INTERSECTION ALTERNATIVES ANALYSIS:
CHESTNUT RIDGE RD & VAN VOORHIS RD
MAY 16, 2013

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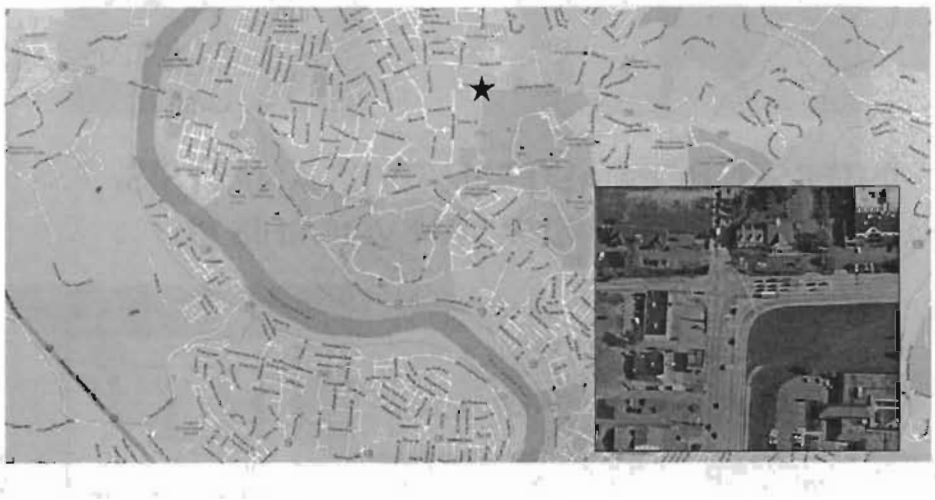
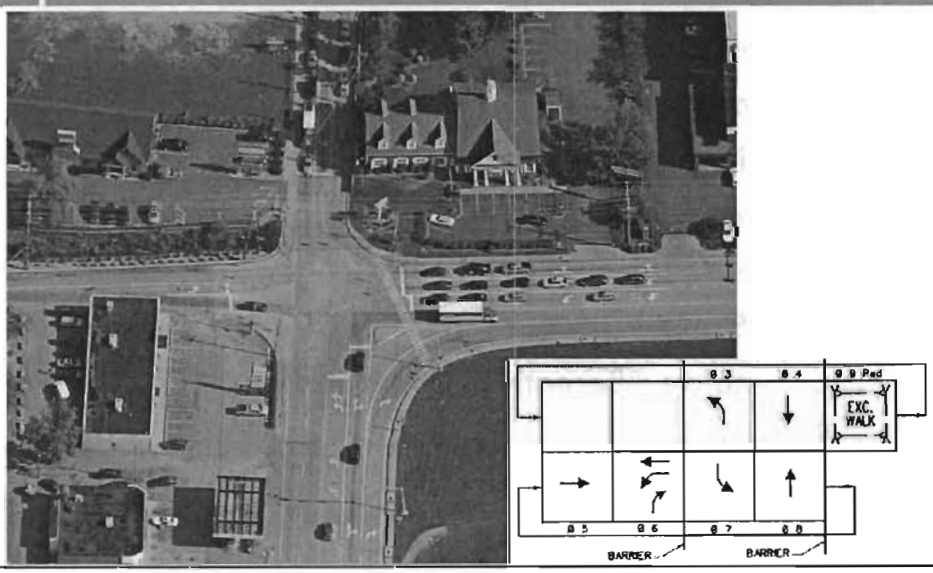
Agenda

- Intersection Overview
- Project Background
- Description of Alternatives
- Alternative Operational Performance
- 20-year Projected Conditions
- New Signal @ Suburban Lanes & Office Depot
- Qualitative Alternative Comparisons
- Summary

Intersection Location



Existing Geometry and Signal Phasing

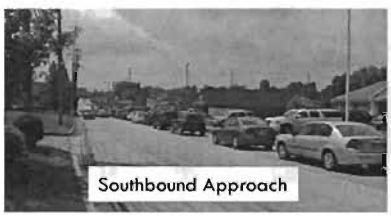


Existing Signal Operations

- Currently runs coordinated timing plans from 7-9am (cycle = 166s) and 2-7pm (cycle = 206s) on weekdays and "Free" other times
  - Coordination plan cycles are 2x the cycle lengths of the adjacent signal system to the east
- The push-button actuated exclusive pedestrian movement is 27 seconds

