SAFETY STUDY

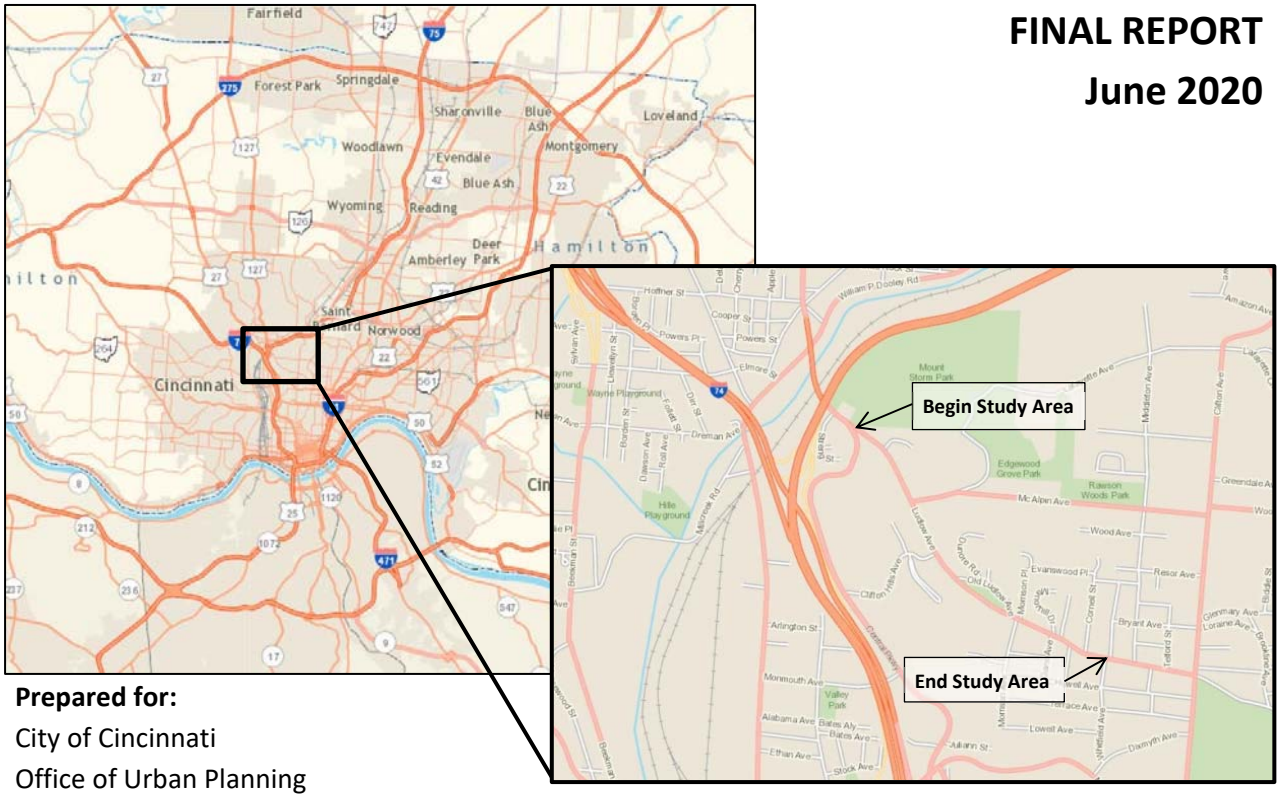
HAM-CR 464-0.00/1.04

Ludlow Avenue Corridor Study - Central Parkway (US 127) to Whitfield Avenue

City of Cincinnati, Hamilton County

FINAL REPORT

June 2020



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HAM-CR464-0.00/1.04 Safety Study

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SAFETY APPLICATION SUMMARY

HAM-CR 464-0.00/1.04

Ludlow Avenue Corridor Study - Central Parkway (US 127) to Whitfield Avenue

City of Cincinnati, Hamilton County

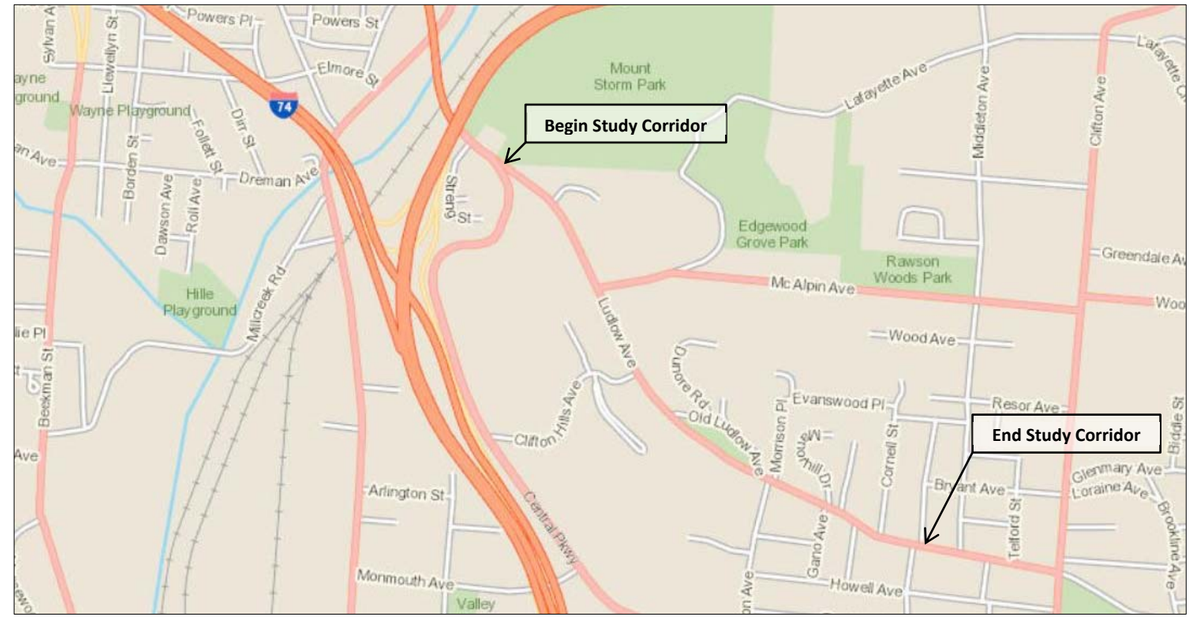
March 2020

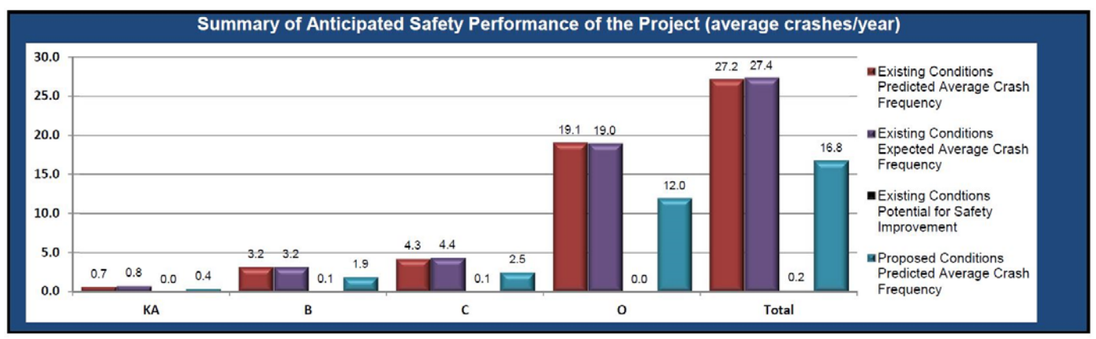
Crash Frequency by Type and Severity

Crash Type	PDO	Injury	Total	% of All PDO	% of All Injury	% of All Crashes
Angle/Left-turn	30	10	40	40.0%	32.3%	37.7%
Rear End	17	11	28	22.7%	35.5%	26.4%
Fixed Object	8	7	15	10.7%	22.6%	14.2%
Sideswipe- Passing	11	0	11	14.7%	0.0%	10.4%
Parked Vehicle	5	0	5	6.7%	0.0%	4.7%
Sideswipe- Meeting	3	0	3	4.0%	0.0%	2.8%
Head On	1	1	2	1.3%	3.2%	1.9%
Pedestrian	0	1	1	0.0%	3.2%	0.9%
Pedalcycles	0	1	1	0.0%	3.2%	0.9%
Total	**75**	**31**	**106**			

