



U.S. 29 / NEW BALTIMORE BRIEFING

Intersection Improvement Projects

 John Lynch, P.E., Culpeper District Engineer

May 24, 2018

History of Improvements

2001: In response to an increase in traffic crashes, flashing beacon installed at U.S. 29/Route 215 (Vint Hill Road)

2001: Environmental Impact Statement (EIS) process initiated for project to widen Route 215 & correct grade on NB approach

October 2004: Public hearing held for relocation & improvement of Vint Hill Road

Early 2005: Flashing beacons converted to full traffic signals with advance signal at crest of hill to regulate NB traffic

Late 2005: Advance signal converted to flashing warning beacons due to driver confusion & safety issues

2006: Rumble strips installed on NB lanes approach to Route 215

History of Improvements (continued)

2008: Intersection study recommends installation of “indirect left turn lanes” on U.S. 29 & addition of acceleration lane on U.S. 29 NB.

2009: EIS completed for Route 215 widening & 29 NB regrading; Fauquier Comprehensive Plan revised, Route 215 widening removed

2009: Route 29 Corridor Study accepted by Commonwealth Transportation Board, including designation of U.S. 29 as a Corridor of Statewide Significance

2009/2013: VTRANS 2035 mandates future viability & safety of corridor for regional & local traffic. Strategies include:

- **Improve safety: Address high-crash areas & make improvements**
- **Increase capacity: Improve intersections, coordinate signals**
- **Evaluate alternative designs before installing additional traffic signals**

History of Improvements (continued)

2014-2017: Facilitated review by stakeholder team of U.S. 29 corridor to develop strategic plan for improvements; ended without consensus

2016: Fauquier applies for SMART SCALE funding to correct grade on NB U.S. 29 approach to Vint Hill Road intersection

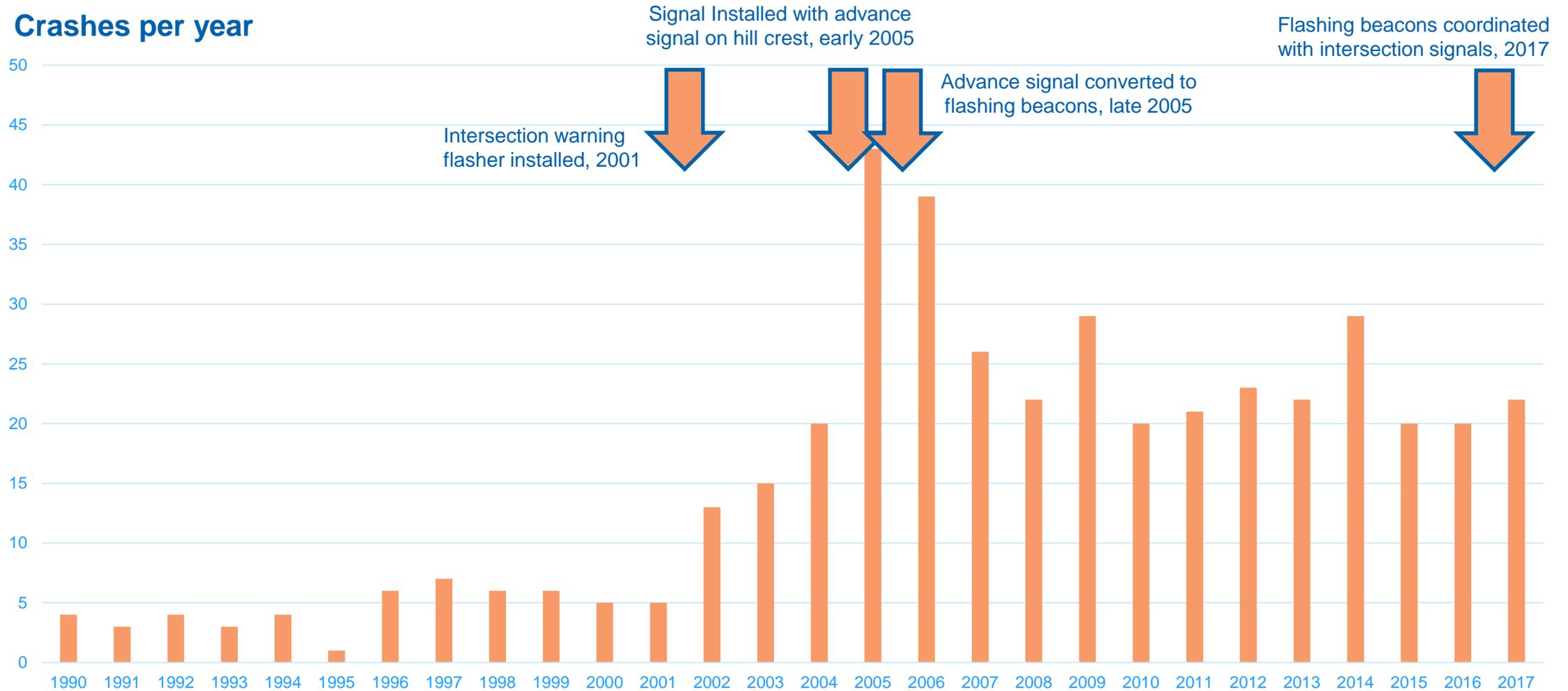
2017: Advance flashers coordinated with signal when queue reaches low area (blind spot) south of Vint Hill Road intersection

2017: VDOT proposes intersection improvements:

- **Michigan Left intersection at Vint Hill Road using Highway Safety Improvement Program (HSIP) funds**
- **RCUT intersection at Broad Run Church Road approved by CTB, preliminary engineering (PE) pending**
- **RCUT at Route 693/838 considered for SMART SCALE application by Fauquier County.**

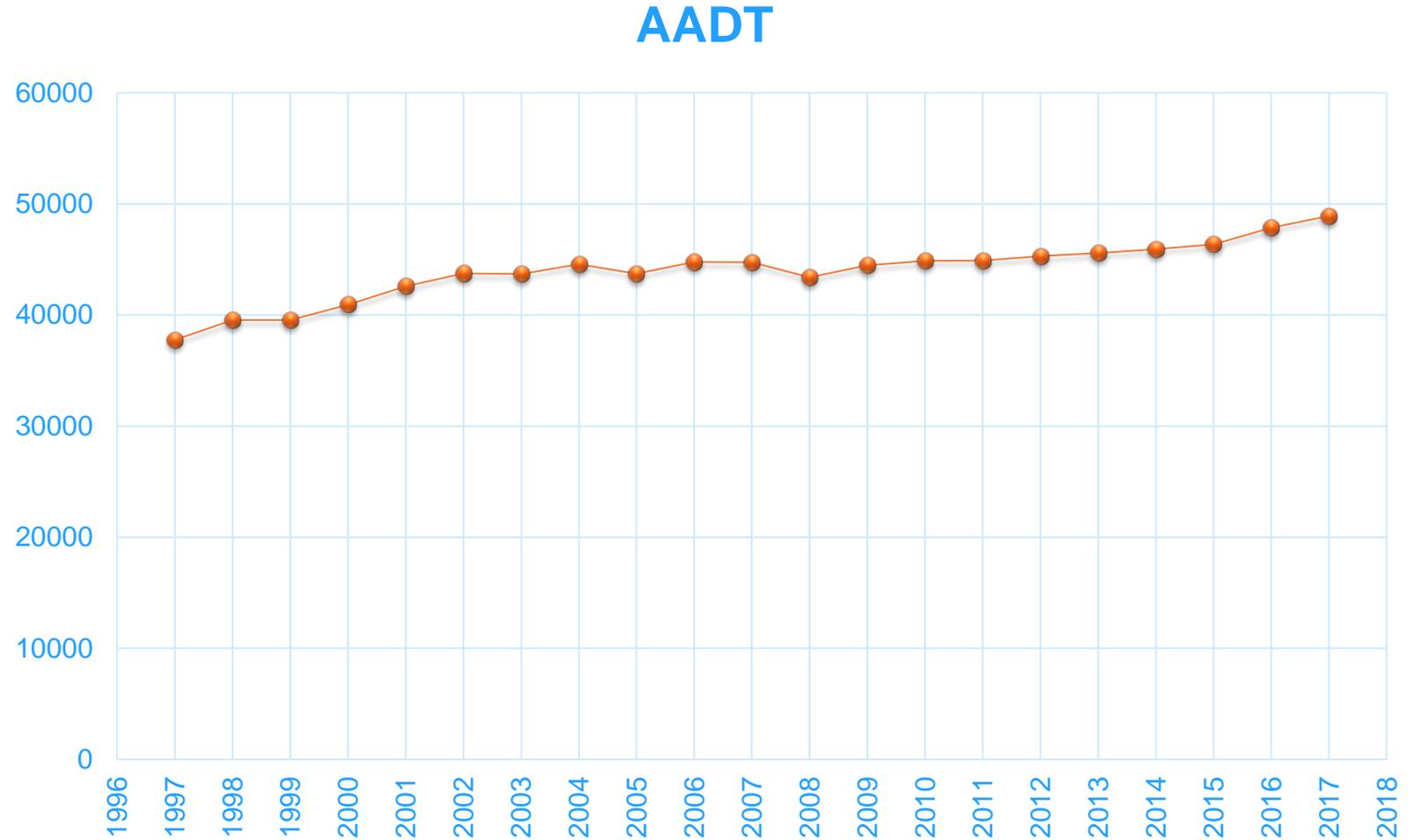
Annual Crash Data, U.S. 29 / Vint Hill Road intersection

Crashes per year



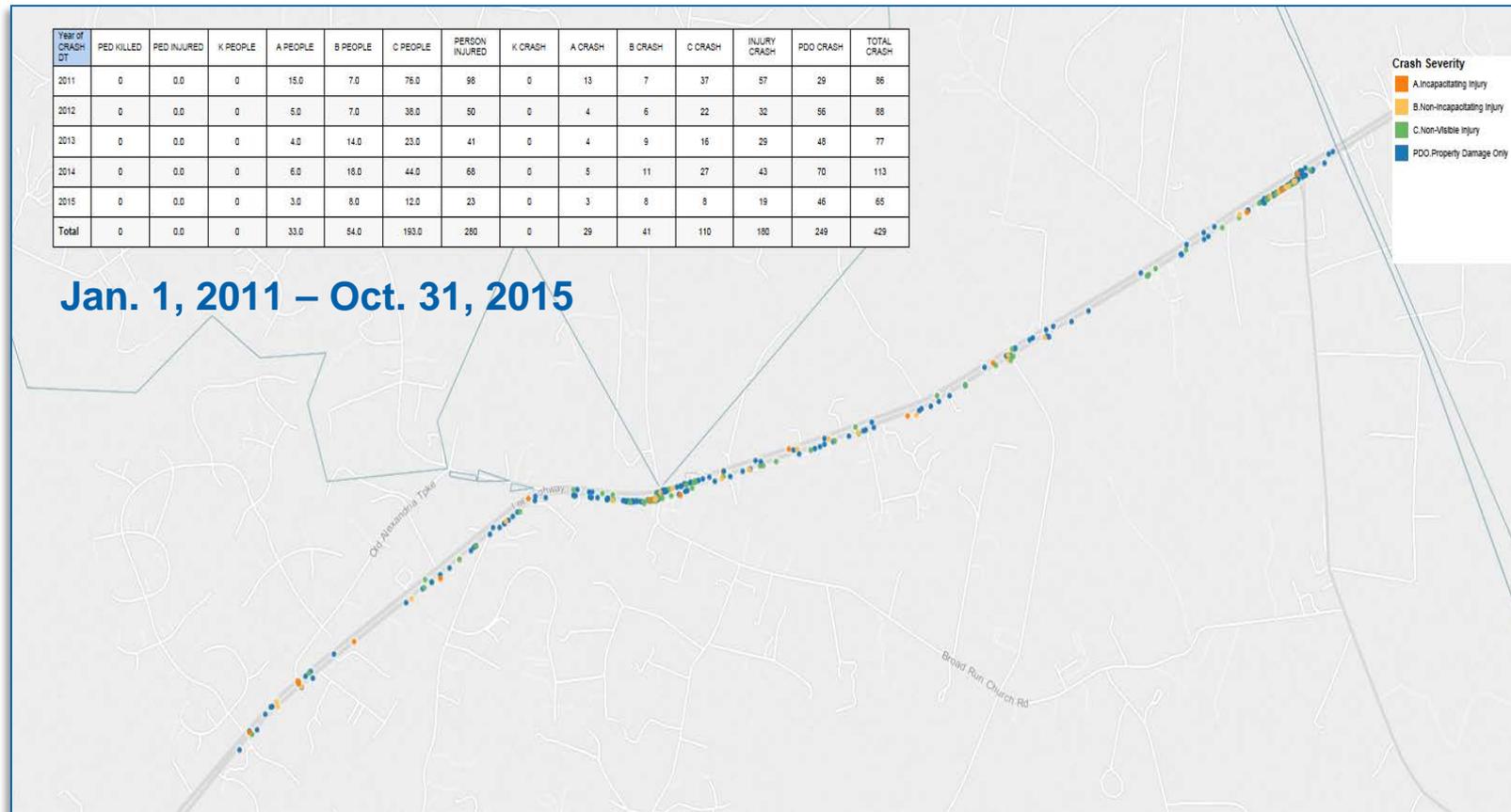
Annual Average Daily Traffic Volumes, 1997-2017

