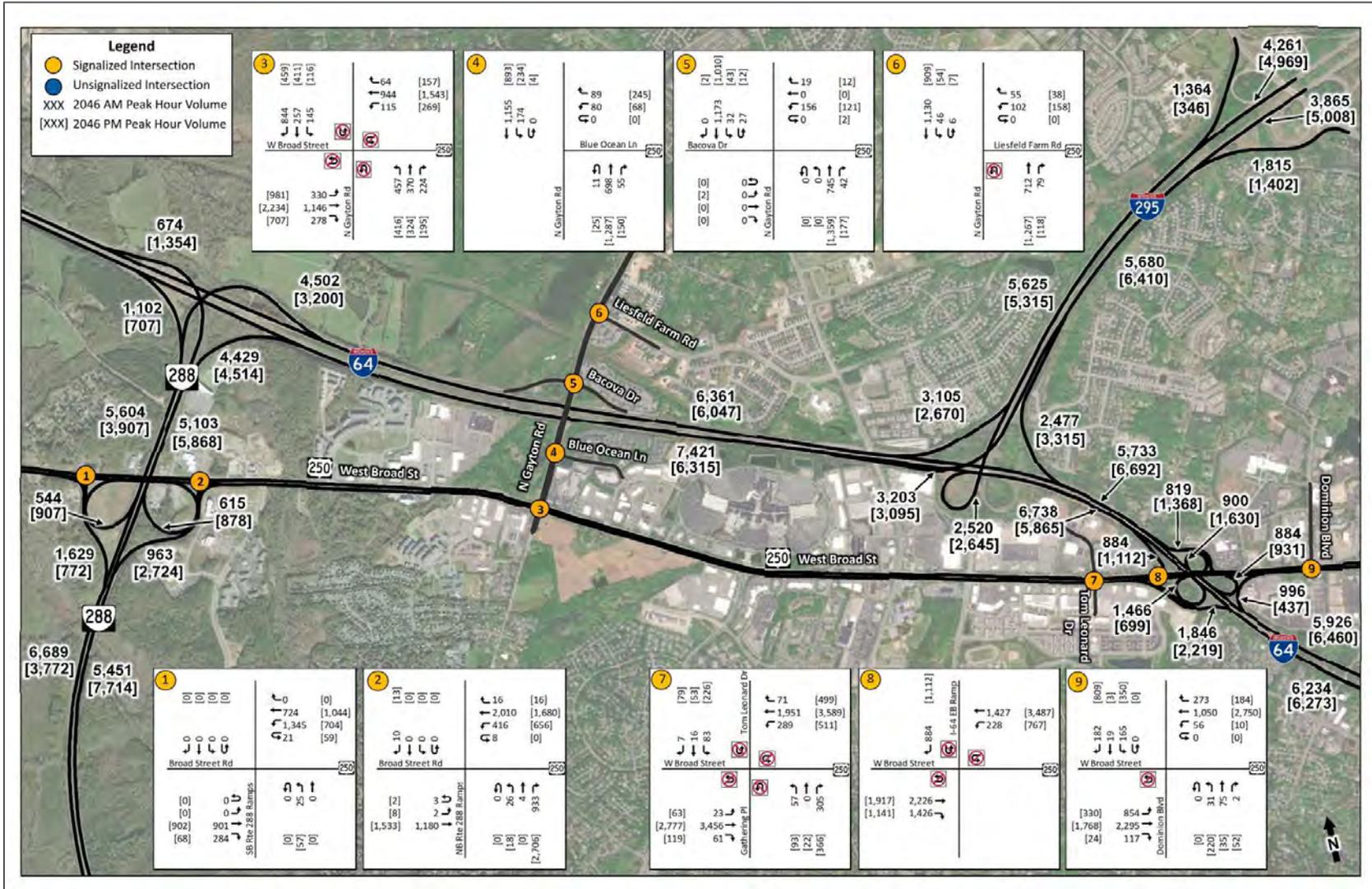


Figure 45: No-Build (2046) Peak Hour Traffic Volumes



## No-Build Conditions Freeway Analysis Results

The AM and PM peak hour average freeway segment density and speed for the 2026 and 2046 No-Build conditions are illustrated in [Figure 46](#) through [Figure 48](#) and [Figure 50](#) through [Figure 53](#). Graphical representation of the freeway results by lane is included in [Appendix E](#).

### AM Peak Hour

In the 2026 AM peak hour, the southwestbound I-295 off-ramp to eastbound I-64 was projected to operate with severely congested densities and slow speeds. The congestion at this location is caused by the limited capacity of the single-lane loop ramp as the demand increased to 2,052 vehicles in the AM peak hour. The congestion was projected to extend along southwestbound I-295 back towards the Nuckols Road interchange. Speeds on southwestbound I-295 range between 20 and 35 mph in this area.

Density was also projected to increase slightly from 2019 at the eastbound I-64 on-ramp from northbound Route 288 and at the southbound Route 288 on-ramp from US 250. At the eastbound I-64 on-ramp from northbound Route 288, vehicles were projected to preposition in the rightmost through lane on eastbound I-64 in advance of the exit to I-295, which resulted in densities above 35 veh/ln/mi on the ramp. Densities above 35 veh/ln/mi were also projected at the southbound Route 288 on-ramp from US 250 and further downstream on Route 288 as Route 288 was projected to serve 4,821 vehicles in three lanes.

By 2046, most of the freeway network within the study area was projected to operate with densities greater than 45 veh/ln/mi. Eastbound I-64 was projected to operate with densities above 100 veh/ln/mi and speeds below 20 mph at the on-ramp from northbound Route 288. The congestion in this area was attributed to vehicles that prepositioned in the rightmost through lane on eastbound I-64 in advance of the exit to I-295. The slow speeds were projected to extend upstream where speeds were projected below 20 mph for all of northbound Route 288 within the study area.

Two bottlenecks on southbound Route 288 contribute to high densities and slow speeds on Route 288 between the US 250 and I-64 interchanges and on westbound I-64: the merge from three to two lanes within the US 250 interchange and the on-ramp from US 250. Westbound I-64 between the I-295 and Route 288 interchanges was projected to operate with speeds below 20 mph.

Speeds and densities were also projected to worsen on southwestbound I-295 as the demand on the single-lane loop ramp to eastbound I-64 was projected to increase to 2,520 vehicles in the AM peak hour. This congestion was projected to affect upstream operations on southwestbound I-295 where speeds were projected to fall below 20 mph.

Speeds were also projected to fall below 25 mph on eastbound I-64 between the on-ramp from southwestbound I-295 and the off-ramp to eastbound US 250. These slow speeds were largely attributed to queuing on eastbound US 250 between the interchange and Dominion Boulevard that backed up to eastbound I-64 as shown in [Figure 49](#).

### PM Peak Hour

In the 2026 PM peak hour, densities greater than 45 veh/ln/mi were projected on westbound I-64 within the US 250 interchange. The high density in this area was attributed to the high number of vehicles exiting to westbound US 250 on a single-lane loop ramp and queuing on westbound US 250 that backs up to the interstate.

The southwestbound I-295 off-ramp to eastbound I-64 was projected to be over capacity as the demand on the single-lane loop ramp was projected to be 1,969 vehicles in the PM peak hour. This excess demand resulted in projected densities greater than 45 veh/ln/mi.

The northeastbound I-295 on-ramp from westbound I-64 was projected to operate with speeds between 20 and 35 mph where the ramp merges from two lanes to one lane prior to merging onto I-295. The slow speeds on the ramp were projected to impact upstream operations on westbound I-64, where speeds were projected to fall below 60 mph between the US 250 and I-295 interchanges.

