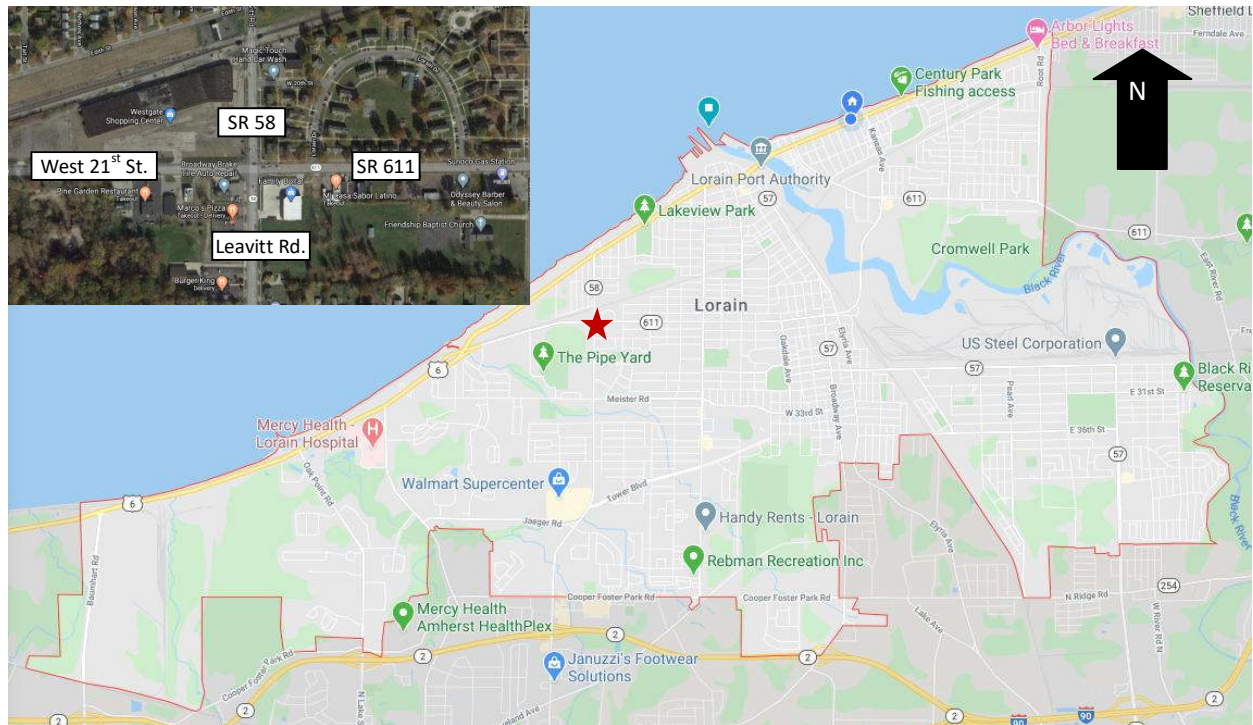




City of Lorain
Engineering Department
Intersection list:
#270 Statewide
#4 Citywide

ABBREVIATED SAFETY STUDY

SR 58 AND SR 611

(LEAVITT ROAD AT WEST 21ST STREET)

CITY OF LORAIN, LORAIN COUNTY

Prepared by: Veronica A Newsome, P.E. and Jessica Potter

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Background

The City of Lorain reached out for guidance at ODOT District 3 to evaluate the intersection of Leavitt Road (SR58) and West 21st Street (SR611). The intersection of Leavitt Road (SR58) and West 21st Street (SR611) ranked #270 statewide Urban Intersections on the 2018 Ohio Department of Transportation Highway Safety Improvement Program list and #4 citywide on the 2018 City of Lorain Safety Priority Intersection List. Please see **Appendix K** for details.

Ohio is one of the first states in the country to fully implement AASHTOWare's Safety Analyst to prioritize safety locations across Ohio. Safety Analyst uses state-of-the-art statistical methodologies to identify roadway locations with the highest potential for reducing crashes. The software system flags spot locations and road segments that have higher-than-predicted crash frequencies. It also flags locations for review based on crash severity. For further explanation on the criteria terminology, refer to the following link:

<http://www.dot.state.oh.us/Divisions/Planning/ProgramManagement/HighwaySafety/HSIP/Pages/Priority-Lists-Initiatives.aspx>

A preliminary crash analysis using the ODOT Economic Crash Analyst Tool (ECAT) found the following statistical results based on the existing conditions and traffic volumes:

Expected Crash Frequency – 4.30 crashes/year

Ratio of observed fatal and serious injuries to observed total crashes 0.00%

Percentage of the potential for safety improvement to total expected crashes
42.79%

Relative severity index \$25,175

Equivalent property damage only index 2.62

As can be seen above, the study intersection currently has a potential for safety improvement of 42.79%. This means that there are approximately 43% more crashes occurring at the intersection than would be expected at a similar intersection.

Existing/Future Conditions

The Leavitt Road (SR58) and West 21st Street (SR611) intersection is located in northern Lorain County. It is approximately 0.5 miles from US6 which runs parallel to Lake Erie and 1.5 miles from Lorain City Hall. There are several residences and commercial sites near the intersection, including a Family Dollar on the southeast corner and an auto repair shop, Burger King, and Marco's Pizza near the southwest corner. The surrounding area is residential to the East of Leavitt Road (SR58) and commercial to the west of Leavitt Road (SR58).

The Leavitt Road (SR58) and West 21st Street (SR611) intersection is a four-leg, signalized intersection located within the City of Lorain in Lorain County. The intersection is relatively flat grade and has adequate intersection and stopping sight distance for all approaches.

The north-south roadway (Leavitt Road) is a two-lane major collector on the north approach and a 3 lane- major collector on the south approach and a 35 MPH speed limit. This roadway will be repaved and restriped in 2021 to reflect a two-lane approach in each direction and bike lanes. Please see

Appendix E for details.

The east-west roadway (West 21st Street) is currently undergoing a road diet. The new east approach will be a two-lane major collector with bike lanes and with a 35 MPH speed limit. The new west approach will be a two-lane major collector on the west approach with right hand turn lane and with a 45 MPH speed limit. Overhead lighting is present along Leavitt Road and West 21st Street.

Stop lines are offset from the intersection for vehicle turning movements. Left turn lanes are on the north (150' storage), south (150' storage), east (300' storage), and west (175' storage) approaches. A previous through traffic lane will be converted to a right turn only lane on the east approach during the 2020 TLCI project. Please see **Appendix F** for details.

The south Leavitt Road approach is curbed and starts at 34' pavement width and widens to 41' for turn lanes after crossing railroad tracks. The north Leavitt Road approach is curbed and is 46' pavement width, the turn lane develops within the existing roadway width. The east West 21st Street approach is curbed and 54' wide. The west West 21st Street approach is curbed and has a width of 54'.

The surrounding area is a combination of urban residential and commercial. The northeast corner of the intersection is occupied by Leavitt Homes, dense public housing. **Figure 1** shown below.



Figure 1 NE corner of Intersection – Courtesy Google Street View

The southeast corner of the intersection is occupied by a Family Dollar and various local restaurant and businesses. **Figure 2** shown below.



Figure 2 SE corner of intersection - Courtesy Google Street View

The southwest corner of the intersection is occupied by an auto repair shop, Pine Garden Restaurant, Marco's Pizza, and a Burger King. **Figure 3** shown below.



Figure 3 SW corner of intersection - Courtesy Google Street View

The northwest corner of the intersection is now an abandoned shopping center. **Figure 4** shown below.



Figure 4 NW corner of intersection - Courtesy Google Street View

This mixture of commercial and residential creates a combination of multimodal travel at this intersection. Local residents may cross at this intersection to reach nearby retail and restaurants. Other city residents may stop at one of these establishments or just be passing through the intersection. **Figure 5** shown below.

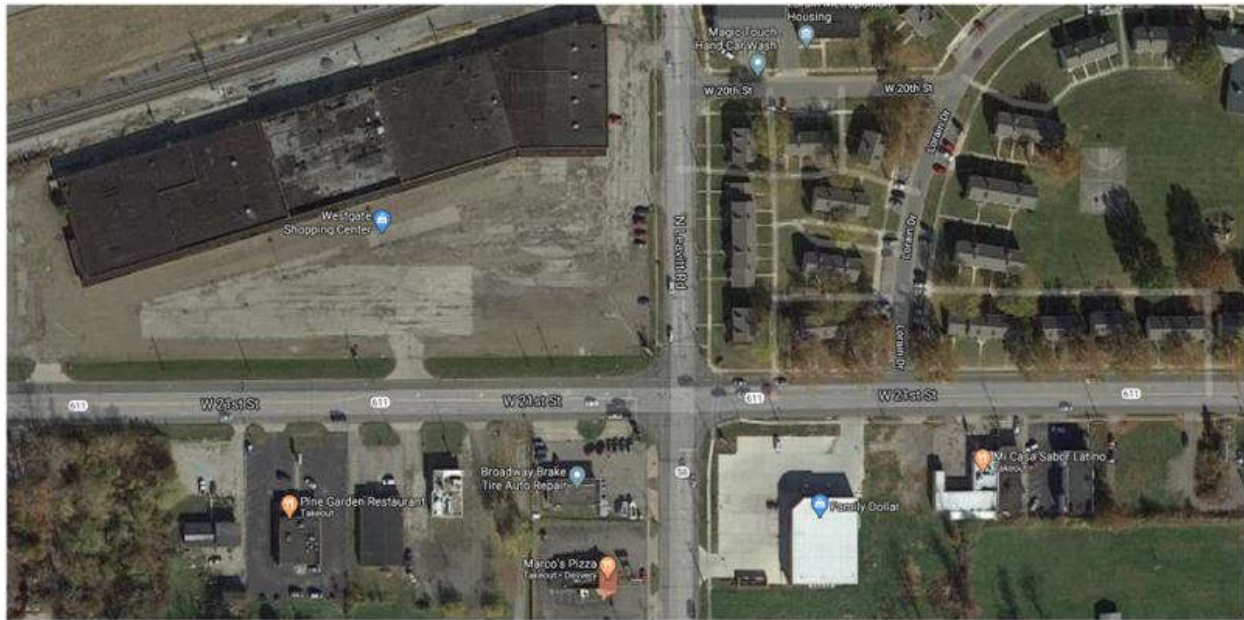


Figure 5 Plan View of Intersection - Courtesy Google Maps

There is a Norfolk Southern Transportation railroad located in close proximity to the intersection – 550' north of the south approach stop line. Since this is an at-grade crossing, there might be a slight sight issue when approaching the signal at SR58 and SR 611 heading southbound on SR58. Northbound traffic delayed by the railroad crossing should not impact the signal at SR58 and SR611.

An urban paving project (PID 101446) is planned for Leavitt Road (SR 58) in 2021. This project will include pavement resurfacing, new bike lanes, upgraded curb ramps, parallel line crosswalks, and stop lines on each approach. A Transportation for Livable Communities (TLCI) project is currently underway on West 21st Street (SR 611). This project includes enhanced crosswalks, new stop lines, and bike lanes.

Traffic Volumes

From 2014 to 2020, the average daily traffic (ADT) volumes on the north, south and west approaches have slightly decreased and the east approach has slightly increased as seen below in **Table 1**.

Table 1. Average Daily Traffic (ADT)

Year	Approach ADT (Both Directions)			
	North	South	East	West
2014	7,420	10,300	7,750	6,050
2020	6,650	9,340	8,280	5,680

A turning movement count was taken at the intersection on Thursday, March 12th, 2020. Based on the count data, the morning peak occurs between 7:00 AM and 8:00 AM and the evening peak occurs between 4:00 PM and 5:00 PM. The detailed traffic count report can be found in **Appendix A**.

Pedestrian movements were also counted on Thursday, March 12th, 2020. A total of 24 crossing movements were counted during the 24 hour period – 4% crossing the south approach, 75% crossing the west approach, and 21% crossing at the east approach.

Signal Operations

The traffic signal is an 100 foot long rectangular span with strain poles at each corner. All signal heads are three-sections consisting of 12 inch red, amber, and green lenses with LED bulbs. The northbound, southbound, and westbound approaches all have two signal heads without back plates controlling the approach. The eastbound approach has three signal heads without back plates controlling the approach. The signal head housings are constructed of aluminum painted yellow and are hung by wire. A view of the signal from the northbound approach is provided in **Figure 6**.



