DEF-15-12.04
FEASIBILITY STUDY

State Route 15 and State Route 18 Intersection
Noble Township, Ohio
September 28, 2023

FIRM PROJECT NO.: 074638 | PID NO.: 115913

Prepared for:
Ohio Department of Transportation

GANNETT FLEMING

TABLE OF CONTENTS

FIGURES

TABLES

PHOTOS

APPENDIX

EXECUTIVE SUMMARY

This report evaluates alternative improvements for two intersections located in Noble Township, Defiance County, Ohio and will identify a preferred alternative for detailed design. The existing tee intersections consist of an east-west route of State Route (SR) 15 with one intersection having a southern route with SR 18 and the second intersection having a northern route with Stever Road. Safety concerns prompted the Ohio Department of Transportation (ODOT) to investigate the SR 15/ SR 18 and SR 15/ Stever Road intersections and commissioned a Feasibility Study to be performed to identify potential improvements to enhance safety and any traffic operational concerns. The purpose of this study is to identify any improvements at the existing two intersections of SR 15/ SR 18 and SR 15/ Stever Road to improve safety and to ensure traffic demands are met.

Photo 1 – Intersection Looking West

SR 15 and SR 18 are functionally classified as rural major collectors with a posted speed of 55 mph. The existing pavement width is 24′ wide with 2-4′ paved shoulders on each side. The pavement widens in the intersection to develop a left turn lane to SR 18. The curve through the SR 18 intersection is designed for approximately 35 mph. The SR 18 intersection has existing overhead flashers to stop SR 18. Approaching on SR 15, there is a slip lane on SR 18 that continues east that yields onto SR 15 eastbound. Stever Road is functionally classified as a minor collector with a posted speed limit of 45 mph. There is one lane in each direction approaching the stop-controlled intersection with SR 15. The existing pavement width is 20′ wide with 2-4′ aggregate shoulders on each side.

Crash data from 2018 to 2022 was obtained and a total of 49 crashes occurred within the study corridor limits. There were no fatalities within the study period and there were 12 injury crashes. Animal, Rear End, Left Turn, and Sideswipe crashes exceed the statewide average for similar type roadways as shown in Table 1. In reviewing all of the crash data (49 crashes), only 15 crashes occurred in snow or rain, with the remaining on dry and clear days. 26 crashes (Fifty three percent) occurred during daylight hours. Potential causes could be lack of sight distance, short turn lanes, speeding and fixed objects being within the clear zone.

Three potential intersection treatments were evaluated as part of this study: a realigned intersection, a 3-leg roundabout with a realigned intersection, and a 4-leg roundabout intersection. These alternatives along with the No Build alternative were evaluated and compared for the study.

- No-Build Alternative – The No-Build alternative does not include any new construction besides providing lighting at both intersections and additional traffic control devices.
- Realignment Alternative – This alternative realigns the intersection with SR 18 and Stever Road to be a 4-leg intersection with a dedicated eastbound left and right turn only lanes on SR 15.
- 3-Leg Roundabout Alternative with Realignment - This alternative constructs a 3-leg roundabout with SR 15 and SR 18. In addition, Stever Road will be realigned farther away from the roundabout to the end of the splitter island.
- 4-Leg Roundabout Alternative – This alternative is a 4-leg elliptical roundabout with the center of roundabout shifted northwest from the existing SR 15 /SR 18 intersection. This roundabout also realigns Stever Road to make the 4th leg.

Six categories were defined for the comparison of the Alternatives:

- Meets Purpose and Need
  - *All the alternatives, with the exception of the No-Build, meet the purpose and need for the project.*
- Traffic Operations
  - *All alternatives operate at an acceptable level of service.*
- Safety Benefits
  - *All three alternatives would have a safety benefit, with the No Build Alternative achieving the least amount of benefit. The 4-leg roundabout offers the most benefit to the project.*
- Right of Way (ROW) Impacts
  - *The No Build Alternative would have no ROW impacts. The 4-leg roundabout would have the greatest impact to ROW with the realignment and 3-leg roundabout having slightly less and similar impacts.*
- Utility Impacts
  - *The No Build Alternative would have minimal utility impacts on the project. The realignment and 4-leg roundabout would have the greatest impact to utilities mainly due to the most impact to the underground communication lines. The 3-leg roundabout is slightly less impactful on the utilities.*
- Construction Costs
  - *The No Build Alternative was the cheapest alternative due to the least amount of improvement. The 4-leg roundabout was the most expensive due to total project length. The realignment and 3-leg roundabout are similar in costs, being approximately $500,000 less than 4-leg roundabout.*

Alternatives Comparison

Each alternative was evaluated in these six categories and given one of the following ratings:

- Excellent
- Very Good
- Good
- Fair
- Poor

The alternatives and the subsequent ratings were compared, and a preferred alternative was selected.

