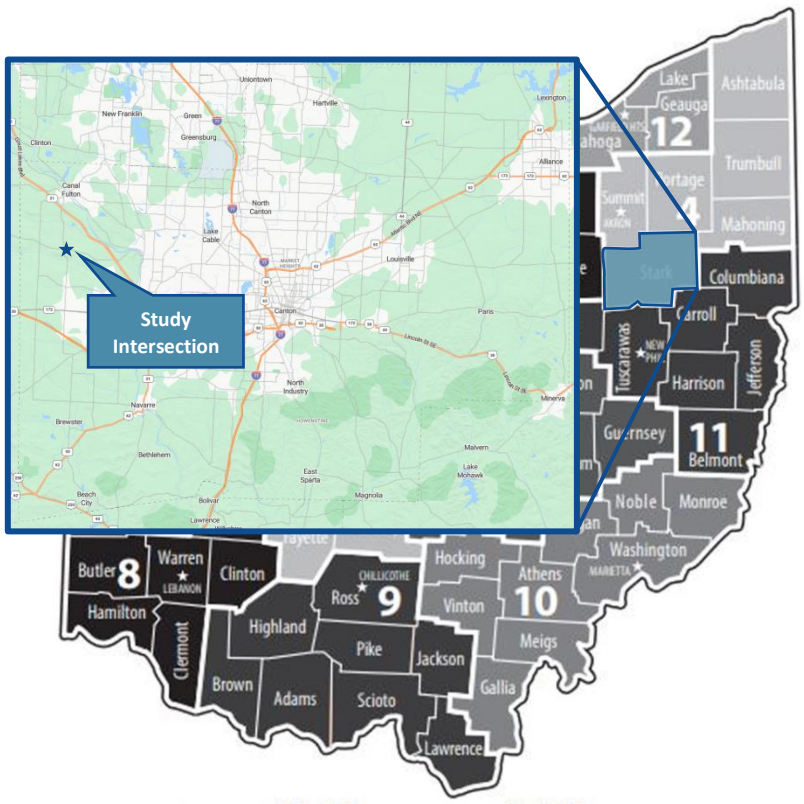
STA-93-15.07 | SAFETY STUDY

STA-93 at Orrville Street

ODOT District 4

August 13th, 2024



Engineers, Surveyors, Planners, Scientists
5500 New Albany Rd., Columbus, OH 43054
p. 614.775.4500 f. 614.775.4800
emht.com

2021-1202 | WO 4-26-4

EMH&T

TABLE OF CONTENTS

EMH&T

FIGURES

TABLES

APPENDICES

1.0 EXECUTIVE SUMMARY

1.1 Background

The study intersection is located in Stark County, Ohio on State Route (SR) 93 (Manchester Ave) at the intersection with Orrville St NW. The study area is rural with SR 93 approach speeds of 55 MPH and minor approach speeds of 40 MPH. The intersection is currently two-way stop controlled on the minor street approaches. SR 93 intersects Orrville St NW through a horizontal curve forming a skew of approximately 12 degrees on the north leg of the intersection. There are also vertical curves present on each leg approaching the intersection. The intersection has a crash history with a high frequency of angle crashes compared to other crash types. Over a recent five-year period, 56% of angle crashes at the intersection resulted in injuries, including one fatal angle crash.

1.2 Purpose and Need

The intersection of SR 93 (Manchester Ave) at Orrville Street NW is ranked #99 on the 2024 Ohio Department of Transportation (ODOT) Highway Safety Improvement Program (HSIP) Priority List for rural intersections. The purpose of this study is to identify crash trends, develop and examine potential countermeasures, and evaluate those countermeasures using Highway Safety Manual methodology and cost-benefit analyses.

1.3 Overview of Safety Concerns

Crash data at the intersection was provided by ODOT District 4 for a five-year period from 2019 to 2023. An average of 4.4 crashes occurred per year with 45% of all crashes resulting in injuries. There was one fatality, in 2019, when a vehicle traveling eastbound on Orrville St NW failed to yield to through traffic on southbound SR 93. The most prominent crash type at the intersection was angle crashes (73%). The majority of angle crashes had a contributing factor of failure to yield, not failure to stop, indicating drivers on Orrville St NW are not selecting appropriate gaps in through traffic before attempting to enter or cross SR 93. Furthermore, 75% of angle crashes involved vehicles traveling southbound on SR 93 indicating possible sight distance issues related to the horizontal curve along SR 93 at the intersection.

1.4 Recommended Countermeasures

Considered countermeasures to help mitigate crashes at the study location included the following:

- Installation of Dedicated Turn Lanes
- Installation of Traffic Signal
- Conversion of Two-way Stop Control to an All-way Stop Control
- Installation of a Modern Single-lane Roundabout

Peak hour turning movements were below the thresholds to warrant the addition of any dedicated turn lanes for the intersection, thus, this countermeasure was dismissed. In accordance with the Ohio Manual of Uniform Traffic Control Devices (OMUTCD), the intersection does not satisfy the criteria for a traffic signal to be warranted at the intersection. The all-way stop control and roundabout alternatives were further analyzed based on safety, capacity, and benefit to cost results to determine the best countermeasure for the study area.

Based on the results of an Intersection Control Evaluation, crash patterns, and the intersection site characteristics, the installation of a modern single lane roundabout is the recommended

countermeasure for SR 93 and Orrville St NW. A modern single-lane roundabout would cost approximately $2,734,000 in construction cost and is expected to reduce crashes to 0.80 crashes/year with a safety benefit to cost ratio of 1.01. Implementing a roundabout would require right-of-way and is estimated to cost $80,000 to acquire the necessary right-of-way.

2.0 PURPOSE AND NEED

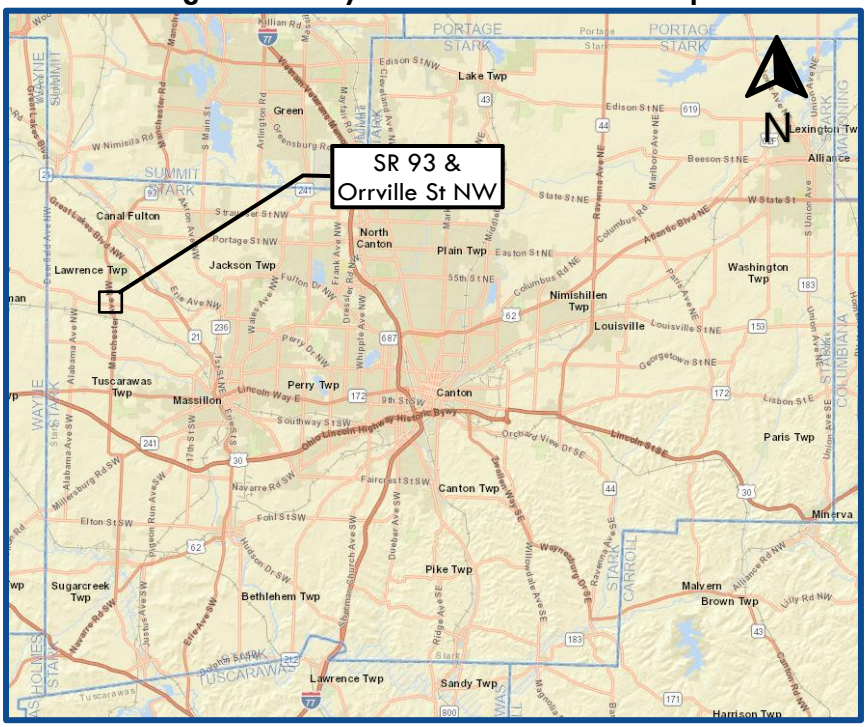
This study analyzes the intersection of SR 93 and Orrville Street NW located in Stark County. This intersection is ranked #99 on the 2024 Ohio Department of Transportation (ODOT) Highway Safety Improvement Program (HSIP) Priority List for rural intersections. From 2019 to 2023, the intersection experienced 22 crashes with the majority (16) being angle crashes. Eight of the angle crashes during this period resulted in injury. One angle crash (2019) resulted in a fatality.

The purpose of this study is to identify crash trends, develop and examine potential countermeasures, and evaluate those countermeasures using Highway Safety Manual methodology and cost-benefit analyses. Methodology, results, and recommendations are included below.

3.0 EXISTING CONDITIONS

The study site is the intersection of SR 93 and Orrville St NW in Stark County, ODOT District 4. The intersection is located in a rural area of Lawrence Township, approximately four miles northwest of the City of Massillon. SR 93 is oriented in a north-south direction while Orrville St NW is aligned in an east-west direction. A location map of the study intersection is provided in **Figure 1**.

Figure 1: Study Intersection Location Map



3.1 Roadway Information

In the study area, SR 93 is an undivided two-lane roadway with approximately eleven-foot wide lanes and two-foot wide paved shoulders. There are currently no posted speed limit signs in the study area along SR 93 indicating a 55 MPH prima facie speed. ODOT's Transportation Information Mapping System (TIMS) classifies the roadway as a Rural Minor Arterial. TIMS indicates that two short-term count stations were placed on SR 93 near the intersection in 2023. The listed Annual Average Daily Traffic (AADT) volume was 6,745 vehicles per day, 0.07 miles north of the intersection, and 4,092 vehicles per day 0.61 miles south of the intersection.

Orrville St NW is an undivided two-lane roadway with approximately ten-foot wide lanes and two-foot wide paved shoulders. There are posted speed limit signs of 40 MPH for both directions of travel on Orrville St NW, and the roadway is classified as a Rural Major Collector. TIMS shows two short-term count stations were located on Orrville St NW both east and west of the intersection. The 2023 AADT was 2,331 vehicles per day, 0.73 miles west of the intersection, and 1,823 vehicles per day, 0.59 miles east of the intersection.

3.2 Intersection Geometry and Conditions

The SR 93/Orrville St NW Study intersection is two-way stop-controlled on the minor roadway approaches (Orrville St NW). The Stark County DESTAPE lists the intersection located at SR 93 County Logpoint 15.07. SR 93 intersects Orrville St NW through a horizontal curve forming a skew of approximately 12 degrees on the north leg of the intersection. There are minor vertical curves present for each leg approaching the intersection. No dedicated turn lanes are present on any approach. In 2023, all approaches of the intersection received very good pavement condition ratings, as defined by the ODOT pavement condition rating scale, ranging from 97 to 99. Current intersection lighting consists of one overhead light located on a wooden utility pole in the southwest quadrant.

The northbound and southbound approaches of SR 93 have dual combination horizontal alignment/intersection warning signs. A 45 MPH advisory speed plaque is attached to the intersection warning sign posts on the northbound approach. The eastbound and westbound approaches have dual-posted Stop Ahead warning signs in advance of the intersection as well as dual-posted stop signs at the intersection for both directions. All four stop signs have red sign post reflectors. In May of 2024, the stop bar at the westbound approach was worn but in fair condition, however, the eastbound stop bar was in poor condition and not visible at the intersection. An existing conditions diagram showing roadway characteristics at the intersection is provided in **Appendix A**.

The intersection is rural in character with multiple access points to single-family residences on all approaches. There is one business present in the southwest quadrant which currently has three access drives, 2 along the eastbound approach of Orrville St NW and one on the south leg of SR 93. Along the west leg of the intersection, there are 6 driveways within 500 feet of the intersection, including one business access driveway located approximately 14 feet from the eastbound stop bar. There are no pedestrian or bicyclist facilities such as crosswalks or shared use paths present at the intersection. No approaches of the study area are part of the State or US Bike Route System. **Figure 2** shows an aerial overview of the study intersection in 2021.

Figure 2: Study Intersection Aerial View

4.0 TRAFFIC DATA AND PROJECTIONS

Recent turning movement counts were collected at the intersection and provided to EMH&T by ODOT District 4. The traffic count was taken on Thursday, January 11, 2024 from 7:00 AM to 7:00 PM. The AM and PM peak hours were identified as 7:00 AM to 8:00 AM and 3:45 PM to 4:45 PM, respectively. As outlined below, the traffic counts were used to develop traffic projections in accordance with the Ohio Traffic Forecasting Manual, for an Opening Year of 2027 and Horizon Year of 2047.

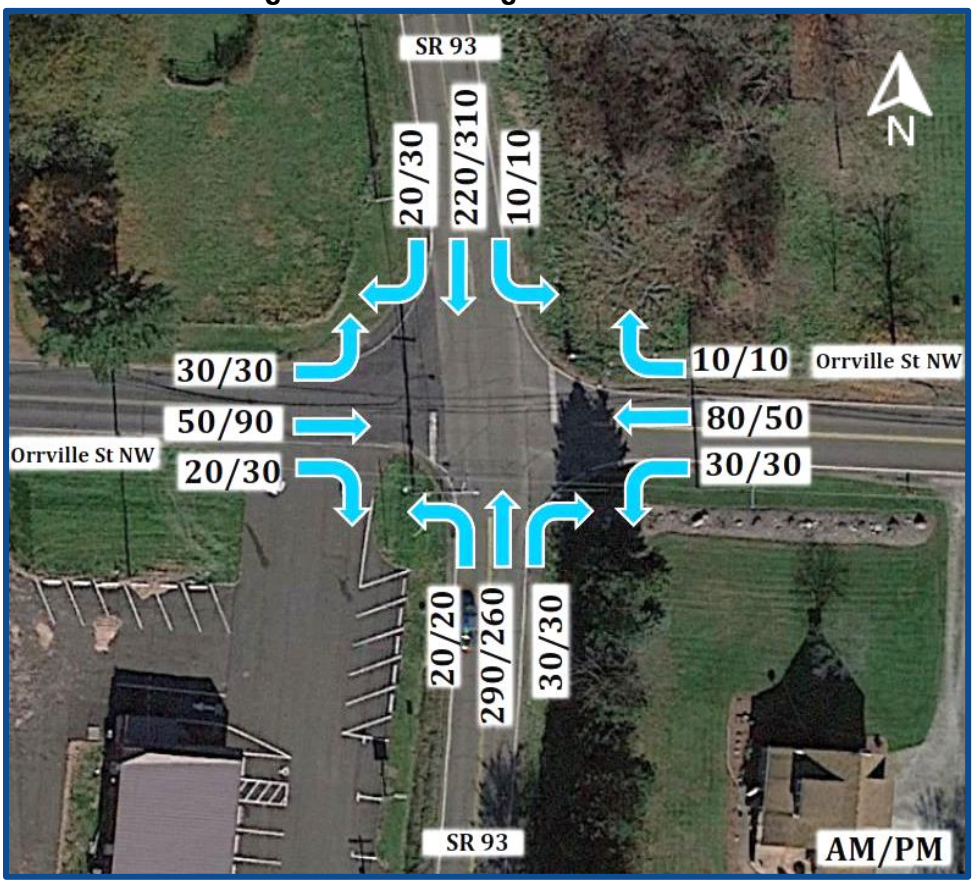
The 2024 AADT for the intersection was estimated using ODOT's Partial Count Factor Form. An expansion factor was applied to the partial day traffic count to estimate the 24-hour turning movement volumes. The calculated ADT was then seasonally adjusted using the factors contained in the Seasonal Adjustment Factor Report.

The surrounding area of the intersection is expected to have low traffic growth rates. Growth rates for each approach were obtained from the Stark County Area Transportation Study (SCATS). The annual growth rates were estimated using Travel Demand Forecasting models and are as follows:

- East leg 0.03%
- North leg 0.15%
- West leg 0.07%
- South leg 0.13%

Design hour traffic volumes were developed by applying a Peak Hour to Design Hour Factor to the raw count data for the AM and PM peak hours. The Peak Hour to Design Hour Factors used were determined using ODOT's 2022 Peak Hour to Design Hour Factor Tables and based on the date of the count data as well as the functional classification of each approach. The annual growth rate for each approach was applied linearly to develop the opening year and horizon year AM and PM peak hour traffic. The final volumes were rounded to the nearest 10 to indicate level of precision. Design hour volumes can be seen below in **Figure 3**.

Figure 3: 2047 Design Hour Volumes



Raw traffic count data, seasonal adjustment factors, partial count factor form, growth rate correspondence, peak hour to design hour factor tables, and Design Hour Volume traffic plates are provided in **Appendix B**.

5.0 CRASH DATA

5.1 Crash Data Summary

Crash data at the intersection was provided by ODOT District 4 for a five-year period from 2019 to 2023. The crash data was analyzed using ODOT's Crash Analysis Module (CAM) Tool. A collision diagram showing all reporting crashes within the time period was provided to EMH&T by ODOT District 4 and is provided in **Appendix C**.

A total of 22 crashes were reported at the intersection over the specified five-year period. Angle crashes were the most predominant crash type and accounted for 73% of all reported crashes. There were 9 crashes that resulted in injuries. There was one fatality, in 2019, when a vehicle traveling eastbound on Orrville St NW failed to yield to through traffic on southbound SR 93. The majority of angle crashes occurred from westbound traffic stopped on Orrville St NW failing to yield to free-flowing traffic southbound on SR 93. There is no indication that road conditions are a main contributing factor to crashes in the study area as 86% occurred on dry pavement. **Table 1** shows a summary of the crash data for the study intersection.

Table 1: Crash Data Summary Tables for SR 93 and Orrville St NW

Year	Crashes	%
2019	4	18%
2020	4	18%
2021	5	23%
2022	6	27%
2023	3	14%
Grand Total	22	100%

Crash Type	Crashes	%
Angle	16	73%
Rear End	2	9%
Left Turn	2	9%
Right Turn	1	5%
Parked Vehicle	1	5%
Grand Total	22	100%

Road Condition	Crashes	%
Dry	19	86%
Wet	3	14%
Grand Total	22	100%

Unit 1 Contributing Factor	Crashes	%
Failure to Yield	13	59%
Ran Stop Sign	5	23%
Following Too Closely/ACDA	2	9%
None	1	5%
Other Improper Action	1	5%
Grand Total	22	100%

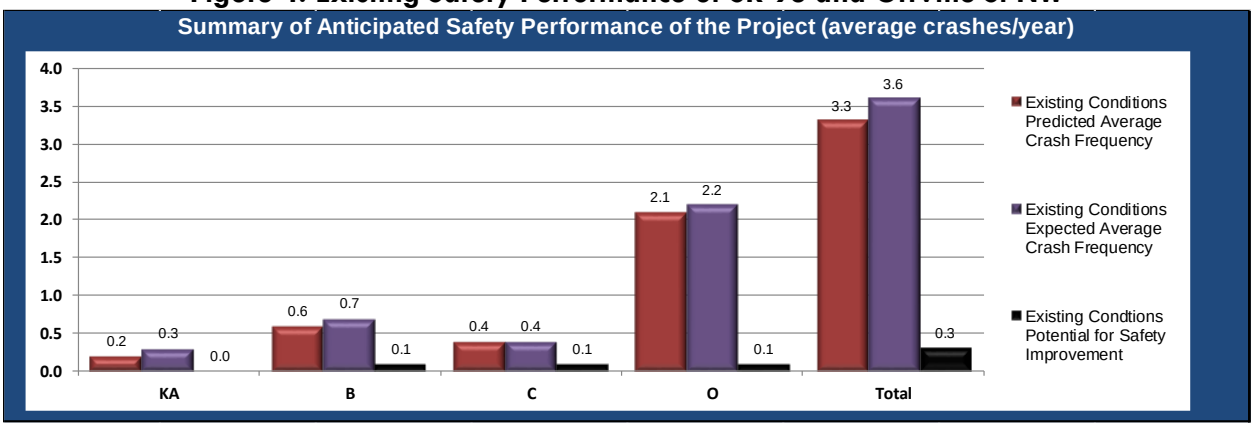
Crash Severity	Crashes	%
Fatal	1	5%
Serious Injury	1	5%
Minor Injury	7	32%
Injury Possible	1	5%
PDO/No Injury	12	55%
Grand Total	22	100%

5.2 Safety Analysis

The Highway Safety Manual (HSM) predictive method for rural intersections was applied to the study area to compare its safety performance to similar intersections. The expected and predicted crash frequency as well as the potential for safety improvement at the intersection was determined using the ODOT Economic Crash Analysis Tool (ECAT). Parameters entered into ECAT included the estimated 2024 AADT, existing intersection characteristics, and CAM Tool crash data. Figure 4

shows the existing safety performance of the intersection. Expected crash frequency for the intersection is higher than predicted, indicating a positive Potential for Safety Improvement.

Figure 4: Existing Safety Performance of SR 93 and Orrville St NW



5.3 Contributing Factors and Potential Countermeasures

Angle crashes were the most common crash type at the intersection. All of these crashes occurred due to a vehicle on the minor approach unsuccessfully attempting to enter or cross SR 93. Approximately 70% of the angle crashes were due to failure to yield, as opposed to failure to stop. This indicates the high frequency of this crash type could be due to sight distance issues from horizontal and vertical curves along SR 93 as well as high speeds. There were two other "failure to yield" crashes which involved a left turning vehicle failing to yield to oncoming traffic. This could be due to vehicles failing to gauge an appropriate gap in oncoming traffic due to pressure of building queues behind them.

Rear end crashes accounted for 9% of the intersection crash types. These collisions occurred on northbound SR 93 when a northbound vehicle was attempting to turn onto Orrville St NW. The remaining crash types included one right turn collision, and one collision with an improperly parked vehicle. There is no apparent pattern for these crash types, specific to the intersection.

Multiple countermeasures were considered as alternatives to mitigate crash frequency and severity in the study area. Potential countermeasures for SR 93 and Orrville St NW include:

- **Installation of exclusive turn lanes:** This countermeasure has potential to decrease rear end crashes involving vehicles slowing in the through lanes in attempts to turn onto the minor approach as well as crashes related to queue build up.
- **Installation of a Traffic Signal**: Installing a signal at this location would eliminate the need for drivers on the minor street approaches of Orrville St NW to determine an appropriate gap, thus likely decreasing the number of angle collisions at this intersection.
- **Converting intersection to All Way Stop Control**: Converting a minor-street stop-controlled intersection to All-Way stop control is used to alleviate crash patterns with high frequencies of frontal impact crashes.
- **Installation of a single lane roundabout**: Roundabouts use channelized curves to reduce travel speeds and minimize conflict points with a circular yield-controlled configuration. This countermeasure is effective at addressing angle crashes reducing severity of intersection crashes.

6.0 TRAFFIC ANALYSIS

6.1 Potential Countermeasure Suitability

6.1.1 Turn Lane Warrants

Turn lane warrants were analyzed for the free flow approaches (SR 93) of the intersection, as outlined in ODOTs Location and Design Manual. The turn lane warrant analysis showed that no left turn lanes or right turn lanes are warranted for the intersection. Horizon year (2047) traffic volumes were used for the analysis, however, peak hour turning volumes were lower than warrant thresholds. Therefore, exclusive turn lanes are not an appropriate countermeasure for the study area.

6.1.2 Signal Warrant

A traffic signal warrant analysis was performed for the intersection using the methodology in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD). Traffic signals should be installed only if an intersection meets the criteria specified in at least one of the nine warrants identified in the OMUTCD. **Table 2** presents a brief description of the OMUTCD signal warrants and whether or not they were evaluated as part of this study.

Table 2: Signal Warrants Evaluated for SR 93 and Orrville St NW

Signal Warrant	Analyzed or Not Applicable
Warrant 1: Eight Hour Vehicular Volume	Analyzed
Warrant 2: Four Hour Vehicular Volume	Analyzed
Warrant 3: Peak Hour	Analyzed
Warrant 4: Pedestrian Volume	Not Applicable
Warrant 5: School Crossing	Not Applicable
Warrant 6: Coordinated Signal System	Not Applicable
Warrant 7: Crash Experience	Analyzed
Warrant 8: Roadway Network	Not Applicable
Warrant 9: Intersection Near a Grade Crossing	Not Applicable

The 2024 collected traffic count volumes were used to evaluate the intersection against signal warrant criteria. Traffic signal warrants were performed with right turn reduction applied per the ODOT Traffic Engineering Manual procedures and 100% volumes as well as high-speed 70% volume thresholds. Based on the results of the traffic signal warrant evaluation, no warrants were satisfied at the intersection at 100% or 70% volume thresholds. Installing a traffic signal at the intersection is not warranted or recommended as an appropriate countermeasure. Results of this analysis are summarized in **Table 3**. Detailed Signal Warrant analysis, TWSC warrant analysis, and Turn-lane warrant results are provided in **Appendix D**.

Table 3: Signal Warrant Result Summary for SR 93 and Orrville St NW

Signal Warrant	100% thresholds	70% thresholds	Warrant satisfied?
Warrant 1: Eight Hour Vehicular Volume	Condition A: 0 hours met Condition B: 0 hours met	Condition A: 1 hour met Condition B: 0 hours met	NO
Warrant 2: Four Hour Vehicular Volume	0 hours met	0 hours met	NO
Warrant 3: Peak Hour	0 hours met	0 hours met	NO
Warrant 7: Crash Experience	-	-	NO

6.1.3 All Way Stop Warrant

The criteria for implementing an All Way Stop Control (AWSC) at an intersection is outlined in the OMUTCD Section 2B.07. The evaluation guidelines consist of crash experience and minimum volume thresholds. A brief description of each criteria and how it weighs at the intersection is shown below in **Table 4**.

Table 4: All-Way Stop Installation Criteria Results for SR 93 and Orrville St NW

ALL-Way Stop Criteria	Criteria Satisfied?
Criteria A: Interim measure for warranted signal	NO
Criteria B: 5 or more correctable crashes in a 12-month period	YES
Criteria C: Minimum vehicle or pedestrian volumes met for any 8 hours	NO
Criteria D: 80% threshold of volumes and crash experience	NO

The only criteria satisfied that supports the installation of an AWSC intersection was Criteria B, regarding crash experience. In the evaluated five-year period (2019-2023), only one 12-month period satisfied Criteria B, which consisted of 5 correctable crashes that occurred in 2021. The other four years did not meet Criteria B as they had less than 5 correctable crashes per year. AWSC may be considered when traffic volumes for all approaches are approximately equal and, in this case, traffic volumes on SR 93 are more than twice as high as the volumes on Orrville St NW. Additionally, the intersection is located in the middle of a 6-mile stretch of SR 93 where vehicles are not otherwise required to stop for any minor road approaches. Careful consideration to travel speeds for free flow traffic and traffic volumes are needed before changing an intersection to AWSC.

6.1.4 Roundabout

Roundabouts are designed to maximize safety and reduce traffic congestion. The installation of a roundabout would reduce the frequency and severity of intersection crashes by reducing the number of conflict points. Roundabouts require more space than other intersection control alternatives and would require some access management and additional right-of-way. Installation of a modern single-lane roundabout would be an appropriate countermeasure to mitigate the crash patterns occurring at the intersection.

6.2 Capacity Analysis

Intersection capacity was evaluated to assess existing intersection operations and to identify deficiencies that may contribute to the occurrence of crashes. EMH&T used Highway Capacity Software (HCS), Version 8.3 to evaluate Level of Service (LOS) and delay for the existing conditions and potential countermeasures of the intersection. For this analysis, LOS D or better was considered acceptable per the standards found in the ODOT Analysis and Traffic Simulation (OATS) Manual.

Build year (2027) and Horizon year (2047) Design Hour Volumes were analyzed for both AM and PM peak hour scenarios. Peak hour factors and heavy vehicle percentages for each approach were calculated based on the raw partial day count volumes and are shown in **Appendix B** for reference. **Table 5** displays a summary of the LOS and delay results for each alternative. Full capacity analysis reports are presented in **Appendix E.**

Table 5: LOS & Delay Results Summary of Existing Conditions & Countermeasures

2027 AM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/19.9	0.32	37.0 / 0.01	B/10.4	0.19	18.5 / 0.01	A/5.0	0.12	10.6 / 0.01
WB Approach	C/21.1	0.38	46.1 / 0.02	B/10.7	0.22	23.0 / 0.01	A/5.6	0.16	15.4 / 0.01
NB Approach	A/0.3	0.01	0.0 / 0.0	B/14.1	0.54	86.5 / 0.03	A/6.2	0.33	36.7 / 0.01
SB Approach	A/0.4	0.01	0.0 / 0.0	B/12.1	0.41	54.4 / 0.02	A/5.8	0.26	27.2 / 0.01
Intersection	-	-	-	B/12.5	-	-	A/5.8	-	-

2027 PM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/22.0	0.44	52.5 / 0.01	B/10.9	0.26	25.0 / 0.01	A/5.5	0.17	15.0 / 0.01
WB Approach	C/22.1	0.32	33.5 / 0.02	B/10.3	0.16	15.5 / 0.01	A/4.8	0.10	7.7 / 0.01
NB Approach	A/0.7	0.02	0.0 / 0.0	B/12.9	0.47	64.5 / 0.02	A/5.8	0.28	31.0 / 0.01
SB Approach	A/0.3	0.01	0.0 / 0.0	B/14.0	0.53	80.6 / 0.03	A/6.0	0.31	33.8 / 0.01
Intersection	-	-	-	B/12.7	-	-	A/5.7	-	-

2047 AM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/21.4	0.35	39.6 / 0.01	B/10.5	0.19	18.5 / 0.01	A/5.1	0.12	10.6 / 0.01
WB Approach	C/22.8	0.41	48.6 / 0.02	B/10.8	0.23	23.0 / 0.01	A/5.7	0.16	15.4 / 0.01
NB Approach	A/0.6	0.02	0.0 / 0.0	B/14.7	0.56	94.3 / 0.03	A/6.3	0.34	39.3 / 0.01
SB Approach	A/0.4	0.01	0.0 / 0.0	B/12.5	0.43	59.8 / 0.2	A/6.0	0.24	29.9 / 0.01
Intersection	-	-	-	B/12.9	-	-	A/6.0	-	-

2047 PM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/22.9	0.45	55.0 / 0.01	B/11.0	0.26	27.5 / 0.01	A/5.6	0.17	15.0 / 0.01
WB Approach	C/23.1	0.33	36.1 / 0.02	B/10.4	0.17	15.5 / 0.01	A/4.8	0.10	7.7 / 0.01
NB Approach	A/0.7	0.02	0.0 / 0.0	B/13.3	0.49	69.7 / 0.2	A/5.9	0.29	31.0 / 0.01
SB Approach	A/0.3	0.01	0.0 / 0.0	B/14.5	0.55	88.4 / 0.03	A/6.1	0.32	36.4 / 0.01
Intersection	-	-	-	B/13.0	-	-	A/5.8	-	-

The results indicate all approaches will operate at an acceptable LOS in 2027 and 2047 under the existing conditions. AWSC Build alternative also operates at an acceptable LOS, however, the northbound and southbound approaches of SR 93 have a notable increased delay compared to the existing conditions. The roundabout alternative has the shortest overall vehicle delay between

all analyzed scenarios. A single lane roundabout is expected to operate at LOS A with 6.3 seconds or less delay for any approach.

7.0 COMPARISION OF CONSIDERED COUNTERMEASURES

7.1 ECAT

The considered countermeasures were evaluated on safety performance using ODOT's ECAT, just as the existing conditions were evaluated. The ECAT process involves calculating the predicted crash frequency of locations similar to the intersection and considers recent crash experience to utilize a mathematical modeling process as defined in the HSM. Crash modification factors (CMF) are used in ECAT to calculate the expected reduction in crashes for each countermeasure. The analysis assumed the same conditions as the existing intersection such as AADT, presence of turn lanes, and other intersection site specific characteristics. ECAT was then used to conduct a safety benefit to cost analysis for the considered countermeasures based on an estimated construction cost. A summary of the ECAT results for each considered countermeasure is discussed below. Full ECAT results can be found in **Appendix F.**

7.1.1 All Way Stop

ECAT has multiple preloaded CMF's available for selection that are obtained from CMF Clearinghouse. The preloaded CMF (ID 315) for converting a TWSC to an AWSC in ECAT changes depending on the crash type and is based on urban and rural intersection types. Because the study intersection is in a rural area with high speeds on the free-flow approach, the preloaded CMF was not used for analysis. The selected CMF referenced is from the same CMF ID (315) published by Clearinghouse, however, it represents rural intersections and has a CMF of 0.52 for all crash types and severities. Details for the selected CMF are presented in **Appendix F**. The average total expected crashes per year was reduced from 3.6 to 1.9. **Figure 4** shows the predicted crash frequency by severity for the AWSC countermeasure. To complete the benefit to cost analysis, an initial cost of $50,000 was estimated for the AWSC conversion. The ECAT benefit to cost analysis results are shown in **Figure 5.**

Figure 5: All-Way Stop ECAT Safety Performance Summary

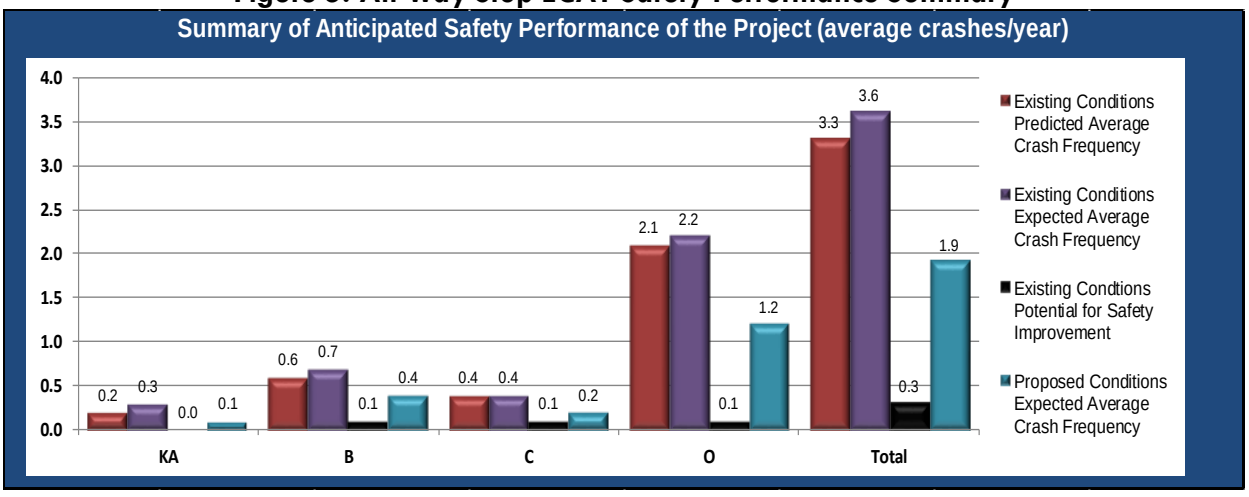


Figure 6: All Way Stop ECAT Benefit to Cost Summary

Benefit - Cost Calculator	
Net Present Value of Project	$50,000.00
Net Present Value of Safety Benefits	$432,599.47
Net Benefit	$382,599.47
Benefit / Cost Ratio	8.65

7.1.2 Roundabout

The CMF when converting a minor-road stop control intersection to a modern rural roundabout is 0.29 for non-injury crashes and 0.13 for all other crashes. The average total expected crashes per year was reduced from 3.6 to 0.8. **Figure 7** shows the predicted crash frequency by severity for the roundabout countermeasure. To complete the benefit to cost analysis, an initial cost of $2,734,000 was estimated for the roundabout conversion. A detailed breakdown of this cost estimate is provided in **Appendix G.** The ECAT benefit to cost analysis results are shown in **Figure 8.** The cost estimates inputted into ECAT includes $80,000 of estimated right-of-way costs which will be required as a result of the improvements.

Figure 7: Roundabout ECAT Safety Performance Summary

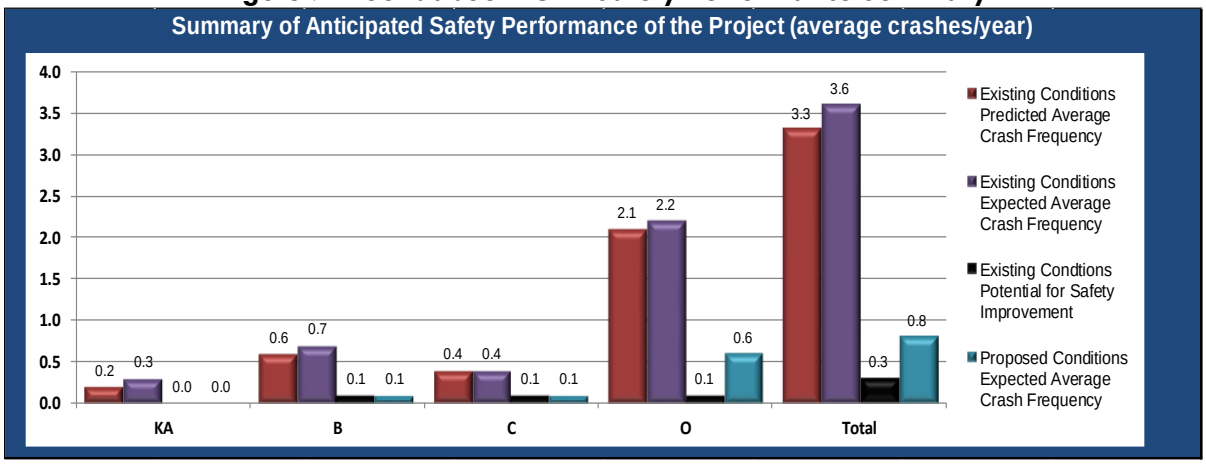


Figure 8: Roundabout ECAT Benefit to Cost Summary

Benefit - Cost Calculator	
Net Present Value of Project	$2,814,000.00
Net Present Value of Safety Benefits	$2,855,663.07
Net Benefit	$41,663.07
Benefit / Cost Ratio	1.01

The Benefit Cost ratio for both considered countermeasures are greater than 1.0 and are expected to have a positive return on investment. The benefit to cost ratio presented by ECAT is limited to crash related costs. The roundabout alternative has a higher annual crash reduction factor and is expected to reduce crashes to less than 1 crash per year. The AWSC alternative is expected to have 1.9 crashes per year. Studies by the Federal Highway Administration (FHWA) show that roundabouts not only achieve a reduction in crashes but also reduce serious injury and deadly crashes by nearly 90% at two-way stop intersections.

7.2 Cap-X Tool

The Capacity Analysis for Planning of Junctions (CAP-X) Tool is used for planning-level traffic operations analysis and can be used to screen the number of feasible intersection control alternatives. Along with guidance from ODOT District 4, CAP-X was used to conduct further analysis of the considered countermeasure to determine the best alternative for the study intersection. The CAP-X Tool analyzes critical lane volumes to rank the considered alternatives based on volume to capacity ratios and pedestrian/bicycle accommodations. The AM and PM design hour volumes of the Horizon year (2047) were analyzed. The CAP-X results are presented below in **Table 6.** No score for the pedestrian/bicycle accommodations was calculated due to the low amount of existing pedestrian activity at the intersection. The detailed CAP-X analysis can be found in **Appendix H**.

