



Interstate 26-Interchange at SR354 (Exit 17)

Diverging Diamond Interchange (DDI) Project

July 29, 2021

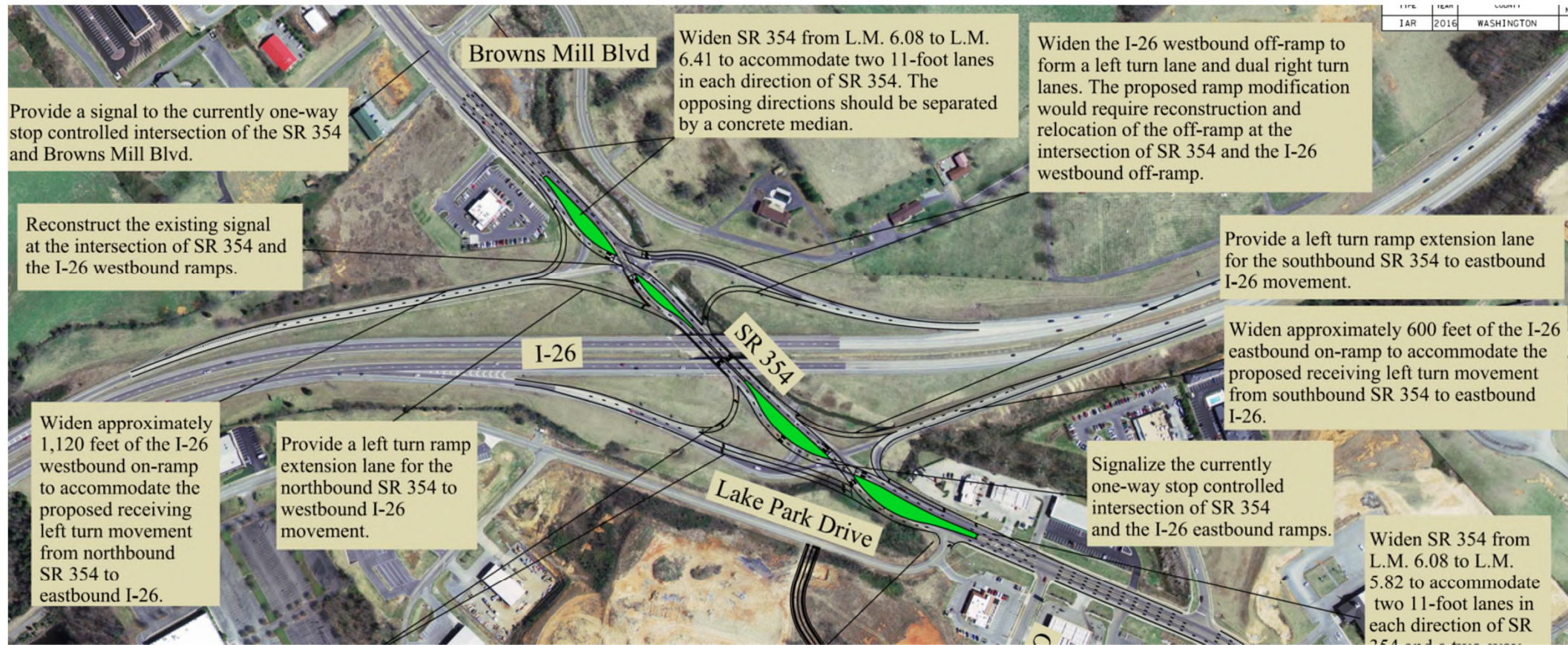


- Planning and Project Development
 - Purpose and Need
 - Traffic Impacts
 - Type of Interchanges
 - Selected Interchange
 - Project Features
- Construction and Operations
 - Project Overview
 - Facts
 - Features
 - Traffic Control
 - Under Construction
 - Final Product
- Lessons Learned

Overview

I-26 Exit 17 DDI Project

Andrew Padgett, P.E., Region 1 Traffic Engineer

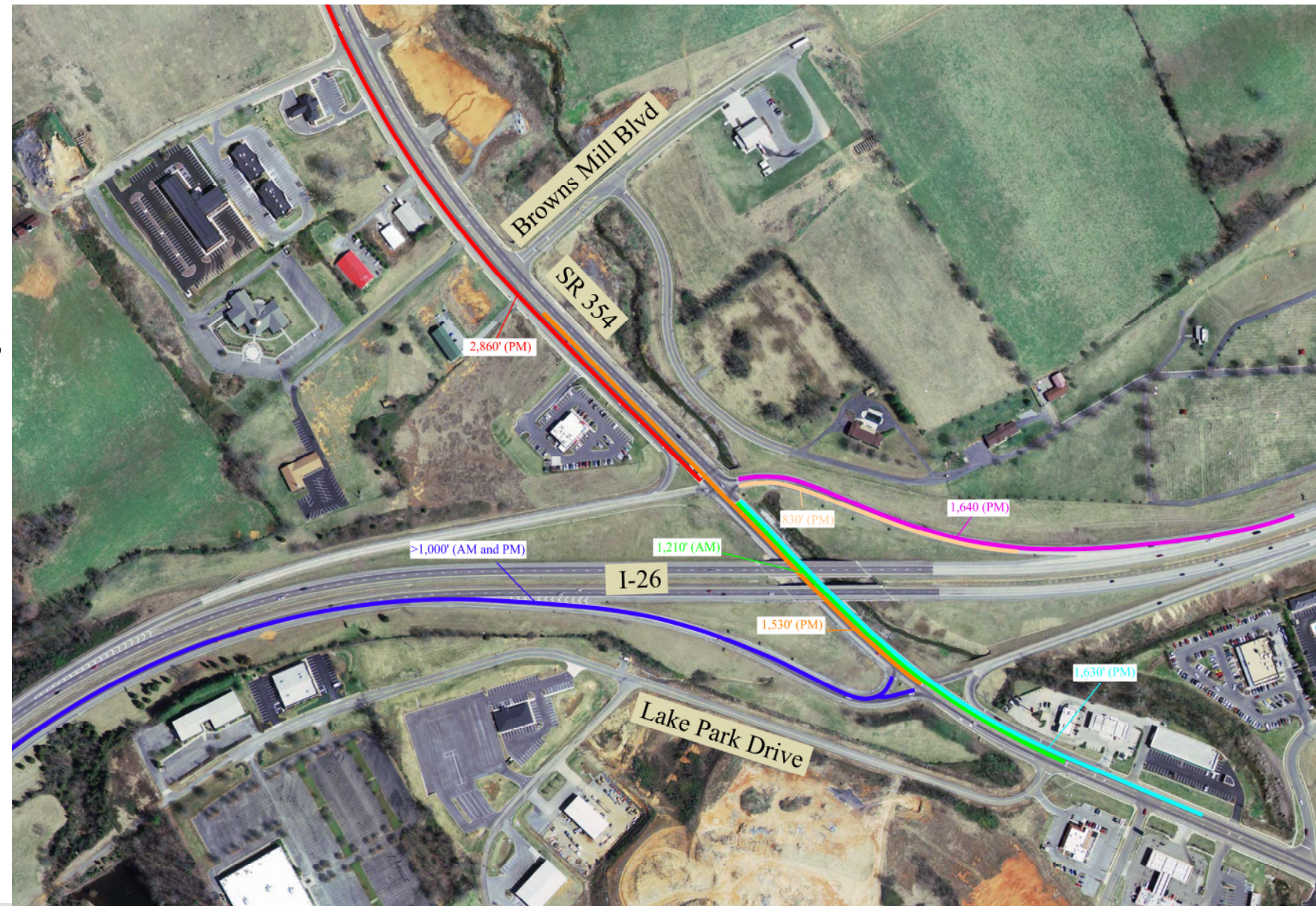


TM

Planning and Development

Purpose and Need

- A study was conducted in 2014 at the request of the city of Johnson City
- Purpose
 - Modify Operations
 - Increase Capacity
 - Improve Level-of-Service
 - Reduce Queues present on I-26 ramps
 - Revise I-26 ramps



Types of Interchanges

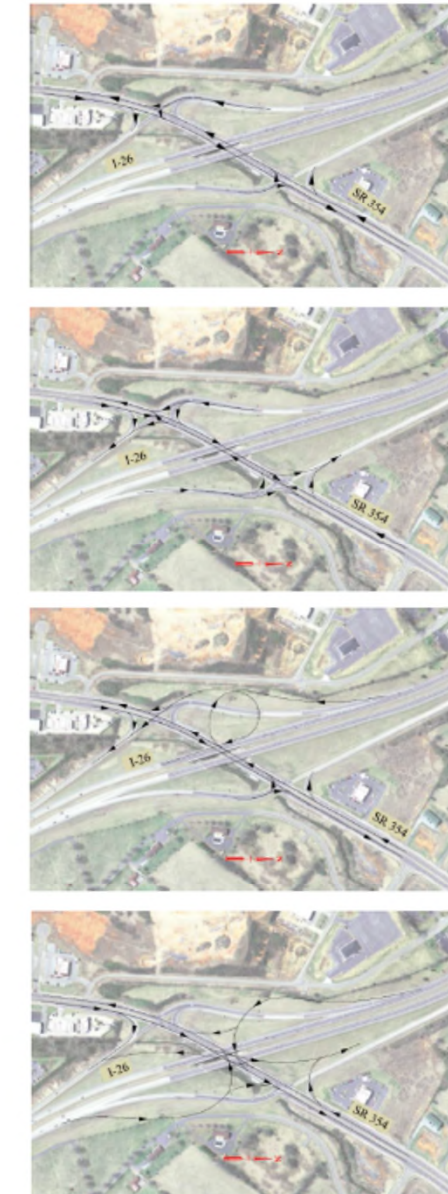
- Diamond
- Tight Diamond
- Cloverleaf
- Stack
- Turbine/Windmill
- Single Point Urban Interchange (SPUI)
- Diverging Diamond Interchange



Types of Interchanges Initially Discussed

Quick Evaluation of Potential Improvements of Interstate 26 (I-26) and State Route (SR) 354 Interchange

