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# INTERSECTION SAFETY STUDY

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Prepared for:  
Ohio Department of Transportation  
District 5 Licking County  
LIC-13 – 9.59  
4<sup>th</sup> Street and W Main Street

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March 18, 2019

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# EXISTING CONDITIONS

The study area for this Safety Study is located at the intersection of OH 13 (4th Street) and W Main Street in the City of Newark, Licking County, within ODOT District 5. The extents of the study area include 500 feet in each direction from the intersection. This intersection is located in the Downtown Commercial Zoning District in Newark. 4th Street is classified as an urban principal arterial and W Main Street is classified as an urban minor arterial. Both streets have posted speed limits of 25 miles per hour.

In the northbound and southbound directions at the intersection, 4th Street has a left-turn lane, a shared through / right-turn lane, and one receiving lane. Westbound W Main Street has a left-turn lane, a shared through / right-turn lane and two westbound receiving lanes. Eastbound W Main Street has a right-turn lane, a through lane, and left-turn lane with one eastbound receiving lane. There is angle parking on the curbs and in the median on W Main Street and parallel parking on 4th Street. There are bike lanes on 4th Street that run from W Church Street to W Canal Street. Sidewalks are present on both sides of the street on all approaches to the intersection. The intersection geometry is shown in Figure 1.



Figure 1: 4th Street and W Main Street

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According to the ODOT Transportation Data Management System (TDMS), the 2-way Average Annual Daily Traffic (AADT) on 4th Street north of W Main Street was 9,778 for the year 2018 with a northbound AADT of 4,007 and a southbound AADT of 5,771. Heavy vehicles make up six percent of the total traffic. The historic AADT shown on the TDMS indicates that the traffic volumes have both grown and declined on the corridor in recent years from a high of 11,460 vehicles per day in 2005 to a low of 8,544 vehicles per day in 2013. The future conditions were analyzed for the year 2038 using a total growth of 5% over the 20-year period, which equates to a nominal growth rate of 0.25% per year. The total growth rate was derived from historic counts and the travel demand model. The growth rate was provided by the Licking County Area Transportation Study.

Turning movement counts were collected on December 4, 2018 for this study. The morning peak hour is from 7:45AM until 8:45AM and the afternoon peak hour is from 3:15PM until 4:15PM. The counts for the AM peak hour are shown in Figure 2 and the counts for the PM peak hour are shown in Figure 3. The 24-hour traffic counts and detailed turning movement counts are given in Appendix A.

The intersection is signalized with protected-permitted left-turn phasing on all approaches. The left-turn phases are only called when there are at least two vehicles waiting to turn left on any approach. The protected left-turn phases and the phases for W Main Street frequently gap out and the additional time is given to 4<sup>th</sup> Street. The crosswalks parallel to 4<sup>th</sup> Street are served during every cycle while the crosswalks across 4<sup>th</sup> Street must be actuated to activate the pedestrian signal phases. None of the signals along the corridor include backplates nor retroreflective borders. The traffic signal at 4<sup>th</sup> Street and W Main Street operates as part of a coordinated system with the signals along 4<sup>th</sup> Street. During the AM peak period the system operates with a cycle length of 100 seconds and during the PM peak period the system operates with a cycle length of 110 seconds. The traffic signal at 5<sup>th</sup> Street and W Main Street is not coordinated with the signal at 4<sup>th</sup> Street and W Main Street.

The pavement condition of the approaches to the intersection range from 'Fair to Poor' to 'Very Good' according to the most recent Pavement Condition Rating (PCR) conducted by the ODOT pavement engineering group in 2016. W Main Street was given a PCR of 98, corresponding to a 'Very Good' condition. North of W Main Street, 4th Street was given a PCR of 77, corresponding to a 'Good' condition. South of W Main Street, 4th Street was given a PCR of 58, corresponding to a 'Fair to Poor' condition. Throughout this segment the pavement included occurrences of raveling, patching, crack seal deficiency, rutting, wheel track cracking, block and transverse cracking, longitudinal joint cracking, and thermal cracking. An example of the pavement condition is shown in Figure 4.



