CATALPA DRIVE AT SIEBENTHALER AVENUE

INTERSECTION SAFETY STUDY

MAY 31, 2023
PID 113190

PREPARED FOR:

ODOT DISTRICT 7
1001 SAINT MARYS AVENUE
SIDNEY, OHIO 45365

MONTGOMERY COUNTY ENGINEER'S OFFICE

451 W. THIRD STREET
DAYTON, OHIO 45422

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EXECUTIVE SUMMARY

The purpose of this study is to evaluate the existing safety performance and to identify potential countermeasures to reduce traffic crashes at the intersection of Siebenthaler Avenue and Catalpa Drive. The intersection is in Harrison Township, Montgomery County, Ohio, and maintained by Montgomery County Engineer's Office. The intersection is ranked 418 in the ODOT HSIP Priority Intersection listing, listed in the MVRPC Top 100 high-crash listing and ranks in the top three in the Montgomery County intersection crash locations listing by crash rate and crash frequency.

Siebenthaler Avenue and Catalpa Road are both two-lane roadways with posted speed limit of 35 miles per hour. The ADT on Siebenthaler Avenue (Minor Arterial) is approximately 10,500 vehicles per day. The ADT on Catalpa Drive (Major Collector) ranges between 4,000 and 5,300 vehicles per day. The intersection operates at LOS F during peak hours.

A total of 67 crashes occurred over a five-year period (2017 through 2021) at the intersection. The following crash types and/or conditions were determined to be over-represented compared to statewide averages for 4-leg all-way STOP intersections (shown in parenthesis).

- Minor Injury Crash: 16.42% (13.79%)
- Injury Possible Crash: 17.91% (9.68%)
- Angle crashes: 62.69% (31.42%)
- Rear end crashes: 23.88% (14.31%)
- Wet road condition (27.94%) (18.65%)
- Ice road condition (2.94%) (1.68%)

A traffic signal and a single lane roundabout were the two alternative countermeasures evaluated to mitigate the high percentage of angle and rear end crashes. The primary contributing factors are high traffic volumes contributing to congestion and lack of clear assignment of right of way with all-way stop control. Existing traffic control devices have not achieved the desired effect of eliminating or reducing crashes over the past 5 years.

The single lane roundabout is the recommended safety countermeasure due to its proven safety record of reducing high severity crashes by reducing or eliminating stops in a low-speed environment. LOS A is expected with a roundabout intersection. The design of a roundabout can be adapted to a wide range of physical conditions. Both a standard circular roundabout and an oblong, "peanut" shaped roundabout were considered in this study to balance impact to adjacent properties. A circular roundabout would likely result in a full property relocation where an oblong shape could shift the intersection to the west and reduce that impact. The estimated cost range for a single lane roundabout at the study intersection is between $4.3 and $5.5 million.

INTRODUCTION

The purpose of this study is to evaluate the existing safety performance and to identify potential countermeasures to reduce traffic crashes at the intersection of Siebenthaler Avenue and Catalpa Drive. The intersection is in Harrison Township, Montgomery County, Ohio, approximately four miles northwest of downtown Dayton. The intersection is maintained by the Montgomery County Engineer's Office. The intersection priorities from the ODOT Safety Map Viewer are listed below:

- Ranked 418 ODOT HSIP Priority intersection listing (CMOTCR00032)
- Listed in the MVPRC Top 100 High-Crash Intersections listing (Harrison Twp)
- Ranked #3 in Montgomery County 2020-2022 Intersection Crash Locations by Rate listing (2.30 crashes per million vehicles miles)
- Ranked #2 in Montgomery County 2020-2022 Intersection Crash Locations by Frequency listing (39 crashes)
- Ranked as High Priority in the CEAO Priority Intersection listing.
- Catalpa Drive ranked medium priority (yellow 11-15) in the CEAO Priority Segments listing.

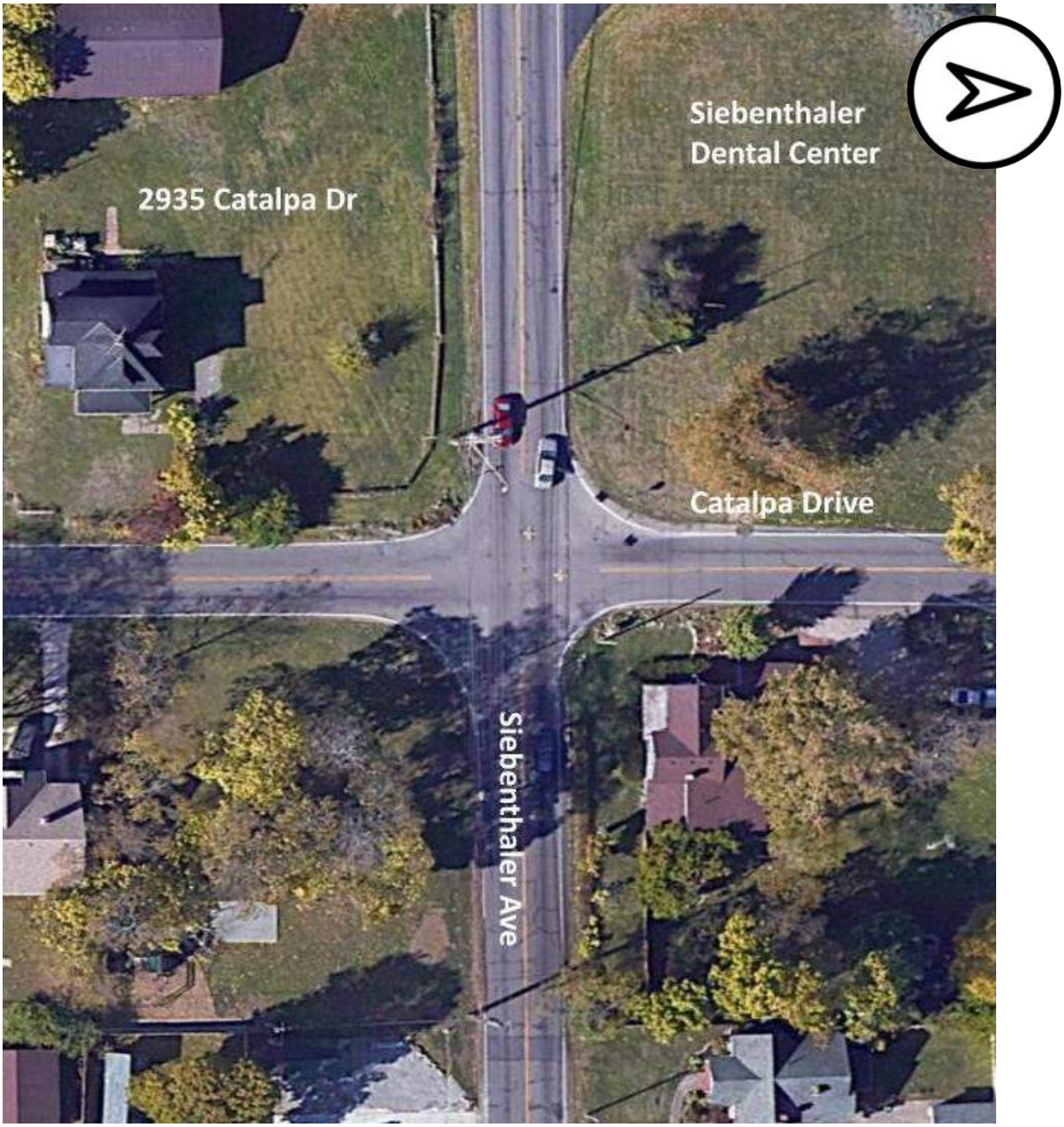
The site's regional location is shown in **Figure 1.** Crash priority documentation is included in **Appendix A.**

FIGURE 1: SITE LOCATION MAP

EXISTING CONDITIONS

Existing conditions of the study intersection are shown in **Figure 2.** Siebenthaler Avenue is a two-lane roadway with a functional classification of Minor Arterial and a posted speed limit of 35 miles per hour. The ADT on Siebenthaler Avenue is approximately 10,500 vehicles per day. Catalpa Drive is a two-lane roadway has a functional classification of Major Collector and a posted speed limit of 35 miles per hour. The ADT on Catalpa Drive is 4,000 vehicles per day north of Siebenthaler Avenue and 5,300 vehicles per day south of Siebenthaler Avenue.

FIGURE 2: INTERSECTION CONDITIONS



TRAFFIC CONTROL

The intersection operates with four-way stop sign control. There are single lanes on each approach with no dedicated turn lanes. The intersection has an overhead mounted intersection control beacon that flashes red for all approaches. Existing signage conditions are summarized below:

- Single STOP signs mounted on the right side of each approach to the intersection.
- STOP AHEAD sign on the northbound Catalpa Drive approach approximately 400 feet in advance of the intersection
- STOP AHEAD sign on the eastbound Siebenthaler Avenue approach approximately 250 feet in advance of the intersection
- STOP AHEAD sign on the westbound Siebenthaler Avenue approach approximately 450 feet in advance of the intersection.
- No advanced signage on the southbound Catalpa Drive approach.

A large deciduous tree was removed from the northeast corner of the intersection between October 2017 and July 2018. Discussions with staff from Montgomery County suggest that this tree was removed, in part, due to sight distance restrictions resulting from the overhang and size of the tree in the public right of way.

PEDESTRIAN CONNECTIVITY

The community surrounding the study intersection is primarily residential supported by neighborhood amenities such as the Northwest branch of the Dayton Metro Library, Dayton Public School Fairview Commons, Our Lady of Mercy Catholic Church, and commercial uses near the Siebenthaler/ Philadelphia intersection. There are no sidewalks or other pedestrian facilities at the study intersection. **Figure 3** provides a graphic depiction of sidewalk connectivity in and around the study area (red lines denote existing sidewalk).

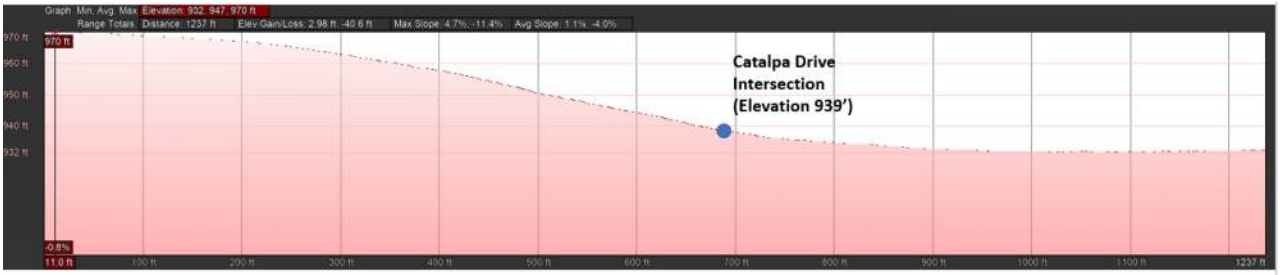
There is a missing sidewalk link (approximately 1,000 feet) on the south side of Siebenthaler Avenue between Ida Avenue and Catalpa Drive. There is a missing sidewalk link on the west side of Catalpa Drive between Gulf View Avenue and Siebenthaler Avenue (approximately 1,400 feet). The photo inset in Figure 3 shows a marked pedestrian crosswalk at Gulf View Avenue. The existing sidewalk link on the west side of Catalpa Drive terminates prior to the marked crosswalk leaving a critical missing link in pedestrian connectivity.

FIGURE 3: SIDEWALK CONNECTIVITY

VERTICAL PROFILE

Siebenthaler Avenue is in a vertical curve through the intersection, as shown in **Figure 4.** Eastbound vehicles approach the intersection on a 5-percent downgrade. Sight distance is not limited due to the vertical curvature, but the approach grade could contribute to longer stopping distances on wet, ice or snow pavement conditions.

FIGURE 4: SIEBENTHALER AVENUE VERTICAL PROFILE



TRAFFIC OPERATIONS

Field observations conducted during afternoon peak hours suggest that the high volume of stopped traffic on Siebenthaler Avenue contributes to congested conditions at the study intersection. **Photo 1** taken from Google Streetview shows a queue of westbound traffic on Siebenthaler Avenue approaching the Catalpa Drive intersection. This photo was likely taken during afternoon/early evening peak periods. Note that westbound vehicle queues form with no queuing on the Catalpa Drive approaches. Similarly, queues form on the eastbound Siebenthaler approach during most afternoon hours. Field observations confirm that eastbound queues extend past the western-most driveway to the Siebenthaler Dental Center which is greater than 600 feet from the intersection.

The high volume of traffic at the intersection creates a condition where vehicles arrive simultaneously at the stopped condition. Drivers do not know which stopped vehicle has the right of way at the intersection which likely results in vehicles entering the intersection at the same time resulting in crashes.

PHOTO 1: EB SIEBENTHALER AVENUE APPROACH TO CATALPA DR

Photo 2 taken from Google Streetview shows the westbound Siebenthaler Avenue approach to Catalpa Drive. The house that sits directly at the northeast corner (right side in Photo 2) forms a barrier by which approaching motorists do not have view of vehicles approaching from the north on Catalpa Drive. Although a stop is required, not having visibility of vehicles on the intersecting street may contribute to failure to stop and failure to yield violations.

PHOTO 2: WB SIEBENTHALER AVENUE APPROACH TO CATALPA DR

TRAFFIC COUNTS

Traffic count data was supplied by the Montgomery County Engineer's Office for use in this study. 24-hour machine counts were conducted on Monday May 23, 2022 on each of the four legs of the study intersection. Peak hour turning movement count data (6:30-8:30 AM and 4:15 – 6:15 PM) from Wednesday May 5, 2021 was also supplied. Peak morning traffic volumes occurred from 7:30-8:30 AM. Peak evening traffic volumes occurred from 4:45-5:45 PM.

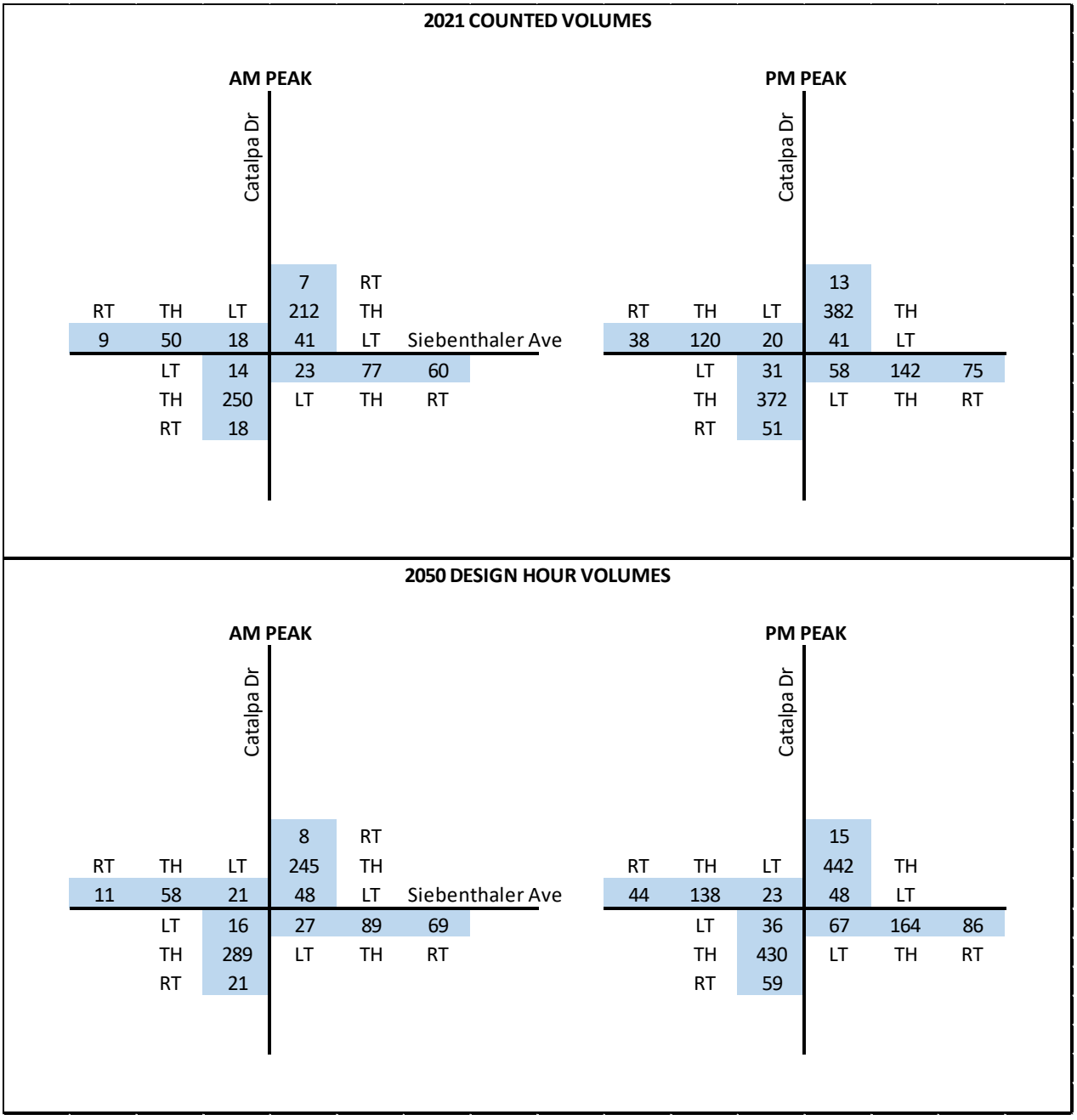
Using counted peak hour traffic volumes, design year 2050 volumes were forecast using the procedures outlined. Traffic count reports and volume projection documentation are included in **Appendix A.** 2021 counted volumes and 2050 design hour volumes are shown graphically in **Figure 5.**

- **COVID factor**: A COVID adjustment factor of 1.07 was applied to the 2021 peak hour turning movement volumes. This factor was obtained from the ODOT Statewide Traffic Analysis dashboard comparing volumes at a permanent count station on Little Richmond Road (FC 6) between 3/1/2020 and 5/5/2021 (count date). The total volume change at this location was -7 percent. This is the most comparable facility for available and represents an approximate range for application to Siebenthaler Avenue and Catalpa Drive.
- **Peak Hour to Design Hour factor**: A Peak Hour to Design Hour factor of 1.08 was applied to the 2021 COVID adjusted volumes to forecast design hour volumes for the AM and PM

peak hours. The 1.08 factor was obtained from the ODOT Peak Hour to Design Hour Factor Report for Function Classification 03,04 and 05 for a Wednesday in May.

- **Growth factor**: The MVRPC regional travel demand model (2020 through 2050) forecasts no traffic growth in the study area. No additional factor was applied to the 2021 COVID and design hour projections to arrive at 2050 AM and PM design hour volumes.

FIGURE 5: TRAFFIC VOLUME PROJECTIONS



CRASH ANALYSIS

Crash data was obtained using the ODOT Transportation Information Mapping System (TIMS). A total of 67 crashes occurred over a five-year period (2017 through 2021) at the intersection (including 500 feet on each approach of Ridge Road). Each crash report documented within the study limits was reviewed to confirm the accuracy and location of the crash. ODOT utilizes AASHTOWare's Safety Analyst to prioritize safety locations within the State of Ohio and the study intersection is ranked in the 2021 Safety Analyst priority lists.

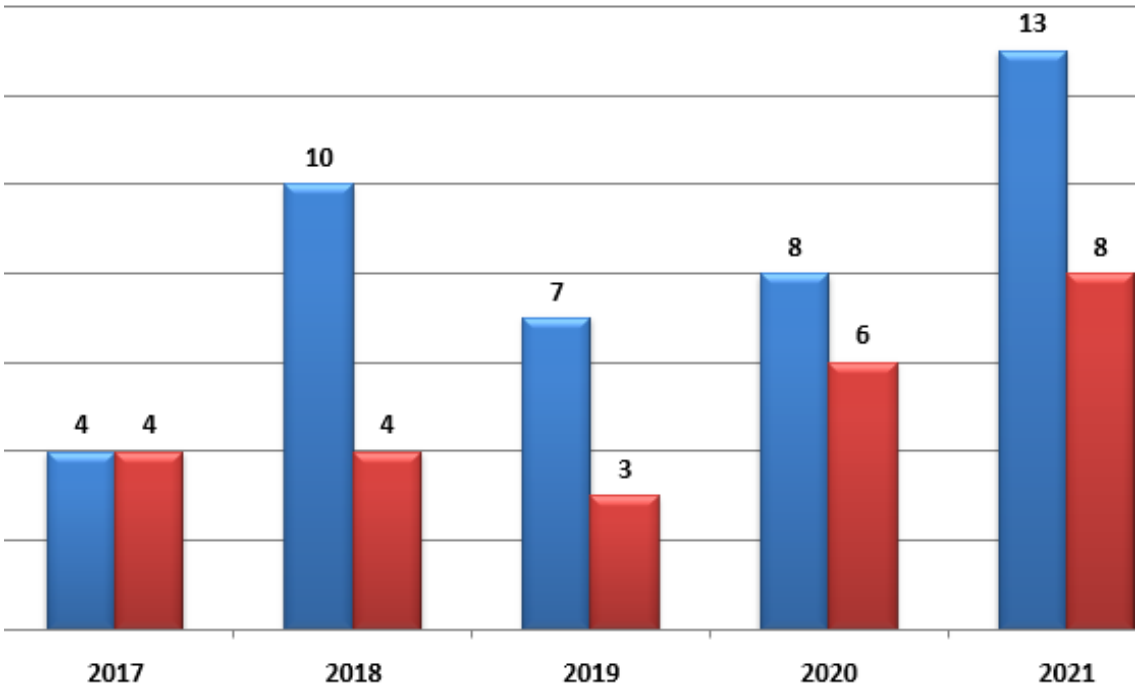
The following crash types and/or conditions were determined to be over-represented compared to statewide averages for 4-leg all-way STOP intersection (rural as urban condition not available) (shown in parenthesis).

- Minor Injury Crash: 16.42% (13.79%)
- Injury Possible Crash: 17.91% (9.68%)
- Angle crashes: 62.69% (31.42%)
- Rear end crashes: 23.88% (14.31%)
- Wet road condition (27.94%) (18.65%)
- Ice road condition (2.94%) (1.68%)

Noteworthy crash statistics are summarized below:

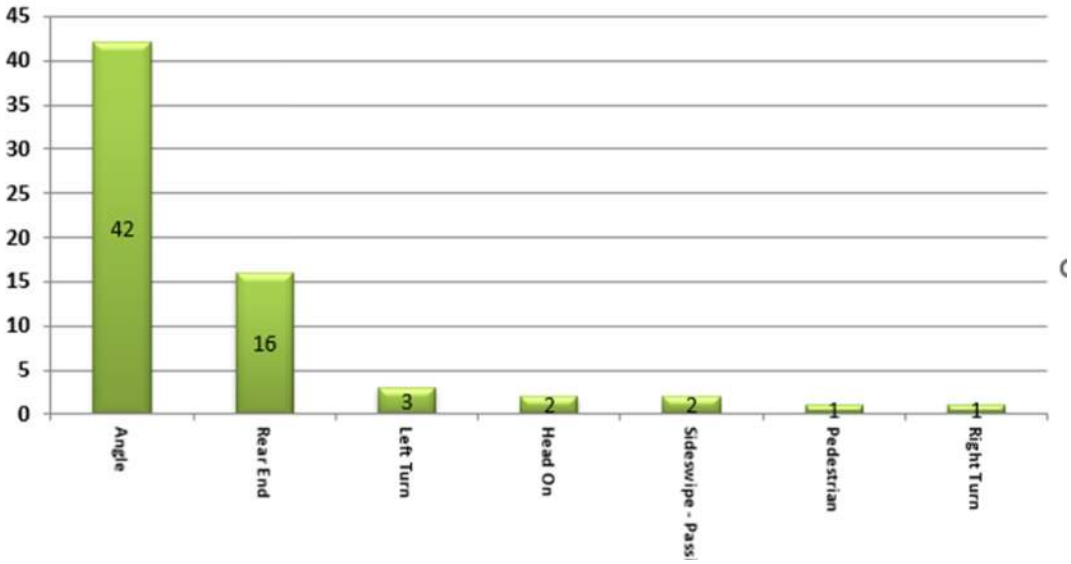
- Crash frequency peaked at 21 crashes (31%) in 2021 although frequency has been trending higher over the past 5 years. **Figure 6** shows frequency by year and severity.

FIGURE 6: CRASH FREQUENCY BY YEAR AND SEVERITY



- Angle (42 crashes - 63%) and Rear End (16 crashes – 24%)) were the top two crash types, accounting for 87-percent of all crashes. **Figure 7** shows frequency by crash type.

FIGURE 7: CRASH FREQUENCY BY TYPE



Of the 16 rear end crashes, twelve involved eastbound vehicles on Siebenthaler Avenue approaching the Catalpa Drive intersection. Of the 16 rear end crashes, 11 involved vehicles traveling eastbound on Siebenthaler Avenue, 3 involved vehicles traveling westbound on Siebenthaler Avenue, and 3 involved vehicles traveling northbound on Catalpa Drive.

Of the 42 Angle crashes, 20 involved eastbound/southbound crashes with the at fault driver on Siebenthaler Avenue in 85% of the crashes. Frequency of angle crashes by direction is shown in **Figure 8**. Narratives in many of the OH-1 reports stated that the at-fault unit stopped then continued into the intersection striking unit 2.

- Ran Stop Sign (19 crashes - 28%), Failure to Yield (18 crashes – 27%) and Following Too Close (15 crashes – 22%) were the top contributing crash factors, accounting for 77-percent of all crashes. **Figure 9** shows crash frequency by contributing factor. Of the 37 stop sign and failure to yield crashes, 33 resulted in angle crashes. The remaining angle crashes were not assigned a contributing factor in the OH-1 report.

FIGURE 8: FREQUENCY OF ANGLE CRASHES BY DIRECTION

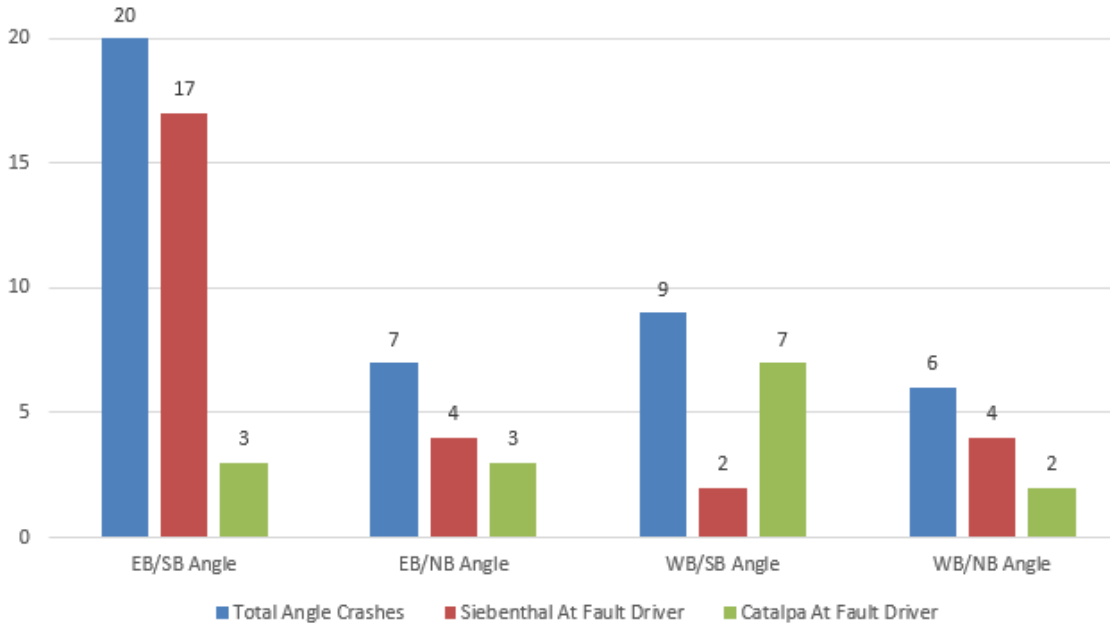
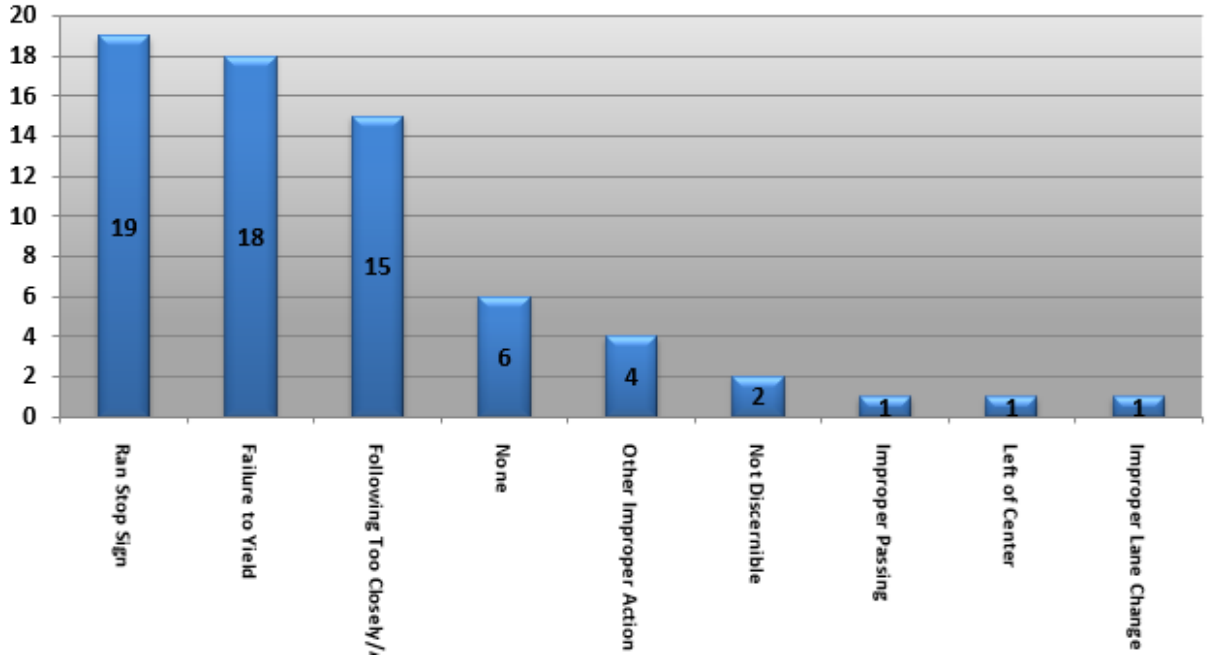
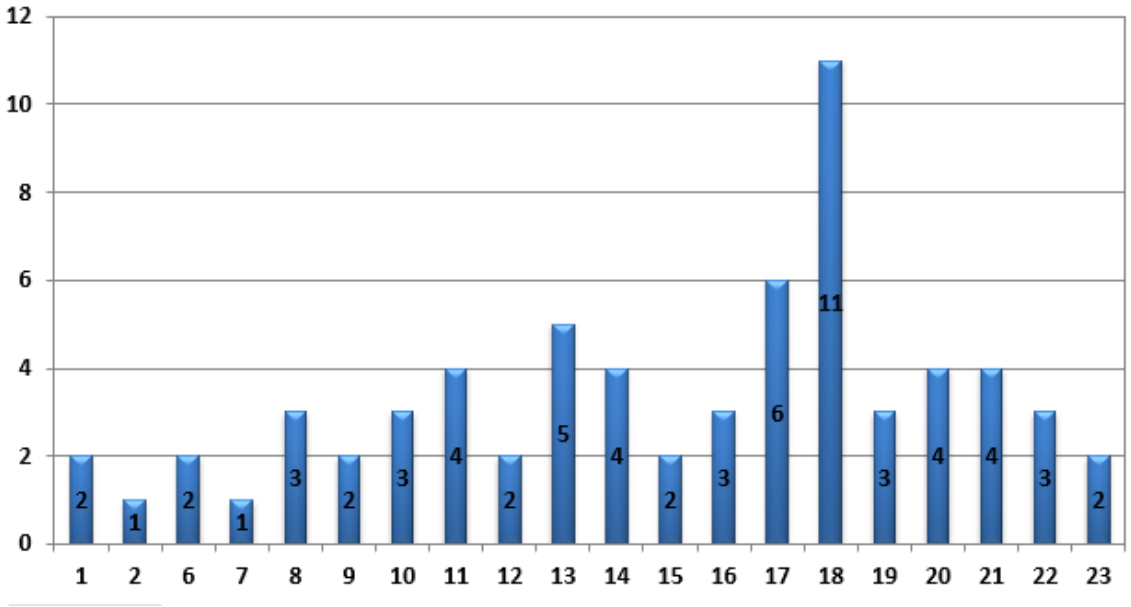


FIGURE 9: CRASH FREQUENCY BY CONTRIBUTING FACTOR



- Crash frequency by hour was distributed throughout the day with the 5:00PM and 6:00 PM hours experiencing the highest frequency of crashes (17 crashes, 25%). **Figure 10** shows frequency by hour of day.

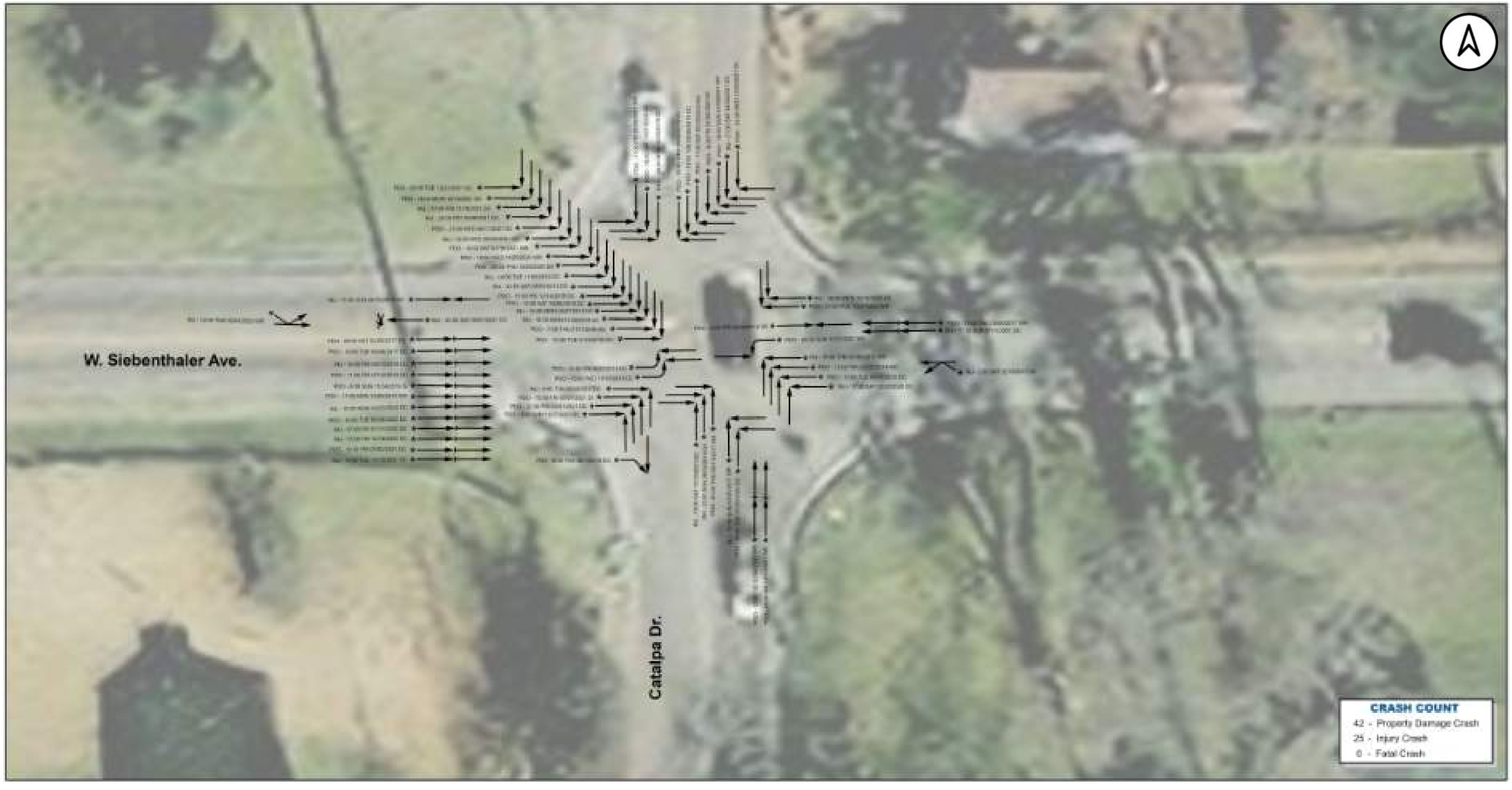
FIGURE 10: CRASH FREQUENCY BY HOUR OF DAY



- Two serious injury crashes were reported during the 5-year dataset. One serious injury crash occurred in 2017 and one in 2020 with both involving sideswipe passing on Siebenthaler Avenue. The 2017 serious injury crash involved alcohol/drugs and a young driver. The 2020 serious injury crash involved a young driver and speed violation.
- One pedestrian crash occurred in August 2021 at 11:30PM and resulted in minor suspected injury to the pedestrian. The pedestrian was issued a citation for walking in the roadway. The crash report did not specify alcohol/drug to be a factor.

The intersection crash diagram is shown in **Figure 11** and in **Appendix B.**

FIGURE 11: CRASH DIAGRAM



ALTERNATIVES EVALUATION

Two alternatives intersection treatments were evaluated for the Siebenthaler Avenue/Catalpa Drive intersection to mitigate the high percentage of angle crashes. The primary contributing factors to angle crashes at the intersection are high traffic volumes and lack of clear assignment of right of way at the intersection with all-way stop control. Existing traffic control devices (overhead flashers and intersection warning signs) have not achieved the desired effect of eliminating or reducing crashes over the past 5 years.

- **Traffic signal –** Traffic signal control may be an effective countermeasure to mitigate angle crashes by implementing traffic control that clearly assigns right of way. The addition of left turn lanes was also evaluated to minimize vehicle queues that form if traffic is blocked by vehicles waiting to make left turns.
- **Single lane roundabout -** A roundabout may be an effective countermeasure to mitigate the high percentage of injuries resulting from angle crashes attributed to vehicles not yielding the right-of-way or running the stop sign.

Since multiple alternatives for improving safety were identified by project stakeholders, criteria have been developed to assist in evaluating the alternatives and forming final recommendations. Evaluation metrics for this project include the following: safety, capacity, operations, property impacts and cost.

SAFETY BENEFITS

FHWA's Proven Safety Countermeasure initiative (PSCi) is a collection of twenty-eight countermeasures and strategies effective in reducing roadway fatalities and serious injuries. Roundabout intersections are listed as one of those proven countermeasures. The safety benefits of roundabout intersections include:

- Promote lower travel speeds through geometric details.
- Reduce crashes that result in injury/death. Converting a signalized intersection to a roundabout can result in a reduction of fatal and injury crashes by up to 80%.
- Reduce vehicle delay by eliminating stops.
- Adaptable to a wide range of traffic and physical conditions.
- Accommodate pedestrians in a low-speed environment.
- The FHWA CMF Clearinghouse provides a 5-star CMF for conversion of an intersection to a single lane roundabout. The CMF is 0.28 for fatal crashes and 0.56 for all injury crashes.