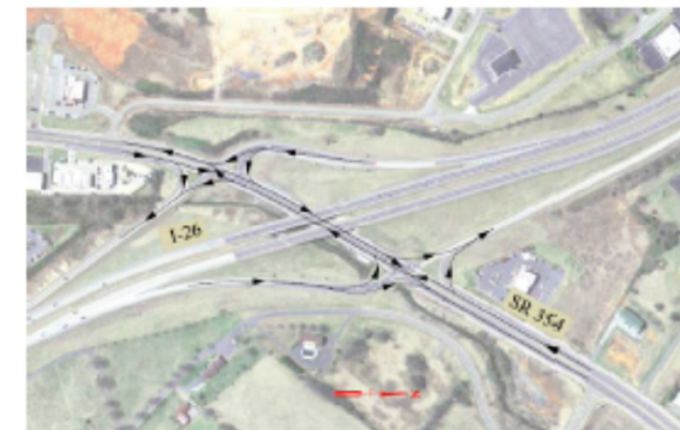
Alternate	General Description	Operational Quality	Geometric Considerations	ROW Requirements	Cost Considerations	FHWA Approval
A	Improvement of existing diamond interchange	<ul style="list-style-type: none"> Requires two multi-phase signals which could increase delay and requires signal coordination Little change to operations, signing, etc. 	<ul style="list-style-type: none"> Left turn lanes on SR 354 at ramp terminals require widening mainline SR 354 Ramp improvements can be made with limited additional impact 	<ul style="list-style-type: none"> Likely completion within existing ROW 	<ul style="list-style-type: none"> Relatively minor improvements beyond required widening of SR 354 Requires bridge reconstruction 	Not required (possibly)
B	Diverging diamond interchange	<ul style="list-style-type: none"> Requires two signals with two phases and signal coordination. Few number of phases and more movements under yield condition operations could decrease overall delay. Significant operational, signing differences 	<ul style="list-style-type: none"> No left turns require no left turn lanes on SR 354 Ramp improvements can be made with limited additional impact 	<ul style="list-style-type: none"> Likely completion within existing ROW 	<ul style="list-style-type: none"> Least structure cost Relatively minor improvements beyond required widening of SR 354 Possible completion without bridge reconstruction 	Not required (possibly)
C	Partial cloverleaf interchange (one loop)	<ul style="list-style-type: none"> Allows the heaviest movement to operate nearly free flow Requires two signals with two or three phases. Few number of phases and more movements under yield condition operations could decrease overall delay. Major signing changes 	<ul style="list-style-type: none"> Potential less widening of mainline SR 354 because of fewer left turn movements Ramp improvements require reconstruction of the existing ramps 	<ul style="list-style-type: none"> Significant ROW acquisition including business relocation(s) required. Slope easements may be significant. 	<ul style="list-style-type: none"> Less need for left turn lanes results in shorter bridge span Major earthwork, roadway construction for ramps Likely need for retaining structures Requires bridge reconstruction 	Required
D	Single-point urban interchange	<ul style="list-style-type: none"> One signalized intersection which is easier to be coordinated with upstream and downstream signals. It could also increase the capacity and decrease the overall delay. Some operational, signing differences 	<ul style="list-style-type: none"> Left turn lanes on SR 354 at ramp terminals require widening mainline SR 354 Ramp improvements require reconstruction of the existing ramps Near completely closed drainage of creek through interchange limits 	<ul style="list-style-type: none"> Some ROW acquisition required. Slope easements may be significant. 	<ul style="list-style-type: none"> Greatest structure cost Signal under bridge may require raising bridge elevation Drainage costs in burying creek Requires ramp retaining structures Requires bridge reconstruction 	Required



Types of Interchanges Initially Discussed

Quick Evaluation of Potential Improvements of Interstate 26 (I-26) and State Route (SR) 354 Interchange

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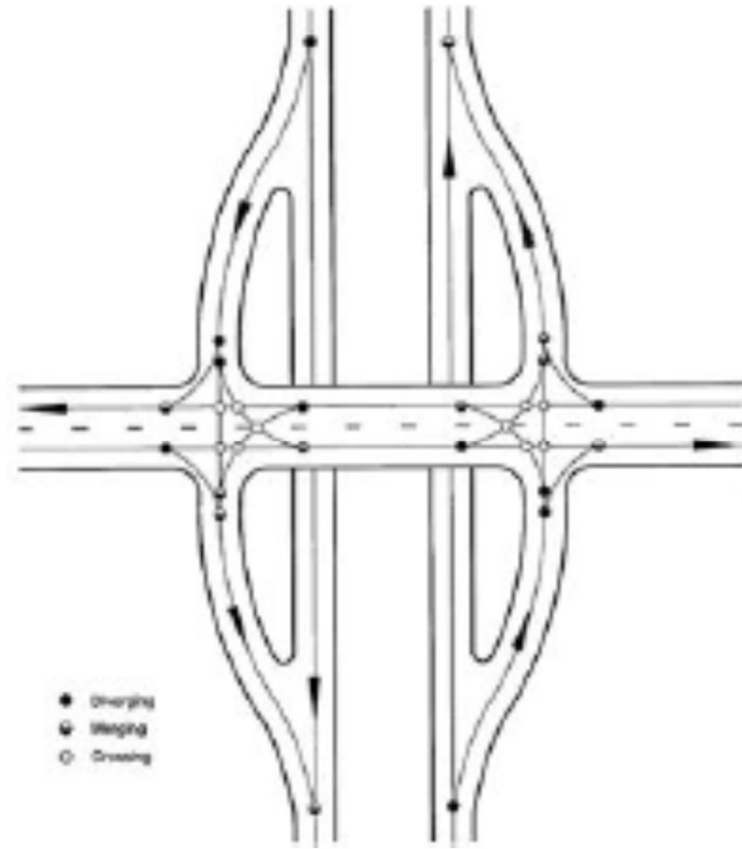
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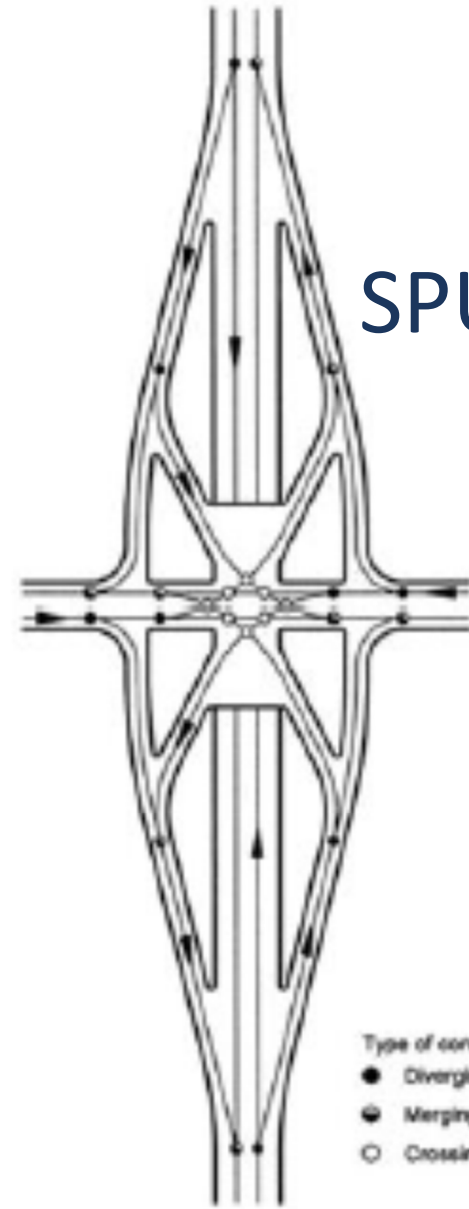
Safety – Conflict Points