Preferred Alternative Recommendation

Based on the alternative comparison, the preferred recommended alternative is the 3-Leg Roundabout with Realignment Alternative. With Good to Excellent ratings as shown in Table 8, the 3-Leg Roundabout addresses the project needs and goals better than the other alternatives.

INTRODUCTION

This report evaluates alternative improvements for two intersections located in Noble Township, Defiance County, Ohio and will identify a preferred alternative for detailed design. The existing tee intersections consist of an east-west route of State Route (SR) 15 with one intersection having a southern route with SR 18 and the second intersection having a northern route with Stever Road. Safety concerns prompted the Ohio Department of Transportation (ODOT) to investigate the SR 15/ SR 18 and SR 15/ Stever Road intersections and commissioned a Feasibility Study to be performed to identify potential improvements to mitigate safety and any traffic operational concerns. See Figure 1 for a study area map.

Figure 1 – Study Area Map

PURPOSE & NEED SUMMARY

The goal of the project is to improve both intersections to enhance safety and to ensure traffic operational efficiencies. The high speeds and some geometric constraints have also made the roadway less safe.

The purpose of this study is to identify any improvements at the existing two intersections of SR 15/ SR 18 and SR 15/ Stever Road to improve safety and to ensure traffic demands are met. The feasibility study evaluates three future build alternatives that will improve safety and address any operational concerns within the study area. Each alternative will be compared against the future 2046 no-build condition and the report will provide a recommendation for an improvement.

STUDY AREA AND EXISTING CONDITIONS

The study area for will be limited to the intersections of SR 15 and SR 18 and SR 15 and Stever Road (CR-153) in Noble Township, Defiance County, Ohio. The study limits beyond the intersections will be limited to approximately 500′ north of SR 15 on Stever Road, 1,000′ south of SR 15 on SR 18, 1,000′ east and west on SR 15 from Stever Road and SR 18. See Figure 1 for the study area and Appendix A for an Existing Conditions Figure.

SR 15 is functionally classified as a rural major collector with a posted speed of 55 mph. The Right of Way (ROW) at the west end of the study area is 100′ wide and narrows to 90′ east of the Stever Road intersection. The ROW then varies through the SR 18 intersection to 66′ east of SR 18 and continuing east to the end of the study area. The existing pavement width is 24′ wide with 2-4′ paved shoulders on each side. The pavement widens in the intersection to develop a left turn lane to SR 18. The approaches to the intersection are on a horizontal tangent

Photo 2 – Intersection Looking East

alignment that curves through the SR 18 intersection. The curve is designed for approximately 35 mph. The movement on SR 15 operates as a free flow movement with one lane in each direction, a left turn lane to SR 18, and has existing overhead flashers at SR 18 intersection. The vertical alignment is generally flat with a slight crest curve just east of the SR 18 intersection. Most of the drainage flows in roadside ditches except for near the intersection that has storm sewers that outlet into the northern ditch of SR 15 east of the SR 18 intersection. That ditch eventually outlets to the Tiffin River.

SR 18 is functionally classified as a rural major collector with a posted speed limit of 55 mph. The ROW width is 60' and widens at the intersection with SR 15. The existing pavement width is 24' wide with 2-4' paved shoulders on each side. The approach to the intersection is on a horizontal tangent alignment that curves to make a stop-controlled intersection leg with SR 15. Approaching the intersection there is one lane in each direction with a slip lane that continues east and yields onto SR 15 eastbound. The vertical alignment is generally flat. The drainage flows within roadside ditches except at the intersection that flows through storm sewers to outlet on the north side of SR 15.

Stever Road is functionally classified as a minor collector with a posted speed limit of 45 mph. The ROW width is 40'. The horizontal alignment approaching the intersection is on a tangent with a flatter vertical crest curve adjacent to the intersection. There is one lane in each direction approaching the stop-controlled intersection. The existing pavement width is 20' wide with 2-4' aggregate shoulders on each side. The drainage flows in roadside ditches with majority of the roadway that flows to the Tiffin River to the north.

