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I-375 CORRIDOR ROAD SAFETY AUDIT
FINAL REPORT

CITY OF DETROIT, WAYNE COUNTY, MICHIGAN

July 14 -17, 2014

Revised 8/ 19/14

PREPARED FOR:

Michigan Department of Transportation

MDOT Michigan Department of Transportation

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Appendices (Included on Attached CD)

1.0 Introduction

This document represents the final report for the Road Safety Audit (RSA) performed within the I-375 corridor including I-375, Jefferson Ave and Chrysler Drive (see Figure 2.1). The goal of this RSA is to answer the following questions:

- What elements of the traveled way may present a safety concern: to what extent, to which road users, and under what circumstances?
- What opportunities exist to eliminate or mitigate identified safety concerns?

This RSA was performed in the City of Detroit, Wayne County, Michigan on July 14 - 17, 2014 as a formal safety performance examination of the existing roadway network and of the alternatives presented as a part of an ongoing Feasibility Study being prepared for MDOT. The Road Safety Audit was conducted in a manner consistent with the FHWA Road Safety Audit Guidelines adopted by the Michigan Department of Transportation. This proactive Audit documents current and potential road safety issues and opportunities to improve safety for all potential road users as identified by the RSA Team.

2.0 Background

I-375 is classified as a principal arterial – interstate by the 2012 Michigan Department of Transportation Sufficiency Report. This segment of I-375 is on the National Highway System (NHS) and on the Priority Commercial Network (PCN). I-375 travels in a north-south direction within the project limits and varies from a four to eight-lane divided freeway with a posted speed limit of 55 mph. Land uses surrounding I-375 are highly commercial serving extensive entertainment and office land uses to the west with dense residential properties located east of the project limits. I-375 serves as an important connection to Downtown Detroit, the East Riverfront, and numerous enterprises located on Jefferson Ave.

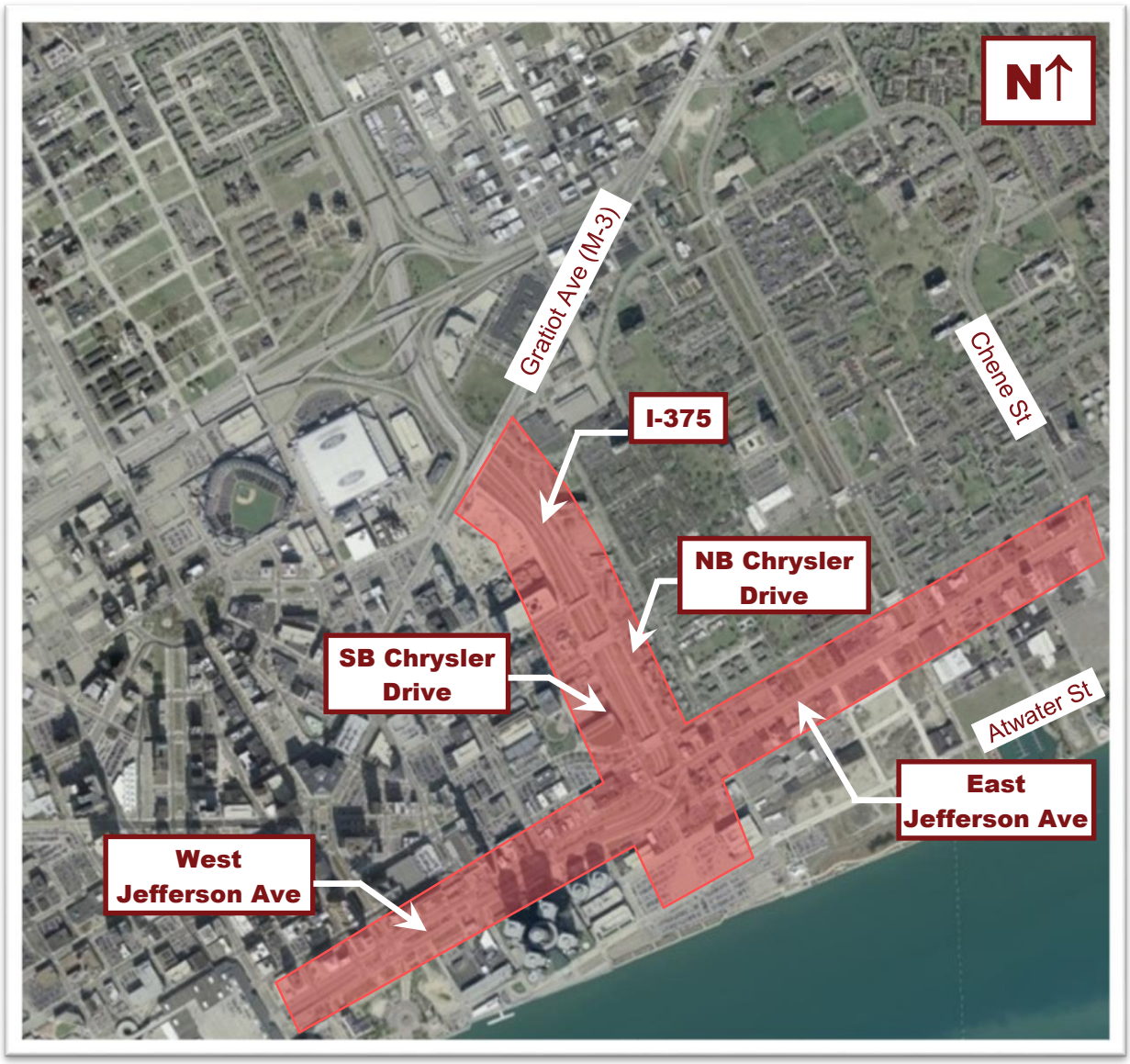
Roadways also reviewed during this RSA include Chrysler Drive, West Jefferson Ave, and East Jefferson Ave. Chrysler Drive serves as a service drive to I-375 within the project limits and varies from a two to four-lane directional one-way pair. Similar to I-375, there is extensive office and entertainment land use adjacent to Chrysler Drive to the west and dense residential properties located east of the project limits. The posted speed limit on Chrysler Drive is 25 mph.

West Jefferson Ave is an eight-lane divided roadway, with a posted speed limit of 30 mph, connecting M-10 and I-375. Extensive office, commercial, entertainment, parking, and government (access to Canada) land uses exist along West Jefferson Ave. Both East and West Jefferson Ave also experience extensive pedestrian use. East Jefferson Ave

varies from a seven lane (off-peak hours) to nine lane (peak hours) undivided roadway with a posted speed limit of 35 mph. The outside lane in both directions is utilized as a shared parking/thru lane during off-peak hours. Extensive commercial land uses exist adjacent to East Jefferson Ave with dense residential properties located north and the riverfront located south.

It is important to note that this RSA has been completed in conjunction with an ongoing Feasibility Study being performed for MDOT. The alternatives presented in the Feasibility Study were examined in addition to the existing project roadways as a part of this RSA to assess potential safety issues associated with the current alternatives. This Road Safety Audit (RSA) was conducted to evaluate the current safety conditions, the safety conditions of the Feasibility Study alternatives, and develop potential mitigations for any identified potential safety issues.

Figure 2.1 - Study Area Map



2.1 RSA Team

The RSA Team was composed of state representatives and led by members of the consultant team. The team consisted of knowledgeable individuals with diverse areas of expertise including geometrics, safety, operations, non-motorized travel, and law enforcement. The RSA Team included the following individuals:

- **Mark Fisher**, MDOT Traffic & Safety - Geometrics
- **Mike Phillips, PE,** MDOT Bay Region – Bridge Specialist
- **Josh DeBruyn, AICP**, MDOT Bicycle & Pedestrian Coordinator
- **John Engle, PE**, MDOT Traffic & Safety - Operations
- **Thomas Taylor**, Detroit Police Department
- **Keith Simons**, **PE, PTOE**, Bergmann Associates
- **Jami Trudelle, PE**, Bergmann Associates

2.2 RSA Pre-Audit Meeting/Summary

The Safety Audit started with a Pre-Audit Meeting consisting of the RSA Team, Lansing Central Office members, members of the MDOT Detroit TSC, and representatives of the Downtown Development Authority (DDA), Detroit River Front Conservancy (DRFC), Greektown Casino, Rock Ventures, Blue Cross Blue Shield (BCBS), Parsons Brinckerhoff, and Downtown Detroit Partnership as well as law enforcement officers. This meeting was held to provide an overview of the RSA process, goals, and objectives; identify known issues; identify the concerns of local stakeholders; identify any constraints that the owners would like the RSA Team to work within; and to provide an overview of the ongoing Feasibility Study for the project area. The known issues and concerns of the stakeholders are listed below:

Local Stakeholder Known Issues and Concerns

- Deteriorating pavement and bridges.
- Traffic operations during special event traffic.
- Short weaving lengths on I-375 and on Chrysler Drive.
- Crashes at the horizontal curve on the south end of I-375.
- Congestion at AM and PM peak hours on Chrysler Drive at parking ramps and driveways.
- Lack of connectivity to the riverfront, E. Jefferson, and Gratiot Ave.
- Poor environment for pedestrians and bicyclists.
- Confusing and inefficient interchange circulation.
- How can the project area be made safer?

Constraints

- None of the suggestions should involve having I-375 within a tunnel.

Planned Mitigations

- A Feasibility Study is currently ongoing and presents 6 alternatives along the I-375 corridor and 2 alternatives for both East and West Jefferson Ave. The alternatives are intended to address the issues and concerns listed above. However, the construction of this project is currently unfunded. There are no additional planned construction projects within the project corridor at this time.

Recent Safety Improvements

- MDOT has recently installed additional large speed reduction signs and a series of flashing lights on SB I-375 at the low speed horizontal curve to alert motorists of the changing speed conditions in an effort to reduce crashes associated with the horizontal curve.

The meeting kicked off with MDOT providing a brief history and introduction to the ongoing Feasibility Study. A brief overview of each of the alternatives was provided along with the goals of the study. Next, a brief presentation was conducted by the consultant describing the RSA process, the goals and objectives of a RSA, the steps that have already been completed by MDOT, the steps that would be completed by the RSA Team over the four day RSA process, and the steps that would be completed at a later date.

After the pre-audit meeting concluded, the team conducted a field visit during an off-peak time period and observed operations within the project area. The team then met in the office to discuss the input received from the Pre-Audit Meeting attendees, the observations from the initial field review, and reviewed the following materials:

Aerial photographs	Adjacent land uses
Traffic volume data	Known safety issues
Crash histories	Feasibility study information
As-built plans	Friction data
Traffic signal timing permits	Synchro models
Safety studies	Crash analyses

Following a review of the project materials, the Audit Team conducted several additional field visits under varying light, environmental, and traffic conditions including: mid-day peak, morning peak, and evening peak conditions; day time (light) and night time (dark) conditions. The RSA Team conducted its field visits by driving and walking through the study area several different times from Monday, July 14th through Wednesday, July 16th. While out at the site, team members verified issues identified during the Pre-Audit

Meeting, discussed additional issues that were observed, and took notes and photographs.

The field review considered all potential users of the facility (i.e. cars, trucks, motorcycles, buses, pedestrians, bicyclists, etc.).

The Audit Team reconvened each morning to complete the Audit analysis. The RSA Team discussed results of the field reviews, reviewed the Feasibility Study alternatives, identified potential suggestions to address identified issues for both the existing roadway and the study alternatives, and developed a consensus on the finalized issues/suggestions. The Preliminary Audit findings for the existing roadways in the project area and for the Feasibility Study alternatives were then recorded and assigned levels of risk and consequence. The team assigned risk and consequence values to each safety issue independently, then ranked the identified safety issues from highest to lowest priority. A presentation was developed that reflected the activities and findings of the Audit Team which was presented by the moderator to the MDOT Project Manager, RSA Project Manager, Detroit TSC, DDA, DRFC, Greektown Casino, Rock Venture, and BCBS representatives and the RSA Team based upon the Audit Team's conclusions.

The consultant subsequently prepared this report, which was circulated to and commented upon by the Audit Team members, prior to being finalized.

2.3 RSA Report

This report provides information on issues identified by the RSA Team, which they deemed relevant to the stated goal of a RSA; identifying opportunities to improve road safety of the existing roadways within the study area and within the Feasibility Study alternatives.

Where appropriate, an assessment of road user safety risk and suggestions for improvement are included. These suggestions should not be viewed as design or operational recommendations; they are intended to be illustrative of potential solutions to the safety issues identified, and are presented for consideration only.

For comparative purposes, where possible, a benefit-to-cost ratio has been calculated for the crash countermeasures that have been suggested for consideration. This ratio compares the net annual benefits resulting from an individual improvement to the annual installation cost over the expected service life of the improvement. A five step process was utilized to determine this ratio as follows:

1. Estimate the expected crash frequency at each location of interest.
2. Estimate the change in crashes by severity for each suggested crash countermeasure.
3. Estimate the net benefit resulting from the change in crashes for each suggested crash countermeasure.
4. Estimate initial cost for installation of each suggested crash countermeasure.
5. Calculate the annual benefit-to-annual cost ratio.

Preliminary estimated costs are provided in this report for the installation of each suggested crash countermeasure which will require further evaluation and refinement prior to implementation. The estimated costs presented include the estimated costs associated with the initial construction of the suggestion only and are based on available old plan information, aerial imagery, and engineering judgment. The estimated costs do not include costs associated with Right-of-Way, professional engineering (PE), construction engineering (CE), maintenance of traffic, aesthetic enhancements, environmental impacts, etc.

To estimate the expected crash frequency at each location of interest for the existing roadways, Chapter 12 - *Predictive Methods for Urban and Suburban Arterials* of the Highway Safety Manual was utilized on the local (non-freeway) road systems while the Enhanced Safety Predication Methodology and Analysis Tool for Freeways and Interchanges (ISATe) was utilized for the freeway road systems. ISATe incorporates the disaggregate safety evaluation approach recommended by the Highway Safety Manual for its Part C predictive methods. These methods provide a structured approach to estimate the expected crash frequency and severity for facilities with known characteristics. For this report, they were utilized to determine the average expected crash frequencies at existing sites by using the available crash history. At locations where these methods could not be applied to the road systems, the expected crash frequency was determined utilizing the short-term average crash frequency derived from the most recent 5 years of crash data available at the time of this report. Once the average crash frequency was estimated, methodologies presented in Chapter 13 – *Roadway Segments* and Chapter 14 – *Intersections* of the Highway Safety Manual were used to estimate the change in crashes resulting from each countermeasure with Crash Modification Factors (CMF).

CMF's quantify the change in expected average crash frequency at a site by implementing a particular countermeasure. After the change in crashes was determined for each countermeasure, traffic crash costs by casualty severity for Wayne County (published by The University of Michigan Transportation Research Institute (UMTRI)) were used to estimate the net benefit for each countermeasure. The initial installation cost for each countermeasure was estimated based on current MDOT average prices and annualized assuming a twenty (20) year service life and a five percent (5.00%) discount

rate. Finally, the annual benefit to-annual cost ratio was calculated for each suggestion and can be used to compare treatments at locations within this Road Safety Audit.

3.0 General Observations

I-375 – I-375 is an urban divided freeway varying from four to eight-lanes. Land uses surrounding I-375 are highly commercial serving extensive entertainment and office land uses to the east with commercial and dense residential properties to the east. The portion of I-375 within the project limits is approximately one mile long and serves as a connection between I-75 and Jefferson Ave in downtown Detroit. The residents, businesses, and developments of downtown Detroit have changed dramatically since the original construction of I-375 corridor. Through observations it is apparent that current and future traffic circulation needs may be better served with modifications to the existing I-375 roadway and project area roadways.

The existing horizontal curve at the south end of I-375 at Jefferson Ave is deficient for the 55 mph posted speed limit. Several warning devices have been implemented in an effort to warn drivers and reduce crashes occurring as a result of the substandard geometry. Freeway lighting is present along I-375, however, several lights are turned off and/or have burned out lights. Additionally, lighting is not installed under all bridges over I-375 and the existing lighting under some bridges is not operational.

Chrysler Drive – Chrysler Drive is a north-south directional one-way pair and serves as a service drive to I-375. The existing Chrysler Drive cross section varies from two to four-lanes in each direction with curb and gutter adjacent to the travel lane. The posted speed limit on Chrysler Drive is 25 mph. Downtown Detroit is immediately west of SB Chrysler Drive and contains highly commercial, business, and entertainment land usages. NB Chrysler Drive provides access to and from the residential and commercial areas located east of I-375. Chrysler Drive does not currently experience a high volume of pedestrian or bicycle traffic. Sidewalks, ADA ramps, and pedestrian countdown signals are present on Chrysler Drive however, bike lanes are not present. Roadway lighting is present on Chrysler Drive but not all of it is currently being utilized.

West Jefferson Ave – West Jefferson Ave is an east-west roadway which connects M-10 and I-375. West Jefferson Ave is a divided roadway with four-lanes in each direction with curb and gutter adjacent to the roadway and a posted speed limit of 30 mph. West Jefferson Ave is in Downtown Detroit and is surrounded by commercial, business, and entertainment venues. This roadway experiences a high volume of pedestrian traffic due to its surrounding land usage. Pedestrian traffic consists of weekday workers walking between offices, parking ramps, commercial properties, etc. and those attending special events. Pedestrian facilities and pedestrian countdown signals are present along West Jefferson Ave. Roadway lighting is present throughout West Jefferson Ave.