Traffic Volumes

Year	AADT	% change
Ludlow Avenue K=9%; D=69%, T=4%		
2013	40,343 veh	
2018	14,143 veh	- 65%
Central Parkway K=9%; D=63%, T=2%		
2013	12,164 veh	
2018	7,248 veh	- 40%





Proposed Countermeasures
Road Diet (convert 4-lane cross section to 3-lane with TWLTL) between Rue De La Paix and Whitfield Avenue
Install Rectangular Rapid Flashing Beacon at midblock crossing (near Clifton Hills Avenue)
Improve crosswalk markings to High Intensity Crosswalk markings
Improve Signal Visibility
Remove Right-turn slip ramps at Central Parkway and Rue De La Paix

Existing Signalized Intersection Level of Service

Intersecting Street(s)	2019 AM Peak LOS	2019 PM Peak LOS
Central Parkway	A	B
Rue De La Paix	A	A
Lafayette Avenue	A	B

Proposed Countermeasures Predicted Level of Service

Intersecting Street(s)	2019 AM Peak LOS	2019 PM Peak LOS
Central Parkway	B	B
Rue De La Paix	B	C
Lafayette Avenue	B	C; SEB LT = D

Executive Summary

Project Background

Location History

Ludlow Avenue is a four-lane Minor Arterial in the Clifton neighborhood of Cincinnati. The T-intersection of Central Parkway & Ludlow Avenue is the beginning log point for CR 464. North of this intersection, Ludlow Avenue is US 127. At Central Parkway, Ludlow Avenue continues on a southeasterly direction toward the commercial district of Clifton and where the study area ends at the Whitfield Avenue & Ludlow Avenue intersection. As Ludlow Avenue approaches the end of the study area, the alignment becomes an east/west route. The northwest 0.3 mile of the study area is focused on the Cincinnati State campus and adjacent multi-family residential land uses. The remaining 1.0 mile of the study area is mostly surrounded by single-family homes, with the southeastern end transitioning into commercial land uses. There are 14 intersections within the study area, four of which are signalized.

ODOT traffic data indicates that traffic volumes have dropped more than 60% on Ludlow Avenue between 2013 and 2018, and AADT was 14,143 in 2018. This significant decrease in traffic volumes has resulted in a Minor Arterial corridor with excess vehicle capacity. At the same time, the Ludlow Avenue corridor is supporting more pedestrian traffic for both the Cincinnati State Community College campus located in the study corridor and the recently opened DePaul Cristo Rey High School campus that is on a cross street of the corridor.

Reason for Study

The City of Cincinnati requested this safety study to identify safety improvements that will support the pedestrian users in this corridor while providing appropriate vehicular capacity.

Project Purpose and Safety Need

Analyze Crashes

During the analysis period of 2016-2018, 106 crashes occurred in the Ludlow Avenue study corridor. Slightly more crashes occurred in 2017 (39; 36.8%) and 2018 (37; 34.9%) than in 2016 (30; 28.3%). There were no fatalities in the corridor, but 31 of the crashes (29.2%) involved some level of injury. The remaining 75 (70.8%) were property damage only. A vast majority of the crashes (78; 73.6%) occurred on dry pavement and more (87; 82.1%) occurred during clear or cloudy weather conditions. Most crashes occurred during daylight conditions (74; 69.8%) while only 4 crashes (3.7%) occurred during dawn or dusk conditions.

A slight majority of crashes (55; 51.9%) are not considered intersection-related; another 3 crashes (2.8%) were related to a driveway access point. There are 12 T-intersections in the study area that involved 34 crashes (32.1%). The two 4-way intersections in the study area involved 13 crashes (12.3%). One crash was coded at a Y-intersection with a right-turn slip ramp at Lafayette Avenue.

Central Parkway & Ludlow Avenue had the highest number of crashes, with a total of 24 in the intersection area. Whitfield Avenue, at the other end of the study area, had the next highest number of

crashes, with a total of 23 in the intersection area and on the approaches. There were 10 crashes at the Rue De La Paix & Ludlow Avenue intersection, and seven crashes at the Lafayette Avenue & Ludlow Avenue intersection. Nearly a third of the study area crashes (31, 29.2%) occurred in the 0.68-mile section of Ludlow Avenue between Lafayette Avenue and Cornell Place.

Crashes in the corridor were predominately angle/left-turn collisions (40; 37.7%), with rear-end crashes being the second most-common (28; 26.4%). There were 15 (14.2%) fixed object crashes, including one were a vehicle impacted a building. The remaining 21.7% of the crashes included sideswipe-passing, parked vehicles, sideswipe-meeting, head-on, pedalcycle, and pedestrian collisions.

Potential for Safety Improvement

The Economic Crash Analysis Tool (ECAT) used the crash data compiled with ODOT's CAM Tool to analyze 28 project elements for the study corridor. Each intersection, whether signalized or unsignalized, was analyzed as its own element. Roadway segments between the intersections were analyzed as individual elements. A number of segment lengths are sufficiently short (0.01-0.8 mile) that they are heavily influenced by the intersection radius length at each end of the segments. The Existing Conditions Expected Average Crash Frequency (based on historical crash data) is 27.4376 crashes per year, while the Existing Conditions Predicted Average Crash Frequency is 27.2321 crashes per year. This means that this facility is not currently experiencing an excess of crashes for the existing location conditions. On the other hand, modifications to the existing conditions may still reduce predicted crashes if appropriate countermeasures are implemented.

Overview of Safety Issues and Possible Causes

Roadway Conditions

The Ludlow Avenue study corridor has a posted speed limit of 35mph. There are 4-foot wide sidewalks with ADA compliant curb ramps on both sides of the roadway along the entire corridor. The sidewalk is separated from the curb with a narrow tree lawn, which also contains streetlights, utility poles, and fire hydrants. Ludlow Avenue serves as a transit route and there are numerous bus stops along the corridor.

The major intersection in the study corridor is with Central Parkway (US 127), a Primary Arterial. This signalized T-intersection has two through-lanes on each approach, right-turn slip ramps (by-pass lanes) on the southbound and eastbound approaches and a dedicated left-turn lane on the northbound approach. The signalized intersection of Rue De La Paix is located 0.1 mile southeast of the Central Avenue intersection. The southbound approach of Ludlow Avenue has a free-flow right-turn slip ramp onto the west leg of Rue De La Paix and a dedicated left-turn lane onto the east approach of Rue De La Paix. The northbound approach of Ludlow Avenue has a dedicated left-turn lane on the west leg of Rue De La Paix.