DIAMOND



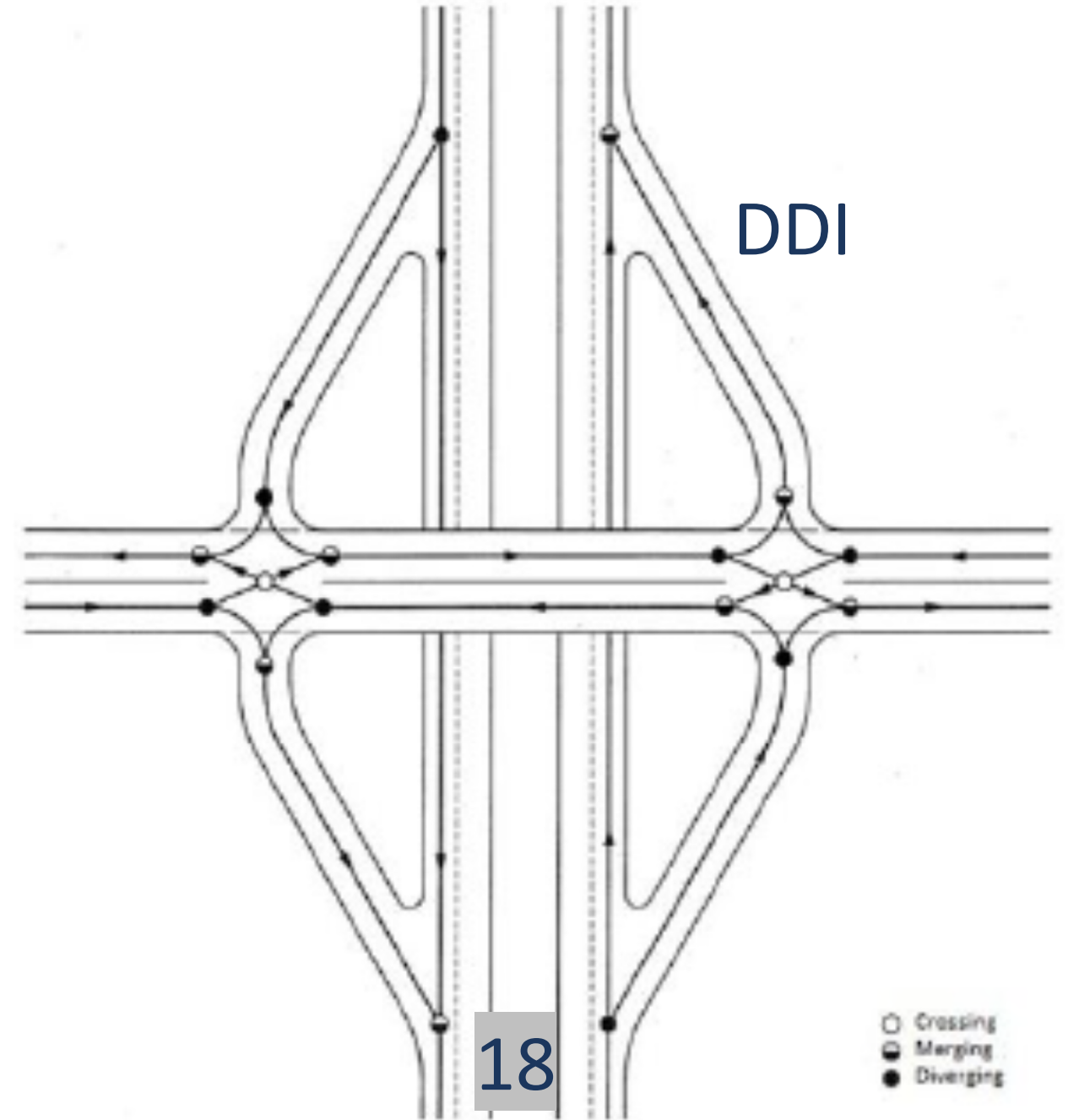
30

SPUI



24

DDI



18

Data

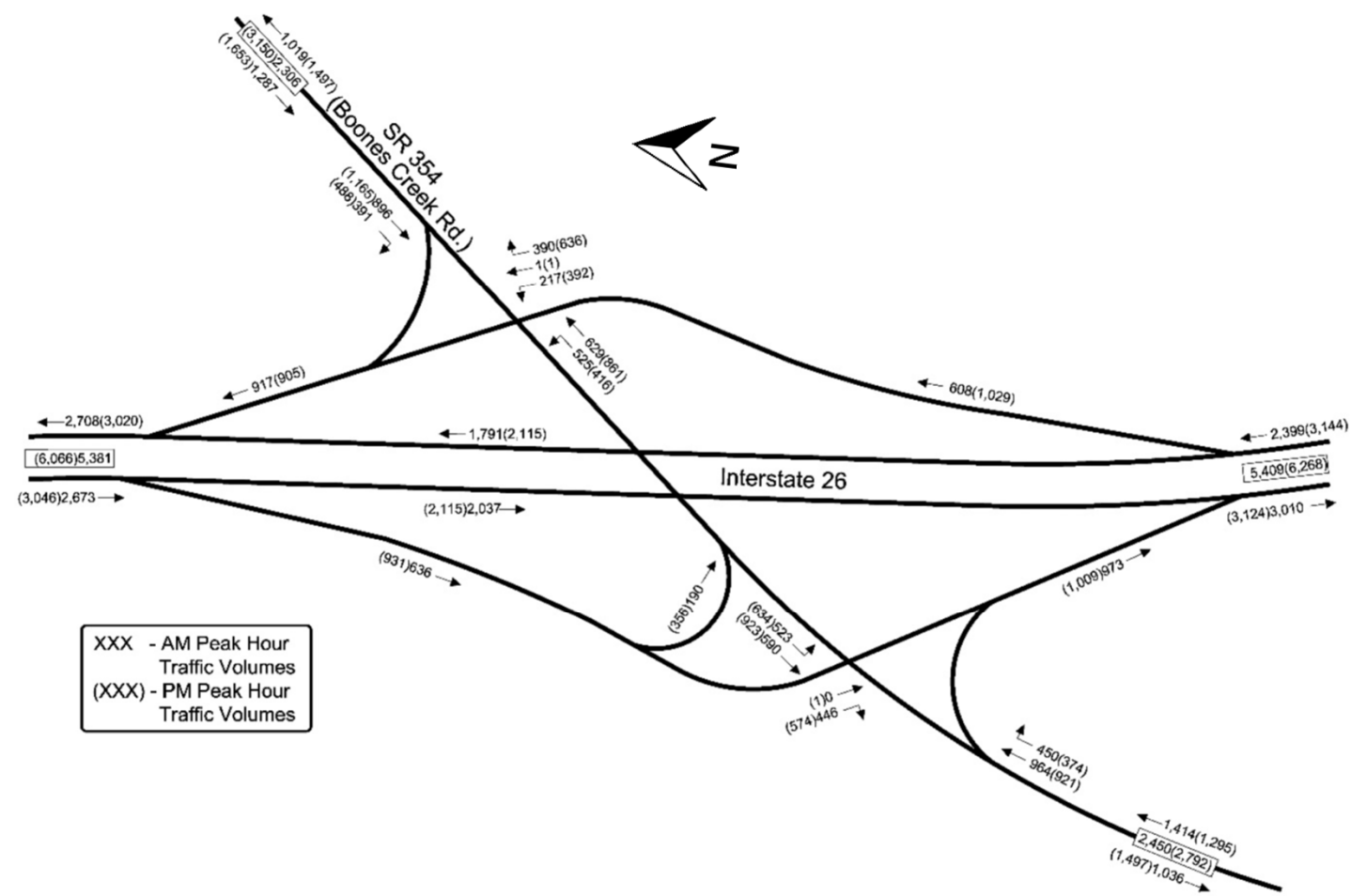
- Land use
 - Commercial (restaurants, hotels, gas station)
 - New development in cemetery limited some options
- Traffic
 - I-26
 - 2016 roughly 54000 vpd
 - Projected 64000 vpd by 2020
 - Projected 84000 vpd by 2040
 - SR354
 - 2016 roughly 20000 vpd
 - Projected 32000 vpd by 2020
 - Projected 44000 vpd by 2040