Figure 4 - Westbound Intersection Approach - Courtesy Google Street View

The traffic signal operates with protected-only left turn phasing all four approaches to the intersection. Since neither approaching roadway is located along a coordinated signal system, this intersection operates in free mode with the EB and WB approaches operating on minimum recall with all other approaches with no recall. Stop bar induction loop detectors are present on all eight (8) approach lanes to this intersection. This detection allows each signal phase to be actuated only when a vehicle is present and also allows the signal to gap out once the minimum green time has been provided and no other vehicles are present on the detector. A passage time of 1.5 seconds exists for all signal phases, which is shorter than the typical 3 seconds. Intersection Capacity Analysis was performed for the signalized intersection utilizing the Highway Capacity Software (HCS7), which is based upon the Highway Capacity Manual, 6th Edition. Additionally, the ODOT preferred balanced approach delay methodology was used in this analysis utilizing the existing traffic signal timings. Traffic volumes from the March 12th, 2020 turning movement count were used for the analyses. **Table 2** displays the intersection operating conditions for the AM and PM peak hours. At current traffic volume levels, the intersection overall operates at an acceptable Level of Service (LOS) C in the AM peak hour and LOS D in the PM peak hour. The HCS reports are in **Appendix B**.

Table 2. Existing Year 2020 'No-Build' Intersection Capacity Analysis Results Summary

Peak Period	NB LOS (Delay)	SB LOS (Delay)	EB LOS (Delay)	WB LOS (Delay)	Overall LOS (Delay)
AM Peak	C (31.4)	C (30.9)	C (27.5)	C (31.6)	C (31.6)
PM Peak	D (52.2)	C (31.9)	C (30.6)	D (52.0)	D (43.5)

Signal clearance times were also evaluated for the intersection. The current and ITE (Institute of Transportation Engineers) formula values for the yellow change intervals and the red clearance intervals are found in Table 3 below and a detailed calculation sheet can be found in **Appendix C**.

Table 3. Yellow Change and Red Clearance Intervals

Interval	West 21 st Street (SR611)		Leavitt Road (SR58)	
	Current	ITE Formula	Current	ITE Formula
Yellow Change Interval (sec)	4.00	4.10	4.00	4.00
Red Clearance Interval (sec)	2.00	1.00	2.00	1.00

Crash Data and Analysis

The most recent five years (2015-2019) of crash data was analyzed. The OH-1 report for each documented crash was reviewed for accuracy and to locate crashes properly within the study limit. The crash diagram is included in **Appendix D**. A total of 42 intersection related crashes were reported from 1/1/2015 to 12/31/2019. The general breakdown of the crash data and observable trends can be found below.

Total Crashes = 42 (1/1/15-12/31/19)

Crashes by Year	
2015	11
2016	13
2017	5
2018	7
2019	6
Grand Total	42

Crashes by Severity	
Injury Crash	16
Property Damage Crash	26
Grand Total	42

Crashes by Type	
Rear End	29
Angle	6
Sideswipe - Passing	2
Pedestrian	1
Right Turn	1
Head On	1
Left Turn	1
Backing	1
Grand Total	42

Crashes by Road Condition	
Dry	34
Wet	7
Snow	1
Grand Total	42

Crashes by Time of Day	
0	1
5	1
6	1
7	1
8	1
9	2
10	3
11	2
12	7
13	3
14	2
15	5
16	2
17	1
18	2
19	3
20	2
21	3
Grand Total	42

Young Drivers

-19/42 (45%) total crashes involved 25 year old or younger driver at fault.

Older Drivers

-8/42 (19%) total crashes involved 65 year old or older driver at fault.

Rear end Crashes

-29/42 (69%) total crashes were classified as rear end crashes.

Probable Causes

The main crash type found at the subject intersection is rear-end related crashes, which account for approximately 70% of the total crashes. There are numerous causes that could be contributing factors to the crashes occurring at this intersection, including distracted driving and lack of driver experience. Distracted driving has become more common in recent years and approximately 45% of the crashes occurred due to a motorist being 25 years old or younger. However, these causes cannot be addressed from an engineering perspective. Other factors that could be causing the crashes at this intersection were also investigation that could be mitigated from an engineering perspective.

Looking at the existing conditions at the intersection, it was noted that the current traffic signal installation is an older, span wire installation that lacks traffic signal backplates which affects the

visibility of the existing traffic signal. The below image shows the existing signal heads for the north approach to the intersection.



Due to the span wire installation and the current positioning of the signal heads, a motorist view of the signal heads can be obstructed, see image below -Courtesy Google Street View.



Additionally, on the east approach to the intersection, there are only 2 signal heads for a three (3) lane approach, which does not satisfy the current design standards. One signal head is dedicated to the protected-only left turn movement and the other signal head is the indication for the thru traffic movements. The existing crash pattern that has a significant percentage of rear-end crashes, along with angle crashes, points to the fact that there is a major signal visibility issue at the intersection itself.

The existing traffic signal timings and clearance intervals could be leading to the presence of both rear-end and angle crashes occurring at the intersection. The existing signal timings have not been revised for over 5 years, including the clearance intervals. If the clearance intervals are too short for motorists to clear the intersection during the phase change, angle crashes could be occurring as traffic isn't clearing the intersection before the phase changes.

While the intersection appears to have adequate capacity, the current intersection phasing could be creating unnecessary delay at the intersection. Currently, all four left turn phases at the intersection are protected-only. Under the protected only phasing, additional green time is allocated to the left turn phases since this traffic cannot make the left turn movement under a permissive phase. Based on the traffic volumes and existing conditions at this intersection, there is not a need for the left turn movements to be protected-only.

The rear-end crashes are concentrated on the NB and WB approaches to this intersection, which are also the two approaches with the highest level of vehicular delay according to the capacity analysis results. The increased delay on those two approaches also increases the queuing, which can lead to more rear-end crashes to occur.

Even though no sideswipe – passing crashes occurred on the east leg of the intersection, there is a lane drop condition for westbound traffic. When approaching the intersection there are two approach lanes, one of which becomes a drop left turn onto southbound State Route 58. This condition could lead to vehicles making sudden lane changes while approaching the intersection. These lane changes could create both rear-end and sideswipe – passing crashes.

A review of the crashes near the intersection did not reveal any crashes at the driveways and a review of the operations didn't show any operational issues due to the presence of the driveways. Therefore, no access management will be proposed as part of the improvements.

Countermeasures

In order to address the safety deficiencies at the intersection, as noted in the previous section, the following improvements are recommended at the intersection:

1. Implement updated signal timings and clearance intervals
2. Reconstruct the traffic signal at the intersection, including the backplates and additional primary signal heads to meet current design codes.
3. Convert the left turn phasing at the intersection to protected/permissive for all intersection approaches.
4. Upgrade the pedestrian accommodations at the intersection to include a pedestrian countdown timer.
5. Investigate signal coordination on SR 58 and SR 611
6. Community and school promotion of driver safety to students and parents

The above improvement list will help to mitigate the existing crash patterns that were identified at the study intersection. It should be noted that the existing span wire signal installation will be unable to accommodate the traffic signal backplates, the additional primary signal heads, and the 5 section signal heads required to be installed in order to provide the protected/permissive traffic signal phasing. Therefore, the existing traffic signal installation will need to be reconstructed. The traffic signals should

be reconstructed and upgraded to include full vehicular detection, meet current design standards, and incorporate current technology. All traffic signals should be designed to accommodate traffic signal backplates on all approaches to increase signal visibility and add target value to the signal heads. Additionally, the upgraded signals should provide full pedestrian accommodations with pushbuttons and countdown displays. The new traffic signal should also have updated signal timings and clearance intervals incorporated. The city will also investigate the addition of advance warning signs with street name plaques during the detailed design phase of this project.

The estimated cost for this project is \$411,000, which includes the design, right-of-way, construction, and construction inspection services necessary for the reconstruction project. The cost estimate is included in **Appendix G**. The City of Lorain is requesting 100% of this funding from the ODOT Highway Safety Improvement program. The construction is proposed to occur in ODOT State Fiscal Year 2023, which begins on July 1st, 2022.

Implementation Plan

Intersection Improvements Under Design

Safety improvements are currently underway along SR 611 with the construction of PID 110315 – Lorain TLCL. This project restripes SR 611 from SR58 to Oberlin Avenue. The project is comprised of a road diet, that right sizes the roadway cross section in this residential area to include bike lanes, a center turn lane, and two travel lanes; one in each direction.

Future safety improvements will occur in 2021 along SR 58 with the construction of PID 101446 – SR 58 repaving. This project will resurface and restripe SR 58 from the City of Lorain line to US6. The project is comprised of resurfacing, the extension of the bike lanes from SR58 to US6 to echo the cross section of the roadway from SR611 south, curb ramp improvements, and drainage improvements.

Please refer to **Appendix L** for an Intersection Concept Plan.

Requested Intersection Safety Improvements

This safety study is requesting funding for intersection improvements listed in the 'Countermeasures' section of this document. These improvements are proposed to be constructed in ODOT FY 2023.

Long Term Intersection Improvements

The City of Lorain has an active transportation team, Lorain Connected that is working towards building a better Lorain. Lorain Connected applies for SRTS infrastructure and non-infrastructure yearly as well as other grants from public and private sources. This interdisciplinary team meets monthly to discuss safety concerns in the community and addresses issues. The goal is to engage the community in safety issues and improvements. Over the past 3 years, Lorain Connected has leveraged over \$1 Million dollars in grant funding to host bike and walk to school days, implement temporary safety improvements for study, and assisted in the building of an inclusive playground in the City of Lorain.

In the future the City of Lorain would like to improve travelling along the SR611 corridor by implementing signal coordination. Signal coordination could reduce the number of stops along the corridor, improving air quality from idling vehicles and provide for a continuous flow of traffic at the target speed, by adjusting cycle lengths.

The City of Lorain would look to the ODOT task order consultant to assist in evaluating citywide signal coordination for other intersecting routes.

Benefit to Cost Analysis

The reduction of crashes within the State of Ohio is the top priority of ODOT's Highway Safety Improvement Program. ECAT analysis was performed at the study intersection in order to perform a Benefit to Cost analysis on the proposed intersection improvements. **Table 4** provides a summary of the Benefit to Cost Ratio for the proposed intersection improvements and **Appendix H** contains the Benefit to Cost Analysis worksheets. Additionally, the formal safety application for this improvement project is contained in **Appendix I**.

Table 4. Benefit to Cost Summary Chart

	Net Present Value of Project	Net Present Value of Safety Benefits	Benefit to Cost Ratio
Benefit to Cost Results	\$351,000.00	\$490,440.82	1.40

The Benefit to Cost Ratio analysis was performed based upon a project cost of \$351,000 (which is the total cost of the State Route 611 / State Route 58 intersection improvement project, not including the construction inspection or inflation). This results in a Benefit to Cost Ratio of 1.40. Based on the Benefit to Cost Ratio being significantly greater than 1.00, this intersection safety improvement project should be considered a fundable project and should receive the consideration of the funding committee.

Traffic Signal Warrant Analysis

In order to determine whether the study intersection meets a traffic signal warrant based on the current traffic conditions, the existing traffic volumes were compared to the volumes thresholds and criteria outlined in Section 402-2 of the ODOT Traffic Engineering Manual (TEM). The results of the Existing Year 2020 traffic signal warrant analysis are shown in **Table 5** below and the traffic signal warrant analysis printouts are contained in **Appendix J**.

Table 5. Existing Year 2019 Traffic Signal Warrant Analysis Summary

Intersection	Signal Warrant		
	Warrant #1 (Eight Hour Vehicular Volume)	Warrant #2 (Four Hour Vehicular Volume)	Warrant #3 (Peak Hour Vehicular Volume)
State Route 611 / State Route 58	Satisfied	Satisfied	Satisfied

‘Build’ Intersection Capacity Analysis

Intersection capacity analysis was performed for the ‘Build’ conditions in order to determine the anticipated operating conditions once the proposed improvements are implemented at the study intersection. This analysis was performed utilizing the computer program HCS7 and following the ODOT preferred balanced approach delay methodology. **Table 6** displays the intersection operating conditions for the AM and PM peak hours. Under the proposed intersection operations, the overall intersection is anticipated to operate at an improved LOS C in the AM peak hour and LOS C in the PM peak hour. The HCS reports are contained in **Appendix B**.