East Jefferson Ave – East Jefferson Ave is an east-west undivided roadway. The existing cross section consists of 9 lanes (4 lanes in each direction and a center left turn lane) with curb and gutter. During off peak hours the outside lane in each direction is used as a parking lane. The posted speed limit on East Jefferson is 35 mph and the land usage adjacent to East Jefferson Ave is highly commercial with dense residential properties just north of the commercial properties. East Jefferson Ave experiences extensive pedestrian and bicycle traffic with sidewalks on both sides of the roadway, ADA sidewalk ramps, and pedestrian signals throughout the corridor. There are no bicycle facilities, however, bicycles were observed traveling in the outside thru lane on East Jefferson Ave. Roadway lighting is present on East Jefferson Ave but not all of it is currently being utilized.

4.0 Existing Roadway Audit Findings and Suggestions

Issues identified during the review of existing information, field reviews, and review of the Feasibility Study alternatives were prioritized by the RSA Team. For each safety issue identified, the team developed potential mitigation measures for review by the owner (MDOT). The safety issues were prioritized based upon the observed and perceived frequency of crashes; and the anticipated and observed severity of crashes resulting from each safety issue. As a result, each safety issue was prioritized on the basis of ranking from A (lowest risk and lowest severity) to F (highest risk and highest severity). A table identifying the ranking system is shown in Table 4-1 below. The safety issue prioritization was based upon expectations and judgment of the RSA Team members.

Table 4-1 - Safety Issue Risk Assessment

Risk Category		Severity Rating			
		Negligible	Low	Medium	High
Likelihood	Frequent	C	D	E	F
	Occasional	B	C	D	E
	Infrequent	A	B	C	D
	Rare	A	A	B	C

4.1 Crash Potential #1 – Crashes Associated with Queuing & Weaving/Merging on the SB I-375 Exit Ramp to Lafayette St

Expected Frequency	Expected Severity	D
Occasional	Medium	

Observation: Vehicles exiting SB I-375 at the Lafayette St ramp travel slowly to cross two (2) lanes of Chrysler Drive traffic to turn right onto Macomb St and into the existing casino parking ramp. In addition, due to the high volume of traffic exiting at the Lafayette St ramp and the short storage distance available at the Monroe St signalized intersection, traffic queues onto SB I-375 during the morning peak hour.

Figure 4.1.1 - Queuing on the SB I-375 Exit Ramp to Lafayette St

SUGGESTION: The following options should be considered:

1) **Remove SB Chrysler Drive between Gratiot Ave and Macomb St.**
2) **Construct a 2-lane exit ramp on the SB I-375 exit ramp to Lafayette St.**

Crash Potential #1 – Crashes Associated with Queuing & Weaving/Merging on the SB I-375 Exit Ramp to Lafayette St (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$46,200**
2) **$100,000**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C) ratios:

1) **2.84***
2) **0.55**

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.2 Crash Potential #2 – Intersection of West Jefferson Ave & Beaubien St

Expected Frequency	Expected Severity	D
Occasional	Medium	

Observation: The following safety issues were identified at the intersection of West Jefferson Ave & Beaubien St:

1) Left-turn lockup in the median. The median has the capacity to store only a few vehicles. Vehicles turning left onto Beaubien St from Jefferson Ave cause lockup in the intersection.

2) SB Beaubien St lane confusion. The SB Beaubien thru lane can appear to line up with the people mover pier and it is difficult to see lane lines through the intersection.

3) Pedestrian conflicts with right-turns from the Renaissance center (NB traffic).

Figure 4.2.1 – Left-Turn Lock-up in the Median

Figure 4.2.2 – People Mover Pier in Lane Path

Crash Potential #2 – Intersection of West Jefferson Ave & Beaubien St (Continued)

SUGGESTION: The following options should be considered:

1) **Prohibit direct left turns to eliminate left-turn lockup issue.**
2) **Extend the WB Jefferson left-turn lane to increase the existing left-turn lane storage.**
3) **Install a "Keep Right" sign (R4-8) in front of the people mover pier to clarify the SB laneage.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$98,000 (elimination of median to eliminate left-turns assumed in cost)**
2) **$44,100**
3) **$550**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **22.57***
2) **N/A***
3) **465.63***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.3 Crash Potential #3 – Intersection of SB Chrysler Drive & Lafayette St

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: The following safety issues were identified at the intersection of SB Chrysler Drive & Lafayette St:

1) There was observed lane confusion at this location due to undefined lane usage. There are no pavement markings and the construction joints so not line up with the lane lines.

2) Steady bicycle traffic on Lafayette St without designated bike accommodations.

Figure 4.3.1 - Undefined Lane Usage

Figure 4.3.2 – Bicycle Traffic on Lafayette St

Crash Potential #3 – Intersection of SB Chrysler Drive & Lafayette St (Continued)

SUGGESTION: The following options should be considered:

1) **Refresh pavement markings.**
2) **Reconstruct/re-pave SB Chrysler Drive with pavement joints on the lane lines**
3) **Extend the bike lane on Lafayette St from Rivard St to west of Chrysler Drive (may be accomplished utilizing a marked shared outside lane on Lafayette St)**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$8,900**
2) **$188,000**
3) **$1,600**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **6.82***
2) **1.24***
3) **0***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.4 Crash Potential #4 – Intersection of SB Chrysler Drive & Larned St

Expected Frequency	Expected Severity	C
Occasional	Low	

Observation: The following safety issues were identified at the intersection of SB Chrysler Drive & Larned St:

1) The short weave/merge distance between the SB I-375 exit ramp, parking ramp exit, and Larned St. Traffic exiting the parking ramp north of Larned St stops on SB Chrysler Drive at the ramp during the PM peak waiting to merge all of the way to the left side of the roadway causing Chrysler Drive traffic to stop and wait for this merge with the SB I-375 exit ramp traffic to occur.

2) Visibility of the stop sign on SB Chrysler Drive.

3) The SB right-turn only lane lines up with a thru lane on the opposite side of the intersection. Vehicles in the right turn only lane were observed driving straight through intersection. As a result, sideswipe crashes could occur and the shared right/thru lane is underutilized by right turning vehicles.

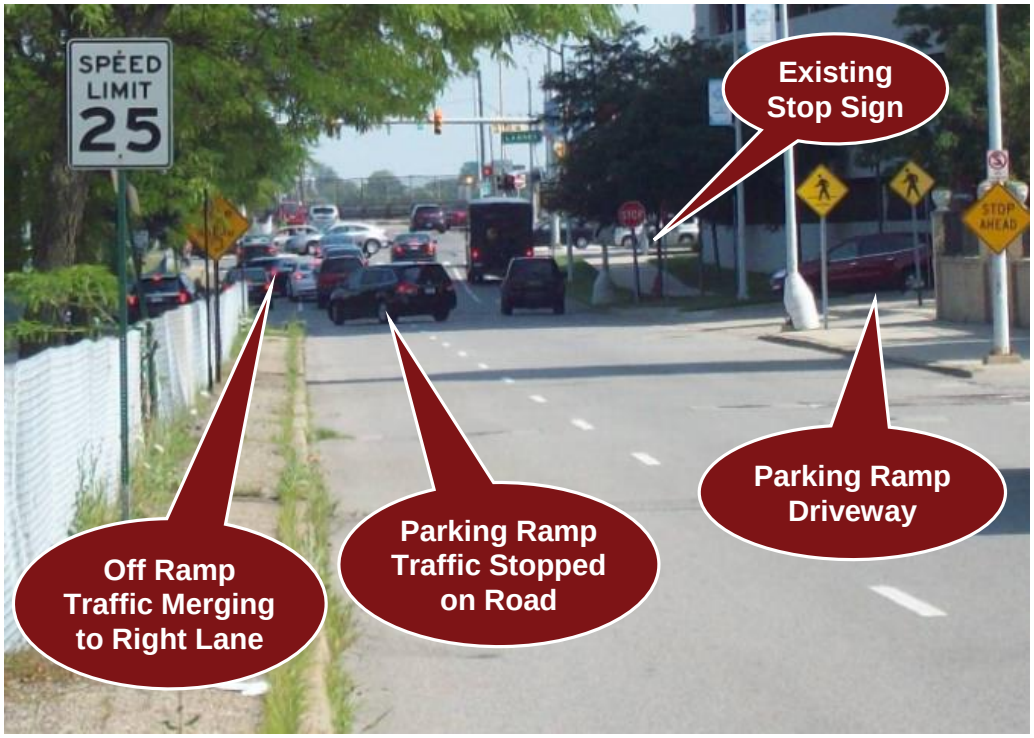


Figure 4.4.1 - SB Chrysler Drive at Parking Ramp and Larned St during PM Peak

Crash Potential #4 – Intersection of SB Chrysler Drive & Larned St (Continued)

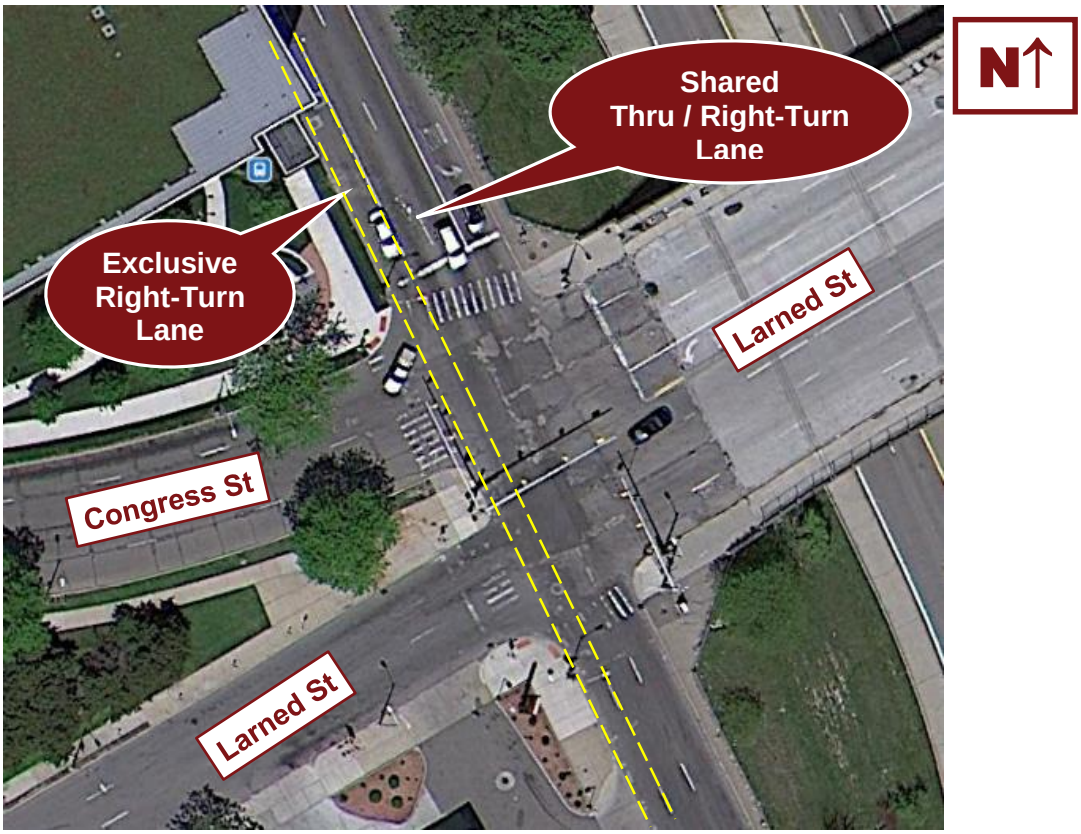


Figure 4.4.2 – Right-Turn Only Lane on SB Chrysler Drive at Larned St

SUGGESTION: The following options should be considered:

1) **Add a stop sign on the left side of SB Chrysler Drive and install a stop bar at the SB I-375 exit ramp intersection for SB traffic.**
2) **Add a lane assignment sign and right-turn lane guide pavement markings through the intersection to discourage through movements from the SB exclusive right-turn lane**
3) **Extend the existing median on Larned St / Congress St to eliminate through movements from the SB exclusive right-turn lane.**

Crash Potential #4 – Intersection of SB Chrysler Drive & Larned St (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$700**
2) **$700**
3) **$3,400**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **17.65***
2) **53.91***
3) **27.39***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.5 Crash Potential #5 – Crashes Associated With Poor Horizontal Sight Distance on SB I-375 at the Lafayette St Exit Ramp

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: The existing retaining wall on the west side of I-375 along with the existing horizontal curve on SB I-375 in this area combine to inhibit sight distance and may reduce reaction time for SB I-375 traffic approaching both Lafayette and Larned St.

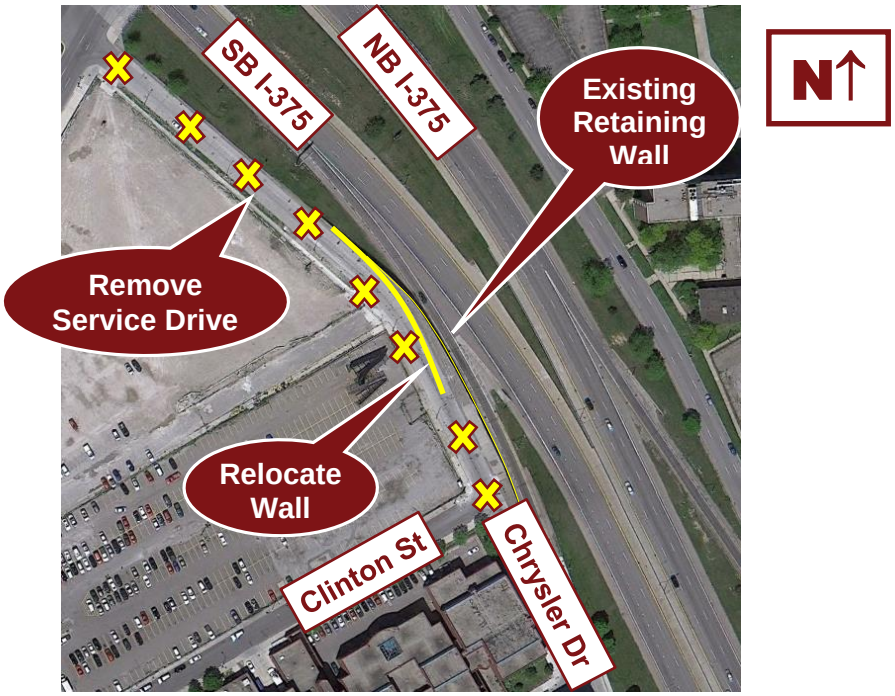


Figure 4.5.1 – SB Chrysler Drive Retaining Wall

SUGGESTION: The following options should be considered:

1) **Remove SB Chrysler Drive from Gratiot Ave to Clinton St and relocate the existing retaining wall further away (west) from SB I-375.**

Crash Potential #5 – Crashes Associated With Poor Horizontal Sight Distance on SB I-375 at the Lafayette St Exit Ramp (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$309,000**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **0.18**

4.6 Crash Potential #6 – Crashes associated with SB I-375 Horizontal Curve at Larned St

Expected Frequency	Expected Severity	
Infrequent	Medium	**C**

Observation: There is a concentration of fixed object crashes on SB I-375 at the horizontal curve at Larned St, with a large percentage of dark and wet condition crashes. These crashes appear to be associated with the abrupt, low speed curve in addition to observed poor sight distance approaching the curve during low-light conditions.