Pedestrian and cycling facilities located in the area of the Central Parkway and Rue De La Paix intersections include dedicated bike lanes on both sides of Ludlow Avenue and marked crossings on some of the legs of the signalized intersections. The northbound bike lane begins at Rue De La Paix and continues across the Ludlow Avenue Viaduct north of the study area. The southbound bike lane starts north of the study area, travels across the viaduct and terminates at a driveway for Cincinnati State

located south of Rue De La Paix. At this point, the bike lane transitions to a shared lane with vehicular traffic, and a "sharrow" marks the transition point. The bike lane is identified with green pavement markings at merge/diverge areas for the right-turn slip ramps at Central Parkway and Rue De La Paix.

The signalized intersection of Lafayette Avenue & Ludlow Avenue is located 0.2 mile south of the Rue De La Paix & Ludlow Avenue intersection. This T-intersection has two through lanes in each direction on Ludlow Avenue, with a dedicated left-turn lane on the southbound approach. Lafayette Avenue has a single lane in each direction. It widens to include a right-turn slip ramp/by-pass lane that uses a channelized concrete median to separate the right-turn movements from the left-turn movements. The turning radii on Lafayette Avenue are very long, which creates a minimum 56-foot crossing distance to reach the channelizing island serving as a pedestrian refuge. The only pedestrian crossing on Ludlow Avenue uses the channelizing island as its east-side terminus, and pedestrians must either cross the slip ramp to continue north or the very wide throat of Lafayette Avenue to continue south. Transit bus stops are located on both sides of Ludlow Avenue just south of the intersection.

Southeast of Lafayette Avenue, Ludlow Avenue is 4-lanes wide with additional pavement for on-street parallel parking. Parking requires a residential parking permit and the spaces are not delineated with any pavement markings, but the pavement is 55-56 feet wide with 10-foot wide travel lanes and 8-foot wide parking lanes. This typical section transitions at Cornell Place to pavement that is 40 feet wide with no on-street parking. Between Lafayette Avenue and Cornell Place, there are 10 unsignalized intersections that use minor approach stop-control. Five of these intersections are located in a 0.1-mile section of the study area. Ludlow Avenue serves primarily single-family home land uses between Lafayette Avenue and Cornell Place. While there are 9 transit bus stops in this 0.7-mile section of Ludlow Avenue, there are no marked crosswalks on Ludlow Avenue to support pedestrian access to these stops.

At Cornell Place, the study corridor characteristics transition to include commercial land uses. Housing density increases, there are several multi-family residential buildings, and the study area ends near the edge of a commercial district. On-street parking ends at the Cornell Place intersection. The study area terminates at the signalized, offset Whitfield Avenue intersection where Ludlow Avenue has two lanes in each direction and Whitfield Avenue has one lane in each direction. There are no turn lanes present. Pedestrian crossings are provided on both Whitfield Avenue approaches, and a single crossing on Ludlow Avenue is located between the two Whitfield Avenue approaches.

Existing Traffic Control

There are four signalized intersections in the study area: Central Parkway, Rue De La Paix, Lafayette Avenue, and Whitfield Avenue. The remaining 10 intersections are stop-controlled on the minor approach. Marked pedestrian crossings are located at the signalized intersections, but not at any unsignalized intersection.

Crash Patterns/Contributing Factors

A general conclusion of the crash analysis is that the crash patterns appear to be related to excess vehicular capacity along the corridor. The northwestern end of the corridor has a high number of conflict points in a very small distance, creating additional safety concerns.

Traffic Volumes

AADT traffic volumes for the corridor were obtained from ODOT's Traffic Data Management System. Ludlow Avenue had a 2018 AADT of 14,143 vehicles per day. Turning movement counts collected in November 2019 at Central Parkway, Rue De La Paix, and Lafayette Avenue reflect that AADT. PM Peak Hour volumes on Ludlow Avenue ranged from 1,675 vehicles at Central Parkway to 1,219 vehicles at Lafayette Avenue.

Recommended Countermeasures and Related Costs

Recommended solutions

Short Term:

- Road Diet (convert 4-lane cross section to 3-lane with TWLTL) pavement marking revisions
- Improve crosswalks with high visibility markings
- Improve Signal Visibility

Medium Term:

- Road Diet (convert 4-lane cross section to 3-lane with center turn lane) curb extensions
- Install Rectangular Rapid Flashing Beacon at midblock crossing near Clifton Hills Avenue
- Improve crosswalk markings to incorporate curb extensions
- Remove Right-turn slip ramps at Central Parkway and Rue De La Paix

Related Costs

Short Term:

Pavement Markings = $25,000
LED Signal Heads - $7,500 per intersection x 4 = $30,000

Medium term:

Curb extensions and refuge islands – $1,500 each x 4 = $6,000
Install RRFB at midblock crossing (Clifton Hills Avenue) = $7,500
Remove Right-turn slip ramps = $60,000

Purpose and Need

The purpose of this study is to identify crash patterns on the Ludlow Avenue (CR 464) corridor between Central Parkway (US 127) and Whitfield Avenue in the City of Cincinnati, and to recommend treatments that will improve pedestrian safety in the corridor. Cincinnati State Technical and Community College has a campus located between Central Parkway and Lafayette Avenue that generates pedestrian traffic from bus stops along Ludlow Avenue and nearby residential properties. DePaul Cristo Rey High School students also use the bus route on Ludlow Avenue to access their campus on Clifton Hills Avenue; the stop located between Lafayette Avenue and Clifton Hills Avenue generates pedestrian crossing traffic on Ludlow Avenue before school in the early morning hours.

Existing Conditions

Background

Ludlow Avenue is a four-lane Minor Arterial in the Clifton neighborhood of Cincinnati. North of the study area, Ludlow Avenue begins at the 5-point intersection with Spring Grove Avenue, Hoffner Street, and Hamilton Avenue, and then crosses Mill Creek and Interstate 75 on the Ludlow Avenue Viaduct. The Central Parkway intersection with Ludlow Avenue is approximately 0.1 mile southeast of the end of the viaduct. From there, Ludlow Avenue continues on a southeasterly direction toward the commercial district of Clifton. As Ludlow Avenue approaches the end of the study area, the alignment becomes an east/west route. The northwest 0.3 mile of the study area is focused on the Cincinnati State campus and adjacent multi-family residential land uses. The remaining 1.0 mile of the study area is mostly surrounded by single-family homes, with the southeastern end transitioning into commercial land uses. There are 14 intersections within the study area, four of which are signalized.

ODOT traffic data collected at Station ID #1203198 in 2013 provided an AADT volume of 40,343 vehicles per day on Ludlow Avenue. Five years later, after significant revisions to access points on I-75 and I-74 in the vicinity of the study area, the AADT volume was adjusted down by over 60% to 14,143 vehicles per day. Central Parkway also experienced a decline in traffic volumes during the same time period, dropping over 30% from 12,164 vehicles per day to 7,248 vehicles per day, according to ODOT records for Station ID #38831 available in the Transportation Data Management System. This significant decrease in traffic volumes has resulted a Minor Arterial corridor with excess vehicle capacity. At the same time, the Ludlow Avenue corridor is supporting more pedestrian traffic for both the Cincinnati State Community College campus located in the study corridor and the recently opened DePaul Cristo Rey High School campus that is on a cross street of the corridor. The City of Cincinnati requested this safety study to identify safety improvements that will support the pedestrian users in this corridor while providing appropriate vehicular capacity.

Conditions Diagrams

Existing Conditions Diagrams are in Appendix A. They identify the traffic control devices including signage, signals, and pavement markings and show adjacent land uses and access points along the corridor.

Physical Condition Narrative

The Ludlow Avenue study corridor has a posted speed limit of 35mph. There are 4-foot wide sidewalks with ADA compliant curb ramps on both sides of the roadway along the entire corridor. The sidewalk is separated from the curb with a narrow tree lawn, which also contains streetlights, utility poles, and fire hydrants.

