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Clague Road Corridor Study

Clague Road from Lorain Road to the Westlake
City Line

October 6, 2020



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Executive summary

The City of North Olmsted has retained Mott MacDonald to study the Clague Road corridor from just north of Lorain Road, to the Westlake City Line. The purpose of this study is to investigate existing conditions, examine corridor crash data trends, and identify safety and congestion improvements prior to an upcoming resurfacing of the study corridor (ODOT PID 113260).

Existing Conditions

The study corridor is approximately 1 mile in length and primarily residential. There are 12 intersections along the study corridor, including one signalized intersection at Clague and Maple Ridge Road. The corridor is a two-lane section throughout, however there is a northbound left turn lane on the south end of the corridor at Delmere Drive. No other intersections currently have left turn lanes.

All intersections have north-south marked crosswalks, but the only east-west crossings of Clague are at the Maple Ridge Road signalized intersection and at a pedestrian actuated mid-block crossing with beacon at the Clague Park driveway.

Corridor Crash Summary

There were 115 crashes along the study corridor between 2015 and 2019 with 23 injury crashes and no fatal crashes. The predominant crash type was rear end, accounting for 73% of all crashes.

Crashes were clustered near intersections, with the primary crash cluster at the signalized intersection at Maple Ridge Road (48 crashes), and secondary crash clusters at Westchester Drive/Alexander Drive (16 crashes), between Stoneybrook Drive and Marion Drive (15 crashes), and at Delmere Drive (5 crashes). 41% of all crashes occurred on wet/snowy/or icy pavements, with some crashes identified as having occurred in ponding or standing water. There was one pedestrian crash on the corridor during the data period involving a pedestrian crossing Clague near the Delmere Drive intersection.

Recommended Countermeasures

Mott MacDonald identified the following countermeasures to address crash patterns, corridor operations, and safety for both vehicle and non-motorized users of the corridor:

At the Intersection of Clague Road and Maple Ridge Road

- Install northbound left turn lane
- Install curb along intersection approaches with drainage inlets tying into existing system
- Replace the existing signal (if necessary), and adjust signal timing and phasing
- Replace curb ramps

At the Intersection of Clague Road and the Clague Park drive

- Install pedestrian actuated Pedestrian Hybrid Beacon (on new mast arm if necessary)
- Install curb along approaches to PHB and replace and align curb ramps
- Install advance pedestrian crosswalk signage
- Replace Clague Park driveway apron

1 Project Background

The Clague Road Corridor Study extends approximately 0.9 miles along Clague Road from just north of Lorain Road to the Westlake City Limits in eastern North Olmsted, OH (Figure 1).

The City of North Olmsted has retained Mott MacDonald to examine traffic and safety along the Clague Road study corridor and to identify potential corridor and site-specific improvements for implementation in conjunction with an upcoming resurfacing project.

1.1 Existing Conditions

The Clague Road corridor is a north-south minor arterial connecting I-90 to I-480 through the communities of Bay Village, Westlake, and North Olmsted.

The corridor is primarily single-family residential, with some multi-family residential on the south end of the study area near Lorain Road. The corridor has sidewalk on both sides and marked pedestrian crossings parallel to Clague at intersections.

Crosswalks across Clague Road are located at the Maple Ridge Road signalized intersection, and at a mid-block crossing with flashers near Clague Park. Currently, there is no public transit service along Clague Road, however RTA serves Lorain Road east-west with bus route #75.

Through the study area, the corridor is a two-lane section without dedicated turn lanes. There is one signalized intersection within the study area, at the tee-intersection with Maple Ridge Road.

Generally, the corridor is uncurbed, however there are drainage inlets at grade a few feet off the pavement on both the east and west sides of the roadway.

Congestion is a common along the corridor during peak periods due to signal inefficiency and capacity constraints at Maple Ridge Road, leading to frequent rear end crashes. The corridor connects I-90 and I-480, both of which have partial interchanges with Clague Road. Much of the travel demand along this corridor is attempting to reach these interchanges to/from points east.

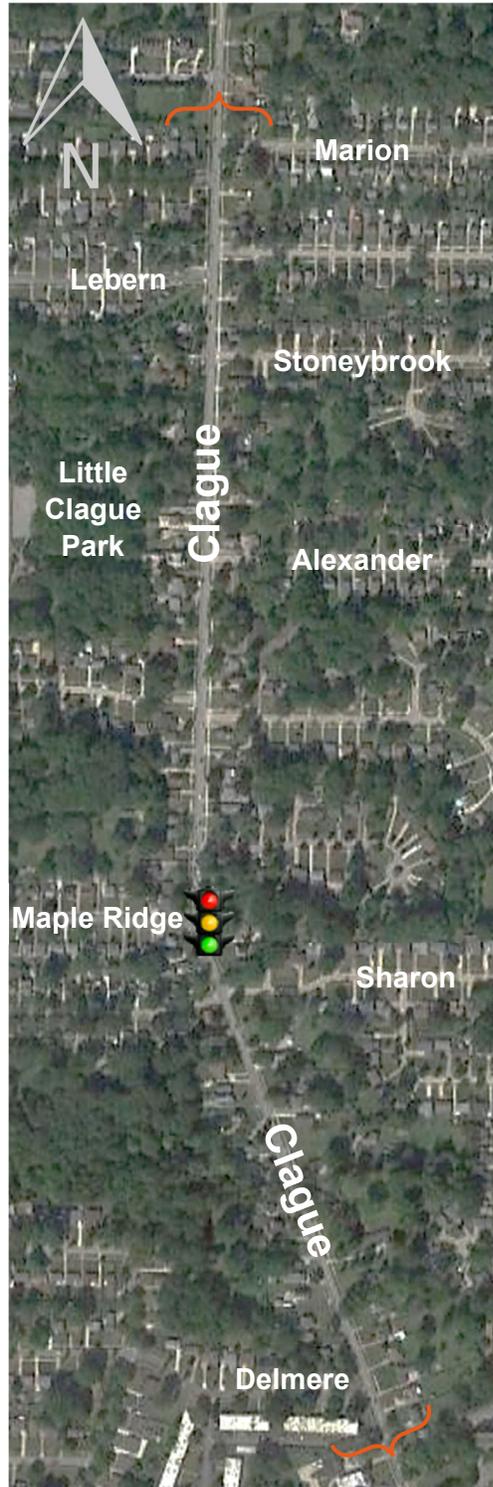


Figure 1 - Clague Road Corridor Study Area

2 Crash Data Analysis

Mott MacDonald obtained crash data for the Clague Road corridor using ODOT's GIS Crash Analysis Tool (GCAT) within the Traffic Information Mapping System (TIMS). Mott MacDonald downloaded crash data and associated crash reports for the 2015-2019 crash data period and examined the data using ODOT's Crash Analysis Module Tool (CAMTool). Complete crash data is presented in **Appendix A**.

The crash data corridor extends along Clague Road from a point just north of the Lorain Road intersection to the Westlake City Limits. This 0.9-mile corridor includes the signalized intersection at Maple Ridge Road, and 11 two-way stop controlled (TWSC) residential street intersections. The corridor features over 60 residential driveways, and one pedestrian actuated flashing mid-block crossing connecting the east side of the corridor to Clague Park.