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Figure 2: 2018 AM Peak Hour Turning Movement Counts



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Figure 3: 2018 PM Peak Hour Turning Movement Counts



Figure 4: 4th Street pavement condition south of W Main Street

## CRASH DATA AND ANALYSIS

From 2013-2017, 53 crashes occurred in the study area. In 2013 there were 15 crashes; in 2014 there were 11 crashes; in 2015 there were 9 crashes; in 2016 there were 10 crashes; and in 2017 there were 8 crashes. Of these crashes, 16 crashes or 30% resulted in injury while 37 or 70% resulted in property damage only (PDO). The most predominant crash type on the corridor was rear end crashes which accounted for 30% of the total number of crashes. This crash type was followed by angle, sideswipe – passing, and backing crashes accounting for 17%, 13%, and 7% of the total, respectively. Based on the detailed crash reports, sixteen crashes, or 30% of all crashes, involved a driver in the process of parking or leaving a parking spot. Two crashes involved pedestrians and two crashes involves bicyclists. Three out of the four pedestrian and bicycle crashes resulted in injury. This intersection was identified as the highest pedestrian crash location in the County.

The majority of crashes, 74%, occurred at an estimated speed of 25 miles per hour and under. Crashes occurred predominantly on Wednesday's followed by Monday's and Friday's accounting for 30%, 23%, and 21% of the total, respectively. Sixty-three percent of crashes occurred between the hours of 12:00PM and 5:00PM. The



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highest contributing factor to crashes in the study area was 'followed too closely/assured clear distance ahead (ACDA)' in 26% of crashes followed by 'failure to yield' in 21% of crashes. In 77% of cases the second vehicle was traveling straight ahead or was slowing or stopped in traffic.

### RECENT CONSTRUCTION

Traffic operations around the Courthouse Square in downtown Newark were recently converted from one-way in the counterclockwise direction to two-way. The previous square operated with three or four travel lanes and angle parking along the majority of the square. The square, which surrounds the Licking County Courthouse, underwent construction between 2015 and 2018 and now operates as two-way with one lane in each direction and roundabouts at the four corners of the square. Traffic calming, pedestrian improvements, streetscaping, and bioswales all combine to form a drastically different space than what existed previously. Elements of the Courthouse Square project extend west through the block on W Main Street to the intersection with 4<sup>th</sup> Street. Before the project, the block of Main Street between the square and 4<sup>th</sup> Street had two lanes in each direction with angle parking on the edges of the road and in the median. After the project, there is one lane in each direction. The angle parking remains but is better defined along the outer edges with concrete that is visually distinct from the road surface while the median parking has been restriped and is not permitted close to the intersections. The pedestrian crosswalk on the east side on 4<sup>th</sup> Street and W Main Street has also been shortened from approximately 95 feet to 55 feet.

### PROBABLE CAUSES

Based on the existing conditions investigation and the crash analysis, specific safety concerns have been identified at the intersection of 4<sup>th</sup> Street and W Main Street. These concerns include items under the categories of traffic operations, geometric features, and parking.

#### TRAFFIC OPERATIONS

- Drivers turning left were observed navigating the turns at relatively high speeds, often cutting the corner of the turn, creating a larger conflict zone through the crosswalk and encroaching on the opposing left-turn lane.
- Drivers were observed accelerating during the yellow indication or running red lights to avoid stopping at the intersection.
- During the peak period, queues from the through traffic on eastbound and westbound W Main Street extend beyond the entrance to the left-turn lanes. Queues from the left-turning vehicles on W Main Street also extend beyond the length of the turn lanes, blocking the through lanes on W Main Street.

#### GEOMETRIC FEATURES

- The large intersection footprint makes navigating the intersection more difficult for pedestrians and drivers.

#### PARKING

- The angle parking on W Main Street begins close to the intersection and is difficult to back out of due to the proximity to the intersection and limited visibility.