The vehicular mix of traffic is 96% Passenger Cars and Type A heavy vehicles, and 4% Type B & C heavy vehicles. Directional distribution for the corridor is 69%, which means that more than 2/3 of the traffic volumes are going in the primary direction during peak travel periods. Ludlow Avenue serves as a transit route and there are numerous bus stops along the corridor.

The major intersection in the study corridor is with Central Parkway (US 127), a Primary Arterial. This signalized T-intersection has two through-lanes on each approach, right-turn slip ramps (by-pass lanes) on the southbound and eastbound approaches and a dedicated left-turn lane on the northbound approach. US 127 is designated on the Central Parkway approach and the north leg of Ludlow Avenue. CR 464 begins at this intersection on the south leg of Ludlow Avenue.

Figure 1 - Central Pkwy approach to Ludlow Ave looking SW

Figure 2 - East leg of Rue De La Paix approach to Ludlow Ave

The signalized intersection of Rue De La Paix is located 0.1 mile southeast of the Central Avenue intersection. The east leg of Rue De La Paix is a dead-end local street that provides access to two large, multi-family housing buildings and terminates at the Clifton Place Independent Living Apartments. This approach has one lane in each direction. The west approach to the intersection provides access to three surface parking lots and one parking garage for Cincinnati State. This approach has two lanes in each direction, including an exclusive

left-turn lane onto Ludlow Avenue. The southbound approach of Ludlow Avenue has a free-flow right-turn slip ramp onto the west leg of Rue De La Paix and a dedicated left-turn lane onto the east approach of Rue De La Paix. The northbound approach of Ludlow Avenue has a dedicated left-turn lane on the west leg of Rue De La Paix.

Figure 3 - Right-turn slip ramp from SEB Ludlow Ave to Rue De La Paix

Pedestrian and cycling facilities located in the area of the Central Parkway and Rue De La Paix intersections include dedicated bike lanes on both sides of Ludlow Avenue and marked crossings on some of the legs of the signalized intersections. The northbound bike lane begins at Rue De La Paix and continues across the Ludlow Avenue Viaduct to the 5-point intersection. The southbound bike lane starts at the 5-point intersection, travels across the viaduct and terminates at a driveway for Cincinnati State located south of Rue De La Paix. At this point, the bike lane transitions to a shared lane with vehicular traffic, and a "sharrow" marks the transition point. The bike lane is identified with green pavement markings at merge/diverge areas for the right-turn slip ramps at Central Parkway and Rue De La Paix. **Figure 6** is an aerial photo of both intersection areas.

Figure 4 - Bike lane on SEB Ludlow Ave between Central Pkwy and Rue De La Paix

Figure 5 - Pedestrian crossing Ludlow Ave at Rue De La Paix

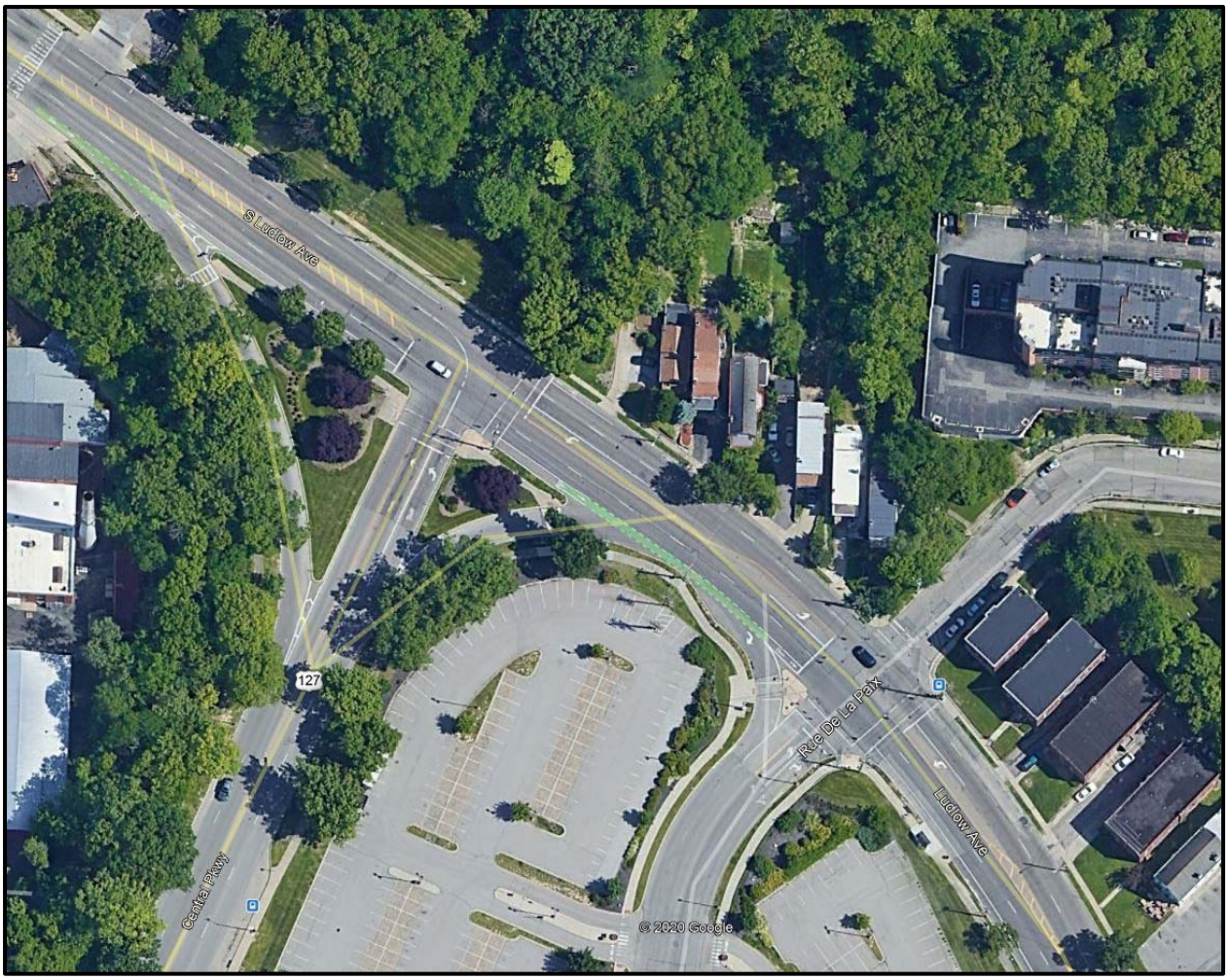


Figure 6- Central Parkway and Rue De La Paix intersections with Ludlow Avenue

The signalized intersection of Lafayette Avenue & Ludlow Avenue is located 0.2 mile south of the Rue De La Paix & Ludlow Avenue intersection. This T-intersection has two through lanes in each direction on Ludlow Avenue, with a dedicated left-turn lane on the southbound approach. Lafayette Avenue, classified as a Minor Arterial at its intersection with Ludlow Avenue, has a single lane in each direction. It widens to include a right-turn slip ramp/by-pass lane that uses a channelized concrete median to separate the right-turn movements from the left-turn movements. The turning radii on Lafayette Avenue are very long, which creates a minimum 56-foot crossing distance to reach the channelizing island serving as a pedestrian refuge. The only pedestrian

Figure 7 - Right-turn slip ramp on Lafayette Ave at Ludlow Ave

crossing on Ludlow Avenue uses the channelizing island as its east-side terminus, and pedestrians must either cross the slip ramp to continue north or the very wide throat of Lafayette Avenue to continue south.

