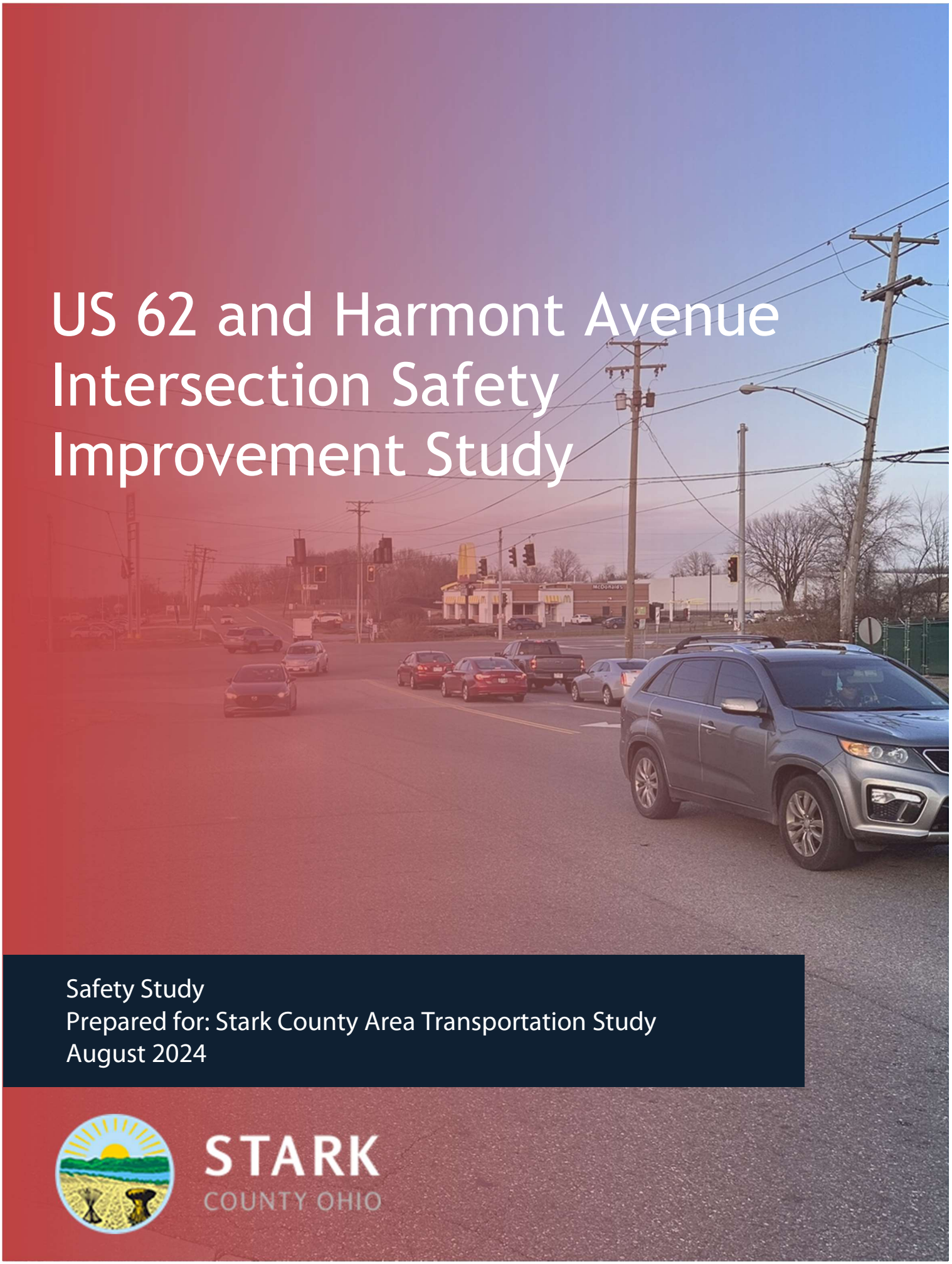
US 62 and Harmont Avenue Intersection Safety Improvement Study



Safety Study
Prepared for: Stark County Area Transportation Study
August 2024

STARK
COUNTY OHIO

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Stark County, Ohio
Intersection: US Route 62 and Harmont Avenue
Study Completion Date: July 2024
Consultant: Environmental Design Group

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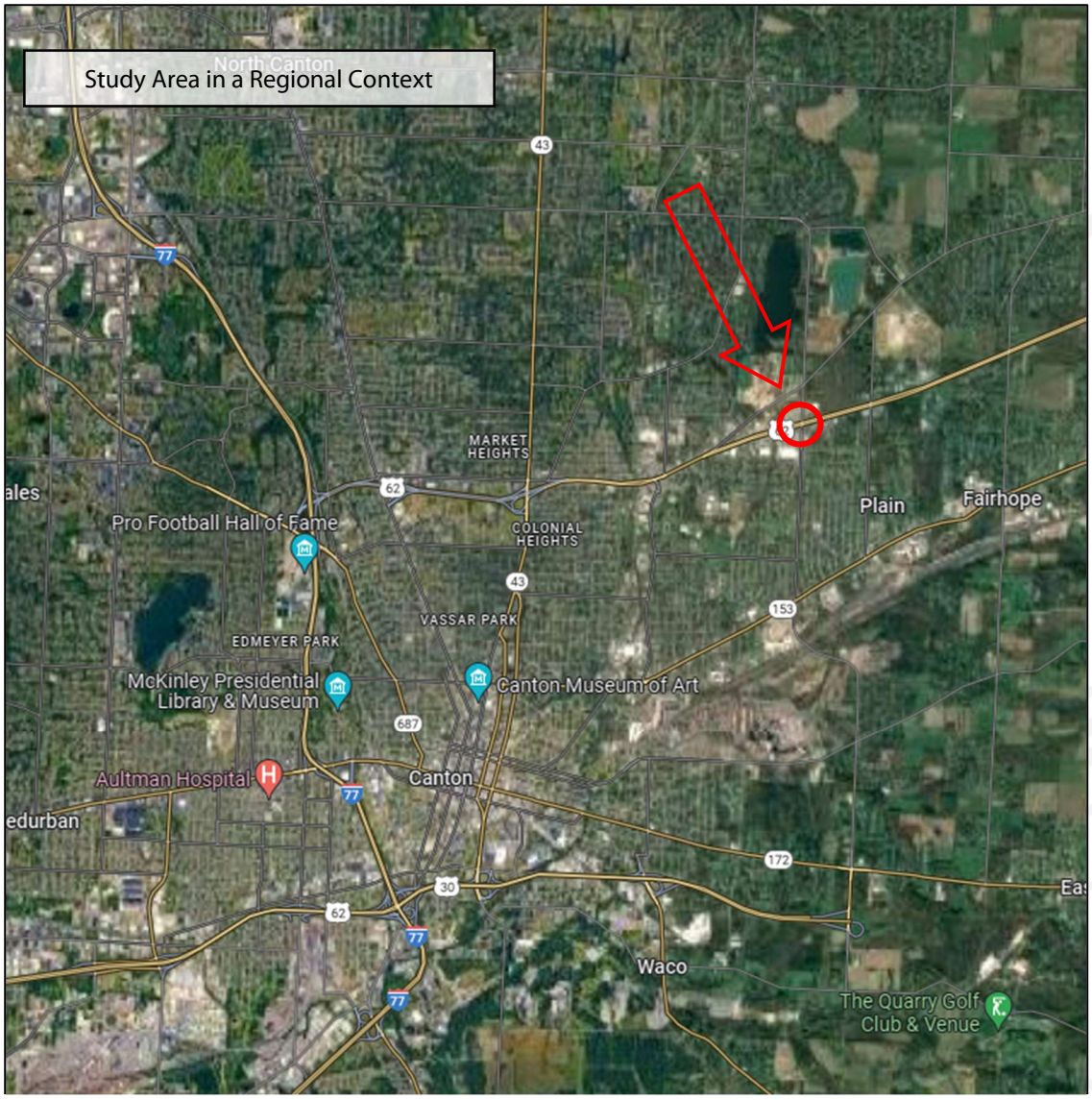
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II. EXECUTIVE SUMMARY

A. Project Background

This study area encompasses the United States Route 62 (US 62) and Harmont Avenue northeast intersection as well as Harmont Avenue northeast roadway segments, and intersecting avenues of Lesh Avenue northeast (north and south of US 62) and Commercial Avenue NE. This intersection has ranked high on safety priority lists and has been studied by various agencies for over 20 years with the most recent look being part of a US 62 corridor study in 2011-2012. This report documents the safety-based study of the intersection group in terms of existing conditions, crash data and patterns, probable causes of crashes, potential safety improvement countermeasures, existing and proposed intersection capacity analyses, and recommendations for safety improvement.

B. Overview of Possible Causes

The study area has several situational factors that likely contribute to a higher than predicted crash frequency. These factors have direct ties to certain aspects of the crash pattern, yet no one factor can be attributed for the crash pattern wholly. The following probable causes have been identified and discussed herein:

1. The geometry of US 62 allows drivers to feel comfortable using speeds above the 55 mph limit,
2. Queuing from the intersection along US 62 may not be anticipated for drivers, or may be difficult to see with sun glare, preventing proper breaking distance,
3. Drivers turning right from US 62 onto Harmont can navigate this turn without significantly reducing speed, leading to poor decision-making and failures to yield for drivers navigating the Lesh/Commercial intersections,
4. Queuing on Harmont from the US 62 intersection can block the traffic on Lesh Streets, causing frustration, unsafe navigation, and confusion on right of way,
5. High traffic access points produce frequent in and out traffic, additional conflict points, and more stop-and-go traffic on Harmont,
6. Current infrastructure, such as the bus stop or dollar store, attract foot- and bike-traffic, yet existing conditions are not safe for pedestrians or bicyclists.

C. Recommended Countermeasures

The following recommendations are provided for the owner and maintaining authority over the subject intersection to reduce the crash frequency and severity.

Alternative 1, Low-Cost Countermeasures:

1. Install high-visibility crossings at intersections, particularly at US 62 and Harmont Avenue.

2. Evaluate signal timings at US 62 and Harmont Avenue to reduce the dilemma zone and lengthen the pedestrian signal cycle.
3. Add a rectangular rapid flashing beacon (RRFB) on Harmont Avenue, accompanied by high-visibility crossings, at the location of the bus stop south of US 62.
4. Place new edge lines along the Harmont Avenue approaches at US 62.

Alternative 2, Medium-Cost Countermeasures:

1. Remove the Lesh Street intersection north of US 62, ending access at the Aldi parking lot entrance.
2. Realign Commercial Road to the existing Wal-Mart access road alignment.
3. Realign Lesh Street south of US 62, rerouting traffic through a new access road alignment that intersects Harmont Avenue at the KFC entrance.
4. Implement all low-cost countermeasures provided in Alternative 1 where applicable.

Alternative 3, High-Cost Countermeasures:

1. Convert the US 62 and Harmont Avenue intersection into a limited access interchange, bridging US 62 over Harmont Avenue and adding entrance/exit ramp intersections. To be built in conjunction with;
2. Remove the Commercial Road and Lesh Street intersection south of US 62, rerouting traffic through new access road alignments that utilize the existing Wal-Mart access road alignment and KFC entrance.
3. Implement all low-cost countermeasures provided in Alternative 1 where applicable.

III. EXISTING CONDITIONS

A. Background

US 62 is a separated, four-lane highway with a Federal Functional Classification of Principal Arterial at the intersection with Harmont Avenue but is classified as Principle Arterial Freeway approximately two miles west of the study area. The highway passes through a series of intersections that are at grade and signalized. The land around US 62 and Harmont Avenue is zoned Business (Special and General) and Light Industrial. Harmont Avenue is a Minor Arterial that runs north-south through the signalized intersection of US 62. South of US 62, Harmont Avenue has two lanes with a left-turn lane at the Commercial Road/Lesh Street and US 62 intersections. North of US 62, it has two through lanes with a two-way left turn lane.

Lesh Street and Commercial Road intersections are near the intersection of US 62 with Harmont Avenue. Lesh Street is an unclassified local street that intersects Harmont Avenue twice: on the south side and on the north side of US 62. Commercial Road (also notated as Atlantic Avenue by street sign) is also an

unclassified local street, runs parallel to US 62, and serves as a frontage road for the Wal-Mart development.

South of US 62, Lesh Street and Commercial Road intersect Harmont Avenue as westbound and eastbound approaches, respectively, with these approaches stop-controlled. The Lesh Street intersection with Harmont Avenue on the north side of US 62 is a three-leg, minor road stop-controlled intersection.

The study area includes segments of Harmont Avenue approximately 700 feet to the south and 300 feet to the north of US 62. There are numerous driveways to commercial development along Harmont Avenue including a Wal-Mart superstore (built around 2003). Such developments usually spur other smaller developments, and this area is no exception. In recent years, several new stores and fast-food restaurants have developed near the Wal-Mart. On the north side of the intersection, a new Aldi grocery store has been built within the past year. There is also a large sand and gravel quarry about one-third of a mile northwest of the intersection. A one-million square foot Amazon Fulfillment Center is located approximately one mile northeast of the study area. This facility just opened and began operations in May of 2023. Although the direct impact of this development is more likely felt at the next intersection east, which is Kirby Avenue, it has an indirect impact here by generating more traffic, especially trucks.

B. Conditions Diagram

Environmental Design Group staff traveled to the intersection for a field review of existing conditions on November 29, 2023. The investigation followed the GORE (Geometry, Operations, Roadway Users/Human Factors, and Environment) Model as described in the ODOT Regional Road Safety Audit Implementation Guide. The time envelope was 3:00pm – 5:15pm and weather conditions were dry, sunny, and 35 degrees. During the field visit, staff observed most of the peak hour traffic during 4:15pm to 5:15pm. The field-gathered information is supplemented with other sources of information from ODOT and Google Earth imaging. The observations, traffic controls, and current conditions are described below and visually articulated in Figure 1 - Figure 6. Full sheets are in Appendix A.

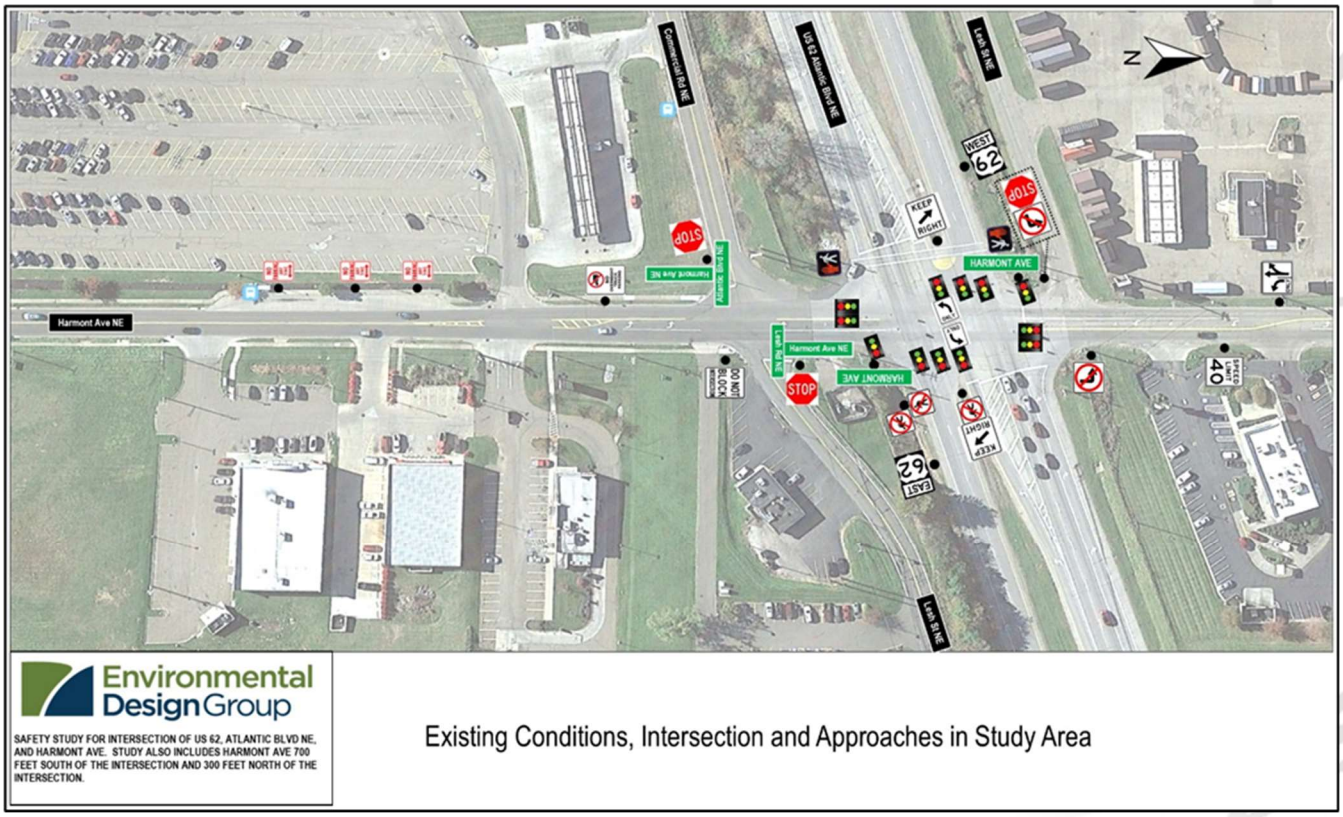


Figure 1 - Existing Conditions, traffic control, intersection and approaches.