Table 6. Existing Year 2020 ‘Build’ Intersection Capacity Analysis Results Summary

Peak Period	NB LOS (Delay)	SB LOS (Delay)	EB LOS (Delay)	WB LOS (Delay)	Overall LOS (Delay)
AM Peak	C (24.4)	C (24.2)	C (24.5)	C (22.7)	C (23.9)
PM Peak	C (30.6)	C (23.2)	C (30.7)	C (29.4)	C (28.7)

When comparing the capacity analysis results between the ‘No-Build’ (shown in **Table 1**) and ‘Build’ (shown in **Table 6**) conditions, there is a significant reduction in overall delay noted between the two conditions. In the AM peak hour, the overall intersection is anticipated to operate at LOS C during the ‘No-Build’ and ‘Build’ conditions, however the overall intersection delay is reduced from 31.6 seconds of delay to 23.9 seconds. In the PM peak hour, the overall intersection improves from a LOS D in the ‘No-Build’ conditions to a LOS C in the ‘Build’ and the overall intersection delay decreases from 43.5 seconds to 28.7 seconds.

APPENDIX A
Traffic Count Data

Leavitt Rd and West 21st St
Lorain Ohio
03/12/2020 07:00:00

Time	Southbound Leavitt Rd						Westbound West 21st St						Northbound Leavitt Rd						Eastbound West 21st St						VEHICLE TOTAL
	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	
12:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:00 AM	0	7	43	2	0	52	0	13	37	7	1	57	0	7	17	12	0	36	0	3	29	10	0	42	187
7:15 AM	0	5	62	4	0	71	0	14	33	6	0	53	0	14	26	15	0	55	0	3	35	8	0	46	225
7:30 AM	0	10	47	3	0	60	0	16	35	4	0	55	0	6	24	17	0	47	0	3	33	15	3	51	213
7:45 AM	0	6	54	2	0	62	0	33	32	9	3	74	0	8	40	22	0	70	0	9	43	7	0	59	265
Hourly Total	0	28	206	11	0	245	0	76	137	26	4	239	0	35	107	66	0	208	0	18	140	40	3	198	890

Leavitt Rd and West 21st St
Lorain Ohio
03/12/2020 07:00:00

Time	Southbound Leavitt Rd					Westbound West 21st St					Northbound Leavitt Rd					Eastbound West 21st St					VEHICLE TOTAL				
	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns		Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total
8:00 AM	0	12	53	2	0	67	0	17	25	6	0	48	0	17	42	30	0	89	0	2	30	5	0	37	241
8:15 AM	0	6	39	3	0	48	0	24	25	6	0	55	0	8	34	22	0	64	0	2	49	5	0	56	223
8:30 AM	0	5	37	2	0	44	0	25	34	11	0	70	0	7	19	17	0	43	0	3	32	9	0	44	201
8:45 AM	0	11	38	4	0	53	0	23	31	7	1	61	0	4	33	16	0	53	0	1	22	4	0	27	194
Hourly Total	0	34	167	11	0	212	0	89	115	30	1	234	0	36	128	85	0	249	0	8	133	23	0	164	859
9:00 AM	0	5	36	2	0	43	0	23	34	3	0	60	0	8	27	15	0	50	0	1	27	12	0	40	193
9:15 AM	0	3	31	4	0	38	0	25	26	3	0	54	0	14	24	19	0	57	0	1	20	11	0	32	181
9:30 AM	0	5	46	0	0	51	0	17	24	9	0	47	0	15	25	16	0	58	0	4	15	11	0	30	186
9:45 AM	0	4	29	3	0	36	0	28	37	7	2	72	0	5	42	20	0	67	0	1	34	12	0	47	222
Hourly Total	0	17	142	9	0	168	0	90	121	22	2	233	0	44	118	70	0	232	0	7	96	46	0	149	782
10:00 AM	0	8	31	0	0	39	0	25	27	10	1	62	0	7	42	17	0	66	0	0	27	14	0	41	208
10:15 AM	0	6	26	3	0	35	0	28	39	7	0	74	0	6	27	15	0	48	0	5	30	10	0	45	202
10:30 AM	0	8	39	1	0	48	0	34	19	8	0	61	0	7	26	13	0	46	0	2	29	12	0	43	198
10:45 AM	0	6	39	3	0	48	0	24	31	12	0	67	0	7	40	29	0	76	0	4	29	10	1	43	234
Hourly Total	0	28	135	7	0	170	0	111	116	37	1	264	0	27	135	74	0	236	0	11	115	46	1	172	842
11:00 AM	0	10	39	1	0	50	0	28	19	10	0	57	0	10	37	24	0	71	0	4	27	11	0	42	220
11:15 AM	0	10	40	1	0	51	0	25	23	6	0	54	0	7	27	32	0	66	0	2	31	11	0	44	215
11:30 AM	0	5	40	3	0	48	0	25	26	6	1	57	0	5	36	37	0	78	0	1	36	13	0	50	233
11:45 AM	0	4	57	6	0	67	0	23	27	13	0	63	0	4	53	22	0	79	0	4	28	21	0	53	262
Hourly Total	0	29	176	11	0	216	0	101	95	35	1	231	0	26	153	115	0	294	0	11	122	56	0	169	930
12:00 PM	0	9	56	1	0	66	0	30	36	12	0	78	0	15	40	35	0	90	0	3	41	13	0	57	291
12:15 PM	0	12	35	2	0	49	0	25	25	15	1	65	0	6	43	25	0	74	0	4	35	11	0	50	238
12:30 PM	0	8	50	3	0	61	0	33	38	6	0	77	0	14	50	26	0	90	0	1	47	6	0	54	282
12:45 PM	0	3	43	3	0	49	0	27	33	4	0	64	0	12	55	19	0	86	0	3	24	10	0	37	236
Hourly Total	0	32	184	9	0	225	0	115	132	37	1	284	0	47	188	105	0	340	0	11	147	40	0	198	1047
1:00 PM	0	6	40	2	0	48	0	23	39	3	0	65	0	12	44	20	0	76	0	4	36	16	0	56	245
1:15 PM	0	9	40	4	0	53	0	33	41	10	0	84	0	1	52	30	0	83	0	3	38	14	0	55	275
1:30 PM	0	6	36	2	0	44	0	27	26	13	1	66	0	11	46	27	0	84	0	0	33	11	0	44	238
1:45 PM	0	9	37	3	0	49	0	27	34	20	0	81	0	13	37	10	0	60	0	5	25	16	0	46	236
Hourly Total	0	30	153	11	0	194	0	110	140	46	1	296	0	37	179	87	0	303	0	12	132	57	0	201	994
2:00 PM	0	14	47	4	0	65	0	27	37	15	0	79	0	11	40	28	0	79	0	3	41	10	0	54	277
2:15 PM	0	19	66	4	0	89	0	31	34	12	0	77	0	8	38	29	0	75	0	3	33	7	0	43	284
2:30 PM	0	10	45	2	0	57	0	47	27	25	0	99	0	19	62	27	0	108	0	4	36	9	0	49	313
2:45 PM	0	9	52	5	0	66	0	35	32	18	0	85	0	14	55	35	0	104	0	2	46	10	0	58	313
Hourly Total	0	52	210	15	0	277	0	140	130	70	0	340	0	52	195	119	0	366	0	12	156	36	0	204	1187
3:00 PM	0	20	60	4	0	84	0	37	43	8	1	88	0	15	55	42	0	112	0	6	35	19	0	60	344
3:15 PM	0	13	58	2	0	73	0	42	39	18	0	99	0	18	53	30	0	101	0	3	27	15	0	45	318
3:30 PM	0	9	52	5	0	66	0	41	34	15	1	90	0	14	66	40	0	120	0	2	50	18	0	70	346
3:45 PM	0	4	48	4	0	56	0	38	48	19	1	105	0	14	46	44	0	104	0	5	45	13	0	63	328
Hourly Total	0	46	218	15	0	279	0	158	164	60	3	382	0	61	220	156	0	437	0	16	157	65	0	238	1336

Leavitt Rd and West 21st St
Lorain Ohio

03/12/2020 07:00:00

Time	Southbound Leavitt Rd					Westbound West 21st St					Northbound Leavitt Rd					Eastbound West 21st St					VEHICLE TOTAL				
	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns		Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total
4:00 PM	0	10	42	4	0	56	0	29	50	16	0	95	0	17	60	30	0	107	0	7	50	11	0	68	326
4:15 PM	0	15	50	3	0	68	0	32	59	22	0	113	0	14	59	24	0	97	0	3	51	17	0	71	349
4:30 PM	0	15	63	8	0	86	0	50	56	18	1	124	0	10	59	35	0	104	0	2	57	25	0	84	398
4:45 PM	0	16	63	11	0	90	0	30	47	19	0	96	0	11	70	17	0	98	0	3	54	14	0	71	355
Hourly Total	0	56	218	26	0	300	0	141	212	75	1	428	0	52	248	106	0	406	0	15	212	67	0	294	1428
5:00 PM	0	11	51	4	0	66	0	41	35	29	0	105	0	12	72	34	0	118	0	2	45	19	0	66	355
5:15 PM	0	16	46	7	0	69	0	38	35	15	0	88	0	10	53	27	0	90	0	2	59	9	0	70	317
5:30 PM	0	10	37	10	0	57	0	43	30	12	0	85	0	9	73	20	0	102	0	5	49	13	0	67	311
5:45 PM	0	8	46	6	0	60	0	27	38	9	0	74	0	12	54	24	0	90	0	3	30	7	0	40	264
Hourly Total	0	45	180	27	0	252	0	146	141	65	0	352	0	43	252	105	0	400	0	12	183	48	0	243	1247
6:00 PM	0	17	57	2	0	76	0	27	32	15	2	74	0	8	54	29	0	91	0	6	31	10	0	47	288
6:15 PM	0	13	41	4	0	58	0	32	23	11	0	66	0	12	57	39	0	108	0	9	41	7	0	57	289
6:30 PM	0	9	43	1	1	53	0	21	27	11	1	59	0	10	58	22	0	90	0	0	20	12	1	32	234
6:45 PM	0	6	49	4	0	59	0	28	26	10	0	64	0	13	48	23	0	84	0	11	27	13	0	51	258
Hourly Total	0	45	190	11	1	246	0	108	108	47	3	263	0	43	217	113	0	373	0	26	119	42	1	187	1069
7:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hourly Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DAILY TOTAL	0	442	2179	163	1	2784	0	1385	1611	550	18	3546	0	503	2140	1201	0	3844	0	159	1712	566	5	2437	12611
Cars	0	433	2144	151	1	2728	0	1353	1554	536	18	3443	0	474	2110	1171	0	3755	0	154	1660	535	5	2349	12275
Heavy Vehicles	0	9	35	12	0	56	0	32	57	14	0	703	0	29	30	30	0	89	0	5	52	31	0	88	336
Heavy Vehicle %	0.00%	2.04%	1.61%	7.36%	0.00%	2.01%	0.00%	2.31%	3.54%	2.55%	0.00%	2.50%	0.00%	0.00%	1.40%	2.50%	0.00%	2.32%	0.00%	3.14%	3.04%	5.48%	0.00%	3.61%	2.66%

Leavitt Rd and West 21st St
Lorain Ohio

03/12/2020 07:00:00

AM Peak Hour

Time	Southbound			Westbound			Northbound			Eastbound			VEHICLE TOTAL
	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	
7:15 AM	0	5	62	4	0	71	0	14	26	15	0	55	225
7:30 AM	0	10	47	3	0	60	0	6	24	17	0	47	213
7:45 AM	0	6	54	2	0	62	0	8	40	22	0	70	265
8:00 AM	0	12	53	2	0	67	0	17	42	30	0	89	241
Peak Hour Total	0	33	216	11	0	260	0	45	132	84	0	261	944
PHF	0.000	0.888	0.871	0.688	0.000	0.915	0.000	0.682	0.786	0.700	0.000	0.733	0.891

PM Peak Hour

Time	Southbound			Westbound			Northbound			Eastbound			VEHICLE TOTAL
	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	U Turns	Left Turns	Straight Through	Right Turns	Crosswalk Crossings	Vehicle Approach Total	
4:15 PM	0	15	50	3	0	68	0	14	59	24	0	97	349
4:30 PM	0	15	63	8	0	86	0	10	59	35	0	104	398
4:45 PM	0	16	63	11	0	90	0	11	70	17	0	98	355
5:00 PM	0	11	51	4	0	66	0	12	72	34	0	118	355
Peak Hour Total	0	57	227	26	0	310	0	47	260	110	0	417	1457
PHF	0.000	0.891	0.901	0.591	0.000	0.861	0.000	0.839	0.903	0.786	0.000	0.883	0.915

Total Vehicles On Leg	5633
Vehicles Entering Intersection	2784
Vehicles Exiting Intersection	2849
Southbound	
Cars	151
Heavy	12
Total	163
Westbound	
Cars	2144
Heavy	35
Total	2179
Northbound	
Cars	433
Heavy	9
Total	442
Eastbound	
Cars	0
Heavy	0
Total	0