Notable Existing Problems

- Southbound and Eastbound approaches back up during AM Peak (and other times)
- Northbound thru movement backs up during PM Peak
- Southbound left-turn is permitted which can result in right-angle collisions due to vehicles in intersection


Southbound Approach

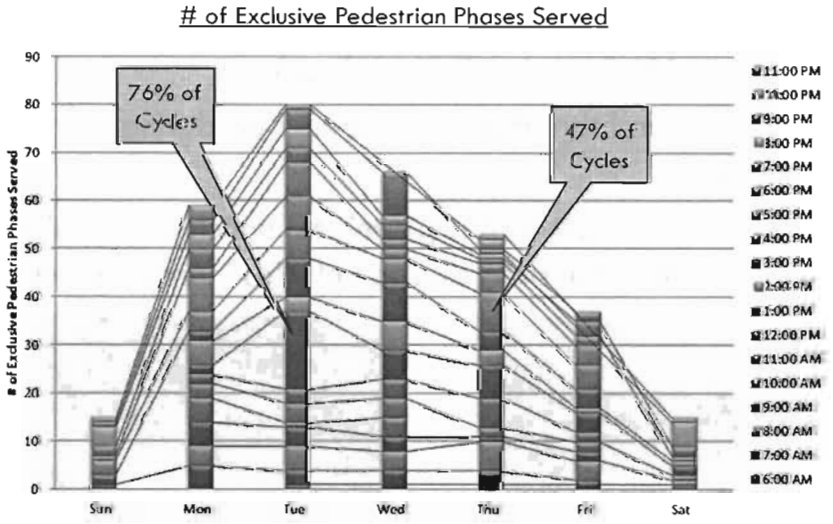

Eastbound Approach

Notable Existing Problems

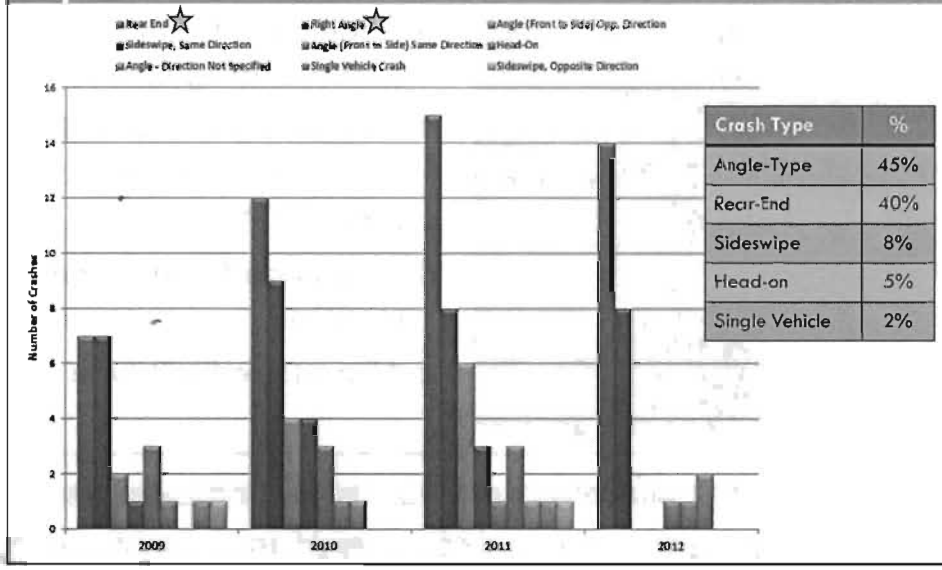
- Northbound right-turn drivers <u>do not stop</u> for pedestrians legally in the crosswalk (i.e., have a walk indication)
  - Motorists see a circular red indication and no green right-turn arrow
- Northbound right-turn movement behavior varies among drivers, which contributes to rear-end collisions