2.1 2015-2019 Crash Data Summary

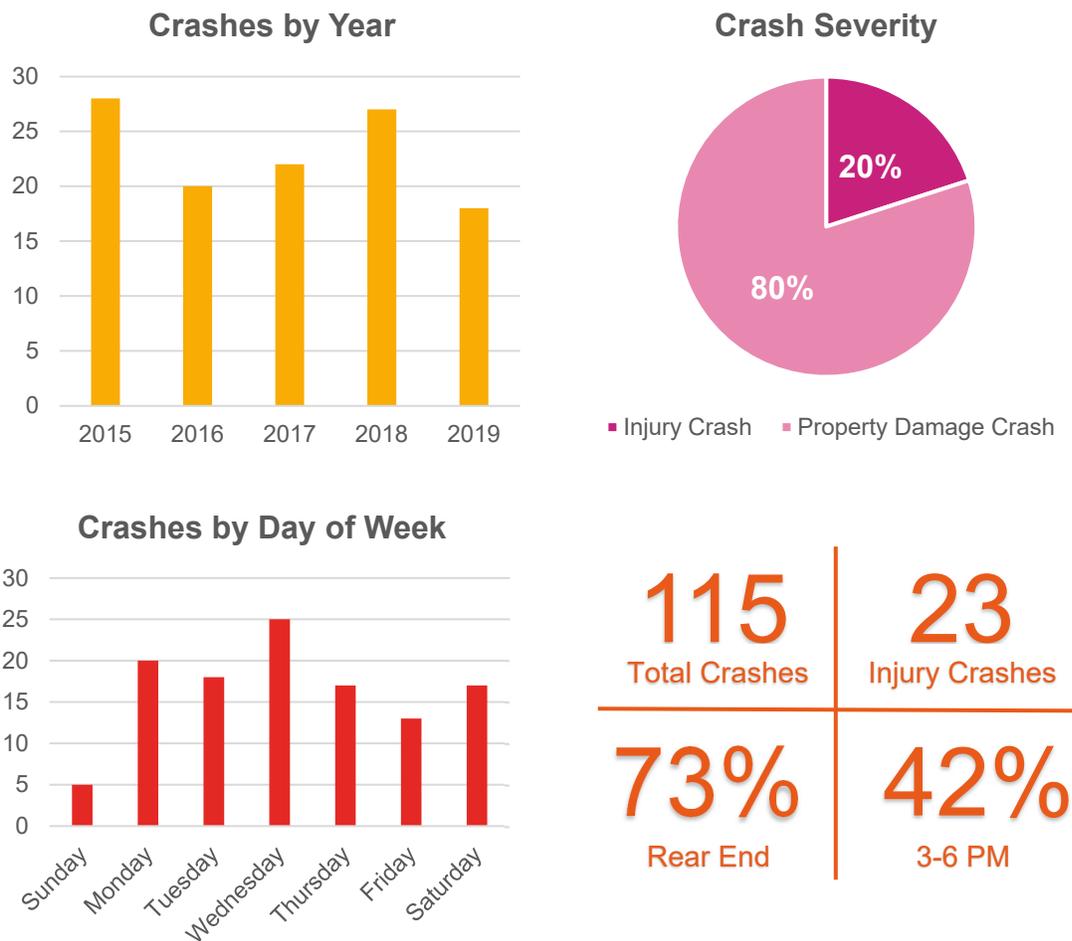


Figure 2 - 2015-2019 Crash Data Summary

Of the 115 crashes that occurred along the Clague Road corridor from 2015 to 2019, 23 resulted in an injury. Of these 23 injury crashes, there were 10 total minor injuries, and 3 incapacitating injuries. Generally, most crashes were low speed property damage only (PDO) crashes, with 67% of all crashes occurring at an officer estimated speed of 20 MPH or lower.

The prevalence of rear end crashes, 73% in total, indicates heavy congestion exists along the corridor (Table 1). Further, the relative lack of any other crash type along a corridor of this length indicates that access to driveways and residential side streets may be constrained, leading to rear end crashes involving vehicles waiting for a gap to turn. A pedestrian crash occurred in 2019 involving a pedestrian crossing Clague Road between Delmere Drive and Lorain Road, this crash resulted in minor injuries to the pedestrian.

Table 1 - Crashes by Crash Type

Crash Type	Frequency	%
Rear End	84	73.0%
Fixed Object	8	7.0%
Backing	5	4.3%
Sideswipe-Passing	4	3.5%
Left Turn	4	3.5%
Angle	4	3.5%
Head On	3	2.6%
Animal	1	0.9%
Right Turn	1	0.9%
Pedestrian	1	0.9%
Total (2015-2019)	115	

Overall, crashes occurred during peak periods, primarily during the PM peak of 3 PM to 6 PM (Figure 3). As a major cross-county commuter route connecting I-90 and I-480, it is not unusual to see higher crash patterns during peak periods.

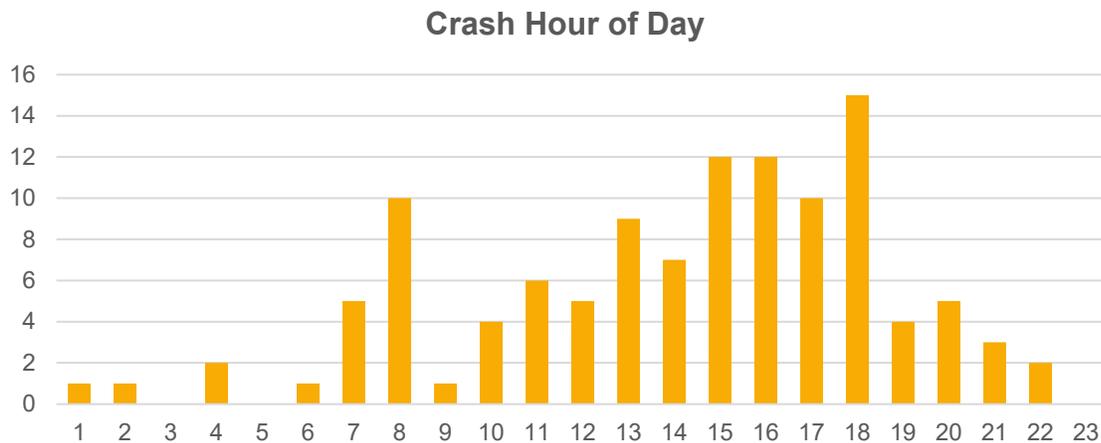


Figure 3 - Crash Distribution by Hour of Day

2.2 Crash Location

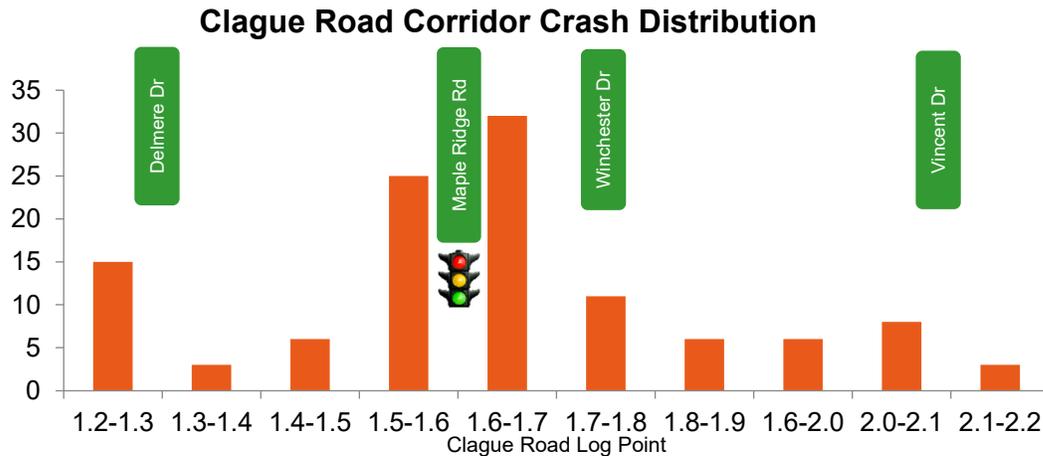


Figure 4 - Corridor Crash Distribution by Location

Mott MacDonald verified crash locations by comparing the data obtained through the GCAT system to location information in the actual crash report of each crash. After verifying crash locations, crashes were organized by their ODOT log point (shown previously in Figure 4). The corridor extends from approximately log point 1.2 to 2.2. A log point is a geographic reference to a specific point on a corridor, broken up here in tenths of a mile.

Of the 115 crashes observed from 2015 to 2019, roughly 50% occurred at the Maple Ridge Road intersection. Another 16% occurred near the Delmere Drive intersection, and approximately 15% occurred between Stoneybrook Drive and Vincent Drive, which is a 600 ft stretch of the Clague Road corridor containing four TWSC T-intersections.

2.3 Existing Condition Corridor Safety Performance

Mott MacDonald examined the existing safety performance of the corridor using ODOT’s Economic Crash Analysis Tool (ECAT) to determine potential for safety improvement or PSI. PSI presents the difference between the expected (based on similar sites statewide) and predicted (based on Clague Road crash data) average crash frequencies. A positive potential for safety improvement implies that a given site exhibits higher crash frequencies when compared to similar sites across the state.

The Clague Road corridor as a whole exhibits a positive potential for safety improvement.