Study Area Observations

Gannett Fleming visited the study area with ODOT District 1 in June 2023 and used a dashboard camera to document the existing conditions and took additional pictures. The site visit documented roadway geometry, the number of lanes, the presence and length of left-turn lanes, intersection control devices, traffic operations, travel patterns, and posted restrictions. Field observations related to traffic operations and safety are summarized below:

- Observed SR 18 traffic not yielding to SR 15 traffic as signed.
- Advanced warning signs for a 30-mph curve represent a 25-mph difference from the posted speed.
- The speed of vehicles on SR 15 seems excessive.
- The speed limit changes on SR 15 just east of SR 18 intersection from 45 mph to 55 mph.
- Many off tracking locations were observed on the inside of the SR 15 curve near Culligan's located in the northeast quadrant of the intersection.
- Higher than expected volume of traffic turning to/from Stever Road than expected.
- Trucks over steer making a left onto SR 18. Trucks sometimes straddle the existing channelizing line making a left onto SR 18. A truck headed eastbound on SR 18 turning left and truck westbound on SR 15 turning to SR 18, both had to stop as neither could make turn with the other there.
- Sight Distance to WB SR 15 appears to be an issue from Stever Road due to vegetation.
- On SR 15, the super elevation rate change happens quickly and pavement cross slope is steep.
- Lighting is all ODOT however two lights are on Toledo Edison Poles.
- Observed farm equipment coming from Stever Road headed westbound on SR 15.

- Centerline rumble stripes are on SR 15 stopping at the curve at SR 18 and then starts again at Stever Road continuing west.

Crash Analysis

Crash data from 2018 to 2022 was obtained from ODOT Transportation Information Mapping System (TIMS). A total of 49 crashes occurred within the study corridor limits. There were no fatalities within the study period and there were 12 injury crashes. The crash data and OH-1 Reports were reviewed for each crash to identify the location of each crash and potential contributing factors. Crash Diagrams and Data are located in Appendix B.

Crash Data Analysis

Crash data for the study area were compared to the statewide averages and were analyzed using ODOT's Crash Analysis Module (CAM) Tool. Statewide averages were obtained from ODOT's historical data. The crash types and statewide averages are shown in Table 1. The frequency of crash types in the study area compared to statewide averages for non-freeways in the state system.

Table 1 – Crash Data

Type of Crash	2018-2022 Number	2018-2022 Percentage	Statewide Average
Fixed Object/Out of Control	11	22.45%	34.58%
Animal	18	36.73%	33.28%
Rear End	10	20.41%	10.26%
Left Turn	4	8.16%	2.66%
Sideswipe - Passing	3	6.12%	3.66%
Head On	1	2.04%	2.86%
Other and Overturning	2	4.08%	4.05%
Total	**49**		
Injury Crash	12	24.49%	21.71%
Property Damage Only	37	75.51%	72.86%

As per Table 1, Animal, Rear End, Left Turn, and Sideswipe exceed the statewide average for similar type roadways. In reviewing all the crash data, only 15 crashes occurred in snow or rain, with the remaining on dry and clear days. Fifty three percent of the crashes occurred during daylight hours.

Probable Causes of Crashes

The probable causes of the crashes are as follows:

- Animal crashes accounted for 37 percent of all crashes with only one injury. Sight Distance around the curve, the rural nature of the intersection and speed of drivers could be contributing to the excessive crashes.
- The remaining high crash types of Fixed Object, Rear-End, Left-Turn and Sideswipe accounted for 57 percent of all crashes and 92 percent of all injuries. The listed contributing factors for all these crashes were the result of the driver making a poor decision such as following too closely, unsafe speed, failure to yield, improper lane change or turn. Potential causes could be lack of sight distance, short turn lanes, speeding and fixed objects being within the clear zone.

Given that the majority of crashes in the study area were found to be Animal, Fixed Object, Rear-End, Left-turn and Sideswipe collisions related to sight distance, speed or improper handling of the motor vehicle, potential mitigation efforts could include improving visibility at the intersection and traffic control devices, improving the deficient curve, measures to slow speeds, ensure objects are outside the clear zone and improving sight distance.

INTERSECTION ALTERNATIVES

The scope of the project was to evaluate four alternatives. The alternatives considered a No-Build, Realignment, Roundabout, and 4th alternatives. The fourth alternative was to be developed by Gannett Fleming with the approval of ODOT. Gannett Fleming screened alternatives such as a Green T intersection, signalization of the existing intersection, and mini roundabouts. After screening the alternatives, it was proposed to provide a second roundabout alternative which was approved by ODOT to evaluate further. Appendix I includes a plan view figure of each alternative. Each alternative will improve access management with the Culligan Sales business.

