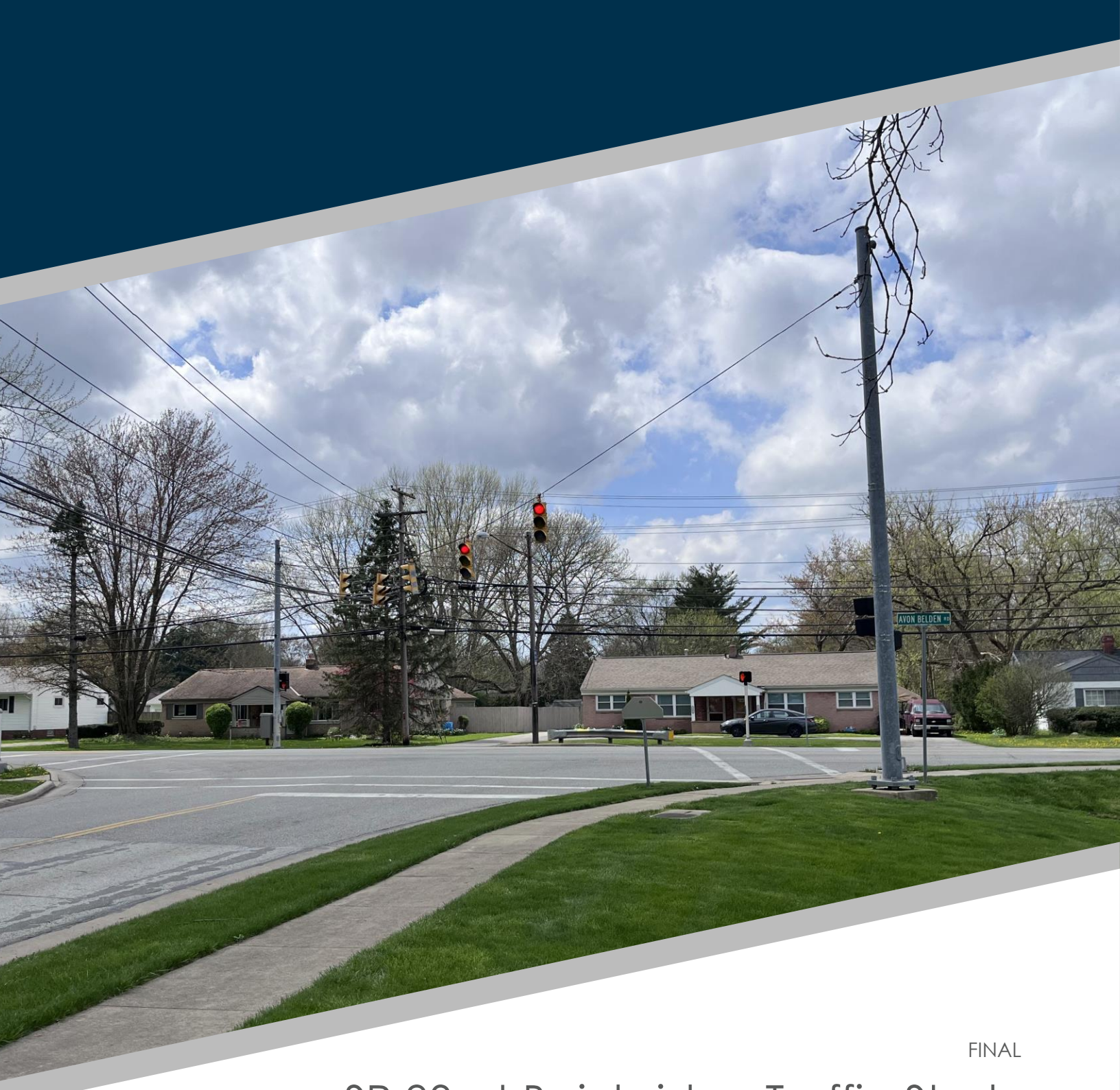


FINAL

SR 83 at Bainbridge Traffic Study

City of North Ridgeville, OH

August 16, 2024

CITY OF NORTH Ridgeville

WOOLPERT

FINAL

SR 83 at Bainbridge Traffic Study

City of North Ridgeville, OH

August 16, 2024

Prepared by:

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Report | Document Acceptance

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Date: _____

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Date: 8/16/2024

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1 Executive Summary

1.1 Project Background

The City of North Ridgeville retained Woolpert to evaluate safety and traffic operations within a study area bounded by Center Ridge Rd to the North, SR 83 to the west, Bainbridge Rd to the South, and Ranger Way to the east. The Study Area (**Figure 1**) forms the core of the City of North Ridgeville and includes many of the City's civic, service, and educational facilities.

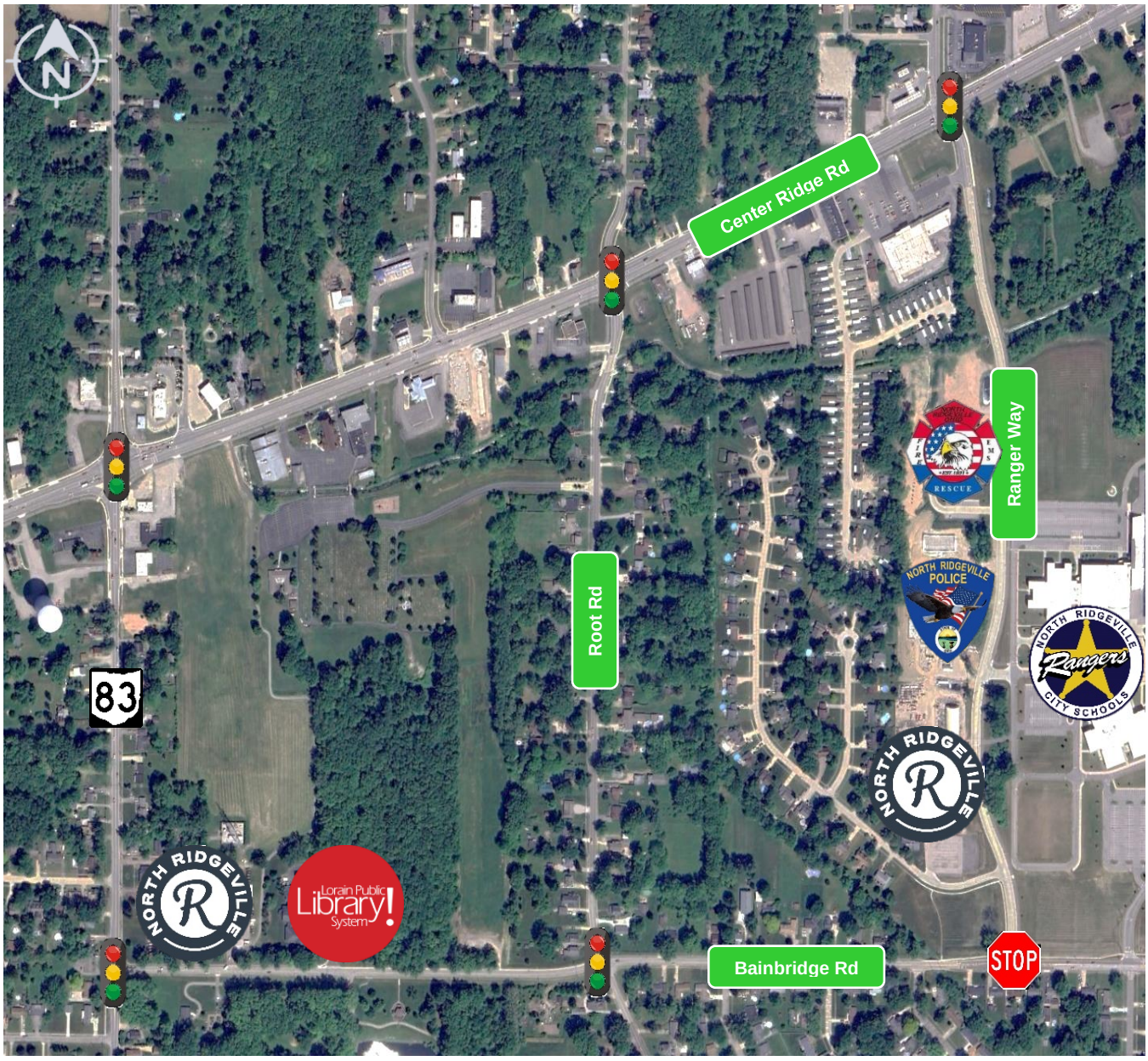


Figure 1 - Project Study Area

1.2 Purpose and Need

Significant queueing occurs during peak periods throughout the study area, but most critically along SR 83 approaching Bainbridge Rd, at Bainbridge Rd and Root Rd during school arrival and dismissal, and along Ranger Way during school arrival and dismissal. Queueing along Ranger Way, which can extend hundreds of feet from Center Ridge Rd in the school dismissal period creates significant impacts for emergency service access to the community. Both North Ridgeville Fire Station No. 1, the Police Station, and North Ridgeville's Public Works building are located along Ranger Way, across from North Ridgeville Academic Center and High School and see their access points blocked or near blocked by arriving and departing school traffic. This is most impactful during the return period from a run, where difficultly accessing the police and fire facilities slows down return time and can impact response time for subsequent emergency runs.



Figure 2 - School Dismissal Queueing Blocking Police and Fire Department Access Points

The purpose of this study is to evaluate congestion within the study area during the AM/School Arrival, School Dismissal, and PM Peak periods. Specifically, the study will focus on developing short- and long-term countermeasures to address:

- Queueing/Traffic Operations at SR 83 and Bainbridge Rd
- Queueing/Traffic Operations at Bainbridge Rd and Root Rd
- Queueing during School Arrival/Dismissal along Ranger Way (**Figure 2**)

Woolpert included Center Ridge Rd from SR 83 to Ranger Way in the analysis of alternatives to account for the coordinated signal system along Center Ridge Rd, and to ensure any recommendations made within the study area do not negatively impact operations along the Center Ridge Rd corridor.

1.3 Evaluation and Analysis

Woolpert collected 13-hour traffic counts at the six study area intersections on Thursday, March 21, 2024. These counts were used to conduct an analysis of existing traffic operations and queueing and served as a basis for the development of proposed countermeasures and proposed condition capacity analysis.

Woolpert also conducted a StreetLight Origin-Destination (O-D) analysis of the study area focusing on arrival and departure routes from the North Ridgeville City School District campus on the east side of the study area. Based upon

the O-D analysis, the Bainbridge Rd corridor from SR 83 to Ranger Way appeared as a predominant arrival and departure route for the campus, which is backed up by traffic counts collected in March of 2021.

The evaluation of traffic counts and O-D data suggests there are opportunities to improve movement through the study area by improving signal operations to increase efficiency, and by targeted capacity improvements to reducing queueing caused by turning vehicles or other high-demand vehicle movement patterns.