Traffic signalization is an option when stop controlled intersections are no longer able to accommodate traffic demand. Traffic signals provide clear assignment of right of way and improve operations by reducing delay (stops) compared to multi-way stop conditions under congested conditions. Traffic signals are often chosen for operational reasons and in some cases may represent a trade-off between safety and mobility. FHWA guidance state: "With approximately one-third of all intersection fatalities occurring at signalized intersections, it is important to assess and design there intersection with safety in mind."

OPERATIONS/CAPACITY

The following technical analyses were performed to evaluate operations of the two alternate intersection types: traffic signal or roundabout. Results are summarized below.

Traffic Signal Warrants

Traffic signals should be installed only if an intersection meets at least one of the criteria specified in the Ohio Manual of Uniform Traffic Control Devices, § 4C (Ohio Department of Transportation, 2012 Edition) (hereafter referred to as the OMUTCD). Traffic signal warrant thresholds are dependent on volume of traffic on the major and minor streets, number of approach lanes on the major and minor street, and speed limit on the major street. Volume based warrants, Warrant 1, 2, and 3 were evaluated for this study. Warrants were evaluated using the following criteria:

- Raw volume data collected on Monday May 23, 2022 for a 15-hour period beginning at 6:00AM through 9:00PM
- Low speed criteria (less than 40 MPH)
- Single lane approaches
- No right turn reductions

Warrants are met for Warrant 1 (eight-hour volume) and Warrant 2 (4-hour volume). Results of the signal warrant analysis as summarized in **Table 1**. Signal warrant worksheets are included in **Appendix C.**

TABLE 1: TRAFFIC SIGNAL WARRANT RESULTS

Intersection	Warrant 1: Eight Hour Volume	Warrant 2: Four Hour Volume	Warrant 3: Peak Hour
Siebenthaler Avenue @ Catalpa Drive	**Warrant Met** Condition B 8 of 8 required hours met	**Warrant Met** 4 of 4 required hours met	Not met

Capacity Analyses

Capacity analyses were performed to assess current operating conditions at the Siebenthaler Avenue/Catalpa Drive intersection and the operational impacts of the following alternatives:

- **No Build**: Existing four-way stop conditions.
- **Alternative 1A - Traffic signal without turn lanes**: Traffic signal control without widening for turn lanes on Siebenthaler Avenue or Catalpa Drive. Assumed 2 phase operation (permissive left turn movements) with a 60 second cycle length.
- **Alternative 1B – Traffic signal with left turn lanes on all approaches.** Traffic signal control and widening for left turn lanes on both Siebenthaler Avenue and on Catalpa Drive.

Assumed 3-phase operation (protected/permissive LT phases on Siebenthaler approaches) with a 60 second cycle.

- **Alternative 1C - Traffic signal with left turn lanes on Siebenthaler Avenue**: Traffic signal control and widening for left turn lanes on Siebenthaler Avenue. Assumed 2 phase operation (permissive left turn movements) with a 60 second cycle length.
- **Alternative 2 - Roundabout intersection:** Single entry and departure lanes.

Capacity analyses were performed using AM and PM design hour volumes projected for a 2050 design year. All analyses were prepared using Highway Capacity Software version 2023. **Table 2** shows the HCM level of service (LOS) thresholds for signalized and unsignalized intersections.

TABLE 2: LEVEL OF SERVICE THRESHOLDS

Level of Service (LOS)	Description	Signalized Intersections Control Delay (sec/veh)	Unsignalized Intersections Control Delay (sec/veh)
A	Very low delay	0-10	0-10
B	Good progression	>10-20	>10-15
C	Acceptable delay	>20-35	>15-25
D	Upper limit of acceptable delay	>35-55	>25-35
E	High delay	>55-80	>35-50
F	Congested conditions; unacceptable delay	>80 or V/C ratio > 1.00	>50

Table 3 did not include Alternative 1B in the comparison of alternatives since the level of service for Alternative 1B is equal to LOS C in the PM peak. Capacity analysis reports for all alternatives are included in **Appendix D.**

TABLE 3A: CAPACITY ANALYSIS SUMMARY (AM PEAK)

Intersection/ Approach	Design Year 2050 - AM Peak Hour				
	No Build 4-way stop condition	Alternative 1A traffic signal no turn lanes	Alternative 1B traffic signal left turn lanes (all)	Alternative 1C traffic signal left turn lanes on Siebenthaler	Alternative 2 Single Lane Roundabout
	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)
Siebenthaler Ave @ Catalpa Drive	**B/13.0**	**B/13.6**	**B/18.3**	**B/13.5**	**A/5.7**
EB Approach	B/14.1	B/13.5	B/17.9	B/13.5	A/5.9
WB Approach	B/13.6	B/14.0	B/16.8	B/13.7	A/5.7
NB Approach	B/11.5	B/13.9	C/21.1	B/13.9	A/6.0
SB Approach	B/10.4	B/12.4	B/19.1	B/12.4	A/4.8

TABLE 3B: CAPACITY ANALYSIS SUMMARY (PM PEAK)

Intersection/ Approach	Design Year 2050 - PM Peak Hour				
	No Build 4-way stop condition	Alternative 1A traffic signal no turn lanes	Alternative 1B traffic signal left turn lanes (all)	Alternative C traffic signal left turn lanes on Siebenthaler	Alternative 2 Single Lane Roundabout
	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)	LOS/ Delay (s/veh)
Siebenthaler Ave @ Catalpa Drive	**F/109.4**	**B/17.0**	**C/24.6**	**B/16.6**	**B/10.1**
EB Approach	F/156.3	B/16.4	C/22.8	B/16.1	A/9.8
WB Approach	F/141.3	B/18.0	C/24.2	B/16.9	B/10.6
NB Approach	E/36.9	B/17.7	C/28.3	B/17.7	B/10.5
SB Approach	C/22.6	B/14.9	C/23.9	B/14.9	A/8.8

Results indicate LOS F for the No Build (4-way stop) condition in the PM peak hour. This result supports field observations that indicate congestion being a contributing factor in the crash patterns at the study intersection – aggressive drivers do not wait for gaps in crossing traffic after experiencing delays on the approaches. Both the traffic signal and roundabout alternatives are expected to mitigate congestion issues at the intersection, with LOS B or better expected through the 2050 design year. With a traffic signal, left turn lanes only on Siebenthaler Avenue provided the highest level of operational benefit. The roundabout alternative is expected to have the lowest overall vehicle delay when compared to each of the evaluated alternatives.

PROPERTY IMPACTS

Figure 12 shows existing right of way widths. The property located at 3000 Catalpa Drive (NE quadrant) is a constraint affecting the selection of a preferred alternative. To avoid a full take of this property, any of the alternatives that require pavement widening (Alternatives 1B, 1C and 2) will require relocation of the intersection west of the current location.

A traffic signal alternative (1C) could shift the alignment of Catalpa Drive to the west to avoid a full property take, as shown in **Figure 13.**

A standard roundabout configuration (Alternative 2) with a single inscribed circle will require a full property relocation, as shown in **Figure 14**.

FIGURE 12: EXISTING RIGHT OF WAY

A peanut shaped roundabout may be a feasible alternative design due to its shape offering the opportunity to reduce impact to adjacent property, as shown in **Figure 15**. A peanut shaped roundabout is essentially two closely spaced circles where each circle does not permit a 360-degree movement. This shape is an alternate configuration to a standard circular shaped roundabout used at intersections with extreme skews and/or when right of way is constrained. The peanut shaped roundabout maintains all the design features of a standard circular design including horizontal deflection for low vehicle entry speeds into the roundabout (approximately 25 MPH). An inscribed circle of 115 feet is shown for the peanut configuration as compared to 135 feet for the standard circular design.

Concept plans have been included in **Appendix F**.

FIGURE 13: CONCEPT PLAN (ALTERNATIVE 1C)

FIGURE 14: CONCEPT PLAN (ALTERNATIVE 2)

MCEO

MODEL: CLX_SiebenthalerAve - Plan 1 (Sheet) PAPERSIZE: 34x22 (in.) DATE: 9/15/2023 TIME: 11:21:58 AM USER: kellie
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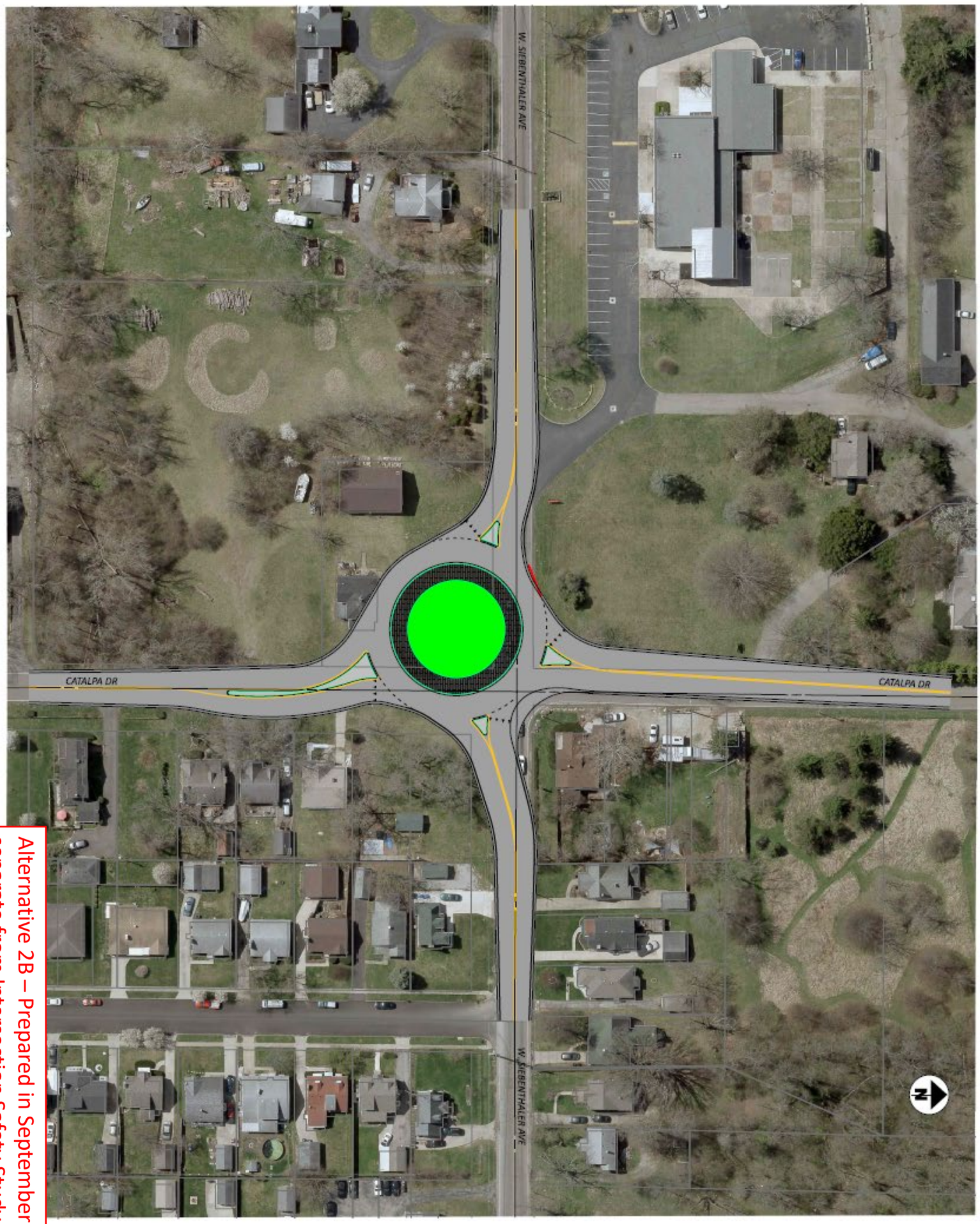


Alternative 2B – Prepared in September 2023 separate from Intersection Safety Study

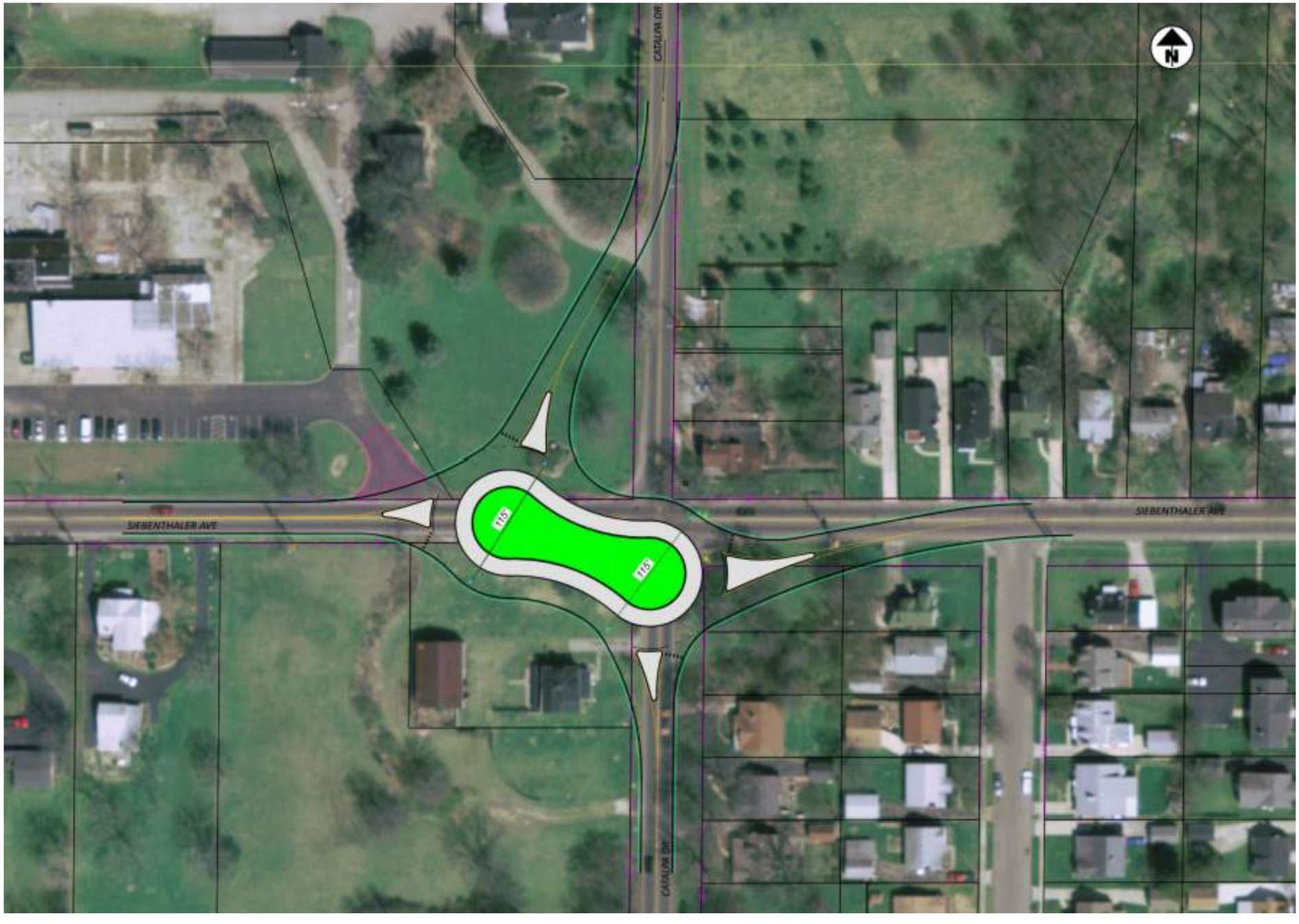
SHEET 1	TOTAL 1	PROJECT ID 23105-001	REVISED SMS 09/15/23	DESIGNER KLL	DESIGN AGENCY

PLAN PREPARED BY:
TEC Engineering, Inc.
7288 Central Forke Blvd.
Mason, OH 45040

W. SIEBENTHALER AVE AND CATLPA DR
PRELIMINARY ROUNDABOUT DESIGN

HORIZONTAL SCALE IN FEET
0 40
20 80

FIGURE 15: CONCEPT PLAN (ALTERNATIVE 3)



COST

Detailed construction costs were estimated for the proposed safety countermeasures shown in **Figures 13 and 14**. A summary of probably project costs is shown in **Table 4**. Cost estimates are included in **Appendix G.**

TABLE 4: COST ESTIMATES

Cost Items	Alt 1C Traffic signal with widening for turn lanes on Siebenthaler	Alt 2 Single Lane Roundabout - Circular Design
Construction cost	$1,711,165	$1,982,865
Right of way cost	$80,000	$470,000
Contingency	$537,350	$735,860
Engineering Design, Inspection, and Adminstration	$537,350	$735,860
Inflation	$281,213	$385,100
TOTAL	**$3,150,000**	**$4,310,000**

Note that detailed estimates were not prepared for the peanut roundabout (Alternative 3) shown in **Figure 15** but a budgetary estimate of $5.5 million is estimated for that option.

ALTERNATIVES RATING

A rating system was applied to the criteria outlined above as a means of comparing the evaluated alternatives on their ability to improve safety performance and balance impacts to adjacent properties. The scoring ranged from a -5, representing a poor or least desirable condition to a +5, representing the best or most desirable condition. The relative scoring was to enable an order of magnitude evaluation of the safety countermeasures. An Alternative Evaluation Matrix is shown in **Figure 5.**

Note the relative scoring for Alternative 2 (Single Lane Roundabout) is comparable to the scoring for Alterative 3 (Peanut Roundabout).

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TABLE 5: ALTERNATIVE EVALUATION MATRIX

Alternative	Safety	Capacity	Operations	Property Impact	Cost	Score
No Build **4-way stop condition with sign upgrades**	-5	-5	-5	5	5	-5
	-67 crashes in 5 year period	'- LOS F expected in 2050 design year	- Queues >600 feet form on Siebenthaler Road during PM peak period	- no property impacts	- no cost	
Alternative 1A **Traffic signal control without turn lanes**	0	3	-1	-2	-1	-1
	- Traffic signal control could increase rear end and left turn crashes - Mitigate angle crashes by assigning ROW	'- LOS B expected in 2050 design year	-Absence of left turn lanes could result in queues that form behind vehicles waiting to turn lane	- R/W needed for signal supports - Minimal property impact although proximity of house at 3000 Catalpa an impact	- Lowest cost Build alternative - Cost includes traffic installation without pavement widening	
Alternative 1B **Traffic signal control with turn lanes on Siebenthaler Ave and Catalpa Drive**	3	3	4	-5	-3	2
	- Traffic signal control could increase rear end and left turn crashes - Mitigate angle crashes by assigning ROW	'- LOS B expected in 2050 design year	- Removes left turners from through traffic on both roadways	- Realignment not feasble due to tapers for LT lanes - Requires pavement widening on Siebenthaler and Catalpa - Assume property relocation at 3000 Catalpa Drive	- Cost higher than Alt 1C ($3.2 Million)	
Alternative 1C **Traffic signal control with turn lanes on Siebenthaler Ave**	2	3	3	-2	-2	4
	- Traffic signal control could increase rear end and left turn crashes - Mitigate angle crashes by assigning ROW	'- LOS B expected in 2050 design year	- Left turners removed from through traffic on Siebenthaler reduces queues/ mitigate rear end crash potential	- Shift Catalpa Drive alignment to reduce property impacts - Requires pavement widening on Siebenthaler - Potential strip acquisition of 3000 Catalpa Drive	- Estimated cost $3.2 Million	
Alternative 2 **Single Lane Roundabout**	5	5	5	-4	-4	7
	- roundabout configuration reduces 80% of serious injury crashes.	'- LOS A expected in 2050 design year	- minimal queues on all approaches	- Assume property relocation with a traditional circular shape - Oblong "peanut" shape offers more flexibility in placement of intersection compared to traffic signal alternative	- Estimated cost between $4.3 and $5.2 Million	

-5 to -3	high impact/ low benefit
-2 to +2	medium impact/ moderate benefit
+3 to +5	low impact/ high benefit

RECOMMENDATIONS

Countermeasures improve safety performance by focusing on the crash types having the greatest potential for mitigation. The focus of the countermeasures is mitigation of specific factors contributing to safety performance. Secondary countermeasures may also be recommended that are low cost and focus on existing signing and pavement markings not consistent with the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). Compliance with the OMUTCD will reduce driver workload thus improve safety performance.

Changes to the ODOT Highway Safety Improvement Program (HSIP) focus funding to mitigate fatal and serious injury crashes. These changes are being made because traffic deaths in Ohio have risen six of the past seven years. Updates to the new safety programs were initially shared as part of a webinar hosted by ODOT on 9/1/21. These changes have been incorporated into the Countermeasures section of this study by structuring the preferred alternatives to position for future funding.

The new ODOT funding structure is organized into 3 categories:

- **Systemic Safety Funding** which includes proactive improvements that target Road Departure crashes (i.e., shoulder widening, fixed objects) and Pedestrian crashes (i.e. sidewalks). An Active Transportation metric and an Equity (poverty) metric will be additional factors considered when awarding up to $2 million per project for pedestrian improvements or up to $5 million for roadway departure improvements from this category. A 10-percent local match will be required but may be reduced or removed depending on the needs of the project sponsor.
- **Abbreviated Safety Funding** which includes low-cost countermeasures (under $500,000) that may include typical improvements such as signing, pavement markings, longitudinal rumble stripes, traffic signal upgrades (no signal reconstruction), and RRFB/ PHBs. Funding is eligible for construction and in some cases, design based on project sponsor needs. Criteria includes locations having a minimum of 3 crashes per year with special consideration given to locations with high injury severity and pedestrian safety improvements.
- **Formal Safety Funding** is eligible for complex projects up to $5 million that may include right-of-way and design costs. Criteria includes locations having a minimum of 3 crashes per year and 30% injury crashes. Funding is available for FY 2025 and beyond.

Countermeasure: Convert the ALL-WAY Stop intersection to a single lane roundabout

A roundabout is proposed as an effective countermeasure to mitigate the high percentage of injury crashes resulting from angle crashes with vehicles failing to yield or stop at the stop condition on Siebenthaler and Catalpa. High traffic volumes on Siebenthaler Avenue contribute to vehicle congestion at the intersection, confirmed by the LOS F during the PM peak hour. Existing traffic control devices (overhead flashers, dual stop signs, and intersection warning signs) have not achieved the desired effect of eliminating injuries crashes over the past 5 years.

A single lane, modern roundabout is proposed to mitigate crash types and severity attributed to the existing intersection layout – 4 leg intersection with 4-way stop control. A total of 58 angle and rear end crashes would be mitigated by converting the intersection to a roundabout.

The peanut shaped roundabout provides a high degree of flexibility to avoid property relocation. However, either design option (**Figure 14** or **Figure 15**) will offer similar safety and operation improvement compared to the existing condition.

The FHWA CMF Clearinghouse provides a 5-star CMF for converting an intersection to a roundabout (Road safety effects of roundabouts: A meta-analysis, 2017) with a CMF of 0.56 for A, B, C, Injury crashes. The roundabout's ability to reduce or eliminate stops in a lower speed environment with fewer conflict points is expected to mitigate all angle and rear end crashes at the intersection.

Countermeasure: Install Sidewalk on Siebenthaler Avenue

Installation of a sidewalk on the south side of Siebenthaler Avenue between Catalpa Drive and Ida Avenue is recommended. This countermeasure will fill a critical missing sidewalk link and provide pedestrian connectivity to the study intersection from the east. The proposed sidewalk link is approximately 1,000 feet in length and will provide pedestrian connectivity to Main Street.

BENEFIT COST ANALYSIS

A benefit cost analysis was performed for the traffic signal with left turn lanes on Siebenthaler Avenue (**Alternative 1C**) and for a single lane roundabout (**Alternative 2**). The financial benefits of the recommended safety countermeasures were determined by comparing the net present value of the project construction costs to the safety benefits provided by the countermeasures.

Since the base condition of the proposed roundabout differs from the existing all-way stop controlled (AWSC) condition, safety benefits were first calculated using Highway Safety Manual Part C methodology. Part C CMFs are based on demand volumes and physical characteristics and do not consider historical crash patterns. The benefit-cost (BC) ratio is calculated in ECAT using *predicted* (not actual) crashes in both the existing and proposed conditions. In this case, 2.3 annual crashes are predicted for an AWSC intersection compared to the actual 13 annual crashes reported at the study intersection (67 crashes over 5 years). Using this methodology, the resulting BC ratio may be lower since the predicted crashes for an all-way stop control condition are much less than the historical crashes at the study intersection.

Calculated BC ratios using Part C methodology are summarized below:

Traffic signal with left turn lanes on Siebenthaler Avenue: - 0.41

Single lane roundabout: 0.11

The Highway Safety Manual Part D methodology uses CMFs that are independent of the base condition. The ECAT calculates BC ratio using *expected* crashes of an AWSC with existing physical features that considers historical crash patterns. Part D CMFs were **calculated BC ratios using Part D methodology are summarized below:**

Traffic signal with left turn lanes on Siebenthaler Avenue: 0.33

Single lane roundabout: 0.37

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX A: TRAFFIC COUNT DATA AND VOLUME PROJECTIONS

Intersection of
Catalpa Road / Siebenthaler Avenue
May 2021 AM PM Peak Hour Turn Count

AM Peak hour for 2021

		Northbound			Southbound			Westbound			Eastbound				
Begin	End	L	TH	R	L	TH	R	L	TH	R	L	TH	R		
6:30	6;45	6	16	5	5	6	3	4	21	0	0	25	3	94	435	
6:45	7:00	4	8	5	3	6	4	2	28	6	4	29	2	101	513	
7:00	7:15	6	10	12	1	7	1	4	27	5	0	29	5	107	627	
7:15	7:30	3	12	6	4	13	2	8	37	1	2	38	7	133	719	
7:30	7:45	6	23	12	3	14	2	12	36	2	1	60	1	172	779	0.905814
7:45	8:00	7	22	17	7	11	3	8	64	2	3	65	6	215	607	
8:00	8:15	4	17	20	5	17	2	10	55	1	4	61	3	199		
8:15	8:30	6	15	11	3	8	2	11	57	2	6	64	8	193		
Totals for Peak hour		23	77	60	18	50	9	41	212	7	14	250	18			

Peak Hour 7:30 8:30
Peak Hr. Factor 0.905814

PM Peak hour for 2021

		Northbound			Southbound			Westbound			Eastbound				
Begin	End	L	TH	R	L	TH	R	L	TH	R	L	TH	R		
4:15	4:30	14	34	19	3	26	5	12	95	5	9	94	15	331	1342	
4:30	4:45	15	34	15	8	35	9	11	92	3	10	81	20	333	1337	
4:45	5:00	16	40	15	4	32	9	7	95	8	7	100	15	348	1343	0.964799
5:00	5:15	11	35	14	6	36	12	7	102	1	4	86	16	330	1315	
5:15	5:30	12	36	23	3	29	4	12	94	1	8	95	9	326	1286	
5:30	5:45	19	31	23	7	23	13	15	91	3	12	91	11	339	960	
5:45	6:00	6	29	16	3	27	13	21	80	6	10	91	18	320		
6:00	6:15	9	24	12	5	30	4	20	82	4	6	86	19	301		
Totals for Peak hour		58	142	75	20	120	38	41	382	13	31	372	51			

Peak Hour 4:45 5:45
Peak Hr. Factor 0.964799

24-hour Machine Counts
Monday May 23, 2022

Hour	Siebenthaler Ave (west of Catulpa)		Siebenthaler Ave (east of Catulpa)		Catalpa Drive (north of Siebenthaler)		Catalpa Drive (south of Siebenthaler)	
	Eastbound	Westbound	Eastbound	Westbound	Northbound	Southbound	Northbound	Southbound
7:00 AM	236	185	300	250	90	86	148	106
8:00 AM	280	282	291	309	91	78	147	132
9:00 AM	256	245	269	262	107	86	132	91
10:00 AM	271	287	313	290	112	80	149	83
11:00 AM	329	272	321	344	110	100	120	139
12:00 PM	304	314	309	333	128	117	134	144
1:00 PM	355	301	352	319	140	115	165	138
2:00 PM	339	382	345	456	148	151	184	163
3:00 PM	366	426	345	459	184	156	239	206
4:00 PM	388	420	363	459	192	151	236	199
5:00 PM	330	415	338	399	148	153	211	179
6:00 PM	293	322	292	351	150	125	192	187
7:00 PM	308	301	276	304	113	112	131	167
8:00 PM	265	208	229	237	101	85	137	147
9:00 PM	202	206	211	223	91	92	102	126
10:00 PM	158	179	144	175	57	62	84	82
11:00 PM	122	110	93	101	37	35	56	65
12:00 AM	75	94	68	70	18	24	34	42
1:00 AM	64	39	46	34	15	11	17	27
2:00 AM	35	32	21	29	12	7	15	14
3:00 AM	23	21	23	18	9	10	13	14
4:00 AM	29	19	43	28	17	9	25	9
5:00 AM	92	56	126	68	28	14	37	19
6:00 AM	125	111	117	102	43	40	65	49
ADT	5245	5227	5235	5620	2141	1899	2773	2528
	10472		10855		4040		5301	

Montgomery County Engineer's Office
Traffic Department

Location : Catalpa Drive
Cross Street : 525' N of Siebenthaler Avenue
By : KRL

Site: 22 658
5/23/2022
Monday

24 Hour Volume

Interval Start	Northbound		Southbound		Combined	
7:00 AM	15	90	14	86	29	176
7:15 AM	23		26		49	
7:30 AM	26		24		50	
7:45 AM	26		22		48	
8:00 AM	21	91	18	78	39	169
8:15 AM	21		18		39	
8:30 AM	23		18		41	
8:45 AM	26		24		50	
9:00 AM	29	107	14	86	43	193
9:15 AM	20		36		56	
9:30 AM	29		13		42	
9:45 AM	29		23		52	
10:00 AM	21	112	16	80	37	192
10:15 AM	29		21		50	
10:30 AM	33		16		49	
10:45 AM	29		27		56	
11:00 AM	25	110	26	100	51	210
11:15 AM	23		31		54	
11:30 AM	27		21		48	
11:45 AM	35		22		57	
12:00 PM	30	128	29	117	59	245
12:15 PM	34		36		70	
12:30 PM	30		26		56	
12:45 PM	34		26		60	
1:00 PM	41	140	34	115	75	255
1:15 PM	31		30		61	
1:30 PM	39		25		64	
1:45 PM	29		26		55	
2:00 PM	32	148	32	151	64	299
2:15 PM	44		36		80	
2:30 PM	39		31		70	
2:45 PM	33		52		85	
3:00 PM	37	184	35	156	72	340
3:15 PM	49		38		87	
3:30 PM	51		45		96	
3:45 PM	47		38		85	
4:00 PM	51	192	37	151	88	343
4:15 PM	49		43		92	
4:30 PM	36		37		73	
4:45 PM	56		34		90	
5:00 PM	39	148	41	153	80	301
5:15 PM	39		41		80	
5:30 PM	38		38		76	
5:45 PM	32		33		65	
6:00 PM	41	150	34	125	75	275
6:15 PM	40		32		72	
6:30 PM	40		29		69	
6:45 PM	29		30		59	

Interval Start	Northbound		Southbound		Combined	
7:00 PM	26	113	24	112	50	225
7:15 PM	30		26		56	
7:30 PM	33		29		62	
7:45 PM	24		33		57	
8:00 PM	16	101	23	85	39	186
8:15 PM	30		17		47	
8:30 PM	27		27		54	
8:45 PM	28		18		46	
9:00 PM	22	91	28	92	50	183
9:15 PM	25		27		52	
9:30 PM	22		22		44	
9:45 PM	22		15		37	
10:00 PM	22	57	17	62	39	119
10:15 PM	14		15		29	
10:30 PM	10		15		25	
10:45 PM	11		15		26	
11:00 PM	12	37	6	35	18	72
11:15 PM	12		11		23	
11:30 PM	5		10		15	
11:45 PM	8		8		16	
5/24/2022 12:00 AM	6	18	5	24	11	42
12:15 AM	7		5		12	
12:30 AM	3		9		12	
12:45 AM	2		5		7	
1:00 AM	6	15	3	11	9	26
1:15 AM	3		2		5	
1:30 AM	4		3		7	
1:45 AM	2		3		5	
2:00 AM	1	12	1	7	2	19
2:15 AM	2		2		4	
2:30 AM	4		1		5	
2:45 AM	5		3		8	
3:00 AM	1	9	5	10	6	19
3:15 AM	3		2		5	
3:30 AM	1		3		4	
3:45 AM	4		0		4	
4:00 AM	3	17	3	9	6	26
4:15 AM	2		0		2	
4:30 AM	8		2		10	
4:45 AM	4		4		8	
5:00 AM	1	28	1	14	2	42
5:15 AM	6		2		8	
5:30 AM	11		8		19	
5:45 AM	10		3		13	
6:00 AM	11	43	11	40	22	83
6:15 AM	13		11		24	
6:30 AM	17		12		29	
6:45 AM	2		6		8	

Volume Totals

	Northbound	Southbound	Combined
12:00 AM - 12:00 PM	652 (54.5%)	545 (45.5%)	1197
12:00 PM - 12:00 AM	1489 (52.4%)	1354 (47.6%)	2843
24 Hours	2141 (53.0%)	1899 (47.0%)	4040

Peak Hours

12:00 AM - 12:00 PM

	Northbound	Southbound	Combined
Started	10:15 AM	10:45 AM	10:30 AM
Volume	116	105	210
Factor	0.88	0.85	0.94

12:00 PM - 12:00 AM

	Northbound	Southbound	Combined
Started	3:15 PM	2:45 PM	3:30 PM
Volume	198	170	361
Factor	0.97	0.82	0.94

Montgomery County Engineer's Office
Traffic Department

Location : Catalpa Drive
Cross Street : 525' S of Siebenthaler Avenue
By : KRL

Site: 22 656
5/23/2022
Monday

24 Hour Volume

Interval Start	Northbound		Southbound		Combined	
7:00 AM	31	148	20	106	51	254
7:15 AM	32		26		58	
7:30 AM	43		33		76	
7:45 AM	42		27		69	
8:00 AM	47	147	37	132	84	279
8:15 AM	38		23		61	
8:30 AM	34		29		63	
8:45 AM	28		43		71	
9:00 AM	28	132	21	91	49	223
9:15 AM	27		32		59	
9:30 AM	39		13		52	
9:45 AM	38		25		63	
10:00 AM	25	149	20	83	45	232
10:15 AM	57		22		79	
10:30 AM	34		14		48	
10:45 AM	33		27		60	
11:00 AM	31	120	38	139	69	259
11:15 AM	22		34		56	
11:30 AM	31		36		67	
11:45 AM	36		31		67	
12:00 PM	31	134	36	144	67	278
12:15 PM	31		32		63	
12:30 PM	37		29		66	
12:45 PM	35		47		82	
1:00 PM	42	165	30	138	72	303
1:15 PM	39		43		82	
1:30 PM	39		26		65	
1:45 PM	45		39		84	
2:00 PM	44	184	38	163	82	347
2:15 PM	49		36		85	
2:30 PM	43		40		83	
2:45 PM	48		49		97	
3:00 PM	43	239	48	206	91	445
3:15 PM	67		53		120	
3:30 PM	68		57		125	
3:45 PM	61		48		109	
4:00 PM	63	236	53	199	116	435
4:15 PM	48		58		106	
4:30 PM	61		39		100	
4:45 PM	64		49		113	
5:00 PM	57	211	47	179	104	390
5:15 PM	53		52		105	
5:30 PM	47		40		87	
5:45 PM	54		40		94	
6:00 PM	54	192	54	187	108	379
6:15 PM	51		47		98	
6:30 PM	42		45		87	
6:45 PM	45		41		86	

Interval Start	Northbound		Southbound		Combined	
7:00 PM	34	131	46	167	80	298
7:15 PM	40		39		79	
7:30 PM	25		41		66	
7:45 PM	32		41		73	
8:00 PM	33	137	35	147	68	284
8:15 PM	38		40		78	
8:30 PM	26		33		59	
8:45 PM	40		39		79	
9:00 PM	25	102	31	126	56	228
9:15 PM	28		42		70	
9:30 PM	25		26		51	
9:45 PM	24		27		51	
10:00 PM	32	84	20	82	52	166
10:15 PM	21		22		43	
10:30 PM	14		21		35	
10:45 PM	17		19		36	
11:00 PM	13	56	23	65	36	121
11:15 PM	18		20		38	
11:30 PM	14		17		31	
11:45 PM	11		5		16	
5/24/2022 12:00 AM	10	34	9	42	19	76
12:15 AM	12		16		28	
12:30 AM	9		11		20	
12:45 AM	3		6		9	
1:00 AM	9	17	4	27	13	44
1:15 AM	3		6		9	
1:30 AM	2		10		12	
1:45 AM	3		7		10	
2:00 AM	3	15	3	14	6	29
2:15 AM	3		5		8	
2:30 AM	4		4		8	
2:45 AM	5		2		7	
3:00 AM	3	13	8	14	11	27
3:15 AM	4		1		5	
3:30 AM	3		2		5	
3:45 AM	3		3		6	
4:00 AM	5	25	2	9	7	34
4:15 AM	8		1		9	
4:30 AM	7		3		10	
4:45 AM	5		3		8	
5:00 AM	3	37	4	17	7	54
5:15 AM	8		3		11	
5:30 AM	15		6		21	
5:45 AM	11		4		15	
6:00 AM	12	65	6	49	18	114
6:15 AM	22		13		35	
6:30 AM	17		24		41	
6:45 AM	14		6		20	

Volume Totals

	Northbound	Southbound	Combined
12:00 AM - 12:00 PM			
	902	723	1625
	(55.5%)	(44.5%)	
12:00 PM - 12:00 AM			
	1871	1803	3674
	(50.9%)	(49.1%)	
24 Hours			
	2773	2526	5299
	(52.3%)	(47.7%)	

Peak Hours

12:00 AM - 12:00 PM

	Northbound	Southbound	Combined
Started			
	7:30 AM	11:00 AM	7:30 AM
Volume			
	170	139	290
Factor			
	0.90	0.91	0.86

12:00 PM - 12:00 AM

	Northbound	Southbound	Combined
Started			
	3:15 PM	3:30 PM	3:15 PM
Volume			
	259	216	470
Factor			
	0.95	0.93	0.94