Table 6: CAP-X Results Summary for SR 93 and Orrville St NW

2047 AM Design Hour Volumes			
TYPE OF INTERSECTION	Overall v/c Ratio	V/C Ranking	Pedestrian Accommodations
1 X 1 Roundabout	0.29	1	0.00
Two-Way Stop Control	0.33	2	0.00
All-Way Stop Control	0.71	3	0.00
2047 PM Design Hour Volumes			
TYPE OF INTERSECTION	Overall v/c Ratio	V/C Ranking	Pedestrian Accommodations
1 X 1 Roundabout	0.30	1	0.00
Two-Way Stop Control	0.43	2	0.00
All-Way Stop Control	0.77	3	0.00

The analysis showed the roundabout alternative as the best alternative with respect to volume to capacity ratios. The AWSC alternative presented an unfavorable volume to capacity ratio for the horizon year PM peak hour and was ranked lower than the existing condition for both the AM and PM peak hour analysis.

7.3 Intersection Control Evaluation (ICE)

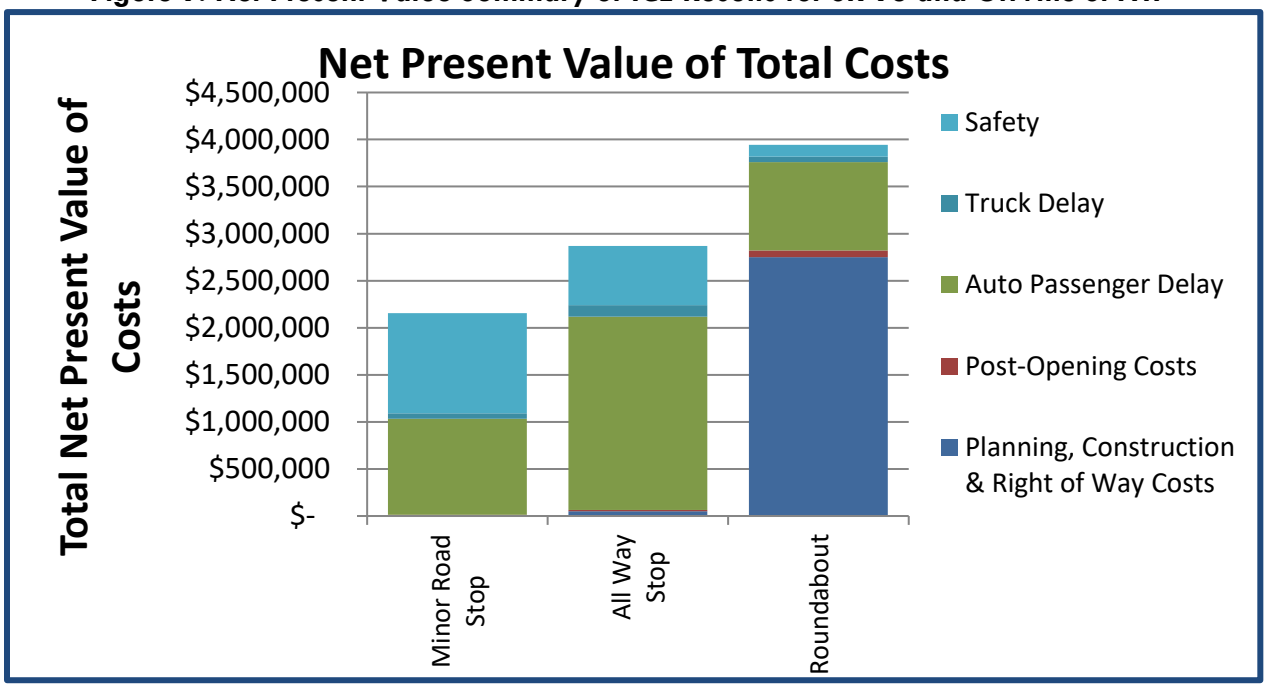
The Intersection Control Evaluation (ICE) methodology is a process that evaluates a combination of traffic control and geometric strategies at intersections. The goal of ICE is to aid the decision making of the roadway agency in identifying and selecting an intersection alternative that meets the project purpose and reflects the overall best value using performance-based criteria. The ICE process is applicable when planning new intersections or upgrading existing intersections. To support ICE, ODOT has developed an ICE Tool which EMH&T used to further evaluate the considered countermeasures for the SR 93 and Orrville St NW intersection.

The ODOT ICE Tool uses quantitative and qualitative analyses to provide life cycle cost comparisons between different intersection alternatives. The comparisons are made between safety, vehicular delay, operations and maintenance, design and construction, and right-of-way costs. Results from the ECAT and CAP-X evaluations were imported into the ICE Tool. Results of the ICE Tool analysis are summarized in **Table 7** and **Figure 9**. Detailed ICE output reports are included in **Appendix I**.

Table 7: ICE Results Summary for SR 93 and Orrville St NW

Benefit Categories	Net Present Value of Benefits Relative to Base Case		
	Minor Road Stop	All Way Stop	Roundabout
Safety B/C		8.69	0.33
Delay B/C		Control Strategy not preferred. Benefits are less than base case and cost is greater than base case.	0.03
Benefit-Cost (B/C) Ratio		Control Strategy not preferred. Benefits are less than base case and cost is greater than base case.	0.36

Figure 9: Net Present Value Summary of ICE Results for SR 93 and Orrville St NW



8.0 CONCLUSIONS AND RECOMMENDATIONS

The intersection of SR 93 and Orrville St NW in Stark County has experienced an average of 4.4 crashes per year over the past 5 calendar years (2019-2023). The majority of these crashes are angle crashes (73%) and approximately half of those crashes resulted in injuries, including one fatality in 2019. Most angle crashes occurred from failure to yield at the stop sign, with two crashes from a failure to stop. The crash history indicates drivers are making poor decisions when selecting an appropriate gap in approaching traffic. The intersection was ranked #99 on the 2024 Ohio Department of Transportation (ODOT) Highway Safety Improvement Program (HSIP) Priority List for rural intersections.

Multiple countermeasures were considered in order to mitigate the crash patterns at the intersection. Foremost, a roundabout was considered. The intersection crash history makes a roundabout an appropriate potential solution. Dedicated turn lanes on SR 93 were considered, however analyses determined no turn lanes are warranted. Similarly, the installation of a traffic signal is not warranted. Following the guidance of the installation of an AWSC intersection, only the crash criteria is satisfied. There are additional concerns of the mainline and side street approaches having disproportionate volumes, and the interruption of the high speed 6-mile continuous stretch of SR 93.

The intersection has vertical and horizontal curves that may impact sight distance, depending where the motorist stops on the minor street approaches. SR 93 has a speed limit of 55 MPH while Orrville St NW is 40 MPH. AWSC intersections do not provide geometric features to slow vehicles and instead rely entirely on traffic control devices. Installing stop control on SR 93 will likely increase rear end crashes on the north/south approaches. While a roundabout is designed with entrance curves to slow down entering traffic.

EMH&T evaluated implementing AWSC and a roundabout as alternatives to alleviate crash frequency and severity, in order to improve safety. AWSC shows an anticipated crash reduction of 1.7 crashes per year, while a roundabout shows a reduction of 2.8 crashes per year. A roundabout is also expected to reduce serious injury crashes, of which there were 45% at the intersection from 2019-2023. Capacity analysis results showed an increase in intersection delay for an AWSC intersection compared to the existing two-way stop control, while a roundabout improves overall delay.

Based on the results of ICE, crash patterns, and the intersection site characteristics, the installation of a modern single lane roundabout is the recommended countermeasure for SR 93 and Orrville St NW. The intersection experiences a high crash severity, and has a high frequency of failure to yield angle crashes. A roundabout as a countermeasure has the highest crash reduction, and is best suited to address the crash severity, and mitigate this primary crash type. The roundabout also has the lowest delay of the considered countermeasures. Installation of a single-lane roundabout is expected to have a positive return on investment cost with a safety to benefit ratio of 1.01.

The proposed roundabout design will take into consideration access management at the intersection. The existing driveway closest to the intersection along eastbound Orrville St NW is proposed to be removed to improve compliance with driveway and intersection spacing criteria provided in the. The impacted driveway is associated with a small business that resides in the southwest quadrant of the study area. After removing this driveway, the business will retain two access driveways. A conceptual plan showing the proposed roundabout countermeasure is included in **Appendix J**, which includes a preliminary layout of the proposed drives in the study area.

EMH&T

APPENDIX A:

Existing Conditions Diagram

1 / 1	Existing Conditions	STA SR 93 at Orrville St (CR 148)	PREPARED BY JMW ISSUED BY DEG

EMH&T

APPENDIX B:

Existing Traffic Counts, Peak Hour Data, Forecasted Design Hour Volume Plates, and Supplemental Worksheets

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Summary **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
7:00AM	4	44	4	0	0	52	3	10	2	0	0	15	0	28	3	0	0	31	6	13	3	0	0	22	120
7:15AM	1	65	1	0	0	67	5	7	8	0	0	20	1	47	5	0	0	53	13	15	2	0	0	30	170
7:30AM	5	67	8	0	0	80	10	7	2	0	0	19	4	43	3	0	0	50	5	16	3	0	0	24	173
7:45AM	1	41	6	0	0	48	6	12	1	0	0	19	0	42	3	0	0	45	2	19	3	0	0	24	136
Hour Total	11	217	19	0	0	247	24	36	13	0	0	73	5	160	14	0	0	179	26	63	11	0	0	100	599
8:00AM	1	44	3	0	0	48	3	7	3	0	0	13	2	34	1	0	0	37	4	14	4	0	0	22	120
8:15AM	2	45	7	0	0	54	7	8	5	0	0	20	1	28	4	0	0	33	1	7	3	0	0	11	118
8:30AM	2	37	5	0	0	44	4	7	1	0	0	12	1	26	6	0	0	33	8	11	0	0	0	19	108
8:45AM	1	27	2	0	0	30	4	3	3	0	0	10	1	29	4	0	0	34	3	7	0	0	0	10	84
Hour Total	6	153	17	0	0	176	18	25	12	0	0	55	5	117	15	0	0	137	16	39	7	0	0	62	430
9:00AM	3	21	2	0	0	26	3	3	1	0	0	7	0	28	4	0	0	32	3	12	1	0	0	16	81
9:15AM	1	27	2	0	0	30	3	3	1	0	0	7	2	18	3	0	0	23	5	2	4	0	0	11	71
9:30AM	0	23	2	0	0	25	5	9	0	0	0	14	2	26	1	0	0	29	5	2	2	0	0	9	77
9:45AM	1	21	1	0	0	23	4	3	1	0	0	8	0	28	4	0	0	32	2	3	0	0	0	5	68
Hour Total	5	92	7	0	0	104	15	18	3	0	0	36	4	100	12	0	0	116	15	19	7	0	0	41	297
11:00AM	4	28	2	0	0	34	6	6	1	0	0	13	2	22	0	0	0	24	4	5	4	0	0	13	84
11:15AM	0	26	2	0	0	28	1	9	2	0	0	12	1	38	4	0	0	43	1	6	3	0	0	10	93
11:30AM	0	21	3	0	0	24	6	10	1	0	0	17	1	23	4	0	0	28	4	1	0	0	0	5	74
11:45AM	5	21	1	0	0	27	3	8	1	0	0	12	4	26	3	0	0	33	6	7	0	0	0	13	85
Hour Total	9	96	8	0	0	113	16	33	5	0	0	54	8	109	11	0	0	128	15	19	7	0	0	41	336
12:00PM	1	33	2	0	0	36	3	8	1	0	0	12	1	19	6	0	0	26	3	3	1	0	0	7	81
12:15PM	2	18	3	0	0	23	3	7	2	0	0	12	1	24	2	0	0	27	3	6	3	0	0	12	74
12:30PM	2	32	3	0	0	37	3	10	3	0	0	16	2	24	6	0	0	32	6	6	0	0	0	12	97
12:45PM	1	18	2	0	0	21	2	7	3	0	0	12	2	21	3	0	0	26	1	10	3	0	0	14	73
Hour Total	6	101	10	0	0	117	11	32	9	0	0	52	6	88	17	0	0	111	13	25	7	0	0	45	325
1:00PM	3	29	1	0	0	33	6	10	0	0	0	16	1	21	6	0	0	28	2	6	1	0	0	9	86
1:15PM	3	17	3	0	0	23	4	10	1	0	0	15	1	32	2	0	0	35	0	3	1	0	0	4	77
1:30PM	0	24	6	0	0	30	3	5	2	0	0	10	1	25	3	0	0	29	3	4	3	0	0	10	79
1:45PM	1	21	2	0	0	24	5	12	3	0	0	20	0	31	6	0	0	37	3	7	0	0	0	10	91
Hour Total	7	91	12	0	0	110	18	37	6	0	0	61	3	109	17	0	0	129	8	20	5	0	0	33	333

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Summary **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
2:00PM	1	28	5	0	0	34	3	5	3	0	0	11	2	41	3	0	0	46	3	10	3	0	0	16	107
2:15PM	0	30	1	0	0	31	3	7	2	0	0	12	5	34	4	0	0	43	4	16	0	0	0	20	106
2:30PM	1	27	5	0	0	33	4	16	1	0	0	21	1	33	3	0	0	37	2	11	1	0	0	14	105
2:45PM	6	46	4	0	0	56	5	10	2	0	0	17	2	33	4	0	0	39	3	7	3	0	0	13	125
Hour Total	8	131	15	0	0	154	15	38	8	0	0	61	10	141	14	0	0	165	12	44	7	0	0	63	443
3:00PM	2	39	7	0	0	48	2	12	9	0	0	23	5	36	5	0	0	46	3	9	2	0	0	14	131
3:15PM	3	36	4	0	0	43	3	20	7	0	0	30	0	50	5	0	0	55	8	5	6	0	0	19	147
3:30PM	5	41	7	0	0	53	4	20	3	0	0	27	3	47	6	0	0	56	7	8	1	0	0	16	152
3:45PM	3	46	5	0	0	54	5	17	6	0	0	28	3	68	5	0	0	76	5	14	1	0	0	20	178
Hour Total	13	162	23	0	0	198	14	69	25	0	0	108	11	201	21	0	0	233	23	36	10	0	0	69	608
4:00PM	4	39	8	0	0	51	7	13	3	0	0	23	4	45	2	0	0	51	8	9	2	0	0	19	144
4:15PM	3	55	5	0	0	63	7	24	4	0	0	35	1	53	9	0	0	63	6	11	4	0	0	21	182
4:30PM	4	49	6	0	0	59	7	16	6	0	0	29	0	59	8	0	0	67	7	6	2	0	0	15	170
4:45PM	6	39	11	0	0	56	4	18	1	0	0	23	2	57	5	0	0	64	5	9	0	0	0	14	157
Hour Total	17	182	30	0	0	229	25	71	14	0	0	110	7	214	24	0	0	245	26	35	8	0	0	69	653
5:00PM	4	38	6	0	0	48	3	9	1	0	0	13	1	57	3	0	0	61	2	12	0	0	0	14	136
5:15PM	3	45	6	0	0	54	7	26	3	0	0	36	0	52	10	0	0	62	4	8	1	0	0	13	165
5:30PM	1	38	9	0	0	48	6	23	2	0	0	31	3	46	6	0	0	55	5	10	2	0	0	17	151
5:45PM	3	32	3	0	0	38	4	8	5	0	0	17	3	34	13	0	0	50	8	9	3	0	0	20	125
Hour Total	11	153	24	0	0	188	20	66	11	0	0	97	7	189	32	0	0	228	19	39	6	0	0	64	577
6:00PM	2	33	5	0	0	40	3	13	2	0	0	18	4	29	8	0	0	41	6	4	1	0	0	11	110
6:15PM	1	22	3	0	0	26	3	9	2	0	0	14	2	27	4	0	0	33	5	9	1	0	0	15	88
6:30PM	2	24	2	0	0	28	3	3	3	0	0	9	2	39	4	0	0	45	2	9	0	0	0	11	93
6:45PM	3	24	2	0	0	29	0	11	1	0	0	12	2	22	3	0	0	27	3	3	0	0	0	6	74
Hour Total	8	103	12	0	0	123	9	36	8	0	0	53	10	117	19	0	0	146	16	25	2	0	0	43	365
App Total	106	1,572	187	0	-	1,865	202	492	126	0	-	820	81	1,633	212	0	-	1,926	197	378	85	0	-	660	5,271
App %	5.7	84.3	10	0	-	-	24.6	60	15.4	0	-	-	4.2	84.8	11	0	-	-	29.8	57.3	12.9	0	-	-	-
Total %	2	29.8	3.5	0	-	35.4	3.8	9.3	2.4	0	-	15.6	1.5	31	4	0	-	36.5	3.7	7.2	1.6	0	-	12.5	-
Passenger Vehicle	101	1448	179	0	0	1728	187	477	124	0	0	788	76	1476	203	0	0	1755	186	356	83	0	0	625	4896
Passenger Vehicle %	95.3	92.1	95.7	0	0	92.7	92.6	97	98.4	0	0	96.1	93.8	90.4	95.8	0	0	91.1	94.4	94.2	97.6	0	0	94.7	92.9
Heavy	0	49	0	0	0	49	4	1	1	0	0	6	0	74	3	0	0	77	0	2	0	0	0	2	134
Heavy %	0	3.1	0	0	0	2.6	2	0.2	0.8	0	0	0.7	0	4.5	1.4	0	0	4	0	0.5	0	0	0	0.3	2.5
Medium	5	75	8	0	0	88	11	14	1	0	0	26	5	83	6	0	0	94	11	20	2	0	0	33	241
Medium %	4.7	4.8	4.3	0	0	4.7	5.4	2.8	0.8	0	0	3.2	6.2	5.1	2.8	0	0	4.9	5.6	5.3	2.4	0	0	5	4.6

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Passenger **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
7:00AM	4	41	4	0	0	49	3	8	2	0	0	13	0	26	3	0	0	29	5	11	3	0	0	19	110
7:15AM	1	63	1	0	0	65	4	7	8	0	0	19	1	43	4	0	0	48	13	15	2	0	0	30	162
7:30AM	4	64	6	0	0	74	10	7	2	0	0	19	3	40	3	0	0	46	5	16	3	0	0	24	163
7:45AM	1	38	6	0	0	45	4	12	1	0	0	17	0	33	3	0	0	36	2	19	3	0	0	24	122
Hour Total	10	206	17	0	0	233	21	34	13	0	0	68	4	142	13	0	0	159	25	61	11	0	0	97	557
8:00AM	1	43	3	0	0	47	3	6	3	0	0	12	2	28	1	0	0	31	3	13	4	0	0	20	110
8:15AM	2	43	7	0	0	52	7	8	5	0	0	20	1	26	3	0	0	30	1	6	3	0	0	10	112
8:30AM	2	33	5	0	0	40	4	7	1	0	0	12	1	20	6	0	0	27	8	11	0	0	0	19	98
8:45AM	1	24	2	0	0	27	3	2	3	0	0	8	1	27	3	0	0	31	3	7	0	0	0	10	76
Hour Total	6	143	17	0	0	166	17	23	12	0	0	52	5	101	13	0	0	119	15	37	7	0	0	59	396
9:00AM	3	18	2	0	0	23	2	3	0	0	0	5	0	24	4	0	0	28	3	11	1	0	0	15	71
9:15AM	0	23	1	0	0	24	3	3	1	0	0	7	2	18	3	0	0	23	5	2	4	0	0	11	65
9:30AM	0	20	1	0	0	21	5	9	0	0	0	14	1	21	1	0	0	23	5	2	2	0	0	9	67
9:45AM	1	19	1	0	0	21	3	2	1	0	0	6	0	17	3	0	0	20	2	1	0	0	0	3	50
Hour Total	4	80	5	0	0	89	13	17	2	0	0	32	3	80	11	0	0	94	15	16	7	0	0	38	253
10:00AM	0	27	3	0	0	30	4	5	3	0	0	12	0	17	3	0	0	20	1	5	1	0	0	7	69
10:15AM	2	15	2	0	0	19	2	2	2	0	0	6	2	24	6	0	0	32	2	2	2	0	0	6	63
10:30AM	2	24	4	0	0	30	4	12	3	0	0	19	0	14	3	0	0	17	1	3	2	0	0	6	72
10:45AM	1	16	0	0	0	17	4	10	4	0	0	18	2	18	4	0	0	24	3	3	3	0	0	9	68
Hour Total	5	82	9	0	0	96	14	29	12	0	0	55	4	73	16	0	0	93	7	13	8	0	0	28	272
11:00AM	4	24	2	0	0	30	5	6	1	0	0	12	2	20	0	0	0	22	3	3	4	0	0	10	74
11:15AM	0	24	2	0	0	26	1	9	2	0	0	12	1	34	4	0	0	39	1	6	2	0	0	9	86
11:30AM	0	20	3	0	0	23	6	10	1	0	0	17	1	19	4	0	0	24	3	1	0	0	0	4	68
11:45AM	5	20	1	0	0	26	2	7	1	0	0	10	4	24	2	0	0	30	6	7	0	0	0	13	79
Hour Total	9	88	8	0	0	105	14	32	5	0	0	51	8	97	10	0	0	115	13	17	6	0	0	36	307
12:00PM	1	23	2	0	0	26	3	8	1	0	0	12	1	17	6	0	0	24	3	3	1	0	0	7	69
12:15PM	2	14	3	0	0	19	3	7	2	0	0	12	1	20	2	0	0	23	3	6	3	0	0	12	66
12:30PM	2	26	2	0	0	30	2	9	3	0	0	14	2	22	5	0	0	29	6	6	0	0	0	12	85
12:45PM	1	15	2	0	0	18	2	7	3	0	0	12	2	19	2	0	0	23	1	9	3	0	0	13	66
Hour Total	6	78	9	0	0	93	10	31	9	0	0	50	6	78	15	0	0	99	13	24	7	0	0	44	286

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Passenger **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
1:00PM	2	28	1	0	0	31	6	9	0	0	0	15	1	18	6	0	0	25	2	4	1	0	0	7	78
1:15PM	3	16	3	0	0	22	4	10	1	0	0	15	1	23	2	0	0	26	0	3	1	0	0	4	67
1:30PM	0	18	6	0	0	24	3	5	1	0	0	9	1	24	3	0	0	28	2	4	3	0	0	9	70
1:45PM	1	20	2	0	0	23	5	12	3	0	0	20	0	27	4	0	0	31	3	5	0	0	0	8	82
Hour Total	6	82	12	0	0	100	18	36	5	0	0	59	3	92	15	0	0	110	7	16	5	0	0	28	297
2:00PM	1	27	4	0	0	32	3	4	3	0	0	10	2	32	3	0	0	37	3	9	3	0	0	15	94
2:15PM	0	27	1	0	0	28	2	6	2	0	0	10	5	30	4	0	0	39	3	13	0	0	0	16	93
2:30PM	1	24	5	0	0	30	4	16	1	0	0	21	1	33	3	0	0	37	2	11	0	0	0	13	101
2:45PM	5	44	4	0	0	53	5	9	2	0	0	16	1	27	4	0	0	32	3	6	3	0	0	12	113
Hour Total	7	122	14	0	0	143	14	35	8	0	0	57	9	122	14	0	0	145	11	39	6	0	0	56	401
3:00PM	2	33	7	0	0	42	2	12	9	0	0	23	5	34	5	0	0	44	2	9	2	0	0	13	122
3:15PM	2	29	4	0	0	35	3	20	7	0	0	30	0	48	5	0	0	53	7	5	6	0	0	18	136
3:30PM	5	37	6	0	0	48	3	19	3	0	0	25	2	40	6	0	0	48	7	8	1	0	0	16	137
3:45PM	3	44	5	0	0	52	5	17	6	0	0	28	3	64	5	0	0	72	4	14	1	0	0	19	171
Hour Total	12	143	22	0	0	177	13	68	25	0	0	106	10	186	21	0	0	217	20	36	10	0	0	66	566
4:00PM	4	37	8	0	0	49	7	13	3	0	0	23	4	40	2	0	0	46	7	9	2	0	0	18	136
4:15PM	3	51	5	0	0	59	7	24	4	0	0	35	1	51	9	0	0	61	6	11	4	0	0	21	176
4:30PM	4	49	6	0	0	59	7	16	6	0	0	29	0	58	8	0	0	66	7	5	2	0	0	14	168
4:45PM	6	35	11	0	0	52	4	18	1	0	0	23	2	57	5	0	0	64	5	9	0	0	0	14	153
Hour Total	17	172	30	0	0	219	25	71	14	0	0	110	7	206	24	0	0	237	25	34	8	0	0	67	633
5:00PM	4	38	6	0	0	48	3	9	1	0	0	13	1	57	3	0	0	61	2	12	0	0	0	14	136
5:15PM	3	44	6	0	0	53	6	26	3	0	0	35	0	51	10	0	0	61	4	7	1	0	0	12	161
5:30PM	1	38	9	0	0	48	6	23	2	0	0	31	3	45	6	0	0	54	5	10	2	0	0	17	150
5:45PM	3	32	3	0	0	38	4	8	5	0	0	17	3	33	13	0	0	49	8	9	3	0	0	20	124
Hour Total	11	152	24	0	0	187	19	66	11	0	0	96	7	186	32	0	0	225	19	38	6	0	0	63	571
6:00PM	2	33	5	0	0	40	3	12	2	0	0	17	4	28	8	0	0	40	6	4	1	0	0	11	108
6:15PM	1	21	3	0	0	25	3	9	2	0	0	14	2	26	4	0	0	32	5	9	1	0	0	15	86
6:30PM	2	24	2	0	0	28	3	3	3	0	0	9	2	37	4	0	0	43	2	9	0	0	0	11	91
6:45PM	3	22	2	0	0	27	0	11	1	0	0	12	2	22	3	0	0	27	3	3	0	0	0	6	72
Hour Total	8	100	12	0	0	120	9	35	8	0	0	52	10	113	19	0	0	142	16	25	2	0	0	43	357
App Total	101	1,448	179	0	-	1,728	187	477	124	0	-	788	76	1,476	203	0	-	1,755	186	356	83	0	-	625	4,896
App %	5.8	83.8	10.4	0.0	-	-	23.7	60.5	15.7	0.0	-	-	4.3	84.1	11.6	0.0	-	-	29.8	57.0	13.3	0.0	-	-	-
Total %	2.1	29.6	3.7	0.0	-	35.3	3.8	9.7	2.5	0.0	-	16.1	1.6	30.1	4.1	0.0	-	35.8	3.8	7.3	1.7	0.0	-	12.8	-

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Medium **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
7:00AM	0	1	0	0	0	1	0	2	0	0	0	2	0	1	0	0	0	1	1	2	0	0	0	3	7
7:15AM	0	1	0	0	0	1	1	0	0	0	0	1	0	3	1	0	0	4	0	0	0	0	0	0	6
7:30AM	1	3	2	0	0	6	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	0	0	0	8
7:45AM	0	2	0	0	0	2	1	0	0	0	0	1	0	2	0	0	0	2	0	0	0	0	0	0	5
Hour Total	1	7	2	0	0	10	2	2	0	0	0	4	1	7	1	0	0	9	1	2	0	0	0	3	26
8:00AM	0	1	0	0	0	1	0	1	0	0	0	1	0	4	0	0	0	4	1	1	0	0	0	2	8
8:15AM	0	2	0	0	0	2	0	0	0	0	0	0	0	2	1	0	0	3	0	1	0	0	0	1	6
8:30AM	0	4	0	0	0	4	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	9
8:45AM	0	2	0	0	0	2	1	1	0	0	0	2	0	2	1	0	0	3	0	0	0	0	0	0	7
Hour Total	0	9	0	0	0	9	1	2	0	0	0	3	0	13	2	0	0	15	1	2	0	0	0	3	30
9:00AM	0	3	0	0	0	3	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	5
9:15AM	1	2	1	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
9:30AM	0	1	1	0	0	2	0	0	0	0	0	0	1	2	0	0	0	3	0	0	0	0	0	0	5
9:45AM	0	0	0	0	0	0	1	1	0	0	0	2	0	3	0	0	0	3	0	2	0	0	0	2	7
Hour Total	1	6	2	0	0	9	2	1	1	0	0	4	1	5	0	0	0	6	0	2	0	0	0	2	21
10:00AM	0	0	0	0	0	0	2	1	0	0	0	3	0	1	0	0	0	1	0	0	0	0	0	0	4
10:15AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1	2
10:30AM	0	1	0	0	0	1	1	0	0	0	0	1	1	4	0	0	0	5	0	0	0	0	0	0	7
10:45AM	0	4	1	0	0	5	0	1	0	0	0	1	0	2	0	0	0	2	1	0	0	0	0	1	9
Hour Total	0	5	1	0	0	6	3	2	0	0	0	5	1	8	0	0	0	9	1	1	0	0	0	2	22
11:00AM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	3	5
11:15AM	0	1	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	4	0	0	1	0	0	1	6
11:30AM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2
11:45AM	0	1	0	0	0	1	1	1	0	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	5
Hour Total	0	5	0	0	0	5	1	1	0	0	0	2	0	6	0	0	0	6	2	2	1	0	0	5	18
12:00PM	0	4	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	5
12:15PM	0	3	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	4
12:30PM	0	6	1	0	0	7	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	9
12:45PM	0	2	0	0	0	2	0	0	0	0	0	0	0	1	1	0	0	2	0	1	0	0	0	1	5
Hour Total	0	15	1	0	0	16	0	1	0	0	0	1	0	4	1	0	0	5	0	1	0	0	0	1	23

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Medium **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
1:00PM	1	0	0	0	0	1	0	1	0	0	0	1	0	3	0	0	0	3	0	2	0	0	0	2	7
1:15PM	0	1	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	5
1:30PM	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4
1:45PM	0	1	0	0	0	1	0	0	0	0	0	0	0	4	2	0	0	6	0	2	0	0	0	2	9
Hour Total	1	5	0	0	0	6	0	1	0	0	0	1	0	11	2	0	0	13	1	4	0	0	0	5	25
2:00PM	0	1	1	0	0	2	0	1	0	0	0	1	0	5	0	0	0	5	0	1	0	0	0	1	9
2:15PM	0	1	0	0	0	1	0	1	0	0	0	1	0	2	0	0	0	2	1	3	0	0	0	4	8
2:30PM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
2:45PM	1	2	0	0	0	3	0	1	0	0	0	1	1	3	0	0	0	4	0	1	0	0	0	1	9
Hour Total	1	5	1	0	0	7	0	3	0	0	0	3	1	10	0	0	0	11	1	5	1	0	0	7	28
3:00PM	0	4	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	6
3:15PM	1	4	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	1	7
3:30PM	0	0	1	0	0	1	1	1	0	0	0	2	1	4	0	0	0	5	0	0	0	0	0	0	8
3:45PM	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	1	0	0	0	0	1	5
Hour Total	1	8	1	0	0	10	1	1	0	0	0	2	1	10	0	0	0	11	3	0	0	0	0	3	26
4:00PM	0	2	0	0	0	2	0	0	0	0	0	0	0	4	0	0	0	4	1	0	0	0	0	1	7
4:15PM	0	3	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	5
4:30PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
4:45PM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hour Total	0	7	0	0	0	7	0	0	0	0	0	0	0	6	0	0	0	6	1	1	0	0	0	2	15
5:00PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15PM	0	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	3
5:30PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
5:45PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
Hour Total	0	1	0	0	0	1	1	0	0	0	0	1	0	3	0	0	0	3	0	0	0	0	0	0	5
6:00PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45PM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hour Total	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
App Total	5	75	8	0	-	88	11	14	1	0	-	26	5	83	6	0	-	94	11	20	2	0	-	33	241
App %	5.7	85.2	9.1	0	-	-	42.3	53.8	3.8	0	-	-	5.3	88.3	6.4	0	-	-	33.3	60.6	6.1	0	-	-	-
Total %	2.1	31.1	3.3	0	-	36.5	4.6	5.8	0.4	0	-	10.8	2.1	34.4	2.5	0	-	39	4.6	8.3	0.8	0	-	13.7	-

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Heavy **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
7:00AM	0	2	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	3
7:15AM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
7:30AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	2
7:45AM	0	1	0	0	0	1	1	0	0	0	0	1	0	7	0	0	0	7	0	0	0	0	0	0	9
Hour Total	0	4	0	0	0	4	1	0	0	0	0	1	0	11	0	0	0	11	0	0	0	0	0	0	16
8:00AM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	2
8:15AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30AM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
8:45AM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hour Total	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	4
9:00AM	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	1	0	0	0	1	5
9:15AM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9:30AM	0	2	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	5
9:45AM	0	2	0	0	0	2	0	0	0	0	0	0	0	8	1	0	0	9	0	0	0	0	0	0	11
Hour Total	0	6	0	0	0	6	0	0	0	0	0	0	0	15	1	0	0	16	0	1	0	0	0	1	23
10:00AM	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	4
10:15AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:30AM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
10:45AM	0	2	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	5
Hour Total	0	4	0	0	0	4	0	0	0	0	0	0	0	7	0	0	0	7	0	0	0	0	0	0	11
11:00AM	0	2	0	0	0	2	1	0	0	0	0	1	0	2	0	0	0	2	0	0	0	0	0	0	5
11:15AM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
11:30AM	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	4
11:45AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1
Hour Total	0	3	0	0	0	3	1	0	0	0	0	1	0	6	1	0	0	7	0	0	0	0	0	0	11
12:00PM	0	6	0	0	0	6	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	7
12:15PM	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	4
12:30PM	0	0	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	2	0	0	0	0	0	0	3
12:45PM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
Hour Total	0	8	0	0	0	8	1	0	0	0	0	1	0	6	1	0	0	7	0	0	0	0	0	0	16

Ohio Department of Transportation

Volume by Approach

TMC Date 1/11/2024 **Time Interval** 15 Min. **Intersection ID** 20976 **Classification** Heavy **Owner ID** Bridget.Richard **County** Stark

	SR-93 Northbound						Orrville St (CR-348) Eastbound						SR-93 Southbound						Orrville St (CR-348) Westbound						
Start Time	Left	Thru	Right	U-Turn	Ped	NB Total	Left	Thru	Right	U-Turn	Ped	EB Total	Left	Thru	Right	U-Turn	Ped	SB Total	Left	Thru	Right	U-Turn	Ped	WB Total	Total
1:00PM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1:15PM	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	5
1:30PM	0	3	0	0	0	3	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	5
1:45PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	4	0	0	0	4	0	0	1	0	0	1	0	6	0	0	0	6	0	0	0	0	0	0	11
2:00PM	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	4
2:15PM	0	2	0	0	0	2	1	0	0	0	0	1	0	2	0	0	0	2	0	0	0	0	0	0	5
2:30PM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2:45PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	3
Hour Total	0	4	0	0	0	4	1	0	0	0	0	1	0	9	0	0	0	9	0	0	0	0	0	0	14
3:00PM	0	2	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	3
3:15PM	0	3	0	0	0	3	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	4
3:30PM	0	4	0	0	0	4	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	7
3:45PM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hour Total	0	11	0	0	0	11	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	16
4:00PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
4:15PM	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4:30PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
4:45PM	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Hour Total	0	3	0	0	0	3	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	5
5:00PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:15PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
5:30PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:45PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
6:00PM	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	2
6:15PM	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2
6:30PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	2
6:45PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hour Total	0	1	0	0	0	1	0	1	0	0	0	1	0	4	0	0	0	4	0	0	0	0	0	0	6
App Total	0	49	0	0	-	49	4	1	1	0	-	6	0	74	3	0	-	77	0	2	0	0	-	2	134
App %	0	100	0	0	-	-	66.7	16.7	16.7	0	-	-	0	96.1	3.9	0	-	-	0	100	0	0	-	-	-
Total %	0	36.6	0	0	-	36.6	3	0.7	0.7	0	-	4.5	0	55.2	2.2	0	-	57.5	0	1.5	0	0	-	1.5	-

STA-93 at Orville Rd
Peak Hour

	Northbound (SR 93)	Eastbound (Orrville St)	Southbound (SR93)	Westbound (Orrville St)	Entering Totals	Hourly Totals	
7:00AM	52	15	31	22	120	-	
7:15AM	67	20	53	30	170	-	
7:30AM	80	19	50	24	173	-	
7:45AM	48	19	45	24	136	**599**	**7:00 AM- 8:00AM**
8:00AM	48	13	37	22	120	599	
8:15AM	54	20	33	11	118	547	
8:30AM	44	12	33	19	108	482	
8:45AM	30	10	34	10	84	430	
9:00AM	26	7	32	16	81	391	
9:15AM	30	7	23	11	71	344	
9:30AM	25	14	29	9	77	313	
9:45AM	23	8	32	5	68	297	
10:00AM	31	15	24	7	77	293	
10:15AM	19	6	33	7	65	287	
10:30AM	32	20	23	6	81	291	
10:45AM	24	19	29	10	82	305	
11:00AM	34	13	24	13	84	312	
11:15AM	28	12	43	10	93	340	
11:30AM	24	17	28	5	74	333	
11:45AM	27	12	33	13	85	336	
12:00PM	36	12	26	7	81	333	
12:15PM	23	12	27	12	74	314	
12:30PM	37	16	32	12	97	337	
12:45PM	21	12	26	14	73	325	
1:00PM	33	16	28	9	86	330	
1:15PM	23	15	35	4	77	333	
1:30PM	30	10	29	10	79	315	
1:45PM	24	20	37	10	91	333	
2:00PM	34	11	46	16	107	354	
2:15PM	31	12	43	20	106	383	
2:30PM	33	21	37	14	105	409	
2:45PM	56	17	39	13	125	443	
3:00PM	48	23	46	14	131	467	
3:15PM	43	30	55	19	147	508	
3:30PM	53	27	56	16	152	555	
3:45PM	54	28	76	20	178	608	
4:00PM	51	23	51	19	144	621	
4:15PM	63	35	63	21	182	656	
4:30PM	59	29	67	15	170	**674**	**3:45-4:45PM**
4:45PM	56	23	64	14	157	653	
5:00PM	48	13	61	14	136	645	
5:15PM	54	36	62	13	165	628	
5:30PM	48	31	55	17	151	609	
5:45PM	38	17	50	20	125	577	
6:00PM	40	18	41	11	110	551	
6:15PM	26	14	33	15	88	474	
6:30PM	28	9	45	11	93	416	
6:45PM	29	12	27	6	74	365	
App Total	1865	820	1926	660	5271	5526	