- No-Build Alternative – The No-Build alternative does not include any new construction besides providing lighting at both intersections, rumble strips to prevent off tracking and speed management as well as additional animal signing. The substandard roadway design curve is to remain for this alternative and will require a design exception.
- Realignment Alternative – This alternative realigns the intersection with SR 18 and Stever Road to be a 4-leg intersection. The intersection will require a dedicated eastbound left and right turn only lanes on SR 15. The intersection will be stopped-controlled for SR 18 and Stever Road. The alignment of SR 15 will be improved to meet design requirements. No design exceptions are anticipated. Additional traffic control and roadway lighting will be included.
- 3-Leg Roundabout Alternative with Realignment - This alternative constructs a 3-leg roundabout with SR 15 and SR 18. The geometrics of the legs of the roundabout will be similar to the alignment of SR 15 with improved SR 18 alignment to meet design requirements. In addition, Stever Road will be realigned farther away from the roundabout to the end of the splitter island. No design exceptions are anticipated. The alternative will add traffic control and lighting to both intersections.
- 4-Leg Roundabout Alternative – This alternative constructs a 4-leg elliptical roundabout with the center of roundabout shifted northwest from the existing SR 15 /SR 18 intersection. This roundabout also realigns Stever Road to make the 4th leg. The geometrics of the roundabout will meet design requirements and no design exceptions are anticipated. The alternative will add traffic control and lighting for the roundabout.

The three alternatives will follow the below design guidelines:

Roadway Design

The design of the roadway was based on a design speed of 55 mph for SR 15 and SR 18, and 45 mph for Stever Road. The design vehicle for the project will be a WB-67 for SR 15 and SR 18, and WB-62 for Stever Road. The alternative designs will follow applicable ODOT standards. All design features were checked to ensure they meet those standards.

All existing roadway design features meet standards except for the following substandard elements:

- Graded Shoulder Width along both sides of SR 15 and SR 18 are approximately 6-15′ adjacent to the intersection. Treated width ranges from 2′-4′. Standard graded width is 8′ with flatter than 6:1 foreslopes and 12′ for steeper than 6:1. Treated standard width is 4′.

- The horizontal curve on SR 15 near the intersection with SR 18 is substandard with an approximate radius of 360′ resulting in an approximate design speed between 35 mph. The standard for 55 mph is a curve with a radius of 955′.
- Based on the field visit, it appears the pavement slope and/or superelevation rate on SR 15 curve is substandard but would have to be verified during a future project.

Design exceptions for horizontal curve and graded shoulders would be required on SR 15 and SR 18 due to the design speed being 55 mph. The intent of the study was for the alternatives to address the substandard criteria with the exception of the no build alternative. Access management for the Culligan property at the northeast corner was considered and will be shown on the alternative figures. For a complete list of design criteria utilized for the study, see Appendix F.

Pavement Design

For the purpose of this study, the pavement design for all the alternatives will be similar to the ODOT simplified pavement design for short projects. The buildup is as follows:

- 1.25″ of Item 441 – Asphalt Concrete Surface Course, Type 1, (449), PG70-22
- 1.75″ of Item 441 – Asphalt Concrete Intermediate Course, Type 2, (449)
- 9″ of Item 302 – Asphalt Concrete Base, PG64-22, (449)
- 6″ of Item 304 – Aggregate Base

For cost estimating purposes it is assumed that the pavement will require 12″ of subgrade stabilization for the project.

Typical Section

Standard travel lane widths of 12′ and 4′ paved shoulders will be used at a minimum for all of the alternatives. Due to the majority of the project needing vertical or horizontal changes, each alternative will be full depth reconstruction with the exception of the no build alternative. Grading will be set to minimize ROW impacts, however a maximum foreslope and backslope of 4:1 will be utilized. Standard ditches with a 2′ bottom and a minimum 12″ depth will be utilized.

Drainage Design

The existing drainage system along SR 15, SR 18 and Stever Road are predominantly a series of roadside ditches, storm sewers, and drive pipes that outlet on the north side of SR 15 into a ditch that eventually flows east into the Tiffin River.

The proposed drainage system for each alternative will basically mimic the existing drainage system. The conveyance of stormwater run-off through a series of roadside ditches, storm sewer, and drive pipes will discharge to the ditch on the north side of SR 15 and will eventually drain to the Tiffin River. Hydraulic analysis will be performed during detailed design for all proposed storm sewers.

Maintenance of Traffic Concepts

Each alternative will have a similar maintenance of traffic concept. To provide the safest alternative to construct the project the work will require closing of both the intersections with SR 15 due to tie-in work and roundabout construction. The first phase of the project would complete as much offline work as practical. Phase 2 would close the roadway to traffic to complete the project. It is anticipated the truck detour for SR 15 and SR 18 would be US

24 to US 127. A potential westbound local detour could utilize TR149 bypassing SR 15 and SR 18 intersection. A local eastbound detour could utilize CR 164 to CR 70 to CR 150. The local eastbound detour could also be the detour for Stever Road (CR 153). Limiting the detour for just work overlapping the existing routes will shorten the detour time frame.