Montgomery County Engineer's Office
Traffic Department

Location : Siebenthaler Avenue
Cross Street : 525' E of Catalpa Drive
By : KRL

Site: 22 659
5/23/2022
Monday

24 Hour Volume (Volume factor 0.500)

Interval Start	Westbound		Eastbound		Combined	
7:00 AM	40	250	56	300	96	550
7:15 AM	70		80		150	
7:30 AM	65		92		157	
7:45 AM	75		72		147	
8:00 AM	78	309	78	291	156	600
8:15 AM	82		84		166	
8:30 AM	85		66		151	
8:45 AM	64		63		127	
9:00 AM	60	262	64	269	124	531
9:15 AM	66		72		138	
9:30 AM	70		74		144	
9:45 AM	66		59		125	
10:00 AM	72	290	90	313	162	603
10:15 AM	72		92		164	
10:30 AM	77		58		135	
10:45 AM	69		73		142	
11:00 AM	84	344	80	321	164	665
11:15 AM	86		85		171	
11:30 AM	81		90		171	
11:45 AM	93		66		159	
12:00 PM	73	333	74	309	147	642
12:15 PM	82		81		163	
12:30 PM	100		76		176	
12:45 PM	78		78		156	
1:00 PM	84	319	76	352	160	671
1:15 PM	79		104		183	
1:30 PM	73		91		164	
1:45 PM	83		81		164	
2:00 PM	116	456	74	345	190	801
2:15 PM	108		100		208	
2:30 PM	100		91		191	
2:45 PM	132		80		212	
3:00 PM	126	459	78	345	204	804
3:15 PM	120		60		180	
3:30 PM	110		109		219	
3:45 PM	103		98		201	
4:00 PM	107	459	101	363	208	822
4:15 PM	135		61		196	
4:30 PM	108		109		217	
4:45 PM	109		92		201	
5:00 PM	112	399	86	338	198	737
5:15 PM	102		96		198	
5:30 PM	93		80		173	
5:45 PM	92		76		168	
6:00 PM	109	351	80	292	189	643
6:15 PM	92		72		164	
6:30 PM	66		76		142	
6:45 PM	84		64		148	

Interval Start	Westbound		Eastbound		Combined	
7:00 PM	92	304	78	276	170	580
7:15 PM	76		69		145	
7:30 PM	78		70		148	
7:45 PM	58		59		117	
8:00 PM	62	237	55	229	117	466
8:15 PM	52		68		120	
8:30 PM	58		64		122	
8:45 PM	65		42		107	
9:00 PM	49	223	53	211	102	434
9:15 PM	60		56		116	
9:30 PM	64		42		106	
9:45 PM	50		60		110	
10:00 PM	51	175	40	144	91	319
10:15 PM	40		44		84	
10:30 PM	40		28		68	
10:45 PM	44		32		76	
11:00 PM	29	101	24	93	53	194
11:15 PM	23		23		46	
11:30 PM	17		28		45	
11:45 PM	32		18		50	
5/24/2022 12:00 AM	22	70	16	68	38	138
12:15 AM	17		18		35	
12:30 AM	20		12		32	
12:45 AM	11		22		33	
1:00 AM	11	34	12	46	23	80
1:15 AM	9		10		19	
1:30 AM	7		16		23	
1:45 AM	7		8		15	
2:00 AM	6	29	4	21	10	50
2:15 AM	13		9		22	
2:30 AM	4		5		9	
2:45 AM	6		3		9	
3:00 AM	4	18	4	23	8	41
3:15 AM	5		5		10	
3:30 AM	4		6		10	
3:45 AM	5		8		13	
4:00 AM	6	28	11	43	17	71
4:15 AM	3		5		8	
4:30 AM	8		14		22	
4:45 AM	11		13		24	
5:00 AM	8	68	25	126	33	194
5:15 AM	14		38		52	
5:30 AM	26		31		57	
5:45 AM	20		32		52	
6:00 AM	30	102	33	117	63	219
6:15 AM	38		42		80	
6:30 AM	34		42		76	
6:45 AM	0		0		0	

Volume Totals

	Westbound	Eastbound	Combined
12:00 AM - 12:00 PM	1804 (48.2%)	1938 (51.8%)	3742
12:00 PM - 12:00 AM	3816 (53.6%)	3297 (46.4%)	7113
24 Hours	5620 (51.8%)	5235 (48.2%)	10855

Peak Hours

12:00 AM - 12:00 PM

	Westbound	Eastbound	Combined
Started	11:00 AM	10:45 AM	11:00 AM
Volume	344	328	665
Factor	0.92	0.91	0.97

12:00 PM - 12:00 AM

	Westbound	Eastbound	Combined
Started	2:45 PM	4:30 PM	3:30 PM
Volume	488	383	824
Factor	0.92	0.88	0.94

Montgomery County Engineer's Office
Traffic Department

Location : Siebenthaler Avenue
Cross Street : 525' W of Catalpa Drive
By : KRL

Site: 22 657
5/23/2022
Monday

24 Hour Volume

Interval Start	Eastbound		Westbound		Combined	
7:00 AM	38	236	26	185	64	421
7:15 AM	53		35		88	
7:30 AM	68		58		126	
7:45 AM	77		66		143	
8:00 AM	66	280	54	282	120	562
8:15 AM	69		76		145	
8:30 AM	67		76		143	
8:45 AM	78		76		154	
9:00 AM	64	256	54	245	118	501
9:15 AM	70		56		126	
9:30 AM	54		66		120	
9:45 AM	68		69		137	
10:00 AM	63	271	63	287	126	558
10:15 AM	64		81		145	
10:30 AM	88		61		149	
10:45 AM	56		82		138	
11:00 AM	70	327	58	272	128	599
11:15 AM	77		65		142	
11:30 AM	91		72		163	
11:45 AM	89		77		166	
12:00 PM	76	304	88	314	164	618
12:15 PM	60		79		139	
12:30 PM	92		69		161	
12:45 PM	76		78		154	
1:00 PM	80	355	84	301	164	656
1:15 PM	79		77		156	
1:30 PM	91		74		165	
1:45 PM	105		66		171	
2:00 PM	76	339	76	382	152	721
2:15 PM	75		95		170	
2:30 PM	88		111		199	
2:45 PM	100		100		200	
3:00 PM	99	366	106	426	205	792
3:15 PM	91		108		199	
3:30 PM	106		107		213	
3:45 PM	70		105		175	
4:00 PM	90	388	95	420	185	808
4:15 PM	108		93		201	
4:30 PM	83		119		202	
4:45 PM	107		113		220	
5:00 PM	81	330	103	415	184	745
5:15 PM	73		113		186	
5:30 PM	98		104		202	
5:45 PM	78		95		173	
6:00 PM	74	293	78	322	152	615
6:15 PM	71		100		171	
6:30 PM	80		79		159	
6:45 PM	68		65		133	

Interval Start	Eastbound		Westbound		Combined	
7:00 PM	77	308	89	301	166	609
7:15 PM	90		73		163	
7:30 PM	79		66		145	
7:45 PM	62		73		135	
8:00 PM	66	265	63	208	129	473
8:15 PM	65		50		115	
8:30 PM	70		49		119	
8:45 PM	64		46		110	
9:00 PM	40	202	56	206	96	408
9:15 PM	58		42		100	
9:30 PM	54		52		106	
9:45 PM	50		56		106	
10:00 PM	49	158	44	179	93	337
10:15 PM	35		51		86	
10:30 PM	41		49		90	
10:45 PM	33		35		68	
11:00 PM	36	122	38	110	74	232
11:15 PM	34		24		58	
11:30 PM	24		28		52	
11:45 PM	28		20		48	
5/24/2022 12:00 AM	19	75	22	94	41	169
12:15 AM	19		32		51	
12:30 AM	21		20		41	
12:45 AM	16		20		36	
1:00 AM	20	64	17	39	37	103
1:15 AM	14		8		22	
1:30 AM	13		8		21	
1:45 AM	17		6		23	
2:00 AM	15	35	8	32	23	67
2:15 AM	6		6		12	
2:30 AM	6		11		17	
2:45 AM	8		7		15	
3:00 AM	3	23	6	21	9	44
3:15 AM	6		4		10	
3:30 AM	8		5		13	
3:45 AM	6		6		12	
4:00 AM	6	29	4	19	10	48
4:15 AM	11		7		18	
4:30 AM	3		2		5	
4:45 AM	9		6		15	
5:00 AM	10	92	11	56	21	148
5:15 AM	18		9		27	
5:30 AM	38		10		48	
5:45 AM	26		26		52	
6:00 AM	26	125	19	111	45	236
6:15 AM	33		27		60	
6:30 AM	25		29		54	
6:45 AM	41		36		77	

Volume Totals

	Eastbound	Westbound	Combined
12:00 AM - 12:00 PM			
	1813	1643	3456
	(52.5%)	(47.5%)	
12:00 PM - 12:00 AM			
	3430	3584	7014
	(48.9%)	(51.1%)	
24 Hours			
	5243	5227	10470
	(50.1%)	(49.9%)	

Peak Hours

12:00 AM - 12:00 PM

	Eastbound	Westbound	Combined
Started			
	11:00 AM	10:00 AM	11:00 AM
Volume			
	327	287	599
Factor			
	0.90	0.87	0.90

12:00 PM - 12:00 AM

	Eastbound	Westbound	Combined
Started			
	2:45 PM	4:30 PM	2:45 PM
Volume			
	396	448	817
Factor			
	0.93	0.94	0.96

Traffic Volume Calculations
Intersection of Siebenthal Avenue and Catalpa Drive
Montgomery Couty, Ohio

Turning Movement Count from
May-21
Conducted by Montgomery County Engineer's Office

Factors	Value	Unit
COVID	1.07	-
Peak Hour to Design Hour	1.08	
Growth	**0**	per year
2021 - 2050 Growth Factor	1.00	-

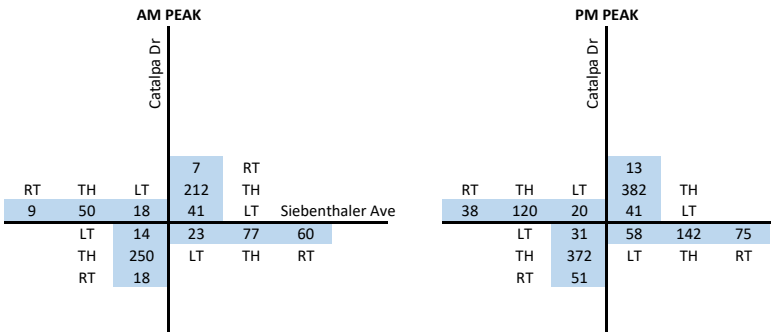
AM Peak Hour

Seasonally Adjusted IPF 2022 TMC												
Period	Catalpa Dr			Siebenthaler Ave			Catalpa Dr			Siebenthaler Ave		
	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT
2021 AM Counted (7:30-8:30 AM)	9	50	18	7	212	41	60	77	23	18	250	14
COVID Adjusted	10	54	19	7	227	44	64	82	25	19	268	15
Peak Hour to Design Hour Adjusted	11	58	21	8	245	48	69	89	27	21	289	16
2021 AM DHV	11	58	21	8	245	48	69	89	27	21	289	16
2050 AM DHV	**11**	**58**	**21**	**8**	**245**	**48**	**69**	**89**	**27**	**21**	**289**	**16**

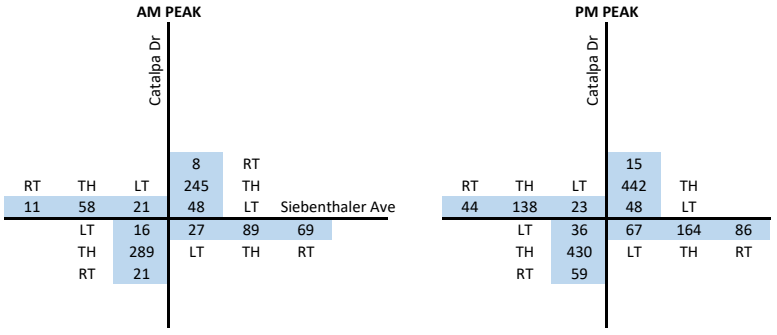
PM Peak Hour

Seasonally Adjusted IPF 2022 TMC												
Period	Catalpa Dr			Siebenthaler Ave			Catalpa Dr			Siebenthaler Ave		
	SBRT	SBTH	SBLT	WBRT	WBTH	WBLT	NBRT	NBTH	NBLT	EBRT	EBTH	EBLT
2021 PM Counted (4:45 - 5:45 PM)	38	120	20	13	382	41	75	142	58	51	372	31
COVID Adjusted	41	128	21	14	409	44	80	152	62	55	398	33
Peak Hour to Design Hour Adjusted	44	138	23	15	442	48	86	164	67	59	430	36
2021 PM DHV	44	138	23	15	442	48	86	164	67	59	430	36
2050 PM DHV	**44**	**138**	**23**	**15**	**442**	**48**	**86**	**164**	**67**	**59**	**430**	**36**

2021 COUNTED VOLUMES



2050 DESIGN HOUR VOLUMES



Statewide Traffic Analysis

The analysis in this report is from permanent traffic counters at ODOT and compares average day of the week by month in 2019 to specific days in 2020

Data refreshes daily at 5:00 AM

Total Percent Change

-7 %

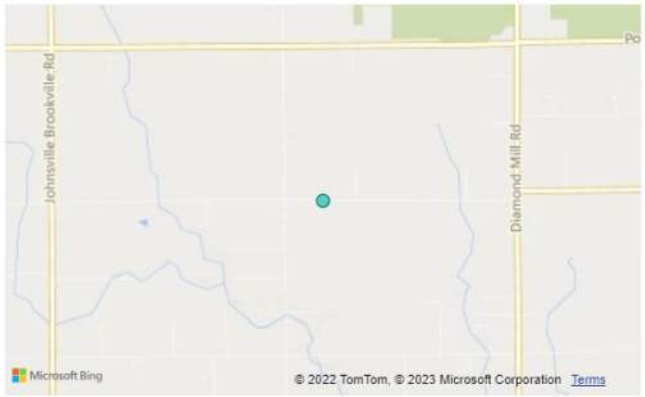
Total

-6 %

Passenger

-13 %

Truck



District

Select all

7

Date

3/1/2020

5/5/2021

Functional Class

Select all

2

3

6

County

Select all

Miami

Montgomery

MS2 ID	Station Alias	County	ODOT District	Month	Day	DAY_OF_THE_WEEK	2020 Total	2019 Total Average	Total % Change	2020 Passenger	2019 Passenger Average	PA % Change	2020 Truck	2019 Truck Average	Truck % Chang
55157	548	Montgomery	7	March	20	Saturday	543	468	16 %	533	464	15 %	10	5	100
55157	548	Montgomery	7	January	19	Tuesday	617	533	16 %	603	521	16 %	14	12	17
55157	548	Montgomery	7	March	21	Sunday	459	392	17 %	456	391	17 %	3	1	200
55157	548	Montgomery	7	March	7	Saturday	554	468	18 %	549	464	18 %	5	5	0
55157	548	Montgomery	7	January	26	Tuesday	634	533	19 %	623	521	20 %	11	12	-8
55157	548	Montgomery	7	April	26	Monday	783	650	20 %	730	636	15 %	53	14	279
55157	548	Montgomery	7	March	8	Sunday	492	392	26 %	490	391	25 %	2	1	100
55157	548	Montgomery	7	January	9	Saturday	478	376	27 %	476	370	29 %	2	6	-67
55157	548	Montgomery	7	January	30	Saturday	490	376	30 %	482	370	30 %	8	6	33
55157	548	Montgomery	7	January	23	Saturday	513	376	36 %	507	370	37 %	6	6	0

PEAK HOUR to DESIGN HOUR FACTORS

FUNCTIONAL CLASSIFICATION = 03, 04, 05u

(Urban Principal Arterial, Urban Minor Arterial, & Urban Minor Collector)

Day / Month	Monthly Average by Day-of-Week							
	WEEKDAY MON-THUR	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
January	1.20	1.72	1.22	1.21	1.20	1.17	1.15	1.56
February	1.17	1.63	1.19	1.16	1.17	1.16	1.11	1.48
March	1.15	1.57	1.16	1.16	1.16	1.13	1.11	1.45
April	1.11	1.52	1.13	1.12	1.09	1.09	1.06	1.41
May	1.08	1.44	1.10	1.09	1.08	1.06	1.04	1.35
June	1.14	1.51	1.16	1.15	1.14	1.11	1.09	1.39
July	1.16	1.54	1.19	1.17	1.15	1.15	1.13	1.44
August	1.13	1.51	1.15	1.14	1.13	1.11	1.08	1.40
September	1.12	1.53	1.15	1.11	1.12	1.09	1.04	1.40
October	1.10	1.53	1.13	1.10	1.10	1.08	1.05	1.40
November	1.13	1.56	1.16	1.12	1.13	1.11	1.06	1.48
December	1.13	1.58	1.14	1.13	1.12	1.12	1.09	1.44

peak hour volume * factor = design hour volume

source: year 2016, 2017, & 2018 Automatic Traffic Recorders (ATR) Data

ATR Stations:
550, 565, 605, 765
2017: 21, 123, 523, 538, 543, 544, 550, 565, 605, 725, 765, 28, 134, 169, 517, 131, 166
2016: 21, 123, 523, 538, 539, 543, 544, 550, 565, 605, 765,

Ohio Department of Transportation
Modeling & Forecasting Section
June 2019

NOTE: These are NOT seasonal adjustment factors!!!

Note: Insufficient data exists to produce factors for functional classes 06 and 07 Urban.

2020-2022 Intersection Crash Locations by Frequency

Street Name #1	Route Number		Street Name #2	Route Number		Intersection Average Daily Traffic	2020	2021	2022	Total	Trend	Rate Acc/M Veh	Signal Y/N
Needmore Road	CR	74	North Dixie Drive	CR	99	44000	26	26	22	74	1.05	1.54	S
Siebenthaler Avenue	CR	32	Catalpa Drive	CR	69	15500	12	18	9	39	1.38	2.30	S
Turner Road	CR	74	Philadelphia Drive	CR	159	27100	9	12	18	39	0.92	1.31	S
Byers Road	TR	147	Lyons Road	CR	150	29400	15	10	10	35	0.86	1.09	S
Wolf Road	CR	53	Turner Road	CR	74	14700	10	14	9	33	1.27	2.05	S
Shoup Mill Road	CR	74	Riverside Drive	CR	539	32700	11	10	11	32	0.94	0.89	S
Siebenthaler Avenue	CR	32	Salem Avenue	CR	249	27700	5	16	10	31	1.55	1.02	S
Benchwood Road	TR	68	Miller Lane	TR	1723	31100	11	11	9	31	1.06	0.91	S
Austin Boulevard	CR	166	Austin Landing	TR	1035	44900	8	12	8	28	1.29	0.57	S
Needmore Road	CR	74	Payne Avenue	TR	1319	35100	8	9	9	26	1.04	0.68	S
Spring Valley Pike	CR	86	Yankee Street	CR	175	31200	8	11	4	23	1.43	0.67	S
Siebenthaler Avenue	CR	32	North Dixie Drive	CR	99	25200	6	7	9	22	0.95	0.80	S
Lyons Road	CR	150	Yankee Street	CR	175	39800	5	6	11	22	0.82	0.50	S
Gettysburg Avenue	CR	53A	Salem Avenue	CR	249	18300	7	10	4	21	1.43	1.05	S
Siebenthaler Avenue	CR	32	Klepinger Road	TR	133	22700	11	6	4	21	0.86	0.84	S
Benchwood Road	TR	68	North Dixie Drive	CR	99	25600	10	6	5	21	0.86	0.75	S
Alex-Bell Pike	CR	78	Mad River Road	CR	79	17900	9	9	2	20	1.35	1.02	U
Alex-Bell Pike	CR	78	Lamme Road	CR	175	23000	7	4	8	19	0.63	0.75	S
Needmore Road	CR	74	Webster Street	CR	87	25100	5	7	7	19	1.11	0.69	S
North Dixie Drive	CR	99	Wagner Ford Road	CR	218	27000	5	8	6	19	1.26	0.64	S
Austin Boulevard	CR	166	Yankee Street	CR	175	30100	4	9	4	17	1.59	0.52	S
Needmore Road	CR	74	Wadsworth Road	TR	1299	32900	4	8	5	17	1.41	0.47	S
Dog Leg Road	CR	24	Meeker Road	TR	28	4700	6	2	6	14	0.43	2.72	U
Austin Boulevard	CR	166	Byers/Wood Road	TR	147	21700	7	3	4	14	0.64	0.59	S
Spring Valley Pike	TR	86	Paragon Road	CR	145	21500	7	5	2	14	1.07	0.59	S
North Dixie Drive	CR	99	Little York Road	CR	228	28500	4	5	5	14	1.07	0.45	S
Peters Pike	CR	159	Little York Road	CR	228	8700	6	4	3	13	0.92	1.36	S
Clyo Road	CR	83	Spring Valley Pike	CR	86	16800	6	3	4	13	0.69	0.71	S
Byers Road	TR	147	Benner Road	TR	154	11100	5	3	3	11	0.82	0.91	U
Klepinger Road	TR	133	Salem Avenue	CR	249	18600	6	3	2	11	0.82	0.54	S
Paragon	TR	145	Social Row Road	CR	166	18500	3	3	5	11	0.82	0.54	U
Meeker Road	TR	28	Frederick Pike	CR	165	1800	7	2	1	10	0.60	5.07	U
Farmington	CR	66	Union	CR	125	2100	2	3	2	5	1.80	2.17	U
Manning	CR	64	Diamond Mill	CR	217	5100	1	6	1	8	2.25	1.43	U
Alex-Bell Pike	CR	78	Munger Road	TR	175	14000	5	2	2	9	0.67	0.59	S
Benner	TR	154	Miamisburg Springboro	CR	166	12500	3	4	1	8	1.50	0.58	U
Kingsridge Drive	TR	2660	Lyonsridge Drive	TR	3940	16700	4	3	2	9	1.00	0.49	S
Lamme Road	CR	175	Lehigh Place	TR	1763	12100	3	1	1	5	0.60	0.38	U
North Dixie Drive	CR	99	York Commons	TR	4064	24800	7	1	0	8	0.38	0.29	S
Turner Road	CR	74	Klepinger Road	TR	133	17000	1	2	2	5	1.20	0.27	U

***** Red Text indicates intersections that are new to the list this year

***** Green Text indicates intersections that have been removed from the list this year

2020-2022 Intersection Crash Locations by Rate

Street Name #1	Route Number		Street Name #2	Route Number		Intersection Average Daily Traffic	2020	2021	2022	Total	Trend	Rate Acc/M Veh	Signal Y/N
Meeker Road	TR	28	Frederick Pike	CR	165	1800	7	2	1	10	0.60	5.07	U
Dog Leg Road	CR	24	Meeker Road	TR	28	4700	6	2	6	14	0.43	2.72	U
Siebenthaler Avenue	CR	32	Catalpa Drive	CR	69	15500	12	18	9	39	1.38	2.30	S
Wolf Road	CR	53	Turner Road	CR	74	14700	10	14	9	33	1.27	2.05	S
Needmore Road	CR	74	North Dixie Drive	CR	99	44000	26	26	22	74	1.05	1.54	S
Peters Pike	CR	159	Little York Road	CR	228	8700	6	4	3	13	0.92	1.36	S
Turner Road	CR	74	Philadelphia Drive	CR	159	27100	9	12	18	39	0.92	1.31	S
Byers Road	TR	147	Lyons Road	CR	150	29400	15	10	10	35	0.86	1.09	S
Gettysburg Avenue	CR	53A	Salem Avenue	CR	249	18300	7	10	4	21	1.43	1.05	S
Siebenthaler Avenue	CR	32	Salem Avenue	CR	249	27700	5	16	10	31	1.55	1.02	S
Alex-Bell Pike	CR	78	Mad River Road	CR	79	17900	9	9	2	20	1.35	1.02	U
Benchwood Road	TR	68	Miller Lane	TR	1723	31100	11	11	9	31	1.06	0.91	S
Byers Road	TR	147	Benner Road	TR	154	11100	5	3	3	11	0.82	0.91	U
Shoup Mill Road	CR	74	Riverside Drive	CR	539	32700	11	10	11	32	0.94	0.89	S
Siebenthaler Avenue	CR	32	Klepinger Road	TR	133	22700	11	6	4	21	0.86	0.84	S
Siebenthaler Avenue	CR	32	North Dixie Drive	CR	99	25200	6	7	9	22	0.95	0.80	S
Benchwood Road	TR	68	North Dixie Drive	CR	99	25600	10	6	5	21	0.86	0.75	S
Alex-Bell Pike	CR	78	Lamme Road	CR	175	23000	7	4	8	19	0.63	0.75	S
Clyo Road	CR	83	Spring Valley Pike	CR	86	16800	6	3	4	13	0.69	0.71	S
Needmore Road	CR	74	Webster Street	CR	87	25100	5	7	7	19	1.11	0.69	S
Needmore Road	CR	74	Payne Avenue	TR	1319	35100	8	9	9	26	1.04	0.68	S
Spring Valley Pike	CR	86	Yankee Street	CR	175	31200	8	11	4	23	1.43	0.67	S
North Dixie Drive	CR	99	Wagner Ford Road	CR	218	27000	5	8	6	19	1.26	0.64	S
Austin Boulevard	CR	166	Byers/Wood Road	TR	147	21700	7	3	4	14	0.64	0.59	S
Spring Valley Pike	TR	86	Paragon Road	CR	145	21500	7	5	2	14	1.07	0.59	S
Austin Boulevard	CR	166	Austin Landing	TR	1035	44900	8	12	8	28	1.29	0.57	S
Klepinger Road	TR	133	Salem Avenue	CR	249	18600	6	3	2	11	0.82	0.54	S
Paragon	TR	145	Social Row Road	CR	166	18500	3	3	5	11	0.82	0.54	U
Austin Boulevard	CR	166	Yankee Street	CR	175	30100	4	9	4	17	1.59	0.52	S
Lyons Road	CR	150	Yankee Street	CR	175	39800	5	6	11	22	0.82	0.50	S
Needmore Road	CR	74	Wadsworth Road	TR	1299	32900	4	8	5	17	1.41	0.47	S
North Dixie Drive	CR	99	Little York Road	CR	228	28500	4	5	5	14	1.07	0.45	S
Farmington	CR	66	Union	CR	125	2100	2	3	2	5	1.80	2.17	U
Manning	CR	64	Diamond Mill	CR	217	5100	1	6	1	8	2.25	1.43	U
Alex-Bell Pike	CR	78	Munger Road	TR	175	14000	5	2	2	9	0.67	0.59	S
Benner	TR	154	Miamisburg Springboro	CR	166	12500	3	4	1	8	1.50	0.58	U
Kingsridge Drive	TR	2660	Lyonsridge Drive	TR	3940	16700	4	3	2	9	1.00	0.49	S
Lamme Road	CR	175	Lehigh Place	TR	1763	12100	3	1	1	5	0.60	0.38	U
North Dixie Drive	CR	99	York Commons	TR	4064	24800	7	1	0	8	0.38	0.29	S
Turner Road	CR	74	Klepinger Road	TR	133	17000	1	2	2	5	1.20	0.27	U

***** Red Text indicates intersections that are new to the list this year

***** Green Text indicates intersections that have been removed from the list this year

MIAMI VALLEY Regional Planning Commission

Top 100 High-Crash Intersections by Jurisdiction

(based on 2017 to 2019 crash data)

JURISDICTION	Intersection	Total Crashes	Injury Crashes	Fatal Crashes	Regional Rank	Repeat High-Crash Location
Bath Twp.	SR 235 at Dayton - Yellow Springs Rd	19	11	0	12	
Beavercreek	National Rd at Colonel Glenn Hwy	70	19	0	22	●
	Fairfield Rd at New Germany - Trebein Rd	85	12	0	53	●
Bethel Twp.	US 40 at Palmer Rd	14	5	0	9	
Butler Twp.	Miller Ln at Benchwood Rd	35	12	0	68	●
Centerville	Wilmington Pk at Clyo Rd	74	22	0	40	● Project Completed
	Whipp Rd at Wilmington Pk	63	13	0	52	● Project Completed
	Clyo Rd at Bigger Rd	31	9	0	58	
	SR 48 at Spring Valley Pk	58	17	0	69	● Project Funded
	SR 725 at Alexandersville - Bellbrook Pk	86	20	0	92	● Project Funded
Dayton (continues to next page)	SR 4 at Broadway St	44	20	1	1	● Project Funded
	Gettysburg Ave at Hoover Ave	49	16	0	6	●
	SR 202 at Stanley Ave	52	21	0	7	
	Siebenthaler Ave at Philadelphia Dr	81	23	0	8	● Project Funded
	Wayne Ave at Wyoming St	44	13	0	13	● Project Funded
	SR 48 at Siebenthaler Ave	48	14	0	14	● Project Funded
	Gettysburg Ave at Free Pk	39	14	1	15	
	Salem Ave at Philadelphia Dr	66	27	0	19	●
	James H McGee Blvd at Third St	74	31	0	20	●
	Third St at Gettysburg Ave	64	16	0	21	
	SR 48 at Washington St	21	8	0	25	● Project Completed
	Third St at Findlay St	37	15	0	26	● Project Planned
	Hillcrest Ave at Philadelphia Dr	44	19	0	27	
	Keowee St at Fifth St	38	16	0	31	● Project Planned

JURISDICTION	Intersection	Total Crashes	Injury Crashes	Fatal Crashes	Regional Rank	Repeat High-Crash Location
Dayton (continues to next page)	Smithville Rd and Third St	27	14	0	32	
	Philadelphia Dr at Cornell Dr	32	16	0	33	●
	Salem Ave at Cornell Dr	41	18	0	34	
	Gettysburg Ave at James H. McGee Blvd	60	25	0	42	●
	Salem Ave at Harvard Blvd	14	6	0	44	
	Keowee St at Third St	44	13	0	45	
	Edwin C Moses Blvd at Stewart St	40	17	0	48	●
	Smithville Rd at Linden Ave	47	22	0	50	●
	Wyoming St at Brown St	14	5	0	54	●
	SR 48 at Ridge Ave	19	4	0	55	
	Edwin C Moses Blvd at Washington St	29	13	0	56	
	SR 48 at Helena St	30	11	0	57	● Project Funded
	SR 48 at Hillcrest Ave	30	11	1	59	
	SR 4 at McArthur Ave	19	8	0	60	
	Brooklyn Ave at Third St	26	12	0	62	
	Keowee and First St	37	16	0	63	
	First St at Stanley Ave	36	11	0	66	● Project Funded
	SR 201 at Needmore Rd	63	15	0	72	● Project Funded
	SR 48 at Apple St	10	6	0	73	●
	Irving Ave at Wilmington Pk	14	6	0	75	
	Keowee St at Xenia Ave	10	4	0	76	
	Patterson Blvd at Fifth St	13	5	0	77	
	Woodbine Ave at Woodman Dr	14	7	0	79	
	Little York Rd at Rip Rap Rd	17	8	0	80	
	SR 48 at Monument Ave	25	9	0	81	

JURISDICTION	Intersection	Total Crashes	Injury Crashes	Fatal Crashes	Regional Rank	Repeat High-Crash Location
Dayton (continued)	Fairview Ave at Catalpa Dr	16	7	0	82	
	Little Richmond Rd at James H McGee Blvd	25	8	0	87	
	Hillcrest Ave at Riverside Dr	15	5	1	99	
	SR 4? At Third St	17	7	1	100	
Fairborn	SR 235 at Maple Ave	15	5	0	85	
Franklin	Miami Ave at Franklin - Trenton Rd	16	3	1	24	
Greene Co.	US 42 at Spring Valley - Paintersville Rd	23	11	1	2	
Harrison Twp.	Salem Ave at Siebenthaler Ave	56	32	0	5	● Project Planned
	SR 48 at Shoup Mill Rd	73	33	1	23	● Project Funded
	Catalpa Dr at Siebenthaler Ave	37	13	0	47	
	SR 48 at Shiloh Springs Rd	15	10	0	94	
Huber Heights	Old Troy Pk at Taylorsville Rd	81	20	0	18	● Project Planned
	SR 201 at Kitridge Rd	29	14	0	83	●
	SR 201 at Chambersburg Rd	49	16	0	91	●
	SR 202 at Old Troy Pk	26	8	0	97	●
Kettering	Woodman Dr at Dorothy Ln	58	12	0	28	●
	Whipp Rd at Bigger Rd	19	9	0	30	●
	Stroop Rd at Wlimington Pk	45	14	0	49	● Project Funded
	Indian Ripple Rd at Stroop Rd	42	11	0	67	● Project Funded
	David Rd and SR 48	41	16	0	86	
Miamisburg	SR 725 at Byers Rd	61	21	0	41	●
	SR 725 at Heincke Rd	52	7	0	89	●
	SR 725 at Alex Rd	40	21	0	90	
Montgomery Co. (continues to next page)	SR 741 at Alexandersville - Bellbrook Pk	69	18	0	17	● Project Funded
	Philadelphia Dr at Turner Rd	48	25	0	37	●

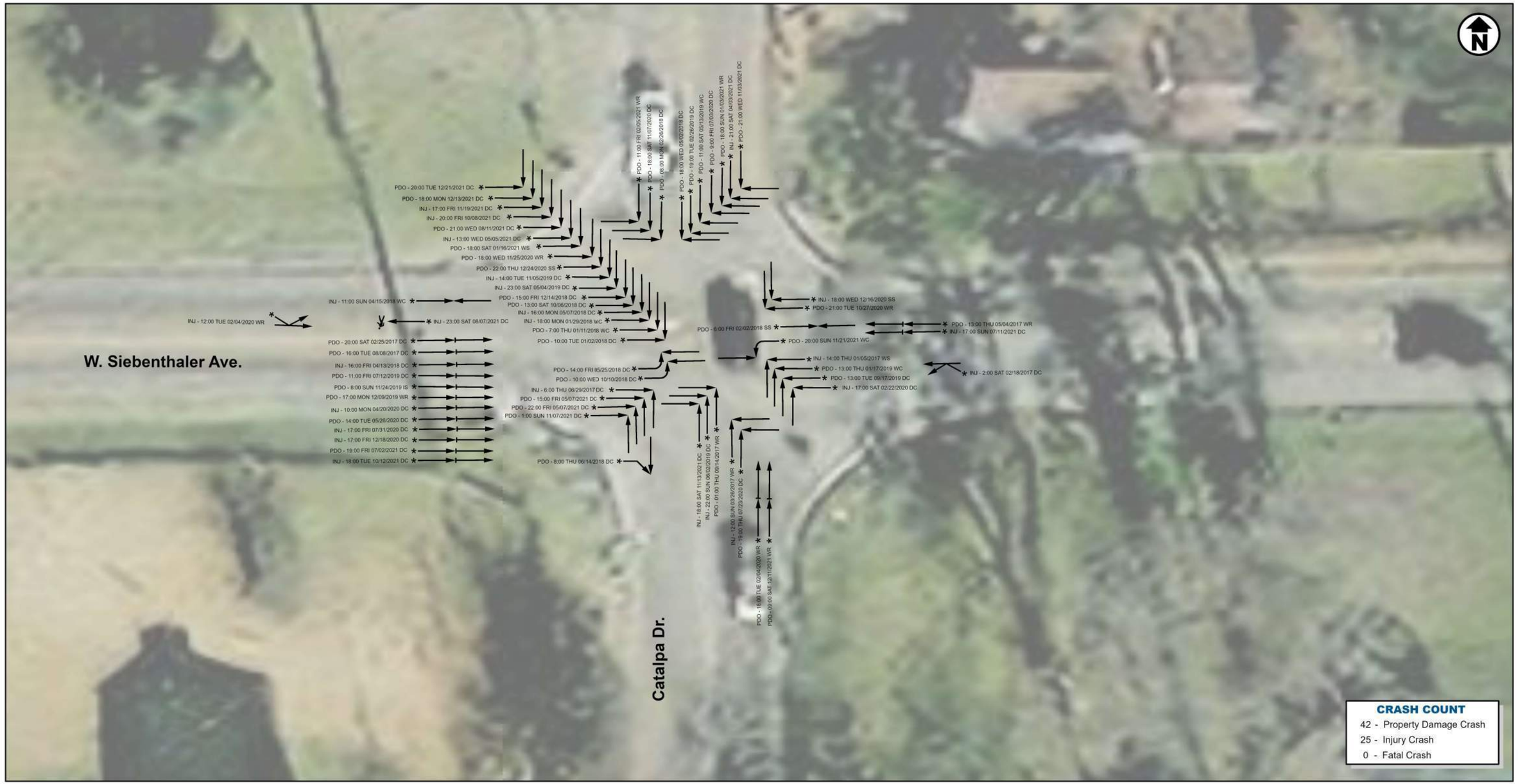
JURISDICTION	Intersection	Total Crashes	Injury Crashes	Fatal Crashes	Regional Rank	Repeat High-Crash Location
Montgomery Co. (continued)	SR 741 at Lyons Rd	60	16	0	38	● Project Completed
	Byers Rd at Lyons Rd	40	21	0	46	● Project Completed
	North Dixie Dr at Needmore Rd	74	29	0	51	●
	Riverside Dr at Shoup Mill Rd	44	18	0	65	● Project Funded
	SR 741 at SR 725	65	17	0	71	●
Moraine	SR 741 at Central Ave	52	16	0	39	●
	Sellars Rd and Dryden Rd	24	8	0	61	
Pleasant Hill	SR 48 at SR 718	13	7	0	10	●
Riverside	SR 202 at Needmore Rd	62	30	0	3	● Project Funded
	Woodman Dr at Burkhardt Rd	58	30	0	16	● Project Funded
	Harshman Rd at Valley Pk	42	13	0	35	●
	Woodman Dr at Airway Rd	51	12	0	36	● Project Funded
	Spinning Rd at Kemp Rd	19	7	0	96	
Spring Valley Twp.	SR 725 at US 42	10	5	0	95	
Sugarcreek Twp.	Waynesville Rd at Centerville Rd	13	1	0	43	
Trotwood	Free Pk at SR 49	45	8	1	70	
	Turner Rd at SR 49	20	8	0	84	
Troy	SR 41 at Experiment Farm Rd	56	5	0	29	●
	SR 55 at at SR 41	40	6	0	88	
Vandalia	US 40 at North Dixie Dr	37	11	0	64	●
West Carrollton	Alex Rd at East Dixie Dr	46	12	0	93	
Xenia	US 35 at Progress Dr	46	18	0	4	●
	Main St at Orange St	20	8	0	78	
	Main St at Orange St	20	8	0	78	

JURISDICTION	Intersection	Total Crashes	Injury Crashes	Fatal Crashes	Regional Rank	Repeat High-Crash Location
Xenia Twp.	Federal Rd at US 35	12	5	0	11	
	SR 235 at US 68	13	4	0	74	

- List based on 2017 to 2019 crash data analysis and ranking of intersections in Montgomery, Greene, Miami, & northern Warren Counties.
- This list omits crashes that occurred on limited access freeways such as Interstates 70, 75, and 675, State Route 4, and US Route 35.
- Locations listed as Greene Co., Miami Co, and Mongtomery Co. are on county or state owned roads outside of corporations.
- "Repeat High-Crash Location" indicates locations that were on high-crash lists from SFY2015 (2001 to '13 data) *and* SFY2018 (2014 to '16 data).
- "Project Funded" or "Project Planned" indicate repeat high-crash locations that have project(s) in the TIP or 2050 LRTP with potential to improve safety.
- "Project Completed" indicates a repeat high-crash locations that have a project recently completed at this location between SFY2018 and SFY2020 (between July 2017 and June '20).
- Visit *http://mvrpc.org/transportation/long-range/safety* for detailed methodology details.