Traffic Data Analysis

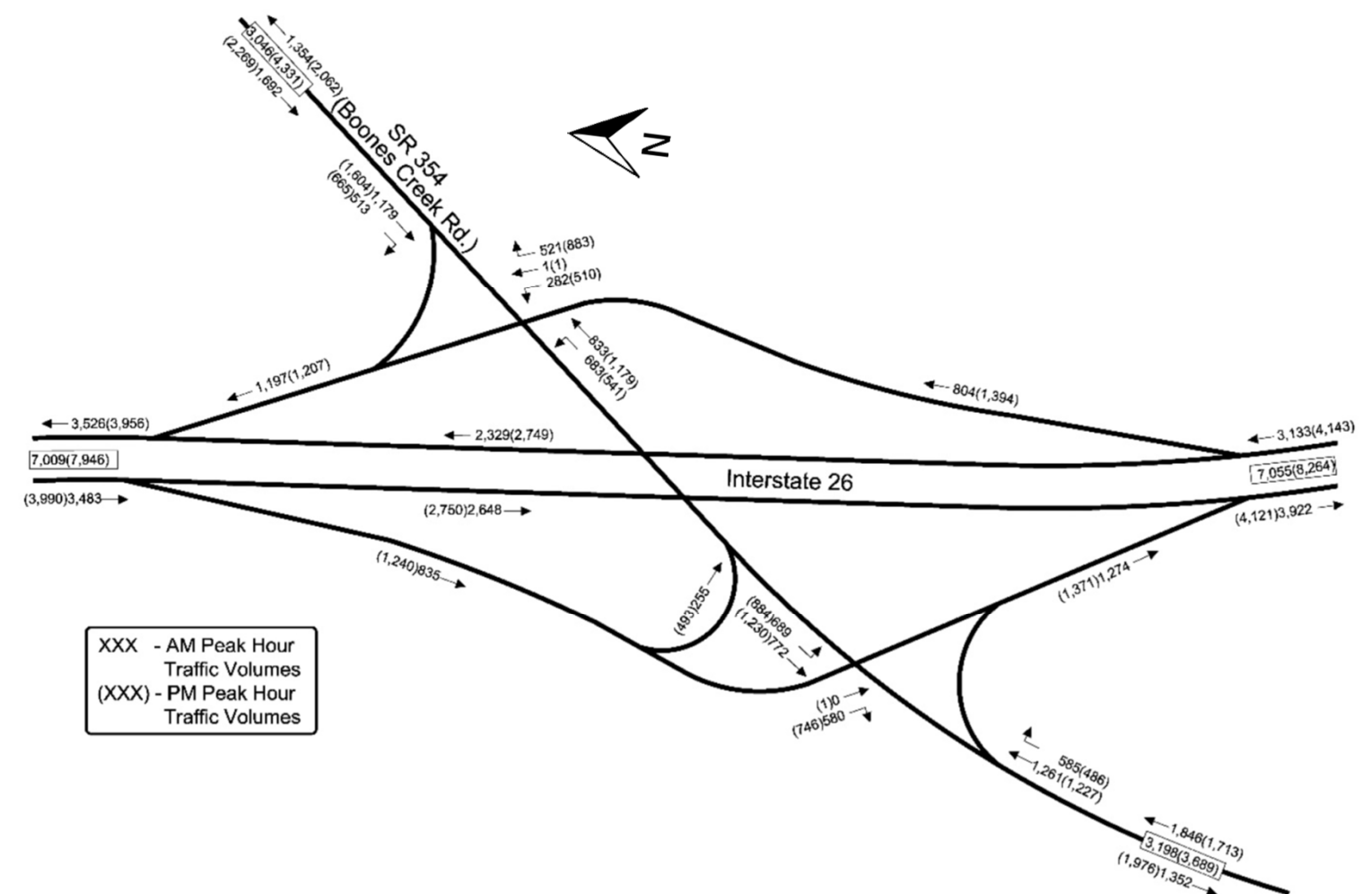
2020

Johnson City – SR-36



2040

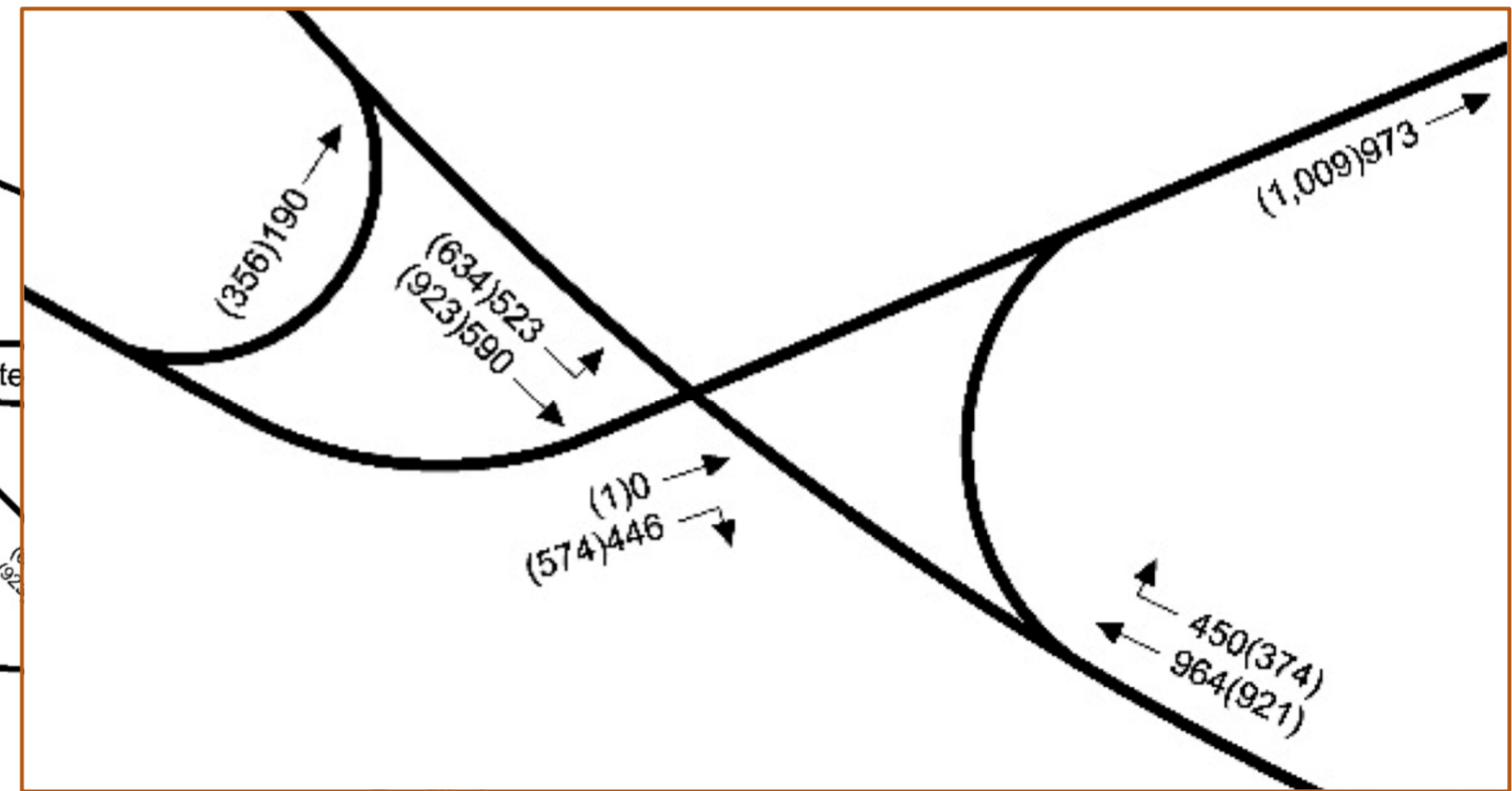
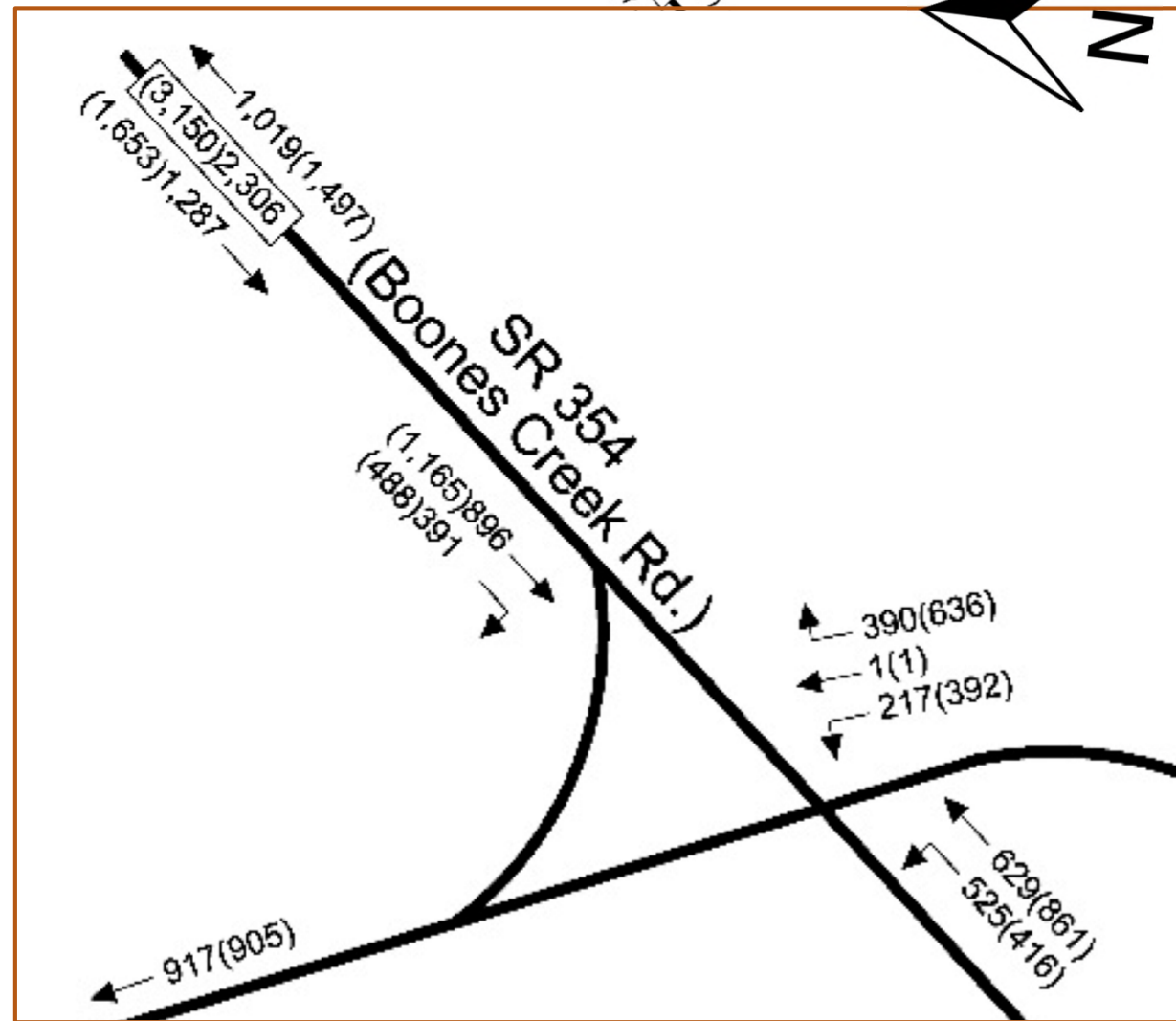
Jonesborough – SR-34, US-11E



