

# APPENDIX C

## ENGINEERING

Stormwater Management Plan

Grading Exhibits

Utilities

Traffic Analysis

# **Greenfield Neighborhood Plan**

---

## **Conceptual Stormwater Management Plan**

**City of Fitchburg**  
**Dane County, Wisconsin**  
**April 2025**

Prepared by:

MSA Professional Services, Inc.  
1702 Pankratz Street  
Madison, WI 53704  
Phone: (608) 242-7779  
[www.msa-ps.com](http://www.msa-ps.com)

Project No. 07729051

© April 2025 MSA Professional Services, Inc.



## **Project Contacts**

### **City of Fitchburg**

Deanna Schmidt  
City Planner/Zoning Administrator  
5520 Lacy Road  
Fitchburg, WI 53711  
(608) 270-4255  
Deanna.Schmidt@fitchburgwi.gov

Brad Sippel  
Community Development Planner  
City Planner/Zoning Administrator  
5520 Lacy Road  
Fitchburg, WI 53711  
(608) 270-4258  
Brad.Sippel@fitchburgwi.gov

### **MSA Professional Services, Inc. (MSA)**

Steve Tremlett, AICP, CNU-A  
Planning Team Leader  
1702 Pankratz Street  
Madison, WI 53704  
(608) 242-6621  
stremlett@msa-ps.com

Gabe Lujan, PE  
Water Resources Engineer  
1702 Pankratz Street  
Madison, WI 53704  
(608) 216-2051  
glujan@msa-ps.com

# Greenfield Neighborhood Plan City of Fitchburg

## TABLE OF CONTENTS

		<u>Page</u>
<b>CHAPTER 1 – Introduction .....</b>		<b>1</b>
1.1	Purpose .....	1
1.2	Background .....	1
1.3	Stormwater Performance Standards .....	2
1.3.1	Summary of Stormwater Performance Criteria .....	3
1.4	Proposed Land Use .....	3
<b>CHAPTER 2 – Methods .....</b>		<b>5</b>
2.1	Peak Discharge .....	5
2.2	Volume Control .....	8
2.3	Water Quality .....	9
2.4	Infiltration .....	9
<b>CHAPTER 3 – Results .....</b>		<b>10</b>
3.1	Runoff Peak Discharge and Volume Control .....	10
3.2	Water Quality .....	11
3.3	Infiltration .....	11
3.4	Summary of Stormwater Management Space Needs .....	14
<b>CHAPTER 4 – Recommendations &amp; Improvements .....</b>		<b>15</b>
4.1	Stormwater Modeling Recommendations .....	15
4.2	Water Resources Recommendations and Improvements .....	15

## LIST OF TABLES

Table 1. Maximum Pre-Development Runoff Curve Numbers .....	3
Table 2. Dane County 24-hour Rainfall Depths .....	5
Table 3. Impervious Areas by Land Use Type .....	7
Table 4. Portion of Impervious Areas that are Directly Connected.....	7
Table 5. Peak Discharge Rates and Runoff Volumes Directed East.....	10
Table 6. Peak Discharge Rates Directed South .....	10
Table 7. Peak Discharge Rates Directed Northeast .....	10
Table 8. Peak Discharge Rates Directed North .....	11
Table 9. Post-Development Total Suspended Solids Reduction.....	11
Table 10. East Watershed Existing Stay-On Calculations .....	12
Table 11. South Watershed Existing Stay-On Calculations .....	12
Table 12. Northeast Watershed Existing Stay-On Calculations .....	13
Table 13. North Watershed Existing Stay-On Calculations.....	13
Table 14. Existing vs. Proposed Conditions Stay-On .....	13
Table 15. Stormwater Area Requirements by Watershed and Impervious Percentage.....	14

## LIST OF FIGURES

Figure 1. Greenfield Neighborhood Site Map .....	2
Figure 2. Greenfield Neighborhood Development Plan. ....	4
Figure 3. Pre-Development Subwatersheds and Time of Concentration Flow Paths.....	6
Figure 4. Post-Development Subwatersheds and Time of Concentration Flow Paths .....	8

## CHAPTER 1 – INTRODUCTION

### 1.1 PURPOSE

The conceptual stormwater plan was developed by MSA Professional Services, Inc. (MSA) for the Greenfield Neighborhood (GFN) Plan. The conceptual stormwater management plan will discuss key water resource issues and provide a planning-level approach to managing stormwater for the future developed neighborhood.