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX B: CRASH DIAGRAM



LEGEND

TYPES OF CRASHES	SYMBOLS
Rear End	Moving Vehicle
Right Angle	Stopped Vehicle
Side Swipe	Bicycle
Out of Control	Pedestrian
Left Turn	Animal
Head On	Vehicle at Fault

WEATHER CONDITION		ROAD CONDITION	
O	Not Stated	X	Not Stated
C	Clear / Cloudy	D	Dry
R	Rain	W	Wet
S	Snow	S	Snow
F	Fog	I	Ice
H	Heavy Wind	M	Mud/Sand

SEVERITY
PDO - Property Damage Only
INJ - Injury
FAT - Fatal

CRASH DIAGRAM

INTERSECTION Catalpa Drive AND W. Siebenthaler Avenue

PERIOD 5 Years FROM 2017 TO 2021

JURISDICTION Montgomery County Engineer's Office/ ODOT District 7

ROUTE NAME / NUMBER Catalpa Drive at W. Siebenthaler Avenue

CMT
Crawford, Murphy & Tilly | Engineers & Consultants
7777 Washington Village Drive, Suite 270 | Dayton, OH | 45459

DATE: February 24, 2023

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX C: TRAFFIC SIGNAL WARRANTS

Signal Warrant Study

Roadway Characteristics

	Roadway	Orientation	Moving Lanes (One Way)		Date
Mainline	Siebenthaler Avenue	East-West	1		2/17/2023
Cross Roadway	Catalpa Drive	North-South	1		

Does the posted speed limit on the major street exceed 40 MPH?	NO	Does the intersection lie within the built-up area of an isolated community having a population less than 10,000 people?	NO

Warrant Summary		Meets
Warrant #1	Eight-Hour Vehicular Volume	YES
Warrant #2	Four-Hour Vehicular Volume	YES
Warrant #3	Peak Hour	NO
Warrant #4	Pedestrian Volume	NO
Warrant #5	School Crossing	NO
Warrant #6	Coordinated Signal System	NO
Warrant #7	Crash Experience	NO
Warrant #8	Roadway Network	NO
Warrant #9	Intersection Near a Grade Crossing	NO

Fill out fields highlighted in TAN

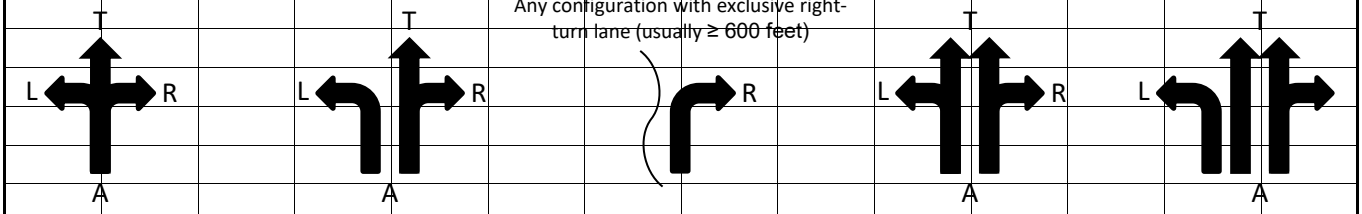
NOTE: This spreadsheet is configured for whole hour counts (not 15 minute counts)

Last Revision: G. Bollinger (01/17/2019)

Raw Traffic Counts

Hour	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
6:00 AM		236			250			148			86	
7:00 AM		280			309			147			78	
8:00 AM		256			262			132			86	
9:00 AM		271			290			149			80	
10:00 AM		329			344			120			100	
11:00 AM		304			333			134			117	
12:00 PM		355			319			165			115	
1:00 PM		339			456			184			151	
2:00 PM		366			459			239			156	
3:00 PM		388			459			236			151	
4:00 PM		330			399			211			153	
5:00 PM		293			351			192			125	
6:00 PM		308			304			131			112	
7:00 PM		265			237			137			85	
8:00 PM		202			223			102			92	

Select lane configuration:



Configuration: 1

Adjusted Traffic Counts												
Hour	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
6:00 AM	0	236	0	0	250	0	0	148	0	0	86	0
7:00 AM	0	280	0	0	309	0	0	147	0	0	78	0
8:00 AM	0	256	0	0	262	0	0	132	0	0	86	0
9:00 AM	0	271	0	0	290	0	0	149	0	0	80	0
10:00 AM	0	329	0	0	344	0	0	120	0	0	100	0
11:00 AM	0	304	0	0	333	0	0	134	0	0	117	0
12:00 PM	0	355	0	0	319	0	0	165	0	0	115	0
1:00 PM	0	339	0	0	456	0	0	184	0	0	151	0
2:00 PM	0	366	0	0	459	0	0	239	0	0	156	0
3:00 PM	0	388	0	0	459	0	0	236	0	0	151	0
4:00 PM	0	330	0	0	399	0	0	211	0	0	153	0
5:00 PM	0	293	0	0	351	0	0	192	0	0	125	0
6:00 PM	0	308	0	0	304	0	0	131	0	0	112	0
7:00 PM	0	265	0	0	237	0	0	137	0	0	85	0
8:00 PM	0	202	0	0	223	0	0	102	0	0	92	0

Warrant #1 -- Eight Hour Traffic Counts	Meets Warrant	YES

Appropriate table to use from MUTCD (2009)	4C-1

Vehicles Per Hour Thresholds		Stand-Alone				Combination			
Number of Lanes		Condition A		Condition B		Condition A		Condition B	
Major Street	Major Street	Major	Minor	Major	Minor	Major	Minor	Major	Minor
1	1	500	150	750	75	400	120	600	60

Hour	Major (2-Way)	Hi Minor (1-Way)	Stand-Alone (either or)			Combination (both)		
			Condition A	Condition B	Meets	Condition A	Condition B	Meets
6:00 AM	486	148	n	n	N	y	n	N
7:00 AM	589	147	n	n	N	y	n	N
8:00 AM	518	132	n	n	N	y	n	N
9:00 AM	561	149	n	n	N	y	n	N
10:00 AM	673	120	n	n	N	y	y	Y
11:00 AM	637	134	n	n	N	y	y	Y
12:00 PM	674	165	y	n	Y	y	y	Y
1:00 PM	795	184	y	y	Y	y	y	Y
2:00 PM	825	239	y	y	Y	y	y	Y
3:00 PM	847	236	y	y	Y	y	y	Y
4:00 PM	729	211	y	n	Y	y	y	Y
5:00 PM	644	192	y	n	Y	y	y	Y
6:00 PM	243	308	n	n	N	n	n	N
7:00 PM	222	265	n	n	N	n	n	N
8:00 PM	194	223	n	n	N	n	n	N
Does Stand-Alone or Combination meet thresholds for 8 total hours?					NO			YES

Warrant #2 -- Four Hour Traffic Counts — Meets Warrant: YES

Appropriate table to use from MUTCD (2009)	4C-3
Number of moving lanes on major street (one-way)	1
Number of moving lanes on minor approach (one-way)	1

Hour	Major (2-Way)	Hi Minor (1-Way)	Critical Minor Volume Per Table 4C-3	Plot above line?
6:00 AM	486	148	268	No
7:00 AM	589	147	224	No
8:00 AM	518	132	254	No
9:00 AM	561	149	235	No
10:00 AM	673	120	191	No
11:00 AM	637	134	204	No
12:00 PM	674	165	191	No
1:00 PM	795	184	150	Yes
2:00 PM	825	239	141	Yes
3:00 PM	847	236	134	Yes
4:00 PM	729	211	171	Yes
5:00 PM	644	192	202	No
6:00 PM	243	308	395	No
7:00 PM	222	265	407	No
8:00 PM	194	223	424	No

Do at least four hours meet the threshold? YES

Warrant #3 -- Peak Hour Volume — Meets Warrant: NO

Appropriate table to use from MUTCD (2009)	4C-6
Number of moving lanes on major street (one-way)	1
Number of moving lanes on minor approach (one-way)	1

Hour	Major (2-Way)	Hi Minor (1-Way)	Critical Minor Volume Per Table 4C-3	Plot above line?
6:00 AM	486	148	430	No
7:00 AM	589	147	376	No
8:00 AM	518	132	413	No
9:00 AM	561	149	390	No
10:00 AM	673	120	336	No
11:00 AM	637	134	353	No
12:00 PM	674	165	335	No
1:00 PM	795	184	283	No
2:00 PM	825	239	271	No
3:00 PM	847	236	262	No
4:00 PM	729	211	311	No
5:00 PM	644	192	350	No
6:00 PM	612	131	365	No

Does at least one hour meet the threshold? NO

Note:

This warrant shall only be applied in unsual cases. Such as the following:

- Office Complexes
- Manufacturing Plants
- Industrial Complexes
- High-Occupancy Vehicle Facilities

Do any unsual cases exist? NO

Warrant #4 -- Pedestrian Volume				Meets Warrant	NO
Four Hour					
Appropriate figure to use from MUTCD (2009), Four Hour Analysis		4C-4			
Appropriate figure to use from MUTCD (2009), Peak Hour Analysis		4C-6			
Number of moving lanes on major street (one-way)		1			
Number of moving lanes on minor approach (one-way)		1			

Hour	Major (2-Way)	Peds Crossing Major Street	Plot above line in Figure 4C-4?	Plot above line in Figure 4C-6?
6:00 AM	486		NO	NO
7:00 AM	589		NO	NO
8:00 AM	518		NO	NO
9:00 AM	561		NO	NO
10:00 AM	673		NO	NO
11:00 AM	637		NO	NO
12:00 PM	674		NO	NO
1:00 PM	795		NO	NO
2:00 PM	825		NO	NO
3:00 PM	847		NO	NO
4:00 PM	729		NO	NO
5:00 PM	644		NO	NO

Do at least four hours meet threshold for Figure 4C-4?	NO
Does one hour meet threshold for Figure 4C-6?	NO

Warrant #5 -- School Crossing	Meets Warrant	NO
If both questions are "Yes", then the warrant is met.		
Do at least 20 school children cross the major street during the highest crossing hour?		
Has an engineering study shown that the number of gaps when school children are crossing is less than the number of minutes that school children are present?		

Warrant #6 -- Coordinated Signal System	Meets Warrant	NO
If one statement is marked "Yes", then the warrant is met.		
On a one-way street or a street that has traffic predominately in one direction, the adjacent traffic control signals are so far apart that they do not provide the necessary degree of vehicular platooning.		
On a two-way street, adjacent traffic control signals do not provide the necessary degree of platooning and the proposed and adjacent traffic control signals will collectively provide a progressive operation.		

Warrant #7 -- Crash Experience	Meets Warrant	NO
If all statements are marked "Yes", then the warrant is met.		
Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency		
Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period, each crash involving personal injury or property damage apparently exceeding the applicable requirements for a reportable crash		
For each of any 8 hours of an average day, the vehicles per hour (vph) given in both of the 80 percent columns* of Condition A in Table 4C-1, or the vph in both of the 80 percent columns* of Condition B in Table 4C-1 exists on the major street and the higher-volume minor street approach, respectively, to the intersection, or the volume of pedestrian traffic is not less than 80 percent of the requirements specified in the Pedestrian Volume warrant. These major street and minor street volumes shall be for the same 8 hours. On the minor street, the higher volume shall not be required to be on the same approach during each of the 8 hours.		
* Substitute 56% column for major street speed limits greater than 40 mph or if located in built-up areas of isolated towns with a population less than 10,000 people.		

Warrant #8 -- Roadway Network	Meets Warrant	NO
If any of the statements are marked "Yes", and the roads qualify as a major route, then the warrant is met.		
The intersection has a total existing, or immediately projected, entering volume of at least 1,000 vehicles per hour during the peak hour of a typical weekday and has 5-year projected traffic volumes, based on an engineering study, that meet one or more of Warrants 1, 2 and 3 during an average weekday; or		
The intersection has a total existing or immediately projected entering volume of at least 1,000 vehicles per day for each of any 5 hours of a non-normal business day (Saturday or Sunday).		
A major route as used in this signal warrant shall have at least one of the following criteria:		

	Siebenthaler Avenue	Catalpa Drive
It is part of the street or highway system that serves as the principal roadway network for through traffic flow.		
It includes rural or suburban highways outside, entering or traversing a city.		
It appears as a major route on an official plan, such as a major street plan in an urban area traffic and transportation study.		

Warrant #9 -- Intersection Near a Grade Crossing	Meets Warrant	NO
If all statements are marked "Yes", then the warrant is met.		
A grade crossing exists on an approach controlled by a STOP or YIELD sign and the center of the track nearest to the intersection is within 140 feet of the stop line or yield line on the approach; and		
During the highest traffic volume hour during which rail traffic uses the crossing, the plotted point representing the vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per hour on the major street (total of both approaches) and the corresponding vehicles per our on the minor-street approach that crosses the track (one direction only, approaching the intersection) falls above the applicable curve in Figure 4C-9 or 4C-10 for the existing combination of approach lanes over the track and the distance D, which the clear storage distance as defined in Section 1A.13.		

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX D: CAPACITY ANALYSIS REPORTS

HCS Reports

No Build

All Way Stop Control

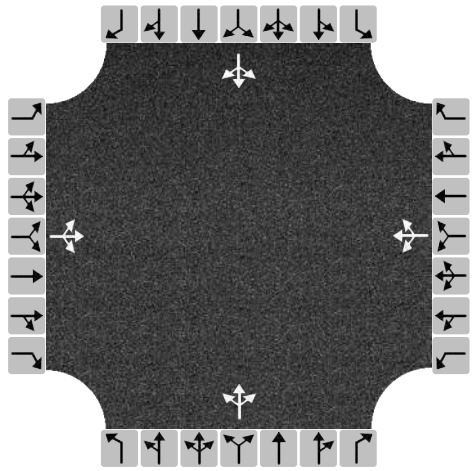
Design Year 2050 – AM & PM

HCS All-Way Stop Control Report

General and Site Information

Analyst	RTM
Agency/Co.	CMT
Date Performed	2/28/2023
Analysis Year	2050
Analysis Time Period (hrs)	0.25
Time Analyzed	AM
Project Description	D7 Catalpa
Intersection	Catalpa & Siebenthaler
Jurisdiction	Montgomery County
East/West Street	Siebenthaler Ave
North/South Street	Catalpa Dr
Peak Hour Factor	0.92

Lanes



Turning Movement Demand Volumes

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume (veh/h)	16	289	21	48	245	8	27	89	69	21	58	11
% Thrus in Shared Lane												

Lane Flow Rate and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	354			327			201			98		
Percent Heavy Vehicles	2			2			2			2		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.315			0.291			0.179			0.087		
Final Departure Headway, h_d (s)	5.35			5.43			5.78			6.19		
Final Degree of Utilization, x	0.526			0.493			0.323			0.168		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	3.35			3.43			3.78			4.19		

Capacity, Delay and Level of Service

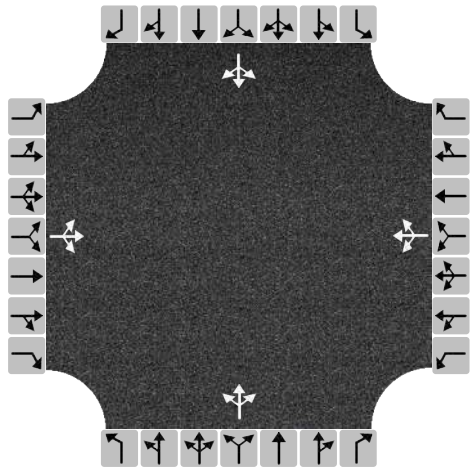
Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	354			327			201			98		
Capacity (veh/h)	673			663			623			582		
95% Queue Length, Q_{95} (veh)	3.1			2.7			1.4			0.6		
Control Delay (s/veh)	14.1			13.6			11.5			10.4		
Level of Service, LOS	B			B			B			B		
Approach Delay (s/veh) | LOS	14.1	B		13.6	B		11.5	B		10.4	B	
Intersection Delay (s/veh) | LOS	13.0						B					

HCS All-Way Stop Control Report

General and Site Information

Analyst	RTM
Agency/Co.	CMT
Date Performed	2/28/2023
Analysis Year	2050
Analysis Time Period (hrs)	0.25
Time Analyzed	PM
Project Description	D7 Catalpa
Intersection	Catalpa & Siebenthaler
Jurisdiction	Montgomery County
East/West Street	Siebenthaler Ave
North/South Street	Catalpa Dr
Peak Hour Factor	0.92

Lanes



Turning Movement Demand Volumes

Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume (veh/h)	36	430	59	48	442	15	67	164	86	23	138	44
% Thrus in Shared Lane												

Lane Flow Rate and Adjustments

Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	571			549			345			223		
Percent Heavy Vehicles	2			2			2			2		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.507			0.488			0.306			0.198		
Final Departure Headway, h_d (s)	7.92			7.97			8.33			8.96		
Final Degree of Utilization, x	1.255			1.215			0.797			0.555		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	5.92			5.97			6.33			6.96		

Capacity, Delay and Level of Service

Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	571			549			345			223		
Capacity (veh/h)	455			452			432			402		
95% Queue Length, Q_{95} (veh)	23.6			21.7			7.1			3.3		
Control Delay (s/veh)	156.3			141.3			36.9			22.6		
Level of Service, LOS	F			F			E			C		
Approach Delay (s/veh) | LOS	156.3	F		141.3	F		36.9	E		22.6	C	
Intersection Delay (s/veh) | LOS	109.4						F					

HCS Reports

Alternative 1A

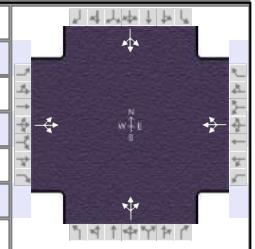
Traffic Signal

No Left Turn Lanes

Design Year 2050 – AM & PM

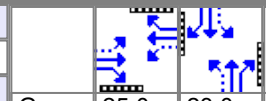
HCS Signalized Intersection Input Data

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				

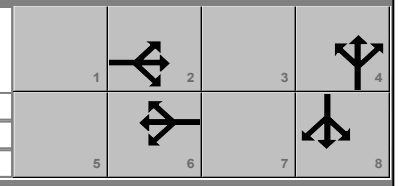


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	25.0	23.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



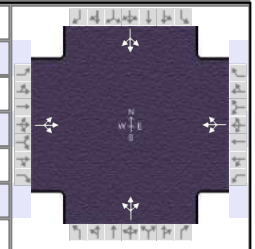
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11
Initial Queue (Q_b), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None			None			None			None	
Heavy Vehicles (P_{HV}), %		2			2			2			2	
Ped / Bike / RTOR, /h	0	0	0	0	0	0	0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0	0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft		12.0			12.0			12.0			12.0	
Turn Bay Length, ft		0			0			0			0	
Grade (*Pg*), %		-6			0			0			0	
Speed Limit, mi/h	35	35	35	35	35	35	35	35	35	35	35	35

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		31.0		31.0		29.0		29.0
Yellow Change Interval (*Y*), s		4.0		4.0		4.0		4.0
Red Clearance Interval (R_c), s		2.0		2.0		2.0		2.0
Minimum Green (G_{min}), s		20		20		10		10
Start-Up Lost Time (*l*t), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green (e), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Passage (*PT*), s		2.0		2.0		2.0		2.0
Recall Mode		Max		Max		Max		Max
Dual Entry		Yes		Yes		Yes		Yes
Walk (*Walk*), s		10.0		10.0		10.0		10.0
Pedestrian Clearance Time (*PC*), s		7.0		7.0		7.0		7.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0
Walkway / Crosswalk Width / Length, ft	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0
Street Width / Island / Curb, ft	0.0	0	No	0.0	0	No	0.0	0	No	0.0	0	No
Width Outside / Bike Lane / Shoulder, ft	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No	0.50		No	0.50		No	0.50	

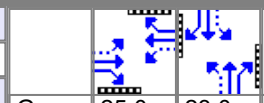
HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	25.0	23.0	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	2.0	2.0	0.0	0.0	0.0	0.0				

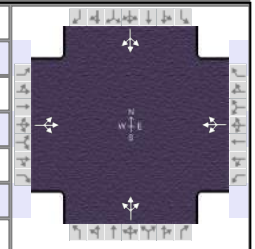
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		4		8
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		31.0		31.0		29.0		29.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						6.8		4.1
Green Extension Time (g_e), s		0.0		0.0		0.5		0.5
Phase Call Probability						1.00		1.00
Max Out Probability						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	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h		354			327			201			98	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		2054			1731			1699			1684	
Queue Service Time (g_s), s		0.0			0.0			0.0			0.0	
Cycle Queue Clearance Time (g_c), s		7.2			7.5			4.8			2.1	
Green Ratio (*g/C*)		0.42			0.42			0.38			0.38	
Capacity (*c*), veh/h		919			791			720			719	
Volume-to-Capacity Ratio (*X*)		0.386			0.414			0.279			0.136	
Back of Queue (*Q*), ft/ln (95 th percentile)		143			135.7			83.1			37.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		5.6			5.3			3.3			1.5	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		12.3			12.4			12.9			12.1	
Incremental Delay (d_2), s/veh		1.2			1.6			1.0			0.4	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		13.5			14.0			13.9			12.4	
Level of Service (LOS)		B			B			B			B	
Approach Delay, s/veh / LOS	13.5	B		14.0	B		13.9	B		12.4	B	
Intersection Delay, s/veh / LOS	13.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.67	B	1.67	B	1.67	B	1.67	B
Bicycle LOS Score / LOS	1.07	A	1.03	A	0.82	A	0.65	A

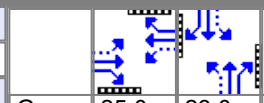
HCS Signalized Intersection Intermediate Values

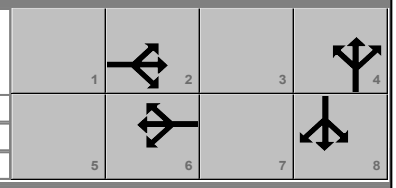
General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



												
							1	2	3	4		
Green	25.0	23.0	0.0	0.0	0.0	0.0	5	6	7	8		
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

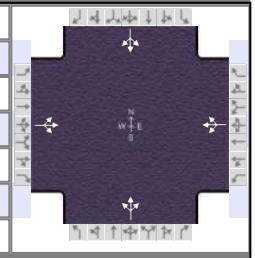
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.984	1.108	1.108	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.987	0.975		0.930	0.926		0.967	0.908		0.918	0.900	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.975		0.000	0.926		0.000	0.908		0.000	0.900
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000			1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Prot. CAV Adj. Factor ($f_{CAV,prot}$)												
Left-Turn Perm. CAV Adj. Factor ($f_{CAV,perm}$)	1.00			1.00			1.00			1.00		
Movement Saturation Flow Rate (s), veh/h	101	1821	132	276	1409	46	248	817	634	393	1085	206
Proportion of Vehicles Arriving on Green (P)	0.42	0.42	0.42	0.42	0.42	0.42	0.38	0.38	0.38	0.38	0.38	0.38
Incremental Delay Factor (k)		0.50			0.50			0.50			0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		6.0		6.0		6.0		6.0
Green Ratio (g/C)		0.42		0.42		0.38		0.38
Permitted Saturation Flow Rate (s_p), veh/h/ln		1122		1060		1346		1232
Shared Saturation Flow Rate (s_{sh}), veh/h/ln		2037		1660		1764		1661
Permitted Effective Green Time (g_p), s		25.0		25.0		23.0		23.0
Permitted Service Time (g_u), s		17.5		17.8		20.9		18.2
Permitted Queue Service Time (g_{ps}), s		0.0		0.0		0.0		0.0
Time to First Blockage (g_f), s		14.8		9.3		9.8		6.3
Queue Service Time Before Blockage (g_{fs}), s		6.4		7.1		2.4		1.7
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	0.972	0.000	0.972	0.000	0.972	0.000	0.972	0.000
Pedestrian F_s / F_{delay}	0.000	0.093	0.000	0.093	0.000	0.098	0.000	0.098
Pedestrian M_{corner} / M_{cw}	0.00		0.00		0.00		0.00	
Bicycle c_b / d_b	833.33	10.21	833.33	10.21	766.67	11.41	766.67	11.41
Bicycle F_w / F_v	-3.64	0.58	-3.64	0.54	-3.64	0.33	-3.64	0.16

HCS Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				

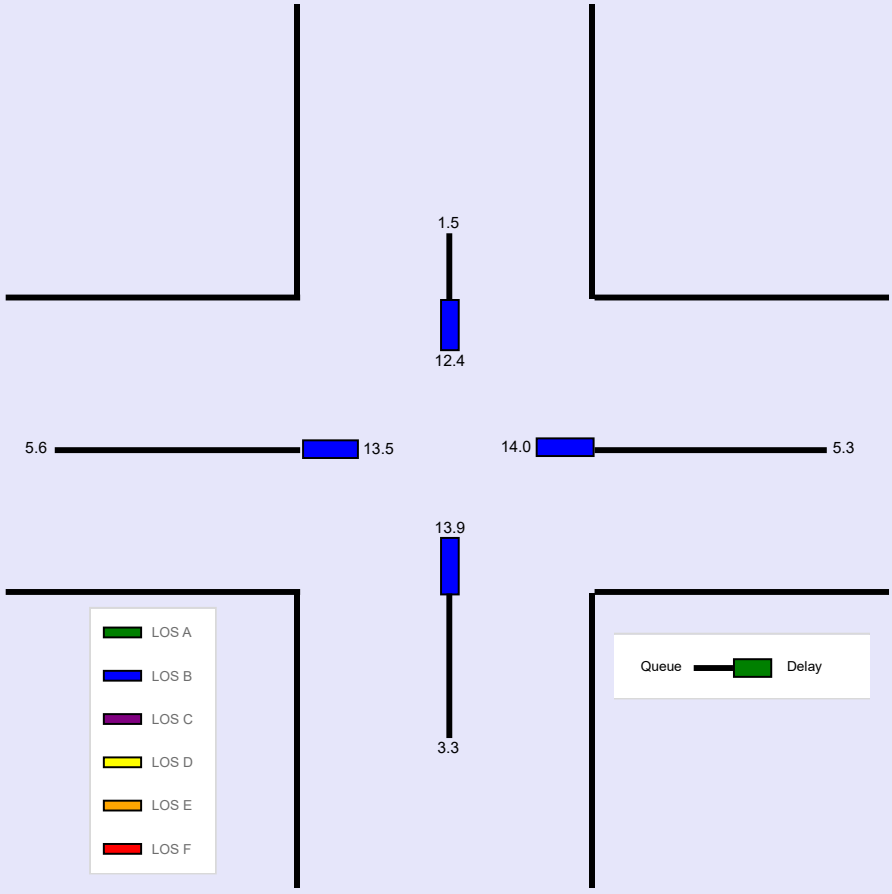


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4		
Green	25.0	23.0	0.0	0.0	0.0	0.0	5	6	7	8		
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)		143			135.7			83.1			37.4	
Back of Queue (*Q*), veh/ln (95 th percentile)		5.6			5.3			3.3			1.5	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Control Delay (*d*), s/veh		13.5			14.0			13.9			12.4	
Level of Service (LOS)		B			B			B			B	
Approach Delay, s/veh / LOS	13.5		B	14.0		B	13.9		B	12.4		B
Intersection Delay, s/veh / LOS	13.6						B					



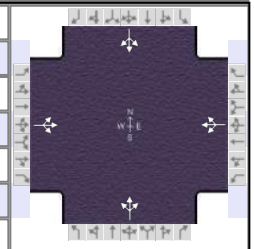
--- Messages ---

No errors or warnings exist.

--- Comments ---

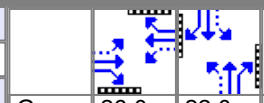
HCS Signalized Intersection Input Data

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	26.0	22.0	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	2.0	2.0	0.0	0.0	0.0	0.0				

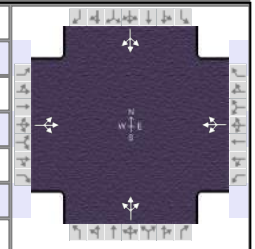
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44
Initial Queue (Q_b), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None			None			None			None	
Heavy Vehicles (P_{HV}), %		2			2			2			2	
Ped / Bike / RTOR, /h	0	0	0	0	0	0	0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0	0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft		12.0			12.0			12.0			12.0	
Turn Bay Length, ft		0			0			0			0	
Grade (*Pg*), %		-6			0			0			0	
Speed Limit, mi/h	35	35	35	35	35	35	35	35	35	35	35	35

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		32.0		32.0		28.0		28.0
Yellow Change Interval (*Y*), s		4.0		4.0		4.0		4.0
Red Clearance Interval (R_c), s		2.0		2.0		2.0		2.0
Minimum Green (G_{min}), s		20		20		10		10
Start-Up Lost Time (*l*t), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Passage (*PT*), s		2.0		2.0		2.0		2.0
Recall Mode		Max		Max		Max		Max
Dual Entry		Yes		Yes		Yes		Yes
Walk (*Walk*), s		10.0		10.0		10.0		10.0
Pedestrian Clearance Time (*PC*), s		7.0		7.0		7.0		7.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0
Walkway / Crosswalk Width / Length, ft	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0
Street Width / Island / Curb, ft	0.0	0	No	0.0	0	No	0.0	0	No	0.0	0	No
Width Outside / Bike Lane / Shoulder, ft	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No	0.50		No	0.50		No	0.50	

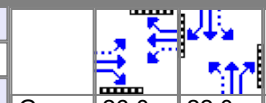
HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	26.0	22.0	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	2.0	2.0	0.0	0.0	0.0	0.0				

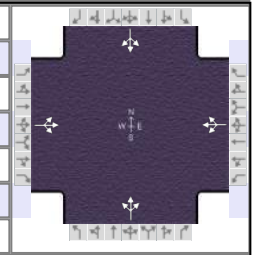
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		4		8
Case Number		8.0		8.0		8.0		8.0
Phase Duration, s		32.0		32.0		28.0		28.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						11.5		7.4
Green Extension Time (g_e), s		0.0		0.0		1.0		1.1
Phase Call Probability						1.00		1.00
Max Out Probability						0.02		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	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h		571			549			345			223	
Adjusted Saturation Flow Rate (*s*), veh/h/ln		1991			1748			1651			1741	
Queue Service Time (g_s), s		0.0			1.8			3.2			0.0	
Cycle Queue Clearance Time (g_c), s		13.1			14.9			9.5			5.4	
Green Ratio (*g/C*)		0.43			0.43			0.37			0.37	
Capacity (*c*), veh/h		927			823			678			705	
Volume-to-Capacity Ratio (*X*)		0.616			0.667			0.508			0.316	
Back of Queue (*Q*), ft/ln (95 th percentile)		247			251			168.6			96.8	
Back of Queue (*Q*), veh/ln (95 th percentile)		9.7			9.9			6.6			3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Uniform Delay (d_1), s/veh		13.3			13.7			15.0			13.7	
Incremental Delay (d_2), s/veh		3.1			4.3			2.7			1.2	
Initial Queue Delay (d_3), s/veh		0.0			0.0			0.0			0.0	
Control Delay (*d*), s/veh		16.4			18.0			17.7			14.9	
Level of Service (LOS)		B			B			B			B	
Approach Delay, s/veh / LOS	16.4		B	18.0		B	17.7		B	14.9		B
Intersection Delay, s/veh / LOS	17.0						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.66	B	1.66	B	1.67	B	1.67	B
Bicycle LOS Score / LOS	1.43	A	1.39	A	1.06	A	0.86	A

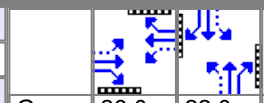
HCS Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				

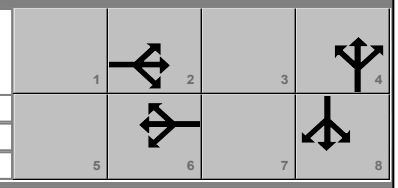


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	26.0	22.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



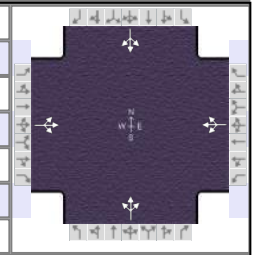
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.984	1.108	1.108	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.962	0.946		0.939	0.935		0.922	0.883		0.965	0.931	
Right-Turn Adjustment Factor (f_{RT})		0.000	0.946		0.000	0.935		0.000	0.883		0.000	0.931
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000			1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Prot. CAV Adj. Factor ($f_{CAV,prot}$)												
Left-Turn Perm. CAV Adj. Factor ($f_{CAV,perm}$)	1.00			1.00			1.00			1.00		
Movement Saturation Flow Rate (s), veh/h	137	1631	224	166	1530	52	349	854	448	195	1172	374
Proportion of Vehicles Arriving on Green (P)	0.43	0.43	0.43	0.43	0.43	0.43	0.37	0.37	0.37	0.37	0.37	0.37
Incremental Delay Factor (k)		0.50			0.50			0.50			0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		6.0		6.0		6.0		6.0
Green Ratio (g/C)		0.43		0.43		0.37		0.37
Permitted Saturation Flow Rate (s_p), veh/h/ln		915		886		1204		1125
Shared Saturation Flow Rate (s_{sh}), veh/h/ln		1961		1687		1667		1736
Permitted Effective Green Time (g_p), s		26.0		26.0		22.0		22.0
Permitted Service Time (g_u), s		11.1		12.9		16.6		12.5
Permitted Queue Service Time (g_{ps}), s		0.0		1.8		3.2		0.0
Time to First Blockage (g_f), s		11.5		9.8		6.3		11.4
Queue Service Time Before Blockage (g_{fs}), s		10.4		9.8		5.4		3.7
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	0.972	0.000	0.972	0.000	0.972	0.000	0.972	0.000
Pedestrian F_s / F_{delay}	0.000	0.091	0.000	0.091	0.000	0.100	0.000	0.100
Pedestrian M_{corner} / M_{cw}	0.00		0.00		0.00		0.00	
Bicycle c_b / d_b	866.67	9.63	866.67	9.63	733.33	12.03	733.33	12.03
Bicycle F_w / F_v	-3.64	0.94	-3.64	0.91	-3.64	0.57	-3.64	0.37

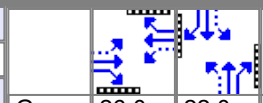
HCS Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_No Turn Lanes.xus		
Project Description	2050 Capacity Analysis				

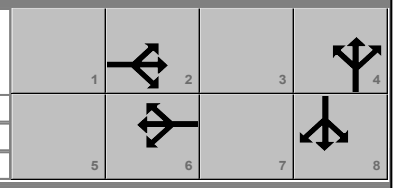


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

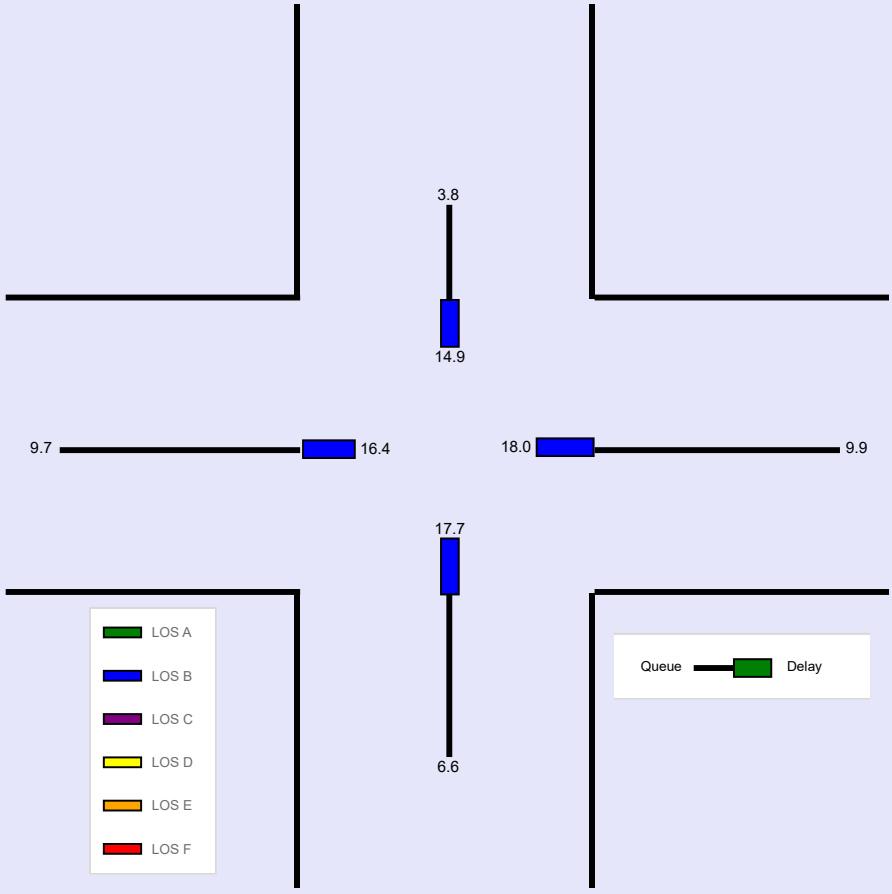
Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	26.0	22.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)		247			251			168.6			96.8	
Back of Queue (*Q*), veh/ln (95 th percentile)		9.7			9.9			6.6			3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)		0.00			0.00			0.00			0.00	
Control Delay (*d*), s/veh		16.4			18.0			17.7			14.9	
Level of Service (LOS)		B			B			B			B	
Approach Delay, s/veh / LOS	16.4		B	18.0		B	17.7		B	14.9		B
Intersection Delay, s/veh / LOS	17.0						B					



--- Messages ---

No errors or warnings exist.