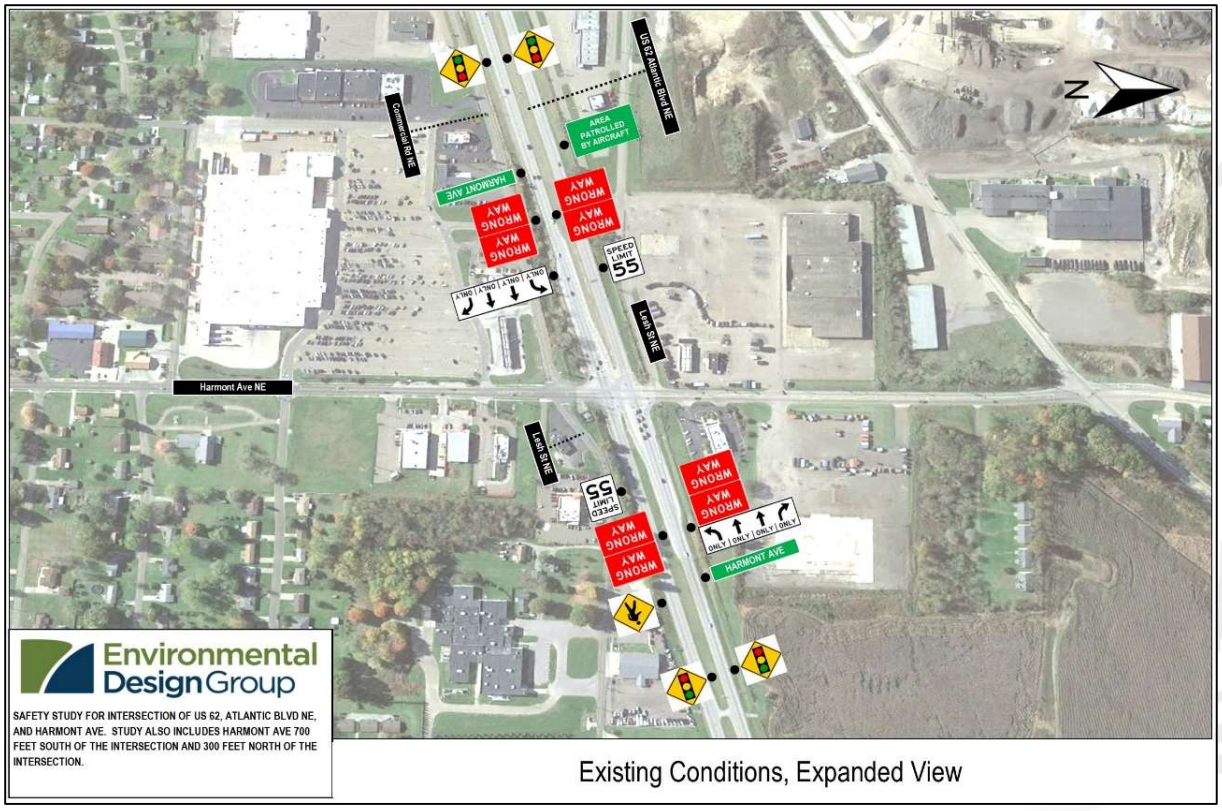


Figure 2 - Existing Conditions, traffic control, expanded view.

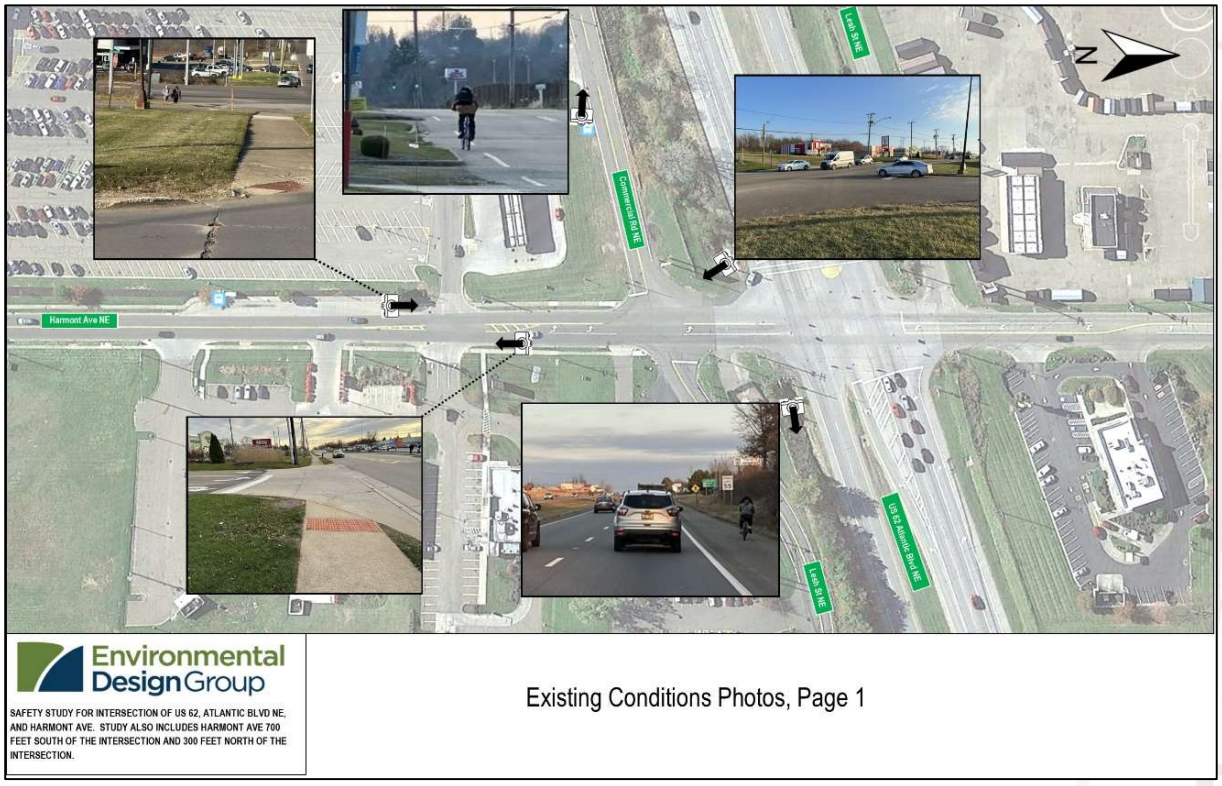


Figure 3 - Existing Conditions, photos.

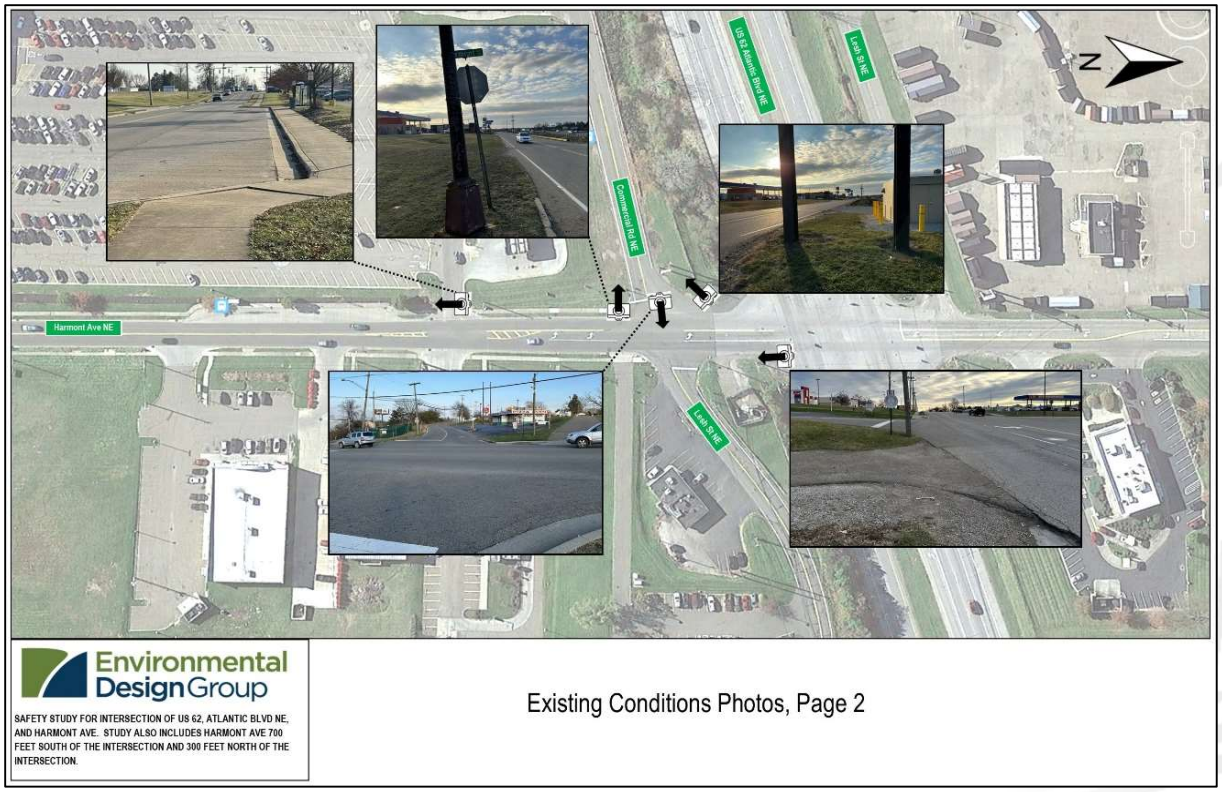


Figure 4 - Existing Conditions, photos.

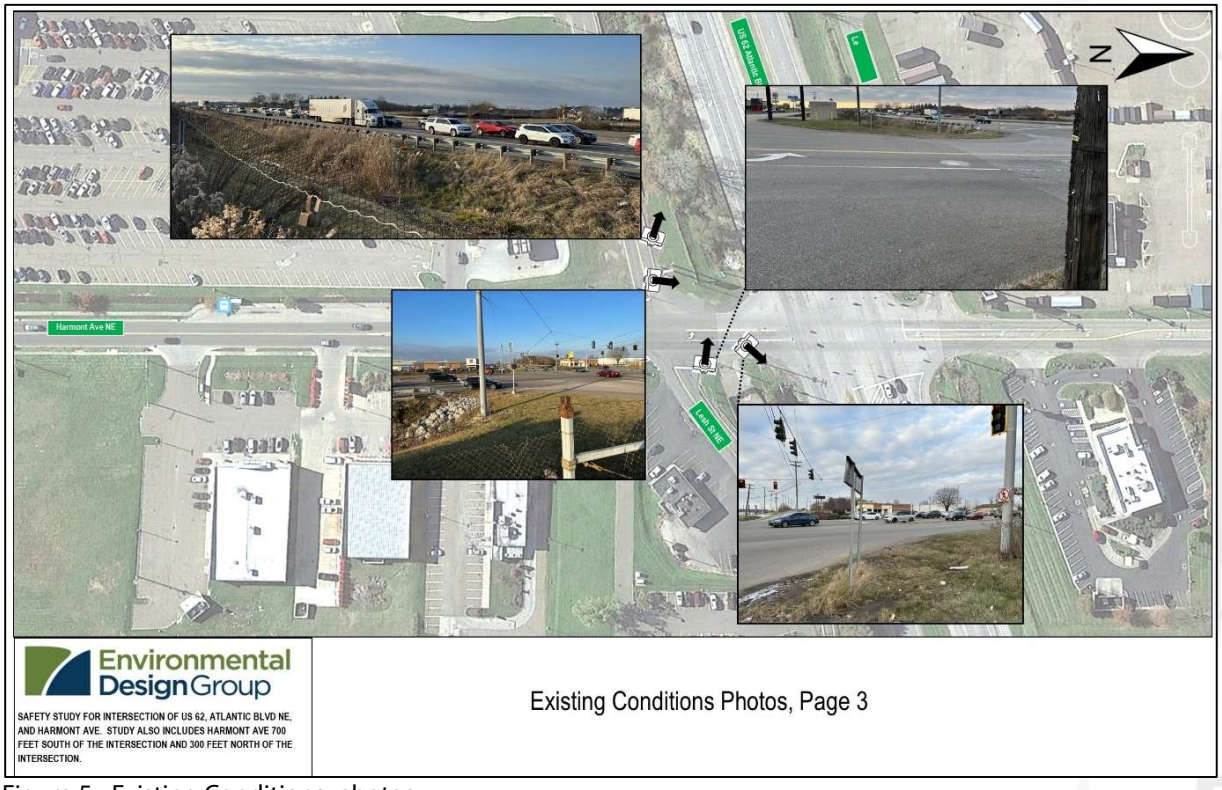


Figure 5 - Existing Conditions, photos.

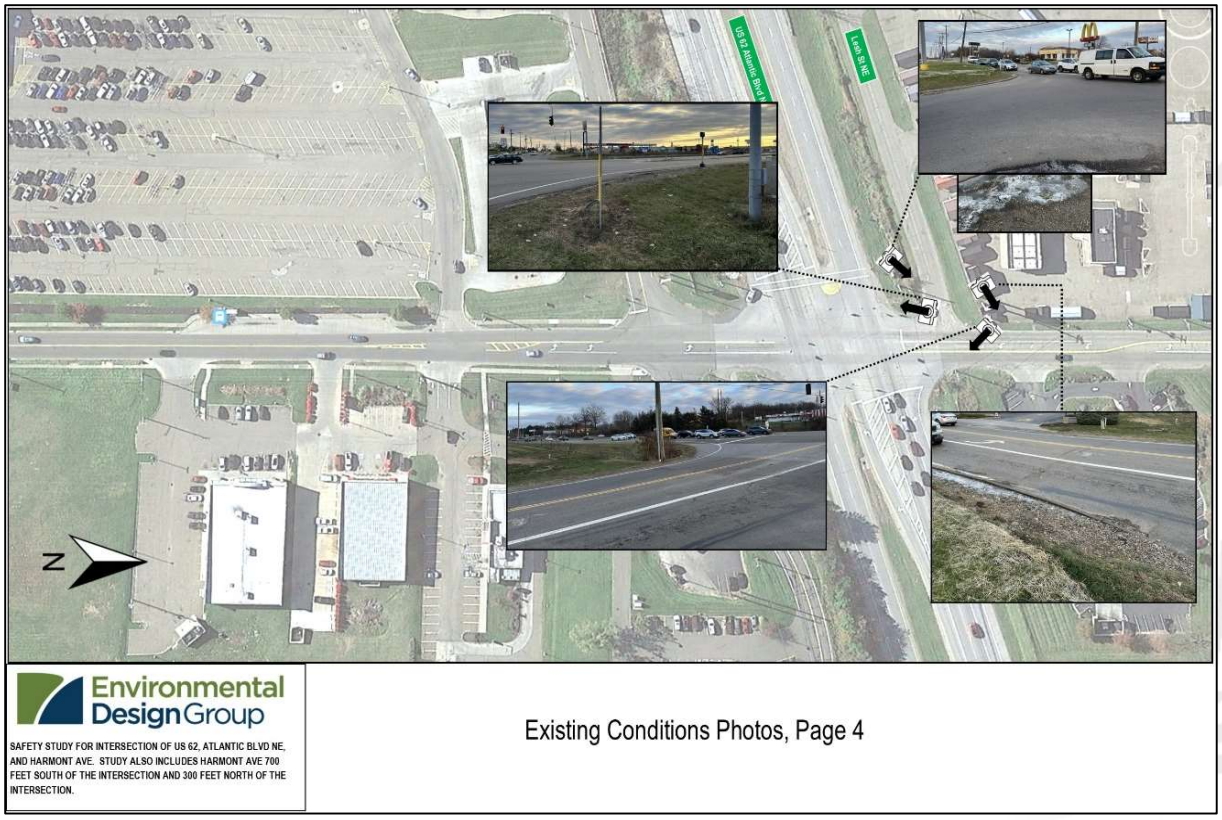


Figure 6 - Existing Conditions, photos.