Intersection Pedestrian Demand

July 7-13, 2012



Summary of Crashes by Type
2009-12 in Intersection Vicinity



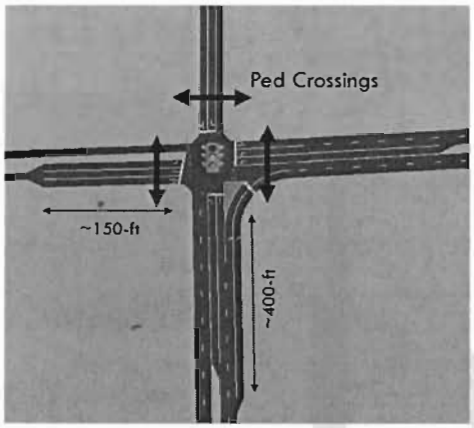
Crash Type	%
Angle-Type	45%
Rear-End	40%
Sideswipe	8%
Head-on	5%
Single Vehicle	2%

Project Background

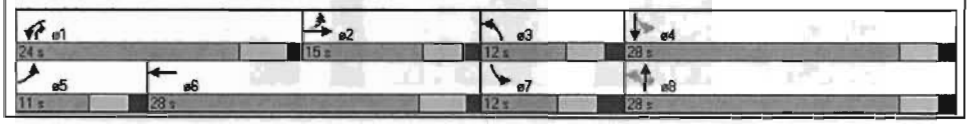
- Initial alternatives analysis evaluated both 2-lane and 3-lane roundabouts at this intersection
- 3-lane roundabout was necessary to meet the operational demand, but was not feasible due to
  - The right-of-way needed to accommodate the necessary geometry
  - The potential delay for the eastbound approach
  - Lack of pedestrian accommodations
- Two alternatives identified for detailed analysis

Alternative 1 Conceptual Layout

Add Northbound & Eastbound Lanes

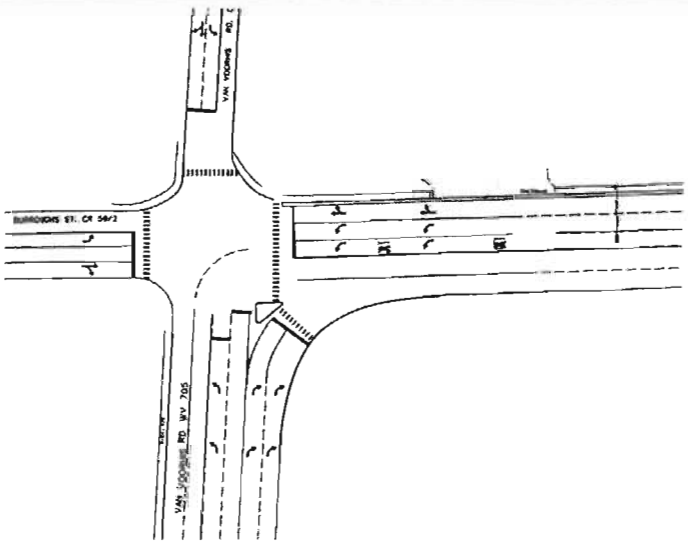


- Additional NB lane (within existing R/W)
- Additional EB lane and extended LT storage (add'l R/W needed)
- 3 signalized pedestrian crossings
- All protected left-turns



Alternative 1 Design Layout

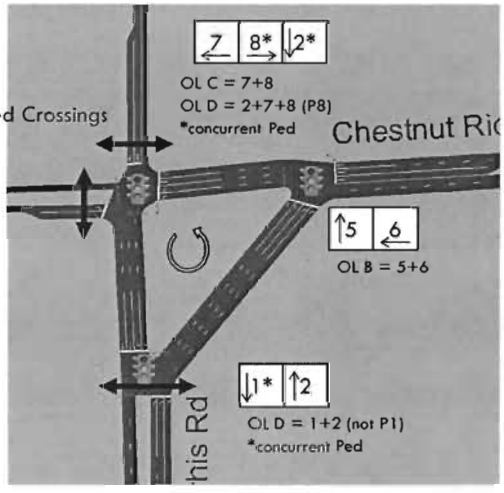
Add Northbound & Eastbound Lanes



Alternative 1 Benefits
Add Northbound & Eastbound Lanes

- Pedestrian movements will be provided across 3 approaches running concurrently with vehicles
- Protected only left-turns will reduce crashes
- Northbound right turn will be signalized to eliminate driver confusion and ensure pedestrian right-of-way
- Westbound thru movement runs concurrently with eastbound movement, increasing its green time