Figure 8 - Pedestrian refuge at crossing Lafayette Ave

Transit bus stops are located on both sides of Ludlow Avenue just south of the intersection. A Red Bike rental station is located on the northwest side of the intersection, adjacent to the Cincinnati State campus. Lafayette Avenue extends east towards Mount Storm Park. It intersects with the Minor Arterial McAlpin Avenue 0.13 miles east of Ludlow Avenue, which provides connectivity to single-family residential areas in the Clifton neighborhood. The Lafayette/McAlpin corridor is also a transit bus route. **Figure 9** is an aerial photo of the Lafayette Avenue & Ludlow Avenue intersection.

Figure 9 - Lafayette Avenue & Ludlow Avenue Intersection

Synchro traffic analysis software was used to analyze Level of Service for the three signalized intersections at the northwest end of the corridor. The analysis used 8-hour traffic counts collected on November 14, 2019 between 6-10am and 3-7pm, and was prepared with existing signal timing plans provided by the City. This analysis establishes the existing traffic flow characteristics and capacity for the corridor. The following table summarizes the results for overall intersection Level of Service. Synchro Reports of the Existing Conditions HCS analyses are in Appendix B.

Table 1 - Existing Signalized Intersection Level of Service

Intersecting Street(s)	2019 AM Peak LOS	2019 PM Peak LOS
Central Parkway	A	B
Rue De La Paix	A	A
Lafayette Avenue	A	B

All three intersections are operating at excellent Levels of Service, particularly for an urban area. There are no approaches operating at LOS D or worse; in fact there are only two approaches among the three intersections that are operating at LOS C.

Southeast of Lafayette Avenue, Ludlow Avenue is 4-lanes wide with additional pavement for on-street parallel parking for most of the remaining study corridor. Parking requires a residential parking permit. The spaces are not delineated with any pavement markings, but the pavement is 55-56 feet wide with 10-foot wide travel lanes and 8-foot wide parking lanes. This typical section transitions at Cornell Place to pavement that is 40 feet wide with no on-street parking. Between Lafayette Avenue and Cornell Place, there are 10 unsignalized intersections that use minor approach stop-control. Five of these intersections are located in a 0.1-mile section of the study area.

Ludlow Avenue serves primarily single-family homes between Lafayette Avenue and Cornell Place. While there are 9 transit bus stops in this 0.7-mile section of Ludlow Avenue, there are no marked crosswalks on Ludlow Avenue to support pedestrian access to these stops. A typical situation is represented by the area around Clifton Hills Avenue, which does generate pedestrian traffic crossing Ludlow Avenue at the beginning of DePaul Cristo Rey High School's day (**Figures 10-13**).

Figure 10 - Ludlow Avenue looking NW at transit stop across from Clifton Hills Ave

Figure 11 - Ludlow Ave looking SE at Clifton Hills Ave

Figure 12 - Clifton Hills Ave approach to Ludlow Ave

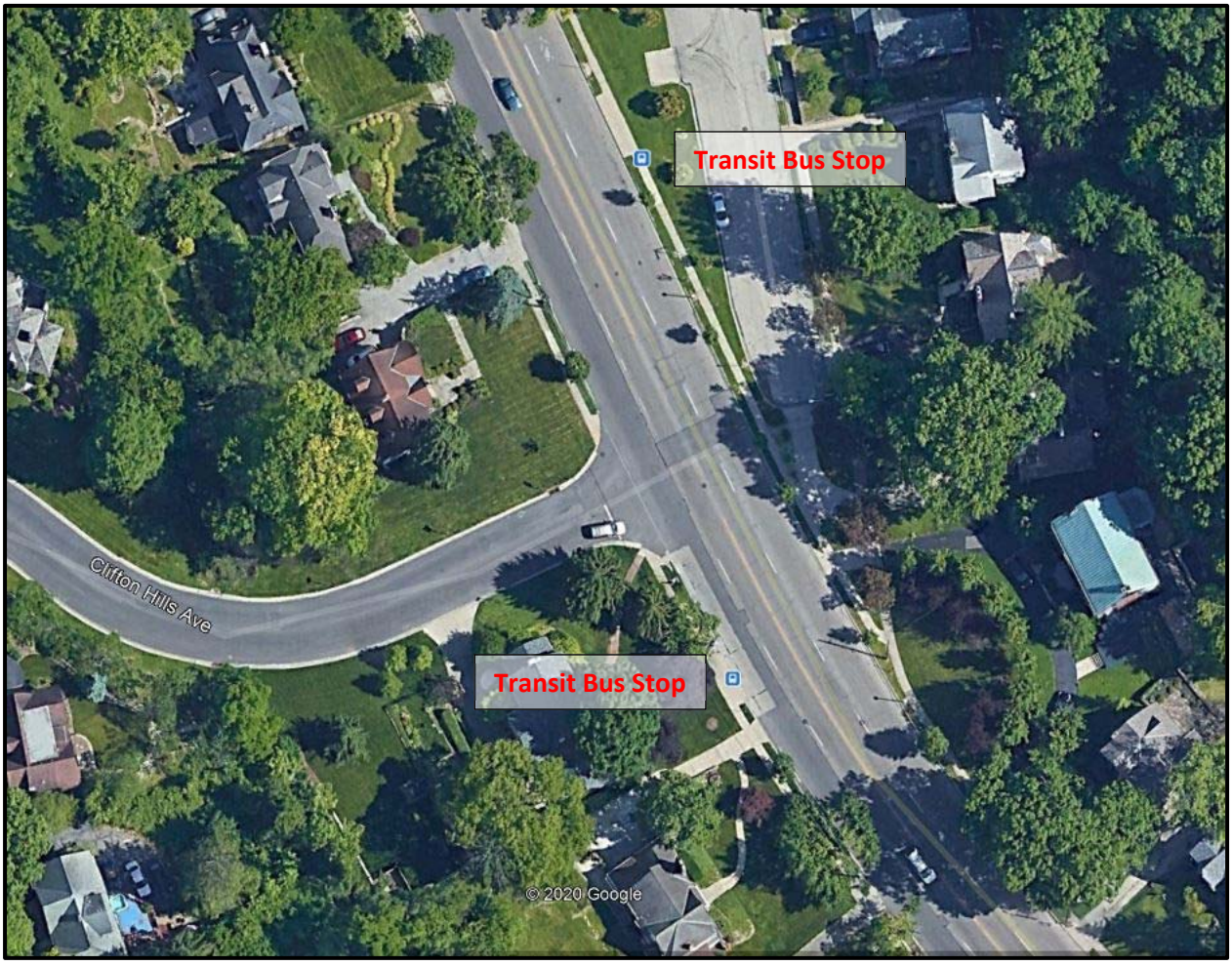


Figure 13 - Clifton Hills Avenue and Ludlow Avenue intersection area

At Cornell Place, the roadway characteristics and the surrounding land uses transition to represent the neighborhood's central business district. Housing density increases, there are several multi-family residential buildings, and the study area ends near the edge of a commercial district. On-street parking ends at a bend in the roadway alignment where Ludlow Avenue takes on an east/west orientation.

Figure 14 - Pavement markings for end of on-street parking

The study area terminates at the signalized, offset Whitfield Avenue intersection where Ludlow Avenue has two lanes in each direction and Whitfield Avenue has one lane in each direction. There are no turn lanes present. Pedestrian crossings are provided on both Whitfield Avenue approaches, and a single crossing on Ludlow Avenue is located between the two Whitfield Avenue approaches. **Figure 16** is an aerial photograph of 0.1-mile section of the corridor between Sherlock Avenue and Whitfield Avenue, where the transition between the wider pavement section and the 40-foot pavement section occurs.