1.4 Recommended Countermeasures

Woolpert developed short- and long-term proposed countermeasures to address existing crash patterns and to address congestion and poor traffic operations. Based on an evaluation of safety, capacity, and benefit/cost analysis Woolpert recommends the following countermeasures:

Short-Term

- Optimize signal timing for AM Peak, School Dismissal Peak, and PM Peak periods based on 2024 traffic counts.
- Implement a School Dismissal Timing Plan (2:30-3:30 PM) and introduce a Leading Pedestrian Interval (LPI) for northbound/southbound pedestrian movements.

Long-Term

At SR 83 and Bainbridge Rd

- Extend southbound left turn lane from 70 ft to approximately 275 ft.
- Convert westbound approach from single lane to two lane (left, right) approach with 250 ft of storage length.
- Reconstruct signal and curb ramps to accommodate new intersection geometry.
- Optimize signal timing to include SBL/WBR overlap phasing and improve overall efficiency in all periods.

At Bainbridge Rd and Root Rd

- Convert existing conventional signalized intersection to 100 ft Inscribed Circle Diameter (ICD) single lane compact roundabout.

At Bainbridge Rd and Ranger Way

- Coordinate with the North Ridgeville City School District's Traffic Impact Study to determine whether future improvements to the district building campus will produce volumes that warrant a conversion from Two-Way Stop Control (TWSC) to signalized operation.

At Center Ridge Rd and Ranger Way

- Consider potential widening of the northbound approach from thru/left-right to left-thru/left-right to align with modifications to the crosswalks to improve signal efficiency and pedestrian safety.

2 Crash Data Analysis

Woolpert collected 2021-2023 crash data for the study area using ODOT's Traffic Information Mapping System (TIMS) and the GIS Crash Analysis Tool (GCAT). 165 crashes occurred in the study area during the crash data collection period, including 135 property damage only (PDO) crashes and 30 injury crashes for a study area injury rate of 18.2%. Crashes at the six intersections in the study area accounted for 73.9% of all crashes in the study area during the crash data collection period. **Figure 3** and **Table 1** presents high level crash statistics for the study area. Complete crash data for the study area is presented in **Appendix A**. Crashes in the study area represent approximately 10.2% of all crashes in North Ridgeville during the crash data period.

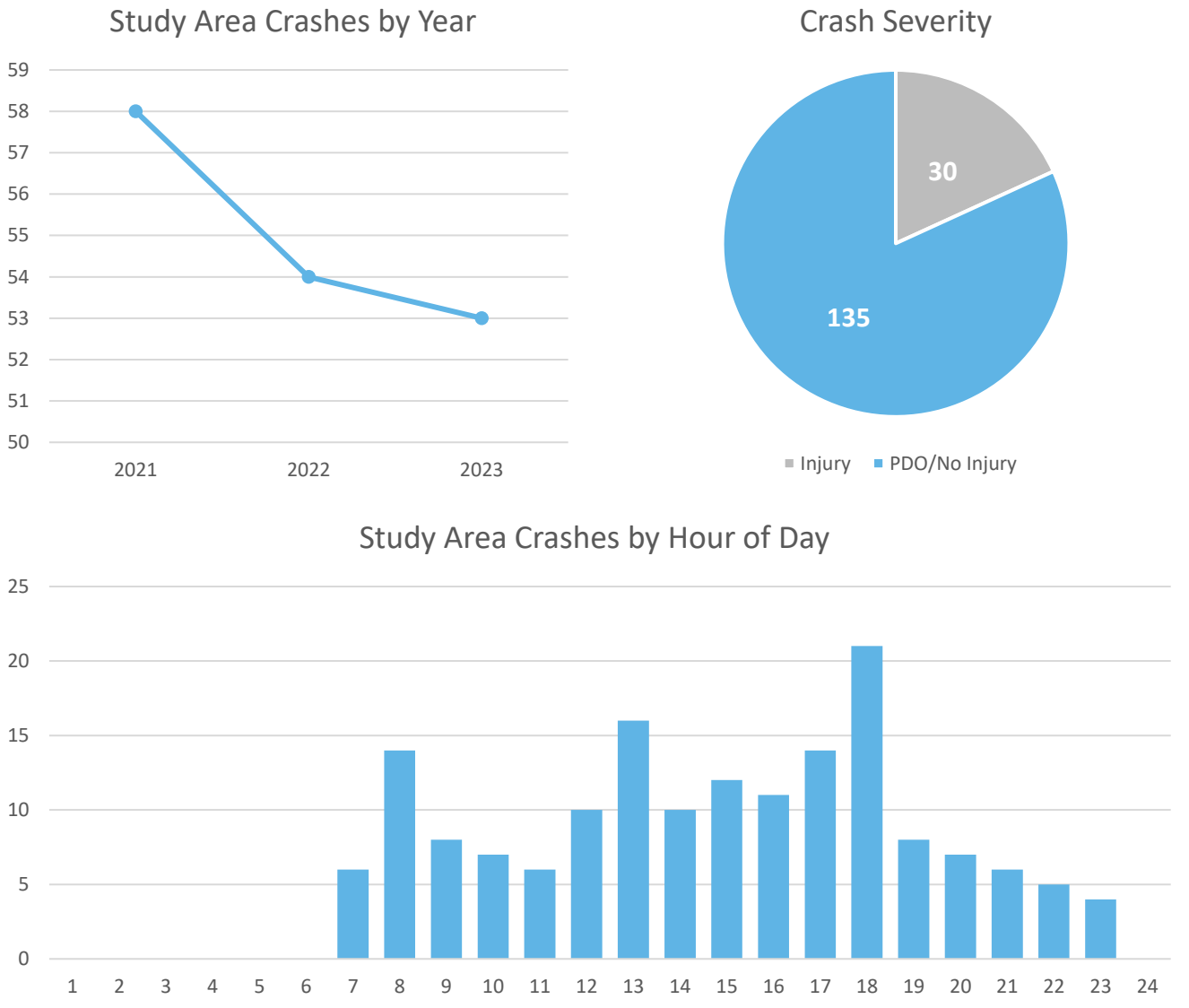


Figure 3 - Study Area Crash Statistics

Table 1 - Study Area Crashes by Crash Type

Crash Type	Total Crashes	% of Total
Rear End	85	51.5%
Angle	23	13.9%
Left Turn	20	12.1%
Sideswipe - Passing	10	6.1%
Right Turn	9	5.5%
Backing	4	2.4%
Head On	4	2.4%
Fixed Object	4	2.4%
Pedalcycles	3	1.8%
Other Crash Types	3	1.8%

The predominant crash pattern throughout the study area are rear end crashes occurring at intersections. The pattern of rear end crashes, in combination with the crash frequency by hour of day indicates that congestion at signalized intersections during peak periods is a contributing factor to crashes in the study area. Angle, and right/left-turn crashes are predominantly associated with failure to yield at unsignalized intersections and signalized intersections with permissive signal phasing.

Approximately 17.3% of angle and right/left-turn crashes occurred at the Center Ridge Road/SR 83 signalized intersection, which is also the busiest intersection by vehicle volume within the study corridor. Sideswipe-Passing crashes are generally associated with lane alignment and lane shift movements such as offset intersections or movements to enter a turn lane. 50% of all sideswipe-passing crashes occurred at the Center Ridge Road/SR 83 intersection. **Table 2** presents crash frequencies and severity by major intersection in the study area:

Table 2 - Crash Summary by Intersection (2021-2023 Data)

Intersection	Traffic Control	Crash Frequency	Injury %	Top Crash Type
Center Ridge Rd (US 20) at SR 83	Signal	65	12.3%	Rear End
Bainbridge Rd at Root Rd	Signal	19	**31.3%**	Rear End
SR 83 at Bainbridge Rd	Signal	17	17.6%	Rear End
Center Ridge Rd (US 20) at Ranger Way	Signal	12	25.0%	Rear End
Center Ridge Rd (US 20) at Root Rd	Signal	9	**33.3%**	Rear End
Bainbridge Rd at Ranger Way	Unsignalized (TWSC)	2	**50.0%**	N/A

From 2021 to 2023 there were 1,612 crashes within the city boundaries of North Ridgeville, and the 130 crashes in the SR 83/Bainbridge study area represent approximately 8% of that total, which is significant considering that the study area contains only 5 signalized intersections. Rear end crashes are particularly common at suburban and urban signalized intersections. Rear end crash patterns are typically driven by congestion, especially in peak periods. Statewide, rear end crashes account for between 40-50% of all signalized intersection crashes on average.

Based on statewide data, the average injury % at an urban or suburban signalized intersection is approximately 25%. Signalized intersections with injury rates over 25% (see **Table 2**) represent locations that exceed the statewide average for injury crashes and could increase their eligibility for statewide safety project funding.

2.1 Multimodal Safety Analysis

There were no recorded crashes involving pedestrians during the 2021-2023 crash data period. Three crashes during the crash data period involved bicycles being struck by vehicles, two of which involved minor age bicycle riders. In all three crashes, the bicycle rider was attempting to cross an intersection when they either struck a vehicle at the intersection (one crash) or were struck by vehicles which failed to yield the right of way (two crashes).

None of the bicycle related crashes in the study area resulted in a serious injury. Woolpert reviewed crash reports produced by the officers who responded to crashes in the study area and did not find any specific reference to whether the bicycle crashes observed are related to school arrival or dismissal, however one of the bicycle crashes involving a minor occurred on a weekday during AM arrival period of a school day at Center Ridge Rd and Ridge Plaza Drive, with the bicycle heading eastbound towards Ranger Way.

2.2 Bainbridge Rd Corridor Crash Analysis

There were 38 crashes on Bainbridge Rd between SR 83 and Ranger Way (**Figure 4**), with nearly all crashes in this section at the intersections of SR 83, Root Rd, and Ranger Way. Rear End and Left Turn are the predominant crash types in this section of the study area, accounting for 42.1% and 21.1% of the 38 crashes, respectively.