Total Vehicles on Leg	Eastbound			Total
	Vehicles Entering Intersection	Cars	Heavy	
2437	5	0	0	5
4714	0	0	0	0
	154	5	159	159
	1860	52	1712	1712
	535	31	566	566



Total Vehicles on Leg	Westbound			Total
	Vehicles Entering Intersection	Cars	Heavy	
3546	536	14	550	550
6901	1554	57	1611	1611
	1353	32	1385	1385
	0	0	0	0
	18	0	18	18



Daily Volumes



Cars	0	0	474	2110	1171
Heavy	0	0	29	30	30
Total	0	0	503	2140	1201
Northbound					
Vehicles Entering Intersection	3844	Vehicles Exiting Intersection	4130		
Total Vehicles On Leg			7974		

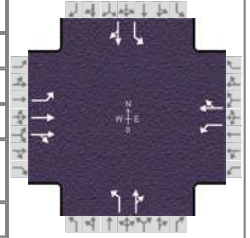
APPENDIX B

Capacity Analysis – ‘No Build’ and ‘Build’ Conditions

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	Jun 22, 2020	Area Type	Other
Jurisdiction	City of Lorain	Time Period	AM Peak Hour	PHF	0.92
Urban Street	State Route 611	Analysis Year	Existing Year 2020 'No-Build'	Analysis Period	1> 7:00
Intersection	State Route 611 / State...	File Name	1 - 611 and 58 - AM Peak - 2020 NB.xus		
Project Description	State Route 611 / State Route 58 Safety Study				





Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	20	160	40	90	140	30	50	150	90	40	240	10

Signal Information														
Cycle, s	90.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On	Green	10.0	22.9	10.0	23.1	0.0	0.0				
				Yellow	4.0	4.0	4.0	4.0	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	2.0	0.0	0.0				

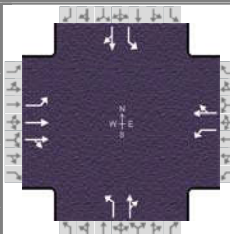
													
1		2		3		4				5		6	
													
5		6		7		8							

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0
Phase Duration, s	16.0	28.9	16.0	28.9	16.0	29.1	16.0	29.1
Change Period, (Y+R c), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (MAH), s	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Queue Clearance Time (g s), s	3.0	6.3	6.6	9.5	4.5	13.5	4.0	13.3
Green Extension Time (g e), s	0.0	0.4	0.0	0.4	0.0	0.5	0.0	0.5
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.00	0.27	0.00	0.00	0.01	0.00	0.00

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	22	110	107	98	185		54	261		43	272	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900	1771	1810	1842		1810	1780		1810	1886	
Queue Service Time (g_s), s	1.0	4.1	4.3	4.6	7.5		2.5	11.5		2.0	11.3	
Cycle Queue Clearance Time (g_c), s	1.0	4.1	4.3	4.6	7.5		2.5	11.5		2.0	11.3	
Green Ratio (g/C)	0.11	0.25	0.25	0.11	0.25		0.11	0.26		0.11	0.26	
Capacity (c), veh/h	201	483	451	201	469		201	457		201	484	
Volume-to-Capacity Ratio (X)	0.108	0.228	0.238	0.487	0.394		0.270	0.571		0.216	0.561	
Back of Queue (Q), ft/ln (50 th percentile)	10.6	45.8	44.7	50.3	80.5		27.1	121.6		21.5	125.7	
Back of Queue (Q), veh/ln (50 th percentile)	0.4	1.8	1.8	2.0	3.2		1.1	4.9		0.9	5.0	
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	36.0	26.6	26.6	37.6	27.8		36.7	29.1		36.4	29.0	
Incremental Delay (d_2), s/veh	0.1	0.1	0.1	0.7	0.2		0.3	1.1		0.2	0.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	36.1	26.6	26.7	38.3	28.0		36.9	30.2		36.6	30.0	
Level of Service (LOS)	D	C	C	D	C		D	C		D	C	
Approach Delay, s/veh / LOS	27.5		C		31.6		C		31.4		C	
Intersection Delay, s/veh / LOS	30.5						C					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	1.93	B		1.93	B		2.12	B		2.12	B	
Bicycle LOS Score / LOS	0.68	A		0.95	A		1.01	A		1.01	A	

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency	GPD Group			Duration, h	0.250	
Analyst	Curtis J. Deibel, PE, RSP	Analysis Date	Jun 22, 2020	Area Type	Other	
Jurisdiction	City of Lorain	Time Period	PM Peak Hour	PHF	0.92	
Urban Street	State Route 611	Analysis Year	Existing Year 2020 'No-Build'	Analysis Period	1> 7:00	
Intersection	State Route 611 / State...	File Name	2 - 611 and 58 - PM Peak - 2020 NB.xus			
Project Description	State Route 611 / State Route 58 Safety Study					

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	230	80	170	220	100	50	290	120	60	260	30

Signal Information												
Cycle, s	90.0	Reference Phase	2									
Offset, s	0	Reference Point	End									
Uncoordinated	Yes	Simult. Gap E/W	On	Green	12.0	19.8	10.0	24.2	0.0	0.0		
				Yellow	4.0	4.0	4.0	4.0	0.0	0.0		
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0	2.0	2.0	0.0	0.0		

													
1	2	3	4	5	6	7	8	9	10	11	12	13	14

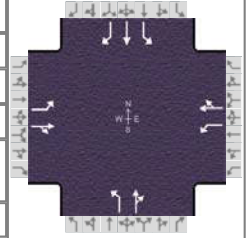
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	2.0	4.0	2.0	4.0	2.0	4.0	2.0	4.0
Phase Duration, s	18.0	25.8	18.0	25.8	16.0	30.2	16.0	30.2
Change Period, (Y+R c), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Allow Headway (MAH), s	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Queue Clearance Time (g s), s	2.5	9.3	10.9	18.8	4.5	23.6	5.0	15.4
Green Extension Time (g e), s	0.0	0.7	0.0	0.2	0.0	0.1	0.0	0.8
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.00	0.01	1.00	1.00	0.00	1.00	0.01	0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	173	164	185	348		54	446		65	315	
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1900	1734	1810	1799		1810	1805		1810	1865	
Queue Service Time (g_s), s	0.5	7.0	7.3	8.9	16.8		2.5	21.6		3.0	13.4	
Cycle Queue Clearance Time (g_c), s	0.5	7.0	7.3	8.9	16.8		2.5	21.6		3.0	13.4	
Green Ratio (g/C)	0.13	0.22	0.22	0.13	0.22		0.11	0.27		0.11	0.27	
Capacity (c), veh/h	241	418	382	241	396		201	485		201	502	
Volume-to-Capacity Ratio (X)	0.045	0.414	0.430	0.766	0.879		0.270	0.918		0.324	0.628	
Back of Queue (Q), ft/ln (50 th percentile)	5.1	78.8	75	116.2	229.1		27.1	298.9		32.8	150.4	
Back of Queue (Q), veh/ln (50 th percentile)	0.2	3.2	3.0	4.6	9.2		1.1	12.0		1.3	6.0	
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00	0.00	0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	34.0	30.1	30.2	37.6	33.9		36.7	31.9		36.9	28.9	
Incremental Delay (d_2), s/veh	0.0	0.2	0.3	12.4	19.0		0.3	22.1		0.3	1.9	
Initial Queue Delay (d_3), s/veh	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (d), s/veh	34.0	30.4	30.5	50.1	53.0		36.9	54.0		37.2	30.8	
Level of Service (LOS)	C	C	C	D	D		D	D		D	C	
Approach Delay, s/veh / LOS	30.6	C		52.0	D		52.2	D		31.9	C	
Intersection Delay, s/veh / LOS	43.5						D					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	1.93	B		1.93	B		2.12	B		2.12	B	
Bicycle LOS Score / LOS	0.77	A		1.37	A		1.31	A		1.12	A	

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information	
Agency				Duration, h	0.250
Analyst		Analysis Date	Jun 22, 2020	Area Type	Other
Jurisdiction	City of Lorain	Time Period	AM Peak Hour	PHF	0.92
Urban Street	State Route 611	Analysis Year	Existing Year 2020 'Build'	Analysis Period	1> 7:00
Intersection	State Route 611 / State...	File Name	3 - 611 and 58 - AM Peak - 2020 B.xus		
Project Description	State Route 611 / State Route 58 Safety Study				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	20	160	40	90	140	30	50	150	90	40	240	10

Signal Information														
Cycle, s	89.8	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On	Green	7.0	27.2	7.0	27.9	0.0	0.0				
				Yellow	4.0	4.1	3.2	4.0	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.7	1.0	1.7	1.0	0.0	0.0				

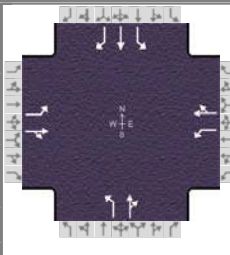
														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	3.0
Phase Duration, s	12.7	32.3	12.7	32.3	11.9	32.9	11.9	32.9
Change Period, (Y+R c), s	5.7	5.1	5.7	5.1	4.9	5.0	4.9	5.0
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Queue Clearance Time (g s), s	2.7	10.4	5.2	9.0	3.7	12.6	3.4	11.9
Green Extension Time (g e), s	0.0	1.3	0.0	1.3	0.0	1.7	0.0	1.7
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.73	0.00	1.00	0.00	1.00	0.02	1.00	0.01

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	22	217		98	185		54	261		43	261	11
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1834		1810	1842		1810	1780		1810	1900	1610
Queue Service Time (g s), s	0.7	8.4		3.2	7.0		1.7	10.6		1.4	9.9	0.4
Cycle Queue Clearance Time (g c), s	0.7	8.4		3.2	7.0		1.7	10.6		1.4	9.9	0.4
Green Ratio (g/C)	0.38	0.30		0.38	0.30		0.39	0.31		0.39	0.31	0.31
Capacity (c), veh/h	468	556		442	558		424	553		414	590	500
Volume-to-Capacity Ratio (X)	0.046	0.391		0.221	0.331		0.128	0.472		0.105	0.442	0.022
Back of Queue (Q), ft/ln (50 th percentile)	6.9	89.9		32.5	74.7		17.3	110		13.8	108.5	3.9
Back of Queue (Q), veh/ln (50 th percentile)	0.3	3.6		1.3	3.0		0.7	4.4		0.6	4.3	0.2
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	0.00
Uniform Delay (d 1), s/veh	17.9	24.8		18.9	24.3		18.1	25.0		18.1	24.7	21.5
Incremental Delay (d 2), s/veh	0.0	0.4		0.2	0.3		0.1	0.6		0.1	0.5	0.0
Initial Queue Delay (d 3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Control Delay (d), s/veh	17.9	25.2		19.1	24.6		18.3	25.6		18.2	25.3	21.5
Level of Service (LOS)	B	C		B	C		B	C		B	C	C
Approach Delay, s/veh / LOS	24.5	C		22.7	C		24.4	C		24.2	C	
Intersection Delay, s/veh / LOS	23.9						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.92	B	2.11	B	1.92	B	1.92	B
Bicycle LOS Score / LOS	0.88	A	0.95	A	1.01	A	1.01	A

HCS7 Signalized Intersection Results Summary

General Information				Intersection Information		
Agency				Duration, h	0.250	
Analyst		Analysis Date	Jun 22, 2020	Area Type	Other	
Jurisdiction	City of Lorain	Time Period	PM Peak Hour	PHF	0.92	
Urban Street	State Route 611	Analysis Year	Existing Year 2020 'Build'	Analysis Period	1> 7:00	
Intersection	State Route 611 / State...	File Name	4 - 611 and 58 - PM Peak - 2020 B.xus			
Project Description	State Route 611 / State Route 58 Safety Study					

Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (v), veh/h	10	230	80	170	220	100	50	290	120	60	260	30

Signal Information														
Cycle, s	90.0	Reference Phase	2											
Offset, s	0	Reference Point	End											
Uncoordinated	Yes	Simult. Gap E/W	On	Green	7.0	25.7	7.0	29.6	0.0	0.0				
				Yellow	4.0	4.1	3.2	4.0	0.0	0.0				
Force Mode	Fixed	Simult. Gap N/S	On	Red	1.7	1.0	1.7	1.0	0.0	0.0				