In 2046, four defined freeway bottlenecks were projected within the study area:

- Westbound I-64 was projected to experience densities over 100 veh/ln/mi and speeds below 10 mph within the weave at the US 250 interchange that was attributed to the high number of vehicles exiting to westbound US 250 on a single-lane loop ramp and queuing on westbound US 250 that backs up to the interstate. The maximum queue length on westbound I-64 was projected to extend approximately 5 miles back to the interchange with US 250 and Glenside Drive as shown in *Figure 54*. The 5-mile projected queue was not solely attributable to the weave at the US 250 interchange. It is worsened by the congestion and cumulative queuing impacts as it extends past the interchanges to the east. This bottleneck was projected to prevent some vehicles from reaching I-295 or the section of I-64 between I-295 and Route 288.
- The northeastbound I-295 on-ramp from westbound I-64 was projected to operate with speeds below 10 mph prior to the merge from two lanes to one lane. The slow speeds on the ramp were projected to impact upstream operations on westbound I-64, where speeds were projected to fall below 20 mph between the US 250 and I-295 interchanges.
- Queues from the northbound Route 288 off-ramp to US 250 were projected to extend the length of the ramp and back to mainline Route 288, causing severe congestion and slow speeds. The heavy northbound right-turn movement at the ramp terminal and the close proximity of the intersection with Wilkes Ridge Parkway contribute to the ramp queuing. Densities on northbound Route 288 were projected to exceed 100 veh/ln/mi upstream of the interchange and the congestion resulted in a bottleneck that prevents some vehicles from reaching I-64.
- The southwestbound I-295 off-ramp to eastbound I-64 was projected to be over capacity as the demand on the single-lane loop ramp was projected to be 2,645 vehicles in the PM peak hour. The congestion from the loop ramp was projected to extend upstream on southeastbound I-295 with densities above 100 veh/ln/mi and speeds below 20 mph. The bottleneck caused by the off-ramp to eastbound I-64 not only limited the number of vehicles that reached eastbound I-64 (56 percent), but also the number of vehicles that reached westbound I-64 (66 percent).

The segment of I-64 between Route 288 and I-295 was projected to operate with densities below 25 veh/ln/mi and speeds above 55 mph during the PM peak hour. However, these speeds and densities were achievable because the bottlenecks elsewhere in the study area prevented many vehicles from reaching this segment of I-64. Eastbound and westbound I-64 in this area were only projected to serve 74 and 78 percent of the PM peak hour demand.