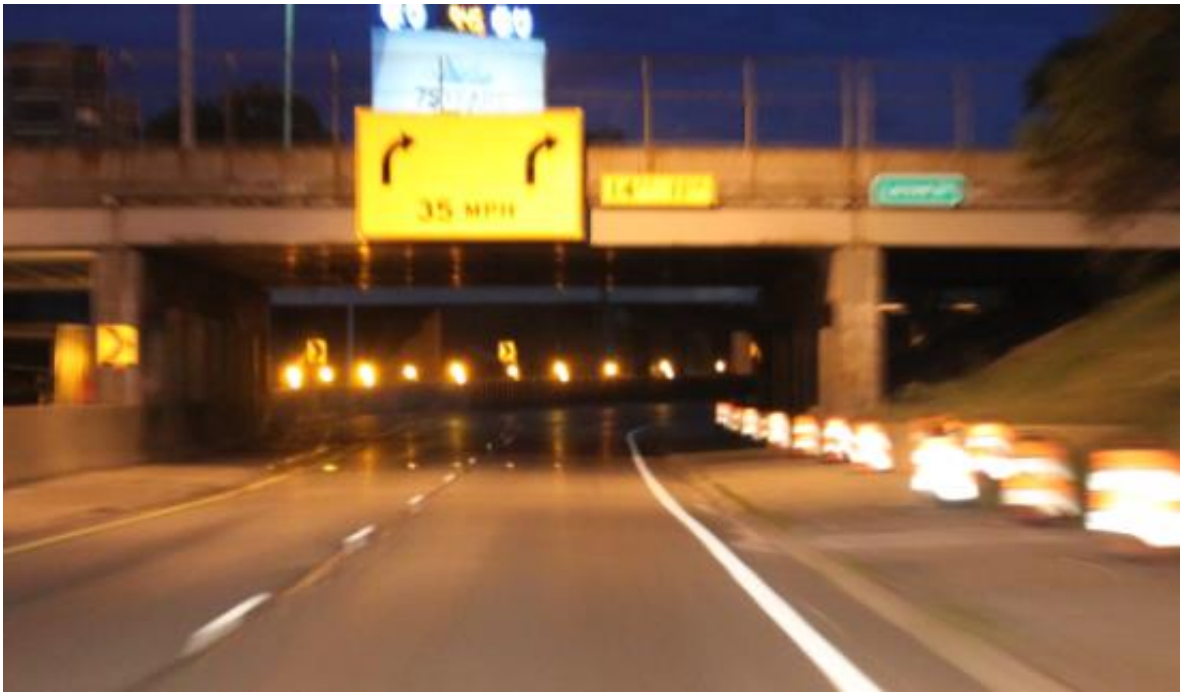


Figure 4.6.1 - SB I-375 Horizontal Curve at Lafayette St

SUGGESTION: The following options should be considered:

1) **Install reflective tabs (similar to guardrail reflectors) on the existing black attenuators located on the median barrier wall (SB I-375 only).**
2) **Investigate friction values and drainage within the curve.**
3) **Review the use of a progressive pattern for the existing flashing beacons.**
4) **Reduce the number of flashing beacons in use during dark conditions to limit driver confusion.**

Crash Potential #6 – Crashes associated with SB I-375 Horizontal Curve at Lafayette St (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$300**
2) **$3,300**
3) **$3,300**
4) **$2,000**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **397.18**
2) **N/A (No CMF Available for countermeasure)**
3) **N/A (No CMF Available for countermeasure)**
4) **N/A (No CMF Available for countermeasure)**

4.7 Crash Potential #7 – EB Jefferson Ave at Randolph St (Tunnel to Canada)

Expected Frequency	Expected Severity	C
Occasional	Low	

Observation: The EB outside lane on Jefferson Ave drops as a right-turn lane to Canada and is not well signed which may be confusing for unfamiliar motorists. In addition, signing approaching the intersection is cluttered and may further confuse motorists at this location.

Figure 4.7.1 – EB Jefferson Ave at Tunnel to Canada

SUGGESTION: The following options should be considered:

1) **Reapply existing "CANADA" pavement markings and thicken the solid line separating the right-turn lanes from thru lanes to 8".**
2) **Add an 8" dotted line in advance of the right-turn lane to further denote that the lane ends ahead.**
3) **Install additional / larger advanced signing for the lane drop.**
4) **Consider cantilever lane assignment signing.**
5) **Reduce and consolidate non-essential signing.**

Crash Potential #7 – EB Jefferson Ave at Randolph St (Tunnel to Canada) (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$2,000**
2) **$600**
3) **$1,600**
4) **$24,900**
5) **$1,500**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **56.16***
2) **449.29***
3) **105.30***
4) **6.77***
5) **112.32***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.8 Crash Potential #8 – Lighting Within Project Area

Expected Frequency	Expected Severity	
Infrequent Surface Streets Infrequent I-375	Medium (Surface Streets Only) Low (I-375 Only)	**C** (Surface Streets Only) **B** (I-375 Only)
Observation: Although lighting is present throughout the project limits, at several locations it is either not in use, burnt out, or not operational. Based upon field reviews, it was difficult to see the roadway features, particularly bicyclists on the roadway during low-light conditions.		

Figure 4.8.1 – Low Light Conditions on Jefferson Ave

SUGGESTION: The following options should be considered:

1) **Check and replace burnt out lights.**
2) **Ensure proper operation of existing lighting.**
3) **Consider lighting under all bridges on I-375.**

Crash Potential #8 – Lighting Within Project Area (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$5,500**
2) **No applicable construction cost associated with this countermeasure**
3) **$102,300**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

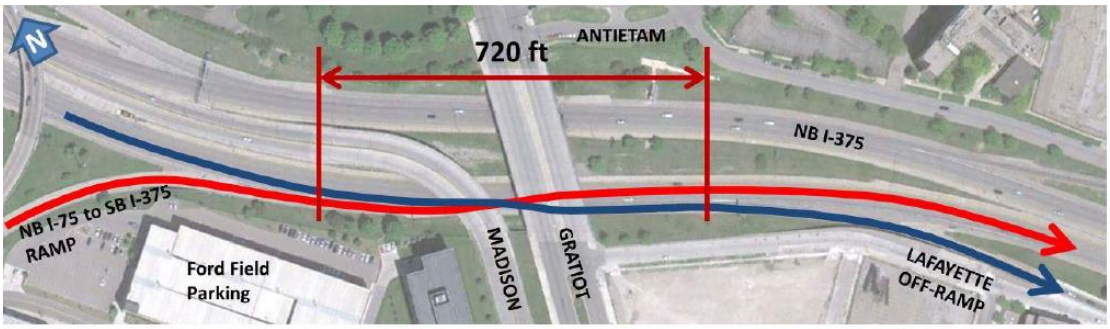
1) **601.27***
2) **N/A (No construction cost associated with this countermeasure)**
3) **4.29**

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.9 Crash Potential #9 – Weave Length on SB I-375 between Entrance Ramp from NB I-75 & Exit Ramp to Lafayette St

Expected Frequency	Expected Severity	
Infrequent	Low	**B**

Observation: The existing weave length between the entrance ramp from NB I-75 & the exit ramp to Lafayette St on SB I-375 is short (approx. 720 ft). A heavy stream of weaving traffic was observed, particularly during the AM peak hour, at this location between vehicles on SB I-375 trying to merge right onto the exit ramp and vehicles on the I-75 ramp trying to merge left to stay on I-375. The occurrence of sideswipe crashes could be attributed to the short weave length at this location.



Source: Parsons Brinckerhoff

Figure 4.9.1 – Weave on I-375 between Entrance Ramp from NB I-75 & Exit Ramp to Lafayette St

SUGGESTION: The following options should be considered:

1) **Provide 2 exit lanes on the ramp to Lafayette St and make the existing 2nd SB I-375 lane an optional thru/exit lane.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$100,000**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **0.55**

4.10 Crash Potential #10 – Merge From NB Chrysler Drive Entrance Ramps onto NB I-375

Expected Frequency	Expected Severity	
Infrequent	Low	**B**

Observation: Per observation, it is difficult to merge from the NB Chrysler Entrance Ramps onto NB I-375 primarily during the PM peak hours. The difficulty is observed to be caused by the I-75 interchange north of the ramps and causes queuing on NB I-375.

Figure 4.10.1 – Example of Ramp "Braiding"

SUGGESTION: The following options should be considered:

1) **"Braid" the NB I-375 entrance ramp from Monroe St with the NB I-75 / Gratiot Ave exit ramp.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$18,131,000**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **N/A (No CMF Available for countermeasure)**

4.11 Crash Potential #11 – Poor Sign Retroreflectivity

Expected Frequency	Expected Severity	B
Infrequent	Low	

Observation: Several aging signs were observed to have poor sign retroreflectivity during low light conditions, making it difficult to read the sign message.

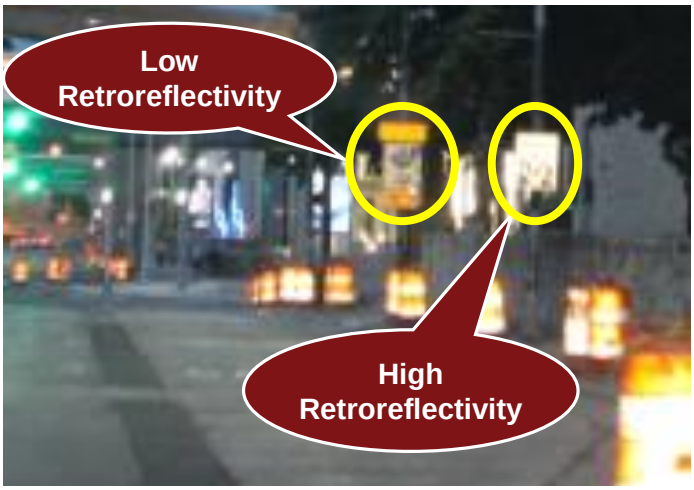


Figure 4.11.1 – Sign Retroreflectivity under Low Light Conditions

SUGGESTION: The following options should be considered:

1) **Replace/upgrade existing signing to meet current signing & retroreflectivity standards.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$175,200**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):
*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

1) **13.48***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.12 Crash Potential #12 – EB Jefferson Ave Lane Drop at Griswold St

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: The right two lanes on EB Jefferson Ave drop to a single lane after the Griswold St intersection with no advance notice. This can be unexpected and confusing to motorists unfamiliar with the area.

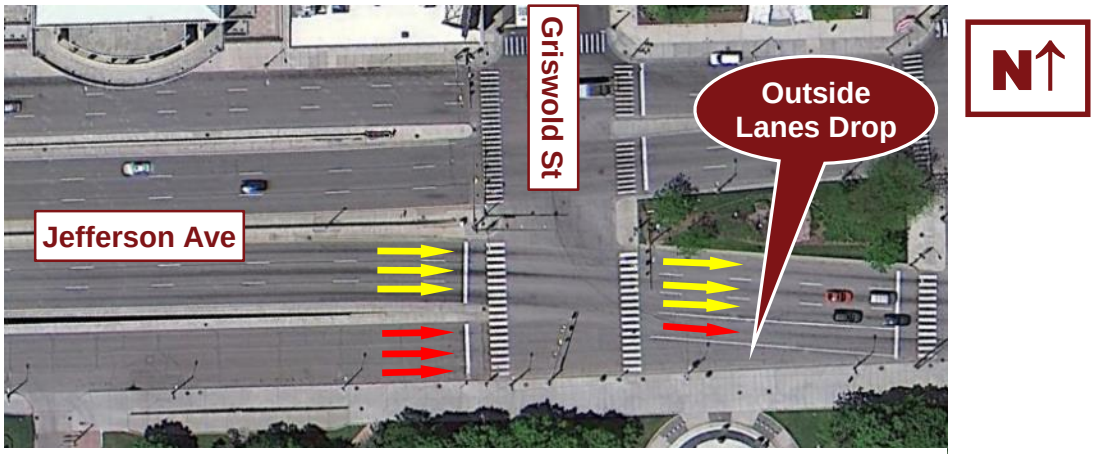


Figure 4.12.1 – EB Jefferson Ave Lane Drop at Griswold St

SUGGESTION: The following options should be considered:

1) **Reduce EB Jefferson Ave to one (1) lane prior to Griswold St and define parking lane using pavement markings.**
2) **Reduce EB Jefferson Ave to one (1) lane prior to Griswold using curb and gutter.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$1,000**
2) **$43,900**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **N/A (No CMF available for countermeasure)**
2) **N/A (No CMF available for countermeasure)**

4.13 Crash Potential #13 – SB Chrysler Drive to EB Jefferson Ave Lane Usage

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: SB Chrysler Service Drive consists of three lanes approaching WB Jefferson Ave. Per field observation, the SB Chrysler Service Drive Bridge over I-375 does not have pavement markings. Motorists were utilizing the three lane bridge as two lanes. Additionally, the pavement and curb and gutter on the bridge is deteriorated.

Figure 4.13.1 – SB Chrysler Drive to EB Jefferson Ave Lane Usage

SUGGESTION: The following options should be considered:

1) **Install pavement markings.**
2) **Consider capping the deck with HMA.**

Crash Potential #13 – SB Chrysler Drive to EB Jefferson Ave Lane Usage (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$1,500**
2) **$26,200**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):
*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

1) **11.98***
2) **0.39***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.14 Crash Potential #14 – SB Chrysler Drive at Macomb St

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: Concrete curb is in place at this location requiring SB Chrysler Drive traffic to turn right at Macomb St and does not allow traffic to continue straight on SB Chrysler Drive. Quick curb with vertical delineators has also been installed at the end of the curb to extend the turn guidance. The additional length of quick curb extends through the path of the pedestrian crossing on Macomb St. Additionally, per field observations, it is difficult to see the curb ahead when traveling SB on Chrysler Drive, especially during low light conditions.

Figure 4.14.1 – Curb on SB Chrysler Drive at Macomb St

SUGGESTION: The following options should be considered:

1) **Extend the curb and gutter and remove the quick curb. Maintain a curb cut in the radius for pedestrian access.**
2) **Paint the curb yellow and install vertical delineators.**
3) **Remove SB Chrysler Drive between Clinton St and Macomb St.**

Crash Potential #14 – SB Chrysler Drive at Macomb St (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$12,900**
2) **$500**
3) **$46,200**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **15.28***
2) **78.63***
3) **0.99***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

4.15 Crash Potential #15 – Vegetation within Project Area

Expected Frequency	Expected Severity	A
Rare	Low	

Observation: Existing vegetation is obscuring signing throughout the project area, but more specifically on SB Chrysler Drive near Larned St and on EB Jefferson Ave at I-375. The existing vegetation is also obscuring the street lighting on the WB side of West Jefferson Ave.

Figure 4.15.1 – Vegetation Obscuring Sign on NB I-375

SUGGESTION: The following options should be considered:

1) **Routine pruning of existing vegetation**
2) **Lower lighting height on the WB side of West Jefferson so the lighting is not obstructed by the trees.**

Crash Potential #15 – Vegetation within Project Area (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$5,000**
2) **$19,200**

A Benefit-to-Cost analysis was conducted per the Highway Safety Manual methodology utilizing the predictive method for estimating average crash frequency and severity. See Appendix C for results of this analysis. The results of this analysis show the following annual benefit-to-annual cost (B/C):

1) **N/A (No CMF available for countermeasure)**
2) **36.50***

*** Where indicated, the expected crash frequency was determined utilizing short term average crash frequency.**

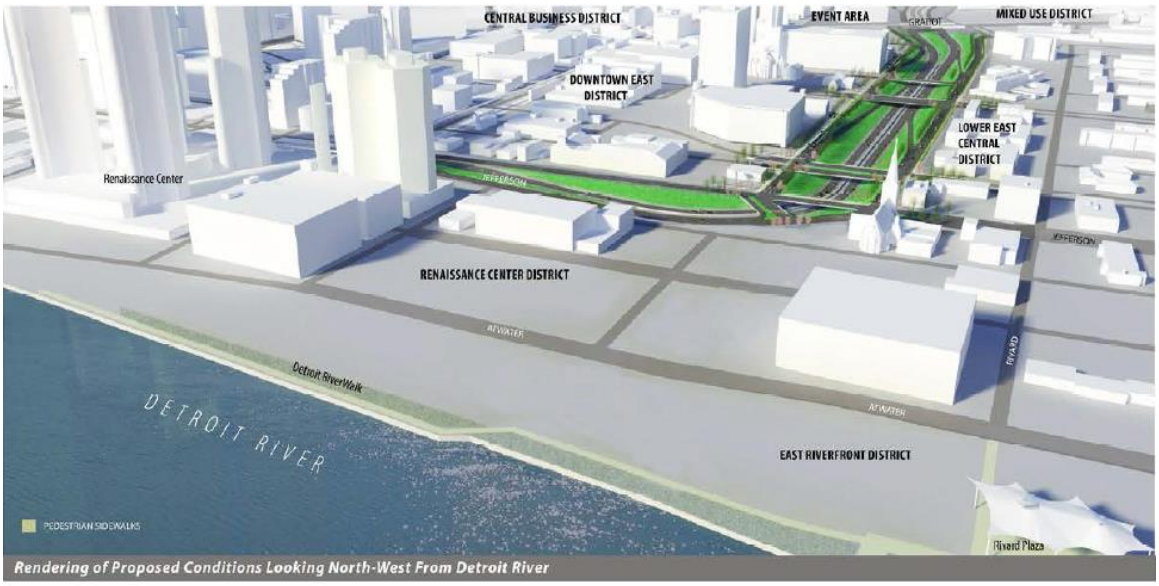
5.0 Feasibility Study Roadway Audit Findings and Suggestions

After completing the evaluation and ranking of the existing project roadways, the RSA Team then evaluated the Feasibility Study Alternatives utilizing the same process. Evaluation of the Feasibility Study Alternatives was based on conceptual drawings from the study. All suggested crash potentials and ranking assigned to each crash potential was based on the knowledge and professional judgment of the RSA Team members. Review of the Feasibility Study Alternatives included the I-375 Corridor Alternatives 1 – 6, the East Jefferson Ave Corridor Alternatives 1 & 2, and the West Jefferson Ave Corridor Alternatives 1 & 2. Issues identified during the review of the Feasibility Study alternatives were prioritized by the RSA Team. For each safety issue identified, the team developed potential mitigation measures for review by the owner (MDOT). The safety issues were prioritized based upon the perceived frequency of crashes; and the anticipated severity of crashes resulting from each safety issue. As a result, each safety issue was prioritized on the basis of ranking from A (lowest risk and lowest severity) to F (highest risk and highest severity). A table identifying the ranking system is previously shown in Table 4-1 above. This prioritization was based upon expectations and judgment of the RSA Team members.