Mott MacDonald also used ECAT to identify positive PSI locations along the Clague Road corridor. Identifying locations with a positive PSI allows for the development of targeted site-specific countermeasures within a broader corridor safety improvement.

Based on the ECAT analysis, Mott MacDonald identified the section between Delmere Drive and Maple Ridge Road with the highest PSI, implying a higher than expected average crash frequency at this location. Overall, this section experiences over 2 crashes per year more on average than would be predicted based on the existing condition. Congestion approaching Maple Ridge Road is likely a leading factor in this result.

Overall, the corridor’s highest PSI by crash type was in rear end crashes. The Clague Road corridor sees more rear end crashes per year on average, than would be predicted on a corridor of similar length and makeup.

2.4 Intersection Crash Analysis

84 crashes (73%) from 2015 to 2019 occurred near or at an intersection along the Clague Road study corridor. Table 2 presents crash frequencies for the intersections with the most crashes during the data period. Due to the proximity of some intersections, several have been grouped together. Crash diagrams for these key locations are presented in **Appendix B**.

Table 2 - Intersection Crash Frequency (2015-2019)

Intersection(s)	Crashes	% of 2015-2019 Total
Stoneybrook to Marion	15	13%
Westchester to Alexander	16	14%
Frank/Maple Ridge/Carriage	48	42%
Delmere Drive	5	4%

2.4.1 Frank Street/Sharon Drive, Maple Ridge Road, Carriage Lane



Between 2015 and 2019, there were 48 crashes between Frank St/Sharon Drive and Carriage Lane, including the Maple Ridge Road signalized intersection (Figure 5). Of these crashes, there were 6 injury crashes.

The predominant crash type at the intersection was rear end, which represented 80% of all crashes between these three intersections. Of the 48 crashes, 23 crash reports (48%) specifically cited the crash location as the Maple Ridge Road intersection. While only half of the crashes specifically cited the Maple Ridge Road intersection, queueing at the intersection routinely backs up to Frank/Sharon for northbound traffic, and to Carriage for southbound traffic. The lack of a dedicated northbound left turn lane and related signal inefficiencies are likely impacting the crash pattern, with vehicles stopping at the signal being rear ended by vehicles unaware that the car in front of them is stopping to complete their turn.



Figure 5 - Northbound Approach to Maple Ridge Road

2.4.2 Westchester Drive to Alexander Drive

Clague Road from Westchester Drive to Alexander Drive saw predominantly rear end crashes over the 2015-2019 crash data period. These crashes were split roughly 50/50 in terms of directionality, with 7 crashes occurring in the northbound direction, and 9 crashes in the southbound direction, approaching Maple Ridge Road.



The lack of left turn lanes and a generally inefficient corridor are the primary contributing factors in most of the crashes in this section, 13 (81%) of crashes along this section of Clague Road occurred in “Stopped or Slowing Traffic” which is an indication of queueing in the area, either originating at Maple Ridge Road in the case of southbound traffic, or northbound left turning vehicles waiting for gaps.

Overall, 3 of the 16 crashes in this section resulted in an injury over the crash data period, producing only one minor injury.

2.4.3 Stoneybrook Drive to Marion Drive



Of the 15 crashes that occurred along this 700 ft section of the Clague Road corridor between 2015 and 2019, 5 (33%) resulted in an injury. None of these injury crashes resulted in a serious injury.

Most of the crashes observed in this section were rear end crashes, accounting for 53% of the 15 crashes. There were 4 backing crashes along this corridor, however there was no defined trend associated with them. One backing crash was the result of a truck making a U-Turn that it could not complete, and another was related to a temporary lane closure.

2.4.4 Delmere Drive

Delmere Drive (Figure 6) is the only location on the corridor where a northbound left turn is provided. The intersection is also the one with the fewest crashes within the study corridor. This is notable as queueing from both Lorain Road to the south, and Maple Ridge Road to the north impact this intersection during peak periods.



A dedicated left turn lane allows vehicles turning left from the northbound direction to exit the thru lane and allow northbound thru traffic to continue unobstructed, reducing the risk of rear end crashes caused by turning movement demand.



Figure 6 - Delmere Drive Intersection

2.5 Pavement Condition

The proportion of crashes occurring on wet, snowy, or icy pavements along the corridor is higher than would be expected. The high proportion of crashes on non-dry pavements indicates potential drainage issues and/or roadway surface polishing along the entirety of the corridor.

The corridor is predominantly uncurbed, as shown in Figure 7, except for a part of curbed section on the south end of the study area near Lorain Road (Figure 8). As shown, the part of the study area near Lorain Road is higher than the area approaching Maple Ridge Road, with a notable downgrade from Lorain to Maple Ridge.

There are no open ditches along the corridor for water collection and storage, but there is a closed system with inlets along the east and west side of Clague Road. Examination of the cross-section and drainage properties of Clague Road is warranted, and consideration of a curbed section with curb inlets may be necessary.

41%
Wet/Snowy/Icy
Pavement Condition

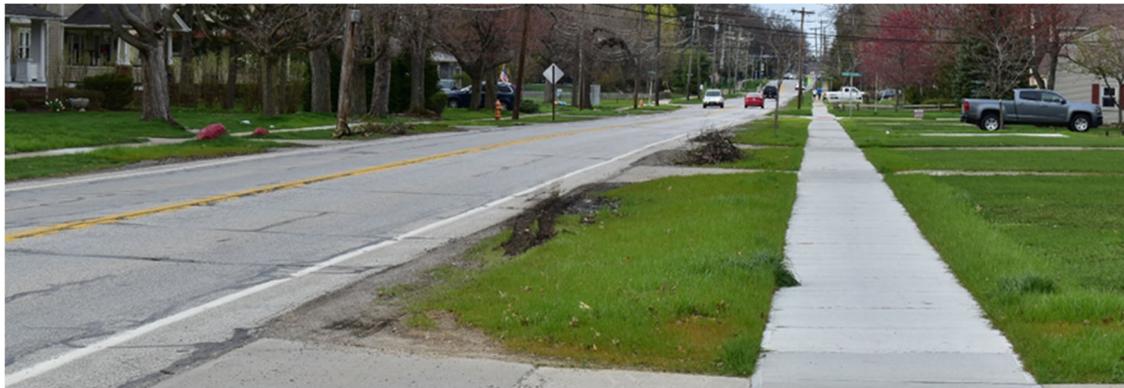


Figure 7 - Clague Road Northbound Approaching Stoneybrook Drive



Figure 8 - Clague Road Northbound near Lorain Road

3 Transportation Analysis

3.1 Data Collection

Mott MacDonald used StreetLight Data to collect corridor volumes and turning movement counts. In addition, corridor volumes were obtained from NOACA’s regional travel demand model and historic traffic counts were obtained from the City of Westlake for the Clague/Westwood intersection. Mott MacDonald chose StreetLight as its data reflects conditions in the Spring and Fall of 2019. The ongoing COVID-19 pandemic has significantly altered travel patterns throughout the region, impacting the accuracy of real-time data collection efforts.

The opening year, 2024, is based on the upcoming resurfacing project schedule and includes current year traffic volumes. Design year 2044 includes forecasted volumes grown from the opening year with growth rates provided by NOACA, and presented in **Appendix B**.

3.2 Left Turn Lane Analysis

Using the volumes collected, Mott MacDonald analyzed intersections along the Clague Road corridor with elevated numbers (>30/peak hour) of left turns to determine if left turn lanes were warranted. For unsignalized and signalized intersections, Mott MacDonald used the methods prescribed by the ODOT Location and Design Manual, Volume 1 (L&D). Left turn lane warrants and storage length calculations are presented in **Appendix C**.

3.2.1 Unsignalized Intersections

Alexander Drive on the north end of the study corridor, and Frank Street/Sharon Drive just south of Maple Ridge Road had an elevated number of left turn lanes during either the AM Peak, PM Peak, or both. Using L&D Figure 401-5a, left turn lane warrants were conducted for the Alexander Drive SBL, Frank Street NBL, and Sharon Drive SBL movements. Each movement had approximately 5% left turns, so the 5% left turn lane warrant curve was used. Table 3, presents the results of the unsignalized left turn lane warrant analysis, for low speed (<40 MPH Posted) roadways.