- Crash reports detail sixteen crashes, or 30% of crashes at the intersection, related to the angled parking in the median and on the curbsides along W Main Street, particularly on the section between 4<sup>th</sup> Street and 5<sup>th</sup> Street.

# POTENTIAL COUNTERMEASURES

The 4<sup>th</sup> Street Sewer Separation project along 4<sup>th</sup> Street, expected to be completed in 2020, provides an opportunity to implement significant changes at the intersection of 4<sup>th</sup> Street and W Main Street. The countermeasures below include two scenarios: a roundabout at 4<sup>th</sup> Street and W Main Street and a signalized intersection with safety improvements. Some countermeasures are recommended for both scenarios and those are given below as the common countermeasures. Based on traffic analysis performed using Synchro and Sidra for the year 2038, a roundabout would operate at Level of Service (LOS) A during both peaks with queues under 90 feet for all approaches. The conventional intersection would operate at LOS C during both peaks with the countermeasures below incorporated into the Synchro traffic models. The westbound and northbound 95<sup>th</sup> percentile queues would measure approximately 200 feet during the PM peak hour. In both scenarios, the northbound queue at West Church Street would not reach the intersection at West Main Street. Details from this analysis can be found in Appendix B and Appendix C. The common countermeasures listed below also includes countermeasure recommendations for the blocks adjacent to the intersection. A concept of the roundabout scenario using existing roundabout dimensions in City of Newark is shown in Figure 5.

## COMMON COUNTERMEASURES

1. Implement a road diet to the block of W Main Street between 4<sup>th</sup> Street and 5<sup>th</sup> Street reducing the street to one through lane in each direction with an eastbound left-turn lane at 5<sup>th</sup> Street and W Main Street, remove median parking, and install reverse (back-in) angle parking on the edges of the street. This can be accomplished through pavement markings and temporary materials in the short-term and curbs and pavement in the long term. Install streetscaping on W Main Street between 4<sup>th</sup> Street and 5<sup>th</sup> Street to match the characteristics between 3<sup>rd</sup> Street and 4<sup>th</sup> Street including wider brick sidewalks, bioswales, landscaping, benches, etc.
2. Increase enforcement related to motorist yielding in marked crosswalks combined with a public education campaign.
3. Review the bicycle network outlined in the Newark Bike Trails Comprehensive Plan; remove bicycle lanes from 4<sup>th</sup> Street and create a bicycle route connection between Church Street and Market Street using low volume streets that are not state routes.

## ROUNDBOUT

1. Convert the intersection of 4<sup>th</sup> Street and W Main Street to a single-lane roundabout in conjunction with the 4<sup>th</sup> Street Sewer Separation project work through the intersection.

## SIGNALIZED INTERSECTION

1. Reinstall traffic signal in conjunction with the 4<sup>th</sup> Street Sewer Separation project work through the intersection:
  - a. Install a hardened centerline (rubber curb and bollards) on the east and west legs of W Main Street to prevent southbound and northbound left-turning drivers from cutting the corner and to

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- decrease the conflict exposure for pedestrians, example shown in Figure 5.
- b. Increase the length of the eastbound left-turn lane at the intersection to accommodate a queue of 100 feet so that drivers turning left do not block the through lane.
  - c. Install curb extensions to reduce the intersection footprint and shorten crossing distances for pedestrians. This can be accomplished through pavement markings and temporary materials in the short-term and curbs and pavement in the long term. Move the existing stop bars to operate with the smaller intersection footprint.
  - d. Restrict parking within 30 feet of the intersection.
  - e. Install backplates with retroreflective border.
  - f. Implement leading pedestrian intervals combined with permitted-protected left-turn phases (i.e. lagging protected left-turn phases, ensure opposing left-turn phases are equal duration to avoid a yellow trap).
  - g. Implement signal timing that is coordinated with the adjacent system of traffic signals.