														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6	3	8	7	4
Case Number	1.1	4.0	1.1	4.0	1.1	4.0	1.1	3.0
Phase Duration, s	12.7	30.8	12.7	30.8	11.9	34.6	11.9	34.6
Change Period, (Y+R c), s	5.7	5.1	5.7	5.1	4.9	5.0	4.9	5.0
Max Allow Headway (MAH), s	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Queue Clearance Time (g s), s	2.3	16.7	8.5	17.4	3.7	21.8	4.0	12.6
Green Extension Time (g e), s	0.0	1.9	0.0	1.8	0.0	1.9	0.0	2.7
Phase Call Probability	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Max Out Probability	0.38	0.24	1.00	0.30	1.00	0.37	1.00	0.03

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Assigned Movement	5	2	12	1	6	16	3	8	18	7	4	14
Adjusted Flow Rate (v), veh/h	11	337		185	348		54	446		65	283	33
Adjusted Saturation Flow Rate (s), veh/h/ln	1810	1816		1810	1799		1810	1805		1810	1900	1610
Queue Service Time (g s), s	0.3	14.7		6.5	15.4		1.7	19.8		2.0	10.6	1.2
Cycle Queue Clearance Time (g c), s	0.3	14.7		6.5	15.4		1.7	19.8		2.0	10.6	1.2
Green Ratio (g/C)	0.36	0.29		0.36	0.29		0.41	0.33		0.41	0.33	0.33
Capacity (c), veh/h	317	518		327	514		432	594		304	625	530
Volume-to-Capacity Ratio (X)	0.034	0.650		0.565	0.677		0.126	0.751		0.215	0.452	0.062
Back of Queue (Q), ft/ln (50 th percentile)	3.6	162.8		70.7	171.6		16.8	224		20.5	115.5	11.5
Back of Queue (Q), veh/ln (50 th percentile)	0.1	6.5		2.8	6.9		0.7	9.0		0.8	4.6	0.5
Queue Storage Ratio (RQ) (50 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	0.00
Uniform Delay (d 1), s/veh	20.1	28.2		22.2	28.5		17.3	26.9		19.3	23.8	20.7
Incremental Delay (d 2), s/veh	0.0	2.9		2.2	3.5		0.1	5.3		0.3	0.5	0.0
Initial Queue Delay (d 3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	0.0
Control Delay (d), s/veh	20.1	31.1		24.4	32.0		17.4	32.2		19.6	24.3	20.7
Level of Service (LOS)	C	C		C	C		B	C		B	C	C
Approach Delay, s/veh / LOS	30.7	C		29.4	C		30.6	C		23.2	C	
Intersection Delay, s/veh / LOS	28.7						C					

Multimodal Results	EB			WB			NB			SB		
Pedestrian LOS Score / LOS	1.92	B		2.11	B		1.92	B		1.92	B	
Bicycle LOS Score / LOS	1.06	A		1.37	A		1.31	A		1.12	A	

APPENDIX C

Yellow Change and Red Clearance Intervals Calculations

APPENDIX D
Crash Diagram

CRASH DIAGRAM

SR-611 & 58
Date: 2015-2019

Notes:
Crashes By Year
2015: 11
2016: 13
2017: 5
2018: 7
2019: 6

03-28-16
07-03-15
10-10-15
10-03-16
10-19-17
04-29-15

SR 611



07-13-15
02-25-16
03-19-15
06-13-15
08-03-16
01-26-15
08-29-15
11-20-18

03-11-16

07-18-17
01-01-18
08-17-19

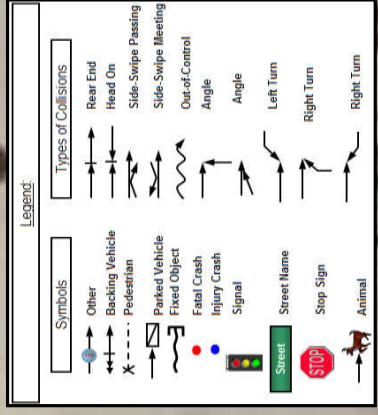
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10-05-16
07-08-16

07-18-18



11-05-19
03-24-15
07-06-15
08-25-18
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05-08-16
06-28-17
11-07-16
04-19-18
11-02-16
01-05-18
11-27-17
01-06-18

SR 58



APPENDIX E

2021 SR58 Restriping PID 101446

12
15

PAVEMENT MARKING DETAILS
SR 58 (LEAVITT ROAD)
ODOT RESURFACING PROJECT
SLM 24.65-27.54
CITY OF LORAIN
COUNTY OF LORAIN, STATE OF OHIO

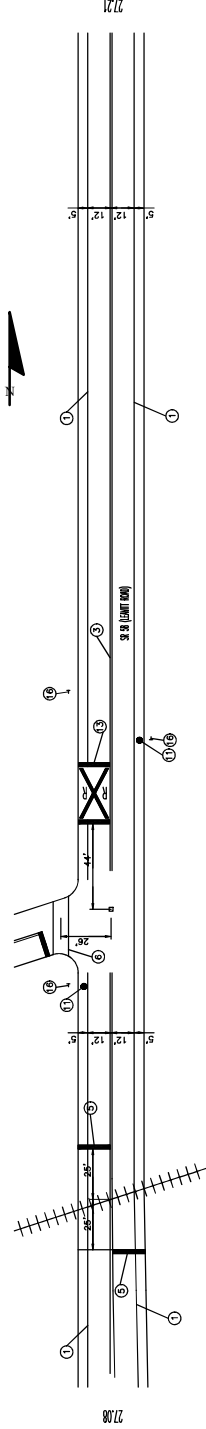


CITY OF LORAIN
ENGINEERING DEPARTMENT
200 WEST ERIE AVENUE
4TH FLOOR
LORAIN, OH 44052
PHONE: (440) 204-2003
FAX: (440) 244-2136

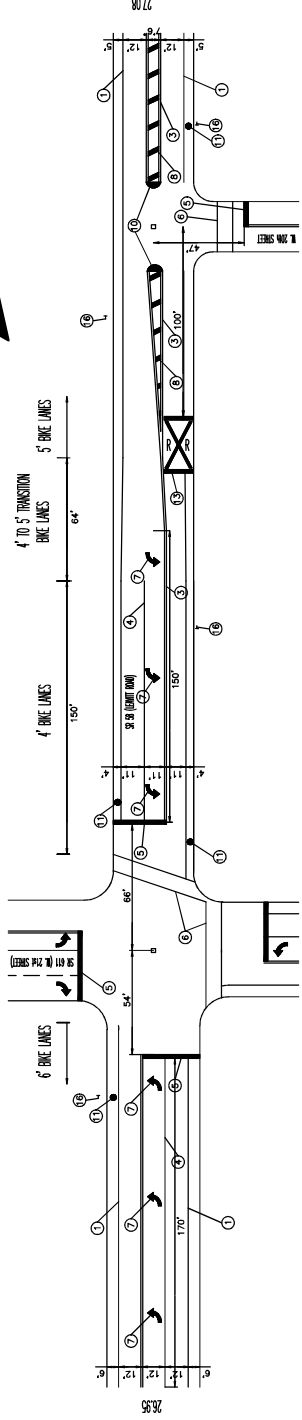
DATE: 04/24/20
DRAWN BY: VAN
CHECKED BY: AF

REVISIONS

DATE	DESCRIPTION	BY
04/24/20	ISSUED DRAWINGS	VAN



1 | SR 58 (LEAVITT ROAD) SLM - 26.95 TO 27.08



APPENDIX F

2020 SR611 Restriping TLCI 110315

W. 21ST ST 0+00-9+00
TLCI
2019
CITY OF LORAIN
COUNTY OF LORAIN, STATE OF OHIO
W 21ST AND E 31ST STREETS

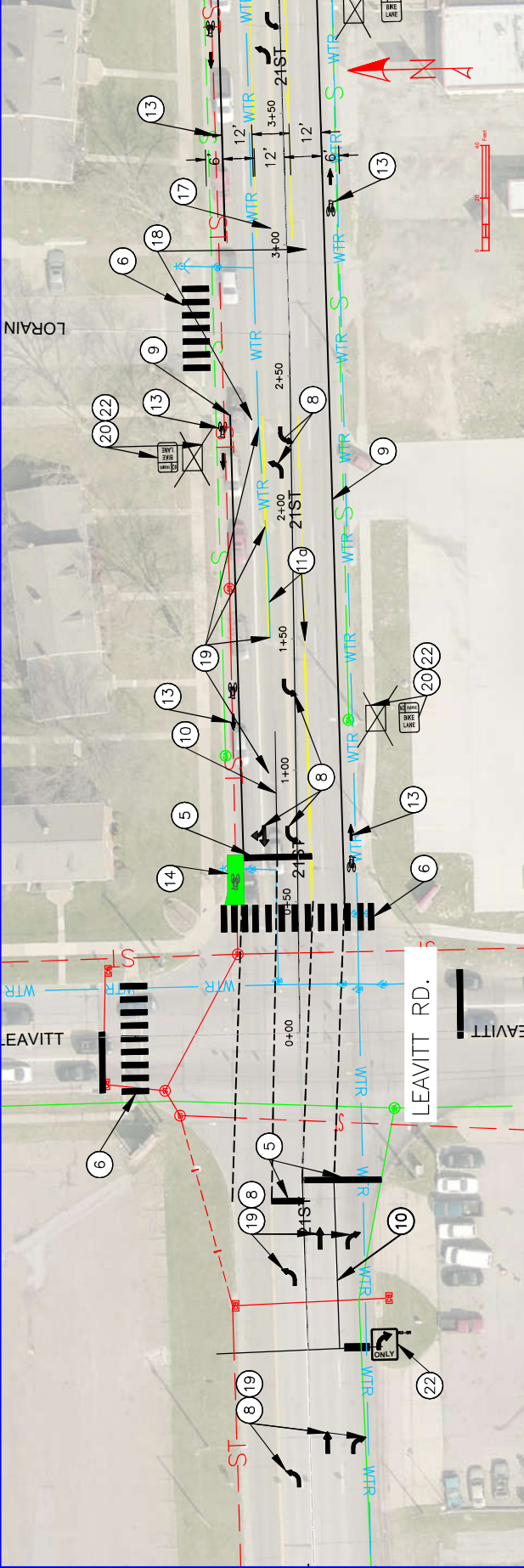


CITY OF LORAIN
ENGINEERING DEPARTMENT
200 WEST ERIE AVENUE
LORAIN, OH 44052
PHONE: (440) 204-2003
FAX: (440) 204-2522

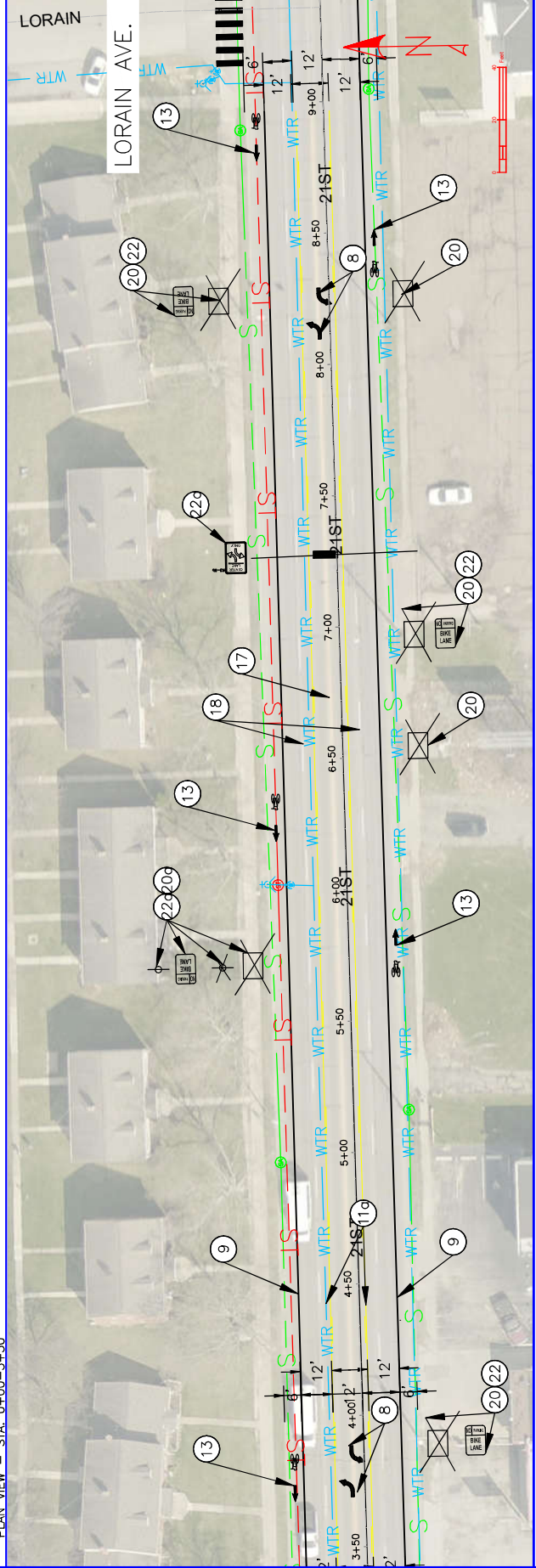
DATE: DEC. 01, 2019
DRAWN BY: JSP & VAN
CITY BY: KTM