Figure 46: No-Build (2026) AM Peak Hour Average Density

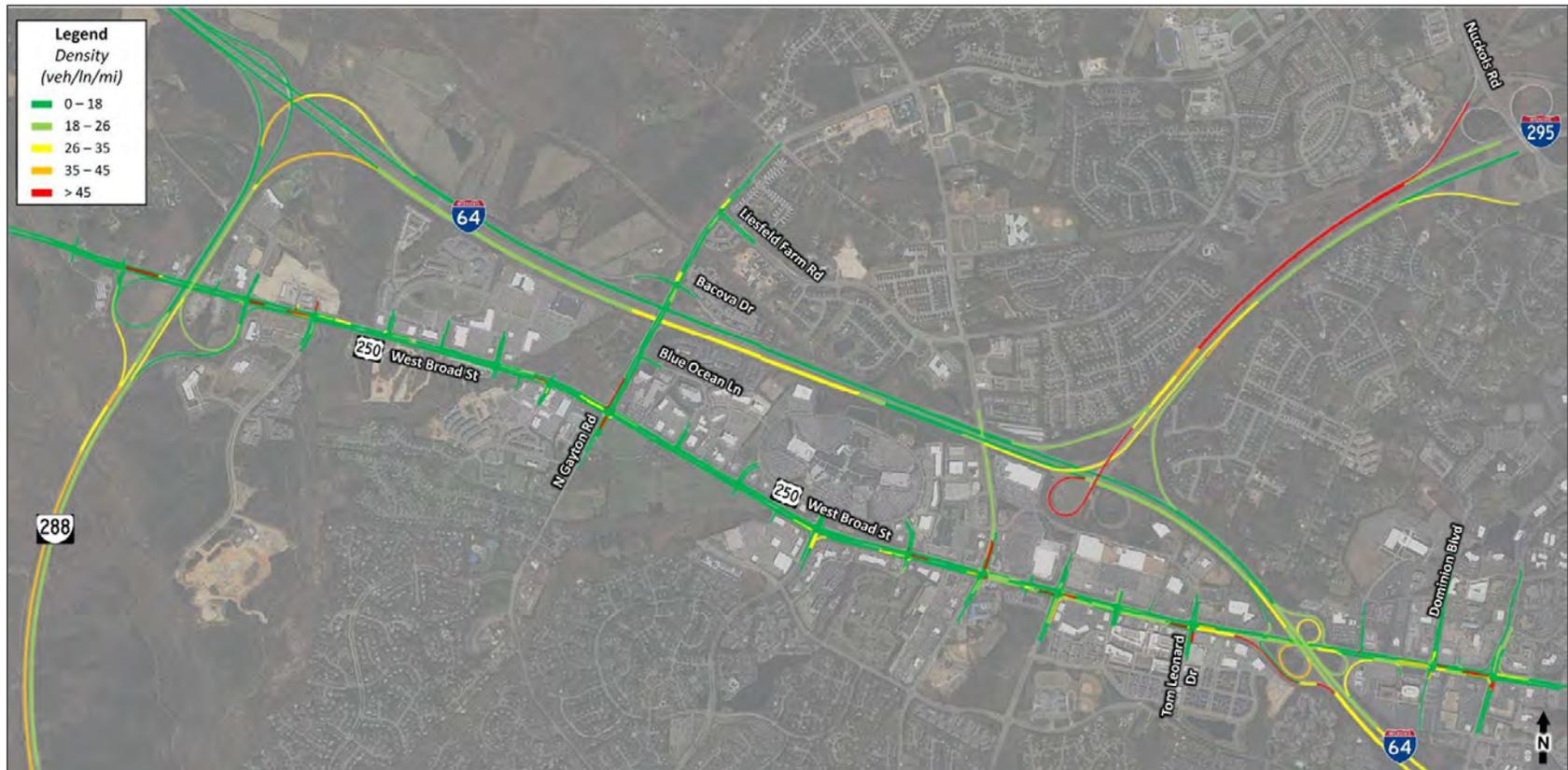


Figure : No-Build (2026) AM Peak Hour Average Speed

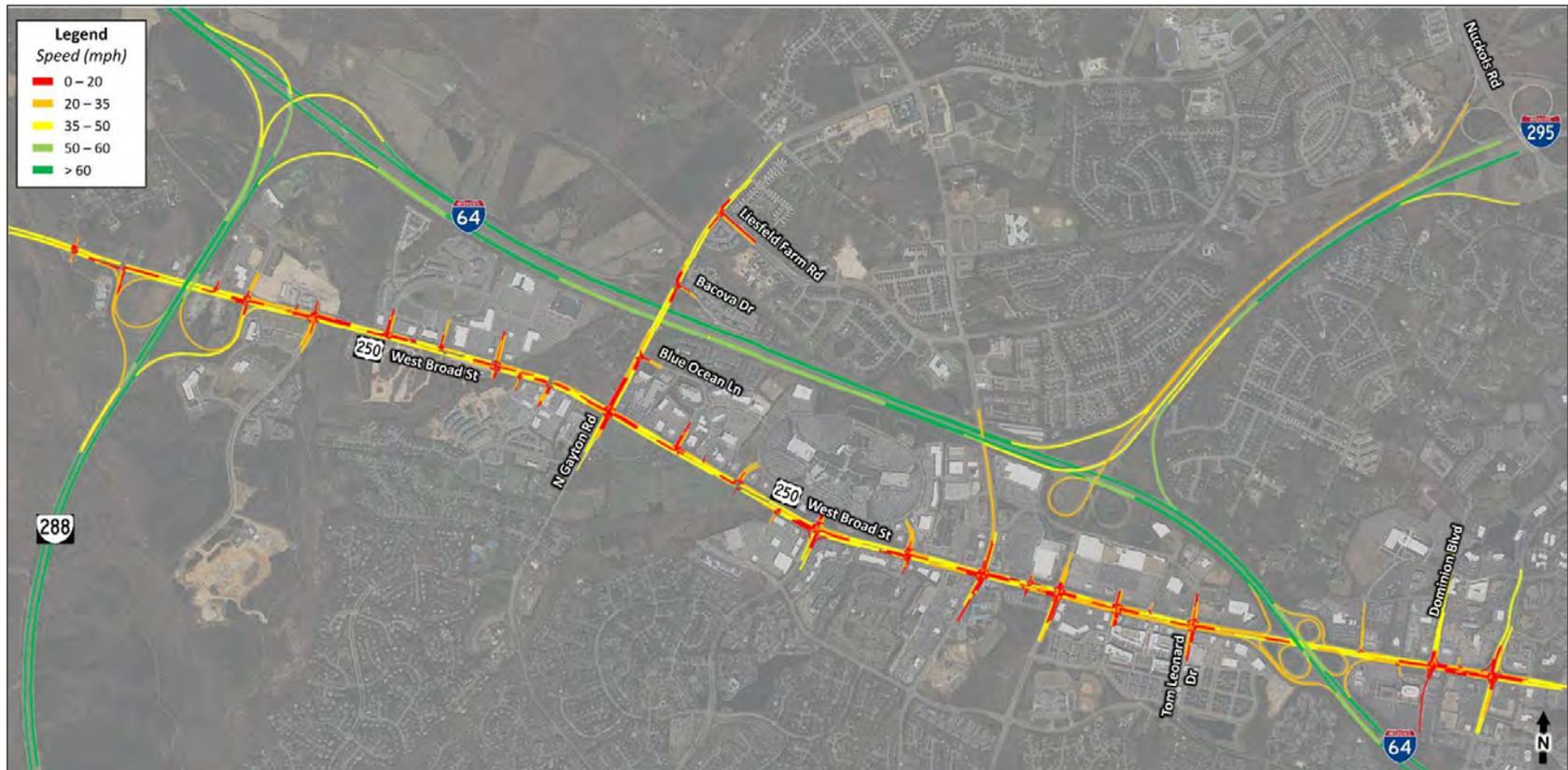


Figure 47: No-Build (2046) AM Peak Hour Average Density

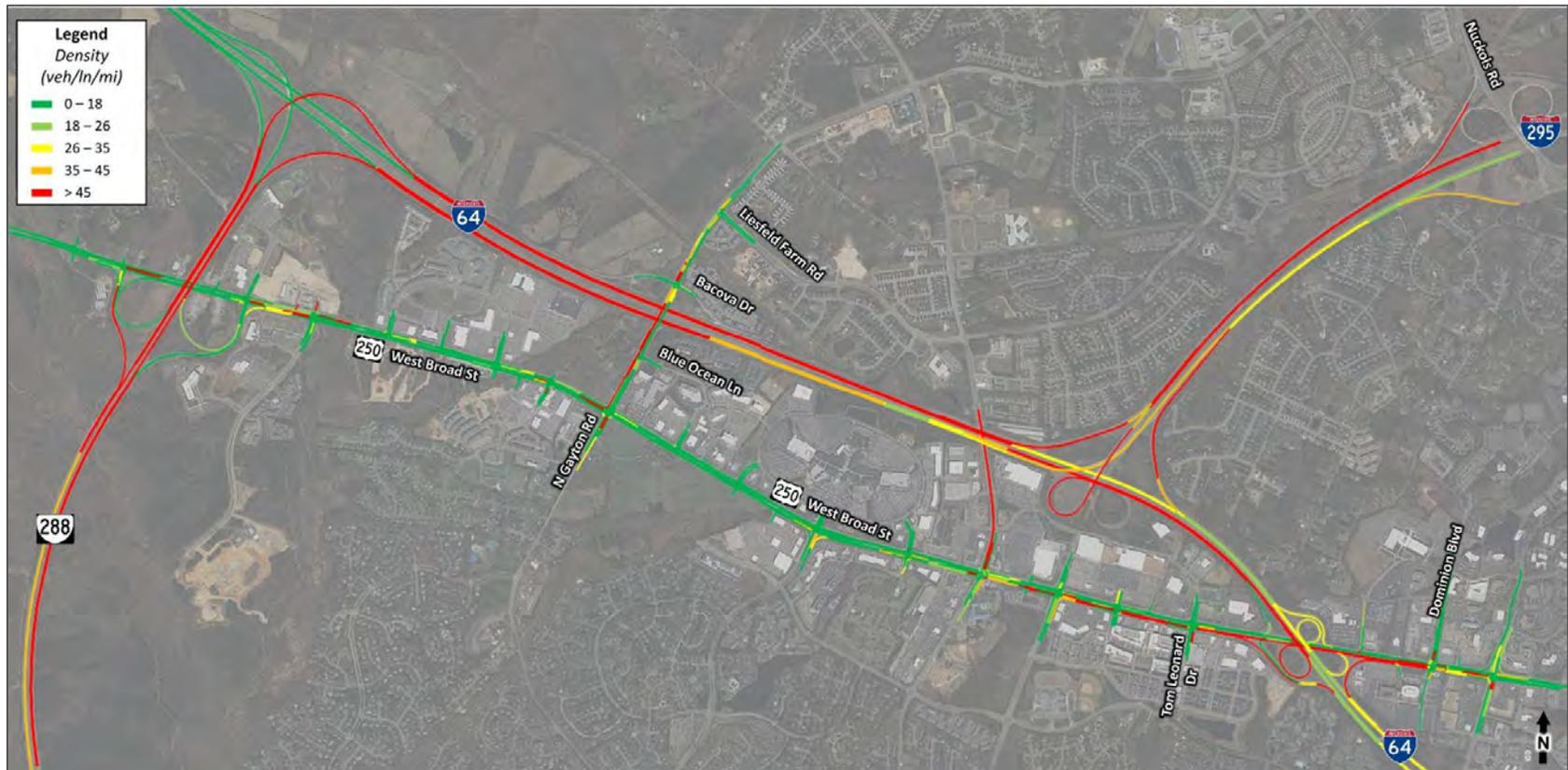


Figure 48: No-Build (2046) AM Peak Hour Average Speed



Figure 49: No-Build (2046) AM Peak Hour Maximum Queue Length (Depictive)