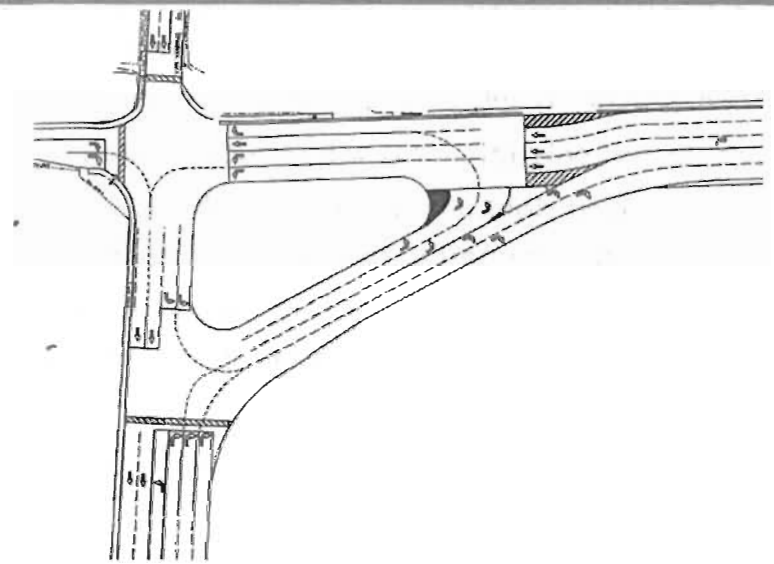
Alternative 2 Conceptual Layout
Triangabout



- Three 2/3 Phase signalized intersections
- One-way flow in triangle
- Additional NB lane (within R/W)
- Additional WB lane (within R/W)
- 3 signalized pedestrian crossings
- All protected left-turns

Alternative 2 Design Layout

Triangabout



Alternative 2 Simulation

Triangabout

Alternative 2 Benefits
Triangabout

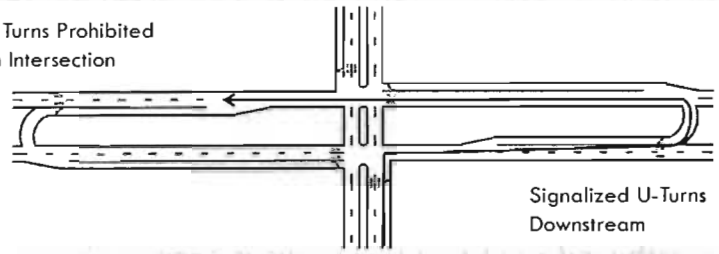
- All intersections are 2 or 3 phases, which increases available green time
- Has safety benefits of a roundabout
- Additional westbound lane allows thru and right-turn movements to be separated
- Westbound right-turn is continuous except when pedestrian crosses
- Westbound thru movement runs concurrently with eastbound movement, increasing its green time
- All left-turns are protected

Unconventional Intersection Designs
Examples

- FHWA Every Day Counts 2 Initiative
- Intersections with Displaced Left-turns
- Benefits are Improved Safety and Reduced Delays
- Types
  - Median U-Turns (Michigan Lefts, ThrU-Turns)
  - Quadrant Intersections
  - Jug Handle Intersections

Unconventional Intersection Designs
Median U-Turns

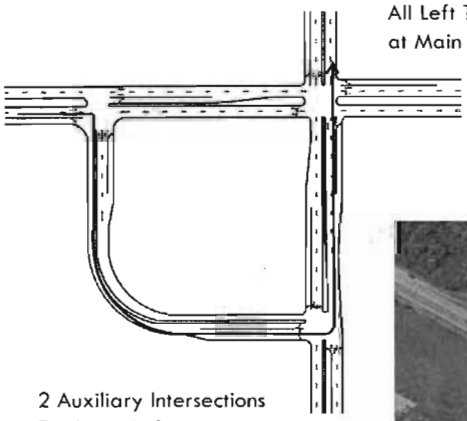
All Left Turns Prohibited
at Main Intersection