C. Physical Conditions

This section will describe each portion of the study area separately, incorporating the four elements of the GORE Model. Each of these elements are defined below:

Geometry is roadway elements such as curves, gradient, sight distance, and clear zones.

Operations describes how the road is utilized and how effective current operational practices are at preventing or mitigating crashes.

Roadway Users/Human Factors are the various modes present along the roadway and the potential conflicts that may exist.

Environmental is the performance of a roadway under various environmental conditions such as differing weather patterns and lighting scenarios.

The study area has been divided into the following subsections when describing existing conditions:

- *Segment 1* - Harmont Avenue from 3526 Harmont (Dollar Tree) driveway to Commercial Road/Lesh Street

- *Intersection 1* - Harmont Avenue and Commercial Road/Lesh Street
- *Intersection 2* - US 62 and Harmont Avenue
- *Intersection 3* - Harmont Avenue and Lesh Street
- *Segment 2* - Harmont Avenue from Lesh Street to 3700 Harmont (McDonald's) north driveway.

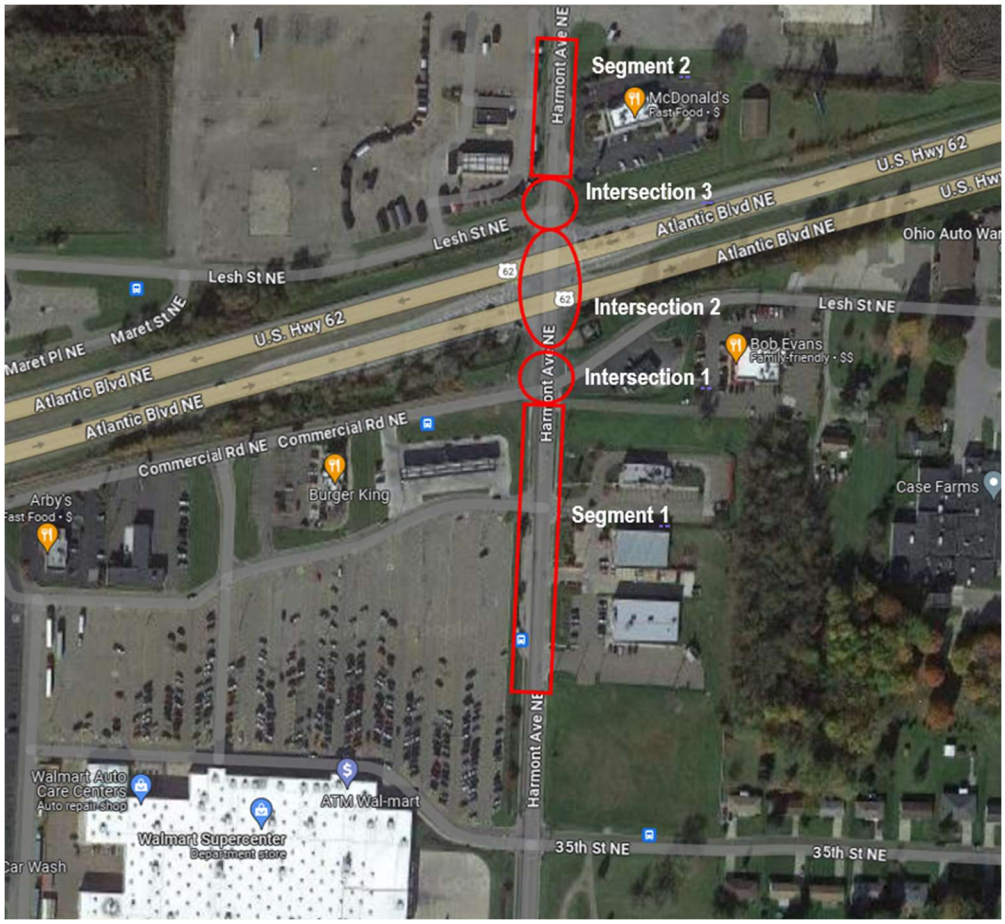


Figure 7 - Subsections of Study Area.

Segment 1 – Harmont Avenue from 3526 Harmont (Dollar Tree) driveway to Commercial Road/Lesh Street

Geometry: This segment is approximately 500 feet long. The overall grade of the segment is an approximate 2% decline south to north. On the north end of the segment, the pavement gradually widens as it approaches the intersection with Lesh Street/Commercial Drive to accommodate a northbound left turn lane. This left turn lane serves the intersection with Lesh Street/Commercial Drive and with US 62. The segment has a slight vertical crest curve but it does not appear to create any sight distance issues. There are utility poles residing in the clear zone and a cast iron fire hydrant that is approximately two feet behind the curb on the east side.

Operations: This segment has two asphalt lanes approximately 13 feet wide with curb and gutter and storm water management. The segment runs through much of the new development in the area. There are four commercial driveways that intersect this segment. During busy times, a left-turning vehicle blocks the flow of traffic. On the west side at the middle of the segment, there is a transit bus pullover that is approximately 200 feet long and 16 feet wide. Google Maps Streetview shows a 35 mph speed limit sign. However, the sign is no longer present, at the time of the field visit. The Pavement Condition Rating (PCR) is 96 according to data obtained from ODOT. Pavement markings were in good condition and visible.

Roadway Users/Human Factors: While visiting the site, the majority of the traffic was cars, light trucks, and SUVs. A transit bus route runs on the segment and a couple buses were observed. Both sides of the street have approximately 5 feet wide sidewalks that are in reasonably good condition. There are truncated domes at the commercial driveways but no crosswalks anywhere. While there are pedestrian push buttons at the crosswalk, crossing the street can be difficult due to the cycle length and available time to cross, especially during busy traffic hours. We observed a few pedestrians while at the site. The bus pullover is likely a popular destination for pedestrians throughout the day. According to ODOT the Average Daily Traffic (ADT) is 7,448 vehicles.

Environment: Curb returns at some of the driveways on the west side have rubber scuff marks and are breaking up which may be caused by larger vehicles such as buses and trucks needing a larger radius to make the turn. The storm water management system uses cast iron grates that are incorporated into the concrete gutter. The grooves on the grates run parallel to the street and could cause issues for bicycle tires. The street has lighting on the east side only.

Intersection 1 – Harmont Avenue and Lesh Street/Commercial Road

Geometry: The intersection has a skew angle of 17 degrees with Commercial Road and Lesh Street. It is located approximately 100 feet south of the US 62 eastbound lanes. The north leg of this intersection is also the south leg of the intersection with US 62 (Intersection 2). The north and south legs slope down to the north at approximately 4%. The east leg has a decline slope east to west of approximately 4.5%. The west leg is almost flat. The south leg has a northbound left turn lane which is also used for northbound left turning traffic onto US 62. Three of the four intersection quadrants have obstacles in the clear zone. The southwest corner clear zone has an old rusty light pole mounted on a concrete base, the northwest corner clear zone has a steel column supporting a sign, and the northeast corner has a wooden utility pole very close to the pavement. See Table 1 for data and details.

Operations: The intersection is stop-controlled by stop signs on the east and west approaches. This is the location where most of the angle crashes occur in the study

area. Traffic waiting for the signal at US 62 develops a long queue through this intersection, making sight distance and egress difficult for the stop-controlled cross streets. There is a "Do Not Block Intersection Sign" on the south leg for northbound traffic but it appeared mostly ignored. The north leg of the intersection, also being the south leg of the US 62 intersection, is short, approximately 100 feet, and poorly marked. The pavement transitions from the Harmont Avenue pavement to the US 62 pavement in the middle of this leg. It receives traffic from a long eastbound right turn only lane on US 62. It was observed that some of the right turning traffic from US 62 makes this movement at a high rate of speed, especially when the light is green. There is no curbing or storm sewers and there is evidence of past and present erosion on both sides. There are deep drainage ditches on both sides of this leg but no protective guardrail. The south leg of the intersection is a continuation of Harmont Avenue (Segment 1). Here, there is one lane in each direction, approximately 11 feet wide, and a northbound left turn lane, approximately 13 feet wide. These lanes are in good condition. A unique feature of this leg is a driveway on the east side that is very near the intersection. This driveway goes uphill to a Bob Evans restaurant. It is an auxiliary driveway and appears to not get much use. The east leg of the intersection is Lesh Street. The south side of this leg is consumed by driveway aprons for a pizza business. This leg has two asphalt lanes approximately 13 feet wide in good condition. There is no curbing except at the southeast corner. Because of the absence of curbing and storm water management, the north side of the leg is experiencing some erosion. The west leg of the intersection is called Commercial Drive on maps, but the street sign name is Atlantic Blvd. This leg has two asphalt lanes approximately 13 feet wide. It runs parallel to US 62 and serves as a frontage road for the Wal-Mart development and as a connection to the next north-south street to the west which is Regent Avenue.

Roadway Users/Human Factors: A bicycle rider was observed on the west leg (Commercial Road) during the field visit. The only leg of this intersection with sidewalk is the south leg (Harmont Avenue). The sidewalks terminate here with wheelchair ramps at the curb radii but no crosswalks or additional sidewalks on the north leg to receive them. Crossing any of the legs of the intersection as a pedestrian is challenging because there are no crosswalks, signs, or signals to assist. In addition, there are few gaps in traffic because of frequent right on red turning movements.

Environment: The absence of curbs and storm water management have allowed for the deterioration along the edge of the pavement in the northeast and southeast quadrants. The parking lot for the pizza business on the southeast quadrant has no stormwater collection system and the water appears to drain into the intersection. There is a catch basin in the area, but it appears to not be at the proper elevation to work effectively. The only streetlight at the intersection is on the northeast corner.

Table 1 - Site Visit Findings for Harmont Avenue and Lesh Street/Commercial Road

Site Visit Findings per GORE Model		Harmont Avenue	Lesh St/Commercial Rd
DATA OBTAINED	Travel Direction	N-S	E-W
	Stop Control	Two-Way Stop Controlled	
	AADT (October 2023)	9417/8333	2115/1847
	Skew (degrees)	0	17
	Shoulder Dimensions	Curbed without marked shoulders	Varies, 4' to 6'
	Lane Widths	Varies, 11' to 13'	13'
	Turn Radii	35', 80'	30', 35'
	Intersection Lighting	Yes	Yes

Intersection 2 - US 62 and Harmont Avenue

Geometry: US 62 is a four-lane divided highway with exclusive left and right turn lanes. The medians on the eastbound and westbound approaches are approximately 18 feet and 22 feet wide, respectively. The lanes are 12 feet wide and shoulder widths vary from approximately 9 feet to 12 feet. The east and west legs of the intersection (US 62) have a very gradual slope downward into the intersection. The north and south legs (Harmont Avenue) also slope downward into the intersection, but at a higher grade. The northeast corner of the intersection has a wood utility pole that is very close to the edge of pavement. There is evidence that this pole has been hit, probably by trucks, trying to make the westbound to northbound turning movement from US 62. See Table 2 for data and details.

Operations: This intersection is the busiest intersection of the group and the focus of this study. The eastbound and westbound US 62 left turn lanes are offset by approximately 16 feet and 19 feet, respectively. The north and south legs of the intersection (Harmont Avenue) also have a left turn lane. The intersection is controlled by span wire traffic signals with one signal above each lane for the through and left turn lanes, and pole-mounted signals for the right turn lanes. The pole-mounted signals also serve as offset signals for traffic that has a blocked view of the other signals due to high profile vehicles. Traffic turning left is protected/permitted on all legs. The speed limit through the intersection on US 62 is 55 mph. The pavement through the intersection on US 62 has a PCR of 99 and is in good condition. The pavement markings are also in good condition.

Roadway Users/Human Factors: Unlike Harmont Avenue, US 62 has a broader mix of traffic including passenger cars, light trucks, SUVs, and all types of larger trucks. Traffic counts conducted in October 2023 show that 6.8% of the 27,218 daily vehicles are trucks. The west leg of the intersection has pedestrian signal heads but no crosswalk or sidewalks. There were two pedestrians observed crossing US 62

while conducting the field visit. Previous satellite images of the intersection show a crosswalk at this location. The intersection has a high stress level for non-motorized users due to its size and volume of traffic. When conducting the field visit, staff elected to drive across US 62 rather than walk. There are no sidewalks at the intersection. A young child was observed riding a bike westbound in the eastbound lanes of US 62 and turning onto Harmont Avenue. Later, that same child was observed riding eastbound on the US 62 mainline shoulder.

Environment: As with most east-west highways, sun glare at sunrise and sunset is a concern. The signals have backplates to help with this but during certain times of the year, the path of the rising or setting sun is directly in the drivers' eyes. During the site visit in November the sun's ecliptic was already in the southern part of the sky and distracting. There are no streetlights at the intersection. There are no curbs at the radii and storm water appears to be directed into ditches parallel to US 62. The returns on all four quadrants appear to be patched because of pavement deterioration from turning vehicles.

Table 2 - Site Visit Findings for US 62 and Harmont Avenue

Site Visit Findings per GORE Model		Harmont Avenue	US 62
DATA OBTAINED	Travel Direction	N-S	E-W
	Stop Control	Signalized	
	AADT (October 2023)	6605/9217	19405/19197
	Skew (degrees)	17	0
	Shoulder Dimensions	Varies, 8' to 20'	Varies, 9' to 12'
	Lane Widths	Varies, 11' to 12'	12'
	Turn Radii	70', 45'	45' ,45'
	Intersection Lighting	No	No

Intersection 3 - Harmont Avenue and Lesh Street

Geometry: Lesh Street transitions from the south side of US 62 to the north side and thus creates another intersection with Harmont Avenue. Like the one on the south side, this intersection is very close to US 62, with an offset of only about 50 feet. There are only three legs at Intersection 3 due to the absence of an east leg. The west leg, Lesh Street, has two lanes approximately 12 feet wide with newer pavement but no pavement markings. The eastbound approach is a single right turn lane and no left turn lane. The north and south legs are Harmont Avenue. The

south leg of this intersection is also the north leg of the intersection with US 62 (Intersection 2). Harmont Avenue is two lanes through this intersection with a left turn lane intended for US 62. The west and south legs are flat, and the north leg has a north to south decline of approximately 2%. See Table 3 for data and details.

Operations: Lesh Street is stop controlled with one stop sign. The north-south traffic does not stop. There is a northbound "No Left Turn" sign prohibiting a northbound to westbound left turn onto Lesh Street and one on Lesh Street prohibiting an eastbound to northbound left turn onto Harmont Avenue. Any left turns at this intersection would be difficult and risky because of traffic backed up from the signal at US 62. Lesh Street did not show a large volume of traffic during the field visit. There is a new Aldi grocery store on the northwest corner of the intersection. The parking lot for this store has access from both Lesh Street and Harmont Avenue.

Roadway Users/Human Factors: Most of the traffic going through the intersection was passenger cars, light trucks, and SUVs. Transit does not service this side of US 62 and there were no buses. We did not witness any non-motorized users. There are no sidewalks, bike lanes, or pedestrian facilities in the vicinity of this intersection.

Environment: This intersection does not have curbs or stormwater management except on the northwest corner where there is a curb and stormwater inlet from Harmont Avenue. There was evidence of standing water on the southwest corner of the intersection. This side of US 62 does not have street lighting. On Lesh Street, west of the intersection there was excavation equipment parked on vacant land which may indicate more development in the future.

Table 3 - Site Visit Findings for Harmont Avenue and Lesh Street

Site Visit Findings per GORE Model		Harmont Avenue	Lesh Street
DATA OBTAINED	Travel Direction	N-S	E-W
	Stop Control	One-Way Stop Controlled	
	AADT (October 2023)	6687/6960	477
	Skew (degrees)	0	16
	Shoulder Dimensions	Varies, 0' to 20'	1'
	Lane Widths	Varies, 10' to 12'	12'
	Turn Radii	30'	25'
	Intersection Lighting	No	No

Segment 2 - Harmont Avenue from Lesh Street to 3700 Harmont (McDonald's) northern driveway

Geometry: This segment has a negative grade of approximately 2% toward US 62 with a crest just north of the end of the segment. The pavement is in reasonably

good condition with a PCR of 79. There are wooden utility poles along with some signs on each side of the segment that are in the clear zone.

Operations: This segment of Harmont Avenue has two through lanes with a left turn lane. The left turn lane in the southbound direction serves US 62, as well as a driveway to a McDonald's. In the northbound direction, it serves as a driveway to a MAC BID Discount Store. There is a McDonald's on the east side of this segment that has two one-way driveways (in and out). The entrance driveway is near US 62 and the exit driveway is about 100 feet north. There is a new Aldi supermarket on the west side of the segment and a wide driveway apron for the parking lot has recently been constructed. The new apron is situated midway between the McDonald's driveways. It is located where the left turn lane referenced above begins. There is a driver expectation that this is a two way left turn lane that also serves the new driveway.