Figure 15 - Study end point at Whitfield Avenue, looking east

Figure 16 - Sherlock Avenue to Whitfield Avenue corridor

Crash Data

Crash Data Summary

During the analysis period of 2016-2018, 106 crashes occurred in the Ludlow Avenue study corridor. Slightly more crashes occurred in 2017 (39; 36.8%) and 2018 (37; 34.9%) than in 2016 (30; 28.3%). There were no fatalities in the corridor, but 31 of the crashes (29.2%) involved some level of injury. The remaining 75 (70.8%) were property damage only. A majority of the crashes (78; 73.6%) occurred on dry pavement and more (87; 82.1%) occurred during clear or cloudy weather conditions. Most crashes occurred during daylight conditions (74; 69.8%) while only 4 crashes (3.7%) occurred during dawn or dusk conditions.

A slight majority of crashes (55; 51.9%) are not considered intersection-related; another 3 crashes (2.8%) were related to a driveway access point. There are 12 T-intersections in the study area that involved 34 crashes (32.1%). The two 4-way intersections in the study area involved 13 crashes (12.3%). One crash was coded at a Y-intersection with a right-turn slip ramp at Lafayette Avenue.

Central Parkway & Ludlow Avenue had the highest number of crashes, with a total of 24 in the intersection area. Whitfield Avenue, at the other end of the study area, had the next highest number of crashes, with a total of 23 in the intersection area and on the approaches. There were 10 crashes at the Rue De La Paix & Ludlow Avenue intersection, and seven crashes at the Lafayette Avenue & Ludlow Avenue intersection. Nearly a third of the study area crashes (31, 29.2%) occurred in the 0.68-mile section of Ludlow Avenue between Lafayette Avenue and Cornell Place.

Crashes in the corridor were predominately angle/left-turn collisions (40; 37.7%), with rear-end crashes being the second most-common (28; 26.4%). There were 15 (14.2%) fixed object crashes, including one were a vehicle impacted a building. The remaining 21.7% of the crashes included sideswipe-passing, parked vehicles, sideswipe-meeting, head-on, pedalcycle, and pedestrian collisions.

Figure 3 - Building opposite Cornell Pl that was struck

Collision Diagrams

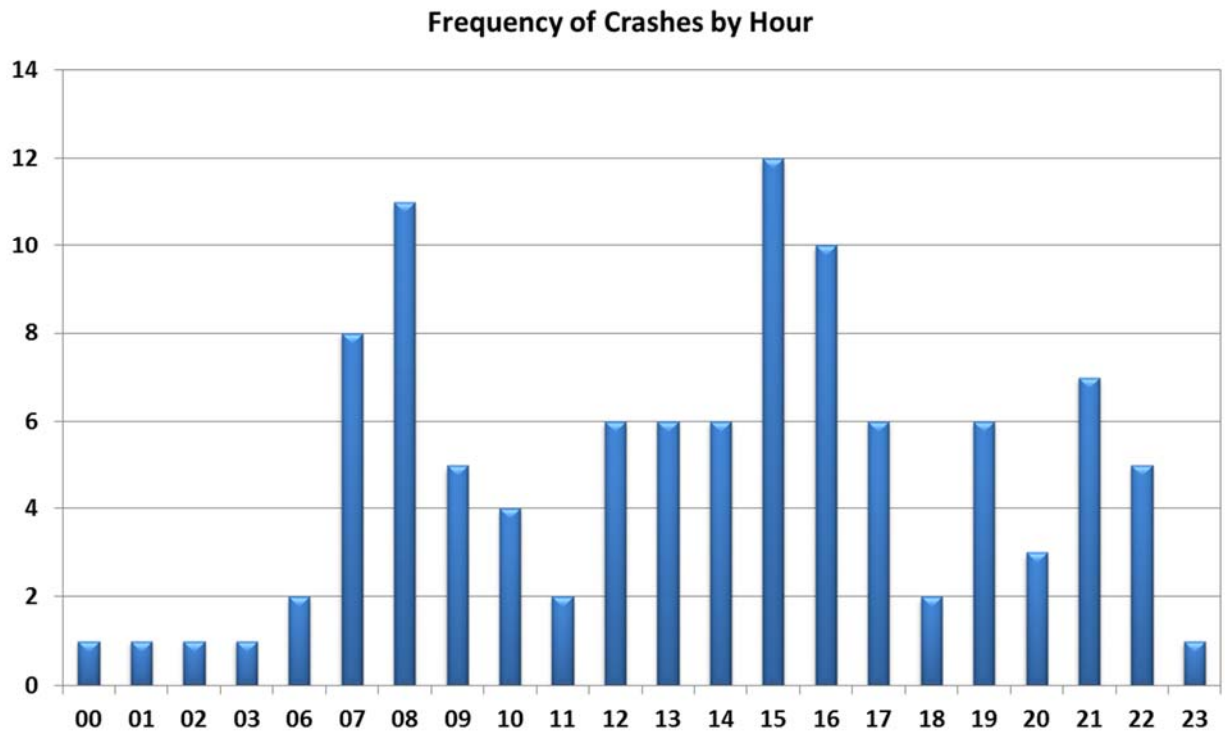
Collision Diagrams are in Appendix C. They indicate crash location, type, severity and time of occurrence.