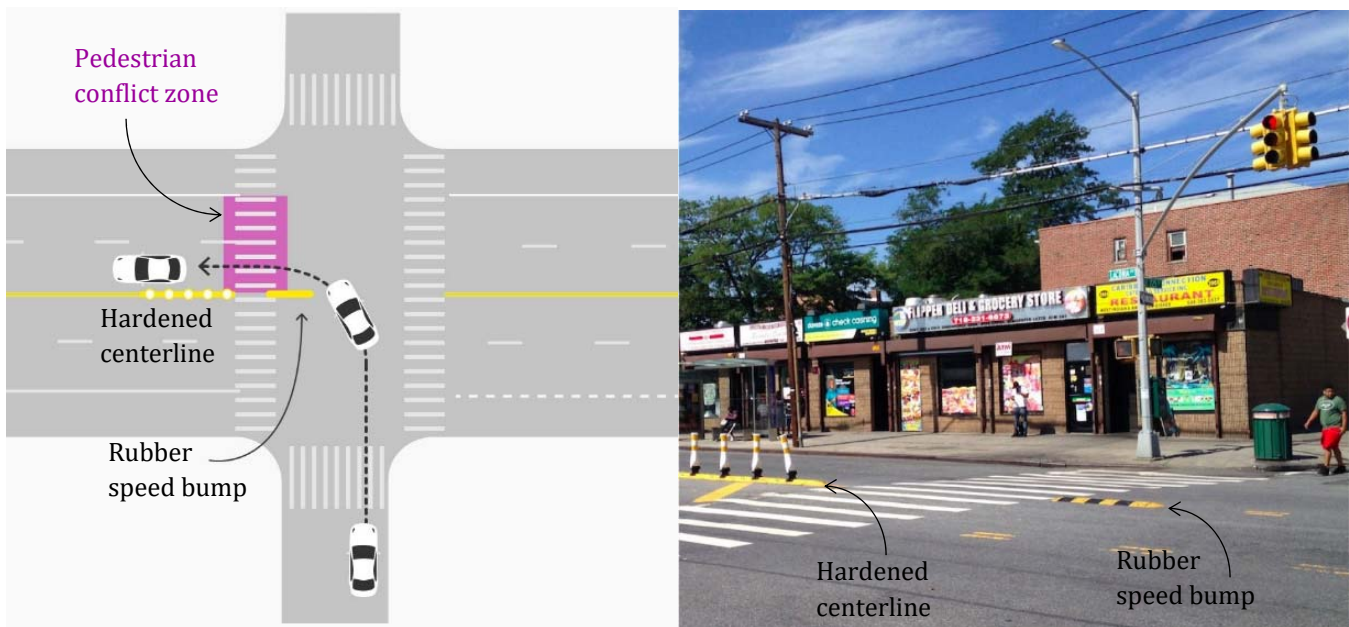


Figure 5: Hardened centerline example (Source: NYC DOT)