--- Comments ---

HCS Reports

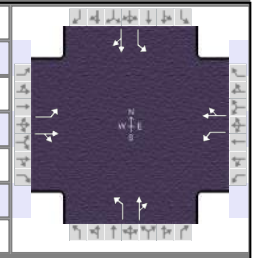
Alternative 1B

Traffic Signal with left turn lanes on Siebenthaler and Catalpa

Design Year 2050 – AM & PM

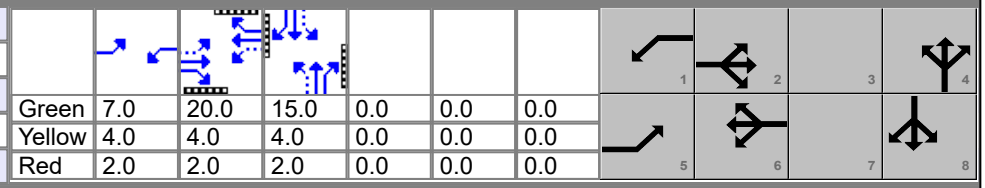
HCS Signalized Intersection Input Data

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	20.0	15.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

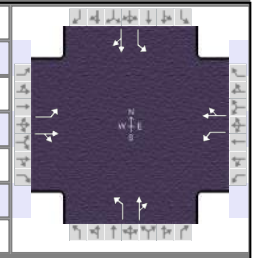
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11
Initial Queue (Q_b), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None			None			None			None	
Heavy Vehicles (P_{HV}), %	2	2		2	2		2	2		2	2	
Ped / Bike / RTOR, /h	0	0	0	0	0	0	0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0	0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Turn Bay Length, ft	0	0		0	0		0	0		0	0	
Grade (*Pg*), %		-6			0			0			0	
Speed Limit, mi/h	35	35	35	35	35	35	35	35	35	35	35	35

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s	13.0	26.0	13.0	26.0		21.0		21.0
Yellow Change Interval (*Y*), s	4.0	4.0	4.0	4.0		4.0		4.0
Red Clearance Interval (R_c), s	2.0	2.0	2.0	2.0		2.0		2.0
Minimum Green (G_{min}), s	7	20	7	20		10		10
Start-Up Lost Time (*l*t), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Passage (*PT*), s	2.0	2.0	2.0	2.0		2.0		2.0
Recall Mode	Max	Max	Max	Max		Max		Max
Dual Entry	No	Yes	No	Yes		Yes		Yes
Walk (*Walk*), s		10.0		10.0		10.0		10.0
Pedestrian Clearance Time (*PC*), s		7.0		7.0		7.0		7.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0
Walkway / Crosswalk Width / Length, ft	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0
Street Width / Island / Curb, ft	0.0	0	No	0.0	0	No	0.0	0	No	0.0	0	No
Width Outside / Bike Lane / Shoulder, ft	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No	0.50		No	0.50		No	0.50	

HCS Signalized Intersection Results Summary

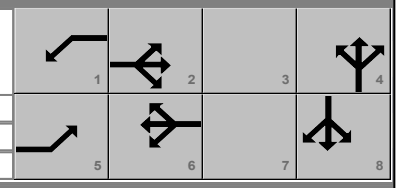
General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

Green	7.0	20.0	15.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



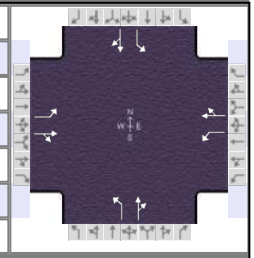
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		4		8
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	13.0	26.0	13.0	26.0		21.0		21.0
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		3.2		3.2
Queue Clearance Time (g_s), s	2.3		3.0			6.9		7.9
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.4		0.4
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.03		0.23			0.02		0.04

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	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h	17	337		52	275		29	172		23	75	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	2006	2081		1781	1860		1325	1734		1213	1818	
Queue Service Time (g_s), s	0.3	7.7		1.0	6.9		1.1	4.9		1.0	1.9	
Cycle Queue Clearance Time (g_c), s	0.3	7.7		1.0	6.9		3.0	4.9		5.9	1.9	
Green Ratio (*g/C*)	0.45	0.33		0.45	0.33		0.25	0.25		0.25	0.25	
Capacity (*c*), veh/h	583	694		506	620		408	434		323	455	
Volume-to-Capacity Ratio (*X*)	0.030	0.486		0.103	0.444		0.072	0.396		0.071	0.165	
Back of Queue (*Q*), ft/ln (95 th percentile)	5.5	168.2		17.4	135.8		15.4	96.6		13.2	38	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	6.6		0.7	5.3		0.6	3.8		0.5	1.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	9.8	15.9		10.2	15.6		18.8	18.7		21.2	17.6	
Incremental Delay (d_2), s/veh	0.1	2.4		0.4	2.3		0.3	2.7		0.4	0.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	9.9	18.3		10.6	17.9		19.1	21.4		21.6	18.4	
Level of Service (LOS)	A	B		B	B		B	C		C	B	
Approach Delay, s/veh / LOS	17.9	B		16.8	B		21.1	C		19.1	B	
Intersection Delay, s/veh / LOS	18.3						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.90	B	1.90	B	1.91	B	1.91	B
Bicycle LOS Score / LOS	1.07	A	1.03	A	0.82	A	0.65	A

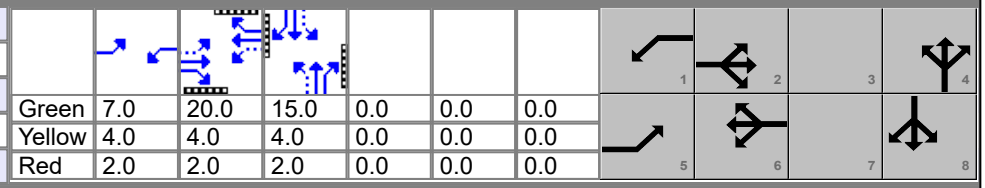
HCS Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	20.0	15.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

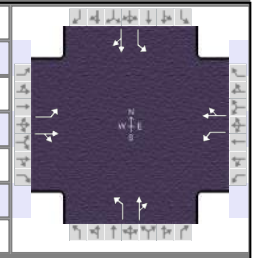
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	1.108	1.108	1.108	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000		0.952	0.000		0.697	0.000		0.639	0.000	
Right-Turn Adjustment Factor (f_{RT})		0.988	0.988		0.994	0.994		0.927	0.927		0.972	0.972
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000			1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Prot. CAV Adj. Factor ($f_{CAV,prot}$)	1.00			1.00								
Left-Turn Perm. CAV Adj. Factor ($f_{CAV,perm}$)							1.00			1.00		
Movement Saturation Flow Rate (s), veh/h	2006	1940	141	1781	1801	59	1325	977	757	1213	1528	290
Proportion of Vehicles Arriving on Green (P)	0.12	0.33	0.33	0.12	0.33	0.33	0.25	0.25	0.25	0.25	0.25	0.25
Incremental Delay Factor (k)	0.50	0.50		0.50	0.50		0.50	0.50		0.50	0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)	6.0	6.0	6.0	6.0		6.0		6.0
Green Ratio (g/C)	0.45	0.33	0.45	0.33		0.25		0.25
Permitted Saturation Flow Rate (s_p), veh/h/ln	1243	0	1043	0		1325		1213
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								
Permitted Effective Green Time (g_p), s	20.0	0.0	20.0	0.0		15.0		15.0
Permitted Service Time (g_u), s	11.1	0.0	10.3	0.0		13.1		10.1
Permitted Queue Service Time (g_{ps}), s	0.1		0.5			1.1		1.0
Time to First Blockage (g_f), s	0.0	0.0	0.0	0.0		0.0		0.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.198	0.000	1.198	0.000	1.198	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.104	0.000	0.104	0.000	0.113	0.000	0.113
Pedestrian M_{corner} / M_{cw}	0.00		0.00		0.00		0.00	
Bicycle c_b / d_b	666.67	13.33	666.67	13.33	500.00	16.88	500.00	16.88
Bicycle F_w / F_v	-3.64	0.58	-3.64	0.54	-3.64	0.33	-3.64	0.16

HCS Signalized Intersection Results Graphical Summary

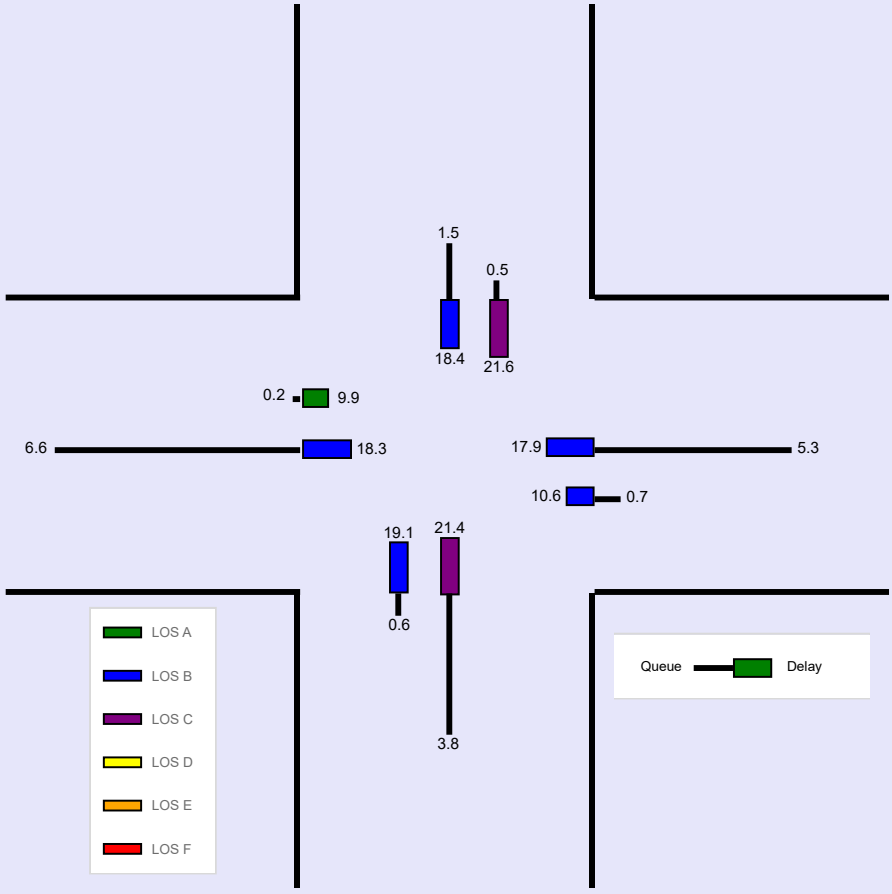
General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information					EB			WB			NB			SB		
Cycle, s	60.0	Reference Phase	2													
Offset, s	0	Reference Point	End	Green	7.0	20.0		15.0	0.0	0.0	0.0					
Uncoordinated	No	Simult. Gap E/W	On	Yellow	4.0	4.0		4.0	0.0	0.0	0.0					
Force Mode	Fixed	Simult. Gap N/S	On	Red	2.0	2.0		2.0	0.0	0.0	0.0					

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	5.5	168.2		17.4	135.8		15.4	96.6		13.2	38	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.2	6.6		0.7	5.3		0.6	3.8		0.5	1.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Control Delay (*d*), s/veh	9.9	18.3		10.6	17.9		19.1	21.4		21.6	18.4	
Level of Service (LOS)	A	B		B	B		B	C		C	B	
Approach Delay, s/veh / LOS	17.9	B		16.8	B		21.1	C		19.1	B	
Intersection Delay, s/veh / LOS	18.3						B					



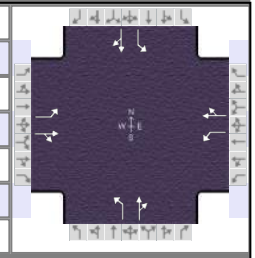
--- Messages ---

No errors or warnings exist.

--- Comments ---

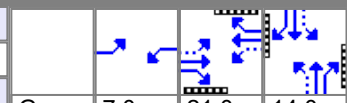
HCS Signalized Intersection Input Data

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				

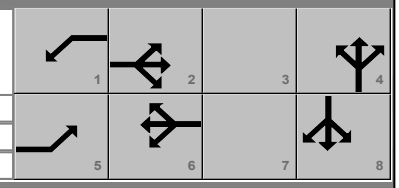


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	21.0	14.0	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						



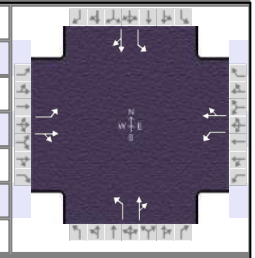
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44
Initial Queue (Q_b), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None			None			None			None	
Heavy Vehicles (P_{HV}), %	2	2		2	2		2	2		2	2	
Ped / Bike / RTOR, /h	0	0	0	0	0	0	0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0	0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft	12.0	12.0		12.0	12.0		12.0	12.0		12.0	12.0	
Turn Bay Length, ft	0	0		0	0		0	0		0	0	
Grade (*Pg*), %		-6			0			0			0	
Speed Limit, mi/h	35	35	35	35	35	35	35	35	35	35	35	35

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s	13.0	27.0	13.0	27.0		20.0		20.0
Yellow Change Interval (*Y*), s	4.0	4.0	4.0	4.0		4.0		4.0
Red Clearance Interval (R_c), s	2.0	2.0	2.0	2.0		2.0		2.0
Minimum Green (G_{min}), s	7	20	7	20		10		10
Start-Up Lost Time (*l*t), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green (*e*), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Passage (*PT*), s	2.0	2.0	2.0	2.0		2.0		2.0
Recall Mode	Max	Max	Max	Max		Max		Max
Dual Entry	No	Yes	No	Yes		Yes		Yes
Walk (*Walk*), s		10.0		10.0		10.0		10.0
Pedestrian Clearance Time (*PC*), s		7.0		7.0		7.0		7.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0
Walkway / Crosswalk Width / Length, ft	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0
Street Width / Island / Curb, ft	0.0	0	No	0.0	0	No	0.0	0	No	0.0	0	No
Width Outside / Bike Lane / Shoulder, ft	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No	0.50		No	0.50		No	0.50	

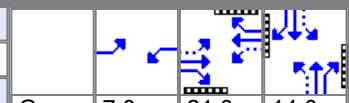
HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				

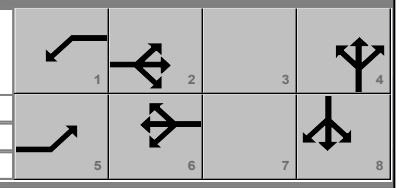


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	21.0	14.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0



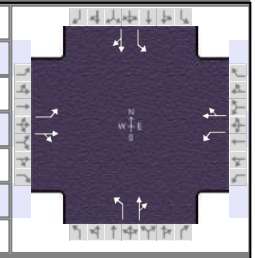
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase	5	2	1	6		4		8
Case Number	1.1	4.0	1.1	4.0		6.0		6.0
Phase Duration, s	13.0	27.0	13.0	27.0		20.0		20.0
Change Period, ($Y+R_c$), s	6.0	6.0	6.0	6.0		6.0		6.0
Max Allow Headway (*MAH*), s	3.1	0.0	3.1	0.0		3.2		3.2
Queue Clearance Time (g_s), s	2.6		3.0			11.1		11.6
Green Extension Time (g_e), s	0.0	0.0	0.0	0.0		0.4		0.4
Phase Call Probability	1.00		1.00			1.00		1.00
Max Out Probability	0.11		0.22			1.00		1.00

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	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h	39	532		52	497		73	272		25	198	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	2006	2061		1781	1859		1185	1761		1108	1792	
Queue Service Time (g_s), s	0.6	13.6		1.0	14.2		3.4	8.4		1.3	5.7	
Cycle Queue Clearance Time (g_c), s	0.6	13.6		1.0	14.2		9.1	8.4		9.6	5.7	
Green Ratio (*g/C*)	0.47	0.35		0.47	0.35		0.23	0.23		0.23	0.23	
Capacity (*c*), veh/h	435	721		407	651		284	411		224	418	
Volume-to-Capacity Ratio (*X*)	0.090	0.737		0.128	0.763		0.257	0.661		0.112	0.473	
Back of Queue (*Q*), ft/ln (95 th percentile)	12.7	282.9		17.5	278.9		47.8	184.2		16.9	118.4	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.5	11.1		0.7	11.0		1.9	7.3		0.7	4.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Uniform Delay (d_1), s/veh	11.0	17.1		10.9	17.3		23.7	20.9		25.2	19.8	
Incremental Delay (d_2), s/veh	0.4	6.6		0.6	8.3		2.2	8.1		1.0	3.8	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Control Delay (*d*), s/veh	11.4	23.7		11.6	25.6		25.9	29.0		26.2	23.6	
Level of Service (LOS)	B	C		B	C		C	C		C	C	
Approach Delay, s/veh / LOS	22.8	C		24.2	C		28.3	C		23.9	C	
Intersection Delay, s/veh / LOS	24.6						C					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.90	B	1.90	B	1.91	B	1.91	B
Bicycle LOS Score / LOS	1.43	A	1.39	A	1.06	A	0.86	A

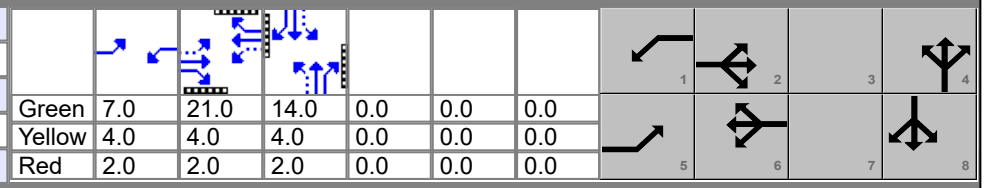
HCS Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	21.0	14.0	0.0	0.0	0.0						
Yellow	4.0	4.0	4.0	0.0	0.0	0.0						
Red	2.0	2.0	2.0	0.0	0.0	0.0						

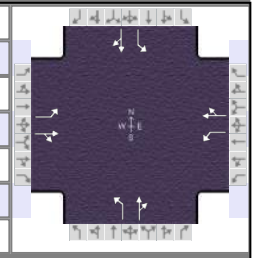
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	1.108	1.108	1.108	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.952	0.000		0.952	0.000		0.624	0.000		0.583	0.000	
Right-Turn Adjustment Factor (f_{RT})		0.979	0.979		0.994	0.994		0.942	0.942		0.958	0.958
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000			1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Prot. CAV Adj. Factor ($f_{CAV,prot}$)	1.00			1.00								
Left-Turn Perm. CAV Adj. Factor ($f_{CAV,perm}$)							1.00			1.00		
Movement Saturation Flow Rate (s), veh/h	2006	1813	249	1781	1798	61	1185	1155	606	1108	1359	433
Proportion of Vehicles Arriving on Green (P)	0.12	0.35	0.35	0.12	0.35	0.35	0.23	0.23	0.23	0.23	0.23	0.23
Incremental Delay Factor (k)	0.50	0.50		0.50	0.50		0.50	0.50		0.50	0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)	6.0	6.0	6.0	6.0		6.0		6.0
Green Ratio (g/C)	0.47	0.35	0.47	0.35		0.23		0.23
Permitted Saturation Flow Rate (s_p), veh/h/ln	1014	0	872	0		1185		1108
Shared Saturation Flow Rate (s_{sh}), veh/h/ln								
Permitted Effective Green Time (g_p), s	21.0	0.0	21.0	0.0		14.0		14.0
Permitted Service Time (g_u), s	4.8	0.0	5.4	0.0		8.3		5.6
Permitted Queue Service Time (g_{ps}), s	0.7		1.0			3.4		1.3
Time to First Blockage (g_f), s	0.0	0.0	0.0	0.0		0.0		0.0
Queue Service Time Before Blockage (g_{fs}), s								
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	1.198	0.000	1.198	0.000	1.198	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.102	0.000	0.102	0.000	0.115	0.000	0.115
Pedestrian M_{corner} / M_{cw}	0.00		0.00		0.00		0.00	
Bicycle c_b / d_b	700.00	12.68	700.00	12.68	466.67	17.63	466.67	17.63
Bicycle F_w / F_v	-3.64	0.94	-3.64	0.91	-3.64	0.57	-3.64	0.37

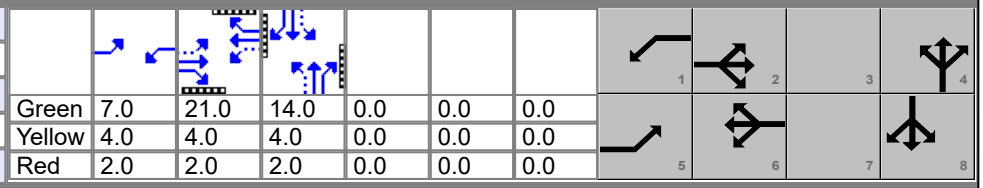
HCS Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes.xus		
Project Description	2050 Capacity Analysis With Left Turn Lanes				



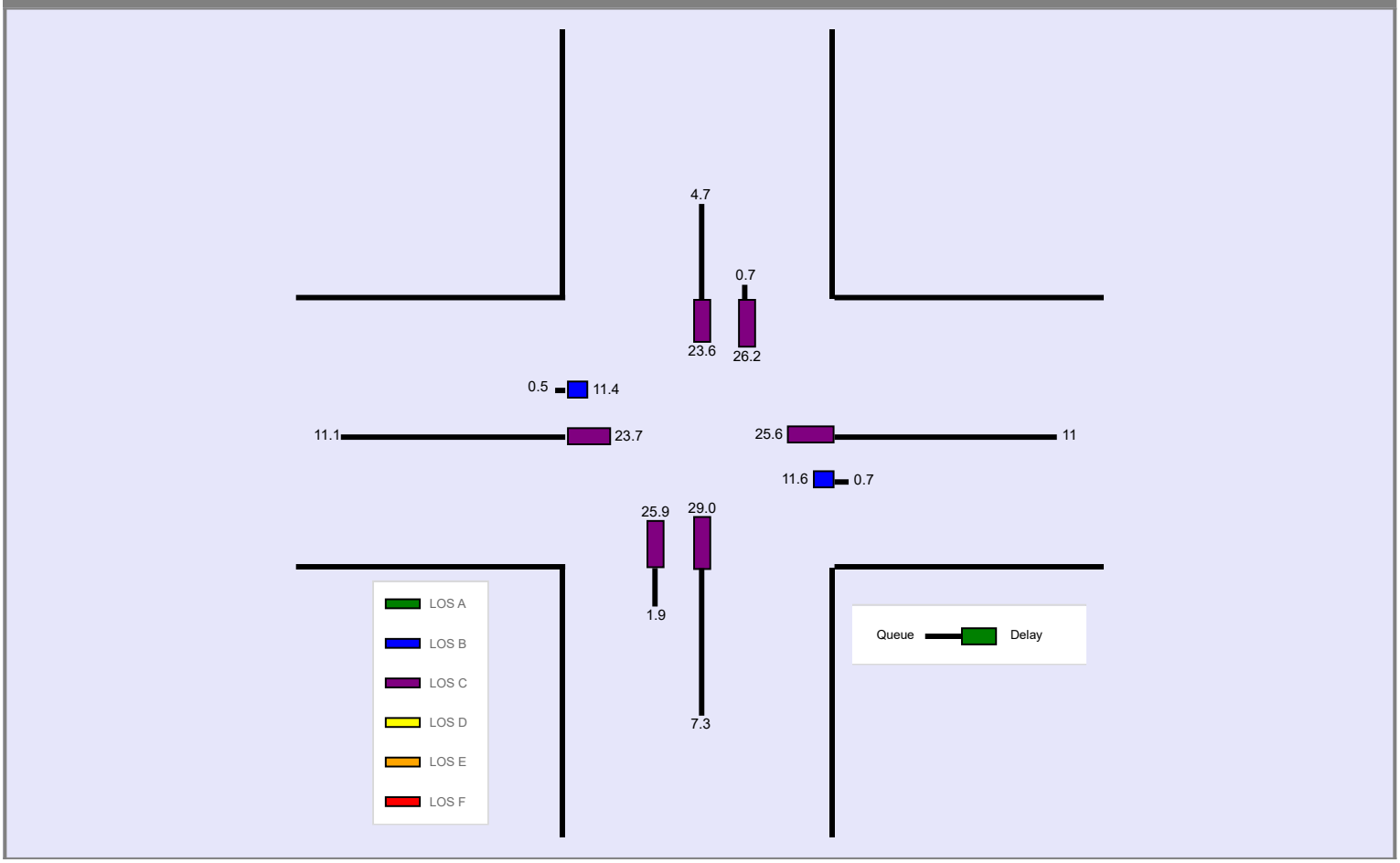
Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	7.0	21.0	14.0	0.0	0.0	0.0
Yellow	4.0	4.0	4.0	0.0	0.0	0.0
Red	2.0	2.0	2.0	0.0	0.0	0.0

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	12.7	282.9		17.5	278.9		47.8	184.2		16.9	118.4	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.5	11.1		0.7	11.0		1.9	7.3		0.7	4.7	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00	
Control Delay (*d*), s/veh	11.4	23.7		11.6	25.6		25.9	29.0		26.2	23.6	
Level of Service (LOS)	B	C		B	C		C	C		C	C	
Approach Delay, s/veh / LOS	22.8	C		24.2	C		28.3	C		23.9	C	
Intersection Delay, s/veh / LOS	24.6						C					



--- Messages ---

No errors or warnings exist.

--- Comments ---

HCS Reports

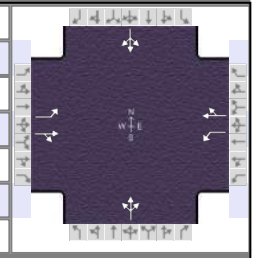
Alternative 1C

Traffic Signal with left turn lanes on Siebenthaler only

Design Year 2050 – AM & PM

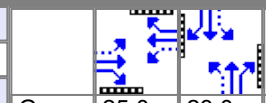
HCS Signalized Intersection Input Data

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				

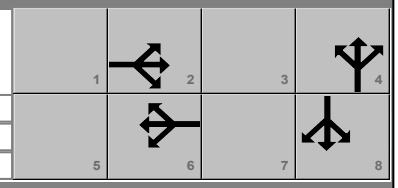


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	25.0	23.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



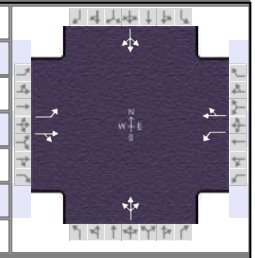
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11
Initial Queue (Q_b), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None			None			None			None	
Heavy Vehicles (P_{HV}), %	2	2		2	2			2			2	
Ped / Bike / RTOR, /h	0	0	0	0	0	0	0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0	0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft	12.0	12.0		12.0	12.0			12.0			12.0	
Turn Bay Length, ft	0	0		0	0			0			0	
Grade (*Pg*), %		-6			0			0			0	
Speed Limit, mi/h	35	35	35	35	35	35	35	35	35	35	35	35

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		31.0		31.0		29.0		29.0
Yellow Change Interval (*Y*), s		4.0		4.0		4.0		4.0
Red Clearance Interval (R_c), s		2.0		2.0		2.0		2.0
Minimum Green (G_{min}), s		20		20		10		10
Start-Up Lost Time (*l*t), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green (e), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Passage (*PT*), s		2.0		2.0		2.0		2.0
Recall Mode		Max		Max		Max		Max
Dual Entry		Yes		Yes		Yes		Yes
Walk (*Walk*), s		10.0		10.0		10.0		10.0
Pedestrian Clearance Time (*PC*), s		7.0		7.0		7.0		7.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0
Walkway / Crosswalk Width / Length, ft	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0
Street Width / Island / Curb, ft	0.0	0	No	0.0	0	No	0.0	0	No	0.0	0	No
Width Outside / Bike Lane / Shoulder, ft	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No	0.50		No	0.50		No	0.50	

HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On

							1	2	3	4
							5	6	7	8
Green	25.0	23.0	0.0	0.0	0.0	0.0				
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	2.0	2.0	0.0	0.0	0.0	0.0				

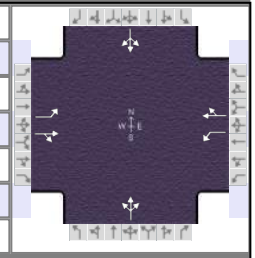
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		4		8
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		31.0		31.0		29.0		29.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						6.8		4.1
Green Extension Time (g_e), s		0.0		0.0		0.5		0.5
Phase Call Probability						1.00		1.00
Max Out Probability						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	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h	17	337		52	275			201			98	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	1104	2081		1043	1860			1699			1684	
Queue Service Time (g_s), s	0.7	6.8		2.2	6.1			0.0			0.0	
Cycle Queue Clearance Time (g_c), s	6.7	6.8		9.0	6.1			4.8			2.1	
Green Ratio (*g/C*)	0.42	0.42		0.42	0.42			0.38			0.38	
Capacity (*c*), veh/h	468	867		437	775			720			719	
Volume-to-Capacity Ratio (*X*)	0.037	0.389		0.119	0.355			0.279			0.136	
Back of Queue (*Q*), ft/ln (95 th percentile)	7.6	135.6		24.4	110			83.1			37.4	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	5.3		1.0	4.3			3.3			1.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00			0.00			0.00	
Uniform Delay (d_1), s/veh	14.3	12.2		15.3	12.0			12.9			12.1	
Incremental Delay (d_2), s/veh	0.1	1.3		0.6	1.3			1.0			0.4	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0			0.0			0.0	
Control Delay (*d*), s/veh	14.4	13.5		15.9	13.3			13.9			12.4	
Level of Service (LOS)	B	B		B	B			B			B	
Approach Delay, s/veh / LOS	13.5	B		13.7	B		13.9	B		12.4	B	
Intersection Delay, s/veh / LOS	13.5						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.67	B	1.67	B	1.90	B	1.90	B
Bicycle LOS Score / LOS	1.07	A	1.03	A	0.82	A	0.65	A

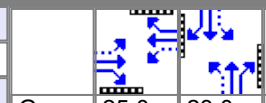
HCS Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	25.0	23.0	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	2.0	2.0	0.0	0.0	0.0	0.0				

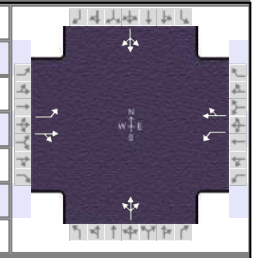
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.984	1.108	1.108	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.581	0.000		0.549	0.000		0.967	0.908		0.918	0.900	
Right-Turn Adjustment Factor (f_{RT})		0.988	0.988		0.994	0.994		0.000	0.908		0.000	0.900
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000			1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Prot. CAV Adj. Factor ($f_{CAV,prot}$)												
Left-Turn Perm. CAV Adj. Factor ($f_{CAV,perm}$)	1.00			1.00			1.00			1.00		
Movement Saturation Flow Rate (s), veh/h	1104	1940	141	1043	1801	59	248	817	634	393	1085	206
Proportion of Vehicles Arriving on Green (P)	0.42	0.42	0.42	0.42	0.42	0.42	0.38	0.38	0.38	0.38	0.38	0.38
Incremental Delay Factor (k)	0.50	0.50		0.50	0.50			0.50			0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		6.0		6.0		6.0		6.0
Green Ratio (g/C)		0.42		0.42		0.38		0.38
Permitted Saturation Flow Rate (s_p), veh/h/ln		1104		1043		1346		1232
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						1764		1661
Permitted Effective Green Time (g_p), s		25.0		25.0		23.0		23.0
Permitted Service Time (g_u), s		18.9		18.2		20.9		18.2
Permitted Queue Service Time (g_{ps}), s		0.7		2.2		0.0		0.0
Time to First Blockage (g_f), s		0.0		0.0		9.8		6.3
Queue Service Time Before Blockage (g_{fs}), s						2.4		1.7
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	0.972	0.000	0.972	0.000	1.198	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.093	0.000	0.093	0.000	0.098	0.000	0.098
Pedestrian M_{corner} / M_{cw}	0.00		0.00		0.00		0.00	
Bicycle c_b / d_b	833.33	10.21	833.33	10.21	766.67	11.41	766.67	11.41
Bicycle F_w / F_v	-3.64	0.58	-3.64	0.54	-3.64	0.33	-3.64	0.16

HCS Signalized Intersection Results Graphical Summary

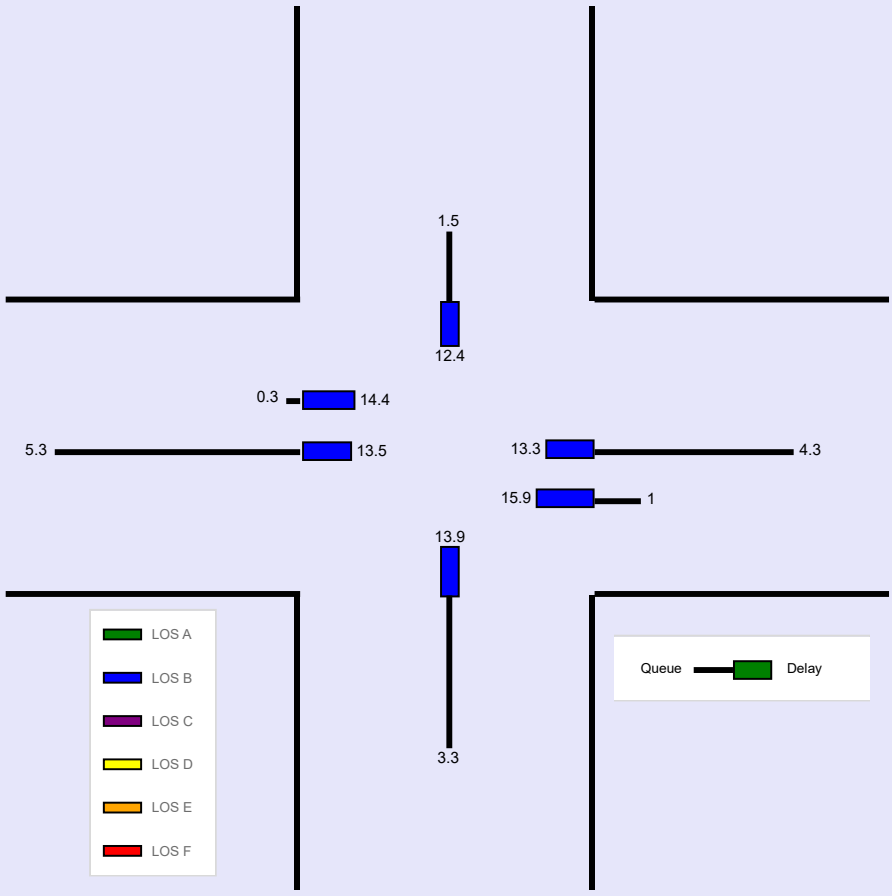
General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	AM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 AM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	16	289	21	48	245	8	27	89	69	21	58	11

Signal Information					EB		WB				NB				SB			
Cycle, s	60.0	Reference Phase	2															
Offset, s	0	Reference Point	End								1	2	3	4				
Uncoordinated	No	Simult. Gap E/W	On	Green	25.0	23.0	0.0	0.0	0.0	0.0								
Force Mode	Fixed	Simult. Gap N/S	On	Yellow	4.0	4.0	0.0	0.0	0.0	0.0								
				Red	2.0	2.0	0.0	0.0	0.0	0.0	5	6	7	8				

Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	7.6	135.6		24.4	110			83.1			37.4	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.3	5.3		1.0	4.3			3.3			1.5	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00			0.00			0.00	
Control Delay (*d*), s/veh	14.4	13.5		15.9	13.3			13.9			12.4	
Level of Service (LOS)	B	B		B	B			B			B	
Approach Delay, s/veh / LOS	13.5	B		13.7	B		13.9	B		12.4	B	
Intersection Delay, s/veh / LOS	13.5						B					



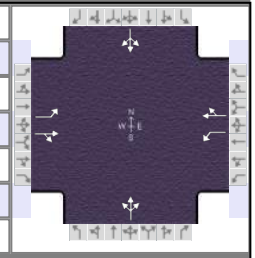
--- Messages ---

No errors or warnings exist.