Signalized U-Turns
Downstream

Unconventional Intersection Designs
Quadrant Intersections

All Left Turns Prohibited
at Main Intersection



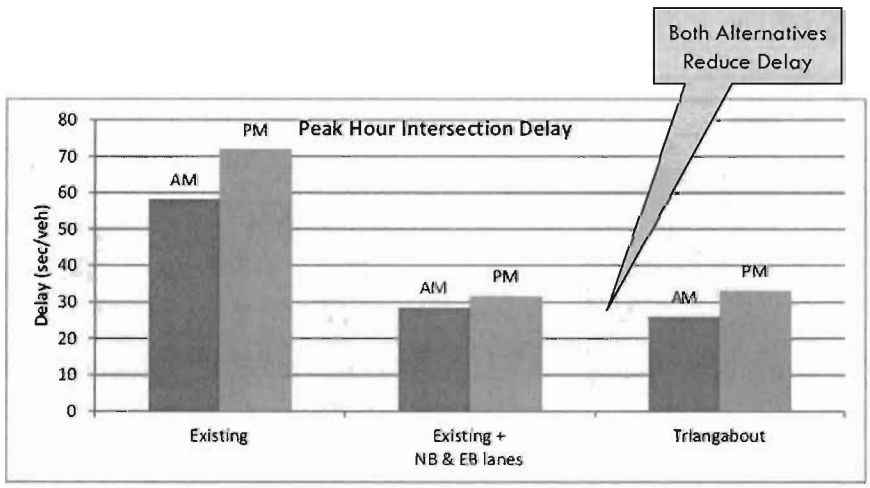
2 Auxiliary Intersections
Facilitate Left-turn Access

Operational Analysis

- Alternative configuration and analysis conducted with VISSIM software
- Conditions Modeled
  - Includes pedestrian demand
  - Cycle lengths constrained to adjacent signal system
- Alternative 1 (Existing + NB & EB lanes)
- Alternative 2 (Triangabout)

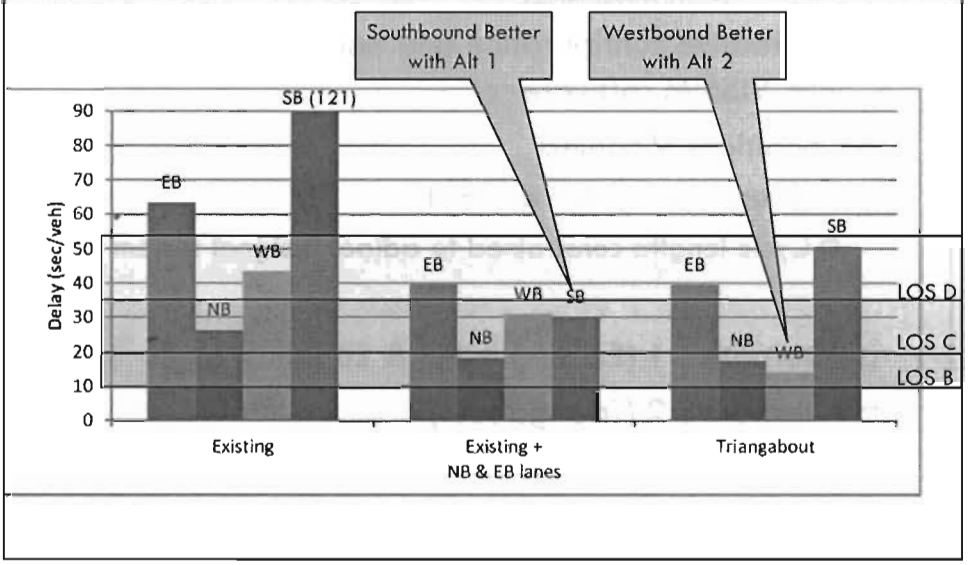
VISSIM Results

Intersection Delay (Peak Hours)