Roadway Users/Human Factors: Most of the traffic on the segment was passenger cars, light trucks, and SUVs. Transit does not service this side of US 62 so there were no buses. Staff did not witness any non-motorized users. There are no sidewalks, bike lanes, or pedestrian facilities in the segment. According to ODOT, the ADT on this segment is 5,104 vehicles.

Environment: The west side of the segment has curbing. The existing curbing is overgrown with grass and is starting to deteriorate. There is some erosion on the east side of the segment where curbing is not present. There are no streetlights in this area.

IV. CRASH DATA AND ANALYSIS

A. Available Traffic Data

Traffic data turning movements were collected in the field on Tuesday, October 17, 2023. The turning movement counts are supplemented by data that was obtained from ODOT, SCATS, and Streetlight Insight for determining Average Daily Traffic (ADT) on the segments. Streetlight Insight is a big data web platform that harnesses data from bluetooth devices, such as those in your car and cell phone, and converts it to vehicle, transit, bike, and foot traffic virtually anywhere. It is useful to use Streetlight Insight to determine counts where no actual field counts are provided. The available ADT data is shown in **Figure 8** below. The turning movement data was collected at four intersections: Harmont Avenue and KFC/Murphey Gas Station Driveways; Harmont Avenue and Commercial Road/Lesh Street; US 62 and Harmont Avenue; and Harmont Avenue and Lesh Street (north of US 62). The turning movement data was compiled into four categories: 7:00 AM–7:00 PM; Morning Peak Hour, Mid-Day Peak Hour; and Evening Peak Hour. The 12-hour counts captured the time of day that 77% of the crashes in the study area occurred. The 12-hour counts are shown in Figure 9 -

Figure 12. The peak hours occurred at slightly different times at each intersection. A summary of the peak hour counts and the times they occurred are shown in Figure 13 and Figure 14.

More traffic count data can be found in Appendix B.

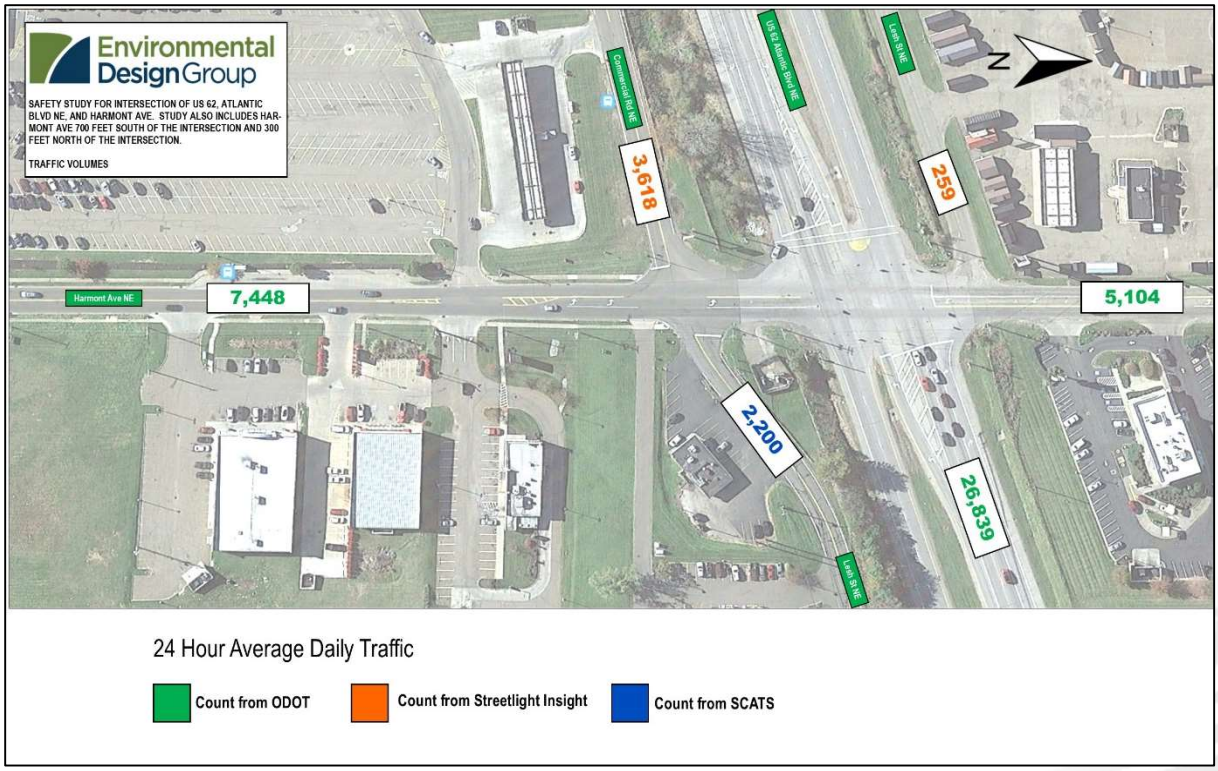


Figure 8 - Average Daily Traffic and the source of the data.

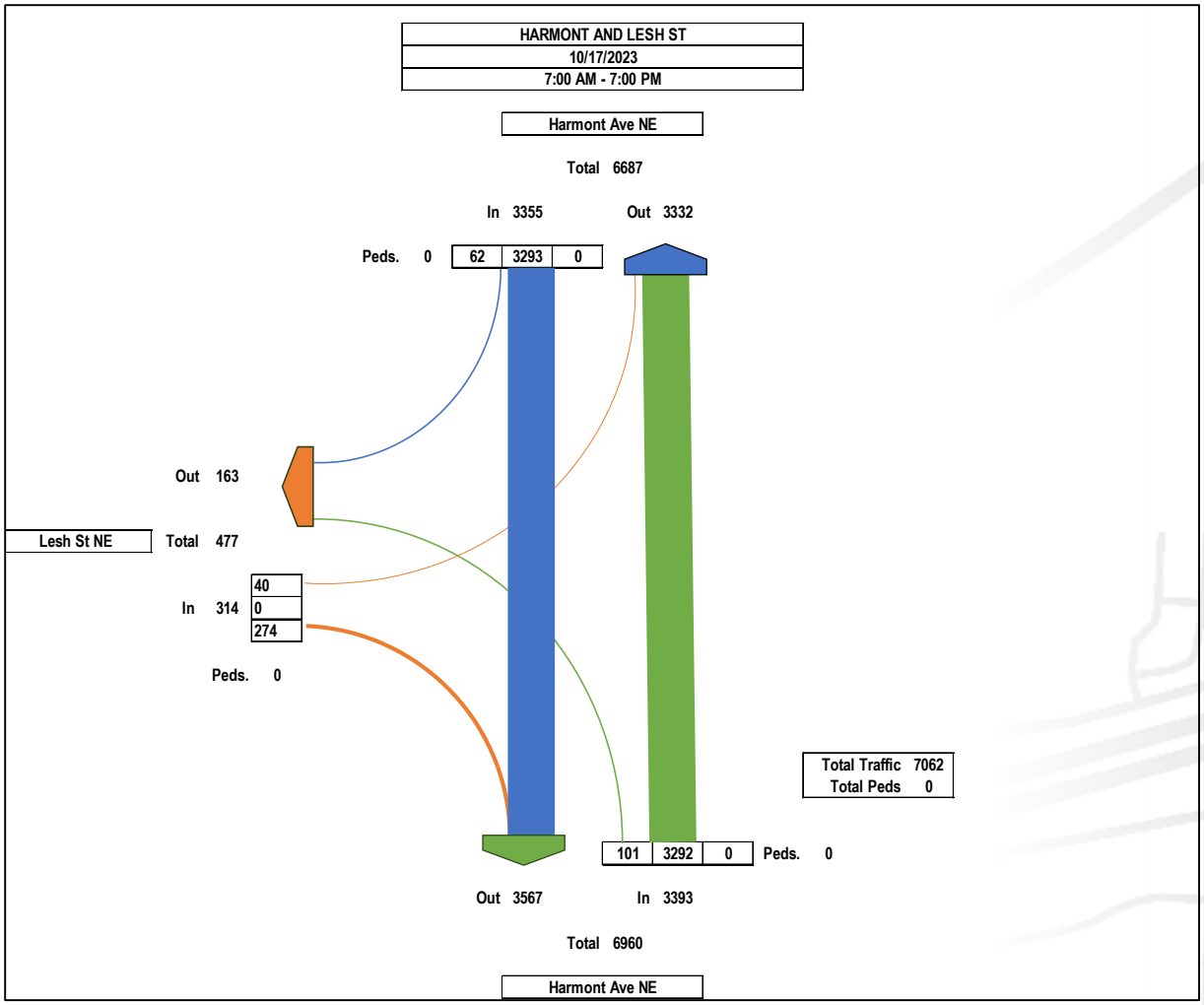


Figure 9 - Intersection movements on October 17, 2023 between 7:00AM-7:00PM at Harmont Avenue and Lesh Street (Intersection 3).

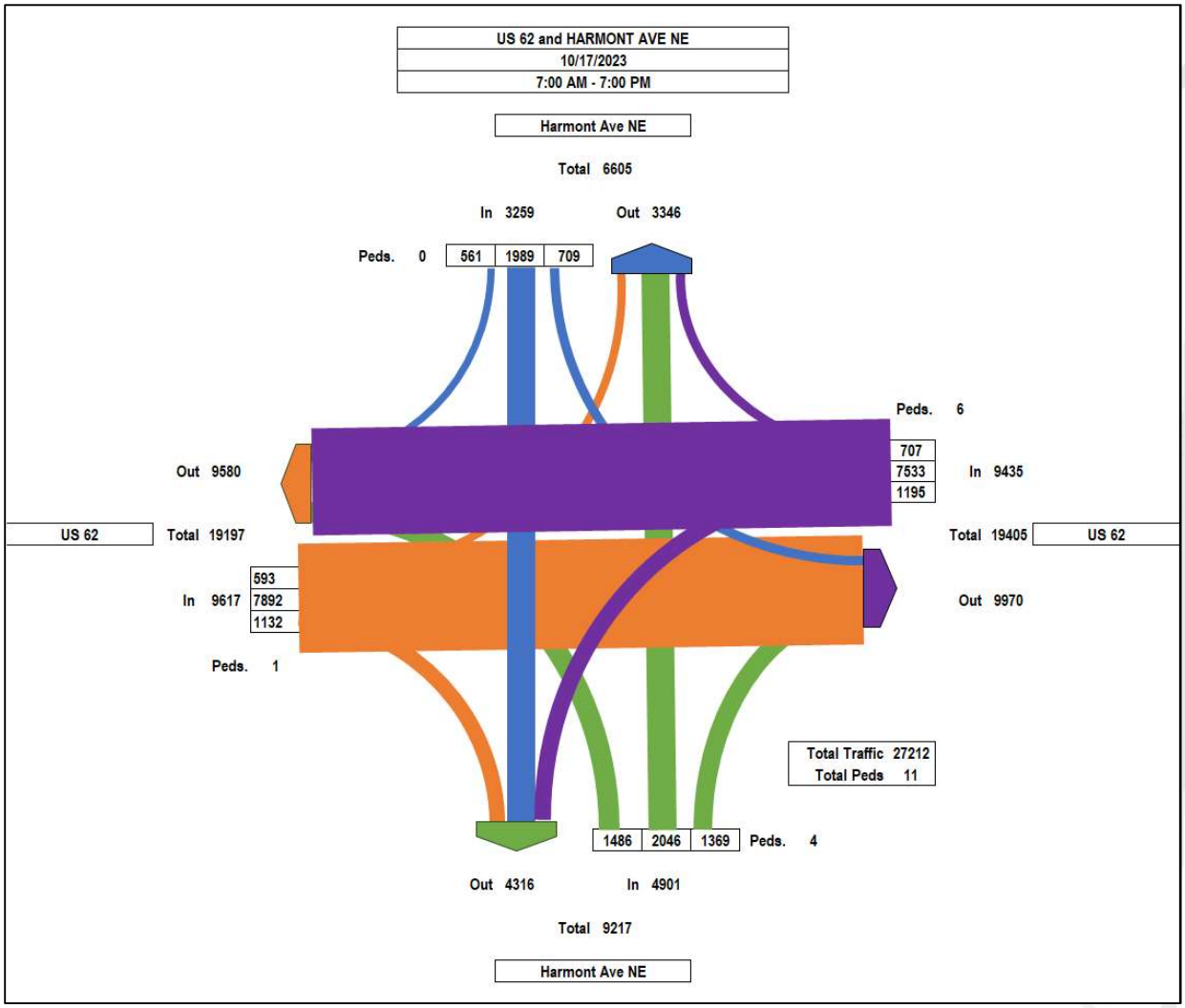


Figure 10 - Intersection movements on October 17, 2023 between 7:00AM – 7:00PM at US 62 and Harmont Avenue (Intersection 2).

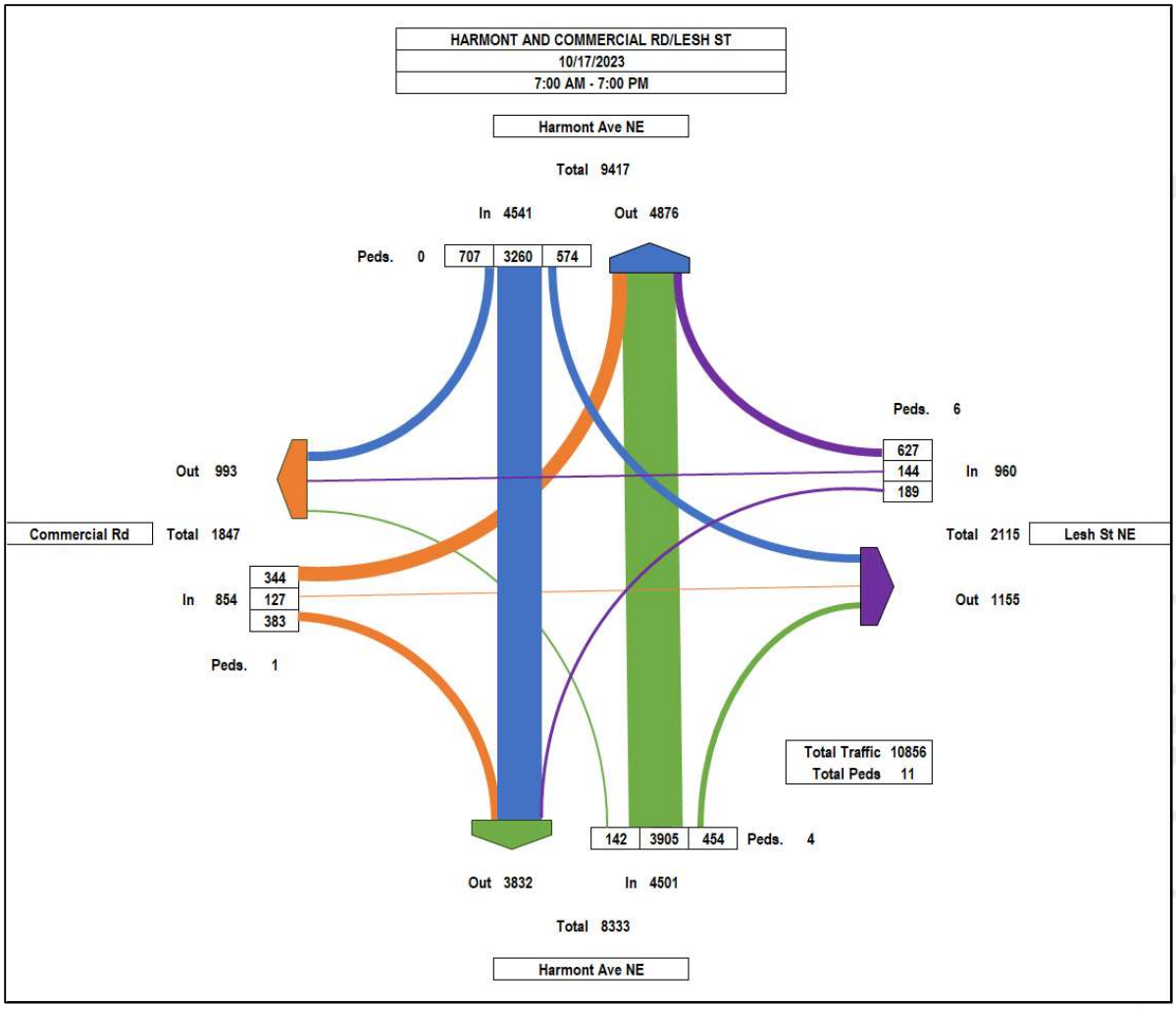


Figure 11 - Intersection movements on October 17, 2023 between 7:00AM – 7:00PM at Harmont Avenue and Commercial Road/Lesh Street (Intersection 1).