--- Comments ---

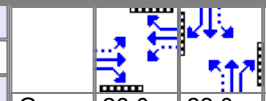
HCS Signalized Intersection Input Data

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				

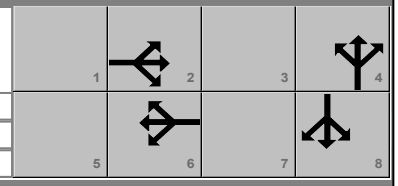


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	26.0	22.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



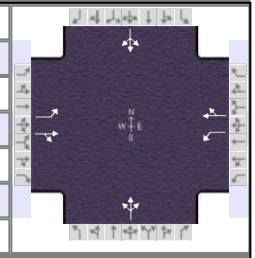
Traffic Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44
Initial Queue (Q_b), veh/h	0	0	0	0	0	0	0	0	0	0	0	0
Base Saturation Flow Rate (s_o), veh/h	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Parking (N_m), man/h		None			None			None		0	L	
Heavy Vehicles (P_{HV}), %	2	2		2	2			2			2	
Ped / Bike / RTOR, /h	0	0	0	0	0	0	0	0	0	0	0	0
Buses (N_b), buses/h	0	0	0	0	0	0	0	0	0	0	0	0
Arrival Type (*AT*)	3	3	3	3	3	3	3	3	3	3	3	3
Upstream Filtering (*I*)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Width (*W*), ft	12.0	12.0		12.0	12.0			12.0			12.0	
Turn Bay Length, ft	0	0		0	0			0			0	
Grade (*Pg*), %		-6			0			0			0	
Speed Limit, mi/h	35	35	35	35	35	35	35	35	35	35	35	35

Phase Information	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Maximum Green (G_{max}) or Phase Split, s		32.0		32.0		28.0		28.0
Yellow Change Interval (*Y*), s		4.0		4.0		4.0		4.0
Red Clearance Interval (R_c), s		2.0		2.0		2.0		2.0
Minimum Green (G_{min}), s		20		20		10		10
Start-Up Lost Time (*l*t), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Extension of Effective Green (e), s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Passage (*PT*), s		2.0		2.0		2.0		2.0
Recall Mode		Max		Max		Max		Max
Dual Entry		Yes		Yes		Yes		Yes
Walk (*Walk*), s		10.0		10.0		10.0		10.0
Pedestrian Clearance Time (*PC*), s		7.0		7.0		7.0		7.0

Multimodal Information	EB			WB			NB			SB		
85th % Speed / Rest in Walk / Corner Radius	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0	0.0	No	25.0
Walkway / Crosswalk Width / Length, ft	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0	9.0	12.0	0.0
Street Width / Island / Curb, ft	0.0	0	No	0.0	0	No	0.0	0	No	0.0	0	No
Width Outside / Bike Lane / Shoulder, ft	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0	12.0	5.0	2.0
Pedestrian Signal / Occupied Parking	No	0.50		No	0.50		No	0.50		No	0.50	

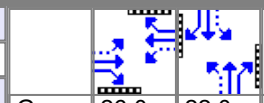
HCS Signalized Intersection Results Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				



Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



							1	2	3	4
Green	26.0	22.0	0.0	0.0	0.0	0.0	5	6	7	8
Yellow	4.0	4.0	0.0	0.0	0.0	0.0				
Red	2.0	2.0	0.0	0.0	0.0	0.0				

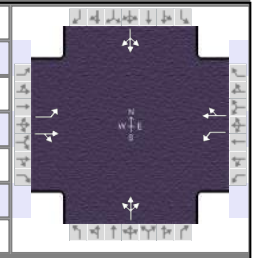
Timer Results	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Assigned Phase		2		6		4		8
Case Number		6.0		6.0		8.0		8.0
Phase Duration, s		32.0		32.0		28.0		28.0
Change Period, ($Y+R_c$), s		6.0		6.0		6.0		6.0
Max Allow Headway (*MAH*), s		0.0		0.0		3.2		3.2
Queue Clearance Time (g_s), s						11.5		7.4
Green Extension Time (g_e), s		0.0		0.0		1.0		1.1
Phase Call Probability						1.00		1.00
Max Out Probability						0.02		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	7	4	14	3	8	18
Adjusted Flow Rate (*v*), veh/h	39	532		52	497			345			223	
Adjusted Saturation Flow Rate (*s*), veh/h/ln	901	2061		872	1859			1651			1741	
Queue Service Time (g_s), s	2.1	11.8		2.9	12.4			3.2			0.0	
Cycle Queue Clearance Time (g_c), s	14.5	11.8		14.7	12.4			9.5			5.4	
Green Ratio (*g/C*)	0.43	0.43		0.43	0.43			0.37			0.37	
Capacity (*c*), veh/h	324	893		326	806			678			705	
Volume-to-Capacity Ratio (*X*)	0.121	0.595		0.160	0.616			0.508			0.316	
Back of Queue (*Q*), ft/ln (95 th percentile)	21.4	229		28.8	222.9			168.6			96.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	9.0		1.1	8.8			6.6			3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00			0.00			0.00	
Uniform Delay (d_1), s/veh	18.8	13.0		18.6	13.1			15.0			13.7	
Incremental Delay (d_2), s/veh	0.8	2.9		1.0	3.5			2.7			1.2	
Initial Queue Delay (d_3), s/veh	0.0	0.0		0.0	0.0			0.0			0.0	
Control Delay (*d*), s/veh	19.5	15.9		19.7	16.7			17.7			14.9	
Level of Service (LOS)	B	B		B	B			B			B	
Approach Delay, s/veh / LOS	16.1	B		16.9	B		17.7	B		14.9	B	
Intersection Delay, s/veh / LOS	16.6						B					

Multimodal Results	EB		WB		NB		SB	
Pedestrian LOS Score / LOS	1.66	B	1.66	B	1.90	B	1.90	B
Bicycle LOS Score / LOS	1.43	A	1.39	A	1.06	A	0.86	A

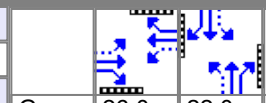
HCS Signalized Intersection Intermediate Values

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				

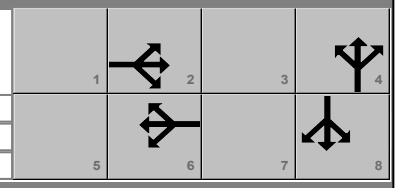


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	26.0	22.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



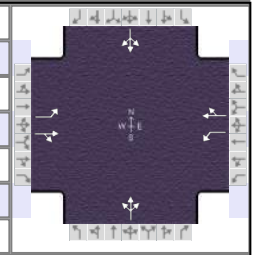
Saturation Flow / Delay	L	T	R	L	T	R	L	T	R	L	T	R
Lane Width Adjustment Factor (f_w)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Heavy Vehicles and Grade Factor (f_{HVg})	0.984	1.108	1.108	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984	0.984
Parking Activity Adjustment Factor (f_p)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Bus Blockage Adjustment Factor (f_{bb})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Area Type Adjustment Factor (f_a)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Lane Utilization Adjustment Factor (f_{LU})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adjustment Factor (f_{LT})	0.474	0.000		0.459	0.000		0.922	0.883		0.965	0.931	
Right-Turn Adjustment Factor (f_{RT})		0.979	0.979		0.994	0.994		0.000	0.883		0.000	0.931
Left-Turn Pedestrian Adjustment Factor (f_{Lpb})	1.000			1.000			1.000			1.000		
Right-Turn Ped-Bike Adjustment Factor (f_{Rpb})			1.000			1.000			1.000			1.000
Work Zone Adjustment Factor (f_{wz})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DDI Factor (f_{DDI})	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Prot. CAV Adj. Factor ($f_{CAV,prot}$)												
Left-Turn Perm. CAV Adj. Factor ($f_{CAV,perm}$)	1.00			1.00			1.00			1.00		
Movement Saturation Flow Rate (s), veh/h	901	1813	249	872	1798	61	349	854	448	195	1172	374
Proportion of Vehicles Arriving on Green (P)	0.43	0.43	0.43	0.43	0.43	0.43	0.37	0.37	0.37	0.37	0.37	0.37
Incremental Delay Factor (k)	0.50	0.50		0.50	0.50			0.50			0.50	

Signal Timing / Movement Groups	EBL	EBT/R	WBL	WBT/R	NBL	NBT/R	SBL	SBT/R
Lost Time (t_L)		6.0		6.0		6.0		6.0
Green Ratio (g/C)		0.43		0.43		0.37		0.37
Permitted Saturation Flow Rate (s_p), veh/h/ln		901		872		1204		1125
Shared Saturation Flow Rate (s_{sh}), veh/h/ln						1667		1736
Permitted Effective Green Time (g_p), s		26.0		26.0		22.0		22.0
Permitted Service Time (g_u), s		13.6		14.2		16.6		12.5
Permitted Queue Service Time (g_{ps}), s		2.1		2.9		3.2		0.0
Time to First Blockage (g_f), s		0.0		0.0		6.3		11.4
Queue Service Time Before Blockage (g_{fs}), s						5.4		3.7
Protected Right Saturation Flow (s_R), veh/h/ln								
Protected Right Effective Green Time (g_R), s								

Multimodal	EB		WB		NB		SB	
Pedestrian F_w / F_v	0.972	0.000	0.972	0.000	1.198	0.000	1.198	0.000
Pedestrian F_s / F_{delay}	0.000	0.091	0.000	0.091	0.000	0.100	0.000	0.100
Pedestrian M_{corner} / M_{cw}	0.00		0.00		0.00		0.00	
Bicycle c_b / d_b	866.67	9.63	866.67	9.63	733.33	12.03	733.33	12.03
Bicycle F_w / F_v	-3.64	0.94	-3.64	0.91	-3.64	0.57	-3.64	0.37

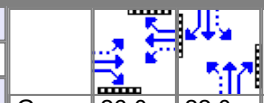
HCS Signalized Intersection Results Graphical Summary

General Information				Intersection Information	
Agency	CMT			Duration, h	0.250
Analyst	RTM	Analysis Date	Feb 28, 2023	Area Type	Other
Jurisdiction	Montgomery County	Time Period	PM	PHF	0.92
Urban Street	D7 Catalpa	Analysis Year	2050	Analysis Period	1> 7:00
Intersection	Catalpa & Siebenthaler	File Name	2050 PM_Signal_With Left Turn Lanes_No LT Ph…		
Project Description	2050 w/ Left Turn Lanes w/o LT Phases				

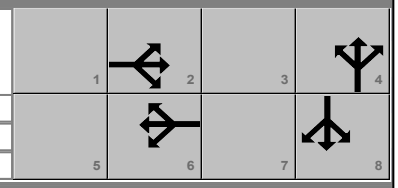


Demand Information	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Demand (*v*), veh/h	36	430	59	48	442	15	67	164	86	23	138	44

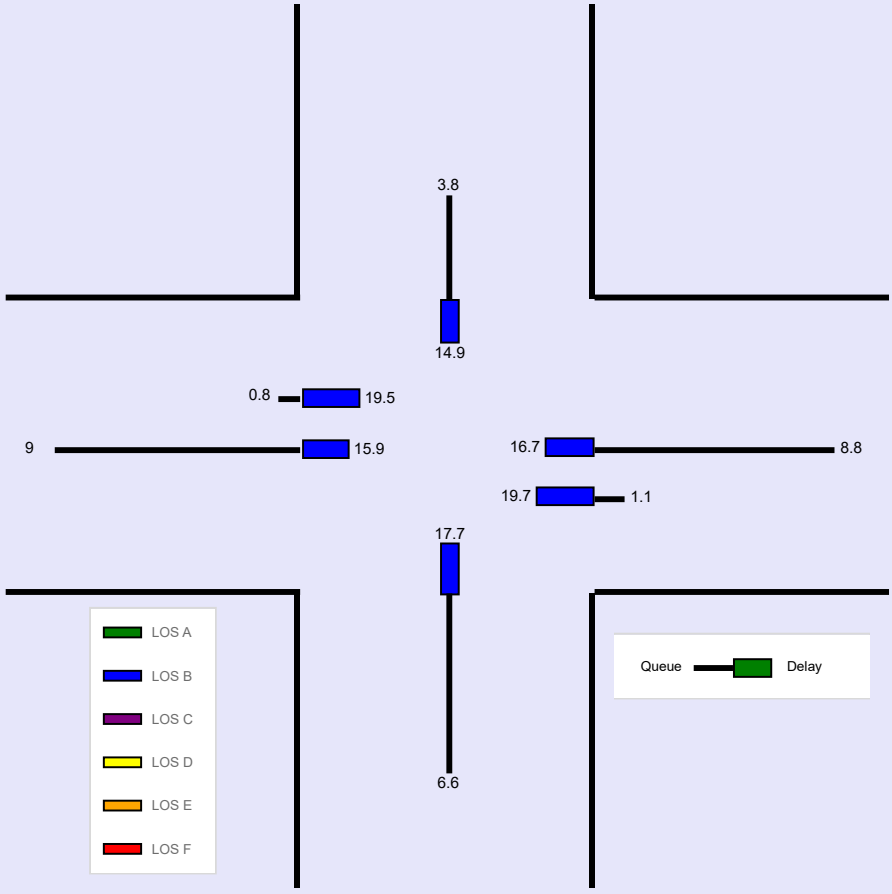
Signal Information			
Cycle, s	60.0	Reference Phase	2
Offset, s	0	Reference Point	End
Uncoordinated	No	Simult. Gap E/W	On
Force Mode	Fixed	Simult. Gap N/S	On



Green	26.0	22.0	0.0	0.0	0.0	0.0						
Yellow	4.0	4.0	0.0	0.0	0.0	0.0						
Red	2.0	2.0	0.0	0.0	0.0	0.0						



Movement Group Results	EB			WB			NB			SB		
Approach Movement	L	T	R	L	T	R	L	T	R	L	T	R
Back of Queue (*Q*), ft/ln (95 th percentile)	21.4	229		28.8	222.9			168.6			96.8	
Back of Queue (*Q*), veh/ln (95 th percentile)	0.8	9.0		1.1	8.8			6.6			3.8	
Queue Storage Ratio (*RQ*) (95 th percentile)	0.00	0.00		0.00	0.00			0.00			0.00	
Control Delay (*d*), s/veh	19.5	15.9		19.7	16.7			17.7			14.9	
Level of Service (LOS)	B	B		B	B			B			B	
Approach Delay, s/veh / LOS	16.1	B		16.9	B		17.7	B		14.9	B	
Intersection Delay, s/veh / LOS	16.6						B					



--- Messages ---

No errors or warnings exist.

--- Comments ---

HCS Reports

Alternative 2

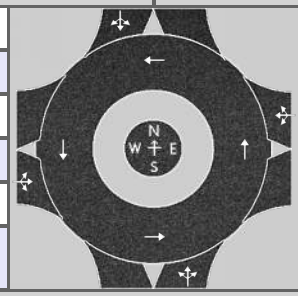
Roundabout intersection with single entry and departure lanes

Design Year 2050 – AM & PM

HCS Roundabouts Report

General Information

Analyst	RTM
Agency or Co.	CMT
Date Performed	2/28/2023
Analysis Year	2050
Time Analyzed	AM
Project Description	D7 Catalpa



Site Information

Intersection	Siebenthaler & Catalpa
E/W Street Name	Siebenthaler Ave
N/S Street Name	Catalpa Dr
Analysis Time Period, hrs	0.25
Peak Hour Factor	0.92
Jurisdiction	Montgomery County

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	16	289	21	0	48	245	8	0	27	89	69	0	21	58	11
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flow Rate (v_{PCE}), pc/h	0	18	320	23	0	53	272	9	0	30	99	76	0	23	64	12
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			
Proportion of CAVs	0															

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway, s		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		361			334			205			99	
Entry Volume, veh/h		354			327			201			97	
Circulating Flow (v_c), pc/h	140			147			361			355		
Exiting Flow (v_{ex}), pc/h	419			314			126			140		
Capacity (c_{pce}), pc/h		1196			1188			955			961	
Capacity (c), veh/h		1173			1165			936			942	
v/c Ratio (x)		0.30			0.28			0.21			0.10	

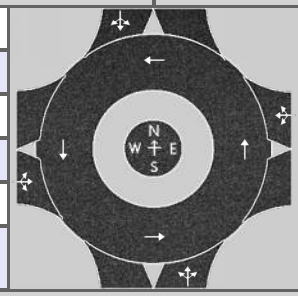
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		5.9			5.7			6.0			4.8	
Lane LOS		A			A			A			A	
95% Queue, veh		1.3			1.2			0.8			0.3	
Approach Delay, s/veh | LOS	5.9	A		5.7	A		6.0	A		4.8	A	
Intersection Delay, s/veh | LOS	5.7						A					

HCS Roundabouts Report

General Information

Analyst	RTM
Agency or Co.	CMT
Date Performed	2/28/2023
Analysis Year	2050
Time Analyzed	PM
Project Description	D7 Catalpa



Site Information

Intersection	Siebenthaler & Catalpa
E/W Street Name	Siebenthaler Ave
N/S Street Name	Catalpa Dr
Analysis Time Period, hrs	0.25
Peak Hour Factor	0.92
Jurisdiction	Montgomery County

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	36	430	59	0	48	442	15	0	67	164	86	0	23	138	44
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flow Rate (v_{PCE}), pc/h	0	40	477	65	0	53	490	17	0	74	182	95	0	26	153	49
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			
Proportion of CAVs	0															

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway, s		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		582			560			351			228	
Entry Volume, veh/h		571			549			344			224	
Circulating Flow (v_c), pc/h	232			296			543			617		
Exiting Flow (v_{ex}), pc/h	598			613			239			271		
Capacity (c_{pce}), pc/h		1089			1020			793			735	
Capacity (c), veh/h		1068			1000			778			721	
v/c Ratio (x)		0.53			0.55			0.44			0.31	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		9.8			10.6			10.5			8.8	
Lane LOS		A			B			B			A	
95% Queue, veh		3.3			3.4			2.3			1.3	
Approach Delay, s/veh | LOS	9.8	A		10.6	B		10.5	B		8.8	A	
Intersection Delay, s/veh | LOS	10.1						B					

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX E: TURN LANE SIZING CALCULATIONS

Siebenthaler Avenue/Catalpa Drive Safety Study

Turn Lane Length Calculations

Movement: NB Left Turn 2050 AM Design Hour		
Movement	NBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	153	vph
Number of Through Lanes	1	
Turning Volume	26	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	15%	
Vehicles Per Cycle	0.4	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	125	feet
No Block Turn Lane Length	125	feet

Movement: NB Left Turn 2050 PM Design Hour		
Movement	NBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	244	vph
Number of Through Lanes	1	
Turning Volume	65	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	21%	
Vehicles Per Cycle	1.1	
Storage Length	**55**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**105**	**feet**
No Block Distance	175	feet
No Block Turn Lane Length	175	feet

Movement: SB Left Turn 2050 AM Design Hour		
Movement	SBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	66	vph
Number of Through Lanes	1	
Turning Volume	21	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	24%	
Vehicles Per Cycle	0.4	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	55	feet
No Block Turn Lane Length	100	feet

Movement: SB Left Turn 2050 PM Design Hour		
Movement	SBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	178	vph
Number of Through Lanes	1	
Turning Volume	23	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	11%	
Vehicles Per Cycle	0.4	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	145	feet
No Block Turn Lane Length	145	feet

Movement: EB Left Turn 2050 AM Design Hour		
Movement	EBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	302	vph
Number of Through Lanes	1	
Turning Volume	16	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	5%	
Vehicles Per Cycle	0.3	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	200	feet
No Block Turn Lane Length	200	feet

Movement: EB Left Turn 2050 PM Design Hour		
Movement	EBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	475	vph
Number of Through Lanes	1	
Turning Volume	35	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	7%	
Vehicles Per Cycle	0.6	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	320	feet
No Block Turn Lane Length	320	feet

Movement: WB Left Turn 2050 AM Design Hour		
Movement	WBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	246	vph
Number of Through Lanes	1	
Turning Volume	46	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	16%	
Vehicles Per Cycle	0.8	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	178	feet
No Block Turn Lane Length	178	feet

Movement: WB Left Turn 2050 PM Design Hour		
Movement	WBLT	
Design Speed	35	mph
Cycle Length	60	seconds
Control (Stop or Signal)	Signal	
Through Volume	444	vph
Number of Through Lanes	1	
Turning Volume	46	vph
Number of Turning Lanes	1	
Design Condition	A	A, B, or C
Turning Percentage	9%	
Vehicles Per Cycle	0.8	
Storage Length	**50**	**feet**
Deceleration/Taper	50	feet
Calculated Turn Lane Length	**100**	**feet**
No Block Distance	295	feet
No Block Turn Lane Length	295	feet

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX F: CONCEPT PLANS

CTY-RTE-SECTION

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HORIZONTAL SCALE IN FEET

0 20 40 80

CATALPA DR & W. SIEBENTHALER AVE TRAFFIC SIGNAL CONCEPT PLAN

DESIGN AGENCY

CMT
CRAWFORD, MURPHY & TILLY, INC.
7777 WASHINGTON VILLAGE DR
SUITE 270
DAYTON, OHIO 45459
PH (937)701-2193
www.cmtengr.com

DESIGNER
RTM

REVIEWER
ELS 03/07/23

PROJECT ID
N/A

SHEET P.0 | TOTAL 0

CTY-RTE-SECTION

MODEL: 999999_CP101 [Sheet] PAPERSIZE: 34x22 (in.) DATE: 3/16/2023 TIME: 1:34:02 PM USER: rmulvaney
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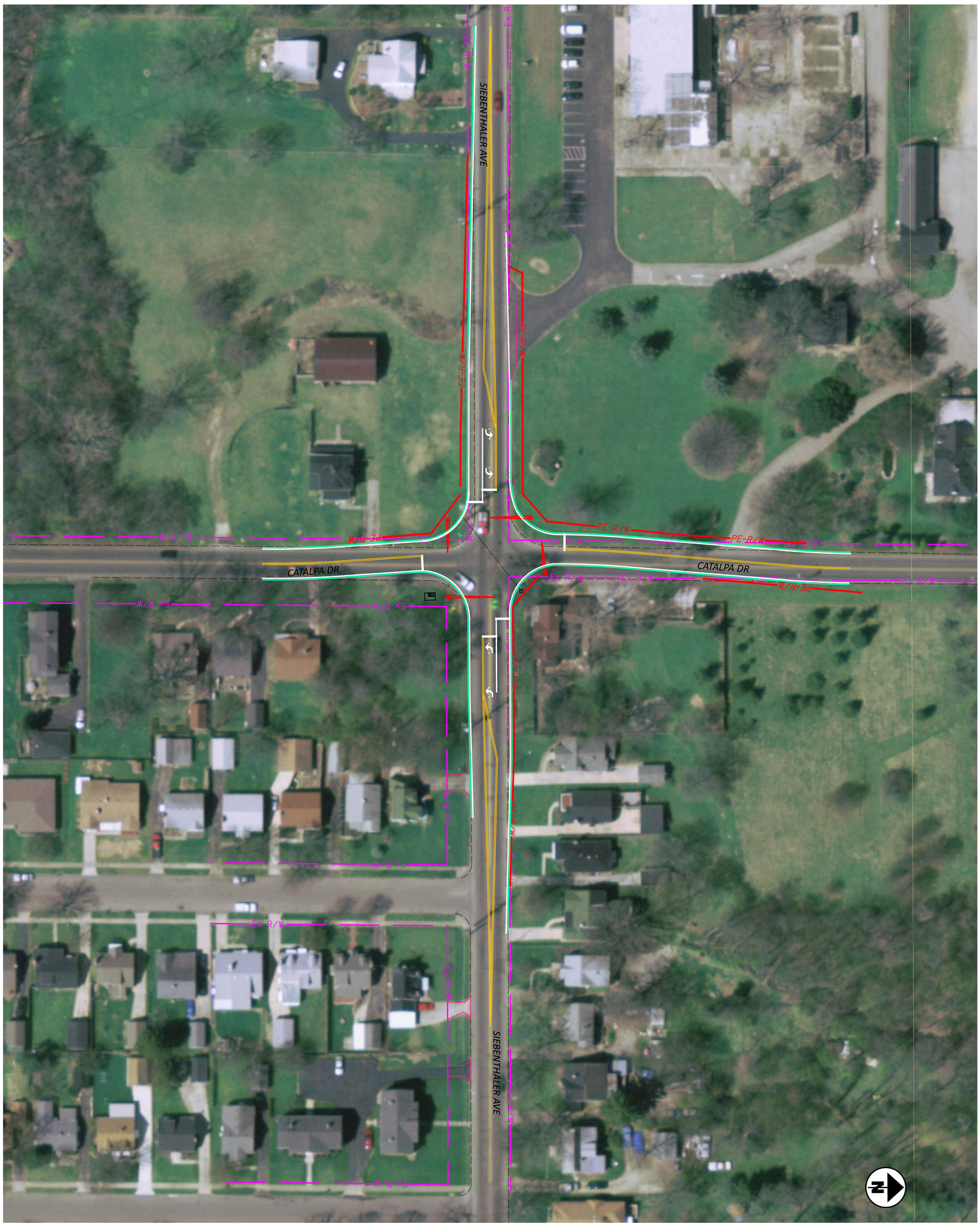

SHEET	TOTAL	PROJECT ID	REVIEWER	DESIGNER	DESIGN AGENCY
1	1	N/A	BLS 03/07/23	RTM	CMT CRAWFORD, MURPHY & TILLY, INC. 7777 WASHINGTON VILLAGE DR SUITE 270 DAYTON, OHIO 45459 PH (937)701-2193 www.cmtengr.com

CATALPA DR & W. SIEBENTHALER AVE
TRAFFIC SIGNAL CONCEPT PLAN

HORIZONTAL SCALE IN FEET
0 40
20 80

CATALPA / SIEBENTHALER SAFETY STUDY

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SHEET	TOTAL	PROJECT ID	REVIEWER	DESIGNER
1	1	N/A	BLS 5/16/23	AJK

CMT
CRAWFORD, MURPHY & TILLY, INC.
7777 WASHINGTON VILLAGE DR
SUITE 270
DAYTON, OHIO 45459
PH (937)701-2193
www.cmtengr.com

DESIGN AGENCY

ROUNDABOUT CONCEPT PLAN
SIEBENTHALER AVE AND CATALPA DR

HORIZONTAL SCALE IN FEET

0 40
20 80

MCEO

MODEL: CLX_SiebenthalerAve - Plan 1 (Sheet) PAPERSIZE: 34x22 (in.) DATE: 9/15/2023 TIME: 11:21:58 AM USER: kellie
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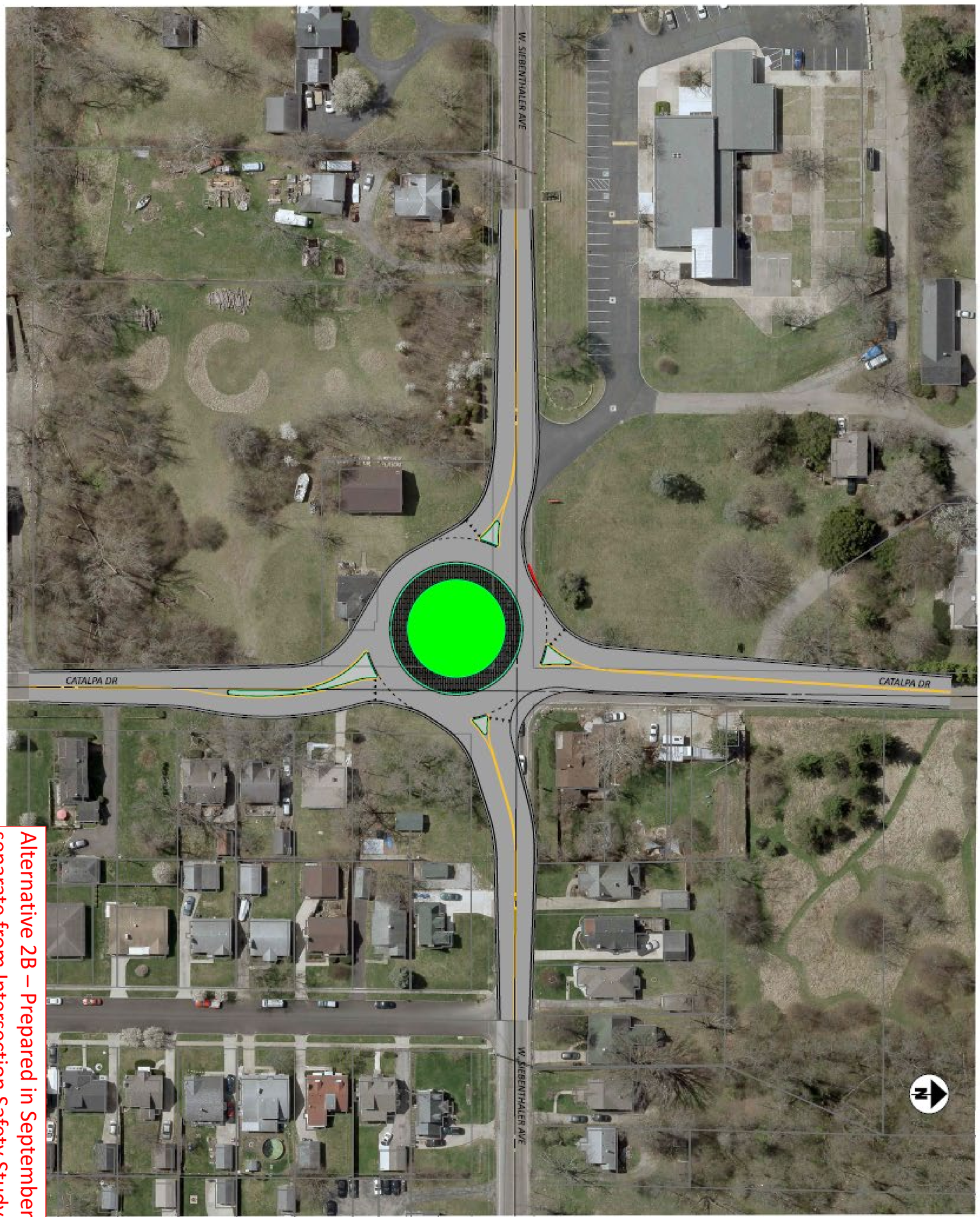

Alternative 2B – Prepared in September 2023 separate from Intersection Safety Study

SHEET 1	DESIGNED KLL	TEC PLAN PREPARED BY: TEC Engineering, Inc. 7288 Central Parke Blvd. Mason, OH 45040	DESIGN AGENCY	W. SIEBENTHALER AVE AND CATLPA DR PRELIMINARY ROUNDABOUT DESIGN	HORIZONTAL SCALE IN FEET 0 40 20 80
DATA 1	REVIEWED SMS 09/15/23	PROJECT NO. 23105-001			

CTY-RTE-SECTION

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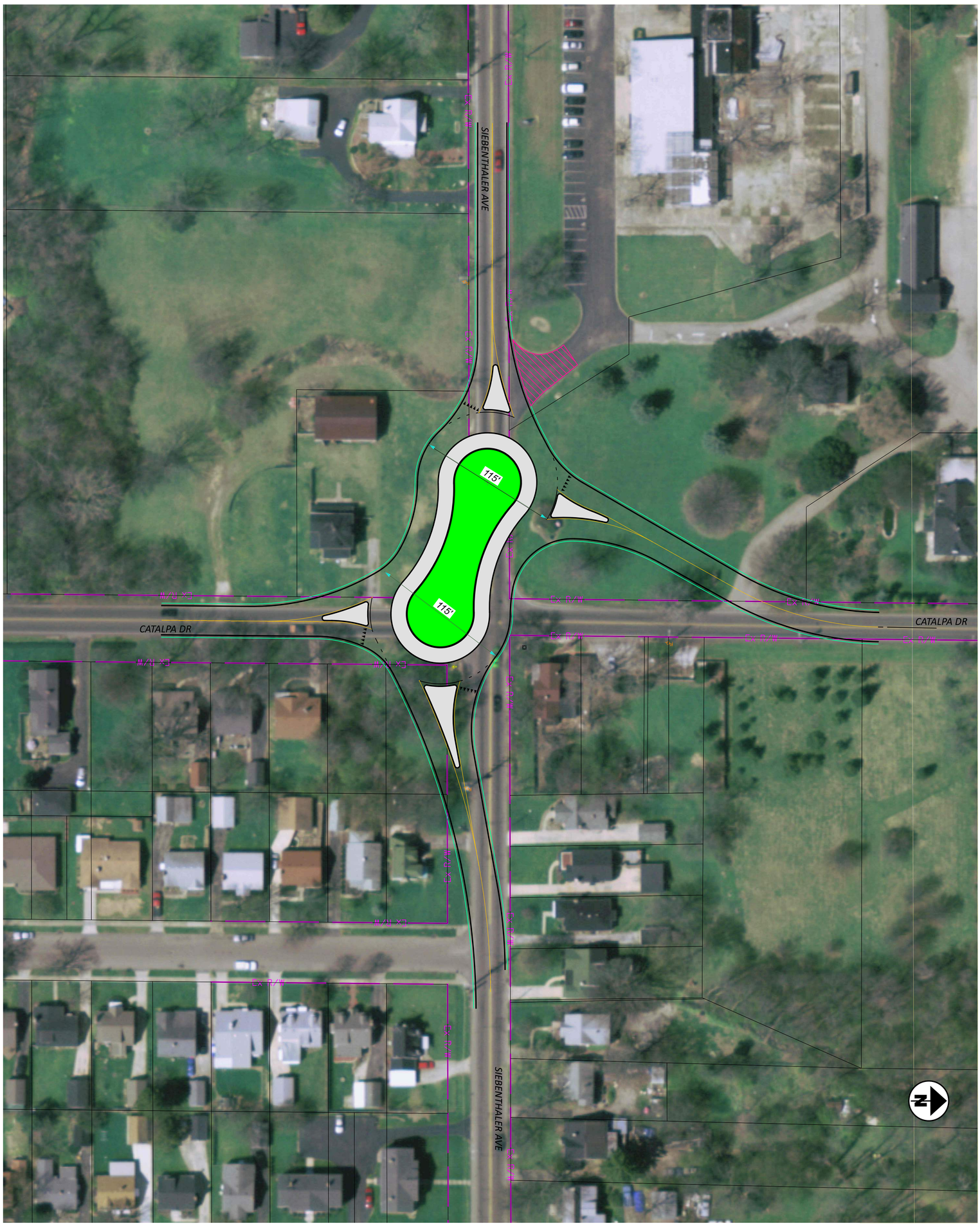


SHEET 1 | TOTAL 1

PROJECT ID N/A

REVIEWER SAK 05-16-23

DESIGNER AS

DESIGN AGENCY
CMT
CRAWFORD, MURPHY & TILLY, INC.
7777 WASHINGTON VILLAGE DR
SUITE 270
DAYTON, OHIO 45459
PH (937)701-2193
www.cmtengr.com

PEANUT ROUNDABOUT CONCEPT PLAN
SIEBENTHALER AVE AND CATALPA DR

HORIZONTAL SCALE IN FEET
0 40
20 80

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX G: COST ESTIMATES

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Catalpa & Siebenthaler Alternative 1C: Traffic Signal with Widening for Turn Lanes on Siebenthalter

Project number: N/A **Date:** 5/15/2023

Client name: ODOT D8/Montgomery County

(Based upon 2022 Construction Costs)

Ref. No.	Item No.	Description	Total Estimated Quantity	Unit	Estimated Unit Cost	Total Estimated Cost
		ROADWAY				
1	201	CLEARING AND GRUBBING	1	LS	$ 20,000.00	$ 20,000.00
2	202	PAVEMENT REMOVED	3890	SQ YD	$ 10.00	$ 38,900.00
3	202	CURB REMOVED	450	FT	$ 7.00	$ 3,150.00
4	202	INLET REMOVED	6	EACH	$ 600.00	$ 3,600.00
5	202	PIPE REMOVED	500	FT	$ 30.00	$ 15,000.00
6	203	EXCAVATION	1450	CU YD	$ 25.00	$ 36,250.00
7	204	EMBANKMENT	750	CU YD	$ 18.00	$ 13,500.00
8	204	SUBGRADE COMPACTION	2175	SQ YD	$ 3.00	$ 6,525.00
9	204	PROOF ROLLING	2	HOUR	$ 250.00	$ 500.00
10	206	CEMENT STABILIZED SUBGRADE, 16 INCHES DEEP	1,100	SQ YD	$ 4.00	$ 4,400.00
11	206	LIME	50	TON	$ 184.00	$ 9,200.00
12	206	CURING COAT	1,100	SQ YD	$ 1.20	$ 1,320.00
13	206	TEST ROLLING	0	HOUR	$ 250.00	$ -
14	206	MIXTURE DESIGN FOR CHEMICALLY STABILIZED SOILS	1	LS	$ 25,000.00	$ 25,000.00
15	608	4" CONCRETE WALK	4340	SQ FT	$ 8.00	$ 34,720.00
16	608	CURB RAMPS	645	SQ FT	$ 24.00	$ 15,480.00
		EROSION CONTROL				
17	659	TOPSOIL, SEEDING AND MULCHING	3000	SQ YD	$ 8.00	$ 24,000.00
18	832	CONSTRUCTION EROSION CONTROL	65000	EACH	$ 1.00	$ 65,000.00
19	832	SWPPP	1	LS	$ 5,000.00	$ 5,000.00
20	832	SWPPP INSPECTIONS	1	LS	$ 5,000.00	$ 5,000.00
21	832	SWPPP SOFTWARE	1	LS	$ 5,000.00	$ 5,000.00
		PAVEMENT				
22	254	PAVEMENT PLANING, ASPHALT CONCRETE (VARIABLE DEPTH)	3155	SQ YD	$ 10.00	$ 31,550.00
23	302	ASPHALT CONCRETE BASE, PG64-22	345	CU YD	$ 180.00	$ 62,100.00
24	304	AGGREGATE BASE	355	CU YD	$ 75.00	$ 26,625.00
25	407	NON-TRACKING TACK COAT	465	GAL	$ 4.00	$ 1,860.00
26	441	ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)	245	CU YD	$ 225.00	$ 55,125.00
27	441	ASPHALT CONCRETE SURFACE COURSE, TYPE 1, PG64-22, (448)	180	CU YD	$ 230.00	$ 41,400.00
28	452	6" NON REINFORCED CONCRETE PAVEMENT	160	SQ YD	$ 140.00	$ 22,400.00
29	609	CURB, TYPE 6	1880	FT	$ 25.00	$ 47,000.00
		DRAINAGE				
30	605	4" BASE PIPE UNDERDRAINS	1880	FT	$ 12.00	$ 22,560.00
31	611	DRAINAGE (STORM SEWER AND STRUCTURES)	1	LS	$ 50,000.00	$ 50,000.00
32	611	STORM WATER BMP	1	LS	$ 25,000.00	$ 25,000.00
		TRAFFIC CONTROL, SIGNALS & LIGHTING				

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Catalpa & Siebenthaler Alternative 1C: Traffic Signal with Widening for Turn Lanes on Siebenthalter

Project number: N/A **Date:** 5/15/2023

Client name: ODOT D8/Montgomery County

(Based upon 2022 Construction Costs)

Ref. No.	Item No.	Description	Total Estimated Quantity	Unit	Estimated Unit Cost	Total Estimated Cost
33	625	LIGHTING	1	LS	$4,000.00	$ 4,000.00
34	632	TRAFFIC SIGNAL	1	LS	$250,000.00	$ 250,000.00
35	644	PAVEMENT MARKINGS	1	LS	$10,000.00	$ 10,000.00
		MISCELLANEOUS				
36	614	MAINTAINING TRAFFIC	1	LS	$ 59,000.00	$ 59,000.00
37	619	FIELD OFFICE	8	MONTH	$ 2,500.00	$ 20,000.00
38	623	CONSTRUCTION LAYOUT STAKES AND SURVEYING	1	LS	$ 11,000.00	$ 11,000.00
39	624	MOBILIZATION	1	LS	$ 40,000.00	$ 40,000.00
40	690	UTILITIES	1	LS	$ 600,000.00	$ 600,000.00
					SUBTOTAL ESTIMATED CONSTRUCTION COST	$ 1,711,165.00
					SUBTOTAL ESTIMATED RIGHT OF WAY COST	$ 80,000.00
						$ 1,791,165.00
					CONSTRUCTION CONTINGENCY 30%	$ 537,350.00
					ENGINEERING DESIGN, CONSTRUCTION INSPECTION & CONSTRUCTION ADMINISTRATION 30%	$ 537,350.00
						$ 2,865,865.00
					INFLATION CONTINGENCY (CONSTRUCTION MIDPOINT ESTIMATED 7/1/2027) 15.7%	$ 281,213.00
					TOTAL ESTIMATED PROJECT COST	$ 3,147,078.00

ASSUMPTIONS:

1. Detour is assumed MOT scheme
2. Cost for utilities assumes avoiding need to relocate gas regulator station on SE quadrant of intersection
3. Cost for utilities assumes relocation of one fire hydrant on SW corner of intersection
4. Cost for utilities assumes relocation of tranmission utility pole laterally 30' to west on SW corner of intersection

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Siebenthaler & Catalpa Alternative 2: Single Lane Roundabout

Project number: N/A **Date:** 5/15/2023

Client name: ODOT D8/Montgomery County

(Based upon 2022 Construction Costs)

Ref. No.	Item No.	Description	Total Estimated Quantity	Unit	Estimated Unit Cost	Total Estimated Cost
		ROADWAY				
1	201	CLEARING AND GRUBBING	1	LS	$ 20,000.00	$ 20,000.00
2	202	PAVEMENT REMOVED	7105	SQ YD	$ 10.00	$ 71,050.00
3	202	CURB REMOVED	450	FT	$ 7.00	$ 3,150.00
4	202	INLET REMOVED	6	EACH	$ 600.00	$ 3,600.00
5	202	PIPE REMOVED	500	FT	$ 30.00	$ 15,000.00
6	203	EXCAVATION	1550	CU YD	$ 25.00	$ 38,750.00
7	204	EMBANKMENT	850	CU YD	$ 18.00	$ 15,300.00
8	204	SUBGRADE COMPACTION	2670	SQ YD	$ 3.00	$ 8,010.00
9	204	PROOF ROLLING	2	HOUR	$ 250.00	$ 500.00
10	206	CEMENT STABILIZED SUBGRADE, 16 INCHES DEEP	1,550	SQ YD	$ 4.00	$ 6,200.00
11	206	LIME	75	TON	$ 200.00	$ 15,000.00
12	206	CURING COAT	1,550	SQ YD	$ 2.00	$ 3,100.00
13	206	TEST ROLLING	1	HOUR	$ 250.00	$ 250.00
14	206	MIXTURE DESIGN FOR CHEMICALLY STABILIZED SOILS	1	LS	$ 25,000.00	$ 25,000.00
15	608	4" CONCRETE WALK	4340	SQ FT	$ 8.00	$ 34,720.00
16	608	CURB RAMPS	645	SQ FT	$ 30.00	$ 19,350.00
		EROSION CONTROL				
17	659	TOPSOIL, SEEDING AND MULCHING	3000	SQ YD	$ 10.00	$ 30,000.00
18	832	CONSTRUCTION EROSION CONTROL	65000	EACH	$ 1.00	$ 65,000.00
19	832	SWPPP	1	LS	$ 5,000.00	$ 5,000.00
20	832	SWPPP INSPECTIONS	1	LS	$ 5,000.00	$ 5,000.00
21	832	SWPPP SOFTWARE	1	LS	$ 5,000.00	$ 5,000.00

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Siebenthaler & Catalpa Alternative 2: Single Lane Roundabout