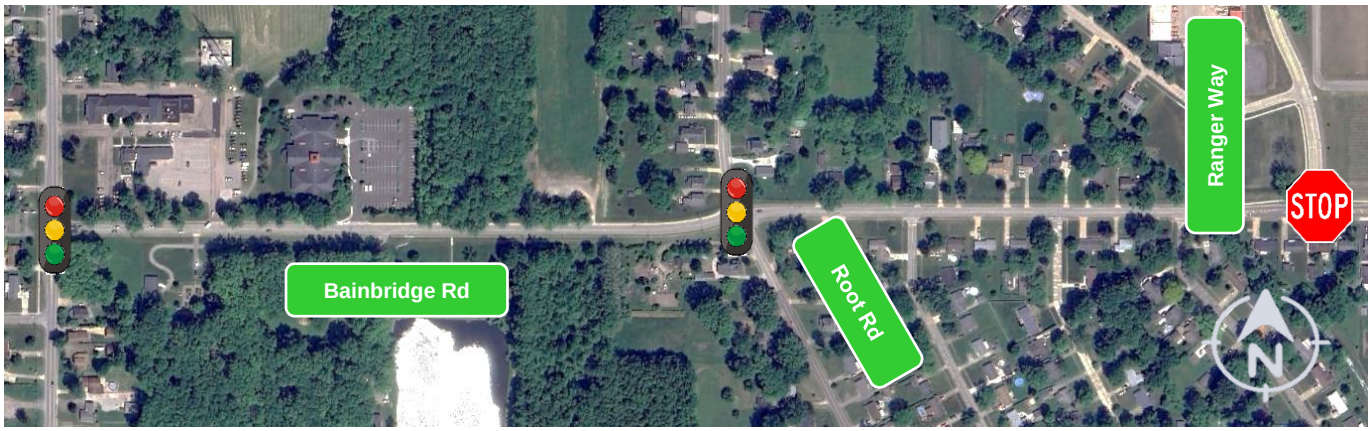


Figure 4 - Bainbridge Rd Corridor from SR 83 to Ranger Way (North to the Top)

2.2.1 Bainbridge Rd at SR 83

Rear end crashes were the most frequent crash type at the Bainbridge Rd/SR 83 intersection, with rear end crashes distributed across all intersection approaches. The existing southbound left turn lane is approximately 70 ft in length (

Figure 5) yet demand for the southbound left turn movement is high during peak periods. While there are not a significant number of crashes associated with this specific movement, there is a high incidence of near misses and notable intersection inefficacy created between the mismatch of existing demand to available storage length.

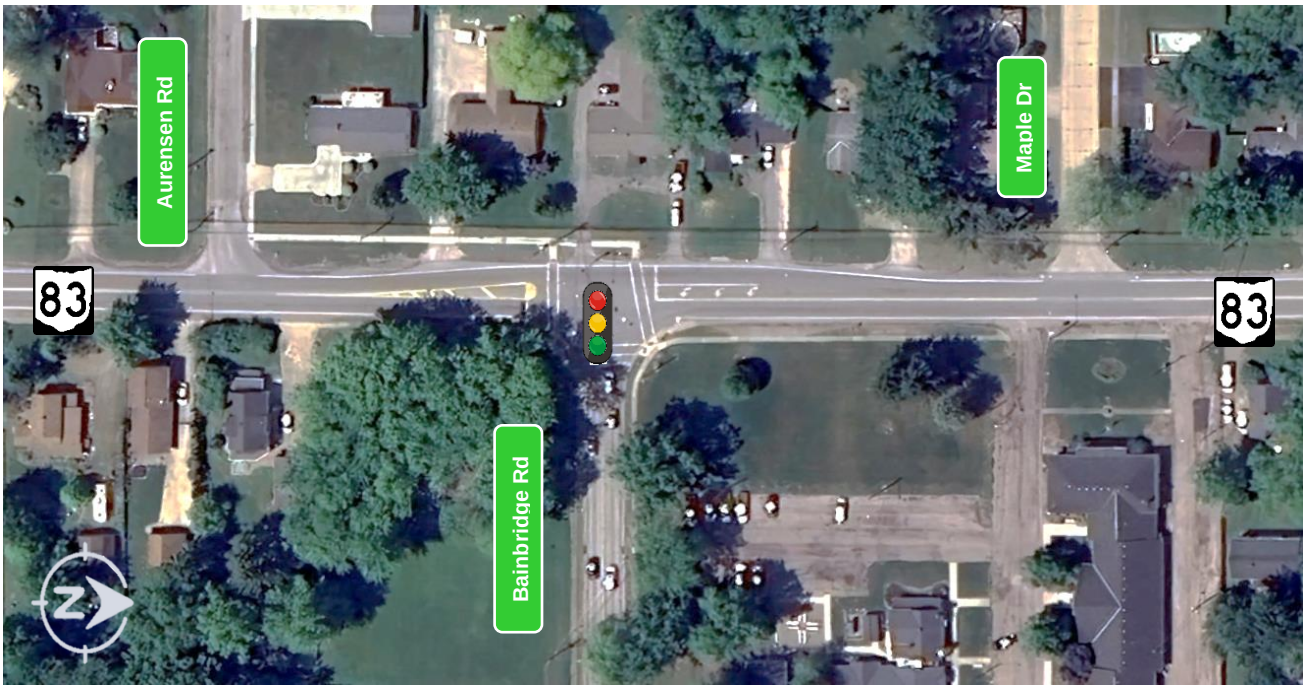


Figure 5 - Bainbridge Rd at SR 83 (North to the Right)

2.2.2 Bainbridge Rd at Root Rd

While rear end crashes are a common theme at all signalized study intersections, the crash pattern at Root Rd differed with a slightly higher frequency of Left Turn and Angle crashes than the other study intersections. The signalized intersection at Root Rd differs from the other study intersections in that there is horizontal curvature on all approaches that creates a notable skew through the intersection. This skew creates a negative offset in the turning paths of east and westbound left turns.

2.3 Existing Condition Safety Performance

Woolpert utilized the Ohio Department of Transportation Economic Crash Analysis Tool (ECAT) to evaluate the safety performance of the existing geometric condition at SR 83/Bainbridge Rd and Bainbridge Rd/Root Rd to determine if current crash patterns warrant a potential for safety improvement (PSI). ECAT uses Highway Safety Manual (HSM) methodology to compare the study intersections to comparable intersections with calibration factors specific to Ohio.

ECAT Analysis indicated that there is a positive PSI at both SR 83 and Bainbridge Rd and at Bainbridge Rd and Root Rd. A positive PSI indicates that the study intersections experience more crashes per year (known to ECAT as "Expected Crashes") than would be predicted for similar sites "Predicted Crashes". "Expected Crashes" are not a one-to-one representation of existing crash data but are instead evaluated in the context of the existing geometry and site conditions. Similarly, predicted crashes are based on HSM formulas for comparable geometries and site conditions. A PSI is an important factor in the justification of safety improvements at a subject location. **Table 3** presents the ECAT analysis results for the subject study intersections:

Table 3 - ECAT Analysis Results

Intersection	HSM Site Type	Predicted Crashes/Yr	Expected Crashes/Yr	Potential for Safety Improvement
SR 83 at Bainbridge Rd	Urban Signalized	5.0059	5.6232	**0.6173**
Bainbridge Rd at Root Rd	Urban Signalized	4.1573	4.4184	**0.2611**

3 Existing Conditions Analysis

3.1 Data Collection

Woolpert collected 13-hour turning movement counts on Thursday, March 21, 2024 at all six study area intersections. The turning movement counts included video at each intersection and coincided with a regular school day for North Ridgeville City Schools to ensure the arrival and dismissal peaks were accurately captured. Woolpert utilized these counts to conduct a capacity analysis and origin-destination analysis of the study area.

The six intersections counted include:

- SR 83 at Bainbridge Rd (Signalized)
- Bainbridge Rd at Root Rd (Signalized)
- Bainbridge Rd at Ranger Way (Unsignalized, TWSC)
- Center Ridge Rd (US 20) at Ranger Way
- Center Ridge Rd (US 20) at Root Rd
- Center Ridge Rd (US 20) at SR 83

Woolpert supplemented traffic count collection with an in-person field review on April 17, 2024. Each intersection was reviewed and documented, with specific emphasis on review of existing signal operations and queueing. Field observations occurred during the afternoon, in line with the school dismissal peak period. Traffic Count data is presented in **Appendix B**.



Figure 6 - AM Peak Period Video Collected at SR 83 and Bainbridge Rd

A review of video collected during the traffic counts (**Figure 6**) confirmed notable congestion during peak periods at intersections within the study area. In the school dismissal period (approximately 2:45 to 3:15 PM), significant queueing was observed southbound on Ranger Way at Bainbridge Rd and northbound on Ranger Way at Center Ridge Rd. Most of the school buses leaving the school campus use Ranger Way and turn onto Bainbridge Rd to make their way into the community.

Departing vehicles use Ranger Way northbound and southbound to reach the street network. The AM Peak period (approximately 7:30 to 8:30 AM) at study area intersections generally corresponded with the school arrival period. The PM Peak period was approximately 4:00 to 5:00 PM.

3.2 StreetLight Origin-Destination Analysis

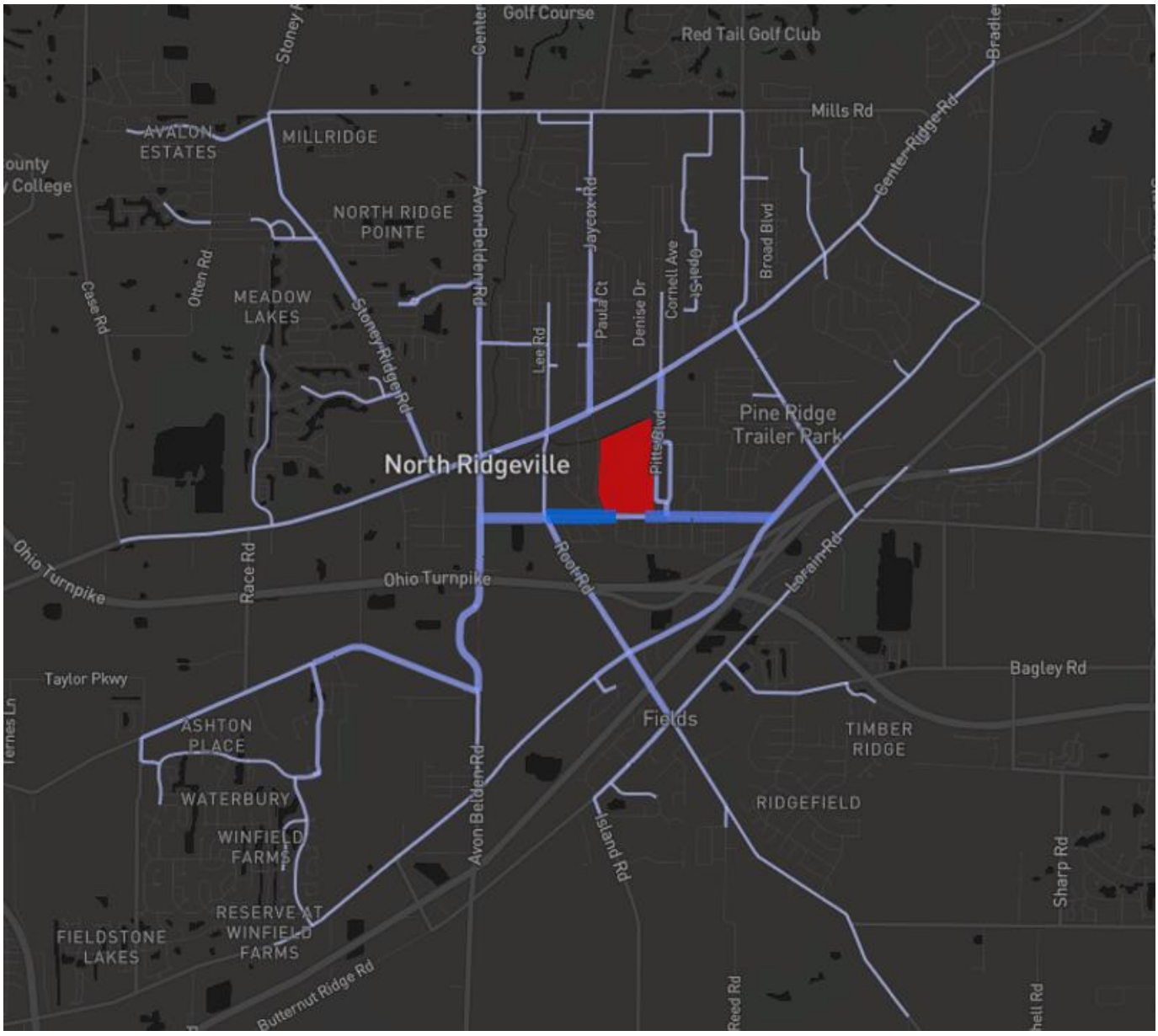


Figure 7 - AM Peak Arrival Routes into the School Campus

Woolpert conducted a StreetLight Origin-Destination (O-D) analysis on the study area, primarily focused on vehicles arriving at or departing from the North Ridgeville City School District campus on the east side of the study area. The purpose of the O-D analysis is to determine which routes are used as primary access routes to the school campus, and how these demand paths impact operations at intersections in the study area.