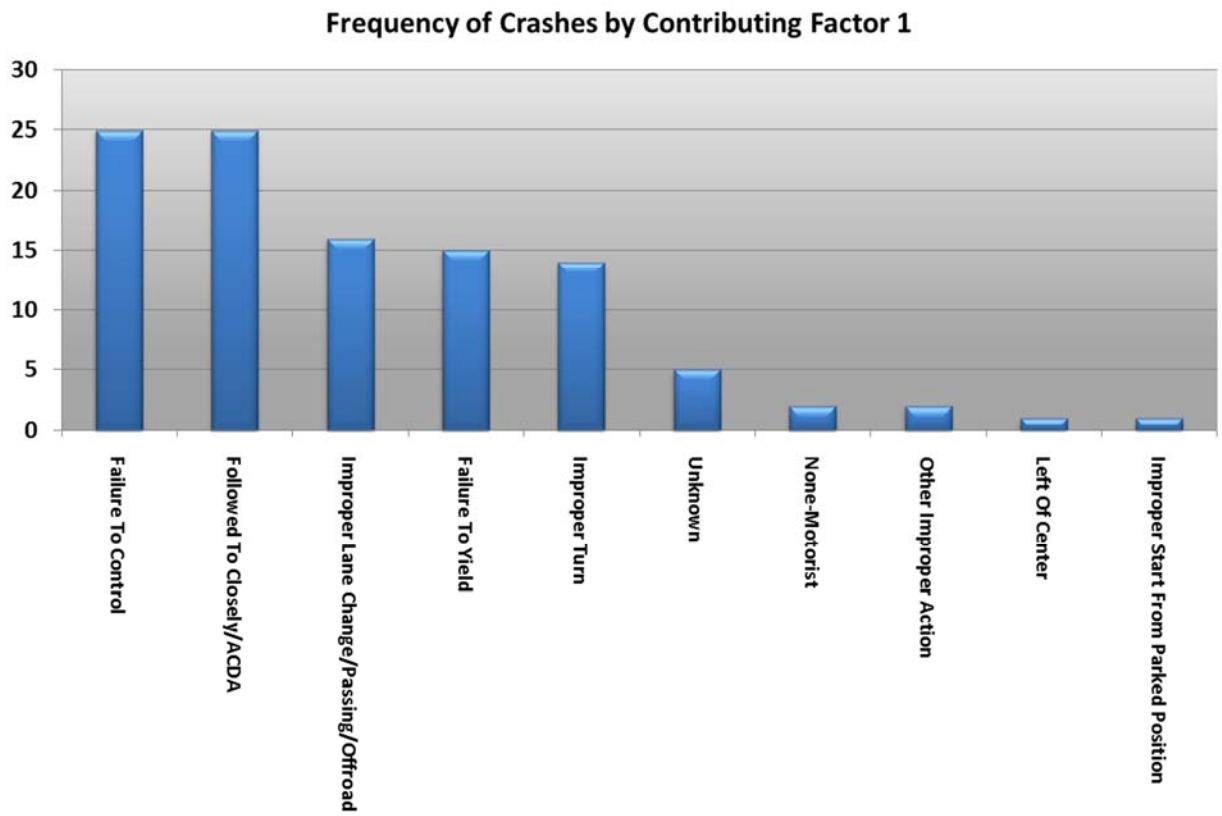
Crash Graphs and Tables

The following tables and graphs provide general corridor crash data. Due to the nature of the study area, the crash analyses discussion that follows provides greater context for these summary tools.

Table 2 - Crash Frequency by Type and Severity

Crash Type	PDO	Injury	Total	% of All PDO	% of All Injury	% of All Crashes
Angle/Left-turn	30	10	40	40.0%	32.3%	37.7%
Rear End	17	11	28	22.7%	35.5%	26.4%
Fixed Object	8	7	15	10.7%	22.6%	14.2%
Sideswipe- Passing	11	0	11	14.7%	0.0%	10.4%
Parked Vehicle	5	0	5	6.7%	0.0%	4.7%
Sideswipe- Meeting	3	0	3	4.0%	0.0%	2.8%
Head On	1	1	2	1.3%	3.2%	1.9%
Pedestrian	0	1	1	0.0%	3.2%	0.9%
Pedalcycles	0	1	1	0.0%	3.2%	0.9%
Total	**75**	**31**	**106**			





Crash Analyses

The primary location for intersection crashes occurred at the signalized locations in the study area. A large number of these crashes were angle/left-turn related, which are crash types that signals are typically implemented to reduce. Rear-end crashes were usually the second most prevalent crash type at the signalized intersections.

- ***Central Avenue & Ludlow Avenue***: There were 11 angle/left turn crashes and 9 rear-end crashes. The remaining 4 crashes were sideswipe-meeting, sideswipe-passing, fixed object, and head-on. The collision diagram for this intersection does not lead to a single explanation for the crash pattern at this location. Four of the rear-end crashes occurred after vehicles **exited** the intersection and may be related to a midblock crossing in front of the former police station. Six of the angle/left-turn crashes appear to be related to vehicles making a left turn onto Central Parkway from NWB Ludlow Avenue; this movement has protected/permissive left-turn signal phasing. Three of the other angle crashes are located at driveways adjacent to the intersection.
- ***Whitfield Avenue & Ludlow Avenue***: The offset intersection configuration led to 13 angle/left-turn crashes and 4 rear-end crashes. There were also 3 fixed object/parked car crashes in the Ludlow Avenue approaches to Whitfield Avenue. The remaining 3 crashes were sideswipe-passing, sideswipe-meeting, and pedestrian. The pedestrian crash occurred on the sidewalk on Ludlow Avenue approximately 140 feet west of the intersection. This is the only signalized intersection located within the narrower pavement cross section of the study area. The lack of

space available for a left-turn bay and the offset configuration definitely impacts the crash pattern at this location. The narrower pavement area may also contribute to the sideswipe and pedestrian crashes here.

- ***Rue De La Paix & Ludlow Avenue***: There were 5 angle/left-turn crashes, 3 fixed object/parked vehicle crashes, and 2 rear-end crashes. Only two angle/left-turn crashes occurred within the intersection area; one appears to be a NWB left-turning vehicle turning in front of a SEB vehicle where there is no protected left-turn phasing. The remaining three angle crashes appear to be related to improper lane changes and may actually be sideswipe passing crashes.
- ***Lafayette Avenue & Ludlow Avenue***: there were 3 angle/left-turn crashes, 2 rear-end crashes, 1 sideswipe-meeting crash and 1 pedalcycle crash. The pedalcycle crash occurred in the Lafayette Avenue crosswalk and was attributed to an improper turn. One angle/left-turn crash involved a SEB vehicle turning left in front of a NWB vehicle in the outside through lane. One angle/left-turn crash involved a vehicle turning right from the Lafayette Avenue slip ramp and colliding with a NWB through vehicle. The remaining angle/left-turn crash was not in the intersection area and appears to be a mis-coded sideswipe passing crash related to an improper lane change.

The study area section located between Lafayette Avenue and Cornell Place had nearly 1/3 of the study area crashes (31, 29.2%). This 0.68-mile section contains no signalized intersections, but has 10 T-intersections controlled by stop signs on the minor approach. Eleven crashes were angle/left-turn collisions; while another 10 were fixed object/parked vehicle collisions. One of these fixed object crashes involved an eastbound vehicle jumping the curb opposite Cornell Place and impacting an apartment building that is set approximately 40 feet behind the curb. Seven crashes in this section were rear-end collisions. There were two sideswipe passing crashes and one head-on crash in the section. The number of fixed object/parked vehicle crashes, sideswipe crashes, and head-on crashes in this section are particularly remarkable, and indicate that traffic may be traveling at speeds higher than conditions warrant.

Identification of Potential Countermeasures

Potential for Safety Improvement

The Economic Crash Analysis Tool (ECAT) used the crash data compiled with ODOT's CAM Tool to analyze 28 project elements for the study corridor. Each intersection, whether signalized or unsignalized, was analyzed as its own element. Roadway segments between the intersections were analyzed as individual elements. A number of segment lengths are sufficiently short (0.01-0.8 mile) that they are heavily influenced by the intersection radius length at each end of the segments. The Existing Conditions Expected Average Crash Frequency (based on historical crash data) is 27.4376 crashes per year, while the Existing Conditions Predicted Average Crash Frequency is 27.2321 crashes per year. This means that this facility is not currently experiencing an excess of crashes for the existing location conditions. On the other hand, modifications to the existing conditions may still reduce predicted crashes if appropriate countermeasures are implemented.

Potential Countermeasures

The review of existing intersection Level of Service, corridor crash patterns, and existing land uses indicates that a number of countermeasures may be appropriate for the corridor.