### 1.2 BACKGROUND

The GFN development area has multiple issues related to stormwater management with additional off-site drainage issues that would impact the neighborhood plan. Key issues include the following:

- The GFN land use includes an existing low-density, wooded neighborhood surrounded by agricultural fields and high-quality sedge wetlands.
- There are regulatory wetlands located in the GFN project area. They are primarily located around local streams with three mapped wetlands on the eastern side of the neighborhood (**Figure 1**). High quality wetlands are present downstream in the Swan Creek watershed, including the Waubesa Wetlands State Natural Area.
- Surface water runoff drains in three general directions. The runoff draining to the north will travel to an intermittent stream of Swan Creek. The runoff draining to the east will flow into a closed depression just outside the GFN project area. The runoff draining to the south will flow into Murphys Creek.
- Localized flooding has been an issue near Curry Court and Old Indian Trail. A study was completed by AE2S in 2021.
- Localized flooding has been an issue near the Syene/Irish intersection, with occurrences of stormwater over topping Syene Rd and flooding of homes.

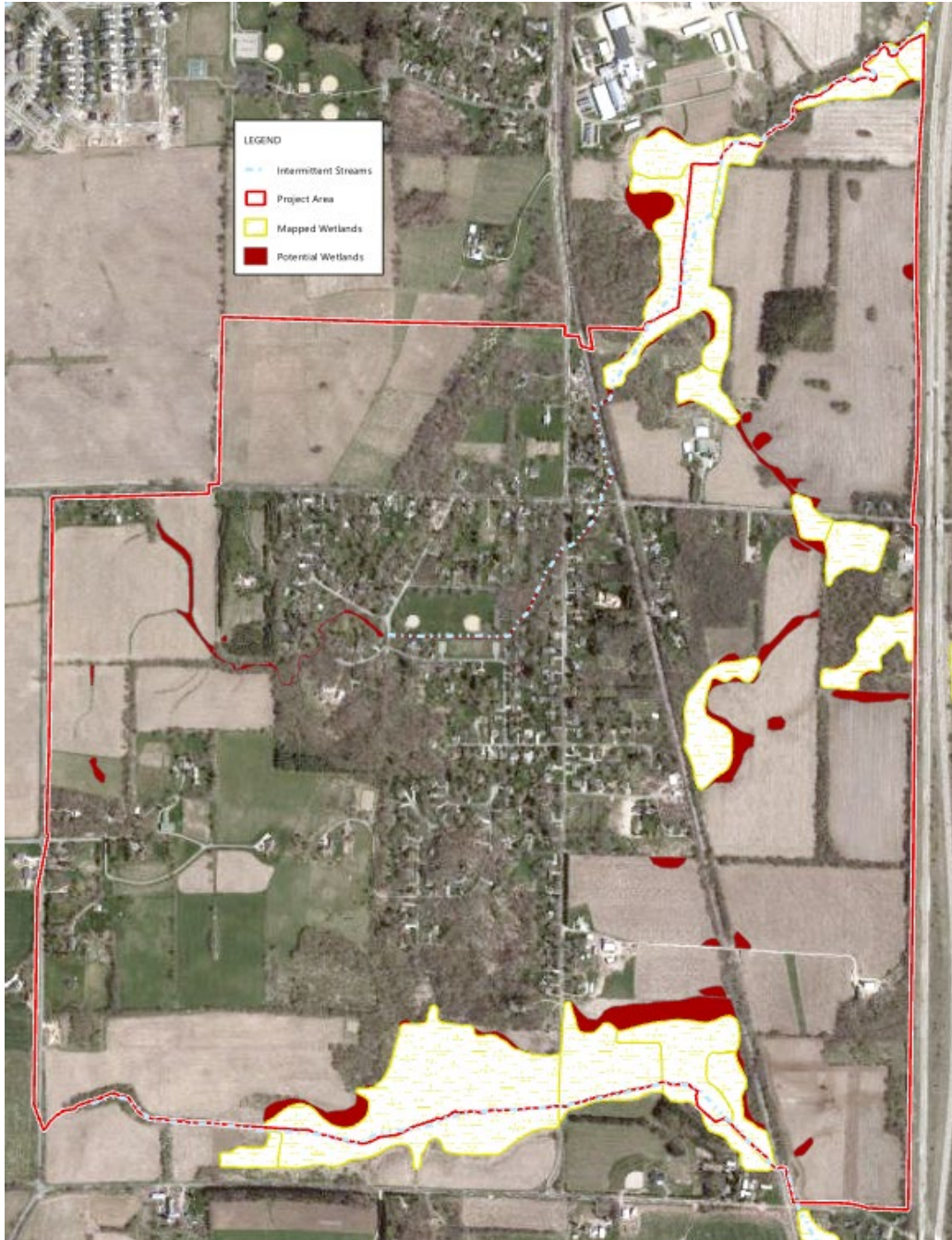


Figure 1. Greenfield Neighborhood Site Map

### 1.3 STORMWATER PERFORMANCE STANDARDS

The individual development parcels within the Greenfield Neighborhood will exceed the thresholds for stormwater management and erosion control permit applicability from both the City and the State. Therefore, the entire neighborhood will be subject to the criteria outlined in the City's ordinance and State's administrative code.

In addition to meeting these criteria on both the City and State level, in order to preserve the habitat function in Swan and Murphys Creek, Neighborhood-specific design objectives will also be necessary that go above and beyond the City’s and State’s standard ordinance criteria.

**1.3.1 SUMMARY OF STORMWATER PERFORMANCE CRITERIA**

Peak Discharge Control