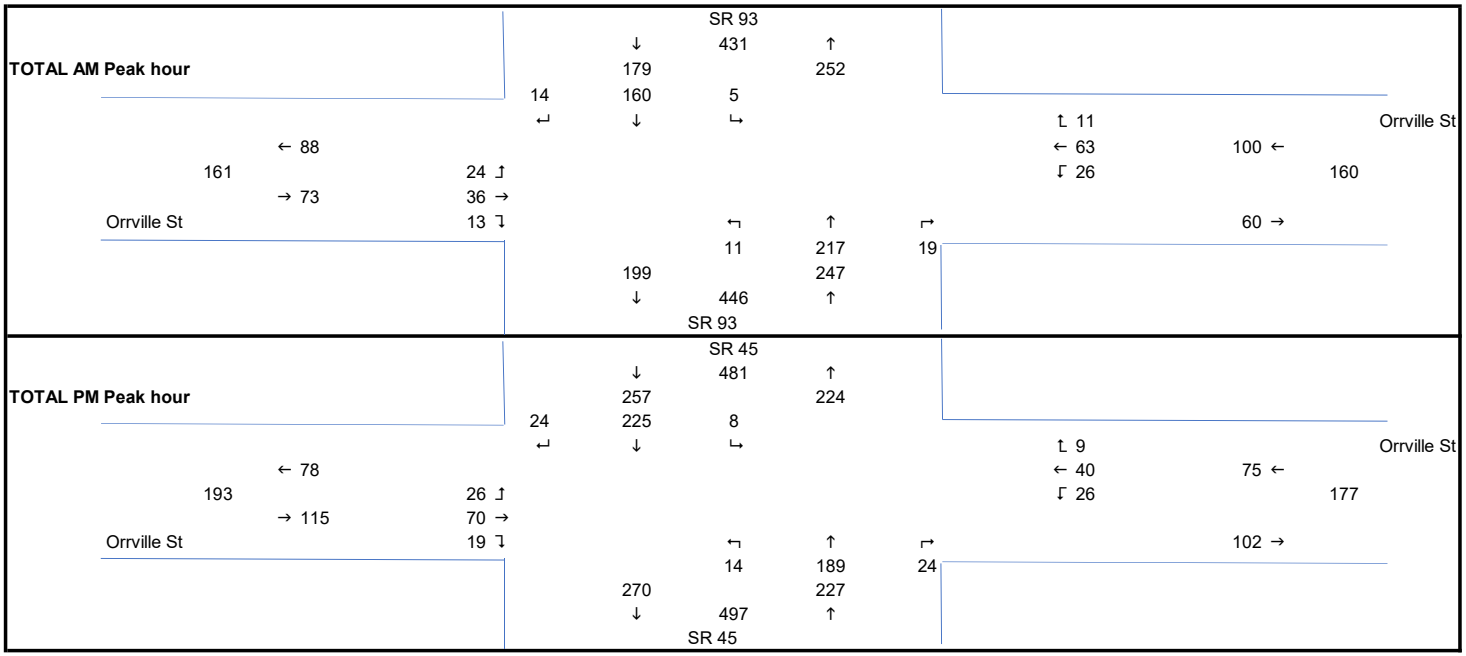
STA-93 at Orrville Rd
Peak Hour Factors

	SR 93 & Orrville St.		Entering Totals	Hourly Totals
7:00 AM	120		120	-
7:15 AM	170		170	-
7:30 AM	173	**0.87**	173	463
7:45 AM	136		136	**599**

3:45 PM	178		178	178
4:00 PM	144		144	322
4:15 PM	182	**0.93**	182	504
4:30 PM	170		170	**674**

January 11 2024

	South Leg				West Leg				North Leg				East Leg				
	SR 93 Northbound				Orrville St Eastbound				SR 93 Southbound				Orrville ST Westbound				
Start Time	Left	Thru	Right	NB Total	Left	Thru	Right	EB Total	Left	Thru	Right	SB Total	Left	Thru	Right	WB Total	Intersection Total
7:00AM	4	44	4	52	3	10	2	15	0	28	3	31	6	13	3	22	120
7:15AM	1	65	1	67	5	7	8	20	1	47	5	53	13	15	2	30	170
7:30AM	5	67	8	80	10	7	2	19	4	43	3	50	5	16	3	24	173
7:45AM	1	41	6	48	6	12	1	19	0	42	3	45	2	19	3	24	136
Total for AM peak hour	*11*	*217*	*19*	*247*	*24*	*36*	*13*	*73*	*5*	*160*	*14*	*179*	*26*	*63*	*11*	*100*	*599*
3:45PM	3	46	5	54	5	17	6	28	3	68	5	76	5	14	1	20	178
4:00PM	4	39	8	51	7	13	3	23	4	45	2	51	8	9	2	19	144
4:15PM	3	55	5	63	7	24	4	35	1	53	9	63	6	11	4	21	182
4:30PM	4	49	6	59	7	16	6	29	0	59	8	67	7	6	2	15	170
Total for PM peak hour	*14*	*189*	*24*	*227*	*26*	*70*	*19*	*115*	*8*	*225*	*24*	*257*	*26*	*40*	*9*	*75*	*674*



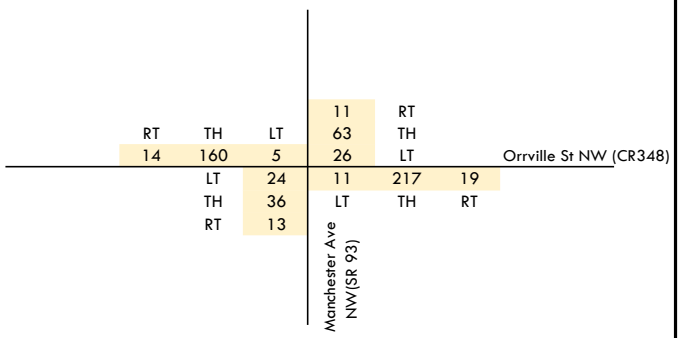
Combined Heavy and Medium Vehicle Counts

January 11 2024

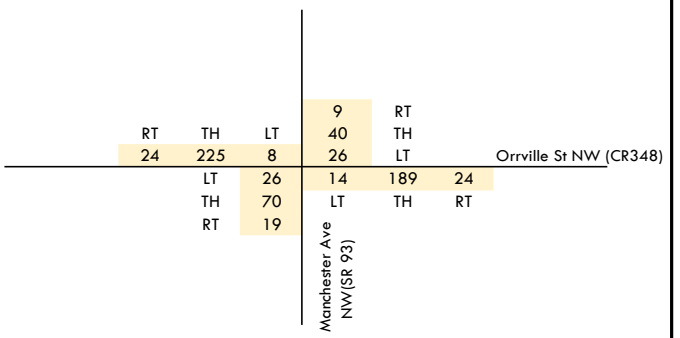
	South Leg				West Leg				North Leg				East Leg				
	SR 93 Northbound				Orrville St Eastbound				SR 93 Southbound				Orrville ST Westbound				
Start Time	Left	Thru	Right	NB Total	Left	Thru	Right	EB Total	Left	Thru	Right	SB Total	Left	Thru	Right	WB Total	Intersection Total
7:00AM	0	3	0	3	0	2	0	2	0	2	0	2	1	2	0	3	10
7:15AM	0	2	0	2	1	0	0	1	0	4	1	5	0	0	0	0	8
7:30AM	1	3	2	6	0	0	0	0	1	3	0	4	0	0	0	0	10
7:45AM	0	3	0	3	2	0	0	2	0	9	0	9	0	0	0	0	14
Total for AM peak hour	*1*	*11*	*2*	*14*	*3*	*2*	*0*	*5*	*1*	*18*	*1*	*20*	*1*	*2*	*0*	*3*	*42*
%HV	9%	5%	11%	**6%**	13%	6%	0%	**7%**	20%	11%	7%	**11%**	4%	3%	0%	**3%**	7%
3:45PM	0	2	0	2	0	0	0	0	0	4	0	4	1	0	0	1	7
4:00PM	0	2	0	2	0	0	0	0	0	5	0	5	1	0	0	1	8
4:15PM	0	4	0	4	0	0	0	0	0	2	0	2	0	0	0	0	6
4:30PM	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	2
Total for PM peak hour	*0*	*8*	*0*	*8*	*0*	*0*	*0*	*0*	*0*	*12*	*0*	*12*	*2*	*1*	*0*	*3*	*23*
%HV	0%	4%	0%	**4%**	0%	0%	0%	**0%**	0%	5%	0%	**5%**	8%	3%	0%	**4%**	3%

STA-93 at Orrville Street
Design Hour Traffic

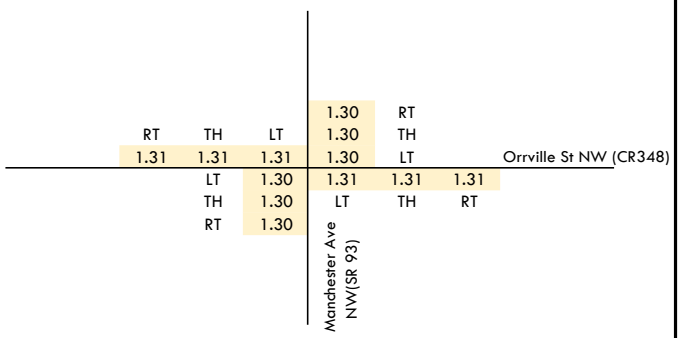
Raw Count Volumes (Jan 11, 2024) — **AM Peak Hour**
7:00 - 8:00 AM — **Plate 1A**



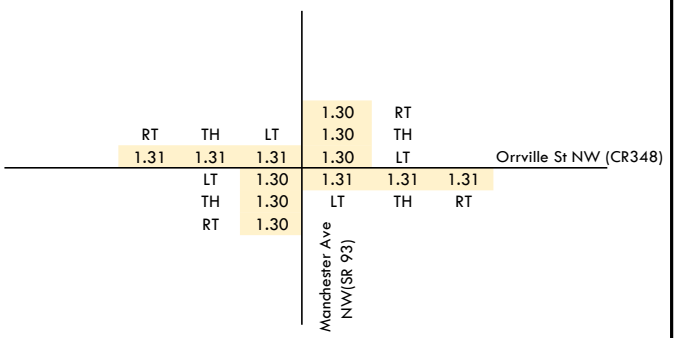
Raw Count Volumes (Jan 11, 2024) — **PM Peak Hour**
3:45 PM - 4:45 PM — **Plate 1B**



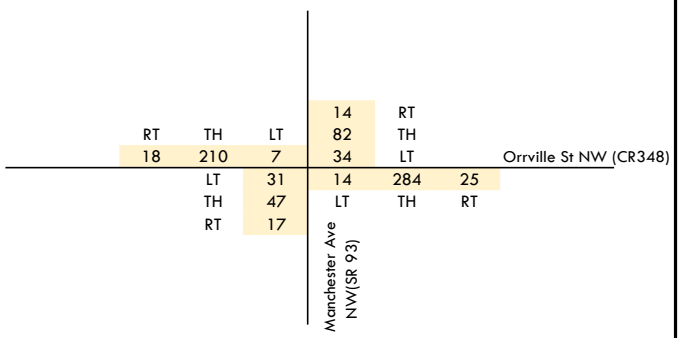
Design Hour Factors — **AM Peak Hour**
7:00 - 8:00 AM — **Plate 2A**



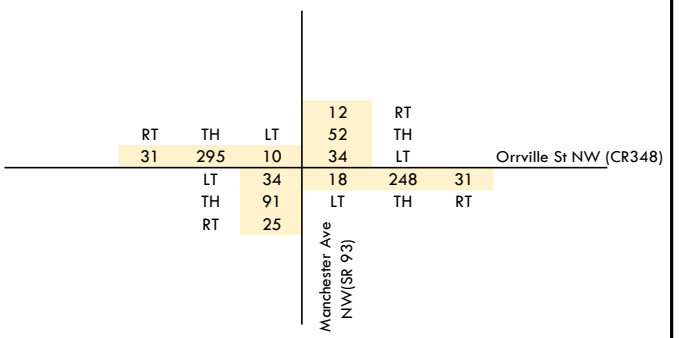
Design Hour Factors — **PM Peak Hour**
3:45 PM - 4:45 PM — **Plate 2B**



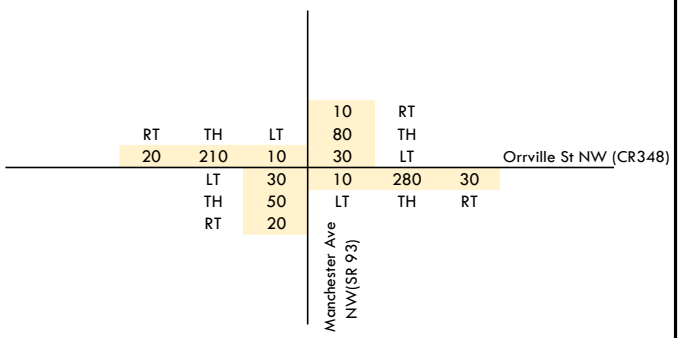
2024 Design Hour Volumes — **AM Peak Hour**
7:00 - 8:00 AM — **Plate 3A=1A*2A**



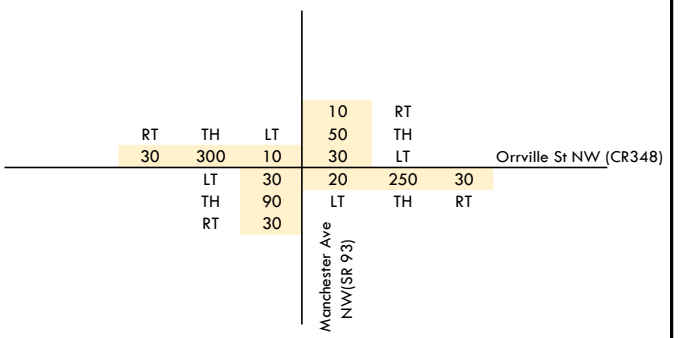
2024 Design Hour Volumes — **PM Peak Hour**
3:45 PM - 4:45 PM — **Plate 3B=1B*2B**



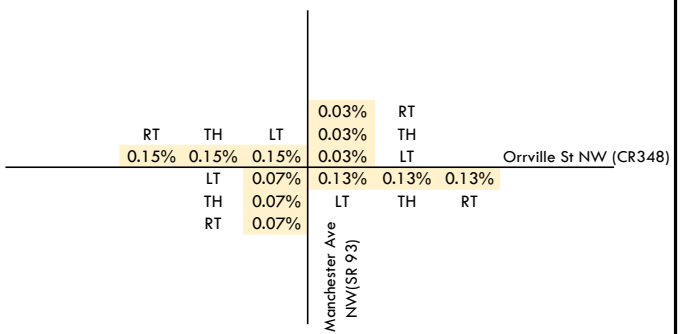
2024 Design Hour Volumes Rounded — **AM Peak Hour**
7:00 - 8:00 AM — **Plate 3C=3A Rounded**



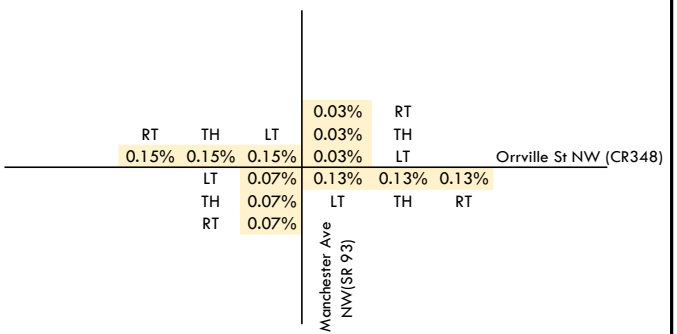
2024 Design Hour Volumes Rounded — **PM Peak Hour**
3:45 PM - 4:45 PM — **Plate 3D=3B Rounded**



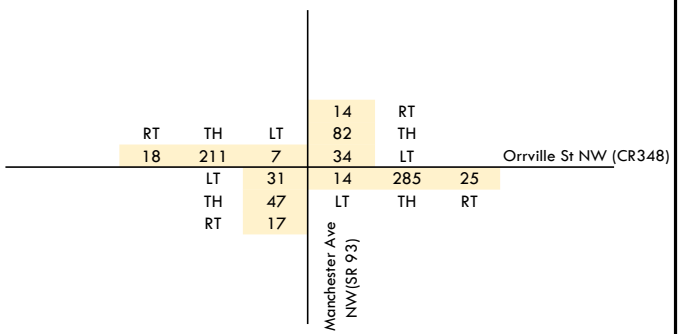
Growth Rates — **AM Peak Hour** — **Plate 4A**



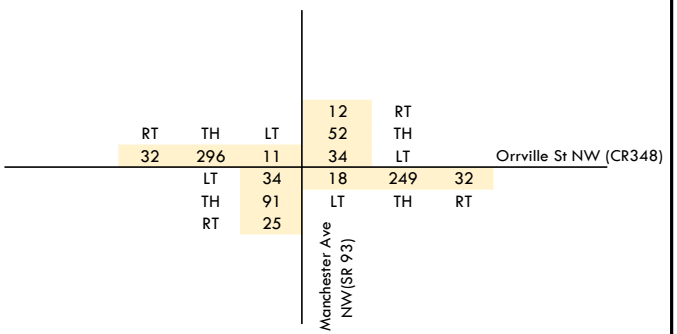
Growth Rates — **PM Peak Hour** — **Plate 4B**



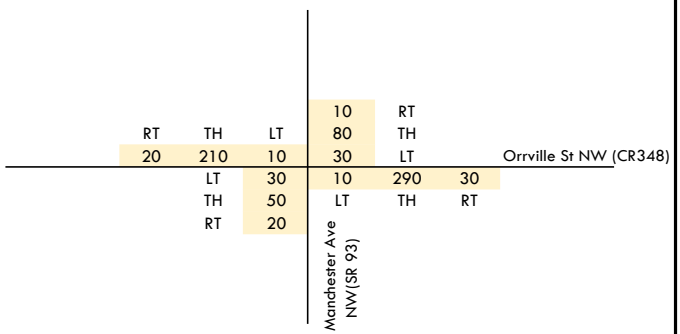
2027 Design Hour Volumes — **AM Peak Hour**
7:00 - 8:00 AM — **Plate 5A=3A*4A(compounded)**



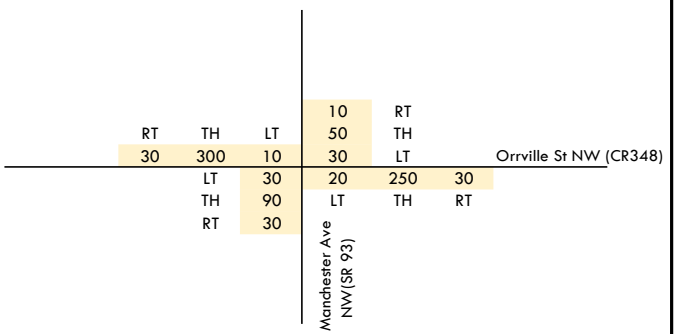
2027 Design Hour Volumes — **PM Peak Hour**
3:45 PM - 4:45 PM — **Plate 5B=3B*4B(compounded)**



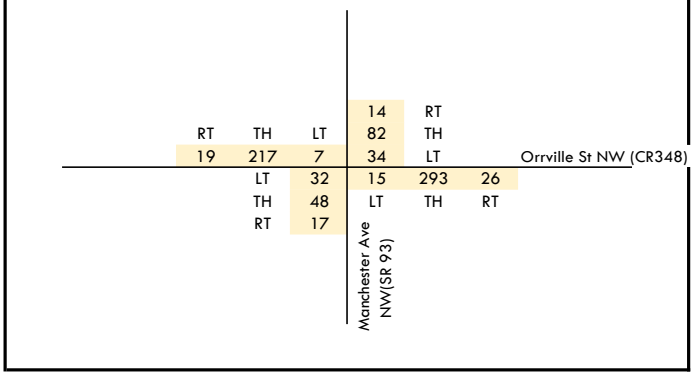
2027 Design Hour Volumes Rounded — **AM Peak Hour**
7:00 - 8:00 AM — **Plate 6A=5A Rounded**



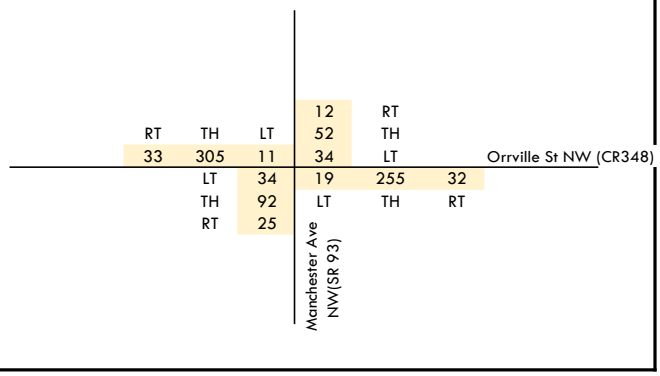
2027 Design Hour Volumes Rounded — **PM Peak Hour**
3:45 PM - 4:45 PM — **Plate 6B=5B Rounded**



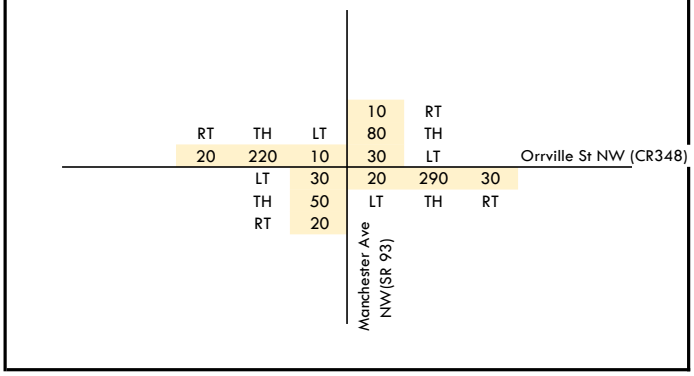
2047 Design Hour Volumes **AM Peak Hour**
7:00 - 8:00 AM **Plate 5C=3A*4A(compounded)**



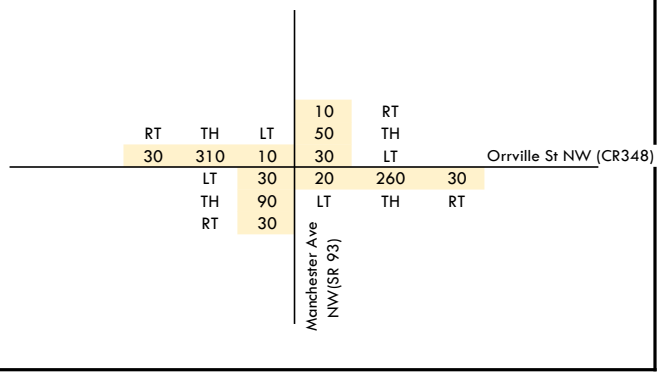
2047 Design Hour Volumes **PM Peak Hour**
3:45 PM - 4:45 PM **Plate 5D=3B*4B(compounded)**



2047 Design Hour Volumes Rounded **AM Peak Hour**
7:00 - 8:00 AM **Plate 6C=5C Rounded**



2047 Design Hour Volumes Rounded **PM Peak Hour**
3:45 PM - 4:45 PM **Plate 6D=5D Rounded**



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	1.25	1.81	1.27	1.25	1.25	1.23	1.18	1.61
February	1.23	1.78	1.26	1.23	1.23	1.19	1.17	1.58
March	1.18	1.63	1.20	1.18	1.17	1.17	1.12	1.47
April	1.13	1.57	1.15	1.14	1.12	1.11	1.08	1.42
May	1.10	1.47	1.12	1.10	1.10	1.07	1.06	1.35
June	1.14	1.51	1.16	1.14	1.14	1.11	1.10	1.40
July	1.14	1.54	1.16	1.14	1.13	1.14	1.11	1.45
August	1.12	1.49	1.14	1.14	1.12	1.10	1.06	1.41
September	1.12	1.53	1.15	1.13	1.13	1.09	1.05	1.42
October	1.12	1.54	1.15	1.12	1.11	1.10	1.05	1.42
November	1.16	1.63	1.17	1.15	1.15	1.15	1.08	1.52
December	1.16	1.61	1.18	1.16	1.16	1.13	1.10	1.50

peak hour volume * factor = design hour volume

source: year 2018,2019,2021 Automatic Traffic Recorders (ATR) Data

ATR Stations:

2018: 15 Stations
2019: 21 Stations
2021: 22 Stations

Ohio Department of Transportation
Modeling & Forecasting Section
Nov 2022

NOTE: These are NOT seasonal adjustment factors!!!

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

PEAK HOUR to DESIGN HOUR FACTORS

FUNCTIONAL CLASSIFICATION = 04r

(Rural Minor Arterial)

Day / Month	Monthly Average by Day-of-Week							
	WEEKDAY MON-THUR	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
January	1.34	1.87	1.38	1.35	1.33	1.31	1.25	1.66
February	1.31	1.82	1.35	1.30	1.31	1.28	1.22	1.59
March	1.25	1.66	1.28	1.25	1.23	1.23	1.14	1.46
April	1.19	1.56	1.22	1.20	1.19	1.16	1.09	1.39
May	1.16	1.46	1.20	1.16	1.16	1.12	1.06	1.30
June	1.17	1.40	1.21	1.18	1.17	1.13	1.07	1.29
July	1.19	1.43	1.23	1.19	1.17	1.15	1.08	1.32
August	1.17	1.38	1.21	1.18	1.17	1.12	1.04	1.26
September	1.17	1.44	1.21	1.17	1.17	1.12	1.03	1.30
October	1.16	1.45	1.19	1.16	1.15	1.13	1.03	1.31
November	1.22	1.60	1.26	1.22	1.20	1.21	1.10	1.47
December	1.23	1.65	1.26	1.23	1.23	1.20	1.14	1.48

peak hour volume * factor = design hour volume

source: year 2018,2019,2021 Automatic Traffic Recorders (ATR) Data

ATR Stations:

2018: 10 Stations
2019: 11 Stations
2021: 10 Stations

Ohio Department of Transportation
Modeling & Forecasting Section
Nov 2022

NOTE: These are NOT seasonal adjustment factors!!!

PEAK HOUR to DESIGN HOUR FACTORS

FUNCTIONAL CLASSIFICATION = 05, 06r

(Rural Major Collector & Rural Minor Collector)

Day / Month	Monthly Average by Day-of-Week							
	WEEKDAY MON-THUR	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
January	1.32	1.97	1.33	1.33	1.31	1.30	1.23	1.74
February	1.28	1.96	1.31	1.27	1.28	1.26	1.22	1.69
March	1.22	1.75	1.23	1.22	1.21	1.22	1.16	1.55
April	1.15	1.59	1.17	1.15	1.12	1.15	1.09	1.45
May	1.12	1.53	1.16	1.11	1.10	1.10	1.05	1.36
June	1.15	1.52	1.20	1.14	1.13	1.14	1.09	1.39
July	1.16	1.53	1.18	1.16	1.14	1.14	1.12	1.39
August	1.12	1.45	1.16	1.14	1.12	1.09	1.06	1.32
September	1.13	1.52	1.17	1.12	1.12	1.09	1.03	1.36
October	1.15	1.59	1.19	1.14	1.13	1.12	1.06	1.38
November	1.20	1.75	1.22	1.19	1.17	1.21	1.11	1.58
December	1.21	1.76	1.23	1.19	1.22	1.20	1.12	1.58

peak hour volume * factor = design hour volume

source: year 2018,2019,2021 Automatic Traffic Recorders (ATR) Data

ATR Stations:

2018: 8 Stations
2019: 8 Stations
2021: 8 Stations

Ohio Department of Transportation
Modeling & Forecasting Section
Nov 2022

NOTE: These are NOT seasonal adjustment factors!!!

Note: Insufficient data exists to produce factors for functional class 07 Rural.

PEAK HOUR to DESIGN HOUR FACTORS

Recreational Traffic*

Day / Month	Monthly Average by Day-of-Week							
	WEEKDAY MON-THUR	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
January	2.39	2.69	2.49	2.44	2.36	2.28	2.23	2.55
February	2.35	2.65	2.40	2.35	2.40	2.26	2.16	2.45
March	2.21	2.30	2.23	2.22	2.15	2.23	1.97	2.13
April	1.89	1.97	1.89	1.92	1.91	1.84	1.59	1.75
May	1.59	1.32	1.65	1.61	1.60	1.51	1.26	1.31
June	1.39	1.12	1.41	1.44	1.42	1.31	1.12	1.17
July	1.30	1.06	1.32	1.34	1.32	1.23	1.05	1.05
August	1.43	1.05	1.40	1.52	1.45	1.36	1.10	1.09
September	1.71	1.28	1.74	1.75	1.75	1.59	1.25	1.29
October	1.73	1.44	1.79	1.74	1.76	1.63	1.32	1.40
November	2.03	2.32	2.04	2.00	2.01	2.05	1.77	2.17
December	2.09	2.44	2.13	2.09	2.08	2.04	1.90	2.30

peak hour volume * factor = design hour volume

source: year 2018,2019,2021 Automatic Traffic Recorders (ATR) Data

ATR Stations:

2018: 5 Stations
2019: 5 Stations
2021: 4 Stations

Ohio Department of Transportation
Modeling & Forecasting Section
Nov 2022

NOTE: These are NOT seasonal adjustment factors!!!

*** Important Note:** These factors are based on permanent count stations located on Route 2 and other routes in the vicinity of Lake Erie. Therefore, they may not be suitable for use on other recreational routes within the state of Ohio. Use at your own risk.

Irwin, Ryan

From: Dan K. Slicker <dkslicker@starkcountyohio.gov>
Sent: Monday, June 24, 2024 10:56 AM
To: Irwin, Ryan
Subject: RE: Safety Study
Attachments: nchrp255_SR93_Orrville.xlsx

Follow Up Flag: Follow up
Flag Status: Flagged

Irwin,

I calculated slow growth rates for all four legs of the intersection: East – 0.03%, North – 0.15%, West – 0.07%, and South – 0.13%.

You can review the calculations in the attached spreadsheet.

Let me know if you need anything else.

Dan Slicker, P.E.
SCATS Technical Director
t:330-451-7346
f:330-451-7990

From: Irwin, Ryan <rirwin@emht.com>
Sent: Monday, June 24, 2024 10:36 AM
To: Dan K. Slicker <dkslicker@starkcountyohio.gov>
Subject: Safety Study

Dan,

I'm performing a safety study for ODOT District 4 in Stark County, at the intersection of State Route 93 and Orrville Street. Location can be found here.

I've been directed by Dave Griffith at District 4 to reach out to SCATS to obtain a growth rate to apply to our intersection count data. Can you supply this?

Thanks,

Ryan Irwin, PE
Senior Traffic Engineer
Traffic Engineering Services
o: 614.775.4653 | rirwin@emht.com

EMH&T
EMH&T Engineers, Surveyors, Planners, Scientists
5500 New Albany Road, Columbus, OH 43054
emht.com | in

Date of Count: 1/11/2024 5 Thursday January

PART 1: INPUT PARTIAL DAY P&A VEHICLES — ROUTE: SR 93 / Orrville Street

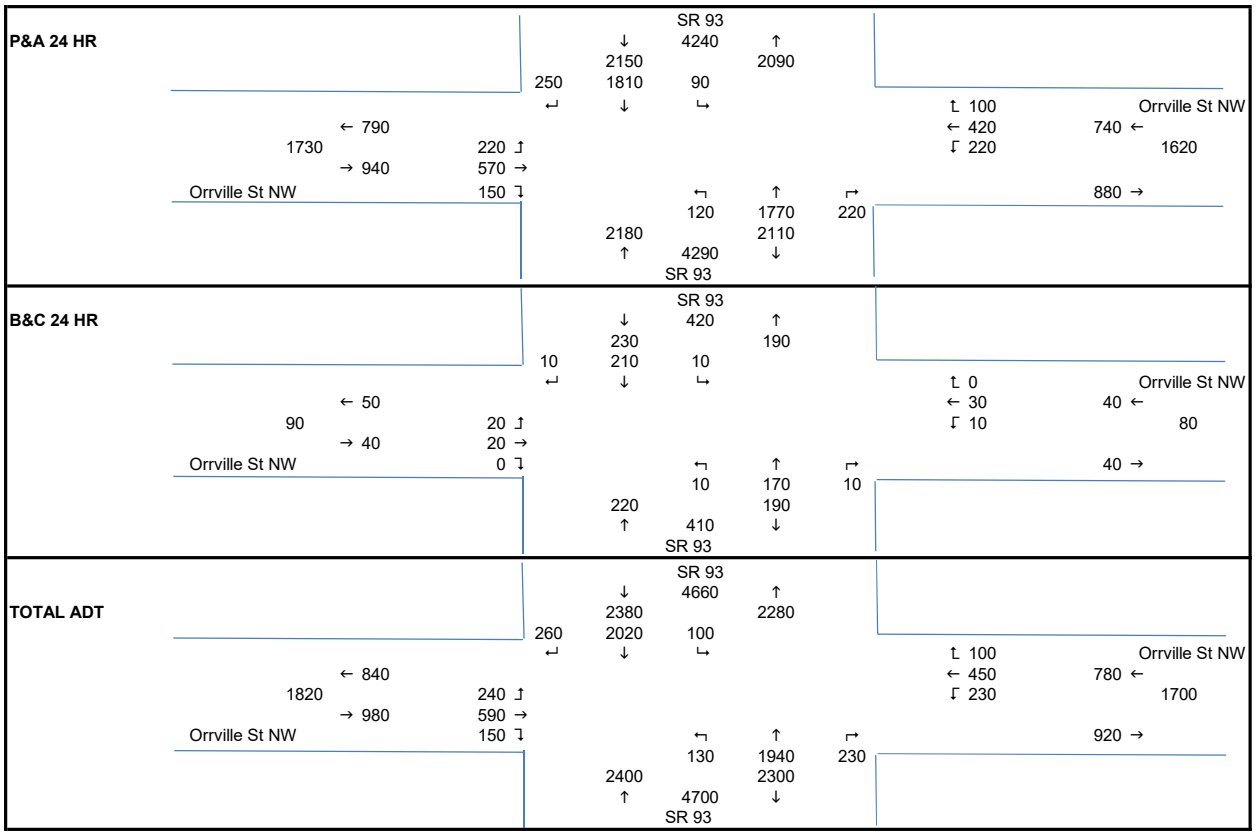
PARTIAL COUNT * FACTOR * SEASONAL FACTOR = 24 HR P&A

SOUTH LEG	SR 93	*FC* =	4	northbound			APROACH	DEPART							
				LT	**THRU**	**RT**	TOTAL	TOTAL		**SOUTH LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	101	1448	179	1728	1786	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
P&A FACTOR	1.224	1.224	1.224	123.624	1772.35	219.096	2115.07	2176.45	120	1770	220		2110	2180	
SEASONAL FACTOR	1.000	1.000	1.000	123.624	1772.35	219.096	2115.07	2176.45	***120***	***1770***	***220***		***2110***	***2180***	
WEST LEG	Orrville St N	FC =	5	eastbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**WEST LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	187	477	124	788	660	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
P&A FACTOR	1.193	1.193	1.193	223.091	569.061	147.932	940.084	796.804	220	570	150		940	790	
SEASONAL F	1.000	1.000	1.000	223.091	569.061	147.932	940.084	796.804	***220***	***570***	***150***		***940***	***790***	
NORTH LEG	SR 93	FC =	4	southbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**NORTH LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	76	1476	203	1755	1718	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
P&A FACTOR	1.224	1.224	1.224	93.024	1806.62	248.472	2148.12	2094.46	90	1810	250		2150	2090	
SEASONAL F	1.000	1.000	1.000	93.024	1806.62	248.472	2148.12	2094.46	***90***	***1810***	***250***		***2150***	***2090***	
EAST LEG	Orrville St N	FC =	5	westbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**EAST LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	186	356	83	625	732	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
P&A FACTOR	1.193	1.193	1.193	221.898	424.708	99.019	745.625	881.181	220	420	100		740	880	
SEASONAL F	1.000	1.000	1.000	221.898	424.708	99.019	745.625	881.181	***220***	***420***	***100***		***740***	***880***	

PART 2: INPUT PARTIAL DAY B&C VEHICLES — ROUTE: SR 93 / Orrville Street

PARTIAL COUNT * FACTOR = 24 HR B&C

SOUTH LEG	SR 93	*FC* =	4	northbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**SOUTH LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	5	124	8	137	170	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
B&C FACTOR	1.335	1.335	1.335	6.675	165.54	10.68	182.895	225	10	170	10		190	220	
SEASONAL FACTOR	1.000	1.000	1.000	6.675	165.54	10.68	182.895	225	***10***	***170***	***10***		***190***	***220***	
WEST LEG	Orrville St N	FC =	5	eastbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**WEST LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	15	15	2	32	36	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
B&C FACTOR	1.185	1.185	1.185	17.775	17.775	2.37	37.92	44.76	20	20	0		40	50	
SEASONAL FACTOR	1.000	1.000	1.000	17.775	17.775	2.37	37.92	38.085	***20***	***20***	***0***		***40***	***50***	
NORTH LEG	SR 93	FC =	4	southbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**NORTH LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	5	157	9	171	141	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
B&C FACTOR	1.335	1.335	1.335	6.675	209.595	12.015	228.285	185.685	10	210	10		230	190	
SEASONAL FACTOR	1.000	1.000	1.000	6.675	209.595	12.015	228.285	185.685	***10***	***210***	***10***		***230***	***190***	
EAST LEG	Orrville St N	FC =	5	westbound			APROACH	DEPART							
	FACTOR			**LT**	**THRU**	**RT**	TOTAL	TOTAL		**EAST LEG**			**APROACH**	**DEPART**	
	LT	THRU	RT	11	22	2	35	28	**LT**	**THRU**	**RT**		**TOTAL**	**TOTAL**	
B&C FACTOR	1.185	1.185	1.185	13.035	26.07	2.37	41.475	35.13	10	30	0		40	40	
SEASONAL FACTOR	1.000	1.000	1.000	13.035	26.07	2.37	41.475	35.13	***10***	***30***	***0***		***40***	***40***	



Hourly Percent By Vehicle Type

Rural Major Collector

Hour	Hour of Day	P&A (Cars)	% P&A (Cars)	B&C (Trucks)	% B&C (Trucks)	Total	% Total
0	12-1am	9,091	**0.1%**	2,053	**0.3%**	11,144	**0.1%**
1	1-2am	6,971	**0.1%**	1,950	**0.3%**	8,921	**0.1%**
2	2-3am	4,370	**0.1%**	2,316	**0.3%**	6,686	**0.1%**
3	3-4am	8,197	**0.1%**	3,364	**0.5%**	11,561	**0.1%**
4	4-5am	41,102	**0.6%**	8,960	**1.3%**	50,062	**0.6%**
5	5-6am	155,979	**2.2%**	20,802	**2.9%**	176,781	**2.3%**
6	6-7am	304,623	**4.3%**	37,846	**5.3%**	342,469	**4.4%**
7	7-8am	475,408	**6.7%**	50,156	**7.0%**	525,564	**6.8%**
8	8-9am	385,901	**5.5%**	54,791	**7.7%**	440,692	**5.7%**
9	9-10am	362,740	**5.1%**	57,678	**8.1%**	420,418	**5.4%**
10	10-11am	392,455	**5.6%**	57,602	**8.0%**	450,057	**5.8%**
11	11-12am	429,855	**6.1%**	58,488	**8.2%**	488,343	**6.3%**
12	12-1pm	455,593	**6.5%**	56,562	**7.9%**	512,155	**6.6%**
13	1-2pm	470,474	**6.7%**	55,824	**7.8%**	526,298	**6.8%**
14	2-3pm	555,025	**7.9%**	55,197	**7.7%**	610,222	**7.8%**
15	3-4pm	660,392	**9.4%**	54,118	**7.6%**	714,510	**9.2%**
16	4-5pm	696,926	**9.9%**	47,157	**6.6%**	744,083	**9.6%**
17	5-6pm	614,543	**8.7%**	34,611	**4.8%**	649,154	**8.3%**
18	6-7pm	403,552	**5.7%**	21,220	**3.0%**	424,772	**5.5%**
19	7-8pm	262,446	**3.7%**	13,484	**1.9%**	275,930	**3.5%**
20	8-9pm	182,412	**2.6%**	9,237	**1.3%**	191,649	**2.5%**
21	9-10pm	104,429	**1.5%**	6,078	**0.8%**	110,507	**1.4%**
22	10-11pm	53,131	**0.8%**	4,081	**0.6%**	57,212	**0.7%**
23	11-12pm	25,241	**0.4%**	2,579	**0.4%**	27,820	**0.4%**
	Total	7,060,856	**100%**	716,154	**100%**	7,777,010	**100%**

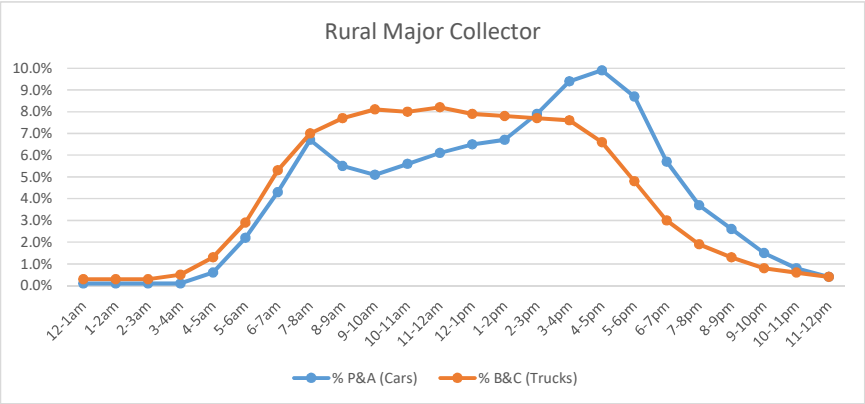
Sample of 894 permanent ATR's and portable counts taken in 2021, Monday to Friday counts only.

for Partial count factor, enter 1 for hours counted.