Table 3 - Left Turn Lane Warrant Analysis Results

Intersection/Movement	Left Turn %	AM Peak Warrant	PM Peak Warrant
Alexander Drive, SBL	5%	Warrant Met	Warrant Met
Frank Street, NBL	5%	Warrant Met	Warrant Met
Sharon Drive, SBL	5%	Warrant Met	Warrant Met



Figure 9 - Alexander Drive SB Approach

At each intersection analyzed, the AM and PM peak warrants were met for the 5% left turn curve. While these left turn lane warrants were met, there are multiple factors which go into whether to install left turn lanes at an intersection.

At Alexander Drive (Figure 9), for example, there is approximately 115 ft between the intersection and the pedestrian crossing for Clague Park, north

of the intersection. While a left turn lane may be desirable for southbound movements, even the minimum recommended left turn lane length (100ft) would impact the pedestrian crossing, and potentially place the left turn lane inside of this crossing, which is not desirable for pedestrians or bicycle users.

Similarly, at Frank Street/Sharon Drive (Figure 10), there is approximately 250 feet between the intersection and the signalized intersection at Maple Ridge Road, north of Frank/Sharon. A left turn lane for the southbound movement to Sharon Drive may be desirable but may also impact the length of any left turn lane proposed at Maple Ridge Road.

In the northbound direction, a left turn lane to Frank Street may be confused by drivers as the left turn lane to Maple Ridge Road. Vehicles entering the left turn lane thinking that it continues to Maple Ridge Road may be surprised to see a vehicle stopping short to turn left onto Frank Street, creating the potential for crashes.



Figure 10 - Maple Ridge Road from Frank Street/Sharon Drive (Facing North)

3.2.2 Maple Ridge Road

At Maple Ridge Road (Figure 10, above), the existing signal provides a leading protected left-thru phase to address heavy left turn queuing in the northbound approach lane. There is no left turn lane at this intersection and left turning vehicles that arrive after the protected phase must wait until a gap appears in southbound traffic before completing their movement.

As both northbound and southbound traffic can be heavy during peak periods, it can be difficult for a northbound vehicle to complete their turn, resulting in heavy queuing that propagates south back towards Lorain Road.

Using volumes from StreetLight, and the ODOT L&D Manual method for calculating left turn lane length at signalized intersection, the resulting recommended minimum left turn lane length at Maple Ridge Road is 200 feet for the 2024 PM Peak period. Turn lane calculations are presented in **Appendix C**.

3.3 Capacity Analysis

Mott MacDonald conducted a capacity analysis of the Clague Road Corridor using TransModeler 5 software. The corridor was modeled using geographically referenced imagery for accuracy and scale. While the focus area of the capacity analysis is the Maple Ridge Road signalized intersection, the signals at Westwood on the north end of the corridor, and Lorain on the south end of the corridor were included to fully capture upstream and downstream impacts to Maple Ridge Road.

All capacity analysis results are based on an average of 10 analysis runs per scenario (AM/PM Peaks); detailed data results are presented in **Appendix D**.

3.3.1 Existing Condition Analysis

The existing conditions analysis represents the No Build condition along the corridor. The existing condition model is defined as no geometric or lane use changes. All signal timings used reflect timing data provided by the City.

Overall intersection Level of Service (LOS) is acceptable in the existing condition, however the lack of turn lanes at Maple Ridge Road results in signal timings that favor the northbound thru-left movement at the expense of the other intersection movements. This bias creates delay imbalances between individual movements that results in the intersection appearing to operate better than it does. This is reflected in the results, shown in Table 4, which show much lower delays for the northbound movements as opposed to the other movements for both the 2024 and 2044 No Build analyses.

Table 4 - No Build Capacity Analysis, Maple Ridge Road

Movement	2024 AM		2024 PM		2044 AM		2044 PM	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Clague Road NB	5.3	A	12.6	B	5.6	A	10.8	B
Clague Road SB	12.1	B	13.6	B	35.0	D	14.1	B
Maple Ridge Road EB	32.1	C	38.6	D	30.4	C	35.3	D
Intersection Overall	9.8	A	15.8	B	18.7	B	14.9	B

The effect of these imbalanced delays is overall intersection inefficiency, additional time given to the northbound thru-left movement translates to time lost by other movements, such as southbound Clague Road and eastbound Maple Ridge Road. Providing a left turn phase at all times without a left turn lane creates additional lost time for the southbound movement, especially at times when left turn demand is low.

3.3.2 Queueing

Signal inefficiency at the signal results in queueing originating at Maple Ridge Road and propagating along the Clague Road corridor. Table 5 and present queueing data at the Maple Ridge Road intersection, including the average queue (Avg Queue) length across 10 simulation runs for each analysis, and the average spillback rate (Spillback).

Table 5 - 2024 Existing Condition Queueing Analysis, Maple Ridge Road

Existing Condition	Analysis Year	Maple Ridge EB		Clague Rd SB		Clague Rd NB	
		Avg Queue	Spillback	Avg Queue	Spillback	Avg Queue	Spillback
	2024 AM	317.3	0.0%	20.3	2.8%	129.2	34.8%
	2024 PM	192.5	0.0%	49.6	9.3%	104.4	29.0%
	2044 AM	153.9	0.0%	79.4	26.9%	56.2	18.8%
	2044 PM	577.7	0.0%	28.3	6.3%	142.5	57.6%

Spillback rate represents the proportion of the analysis that queues at one intersection extended upstream into an adjacent intersection. At Maple Ridge Road, northbound queues spillback into the Frank Street/Sharon Drive intersection; southbound queues spillback into the Carriage Lane intersection. Because of the relatively short distances between the signal and the adjacent intersections, Maple Ridge Road is especially susceptible to frequent queue spillback.

3.4 Multi-Modal Access

Sidewalk is present on both sides of the Clague Road corridor throughout the entire study area. There are marked crosswalks and curb ramps with tactile strips for north-south pedestrian traffic at each intersection (signalized or unsignalized) along the corridor.

There are two locations within the study area that provide marked crosswalks for east-west pedestrians across Clague Road. One of these locations is at Maple Ridge Road, where pedestrian countdown heads and pushbuttons are provided. The second is a pushbutton actuated flashing beacon and mid-block crossing at Clague Park (Figure 11).



Figure 11 - Clague Park Mid-Block Crossing

4 Public Outreach

Mott MacDonald, in conjunction with the City of North Olmsted, conducted a public outreach campaign to gain public feedback on the study area and future of the Clague Road corridor. The public outreach campaign included a virtual public information session to broadcast the purpose and need of the study, an online survey for residents to provide feedback, and updates on the study published to a [project specific webpage on the city's website](#).