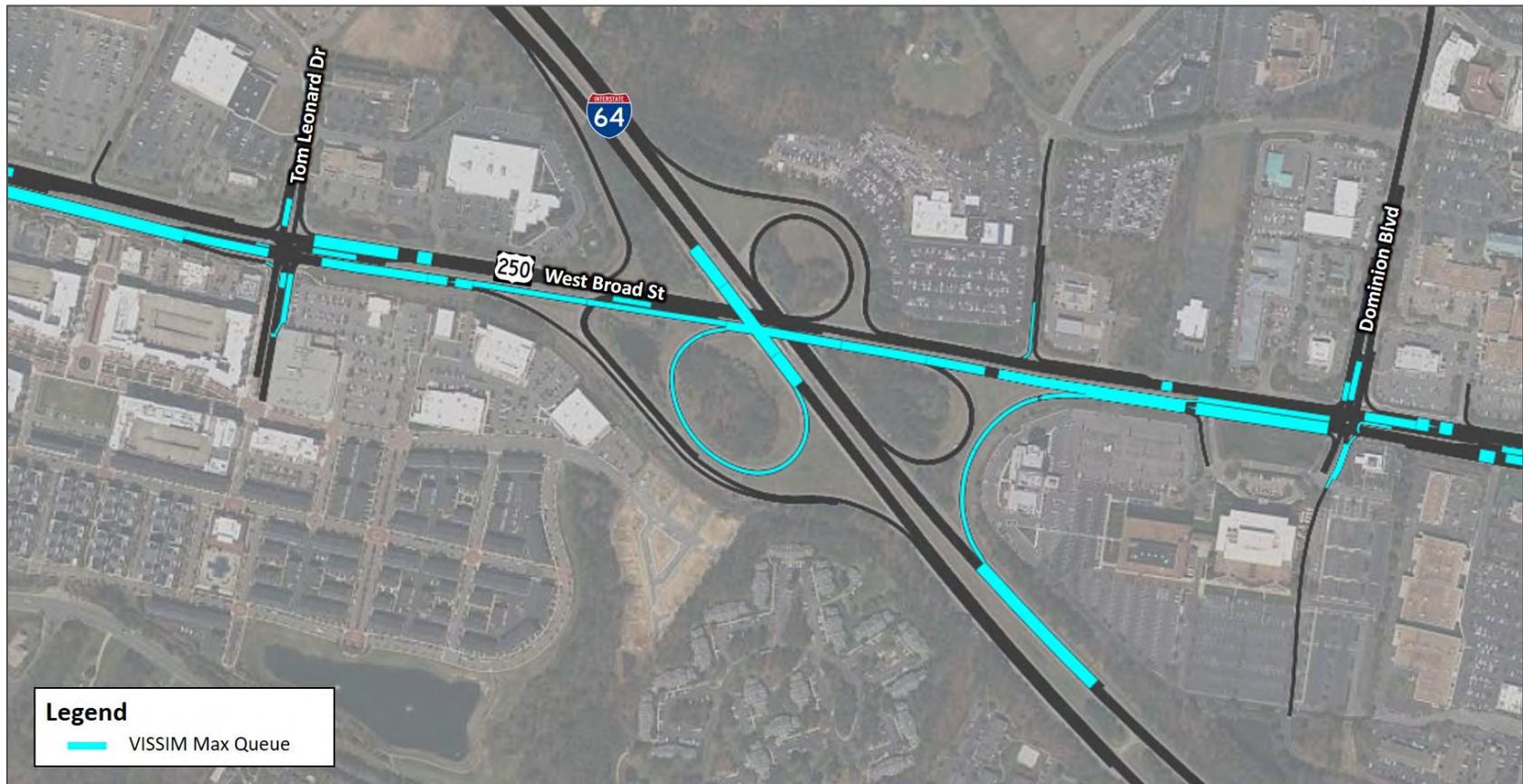


Figure 50: No-Build (2026) PM Peak Hour Average Density

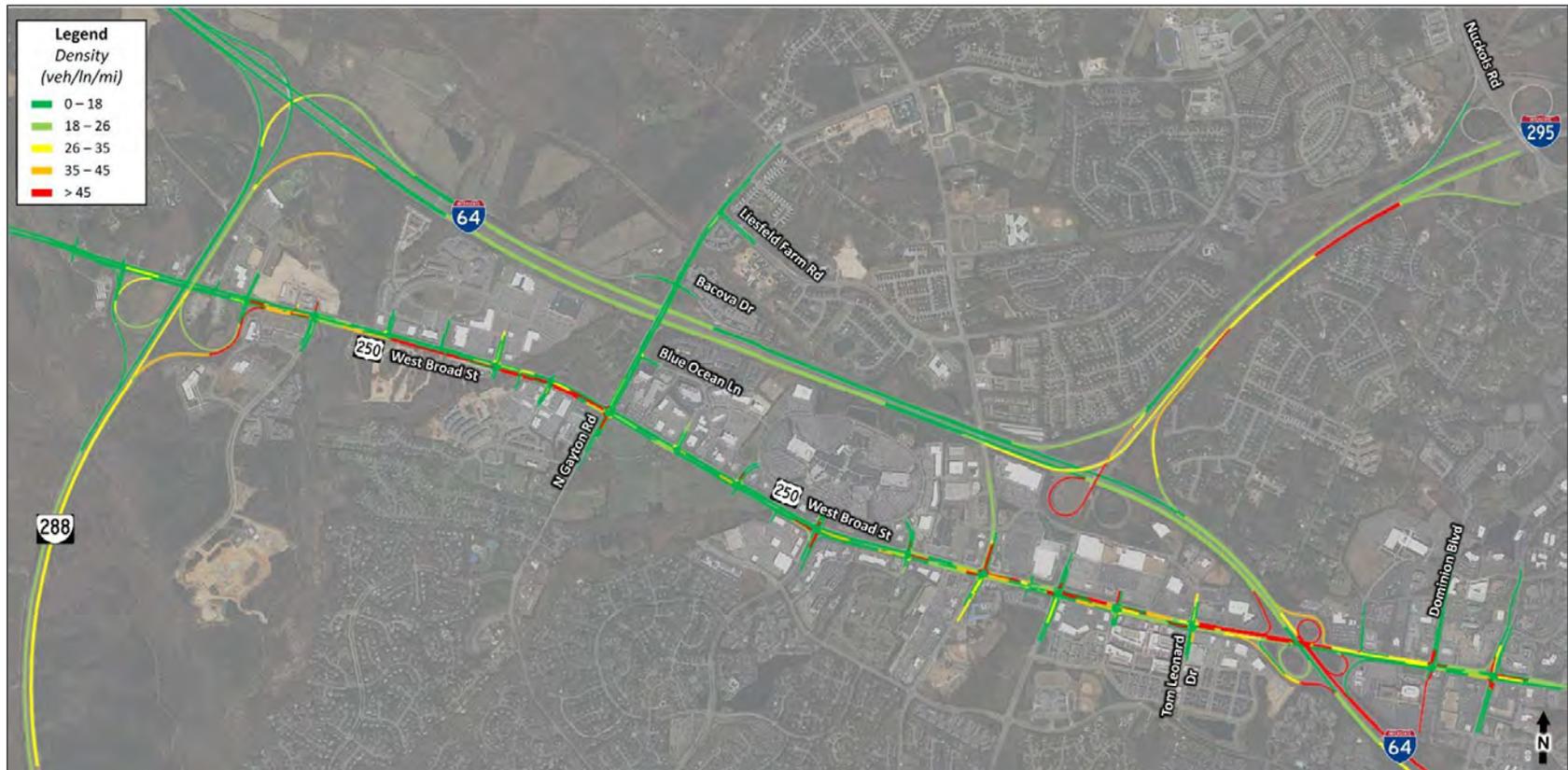


Figure 51: No-Build (2026) PM Peak Hour Average Speed

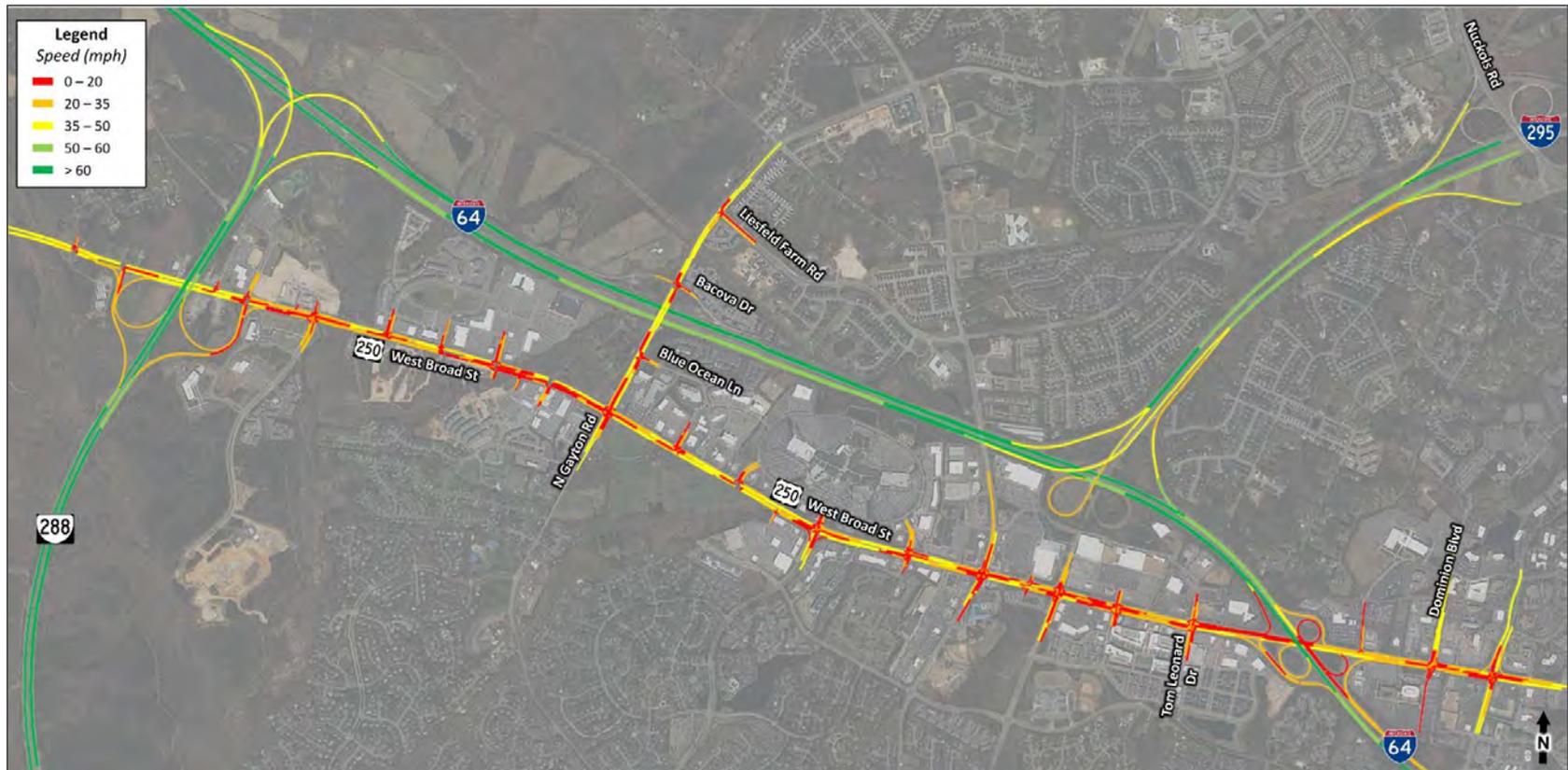


Figure 52: No-Build (2046) PM Peak Hour Average Density

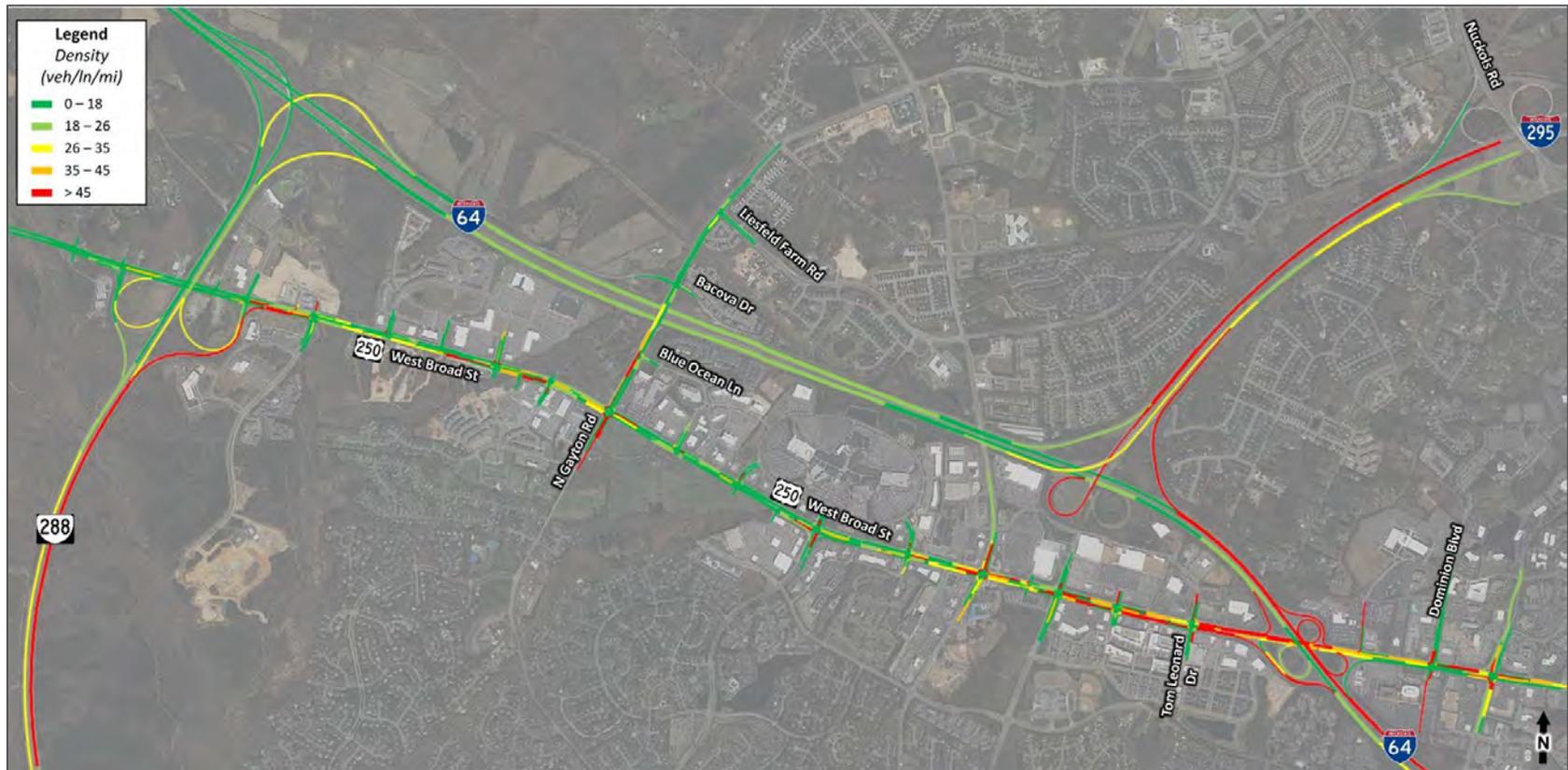


Figure 53: No-Build (2046) PM Peak Hour Average Speed

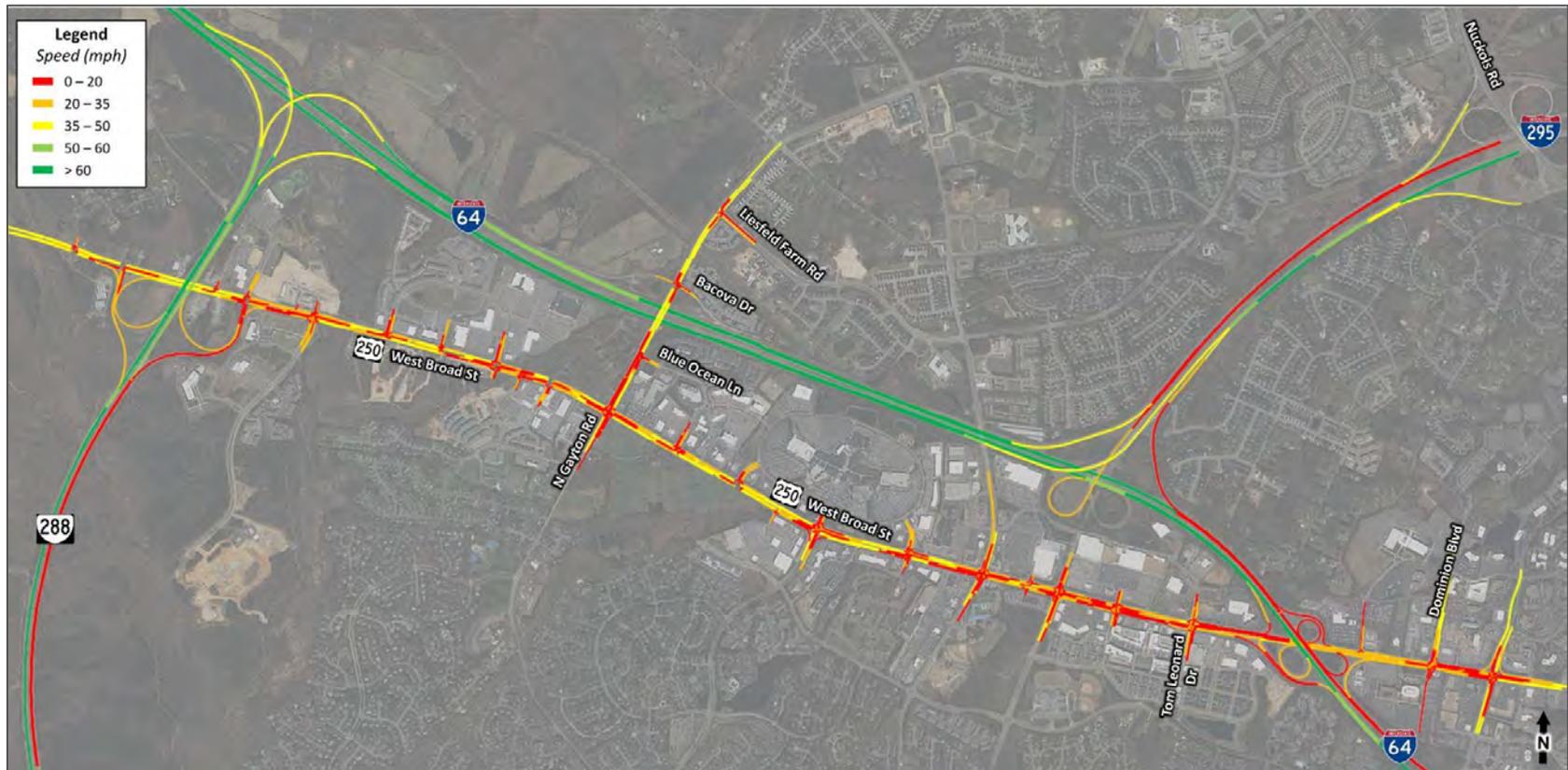
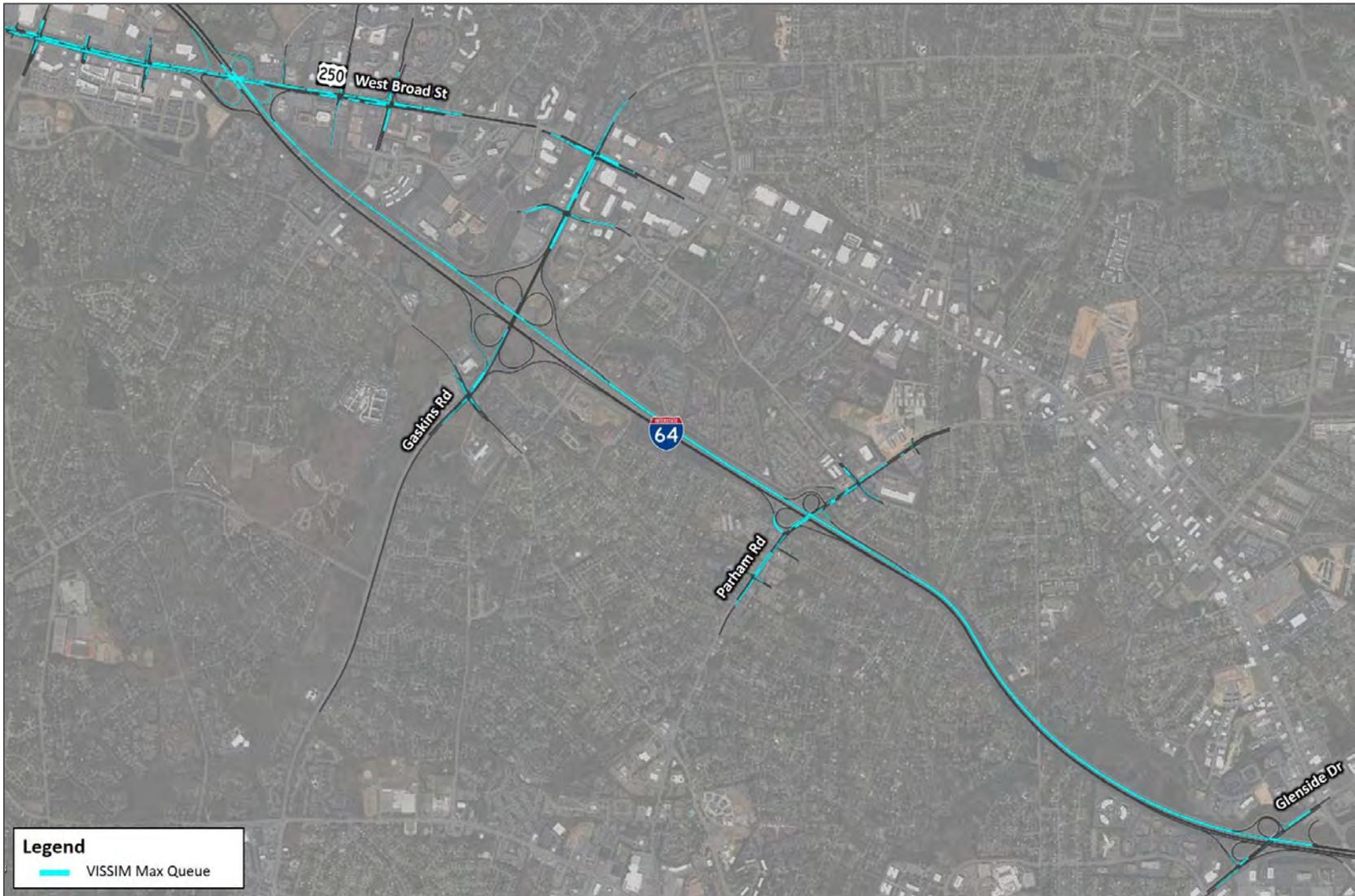


Figure 54: No-Build (2046) PM Peak Hour Maximum Queue Length (Depictive)



## No-Build Conditions Intersection Analysis Results

Graphical representation of the average intersection delay (seconds per vehicle) by movement and maximum queue length (feet) are shown in *Figure 55* through *Figure 62*. Maximum queue lengths reported with an asterisk in the figures indicate a queue length that backs up to the freeway and includes the queue length on the freeway.

### AM Peak Hour

In the 2026 AM peak hour, the intersection of US 250 and N Gayton Road was projected to operate with the most overall intersection delay at 32.1 seconds per vehicle. All left-turn movements at the intersection were projected to operate with delays of 56.9 seconds per vehicle or greater. The southbound right-turn maximum queue at the intersection is projected to extend beyond the end of the 575-foot storage bay.

The longest maximum vehicle queue was projected to occur on eastbound US 250 at the intersection with Tom Leonard Drive (1,060 feet). This queue extends back to the upstream signal at Brownstone Boulevard. All left-turn movements at the intersection were projected to operate with 54.3 seconds per vehicle or greater of delay.

The intersection of US 250 and the southbound Route 288 ramps was projected to operate with an overall intersection delay of 25.9 seconds per vehicle. The westbound left turn at the intersection was projected to operate with 59.6 seconds per vehicle of delay. The maximum queue for the westbound left-turn movement onto southbound Route 288 was projected to extend 975 feet, which is longer than the available storage for the dual left-turn lanes.