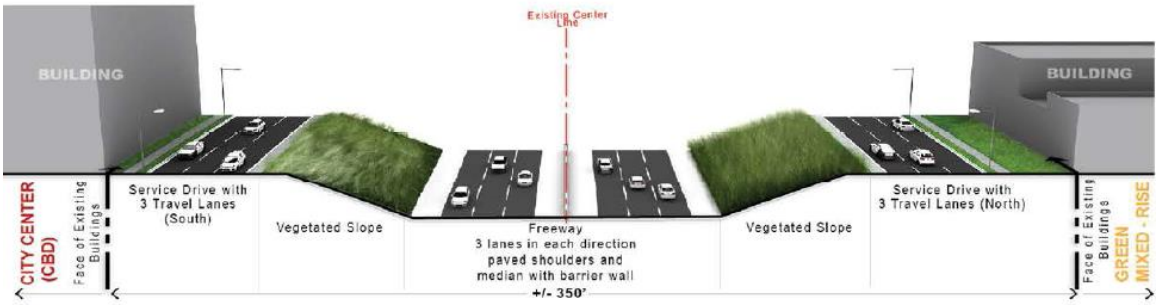
5.1 I-375 Corridor Alternative 1

The general features of I-375 Corridor Alternative 1 are as follows:

- Preserves the I-375 freeway and Chrysler Drive configuration.
- Improvements to SB I-375 off ramp operations and safety.



Rendering of Proposed Conditions Looking North-West From Detroit River



Cross-Section Showing Proposed Conditions Looking North

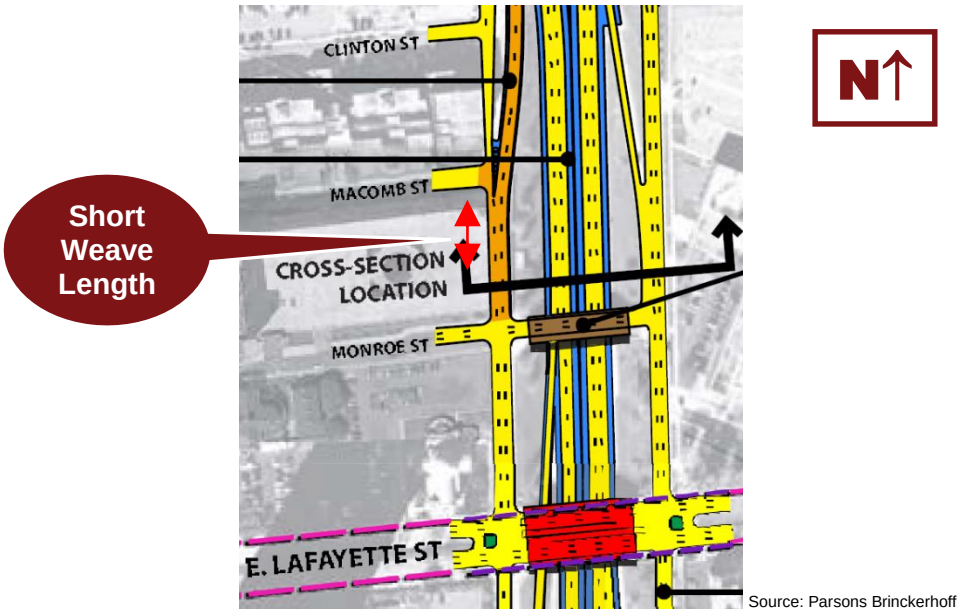
Source: Parsons Brinckerhoff

Figure 5.1.1 – I-375 Corridor Alternative 1

5.1.1 Crash Potential #1 – SB I-375 Exit Ramp to Lafayette St Weaving

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: Vehicles exiting I-375 wanting to enter the casino parking ramp must weave from the ramp to the outside SB Chrysler Drive lane in a relatively short distance (approx. 100') potentially causing queues on the ramp and onto SB I-375.



Source: Parsons Brinckerhoff

Figure 5.1.1.1 – SB I-375 off Ramp Weave at Lafayette St

SUGGESTION: The following options should be considered:

1) **Eliminate SB Chrysler Drive from Gratiot Ave to Clinton St.**
2) **Provide right-turn channelization for SB Chrysler Drive at Macomb St.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$46,200**
2) **$13,600**

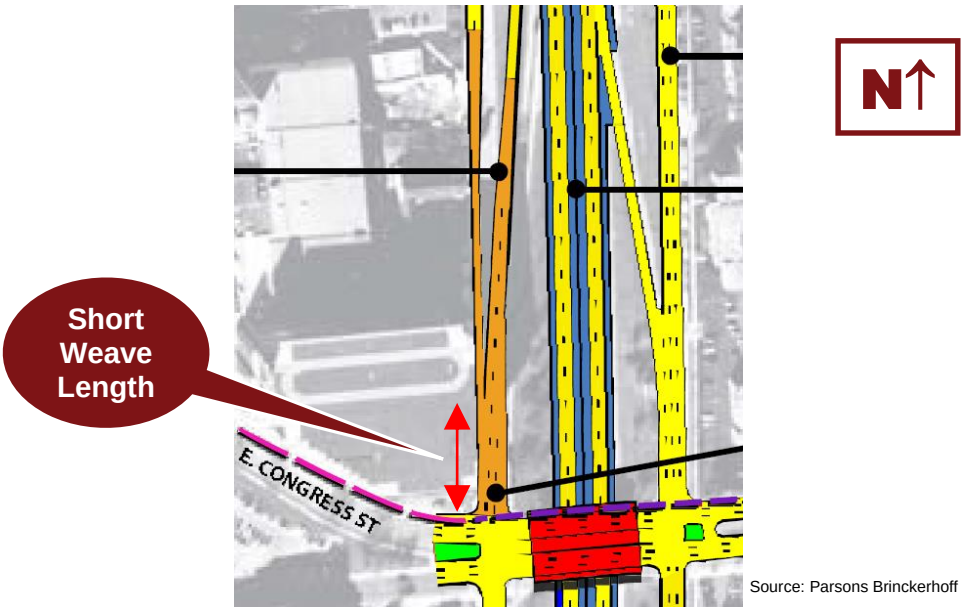
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **100% of crashes involving SB Chrysler Drive vehicles at the SB I-375 ramp**
2) **20% of total Crashes**

5.1.2 Crash Potential #2 – SB I-375 Exit Ramp to Larned St Weaving

Expected Frequency	Expected Severity	C
Occasional	Low	

Observation: Vehicles exiting SB I-375 and exiting vehicles from the parking ramp on SB Chrysler Drive must weave in a relatively short distance (approx. 200') approaching Larned St.



Source: Parsons Brinckerhoff

Figure 5.1.2.1 – SB I-375 off Ramp Weave at Larned St

SUGGESTION: The following options should be considered:

1) **Relocate SB I-375 exit ramp to Larned St north of its current location.**
2) **Investigate elimination of the SB I-375 exit ramp to Larned St.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$334,000**
2) **$69,000**

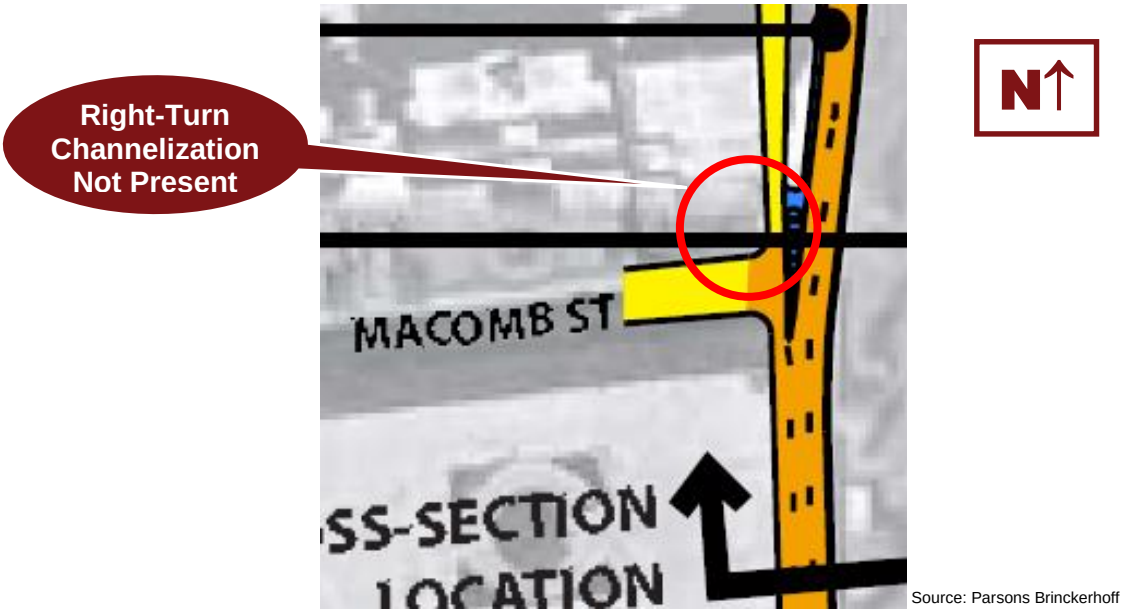
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **100% of ramp-related crashes at this location**

5.1.3 Crash Potential #3 – SB Chrysler Drive Right-Turn Channelization at Macomb St

Expected Frequency	Expected Severity	
Infrequent	Low	**B**

Observation: The existing forced right-turn on SB Chrysler Drive at Macomb St is removed in this alternative, creating a conflict point between thru traffic on SB Chrysler Drive and the SB I-375 exit ramp traffic.



Source: Parsons Brinckerhoff

Figure 5.1.3.1 – Right-Turn Channelization Not Present

SUGGESTION: The following options should be considered:
1) **Maintain existing right-turn channelization on SB Chrysler Drive.**

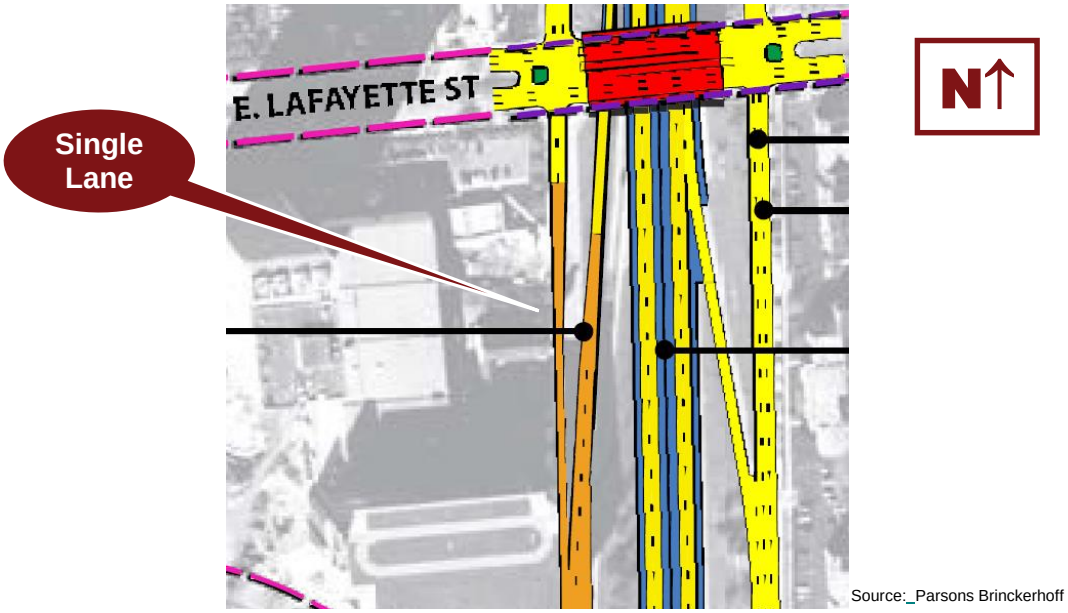
ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:
1) **$6,100**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.
1) **20% of total crashes**

5.1.4 Crash Potential #4 – Bus Stop Access

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: Bus stops located in the single lane segment of SB Chrysler Drive may cause queuing and rear-end crashes.



Source: Parsons Brinckerhoff

Figure 5.1.4.1 – Single Lane Location on SB Chrysler Drive

SUGGESTION: The following options should be considered:

1) **Construct bus turn-outs.**
2) **Construct 2 lane segment on SB Chrysler Drive.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$21,000**
2) **$54,500**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **10% of total crashes**

5.2 I-375 Corridor Alternative 2

The general features of I-375 Corridor Alternative 2 are as follows:

- Preserves the I-375 freeway and Chrysler Drive configuration.
- Improvements to SB I-375 off ramp operations and safety.
- New riverfront connection.
- Greater connectivity between I-75 and Gratiot Ave via the Madison St ramps.
- Provides bike lanes.

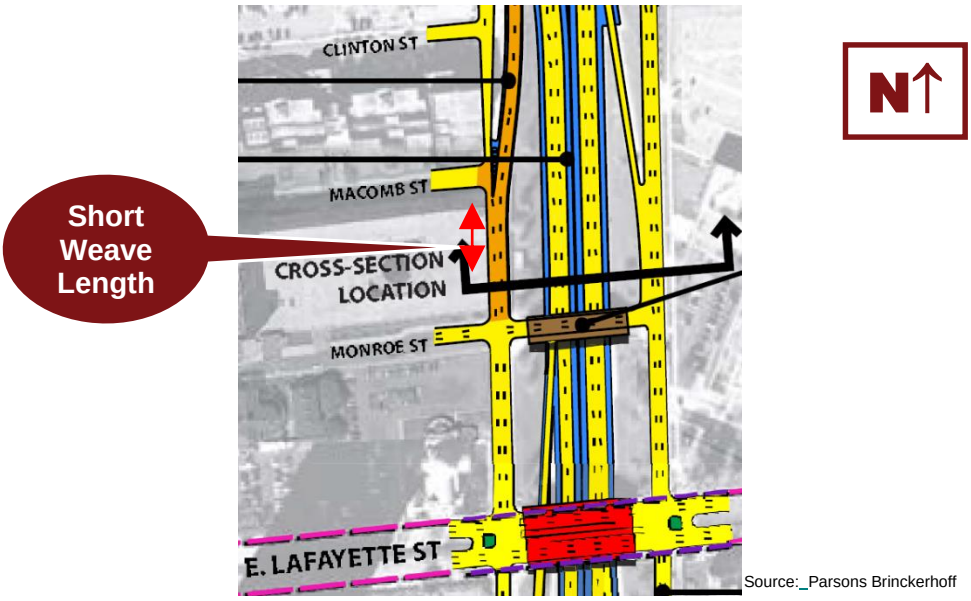
Source: Parsons Brinckerhoff

Figure 5.2.1 – I-375 Corridor Alternative 2

5.2.1 Crash Potential #1 – SB I-375 Exit Ramp to Lafayette St Weaving

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: Vehicles exiting I-375 wanting to enter the casino parking ramp must weave from the ramp to the outside SB Chrysler Drive lane in a relatively short distance (approx. 100') causing queues on the ramp and onto SB I-375.



Source: Parsons Brinckerhoff

Figure 5.2.1.1 – SB I-375 off Ramp Weave at Lafayette St

SUGGESTION: The following options should be considered:

1) **Eliminate SB Chrysler Drive from Gratiot Ave to Clinton St.**
2) **Provide right-turn channelization for SB Chrysler Drive at Macomb St.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$46,200**
2) **$13,600**

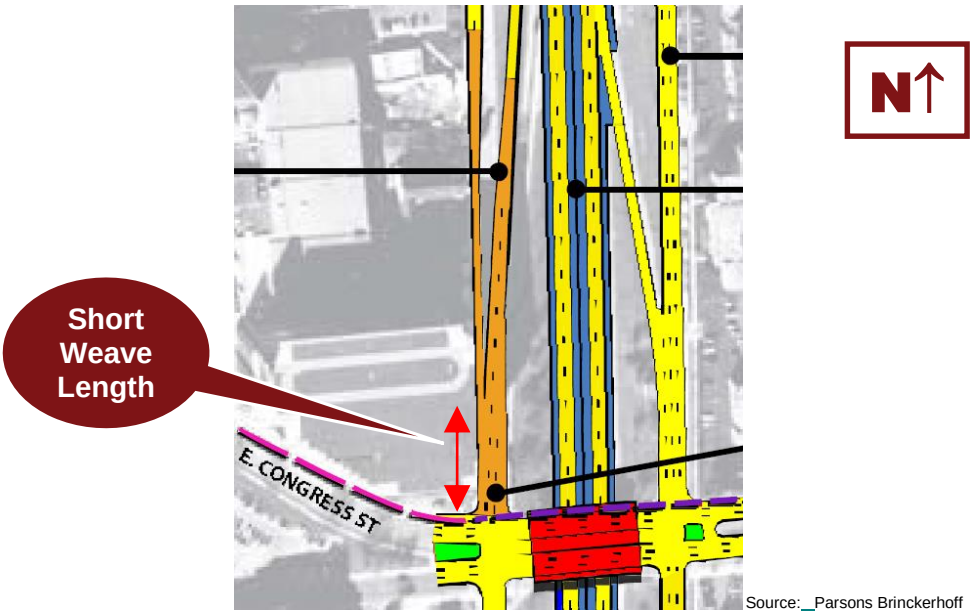
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **100% of select crashes on SB Chrysler Drive within construction limits**
2) **20% of total crashes**

5.2.2 Crash Potential #2 – SB I-375 Exit Ramp to Larned St Weaving

Expected Frequency	Expected Severity	C
Occasional	Low	

Observation: Vehicles exiting SB I-375 and exiting vehicles from the parking ramp on SB Chrysler Drive must weave in a relatively short distance (approx. 200') approaching Larned St.