Year	AADT	% Change
1997	37,762	
1998	39,548	4.73%
1999	39,557	0.02%
2000	40,939	3.49%
2001	42,590	4.03%
2002	43,760	2.75%
2003	43,699	-0.14%
2004	44,575	2.00%
2005	43,727	-1.90%
2006	44,772	2.39%
2007	44,754	-0.04%
2008	43,397	-3.03%
2009	44,474	2.48%
2010	44,891	0.94%
2011	44,896	0.01%
2012	45,313	0.93%
2013	45,595	0.62%
2014	45,946	0.77%
2015	46,364	0.91%
2016	47,882	3.27%
2017	48,939	2.21%



Avg. change per year 1.32%
 Total 20 year increase 29.6%

Corridor crash history, Warrenton to PW Co. line



- **Average 89 crashes/year within 3.5 mile section**
- **180 injury crashes in 4.8 years, 280 people injured**

U.S. 29 Corridor Crash Rates

U.S. 29 Statewide:

Crash: 113.04 crashes/million VMT*

Injury: 77.71 injuries/million VMT

Fatal: 0.26 fatalities/million VMT

U.S. 29 Fauquier Co:

Crash: 75.55

Injury: 38.78

Fatal: 0.19

***Vehicle Miles Traveled**

North Warrenton Town Limit to Prince William Co:

Crash: 145.22

Injury: 72.31

Fatal: 0.30

Route 693 to Prince William Co:

Crash: 158.42

(+40% State Corridor)

Injury: 80.69 (+4% State Corridor)

Fatal: 0.00

U.S. 29 Corridor Facilitated Review

Focused on section of U.S. 29 from north of Warrenton to Prince William County line

Multi-year process involved VDOT, Fauquier County & stakeholder representatives with meetings led by outside facilitator

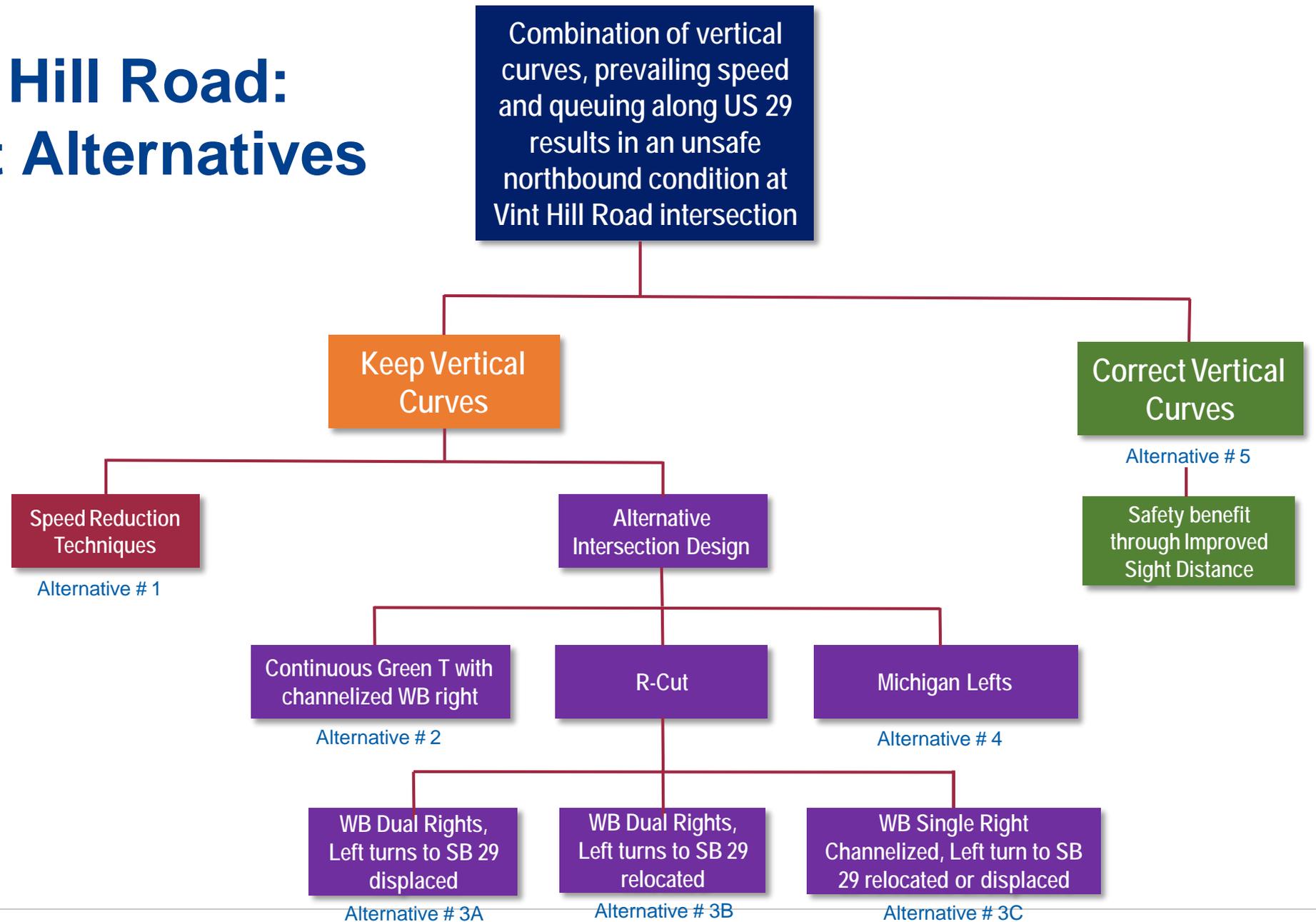
Specific locations identified for safety improvements

Corridor improvements identified to ensure safe and efficient traffic movement

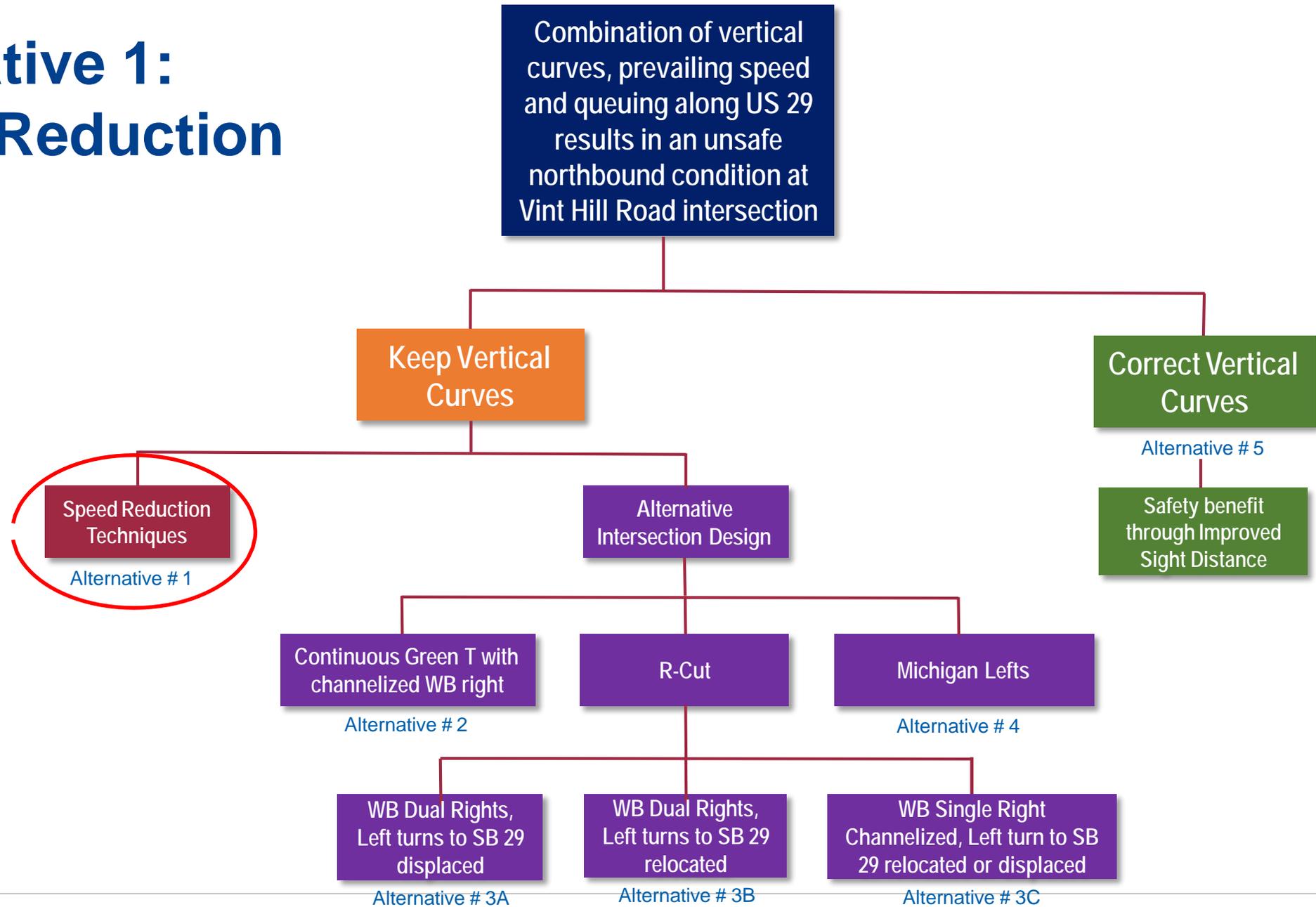
Five alternative concepts developed to address identified safety and capacity issues at U.S. 29 / Vint Hill Road intersection