REVISIONS

DATE	DESCRIPTION	BY
12/01/19	ISSUED DRAWINGS	



PLAN VIEW - STA. 0+00-3+50



PLAN VIEW - STA. 3+50-9+00

APPENDIX G

Cost Estimate

Preliminary Opinion of Probable Cost

ITEM	DESCRIPTION	TOTAL QUANTITY	UNIT	ESTIMATED PRICE	TOTAL COST
	TRAFFIC CONTROL				
	SIGNING	1	LS	\$5,000	\$5,000
	TRAFFIC CONTROL SUBTOTAL:				\$5,000
	SIGNALIZATION				
632	TRAFFIC SIGNAL	1	EACH	\$175,000	\$175,000
	SIGNALIZATION SUBTOTAL:				\$175,000
	MISCELLANEOUS				
623	CONSTRUCTION LAYOUT STAKES	1	LS	\$2,000	\$2,000
624	MOBILIZATION	1	LS	\$10,000	\$10,000
SPECIAL	PERFORMANCE BOND	1	LS	\$2,000	\$2,000
	MISCELLANEOUS SUBTOTAL:				\$14,000
	RIGHT OF WAY				
	PERMANENT R/W TAKE - MINOR - COMMERCIAL	3	EACH	\$10,000	\$30,000
	PERMANENT R/W TAKE - MINOR - RESIDENTIAL	1	EACH	\$5,000	\$5,000
	ACQUISITION SERVICES	4	EACH	\$5,000	\$20,000
	APPRAISAL REVIEW SERVICES	4	EACH	\$500	\$2,000
	RIGHT OF WAY SUBTOTAL:				\$57,000
	TOTAL CONSTRUCTION AND RIGHT OF WAY COST:				\$251,000
	DESIGN ENGINEERING COST:				\$49,000
	DESIGN CONTINGENCY COSTS				\$51,000
	PROJECT SUBTOTAL:				\$351,000
	3% INFLATION CONTINGENCY OVER 2 YEARS (6%):				\$22,000
	PROJECT TOTAL WITHOUT CONSTRUCTION INSPECTION				\$373,000
	CONSTRUCTION INSPECTION COST:		(10% OF PROJECT TOTAL)		\$38,000
				TOTAL:	\$411,000

APPENDIX H

Benefit to Cost Analysis



Safety Benefit - Cost Analysis

General Information

Project Name	State Route 611 / State Route 58	Contact Email	cdeibel@gpdgroup.com
Project Description	Intersection Safety Improvement	Contact Phone	(330) 572-2495
Reference Number	2020060.15	Date Performed	6/22/2020
Analyst	Curtis J. Deibel, PE, RSP	Analysis Year	2020
Agency/Company	GPD Group		

Comments:

Select Site Types to be used in Benefit-Cost Analysis:

All Sites

Countermeasure Service Lives, Costs, and Safety Benefits

Countermeasures	Service Life (Years)	Initial Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value	Net Present Cost of Countermeasure	Total Cost of Countermeasures	Summary of Annual Crash Modifications	Net Present Value of Safety Benefits
Convert left turn phasing to protected/permitting on all four approach legs	20	\$6,992.03			\$6,992.03	\$6,992.03		
		\$0.00			\$0.00	\$0.00	0.985	(\$345,138)
		\$0.00			\$0.00	\$0.00		
		\$0.00			\$0.00	\$0.00		
CMF 1 - Add 3-inch yellow retroreflective sheeting to signal backplates	20	\$323,031.87			\$323,031.87	\$323,031.87	-0.793	\$283,494
CMF 2 - Add signal (additional primary head)	20	\$6,992.03			\$6,992.03	\$6,992.03	-1.258	\$449,949
CMF 3 - Install Pedestrian Countdown Timer	20	\$13,984.06			\$13,984.06	\$13,984.06	-0.285	\$102,136
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
		\$0.00			\$0.00	\$0.00	0.000	\$0
Totals		\$350,999.99	\$0.00	\$0.00	\$350,999.99	\$350,999.99	-1.352	\$490,441



Safety Benefit - Cost Analysis

General Information

Project Name	State Route 611 / State Route 58	Contact Email	cdeibel@gpdgroup.com
Project Description	Intersection Safety Improvement	Contact Phone	(330) 572-2495
Reference Number	2020060.15	Date Performed	6/22/2020
Analyst	Curtis J. Deibel, PE, RSP	Analysis Year	2020
Agency/Company	GPD Group		

Benefit - Cost Calculator

Net Present Value of Project	\$350,999.99
Net Present Value of Safety Benefits	\$490,440.82
Net Benefit	\$139,440.83
Benefit / Cost Ratio	1.40

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.026
Number of Injury Crashes	-0.313
Number of Total Crashes	-1.352

Comments:

Safety Benefits and Project Costs Combined Cash Flows By Countermeasure Per Year



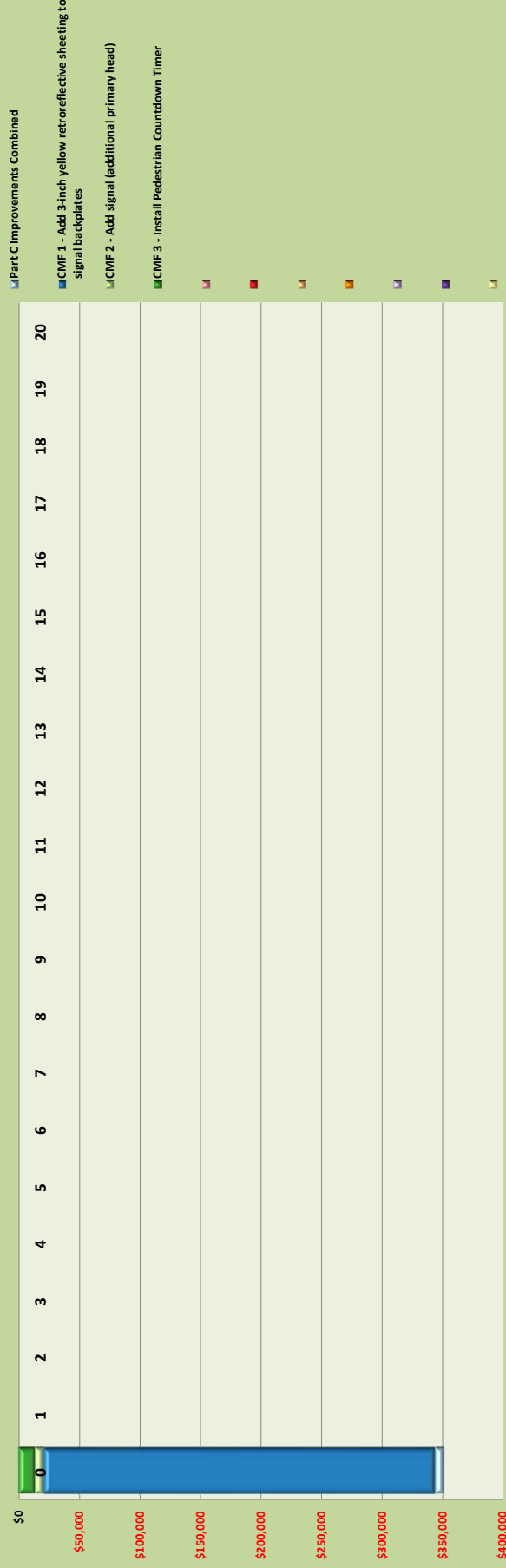


Safety Benefit - Cost Analysis

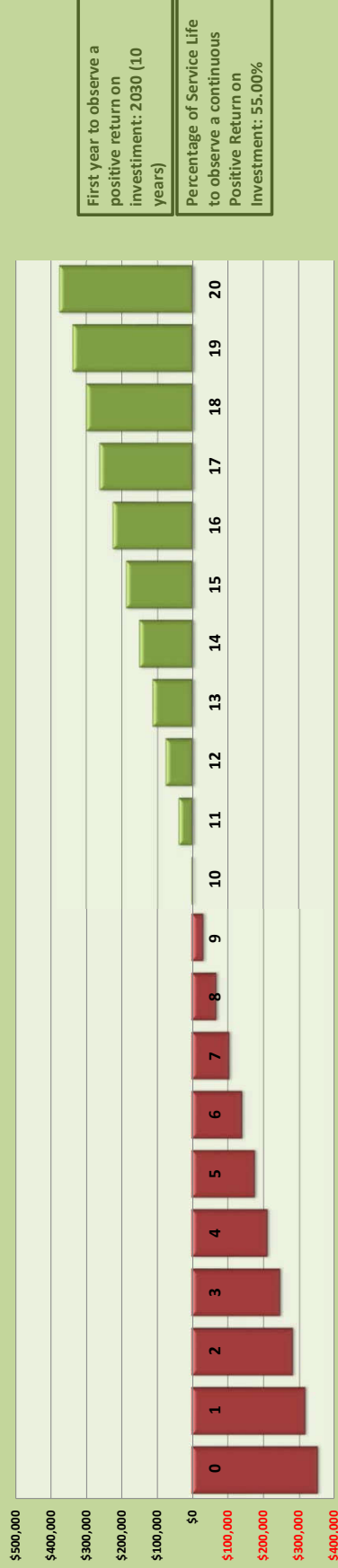
General Information

Project Name	State Route 611 / State Route 58	Contact Email	cdeibel@gpdgroup.com
Project Description	Intersection Safety Improvement	Contact Phone	(330) 572-2495
Reference Number	2020050.15	Date Performed	6/22/2020
Analyst	Curtis J. Deibel, PE, RSP	Analysis Year	2020
Agency/Company	GPD Group		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



APPENDIX I
Formal Safety Application

General Project Information

Project Sponsoring Agency	City of Lorain
Project Name	State Route 611 / State Route 58 Intersection Safety Improvement
PID	Not Assigned
Project Manager	Veronica A. Newsome. P.E.
Contact Phone	(440) 204-2003
Contact Email	veronica_newsome@cityoflorain.org

Location Information

ODOT District	3	County	LOR
Route Number	SR-611R	Road Name	West 21st Street
Begin Logpoint	1.140	End Logpoint	1.140
Begin Latitude	41.451	Begin Longitude	-82.202
End Latitude	41.451	End Longitude	-82.202

Project Description

Summary of Crash Patterns

On the east approach to the intersection, there are only 2 signal heads for a three (3) lane approach, which does not satisfy the current design standards. One signal head is dedicated to the protected-only left turn movement and the other signal head is the indication for the thru traffic movements. The existing crash pattern that has a significant percentage of rear-end crashes, along with angle crashes, points to the fact that there is a major signal visibility issue at the intersection itself.

The existing traffic signal timings and clearance intervals could be leading to the presence of both rear-end and angle crashes occurring at the intersection. The existing signal timings have not been revised for over 5 years, including the clearance intervals. If the clearance intervals are too short for motorists to clear the intersection during the phase change, angle crashes could be occurring as traffic isn't clearing the intersection before the phase changes.

While the intersection appears to have adequate capacity, the current intersection phasing could be creating unnecessary delay at the intersection. Currently, all four left turn phases at the intersection are protected-only. Under the protected only phasing, additional green time is allocated to the left turn phases since this traffic cannot make the left turn movement under a permissive phase. Based on the traffic volumes and existing conditions at this intersection, there is not a need for the left turn movements to be protected-only.

The rear-end crashes are concentrated on the NB and WB approaches to this intersection, which are also the two approaches with the highest level of vehicular delay according to the capacity analysis results. The increased delay on those two approaches also increases the queuing, which can lead to more rear-end crashes to occur.

Even though no sideswipe – passing crashes occurred on the east leg of the intersection, there is a lane drop condition for westbound traffic. When approaching the intersection there are two approach lanes, one of which becomes a drop left turn onto southbound State Route 58. This condition could lead to vehicles making sudden lane changes while approaching the intersection. These lane changes could create both rear-end and sideswipe – passing crashes.

Summary of Recommended Countermeasures

1. Implement updated signal timings and clearance intervals
2. Reconstruct the traffic signal at the intersection, including the backplates and additional primary signal heads to meet current design codes.
3. Convert the left turn phasing at the intersection to protected/permissive for all intersection approaches.
4. Upgrade the pedestrian accommodations at the intersection to include a pedestrian countdown timer.