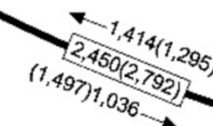
Traffic Data Analysis

2020

Johnson City – SR-36



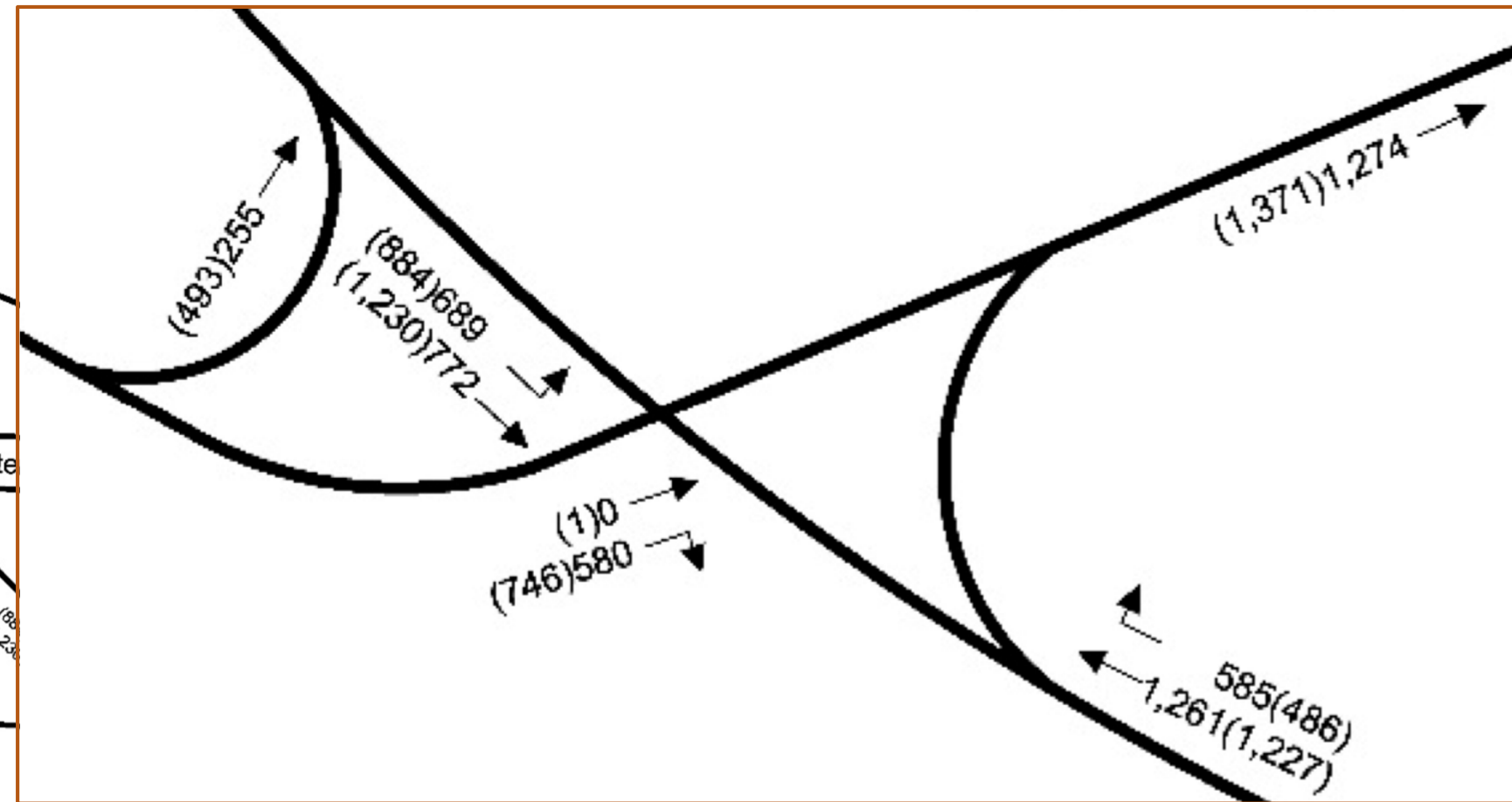
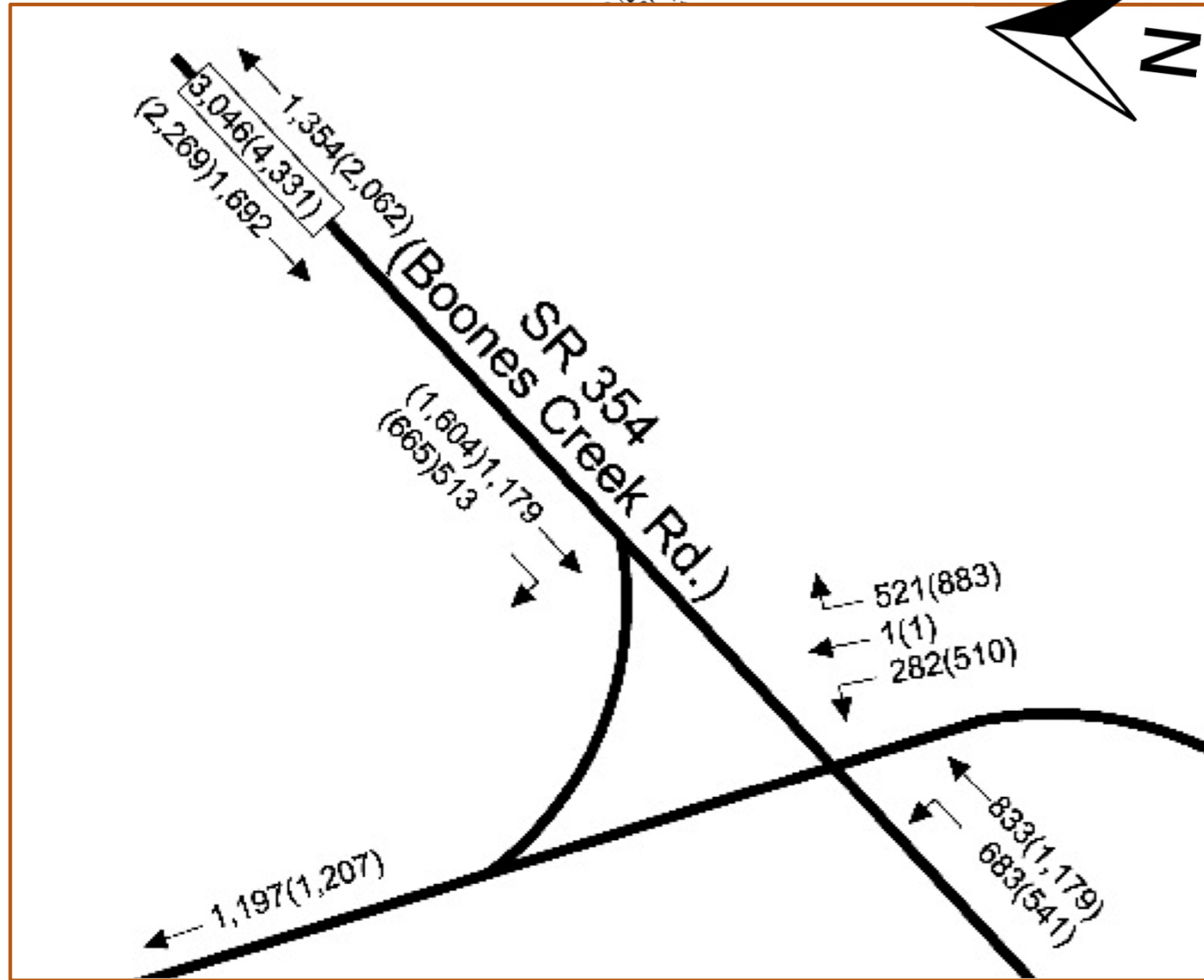
Jonesborough – SR-34, US-11E