Study group was unable to reach consensus, review ended without recommendations

U.S. 29 / Vint Hill Road: Improvement Alternatives



Alternative 1: Speed Reduction



Alternative 1: Speed Reduction Techniques



SLOW Pavement Legend
Speed decrease = 1-2 mph



Optical Speed Bars
Speed decrease = 1-2 mph



Advanced Signal
Flasher Improvements
Speed decrease = 1-2 mph



Speed Activated Warning Sign
Speed decrease = 1-2 mph



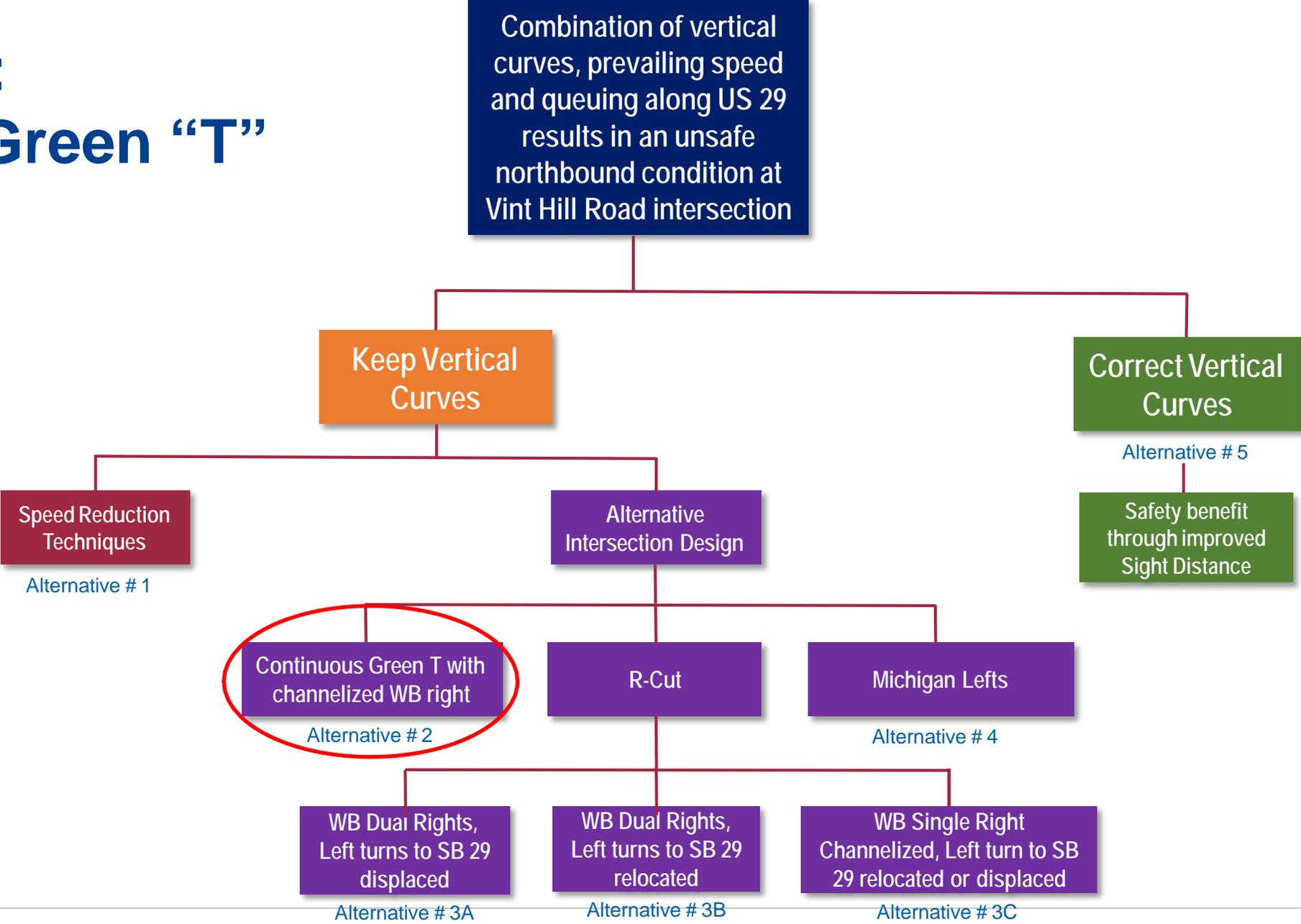
PROS

- Very Low Cost
- Immediate Implementation

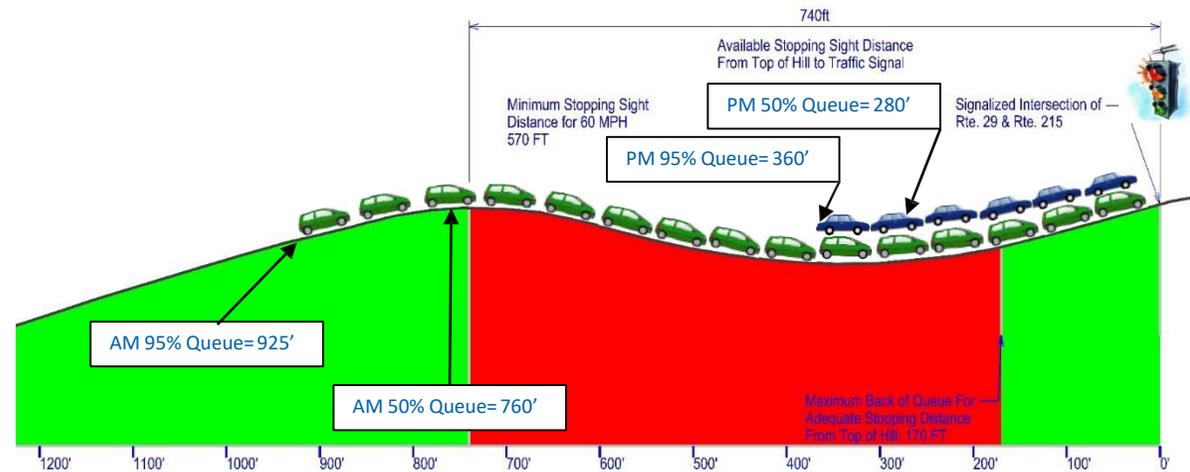
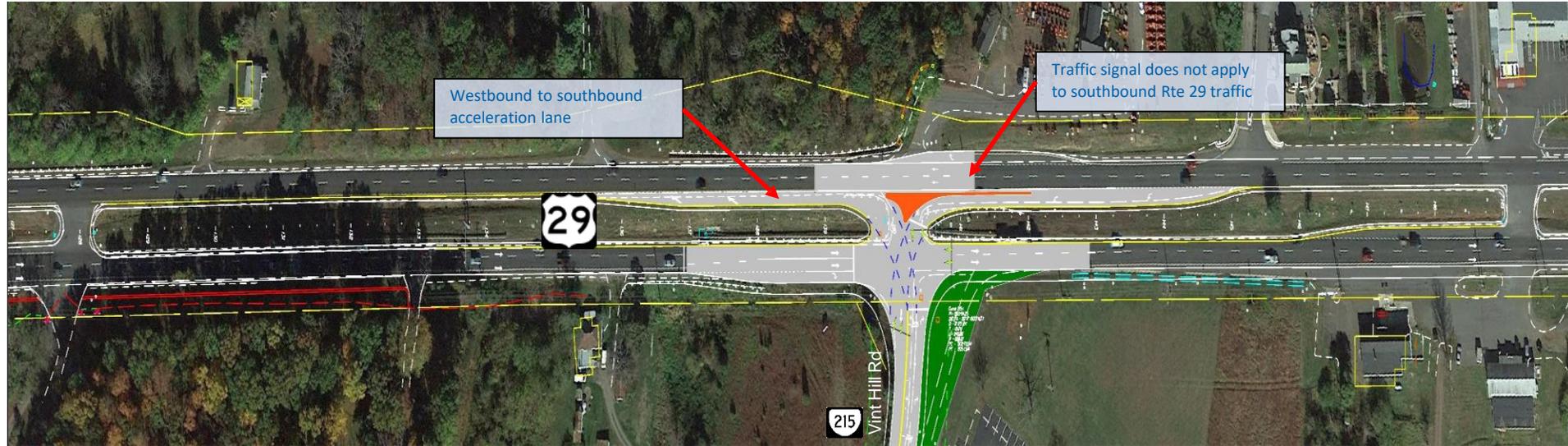
CONS

- Does not eliminate sight distance issue
- Difficult to Enforce

Alternative 2: Continuous Green “T”



Alternative 2: Continuous Green T



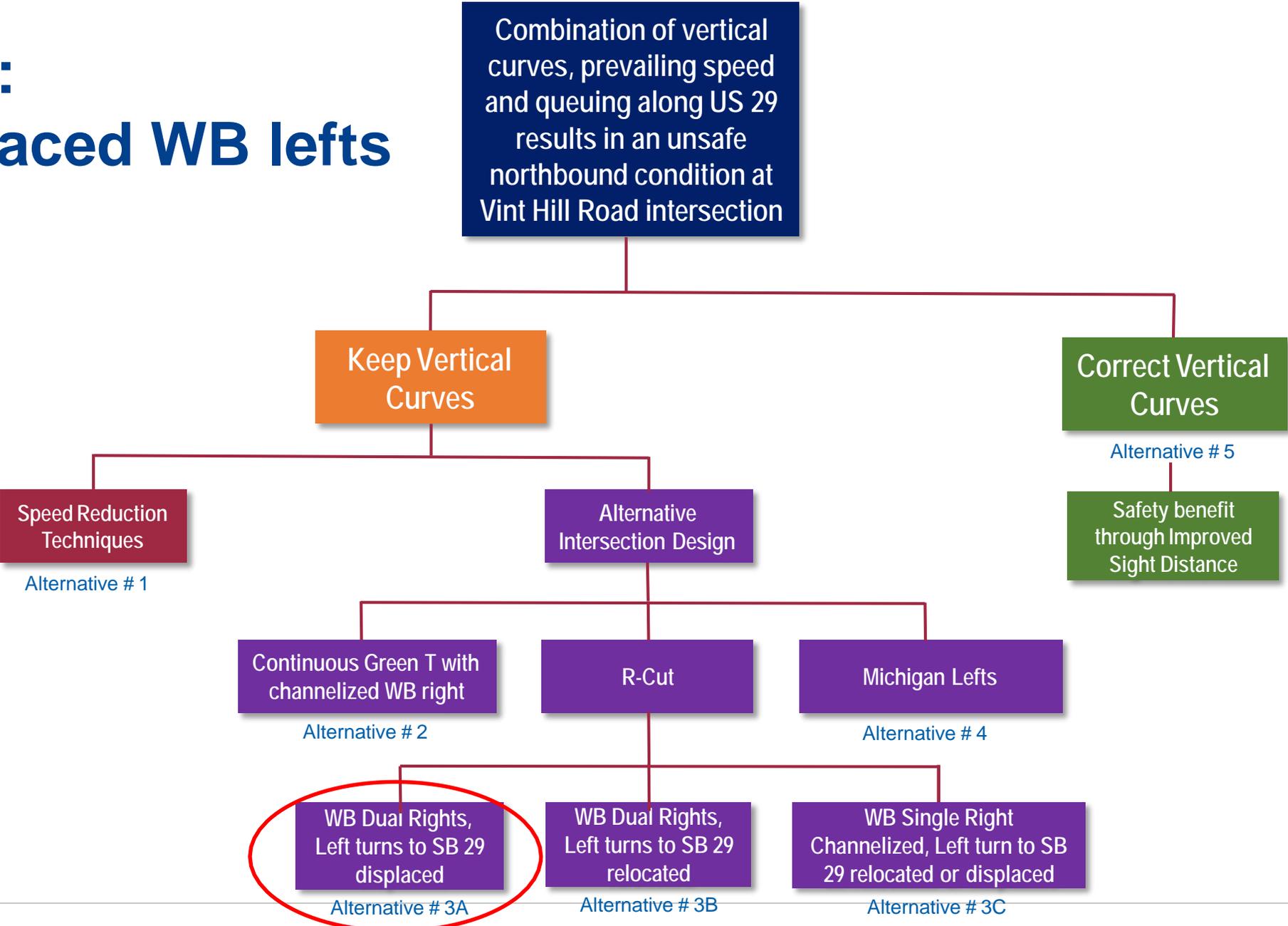
PROS

- Improved Operations
- No stopping for SB Rte. 29
- Improved safety for NB Rte. 29 during PM