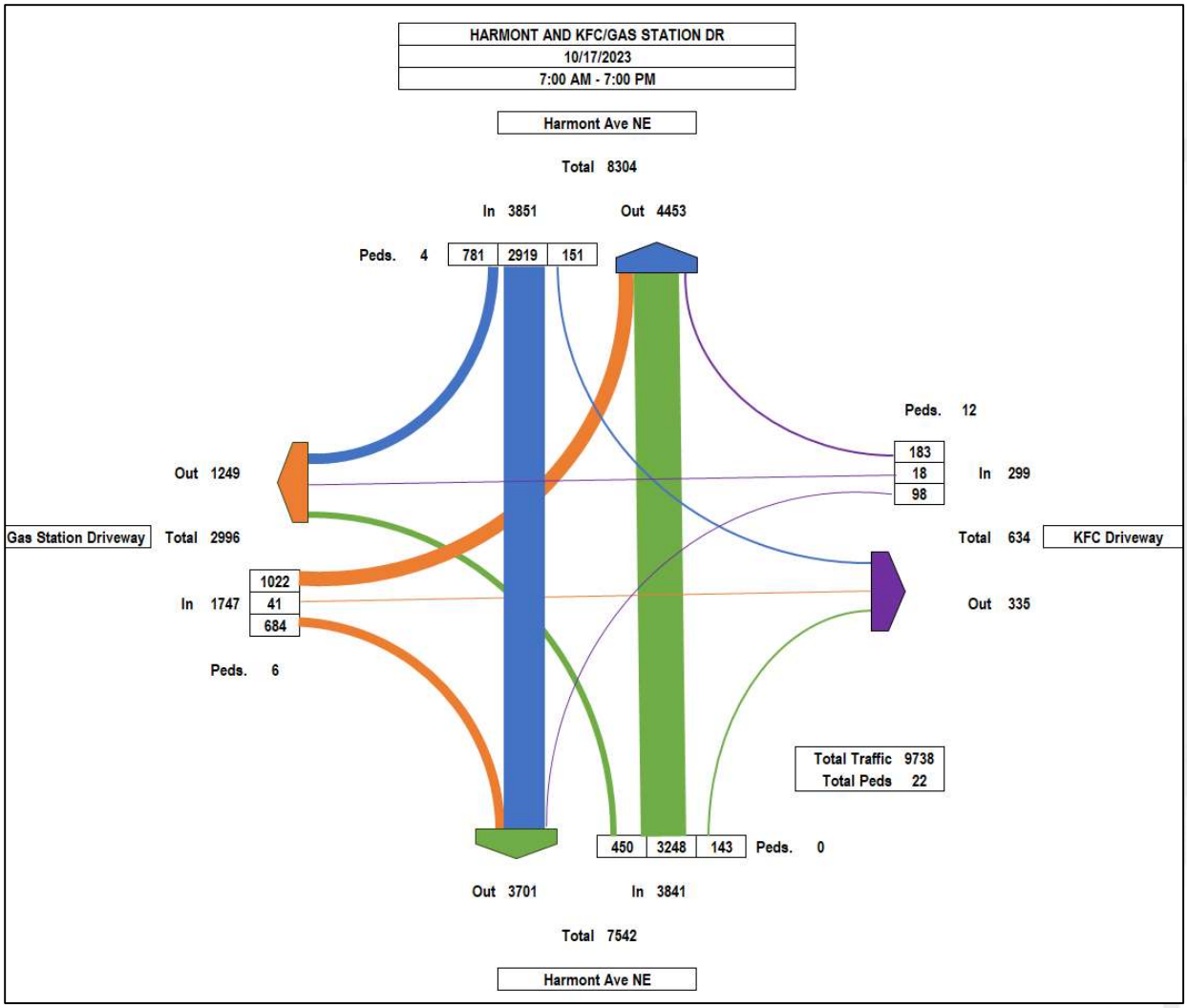


Figure 12 - Intersection movements on October 17, 2023 between 7:00AM – 7:00PM at Harmont Avenue and the KFC/Gas Station Driveway.

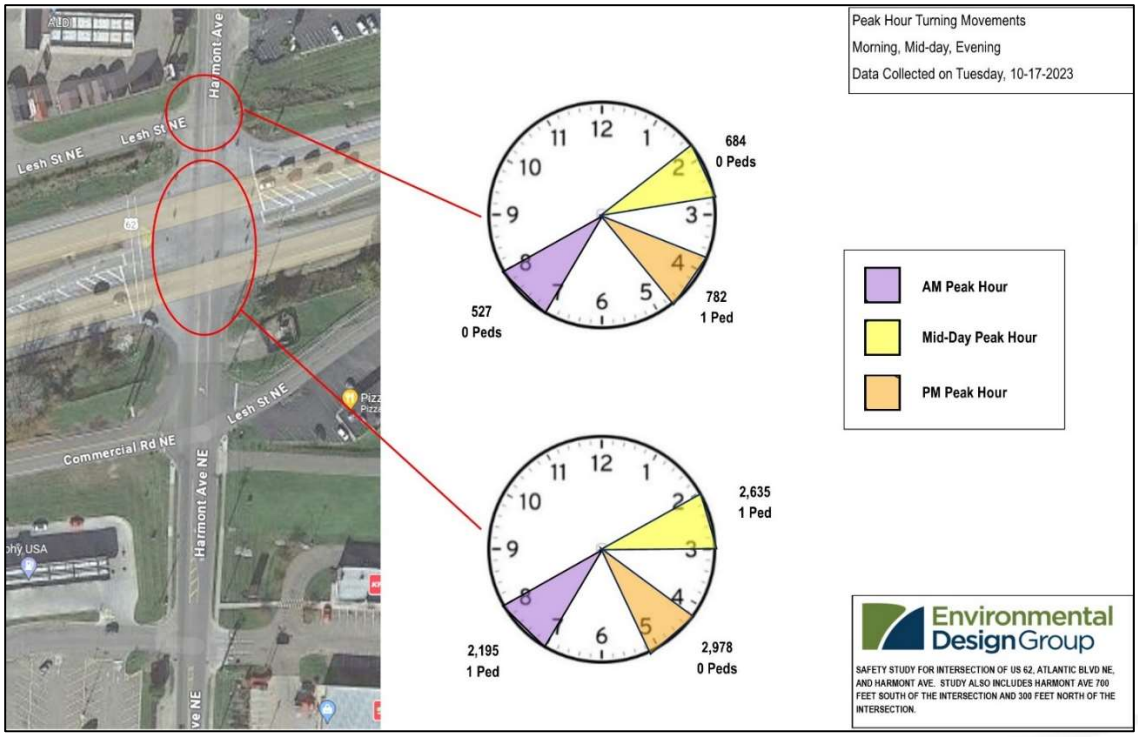


Figure 13 - Peak intersection movements on October 17.

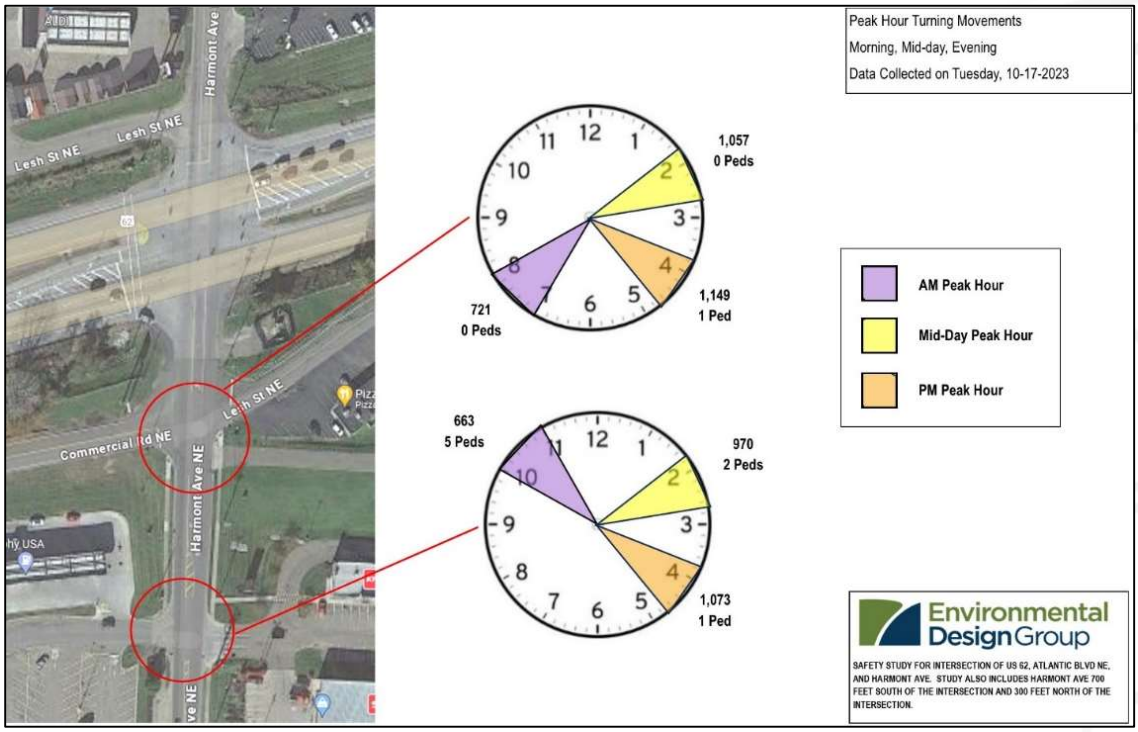


Figure 14 - Peak intersection movements on October 17.

B. Crash Data

The crash data analysis in this study includes the intersection of US 62 and Harmont Avenue and extends south on Harmont Avenue approximately 700 feet and north on Harmont Avenue approximately 300 feet. Within these limits, there are two additional intersections along with numerous commercial driveways. Approximately 100 feet south of US 62 is the four-way intersection of Harmont Avenue and Lesh Street/Commercial Road and approximately 50 feet north of US 62 is the three-way intersection of Harmont Avenue and Lesh Street. Both intersections are stop controlled. There is more traffic on Harmont Avenue south of US 62. The intersection of US 62 and Harmont Avenue has a traffic volume of 32,381 vehicles daily. The crash history from the previous five years (2018 – 2022) was used. Traffic crashes that have been reported to the Ohio Department of Public Safety were obtained from the ODOT TIMS webpage.

Each crash from the data set is reviewed with particular attention to critical elements of the crash such as type of crash, location, contributing factors, driver actions and reactions, and severity of injuries. Some crashes are removed from the data set when they occur outside of project limits, are animal related, or contain other reasons rendering the crash non-applicable. Any necessary corrections are made to the crash data before further processing.

Once the refined collection of crash data is modified, the ODOT Crash Analysis Module (CAM) tool is used to organize the crash data into tables and charts. Information is tabulated in various categories based on significant crash characteristics such as the previously noted critical elements as well as date, time of day, weather conditions, road conditions, and other relevant aspects. The complete crash information tables are provided in Appendix C of this report.

During the period of 2018 through 2022, a total of 144 crashes were reported within the study area. The most common type of crash reported during this period was a rear end crash, which accounted for 61 crashes, or 42% of the identified 144 crashes. Out of the 61 rear end crashes, 44 of them (72%) occurred on US 62. They occurred almost evenly on both sides of Harmont Avenue with 23 crashes in the eastbound approach and 21 in the westbound approach. The rear end crashes peak in the eastbound direction around 4:00 PM and peak in the westbound direction around 7:00 AM. The second most common crash type was an angle crash (35 or 24%). Out of the 35 angle crashes, 24 crashes (69%) occurred at the intersection of Harmont Avenue and Lesh Street/Commercial Road. The third most common crash was a left turn (21 crashes, or 15%). Right turn, sideswipe–passing, and fixed object crashes accounted for 11 (8%), 9 (6%), and 4 (3%) respectively. See Figure 15 for a summary of crash type frequency by crash severity.

Total Crashes	Injury Level				
Crash Type	(2) Serious Inju	(3) Minor Injury	(4) Injury Possi	(5) PDO/No Inju	Grand Total
Rear End	2	4	8	47	61
Angle	1	9	6	19	35
Left Turn	1	7	0	13	21
Right Turn	1	0	1	9	11
Sideswipe - Passing	0	1	1	7	9
Fixed Object	0	0	1	3	4
Backing	0	0	0	1	1
Head On	0	0	0	1	1
Parked Vehicle	0	0	0	1	1
Grand Total	5	21	17	101	144

Figure 15 - Crash severity by crash type.

In the five-year crash analysis period, the study area experienced zero fatalities, five serious injuries, 21 non-severe or minor injuries, 17 suspected injuries, and 101 crashes resulting in property damage only. See Figure 16 for a summary of crashes by crash severity.

Crash Severity	Crashes	%
(5) PDO/No Injury	101	70.14%
(3) Minor Injury Suspected	21	14.58%
(4) Injury Possible	17	11.81%
(2) Serious Injury Suspected	5	3.47%
Grand Total	144	100.00%

Figure 16 - Crashes by severity.

The most frequent contributing factor of crashes noted in the data was Following Too Closely/Assured Clear Distance Ahead, which was cited in 59, or 41%, of the identified 144 crashes. The other factors found were Failure to Yield (49 crashes, or 34%), Ran Stop Sign (7 crashes, or 5%), Other Improper Action (5 crashes, or 3%), Improper Lane Change (5 crashes, or 3%), Improper Turn (4 crashes, or 3%), Ran Red Light (3 crashes, or 2%). Contributing factors that were Not Discernible accounted for 3 crashes (2%). All the other contributing factor categories had two or less crashes and can be seen in Figure 17.

Unit 1 Contributing Factor	Crashes	%
Following Too Closely/ACDA	59	40.97%
Failure to Yield	49	34.03%
Ran Stop Sign	7	4.86%
Other Improper Action	5	3.47%
Improper Lane Change	5	3.47%
Improper Turn	4	2.78%
Ran Red Light	3	2.08%
Not Discernible	3	2.08%
Drove off Road	2	1.39%
Improper Passing	2	1.39%
None	2	1.39%
Improper Backing	1	0.69%
Operating Defective Equipment	1	0.69%
Unsafe Speed	1	0.69%
Grand Total	144	100.00%

Figure 17 - Total crashes by contributing factor.

Other applicable information obtained from the crash data:

- The number of crashes were down in 2019 (19) and 2022 (23). In 2018, 2020, and 2021 they were 35, 33, and 34, respectively. See Figure 18.

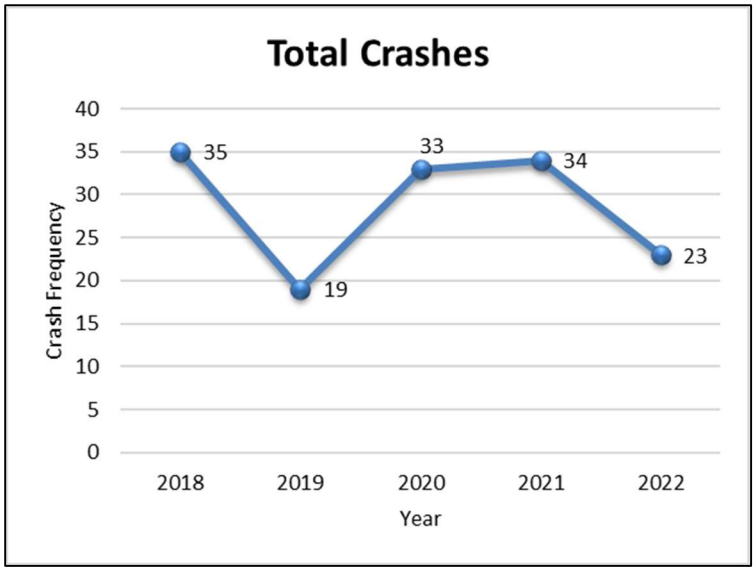


Figure 18 – Crash frequency from 2018 to 2022.

- Thursday was the most frequent day of the week with 27 crashes (19%). 22 of these 27 crashes occurred in the afternoon. See Figure 19.