Source: Parsons Brinckerhoff

Figure 5.2.2.1 – SB I-375 off Ramp Weave at Larned St

SUGGESTION: The following options should be considered:
1) **Relocate SB I-375 exit ramp to Larned St north of its current location.**
2) **Investigate elimination of the SB I-375 exit ramp to Larned St.**

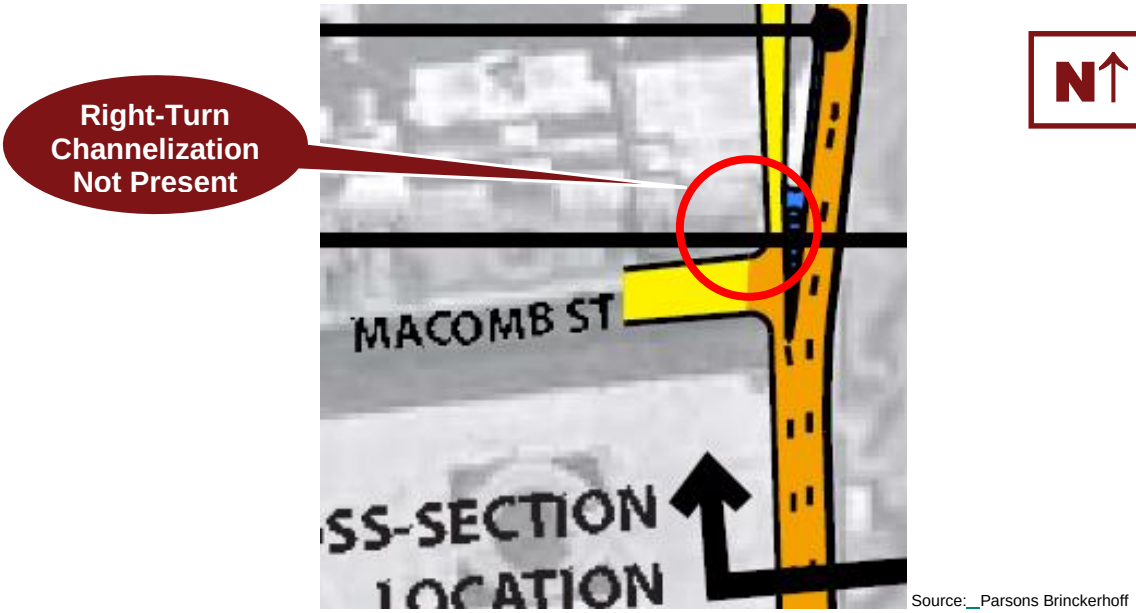
ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:
1) **$334,000**
2) **$69,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.
1) **No CMF available**
2) **100% of ramp-related crashes at this location**

5.2.3 Crash Potential #3 – SB Chrysler Drive Right-Turn Channelization at Macomb St

Expected Frequency	Expected Severity	
Infrequent	Low	**B**

Observation: The existing forced right-turn on SB Chrysler Drive at Macomb St is removed in this alternative, creating a conflict point between thru traffic on SB Chrysler Drive and the SB I-375 exit ramp traffic.



Source: Parsons Brinckerhoff

Figure 5.2.3.1 – Right-Turn Channelization Not Present

SUGGESTION: The following options should be considered:
1) **Maintain existing right-turn channelization on SB Chrysler Drive.**

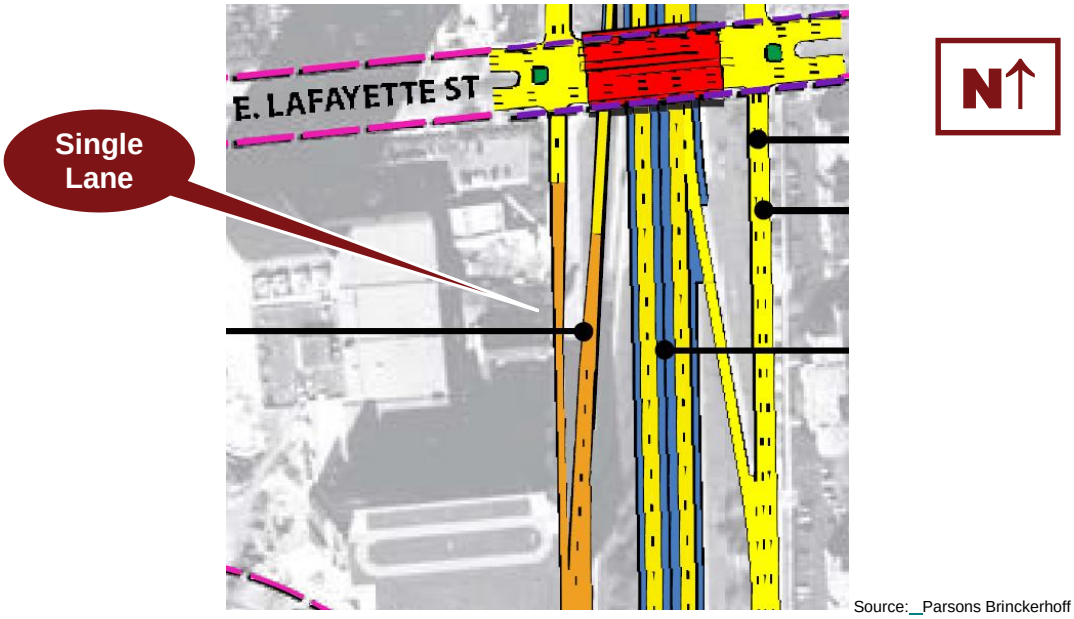
ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:
1) **$6,100**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.
1) **20% of total crashes**

5.2.4 Crash Potential #4 – Bus Stop Access

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: Bus stops located in the single lane segment of SB Chrysler Drive may cause queuing and rear-end crashes.



Source: Parsons Brinckerhoff

Figure 5.2.4.1 – Single Lane Location on SB Chrysler Drive

SUGGESTION: The following options should be considered:

1) **Construct bus turn-outs.**
2) **Construct 2 lane segment on SB Chrysler Drive.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$21,000**
2) **$54,500**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **10% of total crashes**

5.2.5 Crash Potential #5 – Bike Lanes on Chrysler Drive

Expected Frequency	Expected Severity	
Infrequent Issue A Rare Issue B	High Issue A Medium Issue B	**D** Issue A **B** Issue B

Observation: Issue A: Bike lane on NB Chrysler Drive at Jefferson Ave – Dual right-turns on the Atwater Connection at the NB Chrysler Drive & Jefferson Ave intersection may create crossing conflicts between NB bicyclists and EB Jefferson Ave vehicles.

Issue B: Bike lane on SB Chrysler Drive – Weaving movements on SB Chrysler Drive for vehicles entering and exiting ramps, driveways, and side streets create conflicts with bicyclists.

Source: Parsons Brinckerhoff

Figure 5.2.5.1 – NB Chrysler Drive at Jefferson Ave Conflict Point

SUGGESTION: The following options should be considered:

1) **Use green pavement markings at crossover conflict points.**
2) **End the proposed bike lane at the proposed dedicated right-turn lanes.**
3) **Reconsider installation of bicycle lanes on Chrysler Drive.**

Crash Potential #5 – Bike Lanes on Chrysler Drive (Continued)

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$1,100**
2) **N/A (No construction cost associated with this countermeasure)**
3) **N/A (No construction cost associated with this countermeasure)**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

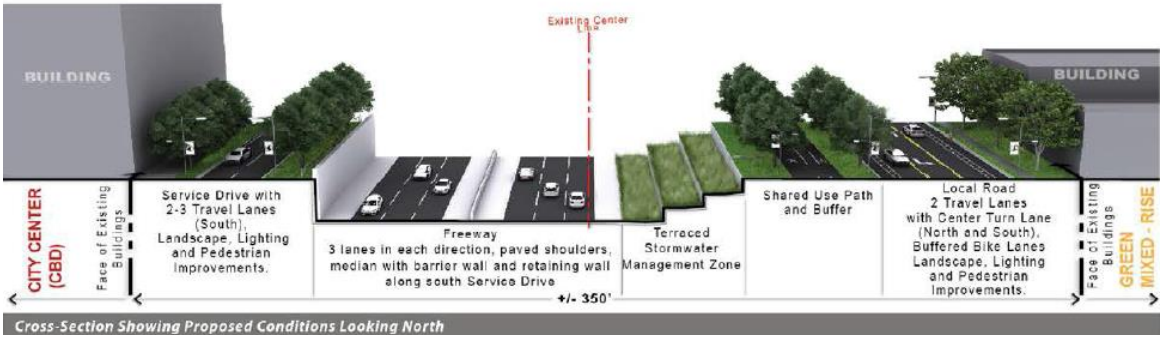
1) **10% of total crashes**
2) **No CMF available**
3) **No CMF available**

5.3 I-375 Corridor Alternative 3

The general features of I-375 Corridor Alternative 3 are as follows:

- Improvements to SB I-375 off ramp operations and safety.
- Improved direct connectivity to the riverfront and East Jefferson Ave corridor.
- Replaces the existing sharp curve on I-375 at Jefferson Ave with an at-grade signalized intersection with indirect left turns.
- Provides shorter street crossing distances for pedestrians, shared used path, and bike lanes.

Rendering of Proposed Conditions Looking North-West From Detroit River



Cross-Section Showing Proposed Conditions Looking North

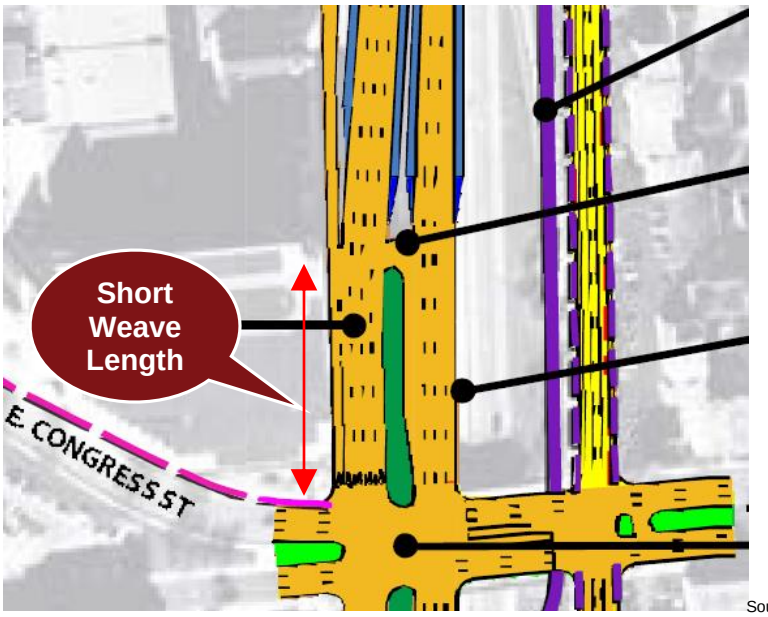
Source: Parsons Brinckerhoff

Figure 5.3.1 – I-375 Corridor Alternative 3

5.3.1 Crash Potential #1 – SB Chrysler Drive & Larned St Signalized Intersection (End of Freeway)

Expected Frequency	Expected Severity	E
Frequent	Medium	

Observation: Vehicles may queue onto SB I-375 at the Larned St signal due to weaving between the SB I-375 traffic and vehicles exiting the parking ramp taking place in a relatively short distance (approx. 200') approaching Larned St.



Source: Parsons Brinckerhoff

Figure 5.3.1.1 – SB I-375 Freeway End at Larned St

SUGGESTION: The following options should be considered:

1) **Create a gateway appearance as far north on I-375 as possible utilizing a curbed roadway section, landscaping, art, rumble strips, etc. to increase awareness of the slower speeds south on I-375.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$190,000**

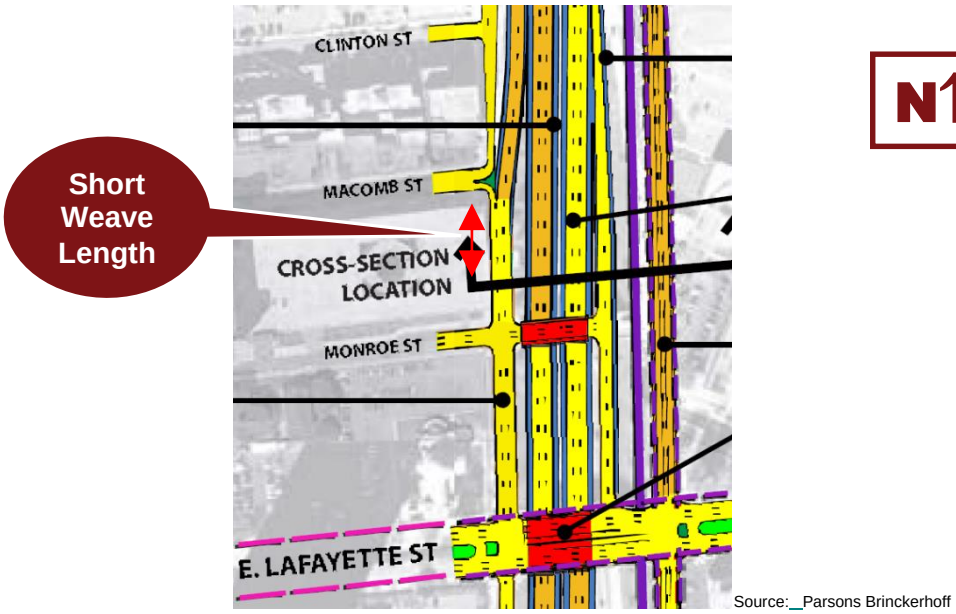
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**

5.3.2 Crash Potential #2 – SB I-375 Exit Ramp to Lafayette St Weaving

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: Vehicles exiting I-375 wanting to enter the casino parking ramp must weave from the ramp to the outside SB Chrysler Drive lane in a relatively short distance (approx. 100') causing queues on the ramp and onto SB I-375.



Source: Parsons Brinckerhoff

Figure 5.3.2.1 – SB I-375 off Ramp Weave at Lafayette St

SUGGESTION: The following options should be considered:

1) **Eliminate SB Chrysler Drive from Gratiot Ave to Clinton St.**
2) **Provide right-turn channelization for SB Chrysler Drive at Macomb St.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$46,200**
2) **$6,100**

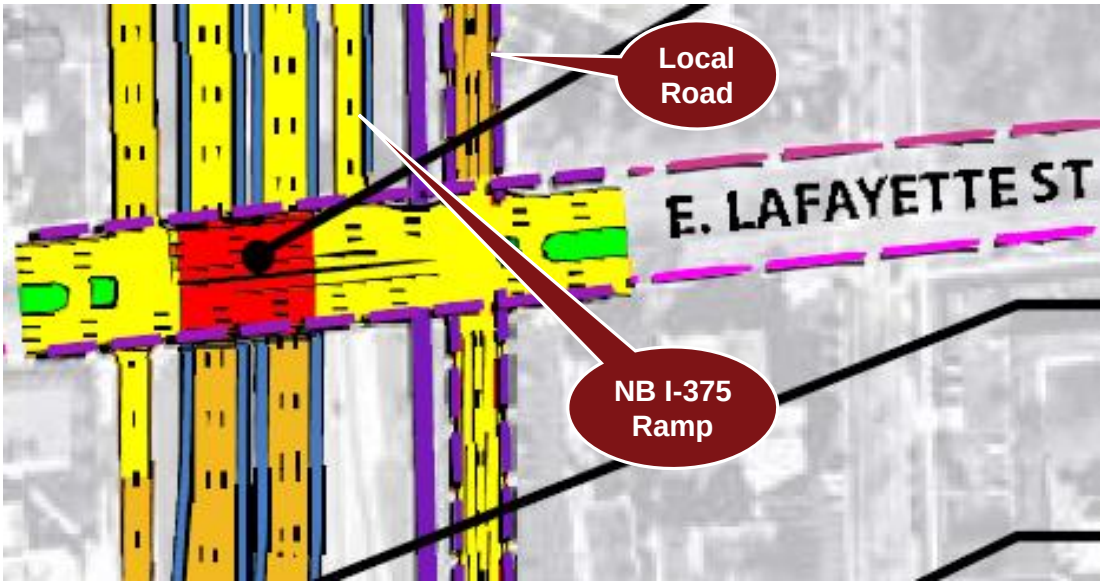
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **100% of select crashes on SB Chrysler Drive within construction limits**
2) **20% of total crashes**

5.3.3 Crash Potential #3 – EB Lafayette St to NB Local Road Left-Turns

Expected Frequency	Expected Severity	
Infrequent	Low	**B**

Observation: The Local Road is in close proximity to the NB I-375 entrance ramp on Lafayette St. Crashes may occur due to EB left-turning vehicles turning onto the NB Local Road getting stuck in the queue of EB vehicles turning left onto NB I-375.



Source: Parsons Brinckerhoff

Figure 5.3.3.1 – Local Road and I-375 at Lafayette St

SUGGESTION: The following options should be considered:
1) Do not allow direct left-turns from EB Lafayette St to the NB Local Road.