Partial Count Factor

Counted Hour	1.193 PA	1.185 BC	1.193 Total
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
1	0.067	0.07	0.068
1	0.055	0.077	0.057
1	0.051	0.081	0.054
1	0.056	0.08	0.058
1	0.061	0.082	0.063
1	0.065	0.079	0.066
1	0.067	0.078	0.068
1	0.079	0.077	0.078
1	0.094	0.076	0.092
1	0.099	0.066	0.096
1	0.087	0.048	0.083
1	0.057	0.03	0.055
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
	0.838	0.844	0.838

pass	coml
6am-6pm	6am-6pm
82.4%	86.7%
1.21	1.15
7am-7pm	7am-7pm
83.8%	84.4%
1.19	1.18
7am-11am	7am-11am
2pm-6pm	2pm-6pm
58.8%	57.5%
1.7	1.74



Hourly Percent By Vehicle Type

Rural Minor Arterial

Hour	Hour of Day	P&A (Cars)	% P&A (Cars)	B&C (Trucks)	% B&C (Trucks)	Total	% Total
0	12-1am	52,746	**0.3%**	17,478	**1.2%**	70,224	**0.4%**
1	1-2am	30,905	**0.2%**	13,860	**1.0%**	44,765	**0.3%**
2	2-3am	24,099	**0.2%**	15,483	**1.1%**	39,582	**0.2%**
3	3-4am	29,376	**0.2%**	21,112	**1.5%**	50,488	**0.3%**
4	4-5am	100,407	**0.6%**	31,697	**2.2%**	132,104	**0.8%**
5	5-6am	338,424	**2.1%**	47,568	**3.4%**	385,992	**2.2%**
6	6-7am	675,704	**4.3%**	68,318	**4.8%**	744,022	**4.3%**
7	7-8am	996,053	**6.3%**	83,948	**5.9%**	1,080,001	**6.3%**
8	8-9am	905,210	**5.7%**	94,097	**6.6%**	999,307	**5.8%**
9	9-10am	849,526	**5.4%**	98,010	**6.9%**	947,536	**5.5%**
10	10-11am	885,411	**5.6%**	105,249	**7.4%**	990,660	**5.8%**
11	11-12am	962,461	**6.1%**	106,180	**7.5%**	1,068,641	**6.2%**
12	12-1pm	1,033,792	**6.6%**	104,520	**7.4%**	1,138,312	**6.6%**
13	1-2pm	1,058,175	**6.7%**	101,754	**7.2%**	1,159,929	**6.7%**
14	2-3pm	1,183,208	**7.5%**	94,414	**6.7%**	1,277,622	**7.4%**
15	3-4pm	1,404,693	**8.9%**	88,435	**6.2%**	1,493,128	**8.7%**
16	4-5pm	1,445,582	**9.2%**	76,859	**5.4%**	1,522,441	**8.9%**
17	5-6pm	1,302,326	**8.3%**	62,402	**4.4%**	1,364,728	**7.9%**
18	6-7pm	859,071	**5.4%**	47,193	**3.3%**	906,264	**5.3%**
19	7-8pm	580,938	**3.7%**	36,415	**2.6%**	617,353	**3.6%**
20	8-9pm	442,205	**2.8%**	30,097	**2.1%**	472,302	**2.7%**
21	9-10pm	307,003	**1.9%**	26,049	**1.8%**	333,052	**1.9%**
22	10-11pm	186,245	**1.2%**	23,977	**1.7%**	210,222	**1.2%**
23	11-12pm	116,616	**0.7%**	21,408	**1.5%**	138,024	**0.8%**
	Total	15,770,176	**100%**	1,416,523	**100%**	17,186,699	**100%**

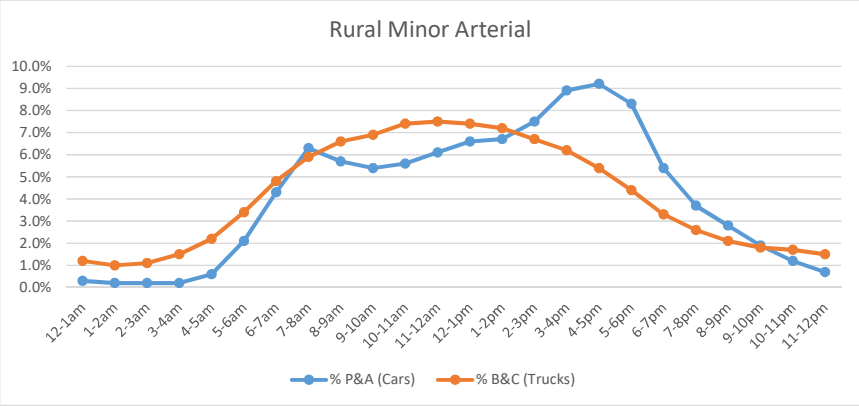
Sample of 335 permanent ATR's and portable counts taken in 2021, Monday to Friday counts only.

for Partial count factor, enter 1 for hours counted.

Partial Count Factor

Counted Hour	1.224 PA	1.335 BC	1.233 Total
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
1	0.063	0.059	0.063
1	0.057	0.066	0.058
1	0.054	0.069	0.055
1	0.056	0.074	0.058
1	0.061	0.075	0.062
1	0.066	0.074	0.066
1	0.067	0.072	0.067
1	0.075	0.067	0.074
1	0.089	0.062	0.087
1	0.092	0.054	0.089
1	0.083	0.044	0.079
1	0.054	0.033	0.053
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
	0.817	0.749	0.811

pass	coml
6am-6pm	6am-6pm
80.6%	76.4%
1.24	1.31
7am-7pm	7am-7pm
81.7%	74.9%
1.22	1.34
7am-11am	7am-11am
2pm-6pm	2pm-6pm
56.9%	49.5%
1.76	2.02



APPENDIX C:

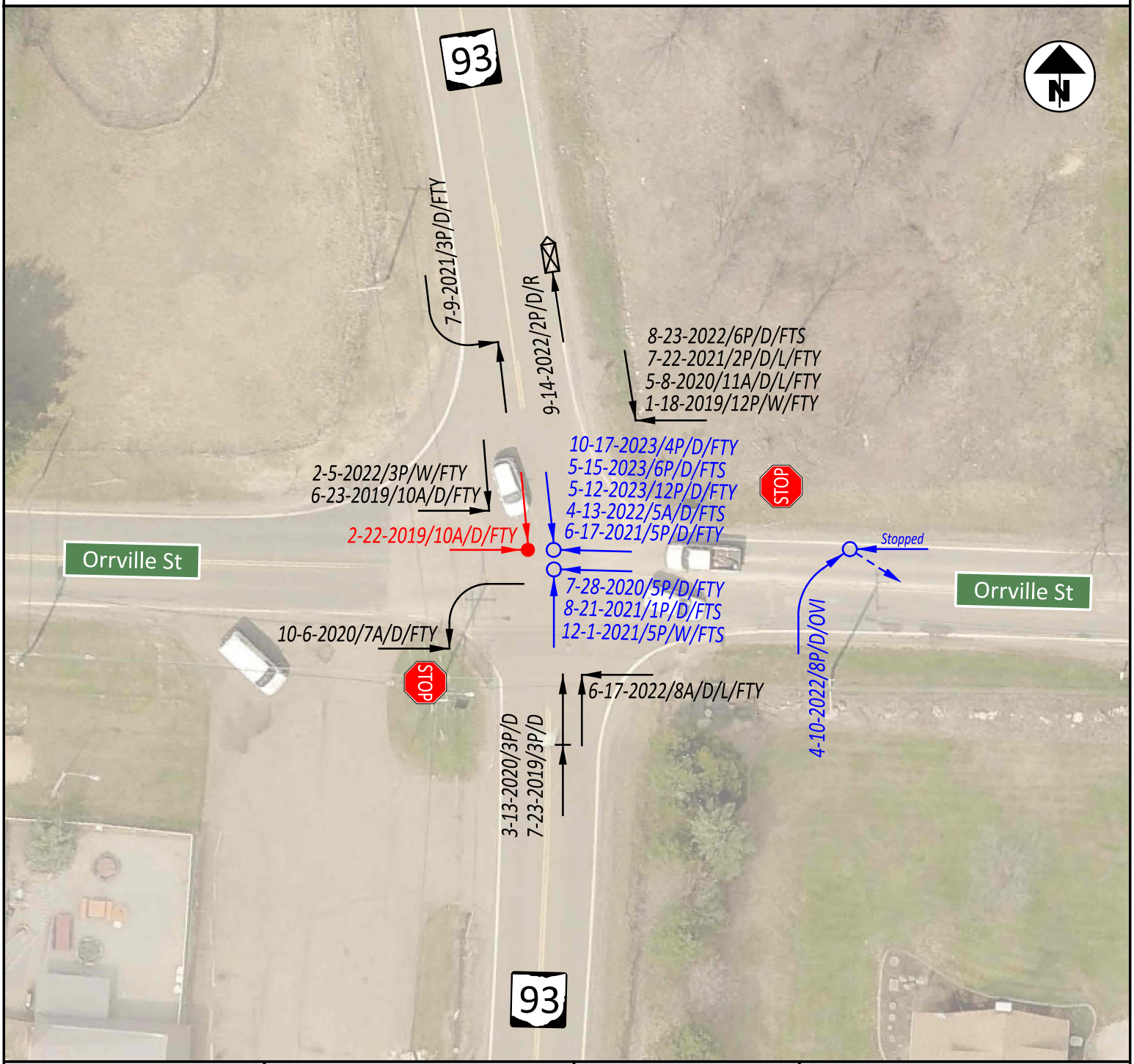
Collision Diagram

COLLISION DIAGRAM

STA SR 93 AT Orrville St

SLM 15.03

2019-2023



Vehicle Direction
Backing
Pedestrian
Out of Control
Overturn

Injury
Fatal
Fixed Object
Parked Vehicle
TEXT Collision Information

Road Condition:
D - Dry
W - Wet
S - Snow
I - Ice

FTY - Failure to Yield
FTS - Failure to Stop
FTC - Failure to Control
LOC - Left of Center
RRL - Ran Red Light
OVI - Operating Vehicle Impaired

TOTAL CRASHES ON PAGE

FREQUENCY		SEVERITY	
4	2019	12	NON-INJURY
4	2020	10	INJURY/FATAL
5	2021		
6	2022	22	TOTAL
3	2023		

EMH&T

APPENDIX D:

Turn-lane Warrants, Signal Warrants, and AWSC Warrants

SR 93 @ Orrville St NW
2-Lane Highway Right Turn Lane Warrant
>40 mph or 70 kph Posted Speed

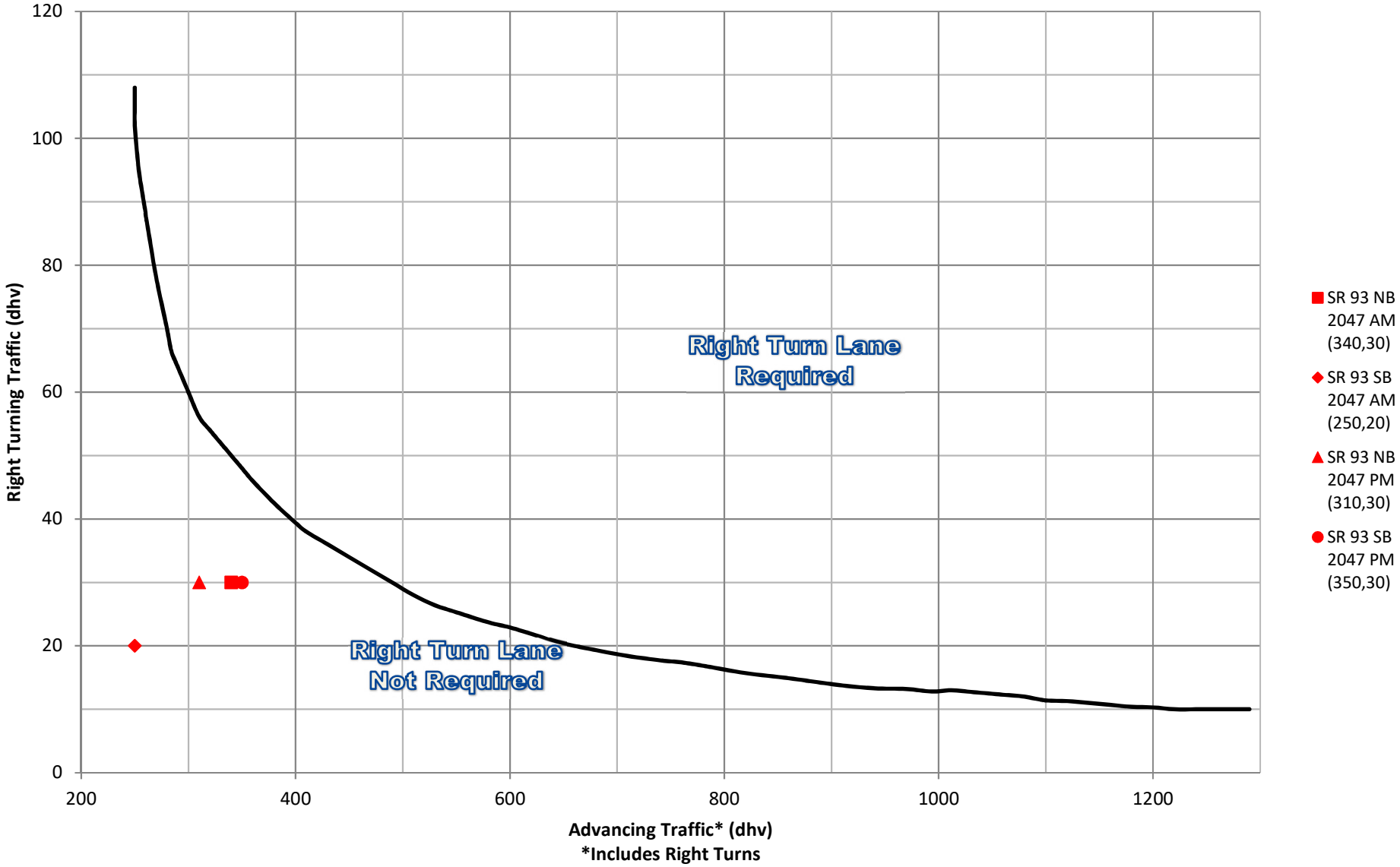


Fig. 401-6bE
ODOT Location and Design Manual, Volume One October 2004

SR 93 @ Orrville St NW
2-Lane Highway Left Turn Lane Warrant
>40 mph or 70 kph Posted Speed

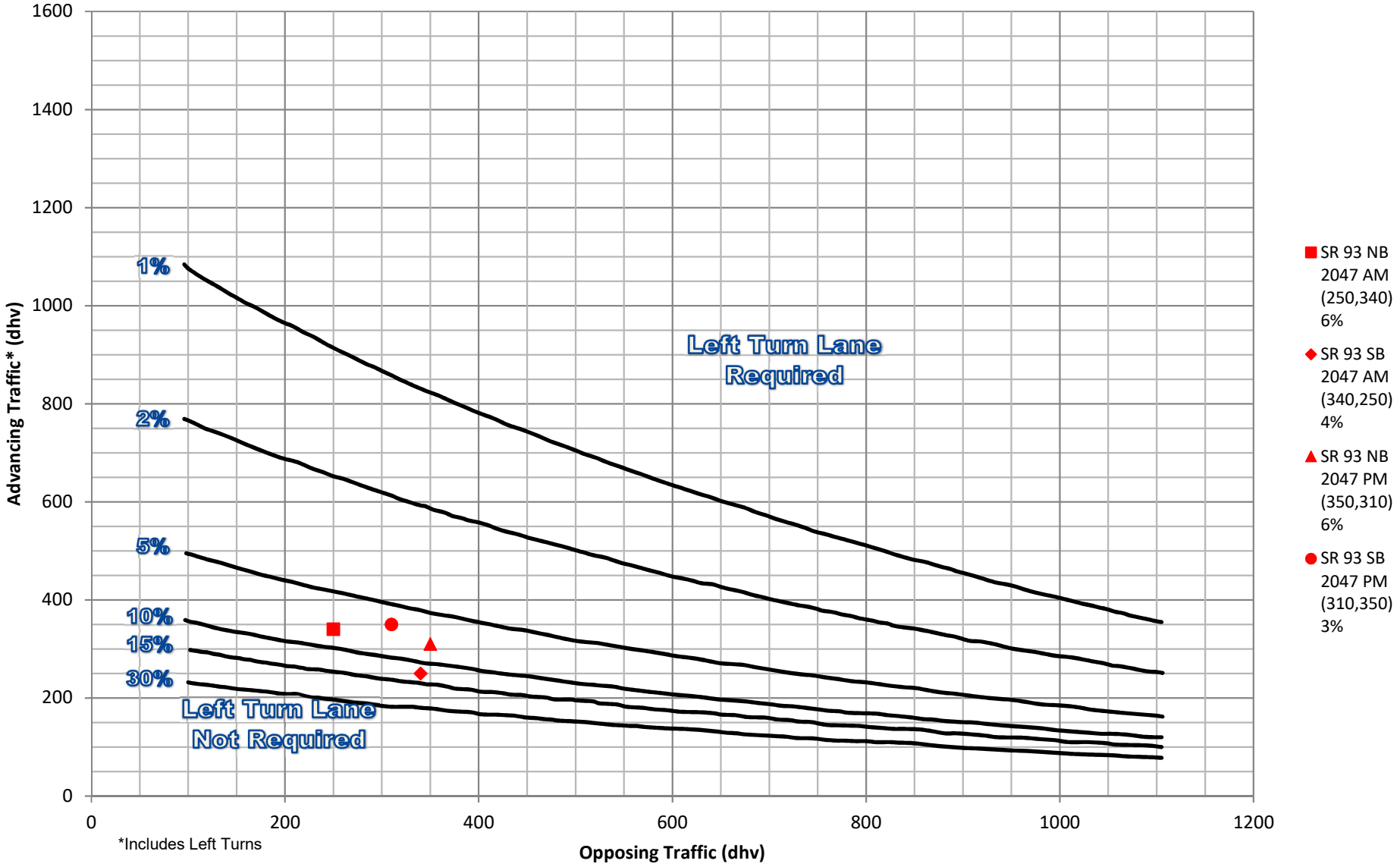


Fig. 401-5bE
ODOT Location and Design Manual, Volume One October 2004

STUDY AND ANALYSIS INFORMATION

Municipality:	Lawrence Township	**Traffic Volumes Obtained By:**	ODOT
County:	Stark	**Analysis Date:**	6/25/2024
ODOT Engineering District:	4	**Agency/ Company Name Performing Warrant Analysis:**	EMH&T
Google map link:	Map		

Analysis Information

Data Collection Date: 1/11/2024

Day of the Week: Thursday

Is the intersection in a built-up area of an isolated community of <10,000 population? No

Existing Traffic Signal at intersection: No

Total Number of Approaches at Intersection: 4

Major Street Information

Major Street Name and Route Number: SR 93 (Manchester Ave NW)

Major Street Approach Direction: N-Bound / S-Bound

Number of Thru Lanes on Each Major Street Approach: 1 **LANE(S)**

Speed Limit or 85th Percentile Speed on the Major Street*: 55 **MPH**

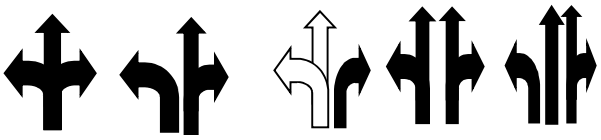
*Unknown assumes below 45 mph

Minor Street Information

Minor Street Name and Route Number: Orrville St NW

Minor Street Approach Configuration:

1	E-Bound
1	W-Bound



1 2 3 4 5

Number of Thru Lanes on Each Minor Street Approach: 1 **LANE(S)**

Apply Right Turn Lane Reduction*: Yes

*Right Turn Lane Reduction Shall be used for Warrants 1, 2, & 3 for New ODOT Signals. Please refer to TEM 402-3.2 for clarification and criteria under which Right Turn Reduction is not required.

TRAFFIC SIGNAL WARRANT ANALYSIS FINDINGS

	Warrant Applicable?	Warrant Satisfied?	Notes and Comments:	
Warrant 1, Eight-Hour Vehicular Volume	Yes	**No**		
Warrant 2, Four-Hour Vehicular Volume	Yes	**No**		
Warrant 3, Peak Hour	Yes	**No**	Signals installed under Warrant 3 should be traffic actuated.	**Peak Hour** 3:45 PM 4:45 PM
For Warrants 1-3, new ODOT signals must be based off of 100% volume thresholds (TEM 402-3.2)				
Warrant 4, Pedestrian Volume	No		If this warrant is met, and a traffic control signal is justified by an engineering study, the traffic control signal shall be equipped with pedestrian signal heads complying with the provisions set forth in Chapter 4E of the OMUTCD.	**Peak Hour** 3:45 PM 4:45 PM
Warrant 5, School Crossing	No		N/A	
Warrant 6, Coordinated Signal System	No		(Shall not be used as the sole warrant in the analysis)	
Warrant 7, Crash Experience	Yes	**No**	If this is the sole warrant, signal must be semi-actuated with control devices which provide proper coordination if installed at an intersection within a coordinated system and normally should be fully traffic actuated if installed at an isolated intersection.	
Warrant 8, Roadway Network	No		(Shall not be used as the sole warrant in the analysis)	
Warrant 9, Intersection Near a Grade Crossing	No		Figure 4C-9	
Multi-Way Stop Warrant	No		May be used as an interim measure if traffic signal warrants are satisfied.	

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

If no warrants are satisfied, additional options may be considered:
1. An engineering study, performed by a firm prequalified by ODOT for signal design, if approved by the ODOT district, may be used to justify a new signal installation or retention of an existing signal that otherwise does not meet the published warrants. An example of such an instance is a traffic signal in proximity to a railroad crossing that serves to reduce queuing across the tracks.
2. According to TEM 402-2, If the actual turning movement counts fail to satisfy a signal warrant, it may be acceptable to use traffic volumes projected to the second year after project completion. The **Modeling and Forecasting Section** should provide the projected traffic volumes.
3. A pedestrian hybrid beacon may be considered for installation to facilitate pedestrian crossings at a location that does not meet traffic signal warrants (see Chapter 4C of TEM) or at a location that meets traffic signal warrants under Sections 4C.05 and/or 4C.06 but a decision is made to not install a traffic control signal. **Please fill inputs on PHB Score Sheet and submit to ODOT.**

Considerations such as geometrics and lack of sight distance generally have not been accepted in lieu of satisfying signal warrants. These considerations may allow an otherwise unwarranted traffic signal to be retained at **100 percent** local cost. Please review TEM 402-4 for details.

Conclusion: Do Not Install New Traffic Signal

Notes:

OMUTCD WARRANT 1, EIGHT-HOUR VEHICULAR VOLUME

Number of Lanes for Moving Traffic on Each Approach	
Major Street:	1 Lane
Minor Street:	1 Lane

Built up Isolated Community with Less Than 10,000 Population or Above 40 MPH on Major Street? Yes

**Only applicable after an adequate trial of other alternatives (See section 4C.02.06 of the 2012 OMUTCD)*

Lanes Major/ Minor	Adjusted Volumes		Condition A				Condition B				Combination A/B*							
											Cond. A		Cond. B		Cond. A		Cond. B	
	Major	Minor	100%		70%		100%		70%		80%		80%		56%		56%	
			Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.	Maj.	Min.
1 / 1	X		500	150	350	105	750	75	525	53	400	120	600	60	280	84	420	42
2+ / 1			600	150	420	105	900	75	630	53	480	120	720	60	336	84	504	42
2+ / 2+			600	200	420	140	900	100	630	70	480	160	720	80	336	112	504	56
1 / 2+			500	200	350	140	750	100	525	70	400	160	600	80	280	112	420	56
12:00 AM	0	0																
12:15 AM	0	0																
12:30 AM	0	0																
12:45 AM	0	0																
1:00 AM	0	0																
1:15 AM	0	0																
1:30 AM	0	0																
1:45 AM	0	0																
2:00 AM	0	0																
2:15 AM	0	0																
2:30 AM	0	0																
2:45 AM	0	0																
3:00 AM	0	0																
3:15 AM	0	0																
3:30 AM	0	0																
3:45 AM	0	0																
4:00 AM	0	0																
4:15 AM	0	0																
4:30 AM	0	0																
4:45 AM	0	0																
5:00 AM	0	0																
5:15 AM	0	0																
5:30 AM	0	0																
5:45 AM	0	0																
6:00 AM	0	0																
6:15 AM	83	22																
6:30 AM	203	51																
6:45 AM	333	75													1			
7:00 AM	426	98			1						1						1	1
7:15 AM	428	98																
7:30 AM	395	79																
7:45 AM	342	74													1			
8:00 AM	313	61																
8:15 AM	286	56																
8:30 AM	252	55																
8:45 AM	229	45																
9:00 AM	220	40																
9:15 AM	217	43																
9:30 AM	216	42																
9:45 AM	217	48																

10:00 AM	215	58																
10:15 AM	218	56																
10:30 AM	237	62																
10:45 AM	234	60																
11:00 AM	241	53																
11:15 AM	245	52																
11:30 AM	224	52																
11:45 AM	241	51																
12:00 PM	228	51																
12:15 PM	227	55																
12:30 PM	235	58																
12:45 PM	225	52																
1:00 PM	239	60																
1:15 PM	258	55																
1:30 PM	274	55																
1:45 PM	285	63													1			
2:00 PM	319	62																
2:15 PM	333	71																
2:30 PM	357	88			1													
2:45 PM	396	93													1	1		
3:00 PM	431	103									1						1	1
3:15 PM	439	105																
3:30 PM	467	110			1	1												
3:45 PM	484	112													1	1		
4:00 PM	474	108									1						1	1
4:15 PM	481	98																
4:30 PM	471	99			1													
4:45 PM	448	102													1	1		
5:00 PM	416	95									1							
5:15 PM	388	100																
5:30 PM	331	78																
5:45 PM	301	56													1			
6:00 PM	269	52																
6:15 PM	188	34																
6:30 PM	129	21																
6:45 PM	56	12																
7:00 PM	0	0																
7:15 PM	0	0																
7:30 PM	0	0																
7:45 PM	0	0																
8:00 PM	0	0																
8:15 PM	0	0																
8:30 PM	0	0																
8:45 PM	0	0																
9:00 PM	0	0																
9:15 PM	0	0																
9:30 PM	0	0																
9:45 PM	0	0																
HOURS MET			**0**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**7**	**3**	**3**	**3**
WARRANT SATISFIED?			**NO**		**NO**		**NO**		**NO**		**NO**				**NO**			

Warrant Met: **No**

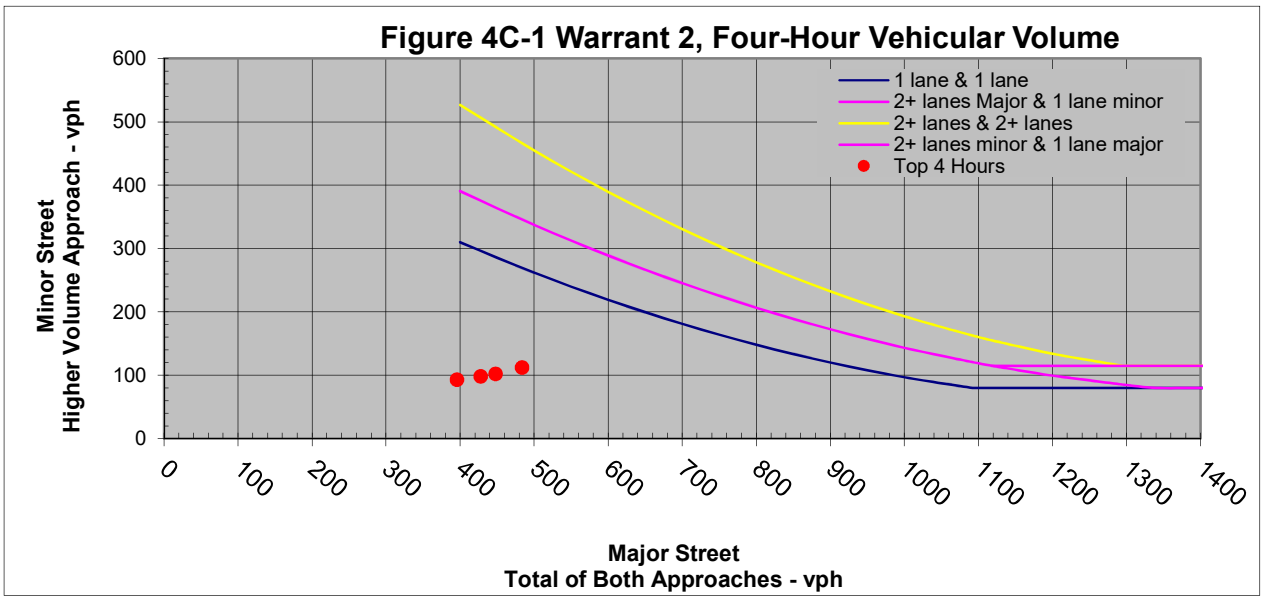
Notes:

OMUTCD WARRANT 2, FOUR-HOUR VEHICULAR VOLUME

Number of Lanes for Moving Traffic on Each Approach		Total Number of Unique Hours Met on Figure 4C-1	0
Major street:	1 Lane	Total Number of Unique Hours Met on Figure 4C-2 (70% Factor)	0
Minor Street:	1 Lane		

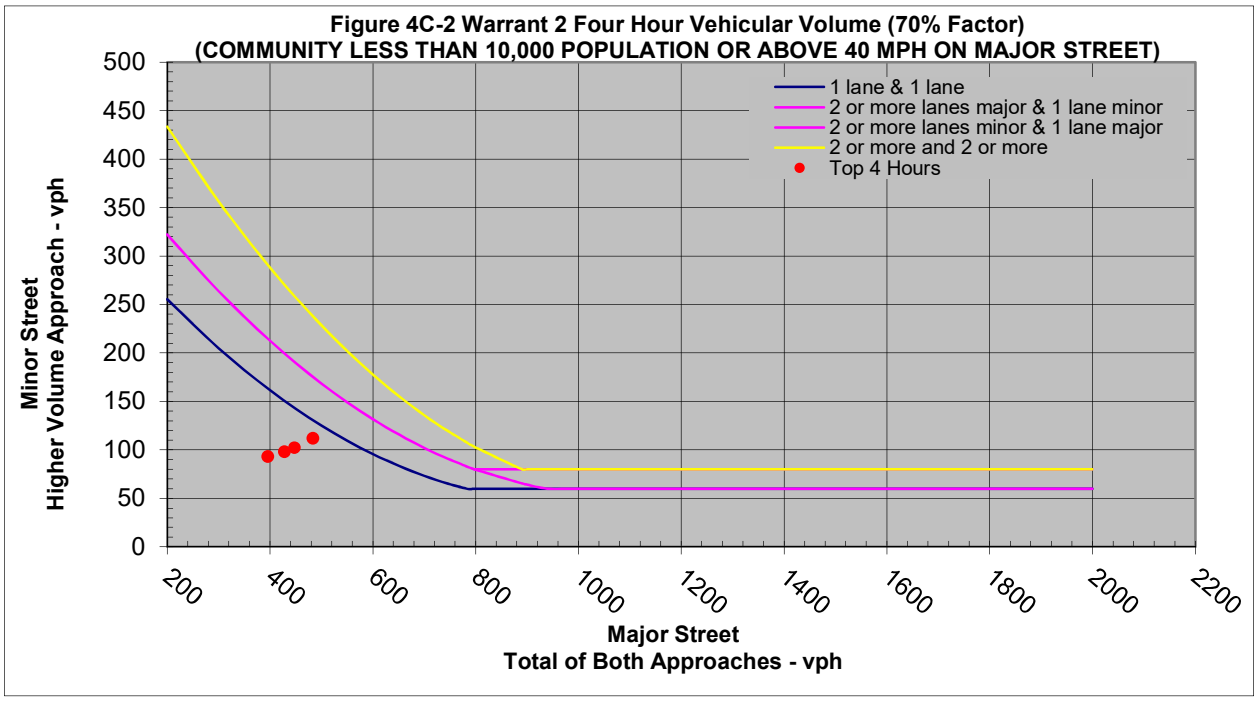
Built up Isolated Community with Less Than 10,000 Population or Above 40 MPH on Major Street?	Yes

Hour Interval Beginning At	Raw Traffic Counts				Total Major Approach Volumes	Highest Actual Minor Street Approach Volumes	Hour Met?	Hour Met? (70% Factor)
	Major - SR 93 (Manchester Ave NW		Minor - Orrville St NW					
	N-Bound	S-Bound	W-Bound	E-Bound				
6:00 AM	0	0	0	0	0	0		
6:15 AM	52	31	22	15	83	22		
6:30 AM	119	84	51	33	203	51		
6:45 AM	199	134	75	52	333	75		
7:00 AM	247	179	98	71	426	98		
7:15 AM	243	185	98	69	428	98		
7:30 AM	230	165	79	69	395	79		
7:45 AM	194	148	74	62	342	74		
8:00 AM	176	137	61	53	313	61		
8:15 AM	154	132	56	47	286	56		
8:30 AM	130	122	55	35	252	55		
8:45 AM	111	118	45	37	229	45		
9:00 AM	104	116	40	36	220	40		
9:15 AM	109	108	31	43	217	43		
9:30 AM	98	118	27	42	216	42		
9:45 AM	105	112	24	48	217	48		
10:00 AM	106	109	29	58	215	58		
10:15 AM	109	109	34	56	218	56		
10:30 AM	118	119	37	62	237	62		
10:45 AM	110	124	36	60	234	60		
11:00 AM	113	128	40	53	241	53		
11:15 AM	115	130	35	52	245	52		
11:30 AM	110	114	37	52	224	52		
11:45 AM	123	118	44	51	241	51		
12:00 PM	117	111	44	51	228	51		
12:15 PM	114	113	46	55	227	55		
12:30 PM	114	121	38	58	235	58		
12:45 PM	107	118	36	52	225	52		
1:00 PM	110	129	32	60	239	60		
1:15 PM	111	147	39	55	258	55		
1:30 PM	119	155	55	51	274	55		
1:45 PM	122	163	60	63	285	63		
2:00 PM	154	165	62	60	319	62		
2:15 PM	168	165	60	71	333	71		
2:30 PM	180	177	58	88	357	88		
2:45 PM	200	196	60	93	396	93		
3:00 PM	198	233	67	103	431	103		
3:15 PM	201	238	72	105	439	105		
3:30 PM	221	246	75	110	467	110		
3:45 PM	227	257	74	112	484	112		
4:00 PM	229	245	68	108	474	108		
4:15 PM	226	255	63	98	481	98		
4:30 PM	217	254	56	99	471	99		
4:45 PM	206	242	58	102	448	102		
5:00 PM	188	228	63	95	416	95		
5:15 PM	180	208	60	100	388	100		
5:30 PM	152	179	62	78	331	78		
5:45 PM	132	169	56	56	301	56		
6:00 PM	123	146	43	52	269	52		
6:15 PM	83	105	32	34	188	34		
6:30 PM	57	72	17	21	129	21		
6:45 PM	29	27	6	12	56	12		
7:00 PM	0	0	0	0	0	0		
7:15 PM	0	0	0	0	0	0		
7:30 PM	0	0	0	0	0	0		
7:45 PM	0	0	0	0	0	0		
8:00 PM	0	0	0	0	0	0		