Photo 3 – Vehicle stopped due to truck making a left

Lighting Design

Each alternative will provide lighting. At a minimum the lighting at the existing SR 15/ SR 18 intersection will be replaced and new lighting will be constructed at Stever Road and SR 15. The No-Build and realignment alternative will provide a typical design for an intersection based on ODOT lighting standards. The roundabout lighting design will be based on ODOT recommended practice utilizing the IES DG-19-08, Design Guide for Roundabout Lighting. A photometric plan will be produced in detail design for the selected alternative.

KEY ISSUES

Traffic Operations

All the traffic analyses were conducted utilizing Highway Capacity Software (HCS). The analyses were conducted for the design year for the a.m. and p.m. design hour volumes utilizing Highway Capacity Manual (HCM) methodologies.

Traffic Volumes

ODOT obtained the traffic counts for the study area. Traffic counts were obtained for the SR 15/ SR 18 and SR 15/ Stever Road intersections. 24-hour turning movement counts were performed on May 23, 2023. Counts were classified as passenger vehicles and trucks. Counts were then processed to establish the average daily traffic (ADT), peak hourly volume, directional distribution and percentage of trucks. Refer to Appendix C for the existing traffic counts performed for this project.

Analysis Years

For purposes of this study and at the direction of ODOT, only the design year of 2046 was utilized for the analyses.

Traffic Forecasting

ODOT provided the traffic growth rate for the study area. The ODOT forecast provided a calculated growth rate of 0.60% for passenger vehicles and 2.9% trucks. The traffic volumes obtained for this study were seasonally adjusted, design-hour adjusted and forecasted utilizing the growth factor stated above to determine the future 2046 design hour volume (DHV) that will be utilized for all analyses. See Appendix D for the ODOT Forecast and Appendix E for the traffic projections and traffic plates utilized for the study.

Capacity Analysis

A capacity analysis is the primary method for evaluating the efficiency of a roadway or intersection as it relates to vehicular traffic. The HCM, published by Transportation Research Board (TRB), outlines capacity analysis procedures and criteria for evaluating the operations of unsignalized and signalized intersections. The criteria for evaluating the operation of an intersection are measured in terms of level of service (LOS), a qualitive measure, and control delay per vehicle. There are six levels of service, designated by the letters A through F. LOS A represents the best operating conditions, and LOS F represents the worst operating conditions. LOS criteria are listed in Table 2.

Table 2 – Level of Service Criteria for Signalized and Unsignalized Intersections

Level of Service	Signalized Intersection Delay (Seconds)	Unsignalized Intersection and Roundabout Delay (Seconds)
A	≤ 10	≤ 10
B	> 10-20	> 10-15
C	> 20-35	> 15-25
D	> 35-55	> 25-35
E	> 55-80	> 35-60
F	> 80 or Volume-Capacity Ratio > 1.0	> 60 or Volume-Capacity Ratio > 1.0

Capacity analyses were conducted for the No Build, Realignment, and Roundabout alternatives for the 2046 design year AM and PM design hour volumes (DHV) only per the scope of work at the direction of ODOT. Capacity results for each alternative are discussed below and detailed capacity analyses are provided in Appendix G. All alternatives have a volume to capacity ratio of under 0.7 for all approaches.

No Build Alternative

The No Build Alternative operates at acceptable LOS with no constrained movement less than LOS C.

Realignment Alternative

The Realignment Alternative operates poorly without the addition of westbound turn lanes. The realignment operates very well with the addition of westbound left and right turn lanes for all approaches (LOS C or better) with the exception of the southbound leg of Stever Road operating at less than desirable LOS F in the PM DHV. The turn lane lengths utilized are discussed below in the Turn Lane Lengths Section.

- Turn Lane Lengths
  - Turn lanes were assessed to improve traffic operations for the Realignment Alternative. Only Turn lanes were warranted for the eastbound left and right turn based on ODOT's Location and Design Manual, Volume 1, Figures 401-5b and 401-6b. Turn Lane storage length calculations were performed, based on Figures 401-9 and 401-10 for the 2046 design year traffic volumes for the westbound leg of the intersection. Turn lane lengths were calculated for a 60 second cycle. The L&D Manual's conservative approach resulted in a westbound left turn lane length of 340', and a westbound right turn lane length of 285'. The turn lane lengths were also analyzed using SimTraffic Software and were based on the 95th Percentile Queue. The turn lane lengths from the SimTraffic analysis were used for the design of the project to minimize impacts while satisfying storage needs of the design year traffic, account for thru lane blockage and utilize maximum queue for turning vehicles to avoid backing up into the free flow lane. The recommended turn lane lengths were shown on the alternative figures and a summary is listed in Table 3. Storage calculations and the queuing reports are in Appendix H.