Traffic Data Analysis

2040

Johnson City – SR-36



Jonesborough – SR-34, US-11E

Level- of -Service

Existing

Analysis Point	Average Intersection Level of Service (Delay)					
	2014 Existing System		2020 Existing System		2040 Existing System	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
SR 354 and Eastbound I-26 Ramps- Eastbound Left Turns	F (>200)	F (>200)	F (>200)	F (>200)	F (>200)	F (>200)
SR 354 and Westbound I-26 Ramps	D (39)	D (36)	E (55)	F (154)	F (158)	F (>200)

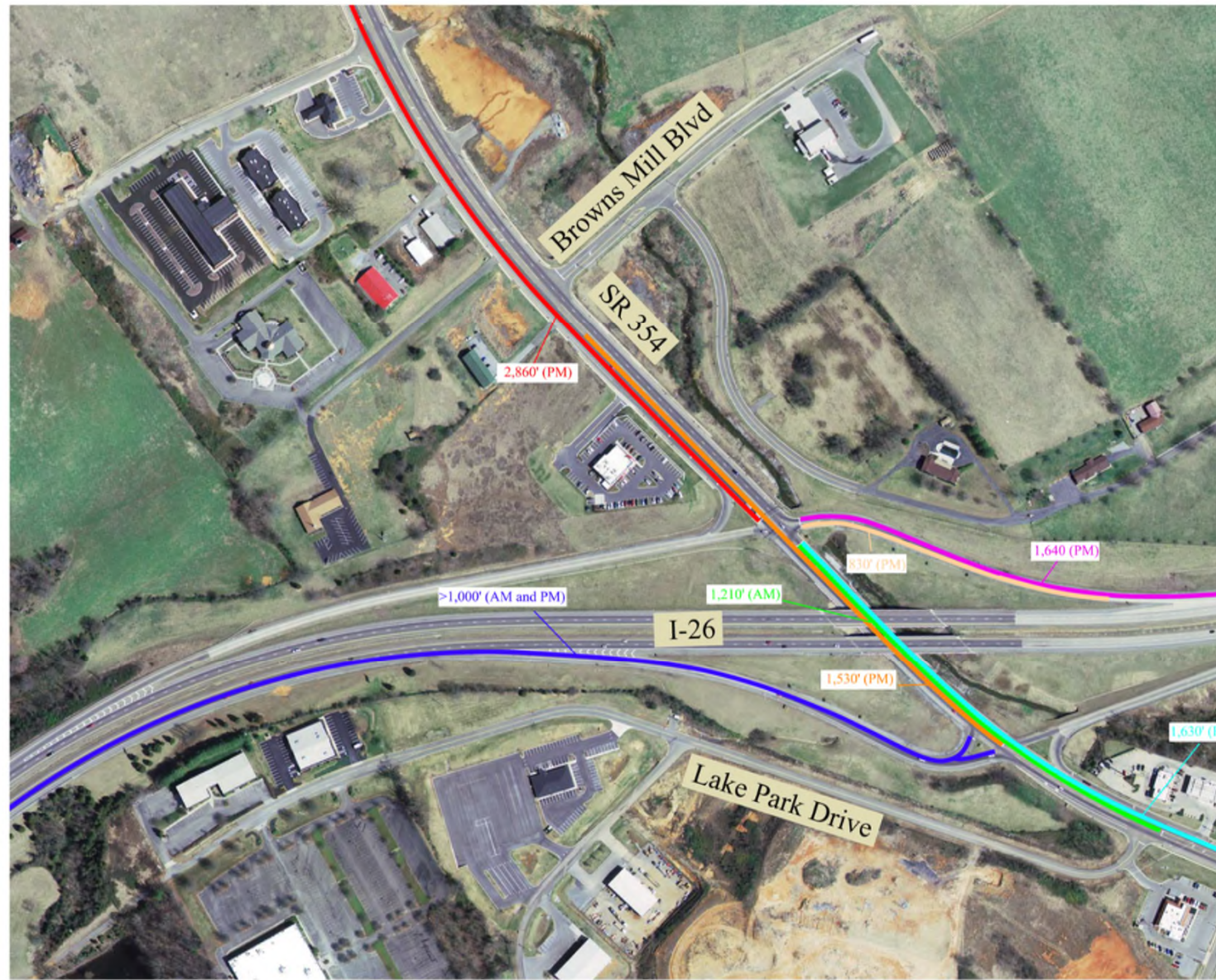
Note: For stop controlled intersections, an LOS is presented for each critical turning movement. For signalized intersections, an overall LOS is presented.

Proposed

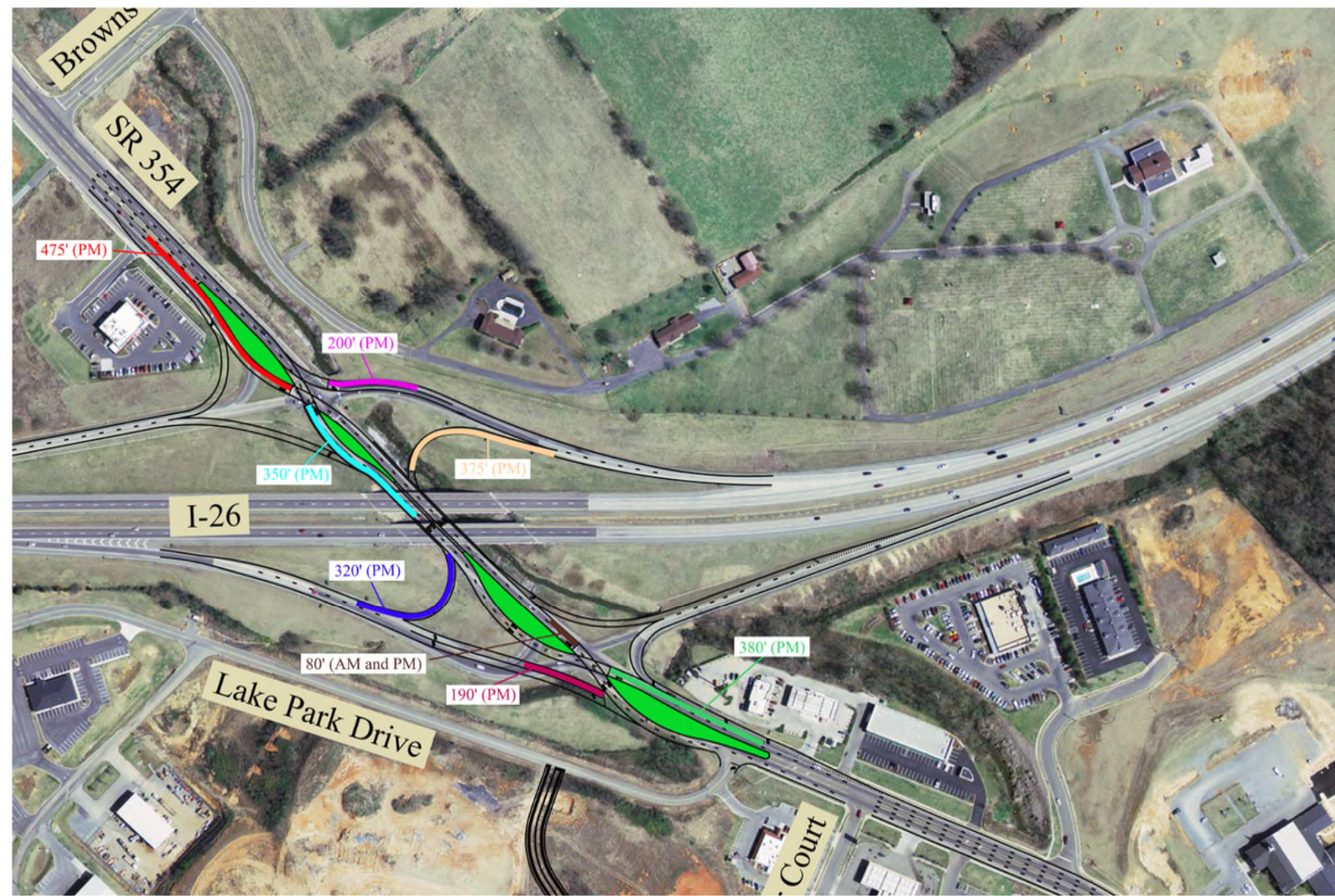
Analysis Point	Average Intersection Level of Service (Delay)							
	2020 Alternate A System		2020 Alternate B System		2040 Alternate A System		2040 Alternate B System	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
SR 354 and Eastbound I-26 Ramps	B (11.0)	B (13)	A (7)	A (9)	B (16)	C (34)	A (8)	B (16)
SR 354 and Westbound I-26 Ramps	B (14)	B (15)	A (7)	A (10)	B (19)	C (33)	A (9)	C (27)