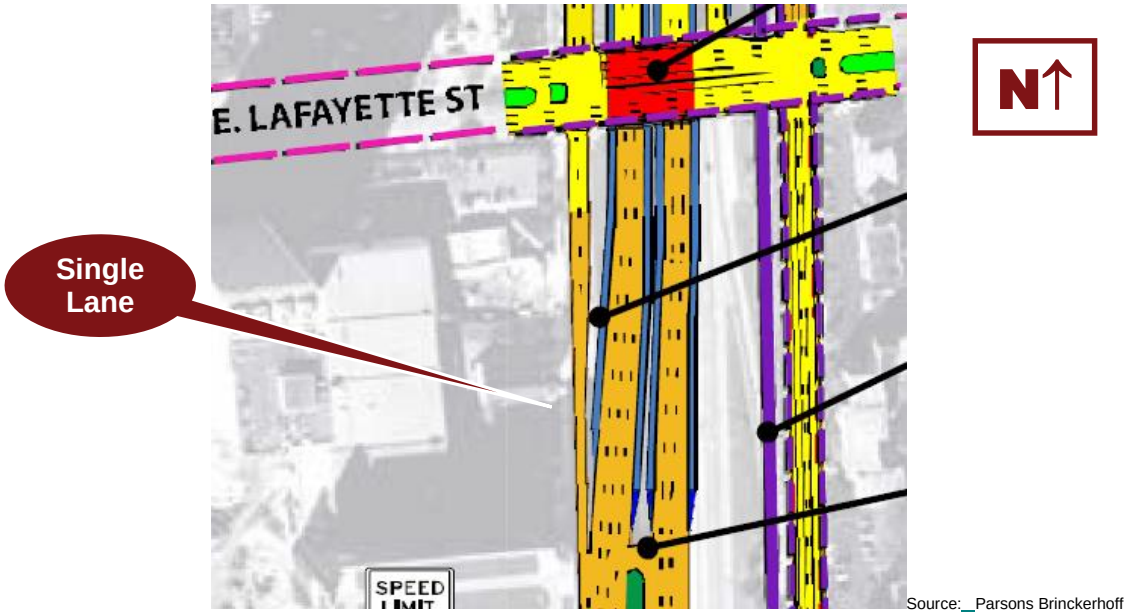
ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:
1) $500 (includes cost to enforce restriction with signing)

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.
1) 45% of total crashes

5.3.4 Crash Potential #4 – Bus Stop Access

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: Bus stops located in the single lane segment of SB Chrysler Drive may cause queuing and rear-end crashes.



Source: Parsons Brinckerhoff

Figure 5.3.4.1 – Single Lane Location on SB Chrysler Drive

SUGGESTION: The following options should be considered:

1) **Construct bus turn-outs.**
2) **Construct 2 lane segment on SB Chrysler Drive.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$21,000**
2) **$54,500**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **10% of total crashes**

5.4 I-375 Corridor Alternative 4

The general features of I-375 Corridor Alternative 4 are as follows:

- Significantly improves street connectivity into the northeast corner of downtown with new access created to Clinton St and Macomb St.
- Improved direct connectivity to the riverfront and East Jefferson Ave corridor.
- Replaces the existing sharp curve on I-375 at Jefferson Ave with an at-grade signalized intersection with indirect left turns.
- Improves existing issues with SB right-turn to Congress St.
- Provides shared used path and bike lanes.

Rendering of Proposed Conditions Looking North-West From Detroit River

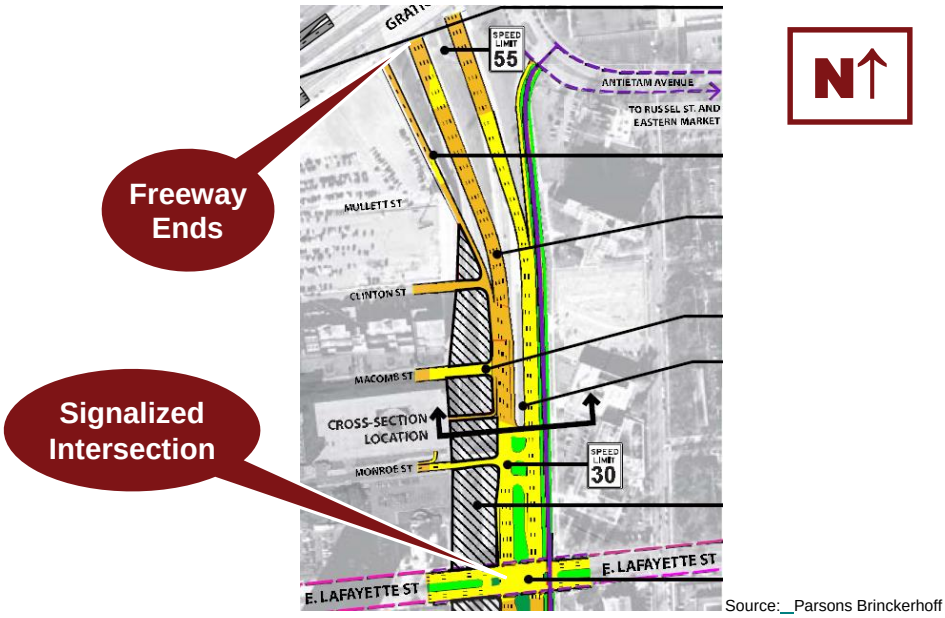
Cross-Section Showing Proposed Conditions Looking North

Source: Parsons Brinckerhoff

Figure 5.4.1 – I-375 Corridor Alternative 4

5.4.1 Crash Potential #1 – Transition from Freeway Segment to Local Road

Expected Frequency	Expected Severity	
Occasional	Low	**C**
Observation: There may be a higher potential for crashes where the high speed freeway segment ends and transitions into a lower speed local road.		



Source: Parsons Brinckerhoff

Figure 5.4.1.1 – I-375 Freeway End

SUGGESTION: The following options should be considered:

1) **Create a gateway appearance as far north on I-375 as possible utilizing a curbed roadway section, landscaping, art, rumble strips, etc. to increase awareness.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

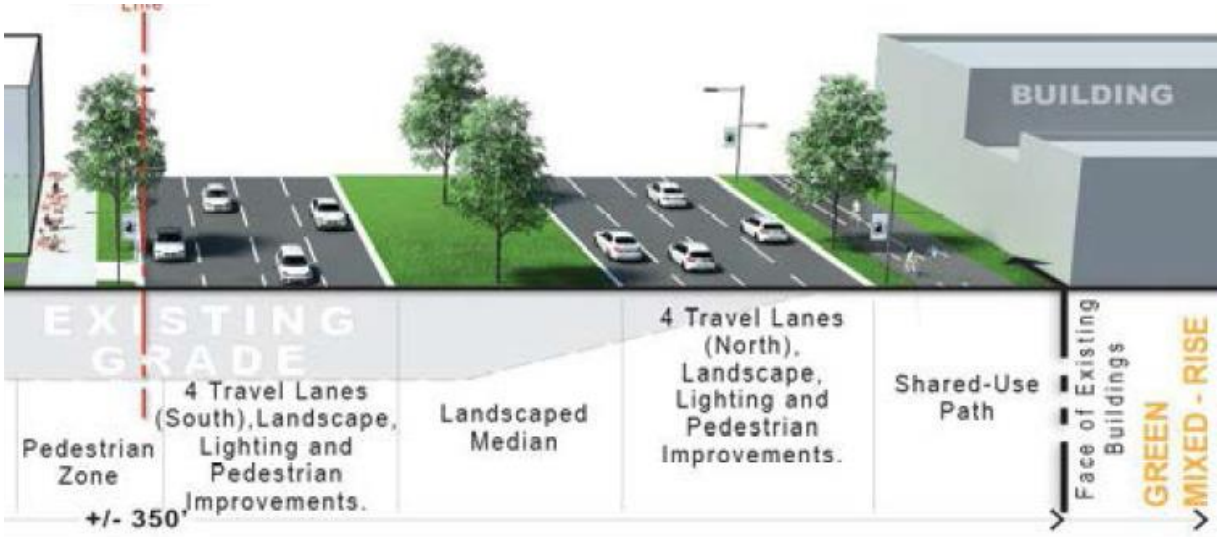
1) **$190,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF Available**

5.4.2 Crash Potential #2 – Conflicts between Driveways and Shared Use Path on I-375 Boulevard

Expected Frequency	Expected Severity	
Rare	Medium	**B**
Observation: Potential conflicts between the proposed shared use path and high volume driveways on the I-375 boulevard poses a safety concern to path users.		



Source: Parsons Brinckerhoff

Figure 5.4.2.1 – Shared Use Path on I-375 Boulevard

SUGGESTION: The following options should be considered:

1) **Evaluate access management.**
2) **Reconsider the use of a shared use path on the I-375 boulevard – consider an alternate route.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

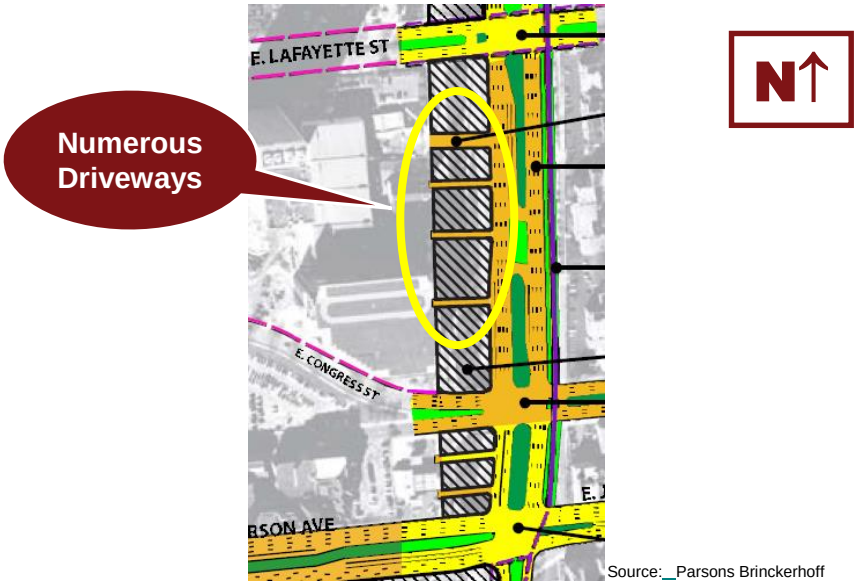
1) **$5,500**
2) **N/A (No construction cost associated with this countermeasure)**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **No CMF available**

5.4.3 Crash Potential #3 – Numerous Access Points along the SB I-375 Boulevard

Expected Frequency	Expected Severity	
Infrequent	Low	**B**
Observation: Potential conflicts due to ingress/egress of the numerous driveways and intersections along the SB I-375 boulevard is a safety concern.		



Source: Parsons Brinckerhoff

Figure 5.4.3.1 – Numerous Driveways on SB I-375 Boulevard

SUGGESTION: The following options should be considered:

1) **Pursue access management. Utilize a single access roadway for the driveways where feasible.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$87,300**

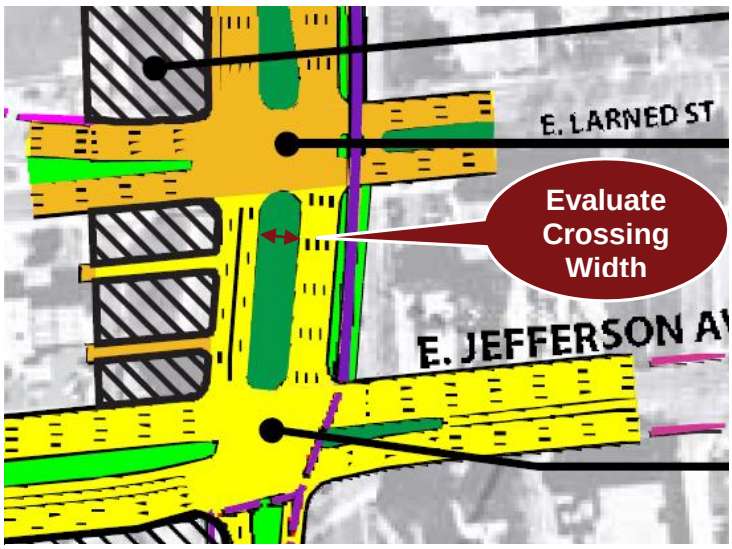
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **33% of driveway-related crashes**

5.4.4 Crash Potential #4 – Pedestrian Crossings along I-375 Boulevard

Expected Frequency	Expected Severity	B
Rare	Medium	

Observation: Potential conflicts resulting from pedestrians trying to cross the entire boulevard section within a single signal phase when signal timings do not allow for this is a safety concern.



Source: Parsons Brinckerhoff

Figure 5.4.4.1 – I-375 Boulevard Width

SUGGESTION: The following options should be considered:

1) **Widen the median to ensure pedestrians travel through the boulevard section in 2 signal cycles, eliminating occurrences of crossing during no walk phases.**
2) **Consider a grade separated crossing for the shared use path.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$1,060,000**
2) **$620,800 (one structure assumed)**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **5% of total crashes**
2) **90% of pedestrian crashes**

5.5 I-375 Corridor Alternative 5

The general features of I-375 Corridor Alternative 5 are as follows:

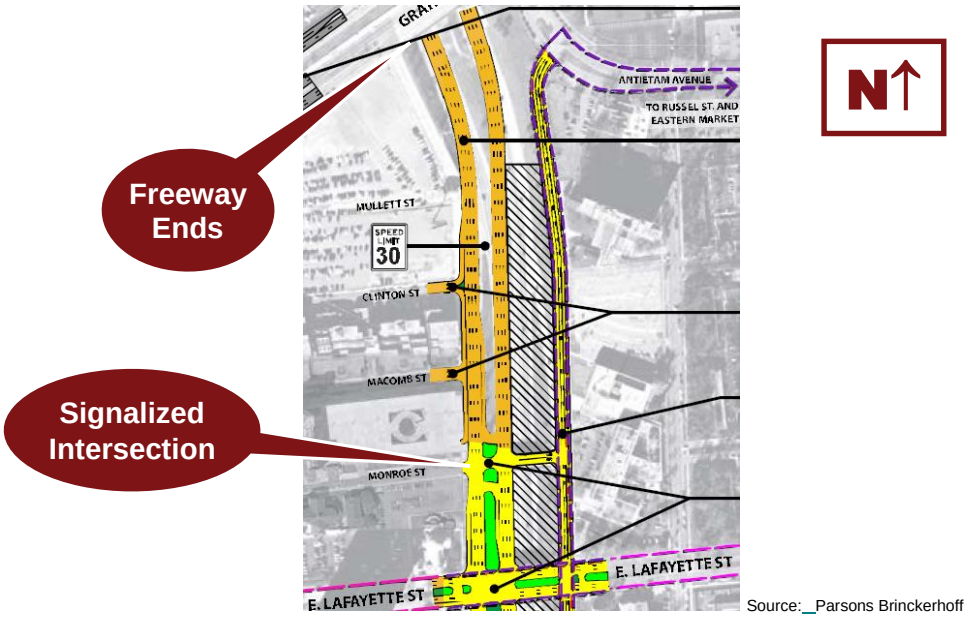
- Improves street connectivity into downtown with new access created to Clinton St and Macomb St.
- Improved direct connectivity to the riverfront and East Jefferson Ave corridor.
- Replaces the existing sharp curve on I-375 at Jefferson Ave with at-grade signalized intersection with indirect left turns.
- Provides a bike lane on the local road.

Source: Parsons Brinckerhoff

Figure 5.5.1 – I-375 Corridor Alternative 5

5.5.1 Crash Potential #1 – Transition from Freeway Segment to Local Road

Expected Frequency	Expected Severity	C
Occasional	Low	
Observation: There may be a higher potential for crashes where the high speed freeway segment ends and transitions into a lower speed local road.		



Source: Parsons Brinckerhoff

Figure 5.5.1.1 – I-375 Freeway Ends

SUGGESTION: The following options should be considered:

1) **Create a gateway appearance as far north on I-375 as possible utilizing a curbed roadway section, landscaping, art, rumble strips, etc. to increase awareness.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

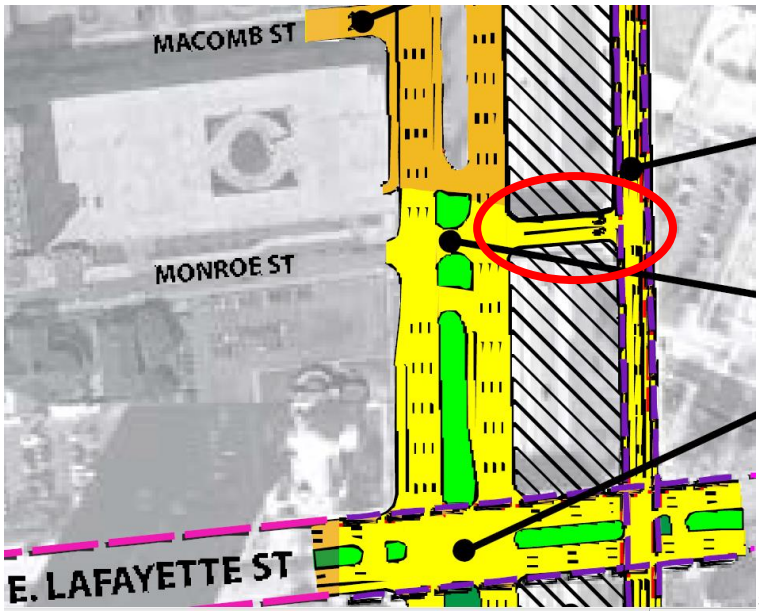
1) **$190,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**

5.5.2 Crash Potential #2 – SB I-375 Left Turn at Monroe St

Expected Frequency	Expected Severity	B
Infrequent	Low	
Observation: Vehicles making a direct left turn from the SB I-375 Boulevard to Monroe St may cause queueing on the SB I-375 boulevard resulting in rear-end crashes.		