Project number: N/A **Date:** 5/15/2023

Client name: ODOT D8/Montgomery County

(Based upon 2022 Construction Costs)

Ref. No.	Item No.	Description	Total Estimated Quantity	Unit	Estimated Unit Cost	Total Estimated Cost
		PAVEMENT				
22	254	PAVEMENT PLANING, ASPHALT CONCRETE (VARIABLE DEPTH)	3135	SQ YD	$ 10.00	$ 31,350.00
23	302	ASPHALT CONCRETE BASE, PG64-22	440	CU YD	$ 180.00	$ 79,200.00
24	304	AGGREGATE BASE	440	CU YD	$ 75.00	$ 33,000.00
25	407	NON-TRACKING TACK COAT	515	GAL	$ 4.00	$ 2,060.00
26	441	ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (448)	270	CU YD	$ 225.00	$ 60,750.00
27	441	ASPHALT CONCRETE SURFACE COURSE, TYPE 1, PG64-22, (448)	195	CU YD	$ 230.00	$ 44,850.00
28	452	6" NON REINFORCED CONCRETE PAVEMENT	160	SQ YD	$ 140.00	$ 22,400.00
29	609	CURB, TYPE 6	1895	FT	$ 30.00	$ 56,850.00
		DRAINAGE				
30	605	4" BASE PIPE UNDERDRAINS	1895	FT	$ 15.00	$ 28,425.00
31	611	DRAINAGE (STORM SEWER AND STRUCTURES)	1	LS	$ 200,000.00	$ 200,000.00
32	611	STORM WATER BMP	1	LS	$ 25,000.00	$ 25,000.00
		TRAFFIC CONTROL, SIGNALS & LIGHTING				
33	625	LIGHTING	1	LS	$150,000.00	$ 150,000.00
34	630	TRAFFIC SIGNS	1	LS	$20,000.00	$ 20,000.00
35	632	REMOVAL OF TRAFFIC SIGNAL EQUIPMENT	1	LS	$20,000.00	$ 20,000.00
36	644	PAVEMENT MARKINGS	1	LS	$15,000.00	$ 15,000.00
		MISCELLANEOUS				
37	614	MAINTAINING TRAFFIC	1	LS	$ 125,000.00	$ 125,000.00
38	619	FIELD OFFICE	8	MONTH	$ 2,500.00	$ 20,000.00
39	623	CONSTRUCTION LAYOUT STAKES AND SURVEYING	1	LS	$ 25,000.00	$ 25,000.00
40	624	MOBILIZATION	1	LS	$ 80,000.00	$ 85,000.00
41	690	UTILITIES	1	LS	$ 550,000.00	$ 550,000.00

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Siebenthaler & Catalpa Alternative 2: Single Lane Roundabout

Project number: N/A **Date:** 5/15/2023

Client name: ODOT D8/Montgomery County

(Based upon 2022 Construction Costs)

Ref. No.	Item No.	Description	Total Estimated Quantity	Unit	Estimated Unit Cost	Total Estimated Cost
					SUBTOTAL ESTIMATED CONSTRUCTION COST	$ 1,982,865.00
					SUBTOTAL ESTIMATED RIGHT OF WAY COST	$ 470,000.00
						$ 2,452,865.00
					CONSTRUCTION CONTINGENCY **30%**	$ 735,860.00
					ENGINEERING DESIGN, CONSTRUCTION INSPECTION & CONSTRUCTION ADMINISTRATION **30%**	$ 735,860.00
						$ 3,924,585.00
					INFLATION CONTINGENCY (CONSTRUCTION MIDPOINT ESTIMATED 7/1/2027) **15.7%**	$ 385,100.00
					TOTAL ESTIMATED PROJECT COST	$ 4,309,685.00

ASSUMPTIONS:

1. Detour is assumed MOT scheme
2. Cost for utilities assumes relocation of one utility pole in front of 3000 Catalpa Dr which may be in a private easement
3. Cost for utilities assumes relocation of gas main and regulator station on SE quadrant of intersection
4. Cost for utilities assumes relocation of one fire hydrant on SW corner of intersection

SIEBENTHALER AVENUE/CATALPA DRIVE SAFETY STUDY

APPENDIX H: ECAT WORKSHEETS

Project Information

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		
Perform Benefit Cost Analysis?	Yes		

Do the proposed improvements fundamentally change the conditions of the base safety performance function (SPF), Or is crash data unavailable for the analysis condition, Or is only predicted (and not expected) analysis needed for the existing or proposed condition?	**Yes**

(Examples: unsignalized to signalized, undivided to divided, increase or decrease in the number of lanes, change the number of approaches to an intersection, significant realignment of the roadway)

If Yes, are you analyzing the existing or proposed conditions?	**Existing**

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name
CR32; 4.264	Urban & Suburban Arterial Intersection	Unsignalized	CMOTCR00032**C	4.264		0.05	CMOTCR000	Catalpa Dr at Siebenthaler Ave

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)	2023	7,900	veh / day
Future ADT (FADT)	2050	7,900	veh / day
Annual Linear Growth Rate		0.0000	

Project Elements Description Table

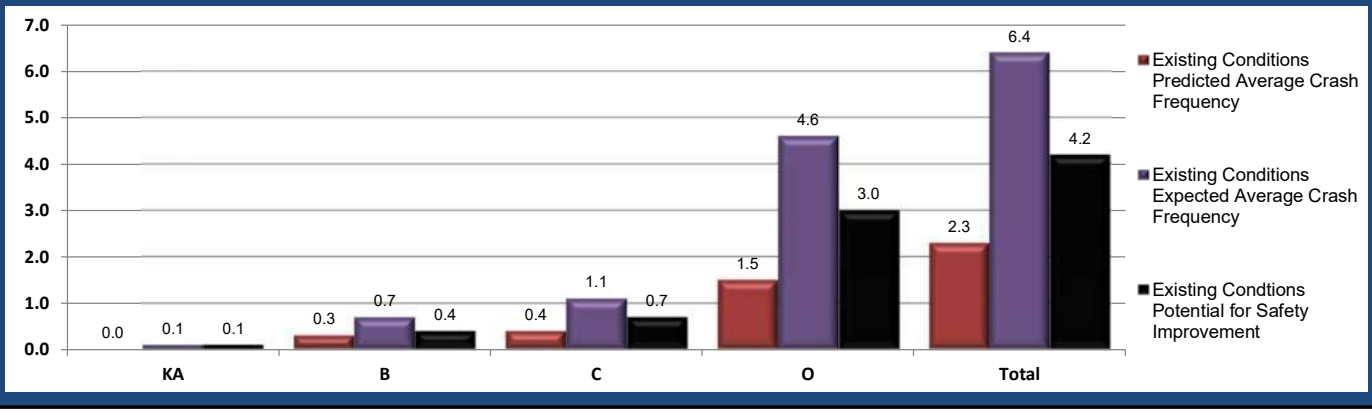
Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.0286	0.2897	0.4264	1.5152	2.2599
$N_{expected}$ - Existing Conditions	0.0820	0.7031	1.0786	4.5586	6.4223
$N_{potential\ for\ improvement}$ - Existing Conditions	**0.0534**	**0.4134**	**0.6522**	**3.0434**	**4.1624**

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0286	0.2897	0.4264	1.5152	2.2599

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.082	0.7031	1.0786	4.5586	6.4223

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0534	0.4134	0.6522	3.0434	4.1624

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.0002	0.0000	-0.0002	
Head On	0.0201	0.0609	**0.0409**	
Rear End	0.5269	1.7046	**1.1777**	
Backing	0.1515	0.5245	**0.3729**	
Sideswipe - Meeting	0.0000	0.0000	0.0000	
Sideswipe - Passing	0.0991	0.3430	**0.2439**	
Angle	1.0218	3.3071	**2.2853**	
Parked Vehicle	0.0958	0.0000	-0.0958	
Pedestrian	0.0330	0.0330	0.0000	
Animal	0.0000	0.0000	0.0000	
Train	0.0000	0.0000	0.0000	
Pedalcycles	0.0242	0.0242	0.0000	
Other Non-Vehicle	0.0000	0.0000	0.0000	
Fixed Object	0.1537	0.0000	-0.1537	
Other Object	0.0000	0.0000	0.0000	
Overturning	0.0000	0.0000	0.0000	
Other Non-Collision	0.0058	0.0000	-0.0058	
Left Turn	0.0493	0.1621	**0.1128**	
Right Turn	0.0784	0.2628	**0.1844**	

Project Information

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		
Perform Benefit Cost Analysis?	Yes		

Do the proposed improvements fundamentally change the conditions of the base safety performance function (SPF), Or is crash data unavailable for the analysis condition, Or is only predicted (and not expected) analysis needed for the existing or proposed condition?	**Yes**

(Examples: unsignalized to signalized, undivided to divided, increase or decrease in the number of lanes, change the number of approaches to an intersection, significant realignment of the roadway)

If Yes, are you analyzing the existing or proposed conditions?	**Proposed**

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name
CR32; 4.264	Urban & Suburban Arterial Intersection	Signalized	CMOTCR00032**C	4.264		0.05	CMOTCR000	Catalpa Dr at Siebenthaler Ave

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)	2023	7,900	veh / day
Future ADT (FADT)	2050	7,900	veh / day
Annual Linear Growth Rate		0.0000	

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

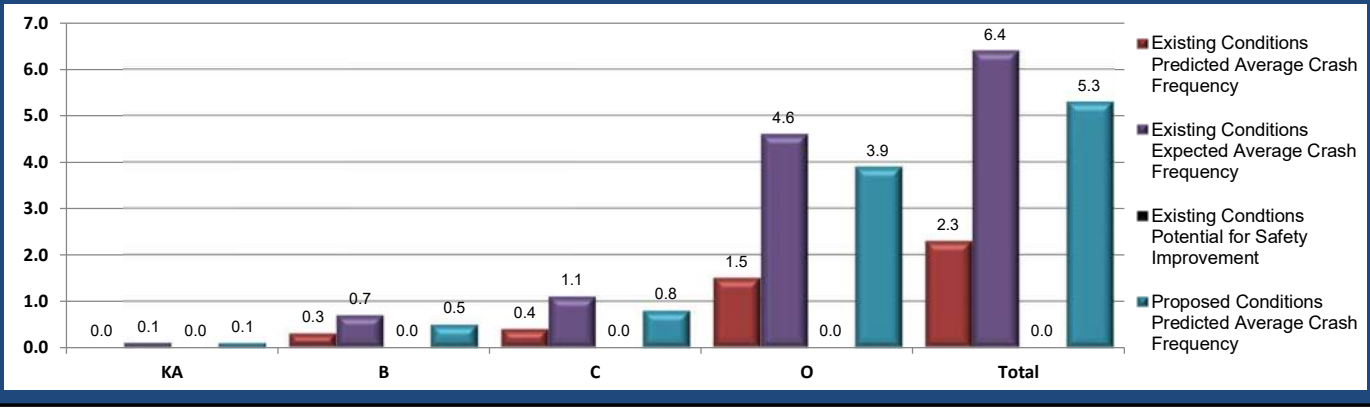
CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1						
CMF 2						
CMF 3						
CMF 4						
CMF 5						
CMF 6						
CMF 7						
CMF 8						
CMF 9						
CMF 10						

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.0286	0.2897	0.4264	1.5152	2.2599
$N_{expected}$ - Existing Conditions	0.0820	0.7031	1.0786	4.5586	6.4223
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0000	0.0000	0.0000	0.0000	0.0000
$N_{predicted}$ - Proposed Conditions	0.0952	0.5131	0.7984	3.9174	5.3241

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0286	0.2897	0.4264	1.5152	2.2599

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.082	0.7031	1.0786	4.5586	6.4223

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0534	0.4134	0.6522	3.0434	4.1624

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0952	0.5131	0.7984	3.9174	5.3241

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0002	0.0000		0.0065
Head On	0.0201	0.0609		0.0871
Rear End	0.5269	1.7046		2.2877
Backing	0.1515	0.5245		0.1664
Sideswipe - Meeting	0.0000	0.0000		0.0039
Sideswipe - Passing	0.0991	0.3430		0.6221
Angle	1.0218	3.3071		0.9448
Parked Vehicle	0.0958	0.0000		0.0649
Pedestrian	0.0330	0.0330		0.0090
Animal	0.0000	0.0000		0.0000
Train	0.0000	0.0000		0.0005
Pedalcycles	0.0242	0.0242		0.1754
Other Non-Vehicle	0.0000	0.0000		0.0001
Fixed Object	0.1537	0.0000		0.1780
Other Object	0.0000	0.0000		0.0055
Overturning	0.0000	0.0000		0.0069
Other Non-Collision	0.0058	0.0000		0.0124
Left Turn	0.0493	0.1621		0.4888
Right Turn	0.0784	0.2628		0.2641

Project Cost Estimate

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Engineering Design %	30%
Contingency %	30%

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Convert AWSC Intersection to Signalized Intersection	$1,711,165.00	$80,000.00	$537,349.50	$537,349.50	**$2,865,864.00**		
Site Characteristic Improvements (i.e. Lighting)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Signal Phasing)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Added Right Turn Lane)			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
Totals	**$1,711,165.00**	**$80,000.00**	**$537,349.50**	**$537,349.50**	**$2,865,864.00**	**$0.00**	**$0.00**

Inflation %	10%

Final Costruction Cost:	**$3,147,005.26**

*Final construction cost should match the Project Cost Estimate

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

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 AWSC Intersection to Signalized Intersection	20	$2,865,864.00			$2,865,864.00	$2,865,864.00	3.064	($1,179,212)
Site Characteristic Improvements (i.e. Lighting)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		$0.00			$0.00	$0.00		
		$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
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$2,865,864.00**	**$0.00**	**$0.00**	**$2,865,864.00**	**$2,865,864.00**	**3.064**	**($1,179,212)**

Safety Benefit - Cost Analysis

General Information

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Agency/Company	CMT		

Benefit - Cost Calculator

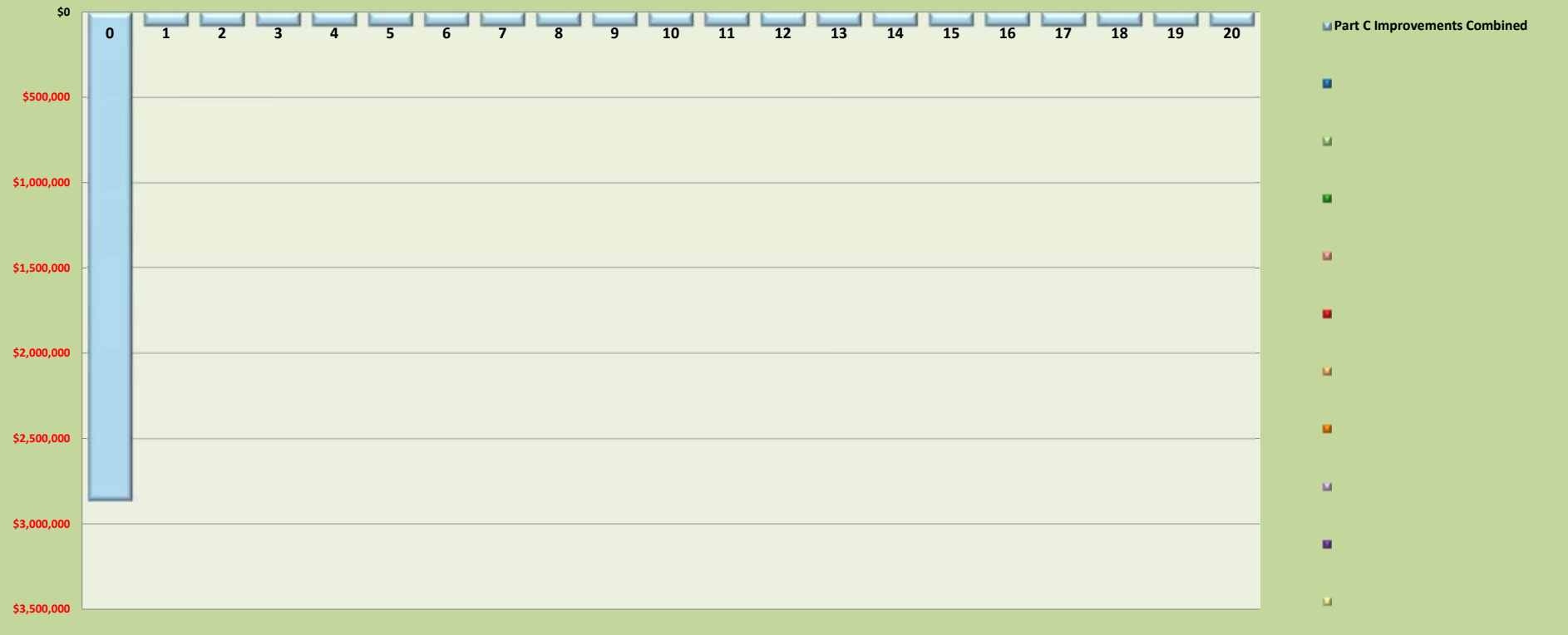
Net Present Value of Project	$2,865,864.00
Net Present Value of Safety Benefits	($1,179,211.92)
Net Benefit	($4,045,075.92)
Benefit / Cost Ratio	-0.41

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	0.067
Number of Injury Crashes	0.662
Number of Total Crashes	3.064

Comments:

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



Safety Benefit - Cost Analysis

General Information

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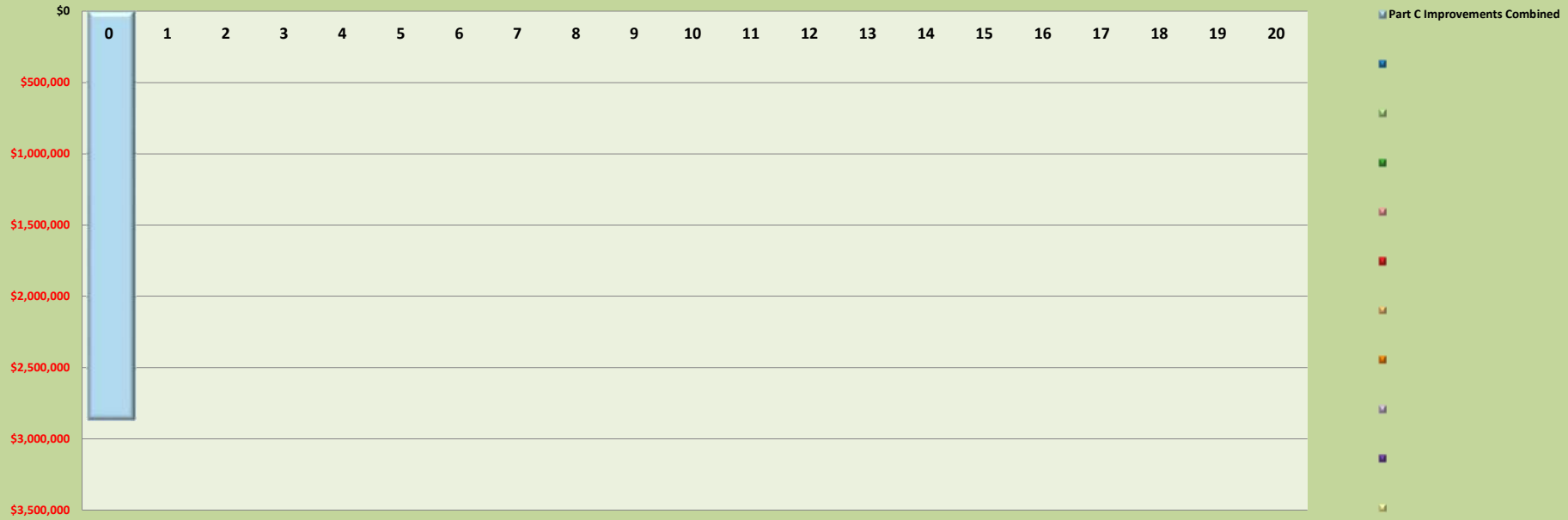
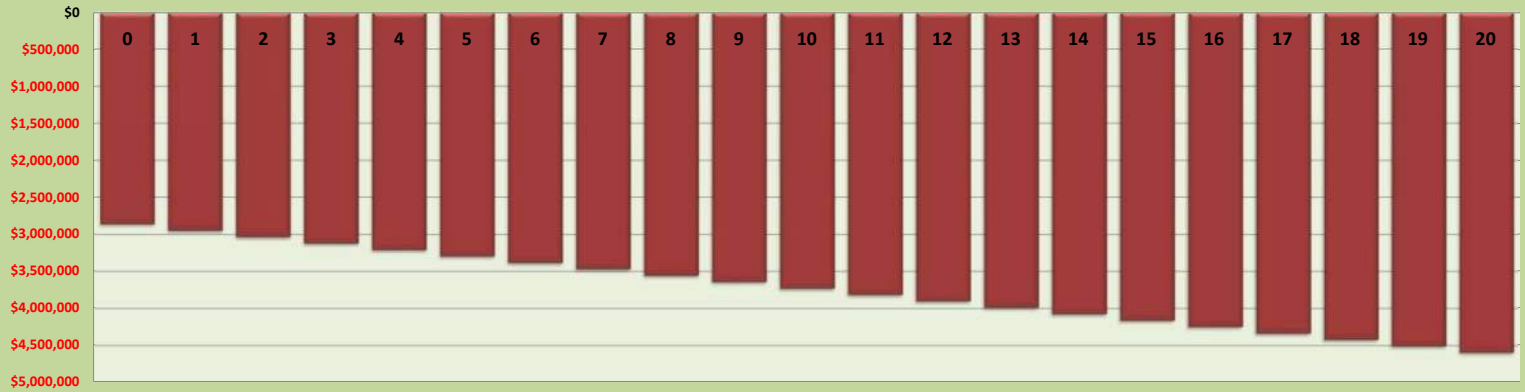
Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: Unknown (Unknown years)

Percentage of Service Life to observe a continuous Positive Return on Investment: Unknown%

Project Information

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		
Perform Benefit Cost Analysis?	Yes		

Do the proposed improvements fundamentally change the conditions of the base safety performance function (SPF), Or is crash data unavailable for the analysis condition, Or is only predicted (and not expected) analysis needed for the existing or proposed condition?	**Yes**

(Examples: unsignalized to signalized, undivided to divided, increase or decrease in the number of lanes, change the number of approaches to an intersection, significant realignment of the roadway)

If Yes, are you analyzing the existing or proposed conditions?	**Proposed**

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name
CR32; 4.264	Roundabout	Unsignalized	CMOTCR00032**C	4.264		0.05	CMOTCR000	Catalpa Dr at Siebenthaler Ave

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)	2023	7,900	veh / day
Future ADT (FADT)	2050	7,900	veh / day
Annual Linear Growth Rate		0.0000	

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

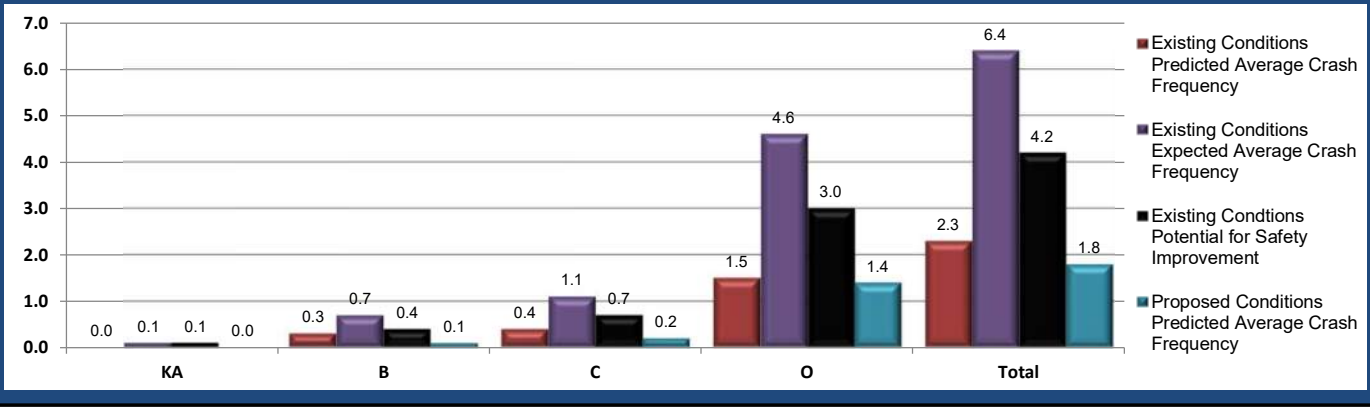
CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1						
CMF 2						
CMF 3						
CMF 4						
CMF 5						
CMF 6						
CMF 7						
CMF 8						
CMF 9						
CMF 10						

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.0286	0.2897	0.4264	1.5152	2.2599
$N_{expected}$ - Existing Conditions	0.0820	0.7031	1.0786	4.5586	6.4223
$N_{potential\ for\ improvement}$ - Existing Conditions	**0.0534**	**0.4134**	**0.6522**	**3.0434**	**4.1624**
$N_{expected}$ - Proposed Conditions	0.0160	0.1344	0.1664	1.4463	1.7631

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0286	0.2897	0.4264	1.5152	2.2599

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.082	0.7031	1.0786	4.5586	6.4223

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0534	0.4134	0.6522	3.0434	4.1624

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.016	0.1344	0.1664	1.4463	1.7631

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0002	0.0000	-0.0002	0.0471
Head On	0.0201	0.0609	**0.0409**	0.0032
Rear End	0.5269	1.7046	**1.1777**	0.2909
Backing	0.1515	0.5245	**0.3729**	0.0146
Sideswipe - Meeting	0.0000	0.0000	0.0000	0.0000
Sideswipe - Passing	0.0991	0.3430	**0.2439**	0.5347
Angle	1.0218	3.3071	**2.2853**	0.4954
Parked Vehicle	0.0958	0.0000	-0.0958	0.0000
Pedestrian	0.0330	0.0330	0.0000	0.0032
Animal	0.0000	0.0000	0.0000	0.0178
Train	0.0000	0.0000	0.0000	0.0000
Pedalcycles	0.0242	0.0242	0.0000	0.0032
Other Non-Vehicle	0.0000	0.0000	0.0000	0.0000
Fixed Object	0.1537	0.0000	-0.1537	0.1781
Other Object	0.0000	0.0000	0.0000	0.0000
Overturning	0.0000	0.0000	0.0000	0.0032
Other Non-Collision	0.0058	0.0000	-0.0058	0.0324
Left Turn	0.0493	0.1621	**0.1128**	0.0420
Right Turn	0.0784	0.2628	**0.1844**	0.1151

Project Cost Estimate

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Engineering Design %	30%
Contingency %	30%

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Convert AWSC Intersection to Single-Lane Roundabout	$1,982,865.00	$470,000.00	$735,859.50	$735,859.50	**$3,924,584.00**		
Site Characteristic Improvements (i.e. Lighting)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Signal Phasing)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Added Right Turn Lane)			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
Totals	**$1,982,865.00**	**$470,000.00**	**$735,859.50**	**$735,859.50**	**$3,924,584.00**	**$0.00**	**$0.00**

Inflation %	10%

Final Costruction Cost:	**$4,309,585.69**

*Final construction cost should match the Project Cost Estimate

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
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Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

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

All Sites

Comments:

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 AWSC Intersection to Single-Lane Roundabout	25	$3,924,584.00			$3,924,584.00	$3,924,584.00	-0.497	$446,560
Site Characteristic Improvements (i.e. Lighting)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		$0.00			$0.00	$0.00		
		$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
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$3,924,584.00**	**$0.00**	**$0.00**	**$3,924,584.00**	**$3,924,584.00**	**-0.497**	**$446,560**

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
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Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Benefit - Cost Calculator

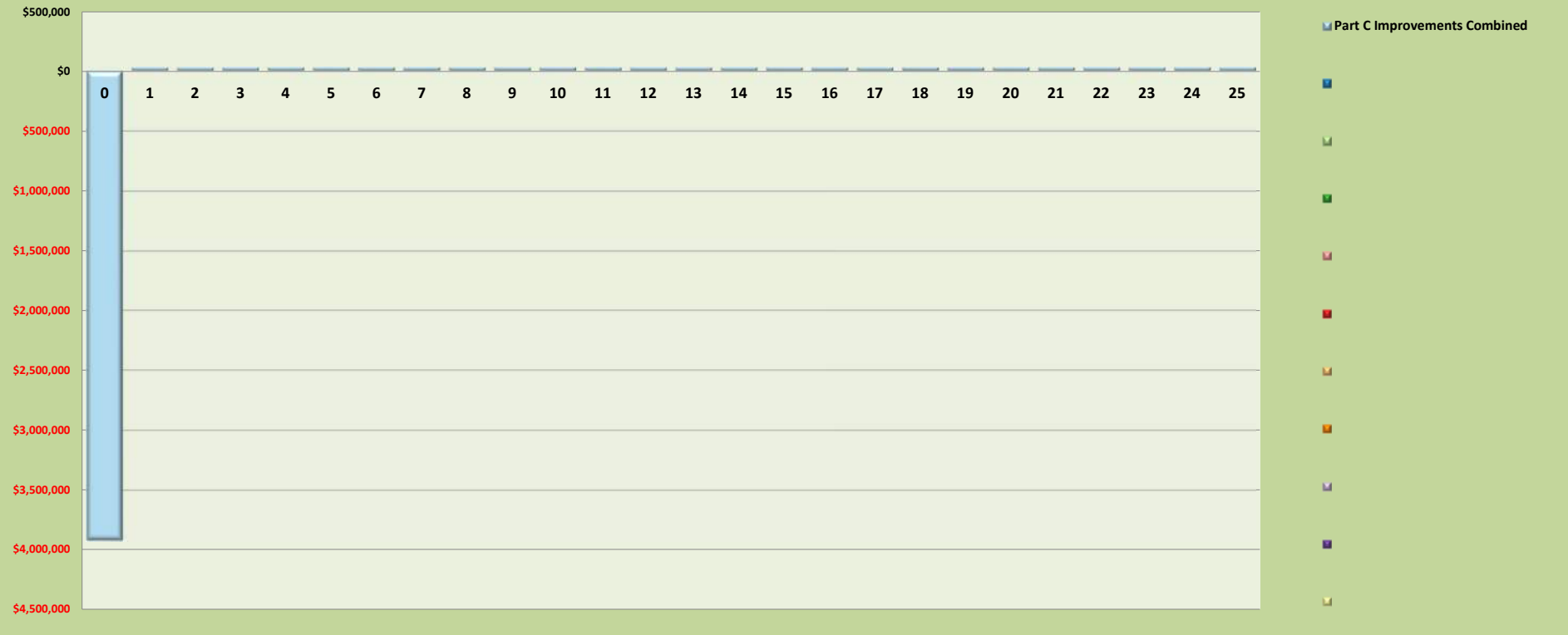
Net Present Value of Project	$3,924,584.00
Net Present Value of Safety Benefits	$446,559.69
Net Benefit	($3,478,024.31)
Benefit / Cost Ratio	0.11

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.013
Number of Injury Crashes	-0.428
Number of Total Crashes	-0.497

Comments:

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



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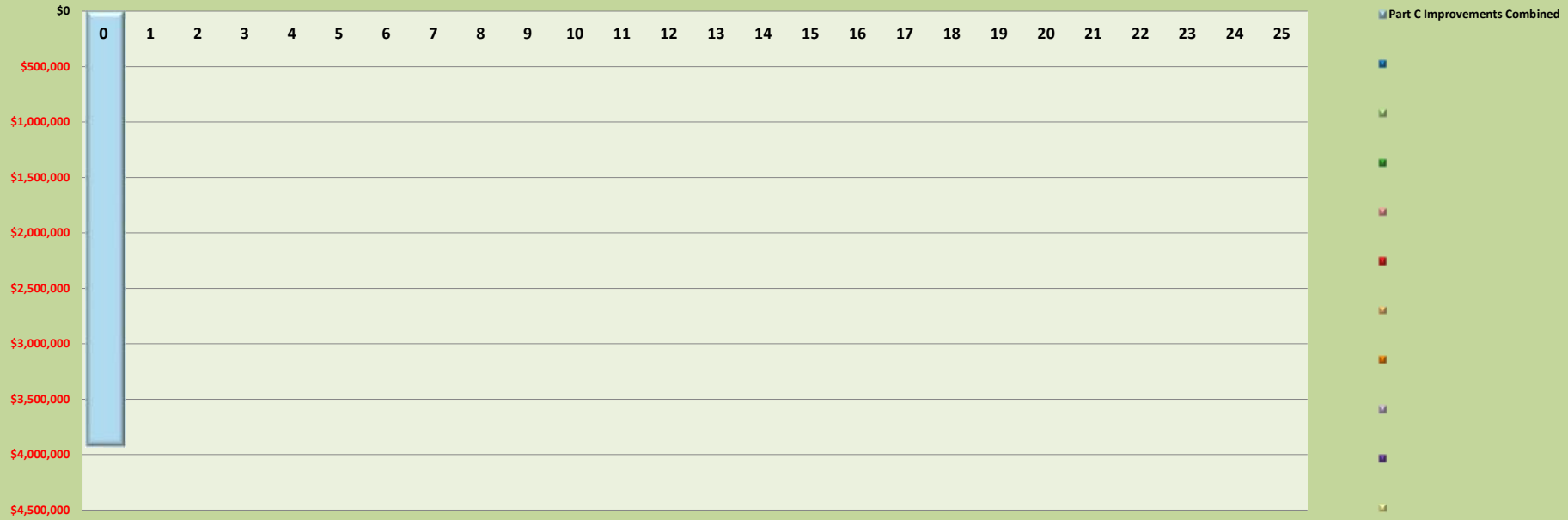
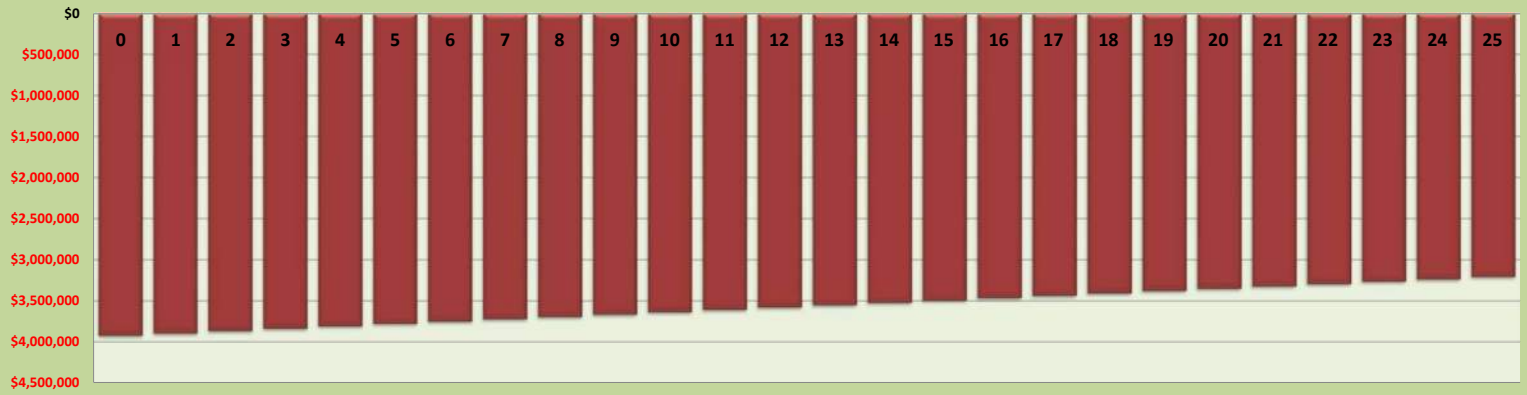
Agency/Company	CMT		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: Unknown (Unknown years)

Percentage of Service Life to observe a continuous Positive Return on Investment: Unknown%

Project Information

General Information

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Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		
Perform Benefit Cost Analysis?	Yes		

Do the proposed improvements fundamentally change the conditions of the base safety performance function (SPF), Or is crash data unavailable for the analysis condition, Or is only predicted (and not expected) analysis needed for the existing or proposed condition?	**Yes**

(Examples: unsignalized to signalized, undivided to divided, increase or decrease in the number of lanes, change the number of approaches to an intersection, significant realignment of the roadway)

If Yes, are you analyzing the existing or proposed conditions?	**Proposed**

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name
CR32; 4.264	Roundabout	Unsignalized	CMOTCR00032**C	4.264		0.05	CMOTCR000	Catalpa Dr at Siebenthaler Ave

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)	2023	7,900	veh / day
Future ADT (FADT)	2050	7,900	veh / day
Annual Linear Growth Rate		0.0000	

Project Elements Description Table

Project Element ID (Must be Unique)	Site Type	Intersection Control Type	Location Information					
			NLFID	Begin Logpoint/ Intersection Midpoint	End Logpoint *(Leave blank for Intersection)*	Length (mi) OR Intersection Radius Buffer (mi)	Cross Route NLFID(s)	Common Name

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1						
CMF 2						
CMF 3						
CMF 4						
CMF 5						
CMF 6						
CMF 7						
CMF 8						
CMF 9						
CMF 10						

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
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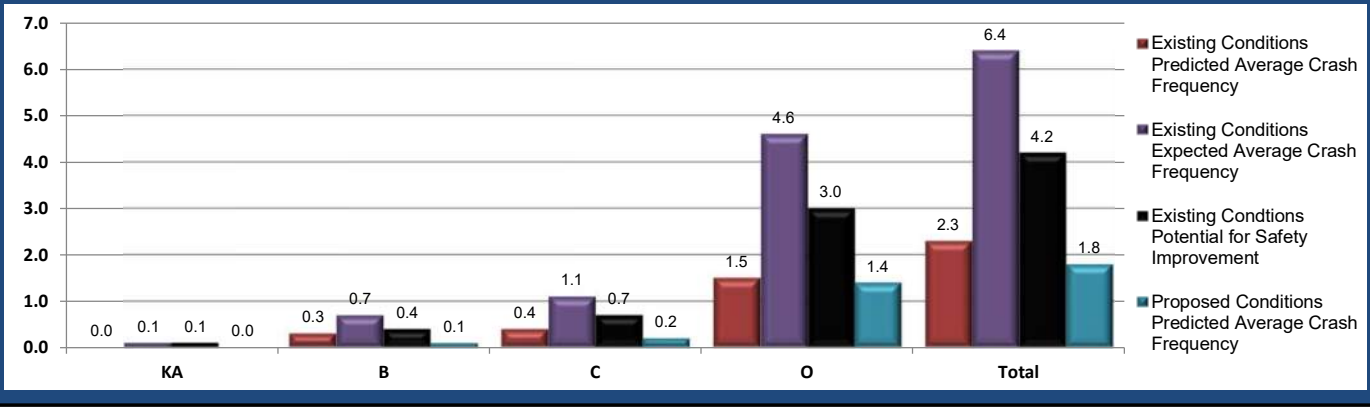
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary of Anticipated Safety Performance of the Project (average crashes/year)



Project Summary Results (Without Animal Crashes)