Table 3 – Turn Lane Lengths

SR 15 Intersection	ODOT L&D Calculated Turn Lane Length	SimTraffic 95% Queue Length	Recommended Turn Lane Length Including Taper
Westbound LT	340′	74′	150′
Westbound RT	285′	2′	150′

- Signalized Intersection
  - To improve on the PM DHV operations of Stever Road, a signal was evaluated for the realigned intersection. A signal warrant was not included in the scope of work however based on the existing traffic counts it appears the signal would be warranted at a minimum for the peak hour and four-hour volume warrants. An 80 second cycle was evaluated for the intersection for both the AM and PM DHV, resulting in LOS B for both analysis periods with no approach operating less than a LOS C.

3-Leg Roundabout and Realignment Alternative

The 3-Leg Roundabout and Realignment Alternative operates well. Both intersections operate at a minimum LOS B with the exception of the southbound leg of Stever Road intersection operating at LOS C in the PM DHV.

4-Leg Roundabout Alternative

The 4-Leg Roundabout Alternative operates very well with no approach operating less than a LOS B.

Safety Benefits

The American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) is used to determine how a corridor, or intersection, is performing compared to similar locations. It is also used to assess the safety benefits of improvements. The HSM Part C discusses the use of a predictive model for this type of analysis. The predictive method estimates the predicted crash frequency ($N_{predicted}$) together with observed crash frequency to estimate the expected crash frequency ($N_{expected}$). The difference between predicted and expected crash frequency is explained below.

$N_{predicted}$ is the anticipated (predicted) crash frequency, which describes how a location is expected to perform relative to similar sites. The calculation of $N_{predicted}$ uses Safety Performance Functions to determine a base condition and applies Crash Modification Factors (CMFs) to account for site-specific features that are different from the base condition. The final value is multiplied by a calibration factor specific to Ohio to normalize the base condition.

$N_{expected}$ is the estimated expected average crash frequency at a site for a given time period. The calculation of $N_{expected}$ uses the Empirical Bayes method to combine actual crash frequency with $N_{predicted}$. The difference between $N_{predicted}$ and $N_{expected}$ is the "expected excess crashes." If $N_{expected}$ is greater than $N_{predicted}$, the location may benefit from a safety improvement. If $N_{expected}$ is less than $N_{predicted}$, the site is experiencing fewer crashes than similar sites.

ODOT's Economic Crash Analysis Tool (ECAT) for intersections was used to calculate $N_{predicted}$ and $N_{expected}$. The existing conditions (traffic control, number of lanes, intersection control, lighting, presence of driveways) of the study area were input into ECAT.

Crash Modification Factors

CMFs were used in ECAT to calculate the reduction in crashes that can be expected if a particular improvement is implemented. ODOT's ECAT was also used to perform a benefit-cost analysis for the recommended improvements. CMFs were applied where available. CMFs used for recommended improvements are summarized with the stated alternative below. All the below CMFs were obtained from the USDOT Federal Highway Administration Crash Modification Factor Clearinghouse website.

No Build Alternative

The No Build Alternative will not provide much safety benefit. The only benefit will be lighting of the intersection at Stever Road and relocating items outside of the clear zone. The following CMF were utilized for this alternative:

- Install intersection lighting – CMF = 0.792
- Relocate fixed objects outside of clear zone – CMF = 0.62

Realignment Alternative

The Realignment Alternative will provide the benefit of a single intersection with improvement of sight distance. It would eliminate the sharp curve and reduce the number of conflict points. The following CMF were utilized for this alternative:

- Install right turn lane – CMF = 0.99
- Install a traffic signal – CMF = 0.56
- Flatten horizontal curve – CMF = 0.584
- Relocate fixed objects outside of clear zone – CMF = 0.62

If the traffic signal CMF is not applied to this intersection type the intersection will operate worse than the existing intersection.

3-Leg Roundabout and Realignment Alternative

Safety benefits of the roundabout include eliminating conflict points, reducing the number and severity of crashes due to lower speeds with providing a second intersection with lighting. The following CMF were utilized for this alternative:

- Convert intersection with minor road stop control to modern roundabout – CMF = 0.13/0.29
- Install right turn lane – CMF = 0.99
- Install intersection lighting – CMF = 0.792
- Relocate fixed objects outside of clear zone – CMF = 0.62

4-Leg Roundabout Alternative

Safety benefits of the roundabout include eliminating conflict points, reducing the number and severity of crashes due to lower speeds at a single intersection.

- Convert intersection with minor road stop control to modern roundabout – CMF = 0.13/0.29
- Relocate fixed objects outside of clear zone – CMF = 0.62

Table 4 shows that the SR 15 study area operates worse than its peers and has the potential for safety improvement. The table also shows that if safety improvements are implemented the intersection is predicted to operate better than its peers. A copy of the CMS obtained from the CMF Clearinghouse and complete ECAT results are included in Appendix J.