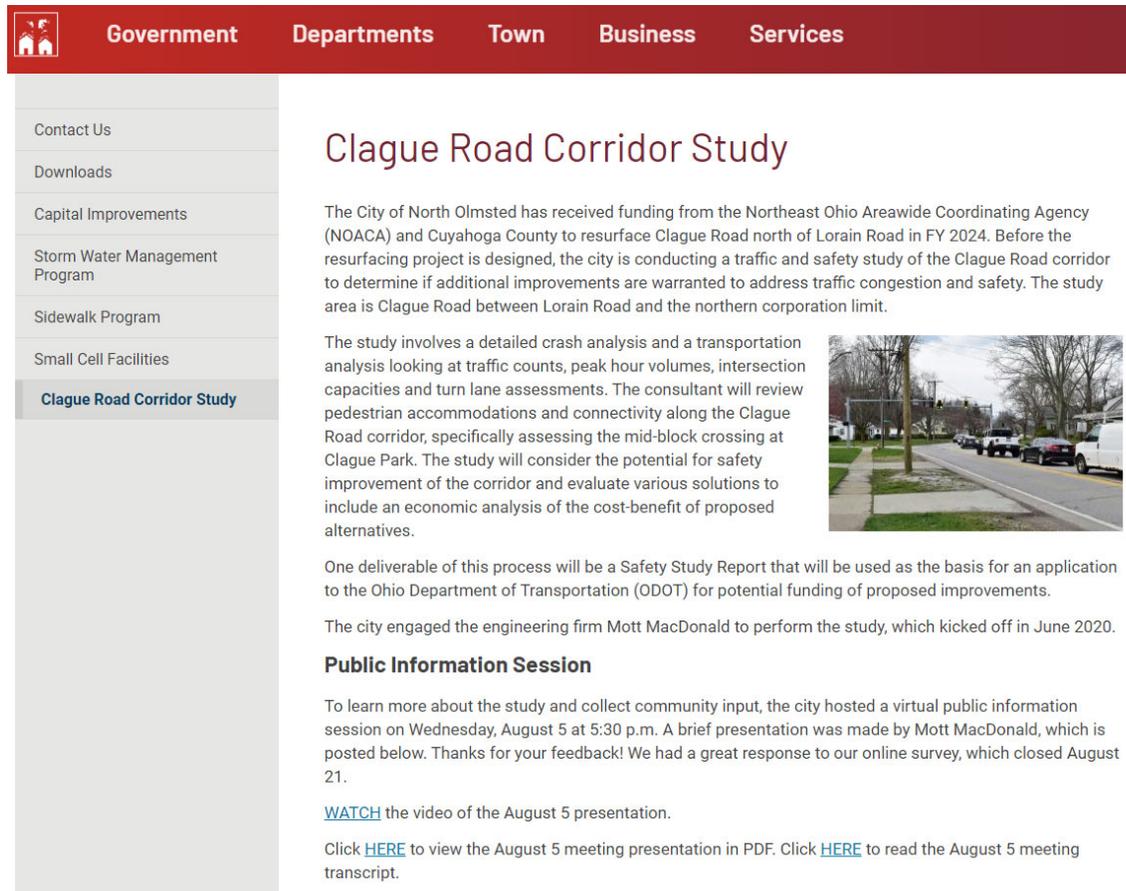


Figure 12 - City of North Olmsted Project Website

4.1 Public Information Session

The public information session, which was held on August 5th, explained the context of the Clague Road Corridor Study, presented the project background and the extent of the study area. The session further presented the current condition of Clague Road (study area section), corridor crash statistics, and a traffic analysis that identified safety issues and proposed improvements, as well as potential funding sources. This session also included information on how to get involved via an online survey and how to get in touch with the project team.

4.2 Engagement Survey Results

190 individuals participated in the online engagement survey, including 178 who reside within the City of North Olmsted. Of the respondents, nearly half reported being daily users of the Clague Road corridor. Usage of the corridor varies, with many respondents indicating they use Clague as part of their commute, or as a route to access to I-90 or I-480. Over 161 participants indicated private vehicle is the most often used mode of transportation on Clague Road followed by walking (51) and cycling (36) (Figure 13).

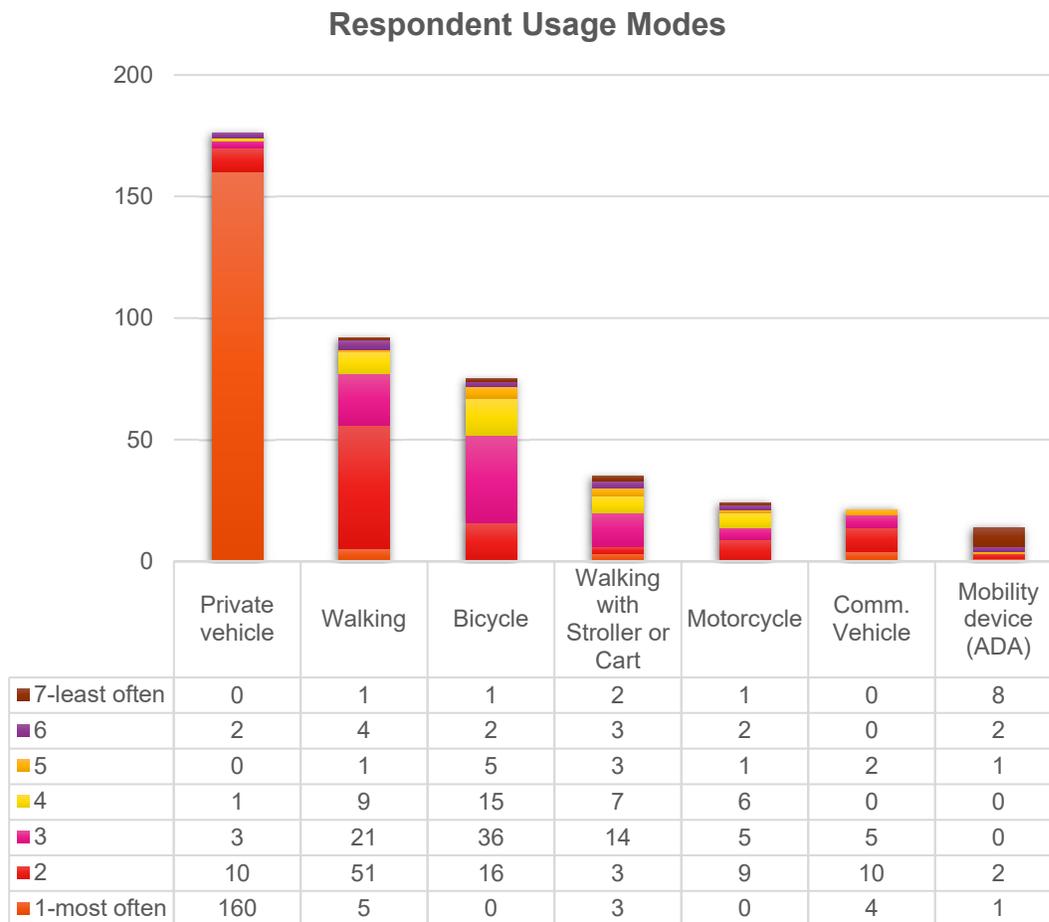


Figure 13 - Respondent Usage Modes

4.2.1 Vehicle Users

The most common feedback among vehicle users is the lack of turning lanes, followed by the perception that the existing lanes are narrow. Vehicle users also indicated that congestion is heavy and frequent along the corridor, specifically at Maple Ridge Road. Vehicle users also identified pavement conditions as a general concern, and difficulty turning left onto or from residential side streets and driveways.

4.2.2 Pedestrian and Active Transportation

The most common feedback among pedestrians and non-motorized users is the condition of the existing sidewalk along the corridor, followed by an interest in improved crosswalks and pedestrian features, especially at Clague Park. Several respondents indicated that vehicles often

do not yield to pedestrians at the existing pedestrian actuated beacon at Clague Park, and that some vehicles travel above the posted speed limit, decreasing pedestrian comfort.

4.2.3 Corridor Characteristics

Multiple respondents indicated concern that improvements to the corridor may change the characteristics of the Clague Road corridor. Residents noted that they do not want to see improvements that increase the right of way width, or which may take away from the residential characteristics of the neighborhood.

While respondents want to see improvements that address vehicle operations and movement along the corridor, they would also like to see improvements to pedestrian features such as improved and more visible crosswalks, especially at Clague Park.



Figure 14 - Engagement Survey Respondent Word Map

5 Proposed Countermeasures and Design Evaluation

Mott MacDonald evaluated several countermeasures to address operations and safety along the corridor. Countermeasures evaluated include geometric changes to Clague Road, pedestrian improvements, and drainage/aesthetic improvements. Each countermeasure incorporates feedback from a virtual public information session and community outreach survey conducted for the purpose of this study.

5.1 Geometric Improvements

Three geometric alternatives were analyzed for comparison to the existing condition:

- **Alternative 1:** Install NB left turn lane and EB right turn lane at Maple Ridge Road
- **Alternative 2:** Install 3 lane section from Delmere Drive to the Westlake City Line, and include a NB left turn lane and EB right turn lane at Maple Ridge Road
- **Alternative 3:** Install a NB left turn lane at Maple Ridge Road
- For all alternatives: Modify signal timings and phasing to optimize operations for the given alternative.

5.1.1 Alternatives Analysis – Capacity

Overall, each alternative improves operations for all movements at the intersection, as shown in Table 6. The addition of a left turn improves intersection efficiency, meaning less green time is lost, and more green time can be distributed among all intersection movements. Notably, there is no significant increase in efficiency or operations gained by the inclusion of an eastbound right turn lane.