StreetLight utilizes signals from Bluetooth enabled devices such as vehicles, smart phones, and smart watches, along with proprietary technology to detect movements through areas and to construct O-D paths from this data. The analysis was conducted in two parts, one for vehicles arriving at the school campus in the AM Peak period, and one for vehicles departing the school campus in the School Dismissal Peak period. The data used represents 2022-2023 data.

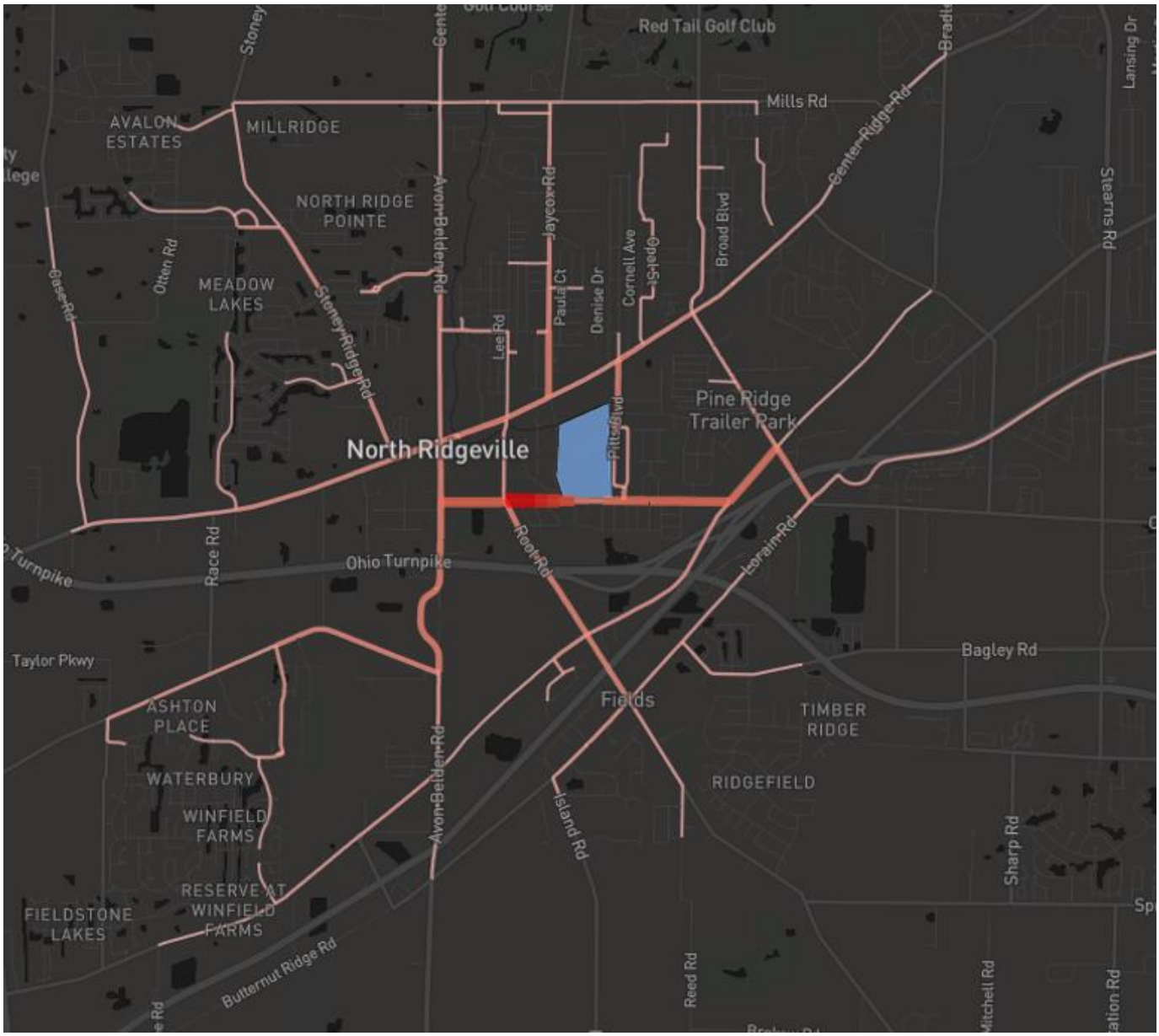


Figure 8 - PM Peak Departure Routes out of the School Campus

As shown in **Figure 7** and **Figure 8**, the Bainbridge Rd corridor is the primary access route to the school campus in the AM Peak and School Dismissal periods. The heaviest flows are seen on the segment of Bainbridge Rd between Root Rd and Ranger Way, indicating significant volumes arriving to the school campus from the west, either via Bainbridge Rd at SR 83, or Root Rd north and south of Bainbridge Rd. The analysis shows that most vehicles do not arrive to the campus from Center Ridge Rd, but rather approach the school campus using the local roadway network.

3.3 Travel Pattern Analysis

There are two defined travel patterns throughout the study area, an AM/PM commute pattern, with vehicles traveling to/from residential areas on workdays, and an AM/Early Afternoon movement pattern to/from the North Ridgeville School Complex on Bainbridge Rd at Ranger Way. These patterns occur independently of each other, yet because they rely on the same street network, create impacts that are noticeable throughout the day. The independent nature of these travel patterns is most noticeable at Bainbridge Rd and Root Rd. At the intersection, shown in **Figure 9**, two well-defined pairs of demand (west to/from south and west to/from east) are present in the 13-Hour traffic counts collected in March 2024.

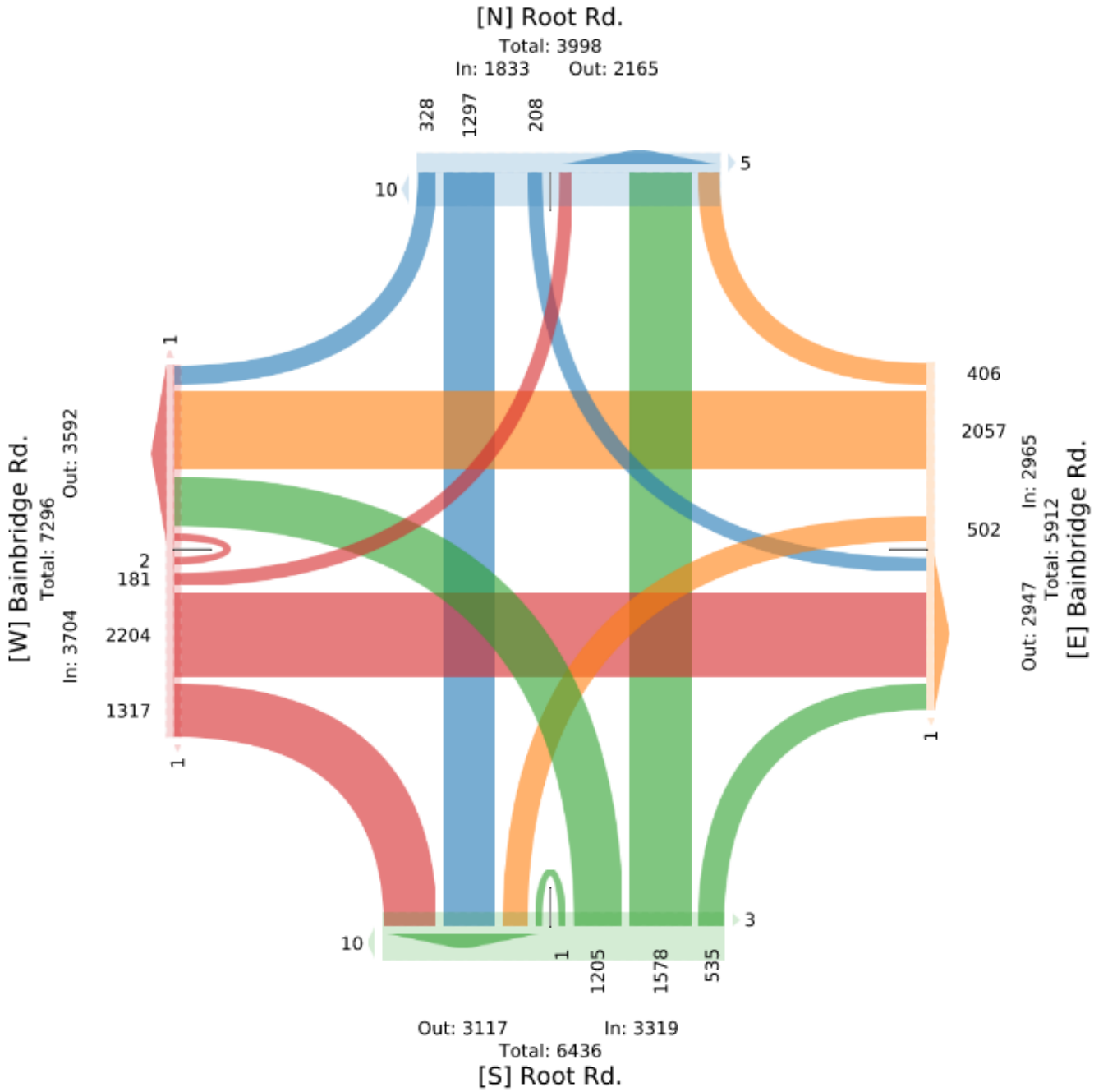


Figure 9 - 13-Hour Turning Movement Count Data at Bainbridge Rd and Root Rd

3.4 Capacity Analysis

The existing roadway network was modeled in TransModeler 7 to evaluate traffic operations conditions and to identify movements that would benefit from optimization and/or geometric improvement. Woolpert obtained existing traffic signal timing data from the City of North Ridgeville and used that, along with 13-hour traffic count data to populate the microsimulation model. Woolpert utilized guidance in the ODOT Analysis and Traffic Simulation (OATS) Manual to construct, calibrate, and validate the existing condition model. To maintain consistency among all analyses, the existing condition model also serves as the base model for all proposed condition analyses.