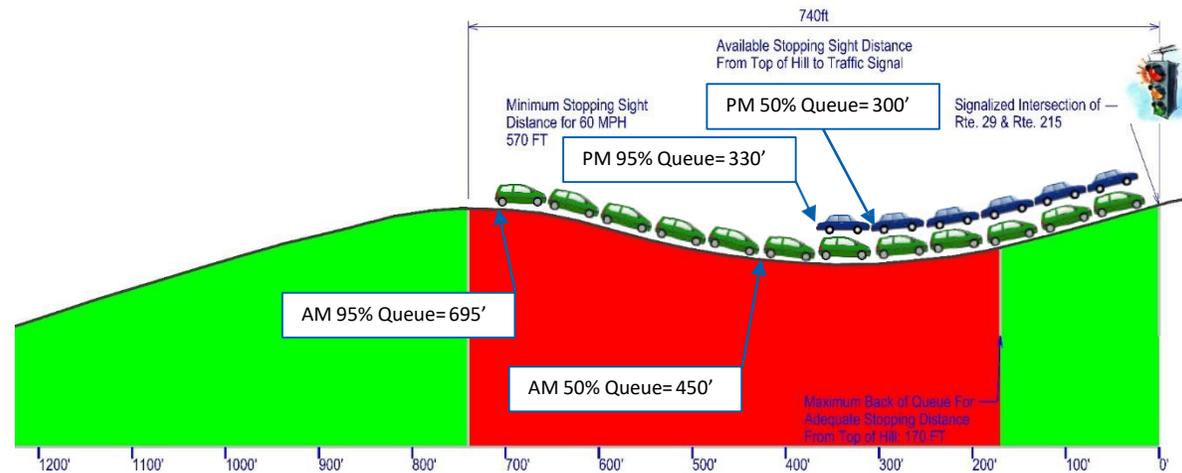
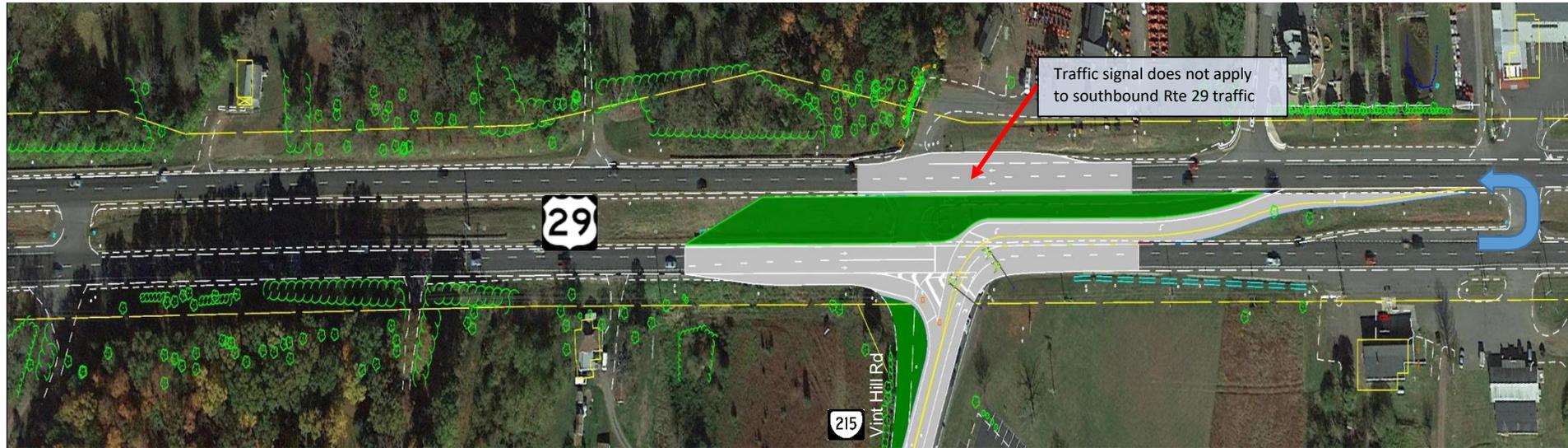
CONS

- Doesn't eliminate PM sight distance issue to back of Queue.

Alternative 3A: RCUT w/ displaced WB lefts



Alternative 3A: RCUT with displaced WB left turns



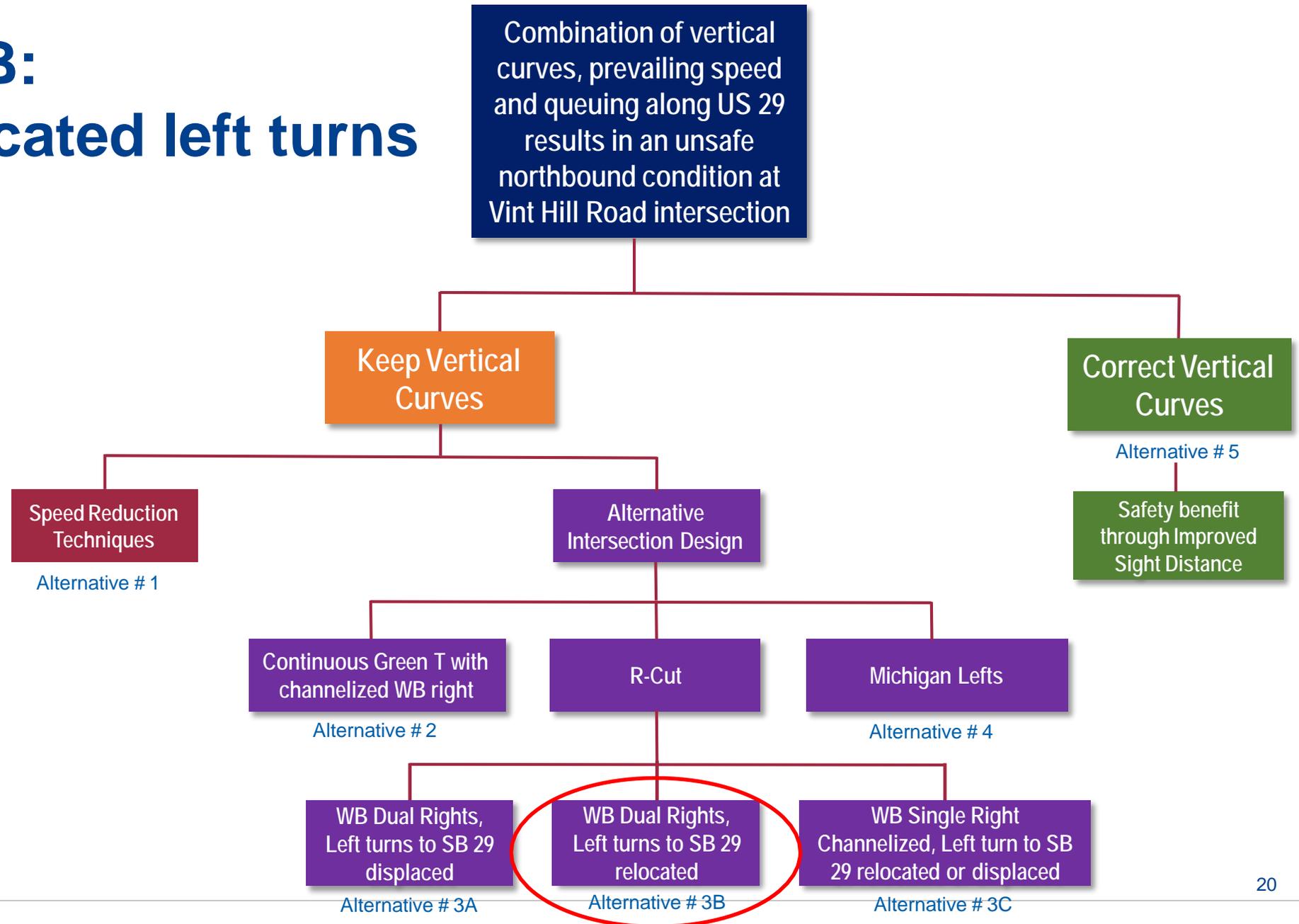
PROS

- Improved Operations
- No stopping for SB Rte. 29
- Improved safety for NB Rte. 29 during PM

CONS

- Doesn't eliminate PM sight distance issue to back of queue.
- Location of AM back of queue within restricted stopping sight distance area

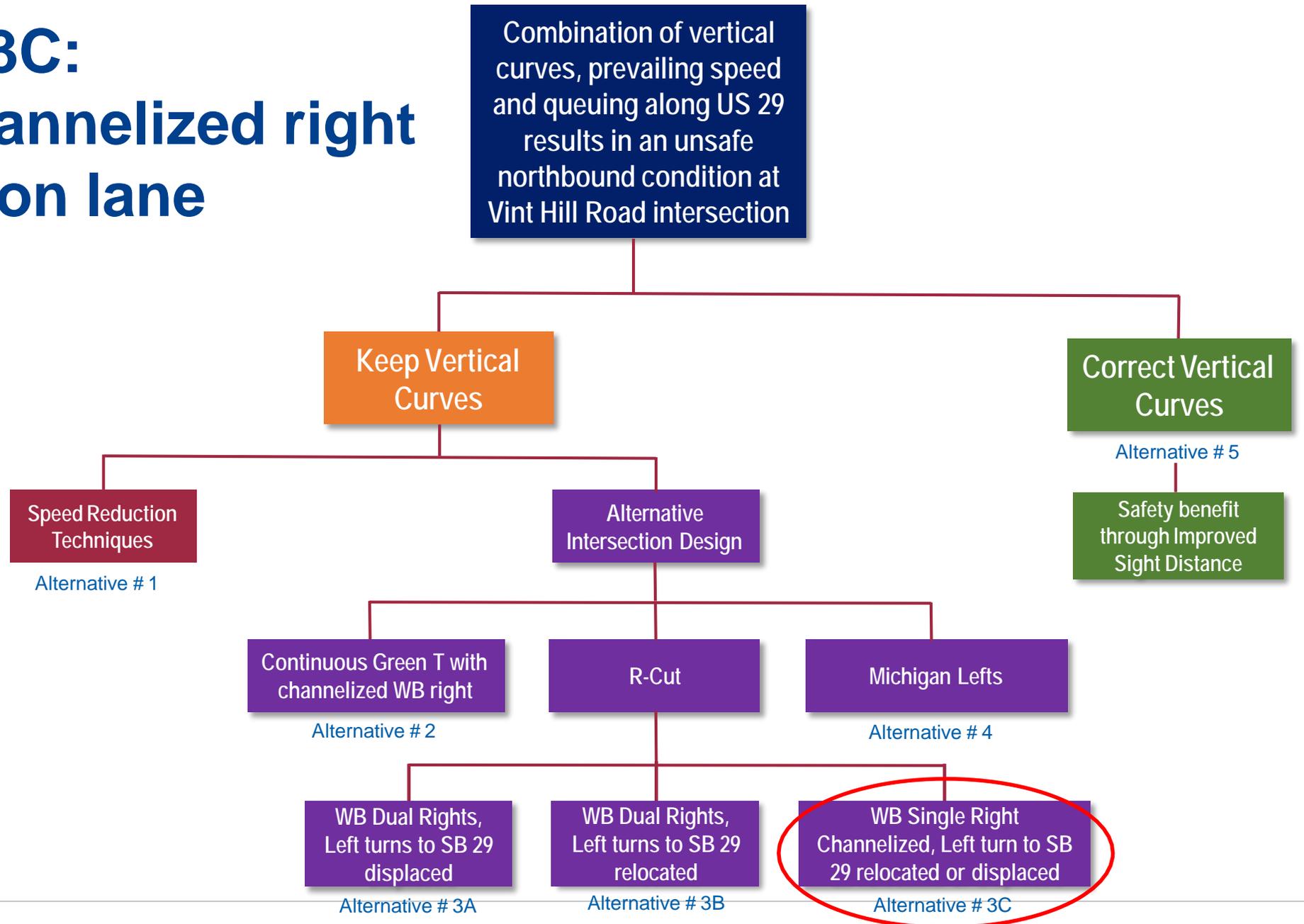
Alternative 3B: RCUT w/ relocated left turns