1. ***Convert 4-lane roadway to 3-lane cross section with turn lane (TWLTL)***, also referred to as a Road Diet. A center turn lane provides a buffer that functions as a median between opposing travel lanes and provides a refuge for left-turning vehicles and pedestrians who may be using a midblock crossing. This modification will also allow a dedicated left-turn lane to be installed on Ludlow Avenue at the south leg of Whitfield Avenue, which should alleviate some of the angle/left-turn and sideswipe crashes that have occurred at that intersection. Signal operation analysis at Whitfield Avenue was not included in this study; adjustments to signal phasing should be reviewed prior to implementing a left turn lane at the intersection. As part of the Road Diet, curb extensions at pedestrian crossing points are recommended to make pedestrians more visible before they enter the travel lanes. A Road Diet typically reduces the frequency of drivers speeding, which is a further benefit to reducing the severity of pedestrian crashes. Road diets also have a positive impact on reducing speeds by contributing to a "platooning effect" where the lead vehicle will control the speed. Bus stops along the corridor will require vehicles to stop for loading and unloading which will also provide for reduced speeds.
2. ***Install Rectangular Rapid Flashing Beacon at midblock crossing.*** The City of Cincinnati is specifically concerned about increased pedestrian crossings that are related to the NWB transit bus stop located northwest of the Clifton Hill Avenue T-intersection. Since this crossing is located where traffic on Ludlow Avenue is otherwise not controlled, an RRFB is recommended to provide greater visibility when pedestrians are in the crosswalk.
3. ***Improve crosswalk markings***. Crosswalks in the study area are marked with traditional transverse crosswalk lines. Making all crosswalks more visible with both high-intensity longitudinal markings (ladder-style or "piano keys" style) and appropriate signage/beacons will provide greater visibility for pedestrians in the corridor. At the Lafayette Avenue right-turn slip ramp, realign the crosswalk to be parallel to and four feet in front of the stop line to create a shorter crossing distance and provide more pedestrian visibility for right-turning vehicles.
4. ***Improve signal visibility***. Making all signal heads 12-inch LED lenses should improve their visibility. Some signal heads are 8-inch diameter, and most are incandescent lenses. Locations will need to be checked for overhead clearance and ability of the span to carry the additional load of 12-inch lenses. Moving signal heads to standard locations above the proposed lane configurations will encourage driver compliance with the signal indications.
5. ***Remove Right-turn slip ramps (bypass lanes)***. This improvement does not have a Countermeasure Mitigation Factor (CMF) available to include in the ECAT analysis; however it is recommended to reduce conflict points at the Central Parkway and Rue De La Paix intersections. Under current conditions, these ramps encourage excessive speeds, create unnecessary conflict points in the intersection area, and create extra pedestrian exposure to vehicles. Removing these ramps will calm vehicular traffic and improve pedestrian safety.

Proposed conditions concepts for the Road Diet are in Appendix D.

Proposed Countermeasure Evaluation

The primary modification at the Central Parkway intersection is removing the long-radius right-turn slip ramps (bypass lanes) for the SEB movement and the NB movement. The ramps rerouted right-turn traffic from the signalized intersection, improving traffic flow at what was formerly an extremely high volume location. With the changes in local traffic patterns that accompanied revisions to the I-75 access points, these slip ramps are no longer necessary to provide adequate Level of Service, as indicated by the Existing Conditions analysis. Additionally, these ramps encourage excessive speeds, create additional conflict points in the intersection area, and create extra pedestrian exposure to vehicles. Removing these ramps will calm vehicular traffic and improve pedestrian safety. This particular countermeasure is not reflected in the ECAT analysis because there are no CMFs available for this particular improvement. The SEB right-turn movement on Ludlow Avenue will be incorporated into the outside SEB through lane. The NB right-turn movement on Central Parkway will be incorporated into the outside left-turn lane. The total number of signal approach lanes will remain the same on the primary roadway alignments; the only modification is removing the slip ramps that currently operate outside the signalized movements.

The SEB right-turn slip ramp at Rue De La Paix is also proposed to be removed, for the same reasons. At this intersection, the outside through lane will become an exclusive right-turn lane. This allows for the transition into the Road Diet typical section. The total number of signal approach lanes on the SEB leg of the Rue De La Paix intersection will remain the same.

The Road Diet is proposed to begin the 3-lane typical section south of the Rue De La Paix & Ludlow Avenue intersection and continue to the southeast study area termini at Whitfield Avenue. This improvement will provide one through lane and a dedicated left-turn lane at all intersection approaches on Ludlow Avenue. The typical section between Rue De La Paix and Cornell Place will include one of three options: 1) a bike lane with a buffer on both sides of the street; 2) on-street parking on both sides of the street; or 3) on-street parking on one side of the street with 6 foot-wide bike lanes and 2 foot-wide buffers on either side of the travel lanes. If bike lanes are included, they would tie into the existing bike lanes at the northwest end of the study area. If on-street parking is maintained, provide curb extensions at pedestrian crossing locations to provide shorter crossing distances and better visibility for pedestrians.

Between Cornell Place and Whitfield Avenue, provide either on-street parking on one side of the street with narrow (10-11 feet) travel lanes OR provide wide (12-14 feet) travel lanes. If parking is provided on one side of the street, use full-lane width curb extensions at pedestrian crossing locations. If wider travel lanes are used, provide 2-4’ wide curb extensions at pedestrian crossing locations if possible to achieve proper corner radii at intersections.

The lane configuration modifications were analyzed to determine if they provided appropriate Levels of Service at the existing signalized intersections on the northwest side of the study area. Signalized analysis used HCS 6 methodology within Synchro 10.0 analysis. While all intersections have a decrease in the Level of Service, all fall within the typical range for urban intersections. In fact, the only approach that operates at LOS D is the SEB left-turn lane at Lafayette Avenue during the PM Peak Hour. LOS D is considered acceptable for urban traffic conditions.

Table 3 - Proposed Countermeasures Predicted Level of Service

Intersecting Street(s)	2019 AM Peak LOS	2019 PM Peak LOS
Central Parkway	B	B
Rue De La Paix	B	C
Lafayette Avenue	B	C SEB LT = D

The proposed countermeasures were incorporated in the ECAT analysis and applied to the specific project elements as appropriate. The results indicate that the Proposed Conditions Predicted Average Crash Frequency is lower than the Existing Conditions Expected Average Crash Frequency and the Existing Conditions Predicted Average Crash Frequency. The difference between Existing Conditions Expected Crash Frequency (27.4376 crashes/year) and the Proposed Conditions Predicted Crash Frequency (16.8320 crashes/year) is more than 10 crashes per year, which is a 38.7% improvement over Existing Conditions. The Project Safety Performance Report is located in Appendix E.

The Benefit/Cost Analysis indicates that the proposed countermeasures will provide a Net Present Value of Safety Benefits of $4,826,900. The Net Present Value of the Project is $172,300, including a 20% cost to design and a 10% contingency. All work is intended to be completed inside existing Right-of-Way. These figures indicate that the Benefit/Cost ratio for the proposed countermeasures is 28.01, due to the relatively low cost of installation. The Safety Benefit-Cost Analysis Worksheet is in Appendix G.

Conclusions

The proposed countermeasures implemented as a comprehensive corridor Road Diet should reduce the number of crashes in the corridor by an average of 10 per year. Since the corridor is supporting up to 60% lower traffic volumes than in the past, the existing roadway has an excess capacity that encourages problematic driver behavior such as excessive speeding. Adjusting the travel lanes to reflect the current traffic demand while providing facilities for active transportation and supporting access to transit stops creates a safer transportation facility for the variety of users in the corridor.

Recommendations and Prioritization

<u>Recommended solutions</u>

Short Term:

- Road Diet (convert 4-lane cross section to 3-lane with TWLTL) pavement marking revisions
- Improve crosswalks with high visibility markings
- Improve Signal Visibility

Medium Term:

- Road Diet (convert 4-lane cross section to 3-lane with center turn lane) curb extensions
- Install Rectangular Rapid Flashing Beacon at midblock crossing near Clifton Hills Avenue
- Improve crosswalk markings to incorporate curb extensions
- Remove Right-turn slip ramps at Central Parkway and Rue De La Paix

Appendices

Appendix A – Existing Conditions Diagram

Appendix B – Existing Conditions Level of Service Analyses

Appendix C – Collision Diagrams

Appendix D – Proposed Concepts

Appendix E – Project Safety Performance Report and Benefit/Cost Analysis

Appendix F – Proposed Conditions Level of Service Analyses

Appendix G – Benefit/Cost Analysis

Appendix H – Traffic Counts