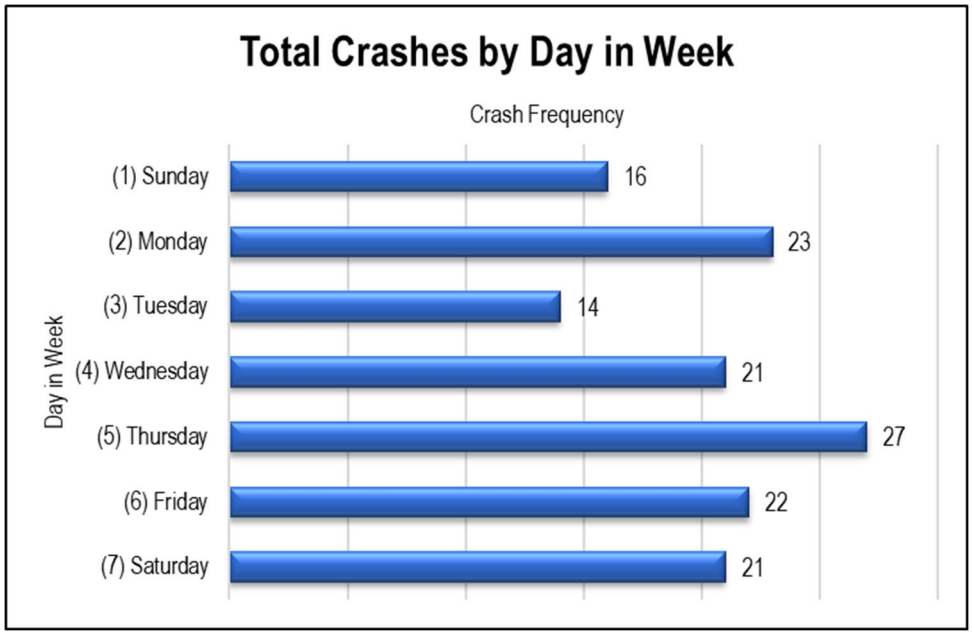


Figure 19 - Crashes by day of week.

- Driver distraction was involved in 30 of the crashes (21%) with 19 of these 30 resulting in a rear end collision. Note: driver distraction means any distraction, not just using a cell phone. See Figure 20.

Distracted By	Total Crashes	Fatalities	Serious Injuries
Not Distracted	114	0	3
Other / Unknown	21	0	1
Other distraction inside the vehicle	5	0	0
Passenger	2	0	0
Other activity with an electronic device	1	0	0
Manually operating an electronic commu	1	0	1
Grand Total	144	0	5

Figure 20 - Crash severity by distraction.

- Only 2 crashes involved alcohol and there were no reported crashes that involved drugs or marijuana.
- Young drivers (age 15-25) were involved in 50 crashes (35%). The statewide average is 34%.
- Older drivers (age 65+) were involved in 40 crashes (28%). The statewide average is 17%.
- The heaviest concentration of crashes occurred between 4:00 and 5:00 pm where 16 crashes or 11% of all the crashes occurred. 63% of all the 144 crashes occurred between 10 am and 5 pm. See Figure 21 for a summary of crashes by hour of day.

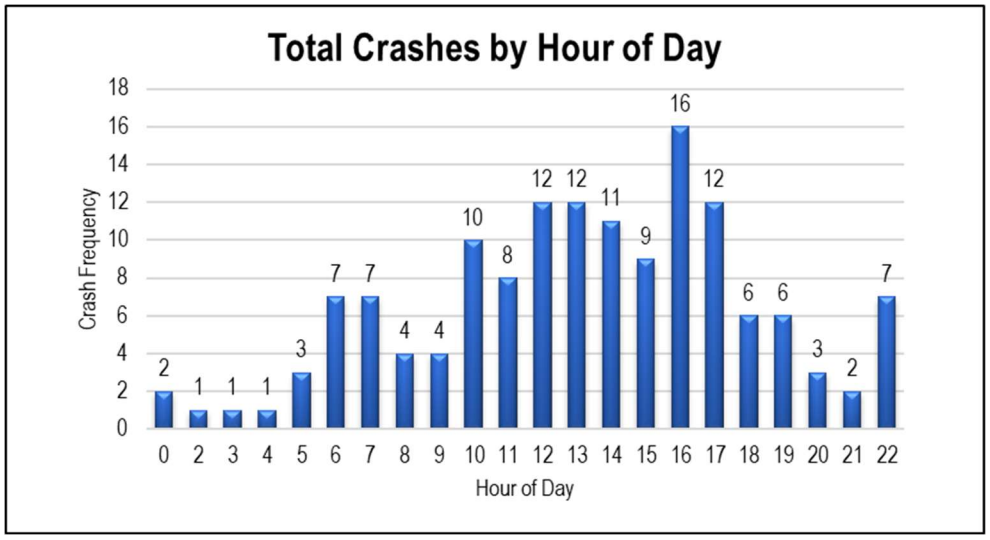


Figure 21 - Crashes by hour of day.

- The months with the highest number of crashes were June with 18 crashes (13%) followed by October with 17 crashes (12%). The months of July and November had 16 crashes (11%) each. See Figure 22 for a summary of crashes by month.

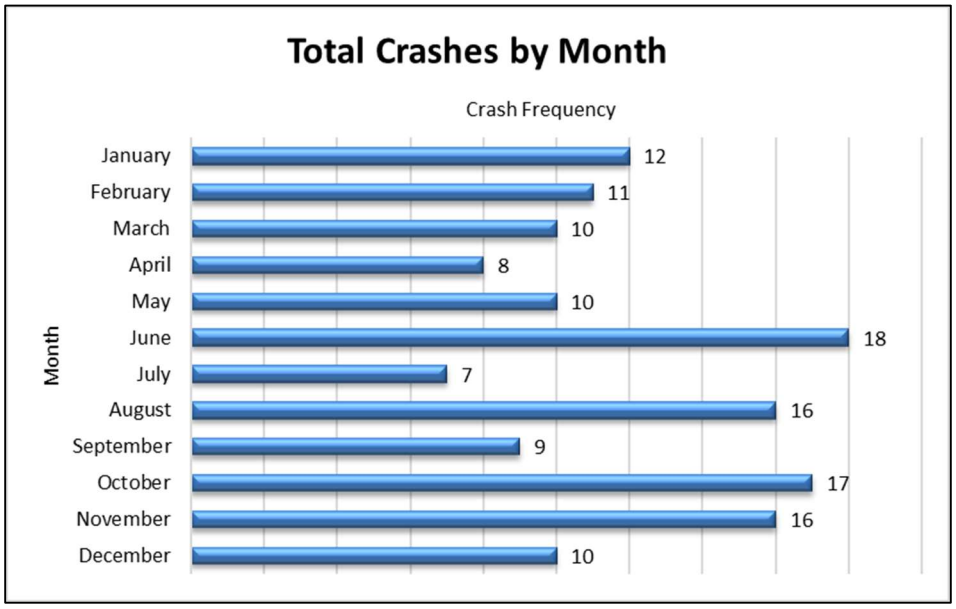


Figure 22 - Crashes by month.

- Many of the crashes, 104 (72%), occurred during daylight conditions. See Figure 23 for a summary of crashes by light condition.

Light Condition	Crashes	%
Daylight	104	72.22%
Dark - Lighted Roadway	25	17.36%
Dawn/Dusk	7	4.86%
Dark - Roadway Not Lighted	7	4.86%
Dark - Unknown Roadway Lighting	1	0.69%
Grand Total	144	100.00%

Figure 23 - Crashes by light condition.

- Most of the crashes, 106 (74%) occurred during dry roadway conditions while 33 (24%) occurred during wet conditions. Only three crashes (2%) were reported during snow conditions Figure 24 shows crash frequency by road condition.

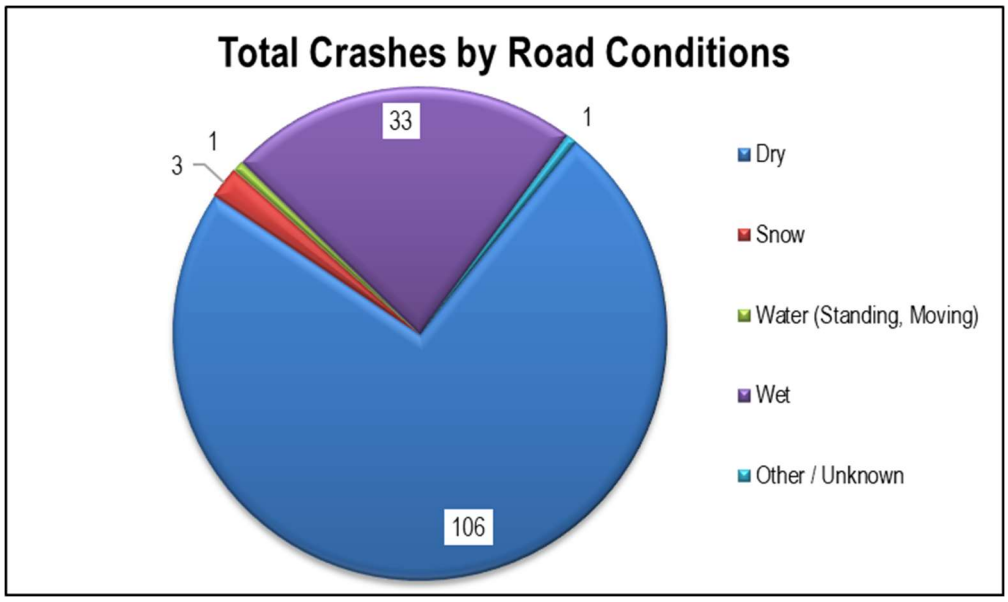


Figure 24 - Crashes by road conditions.

- There were no motorcycle, bicycle or pedestrian related crashes reported in the study area. Passenger Car crashes accounted for 68 (47%) of all crashes. See Figure 25 and Figure 26 below for a summary of crashes categorized by vehicle type.

Unit 1 Type	Crashes	%
Passenger Car	68	47.22%
Sport Utility Vehicle	39	27.08%
Pick up	15	10.42%
Semi-Tractor	6	4.17%
Passenger Van (minivan)	6	4.17%
Unknown or Hit/Skip	3	2.08%
Single Unit Truck	3	2.08%
Other Vehicle	2	1.39%
Motorhome	1	0.69%
Cargo Van	1	0.69%
Grand Total	144	100.00%

Figure 25 - Crashes by vehicle type.

Unit 2 Type	Crashes	%
Passenger Car	75	52.08%
Sport Utility Vehicle	43	29.86%
Pick up	15	10.42%
No Unit 2	4	2.78%
Passenger Van (minivan)	2	1.39%
Semi-Tractor	2	1.39%
Single Unit Truck	1	0.69%
Unknown or Hit/Skip	1	0.69%
Cargo Van	1	0.69%
Grand Total	144	100.00%

Figure 26 - Crashes by vehicle type.

C. Crash Diagram

See Appendix D for the Crash Diagram displaying crashes in the study area from 2018-2022.

D. Crash Analyses

The traffic safety conditions of the study area are further evaluated by conducting a safety performance analysis based on the criteria and methodologies prescribed in the Highway Safety Manual (HSM). The HSM provides an analytical and statistical model for predicting frequency of crashes based on key features such as roadway type, roadway conditions, intersection geometry, and traffic data. The HSM model provides a way to quantitively evaluate the safety aspect of a particular segment of roadway and/or a particular intersection of interest by comparing them to similar segments and intersections.

To facilitate the safety performance analysis, the ODOT Economic Crash Analysis Tool (ECAT) is used. This tool is a spreadsheet that can process the given crash data and, using the HSM crash predictive model, estimate the "predicted" and "expected" frequency of crashes along the subject corridor or at the subject intersection. These conditions are further described as follows:

Predicted Average Crash Frequency (crashes per year): Estimated average crash frequency for a site using the predictive HSM model adjusted for a given set of geometric conditions and traffic volumes. This reflects how the site is "predicted" to perform in comparison to peer sites.

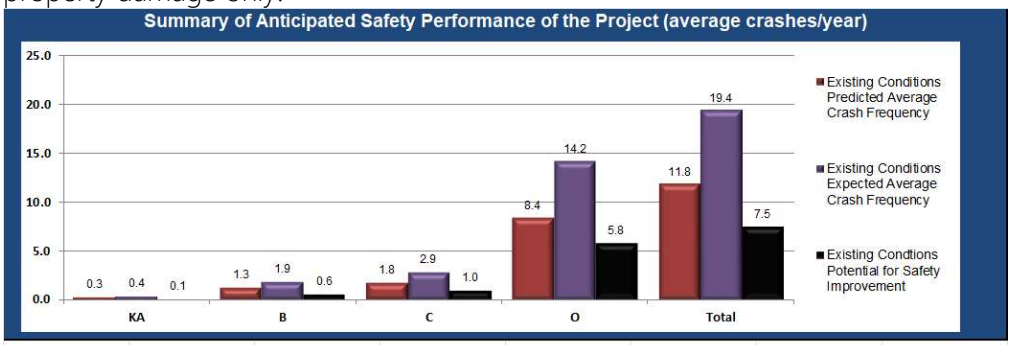
Expected Average Crash Frequency (crashes per year): Estimated average crash frequency for a site with a given set of geometric conditions, traffic volume, and a known crash history. This reflects how the site is "expected" to perform in comparison to peer sites while taking actual historical crash performance into consideration.

If the Expected Average Crash Frequency is greater than the Predicted Average Crash Frequency, this indicates the roadway segment or intersection being studied is experiencing more crashes than would be anticipated for the given roadway conditions and traffic volumes. Thus, the segment or intersection is believed to have potential for safety improvements.

In the case of US 62 and Harmont Avenue, the model provides an estimated Predicted Average Crash Frequency of 11.8 crashes per year and an estimated Expected Average Crash Frequency of 19.4 crashes per year for the existing conditions. The frequency of crashes estimated for the intersection is 7.5 crashes per year more than what the HSM model predicts it should be experiencing. Therefore, the calculated potential for safety improvements (predicted frequency

minus expected frequency) is a positive value, 7.5, as shown in the far right column of Figure 27.

In Figure 27 and similar figures, the graph shows five columns of grouped crash frequencies. The columns labeled KA, B, C, and O are for specific crash severities and the Total (far right column) is the aggregate of all crashes. "KA" is fatal or incapacitating injury, "B" is minor injury suspected, "C" is injury possible, and "O" is property damage only.



Project Summary Results (Without Animal Crashes)					
	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.3013	1.2831	1.8153	8.4405	11.8402
$N_{expected}$ - Existing Conditions	0.4221	1.8919	2.8595	14.2001	19.3736
$N_{potential\ for\ improvement}$ - Existing Conditions	0.1208	0.6088	1.0442	5.7596	7.5334

Figure 27 - ECAT summary of potential safety improvements

Therefore, this intersection is believed to have a positive potential for safety improvement and this study recommends the appropriate countermeasures to achieve it.

E. Probable Causes and Identification of Potential Countermeasures

The crash pattern throughout the study area points to several issues at the intersection that likely negatively impact the crash frequency. The most likely and significant probable causes are:

1. US 62 looks and performs like a limited access freeway. The four-lane divided highway maintains the lane widths, shoulder widths, and design factors present in other limited access sections of this route. Drivers feel comfortable using speeds far higher than the 55 mph limit.
2. The back of queue in both approaches can be a significant distance from the signal during high traffic times. This may not be anticipated, or may be hard to see due to sun glare, and drivers may not have enough braking distance, even if the 55 mph speed limit is followed.
3. On both the eastbound and westbound approaches of US 62, the drivers making a right turn onto Harmont Avenue need not reduce speed significantly to successfully navigate the curve due to a large curb return radius and an extra wide receiving lane on Harmont Avenue. These vehicles are not visible to drivers navigating the Lesh/Commerical

intersections, leading to poor decision-making and failures to yield to traffic from US 62 on Harmont.

4. The intersections of Lesh Street with Harmont Avenue are so close to US 62 that the queues collect and block the traffic on Lesh Streets. This can cause frustration, unsafe navigation (such as "shooting the gap" or running the stop sign), and confusion on right of way.
5. Several high-traffic access points including Walmart, a gas station, and restaurants. These establishments produce frequent in and out traffic, additional conflict points, and more stop-and-go traffic along Harmont Avenue.
6. The bus stop, dollar store, and restaurants draw foot- and bike-traffic without safe crossings and bike facilities. These circumstances are high predictors of pedestrian and bicycle involved crashes.

There are several potential countermeasures to address the crash problem in this study. Many options will not be desirable for reasons such as cost, accessibility, public opinion, business owner needs, SCATS long range planning, or others.

The following countermeasures were evaluated for efficacy, impacts, cost versus benefit, and feasibility:

1. Improve safe navigation and organization of traffic by:
    a. Applying pavement markings to reduce lane widths and direct navigation at the Harmont Avenue approaches to US 62,
    b. Evaluate current signal timing to reduce dilemma zone, reduce queues, and facilitate traffic movement.
2. Consider adding connected, coordinated signals at Lesh Street and Walmart drive intersections (if warranted) to facilitate traffic movements through the study area.
3. Reduce access points through the following options:
    a. Reroute Commercial Road to the north side of the Walmart parcel (to the area currently serving as a Walmart parking lot access way),
    b. Create a frontage access road on the east side of Harmont Avenue (south of US 62) to serve the dollar store and the two fast food restaurants. Continue this access road eastward along the south side of the pizza shop and Bob Evans. Reroute Lesh Street (south of US 62) to meet this access road through the east side of the Bob Evans' parcel.
    c. Remove the eastbound approach of Lesh Street to Harmont Avenue on the north side of US 62.
4. Convert the intersection cluster into a limited access interchange. This could be done by:
    a. Bridging Harmont Avenue over US 62, meeting grade beyond the Lesh Street intersections and constructing alternate access points.