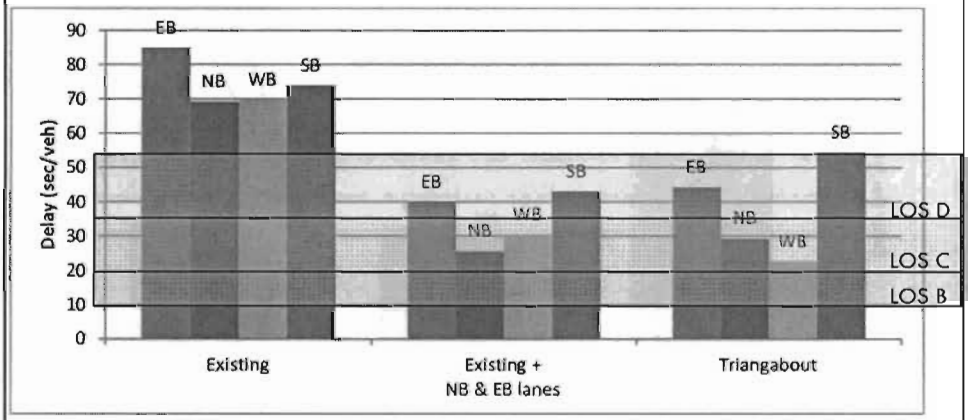
VISSIM Results

Delay by Approach (AM Peak)



VISSIM Results

Delay by Approach (PM Peak)



VISSIM Results

Delay Reductions From Existing Scenario

	Existing + NB & EB lanes		Triangabout	
	AM Peak	**PM Peak**	**AM Peak**	**PM Peak**
Eastbound Approach	-38%	-53%	-38%	-48%
Northbound Approach	-31%	-63%	-34%	-58%
Westbound Approach	-29%	-56%	-68%	-68%
Southbound Approach	-75%	-42%	-58%	-26%
Overall Intersection	**-51%**	**-56%**	**-55%**	**-54%**

VISSIM Results

Delay by Movement (AM Peak)

	Existing		Existing + NB & EB lanes		Triangabout	
	Average	Std Dev	Average	Std Dev	Average	Std Dev
EBRT	66	5	39	4	40	4
EBTH	63	4	41	1	37	1
EBLT	60	8	31	4	59	3
WBRT	41	4	27	3	2	1
WBTH	45	5	29	1	11	2
WBLT	43	4	32	2	16	2
NBRT	19	2	15	2	9	1
NBTH	55	4	30	3	46	2
NBLT	38	14	22	10	53	19
SBRT	108	14	24	5	44	7
SBTH	121	19	24	1	46	6
SBLT	124	18	54	4	67	4

VISSIM Results

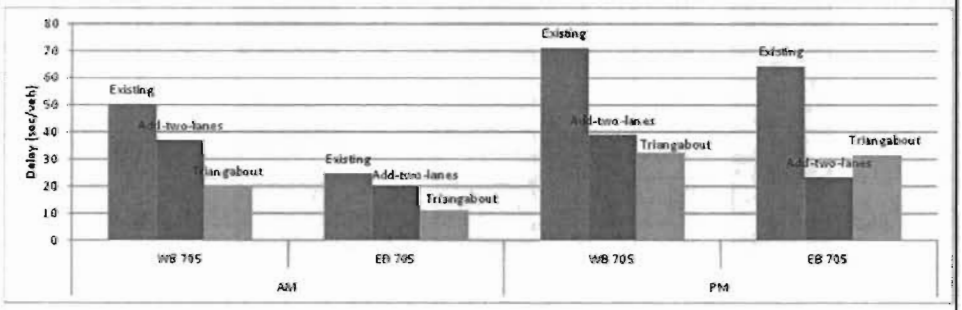
Delay by Movement (PM Peak)

	Existing		Existing + NB & EB lanes		Triangabout	
	Average	Std Dev	Average	Std Dev	Average	Std Dev
EBRT	88	10	40	4	37	5
EBTH	85	7	40	2	43	3
EBLT	83	2	39	3	54	3
WBRT	70	32	25	3	8	1
WBTH	70	33	25	3	15	3
WBLT	69	41	34	1	28	2
NBRT	46	4	17	2	19	1
NBTH	119	9	43	4	49	2
NBLT	116	21	34	5	56	7
SBRT	69	5	30	14	43	5
SBTH	64	4	32	16	45	9
SBLT	102	7	78	21	83	9

VISSIM Results

Mainline WV 705 Delay

- Calculated from Applebee's Signal to North Elementary School Signal
- Triangabout performs better during AM in both directions and PM in westbound direction