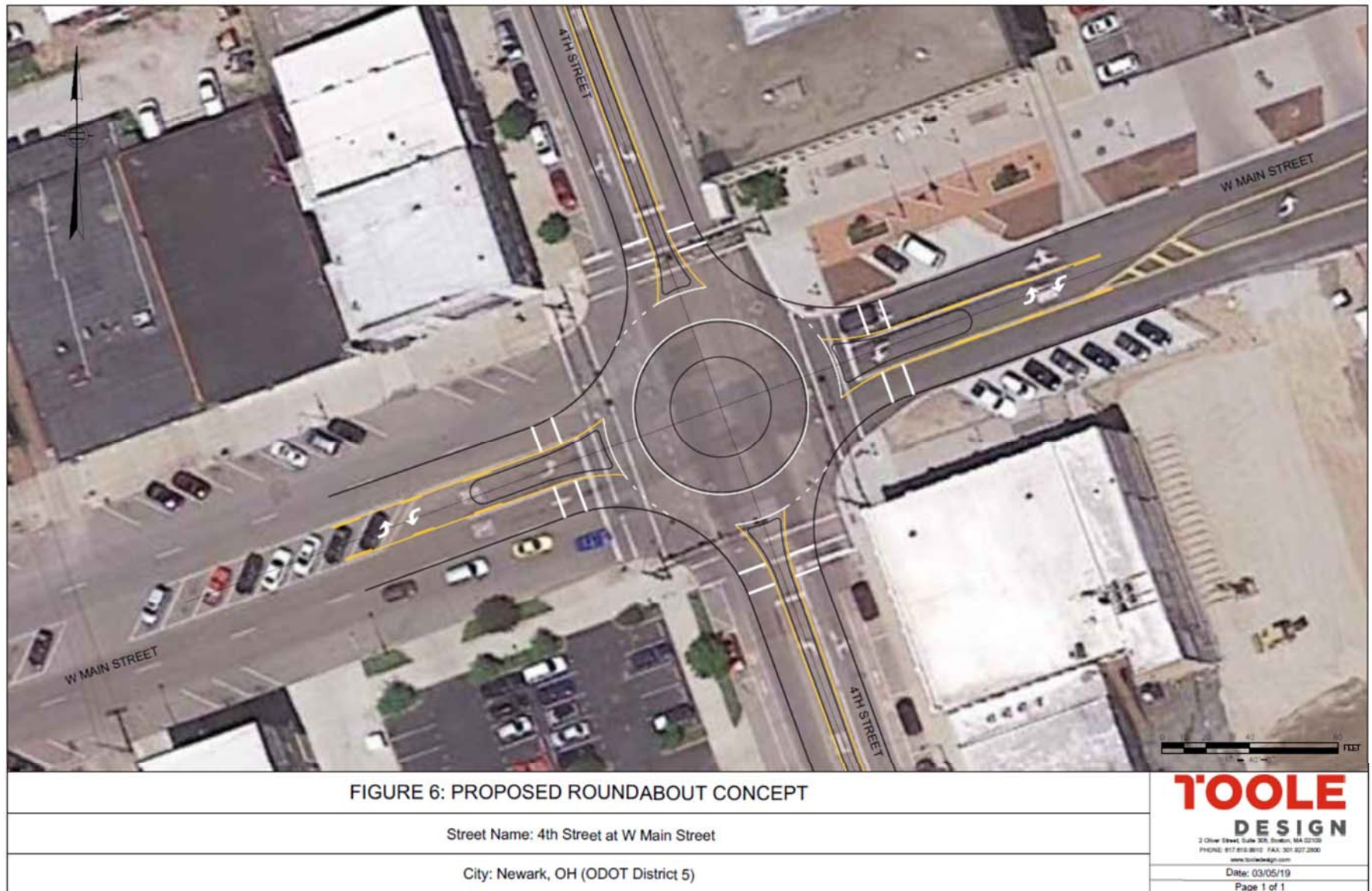


Figure 6: Proposed roundabout concept



# PROPOSED COUNTERMEASURE EVALUATION

The countermeasures were analyzed using the Economic Crash Analysis Tool (ECAT) to determine an expected average crash frequency for the proposed conditions, compared to the existing conditions predicted and expected average crash frequencies. The Crash Modification Factor (CMF) Clearinghouse was used to find individual CMFs for each suggested countermeasure. Using the ECAT, each CMF was applied to the relevant approach segment or intersection and the ECAT developed an expected average crash frequency for the roundabout scenario, shown in Figure 7, and the signalized intersection scenario, shown in Figure 8. The ECAT results indicate an expected average crash frequency of 2.0 total crashes per year with the roundabout and 4.2 crashes per year with the signalized intersection, compared to 4.9 total expected crashes per year for the existing conditions. The detailed output from the ECAT can be seen in Appendix D.