Queuing

Existing

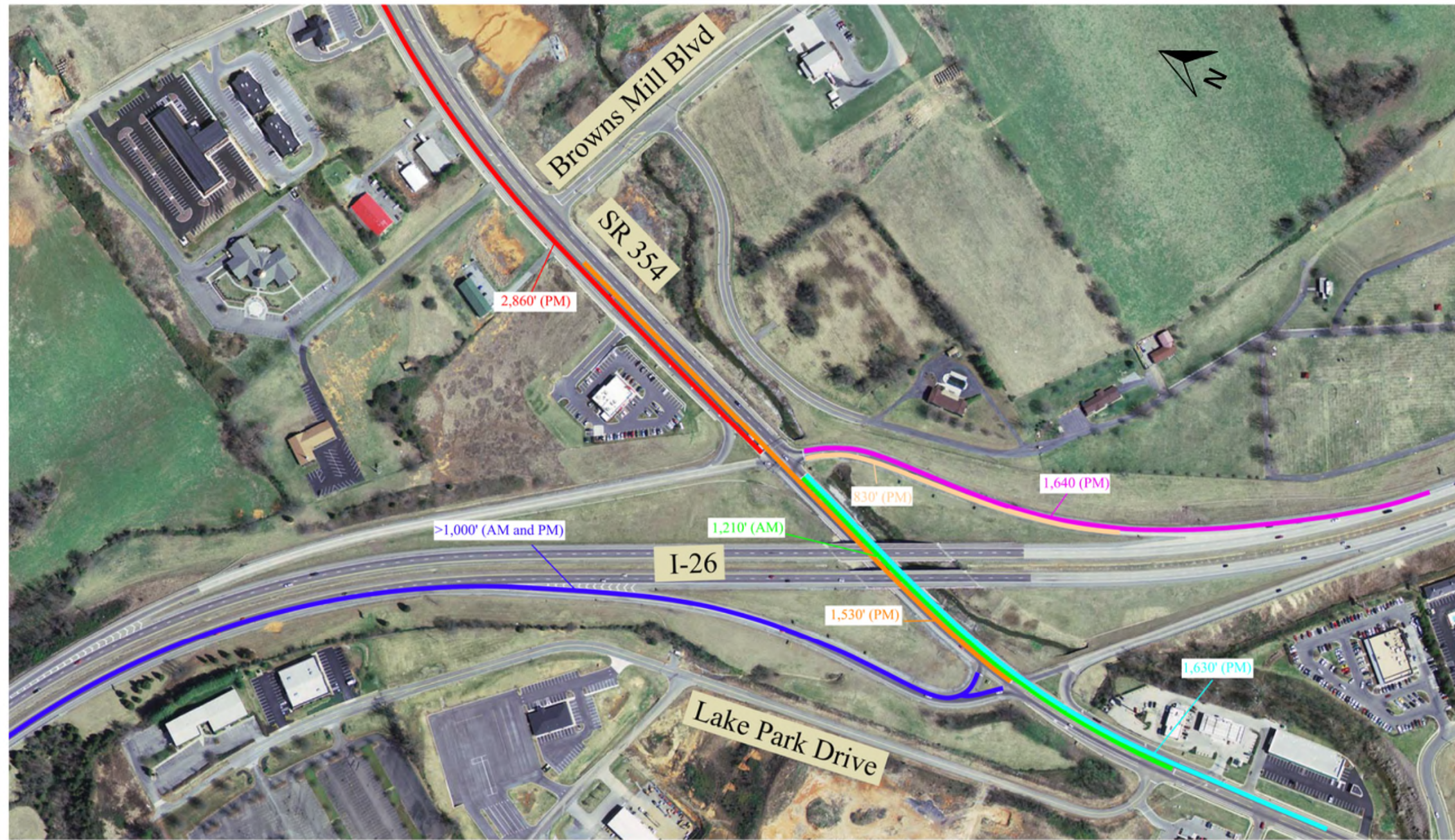


Proposed



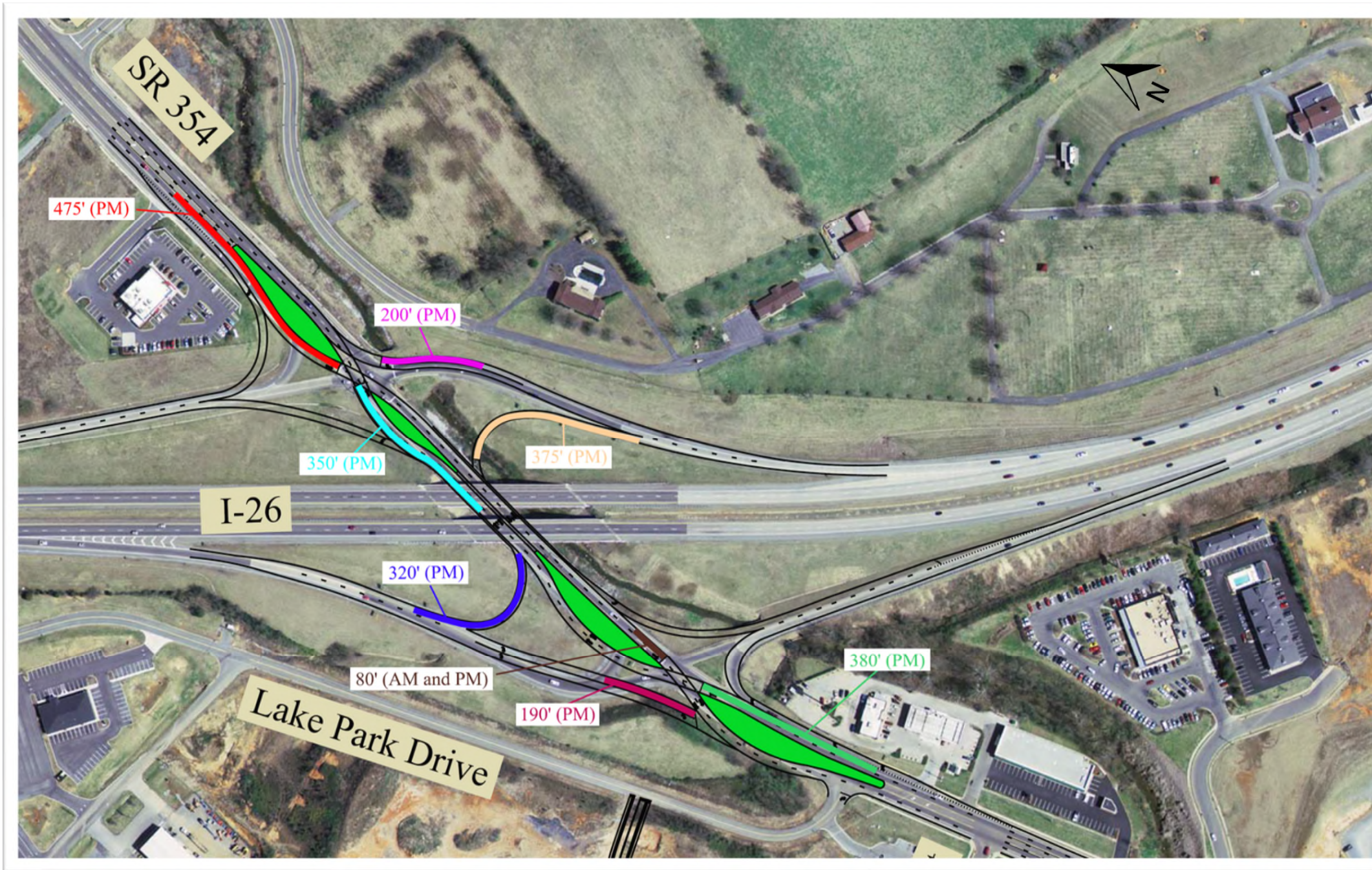
Queuing

Existing



Queuing

Proposed

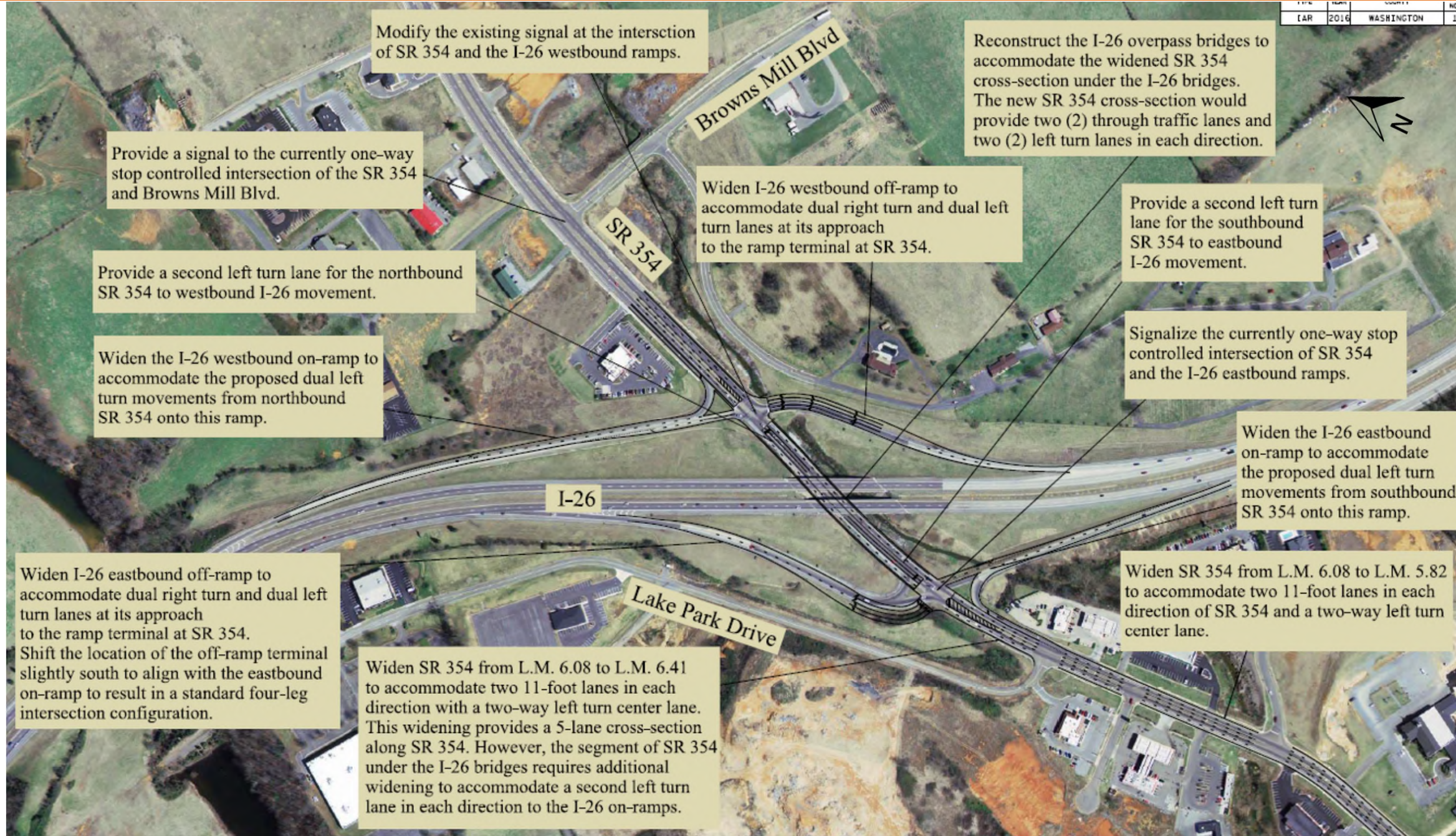


Final Options

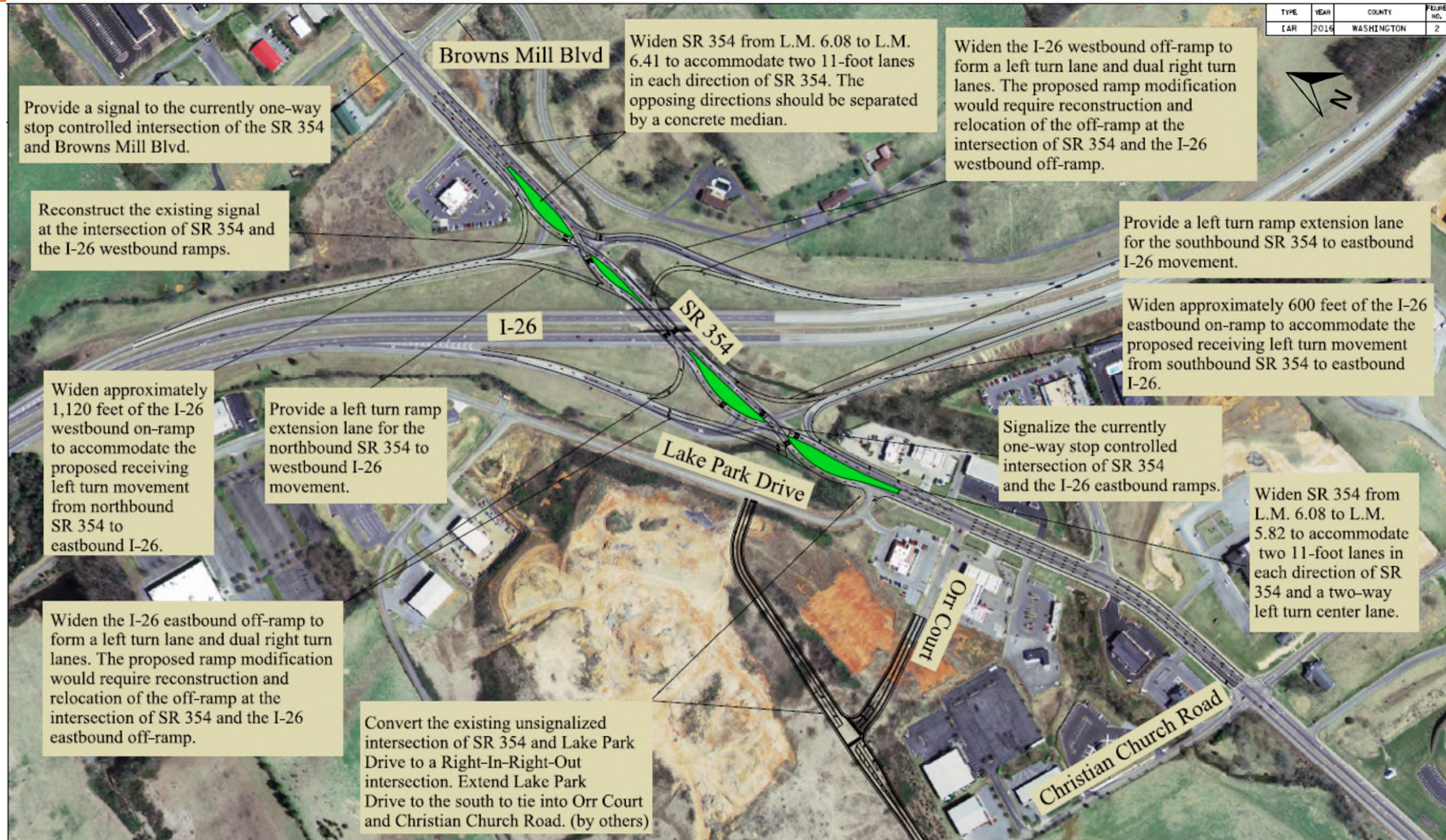
- Improvement of Existing Diamond Interchange
 - Widen south of I-26 to 5 lanes
 - Secondary left-turn from SB SR354 to EB I-26
 - Secondary left-turn from NB SR354 to WB I-26
 - Widen I-26 ramps to accommodate dual turning movements
 - Additional signals
 - Reconstruct I-26 bridges
- Build a Diverging Diamond Interchange
 - Similar Improvements different geometry
 - **NO** reconstructing I-26 bridges