- Control post-development peak discharge to pre-development rates for the 1-year and 2-year, 24-hour storm events (Wisconsin Administrative Code, Chapter NR 151).
- Control post-development peak discharge to pre-development rates for the 1-year, 2-year, 10-year, 100-year, and 200-year, 24-hour storm events (City of Fitchburg Ordinances, Section 30-28(b)(4), and Dane County Ordinance Ch. 14.12(2)(c)1.).
- The maximum runoff curve number in such calculations shall be those shown in Table 1.

**Table 1. Maximum Pre-Development Runoff Curve Numbers**

Pre-Development Land Use	Hydrologic Soil Group Curve Number			
	A	B	C	D
Woodland	30	55	70	77
Grassland	39	61	71	78
*Cropland	39	61	71	78

*\*Curve numbers equivalent to grassland use*

Volume Control

- Maintain 100% of the pre-development infiltration (stay-on) volume, with no caps on area required and no exemptions for roads or soil type, based on the 1981 annual rainfall series (City of Fitchburg Ordinances, Section 30-28(b)(6)a and NR 151).

Water Quality

- Retain 80% of Total Suspended Solids post-development compared to no controls (Section 30-28(b)(1)a of the City ordinance and NR 151).

Areas draining to Closed Depressions

- Establish a flood protection elevation in the closed depressions equivalent to standing water level that would result from back-to-back 100-year runoff events (Dane County Ordinances, 14.12(2)(g)3).
- Parts of the GFN will be added to the urban service area, so an amendment will need to be submitted to the Capitol Area Regional Planning Commission (CARPC) before development can occur. Typically, CARPC requires post-development runoff volume for the 1-year, 2-year, 10-year, 100-year, and 200-year, 24-hour storm event to be reduced to 90% of the pre-development runoff volumes.

**1.4 PROPOSED LAND USE**

This conceptual stormwater management plan was developed during the neighborhood planning process. Proposed land use will be a mix of lower density residential areas on the west side of the neighborhood and high-density residential/business park on the east side of the neighborhood. **Figure 2** shows the proposed development plan for the Greenfield Neighborhood.