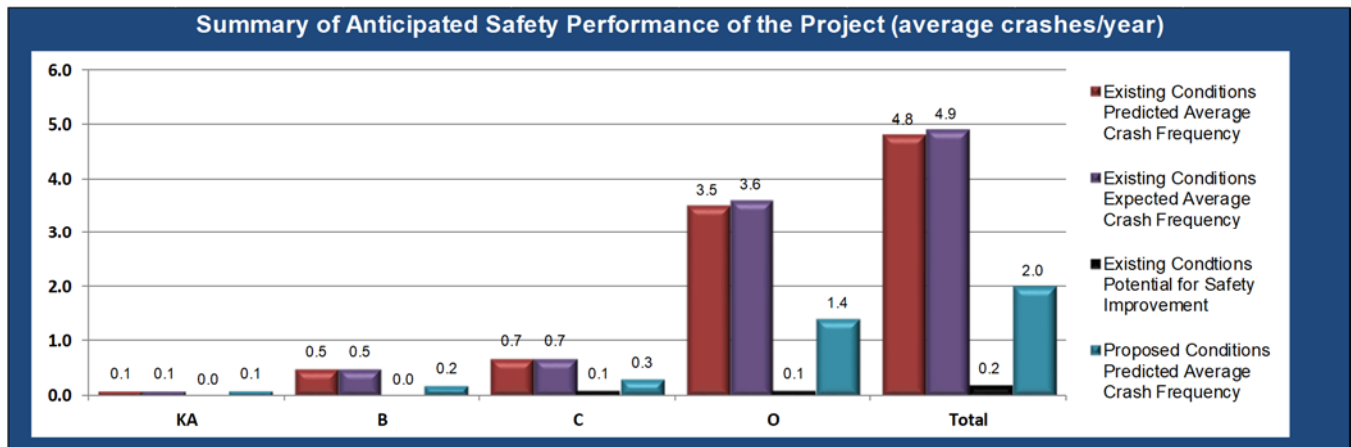


Figure 7: ECAT Existing versus Proposed Conditions Crash Frequency – Roundabout

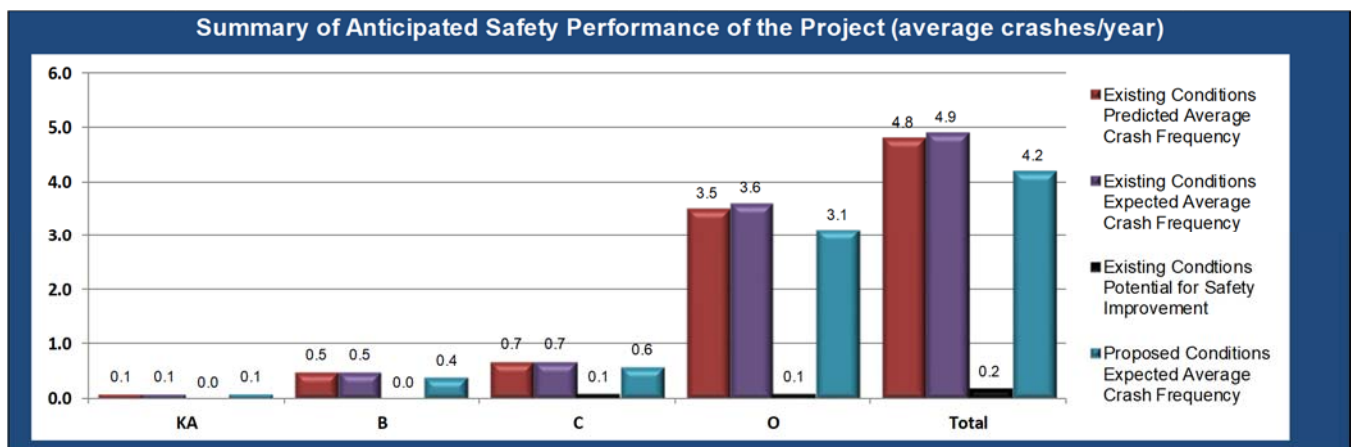


Figure 8: ECAT Existing versus Proposed Conditions Crash Frequency – Signalized Intersection

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Based on ODOT's Historical Bid Data and local estimates, cost estimates for each of the proposed countermeasures were determined and input in the ECAT. The cost estimates include intersection reconstruction costs with a 40% contingency, engineering design costs, and annual maintenance and energy costs. The total 20-year estimated cost for the roundabout scenario was determined to be \$1,421,000 and the total 20-year estimated cost for the signalized intersection scenario was determined to be \$1,483,000. The cost estimate for each countermeasure is shown in Table 1.