Table 6 - Capacity Analysis Results for Proposed Alternatives

	Condition	Maple Ridge EB		Clague Rd SB		Clague Rd NB		Overall	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
2024 AM	Existing Condition	32.1	D	12.1	B	5.3	A	9.8	B
	Alternative 1	18.7	B	7.3	A	2.7	A	6.1	A
	Alternative 2	17.1	B	8.9	A	3.5	A	6.9	A
	Alternative 3	22.9	C	9.1	A	3.5	A	7.5	A
2024 PM	Existing Condition	38.6	D	13.6	B	12.6	B	15.8	B
	Alternative 1	19.2	B	11.7	B	4.0	A	8.9	A
	Alternative 2	16.8	B	13.4	B	5.5	A	10.0	A
	Alternative 3	28.8	C	11.8	B	5.0	A	10.3	B
2044 AM	Existing Condition	30.4	C	35.0	D	5.6	A	18.7	B
	Alternative 1	17.2	B	9.4	A	3.8	A	7.2	A
	Alternative 2	17.6	B	9.0	A	3.5	A	6.9	A
	Alternative 3	22.7	C	9.2	C	4.0	A	7.7	A
2024 PM	Existing Condition	35.3	D	14.1	B	10.8	B	14.9	B
	Alternative 1	20.2	C	11.9	B	5.3	A	9.6	A
	Alternative 2	18.2	B	12.2	B	4.9	A	9.4	A
	Alternative 3	21.3	C	11.7	B	5.0	A	9.6	A

The proposed signal is not coordinated and will operate fully actuated throughout the day. Given peak period volumes, the northbound movement will still receive priority from the signal in fully actuated operation, and therefore the highest level of service.

Average Control Delay Reduction Compared to Existing



Improved signal efficiency results in benefits for all intersection movements, not just the northbound direction. Overall, and regardless of alternative, each intersection movement sees a reduction in control delay (delay caused by the signal) between 30-40%, reflecting the benefit of turn lanes to service high turning demand at the intersection

Corridor travel time sees a notable improvement with the addition of a northbound left turn lane. The addition of a northbound left turn lane results in a reduction in travel time of approximately 20 seconds, which represents a savings of approximately 20% compared to the existing condition.

5.1.2 Alternatives Analysis – Queueing

With capacity, all alternatives saw improvement when compared to the existing condition. The results are the same for queueing; regardless of alternative, overall queueing and average queue lengths are decreased when compared to the existing condition, as shown below in Table 7.

Table 7 - Queueing Analysis Results for Proposed Alternatives

Condition	Maple Ridge EB		Clague Rd SB		Clague Rd NB		
	Queue	Spillback	Queue	Spillback	Queue	Spillback	
2024 AM	Existing Condition	317.3	0.0%	20.3	2.8%	129.2	34.8%
	Alternative 1	65.3	0.0%	10.6	0.8%	30.5	14.0%
	Alternative 2	4.9	0.0%	14.2	0.5%	5.4	0.2%
	Alternative 3	122.1	0.0%	12.5	0.7%	38.9	17.4%
2024 PM	Existing Condition	192.5	0.0%	49.6	9.3%	104.4	29.0%
	Alternative 1	104.1	0.0%	24.0	5.7%	36.8	16.2%
	Alternative 2	7.1	0.0%	36.3	9.7%	7.8	0.2%
	Alternative 3	148.5	0.0%	24.1	6.2%	41.2	17.6%
2044 AM	Existing Condition	153.9	0.0%	79.4	26.9%	56.2	18.8%
	Alternative 1	80.6	0.0%	12.6	0.7%	36.9	14.9%
	Alternative 2	5.6	0.0%	14.9	1.3%	5.1	0.3%
	Alternative 3	231.9	0.0%	10.5	0.4%	59.6	19.7%
2024 PM	Existing Condition	577.7	0.0%	28.3	6.3%	142.5	57.6%
	Alternative 1	87.1	0.0%	29.0	8.9%	31.4	12.9%
	Alternative 2	7.8	0.0%	32.6	8.7%	6.7	0.4%
	Alternative 3	201.5	1.6%	25.1	7.3%	50.8	22.7%

The queueing results above represent two metrics per intersection approach, average queue length (Queue), and spillback rate (Spillback). Average queue lengths represent the average over 10 one-hour analysis simulation runs. Spillback rate is also an average over 10 one-hour runs and represents the average proportion of each one-hour run that a queue originating at Maple Ridge road extends upstream to an adjacent intersection. In the northbound direction, queues spillback to Frank Street/Sharon Drive, southbound to Carriage Lane, and eastbound to the Maple Intermediate School drive.

Queueing performance was directly proportional to the scale of corridor improvements, with Alternative 2, which added a center left turn lane to the entire corridor, performed best compared to Alternatives 1 and 3, which solely focus on intersection improvements at Maple Ridge Road. That said, each alternative provides substantial improvement over the existing condition. For example, Alternative 3, which showed the least queueing reductions, still provides approximately 30% to 50% reductions in average queue length.

5.1.3 Alternatives Analysis – Geometrics & Safety

In Alternative 1, the proposed eastbound right turn lane provides good operational benefit but presents several geometric challenges. The most critical of these are the existing traffic signal poles, controller box, and a large utility pole (Figure 16, next page). While the traffic signal may need to be reconstructed for any of these alternatives, without an eastbound right turn lane, the location of the controller and the utility pole may not be impacted, providing a cost and coordination savings that may exceed any benefit provided by the eastbound right turn lane.

Another major consideration includes pedestrians and non-motorized users of the intersection. The Maple Ridge Road intersection is approximately 1,500 feet from Maple Intermediate School and is used by students walking and biking to/from school.

Given that most of the operational benefit of all three alternatives is found in providing a northbound left turn lane, removing the proposed eastbound right turn lane would maintain the current crosswalk length across Maple Ridge Road, and keep the intersection as pedestrian friendly as possible, while still improving overall intersection operations.

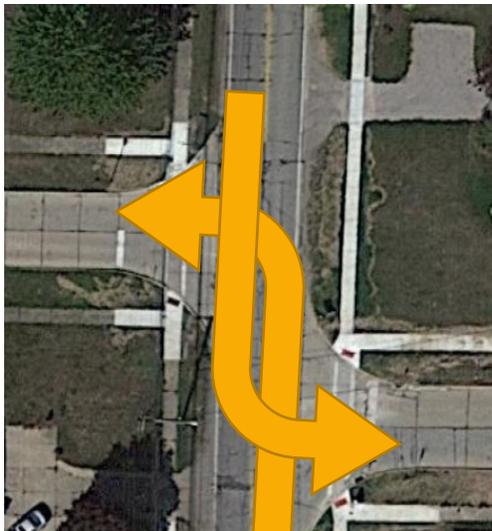


Figure 15 - Opposing Left Turn Movements at Ambour Drive/Winchester Drive

A center two-way left turn lane (TWLTL), as proposed for the study corridor in Alternative 2, provides noticeable operational benefit but introduces some geometric and safety concerns. This is most notable at along the corridor where a TWLTL could produce head-on movements.

The offset between the Ambour Drive and Westchester Drive intersections is such that the paths the two opposing left turn movements overlap head-on (Figure 15), which is both geometrically unfavorable, and an inherent safety risk.

At Frank Street and Sharon Drive, a northbound left turn lane for Frank Street may be confused as the beginning of a left turn lane for Maple Ridge Road. In this case, if a southbound left turn lane were provided for Sharon Drive, this condition would also produce a potential head-on risk.

If no southbound left turn lane were provided for Sharon Drive, it is unlikely that a single northbound left turn lane for Frank Street (a dead-end street) would provide much benefit for safety or operations.



**Figure 16 - Maple Ridge Road Eastbound Approach to Clague Road
(Note the Signal and Utility Pole on the Right Side)**

Alternative 3 proposes a single northbound left turn lane and left turn signal phasing for Clague Road at Maple Ridge Road. While the proposed left turn lane directly benefits vehicle operations, the turn lane along with signal timing improvements will also directly address crashes at and approaching the intersection, which represented 42% of all corridor crashes during the crash data period.

With the northbound left turn lane, left turning vehicles can be stored outside of the travel stream, which reduces the likelihood of future rear end crashes caused by queued left turning vehicles. Further, Alternative 3 maximizes operational benefit while minimizing overall footprint and impact on non-motorized users such as pedestrians.

5.2 Drainage Improvements

The widening of Clague Road to accommodate a northbound left turn lane may impact several drainage structures along the east side of Clague Road. Examination of crash data revealed that a large proportion of crashes occurring along the corridor occurred on wet pavements, or in rainy conditions.