Top Hours for Figure 4C-1	Start Time	End Time	Major Street	Minor Street
Top Hour	3:45 PM	4:45 PM	484	112
2nd Highest Hour	4:45 PM	5:45 PM	448	102
3rd Highest Hour	7:15 AM	8:15 AM	428	98
4th Highest Hour	2:45 PM	3:45 PM	396	93

Top Hours for Figure 4C-2	Start Time	End Time	Major Street	Minor Street
Top Hour	3:45 PM	4:45 PM	484	112
2nd Highest Hour	4:45 PM	5:45 PM	448	102
3rd Highest Hour	7:15 AM	8:15 AM	428	98
4th Highest Hour	2:45 PM	3:45 PM	396	93



Are the requirements for Warrant 2 met?: No

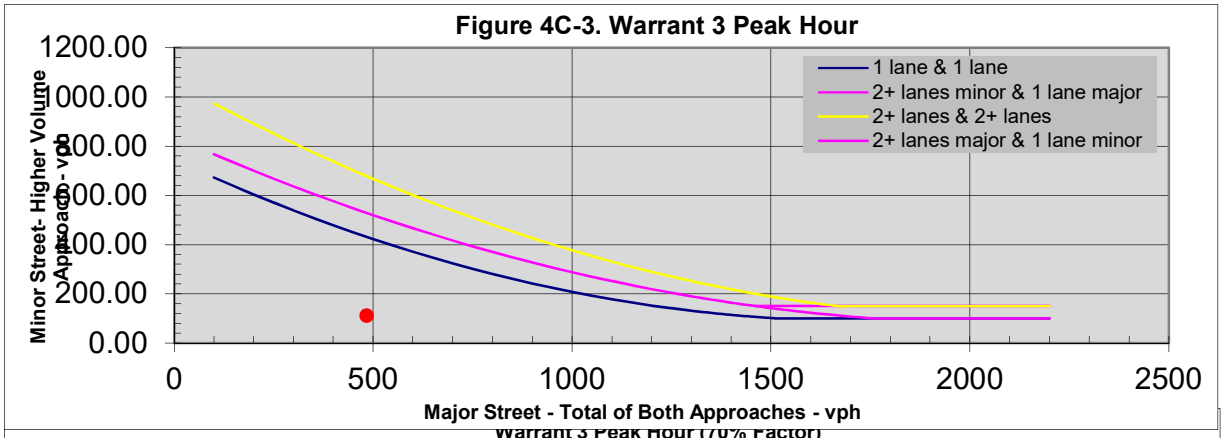
OMUTCD WARRANT 3, PEAK HOUR

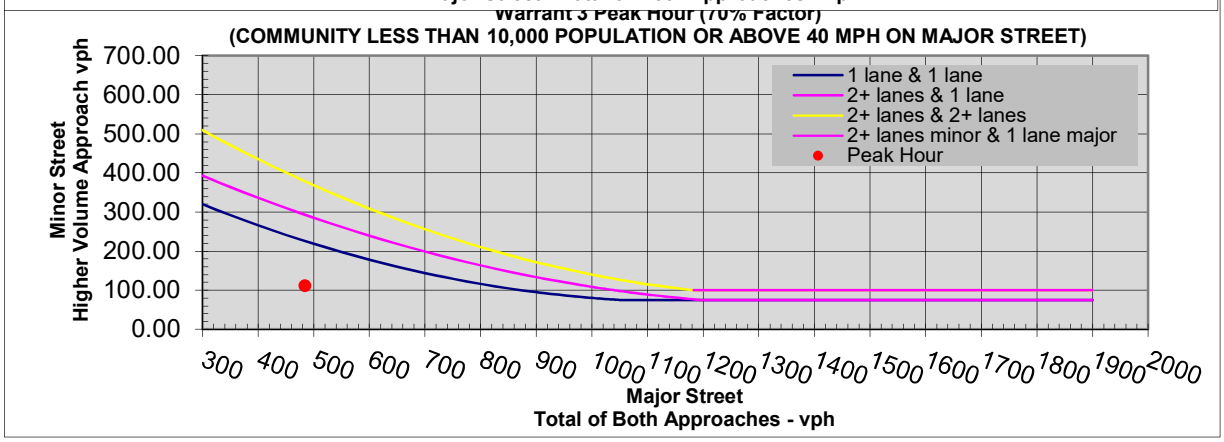
Number of Lanes for Moving Traffic on Each Approach		Peak Hour Start time	3:45 PM
Major Street:	1 Lane	Peak Hour End Time	4:45 PM
Minor Street:	1 Lane		

Built up Isolated Community with Less Than 10,000 Population or Above 40 MPH on Major Street?	Yes

Is this signal warrant being applied for an unusual case, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time?	No

Indicate whether all three of the following conditions for the same 1 hour (any four consecutive 15-minute periods) of an average day are present*	
Does the total stopped time delay experienced by the traffic on one minor-street approach (one direction only) controlled by a STOP sign equal or exceed 4 vehicle-hours for a one-lane approach or 5 vehicle-hours for a two-lane approach?	No
Does the volume on the same minor-street approach (one direction only) equal or exceed 100 vehicles per hour for one moving lane of traffic or 150 vehicles per hour for two moving lanes?	Yes
Does the total entering volume serviced during the hour equal or exceed 650 vehicles per hour for intersection with three approaches or 800 vehicles per hour for intersections with four or more approaches?	No
**If applicable, attach all supporting calculations and documentation.*	
Are the requirements for Warrant 3 met?:	**No**





Hour Vehicular Volume				
Hour Interval Beginning At	**Major Street Combined Vehicles Per Hour (VPH)**	**Highest Minor Street Approach Vehicles Per Hour (VPH)**	**Sum of Major Street and Highest Minor Street**	**Sum of Major Street and Combined Minor Street**
6:00 AM	0	0	0	0
6:15 AM	83	22	105	120
6:30 AM	203	51	254	287
6:45 AM	333	75	408	460
7:00 AM	426	98	524	595
7:15 AM	428	98	526	595
7:30 AM	395	79	474	543
7:45 AM	342	74	416	478
8:00 AM	313	61	374	427
8:15 AM	286	56	342	389
8:30 AM	252	55	307	342
8:45 AM	229	45	274	311
9:00 AM	220	40	260	296
9:15 AM	217	43	260	291
9:30 AM	216	42	258	285
9:45 AM	217	48	265	289
10:00 AM	215	58	273	302
10:15 AM	218	56	274	308
10:30 AM	237	62	299	336
10:45 AM	234	60	294	330
11:00 AM	241	53	294	334
11:15 AM	245	52	297	332
11:30 AM	224	52	276	313
11:45 AM	241	51	292	336
12:00 PM	228	51	279	323
12:15 PM	227	55	282	328
12:30 PM	235	58	293	331
12:45 PM	225	52	277	313
1:00 PM	239	60	299	331
1:15 PM	258	55	313	352
1:30 PM	274	55	329	380
1:45 PM	285	63	348	408
2:00 PM	319	62	381	441
2:15 PM	333	71	404	464
2:30 PM	357	88	445	503
2:45 PM	396	93	489	549
3:00 PM	431	103	534	601
3:15 PM	439	105	544	616
3:30 PM	467	110	577	652
3:45 PM	484	112	596	670
4:00 PM	474	108	582	650
4:15 PM	481	98	579	642
4:30 PM	471	99	570	626
4:45 PM	448	102	550	608
5:00 PM	416	95	511	574
5:15 PM	388	100	488	548
5:30 PM	331	78	409	471
5:45 PM	301	56	357	413
6:00 PM	269	52	321	364
6:15 PM	188	34	222	254
6:30 PM	129	21	150	167
6:45 PM	56	12	68	74
7:00 PM	0	0	0	0
7:15 PM	0	0	0	0
7:30 PM	0	0	0	0
7:45 PM	0	0	0	0
8:00 PM	0	0	0	0

Actual Peak Hour Major Traffic Volume	Actual Peak Hour Minor Traffic Volume	Required Peak Hour Minor Traffic Volume for Fig. 4C-3	Required Peak Hour Minor Traffic Volume for Fig. 4C-4
484	112	431	226

OMUTCD WARRANT 7, CRASH EXPERIENCE

Built-up Isolated Community With Less Than 10,000 Population or Above 40 mph on Major Street?: Yes

Number of Lanes for Moving Traffic on Each Approach
Major Street: 1 Lane
Minor Street: 1 Lane

Has adequate trial of alternative with satisfactory observance and enforcement failed to reduce the crash frequency? Yes

Five or more reportable and/ or non-reportable crashes, of types susceptible to correction by a traffic control signal have occurred within a 12-month period during the most recent 3 years of available crash data.* Yes
**If applicable attach a summary of the crash data analysis used for this criterion*

For each of any 8 hours of an average day, the vehicles per hour given in both the 80% columns of Condition A in Table 4C-1 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, if in a built-up isolated community with less than 10,000 population or above 40 mph on major street, the 56% columns may be used. No

For each of any 8 hours of an average day, the vehicles per hour given in both the 80% columns of Condition B in Table 4C-1 exists on the major-street and the higher-volume minor-street approach, respectively, to the intersection, if in a built-up isolated community with less than 10,000 population or above 40 mph on major street, the 56% columns may be used. No

The volume of pedestrian traffic is 80% or more of the requirements specified in Warrant 4, the Pedestrian Volume warrant.* No
**If applicable, attach all supporting calculations and documentation*

Are the requirements for Warrant 7 met?: No

OMUTCD WARRANT 8, ROADWAY NETWORK*

Does the intersection have 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 the average weekday?

Does the intersection have a total existing or immediately projected entering volume of at least 1,000 vehicles per hour for each of any 5 hours of a non-normal business day (Saturday or Sunday)?

Is the major street part of the street or highway system that serves as the principal roadway network for through traffic flow?

Does the major street include rural or suburban highways outside, entering, or traversing a city?

Does the major street appear as a major route on an official plan, such as a major street plan in an urban area traffic and transportation study?

**Refer to Section 4.3 of ODOT Publication 46 (Traffic Engineering Manual) for additional Department documentation requirements to justify the installation of a signal under Warrant 8. Attach all supplementary documentation and calculations, especially those relating to traffic volume projections and subsequent Warrant analyses.*

Are the requirements for Warrant 8 met?: No

Multi-Way Stop Application

OMUTCD Section 2B.07

	Warranted ?
A. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.	No
B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multiway stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.	Yes
C. Minimum Volumes:	
1 The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day.	Yes
2 The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour.* *If this condition is satisfied, there must also be an average delay of at least 30 seconds per vehicle during the peak hour.	No
3 If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum volume warrants are 70 percent of the values provided in Items 1 and 2.	Yes
D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.	No

Other criteria that may be considered in an engineering study include:

A. The need to control left-turn conflicts;	No
B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;	No
C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and	No
D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.	No

Are the requirements for Multi-Way Stop Satisfied?: Yes

AUTOCALC table								
Each hour is individually checked and tallied if "met"								
Lanes Major/ Minor	ADJUSTED VOLUMES		Condition C.1		Condition C.2		Condition D	
	MAJOR	MINOR	100%		70%		80%	
			MAJ.	MIN.	MAJ.	MIN.	MAJ.	MIN.
Required Volumes			300	200	210	140	240	160
6:00 AM	0	0						
6:15 AM	83	22						
6:30 AM	203	51						
6:45 AM	333	75	1		1		1	
7:00 AM	426	98						
7:15 AM	428	98						
7:30 AM	395	79						
7:45 AM	342	74	1		1		1	
8:00 AM	313	61						
8:15 AM	286	56						
8:30 AM	252	55						
8:45 AM	229	45			1			
9:00 AM	220	40						
9:15 AM	217	43						
9:30 AM	216	42						
9:45 AM	217	48			1			
10:00 AM	215	58						
10:15 AM	218	56						
10:30 AM	237	62						
10:45 AM	234	60			1			
11:00 AM	241	53					1	
11:15 AM	245	52						
11:30 AM	224	52						
11:45 AM	241	51			1			
12:00 PM	228	51						
12:15 PM	227	55						
12:30 PM	235	58						
12:45 PM	225	52			1			
1:00 PM	239	60						
1:15 PM	258	55					1	
1:30 PM	274	55						
1:45 PM	285	63			1			
2:00 PM	319	62	1					
2:15 PM	333	71					1	
2:30 PM	357	88						
2:45 PM	396	93			1			
3:00 PM	431	103	1					
3:15 PM	439	105					1	
3:30 PM	467	110						
3:45 PM	484	112			1			
4:00 PM	474	108	1					
4:15 PM	481	98					1	
4:30 PM	471	99						
4:45 PM	448	102			1			
5:00 PM	416	95	1					
5:15 PM	388	100					1	
5:30 PM	331	78						
5:45 PM	301	56			1			
6:00 PM	269	52						
6:15 PM	188	34						
6:30 PM	129	21						
6:45 PM	56	12						
7:00 PM	0	0						
7:15 PM	0	0						
7:30 PM	0	0						
7:45 PM	0	0						
8:00 PM	0	0						
8:15 PM	0	0						
8:30 PM	0	0						
8:45 PM	0	0						
9:00 PM	0	0						
9:15 PM	0	0						
9:30 PM	0	0						
9:45 PM	0	0						
10:00 PM	0	0						
10:15 PM	0	0						
10:30 PM	0	0						
10:45 PM	0	0						
11:00 PM	0	0						
11:15 PM	0	0						
11:30 PM	0	0						
11:45 PM	0	0						
HOURS MET			**6**	**0**	**12**	**0**	**8**	**0**
CONDITION SATISFIED?			**NO**		**NO**		**NO**	

EMH&T

APPENDIX E:

HCS Capacity Analysis

HCS Two-Way Stop-Control Report

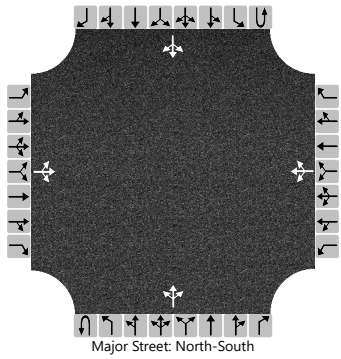
General Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2027
Time Analyzed	AM PEAK DHV
Intersection Orientation	North-South
Project Description	STA-93 at Orrville St

Site Information

Intersection	SR93 at Orrville St
Jurisdiction	ODOT DISTRICT 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.87
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	50	20		30	80	10		10	290	30		10	210	20
Percent Heavy Vehicles (%)		7	7	7		3	3	3		6				11		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.17	6.57	6.27		7.13	6.53	6.23		4.16				4.21		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.56	4.06	3.36		3.53	4.03	3.33		2.25				2.30		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			115				138			11				11		
Capacity, c (veh/h)			355				360			1277				1143		
v/c Ratio			0.32				0.38			0.01				0.01		
95% Queue Length, Q_{95} (veh)			1.4				1.8			0.0				0.0		
95% Queue Length, Q_{95} (ft)			37.0				46.1									
Control Delay (s/veh)			19.9				21.1			7.8	0.1	0.1		8.2	0.1	0.1
Level of Service (LOS)			C				C			A	A	A		A	A	A
Approach Delay (s/veh)	19.9				21.1				0.3				0.4			
Approach LOS	C				C				A				A			

HCS Two-Way Stop-Control Report

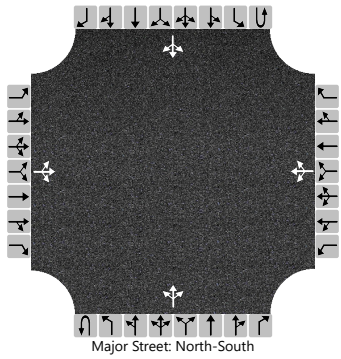
General Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2027
Time Analyzed	PM PEAK DHV
Intersection Orientation	North-South
Project Description	STA-93 at Orrville St

Site Information

Intersection	SR93 at Orrville St
Jurisdiction	ODOT DISTRICT 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.93
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	90	30		30	50	10		20	250	30		10	300	30
Percent Heavy Vehicles (%)		0	0	0		4	4	4		4				5		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.14	6.54	6.24		4.14				4.15		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.54	4.04	3.34		2.24				2.25		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			161				97			22				11		
Capacity, c (veh/h)			370				306			1193				1243		
v/c Ratio			0.44				0.32			0.02				0.01		
95% Queue Length, Q_{95} (veh)			2.1				1.3			0.1				0.0		
95% Queue Length, Q_{95} (ft)			52.5				33.5									
Control Delay (s/veh)			22.0				22.1			8.1	0.2	0.2		7.9	0.1	0.1
Level of Service (LOS)			C				C			A	A	A		A	A	A
Approach Delay (s/veh)	22.0				22.1				0.7				0.3			
Approach LOS	C				C				A				A			

HCS Two-Way Stop-Control Report

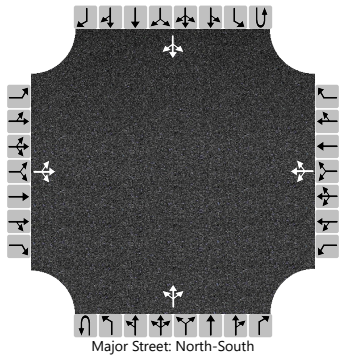
General Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2047
Time Analyzed	AM PEAK DHV
Intersection Orientation	North-South
Project Description	STA-93 at Orrville St

Site Information

Intersection	SR93 at Orrville St
Jurisdiction	ODOT DISTRICT 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.87
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	50	20		30	80	10		20	290	30		10	220	20
Percent Heavy Vehicles (%)		7	7	7		3	3	3		6				11		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.17	6.57	6.27		7.13	6.53	6.23		4.16				4.21		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.56	4.06	3.36		3.53	4.03	3.33		2.25				2.30		

Delay, Queue Length, and Level of Service

Flow Rate, v (veh/h)			115				138			23				11		
Capacity, c (veh/h)			333				339			1264				1143		
v/c Ratio			0.35				0.41			0.02				0.01		
95% Queue Length, Q_{95} (veh)			1.5				1.9			0.1				0.0		
95% Queue Length, Q_{95} (ft)			39.6				48.6									
Control Delay (s/veh)			21.4				22.8			7.9	0.2	0.2		8.2	0.1	0.1
Level of Service (LOS)			C				C			A	A	A		A	A	A
Approach Delay (s/veh)	21.4				22.8				0.6				0.4			
Approach LOS	C				C				A				A			

HCS Two-Way Stop-Control Report

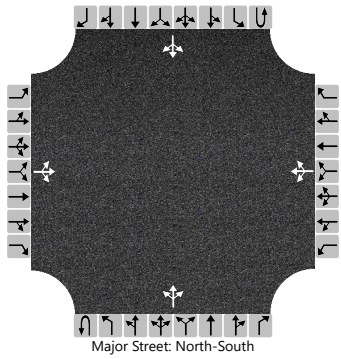
General Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2047
Time Analyzed	PM PEAK DHV
Intersection Orientation	North-South
Project Description	STA-93 at Orrville St

Site Information

Intersection	SR93 at Orrville St
Jurisdiction	ODOT DISTRICT 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.93
Analysis Time Period (hrs)	0.25

Lanes


Major Street: North-South

Vehicle Volumes and Adjustments

Approach	Eastbound				Westbound				Northbound				Southbound			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Priority		10	11	12		7	8	9	1U	1	2	3	4U	4	5	6
Number of Lanes		0	1	0		0	1	0	0	0	1	0	0	0	1	0
Configuration			LTR				LTR				LTR				LTR	
Volume (veh/h)		30	90	30		30	50	10		20	260	30		10	310	30
Percent Heavy Vehicles (%)		0	0	0		4	4	4		4				5		
Proportion Time Blocked																
Percent Grade (%)	0				0											
Right Turn Channelized																
Median Type | Storage	Undivided															

Critical and Follow-up Headways

Base Critical Headway (sec)		7.1	6.5	6.2		7.1	6.5	6.2		4.1				4.1		
Critical Headway (sec)		7.10	6.50	6.20		7.14	6.54	6.24		4.14				4.15		
Base Follow-Up Headway (sec)		3.5	4.0	3.3		3.5	4.0	3.3		2.2				2.2		
Follow-Up Headway (sec)		3.50	4.00	3.30		3.54	4.04	3.34		2.24				2.25		

Delay, Queue Length, and Level of Service

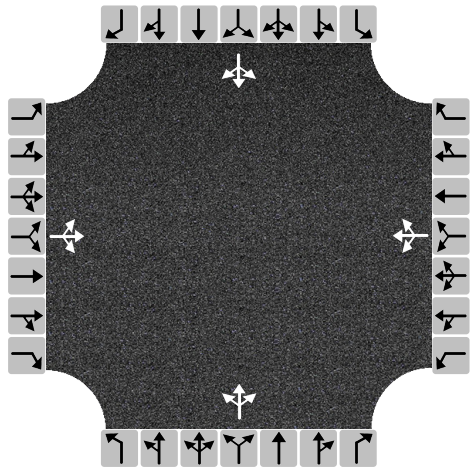
Flow Rate, v (veh/h)			161				97			22				11		
Capacity, c (veh/h)			359				295			1182				1232		
v/c Ratio			0.45				0.33			0.02				0.01		
95% Queue Length, Q_{95} (veh)			2.2				1.4			0.1				0.0		
95% Queue Length, Q_{95} (ft)			55.0				36.1									
Control Delay (s/veh)			22.9				23.1			8.1	0.2	0.2		7.9	0.1	0.1
Level of Service (LOS)			C				C			A	A	A		A	A	A
Approach Delay (s/veh)	22.9				23.1				0.7				0.3			
Approach LOS	C				C				A				A			

HCS All-Way Stop Control Report

General and Site Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2027
Analysis Time Period (hrs)	0.25
Time Analyzed	AM Peak DHV
Project Description	STA-93 at Orrville St
Intersection	SR93 at Orrville St
Jurisdiction	ODOT District 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.87

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)	30	50	20	30	80	10	10	290	30	10	210	20
% 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)	115			138			379			276		
Percent Heavy Vehicles	7			3			6			11		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.102			0.123			0.337			0.245		
Final Departure Headway, h_d (s)	5.99			5.93			5.16			5.39		
Final Degree of Utilization, x	0.191			0.227			0.544			0.413		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	3.99			3.93			3.16			3.39		

Capacity, Delay and Level of Service

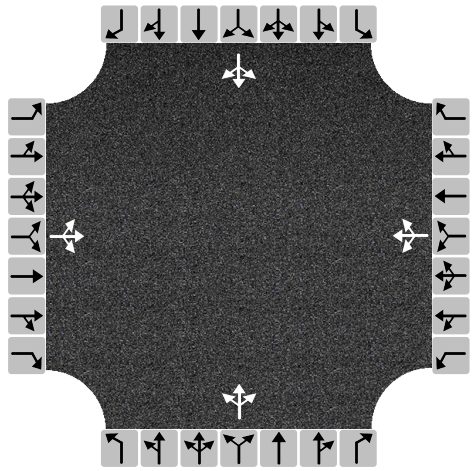
Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	115			138			379			276		
Capacity (veh/h)	601			607			697			668		
95% Queue Length, Q_{95} (veh)	0.7			0.9			3.3			2.0		
95% Queue Length, Q_{95} (ft)	18.5			23.0			86.5			54.4		
Control Delay (s/veh)	10.4			10.7			14.1			12.1		
Level of Service, LOS	B			B			B			B		
Approach Delay (s/veh) | LOS	10.4	B		10.7	B		14.1	B		12.1	B	
Intersection Delay (s/veh) | LOS	12.5						B					

HCS All-Way Stop Control Report

General and Site Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2027
Analysis Time Period (hrs)	0.25
Time Analyzed	2027 PM Peak DHV
Project Description	STA-93 at Orrville St
Intersection	SR93 at Orrville St
Jurisdiction	ODOT District 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.93

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)	30	90	30	30	50	10	20	250	30	10	300	30
% 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)	161			97			323			366		
Percent Heavy Vehicles	0			4			4			5		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.143			0.086			0.287			0.325		
Final Departure Headway, h_d (s)	5.83			6.13			5.27			5.22		
Final Degree of Utilization, x	0.261			0.165			0.472			0.530		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	3.83			4.13			3.27			3.22		

Capacity, Delay and Level of Service

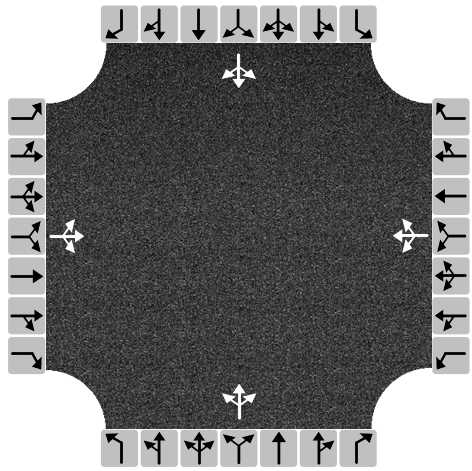
Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	161			97			323			366		
Capacity (veh/h)	617			588			683			689		
95% Queue Length, Q_{95} (veh)	1.0			0.6			2.5			3.1		
95% Queue Length, Q_{95} (ft)	25.0			15.5			64.5			80.6		
Control Delay (s/veh)	10.9			10.3			12.9			14.0		
Level of Service, LOS	B			B			B			B		
Approach Delay (s/veh) | LOS	10.9	B		10.3	B		12.9	B		14.0	B	
Intersection Delay (s/veh) | LOS	12.7						B					

HCS All-Way Stop Control Report

General and Site Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2047
Analysis Time Period (hrs)	0.25
Time Analyzed	2047 AM Peak DHV
Project Description	STA-93 at Orrville St
Intersection	SR93 at Orrville St
Jurisdiction	ODOT District 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.87

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)	30	50	20	30	80	10	20	290	30	10	220	20
% 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)	115			138			391			287		
Percent Heavy Vehicles	7			3			6			11		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.102			0.123			0.347			0.255		
Final Departure Headway, h_d (s)	6.06			6.00			5.20			5.43		
Final Degree of Utilization, x	0.194			0.230			0.565			0.433		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	4.06			4.00			3.20			3.43		

Capacity, Delay and Level of Service

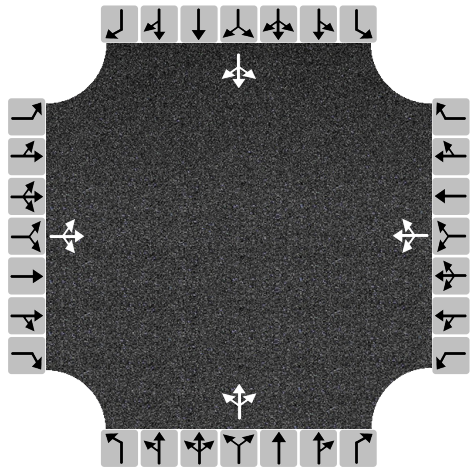
Approach	Eastbound			Westbound			Northbound			Southbound		
Lane	L1	L2	L3	L1	L2	L3	L1	L2	L3	L1	L2	L3
Configuration	LTR			LTR			LTR			LTR		
Flow Rate, v (veh/h)	115			138			391			287		
Capacity (veh/h)	594			600			692			663		
95% Queue Length, Q_{95} (veh)	0.7			0.9			3.6			2.2		
95% Queue Length, Q_{95} (ft)	18.5			23.0			94.3			59.8		
Control Delay (s/veh)	10.5			10.8			14.7			12.5		
Level of Service, LOS	B			B			B			B		
Approach Delay (s/veh) | LOS	10.5	B		10.8	B		14.7	B		12.5	B	
Intersection Delay (s/veh) | LOS	12.9						B					

HCS All-Way Stop Control Report

General and Site Information

Analyst	C.Anderson
Agency/Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2047
Analysis Time Period (hrs)	0.25
Time Analyzed	2047 PM Peak DHV
Project Description	STA-93 at Orrville St
Intersection	SR93 at Orrville St
Jurisdiction	ODOT District 4
East/West Street	Orrville St
North/South Street	SR 93
Peak Hour Factor	0.93

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)	30	90	30	30	50	10	20	260	30	10	310	30
% 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)	161			97			333			376		
Percent Heavy Vehicles	0			4			4			5		
Initial Departure Headway, h_d (s)	3.20			3.20			3.20			3.20		
Initial Degree of Utilization, x	0.143			0.086			0.296			0.335		
Final Departure Headway, h_d (s)	5.90			6.20			5.30			5.25		
Final Degree of Utilization, x	0.264			0.167			0.491			0.549		
Move-Up Time, m (s)	2.0			2.0			2.0			2.0		
Service Time, t_s (s)	3.90			4.20			3.30			3.25		

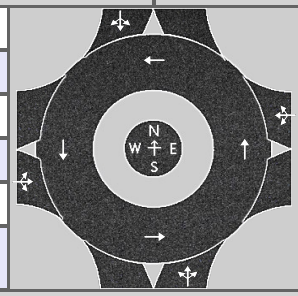
Capacity, Delay and Level of Service

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)	161			97			333			376		
Capacity (veh/h)	610			581			679			685		
95% Queue Length, Q_{95} (veh)	1.1			0.6			2.7			3.4		
95% Queue Length, Q_{95} (ft)	27.5			15.5			69.7			88.4		
Control Delay (s/veh)	11.0			10.4			13.3			14.5		
Level of Service, LOS	B			B			B			B		
Approach Delay (s/veh) | LOS	11.0	B		10.4	B		13.3	B		14.5	B	
Intersection Delay (s/veh) | LOS	13.1						B					

HCS Roundabouts Report

General Information

Analyst	C.Anderson
Agency or Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2027
Time Analyzed	2027 AM Peak DHV
Project Description	STA-93 at Orrville St



Site Information

Intersection	SR93 and Orrville St
E/W Street Name	Orrville St
N/S Street Name	SR 93
Analysis Time Period, hrs	0.25
Peak Hour Factor	0.87
Jurisdiction	ODOT District 4

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	30	50	20	0	30	80	10	0	10	290	30	0	10	210	20
Percent Heavy Vehicles, %	7	7	7	7	0	3	3	3	0	6	6	6	0	11	11	11
Flow Rate (v_{PCE}), pc/h	0	37	61	25	0	36	95	12	0	12	353	37	0	13	268	26
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		123			143			402			307	
Entry Volume, veh/h		115			139			379			277	
Circulating Flow (v_c), pc/h	317			402			111			143		
Exiting Flow (v_{ex}), pc/h	111			133			402			329		
Capacity (c_{pce}), pc/h		999			916			1232			1193	
Capacity (c), veh/h		933			889			1163			1075	
v/c Ratio (x)		0.12			0.16			0.33			0.26	

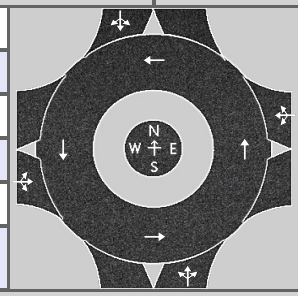
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		5.0			5.6			6.2			5.8	
Lane LOS		A			A			A			A	
95% Queue Length, Q_{95} (veh)		0.4			0.6			1.4			1.0	
95% Queue Length, Q_{95} (ft)		10.6			15.4			36.7			27.2	
Approach Delay, s/veh | LOS	5.0	A		5.6	A		6.2	A		5.8	A	
Intersection Delay, s/veh | LOS	5.8						A					

HCS Roundabouts Report

General Information

Analyst	C.Anderson
Agency or Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2027
Time Analyzed	2027 PM Peak DHV
Project Description	STA-93 at Orrville St



Site Information

Intersection	SR93 and Orrville St
E/W Street Name	Orrville St
N/S Street Name	SR 93
Analysis Time Period, hrs	0.25
Peak Hour Factor	0.93
Jurisdiction	ODOT District 4

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	30	90	30	0	30	50	10	0	20	250	30	0	10	300	30
Percent Heavy Vehicles, %	0	0	0	0	0	4	4	4	0	4	4	4	0	5	5	5
Flow Rate (v_{PCE}), pc/h	0	32	97	32	0	34	56	11	0	22	280	34	0	11	339	34
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		161			101			336			384	
Entry Volume, veh/h		161			97			323			366	
Circulating Flow (v_c), pc/h	384			334			140			112		
Exiting Flow (v_{ex}), pc/h	142			112			323			405		
Capacity (c_{pce}), pc/h		933			982			1196			1231	
Capacity (c), veh/h		933			944			1150			1172	
v/c Ratio (x)		0.17			0.10			0.28			0.31	

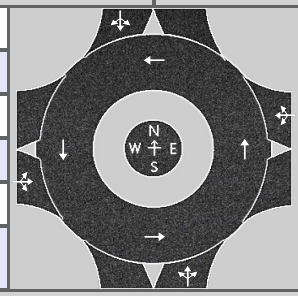
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		5.5			4.8			5.8			6.0	
Lane LOS		A			A			A			A	
95% Queue Length, Q_{95} (veh)		0.6			0.3			1.2			1.3	
95% Queue Length, Q_{95} (ft)		15.0			7.7			31.0			33.8	
Approach Delay, s/veh | LOS	5.5	A		4.8	A		5.8	A		6.0	A	
Intersection Delay, s/veh | LOS	5.7						A					

HCS Roundabouts Report

General Information

Analyst	C.Anderson
Agency or Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2047
Time Analyzed	2047 AM Peak DHV
Project Description	STA-93 at Orrville St



Site Information

Intersection	SR93 and Orrville St
E/W Street Name	Orrville St
N/S Street Name	SR 93
Analysis Time Period, hrs	0.25
Peak Hour Factor	0.87
Jurisdiction	ODOT District 4

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	30	50	20	0	30	80	10	0	20	290	30	0	10	220	20
Percent Heavy Vehicles, %	0	7	7	7	0	3	3	3	0	6	6	6	0	11	11	11
Flow Rate (v_{PCE}), pc/h	0	37	61	25	0	36	95	12	0	24	353	37	0	13	281	26
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		123			143			414			320	
Entry Volume, veh/h		115			139			391			288	
Circulating Flow (v_c), pc/h	330			414			111			155		
Exiting Flow (v_{ex}), pc/h	111			145			402			342		
Capacity (c_{pce}), pc/h		986			905			1232			1178	
Capacity (c), veh/h		921			878			1163			1061	
v/c Ratio (x)		0.12			0.16			0.34			0.27	

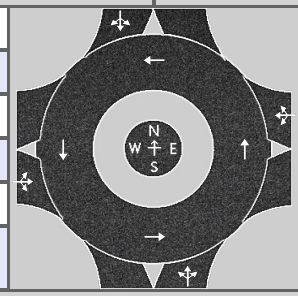
Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		5.1			5.7			6.3			6.0	
Lane LOS		A			A			A			A	
95% Queue Length, Q_{95} (veh)		0.4			0.6			1.5			1.1	
95% Queue Length, Q_{95} (ft)		10.6			15.4			39.3			29.9	
Approach Delay, s/veh | LOS	5.1	A		5.7	A		6.3	A		6.0	A	
Intersection Delay, s/veh | LOS	6.0						A					

HCS Roundabouts Report

General Information

Analyst	C.Anderson
Agency or Co.	EMH&T
Date Performed	6/25/2024
Analysis Year	2047
Time Analyzed	2047 PM Peak DHV
Project Description	STA-93 at Orrville St



Site Information

Intersection	SR93 and Orrville St
E/W Street Name	Orrville St
N/S Street Name	SR 93
Analysis Time Period, hrs	0.25
Peak Hour Factor	0.93
Jurisdiction	ODOT District 4

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	30	90	30	0	30	50	10	0	20	260	30	0	10	310	30
Percent Heavy Vehicles, %	0	0	0	0	0	4	4	4	0	4	4	4	0	5	5	5
Flow Rate (v_{PCE}), pc/h	0	32	97	32	0	34	56	11	0	22	291	34	0	11	350	34
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		161			101			347			395	
Entry Volume, veh/h		161			97			334			376	
Circulating Flow (v_c), pc/h	395			345			140			112		
Exiting Flow (v_{ex}), pc/h	142			112			334			416		
Capacity (c_{pce}), pc/h		922			971			1196			1231	
Capacity (c), veh/h		922			933			1150			1172	
v/c Ratio (x)		0.17			0.10			0.29			0.32	

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		5.6			4.8			5.9			6.1	
Lane LOS		A			A			A			A	
95% Queue Length, Q_{95} (veh)		0.6			0.3			1.2			1.4	
95% Queue Length, Q_{95} (ft)		15.0			7.7			31.0			36.4	
Approach Delay, s/veh | LOS	5.6	A		4.8	A		5.9	A		6.1	A	
Intersection Delay, s/veh | LOS	5.8						A					

Analysis Summary Tables
SR 93 at Orrville Street

2027 AM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/19.9	0.32	37.0 / 0.01	B/10.4	0.19	18.5 / 0.01	A/5.0	0.12	10.6 / 0.01
WB Approach	C/21.1	0.38	46.1 / 0.02	B/10.7	0.22	23.0 / 0.01	A/5.6	0.16	15.4 / 0.01
NB Approach	A/0.3	0.01	0.0 / 0.0	B/14.1	0.54	86.5 / 0.03	A/6.2	0.33	36.7 / 0.01
SB Approach	A/0.4	0.01	0.0 / 0.0	B/12.1	0.41	54.4 / 0.02	A/5.8	0.26	27.2 / 0.01
Intersection	-	-	-	B/12.5	-	-	A/5.8	-	-

2027 PM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/22.0	0.44	52.5 / 0.01	B/10.9	0.26	25.0 / 0.01	A/5.5	0.17	15.0 / 0.01
WB Approach	C/22.1	0.32	33.5 / 0.02	B/10.3	0.16	15.5 / 0.01	A/4.8	0.10	7.7 / 0.01
NB Approach	A/0.7	0.02	0.0 / 0.0	B/12.9	0.47	64.5 / 0.02	A/5.8	0.28	31.0 / 0.01
SB Approach	A/0.3	0.01	0.0 / 0.0	B/14.0	0.53	80.6 / 0.03	A/6.0	0.31	33.8 / 0.01
Intersection	-	-	-	B/12.7	-	-	A/5.7	-	-

2047 AM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/21.4	0.35	39.6 / 0.01	B/10.5	0.19	18.5 / 0.01	A/5.1	0.12	10.6 / 0.01
WB Approach	C/22.8	0.41	48.6 / 0.02	B/10.8	0.23	23.0 / 0.01	A/5.7	0.16	15.4 / 0.01
NB Approach	A/0.6	0.02	0.0 / 0.0	B/14.7	0.56	94.3 / 0.03	A/6.3	0.34	39.3 / 0.01
SB Approach	A/0.4	0.01	0.0 / 0.0	B/12.5	0.43	59.8 / 0.2	A/6.0	0.24	29.9 / 0.01
Intersection	-	-	-	B/12.9	-	-	A/6.0	-	-

2047 PM	Existing Two-Way Stop Control			All-Way Stop Control			Roundabout		
Approach	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR	LOS/Delay (s)	v/c	95th %ile Queue (ft)/QSR
EB Approach	C/22.9	0.45	55.0 / 0.01	B/11.0	0.26	27.5 / 0.01	A/5.6	0.17	15.0 / 0.01
WB Approach	C/23.1	0.33	36.1 / 0.02	B/10.4	0.17	15.5 / 0.01	A/4.8	0.10	7.7 / 0.01
NB Approach	A/0.7	0.02	0.0 / 0.0	B/13.3	0.49	69.7 / 0.2	A/5.9	0.29	31.0 / 0.01
SB Approach	A/0.3	0.01	0.0 / 0.0	B/14.5	0.55	88.4 / 0.03	A/6.1	0.32	36.4 / 0.01
Intersection	-	-	-	B/13.0	-	-	A/5.8	-	-

EMH&T

APPENDIX F:

ECAT Analysis

Project Information

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		
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
SR93; 15.07	Rural Two-Lane Two Way Intersection	Unsignalized	SSTASR00093**C	15.07		0.05	CSTACR0034	Orrville St.