The intersection of US 250 and Dominion Boulevard was projected to experience less delay and shorter queues than the existing AM peak hour analysis. This improvement was attributed to the two background improvements that are projected to be constructed before 2026 as shown in *Table 11*.

All other study area intersections were projected to operate with overall intersection delays of 27.1 seconds per vehicle or better.

By 2046, all left-turn movements at the intersection of US 250 and N Gayton Road were projected to operate with delays of 56 seconds per vehicle or greater. The southbound right-turn maximum queue was projected to extend 1,130 feet, impacting the operations of the other movements on the southbound approach and the upstream signalized intersection at Blue Ocean Lane. The intersection of N Gayton Road and Blue Ocean Lane was projected to operate with the highest overall intersection delay of any study area intersection (83.6 seconds per vehicle) due to the queuing downstream.

The intersection of US 250 and Dominion Boulevard was projected to operate with an overall intersection delay of 51.4 seconds per vehicle. All left-turn movements were projected to operate with 61.5 seconds per vehicle of delay or greater. The eastbound left-turn and through movement queues were project to extend over 1,000 feet on US 250 and impact the operations of the ramps at the interchange. A visual depiction of the queues that extend from this intersection back to the interstate is shown in *Figure 49*.

### PM Peak Hour

In the 2026 PM peak hour, the intersection of US 250 and N Gayton Road was projected to operate with the most overall intersection delay at 45.7 seconds per vehicle. All left-turn movements were projected to operate with delays greater than 67 seconds per vehicle, with the eastbound left-turn projected to exceed 200 seconds per vehicle. Queues were projected to extend beyond the 500-foot turn bay and impact the operations of eastbound US 250.

The northbound right-turn movement at the intersection of US 250 and the northbound Route 288 off-ramps was projected to operate with a delay of 76.9 seconds of delay per vehicle. The queue was projected to extend the length of the off-ramp and impact the operations on northbound Route 288.

All left-turn movements at the intersection of US 250 and Tom Leonard Drive were projected to operate with more than 60.5 seconds of delay per vehicle. The westbound queues at the intersection are projected to extend back several miles onto westbound I-64.

The intersection of US 250 and Dominion Boulevard was projected to experience less delay and shorter queues than the existing PM peak hour analysis. This improvement was attributed to the two background improvements that are projected to be constructed before 2026 as shown in *Table 11*.

By 2046, the intersection of US 250 and the northbound Route 288 ramps was projected to operate with the most overall intersection delay at 153.5 seconds per vehicle. Conditions on the northbound Route 288 off-ramp and specifically the northbound right-turn movement were expected to significantly worsen, with excessive delays of 440.3 seconds per vehicle. The queue from the right-turn movement was projected to extend the length of the off-ramp and cause a bottleneck on northbound Route 288 that prevented some vehicles from continuing to other destinations on I-64 or US 250.

The intersection of US 250 and N Gayton Road was projected to operate with an overall intersection delay of 65.9 seconds per vehicle. The delays and maximum queue lengths for the eastbound approach at the intersection were projected to decrease between 2026 and 2046. This decrease was attributed to the bottleneck on northbound Route 288 that prevented vehicles from reaching this intersection, which improved operations. All movements on the northbound and southbound approaches at the N Gayton Road intersection were projected to operate with significant delays of 72.2 seconds or greater.

Heavy queuing and high delays were projected to continue westbound at the US 250 intersections with Tom Leonard Drive and the I-64 eastbound ramps. These queues were projected to extend back onto both the eastbound and westbound I-64 off-ramps to westbound US 250 and contribute to slow speeds and congestion on I-64 in both directions. A visual depiction of the queues that extend from this intersection back to the interstate is shown in *Figure 54*.