The proposed countermeasures in the roundabout scenario are expected to reduce the total number of crashes by 2.9 crashes per year. The proposed countermeasures in the signalized intersection scenario are expected to reduce the total number of crashes by 0.7 crashes per year. Over the course of twenty years, the net present value of the safety benefits of the roundabout scenario is expected to be \$951,000 for a benefit cost ratio of 0.70. The net present value of the safety benefits of the signalized intersection scenario is expected to be \$354,000 for a benefit cost ratio of 0.26.

**Table 1: ECAT Countermeasure Cost Estimates (including construction costs, engineering design costs, and annual maintenance and energy costs)**

Scenario	Countermeasure	Estimated Initial Cost	Estimated 20-Year Cost
<b>Roundabout</b>	1. Convert the intersection of 4 <sup>th</sup> Street and W Main Street to a single-lane roundabout.	\$930,000	\$961,000
	2. Implement a road diet and install streetscaping to the block of W Main Street between 4 <sup>th</sup> Street and 5 <sup>th</sup> Street.	\$310,000	\$341,000
	3. Increase enforcement related to motorist yielding in marked crosswalks combined with a public education campaign.	\$3,000	\$96,000
	4. Review the bicycle network; remove bicycle lanes from 4 <sup>th</sup> Street and create a bicycle route connection using low volume streets that are not state routes.	\$9,000	\$23,000
	<b>Total</b>	<b>\$1,252,000</b>	<b>\$1,421,000</b>
<b>Signalized Intersection</b>	1. Reinstall the traffic signal at the intersection.	\$868,000	\$1,023,000
	2. Implement a road diet and install streetscaping to the block of W Main Street between 4 <sup>th</sup> Street and 5 <sup>th</sup> Street.	\$310,000	\$341,000
	3. Increase enforcement related to motorist yielding in marked crosswalks combined with a public education campaign.	\$3,000	\$96,000
	4. Review the bicycle network; remove bicycle lanes from 4 <sup>th</sup> Street and create a bicycle route connection using low volume streets that are not state routes.	\$9,000	\$23,000
	<b>Total</b>	<b>\$1,190,000</b>	<b>\$1,483,000</b>

# CONCLUSIONS

The intersection of 4<sup>th</sup> Street and W Main Street that was analyzed in this safety study was identified as the highest pedestrian crash location in Licking County. Based on a field visit on the corridor, crash analysis, and engineering evaluation, a combination of traffic operations, geometric factors, and the parking configuration were determined to contribute to crashes on the corridor. The sewer project is opening the opportunity to reconstruct the intersection with significant changes that will benefit the safety of all users at the intersection. Two scenarios were developed for the intersection. The combination of the proposed countermeasures for the roundabout scenario at the intersection are projected to reduce the expected average crash frequency from 4.9 crashes per year to 2.0 crashes per year based on the results from the ECAT. This reduction in expected crashes result in a benefit-cost ratio of 0.70. The combination of the proposed countermeasures for the signalized intersection scenario at the intersection are projected to reduce the expected average crash frequency from 4.9 crashes per year to 4.2 crashes per year based on the results from the ECAT. This reduction in expected crashes result in a benefit-cost ratio of 0.26.

The 4<sup>th</sup> Street Sewer Separation project provides an opportunity to implement countermeasures that may otherwise have not been considered without the intersection reconstruction taking place as part of the sewer separation project. The impending intersection reconstruction that will occur was considered in this analysis and the total costs for intersection reconstruction were considered in the scenarios. Based on the predicted average crash frequency for each scenario and the resulting benefit-cost ratios, the countermeasures included in the roundabout scenario are recommended at this intersection.