	KA	B	C	O	Total
$N_{predicted}$ - Existing Conditions	0.0286	0.2897	0.4264	1.5152	2.2599
$N_{expected}$ - Existing Conditions	0.0820	0.7031	1.0786	4.5586	6.4223
$N_{potential\ for\ improvement}$ - Existing Conditions	**0.0534**	**0.4134**	**0.6522**	**3.0434**	**4.1624**
$N_{expected}$ - Proposed Conditions	0.0160	0.1344	0.1664	1.4463	1.7631

Project Safety Performance Report

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Agency/Company	CMT		

Existing Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0286	0.2897	0.4264	1.5152	2.2599

Project Safety Performance Report

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Agency/Company	CMT		

Existing Conditions Project Element Expected Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.082	0.7031	1.0786	4.5586	6.4223

Project Safety Performance Report

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Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Existing Conditions Project Element Potential for Safety Improvement Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.0534	0.4134	0.6522	3.0434	4.1624

Project Safety Performance Report

General Information

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Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Proposed Conditions Project Element Predicted Crash Summary (Without Animal Crashes)

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
CR32; 4.264	Catalpa Dr at Siebenthaler Ave	0.016	0.1344	0.1664	1.4463	1.7631

Project Safety Performance Report

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Predicted Crash Frequency
Unknown	0.0002	0.0000	-0.0002	0.0471
Head On	0.0201	0.0609	**0.0409**	0.0032
Rear End	0.5269	1.7046	**1.1777**	0.2909
Backing	0.1515	0.5245	**0.3729**	0.0146
Sideswipe - Meeting	0.0000	0.0000	0.0000	0.0000
Sideswipe - Passing	0.0991	0.3430	**0.2439**	0.5347
Angle	1.0218	3.3071	**2.2853**	0.4954
Parked Vehicle	0.0958	0.0000	-0.0958	0.0000
Pedestrian	0.0330	0.0330	0.0000	0.0032
Animal	0.0000	0.0000	0.0000	0.0178
Train	0.0000	0.0000	0.0000	0.0000
Pedalcycles	0.0242	0.0242	0.0000	0.0032
Other Non-Vehicle	0.0000	0.0000	0.0000	0.0000
Fixed Object	0.1537	0.0000	-0.1537	0.1781
Other Object	0.0000	0.0000	0.0000	0.0000
Overturning	0.0000	0.0000	0.0000	0.0032
Other Non-Collision	0.0058	0.0000	-0.0058	0.0324
Left Turn	0.0493	0.1621	**0.1128**	0.0420
Right Turn	0.0784	0.2628	**0.1844**	0.1151

Project Cost Estimate

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Engineering Design %	30%
Contingency %	30%

Countermeasures	Construction Costs	Right of Way Costs	Engineering Design Costs	Contingency Amount	Total Cost of Countermeasure	Annual Maintenance & Energy Costs	Salvage Value
Convert AWSC Intersection to Single-Lane Dual Roundabout	$2,380,000.00	$564,000.00	$883,200.00	$883,200.00	**$4,710,400.00**		
Site Characteristic Improvements (i.e. Lighting)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Signal Phasing)			$0.00	$0.00	**$0.00**		
Site Characteristic Improvements (i.e. Added Right Turn Lane)			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
			$0.00	$0.00	**$0.00**		
Totals	**$2,380,000.00**	**$564,000.00**	**$883,200.00**	**$883,200.00**	**$4,710,400.00**	**$0.00**	**$0.00**

Inflation %	10%

Final Costruction Cost:	**$5,172,490.24**

*Final construction cost should match the Project Cost Estimate

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

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

All Sites

Comments:

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 AWSC Intersection to Single-Lane Dual Roundabout	25	$4,710,400.00			$4,710,400.00	$4,710,400.00	-0.497	$446,560
Site Characteristic Improvements (i.e. Lighting)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		$0.00			$0.00	$0.00		
		$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
		$0.00			$0.00	$0.00	0.000	$0
Totals		**$4,710,400.00**	**$0.00**	**$0.00**	**$4,710,400.00**	**$4,710,400.00**	**-0.497**	**$446,560**

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Benefit - Cost Calculator

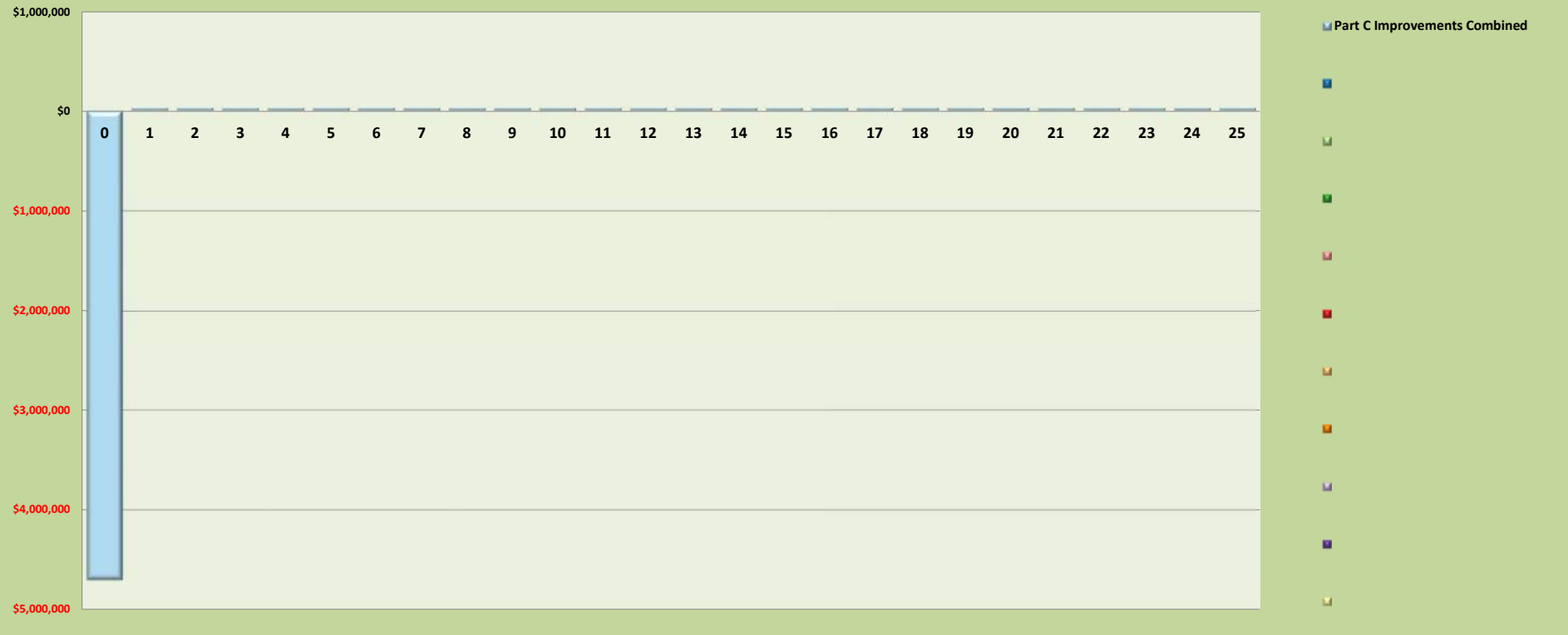
Net Present Value of Project	$4,710,400.00
Net Present Value of Safety Benefits	$446,559.69
Net Benefit	($4,263,840.31)
Benefit / Cost Ratio	0.09

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.013
Number of Injury Crashes	-0.428
Number of Total Crashes	-0.497

Comments:

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

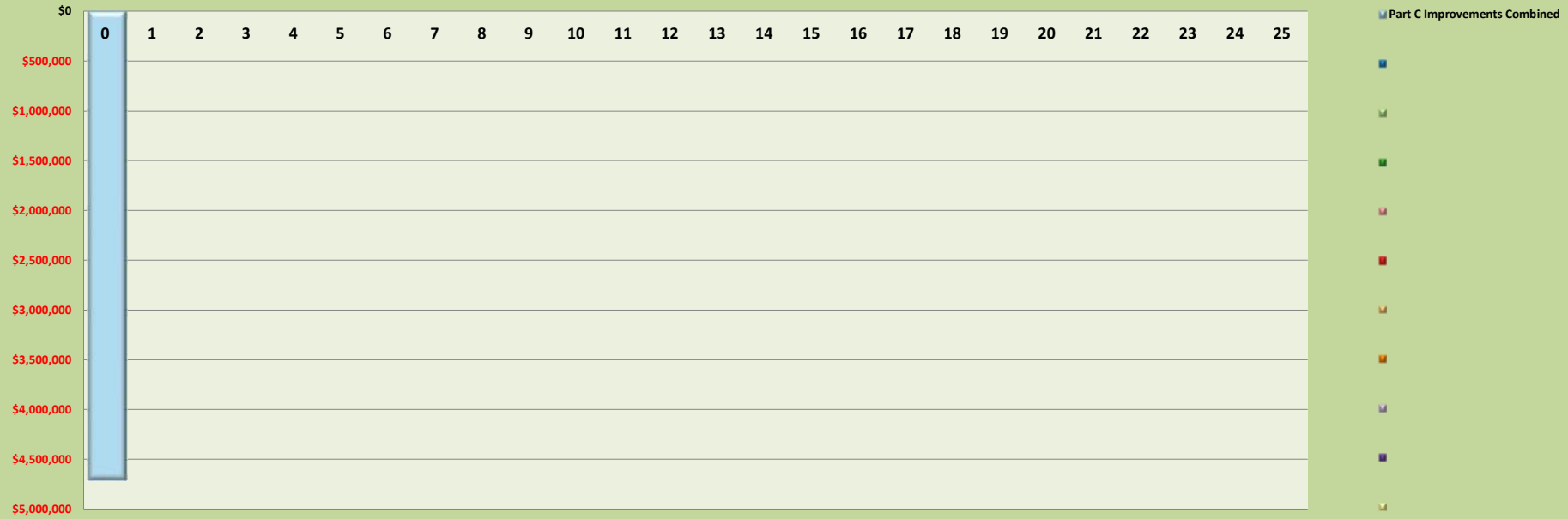


Safety Benefit - Cost Analysis

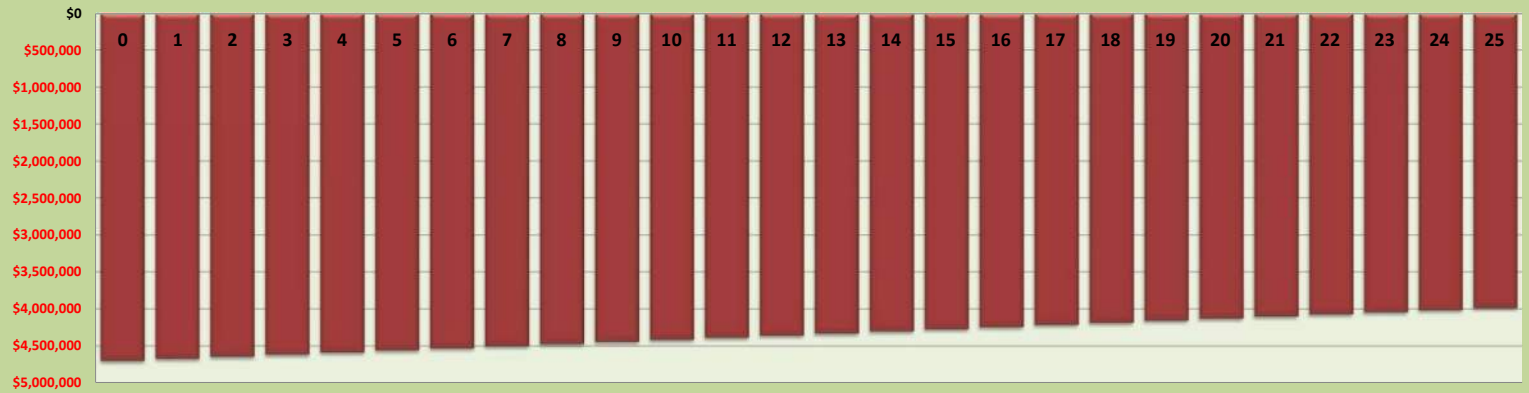
General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: Unknown (Unknown years)

Percentage of Service Life to observe a continuous Positive Return on Investment: Unknown%

STUDY DETAILS

Study Title: Validation and Application of Highway Safety Manual (Part D) in Florida

Authors: Abdel-Aty et al.

Publication Date:MAY, 2014

Abstract: The Highway Safety Manual (HSM) Part D provides a comprehensive list of the effects of safety treatments (countermeasures). These effects are quantified by crash r factors (CMF), which are based on compilation from past studies of the effects of various safety treatments. The HSM Part D provides CMFs for treatments applied to roadway (e.g., roadside elements, alignment, signs, rumble strips, etc.), intersections (e.g., control), interchanges, special facilities (e.g., highway-rail crossings), and road networks. Thus, ar of the applicability of the HSM in Florida is essential. The objectives of this study are (1) to develop CMFs for various treatments in Florida for the same setting (rural/urban), roa type, and severity level, (2) to evaluate the difference between these Florida-specific CMFs and the CMFs in the HSM, and (3) to recommend whether the CMFs in the HSM can Florida or new Florida-specific CMFs are needed. Different methods of observational study - before-after (B-A) and cross-sectional (C-S) - were used to calculate CMFs for a tot treatments applied to roadway segments, intersections and special facilities. The CMFs calculated using the before-after with comparison-group (C-G) and empirical Bayesian (E only the CMF with lower standard error was selected. The methods of calculating CMFs were determined based on the availability of the data and the methods used in the HSM were provided in the HSM. It was found that Florida-specific CMFs were generally statistically significant, and safety effects represented by the CMFs were intuitive, similar to t the HSM. It was also found that Florida-specific CMFs for the treatments not included in the HSM showed significant positive effects in reducing crash frequencies.

Study Citation: Abdel-Aty, M.A., C. Lee, J. Park, J.Wang, M. Abuzwidah, and S. Al-Arifi. "Validation and Application of Highway Safety Manual (Part D) in Florida." Florida Departn Transportation. Tallahassee, Florida. (May 2014).

Related Citations: Park, J., M. Abdel-Aty, J. Lee, and C. Lee. "Developing crash modification functions to assess safety effects of adding bike lanes for urban arterials with differe and socio-economic characteristics". Accident Analysis and Prevention, Vol. 74, (2015) pp. 179-191.

Study Report: DOWNLOAD THE STUDY REPORT DOCUMENT

CMFS ASSOCIATED WITH THIS STUDY

CATEGORY: ACCESS MANAGEMENT

Countermeasure: 10-ft to 100-ft conversion (median width)

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.25	75	★★★☆☆	All	All	Not specified	Urban
0.87	13	★★★☆☆	All	All	Not specified	Urban
0.58	42	★★★☆☆	All	All	Not specified	Urban

Countermeasure: 10-ft to 20-ft conversion (median width)

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.86	14	★★★☆☆	All	All	Not specified	Urban
0.98	2	★★★☆☆	All	All	Not specified	Urban
0.94	6	★★★☆☆	All	All	Not specified	Urban

Countermeasure: 10-ft to 30-ft conversion (median width)

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.73	27	★★★☆☆	All	All	Not specified	Urban
0.94	6	★★★☆☆	All	All	Not specified	Urban
0.89	11	★★☆☆☆	All	All	Not specified	Urban

CATEGORY:HIGHWAY LIGHTING

Countermeasure: Install lighting

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.82	18	★★★☆☆	Other	All	Minor Arterial	Urban
0.63	37	★★★★☆	All	K,A,B,C	All	All
0.84	16	★★★☆☆	All	O	All	All
0.68	32	★★★★☆	All	All	All	All
0.67	33	★★★★☆	Rear end	All	All	All
0.64	36	★★★★☆	Angle	All	All	All
0.72	28	★★★☆☆	Single vehicle	All	All	All
0.72	28	★★★★☆	Other	All	All	All
0.68	32	★★★★☆	All	K,A,B,C	Minor Arterial	Urban
0.76	24	★★★★☆	All	O	Minor Arterial	Urban
0.74	26	★★★★☆	All	All	Minor Arterial	Urban
0.62	38	★★★★☆	Rear end	All	Minor Arterial	Urban
0.82	18	★★★★☆	Angle	All	Minor Arterial	Urban
0.63	37	★★★★☆	Single vehicle	All	Minor Arterial	Urban
0.89	11	★★★☆☆	All	K,A,B,C	All	All
0.77	23	★★★★☆	All	K,A,B,C	Minor Arterial	Urban

CATEGORY:INTERSECTION GEOMETRY

Countermeasure: Conversion of stop-controlled intersection to roundabout

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.38	62	★★★☆☆	All	All	Not specified	Not specified
0.29	71	★★★☆☆	All	K,A,B,C	Not specified	Not specified

Countermeasure: Install left-turn lane

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.73	27	★★★☆☆	All	K,A,B,C	Not specified	Rural
0.69	31	★★☆☆☆	All	All	Not specified	Rural
0.64	36	★★☆☆☆	All	K,A,B,C	Not specified	Rural

CATEGORY:INTERSECTION TRAFFIC CONTROL

Countermeasure: Install a traffic signal

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.61	39	★★★★☆	All	All	Not specified	Urban
0.46	54	★★★★☆	Angle	All	Not specified	Urban
0.71	29	★★☆☆☆	Rear end	All	Not specified	Urban
0.66	34	★★☆☆☆	Left turn	All	Not specified	Urban
1.95	-95	★★★☆☆	Rear end	All	Not specified	Rural

0.5	50	★★★★☆	Left turn	All	Not specified	Rural
0.67	33	★★★★☆	Angle	All	Not specified	Urban
2.26	-126	★★☆☆☆	Rear end	All	Not specified	Urban
0.45	55	★★★★☆	Left turn	All	Not specified	Urban
0.7	30	★★★☆☆	Angle	All	Not specified	Rural

CATEGORY:ROADWAY

Countermeasure: Add a through lane on both directions and a raised median

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.47	53	★☆☆☆☆	All	All	Not specified	Urban
0.52	48	★☆☆☆☆	All	All	Not specified	Urban
0.28	72	★☆☆☆☆	All	All	Not specified	Urban
0.32	68	★★★★☆	All	All	Not specified	Urban
0.33	67	★★★★☆	All	K,A,B,C	Not specified	Urban
0.71	29	★★★★☆	All	All	Not specified	Rural
0.51	49	★★★★☆	All	K,A,B,C	Not specified	Rural

Countermeasure: Convert 12-foot lanes to 10-foot lanes

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.58	42	★★★☆☆	All	All	Not specified	Rural
0.73	27	★★☆☆☆	All	All	Not specified	Rural

Countermeasure: Convert 12-foot lanes to 11-foot lanes

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.76	24	★★★☆☆	All	All	Not specified	Rural
0.85	15	★★☆☆☆	All	All	Not specified	Rural

Countermeasure: Convert 12-foot lanes to 9-foot or less

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.44	56	★★★☆☆	All	All	Not specified	Rural
0.62	38	★★☆☆☆	All	All	Not specified	Rural

Countermeasure: Convert a TWLTL to a raised median

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.67	33	★★☆☆☆	All	K,A,B,C	Not specified	Not specified
0.53	47	★★☆☆☆	All	All	Not specified	Not specified
0.27	73	★★☆☆☆	Head on	All	Not specified	Not specified

Countermeasure: Road diet (Convert 4-lane undivided road to 2-lanes plus turning lane)

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type

CRASH MODIFICATION FACTORS CLEARINGHOUSE

STUDY DETAILS

Study Title: Safety Evaluation of Roundabouts in Georgia

Authors: Gbologah et al.

Publication Date: JAN, 2019

Abstract: U.S. Roundabout growth have been significant in recent years and many published studies have documented significant safety benefits of roundabouts. However, the s benefits for a roundabout may vary from region to region depending many local factors. Therefore, transportation agencies can make more informed implementation decisions safety evaluations rather than published national findings. However, roundabouts are relatively new in the United States and most DOTs, including Georgia, are often hindered l availability requirements of the state-of-the-art empirical Bayes analysis evaluation procedure. This current study provides a safety evaluation of 23 Georgia roundabouts. It ad dependent form of the Highway Safety Manual predictive (empirical Bayes) method to estimate potential crash reductions across all crashes and all injury/fatal crashes. The met the empirical Bayes procedure towards a full Bayesian analysis. The findings indicate a 37-48 percent reduction in average crash frequency for all crashes and a 51-60 percent r average crash frequency for injury/fatal crashes at four-leg roundabouts that were converted from stop-controlled and conventional intersections. In addition, when analyzed a three-leg and four-leg roundabouts converted from stop-controlled and conventional intersections collectively experienced 56 percent reduction in average crash frequency fo and 69 percent reduction in injury/fatal crashes. The study did not consider five-leg roundabouts due to small sample size and concerns about the form of the SPF. The adopted offers DOTs with data availability challenges an alternative evaluation framework that retains the positive attributes of empirical Bayes analysis.

Study Citation: Gbologah, F. E., A. Guin, and M.O. Rodgers. "Safety Evaluation of Roundabouts in Georgia". Presented at the 98th Annual Meeting of the Transportation Researc Paper No. 19-02900, Washington, D.C., (2019).

CMFS ASSOCIATED WITH THIS STUDY

CATEGORY: INTERSECTION GEOMETRY

Countermeasure: Conversion of intersection to roundabout

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.623	37.7	★★★☆☆	All	All	Not specified	All
0.613	38.7	★★★☆☆	All	All	Not specified	All
0.642	35.8	★★★☆☆	All	All	Not specified	All
0.509	49.1	★★★☆☆	All	K,A,B,C	Not specified	All
0.512	48.8	★★★☆☆	All	K,A,B,C	Not specified	All
0.467	53.3	★★★☆☆	All	K,A,B,C	Not specified	All
0.503	49.7	★★★☆☆	All	All	Not specified	All
0.495	50.5	★★★☆☆	All	All	Not specified	All
0.549	45.1	★★★☆☆	All	All	Not specified	All
0.403	59.7	★★★☆☆	All	K,A,B,C	Not specified	All
0.405	59.5	★★★☆☆	All	K,A,B,C	Not specified	All
0.391	60.9	★★★☆☆	All	K,A,B,C	Not specified	All
0.439	56.1	★★★☆☆	All	All	Not specified	All
0.433	56.7	★★★☆☆	All	All	Not specified	All
0.313	68.7	★★★☆☆	All	K,A,B	Not specified	All

0.309	**69.1**	★★★☆☆	All	K,A,B,C	Not specified	All

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

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
Site Characteristic Improvements (i.e. Lane widening)		$0.00			$0.00	$0.00	0.000	$0
Site Characteristic Improvements (i.e. Lighting)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		$0.00			$0.00	$0.00		
CMF 1 - Install a Traffic Signal	20	$2,865,864.00			$2,865,864.00	$2,865,864.00	-2.505	$952,405
		$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		**$2,865,864.00**	**$0.00**	**$0.00**	**$2,865,864.00**	**$2,865,864.00**	**-2.505**	**$952,405**

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Benefit - Cost Calculator

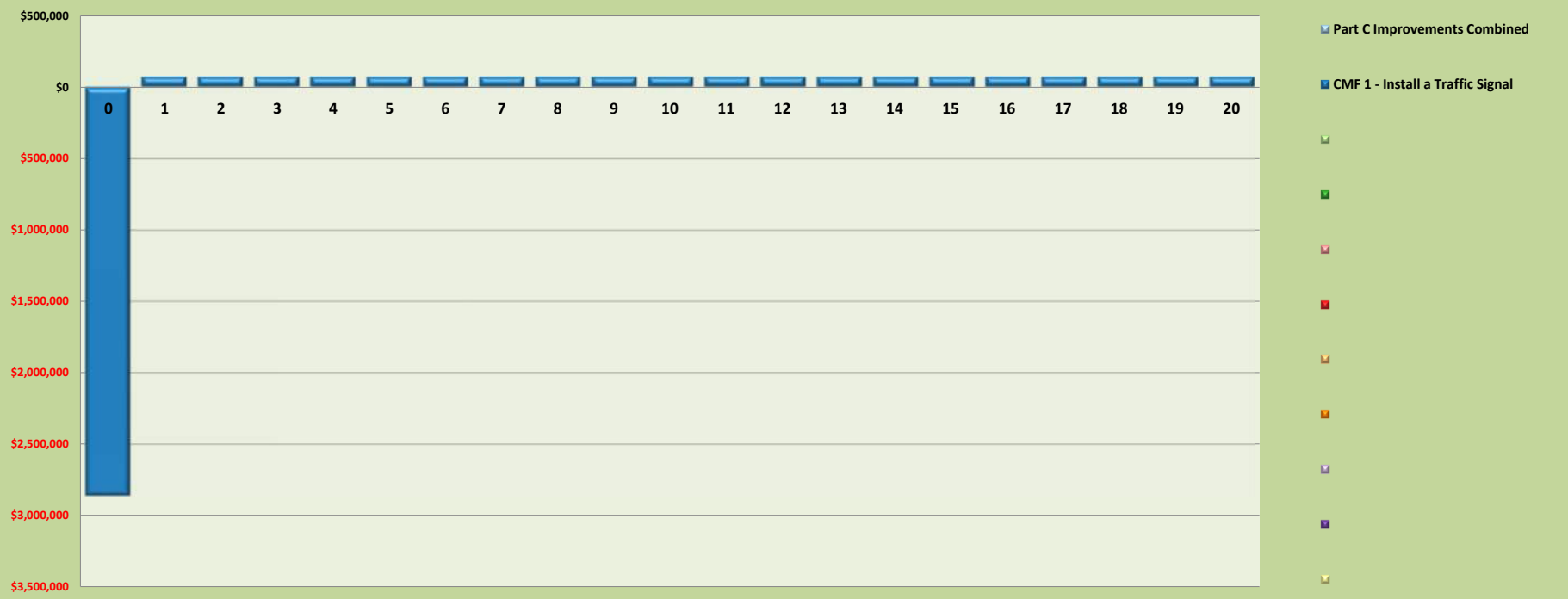
Net Present Value of Project	$2,865,864.00
Net Present Value of Safety Benefits	$952,405.37
Net Benefit	($1,913,458.63)
Benefit / Cost Ratio	0.33

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.032
Number of Injury Crashes	-0.727
Number of Total Crashes	-2.505

Comments:

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



Safety Benefit - Cost Analysis

General Information

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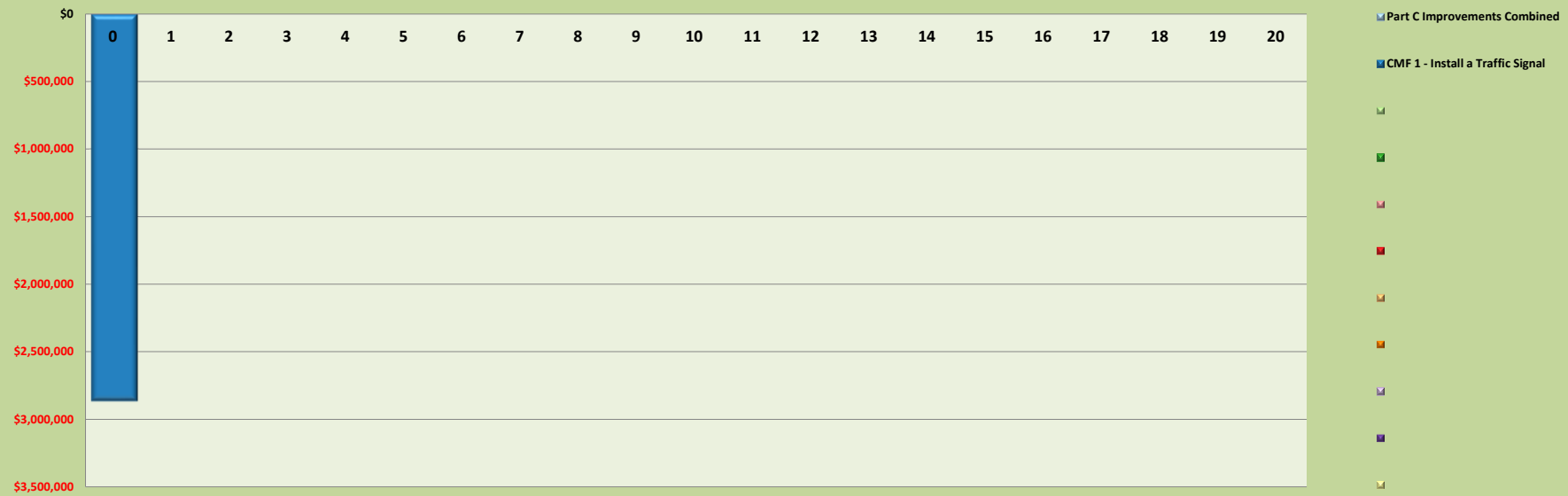
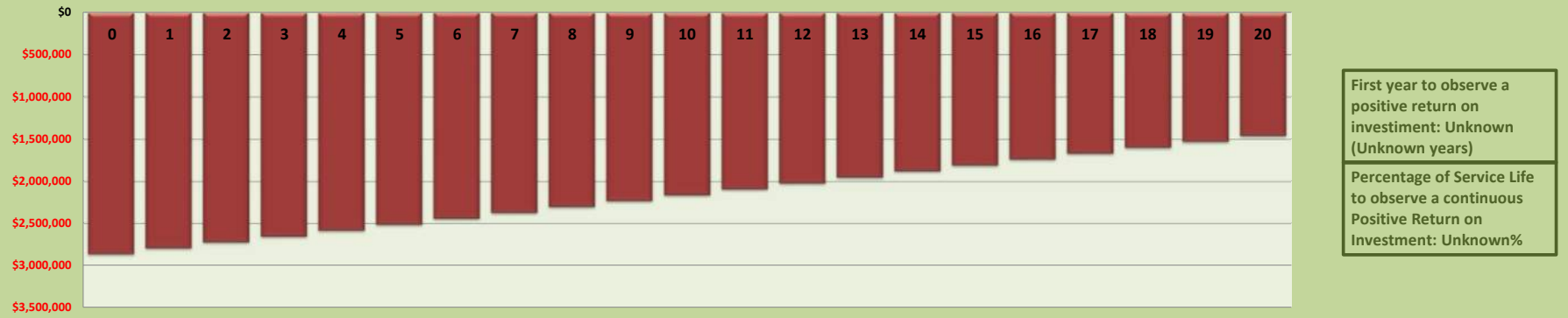
Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: Unknown (Unknown years)

Percentage of Service Life to observe a continuous Positive Return on Investment: Unknown%

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

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

All Sites

Comments:

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
Site Characteristic Improvements (i.e. Lane widening)		$0.00			$0.00	$0.00	0.000	$0
Site Characteristic Improvements (i.e. Lighting)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Signal Phasing)		$0.00			$0.00	$0.00		
Site Characteristic Improvements (i.e. Added Right Turn Lane)		$0.00			$0.00	$0.00		
CMF 1 - Convert Intersection to Roundabout	25	$1,962,292.00			$1,962,292.00	$1,962,292.00	-0.843	$1,080,882
CMF 2 - Conversion of Intersection to Roundabout	25	$1,962,292.00			$1,962,292.00	$1,962,292.00	-2.266	$360,163
		$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		**$3,924,584.00**	**$0.00**	**$0.00**	**$3,924,584.00**	**$3,924,584.00**	**-3.109**	**$1,441,045**

Safety Benefit - Cost Analysis

General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Benefit - Cost Calculator

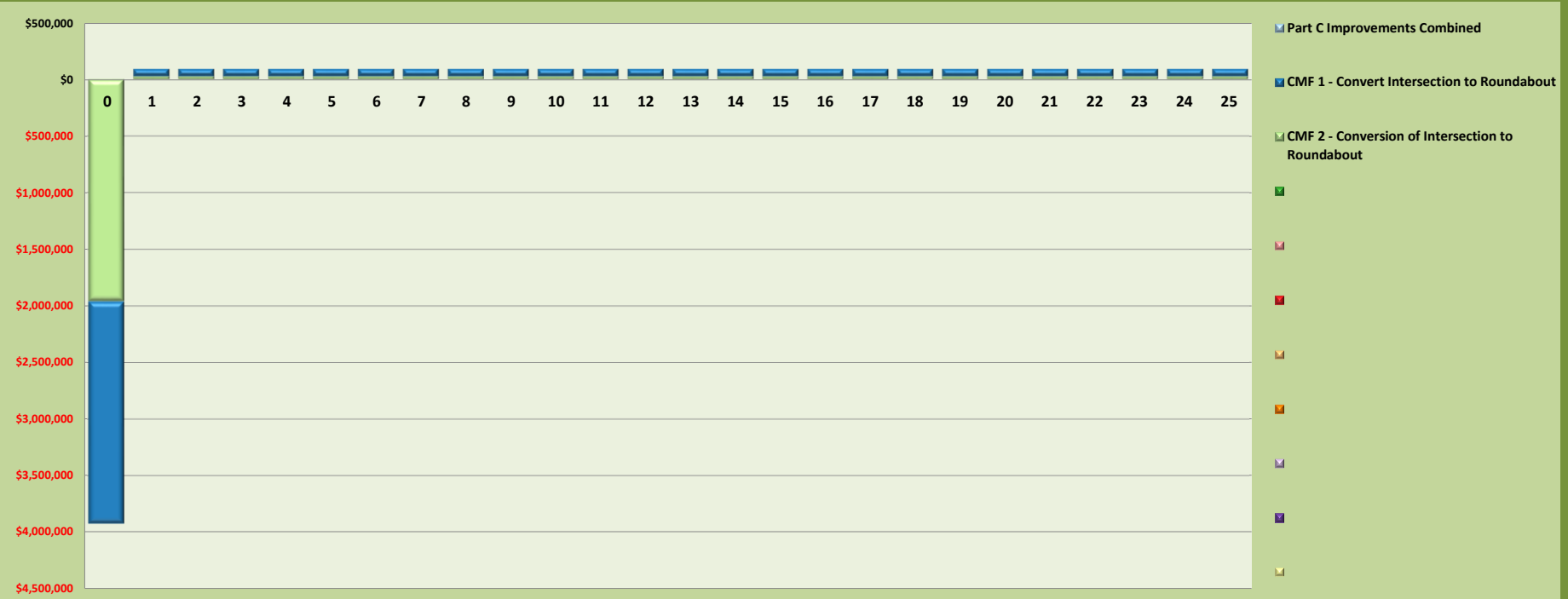
Net Present Value of Project	$3,924,584.00
Net Present Value of Safety Benefits	$1,441,044.75
Net Benefit	($2,483,539.25)
Benefit / Cost Ratio	0.37

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.059
Number of Injury Crashes	-0.843
Number of Total Crashes	-3.109

Comments:

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

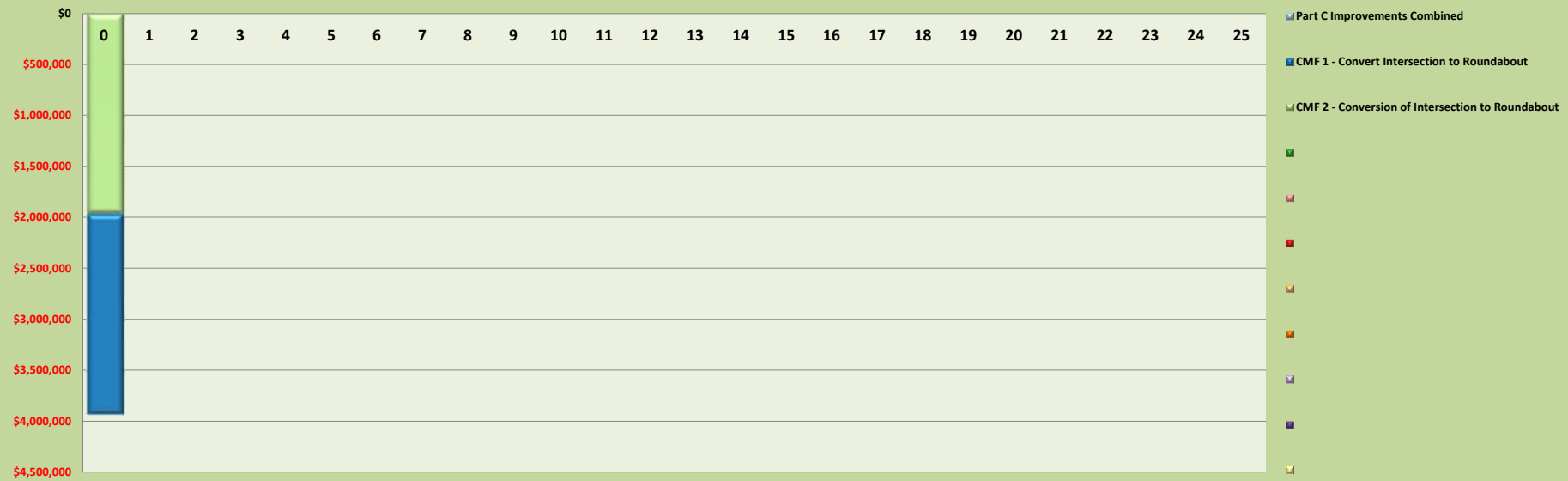


Safety Benefit - Cost Analysis

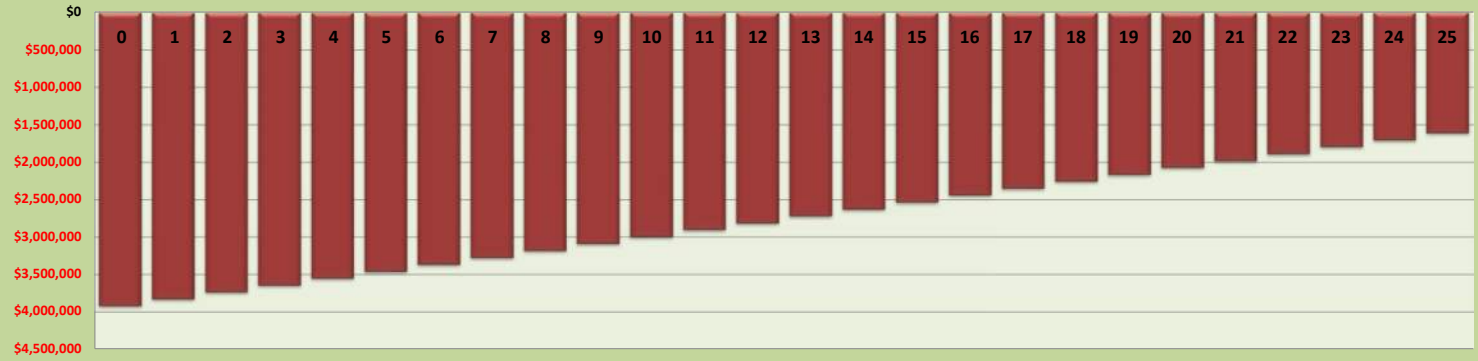
General Information

Project Name	PID 113190	Contact Email	ghansel@cmtengr.com
Project Description	Catalpa Dr at Siebenthaler Ave Safety Study	Contact Phone	(614) 468-1213
Reference Number	PID 113190	Date Performed	5/12/2023
Analyst	GSH	Analysis Year	2050
Agency/Company	CMT		

Project Costs Only Cash Flows By Countermeasure Per Year



Return on Investment (Safety Benefits and Project Investments)



First year to observe a positive return on investiment: Unknown (Unknown years)

Percentage of Service Life to observe a continuous Positive Return on Investment: Unknown%