Exit/Entrance ramps from US 62 could use Commercial Road or Lesh Street alignments. Further geometric study is needed.

b. Bridging US 62 over Harmont, with similar study needed for access points and ramps.

5. Remove the Harmont Avenue intersection with US 62, directing north-south traffic to use Kirby Avenue to the east or Regent Avenue to the west.
6. Construct traffic calming elements along US 62 west of the intersection with Harmont Avenue and for miles east of the intersection, to reduce speeds and convert the route to a multi-access boulevard. (This is highly disfavored.)
7. Improve pedestrian mobility throughout the area including visible, appropriately-timed crossings and protected crossing of Harmont Avenue near the bus stop.

F. Evaluation of Countermeasures and Alternatives

The most effective countermeasure(s) to implement are those that address the crash problem and probable causes determined from crash data and field observations. ECAT is used to evaluate proposed countermeasure performance based on proposed predicted crash frequency. Many safety improvement countermeasures have been studied and assigned crash modification factors (CMFs) to estimate the change in the number of crashes after a countermeasure is implemented, indicating a decrease if the CMF is below 1.0, an increase if it is above 1.0, or no change if it is exactly 1.0. CMFs can be used in the ECAT analysis to compute the expected number of crashes after the implementation of a specific countermeasure.

Funded by the U.S. Department of Transportation Federal Highway Administration and managed by the University of North Carolina Highway Safety Research Center, the CMF Clearinghouse (accessible at www.CMFClearinghouse.org) serves as a centralized online repository for CMFs and related resources. It provides transportation professionals with an updated collection of CMFs, a platform for sharing new CMFs, and educational resources on CMF application and development. The Clearinghouse uses a star rating system to evaluate the quality and reliability of CMFs based on study design, statistical methods, sample sizes, and significance, with scores up to 150 points translating to a star rating from 1 to 5, where 5 represents the highest quality (scores between 135 and 150).

In some cases, changing the geometry or operations of a segment or intersection changes the safety performance function (SPF) without the application of a specific CMF. In these cases, the proposed configuration is modeled in ECAT with or without additional safety improvement countermeasures and CMFs applied.

Multiple countermeasures can be applied in parallel, and this is often the final recommendation. In practice, applying several countermeasures at once has positive and multiplicative impacts, but somewhat diminishing returns. ECAT does not accurately model the outcome that is likely when more than three countermeasures are applied concurrently to an intersection or roadway segment. For a conservative prediction of proposed crash frequency, some countermeasures are omitted from the ECAT analysis although still included in the proposed configuration.

The potential countermeasures to address the crash problems in this study have been organized into effective combinations forming three alternatives for evaluation. The alternatives and associated evaluations are described in this section.

Alternative 1, Low-Cost, Short Term Countermeasures: Vulnerable Road User Infrastructure, Intersection Pavement Markings, and Reduction of Dilemma Zone

There are no pedestrian crossings provided in the study area, making it difficult and less safe for pedestrians to access the local amenities. This can create an unequitable disadvantage for those who are unable to drive or cannot afford to drive. With the presence of bus stops in the study area, pedestrian infrastructure is notably valuable as those who utilize the bus are not currently provided with a safe way to do so.

Providing proper infrastructure for pedestrians, cyclists, and transit users reduces the potential for crashes with these vulnerable road users. Additionally, the addition of this infrastructure contributes to traffic calming, resulting in lower speeds exhibited by motorists and improved safety for all road users. Studies have shown that adding pedestrian infrastructure such as high-visibility crosswalks, protected crossings, and sidewalks can significantly enhance traffic safety and create a calming effect on traffic. For instance, road diets, which involve reducing the number of vehicular lanes to create space for pedestrian and bicycle infrastructure, have been found to decrease vehicle speeds, reduce the number of rear-end and side-swipe crashes, and improve overall safety for all road users. This reallocation of road space makes crossing easier for pedestrians, provides safety buffers, and encourages safer driving behaviors (US Department of Transportation).

Alternative 1 includes sidewalk where none currently exists alongside the northbound and southbound approaches to US 62 and Harmont Avenue. Bicyclists are not encouraged to use US 62 as a limited access freeway, but bicycle infrastructure should be considered in future upgrades to Harmont Avenue.

To reduce the likelihood of pedestrian and bicyclist crashes, Alternative 1 includes the implementation of CMFs 4123, 4115, and 9024 from the CMF Clearinghouse.

CMF 4123 ***Install High-Visibility Crosswalk*** can be utilized at each of the intersections within the study area. The CMF value was found to be 0.6 and applies to pedestrian crashes at urban intersections.

CMF 9024 ***Install a Rectangular Rapid Flashing Beacon*** can be utilized on Harmont Avenue near the bus stop. CMF 9024 has a value of 0.53 and applies to pedestrian crashes on Minor Arterials (which is the functional classification of Harmont Avenue).

To further reduce the likelihood of pedestrian crashes, CMF 4115 ***Increase Cycle Length for Pedestrian Crossing*** can be utilized at the US 62 and Harmont Avenue intersection. CMF 4115 has a value of 0.5 and applies to pedestrian crashes at signalized intersections.

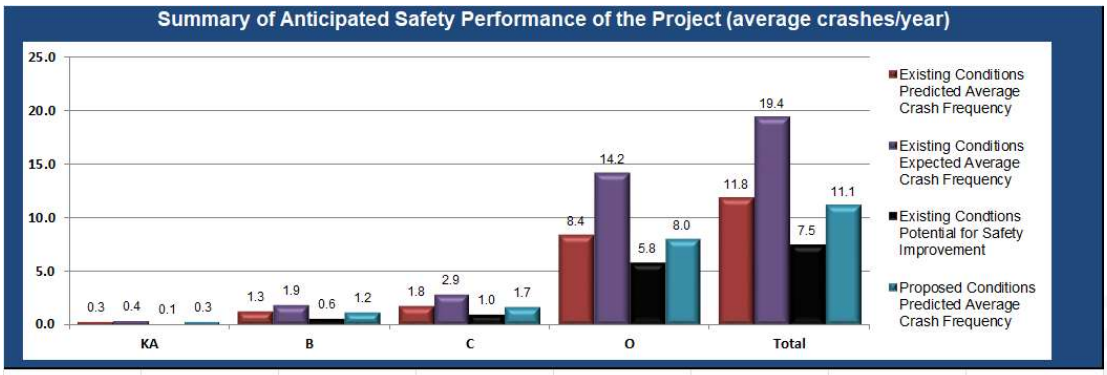
Another contributor of crash reduction is the installation of new edge lines within the US 62 and Harmont Avenue intersection, narrowing the receiving lanes on the south leg and the approach lanes on the north leg. The current lack of edge lines within the intersection results in oversized shoulders that drivers use as an additional right turn lane. This use of a nonexistent right turn lane has made navigating the area much more difficult for drivers on Harmont Avenue or Lesh Streets. For example, if a driver is eastbound on US 62 and treats the excess shoulder as a right turn lane, or even a slip lane, and quickly turns right to drive southbound on Harmont Avenue, unsuspecting traffic crossing or turning onto Harmont Avenue have a short window of time to see the vehicle and react appropriately, potentially resulting in a crash. Furthermore, pedestrians may be using that area to walk as no sidewalks exist at this intersection. To improve the safety of this intersection, edge lines can be installed at the Harmont Avenue approaches to establish and narrow its lanes. Drivers will be more likely to see the edge lines and follow their delineation since drivers are trained to routinely operate within the designated markings. With a narrower path to follow, turning traffic may naturally slow down, improving the safety of the entire corridor. Note that the addition of sidewalk at these returns replaces the excess shoulder area.

CMF 4854 ***Installation of an Actuated Advance Warning Dilemma Zone Protection System at High-Speed Signalized Intersection*** can be utilized at the US 62 and Harmont Avenue intersection. Implementing this countermeasure would likely reduce crashes that result from the dilemma zone—the time in which the signal turns yellow, and a driver must decide to speed to clear the intersection or come to an uncomfortable stop to prevent running a red light. This CMF is referenced in a three-star study completed in 2011 titled *Safety Effect of Dilemma-Zone Protection Using Actuated Advance Warning Systems* by Appiah et al. The CMF

value was found to be 0.56 and applies to angle crashes of any severity at four-leg signalized intersections.

See Appendix E for the proposed layout of Alternative 1.

By implementing all the changes presented in Alternative 1, the Predicted Average Crash Frequency decreases to 11.1 crashes per year. This represents a 43% improvement from the Existing Expected Average Crash Frequency and a 6% improvement from the Existing Predicted Average Crash Frequency. See Figure 28 below to view these values.



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	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.3013	1.2831	1.8153	8.4405	11.8402
$N_{expected}$ - Existing Conditions	0.4221	1.8919	2.8595	14.2001	19.3736
$N_{potential\ for\ improvement}$ - Existing Conditions	0.1208	0.6088	1.0442	5.7596	7.5334
$N_{predicted}$ - Proposed Conditions	0.2714	1.1671	1.6755	8.0140	11.1280

Figure 28 - ECAT Analysis Report for Alternative 1: Pedestrian Improvements and New Edge Lines

Alternative 2, Medium-Cost Countermeasures: Removal of Lesh Street Intersections

The intersections of Lesh Street with Harmont Avenue are each within 100 feet of the intersection of US 62 and Harmont Avenue, resulting in queues that collect from the US 62 intersection and block the traffic on Lesh Streets. This can cause frustration, unsafe navigation (such as "shooting the gap" or running the stop sign), and confusion on right of way.

Several high-traffic access points are present on Harmont Avenue, including Walmart, a gas station, and high turnover restaurants. These establishments produce frequent in and out traffic, additional conflict points, and more stop-and-go traffic along Harmont Avenue. Additionally, the bus stop, dollar store, and restaurants draw foot- and bike-traffic without safe crossings and bike facilities. These circumstances are high predictors of pedestrian- and bicycle-involved crashes.

Taking these probable causes into account, one alternative to reducing crash frequency is to limit the number of access points on Harmont Avenue. There are three locations where access points can be limited:

- Reroute Commercial Road to the north side of the Walmart parcel (to the area currently serving as a Walmart parking lot access way)
- Create a frontage access road on the east side of Harmont Avenue (south of US 62) to serve the dollar store and the two fast food restaurants. Continue this access road eastward along the south side of the pizza shop and Bob Evans. Reroute Lesh Street (south of US 62) to meet this access road through the east side of the Bob Evans' parcel.
- Remove the eastbound approach of Lesh Street to Harmont Avenue on the north side of US 62.

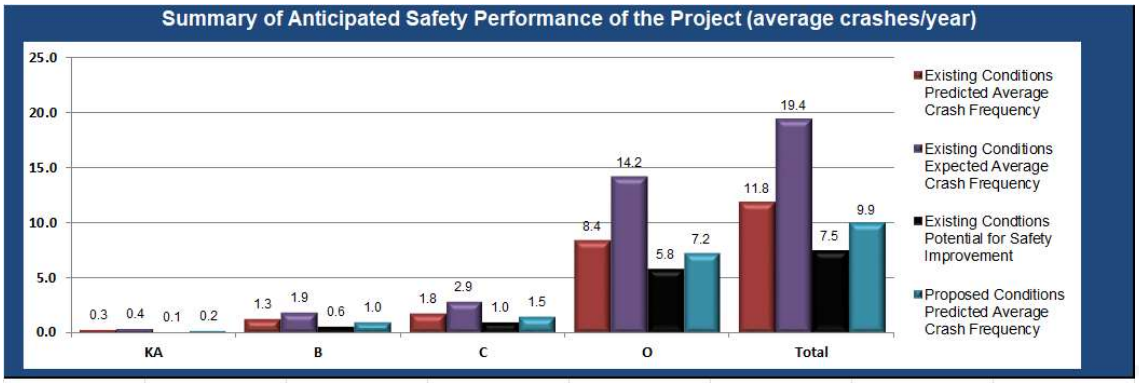
See Appendix E for the proposed layout of Alternative 2. In this map, there are two alternatives: Alternative 2A and 2B. When removing the Lesh Street access point south of US 62, traffic will need to be rerouted. Alternative 2A creates a new roadway that services nearby amenities and intersects with Harmont Avenue using the existing entrance to KFC. This alternative is the basis of the Alternative 2 cost opinion, which will be discussed later in further detail. Alternative 2B is similar to 2A but continues south to 35th Street instead of turning west to intersect Harmont Avenue. This alignment moves traffic further away from the US 62 and Harmont Avenue intersection, which prevents any disruptive queuing between the two intersections. However, this alternative is likely to require the total take of an existing parcel on 35th Street. Alternative 2B results in a new intersection that lies outside the scope of this study and is likely to require further research.

Removing the Lesh Street intersections on both sides of US 62 removes significant conflict points, thereby reducing the potential for intersection-related crashes. This changes the safety performance function of the intersection grouping and can be modeled as such appropriately in a proposed ECAT analysis.

To further improve the safety of the study area, this alternative can be designed in conjunction with additional countermeasures. In addition to the changes proposed above, this alternative also includes *Installation of an Actuated Advance Warning Dilemma Zone Protection System at High-Speed Signalized Intersection* at US 62 and Harmont Avenue, *Increase Cycle Length for Pedestrian Crossing* at US 62 and Harmont Avenue, *Install High-Visibility Crosswalk* at all intersections, and *Install a Rectangular Rapid Flashing Beacon* at the bus stop, as applied in Alternative 1. As previously stated, the true safety benefits of multiple countermeasures are unclear. Therefore, the CMFs for the pedestrian-related

countermeasures have not been applied in ECAT but remain a part of Alternative 2.

By implementing all the changes presented in Alternative 2, the Predicted Average Crash Frequency decreases to 9.9 crashes per year. This represents a 49% improvement from the Existing Expected Average Crash Frequency and a 16% improvement from the Existing Predicted Average Crash Frequency. See Figure 29 below to view these values.



Project Summary Results (Without Animal Crashes)					
	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.3013	1.2831	1.8153	8.4405	11.8402
$N_{expected}$ - Existing Conditions	0.4221	1.8919	2.8595	14.2001	19.3736
$N_{potential\ for\ improvement}$ - Existing Conditions	0.1208	0.6088	1.0442	5.7596	7.5334
$N_{predicted}$ - Proposed Conditions	0.2265	1.0185	1.4967	7.1747	9.9164

Figure 29 - ECAT Analysis Report for Alternative 2: Reduction of Access Points

Alterative 3, High-Cost Countermeasures: Convert US 62 to Limited Access Highway at Harmont Avenue

Of the 144 total crashes recorded during the study period, 84 of these occurred at the intersection of US 62 and Harmont Avenue. The primary crash type at this intersection is rear end crashes (56%). The secondary crash type at this intersection is left turn crashes (17%). The remaining 27% of crashes is made up of sideswipe-passing, angle, right turn, fixed object, and head on crashes.

The back of queue in both approaches on US 62 can be a significant distance from the signal during high traffic times. This may not be anticipated or may be hard to see due to sun glare, and drivers may not have enough braking distance, even if the 55 mph speed limit is followed. This represents one probable cause of the high frequency of rear end crashes.

One alternative to reduce the likelihood of rear end and other intersection related crashes is to reconfigure the intersection altogether. US 62 looks and performs like a limited access freeway, being a four-lane divided highway with lane widths,

shoulder widths, and design factors that allow drivers to feel comfortable driving above the 55 mph speed limit. By converting this intersection to a limited access interchange, drivers will continue to operate at high speeds without the exposure of navigating a signalized intersection. This can be achieved by doing the following:

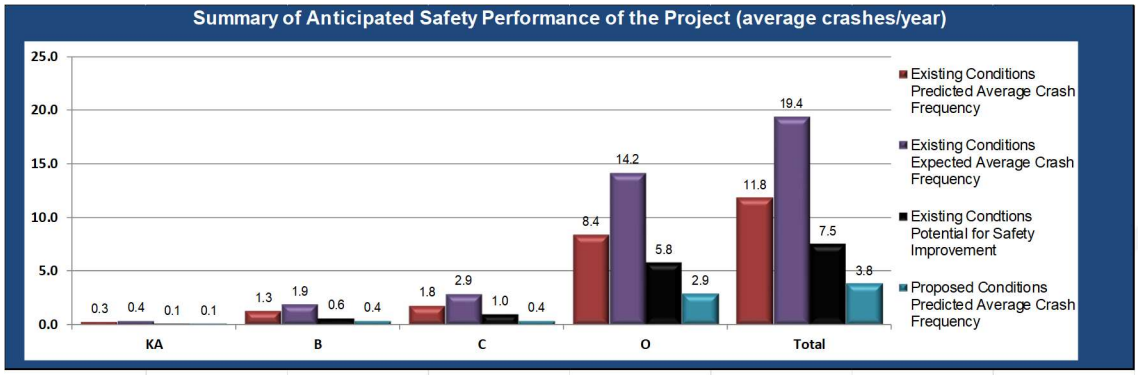
- Bridge US 62 over Harmont Avenue, meeting grade beyond the Lesh Street intersections and constructing alternate access points. Exit/entrance ramps from US 62 could use Commercial Road or Lesh Street alignments. Further geometric study would be required.
- Bridge Harmont Avenue over US 62, requiring a similar study for access points and ramps. Given the proximity of drives to businesses, this is unlikely to be feasible and is not considered a viable option.