Source: Parsons Brinckerhoff

Figure 5.5.2.1 – Monroe St between I-375 and the Service Drive

SUGGESTION: The following options should be considered:

1) **Eliminate Monroe St connection between I-375 and the Service Drive and install indirect left-turns to facilitate this movement.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$43,100**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

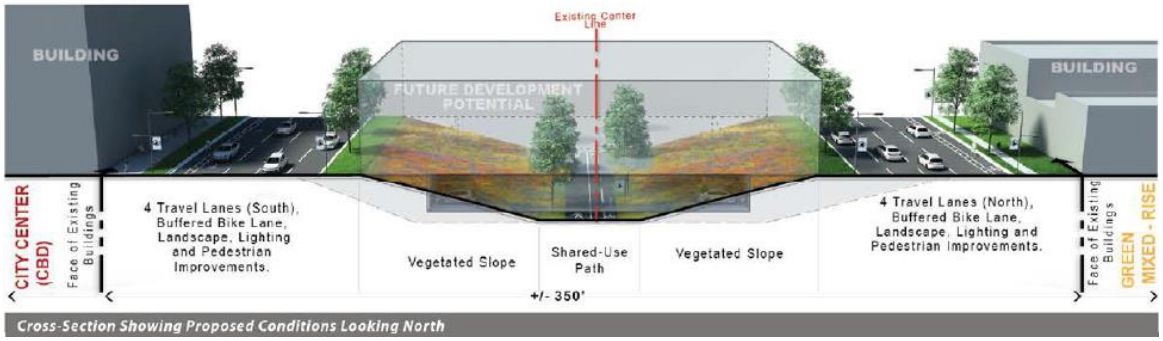
1) **45% of left-turn crashes**

5.6 I-375 Corridor Alternative 6

The general features of I-375 Corridor Alternative 6 are as follows:

- Improves connectivity into downtown with new access created to Clinton St and Macomb St.
- Improved direct connectivity to the riverfront and East Jefferson Ave corridor.
- Replaces the existing sharp curve on I-375 at Jefferson Ave with an at-grade signalized intersection with indirect left turns.
- Accommodates all existing turn maneuvers.
- Provides a shared used path and bike lanes.

Rendering of Proposed Conditions Looking North-West From Detroit River



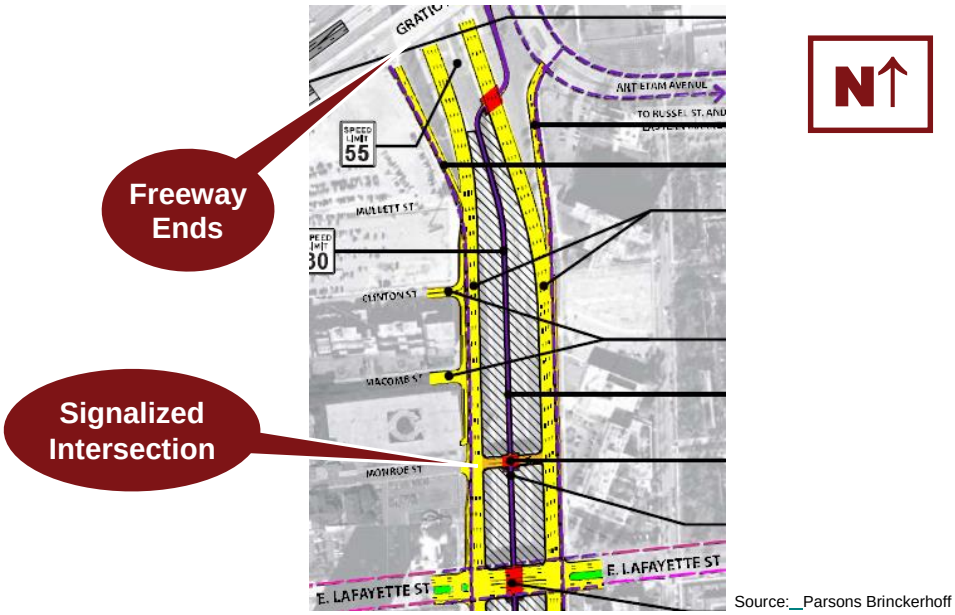
Cross-Section Showing Proposed Conditions Looking North

Source: Parsons Brinckerhoff

Figure 5.6.1 – I-375 Corridor Alternative 6

5.6.1 Crash Potential #1 – Transition from Freeway Segment to Local Road

Expected Frequency	Expected Severity	
Occasional	Low	**C**
Observation: There may be a higher potential for crashes where the high speed freeway segment ends and transitions into a lower speed local road.		



Source: Parsons Brinckerhoff

Figure 5.6.1.1 – I-375 Freeway End

SUGGESTION: The following options should be considered:

1) **Create a gateway appearance as far north on I-375 as possible utilizing a curbed roadway section, landscaping, art, rumble strips, etc. to increase awareness.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$190,000**

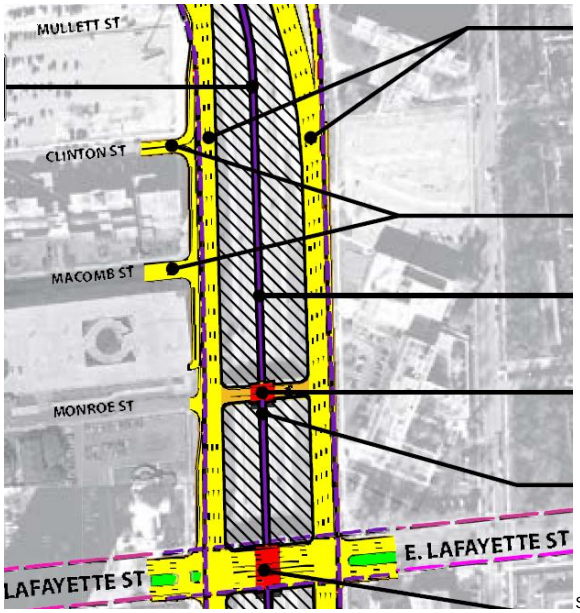
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**

5.6.2 Crash Potential #2 –Bike Lane Conflicts

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: Potential conflicts between the proposed bike lane and the high volume driveways and right-turn lanes on the SB I-375 surface street may pose a safety concern to the bicyclists.



Source: Parsons Brinckerhoff

Figure 5.6.2.1 – Numerous Right-Turn Lanes and Driveways on SB I-375

SUGGESTION: The following options should be considered:

1) **Reconsider the use of a bike lane on the SB I-375 surface street.**
2) **Provide at-grade connections from the shared use path to local crossroads.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

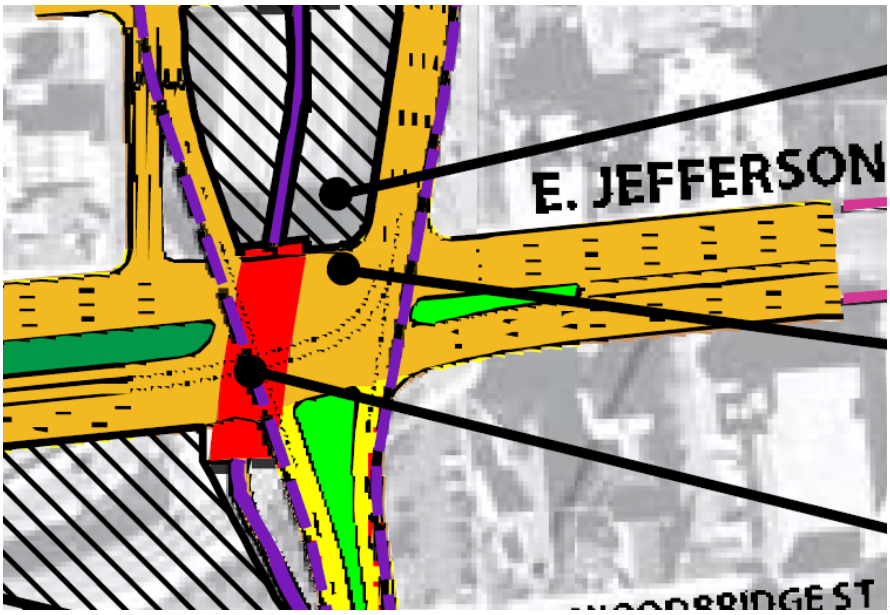
1) **No construction cost associated with this countermeasure**
2) **$44,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **No CMF available**

5.6.3 Crash Potential #3 – Motorist Confusion at the Jefferson Ave & I-375 Surface Street Intersection

Expected Frequency	Expected Severity	
Infrequent	Medium	**B**
Observation: Potential crashes due to motorist confusion over complex operations at the Jefferson Ave & I-375 surface street intersection.		



Source: Parsons Brinckerhoff

Figure 5.6.3.1 – Jefferson Ave & I-375 Surface Street Intersection

SUGGESTION: The following options should be considered:

1) **Consider extending the proposed one-way pair to Atwater St.**
2) **Transition to a boulevard intersection at Jefferson Ave.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$388,000**
2) **$225,000**

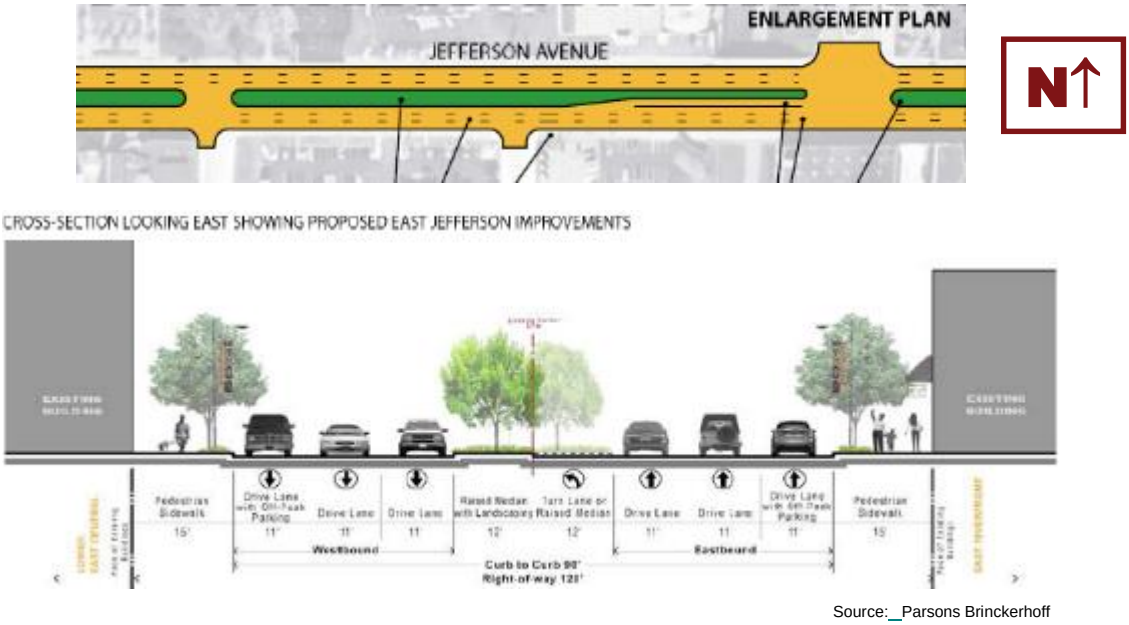
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **15% of total crashes**
2) **15% of total crashes**

5.7 East Jefferson Ave Corridor Alternative 1

The general features of East Jefferson Ave Corridor Alternative 1 are as follows:

- Three lanes in each direction.
- Raised, landscaped median with pedestrian refuge at crossings.
- Sidewalks provided outside of the East Jefferson Ave pavement.
- No designated bike facilities provided.



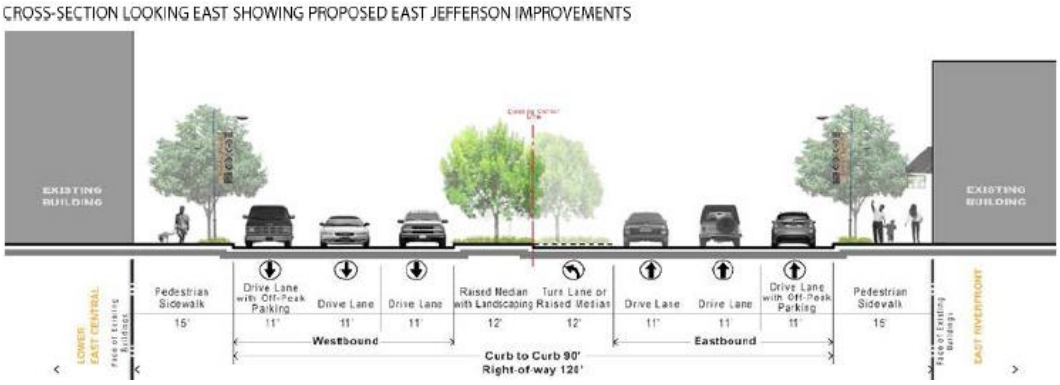
Source: Parsons Brinckerhoff

Figure 5.7.1 – East Jefferson Ave Corridor Alternative 1

5.7.1 Crash Potential #1 – Bicycle Crashes

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: Per field observation, bicyclists currently occupy the outside thru lane on this segment of Jefferson Ave. There is potential for vehicle/bicycle rear-end crashes due to reduced roadway capacity with no bike lanes proposed.



Source: Parsons Brinckerhoff

Figure 5.7.1.1 – Reduced Roadway Cross Section with No Bike Lane

SUGGESTION: The following options should be considered:

1) **Increase bicycle facilities on parallel routes.**
2) **Consider the addition of bike lanes.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **N/A (No construction cost associated with this countermeasure)**
2) **$582,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **36% of bicycle crashes**

5.7.2 Crash Potential #2 – Increase In Rear-End & Sideswipe-Same Crashes

Expected Frequency	Expected Severity	
Infrequent	Low	**B**
Observation: Due to the reduction in roadway capacity, there is a potential for an increase in rear-end and sideswipe-same crashes.		

SUGGESTION: The following options should be considered:

1) **Consider use of right-turn lanes at high volume driveways.**
2) **Consider elimination of on-street parking.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$160,000**
2) **$3,815**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **5% of total crashes**
2) **20% of total crashes**

5.7.3 Crash Potential #3 – Median Landscaping

Expected Frequency	Expected Severity	
Rare	Low	**A**

Observation: Modifying Jefferson Ave from an undivided roadway to a divided roadway with median landscaping may increase fixed object crashes between vehicles and median landscaping.

SUGGESTION: The following options should be considered:

1) **Selective use of median landscaping.**
2) **Consider use of low-growth plantings.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$6,000**
2) **$6,000**

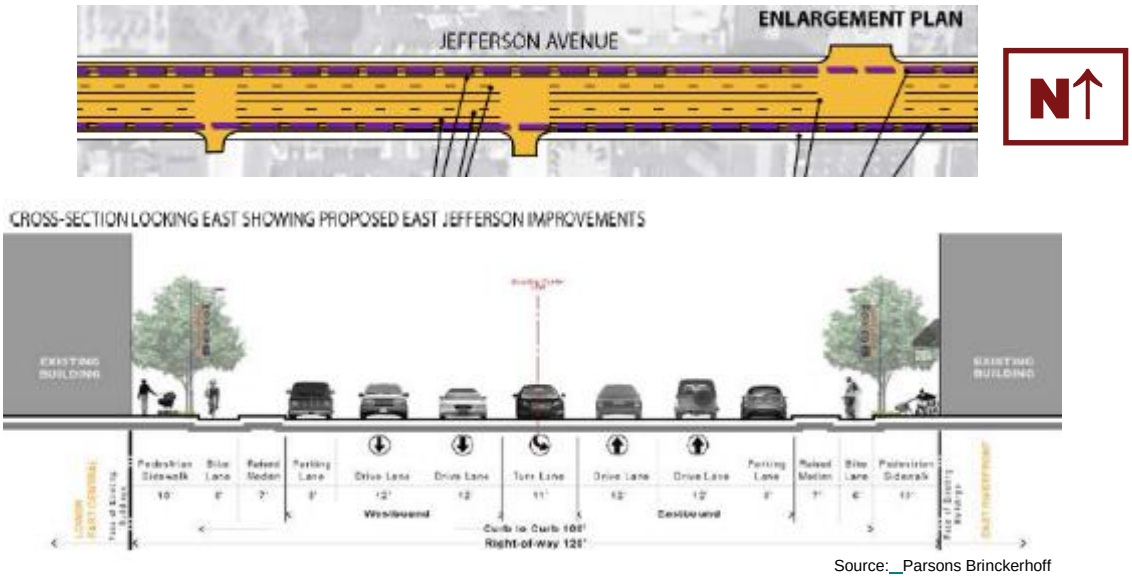
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **No CMF available**

5.8 East Jefferson Ave Corridor Alternative 2

The general features of East Jefferson Ave Corridor Alternative 2 are as follows:

- Two lanes in each direction with a center left-turn lane.
- On-street parking on both sides of the road.
- Bike lanes in both directions buffered from vehicular traffic by a raised divider.
- Sidewalks provided outside of the bike lanes.