The above improvement list will help to mitigate the existing crash patterns that were identified at the study intersection. It should be noted that the existing span wire signal installation will be unable to accommodate the traffic signal backplates, the additional primary signal heads, and the 5 section signal heads required to be installed in order to provide the protected/permissive traffic signal phasing. Therefore, the existing traffic signal installation will need to be reconstructed. The traffic signals should be reconstructed and upgraded to include full vehicular detection, meet current design standards, and incorporate current technology. All traffic signals should be designed to accommodate traffic signal backplates on all approaches to increase signal visibility and add target value to the signal heads. Additionally, the upgraded signals should provide full pedestrian accommodations with pushbuttons and countdown displays. The new traffic signal should also have updated signal timings and clearance intervals incorporated. The city will also investigate the addition of advance warning signs with street name plaques during the detailed design phase of this project.

Project Priority Information

The State Route 611 / State Route 58 intersection is the #270 ranked urban intersection on a statewide basis and the 4th highest ranked intersection within the City of Lorain. These rankings are provided from the 2018 ODOT HSIP safety priority list.

Safety Funding Application

Crash Data					
Crash Totals					
	Fatal & Serious Injury (KA)	Visible Injury (B)	Non-Visible (C)	Property Damage Only (O)	Total
Existing Conditions: Predicted Crash Frequency	0.0558	0.2458	0.3352	1.8212	2.46
Existing Conditions: Expected Crash Frequency	0.0803	0.3704	0.5358	3.3161	4.30
Potential for Safety Improvement	0.0245	0.1246	0.2006	1.4949	1.84
Proposed Conditions: Expected Crash Frequency	0.0545	0.2525	0.3667	2.2773	2.95
Observed Crashes	0.0000	0.8000	2.4000	5.2000	8.40
Observed People Injury Totals					
	Fatal Injury (K)	Serious Injury (A)	Visible Injury (B)	Non-Visible (C)	Total
Observed People Injury Totals	0.0000	0.0000	1.2000	5.0000	6.20
Application Scoring					
Category	Scoring Value	Points Awarded	Points Possible		
Expected Crash Frequency	4.30	2	10		
Ratio of Observed Fatal and Serious Injuries to Observed Total Crashes	0.00	0	5		
% of the Potential for Safety Improvement to Total Expected Crashes	42.79%	20	20		
Relative Severity Index	\$25,175	4	10		
Equivalent Property Damage Only Index	2.62	2	5		
Volume to Capacity Ratio	0.92	8	10		
Benefit Cost Ratio	1.40	9	30		
Safety Funding Request Percentage	100.00%	10	10		
Total		55	100		

Strategic Highway Safety Plan	
Functional Class	Other Principal Arterial Roadway
Major Route AADT	9,340
Ohio Emphasis Area	Serious Crash Types
Ohio Emphasis Area Subcategory	Intersection
FHWA Emphasis Area	Improving the design and operation of highway intersections
FHWA Improvement Category	Intersection traffic control
FHWA Improvement Subcategory	Modify traffic signal - add additional signal heads

Work Locations					
NLFID	Begin Logpoint	End Logpoint	Begin Latitude	Begin Longitude	Location Termini (i.e. from Street 1 to Street 2)
SLORSR00611**C	1.140	1.140	41.451	-82.2023	State Route 611 / State Route 58 Intersection

Safety Funding Application

Project Funding

Project Phase	Safety Study	Interchange Mod. Study	PE - Environmental	PE - Detailed Design	Right of Way /Utilities	Construction	Total
Fiscal Year	2021		2021	2021	2022	2023	
Project Phase Completed	☒	☐	☐	☐	☐	N/A	
Previous Safety	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
New Safety	\$0.00	\$0.00	\$33,000.00	\$16,000.00	\$57,000.00	\$305,000.00	\$411,000.00
Sponsor Funding	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Total	\$0.00	\$0.00	\$33,000.00	\$16,000.00	\$57,000.00	\$305,000.00	\$411,000.00

Additional Funding Detail

The City of Lorain is requesting 100% funding for this project with an anticipated construction in ODOT State Fiscal Year 2023, which will begin on July 1st, 2022. This will give the City of Lorain two years to design and acquire any necessary R/W for this project to move forward. This is intended to be a Local Let project.

At this time, the R/W funding is being requested as it is assumed that corner roundings will be necessary on all 4 corners of the intersection.

Project Development

Project Phase	Completed by	Completion Date
Safety Study	City of Lorain	Jul-20

Applicant Information

Name	Title	Phone Number
Dale Vandersommen, P.E.	City Engineer	(440) 204-2003
Signature		Date

Version: 20150917

The following information should be included in submission of the safety project application:

1. An electronic copy of the Safety Engineering Study
2. All Excel Analysis Files
May include Crash Analysis Module (CAM) Tool, Economic Crash Analysis Tool (ECAT), HSIP Application and Scoring Tool.
3. Benefit-Cost Results (Economic Analysis)
4. DSRT approval signatures

APPENDIX J
Signal Warrants

Study Name: Leavitt and W 21

Study Date : 6/22/2020

Signal Warrants - Summary

Major Street Approaches

Northbound: Leavitt Road

Number of Lanes : 1

Total Approach Volume: 3,844

Southbound: Leavitt Road

Number of Lanes :1

Total Approach Volume: 2,784

Minor Street Approaches

Eastbound: West 21st Street

Number of Lanes :2+

Total Approach Volume: 2,437

Westbound: West 21st Street

Number of Lanes :2+

Total Approach Volume: 3,546

Warrant Summary (Urban Values Apply)

Warrant 1 - Eight Hour Vehicular Volumes..... **Satisfied**

Warrant 1A - Minimum Vehicular Volume..... **Satisfied**

Required volumes reached for 8 hours, 8 are needed

Warrant 1B - Interruption of Continuous Traffic..... **Not Satisfied**

Required volumes reached for 0 hours, 8 are needed

Warrant 1C - Combination of Warrants..... **Not Satisfied**

Required 1A volumes reached for 12 hours, 8 are needed

Required 1B volumes reached for 5 hours, 8 are needed

Warrant 2 - Four Hour Volumes..... **Satisfied**

Number of hours (4) volumes exceed minimum >= minimum required (4).

Warrant 3 - Peak Hour..... **Satisfied**

Warrant 3A - Peak Hour Delay..... **Not Satisfied**

Total approach volumes and delays on minor street do not exceed minimums for any one hour period.

Warrant 3B - Peak Hour Volumes..... **Satisfied**

Volumes exceed minimums for at least one hour period.

Warrant 4 - Pedestrian Volumes..... **Not Evaluated**

Warrant 5 - School Crossing..... **Not Evaluated**

Warrant 6 - Coordinated Signal System..... **Not Evaluated**

Warrant 7 - Crash Experience..... **Not Evaluated**

Warrant 8 - Roadway Network..... **Not Evaluated**

Warrant 9 - Intersection Near a Grade Crossing..... **Not Evaluated**

Study Name: Leavitt and W 21

Study Date : 6/22/2020

Warrant 1A - Minimum Volumes

Description

Intended for sites where the volume of intersecting traffic is the principal reason for consideration of a signal installation.

Summary

8 one hour periods meet minimums.
Warrant IS met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **2 or more**

Volume Requirements

Veh/Hr Major = **500**

Veh/Hr Minor = **200**

	Major Road					Minor Road				
	Leavitt Road					West 21st Street				
Time	Major NB	+	Major SB	=	Total		Minor EB		Minor WB	Met?
16:15 - 17:15	417	+	310	=	727		292		438	Yes
14:15 - 15:15	399	+	296	=	695		210		349	Yes
15:15 - 16:15	432	+	251	=	683		246		389	Yes
17:15 - 18:15	373	+	262	=	635		224		321	Yes
12:00 - 13:00	340	+	225	=	565		198		284	Yes
07:15 - 08:15	261	+	260	=	521		193		230	Yes
13:15 - 14:15	306	+	211	=	517		199		310	Yes
11:00 - 12:00	294	+	216	=	510		189		231	Yes
13:00 - 14:00	303	+	194	=	497		201		296	No
10:45 - 11:45	291	+	197	=	488		179		235	No
10:30 - 11:30	259	+	197	=	456		172		239	No
07:00 - 08:00	208	+	245	=	453		198		239	No
18:15 - 19:15	282	+	170	=	452		140		189	No
10:15 - 11:15	241	+	181	=	422		173		259	No
09:15 - 10:15	248	+	164	=	412		150		235	No
10:00 - 11:00	236	+	170	=	406		172		264	No
08:45 - 09:45	218	+	185	=	403		129		222	No
09:30 - 10:30	239	+	161	=	400		163		255	No
09:00 - 10:00	232	+	168	=	400		149		233	No
08:15 - 09:15	210	+	188	=	398		167		246	No
09:45 - 10:45	227	+	158	=	385		176		269	No
08:30 - 09:30	203	+	178	=	381		143		245	No
06:45 - 07:45	138	+	183	=	321		139		165	No
18:30 - 19:30	174	+	112	=	286		83		123	No
06:30 - 07:30	91		123		214		88		110	No

Study Name: Leavitt and W 21

Study Date : 6/22/2020

Warrant 1B - Interruption of Continuous Traffic

Description

Intended for sites where the volume of the major street is so heavy that traffic on the minor street suffers excessive delay or hazard.

Summary

Only 0 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **2 or more**

Volume Requirements

Veh/Hr Major = **750**

Veh/Hr Minor = **100**

	Major Road					Minor Road				
	Leavitt Road					West 21st Street				
Time	Major NB	+	Major SB	=	Total		Minor EB		Minor WB	Met?
16:15 - 17:15	417	+	310	=	727		292		438	No
14:45 - 15:45	437	+	289	=	726		233		362	No
16:30 - 17:30	410	+	311	=	721		291		413	No
15:00 - 16:00	437	+	279	=	716		238		382	No
16:00 - 17:00	406	+	300	=	706		294		428	No
14:30 - 15:30	425	+	280	=	705		212		371	No
14:15 - 15:15	399	+	296	=	695		210		349	No
16:45 - 17:45	408	+	282	=	690		274		374	No
15:15 - 16:15	432	+	251	=	683		246		389	No
15:45 - 16:45	412	+	266	=	678		286		437	No
15:30 - 16:30	428	+	246	=	674		272		403	No
17:00 - 18:00	400	+	252	=	652		243		352	No
14:00 - 15:00	366	+	277	=	643		204		340	No
17:30 - 18:30	391	+	251	=	642		211		299	No
17:15 - 18:15	373	+	262	=	635		224		321	No
17:45 - 18:45	379	+	247	=	626		176		273	No
18:00 - 19:00	373	+	246	=	619		187		263	No
13:45 - 14:45	322	+	260	=	582		192		336	No
11:45 - 12:45	333	+	243	=	576		214		283	No
12:00 - 13:00	340	+	225	=	565		198		284	No
11:30 - 12:30	321	+	230	=	551		210		263	No
12:30 - 13:30	335	+	211	=	546		202		290	No
11:15 - 12:15	313	+	232	=	545		204		252	No
13:30 - 14:30	298	+	247	=	545		187		303	No
12:15 - 13:15	326		207		533		197		271	No

Study Name: Leavitt and W 21

Study Date : 6/22/2020

Warrant 1C Combination of Warrants

Description

Intended for sites where the traffic volumes don't meet individual warrants but where Warrants 1A and 1B are both met to 80% of their stated values.

Summary

12 hours meet 1A minimums.
Only 5 hours meet 1B minimums.
Warrant is NOT met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **2 or more**

Volume Requirements

Warrant 1A 1B
Veh/Hr Major = **400 600**
Veh/Hr Minor = **160 80**

Major Road Leavitt Road						Minor Road West 21st Street		
Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met1A?
15:00 - 16:00	437	+	279	=	716	238	382	Yes
16:00 - 17:00	406	+	300	=	706	294	428	Yes
17:00 - 18:00	400	+	252	=	652	243	352	Yes
14:00 - 15:00	366	+	277	=	643	204	340	Yes
18:00 - 19:00	373	+	246	=	619	187	263	Yes
12:00 - 13:00	340	+	225	=	565	198	284	Yes
11:00 - 12:00	294	+	216	=	510	189	231	Yes
13:00 - 14:00	303	+	194	=	497	201	296	Yes
08:00 - 09:00	249	+	212	=	461	164	234	Yes
07:00 - 08:00	208	+	245	=	453	198	239	Yes
10:00 - 11:00	236	+	170	=	406	172	264	Yes
09:00 - 10:00	232	+	168	=	400	149	233	Yes

Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met1B?
15:00 - 16:00	437	+	279	=	716	238	382	Yes
16:00 - 17:00	406	+	300	=	706	294	428	Yes
17:00 - 18:00	400	+	252	=	652	243	352	Yes
14:00 - 15:00	366	+	277	=	643	204	340	Yes
18:00 - 19:00	373	+	246	=	619	187	263	Yes
13:45 - 14:45	322	+	260	=	582	192	336	No
11:45 - 12:45	333	+	243	=	576	214	283	No
12:00 - 13:00	340	+	225	=	565	198	284	No
11:30 - 12:30	321	+	230	=	551	210	263	No
12:30 - 13:30	335	+	211	=	546	202	290	No
11:15 - 12:15	313	+	232	=	545	204	252	No
13:30 - 14:30	298	+	247	=	545	187	303	No

Study Name: Leavitt and W 21

Study Date : 6/22/2020

Warrant 2 - Four Hour Volumes

Description

Intended for sites where the volume of intersecting traffic during any four hours of the day is the principal reason for consideration of a signal installation.