Alternate A



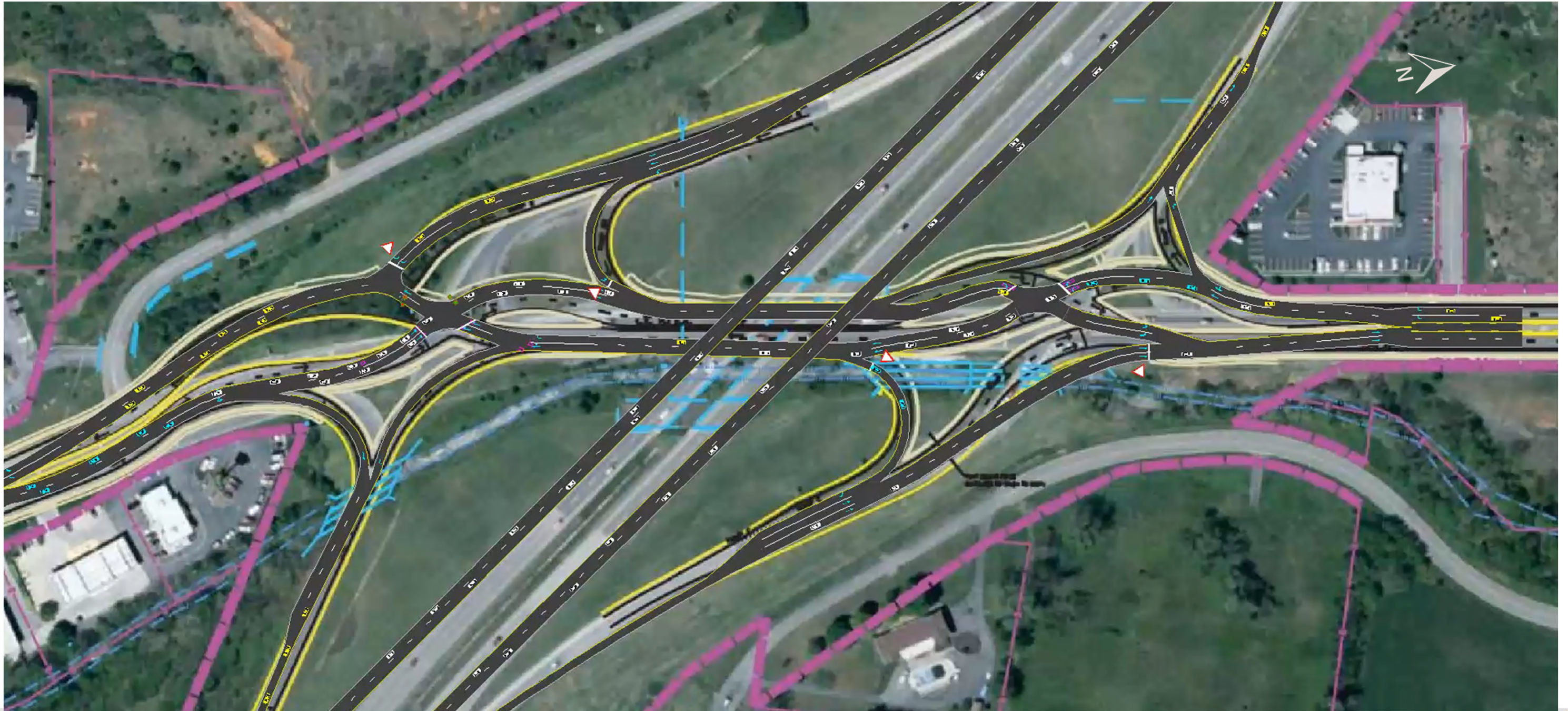
Alternate B



Proposed DDI Layout

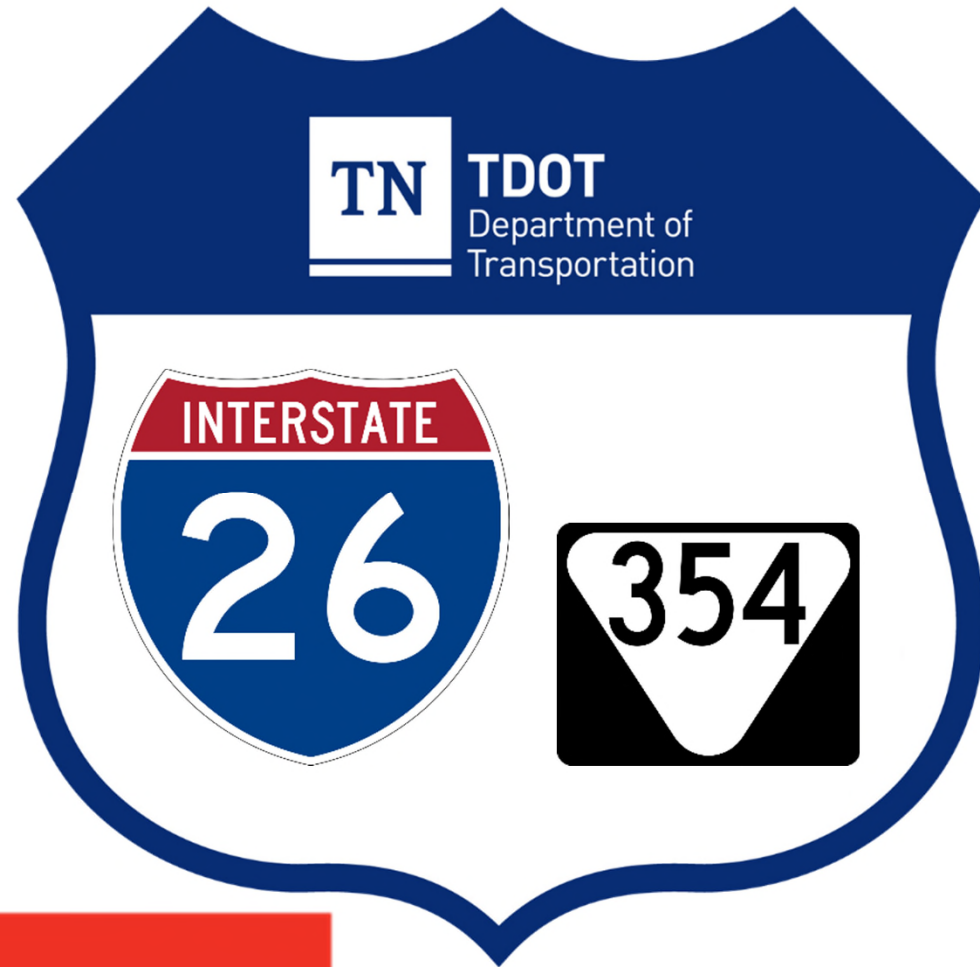


Synchro Simulation



Projected Travel Paths





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Construction and Operations

DDI Project Features



- Realignment of S.R. 354 into diverging diamond interchange (DDI)
- Existing intersection and drive entrance improvements
- New signals and lighting
- New utilities including sewer, water, and telephone
- Multiuse path
- Six retaining walls, various designs
- 62 storm structures
- Bridge repair of I-26 bridge girders over S.R. 354
- Installation of Over-height Detection System
- 140-foot box culvert extension

DDI Project Facts

- **Project Let to Construction**

March 2019

- **Contract Award**

Summers-Taylor

- **Original Estimate**

\$15,268,841.26 – Currently amount approximately \$15.6

- **Estimated Completion**

April 21, 2021 – Completion date was extended

- **Average Daily Traffic**

22,975



Retaining Walls



Retaining Walls



Bridge Repair

- Heat straightening
- Welding
- Painting
- Beams damaged due to collision from vehicles
- Weekend lane closure on I-26 to repair
- Hit during construction



Overheight Exit Right



Overheight Exit Right



Box Extension



Box Extension



Signs, Markings, and Signals

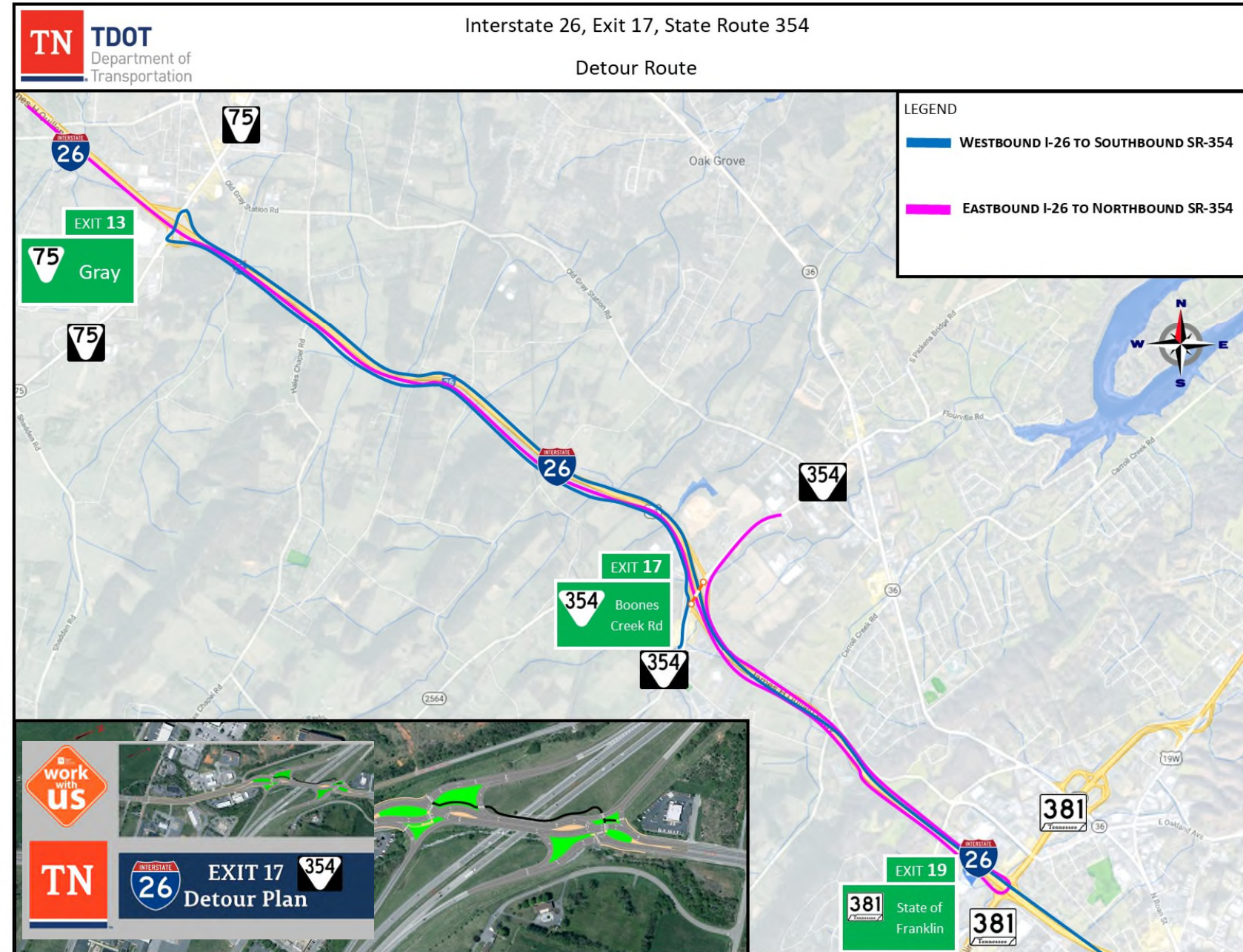
- 6 overhead sign structures
- 12 signs attached to the structures
- Extensive signs and pavement markings used to guide motorists through the weaving movement
- Traffic islands were also used as both a guide, calming mechanism, and limiting conflict points
- Mast Arms – 2 sets
- Near side signals at both locations

Weekend Closure

- Overhead structures completed beforehand
- Shut down all lanes under the bridge beginning at 10:00 pm on 3/19/21
- Right turn movements only from vehicles exiting I-26
- Contractor forces between 80-90 personnel over the next two day
- TDOT forces – 10 working in shifts
- Concrete islands, center barrier rail, signs, pavement markings, asphalt, traffic signals, drainage, sewer
- Lanes opened to traffic on 3/22/21 at 4:30 am
- Minimal work remaining when opened back up



Weekend Closure



Weekend Closure – Travel Paths



INTERSTATE 26 EXIT 17 354
Detour Plan



Project Construction



Project Construction



Project Construction



Contrast Tape



Contrast Tape



DDI – S.R. 354 Southbound



DDI – S.R. 354 Northbound



Bird's Eye Flyover



DDI Final Configuration



DDI Final Configuration



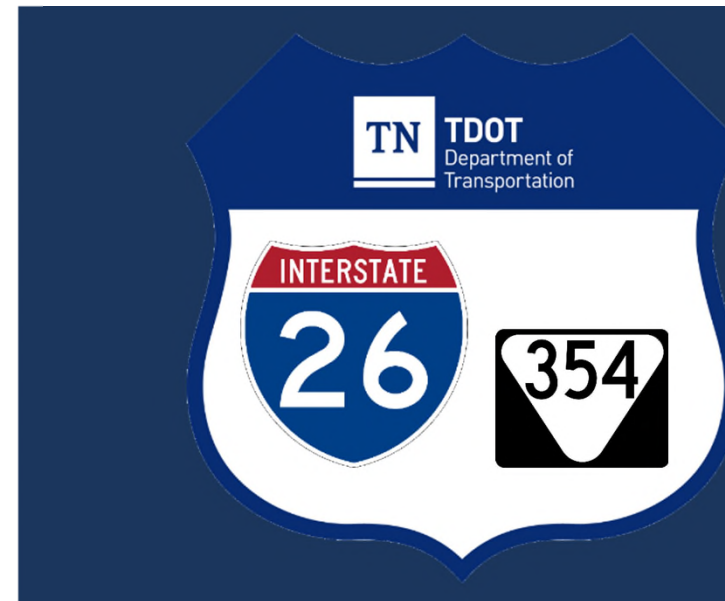
Project Challenges / Lessons Learned

- Issues with initial survey
 - Utility install/relocation and traffic control phasing (deep excavations)
- Creating a safe multiuse path as width of area between bridge bents restricted location
 - Retaining wall design and construction
- Traffic control and phasing construction (exit ramps and additional phases)
 - Signal timing and phasing
 - Weekend interchange closure for final phasing
 - Proper signage/placement (plans vs. actual)
- MEETING with contractor scheduled for the post construction review-MORE TO COME!

Andrew Padgett, P.E.

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Quærski y o ɛ?