Figure 55: No-Build (2026) AM Peak Hour Intersection Delay

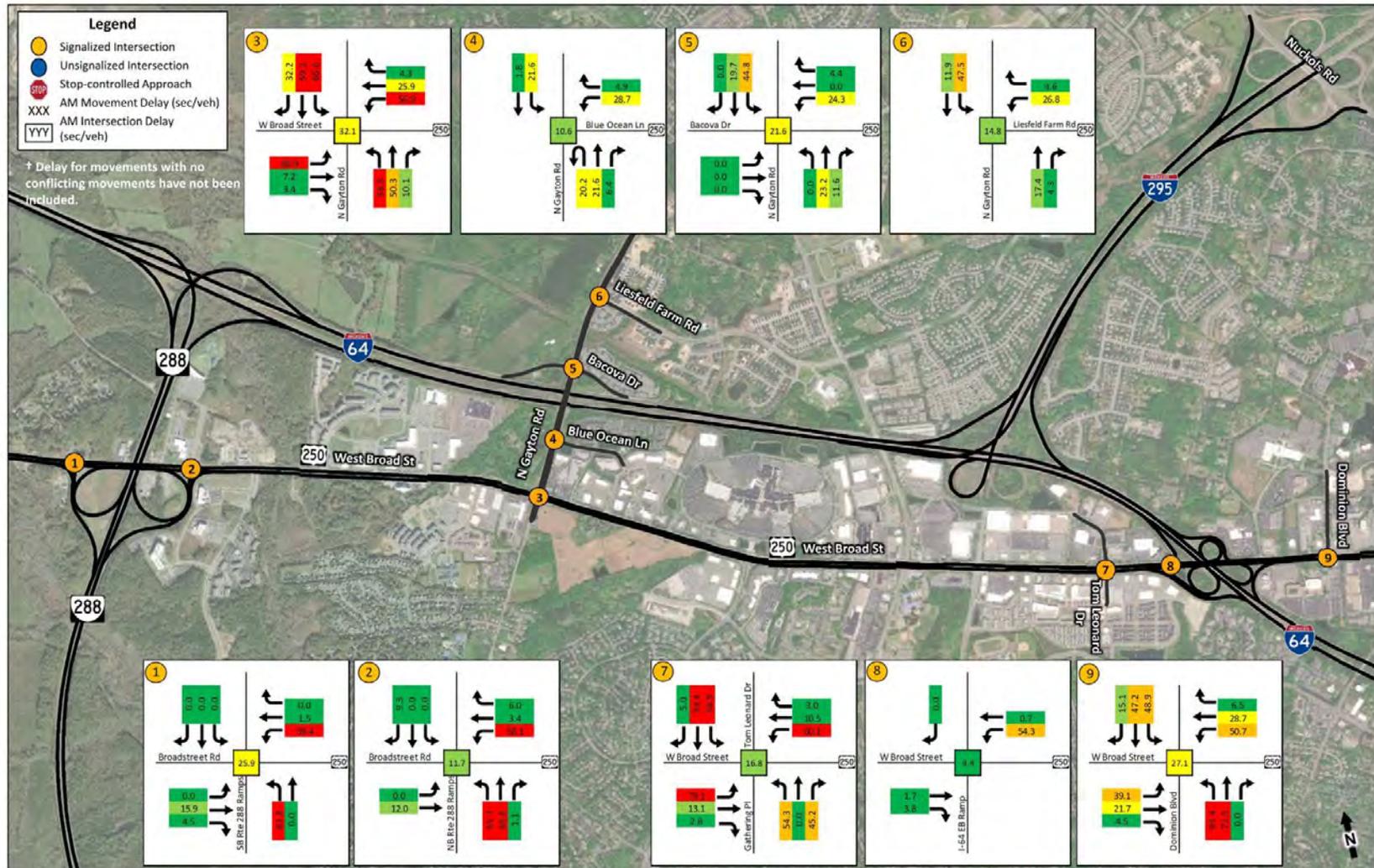


Figure 56: No-Build (2026) AM Peak Hour Maximum Queue Length



Figure 57: No-Build (2046) AM Peak Hour Intersection Delay

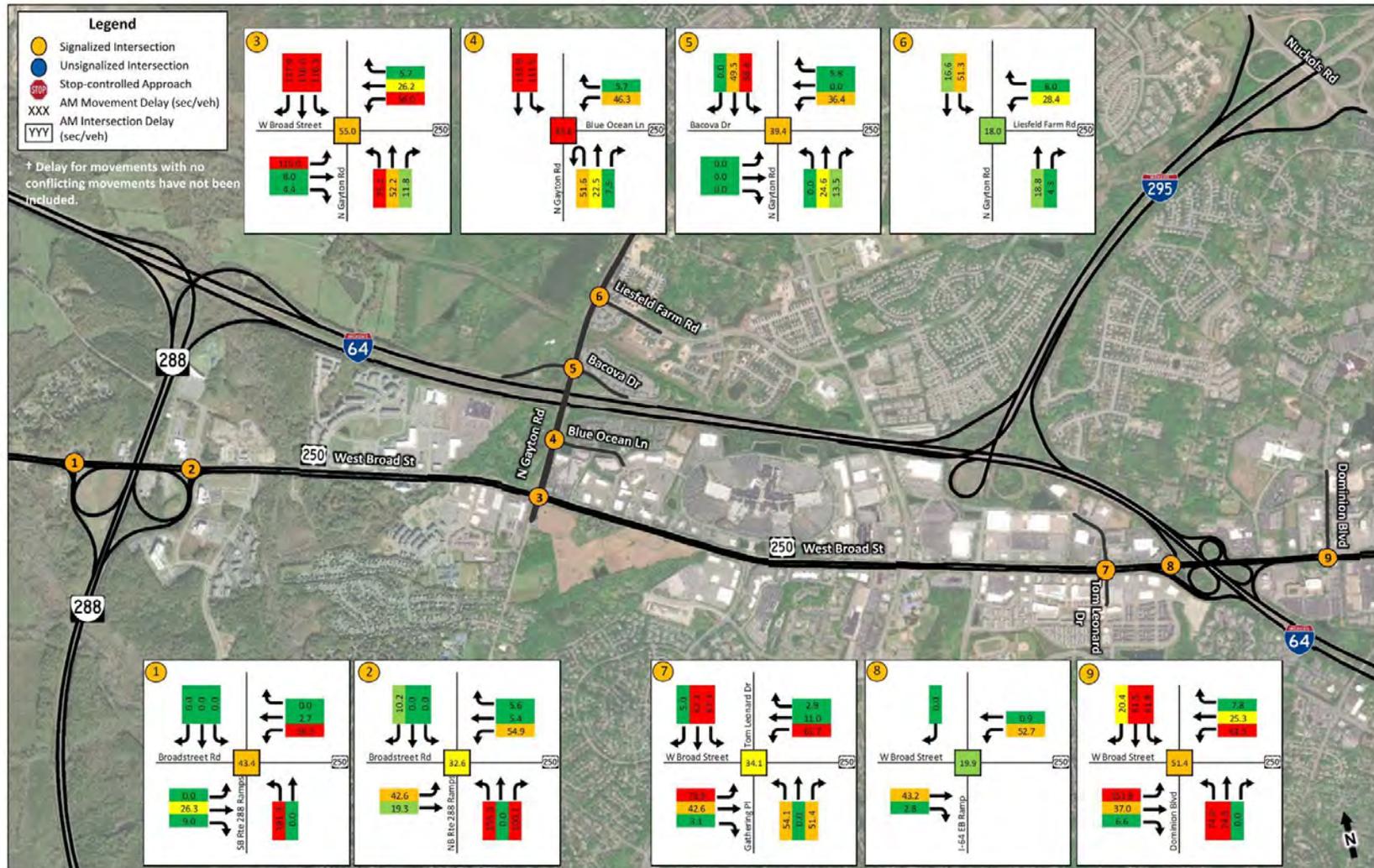


Figure 58: No-Build (2046) AM Peak Hour Maximum Queue Length





Figure 60: No-Build (2026) PM Peak Hour Maximum Queue Length



Figure 61: No-Build (2046) PM Peak Hour Intersection Delay

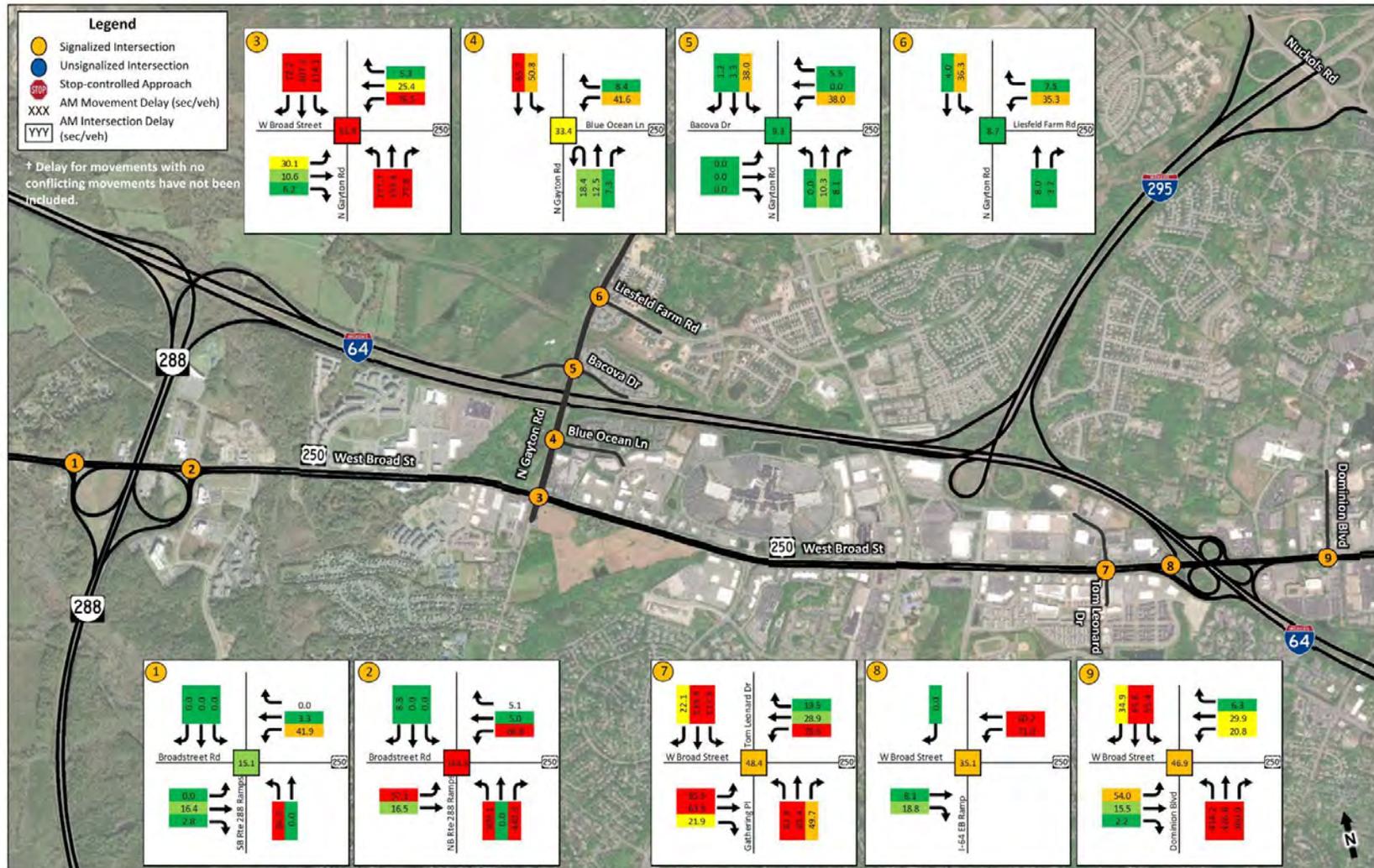


Figure 62: No-Build (2046) PM Peak Hour Maximum Queue Length