The upcoming resurfacing project (ODOT PID 113260) will improve this condition, however, with the proposed impact to the existing drainage structures there is an opportunity to curb the area within and approaching the intersection to further improve roadway drainage and address wet weather crashes.

Curb can help in other ways as well, by collecting water and directing it to purposely positioned drainage inlets, water draining from the roadway is kept off tree lawns and front yards, which can provide aesthetic benefits to the corridor. Additionally, the presence of curb can enhance the residential character of the neighborhood, which is both a goal of the City in its Master Plan, and of the community, as reflected in the responses to the community outreach survey.

5.3 Pedestrian Improvements

Mott MacDonald examined enhancements to the pedestrian crossing for Clague Road at Clague Park, just north of the Alexander Drive intersection. Currently, the crossing features a pedestrian actuated beacon mounted to a mast arm. There is a “Yield to Pedestrians When Flashing” sign that accompanies the beacon.

Mott MacDonald explored proactive improvements to the mid-block crossing to address known low compliance rates at the existing mast-arm mounted crossing beacon, and to address public interest in creating a welcoming and visible entrance to Clague Park for pedestrians and other non-motorized users.

5.3.1 Rapid Rectangular Flashing Beacon

A Rapid Rectangular Flashing Beacon (RRFB) is a pedestrian actuated device that combines a high visibility fluorescent yellow sign with rapid flashing LED strobes to increase driver awareness of pedestrians using a crosswalk.

As it is pedestrian actuated, the strobe lights are dark until activated by a pedestrian and remain flashing for a given duration of time to allow a pedestrian to cross the road. Installations can be solar powered, and require limited controller equipment, which reduces both cost and maintenance burden.

RRFBs are commonly installed at mid-block crossings, and near schools or along known school routes, such as the installation in Figure 17, installed along W 210th Street in Fairview Park.

RRFBs are installed on the near side of the crosswalk (as approached by a vehicle). The existing driveway apron for Clague Park may constrain the location of the RRFB as a result, requiring the proposed crosswalk to shift several feet either north or south of the existing crosswalk. This would take the crossing out of alignment with the existing walk leading into Clague Park, which may be unfavorable to pedestrians.



Figure 17 - Example RRFB

5.3.2 Pedestrian Hybrid Beacon

A Pedestrian Hybrid Beacon (PHB) is a pedestrian actuated device designed to alert and stop vehicles approaching a pedestrian crossing. A PHB uses two three indication heads mounted to a mast arm above the road to alert drivers of a pedestrian movement. The major difference

between a PHB and a typical traffic signal is its operation. The PHB remains dark when not in use, and only illuminates when actuated by a pedestrian.

When actuated by a pedestrian, the PHB cycles through a pre-timed sequence of flashing yellow, solid yellow, solid red, and flashing red indications alerting oncoming vehicles of a pedestrian movement (Figure 18). Signage mounted to the mast arm directs vehicles to stop on a solid red indication, allowing safe passage of the pedestrian.

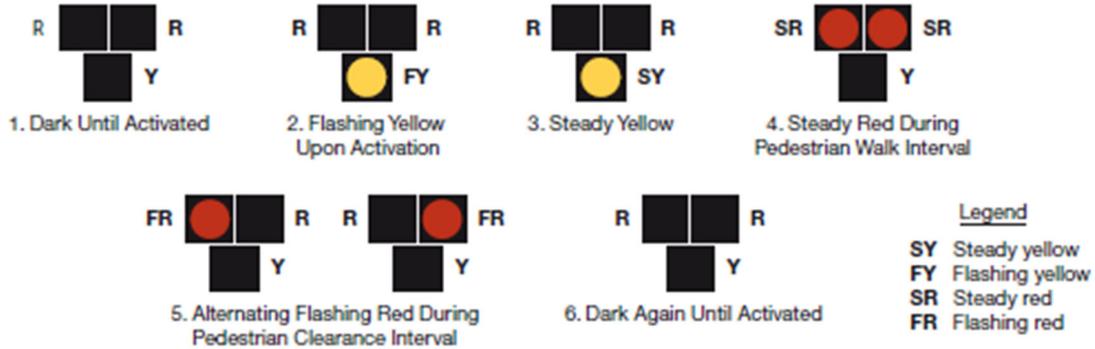


Figure 18 - Typical PHB Activation Sequence (FHWA)

By providing a solid red indication, a PHB directly reinforces the requirement of stopping to allow pedestrians to pass through the crossing, which improves overall crossing safety. A PHB is also a visible indication that will stand out, identifying the entrance of the park and the presence of a pedestrian crossing against other signs and side streets, including Alexander Drive which is approximately 150 ft to the south of the crossing.



Figure 19 - Example PHB

The Federal Highway Administration (FHWA) identifies PHBs as a Proven Safety Countermeasure, and nationwide research shows an average reduction in pedestrian crashes of over 50%, and a reduction in serious injury and fatal crashes of 15% at locations where a PHB

has been installed. Figure 19 (previous page) presents a typical installation of a PHB, along a high-volume corridor in SW Ohio.

5.3.3 Additional Considerations

In order to properly align curb ramps, and position either an RRFB or PHB and associated pedestrian push buttons, it may be necessary to reconstruct the driveway apron to Clague Park. Additionally, curbing along the Clague Road approaches to the PHB should be considered, both to address drainage and wet weather crashes, but also to emphasize the residential nature of the corridor, and encourage slower traffic approaching the pedestrian crossing.

6 Recommendations

6.1 Proposed Countermeasures

Based on an examination of alternatives, and incorporation of feedback from the community, and local agency stakeholders, Mott MacDonald recommends the following countermeasures for implementation alongside the upcoming resurfacing project:

At the Intersection of Clague Road and Maple Ridge Road

- Install northbound left turn lane
- Install curb along intersection approaches with drainage inlets tying into existing system
- Replace the existing signal (if necessary)
- Adjust signal timing and phasing to accommodate new traffic signal
- Replace curb ramps

At the Intersection of Clague Road and Maple Ridge Road

- Install pedestrian actuated Pedestrian Hybrid Beacon (on new mast arm if necessary)
- Install curb along approaches to PHB
- Install advance pedestrian crosswalk signage
- Replace and align curb ramps
- Replace Clague Park driveway apron

Figure 20 (Clague/Maple Ridge) and Figure 21 (PHB) present the recommended countermeasures.