Table 4 – ECAT Analysis Results Summary

	KA	B	C	O	Total
$N_{predicted}$ (Existing Conditions)	0.1301	0.3776	0.2749	1.6314	2.4140
$N_{expected}$ (Existing Conditions)	0.1809	0.5244	0.3812	3.5927	4.6792
$N_{Potential\ for\ Improvement}$ (Existing Conditions)	0.0508	0.1468	0.1063	1.9613	2.2652
$N_{predicted}$ (Proposed Conditions) – No Build	0.1158	0.3354	0.2439	1.4491	2.1442
$N_{predicted}$ (Proposed Conditions) – Realignment	0.1292	0.3127	0.2084	1.1193	1.7696
$N_{predicted}$ (Proposed Conditions) – 3-Leg Roundabout	0.0479	0.1388	0.1008	0.8030	1.0905
$N_{predicted}$ (Proposed Conditions) – 4-Leg Roundabout	0.0430	0.1042	0.0694	0.8328	1.0494

Right-of-Way

The ROW and property lines were established from record plans and Defiance County GIS. The ROW on SR 15 varies across the study area. The ROW at the west end of the study area is 100' wide, narrows to 90' west of the SR 18 intersection and narrows again east of the intersection to 66' wide for the remainder of the study area. The ROW width along SR 18 is 60' and 40' for Stever Road.

Right of Way Impacts

The proposed ROW impacts are shown on the alternative figures in Appendix I with a summary shown in Table 5. Detailed ROW costs are included in Appendix K.

Table 5 – ROW Impacts

ROW Impact	No Build	Realignment	3-Leg Roundabout	4-Leg Roundabout
# Of Impacted Parcels	0	3	4	3
Acres of Perm. ROW	0	3.26	1.89	3.01
Approx. ROW Cost	$0.00	$261,389	$163,725	$252,464

Utilities

Utilities located within the project study area were developed by contacting OUPS and record drawings. The existing utilities are shown on the exhibits located in Appendix A. In general, only water, communications and gas are underground. Utilities such as power, cable, phone are above ground. The utility owners located within the project area are listed in Table 6:

Table 6 – Utility Companies

Utility Companies Potentially Impacted			
Toledo Edison	ANR Pipeline (TransCanada)	Defiance County Engineer's Office	Brunersburg Water District
ODOT District 1	Charter Communications	Ohio Gas Company	Brightspeed

Utility Impacts

The utility impacts are shown on the alternative figures in Appendix I and discussed below.

No Build Alternative

The No Build Alternative will have minimal impact on utilities on the project. It is anticipated to relocate three utility poles within the right of way to move them outside of the clear zone.

Realignment Alternative

Realigning the intersection and ancillary improvements, it is anticipated to impact the following utilities:

- 3 utility poles are in conflict.
- 2 cable boxes are in conflict and 1 will need to be adjusted or reconstructed to grade.
- Approximately 1,400' of underground communication lines will need to be relocated due to realignment and widening.

3-Leg Roundabout with Realignment Alternative

Construction of the roundabout, realignment and ancillary improvements will have the anticipated impact on the following utilities:

- 3 utility poles are in conflict.
- 1 cable box is in conflict and 2 will need to be adjusted or reconstructed to grade.
- Approximately 800' of underground communication lines will need to be relocated due to realignment and roundabout construction.

4-Leg Roundabout Alternative

Construction of the roundabout and ancillary improvements will have the anticipated impact on the following utilities:

- 2 utility poles are in conflict.
- 3 cable boxes are in conflict and 1 will need to be adjusted or reconstructed to grade.
- Approximately 1,100' of underground communication lines will need to be relocated due to realignment and widening.

Construction Cost/Benefit Cost Ratios

A conceptual estimate of construction costs for the four alternatives was prepared. Estimated construction costs were developed using estimated quantities for items that would be needed or impacted to implement the required improvements.

The following assumptions were utilized in estimating construction costs:

- Unit prices were estimated based on ODOT's Summary of Contracts Awarded for 2022, Procedures for Budget Estimating, and prior ODOT bid tabs.
- A 30 percent contingency was selected based on the Procedures for Budget Estimating.
- The rate of inflation was calculated using the ODOT Office of Estimating Fiscal Year Business Plan Inflation Calculator. Based on a construction midpoint of July 2026, a 16.1 percent rate of inflation (midpoint of construction) was assumed.
- The performance bond cost was estimated to be 0.75 percent of the construction cost before adding the contingency.
- The cost for construction layout stakes was estimated to be 1.0 percent of the construction cost before adding the contingency.
- Maintenance of traffic costs were estimated to be 5 percent of the construction cost before adding the contingency.

The conceptual estimate of probable project cost (with inflation) and benefit cost ratio for each alternative is summarized below in Table 7 and included in Appendix K.