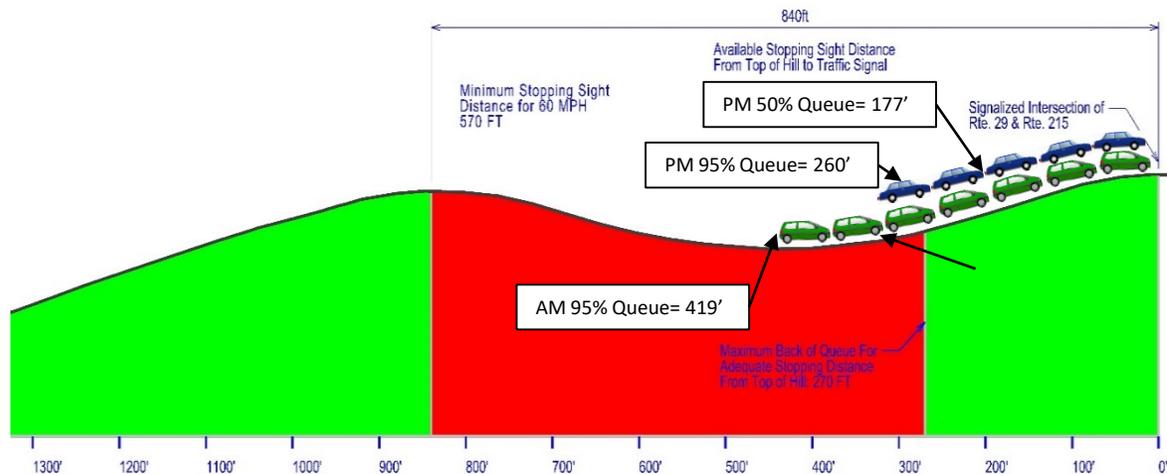
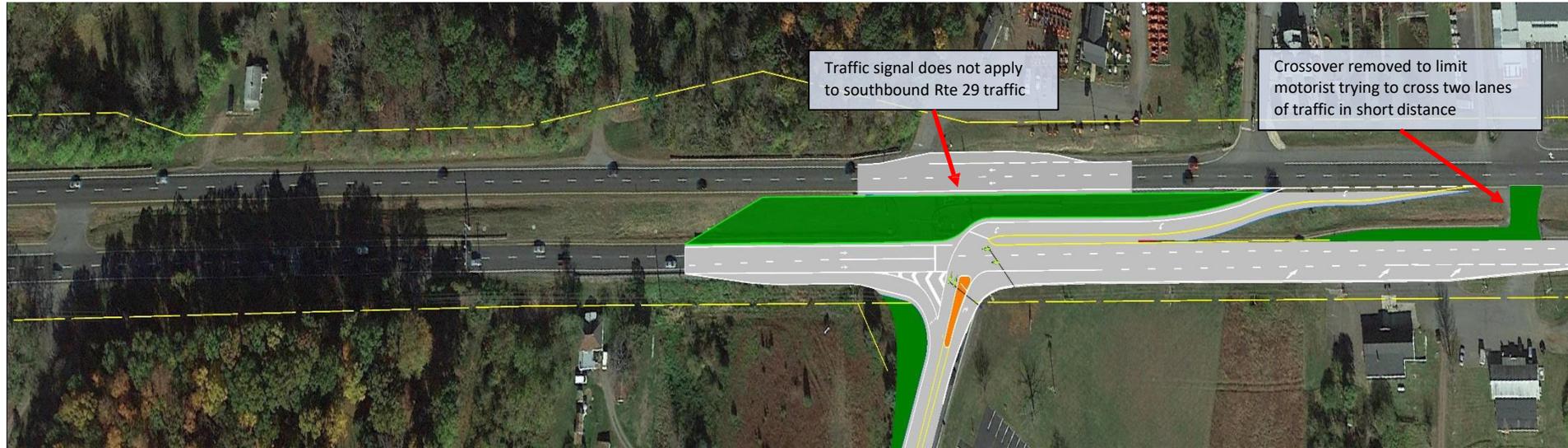
Alternative 3B: RCUT w/ left turns relocated to Riley Rd.



Alternative 3C: RCUT w/ channelized right & acceleration lane



Alternative 3C: RCUT w/ channelized right & accel lane

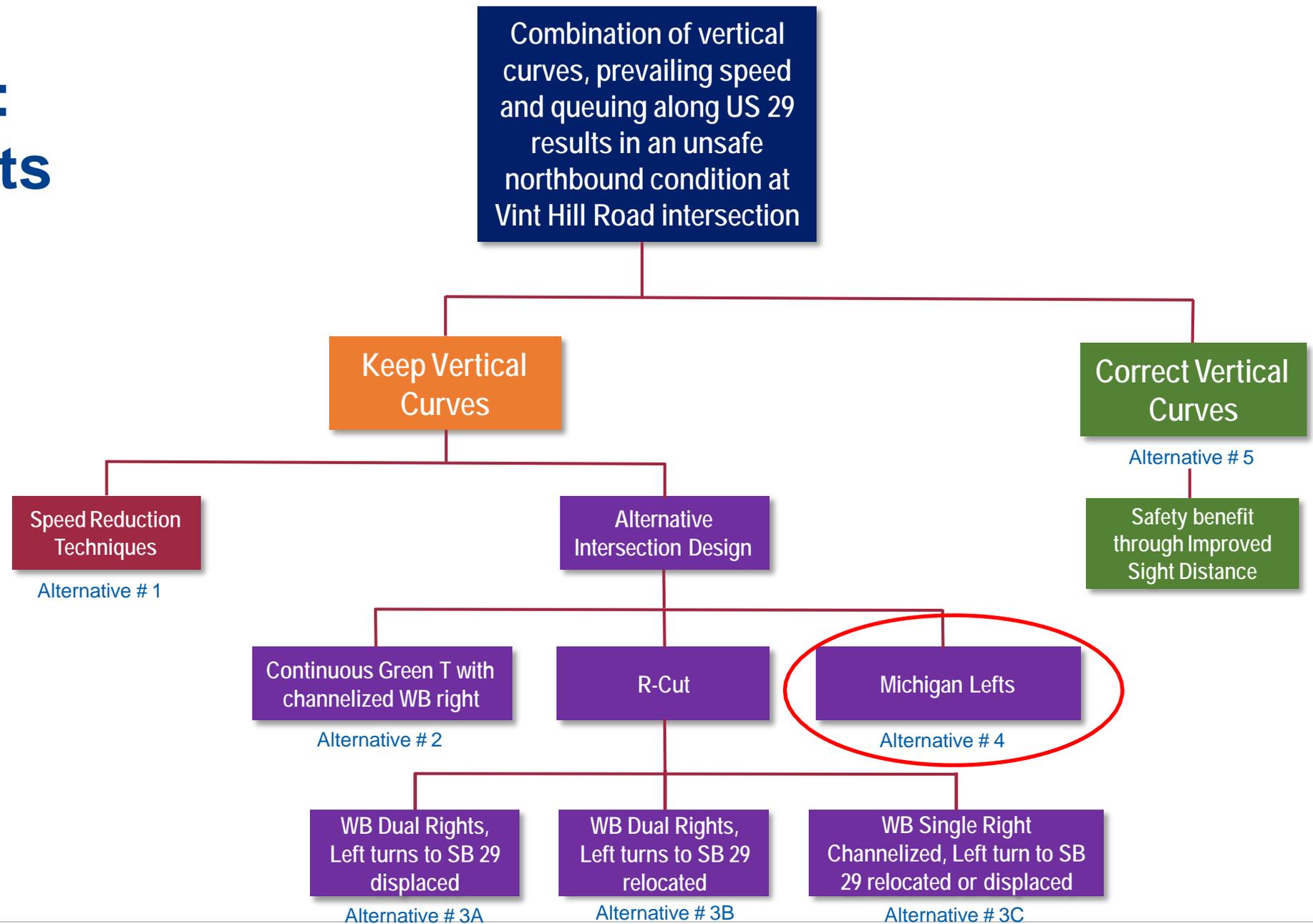


Note: Protected-Permissive Phasing with Flashing Yellow Arrow yields 95th percentile queues of 314 FT and 150FT for the AM and PM peaks respectively.

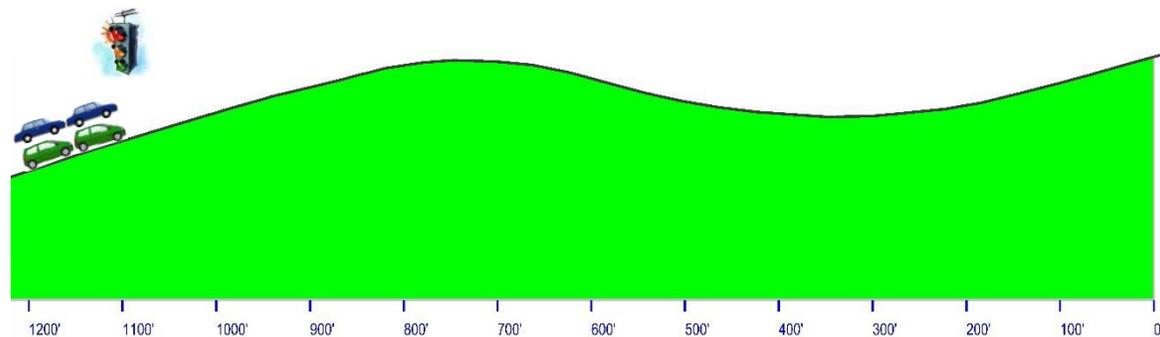
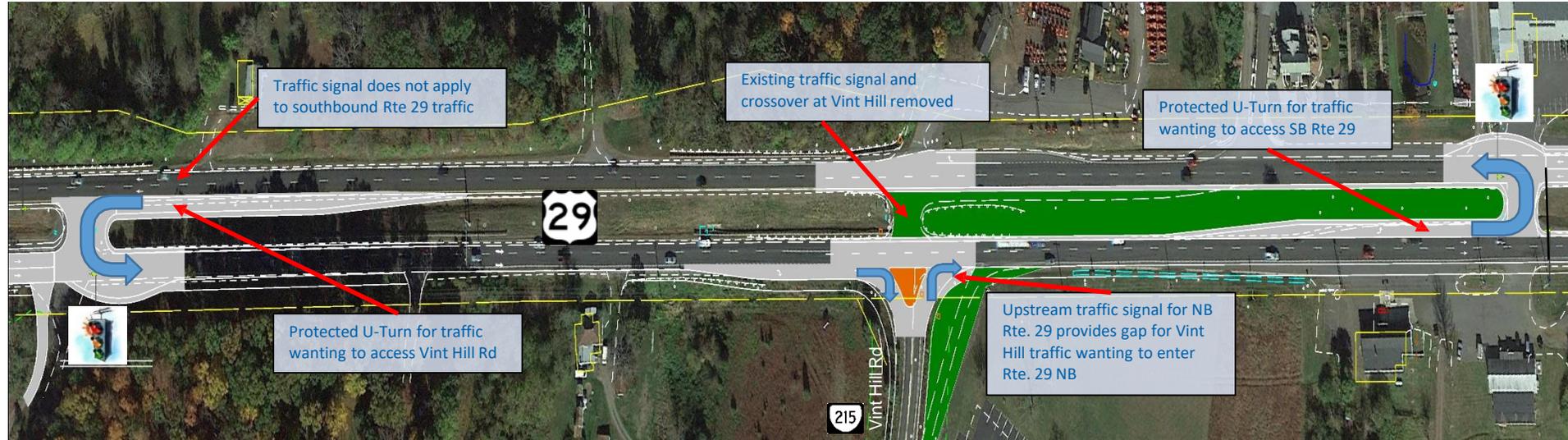
- PROS**
- Improved Operations
 - No stopping for SB Rte. 29
 - Improved safety for NB Rte. 29 during PM