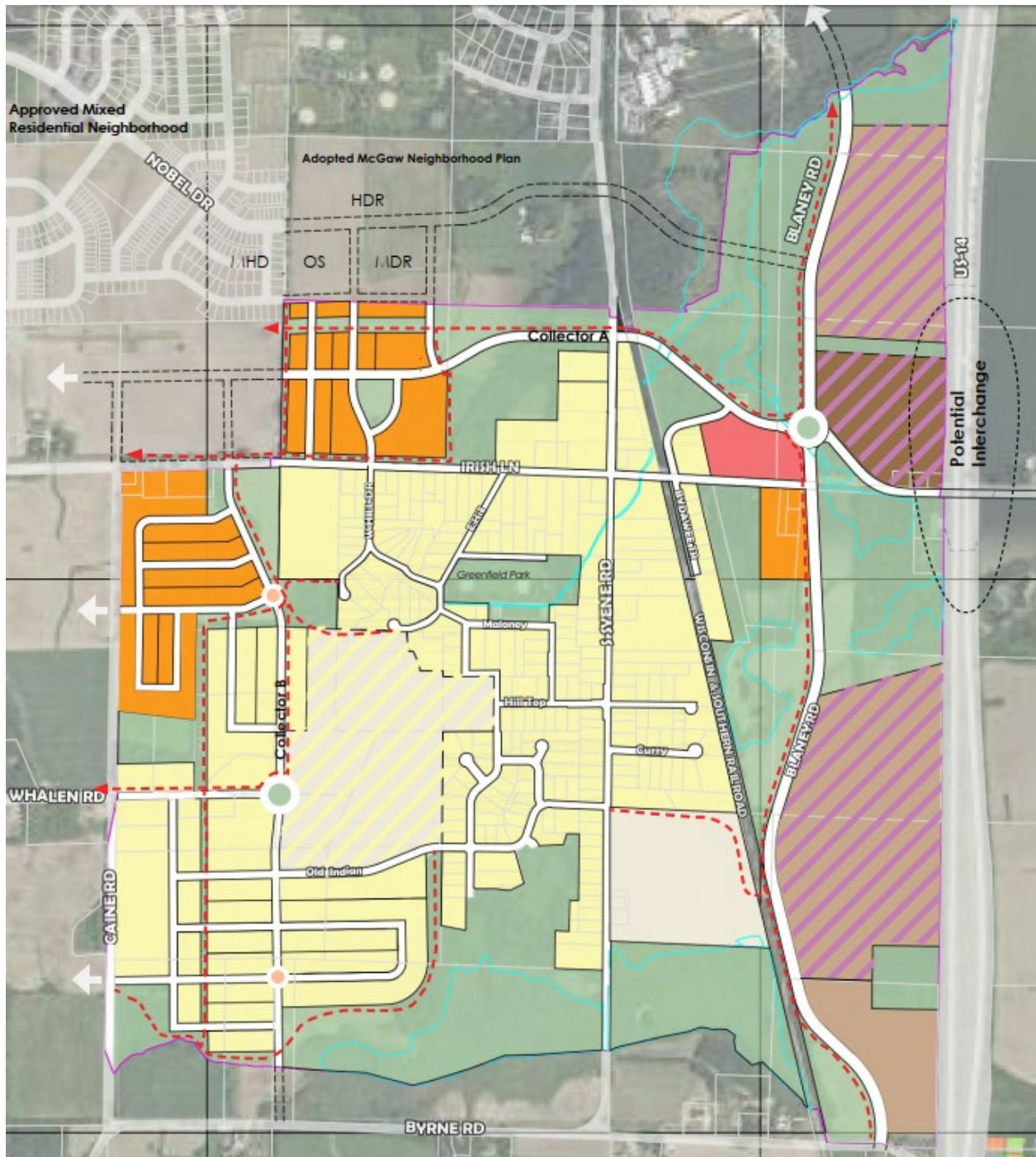


Figure 2. Greenfield Neighborhood Development Plan.

## CHAPTER 2 – METHODS

The performance of the conceptual stormwater management plan was analyzed with multiple models: HydroCAD (Peak Discharge and Runoff Volume), WinSLAMM (Water Quality and Post-Development Infiltration), and Dane County Target Stay-On (Pre-development Infiltration).