The existing condition is defined as the existing roadway geometry, lane use, and signal timings. No optimization or improvements were made prior to running the existing condition capacity analysis in TransModeler. **Table 4** presents Level of Service (LOS), delay, and maximum queueing by approach and overall, at each intersection. All results shown reflect the average of 10 microsimulation runs, per OATS manual guidance. Results at the TWSC intersection at Bainbridge Rd and Ranger Way are excluded from this table but are discussed below.

Table 4 - Existing Condition Capacity Analysis Results

Existing Condition		AM Peak/School Arrival			School Dismissal Peak			PM Peak		
Intersection/Movement		LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)
SR 83 at Bainbridge	NB	C	24.3	74.0	C	22.3	36.8	D	35.9	129.7
	SB	F	322.3	1412.6	F	82.9	297.7	F	229.3	1196.5
	WB	D	43.7	102.2	C	26.5	89.7	C	33.9	97.6
	Overall	***F***	***134.9***		***D***	***46.8***		***F***	***111.8***	
Bainbridge at Root	NB	F	213.1	525.1	F	229.2	552.0	F	201.1	524.4
	SB	F	87.3	164.6	F	53.5	86.7	F	56.1	76.2
	WB	B	15.4	47.5	B	13.9	51.1	B	14.1	48.4
	EB	C	29.5	103.5	C	26.2	56.7	C	24.1	42.7
	Overall	***E***	***72.1***		***E***	***66.3***		***E***	***65.7***	
Center Ridge at Jaycox/Ranger	NB	C	32.0	86.1	D	45.4	129.9	D	37.0	50.5
	SB	F	99.0	309.8	D	35.2	73.0	D	43.1	120.3
	WB	C	22.7	46.0	C	24.6	80	D	45.7	218.2
	EB	B	12.1	27.4	B	15.7	48.5	C	23.7	72.7
	Overall	***D***	***37.8***		***C***	***27.1***		***D***	***37.3***	
Center Ridge at Root	NB	C	27.0	29.5	C	29.2	49.4	D	42.4	57.3
	SB	D	42.0	37.6	D	43.8	13.2	D	45.2	18.3
	WB	B	15.9	37.7	B	17.1	51.5	F	85.4	482.6
	EB	B	18.7	44.1	B	15.1	38.8	A	9.7	24.5
	Overall	***C***	***20.6***		***B***	***18.9***		***D***	***49.3***	
Center Ridge at SR 83	NB	C	26.6	67.7	C	30.9	101.2	F	125.6	575.1
	SB	F	119.0	309.9	C	28.3	79.3	F	94.5	297.1
	WB	D	45.0	125.2	C	31.9	92.7	F	338.5	1543.0
	EB	F	138.1	378.5	C	21.5	58.2	F	89.5	299.4
	Overall	***F***	***82.1***		***C***	***28.1***		***F***	***162.5***	

LOS results are presented based on Highway Capacity Manual (HCM) methodology, which defines LOS as a letter scale based on intersection delay in seconds/vehicle (**Table 5**). An LOS of D or better is assumed to be an acceptable LOS.

Table 5 - HCM LOS Definitions

Level of Service	Signalized (sec./veh.)	Unsignalized (sec./veh.)
A	≤ 10 sec.	≤ 10 sec.
B	10-20 sec.	10-15 sec.
C	20-35 sec.	15-25 sec.
D	35-55 sec.	25-35 sec.
E	55-80 sec.	35-50 sec.
F	> 80 sec.	> 50 sec.

The Bainbridge Rd at Ranger Way intersection is Two-Way Stop Control (TWSC) with free-flow movements on Bainbridge Rd. Because Bainbridge Rd is free-flow through the intersection, there are no LOS results for the thru-movements on those approaches. Woolpert evaluated LOS at this intersection in TransModeler along with the signalized intersection analysis. **During the School Dismissal Period, which saw the highest volumes on the southbound approach of Ranger Way at Bainbridge Rd, southbound LOS was B with average delay of 13.5 seconds per vehicle.**

Woolpert evaluated the Bainbridge Rd at Ranger Way intersection to determine if a traffic signal may be warranted based on current volumes. Woolpert utilized ODOT's Traffic Signal Warrant Spreadsheet, which is based on signal warrant evaluation as described in the Ohio Manual for Uniform Traffic Control Devices, and input traffic counts and location information and determined that a signal is not warranted at this intersection based on current volumes.

Complete TransModeler outputs for the existing condition capacity analysis are presented in **Appendix C**. Signal warrant analysis information is presented in **Appendix D**.

4 Countermeasure Evaluation

Woolpert evaluated potential short- and long-term countermeasures to address existing crash patterns, traffic counts, O-D analysis results, and existing condition capacity analysis to identify practical and effective solutions at various locations within the study area. Because the study area comprises a large area, and because the context of each focus location within the study area is unique, Woolpert evaluated countermeasures with independent utility, in that they can serve as standalone improvements or as part of a broader project to improve a larger portion of the study area.

All capacity analysis results presented in this evaluation represent the average of 10 simulation runs in TransModeler 7. While results may be presented individually for clarity, proposed condition results come from the same proposed condition traffic model that was built from the validated existing condition traffic model.

Supporting files, including turn lane length calculations, and complete capacity analysis results can be found in **Appendix E**. Conceptual geometric layouts are presented in **Appendix F**. Proposed signal timings are presented in **Appendix G**.

4.1 SR 83 at Bainbridge Rd

The signalized intersection at SR 83 and Bainbridge Rd experiences significant queueing and inefficiency in the southbound direction caused by the existing 70 ft left turn lane, which does not have enough storage capacity to meet the existing southbound left turn vehicle demand. Additionally, the southbound thru movement must drive around the southbound left turn lane to proceed through the intersection.

This atypical intersection geometry results in one of two conditions during peak periods: either the queue of thru vehicles block access to the left turn lane, or the queue of left turning vehicles blocks access to the thru movement (**Figure 10**). In both cases, this bottlenecking caused by physical conditions significantly reduces the efficiency of the southbound signal phases, and thus the entire intersection.



Figure 10 - Thru Demand Blocking Southbound Left Turn Lane

The intersection approaches are bounded to the north by Maple Dr, a residential cul-de-sac street, and the entrance drives to North Ridgeville City Hall. Woolpert aimed to balance the improvements at SR 83/Bainbridge against the potential impacts to upstream intersections such as Maple Dr, to avoid creating a potential crash pattern where one does not currently exist. To that end, Woolpert used Maple Dr as a physical limit for improvements to the north of the SR 83/Bainbridge intersection.

4.1.1 Alternative 1: Conventional Intersection Widening

A traditional approach to high left turn demand and unconventional left turn lane geometry is to extend the existing left turn lane to a suitable length per ODOT Location and Design (L&D) Manual Volume 1 methodology and to revise the geometry to meet L&D Figure 401-7 criteria. As noted previously, Woolpert evaluated turn lane length (**Table 6**) per L&D Manual Figure 401-9 and 401-10 but balanced that against the need to maintain access at Maple Dr.

Table 6 - L&D Manual Figure 401-9/401-10 Turn Lane Length Calculation Results

Movement	AM Peak	School Dismissal	PM Peak	Recommended
Southbound Left	425 ft	250 ft	325 ft	**275 ft**
Westbound Right	300 ft	250 ft	325 ft	**250 ft**
Westbound Left	200 ft	250 ft	225 ft	**250 ft**

As noted above, the existing turning movement counts in the AM Peak Period result in a computed southbound left turn lane length of 425 ft per L&D Manual methodology. This would result in a left turn lane that extends through and beyond the Maple Dr intersection and could also be confused as a southbound left turn lane for both Bainbridge Rd and North Ridgeville City Hall, which is not the intent of this improvement. As such, Woolpert evaluated a 275 ft southbound left turn lane (**Figure 11**), which ends immediately south of Maple Dr, before tapering back to meet the existing SR 83 north of Maple Dr.

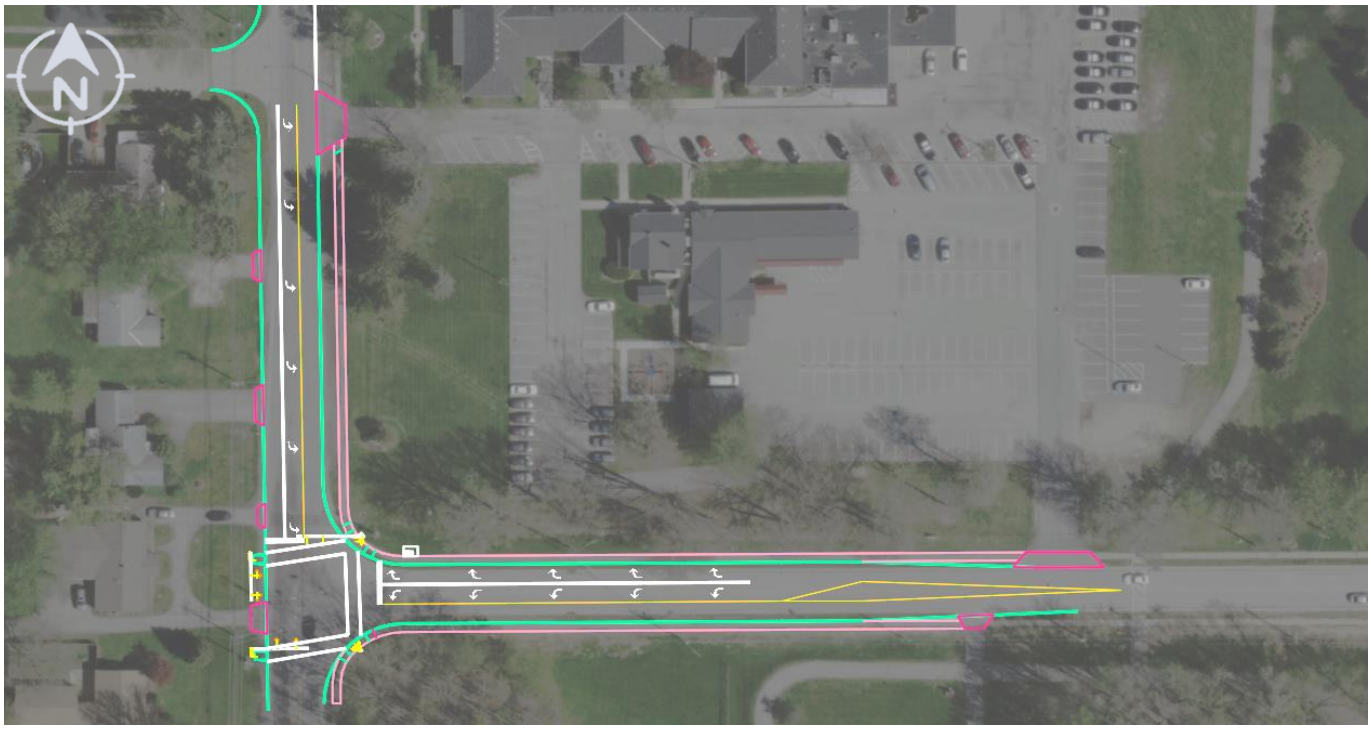


Figure 11 - Conceptual Turn Lane Layout at SR 83 and Bainbridge Rd

To accommodate for a southbound left turn lane that is shorter than L&D recommendations, Woolpert evaluated a combination of signal timing efficiency improvements for the signal as a whole and geometric modifications to the westbound Bainbridge Rd approach. Converting the single-lane westbound approach to a two-lane approach with dedicated left and right turn lanes allows for additional storage capacity on the westbound approach that reduces the green time required to clear the approach by using an overlap phase. This green time can then be allocated towards clearing the southbound approach. **Table 7** presents capacity analysis results for Alternative 1:

Table 7 - SR 83/Bainbridge Alternative 1 Capacity Analysis Results

Proposed Conventional		AM Peak/School Arrival			School Dismissal Peak			PM Peak		
Intersection/Movement		LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)
SR 83 at Bainbridge	NB	C	23.1	77.0	C	20.2	59.6	C	20.1	66.1
	SB	B	19.8	75.9	B	15.1	44.7	B	16.8	65.5
	WB	C	20.2	34.3	B	19.6	46.6	C	20.0	38.5
	Overall	***C***	***21.1***		***B***	***18.1***		***B***	***18.8***	

Widening the intersection would likely require reconstruction of the signal, along with new curb ramps and pedestrian signals. Given the likelihood of future growth along SR 83, Woolpert recommends designing the improvements at this intersection to accommodate a future three-lane section on SR 83, including sidewalk and any utility relocations. **Based on County Auditor GIS data, Woolpert believes this alternative could be constructed within the existing right-of-way.**

4.1.2 Alternative 2: Conversion to Roundabout

Converting the signalized intersection at SR 83 and Bainbridge Rd to a single-lane roundabout would eliminate the need for significant widening to accommodate additional turn lanes and storage length, with the added benefit of improved traffic operations. A single-lane roundabout has significant capacity advantages over stop-controlled and signalized movements due to its fully yield-controlled nature, allowing most vehicles to approach and proceed through the roundabout with little to no delay. The primary drawbacks to roundabouts are driver unfamiliarity and larger overall footprint impacts when compared to conventional intersection treatments.

Footprint is a major consideration in the design and utility of a roundabout and is driven primarily by the “design” and “control” vehicles that will use it on a regular basis. The National Association of City Transportation Officials (NACTO) Urban Street Design Guide generally defines “design” vehicles as frequent users of the roadway that dictate design elements such as inscribed circle diameter (ICD) and lane widths. “Control” vehicles are generally defined as larger, but infrequent users of the roadway which need to be accommodated through design elements, but not necessarily drive the overall design.

SR 83 is a state route but is not a federal truck route through the study area. During field observations, Woolpert observed higher frequencies of single unit trucks and school buses compared to tractor/trailer trucks. As such, Woolpert evaluated the roundabout alternative with a school bus and fire truck as the design vehicle, and a WB-62 (a standard tractor/trailer with a 48 ft trailer) as the control vehicle.

Woolpert used the design vehicle to set an ICD of 130 ft, and the control vehicle to set the location and sizing of mountable truck aprons and the central island. Woolpert used AutoTurn to evaluate design and control vehicle paths entering and proceeding through the roundabout.

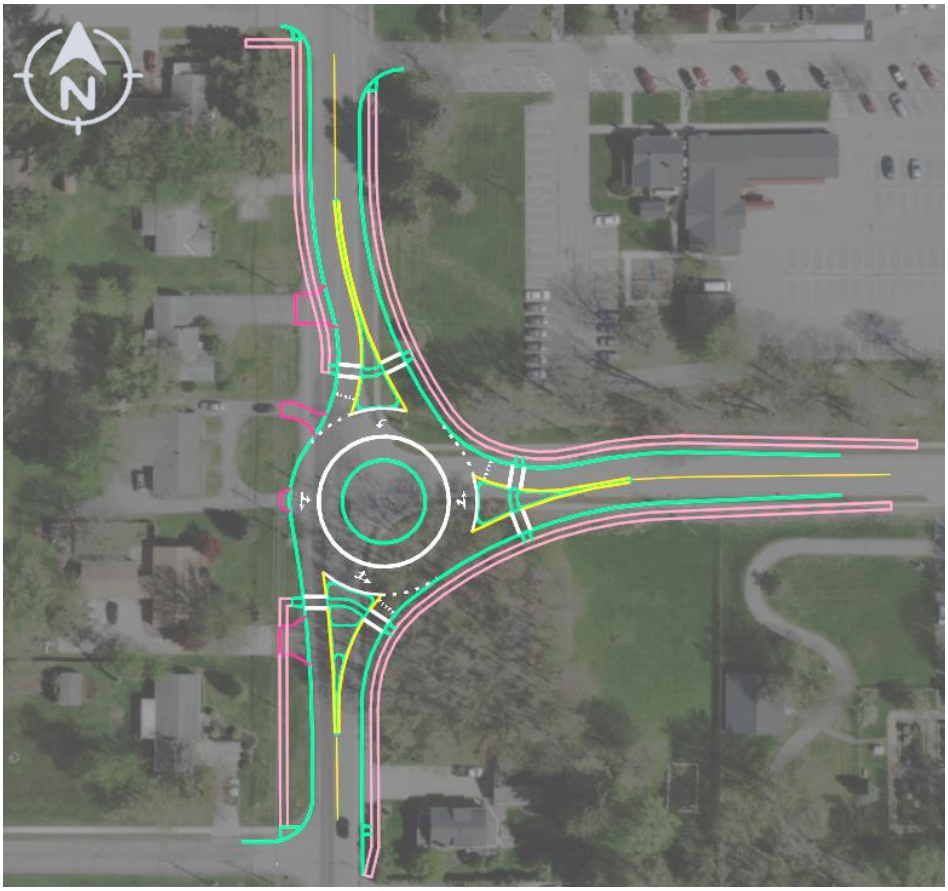


Figure 12 - Conceptual Roundabout at SR 83 and Bainbridge Rd

Woolpert evaluated capacity for the roundabout using TransModeler 7 by coding in a roundabout intersection with geometrics matching the proposed geometrics shown in **Figure 12** and in **Appendix F**. **Table 8** presents capacity analysis results for Alternative 2:

Table 8 - SR 83/Bainbridge Alternative 2 Capacity Analysis Results

Proposed Roundabout		AM Peak/School Arrival			School Dismissal Peak			PM Peak		
Intersection/Movement		LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)
SR 83 at Bainbridge	NB	B	10.5	26.6	A	5.1	5.6	A	7.3	16.2
	SB	A	6.1	7.3	A	7.7	10.7	A	7.7	11.2
	WB	A	6.1	7.5	A	8.1	17.2	C	15.1	43.1
	Overall	***A***	***7.6***		***A***	***7.1***		***A***	***9.2***	

Converting the existing conventional intersection to a roundabout would have a larger footprint impact versus conventional widening. Woolpert located the roundabout to the east of the existing intersection to keep the footprint entirely within property and right of way already owned by the City of North Ridgeville, per Lorain County Auditor GIS data. At a planning level, a single-lane roundabout can accommodate approximately 1000 vehicles entering and circulating per hour before a second entry lane should be considered. Based on current volumes, a single lane roundabout at SR 83/Bainbridge can accommodate approximately 25% more traffic before a second entry lane would be advantageous, equating to an annualized growth of 1.25% over the next 20 years. As future growth is anticipated on SR 83, consideration should be given to designing an intersection that can accommodate future growth, which may include widening of SR 83 from two lanes to three or five over the long term.

4.2 Bainbridge Rd at Root Rd

The signalized intersection at Bainbridge Rd and Root Rd experience queuing and congestion most frequently during the AM Peak and afternoon School Dismissal periods (**Figure 13**). In the morning rush, there is a significant eastbound thru component heading towards Ranger Way and points east. During the school dismissal period, the volume pattern shifts to a primarily westbound flow, with a healthy westbound left turn component that is served through a leading left turn phase. There are no left turn lanes on any of the approaches, and the only left turn treatment is the previously mentioned westbound leading left turn phase. Through an entire day (13-hour period from 6:00 AM to 7:00 PM) left turns make up approximately 15% of all movements at the intersection, and 36% of all northbound movements at the intersection.



Figure 13 - Westbound Queueing on Bainbridge Rd at Root Rd During School Dismissal Peak

The intersection is skewed by horizontal curvature on the southbound, eastbound, and westbound approaches, with the curvature meeting at the center of the intersection. This curvature creates negative offsets for left turn movements paths on all approaches but is most obvious on the eastbound and westbound approaches. A negative offset results in a condition where opposing left turn paths can overlap, potentially leading to head on collisions between opposing left turning vehicles. The existing signal has pedestrian signals and pushbuttons, and the adjacent sidewalk network is used by students approaching the school complex on Ranger Way during the AM Peak and School Dismissal periods.

The curvature, along with notable congestion during peak periods has led to a crash pattern with an injury rate over 30% and a higher frequency of left turn and angle crashes, which are common to signalized intersections where left turns are difficult to make either because of a lack of green time or dedicated signal phases, or because of geometric deficiencies such as offset geometry or turning path overlaps.

To address this crash pattern and existing vehicle demand, Woolpert evaluated a conventional intersection improvement at Bainbridge/Root to flatten the horizontal curvature, line up approach lanes, and provide left turn lanes/signal phasing. Woolpert also evaluated a single-lane roundabout alternative which can be built into the existing skewed geometry without the need to modify the approaches as significantly as with a conventional solution.

4.2.1 Alternative 1: Conventional Intersection Widening

A conventional intersection improvement would flatten out the horizontal curvature approaching the intersection to line up opposing approaches and create 90-degree angles between adjacent approaches, addressing both the existing intersection skew and the slight negative offset in left turn paths. As shown in **Figure 14** the northbound and westbound left turn movements are the heaviest throughout the 13-hour traffic count period.