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)			veh / day
Future ADT (FADT)			veh / day
Annual Linear Growth Rate		0.0012	

Existing Conditions: General Information and Data for Rural Two-Lane Two-Way Intersection

General Information		Location Information	
Analyst	C.Anderson	Route	SR93
Agency or Company	EMH&T	Logpoint	15.07
Date Performed	07/08/24	Common Name	Orrville St.
Intersection	SR93; 15.07	Analysis Year	2024
Signalized/Unsignalized	Unsignalized		

Input Data		Existing Conditions	HSM Base Conditions
Intersection type (3ST, 4ST, 4SG)		4ST	--
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ = 14,700 (veh/day)	4,980	--
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ = 3,500 (veh/day)	1,870	--
Intersection skew angle (degrees) Skew Angle Help	Does skew differ for minor legs? Else, No.	Skew for Leg 1 (All): 12 / Skew for Leg 2 (4ST only): 0	0
Number of uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)		0	0
Number of uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)		0	0
Intersection lighting (present/not present)		Not Present	Not Present
Calibration Factor, C_i		1.01	1.00
Locality:		State System	

Existing Conditions: Crash Modification Factors (CMFs) for Rural Two-Lane Two-Way Intersection

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.0335	1.0000	1.0000	1.0000	1.0335

Existing Conditions: Predicted Crash Summary for Rural Two-Lane Two-Way Intersection

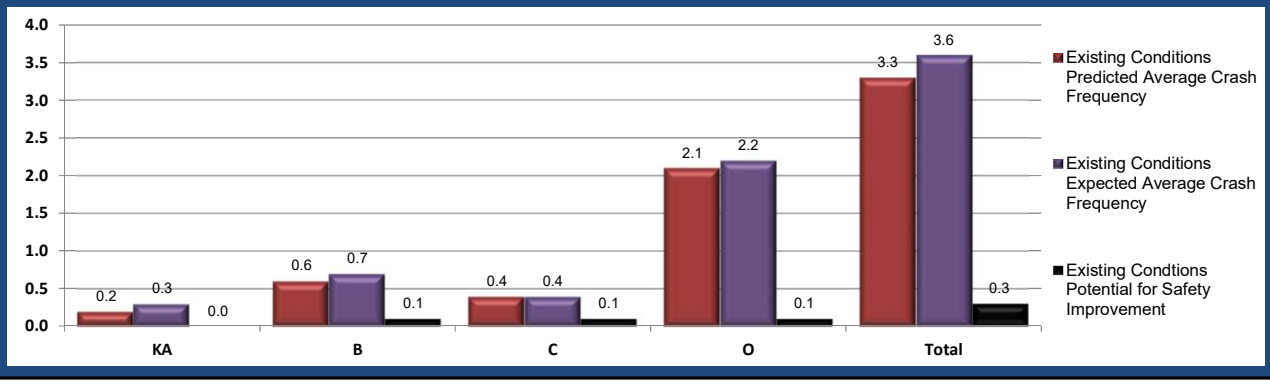
(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL} * (4)$	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	3.138	0.24	1.000	3.138	1.03	1.01	3.275
Fatal and Injury (FI)	--	--	0.367	1.153	1.03	1.01	1.203
Property Damage Only (PDO)	--	--	0.633	1.985	1.03	1.01	2.072

Project Safety Performance Report

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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	0.2390	0.5788	0.3855	2.0718	3.2751
$N_{expected}$ - Existing Conditions	0.2742	0.6649	0.4427	2.1809	3.5627
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0352	0.0861	0.0572	0.1091	0.2876

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93: 15.07	Orrville St.	0.239	0.5788	0.3855	2.0718	3.2751

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93: 15.07	Orrville St.	0.2742	0.6649	0.4427	2.1809	3.5627

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
SR93: 15.07	Orrville St.	0.0352	0.0861	0.0572	0.1091	0.2876

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.0130	0.0140	0.0010	
Head On	0.0280	0.0313	0.0033	
Rear End	0.6999	0.7576	0.0577	
Backing	0.1317	0.1393	0.0076	
Sideswipe - Meeting	0.0952	0.1038	0.0086	
Sideswipe - Passing	0.1481	0.1592	0.0111	
Angle	1.2497	1.3736	0.1239	
Parked Vehicle	0.1165	0.1238	0.0073	
Pedestrian	0.0159	0.0181	0.0022	
Animal	0.0000	0.0000	0.0000	
Train	0.0006	0.0006	0.0000	
Pedalcycles	0.0121	0.0135	0.0014	
Other Non-Vehicle	0.0002	0.0003	0.0001	
Fixed Object	0.5493	0.5933	0.0440	
Other Object	0.0192	0.0204	0.0012	
Overturning	0.0332	0.0368	0.0036	
Other Non-Collision	0.0435	0.0464	0.0029	
Left Turn	0.1190	0.1307	0.0117	
Right Turn	0.0000	0.0000	0.0000	

Project Information

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		
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?	**No**

(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)

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
SR93; 15.07	Rural Two-Lane Two Way Intersection	Unsignalized	SSTASR00093**C	15.07		0.05	CSTACR0034	Orrville Street

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)	2024	6,850	veh / day
Future ADT (FADT)	2047	7,036	veh / day
Annual Linear Growth Rate		0.0012	

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

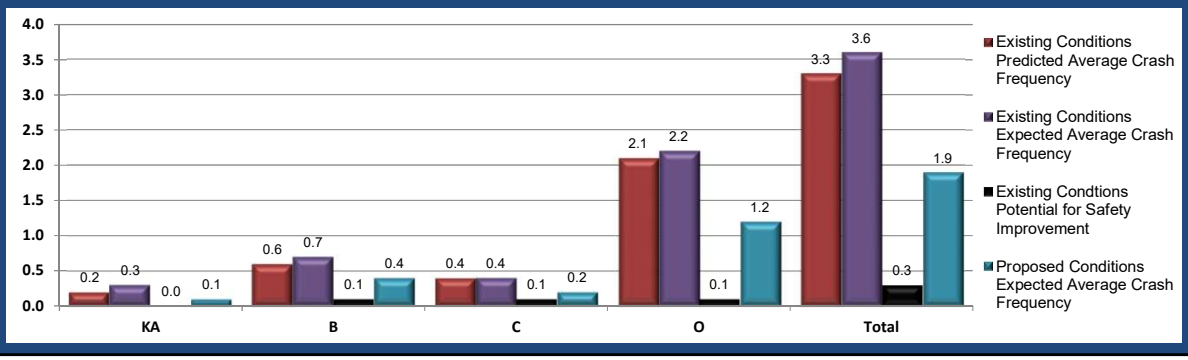
CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1	Convert minor stop to all-way stop Rural	0.52	0.52	0.52	0.52	2 / 5 / 7 / 10
CMF 2						
CMF 3						
CMF 4						
CMF 5						
CMF 6						
CMF 7						
CMF 8						
CMF 9						
CMF 10						

Project Safety Performance Report

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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	0.2389	0.5787	0.3852	2.0709	3.2737
$N_{expected}$ - Existing Conditions	0.2741	0.6646	0.4425	2.1801	3.5613
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0352	0.0859	0.0573	0.1092	0.2876
$N_{expected}$ - Proposed Conditions	0.1461	0.3541	0.2358	1.1580	1.8940

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93; 15.07	Orrville St.	0.2389	0.5787	0.3852	2.0709	3.2737

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93; 15.07	Orrville St.	0.2741	0.6646	0.4425	2.1801	3.5613

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
SR93; 15.07	Orrville St.	0.0352	0.0859	0.0573	0.1092	0.2876

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93; 15.07	Orrville Street	0.1461	0.3541	0.2358	1.158	1.894

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.0134	0.0142	0.0008	0.0074
Head On	0.0290	0.0321	0.0031	0.0167
Rear End	0.7223	0.7744	0.0521	0.4027
Backing	0.1360	0.1423	0.0063	0.0740
Sideswipe - Meeting	0.0982	0.1062	0.0080	0.0552
Sideswipe - Passing	0.1528	0.1627	0.0099	0.0846
Angle	1.2897	1.4050	0.1153	0.7306
Parked Vehicle	0.1202	0.1265	0.0063	0.0658
Pedestrian	0.0166	0.0185	0.0019	0.0096
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0006	0.0006	0.0000	0.0003
Pedalcycles	0.0124	0.0138	0.0014	0.0072
Other Non-Vehicle	0.0002	0.0003	0.0001	0.0002
Fixed Object	0.5669	0.6065	0.0396	0.3154
Other Object	0.0197	0.0208	0.0011	0.0108
Overturning	0.0342	0.0377	0.0035	0.0196
Other Non-Collision	0.0448	0.0474	0.0026	0.0246
Left Turn	0.1227	0.1335	0.0108	0.0694
Right Turn	0.0000	0.0000	0.0000	0.0000

Safety Benefit - Cost Analysis

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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 (Please add description about improvements i.e. Lane widening)					$0.00	$0.00	0.081	($23,180)
Site Characteristic Improvements (Please add description about improvements i.e. Lighting)					$0.00	$0.00		
Site Characteristic Improvements (Please add description about improvements i.e. Signal Phasing)					$0.00	$0.00		
Site Characteristic Improvements (Please add description about improvements i.e. Added Right Turn Lane)					$0.00	$0.00		
CMF 1 - Convert minor stop to all-way stop Rural	5	$50,000.00			$50,000.00	$50,000.00	-1.749	$455,779
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
					$0.00	$0.00	0.000	$0
Totals		**$50,000.00**	**$0.00**	**$0.00**	**$50,000.00**	**$50,000.00**	**-1.667**	**$432,599**

Safety Benefit - Cost Analysis

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

Benefit - Cost Calculator

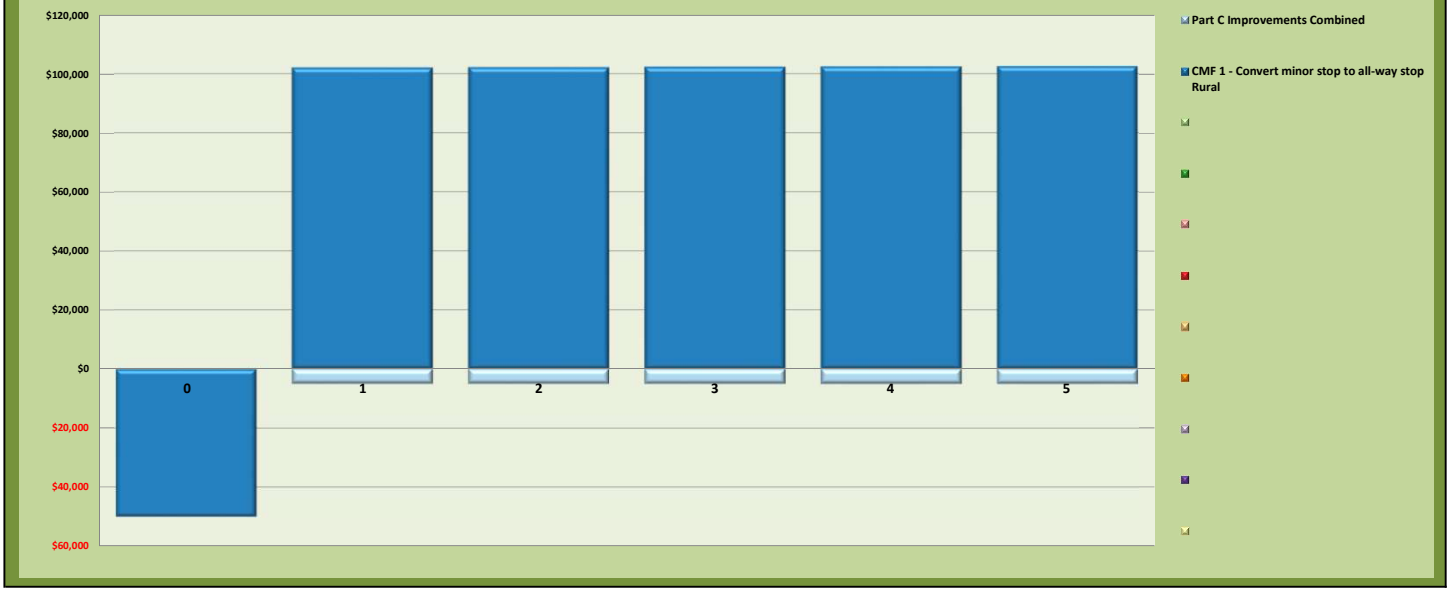
Net Present Value of Project	$50,000.00
Net Present Value of Safety Benefits	$432,599.47
Net Benefit	$382,599.47
Benefit / Cost Ratio	8.65

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.128
Number of Injury Crashes	-0.645
Number of Total Crashes	-1.667

Comments:

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

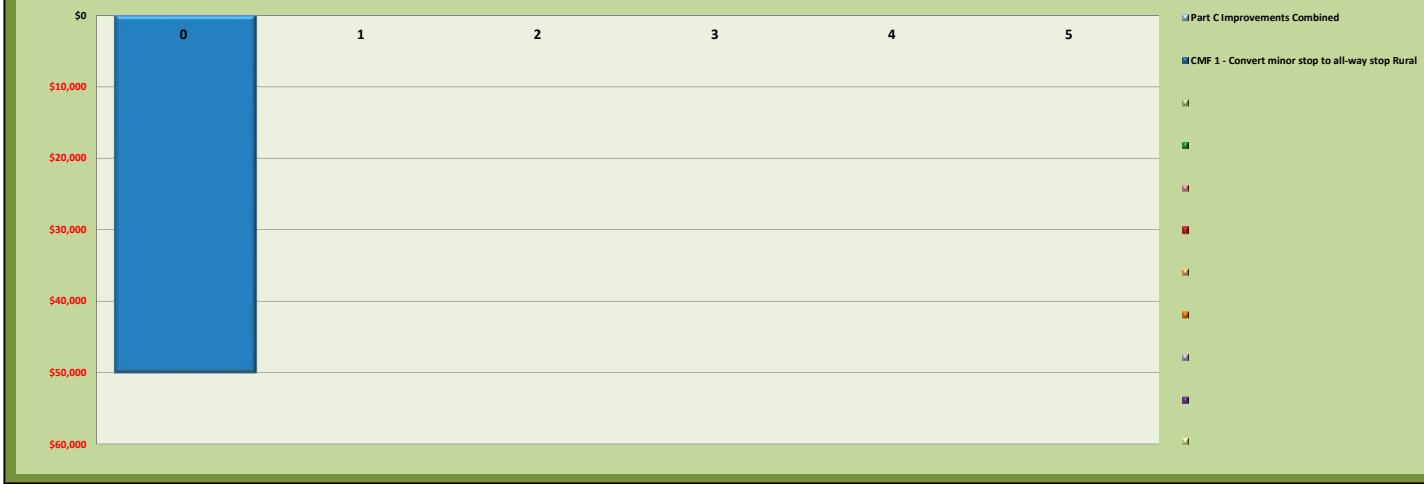


Safety Benefit - Cost Analysis

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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: 2025 (1 years)

Percentage of Service Life to observe a continuous Positive Return on Investment: 100.00%

Project Information

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		
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?	**No**

(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)

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
SR93; 15.07	Rural Two-Lane Two Way Intersection	Unsignalized	SSTASR00093**C	15.07		0.05	CSTACR0034	Orrville St.

Traffic Volume Growth Rate Calculation For Benefit Cost Analysis

	Year	AADT	
Present ADT (PADT)			veh / day
Future ADT (FADT)			veh / day
Annual Linear Growth Rate		0.0012	

Select Other Non-Site Characteristic Based Countermeasures For Entire Project

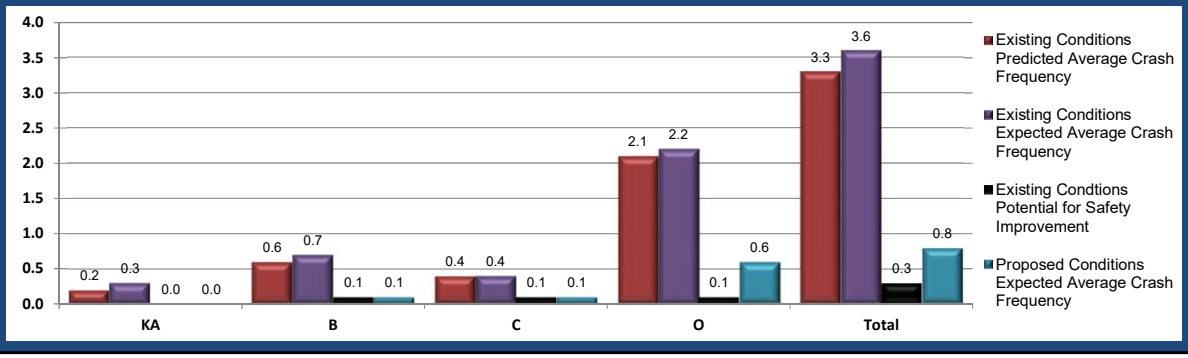
CMF Nbr	Countermeasure	CMF KA Value	CMF B Value	CMF C Value	CMF O Value	CMF Valid for the Following Site Types
CMF 1	Convert intersection with minor-road stop control to modern roundabout (Rural)	0.13	0.13	0.13	0.29	2 / 10
CMF 2						
CMF 3						
CMF 4						
CMF 5						
CMF 6						
CMF 7						
CMF 8						
CMF 9						
CMF 10						

Project Safety Performance Report

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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	0.2389	0.5787	0.3852	2.0709	3.2737
$N_{expected}$ - Existing Conditions	0.2741	0.6646	0.4425	2.1801	3.5613
$N_{potential\ for\ improvement}$ - Existing Conditions	0.0352	0.0859	0.0573	0.1092	0.2876
$N_{expected}$ - Proposed Conditions	0.0356	0.0864	0.0575	0.6322	0.8117

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93; 15.07	Orrville St.	0.2389	0.5787	0.3852	2.0709	3.2737

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93; 15.07	Orrville St.	0.2741	0.6646	0.4425	2.1801	3.5613

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
SR93; 15.07	Orrville St.	0.0352	0.0859	0.0573	0.1092	0.2876

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

Project Element ID	Common Name	Crash Severity Level				
		KA	B	C	O	Total
SR93; 15.07	Orrville St.	0.0356	0.0864	0.0575	0.6322	0.8117

Summary by Crash Type

Crash Type	Existing			Proposed
	Predicted Crash Frequency	Expected Crash Frequency	PSI	Expected Crash Frequency
Unknown	0.0131	0.0140	0.0009	0.0034
Head On	0.0280	0.0313	0.0033	0.0057
Rear End	0.6996	0.7573	0.0577	0.1796
Backing	0.1317	0.1393	0.0076	0.0392
Sideswipe - Meeting	0.0951	0.1037	0.0086	0.0230
Sideswipe - Passing	0.1480	0.1591	0.0111	0.0399
Angle	1.2491	1.3731	0.1240	0.2869
Parked Vehicle	0.1165	0.1237	0.0072	0.0336
Pedestrian	0.0159	0.0181	0.0022	0.0028
Animal	0.0000	0.0000	0.0000	0.0000
Train	0.0006	0.0006	0.0000	0.0001
Pedalcycles	0.0121	0.0135	0.0014	0.0023
Other Non-Vehicle	0.0002	0.0003	0.0001	0.0000
Fixed Object	0.5491	0.5931	0.0440	0.1431
Other Object	0.0192	0.0204	0.0012	0.0055
Overturning	0.0331	0.0368	0.0037	0.0069
Other Non-Collision	0.0434	0.0464	0.0030	0.0122
Left Turn	0.1190	0.1306	0.0116	0.0276
Right Turn	0.0000	0.0000	0.0000	0.0000

Safety Benefit - Cost Analysis

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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 with minor-road stop control to modern roundabout (Rural)	25	$2,814,000.00			$2,814,000.00	$2,814,000.00	-2.750	$2,855,663
		$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		**$2,814,000.00**	**$0.00**	**$0.00**	**$2,814,000.00**	**$2,814,000.00**	**-2.750**	**$2,855,663**

Safety Benefit - Cost Analysis

ECAT Economic Crash Analysis Tool

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

Benefit - Cost Calculator

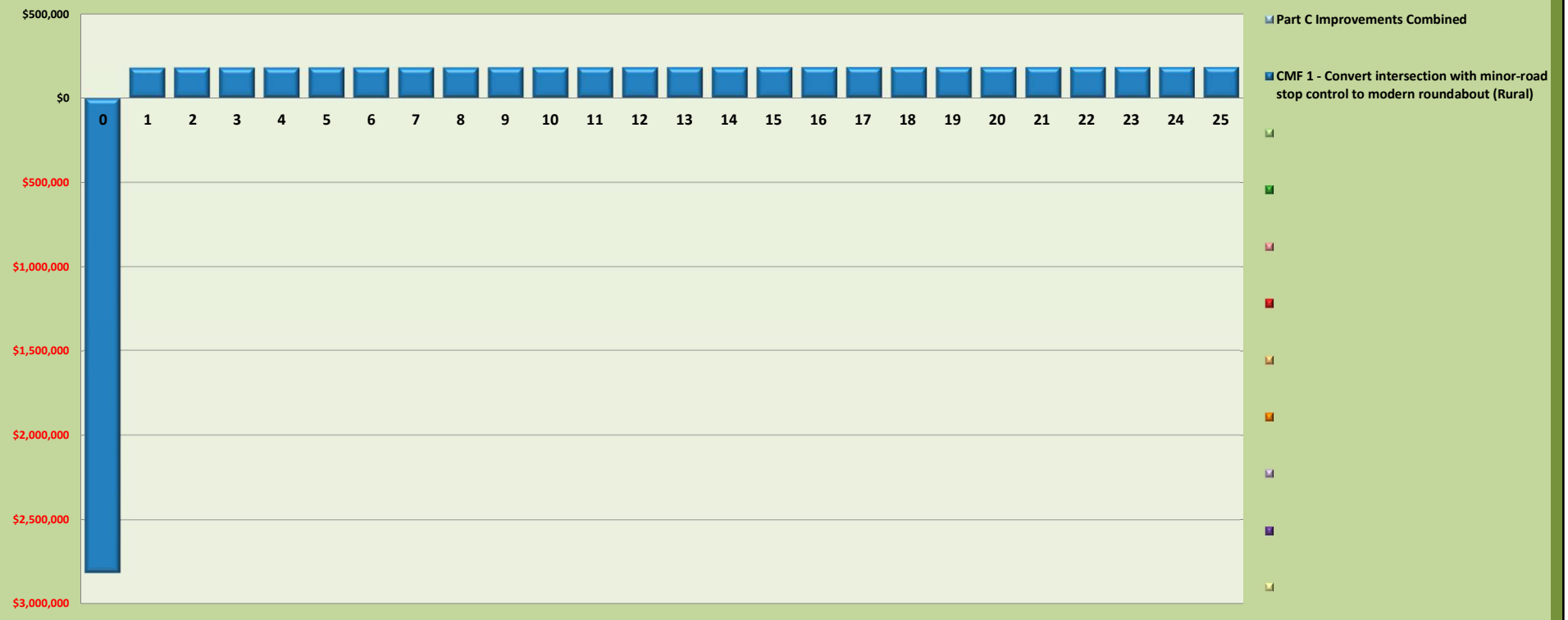
Net Present Value of Project	$2,814,000.00
Net Present Value of Safety Benefits	$2,855,663.07
Net Benefit	$41,663.07
Benefit / Cost Ratio	1.01

Expected Annual Crash Adjustment

Number of Fatal & Incapacitating Injury Crashes	-0.239
Number of Injury Crashes	-1.202
Number of Total Crashes	-2.750

Comments:

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

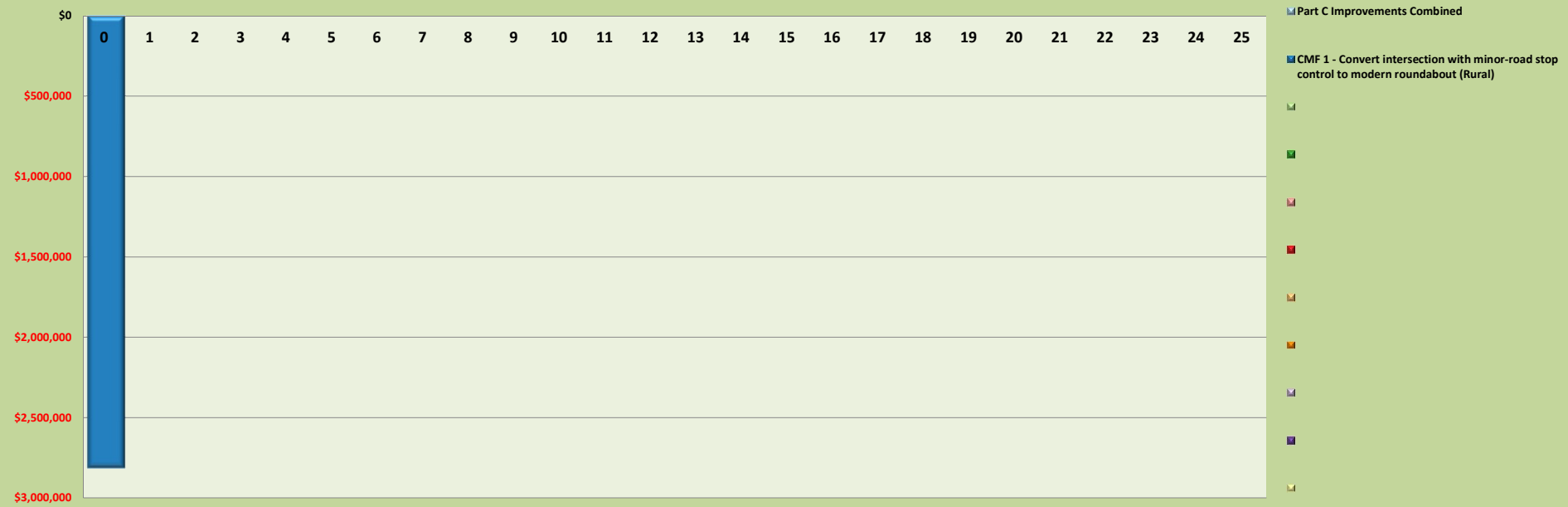


Safety Benefit - Cost Analysis

General Information

Project Name	Safety Study	Contact Email	Canderson@emht.com
Project Description	STA-93 at Orrville Street	Contact Phone	(614) 775-4658
Reference Number	20211202	Date Performed	7/8/2024
Analyst	C.Anderson	Analysis Year	2024
Agency/Company	EMH&T		

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: 2040 (16 years)

Percentage of Service Life to observe a continuous Positive Return on Investment: 40.00%

STUDY DETAILS

Study Title: Prediction of the Expected Safety Performance of Rural Two-Lane Highways

Authors: Harwood et al.

Publication Date: 2000

Abstract: This report presents an algorithm for predicting the safety performance of a rural two-lane highway. The accident prediction algorithm consists of base models and accident modification factors for both roadway segments and at-grade intersections on rural two-lane highways. The base models provide an estimate of the safety performance of a roadway or intersection for a set of assumed nominal or base conditions. The accident modification factors adjust the base model predictions to account for the effects on safety for roadway segments of lane width, shoulder width, shoulder type, horizontal curves, grades, driveway density, two-way left-turn lanes, passing lanes, roadside design and the effects on safety for at-grade intersections of skew angle, traffic control, exclusive left- and right-turn lanes, sight distance, and driveways. The accident prediction algorithm is intended for application by highway agencies to estimate the safety performance of an existing or proposed roadway. The algorithm can be used to compare the anticipated safety performance of two or more geometric alternatives for a proposed highway improvement. The accident prediction algorithm includes a calibration procedure that can be used to adapt the predicted results to the safety conditions encountered by any particular highway agency on rural two-lane highways. The algorithm also includes an Empirical Bayes procedure that can be applied to utilize the safety predictions provided by the algorithm together with actual site-specific accident history data.

Study Citation: Harwood, D. W., Council, F. M., Hauer, E., Hughes, W. E., and Vogt, A., "Prediction of the Expected Safety Performance of Rural Two-Lane Highways." FHWA-RD-99-207, McLean, Va., Federal Highway Administration, (2000)

Study Report: DOWNLOAD THE STUDY REPORT DOCUMENT

CMFS ASSOCIATED WITH THIS STUDY

CATEGORY: ACCESS MANAGEMENT

Countermeasure: Modify access point density

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
F(x)		TEXT TEXT	All	All	Minor Arterial	Rural

CATEGORY:ALIGNMENT

Countermeasure: Improve superelevation variance (SV) where 0.01 <= SV < 0.02

F(x)	TEXT TEXT	All	All	Minor Arterial	Rural	

Countermeasure: Provide a left-turn lane on one major-road approach

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.94[#CHR(176)#]	6	TEXT TEXT	All	K,A,B,C	Minor Arterial	Urban
0.65[#CHR(176)#]	35	TEXT TEXT	All	K,A,B,C	Minor Arterial	Urban

CATEGORY:INTERSECTION TRAFFIC CONTROL

Countermeasure: Change from permissive to protected/permissive or permissive/protected phasing

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.99[#CHR(176)#]	1	TEXT TEXT	All	All	Not specified	Urban

Countermeasure: Convert minor-road stop control to all-way stop control

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
0.52[B]	48	★★☆☆☆	All	All	Not Specified	Rural

CATEGORY:ROADSIDE

Countermeasure: Modify roadside hazard rating

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
F(x)		TEXT TEXT	All	All	Minor Arterial	Rural

CATEGORY:ROADWAY

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

CMF	CRF(%)	Quality	Crash Type	Crash Severity	Roadway Type	Area Type
1.02	-2	TEXT TEXT	Head on,Run off road,Sideswipe,Single	All	Minor Arterial	Rural

CRASH MODIFICATION FACTORS CLEARINGHOUSE

CMF / CRF DETAILS

CMF ID: 315

CONVERT MINOR-ROAD STOP CONTROL TO ALL-WAY STOP CONTROL

DESCRIPTION:

PRIOR CONDITION: *NO PRIOR CONDITION(S)*

CATEGORY: INTERSECTION TRAFFIC CONTROL

STUDY: *PREDICTION OF THE EXPECTED SAFETY PERFORMANCE OF RURAL TWO-LANE HIGHWAYS*, HARWOOD ET AL., 2000

Star Quality Rating:	★★☆☆☆ [VIEW SCORE DETAILS]
Rating Points Total:	60

Crash Modification Factor (CMF)

Value:	0.52
Adjusted Standard Error:	0.04
Unadjusted Standard Error:	0.02

Crash Reduction Factor (CRF)

EMH&T

APPENDIX G:

Cost Estimate for Roundabout Alternative

STA-93 @ Orrville St Roundabout

Preliminary Opinion of Construction Cost

July 31, 2024

Summary of Project Costs	STA-93 @ Orrville St Roundabout
Roadway Subtotal	$ 339,100
Sedimentation & Erosion Control Subtotal	$ 110,900
Drainage Subtotal	$ 189,900
Pavement Subtotal	$ 813,700
Maintenance of Traffic Subtotal	$ 275,000
Lighting Subtotal	$ 195,000
Traffic Control Subtotal	$ 25,000
Miscellaneous Subtotal	$ 238,300
2024 Preliminary Opinion of Construction Cost Total	$2,186,900
Contingency (25%)	$547,000
2024 Preliminary Opinion of Construction Cost including Contingency	**$2,733,900**

Notes & Clarifications

Estimate does not include Right-of-Way, Reimbursement to Private Utilities, Design, and Construction Engineering.
Estimate does not include underground relocation of overhead private utilities.

Pricing reflects probable construction costs obtainable in the project locality on the date of this opinion. Unit rates have been obtained from historical records and/or discussion with contractors. The unit rates reflect current bid costs in the area. This is an opinion of fair market value for the construction of this project. It is not a prediction of low bid. Pricing assumes competitive bidding for every portion of the construction work for all subcontractors and general contractors. Experience indicates that a fewer number of bidders may result in higher bids, conversely an increased number of bidders may result in more competitive bids.

Since EMH&T has no control over the cost of labor, material, equipment, or over the contractor's method of determining prices, or over the competitive bidding or market conditions at the time of bid, the cost opinon is based on industry practice, professional experience and qualifications, and represents EMH&T's best judgment as a consultant familiar with the construction industry. EMH&T does not guarantee that the proposals, bids, or the construction cost will not vary from opinions of probable cost prepared by them.

ITEM NO.	ESTIMATED QUANTITY	UNIT	DESCRIPTION	ENGINEER'S ESTIMATE	
				UNIT COST	TOTAL EXTENDED PRICE
			Roadway		
201	1	L. Sum	Clearing and Grubbing	$ 10,000.00	$ *10,000.00*
202	474	Ft	Pipe Removed, 24" and Under	$ 25.00	$ *11,850.00*
202	3	Each	Catch Basin/Curb Inlet Removed	$ 550.00	$ *1,650.00*
202	5,058	Sq Yd	Pavement Removed	$ 17.00	$ *85,992.00*
203	1,500	Cu Yd	Excavation	$ 28.00	$ *42,000.00*
203	3,500	Cu Yd	Embankment	$ 16.00	$ *56,000.00*
204	105	Sq Yd	Subgrade Compaction	$ 3.00	$ *316.00*
204	1	Hour	Proof Rolling	$ 240.00	$ *240.00*
206	267	TON	Cement	$ 215.00	$ *57,391.00*
206	8,842	SQ YD	Curing Coat	$ 1.00	$ *8,843.00*
206	8,842	SQ YD	14" Cement Stabilized Subgrade	$ 4.50	$ *39,791.00*
206	1	LS	Mixture design for chemically stabilized subgrade	$ 25,000.00	$ *25,000.00*
			Roadway Subtotal		***$ 339,100.00***
			Sediment & Erosion Control		
207	2	Each	Soil Analysis Test	$ 150.00	$ *300.00*
659	731	Cu Yd	Topsoil	$ 40.00	$ *29,240.00*
659	6,584	Sq Yd	Seeding and Mulching	$ 1.50	$ *9,876.00*
659	329	Sq Yd	Repair Seeding and Mulching	$ 2.25	$ *741.00*
659	0.89	Ton	Commercial Fertilizer	$ 950.00	$ *846.00*
659	1.36	Acre	Lime	$ 140.00	$ *191.00*
659	36	M Gal	Water	$ 4.00	$ *144.00*
832	45,000	Each	Erosion Control	$ 1.00	$ *45,000.00*
832	1	Each	Storm Water Pollution Prevention Plan	$ 2,500.00	$ *2,500.00*
832	1	Each	Storm Water Pollution Prevention Plan Inspections	$ 11,000.00	$ *11,000.00*
832	1	Each	Storm Water Pollution Prevention Plan Inspection Software	$ 11,000.00	$ *11,000.00*
			Sediment & Erosion Control Subtotal		***$ 110,900.00***

STA-93 @ Orrville St Roundabout
Preliminary Opinion of Construction Costs

ITEM NO.	ESTIMATED QUANTITY	UNIT	DESCRIPTION	ENGINEER'S ESTIMATE	
				UNIT COST	TOTAL EXTENDED PRICE
			Drainage		
604	6	Each	Curb and Gutter Inlet (AA-S125A)	$ 5,000.00	$ *30,000.00*
604	3	Each	Manhole, Type C	$ 5,200.00	$ *15,600.00*
605	3,510	Ft	6" Pipe Underdrain	$ 20.00	$ *70,200.00*
611	351	Ft	6" Conduit, Type F for Underdrain Outlet	$ 33.00	$ *11,583.00*
611	2	Each	Precast Reinforced Concrete Outlet	$ 400.00	$ *800.00*
901	275	Ft	12" Storm Pipe, with Type 1 Bedding	$ 115.00	$ *31,625.00*
901	150	Ft	24" Storm Pipe, with Type 1 Bedding	$ 200.00	$ *30,000.00*
			Drainage Subtotal		***$ 189,900.00***
			Pavement		
304	1,474	Cu Yd	6" Aggregate Base	$ 105.00	$ *154,743.00*
301	1,472	Cu Yd	7" Asphalt Concrete Base Course	$ 210.00	$ *309,180.00*
452	16	Cu Yd	8" Concrete Base (Drives)	$ 110.00	$ *1,777.00*
407	1,183	Gal	Non-Tracking Tack Coat (0.055 Gal/SY) (For Full-Depth)	$ 5.00	$ *5,914.00*
441	309	Cu Yd	Asphalt Concrete Intermediate Course, Type 1, (448) (T=1.75")	$ 260.00	$ *80,396.00*
441	265	Cu Yd	Asphalt Concrete Surface Course, Type 1, (448), PG64-22 (T=1.5")	$ 260.00	$ *68,911.00*
441	19	Cu Yd	Asphalt Concrete Surface Course, Type 1, (449), (Driveways) (T=2.0")	$ 550.00	$ *10,403.00*
452	632	Sq Yd	10" Non-Reinforced Concrete Pavement, (Truck Apron)	$ 115.00	$ *72,646.00*
609	1,070	Ft	Curb, Straight 18" (Type 6)	$ 35.00	$ *37,450.00*
609	992	Ft	Combination Curb & Gutter (Type 9)	$ 50.00	$ *49,600.00*
609	261	Ft	Combination Curb & Gutter (Type 3)	$ 36.00	$ *9,396.00*
609	189	Sq Yd	Concrete Median (T=6")	$ 70.00	$ *13,195.00*
			Pavement Subtotal		***$ 813,700.00***
			Maintenance of Traffic		
SPEC	1	L. Sum	Maintenance of Traffic Miscellaneous	$ 275,000.00	$ *275,000.00*
			Maintenance of Traffic Subtotal		***$ 275,000.00***
			Lighting		
SPEC	1	L. Sum	Lighting Miscellaneous	$ 195,000.00	$ *195,000.00*
			Lighting Subtotal		***$ 195,000.00***
			Traffic Control		
SPEC	1	L. Sum	Traffic Control Miscellaneous	$ 25,000.00	$ *25,000.00*
			Traffic Control Subtotal		***$ 25,000.00***
			Miscellaneous		
614	1	L.Sum	Maintaining Traffic	$ 75,000.00	$ *75,000.00*
619	7	Month	Field Office, Type B	$ 1,900.00	$ *13,300.00*
623	1	L.Sum	Construction Layout Stakes, As Per Plan	$ 25,000.00	$ *25,000.00*
624	1	L.Sum	Mobilization, As Per Plan	$ 125,000.00	$ *125,000.00*
			Miscellaneous Subtotal		***$ 238,300.00***
* Denotes Contingency Quantity to be Used as Directed.					