### 2.1 PEAK DISCHARGE

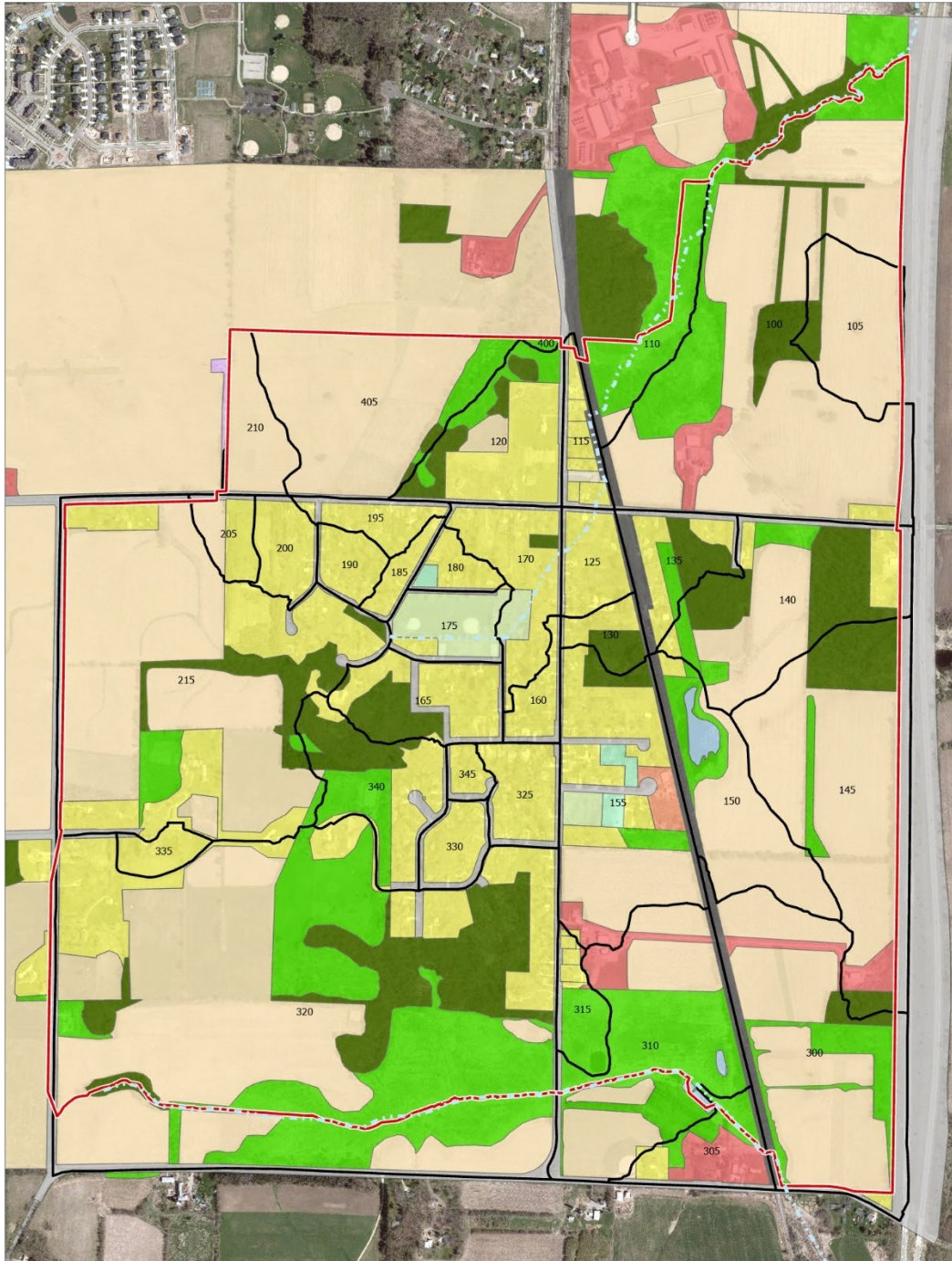
Stormwater peak discharge was evaluated using the HydroCAD-10 model for both pre- and post-development conditions. The model uses standard Soil Conservation Service (SCS) TR-20 runoff hydrograph and curve number procedures, and TR-55 Time of Concentration (Tc) calculations. As required by the ordinance, rainfall events were simulated with the 24-hour MSE4 distribution and rainfall depths from NOAA Atlas 14 (**Table 2**).