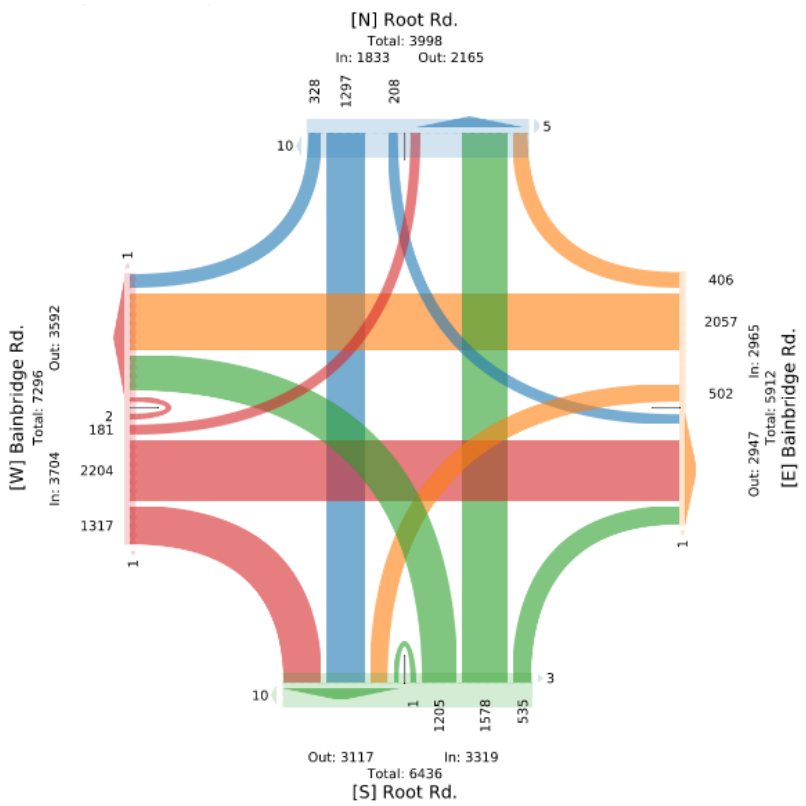


Figure 14 - 13-Hour Turning Movement Count at Bainbridge/Root

Because of the existing curvature and intersection skew, installing northbound and westbound turn lanes without matching eastbound and southbound turn lanes would create approaches with severely negatively offset approaches if no opposite side approach taper is provided. To address geometrics through the entire intersection, Woolpert evaluated the convention intersection widening alternative to include left turn lanes on all approaches.

Woolpert calculated turn lane lengths for left turn lanes using ODOT L&D Manual Figure 401-9/401-10 methodology. Turn lane lengths were evaluated as follows, with controlling peak period noted:

- Eastbound Approach: 100 ft (School Dismissal Peak)
- Westbound Approach: 225 ft (School Dismissal Peak)
- Northbound Approach: 225 ft (School Dismissal Peak)
- Southbound Approach: 200 ft (AM Peak)

Table 9 presents capacity analysis results for Alternative 1 at Bainbridge Rd and Root Rd. The results shown account for signal timing optimization for the new intersection geometry in each peak period.

Table 9 - Bainbridge Rd at Root Rd Alternative 1 Capacity Analysis Results

Proposed Conventional		AM Peak/School Arrival			School Dismissal Peak			PM Peak		
Intersection/Movement		LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)
Bainbridge at Root	NB	C	24.0	42.6	B	19.8	32.5	C	24.7	47.8
	SB	C	25.6	36.3	C	26.7	37.2	C	24.1	34.6
	WB	B	13.4	31.5	B	19.1	63.6	B	16.6	50.6
	EB	B	19.6	67.2	B	14.0	24.7	B	19.3	33.0
	Overall	***C***	***19.9***		***B***	***19.4***		***C***	***20.3***	

4.2.2 Alternative 2: Conversion to Roundabout

A roundabout is an ideal treatment for signalized intersections without turn lanes but with higher frequencies of angle and left turn crashes, such as Bainbridge Rd at Root Rd. Additionally, roundabouts are an FHWA Proven Safety Countermeasure that can reduce crash frequency and crash severity. The Bainbridge Rd/Root Rd intersection has one of the highest injury rates within the study area, at just over 30% from 2021 to 2023.

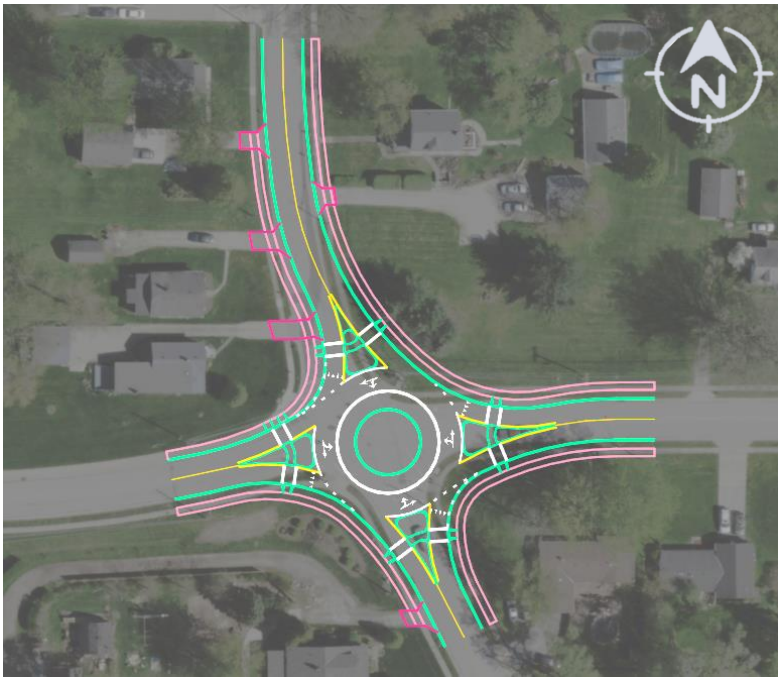


Figure 15 - Conceptual Bainbridge/Root Roundabout

Roundabout approaches utilize geometric curvature to slow vehicles down prior to entry, and the existing approach geometry is ideal for the design of a roundabout. At SR 83 and Bainbridge Rd, the "control" vehicle was a WB-62, which necessitates a larger roundabout ICD to accommodate larger vehicles. In the case of Bainbridge Rd and Root Rd, which are local residential streets, the "control" vehicle becomes a fire truck or school bus, rather than a WB-62, and allows for a smaller ICD which lessens potential footprint impacts on adjacent properties. Further, because the intersection sees less daily traffic than SR 83/Bainbridge, a single lane roundabout can handle existing and future traffic even in a high growth scenario (1-2%+ per year).

Woolpert evaluated a 100 ft ICD single-lane compact roundabout without bypass lanes, to minimize to the extent possible geometrics impacts outside of the existing curb line (**Figure 15**). Given the constrained right of way, it is likely that a roundabout would require a full closure to construct. **For a roundabout of this size, construction could likely occur in one season between school years to minimize any potential impact of construction on traffic that uses the intersection access the school complex on Ranger Way.** **Table 10** presents capacity analysis results for the roundabout alternative at Bainbridge Rd and Root Rd:

Table 10 - Bainbridge Rd at Root Rd Alternative 2 Capacity Analysis Results

Proposed Roundabout		AM Peak/School Arrival			School Dismissal Peak			PM Peak		
Intersection/Movement		LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)	LOS	Delay (sec./veh.)	Avg. Queue (ft.)
Bainbridge at Root	NB	A	9.5	14.1	A	4.4	2.1	A	4.5	2.6
	SB	A	5.7	4.5	A	7.8	8.1	A	8.1	8.0
	WB	A	4.7	3.5	A	5.4	6.1	A	5.6	8.7
	EB	A	2.3	9.3	A	1.5	2.3	A	1.5	2.8
	Overall	***A***	***5.0***		***A***	***4.7***		***A***	***4.8***	

A roundabout presents the opportunity for aesthetic features such as landscaping and plants and can serve as a gateway feature for a neighborhood or city civic area. Alternatively, the central island of a roundabout can be left with minimal or low maintenance landscaping/grass to minimize additional maintenance costs in the long term. Existing right of way is limited at the Bainbridge Rd/Root Rd intersection. Additionally, the intersection is raised by approximately 1-2 feet relative to the property in the northwest quadrant. As a result, it is likely that both a conventional and roundabout alternative will require some right of way acquisition to construct when also accounting for sidewalk/curb ramps and possible utility relocation.

4.3 Ranger Way

During the afternoon School Dismissal peak period, the large volume of traffic leaving the school complex causes significant northbound congestion at Ranger Way and Center Ridge Road. The signal at Ranger Way/Center Ridge Rd operates in a split-phase operation for northbound and southbound movements. Crossing guards direct the movement of pedestrians through the intersection during school arrival and dismissal periods, allowing pedestrians to cross the street before conflicting vehicle movements. Most north/south pedestrian movements at the intersection occur during the northbound signal phase, using the east side crosswalk. The shared nature of green time for vehicles and walk time for pedestrian constrains the northbound right turn vehicle movement. Additionally, the significant demand for northbound left and thru vehicle movements from the shared thru-left lane far exceeds the available capacity of the intersection, contributing to significant intersection inefficiency. This translates into significant northbound queuing during the school dismissal period (**Figure 16**). Woolpert observed left turn queueing exceeding 600 ft approximately 20-30 minutes after school dismissal.



Figure 16 - Northbound Thru/Left Queuing at Ranger Way and Center Ridge Rd



Figure 17 - School Queues Blocking Fire/Police Station Entrances

The queueing shown in **Figure 16** fluctuates during school activity periods and presents challenges for emergency vehicle ingress and egress from both North Ridgeville Fire Station No. 1 and the North Ridgeville Police Station which are both situated on Ranger Way across from the school complex.

During the project field review, Woolpert observed queues related to school dismissal blocking access to the police and fire stations from both the north and south directions (**Figure 17**). This queueing can directly impact public safety response times, which impacts not just the study area but the whole community.

4.3.1 Short Term Alternative: School Dismissal Period Timing Plan with LPI

The signal at Center Ridge Rd and Ranger Way/Jaycox Rd currently operates "free" (no coordination, signal responds only to traffic actuation) from 9:00 PM through 6:30 AM the following day. The signal has two additional coordinated timing plans, an AM Peak plan that runs 6:30 AM to 3:00 PM and again 7:00 PM to 9:00 PM and a PM Peak Plan that runs from 3:00 PM to 7:00 PM. The transition between timing plans occurring during the school dismissal peak is likely a contributing factor to some of the congestion observed, as it takes time for the signals in the coordinated corridor to recover to their new timing plan.

A short-term approach to address queueing and pedestrian safety at the intersection of Center Ridge Rd and Ranger Way/Jaycox Rd would be to introduce an additional timing plan that runs from 2:30 PM to 3:30 PM to provide additional green time to clear vehicles from Ranger Way northbound onto Center Ridge Rd east and westbound. This new timing plan can be combined with a Leading Pedestrian Interval (LPI) to allow northbound/southbound pedestrians to receive a walk indication several seconds prior to the beginning of the northbound green phase to reduce the overall proportion of green time lost to pedestrian movements.

LPI's are an **FHWA Proven Safety Countermeasure** that can reduce the likelihood of a pedestrian/vehicle crash by increasing pedestrian visibility to motorists, reducing direct conflicts between pedestrians and vehicles, and increasing the likelihood that motorists will yield to pedestrians using the crosswalk. Because an LPI is not a true "pedestrian scramble" phase, the impacts to overall signal operations are minimal, while returning significant potential safety benefit, especially at a crosswalk with heavy pedestrian demand and vulnerable users, such as children.