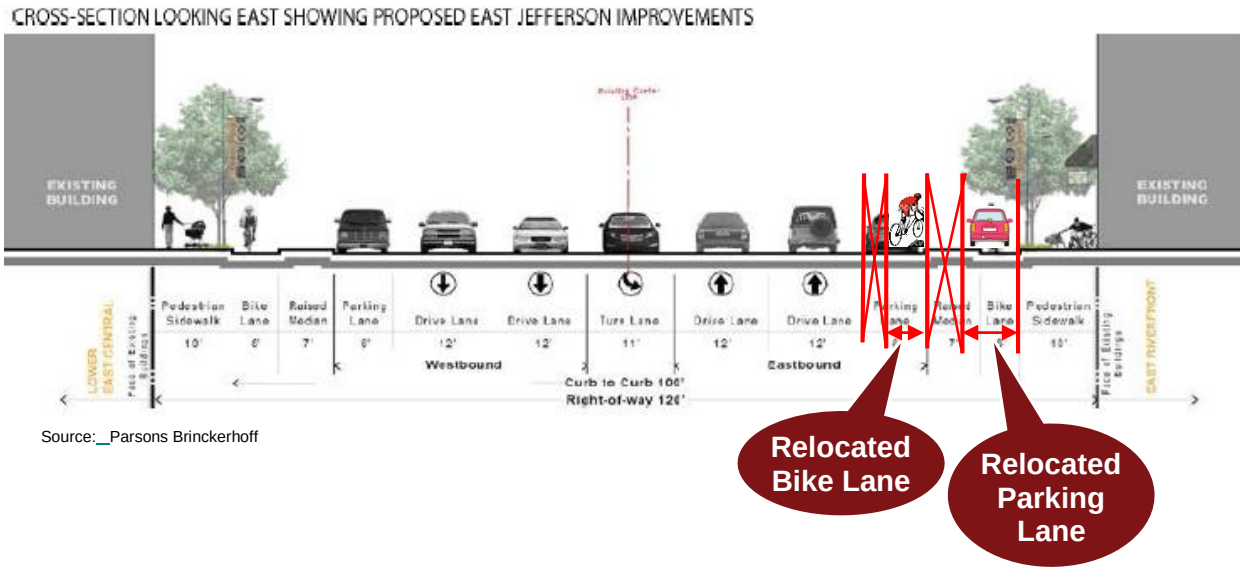
Source: Parsons Brinckerhoff

Figure 5.8.1 – East Jefferson Ave Corridor Alternative 2

5.8.1 Crash Potential #1 – Bicycle Crashes

Expected Frequency	Expected Severity	D
Infrequent	High	

Observation: Due to the separation of the bike lane from the roadway, there is a potential for right-hook bicycle crashes with right-turning vehicles. The separation also increases the potential for wrong-way bicycling crashes.



Source: Parsons Brinckerhoff

Figure 5.8.1.1 – Cross Section Depicting Bike Lane Relocated

SUGGESTION: The following options should be considered:

1) **Place bike lanes adjacent to the travel lane and place the parking lane outside of the bike lane (see Figure 5.8.1.1 above).**
2) **Consider bicycle signals.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$443,000**
2) **$29,400**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **20% of bicycle crashes**

5.8.2 Crash Potential #2 – Increase in Rear-End & Sideswipe-Same Crashes

Expected Frequency	Expected Severity	
Occasional	Low	**C**
Observation: Due to the reduction in roadway capacity, there is a potential for increase in rear-end and sideswipe same crashes.		

SUGGESTION: The following options should be considered:

1) **Consider use of right-turn lanes at high volume driveways.**
2) **Consider elimination of on-street parking.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **$160,000**
2) **$3,815**

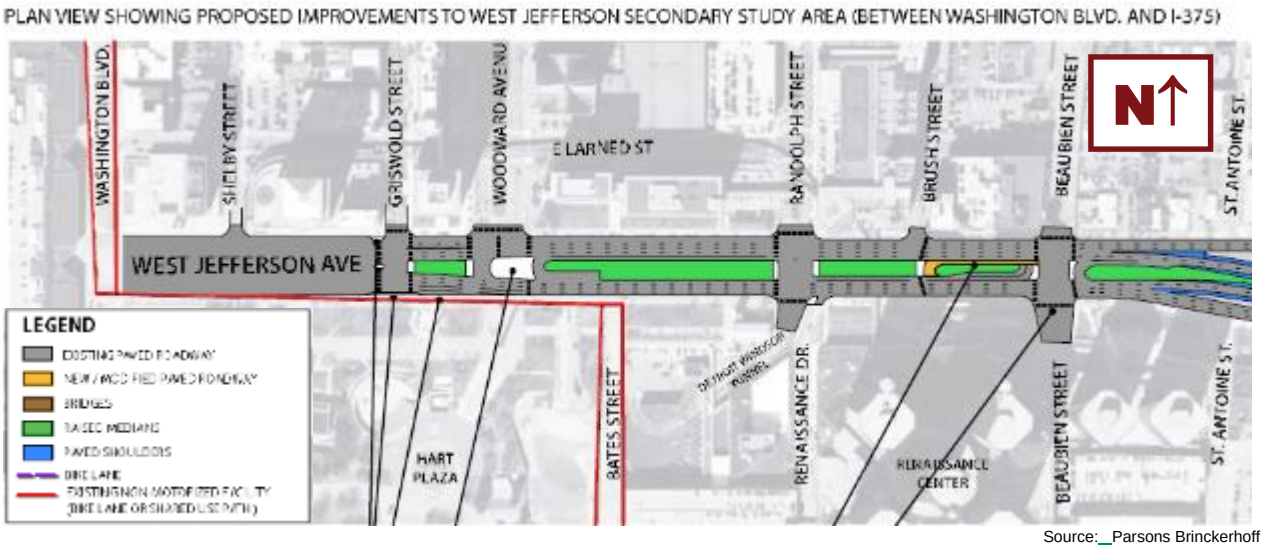
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **5% of total crashes**
2) **20% of total crashes**

5.9 West Jefferson Ave Corridor Alternative 1

The general features of West Jefferson Ave Corridor Alternative 1 are as follows:

- Eliminates EB Jefferson Ave left-turn at Woodward Ave.
- Expands Woodward Ave median space into enhanced pedestrian plaza.
- Relocates the WB Jefferson Ave left-turn at Beaubien St to a new crossover.



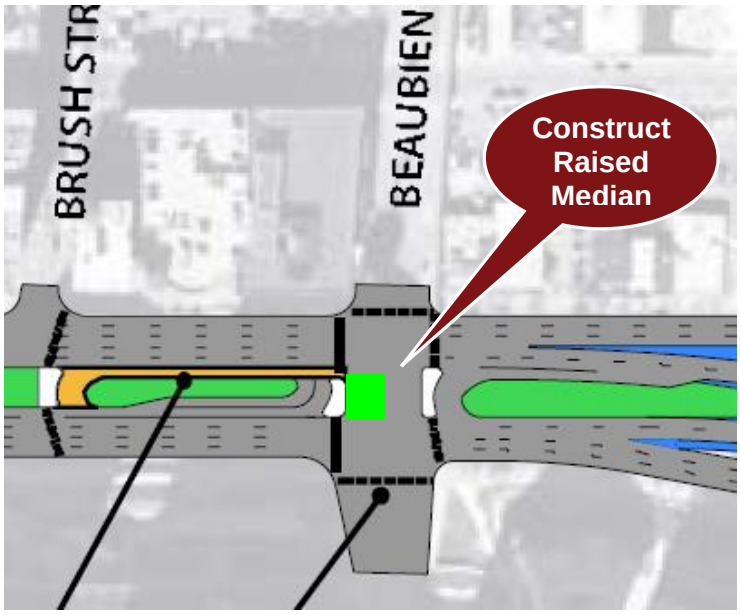
Source: Parsons Brinckerhoff

Figure 5.9.1 – West Jefferson Ave Corridor Alternative 1

5.9.1 Crash Potential #1 – Illegal Left-Turns

Expected Frequency	Expected Severity	A
Rare	Low	

Observation: There is not a physical barrier preventing the WB Jefferson Ave left-turns to Beaubien St. Only turn prohibition signing, while maintaining the existing roadway configuration, is proposed to eliminate these left-turn movements which introduces the potential for illegal left-turns at Beaubien St.



Source: Parsons Brinckerhoff

Figure 5.9.1.1 – Close SB Beaubien Median

SUGGESTION: The following options should be considered:
1) **Provide enforcement.**
2) **Consider closure of the SB Beaubien median (see Figure 5.9.1.1 above).**

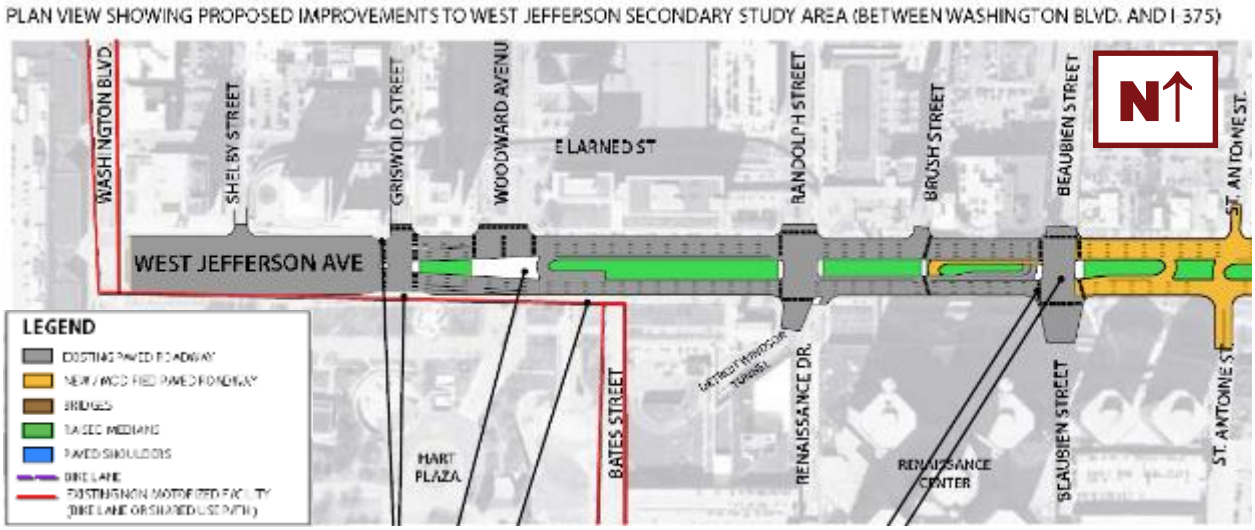
ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:
1) **N/A (No construction cost associated with this countermeasure)**
2) **$30,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.
1) **No CMF available**
2) **15% of total crashes**

5.10 West Jefferson Ave Corridor Alternative 2

The general features of West Jefferson Ave Corridor Alternative 2 are as follows:

- Eliminates EB Jefferson Ave left-turn at Woodward Ave.
- Eliminates SB Woodward Ave left-turns to Jefferson Ave.
- Expands Woodward Ave median space into enhanced pedestrian plaza.
- Relocates all left turns at Beaubien St to new crossovers.



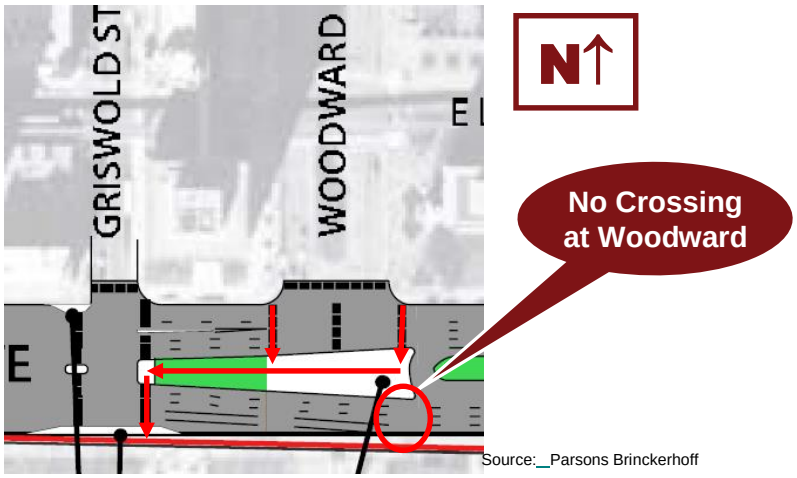
Source: Parsons Brinckerhoff

Figure 5.10.1 – West Jefferson Ave Corridor Alternative 2

5.10.1 Crash Potential #1 – Pedestrians Crossing Mid-Block

Expected Frequency	Expected Severity	C
Infrequent	Medium	

Observation: Option removes the existing signalized pedestrian crossing at Woodward Ave, this, in conjunction with the distance to the nearest signalized crossing (Griswold St) increases the potential for pedestrians crossing mid-block at Woodward Ave.



Source: Parsons Brinckerhoff

Figure 5.10.1.1 – Pedestrian Crossing Route from Woodward Ave

SUGGESTION: The following options should be considered:

1) **Provide enforcement.**
2) **Provide signalized pedestrian crossing at Woodward Ave.**
3) **Consider grade separated pedestrian crossing.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:

1) **N/A (no construction cost associated with this countermeasure)**
2) **$29,400**
3) **$1,134,600**

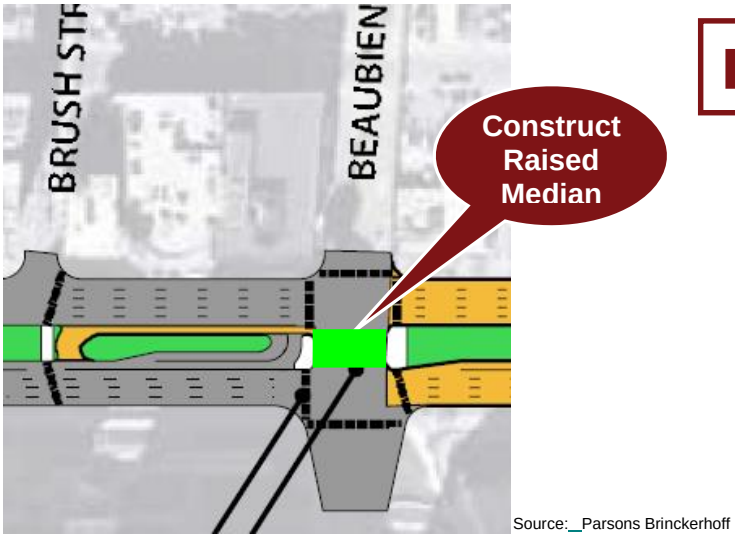
A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.

1) **No CMF available**
2) **50% of pedestrian crashes**
3) **90% of pedestrian crashes**

5.10.2 Crash Potential #2 – Illegal Left-Turns

Expected Frequency	Expected Severity	A
Rare	Low	

Observation: There is not a physical barrier preventing the WB Jefferson Ave left-turns to Beaubien St. Only turn prohibition signing, while maintaining the existing roadway configuration, is proposed to eliminate these left-turn movements which introduces the potential for illegal left-turns at Beaubien St.



Source: Parsons Brinckerhoff

Figure 5.10.2.1 – Close SB Beaubien St Median

SUGGESTION: The following options should be considered:
1) **Provide enforcement.**
2) **Consider closure of the Beaubien median.**

ESTIMATED COST OF SUGGESTION: The following construction costs may be attributed to the options described above:
1) **N/A (no construction cost associated with this countermeasure)**
2) **$55,000**

A potential crash reduction factor is provided below for each countermeasure where available. See Appendix E for a summary of construction costs & potential % reduction in crashes.
1) **No CMF available**
2) **15% of total crashes**

5.11 Summary of Feasibility Study Alternatives Risk Assessment

Table 5-1 – Summary of Feasibility Study

I-375 Corridor						
Risk Category	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**
	# of Crash Potentials Ranked with Risk Category					
F	0	0	0	0	0	0
E	0	0	1	0	0	0
D	0	1	0	0	0	0
C	2	2	1	1	1	2
B	2	2	1	3	1	1
A	1	1	1	0	0	0

East Jefferson Ave Corridor						
Risk Category	**Alternative 1**	**Alternative 2**				
	# of Crash Potentials Ranked with Risk Category					
F	0	0				
E	0	0				
D	0	1				
C	1	1				
B	1	0				
A	1	0				

West Jefferson Ave Corridor						
Risk Category	**Alternative 1**	**Alternative 2**				
	# of Crash Potentials Ranked with Risk Category					
F	0	0				
E	0	0				
D	0	0				
C	0	1				
B	0	0				
A	1	1				

6.0 Conclusion

This audit has been prepared to assist the responsible road authorities in the identification and actualization of opportunities to improve safety within the study area. The audit is based on observations made from July 14th through July 17th, 2014 and information available at the time of the field review and review of the Feasibility Study alternatives. This Road Safety Audit has been performed in accordance with the FHWA guidelines and policies. The suggestions it contains are for consideration only, and are in no way intended to serve as design or operational recommendations.

This report does not preclude the identification of additional issues pertaining to safety by the responsible road authorities, or the emergence of new issues over time.

It is recommended that the responsible agencies review this report; document their responses to the issues identified in a formal response report; and track their progress towards the implementation of safety improvements prompted by this audit.