**Table 2. Dane County 24-hour Rainfall Depths**

Recurrence Interval	Rainfall Depth (inches)
1-year	2.49
2-year	2.84
10-year	4.09
100-year	6.66
200-year	7.53

For the purpose of peak discharge ordinance compliance, the pre-development condition was considered to be prior to the agricultural fields with the assumption that the land use is meadow. The neighborhood was divided into pre-development subwatersheds based on existing land surface topography (**Figure 3**). There are four primary discharge points for the neighborhood.

Pre-development runoff curve numbers were assigned based on pre-development land use, Hydrologic Soil Group, and the maximum allowable pre-development curve numbers shown **Table 1** above.



**Figure 3. Pre-Development Subwatersheds and Time of Concentration Flow Paths**

Post-development subwatersheds and curve numbers are based on the growth model developed during the GFN planning process (**Figure 4**). For proposed conditions modeling, runoff coefficients were assigned on a lot-by-lot basis assuming impervious areas based on planned land. Runoff Curve Numbers under existing and proposed conditions were completed using weighted average Runoff Curve Numbers based on land use classifications. Runoff Curve Numbers under proposed conditions were evaluated using separate subcatchments for directly

connected impervious areas and for pervious areas (this latter subcatchment also includes unconnected impervious areas). Below is a table of impervious areas by land use type and the percentage of impervious areas that are directly connected.

**Table 3. Impervious Areas by Land Use Type**

Land Use	Street	Driveway	Sidewalk	Roof	Open
HDR/BP	-	10%	10%	35%	45%
MHD	-	10%	7%	33%	50%
MDR	-	10%	3%	25%	62%
LDR	-	10%	3%	12%	75%
NMU	-	25%	10%	55%	10%
ROW (New)	40%	4%	6%	-	50%
ROW (Existing)	40%	-	-	-	60%

**Table 4. Portion of Impervious Areas that are Directly Connected**

Land Use	Street	Driveway	Sidewalk	Roof	WinSLAMM Standard Land Use Name
HDR/BP	N/A	100%	50%	50%	High Density Residential (No Alley)
MHD	N/A	100%	100%	30%	Duplex
MDR	N/A	74.67%	50%	30%	Medium Density Residential (No Alley)
LDR	N/A	71.11%	50%	30%	Low Density Residential
NMU	N/A	100%	50%	50%	-
BP	N/A	100%	50%	50%	-
ROW (New)	100%	100%	100%	N/A	-
ROW (Existing)	0%	N/A	N/A	N/A	-

The total percentage of impervious area within each lot was identified by MSA’s site planner, and the distribution of impervious areas by type were prorated accordingly from WinSLAMM standard land use classifications. Land uses that do not have a standard WinSLAMM land use classification was assumed to have 100% connected impervious for driveways/parking lots and 50% connected impervious for sidewalks and roofs.