One potential drawback to a timing plan specific to Ranger Way/Jaycox Rd is that it would negatively impact movements on Center Ridge Rd. This tradeoff may be necessary, however, due to the lack of available capacity on Ranger Way for the demand that exists. Further, while there would be negative impacts to Center Ridge Rd, those impacts would be temporary, as the timing plan would only last for one hour of the broader afternoon demand period and would allow the signal time to get back into coordination with Center Ridge Rd prior to the start of the PM Peak Period.

Woolpert evaluated a timing plan that would begin at 2:30 PM and end at 3:30 PM, includes an LPI, and would increase northbound and southbound green time by reducing green time provided to the eastbound and westbound movements. Additionally, Woolpert extended the westbound left/northbound right overlap phase to provide additional green time for northbound right turn movements during this period. **Table 11** presents a conceptual timing plan for the afternoon School Dismissal Peak.

Timing Plan Begin: 2:30 PM
Timing Plan End: 3:30 PM
Cycle Length: 130 Seconds
Phase Splits:

Table 11 - Capacity Analysis Result for a School Dismissal Timing Plan

Phase 1 WBL	Phase 2 EBT	*Phase 4 LPI*	Phase 4 SB	Phase 5 EBL	Phase 6 WBT	*Phase 8 LPI*	Phase 8 NB
14	36	***5***	35	15	35	***5***	35

4.3.2 Long Term Alternative: Capacity Improvements to Ranger Way

As a long-term approach to address signal inefficiency and intersection safety, Woolpert evaluated potential widening for the northbound approach lane. Specifically, Woolpert evaluated converting the northbound approach from thru/left, right to left, thru/left, right (**Figure 18**).

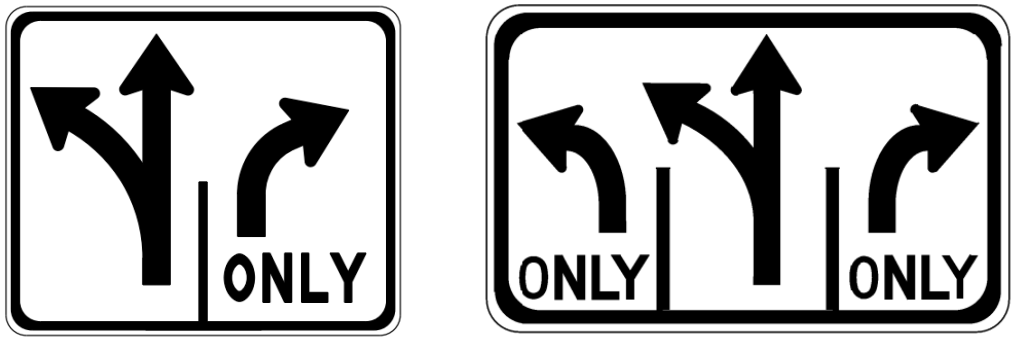


Figure 18 - Existing (Left) and Proposed (Right) Lane Use at Ranger Way Approaching Center Ridge Rd



Figure 19 - Concept Sketch of Widening on Ranger Way Approaching Cener Ridge Rd

This geometric modification (conceptual sketch shown in **Figure 19**) would increase capacity and storage for the northbound approach, reducing the overall green time necessary to clear the northbound approach and returning that green time to other intersection approaches.

There are three notable drawbacks to a geometric modification for the northbound approach at Ranger Way. The first and most impactful is that the improvement would likely require the relocation of the existing shared use path on the east side of the roadway to maintain the alignment between the northbound and southbound approaches to the intersection.

The second notable drawback is the potential that changes to travel patterns associated with the reconstruction of North Ridgeville High School may render these improvements either insufficient or an over-construction depending on the final proposed layout for the building. Continued coordination between the City and the School District is necessary to ensure any proposed modifications to the roadway network work in concert with the proposed modifications to the school district campus.

The third drawback is that an additional northbound lane extends the length of pavement that must be crossed by a pedestrian completing an eastbound or westbound movement along the crosswalk on the south side of the intersection. This also translates into a longer pedestrian clearance interval for Center Ridge Rd, which may constrain some of the potential signal timing improvements associated with the geometric modification.

As shown in Figure XX, the proposed widening approaching Center Ridge Rd would impact the existing shared use path on the east side of Ranger Way. These impacts may extend to an existing pole line on the east side of the roadway, which may require relocation depending on the scope and direction of the widening. Additionally, to improve signal operations during peak periods, the crosswalk on the west side of the intersection is shown as removed and consolidated with the crosswalk on the east leg of the intersection. Traffic count data indicated that most pedestrians cross Center Ridge Rd from the east crosswalk, which will be maintained.

Woolpert recommends the City coordinate with the School District to determine whether a widening alternative is appropriate at a future date given the District's campus improvement plan.

4.4 Coordination with Upcoming School Campus Improvements

The North Ridgeville City School District is currently conducting a Traffic Impact Study for a new high school building on their campus located off Ranger Way. Woolpert met with the City and the School District on July 18, 2024 to discuss how this project may impact the development of a plan for the school campus. Woolpert also reviewed the draft school travel plan recommendations. In general, many of the recommendations do not impact the study area. Areas of future coordination include Ranger Way, and whether the District campus redevelopment brings more traffic to Ranger Way than currently present.



Figure 20 - School Busses Queueing on Ranger Way at Bainbridge Rd During School Dismissal

An increase in traffic on Ranger Way southbound towards Bainbridge Rd (**Figure 20**) would potentially warrant the installation of a signal or roundabout at the Ranger/Bainbridge Intersection. Further, increased pedestrian presence at Ranger/Bainbridge may warrant signalization to provide a protected crosswalk for pedestrians crossing Bainbridge to access the school campus.

Additionally, heavier volumes northbound approaching Center Ridge Rd may warrant capacity improvements such as the widening proposed in Section 4.3.2 to facilitate more efficient movements of vehicles to/from the Campus and points north. Woolpert recommends continued communication and coordination between the District and the City to ensure that any projects originating from this study can be designed in such a way that accommodates potential future volumes from the school, and constructed such that construction periods do not significantly interfere with the school calendar or overlap with major construction on the school campus.

5 Recommended Countermeasures

Woolpert developed short- and long-term proposed countermeasures to address existing crash patterns and to address congestion and poor traffic operations. Based on a detailed evaluation of countermeasures, including safety, capacity, and benefit/cost analysis Woolpert recommends the following countermeasures:

Short-Term

- Optimize signal timing for AM Peak, School Dismissal Peak, and PM Peak periods based on 2024 traffic counts.
- Implement a School Dismissal Timing Plan (2:30-3:30 PM) and introduce a Leading Pedestrian Interval (LPI) for northbound/southbound pedestrian movements.

Long-Term

At SR 83 and Bainbridge Rd

- Extend southbound left turn lane from 70 ft to approximately 275 ft.
- Convert westbound approach from single lane to two lane (left, right) approach with 250 ft of storage length.
- Reconstruct signal and curb ramps to accommodate new intersection geometry.
- Optimize signal timing to include SBL/WBR overlap phasing and improve overall efficiency in all periods.

At Bainbridge Rd and Root Rd

- Convert existing conventional signalized intersection to 100 ft Inscribed Circle Diameter (ICD) single lane compact roundabout.

At Bainbridge Rd and Ranger Way

- Coordinate with the North Ridgeville City School District's Traffic Impact Study to determine whether future improvements to the district building campus will produce volumes that warrant a conversion from Two-Way Stop Control (TWSC) to signalized operation.

At Center Ridge Rd and Ranger Way

- Consider potential widening of the northbound approach from thru/left-right to left-thru/left-right to align with modifications to the crosswalks to improve signal efficiency and pedestrian safety.

5.1 Economic Evaluation

Woolpert developed conceptual cost estimates for the recommended countermeasures using costs from 2023 ODOT's Summary of Contracts Awarded, recent projects completed by ODOT in the region, and the conceptual graphics produced for this study. The estimates represent high level cost drivers such as removal of pavement, new pavement, traffic control, traffic signal, and high-level erosion quantities. The cost of replacing, removing, or relocating existing utilities such as overhead utilities, underground gas, water, or sewer infrastructure is not accounted for in this estimate, however Woolpert accounts for this with a 30% contingency on the high-level cost estimates. The costs also include a 25% value for detailed engineering design.

Woolpert used ODOT guidance to develop inflation calculations for an anticipated 2028 construction year. **Table 12** presents cost estimates for the proposed long-term countermeasures, along with the other long-term countermeasures that were evaluated in this study. Conceptual Cost estimates are presented in **Appendix H**.

Table 12 - Conceptual Cost Estimates of Long-Term Alternatives

Location	Countermeasure	Estimated Cost with Inflation and 30% Contingency
SR 83 at Bainbridge	Conventional Intersection Widening	$2.3 M
	130 ft ICD Roundabout	$2.2 M
Bainbridge at Root	Conventional Intersection Widening	$3.3 M
	100 ft ICD Roundabout	$1.6 M

5.2 Benefit/Cost Analysis

Woolpert utilized ODOT's ECAT Tool to conduct a benefit/cost analysis of the proposed conventional intersection widening at SR 83 and Bainbridge Rd, and the proposed roundabout at Bainbridge Rd and Root Rd. The ECAT Tool's HSM analysis of the proposed countermeasures indicated that both improvements would create a positive net present value of safety benefits. A positive net present value indicates that the proposed condition will reduce crashes over the lifetime of the project, thus generating a positive benefit against the cost. While the anticipated safety benefits are positive, the total lifetime benefits are lower than the initial cost of each project. **Table 13** presents the ECAT HSM results along with the project B/C analysis results. Complete ECAT results are presented in **Appendix I**.

Table 13 - ECAT HSM Benefit/Cost Analysis Results

Location	Countermeasure	HSM Crash Reduction/Year	Net Present Value of Safety Benefit	Cost	B/C Ratio
SR 83 at Bainbridge	Widening/Turn Lanes	0.631	$188 k	$2.3 M	0.082
Bainbridge at Root	Roundabout	1.567	$976 k	$1.6 M	0.610

5.3 Project Funding

With an injury crash rate over 30%, the proposed roundabout at Bainbridge Rd and Root Rd is eligible to compete for ODOT Safety Program funding. This funding, which requires a minimum 10% local match is available for all stages of project development. The proposed widening at SR 83 and Bainbridge Rd is not eligible for safety funding due to the intersection injury rate being less than 30% injury, but both projects may be eligible for additional funding sources, such as Congestion Mitigation and Air Quality (CMAQ) funding through the Northeast Ohio Area Coordinating Agency (NOACA) or through Safe Streets For All (SS4A) funding should these projects be included on the Lorain County SS4A Safety Action Plan being developed by the Lorain County Board of Health.