VISSIM Results

Estimated Benefits Compared to Existing

		Existing + NB & EB lanes		Triangabout	
	Monetary value	AM Peak	PM Peak	AM Peak	PM Peak
Travel Delay	$17.00/hour[1]	$ 429	$ 702	$ 467	$ 678
Emissions	$1.10/hour[2]	$ 28	$ 45	$ 30	$ 44
Fuel Consumption	$3.50/gallon	$ 99	$ 174	$ 107	$ 152
Total	-	$ 556	$ 921	$ 604	$ 874
Annual Projection[3]	-	$1,992,000/year		$2,014,500/year	

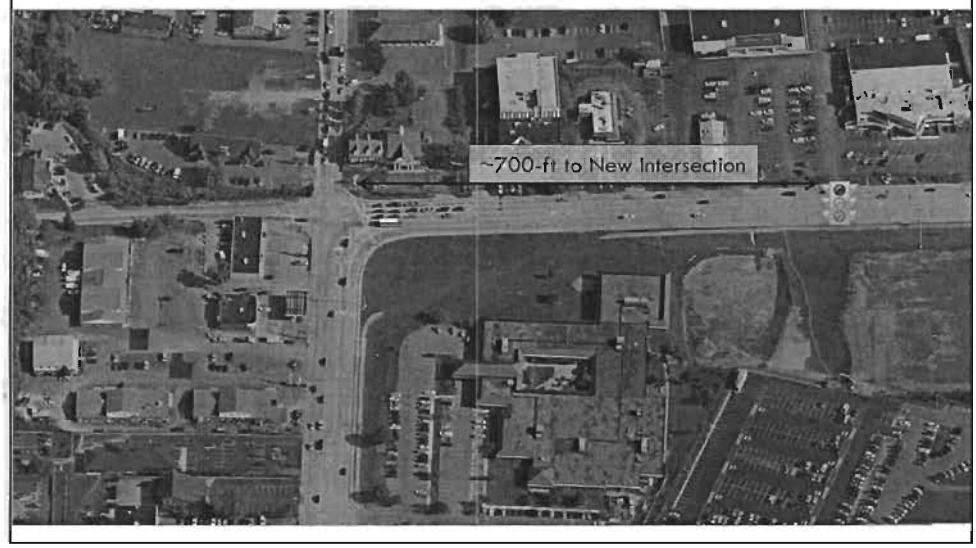
1: TTI: 2012 Urban Mobility Report: http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/mobility-report-2012.pdf
2: Maryland SHA CHARD Evaluation Report: http://chartinput.umd.edu/reports/CHART_2011_website(July2012).pdf
- Emission rates: HC (13.073g/hr-delay), CO (146.831g/hr-delay), NO (6.261g/hr-delay)
- Monetary values: HC ($6.7/kg), CO($6.36/kg), NO($12.875/kg)
3: Assuming AM peak is 6% of daily contribution and PM peak is 11%, 5 weekdays, 52 weeks/year

20-year Projected Conditions

- Growth rate ≈ 1.5% per year
- Overall Intersection Delay Increase
  - Alternative 1: Add NB & EB Lanes
    - AM Peak Hour: +103% (28.5s to 57.8s)
    - PM Peak Hour: +178% (31.6s to 88.0s)
  - Alternative 2: Triangabout
    - AM Peak Hour: +112% (25.9s to 55.0s)
    - PM Peak Hour: +139% (33.0s to 79.2s)

New Signalized Intersection

WV 705 & Suburban Lanes / Office Depot



Impact of New Signal on Chestnut Ridge & Van Voorhis Intersection

- Assuming configuration similar to North Elementary school intersection
- Conservative Estimate of Intersection Delay Increase
  - Alternative 1: Add NB & EB Lanes
    - AM Peak Hour: +19%
    - PM Peak Hour: +24%
  - Alternative 2: Triangabout
    - AM Peak Hour: +23%
    - PM Peak Hour: +15%