EMH&T

APPENDIX H:

CAP-X Analysis

Capacity Analysis for Planning of Junctions

Summary Report

Project Name:	STA-93 at Orrville Street
Project Number:	20211202
Location:	Lawrence Township
Date:	2047 AM
Number of Intersection Legs:	4
Major Street Direction	North-South

Traffic Volume Demand

	Volume (Veh/hr)				Percent (%)	
	U-Turn	Left	Thru	Right	Heavy Vehicles	Volume Growth
Eastbound	0	30	50	20	7.00%	0.00%
Westbound	0	30	80	10	3.00%	0.00%
Southbound	0	10	220	20	11.00%	0.00%
Northbound	0	20	290	30	6.00%	0.00%
Adjustment Factor	0.80	0.95		0.85		
Suggested	**0.80**	**0.95**		**0.85**		

Truck to PCE Factor		**Suggested = 2.00**	2.00
Multimodal Activity Level		**0**	
E-W / Crossing East-West Legs	**Low**	**Low**	**Low**
N-S / Crossing North-South Legs	**Low**	**Low**	**Low**
Critical Lane Volume Threshold	2-phase signal	**Suggested = 1800 (Urban), 1650 (Rural)**	**1650**
	3-phase signal	**Suggested = 1750 (Urban), 1600 (Rural)**	**1600**
	4-phase signal	**Suggested = 1700 (Urban), 1550 (Rural)**	**1550**

Capacity Analysis for Planning of Junctions

Summary Report

# # # # # # # # # # # # #

TYPE OF INTERSECTION	Overall v/c Ratio	V/C Ranking	Pedestrian Accommodations	Bicycle Accommodations
1 X 1 Roundabout	**0.29**	**1**	**0.00**	--
Two-Way Stop Control N-S	**0.33**	**2**	**0.00**	--
All-Way Stop Control	**0.71**	**3**	**0.00**	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--

Capacity Analysis for Planning of Junctions

Detailed Report - Page 1 of 4

Project Name:	STA-93 at Orrville Street
Project Number:	20211202
Location:	Lawrence Township
Date:	2047 AM
Number of Intersection Legs:	4
Major Street Direction:	North-South

Traffic Volume Demand

	Volume (Veh/hr)				Percent (%)	
	U-Turn	Left	Thru	Right	Heavy Vehicles	Volume Growth
Eastbound	0	30	50	20	7.00%	0.00%
Westbound	0	30	80	10	3.00%	0.00%
Southbound	0	10	220	20	11.00%	0.00%
Northbound	0	20	290	30	6.00%	0.00%
Adjustment Factor	0.80	0.95		0.85		
Suggested	**0.80**	**0.95**		**0.85**		

Truck to PCE Factor		**Suggested = 2.00**	2.00
Multimodal Activity Level		**0**	
E-W / Crossing East-West Legs		**Low**	**Low**	**Low**
N-S / Crossing North-South Legs		**Low**	**Low**	**Low**
Critical Lane Volume Threshold	2-phase signal	**Suggested = 1800 (Urban), 1650 (Rural)**	**1650**
	3-phase signal	**Suggested = 1750 (Urban), 1600 (Rural)**	**1600**
	4-phase signal	**Suggested = 1700 (Urban), 1550 (Rural)**	**1550**

Capacity Analysis for Planning of Junctions

Detailed Report - Page 2 of 4

Number of Lanes for Non-roundabout Intersections

TYPE OF INTERSECTION	Sheet	Northbound				Southbound				Eastbound				Westbound			
		U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Conventional Shared RT LN	CSRL		1	2			1	2			1	2			1	2	
Two-Way Stop Control	N-S		1	1	0		1	1	0		0	1	0		0	1	0
All-Way Stop Control	FULL		0	1	0		0	1	0		0	1	0		0	1	0

Number of Lanes for Grade Separated Intersections

TYPE OF INTERCHANGE	Sheet	Northbound				Southbound				Eastbound				Westbound			
		U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R

Number of Lanes for Interchanges

TYPE OF INTERCHANGE	Sheet	Northbound				Southbound				Eastbound				Westbound			
		U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R

Capacity Analysis for Planning of Junctions

Detailed Report - Page 3 of 4

Results for Non-roundabout Intersections

TYPE OF INTERSECTION	Sheet	Zone 1 (North)		Zone 2 (South)		Zone 3 (East)		Zone 4 (West)		Zone 5 (Center)		Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			
Two-Way Stop Control	N-S									--	0.33	0.33	0.00	--
All-Way Stop Control	FULL									856	0.71	0.71	0.00	--

Results for Grade Separated Intersections

TYPE OF INTERSECTION	Sheet	Zone 1 (North)		Zone 2 (South)		Zone 3 (East)		Zone 4 (West)		Zone 5 (Center)		Zone 6 (Raised)		Overall v/c Ratio	Ped	Bicycle
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			

Capacity Analysis for Planning of Junctions

Detailed Report - Page 4 of 4

Results for Roundabouts

TYPE OF ROUNDABOUT	Zone 1 (North)			Zone 3 (East)			Zone 2 (South)			Zone 4 (West)			Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3			
1 X 1	0.23			0.11			0.29			0.13			0.29	--	--

Results for Interchanges

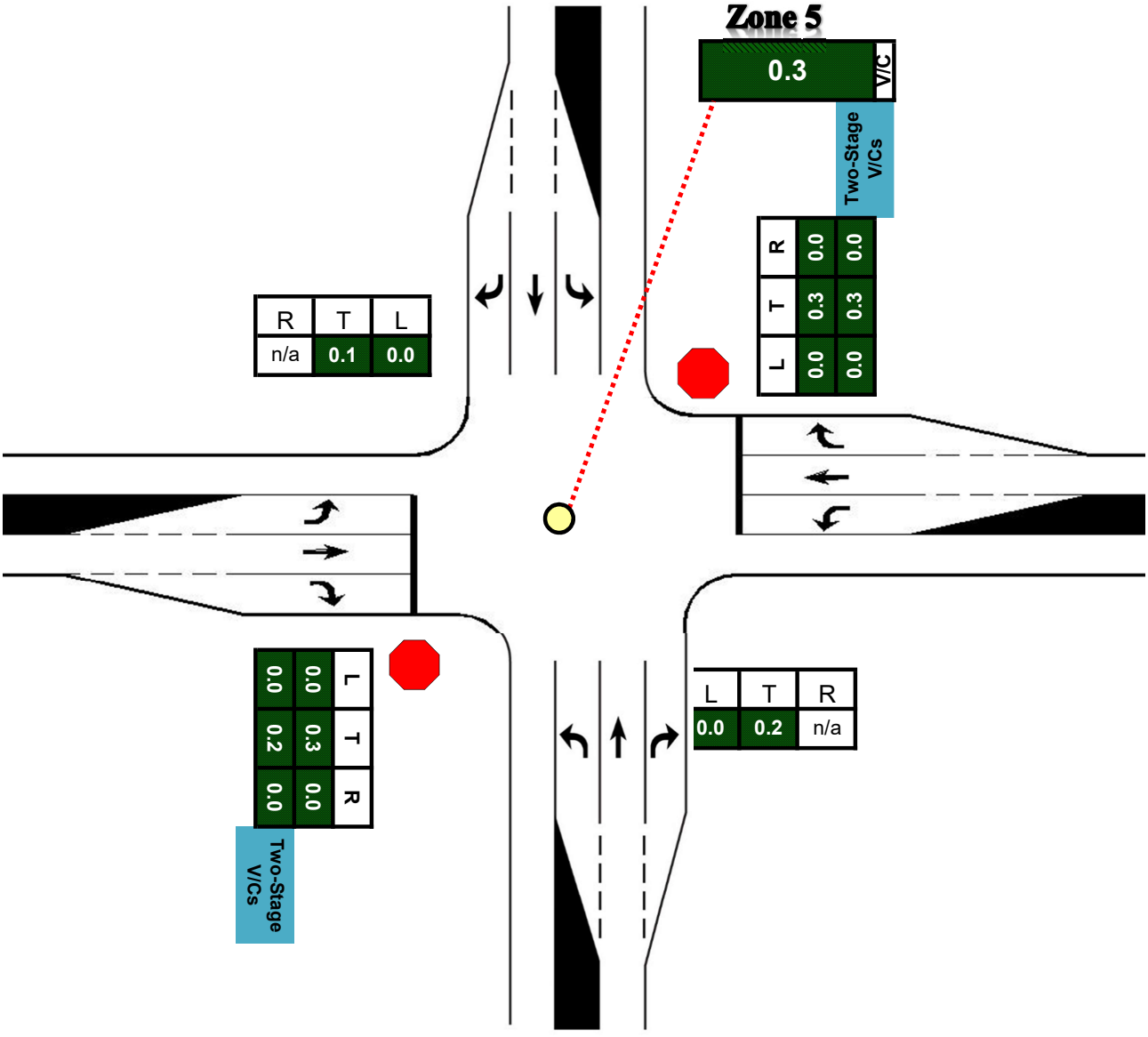
TYPE OF INTERCHANGE	Sheet	Zone 1 (Rt Mrg)		Zone 2 (Lt Mrg)		Zone 3 (Ctr. 1)		Zone 4 (Ctr. 2)		Zone 5 (Lt Mrg)		Zone 6 (Rt Mrg)		Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			

Two Way Stop Control (N-S)

Design and Results

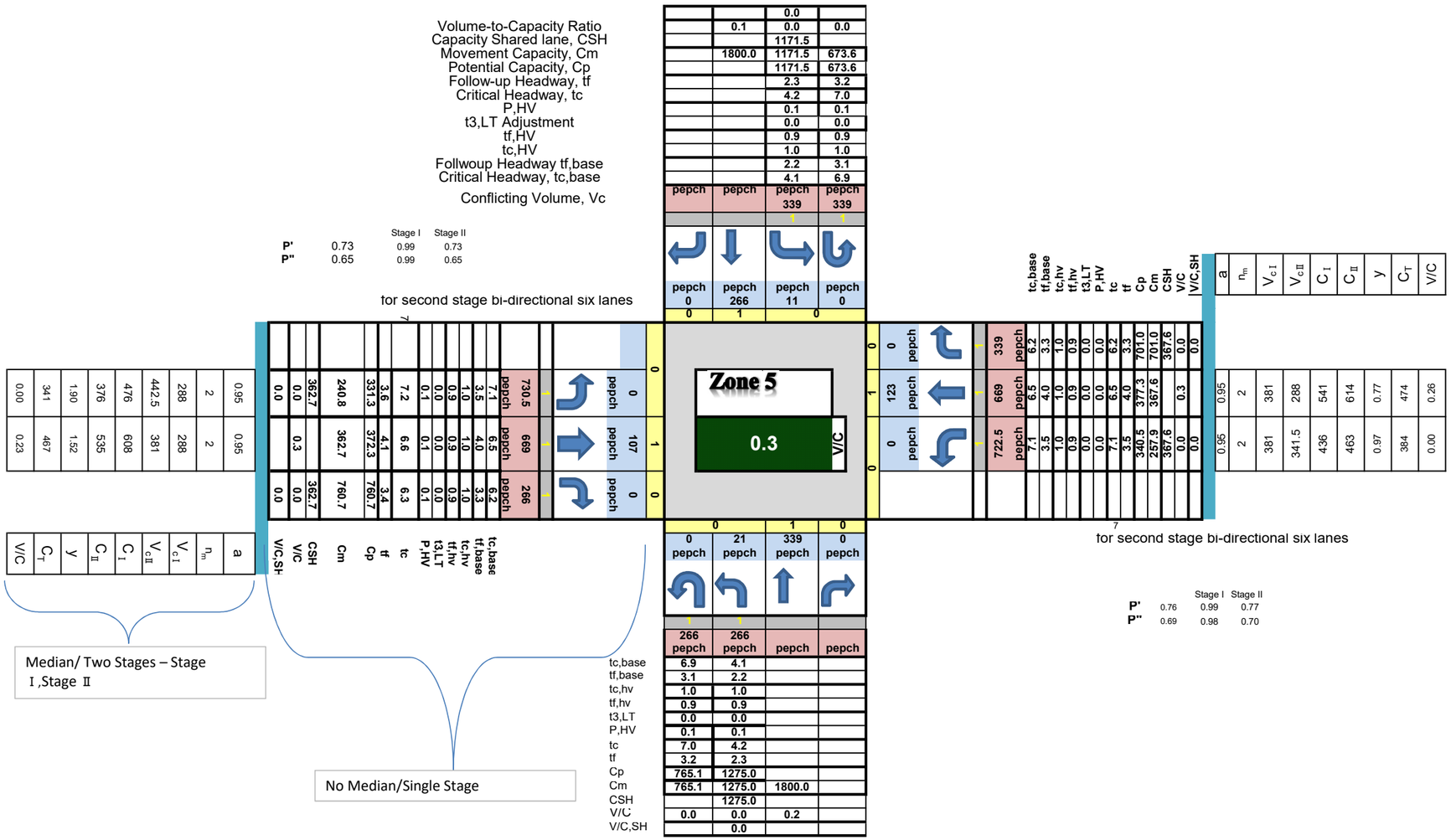
Project Name:	*STA-93 at Orrville Street*
Project Number:	*20211202*
Location	*Lawrence Township*
Date	2047 AM
Is Median Present on Major Street?	No

Volume-to-Capacity Ratio			
< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00
VOLUME / CAPACITY RATIO:			**0.3**



Two Way Stop Control (N-S)

Data Input and Configuration



Assumptions

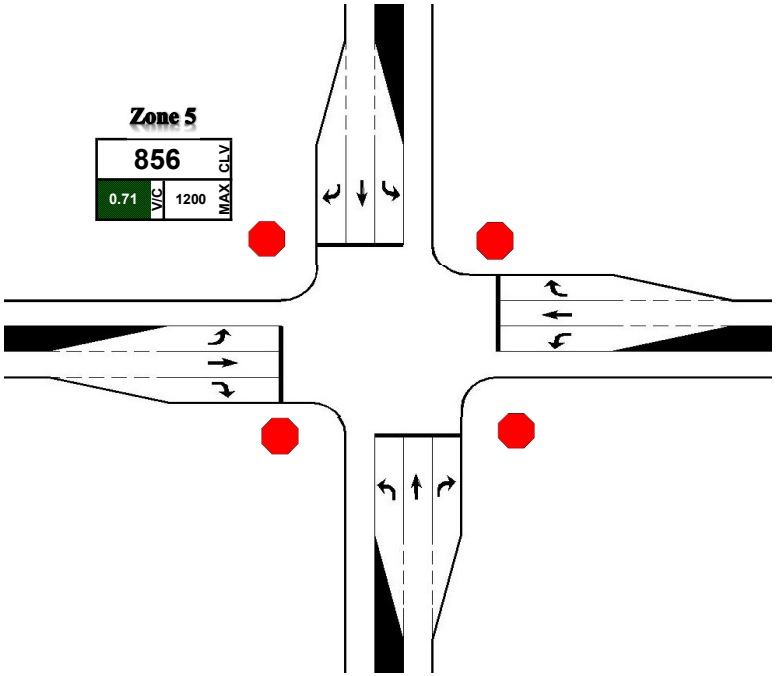
Two-Way Stop-Controlled (TWSC) Intersection

- All approaches have no more than two lanes (PPEAG),
- All minor-street approaches have no more than one lane per movement (HCM);
- Major-street left- and U-turns are provided with an exclusive turn lane (PPEAG);
- There is no median on the major street, or the median has a nose width < 21 ft (PPEAG);
- If an exclusive right-turn lane is provided on the major street, volumes making the right turn are not included as part of the conflicting volume (HCM);
- No channelizing islands for right-turn movements (PPEAG);
- No minor-street U-turns (HCM);
- U-turns from two-lane major streets, as well as U-turns from minor streets, are converted into left-turn movements (CAP-X);
- No median storage for minor-street left-turns and through movements (i.e., one-stage gap acceptance) (PPEAG);
- No pedestrians (PPEAG); and
- No platooning effects from upstream traffic signals (PPEAG).

All Way Stop Control

Design and Results

		Volume-to-Capacity Ratio			
Project Name:	STA-93 at Orrville Street	< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00
Project Number:	20211202				
Location	Lawrence Township	VOLUME / CAPACITY RATIO:		0.71	
Date	2047 AM				



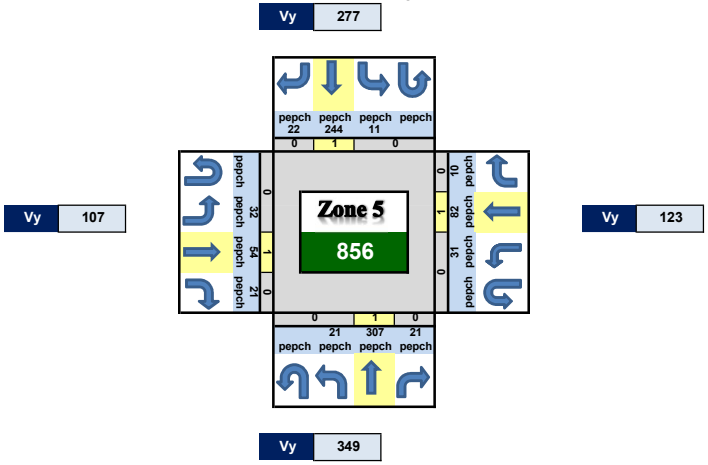
All Way Stop Control

Data Input and Configuration

Total Entering Capacity (veh/h)		E/W App.	N/S App.	Used?
1,200	both streets: 1-lane approaches	TRUE	TRUE	1200
1,500	one street: 1-lane approaches, one street: 2-lane approaches	FALSE	FALSE	FALSE
1,800	both streets: 2-lane approaches	FALSE	FALSE	FALSE

Total Entering Flow Rate
Ve
856

*U-Turns are converted into Left Turns



Back to Results

Assumptions

All-Way Stop-Controlled (AWSC) Intersection

- All approaches have no more than two lanes (PPEAG),
- Opposite approaches have the same number of lanes (PPEAG),
- No pedestrians (PPEAG), and
- U-turns are converted into left-turn movements (CAP-X).

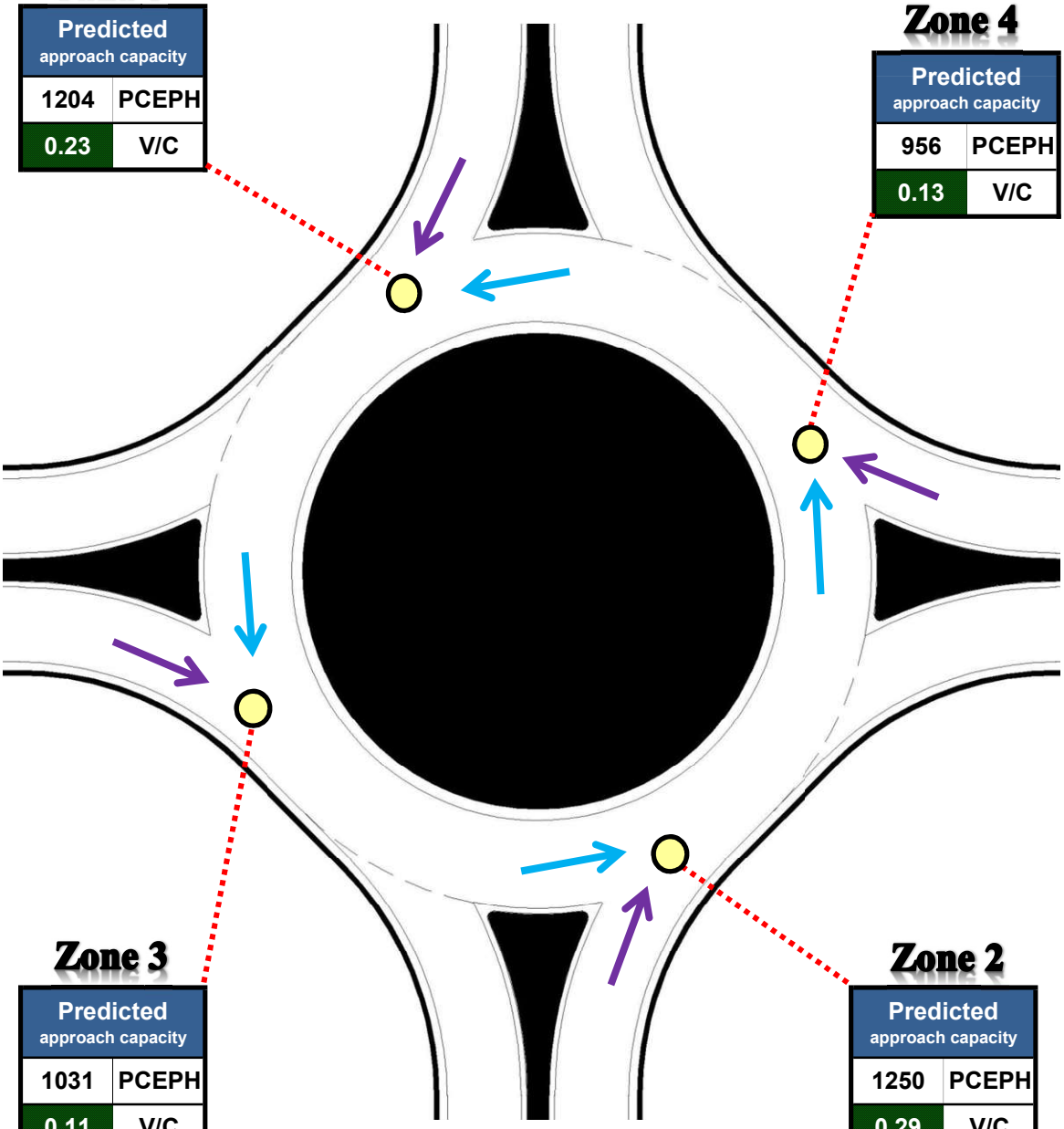
1 NS x 1 EW Roundabout

Design and Results

Project Name:	*STA-93 at Orrville Street*
Project Number:	*20211202*
Location	*Lawrence Township*
Date	2047 AM

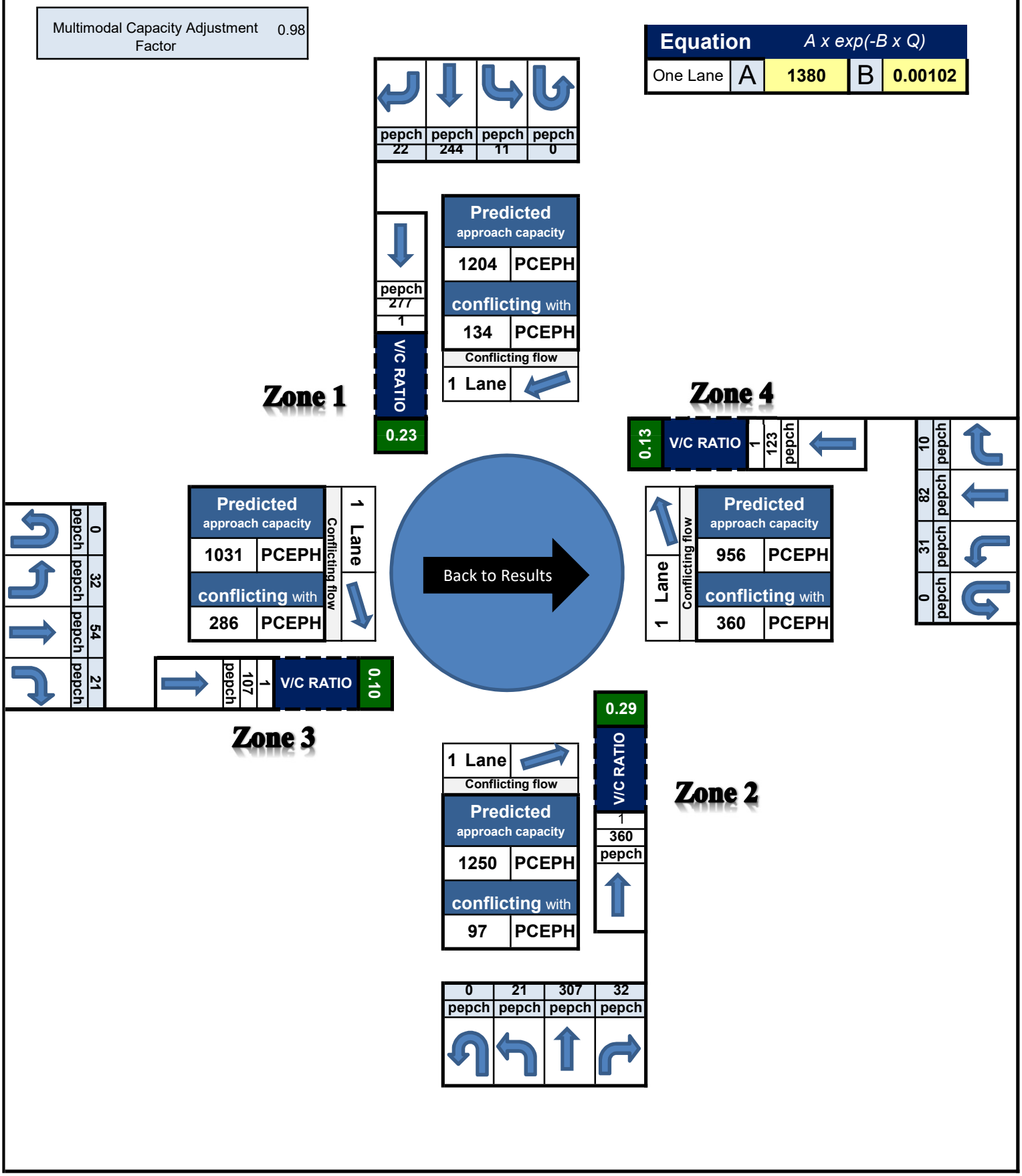
Volume-to-Capacity Ratio			
< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00

VOLUME / CAPACITY RATIO:				
Zone 1	0.23	Zone 4	0.13
Zone 3	0.11	Zone 2	0.29



1 NS x 1 EW Lane Roundabout

Data Input and Configuration



Capacity Analysis for Planning of Junctions

Summary Report

Project Name:	STA-93 at Orrville Street
Project Number:	20211202
Location:	Lawrence Township
Date:	2047 PM
Number of Intersection Legs:	4
Major Street Direction	North-South

Traffic Volume Demand

	Volume (Veh/hr)				Percent (%)	
	U-Turn	Left	Thru	Right	Heavy Vehicles	Volume Growth
Eastbound	0	30	90	30	0.50%	0.00%
Westbound	0	30	50	10	4.00%	0.00%
Southbound	0	10	310	30	5.00%	0.00%
Northbound	0	20	260	30	4.00%	0.00%
Adjustment Factor	0.80	0.95		0.85		
Suggested	**0.80**	**0.95**		**0.85**		

Truck to PCE Factor		**Suggested = 2.00**	2.00
Multimodal Activity Level		**0**	
E-W / Crossing East-West Legs	**Low**	**Low**	**Low**
N-S / Crossing North-South Legs	**Low**	**Low**	**Low**
Critical Lane Volume Threshold	2-phase signal	**Suggested = 1800 (Urban), 1650 (Rural)**	**1650**
	3-phase signal	**Suggested = 1750 (Urban), 1600 (Rural)**	**1600**
	4-phase signal	**Suggested = 1700 (Urban), 1550 (Rural)**	**1550**

Capacity Analysis for Planning of Junctions

Summary Report

############

TYPE OF INTERSECTION	Overall v/c Ratio	V/C Ranking	Pedestrian Accommodations	Bicycle Accommodations
1 X 1 Roundabout	**0.30**	**1**	**0.00**	--
Two-Way Stop Control N-S	**0.43**	**2**	**0.00**	--
All-Way Stop Control	**0.77**	**3**	**0.00**	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--

Capacity Analysis for Planning of Junctions

Detailed Report - Page 1 of 4

Project Name:	STA-93 at Orrville Street
Project Number:	20211202
Location:	Lawrence Township
Date:	2047 PM
Number of Intersection Legs:	4
Major Street Direction:	North-South

Traffic Volume Demand

	Volume (Veh/hr)				Percent (%)	
	U-Turn	Left	Thru	Right	Heavy Vehicles	Volume Growth
Eastbound	0	30	90	30	0.50%	0.00%
Westbound	0	30	50	10	4.00%	0.00%
Southbound	0	10	310	30	5.00%	0.00%
Northbound	0	20	260	30	4.00%	0.00%
Adjustment Factor	0.80	0.95		0.85		
Suggested	**0.80**	**0.95**		**0.85**		

Truck to PCE Factor		**Suggested = 2.00**	2.00
Multimodal Activity Level		**0**	
E-W / Crossing East-West Legs		**Low**	**Low**	**Low**
N-S / Crossing North-South Legs		**Low**	**Low**	**Low**
Critical Lane Volume Threshold	2-phase signal	**Suggested = 1800 (Urban), 1650 (Rural)**	**1650**
	3-phase signal	**Suggested = 1750 (Urban), 1600 (Rural)**	**1600**
	4-phase signal	**Suggested = 1700 (Urban), 1550 (Rural)**	**1550**

Capacity Analysis for Planning of Junctions

Detailed Report - Page 2 of 4

Number of Lanes for Non-roundabout Intersections

TYPE OF INTERSECTION	Sheet	Northbound				Southbound				Eastbound				Westbound			
		U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Conventional Shared RT LN	CSRL		1	2			1	2			1	2			1	2	
Two-Way Stop Control	N-S		1	1	0		1	1	0		0	1	0		0	1	0
All-Way Stop Control	FULL		0	1	0		0	1	0		0	1	0		0	1	0

Number of Lanes for Grade Separated Intersections

TYPE OF INTERCHANGE	Sheet	Northbound				Southbound				Eastbound				Westbound			
		U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R

Number of Lanes for Interchanges

TYPE OF INTERCHANGE	Sheet	Northbound				Southbound				Eastbound				Westbound			
		U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R

Capacity Analysis for Planning of Junctions

Detailed Report - Page 3 of 4

Results for Non-roundabout Intersections

TYPE OF INTERSECTION	Sheet	Zone 1 (North)		Zone 2 (South)		Zone 3 (East)		Zone 4 (West)		Zone 5 (Center)		Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			
Two-Way Stop Control	N-S									--	0.43	0.43	0.00	--
All-Way Stop Control	FULL									924	0.77	0.77	0.00	--

Results for Grade Separated Intersections

TYPE OF INTERSECTION	Sheet	Zone 1 (North)		Zone 2 (South)		Zone 3 (East)		Zone 4 (West)		Zone 5 (Center)		Zone 6 (Raised)		Overall v/c Ratio	Ped	Bicycle
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			

Capacity Analysis for Planning of Junctions

Detailed Report - Page 4 of 4

Results for Roundabouts

TYPE OF ROUNDABOUT	Zone 1 (North)			Zone 3 (East)			Zone 2 (South)			Zone 4 (West)			Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3	Lane 1	Lane 2	Lane 3			
1 X 1	*0.30*			*0.16*			*0.27*			*0.10*			0.30	0.00	--

Results for Interchanges

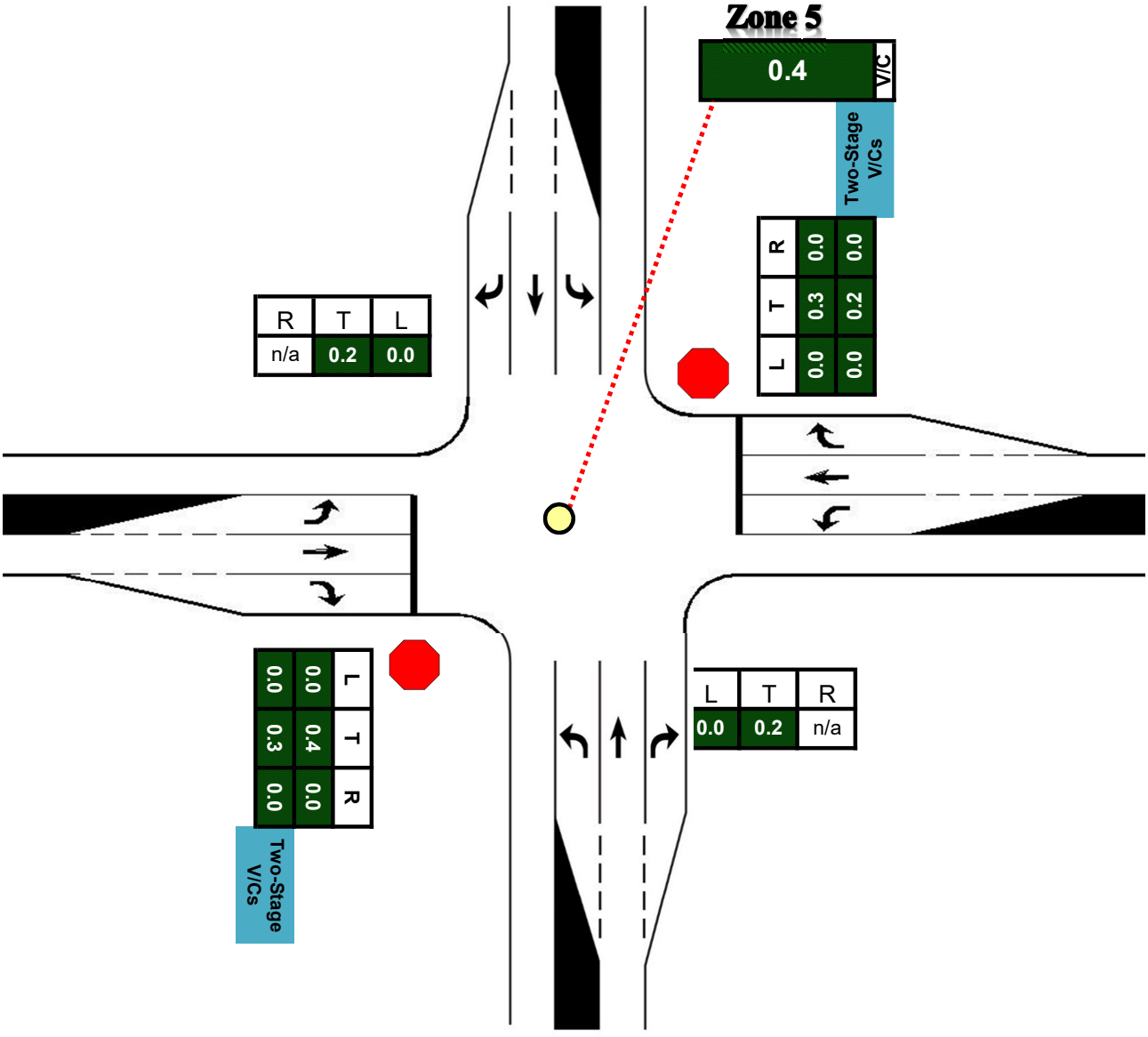
TYPE OF INTERCHANGE	Sheet	Zone 1 (Rt Mrg)		Zone 2 (Lt Mrg)		Zone 3 (Ctr. 1)		Zone 4 (Ctr. 2)		Zone 5 (Lt Mrg)		Zone 6 (Rt Mrg)		Overall v/c Ratio	Pedestrian Accommodations	Bicycle Accommodations
		CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C	CLV	V/C			

Two Way Stop Control (N-S)

Design and Results

Project Name:	*STA-93 at Orrville Street*
Project Number:	*20211202*
Location	*Lawrence Township*
Date	2047 PM
Is Median Present on Major Street?	No

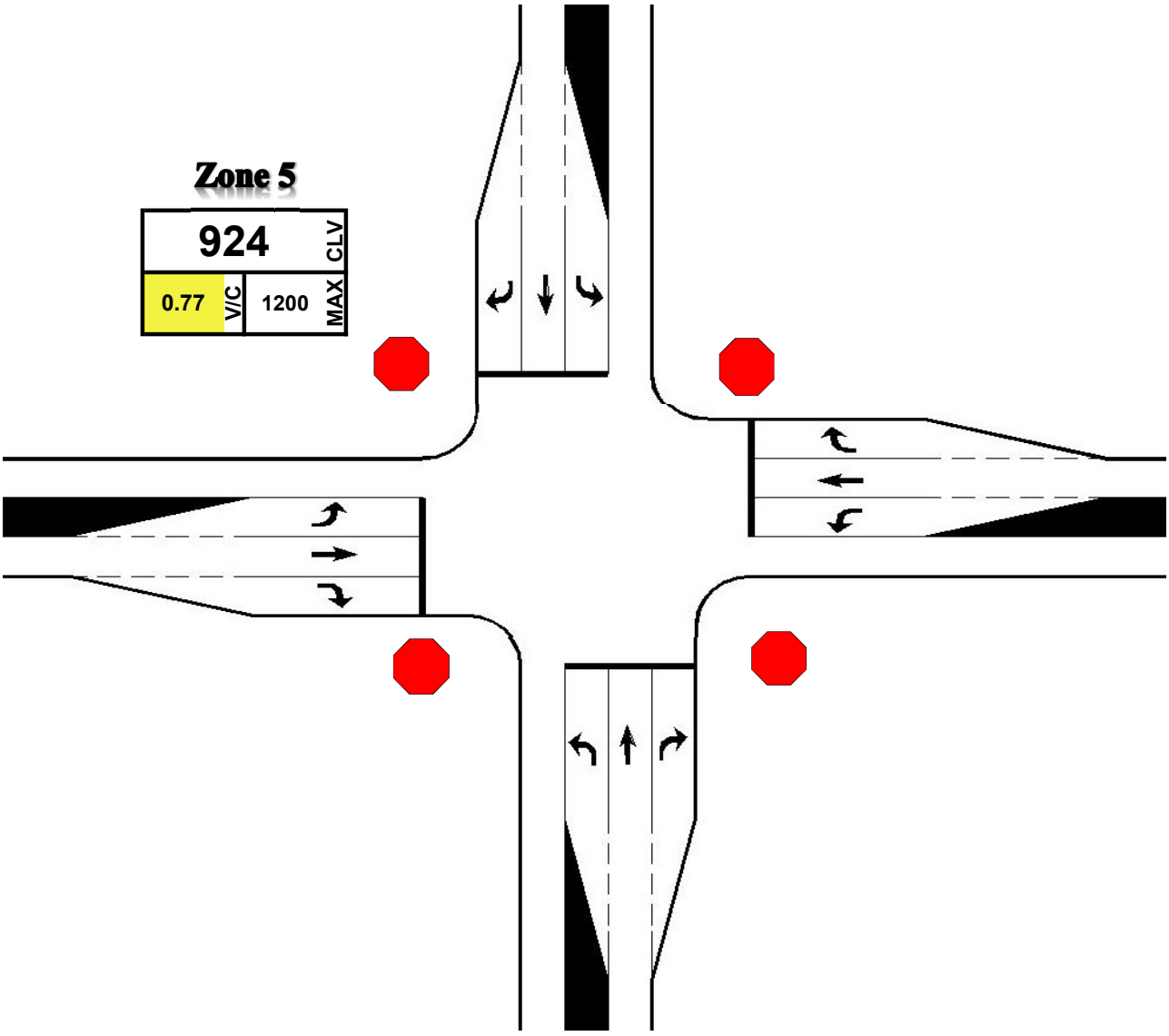
Volume-to-Capacity Ratio			
< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00
VOLUME / CAPACITY RATIO:			**0.4**



All Way Stop Control

Design and Results

Project Name:	*STA-93 at Orrville Street*	***Volume-to-Capacity Ratio***			
Project Number:	*20211202*	**< 0.750**	**0.750 - 0.875**	**0.875 - 1.00**	**≥ 1.00**
Location	*Lawrence Township*	**VOLUME / CAPACITY RATIO:**		**0.77**	
Date	2047 PM				



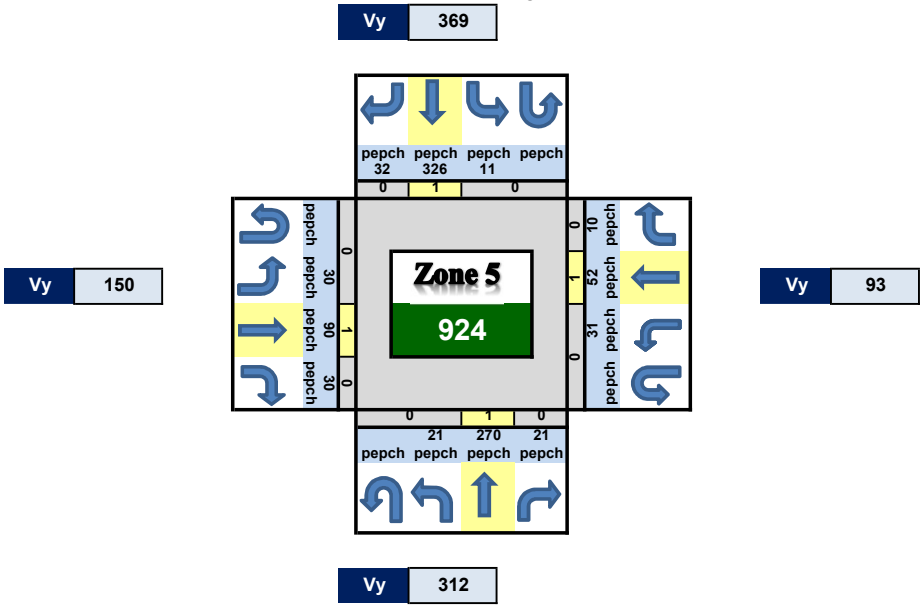
All Way Stop Control

Data Input and Configuration

Total Entering Capacity (veh/h)		E/W App.	N/S App.	Used?
1,200	both streets: 1-lane approaches	TRUE	TRUE	1200
1,500	one street: 1-lane approaches, one street: 2-lane approaches	FALSE	FALSE	FALSE
1,800	both streets: 2-lane approaches	FALSE	FALSE	FALSE

Total Entering Flow Rate
Ve
924

*U-Turns are converted into Left Turns



Back to Results

Assumptions

All-Way Stop-Controlled (AWSC) Intersection

- All approaches have no more than two lanes (PPEAG),
- Opposite approaches have the same number of lanes (PPEAG),
- No pedestrians (PPEAG), and
- U-turns are converted into left-turn movements (CAP-X).