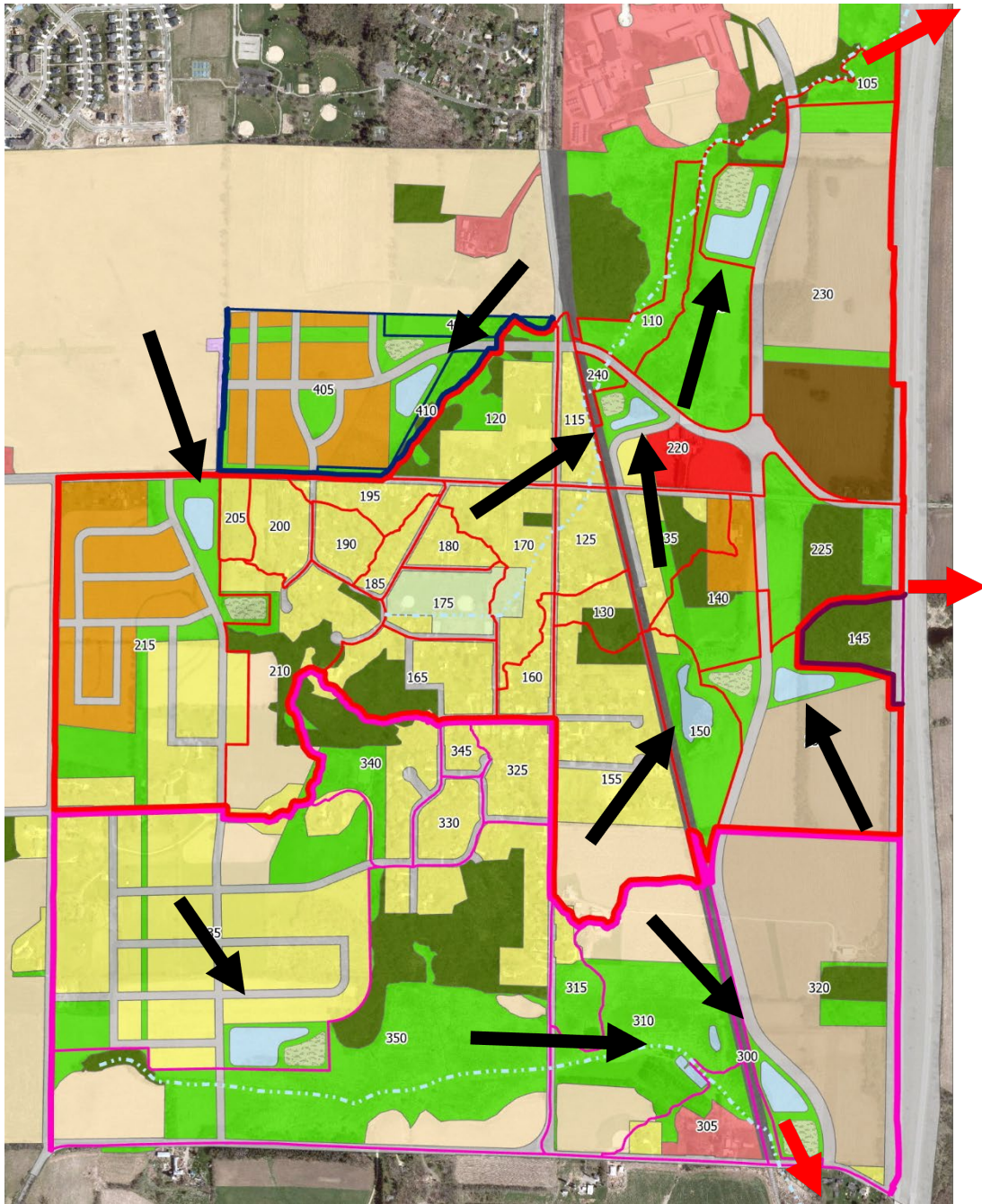


Figure 4. Post-Development Subwatersheds and Time of Concentration Flow Paths

## 2.2 VOLUME CONTROL

Stormwater volume control was evaluated based on individual events using the HydroCAD-10 model for both pre- and post-development conditions. The model uses standard Soil Conservation Service (SCS) TR-20 runoff hydrograph and curve number procedures, and TR-55 Time of Concentration ( $T_c$ ) calculations.

## 2.3 WATER QUALITY

Water quality performance of stormwater control practices was evaluated using the WinSLAMM model version 10.5. The model estimates pollutant loads using a database of monitoring results and performs runoff and hydraulic routing calculations for treatment practices. The model was run continuously using Madison rainfall for the period of March 12, 1981, through December 2, 1981, as specified in NR 151, which had a total rainfall depth of 28.81 inches.

The WinSLAMM standard high density residential (no alley), medium density residential (no alley), and low-density residential land use files were modified to match the impervious surface ratios for the GFN. **Table 3 and 4** summarize the connected and disconnected impervious surface ratios used in the WinSLAMM analysis.