See Appendix E for the proposed layout for Alternative 3. Like Alternative 2, there are two alternatives shown in this layout: Alternative 3A and 3B. Alternatives 3A and 3B follow the same alignments as 2A and 2B. However, due to the addition of an eastbound entrance ramp to US 62, Alternative 3 also includes an access road that services Pizza Oven and Bob Evans.

Like Alternative 2, the safety of the study area can be further improved by being designed in conjunction with additional countermeasures. In addition to the changes proposed above, this alternative also includes ***Install High-Visibility Crosswalk*** at all intersections and ***Install a Rectangular Rapid Flashing Beacon*** at the bus stop, as applied in Alternatives 1 and 2. As previously stated, the true safety benefits of multiple countermeasures are unclear. Therefore, the CMFs for the pedestrian-related countermeasures have not been applied in ECAT but remain a part of Alternative 3.

By implementing the changes listed in Alternative 3, the Predicted Average Crash Frequency calculated in ECAT decreases to 3.8 crashes per year. This represents an 80% improvement from the Existing Expected Average Crash Frequency and a 68% improvement from the Existing Predicted Average Crash Frequency. See Figure 30 to view these values.

When conducting the ECAT analysis, assumptions had to be made regarding the two new ramp terminal intersections on Harmont Avenue. These intersections were assumed to be stop-controlled at the ramp approaches. It was assumed that the Harmont Avenue approaches and ramp approaches will all have left turn lanes. Additionally, there were assumed to be no right turn lanes. These assumptions were preliminary, as lane configuration and signal warranting are dependent on future analyses and design stages upon implementation.



Project Summary Results (Without Animal Crashes)					
	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.3013	1.2831	1.8153	8.4405	11.8402
$N_{expected}$ - Existing Conditions	0.4221	1.8919	2.8595	14.2001	19.3736
$N_{potential\ for\ improvement}$ - Existing Conditions	0.1208	0.6088	1.0442	5.7596	7.5334
$N_{predicted}$ - Proposed Conditions	0.1167	0.3707	0.4444	2.8970	3.8288

Figure 30 - ECAT Analysis Report for Alternative 3: Limited Access Interchange

V. CAPACITY ANALYSES

Both AM and PM Conditions were analyzed using Highway Capacity Software (HCS) for the following scenarios: Existing, No-Build, Alternative 2, and Alternative 3. The design year for the No-Build and Alternative analyses is 2050. Since the crash patterns indicated the highest crash frequency in the PM peak hour, notably at 4:00pm, the analysis results for the PM conditions are discussed below.

The existing scenario for the intersection of US 62 and Harmont Avenue shows an overall level of service (LOS) D with 41.0 second delay. Without any interference, this LOS will continue to worsen in the future. In a No-Build scenario for the year 2050, HCS shows that eastbound through movements, westbound left turn movements, and northbound through and right movements will provide a LOS F. This analysis also shows a worsened queue storage ratio (QSR) at every movement, potentially blocking nearby intersections and driveways. See Table 4 below for a summary of the HCS analyses results at US 62 and Harmont Avenue for PM Existing and PM No-Build (2050).

Table 4 - HCS Analyses Results for PM Existing and PM No Build, US 62 and Harmont Avenue

Harmont Ave & US 62											
		Eastbound US 62			Westbound US 62			Northbound Harmont Ave		Southbound Harmont Ave	
PM Existing		LT	TH	RT	LT	TH	RT	LT	TH RT	LT	TH RT
LOS	D	D	D	B	D	C	B	C	D	C	D
Delay	41.0	49.2	53.2	19.7	47.5	27.9	17.2	30.5	46.2	28.7	42.2
v/c		0.67	0.97	0.20	0.83	0.64	0.10	0.61	0.91	0.31	0.86
QSR		0.17	0.22	0.24	0.37	0.12	0.12	1.32	4.25	1.74	14.28
95th %ile Queue		76'	558'	84'	173'	322'	40'	132'	425'	44'	357'
		D - 49.8			C - 30.1			D - 42.0		D - 40.4	
PM No-Build		LT	TH	RT	LT	TH	RT	LT	TH RT	LT	TH RT
LOS	E	E	F	C	F	C	B	E	F	C	E
Delay	63.0	59.2	70.7	22.0	203.7	32.8	19.0	67.1	81.0	31.9	55.6
v/c		0.80	1.03	0.24	1.24	0.72	0.13	0.87	1.00	0.42	0.87
QSR		0.24	0.32	0.36	0.94	0.16	0.18	1.78	6.73	2.36	19.75
95th %ile Queue		108'	799'	125'	444'	436'	63'	178'	673'	59'	494'
		E - 65.1			E - 57.1			E - 77.1		D - 52.3	

Table 5 - HCS Analyses Results for PM Alternative 2, US 62 and Harmont Avenue

Harmont Ave & US 62											
PM Alternative 2		LT	TH	RT	LT	TH	RT	LT	TH RT	LT	TH RT
LOS	E	E	F	C	F	C	B	E	F	C	E
Delay	63.0	59.2	70.7	22.0	203.7	32.8	19.0	67.1	81.0	31.9	55.6
v/c		0.80	1.03	0.24	1.24	0.72	0.13	0.87	1.00	0.42	0.87
QSR		0.24	0.32	0.36	0.94	0.16	0.18	0.74	2.10	0.30	0.38
95th %ile Queue		108'	799'	125'	444'	436'	63'	178'	673'	59'	494'
		E - 65.1			E - 57.1			E - 77.1		D - 52.3	

In Alternative 2, two intersections near the US 62 and Harmont Avenue intersection are removed or realigned elsewhere. If this alternative were chosen, any resulting queuing from US 62 and Harmont Avenue would no longer pose the threat of blocking access to these nearby intersections or driveways. The LOS and delay at the intersection of US 62 and Harmont Avenue is not impacted, as shown in Table 5.

In Alternative 3, the intersection of US 62 and Harmont Avenue is removed altogether. Entrances to or from US 62 would be contained by entrance and exit ramps while through traffic on Harmont Avenue could safely travel, whether over or under, through traffic on US 62. Therefore, there is not an intersection capacity analysis for US 62 and Harmont Avenue for Alternative 3. Instead, Table 6 shows the design year analyses for constructed US 62 eastbound and US 62 westbound ramps and Harmont Avenue. The LOS for both ramps are predicted to be C, with 27.9 seconds delay for eastbound ramps and 25.4 seconds delay for westbound ramps. The LOS for Harmont Avenue at both of these intersections is A, with delays ranging from 5.4 to 9.7 seconds.

Table 6 - HCS Analyses Results for PM Alternative 3, US 62 and Harmont Avenue *Ramps*

Harmont Ave & EB US-62 Ramps						
PM Alternative 3		LTR		TH RT	LT	TH
LOS	B	C		A	B	A
Delay	11.3	27.9		9.7	15.7	4.9
v/c		0.84		0.62	0.16	0.41
QSR		0.12		1.19	0.32	0.28
95th %ile Queue		149'		191'	32'	70'
		C - 27.9		A - 9.7	A - 6.2	

Harmont Ave & wB US-62 Ramps					
PM Alternative 3		LTR	LT	TH	TH RT
LOS	B	C	A	A	A
Delay	10.5	25.4	5.9	5.2	8.1
v/c		0.84	0.36	0.36	0.46
QSR		0.14	0.25	0.26	0.10
95th %ile Queue		164'	25'	66'	123'
		C - 25.4	A - 5.4		A - 8.1

Analyses performed for the other associated intersections are shown below in Table 7 - Table 9.

Harmont Avenue and Lesh Street (north of US 62) performs at LOS A (Harmont Avenue) and B (Lesh Street) in PM Existing, with little change in PM No-Build. This intersection is removed in Alternatives 2 and 3.

Harmont Avenue and Commercial Road/Lesh Street (south of US 62) performs at LOS A (Harmont Avenue) and C (Commercial Road/Lesh Street) in PM Existing, with a minor change to LOS B (Commercial Road/Lesh Street) in PM No-Build. This intersection is removed in Alternatives 2 and 3.

The intersection of Harmont Avenue with Walmart and KFC driveways, south of Lesh Street, performs at LOS A (Harmont Avenue) and LOS F with 53.3/21.8 seconds delay (Walmart/KFC) in the PM Existing scenario. In the No-Build scenario, the delay grows to 223.4/30.5 seconds delay (Walmart/KFC). In Alternates 2 and 3, the delay grows to 994.5/87.3 seconds delay (Walmart/KFC). With an LOS F in present day, this intersection may be an area of focus for additional study. Conversion to a modern roundabout may be demonstrably better in terms of capacity and safety improvement.

To potentially relieve the lengthy delay and queueing, Alternative 2+ shows a conceptual roundabout at the Harmont and new Lesh Street (Walmart/KFC drives) intersection. This roundabout has an inscribed circle of 120 feet, larger than the typical one-lane roundabout to accommodate what is expected to be frequent bus and semi-truck traffic (Walmart deliveries). The southern exit from the roundabout may offer a traversable bus-only exit to facilitate entry to the bus stop, and/or the bus stop may be moved further south.

This roundabout concept and geometry should be studied further in preliminary engineering. Additional attention should be given to grading and profile needs, among others. See Figure 31 for an image showing the concept in Alternative 2+. Alternative 3+ is similar. Both concepts are in Appendix E.

Traffic plates and HCS reports for all traffic analyses can be found in Appendix F.

Table 7 - HCS Analyses Results for PM Existing and PM No Build, Harmon Avenue and Lesh Street (north)

Harmont Ave & Lesh St					
		Eastbound Lesh Rd		Northbound Harmont Ave	Southbound Harmont Ave
PM Existing		LT RT		LT TH	TH RT
LOS		B		A	
Delay		11.0		0.3	
v/c		0.08		0.01	
95th %ile Queue		8'		0'	
		B - 11.0		A - 0.3	
PM No-Build		LT RT		LT TH	TH RT
LOS		B		A	
Delay		11.5		0.6	
v/c		0.10		0.02	
95th %ile Queue		8'		3'	
		B - 11.5		A - 0.6	

Table 8 - HCS Analyses Results for PM Existing and PM No Build, Harmont Avenue and Commercial Road/Lesh Street (south)

Harmont Ave & Commercial Rd						
		Eastbound Commercial Rd	Westbound Lesh Rd	Northbound Harmont Ave		Southbound Harmont Ave
PM Existing		LTR	LTR	LT TH	TH RT	LTR
LOS		C	C	A	A	A
Delay		20.7	18.8	8.2	0.1	1.4
v/c		0.29	0.26	0.01		0.05
95th %ile Queue		31'	25'	0'		5'
		C - 20.7	C - 18.8	A - 0.2		A - 1.4
PM No-Build		LTR	LTR	LT TH	TH RT	LTR
LOS		D	D	A	A	A
Delay		29.7	29.8	8.5	0.2	1.6
v/c		0.42	0.44	0.02		0.06
95th %ile Queue		49'	53'	3'		5'
		D - 29.7	D - 29.8	A - 0.4		A - 1.6

Table 9 - HCS Analyses Results for PM Existing, PM No Build, PM Alternatives 2 and 3, Harmont Avenue and Driveways

Harmont Ave & Driveways						
		Eastbound Walmart Driveway	Westbound KFC Driveway		Northbound Harmont Ave	Southbound Harmont Ave
PM Existing		LTR	LT	RT	LTR	LTR
LOS		F	D	B	A	A
Delay		53.3	29.1	10.7	1.5	0.6
v/c		0.80	0.18	0.03	0.05	0.02
95th %ile Queue		160'	15'	3'	5'	3'
		F - 53.3	C - 21.8		A - 1.5	A - 0.6
PM No-Build		LTR	LT	RT	LTR	LTR
LOS		F	E	B	A	A
Delay		223.4	43.3	11.4	1.7	0.6
v/c		1.33	0.26	0.04	0.07	0.02
95th %ile Queue		383'	25'	3'	5'	3'
		F - 223.4	D - 30.5		A - 1.7	A - 0.6
PM Alts 2 & 3		LTR	LT	RT	LTR	LTR
LOS		F	F	B	A	A
Delay		994.5	184.4	11.8	2.3	2.1
v/c		3.05	0.97	0.16	0.09	0.08
95th %ile Queue		908'	130'	15'	5'	8'
		F - 994.5	F - 87.3		A - 2.3	A - 2.1

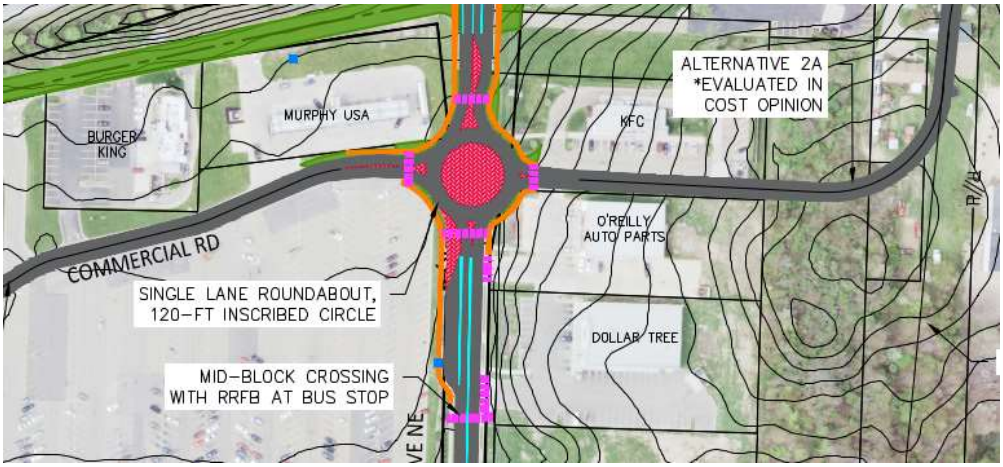


Figure 31 - Potential Roundabout to alleviate queueing and reduce delay.

VI. CONCLUSIONS

See Table 10 for a comparison of results obtained from ECAT reports for countermeasures that are interpreted with the tool. This table summarizes the results as discussed in the previous section of this report. See Appendix G for detailed cost opinions that produce these estimates.

Table 10 - Summary of Proposed Alternatives by ECAT Results and Estimated Cost

Alternative	Existing Conditions			Proposed Conditions			Estimated Cost
	Predicted Average Crash Frequency	Expected Average Crash Frequency	Potential for Safety Improvement	Predicted Average Crash Frequency	Improvement over Predicted Crash Frequency	Improvement over Expected Crash Frequency	
1	11.84	19.37	7.53	11.12	6%	43%	$ 350,000
2	11.84	19.37	7.53	9.92	16%	49%	$ 8,850,000
3	11.84	19.37	7.53	3.83	68%	80%	$ 52,510,000

A. Recommendations and Prioritization

The following recommendations are provided for the owner and maintaining authority over the subject intersection to reduce the crash frequency and severity.

Alternative 1, Low-Cost Countermeasures:

1. Install high-visibility crossings at intersections, particularly at US 62 and Harmont Avenue.
2. Evaluate signal timings at US 62 and Harmont Avenue to reduce the dilemma zone and lengthen the pedestrian signal cycle.
3. Add a rectangular rapid flashing beacon (RRFB) on Harmont Avenue, accompanied by high-visibility crossings, at the location of the bus stop south of US 62.
4. Place new edge lines along the Harmont Avenue approaches at US 62.

Alternative 2, Medium-Cost Countermeasures:

1. Remove the Lesh Street intersection north of US 62, ending access at the Aldi parking lot entrance.
2. Realign Commercial Road to the existing Wal-Mart access road alignment.
3. Realign Lesh Street south of US 62, rerouting traffic through a new access road alignment that intersects Harmont Avenue at the KFC entrance.
4. Implement all low-cost countermeasures provided in Alternative 1 where applicable.

Alternative 3, High-Cost Countermeasures:

1. Convert the US 62 and Harmont Avenue intersection into a limited access interchange, bridging US 62 over Harmont Avenue and adding entrance/exit ramp intersections. To be built in conjunction with;

2. Remove the Commercial Road and Lesh Street intersection south of US 62, rerouting traffic through new access road alignments that utilize the existing Wal-Mart access road alignment and KFC entrance.
3. Implement all low-cost countermeasures provided in Alternative 1 where applicable.