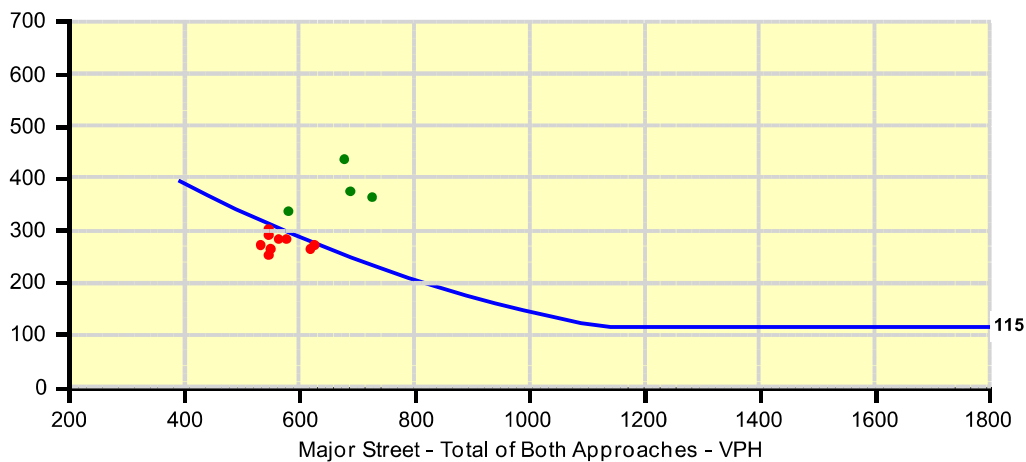
Summary

4 one hour periods meet minimums.
Warrant IS met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **2 or more**

Major Road Leavitt Road						Minor Road West 21st Street		
Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met?
14:45 - 15:45	437	+	289	=	726	233	362	Yes
16:45 - 17:45	408	+	282	=	690	274	374	Yes
15:45 - 16:45	412	+	266	=	678	286	437	Yes
13:45 - 14:45	322	+	260	=	582	192	336	Yes
17:45 - 18:45	379	+	247	=	626	176	273	No
18:00 - 19:00	373	+	246	=	619	187	263	No
11:45 - 12:45	333	+	243	=	576	214	283	No
12:00 - 13:00	340	+	225	=	565	198	284	No
11:30 - 12:30	321	+	230	=	551	210	263	No
12:30 - 13:30	335	+	211	=	546	202	290	No
11:15 - 12:15	313	+	232	=	545	204	252	No
							303	No



Study Name: Leavitt and W 21

Study Date : 6/22/2020

Warrant 3A - Peak Hour Delay

Description

Intended for sites where for one hour of the day minor street traffic suffers undue traffic delay entering or crossing the major street.

Summary

41 one hour periods meet minimums.
Warrant is NOT met.

Site Data Required

Number of Minor Lanes = **2 or more**

Volume and Delay Requirements

Veh/Hr All Approaches = **800**

Veh/Hr Minor = **150**

Total Delay (Veh-Hrs) = **5**

Major Road			Minor Road						
Leavitt Road			West 21st Street						
Time	Total of All Approaches	Met?	Minor EB	Delay EB	Met?	Minor WB	Delay WB	Met?	Warrant Met?
16:15 - 17:15	1457	Yes	292	0.0	---	438	0.0	---	No
16:00 - 17:00	1428	Yes	294	0.0	---	428	0.0	---	No
16:30 - 17:30	1425	Yes	291	0.0	---	413	0.0	---	No
15:45 - 16:45	1401	Yes	286	0.0	---	437	0.0	---	No
15:30 - 16:30	1349	Yes	272	0.0	---	403	0.0	---	No
16:45 - 17:45	1338	Yes	274	0.0	---	374	0.0	---	No
15:00 - 16:00	1336	Yes	238	0.0	---	382	0.0	---	No
14:45 - 15:45	1321	Yes	233	0.0	---	362	0.0	---	No
15:15 - 16:15	1318	Yes	246	0.0	---	389	0.0	---	No
14:30 - 15:30	1288	Yes	212	0.0	---	371	0.0	---	No
14:15 - 15:15	1254	Yes	210	0.0	---	349	0.0	---	No
17:00 - 18:00	1247	Yes	243	0.0	---	352	0.0	---	No
14:00 - 15:00	1187	Yes	204	0.0	---	340	0.0	---	No
17:15 - 18:15	1180	Yes	224	0.0	---	321	0.0	---	No
17:30 - 18:30	1152	Yes	211	0.0	---	299	0.0	---	No
13:45 - 14:45	1110	Yes	192	0.0	---	336	0.0	---	No
17:45 - 18:45	1075	Yes	176	0.0	---	273	0.0	---	No
11:45 - 12:45	1073	Yes	214	0.0	---	283	0.0	---	No
18:00 - 19:00	1069	Yes	187	0.0	---	263	0.0	---	No
12:00 - 13:00	1047	Yes	198	0.0	---	284	0.0	---	No
12:30 - 13:30	1038	Yes	202	0.0	---	290	0.0	---	No
13:30 - 14:30	1035	Yes	187	0.0	---	303	0.0	---	No
13:15 - 14:15	1026	Yes	199	0.0	---	310	0.0	---	No
11:30 - 12:30	1024	Yes	210	0.0	---	263	0.0	---	No
11:15 - 12:15	1001	Yes	204	0.0	---	252	0.0	---	No

Study Name: Leavitt and W 21

Study Date : 6/22/2020

Warrant 3B - Peak Hour Volumes

Description

Intended for sites where the volume of intersecting traffic during one hour of the day is the principal reason for consideration of a signal installation.

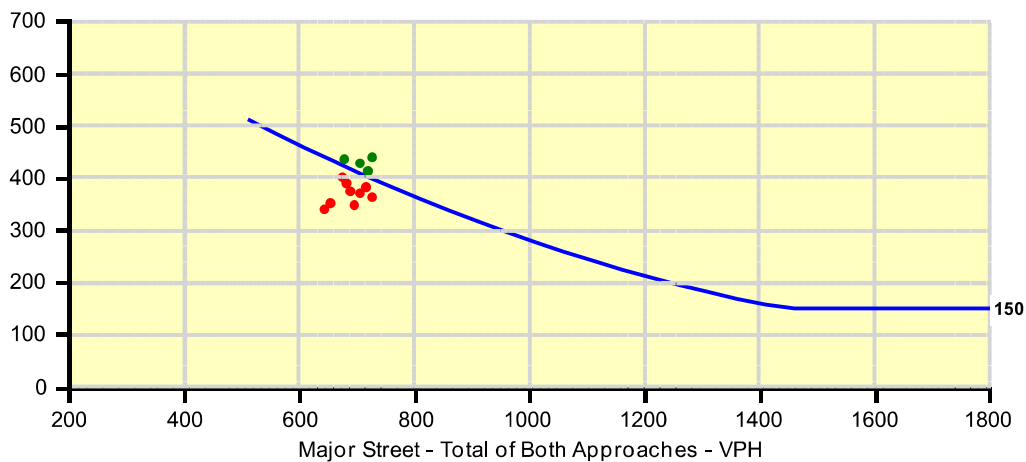
Summary

4 one hour periods meet minimums.
Warrant IS met.

Site Data Required

Rural Settings Apply = **False**
Number of Major Lanes = **1**
Number of Minor Lanes = **2 or more**

Major Road Leavitt Road						Minor Road West 21st Street		
Time	Major NB	+	Major SB	=	Total	Minor EB	Minor WB	Met?
16:15 - 17:15	417	+	310	=	727	292	438	Yes
16:30 - 17:30	410	+	311	=	721	291	413	Yes
16:00 - 17:00	406	+	300	=	706	294	428	Yes
15:45 - 16:45	412	+	266	=	678	286	437	Yes
14:45 - 15:45	437	+	289	=	726	233	362	No
15:00 - 16:00	437	+	279	=	716	238	382	No
14:30 - 15:30	425	+	280	=	705	212	371	No
14:15 - 15:15	399	+	296	=	695	210	349	No
16:45 - 17:45	408	+	282	=	690	274	374	No
15:15 - 16:15	432	+	251	=	683	246	389	No
15:30 - 16:30	428	+	246	=	674	272	403	No
							352	No



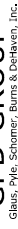
APPENDIX K
City of Lorain Priority List

City Priority	Roadway1	Roadway2	Total Crashes (2014-2018)	FSI Crashes
1	SR611 (W. 21st St)	Kansas Ave	71	2
2	SR58 (Leavitt Rd)	Tower Blvd	64	5
3	SR611 (W. 21st St)	Broadway Ave	60	2
4	SR58 (Leavitt Rd)	SR611 (W. 21st St)	57	1
5	SR611 (W. 21st St)	Oberlin Ave	56	0
6	SR57 (Grove Ave)	Fairless Dr	53	3
7	SR611 (W. 21st St)	Washington Ave	46	0
8	SR57 (Grove Ave)	East 31st St	42	3
9	Oberlin Ave	Meister Rd	42	1
10	SR57 (Grove Ave)	Broadway Ave	40	1
11	SR58 (Leavitt Rd)	Jaeger Rd	40	0
12	SR611 (W. 21st St)	Reid Ave	39	1
13	SR58 (Leavitt Rd)	Meister Rd	38	1
14	SR611 (W. 21st St)	Root Rd	38	1
15	SR611 (W. 21st St)	Oakdale Ave	36	4
16	Tower Blvd	Oberlin Ave	36	0
17	SR611 (W. 21st St)	Elyria Ave	35	3
18	SR57 (Grove Ave)	Elyria Ave	35	2
19	Broadway Ave	W. 33rd St	34	0
20	US6 (W. Erie Ave)	Oberlin Ave	33	0
21	SR58 (Leavitt Rd)	W. 40th St	31	1
22	Broadway Ave	E. 30th St	31	0
23	US6 (W. Erie Ave)	Broadway Ave	31	0
24	Missouri Ave	SR611 (W. 21st St)	30	0
25	SR254 (Cooper Foster Park Rd.)	Broadway Ave	30	0
26	SR57 (Grove Ave)	E. 28th St	29	0
27	Broadway Ave	W. 39th St	28	0
28	SR57 (Grove Ave)	Pearl Ave	27	1
29	US6 (W. Erie Ave)	Leavitt Rd	27	0
30	SR254 (Cooper Foster Park Rd.)	Pearl Ave	27	0
31	W. 37th St	Oberlin Ave	26	1
32	US6 (W. Erie Ave)	Oakpoint Rd.	26	1
33	Reeves Ave	SR611 (W. 21st St)	26	0
34	Tower Blvd	Ashland Ave	24	1
35	SR254 (Cooper Foster Park Rd.)	Oberlin Ave	24	0
36	Fulton Rd	E. 28th St	23	0
37	W. 33rd St	Falbo Ave	22	0
38	SR2	Broadway Ave	22	0
39	SR57 (Grove Ave)	E. 42nd St	21	0
40	W. 28th St	Reid Ave	20	0
41	Pearl Ave	E. 36th St	19	1
42	North Ridge Rd	Cooper Foster Parkway	19	0
43	SR611 (W. 21st St)	Access Dr	18	2
44	US6 (E. Erie Ave)	Colorado Ave	18	0
45	Beech Ave	W. 22nd St	16	1
46	Cooper Foster Park	Oakpoint Rd.	16	0
47	Elyria Ave	E. 36th St	16	0
48	US6 (W. Erie Ave)	Frankie Dr	15	1

APPENDIX L
Intersection Concept Plan



3 UNIT 5 UNIT
SIGNAL HEAD SIGNAL HEAD



JULY 2020