- CONS**
- May not be adequate gaps for U-Turns to SB 29 without separate acceleration lane or traffic signal
 - Doesn't eliminate PM sight distance issue to back of queue
 - Location of AM back of queue within restricted stopping sight distance area

Alternative 4: Michigan Lefts



Alternative 4: Michigan (displaced) Lefts



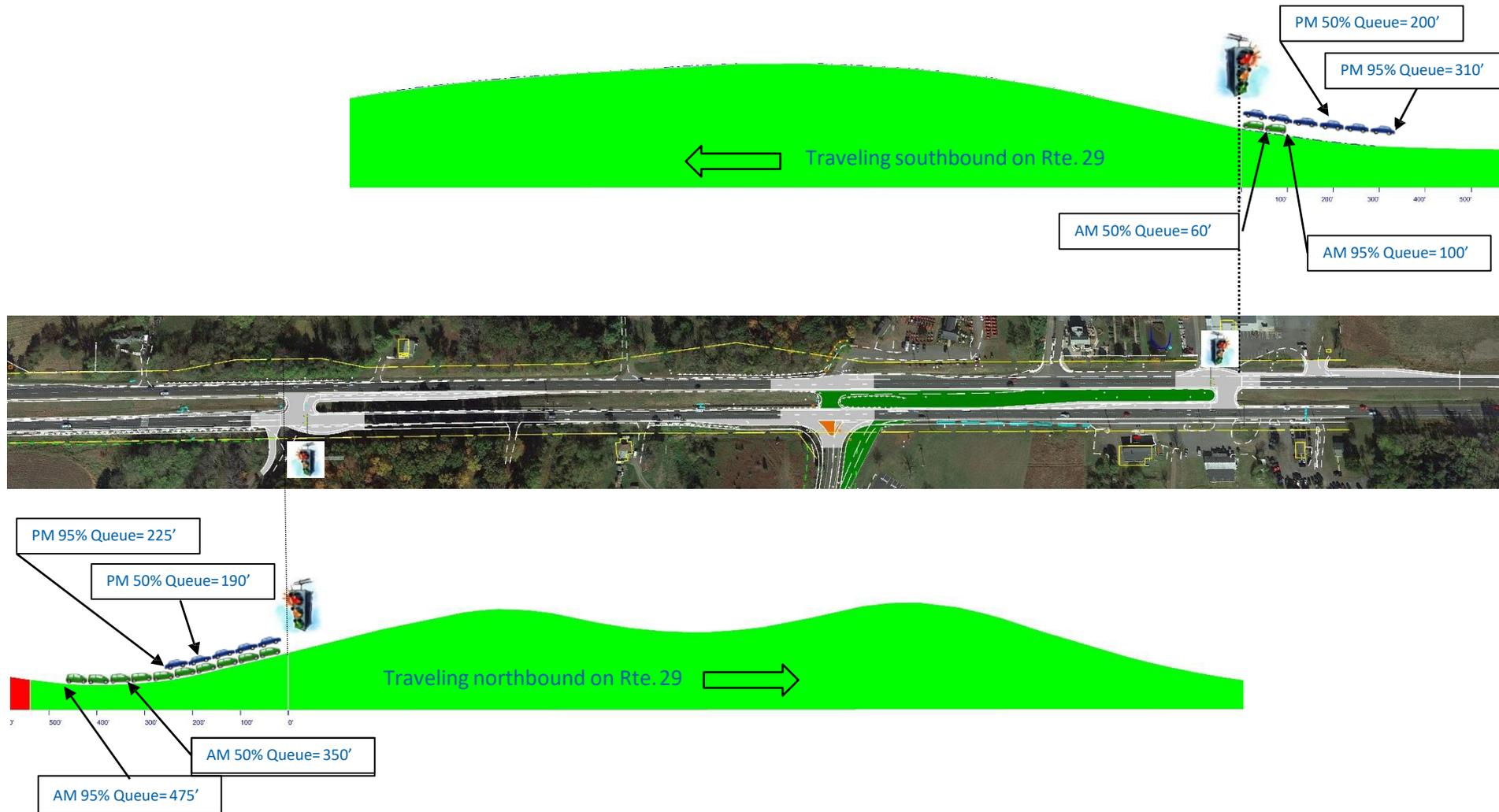
PROS

- Minimal queues for both NB and SB Rte. 29
- Improved operations by splitting traffic signal into two.
- Improved safety since there are no sight distance problems for either traffic signal

CONS

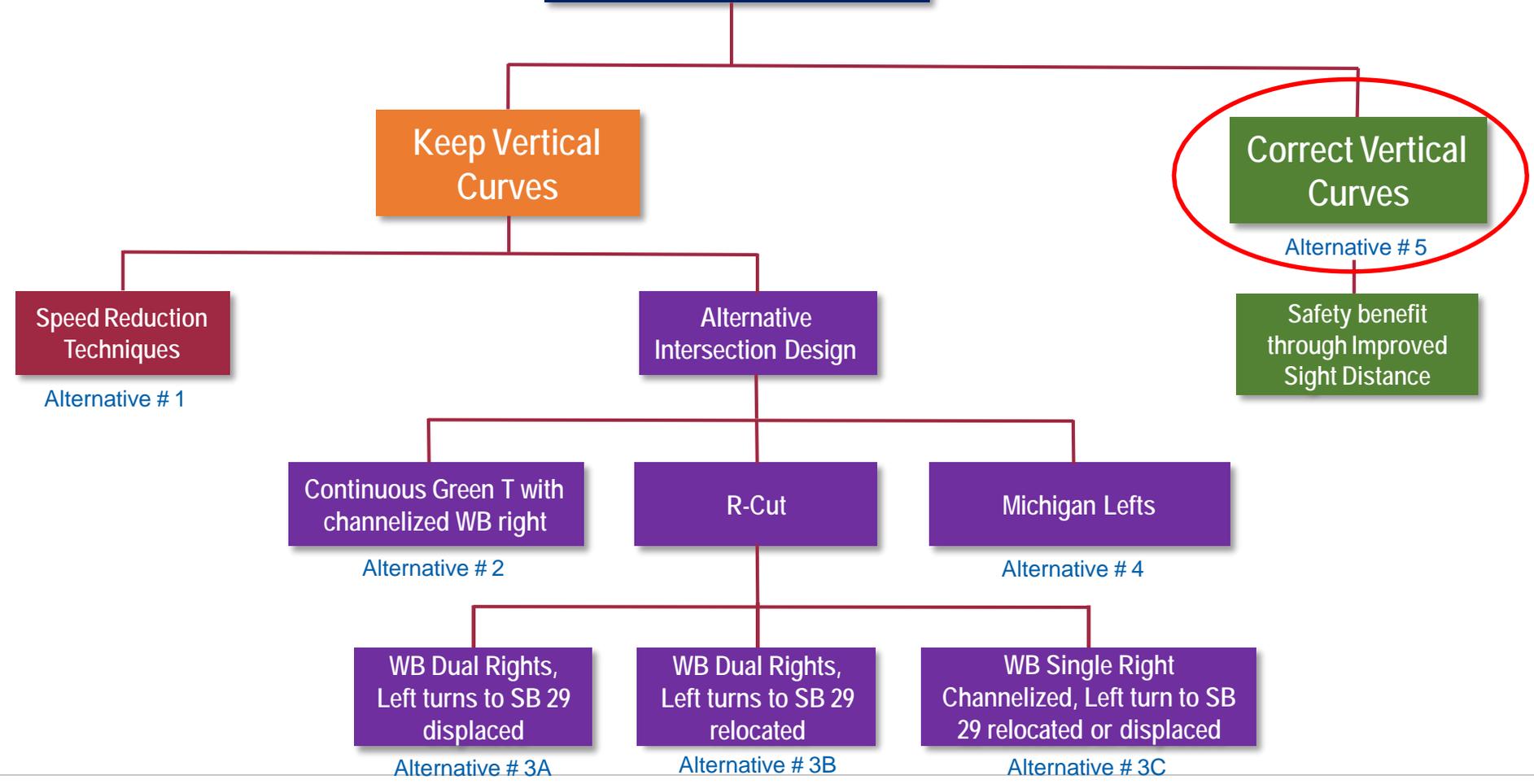
- Increased travel distance for motorists to and from Vint Hill Road

Alternative 4: Michigan (displaced) Lefts, continued

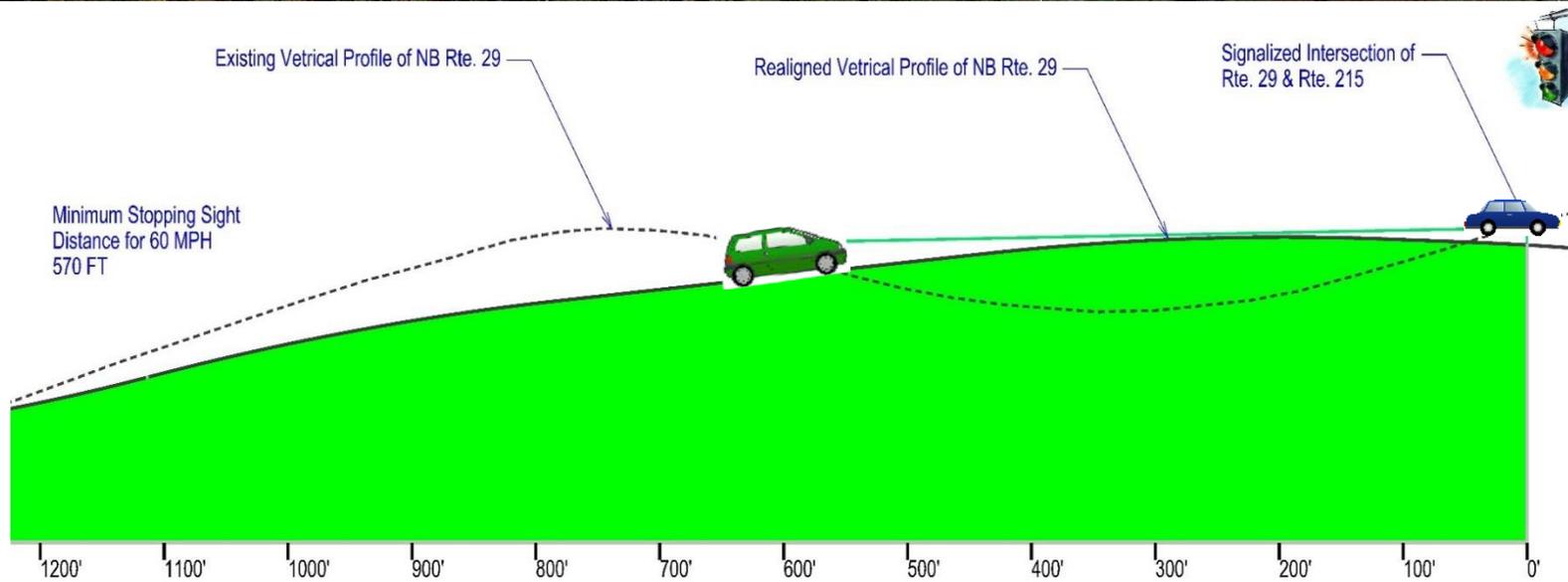


Alternative 5: Correct grade on NB approach

Combination of vertical curves, prevailing speed and queuing along US 29 results in an unsafe northbound condition at Vint Hill Road intersection