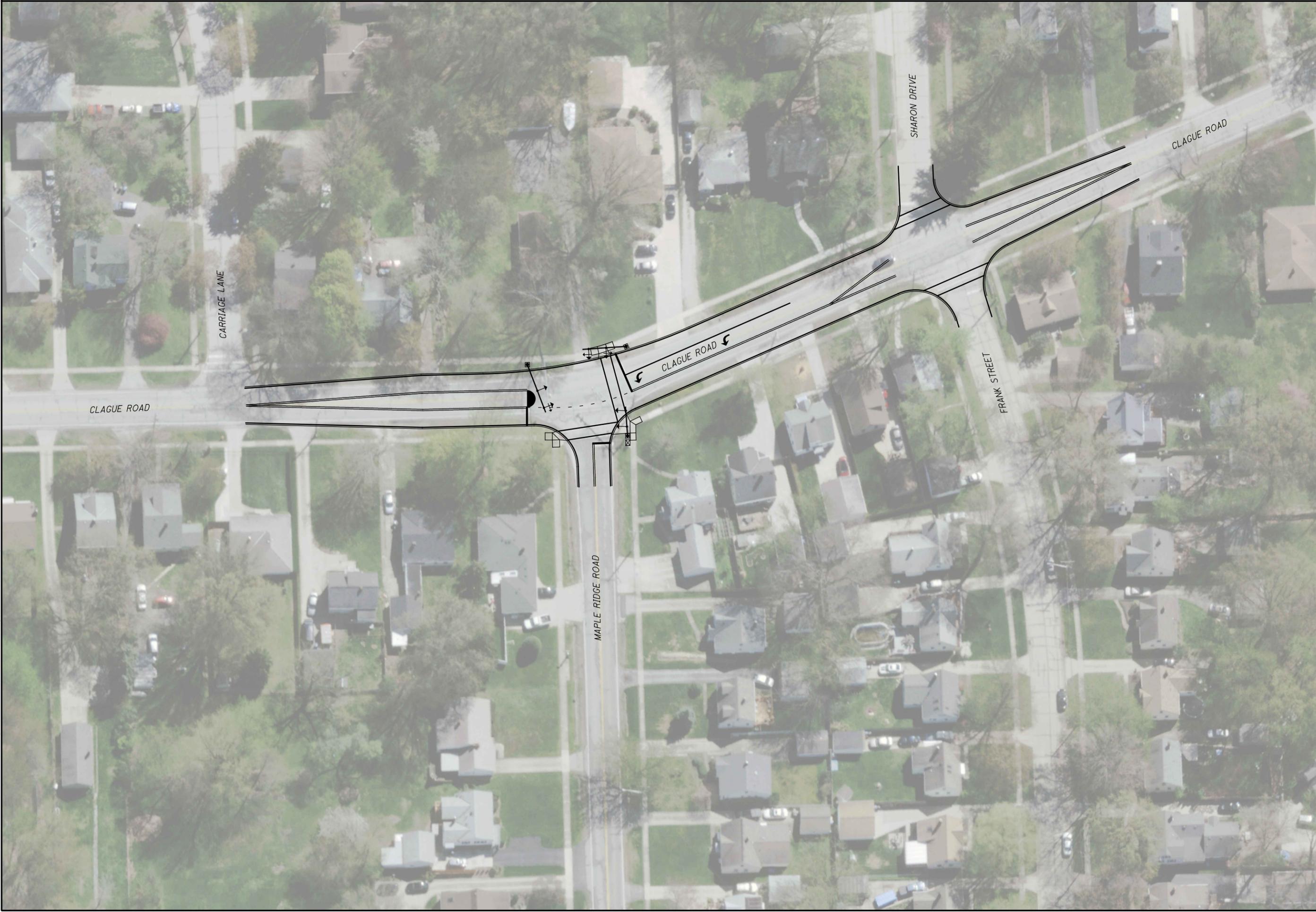
6.2 ECAT Benefit Cost Analysis

Mott MacDonald used ODOT's ECAT Tool to analyze the proposed improvements to determine a benefit to cost ratio based on the safety benefit provided by each improvement. Overall, between the two improvements there is a net present value of safety benefit of approximately \$124,500. With an overall project cost of \$480,000, the safety benefit to cost ratio of the improvement is approximately 0.26.

While the overall benefit to cost ratio is below 1.00, the improvements provide additional benefits that cannot be captured in a traditional ECAT analysis. It is important to note that this improvement directly addresses rear end crashes, which make up the majority of the crashes at Maple Ridge Road and represent 73% of all crashes along the corridor. While most of these crashes are property damage only crashes with lower overall societal costs, the frequency of these crashes along the corridor and specifically at the Maple Ridge Road intersection drive the need for the proposed improvements.

Additionally, there are benefits to the proposed improvements such as reduced corridor travel time of approximately 20% per peak period for each vehicle using the corridor, and aesthetic benefits which emphasize the residential nature of the corridor.

Overall, the proposed improvements are an opportunity to improve the operation of the Clague Road corridor, address safety for all users, and promote the corridor as a livable and walkable place.



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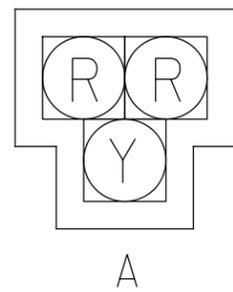
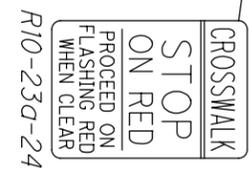
CLAGUE ROAD · SAFETY STUDY
 MAPLE RIDGE ROAD PROPOSED ALTERNATIVE

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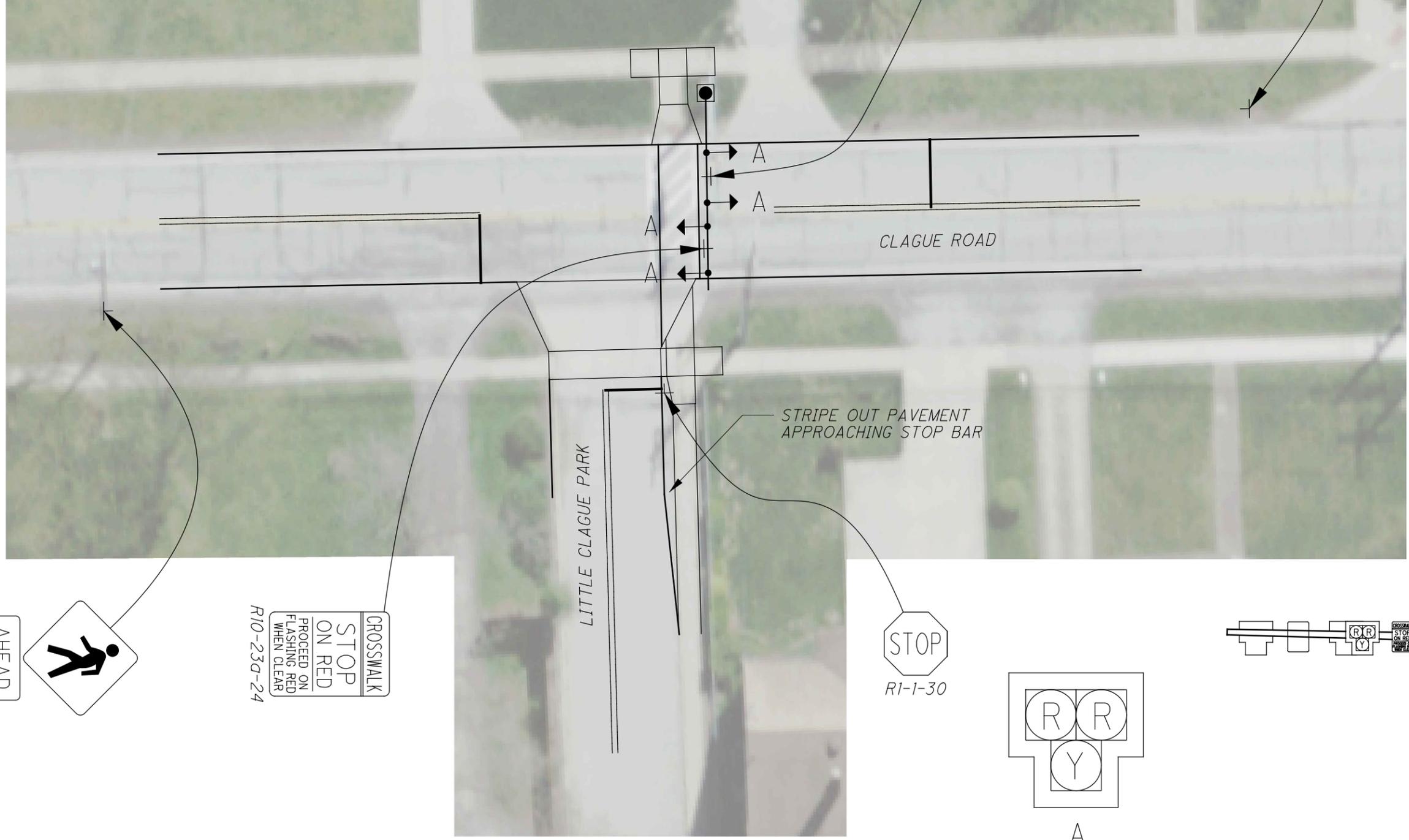
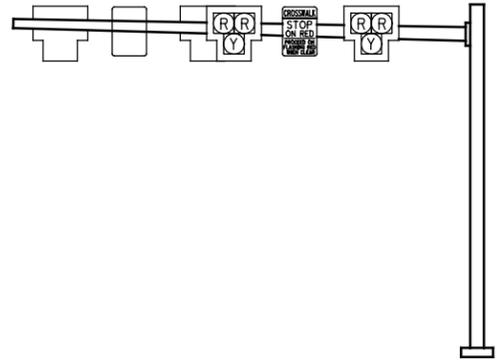
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30
 15
 60
 HORIZONTAL
 SCALE IN FEET



PEDESTRIAN HYBRID BEACON
SIGNAL HEAD



CLAGUE · SAFETY

CLAGUE ROAD · SAFETY STUDY
LITTLE CLAGUE PARK PROPOSED ALTERNATIVE

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