Photo 4 – Trucks halt to make turn manuevers

No Build Alternative

The No-Build Alternative has the lowest cost; however, it is providing the least amount of improvements by only adding lighting and replacing/adding traffic control devices. The benefit cost ratio for this improvement is 0.42.

Realignment Alternative

The Realignment Alternative has the second highest cost including traffic signal. Without the traffic signal the cost of the improvement will be less than $185,000. The benefit cost ratio for this improvement is 0.04 with the traffic signal and 0.05 without the traffic signal.

3-Leg Roundabout with Realignment Alternative

The 3-Leg Roundabout Alternative has the second lowest cost with the second highest benefit cost ratio. The benefit cost ratio for this improvement is 0.37.

4-Leg Roundabout Alternative

The 4-leg roundabout has the highest cost mainly due to the overall total length of the improvement required. The benefit cost ratio for this improvement is 0.32.

Table 7 – Cost Impact

Cost Categories	No Build	Realignment	3-Leg Roundabout	4-Leg Roundabout
Roadway	$23,830.00	$225,990.00	$205,800.00	$270,876.00
Erosion Control	$0.00	$55,000.00	$55,000.00	$55,000.00
Drainage	$0.00	$94,360.00	$67,375.00	$96,110.00
Pavement	$25,410.00	$841,165.00	$860,975.00	$1,195,420.00
Traffic Control	$0.00	$292,840.00	$77,000.00	$109,840.00
Lighting	$175,000.00	$100,000.00	$245,000.00	$170,000.00
MOT	$16,000.00	$113,000.00	$106,000.00	$133,000.00
Incidentals	$34,000.00	$152,000.00	$152,000.00	$162,000.00
Contingency (30%)	$72,072.00	$516,707.00	$485,145.00	$609,074.00
Inflation (16.1%)	$55,757.00	$384,961.00	$362,942.00	$451,013.00
Sub-Total	**$402,069.00**	**$2,776,023.00**	**$2,617,237.00**	**$3,252,333.00**
Benefit Cost Ratio	**0.42**	**0.04**	**0.37**	**0.32**

COMPARISON OF ALTERNATIVES

The No-build, Realignment and both Roundabout Alternatives were compared to determine the best alternative for the SR 15 and SR 18 intersection. There were six categories that were defined as key issues for the comparison process:

- Meets Purpose and Need
- Traffic Operations
- Safety Benefits
- ROW Impacts
- Utility Impacts
- Construction Costs/Benefit Cost Ratios

Meets Purpose and Need

All the alternatives were evaluated to verify that it meets the purpose and need of the project. All the alternatives, with the exception of the No-Build, meet the purpose and need for the project.

Traffic Operations

Various traffic operations were determined and compared for each alternative, including level of service, delay, volume to capacity ratio and queues.

Safety Benefits

For each alternative, the expected safety benefit was evaluated. The results of this review indicated which intersection concept was anticipated to provide the highest level of safety improvement.

ROW Impacts

All alternatives were evaluated for the total impact to the existing right of way. Each alternative compared the total number of affected parcels, total acreage of needed right of way and estimated right of way cost.

Utility Impacts

The alternatives were evaluated based on the total impact on the existing utilities. All public utility relocations will be included in the construction cost of the project. It is believed that no private utility relocations occur within the found easements and all relocations required for the project will be at the owner’s expense.

Construction Cost/ Benefit Cost Ratio

The alternatives were compared based on construction cost and Benefit Cost Ratios of each improvement.

Table 8 describes the comparison of each alternative for each identified category and provides the final rating based on the comparison.

Table 8 – Comparison Matrix

Alternative	Meets Purpose and Need	Traffic Operations	Safety Benefits	ROW Impacts	Utility Impacts	Construction Cost	Overall
No Build	Poor	Good	Poor	Excellent	Excellent	Very Good	Fair
Realignment	Excellent	Good	Very Good	Fair	Good	Good	Good
3-Leg Roundabout	Excellent	Excellent	Excellent	Good	Very Good	Good	Very Good
4-Leg Roundabout	Excellent	Excellent	Excellent	Fair	Good	Fair	Good

Excellent Very Good Good Fair Poor

CONCLUSION AND RECOMMENDATIONS

Based on the alternative comparison shown in Table 8 and described in this report, the preferred recommended alternative is the 3-Leg Roundabout with Realignment Alternative. With Good to Excellent ratings this improvement addresses the project needs and goals to a higher level than the other alternatives. It is one of the lower anticipated construction costs of the potential alternatives, it can handle the proposed traffic demand and provide a level of safety equal to or better than the other alternatives and it has equal to or less impact to ROW and utilities as compared to the other build alternatives.