Alternative 5: Correct grade on NB approach



Comparison of Alternatives

	Criteria							Benefit/Cost Ratio
	Project Cost	R/W & Utility Needs	Anticipated Sight Distance Safety Improvement		AM Peak Hour Congestion Improvement (Delay)	Maintains Direct Access from SB Rt. 29 to Vint Hill Rd	Time to Implement	
			AM	PM				
Alternative 1 Speed reduction Techniques	<\$100 K	None	Minimal	Minimal	No Change	Yes	Short	Not Calculated
Alternative 2 Continuous Green T	\$2.25 M	None	Minimal	Minimal	Minimal	Yes	Moderate	0.78
Alternative 3A R-Cut, Dual RTs, Displaced LTs	\$1.90 M	None	Worsens	Minimal	Substantial	Yes	Moderate	2.14
Alternative 3B R-Cut, Dual RTs, Relocated LTs	\$1.93 M	None	Worsens	Minimal	Substantial	Yes	Moderate	2.12
Alternative 3C R-Cut, Channelized RTs	\$2.10 M	Some Utility Conflicts	Minimal	Substantial	Substantial	Yes	Moderate	2.65
Alternative 4 Michigan (Displaced) Lefts	\$1.37 M	Minimal	Substantial	Substantial	Substantial	No	Moderate	12.41
Alternative 5 Correct Vertical Curves	\$12.50 M	R/W Needed	Substantial	Substantial	No Change	Yes	Long	0.57

- Less than \$500 K
- Between \$500 K and \$5.0 M
- More than \$5.0 M

- Improves from LOS E to LOS C or better
- Improves from LOS E to LOS D
- Degrades from LOS E to LOS F
- Queue length in green zone
- Queue length shortens to but still in same zone (red or green) as existing condition or Queue changes zone but is short enough that there anticipated safety benefits
- Queue length was in green zone but now in red zone

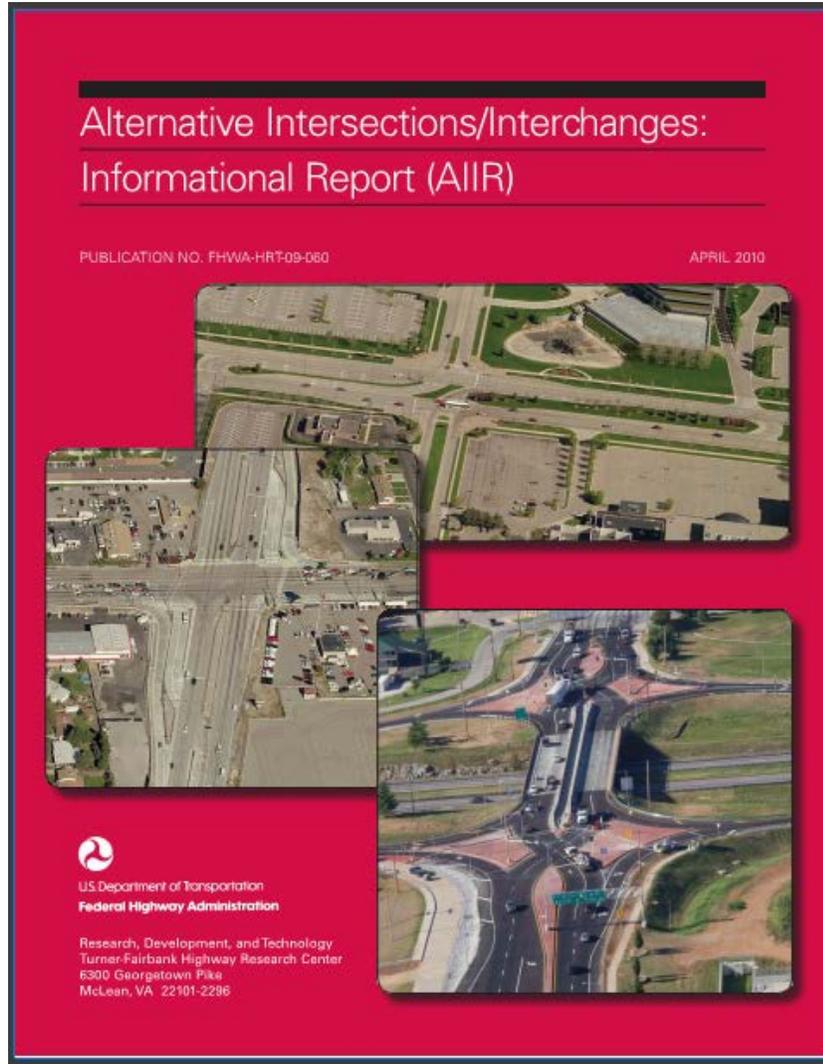
Traffic Engineering Basics

Traffic Signals

- Signals that have capacity issues will see increased crash rates due to congestion
- Signals in more rural, high speed areas or boundaries between rural & urban often see higher injury rates and more severe crashes
- Geometric design and roadway alignment are critical safety factors for signal operations



Alternatives to Conventional Intersection Improvements



Alternative Intersections/Interchanges: Informational Report

FHWA publication, April 2010

Median U-Turn (Michigan Left)

Advantages

- Improved safety: 20-60% crash reduction
- Improved Capacity: 20-30% reduction in stops/delay
- Simplified operation & reduced conflicts
- Lower cost of construction compared with widening or grade separation
- Less impact to surrounding property than larger scale projects

Disadvantages

- Reduced direct access
- Heavy vehicle accommodations

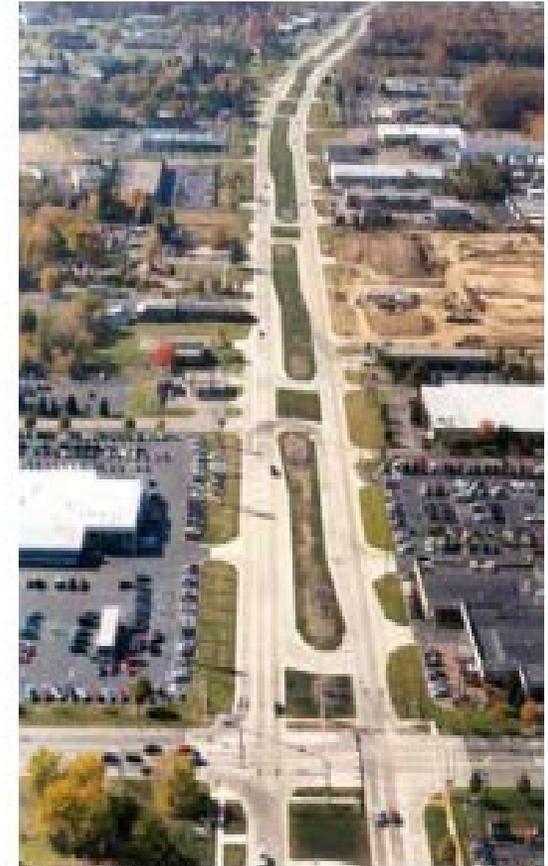


Figure 52. Photo. MUT intersection in a corridor in Michigan. ⁽³²⁾

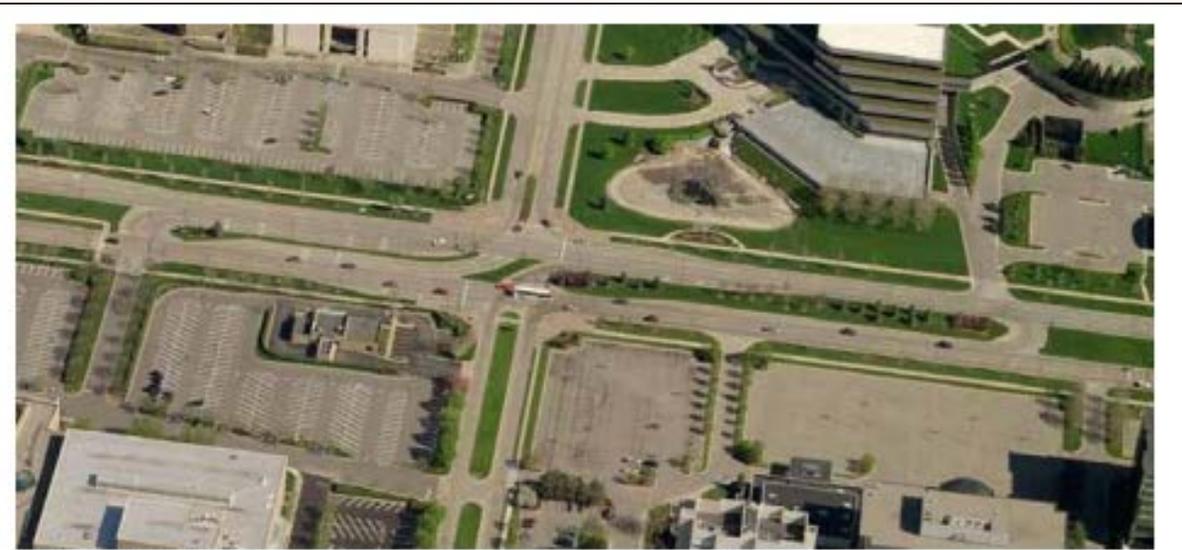
Restricted Crossing U-Turn (RCUT)

Advantages

- Improved Capacity for lower volume side streets (up to 30%)
- Improved Safety due to reduced conflict points (30-50% lower, MD 90-100%)
- Allows more access than MUT
- Generally can be done within ROW

Disadvantages

- Heavy vehicles
- Pedestrian accommodations



Source: Google™ Earth

Figure 82. Photo. RCUT intersection in Troy, MI.

Summary

- **A comprehensive plan for improvements to the section must be developed**
- **Access management is a critical component of the plan**
- **Innovative and alternative intersection designs can help solve problems at lower cost, reduced environmental impact and with a greater sense of place**

Success Stories

U.S. Department of Transportation
Federal Highway Administration

NC 55 Bypass, Holly Springs, NC RESTRICTED CROSSING U-TURN INTERSECTION

THE PROBLEM
Traffic on an already heavily traveled mixed use corridor was expected to more than double within just a few years due to additional growth and the opening of a new interchange.

THE SOLUTION
A series of four Restricted Crossing U-Turn intersections along the corridor.

THE OUTCOME

- Reduced travel times on the main roadway.
- Reduced number of potential conflict points, benefiting both motorized and non-motorized traffic.
- Ability to handle increasing traffic for the next 20 years.
- Innovative design solution funded with private investment in the form of a public-private partnership between NCDOT and a local developer.

Background
Located in Wake County, the NC 55 Bypass is a four-lane divided expressway. The surrounding area consists of residences, big box retail, offices, and other mixed use development. Already a heavily-traveled roadway, planned growth and development were expected to double traffic in the area by 2013.