Qualitative Comparisons

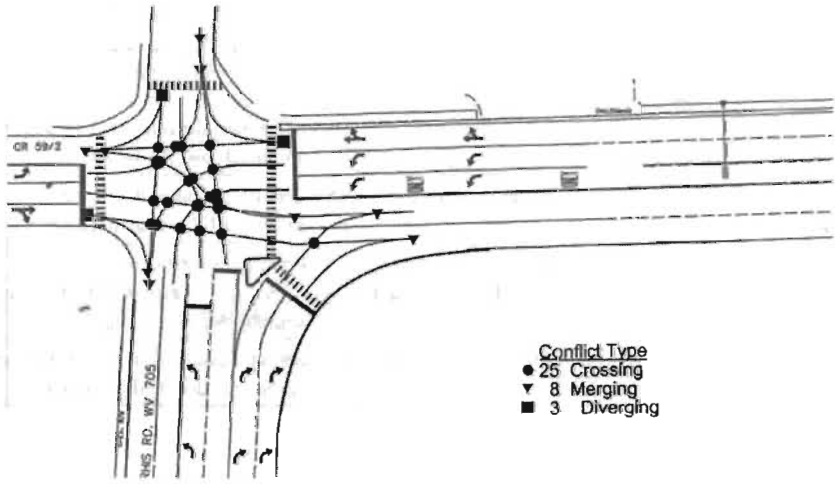
	Alternative 1 Add NB and EB Lanes	Alternative 2 Triangabout
Pedestrians	• All movements concurrent • Ped time across WB approach still impacts signal timing and stops continuous NB Right-Turn	• All movements concurrent • Ped activation at two signals stops continuous movements but doesn't impact signal timing
Right-of-Way	• Will require R/W on southwest quadrant	• Can be accomplished without additional R/W acquisition
Construction Costs	• Costs to install two auxiliary lanes, move signal poles, additional signal heads	• Costs to construct new road, reconfigure existing approaches, new signals, overhead signage
Access	• No improvement to access in vicinity of intersection	• Should facilitate access to property on NE quadrant of intersection

Qualitative Comparisons

	Alternative 1 Add NB and EB Lanes	Alternative 2 Triangabout
Operations	• Can operate in a coordinated system • Compatible with adaptive control • May need longer cycle lengths during peak times • Off-peak may perform better due to ability to skip phases	• Can operate in a coordinated system • May not be compatible with adaptive control • Less delay at each intersection due to fewer phases • Off-peak may be less efficient due to inability to skip phases
Driver Expectancy	• Nothing unconventional	• Operation isn't unconventional, but the configuration will be new to motorists
Safety	• Right-Angle crashes should reduce with protected lefts • 36 total conflict points (25 crossing)	• Crash benefits similar to roundabouts with reduced right-angle crashes • 21 total conflict points (10 crossing)

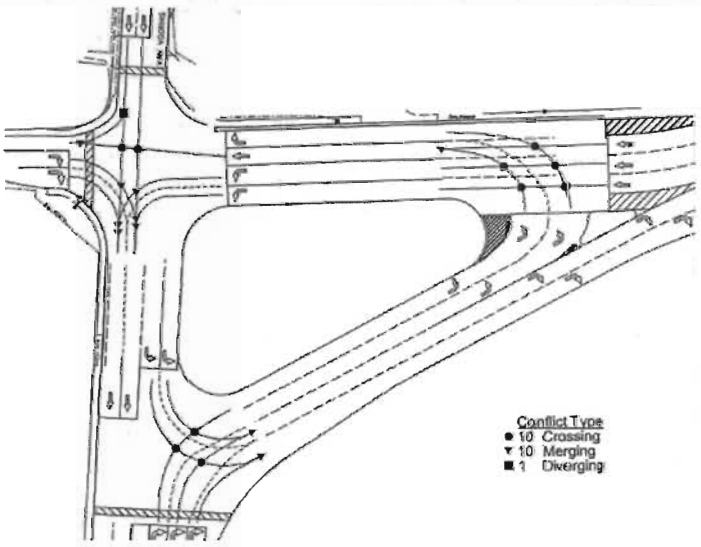
Alternative 1 Conflict Point Analysis

Add Northbound & Eastbound Lanes



Alternative 2 Conflict Point Analysis

Triangabout



Summary

- Both alternatives are feasible from an operational standpoint and exhibit similar peak hour delays
- Both alternatives improve pedestrian safety and minimize impact on vehicle movements
- Triangabout anticipated to improve vehicle safety and access, but will be unfamiliar to drivers
- Cost of both alternatives will likely be similar

Project Contacts

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