1 NS x 1 EW Roundabout

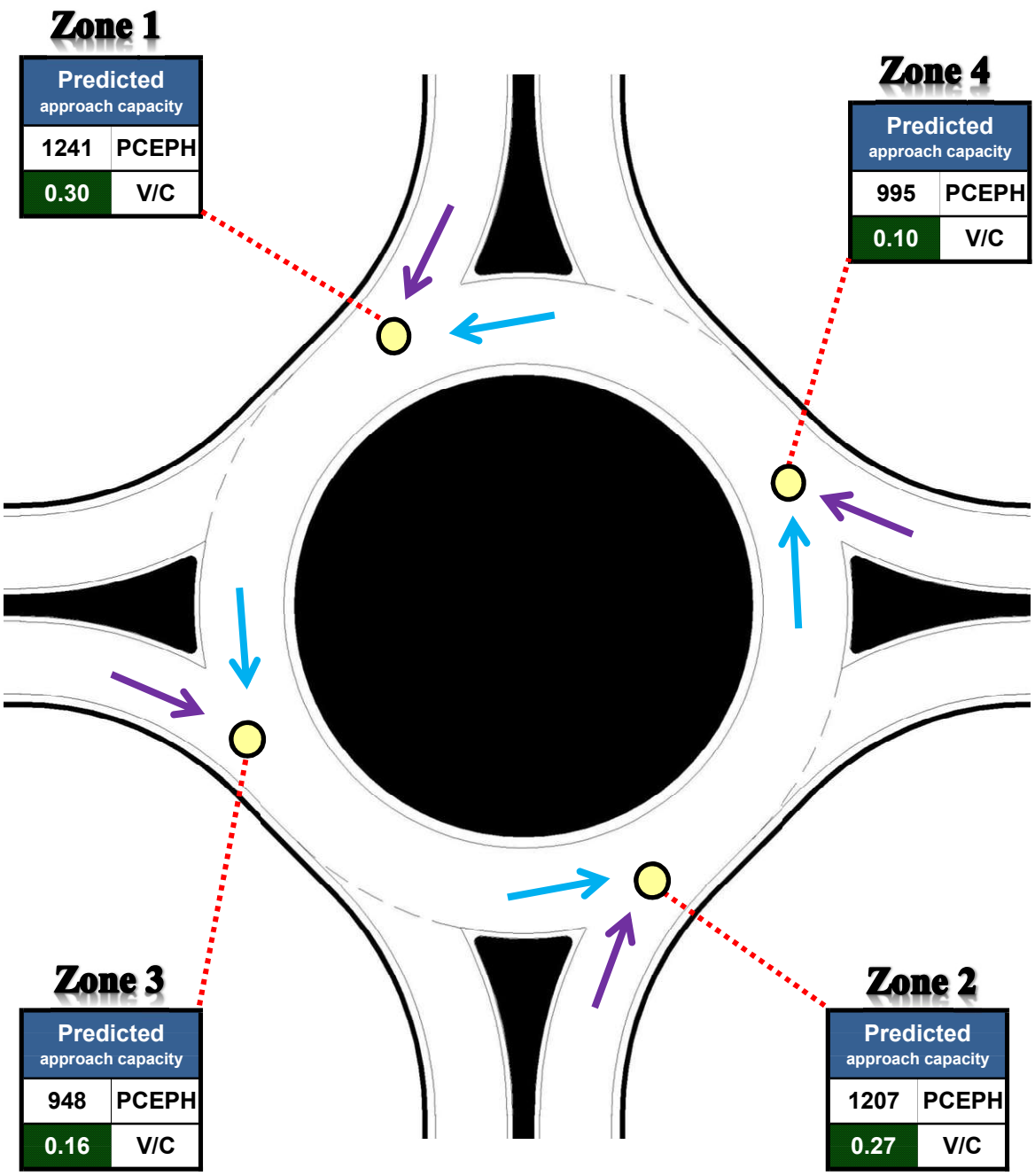
Design and Results

Project Name:	*STA-93 at Orrville Street*
Project Number:	*20211202*
Location	*Lawrence Township*
Date	2047 PM

Volume-to-Capacity Ratio

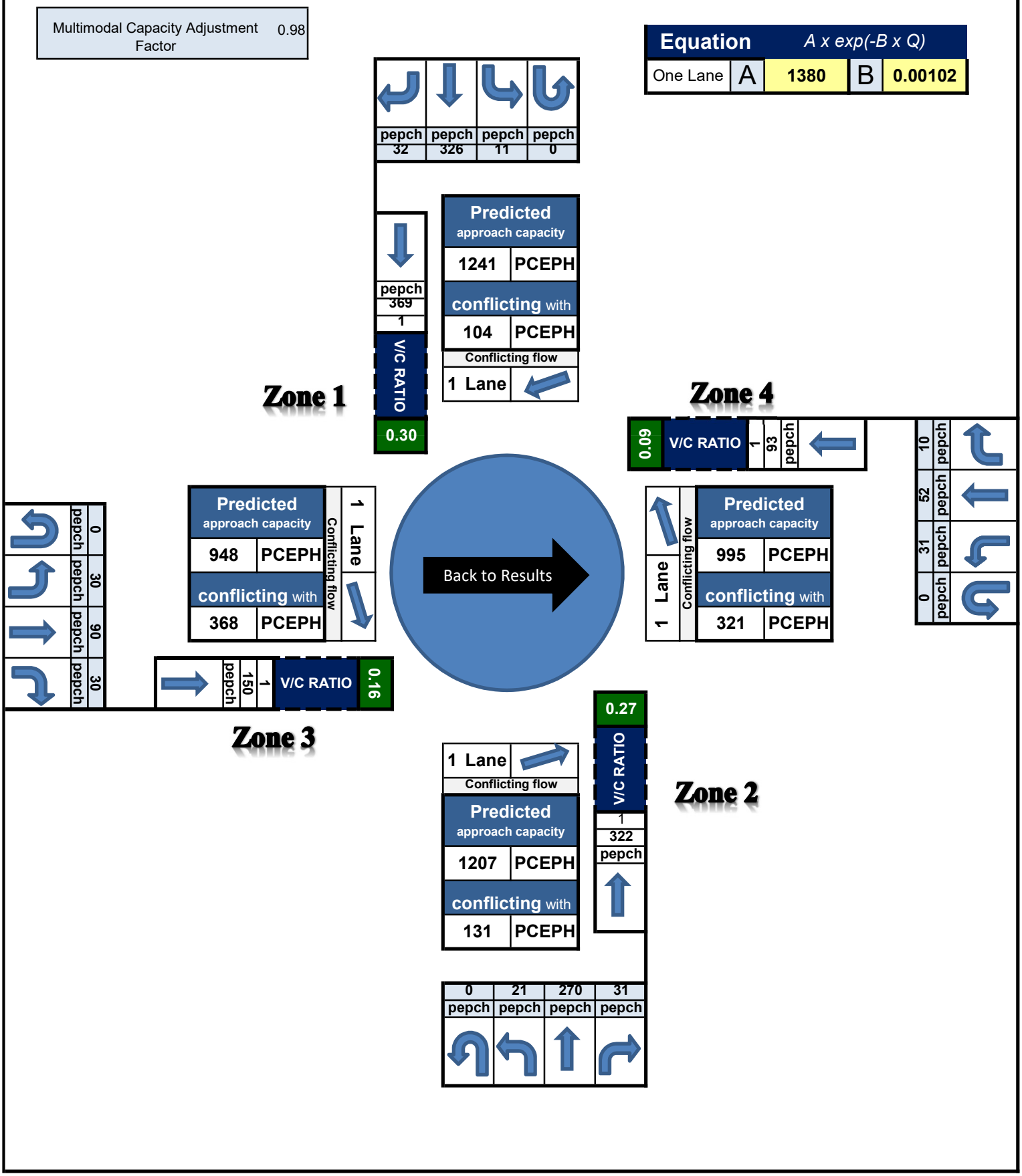
< 0.750	0.750 - 0.875	0.875 - 1.00	≥ 1.00

VOLUME / CAPACITY RATIO:				
Zone 1	0.30	Zone 4	0.10	
Zone 3	0.16	Zone 2	0.27	



1 NS x 1 EW Lane Roundabout

Data Input and Configuration



EMH&T

APPENDIX I:

ICE Analysis

Project / Organization Information

This sheet provides general project information and analysis type selection.

Organization Information	
Analyst:	C.Anderson
Agency/Company:	EMH&T
Date Performed:	July 18 2024
Intersection:	SR93 and Orrville St NW
Route:	SSTASR00093**C
Logpoint:	15.07
Common Name:	Manchester Ave NW
Analysis Type	At-Grade Intersection

Worksheet Instructions:

1. Fill in Project Information

2. Select Analysis Type from drop-down menu

Alternative Selection

Select intersection types from the following table to include in the ICE analysis. To include an intersection, select "Yes" in the include column, and to exclude an intersection, select "No" in the include column.

At-Grade Control Strategies

Control #	Include	Short Name	Description	Notes
1	Yes	MinorStop	Minor Road Stop	Existing intersection is minor street stop controlled
2	Yes	AllStop	All Way Stop	
3	No	TrafficSignal	Traffic Signal	
4	No	TrafficSignalAlt	Traffic Signal (Alt.)	
5	Yes	Roundabout	Roundabout	
6	No	DLT	Displaced Left Turn (DLT)	
7	No	MUT	Median U-Turn (MUT)	
8	No	SignalRCUT	Signalized Restricted Crossing U-Turn (RCUT)	
9	No	UnsignalRCUT	Unsignalized Restricted Crossing U-Turn (RCUT)	
10	No	GreenT	Continuous Green-T Intersection	
11	No	Jughandle	Jughandle	
12	No	Quadrant Itx	Quadrant Roadway Intersection	Note that no safety information is available
13	No	Other1	Other 1	Safety information must be provided
14	No	Other2	Other 2	Safety information must be provided

Volume

Use this sheet to enter traffic volume

		Open Year	Design Year
	Operating Cycle	2027	2047
	Yearly Growth Rate for Volumes		0.1%
	Peak Hour Start	**From**	**To**
Enter peak period begin and end times:	AM peak	7:00 AM	8:00 AM
	PM peak	4:00 PM	5:00 PM
	Weekend peak	10:00 AM	11:00 AM

Worksheet Instructions:

1. Enter open year and design year, growth rate and the start times of peak hour
2. Select Facility Type
3. Select Total Volumes or Turning Volumes (Total Volumes preferred)
4. In most cases, enter peak hour volumes by summing the peak hour turning movements as shown in the example computation figure.
5. Press the Setup Worksheets button at the bottom of the worksheet.

Select facility type:	Rural Minor Arterial	At intersections of varying facilities select the roadway that will be more representative of the volume, or "interpolate" between facility types.

Specify total volumes or turning counts?	Total Volumes	(Select from drop-down menu)

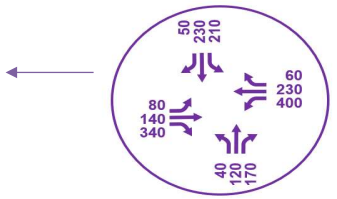
It is generally preferable to use "Total Volumes" and sum individual turning movements outside of the tool (as shown in the example below) rather than using the "Turning Counts" worksheet to sum them

	Changes to demand profiles are not needed for typical analysis and they can generally remain hidden.

Enter the total entering volume (i.e. sum of turning movement counts) for the peak hours. If data is not available for the weekend peak hour please leave blank.

	Units	**Year**	
		Opening	**Design**
		2027	**2047**
		Intersection 1	
AM peak hour volume	veh/hr.	791	810
PM peak hour volume	veh/hr.	879	900
Weekend peak hour volume:	veh/hr.	117	120
Average annual auto occupancy	Passengers per vehicle	1.0	1.0
Average annual % trucks	Average %	2.0%	2.0%

Example Computation of Peak Hour Volume



50 + 230 + 210 + 60 + 230 + 400 + 170 + 120 + 40 + 340 + 140 + 80 = 2070

	Press the "Setup Worksheets" button to create hidden worksheets that compute performance measures for each selected control strategy. Once this button is pressed you cannot add or remove any control strategies from analysis

Cost Parameters

This sheet defines the basic cost parameters used in the benefit-cost analysis.

Worksheet Instructions
1. Enter the Total Design & Construction Cost and the Total Right-of-Way Costs
2. Enter ECAT results into Safety Information table

Type	Category	Unit valuation	Default value	Override value	Use value	Override date	Notes/References
Existing (Base) year for discounting	N/A	N/A	N/A	2027	2027		All costs will be discounted to the Base Year for Discounting. *Enter the year in the "Override Value" column.*
Opening Year	N/A	N/A	N/A	2027	2027		
Design Year	N/A	N/A	N/A	2047	2047		
Discount rate	N/A	Percent	0.04		0.04		Typical Value

Value of time	Person (weekday)
	Person (weekend)
	Trucks
		$ per person hour
		$ per person hour
		$ per truck hour
			$ 18.12
			$ 18.12
			$ 52.14
					$ 18.12
					$ 18.12
					$ 52.14
							2019 TTI Urban Mobility Report

Crashes	Fatal & Injury Crashes Property damage only crashes	$ per crash $ per crash	$ 110,820 $ 11,008		$ 110,820 $ 11,008		ODOT 2023 data ODOT 2023 data

These following values define the planning & construction and the operating & maintenance costs of the control strategy alternatives. A single total cost is required for planning and construction. Default values are provided for all operating & maintenance cost, but can be overridden by the user.

At-Grade Intersections	Total Design & Construction	Total Right of Way Costs	Operating & Maintenance	Signal Retiming	Power	Lighting	Signal Maintenance	Roundabout Landscaping	Other	Other 2	Other 3	Other 4	Other 5
Minor Road Stop	$ -	$ -	Cost	$ -	$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
All Way Stop	$ 50,000	$ -	Cost	$ -	$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)
Roundabout	$ 2,734,000	$ 80,000	Cost	$ -	$ -	$ 3,000	$ -	$ 2,000	$ -	$ -	$ -	$ -	$ -
			Period	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)	1 (yearly)

Safety Information

Enter ECAT results into the table below.

At-Grade Intersection	Crash Type	Opening Year	Design Year
Minor Road Stop	Total	3.6	3.6
	Fatal & Injury	0.3	0.3
All Way Stop	Total	1.9	1.9
	Fatal & Injury	0.2	0.2
Roundabout	Total	0.8	0.8
	Fatal & Injury	0.0	0.0

Delay Information

Use this sheet to enter the delay information for each of the included control strategies.

Worksheet Intstructions: Enter peak hour intersection delay values as determined with HCS, Transmodeler, or other tools as specified in OATS Manual

!!!! DISCLAIMER !!!!
For each control strategy the AM, PM & Weekend Peak delay values within the same year have to be different.
For example:
Opening Year -> AM = 6.2 secs, PM = 6.2 secs, and Weekend = 4.6 secs, needs to be AM = 6.2 secs, PM = 6.2001 secs, and Weekend = 4.6 secs, basically the delay values need to be insignificantly different.

			Opening Year			Design Year		
At-Grade Intersections			Average vehicle delay			Average vehicle delay		
Control Strategy	Delay Type	Units	AM peak	PM peak	Weekend peak	AM peak	PM peak	Weekend peak
Minor Road Stop	Single Input	sec/veh	6.0	6.4		6.4	6.5	
All-Way Stop	Single Input	sec/veh	12.5	12.7		12.9	13.0	
Roundabout	Single Input	sec/veh	5.8	5.7		6.0	5.8	

Outputs

This sheet compiles the data from summary tables in individual alternatives sheets. To populate the output sheet press the "Setup Worksheets" button in the Volumes tab.

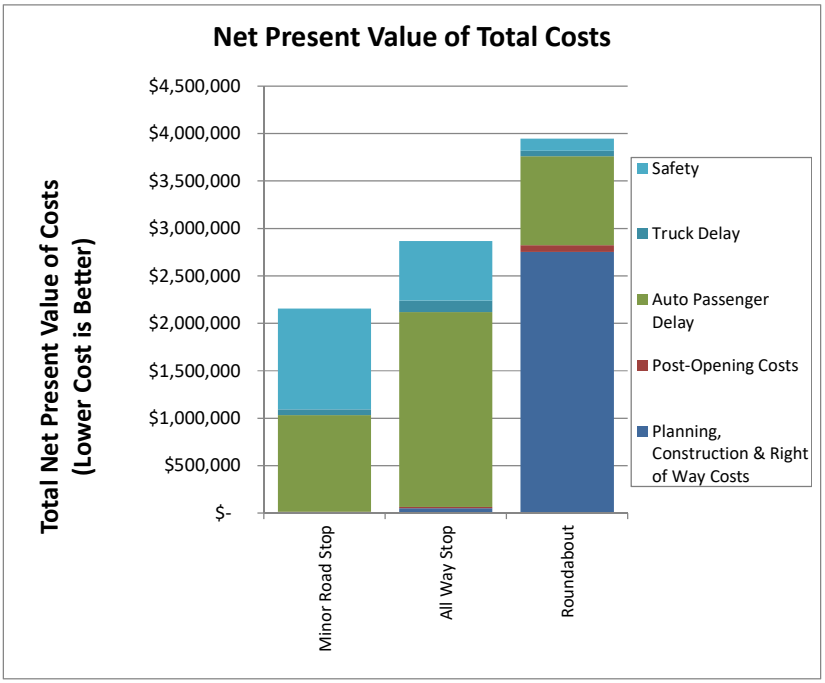
Analyst:	C.Anderson
Agency/Company:	EMH&T
Intersection:	SR93 and Orrville St NW
Route:	SSTASR00093**C
Logpoint:	15.07
Common Name:	Manchester Ave NW
Date Performed:	July 18 2024
Analysis Type	At-Grade Intersection

Analysis Summary

Cost Categories	Net Present Value of Costs		
	Minor Road Stop	All Way Stop	Roundabout
Planning, Construction & Right of Way Costs		$ 50,000	$ 2,750,000
Post-Opening Costs	$ 14,590	$ 14,590	$ 72,952
Auto Passenger Delay	$ 1,017,976	$ 2,054,598	$ 938,584
Truck Delay	$ 59,780	$ 120,655	$ 55,118
Safety	$ 1,063,267	$ 628,540	$ 128,488
Total cost	**$2,155,613**	**$2,868,383**	**$3,945,141**

Select Base Case for Benefit-Cost Comparison: (Choose from list)	Minor Road Stop

Benefit Categories	Net Present Value of Benefits Relative to Base Case		
	Minor Road Stop	All Way Stop	Roundabout
Auto Passenger Delay		$ (1,036,623)	$ 79,392
Truck Delay		$ (60,875)	$ 4,662
Safety		$ 434,728	$ 934,779
Net Present Value of Benefits		**$ (662,770)**	**$ 1,018,833**
Net Present Value of Costs		**$ 50,000**	**$ 2,808,361**
Net Present Value of Improvement		**$ (712,770)**	**$ (1,789,529)**
Benefit-Cost (B/C) Ratio		Control Strategy not preferred. Benefits are less than base case and cost is greater than base case.	0.36
Delay B/C		Control Strategy not preferred. Benefits are less than base case and cost is greater than base case.	0.03
Safety B/C		8.69	0.33



EMH&T

APPENDIX J:

Conceptual Design of Modern Single Lane Roundabout

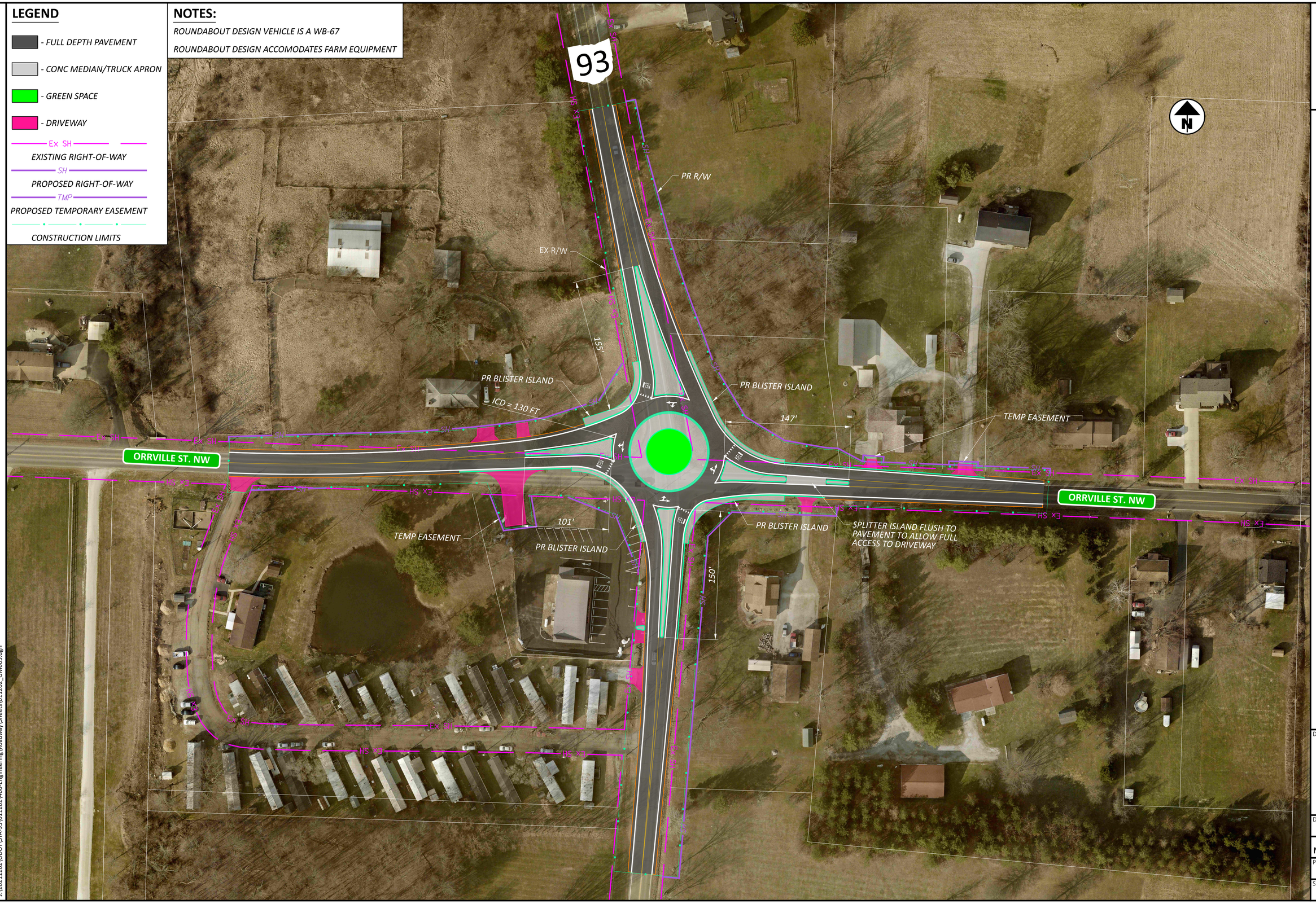
LEGEND

- FULL DEPTH PAVEMENT
- CONC MEDIAN/TRUCK APRON
- GREEN SPACE
- DRIVEWAY
- Ex SH — EXISTING RIGHT-OF-WAY
- SH — PROPOSED RIGHT-OF-WAY
- TMP — PROPOSED TEMPORARY EASEMENT
- CONSTRUCTION LIMITS

NOTES:

ROUNDABOUT DESIGN VEHICLE IS A WB-67

ROUNDABOUT DESIGN ACCOMODATES FARM EQUIPMENT



HORIZONTAL SCALE IN FEET
0 25 50 100

SR 93 AT ORRVILLE STREET NW ROUNDABOUT EXHIBIT

DESIGN AGENCY
EMH&T

DESIGNER TGW

REVIEWER MJR 08-08-24

PROJECT ID TBD

SHEET P.0 | TOTAL 0

STA-93

MODEL: Roundabout Alternative [Sheet] PAPERSIZE: 34x22 (in.) DATE: 8/8/2024 TIME: 3:41:51 PM USER: twilson
J:\2021\202\ODOT\STA-93\011202\400-Engineering\Roadway\Sheets\011202_GM003.dgn

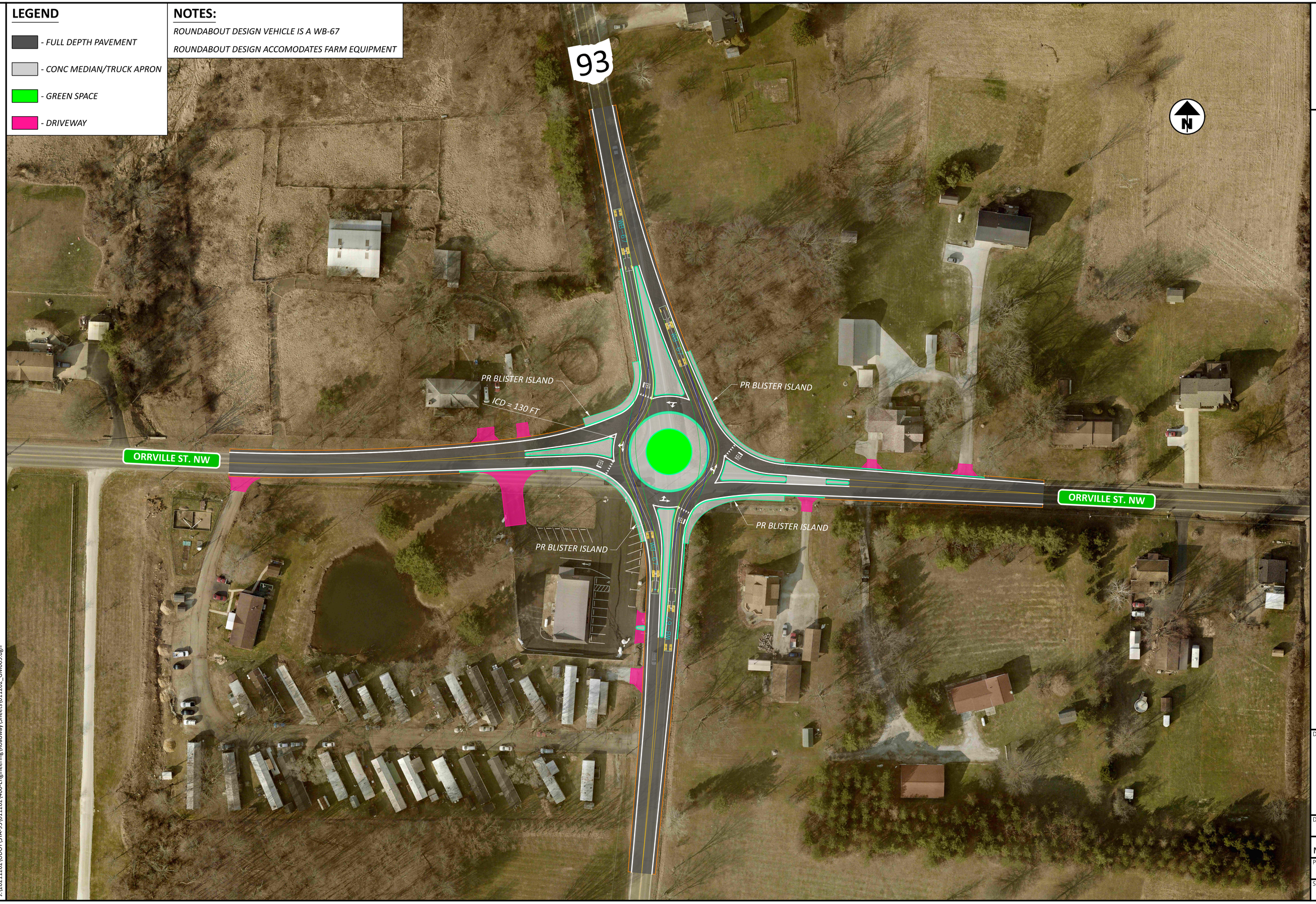
LEGEND

- *FULL DEPTH PAVEMENT*
- *CONC MEDIAN/TRUCK APRON*
- *GREEN SPACE*
- *DRIVEWAY*

NOTES:

ROUNDABOUT DESIGN VEHICLE IS A WB-67

ROUNDABOUT DESIGN ACCOMODATES FARM EQUIPMENT



HORIZONTAL SCALE IN FEET
0 25 50 100

SR 93 AT ORRVILLE STREET NW
WB-67 TURNING TEMPLATE EXHIBIT

DESIGN AGENCY
EMH&T

DESIGNER
TGW

REVIEWER
MJR 08-13-24

PROJECT ID
TBD

SHEET P.0 | TOTAL 0

STA-93

MODEL: Roundabout Alternative [Sheet] PAPERSIZE: 34x22 (in.) DATE: 8/13/2024 TIME: 3:02:38 PM USER: twilson
J:\2021\202\ODOT\STA-93\011202\400-Engineering\Roadway\Sheets\011202_GM005.dgn

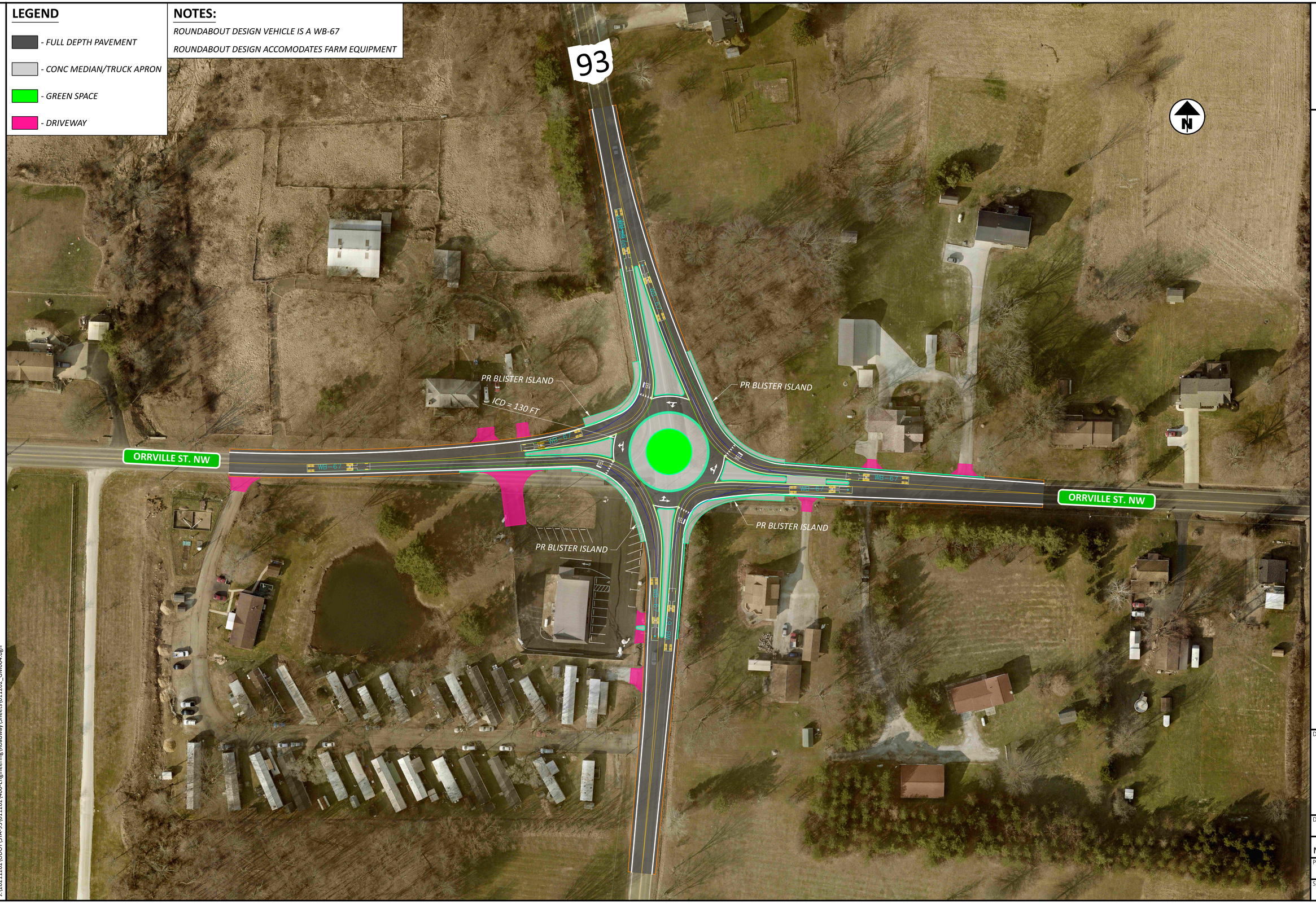
LEGEND

- *FULL DEPTH PAVEMENT*
- *CONC MEDIAN/TRUCK APRON*
- *GREEN SPACE*
- *DRIVEWAY*

NOTES:

ROUNDABOUT DESIGN VEHICLE IS A WB-67

ROUNDABOUT DESIGN ACCOMODATES FARM EQUIPMENT



HORIZONTAL SCALE IN FEET
0 25 50 100

SR 93 AT ORRVILLE STREET NW
WB-67 TURNING TEMPLATE EXHIBIT

DESIGN AGENCY
EMH&T

DESIGNER	TGW
REVIEWER	MJR 08-13-24
PROJECT ID	TBD
SHEET	P.0
TOTAL	0

STA-93

MODEL: Roundabout Alternative [Sheet] PAPERSIZE: 34x22 (in.) DATE: 8/13/2024 TIME: 2:42:59 PM USER: twilson
J:\2021\202\ODOT\STA-93\011202\400-Engineering\Roadway\Sheets\011202_GM004.dgn