Challenges
The opening of a new shopping center and the addition of an interchange with I-540 posed safety and operational challenges for the motorized and non-motorized users of the NC 55 Bypass. While the road carried approximately 25,000 vehicles per day in 2011, these changes were expected to more than double the amount of traffic to 53,000 vehicles per day.¹

Approach
North Carolina DOT (NCDOT) knew it needed to upgrade the corridor to handle the projected increase in traffic, but funding was an issue. NCDOT considered different options and quickly determined that Restricted Crossing U-Turn (RCUT) intersections, also known as Superstreets, would move traffic more efficiently, providing better throughput than a square loop interchange. RCUTs also could reduce conflict points between vehicles by half and total vehicle collisions by 46 percent.² A local developer privately funded the new RCUTs. They were planned to better accommodate existing developments as well as spur new ones.

Results
Because the RCUT design creates a consistent progression along the corridor, the new intersections have increased efficiency by reducing travel times on the main roadway. Furthermore, engineers with the city of Holly Springs expect the NC 55 of Holly Springs to handle increasing Bypass RCUTs to handle increasing and traffic for the next 20 years. Foot and bicycle traffic are accommodated by a signalized crosswalk to the median of the roadway. Pedestrians and cyclists can use the median as a refuge. With the new design, they do not have to worry about turning vehicles conflicting with their path while they cross the street.

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mark.doctor@dot.gov

CORRIDOR LOCATION
35°39'27.2"N, 78°50'54.7"W

FHWA-SA-14-064

When we analyzed the corridor, we saw that a superstreet would actually work better than a square loop interchange ... We could process more traffic more efficiently.
— Johna Dunlap, P.E., Congestion Management Engineer, North Carolina DOT

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U.S. Department of Transportation
Federal Highway Administration

US 15, Frederick County, MD RESTRICTED CROSSING U-TURN INTERSECTION

THE PROBLEM
Located in a rural area, US 15 is a four-lane divided highway that intersects numerous two-lane minor roads. Before conversion, drivers found it difficult to judge left turn and through movements at these intersections, resulting in high levels of fatal and injury crashes.

THE SOLUTION
Install a series of six RCUTs between Frederick and Emmitsburg in Frederick County.

THE OUTCOME

- After construction of the RCUTs, injury and fatal crashes decreased by 40 percent and 70 percent respectively. Property damage crashes decreased by 20 percent.

Background
The state of Maryland has implemented a series of Restricted Crossing U-Turn, or RCUT, intersections along US 15 in the towns of Frederick and Emmitsburg in Frederick County. In 2009, average annual daily traffic (AADT) along that stretch of US 15 ranged from about 45,000 vehicles per day near Frederick down to about 20,000 vehicles per day near the Pennsylvania border.¹

Challenges
US 15 is a four-lane divided highway with several minor road intersections. The stretch between Frederick and Emmitsburg experienced high rates of injury and fatal crashes at these intersections, but there wasn't enough funding to build expensive interchanges. Instead, Maryland started looking for a lower cost solution. The state opted to install a series of RCUT intersections, which can cost only a fraction of what an interchange would cost to build.²

Approach
Maryland installed six RCUTs along US 15. Due to the higher speed limits on this stretch, many of the U-Turn crossovers have dedicated acceleration lanes that allow drivers to safely reach highway speeds before merging with traffic.

Results
After construction of the RCUTs, injury and fatal crashes decreased by 40 percent and 70 percent respectively. Property damage crashes decreased by 20 percent.³

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CORRIDOR LOCATION
39°40'57.7"N, 77°20'50.5"W

FHWA-SA-14-062

We can achieve the [safety] results we're looking for at a fraction of the cost of an interchange.
— Keith Killen, P.E., Transportation Project Manager, Missouri DOT

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This Fact Sheet is a companion to the Video Case Study (FHWA-SA-14-061)

U.S. Department of Transportation
Federal Highway Administration

US 17 Corridor, Wilmington, NC RESTRICTED CROSSING U-TURN INTERSECTION

THE PROBLEM
Conventional intersections along a major access route were operating at maximum capacity, unable to support the mobility, safety, and economic development needs of the region.

THE SOLUTION
A series of six Restricted Crossing U-Turn intersections along a major regional arterial highway.

THE OUTCOME

- Expected reductions in travel time — 25 percent overall.
- Expected reductions in crashes — an average of 46 percent in total crashes and 63 percent in injury crashes.
- Innovative design solution funded with private investment in the form of a public-private partnership between NCDOT and regional developers.

Background
A four-lane divided expressway, US 17 is located near the coastline south of Wilmington, North Carolina. A major north-south highway, US 17 provides access to over 40 named beaches, the Hatteras National Seashore, and the Pea Island National Wildlife Refuge in addition to serving key military bases, ports, and shopping centers. North Carolina DOT (NCDOT) has identified US 17 as one of the state's Strategic Highway Corridors.

Challenges
US 17 was a road with no signals and an average daily traffic (ADT) volume of about 28,000¹. Developers were planning to build a discount super store and a large shopping center, spur residential and economic growth in the area. However, the existing conventional intersections along the corridor near Wilmington and Leland already operated at capacity. They could not meet the mobility, safety, and economic development expectations of the region.

Approach
Local developers shared NCDOT's interest in improving and enhancing area roadways, so they formed a public-private partnership. Their combined resources allowed the installation of a series of six Restricted Crossing U-Turn (RCUT) intersections along US 17. Also known as Superstreets, these intersections were capable of handling nearly twice as much traffic as the original, conventional alternatives.

Results
Users are realizing safety and mobility benefits on the entire corridor. At the Wilmington intersection, drivers are moving through the main intersection 20 percent faster than before, even though ADT has increased to more than 42,000. Simulations of the whole corridor show a 25 percent decrease in travel times during peak hours. A study of North Carolina RCUT intersections shows average decreases of 46 percent in total crashes and 63 percent in injury crashes due to the RCUT design.²

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CORRIDOR LOCATION
34°12'49.88"N, 78°12'22.16"W

FHWA-SA-14-066

I would consider this the perfect application of the [RCUT]. You have a lot of traffic, major developers ... adding grade-separated solution ... and then the level of service ... at a fraction of the cost.
— Boston Schrieber, Ph.D., P.E., Assistant Director, Highway Systems, ITRC, NC State University

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This Fact Sheet is a companion to the Video Case Study (FHWA-SA-14-065)

U.S. 29 Corridor Improvements Grays Mill Rd. to Commerce Court

CONCEPTUAL ROUTE 29 CORRIDOR NEW BALTIMORE

GREENSPACE
MEDIAN
PAVED AREA

Sheet 2
September 2017



Aerial Imagery © Commonwealth of Virginia

U.S. 29 Corridor Improvements Riley Rd. to Vint Hill Rd.

CONCEPTUAL ROUTE 29 CORRIDOR NEW BALTIMORE

GREENSPACE
MEDIAN
PAVED AREA

Sheet 3
September 2017



Aerial Imagery © Commonwealth of Virginia

U.S. 29 / Broad Run Church Rd. Signalized RCUT concept

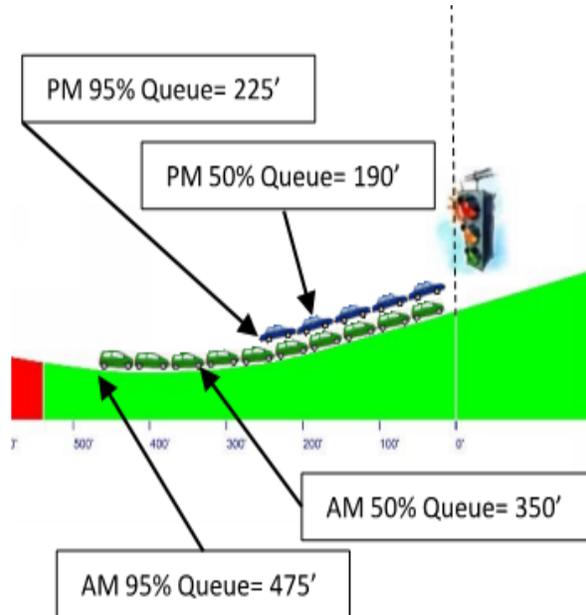
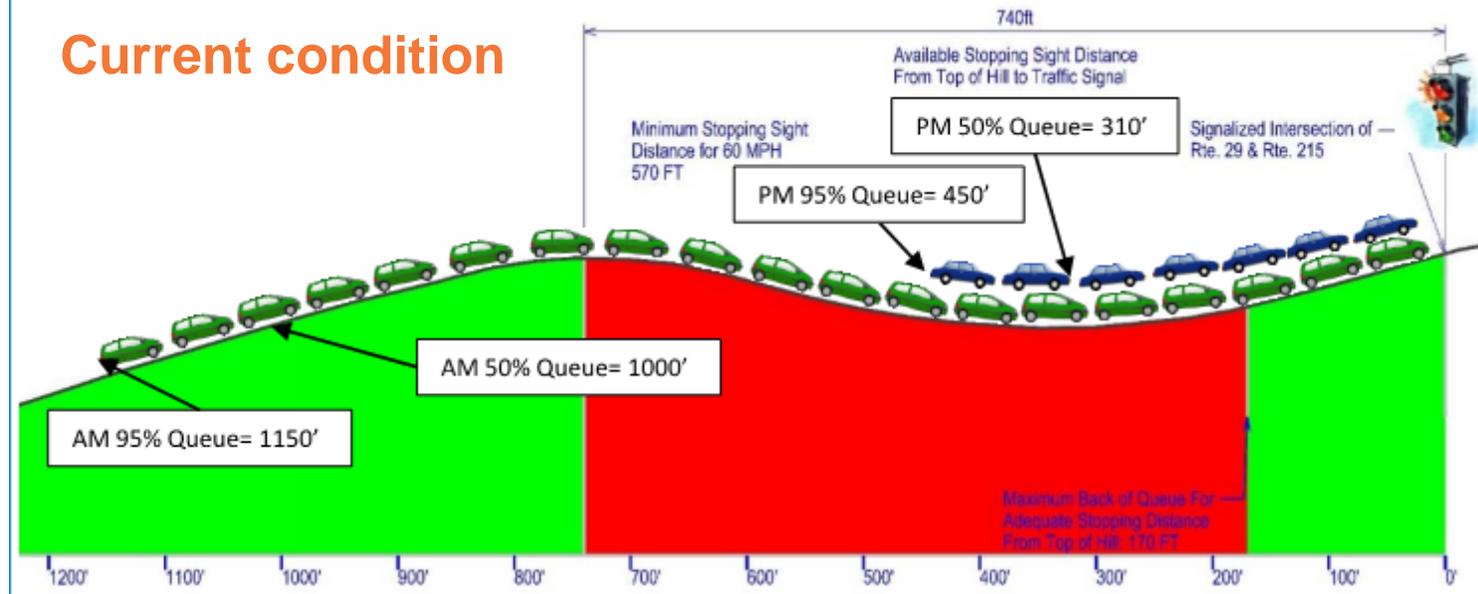


U.S. 29 / Vint Hill Rd. Michigan Left concept



Why Alternative 4 (Michigan Left) Works

Current condition



Traveling northbound on Rte. 29 →

Condition with Michigan (displaced) Left turn

Where We Are Today



- **U.S. 29 at Route 600 (Broad Run Church Road):** RCUT concept has been approved for funding by CTB. Preliminary engineering phase is pending.
- **U.S. 29 at Route 215 (Vint Hill Road):** Michigan Left concept submitted to Traffic Engineering for Highway Safety Improvement Program (HSIP) funding.
- **Fauquier Board of Supervisors requested by resolution that “VDOT and Fauquier County work together to reach a design solution for the U.S. 15/29 corridor no later than May 1, 2019.”**