## 2.4 INFILTRATION

Pre-development stay-on calculations were completed using the pre-development curve numbers. The infiltration calculations were done using two separate targets, 90% and 100% infiltration, since parts of the neighborhood drain to closed depressions and naturally drained watersheds. Dane County Stormwater Manual references a graph showing the 90% and 100% stay-on requirement based on the pre-development runoff curve number. Each target stay-on depth was multiplied by the area to get a total target stay-on volume for each watershed area.

Post-development infiltration performance was evaluated using the WinSLAMM model version 10.5. The model was run continuously using Madison rainfall for the period of March 12, 1981 through December 2, 1981, as specified in NR 151, which had a total rainfall depth of 28.81 inches.

## CHAPTER 3 – RESULTS

### 3.1 RUNOFF PEAK DISCHARGE AND VOLUME CONTROL

The stormwater management system controls peak discharge rates, at each location where discharge currently occurs, to levels less than existing conditions for events ranging from the 1-year, 24-hour storm to the 200-year, 24-hour storm. For the areas in the neighborhood draining to a closed depression, runoff volumes are also controlled to 10% below existing levels for the 1-year, 24-hour storm to the 200-year, 24-hour storm.

**Table 5. Peak Discharge Rates and Runoff Volumes Directed East**

Event (yr)	Existing		Proposed	
	Peak Flow (cfs)	Total Volume (ac-ft)	Peak Flow (cfs)	Total Volume (ac-ft)
1	0.80	1.00	0	0
2	1.36	1.66	0.02	0.01
10	4.12	4.40	0.17	0.17
100	8.07	6.46	3.96	3.84
200	9.01	6.90	5.70	4.83
Area (ac)	64.14		10.67	

**Table 6. Peak Discharge Rates Directed South**

Event (yr)	Existing	Proposed
	Peak Flow (cfs)	Peak Flow (cfs)
1	37.34	31.58
2	55.93	45.93
10	152.34	105.51
100	482.61	443.43
200	626.96	608.85
Area (ac)	395.66	419.14

**Table 7. Peak Discharge Rates Directed Northeast**

Event (yr)	Existing	Proposed
	Peak Flow (cfs)	Peak Flow (cfs)
1	55.74	52.13
2	74.39	66.16
10	170.34	123.49
100	476.86	409.49
200	655.74	650.86
Area (ac)	571.57	589.81

**Table 8. Peak Discharge Rates Directed North**

Event (yr)	Existing	Proposed
	Peak Flow (cfs)	Peak Flow (cfs)
1	1.51	1.46
2	3.36	2.33
10	15.73	7.45
100	58.56	27.19
200	75.98	61.81
Area (ac)	44.56	56.29

### 3.2 WATER QUALITY

The WinSLAMM simulations of post-development conditions indicate that the stormwater management practices will provide the required 80% Total Suspended Solids control for the four regional watersheds. The models include the existing developed areas, and the runoff contributions (but not TSS loads). **Table 9** summarizes the post-development total suspended solids reductions compared to no controls.

**Table 9. Post-Development Total Suspended Solids Reduction**

Watershed	TSS Load Without Controls (lbs)	TSS Load With Controls (lbs)	% TSS Reduction
East	865.3	0	100.0%
South	37,672	230.2	99.4%
Northeast	49,251	145.2	99.7%
North	9,034	17.63	99.8%

### 3.3 INFILTRATION

WinSLAMM modeling completed for this design indicates that the proposed stormwater management systems will achieve infiltration requirements for the east, west, and northwest draining watersheds. **Table 10, 11, 12, and 13** summarize the existing stay-on calculations. **Table 14** summarizes the proposed infiltration meets existing stay-on requirements.

**Table 10. East Watershed Existing Stay-On Calculations**

	Land Use	CN	100% Stay-On Target (in/yr)	Area	Target Stay-On Volume (ac-ft)
East	Open, HSG B	61	28.4	3.340	7.905
	Open, HSG C	71	27.3	4.446	10.115
	Woodland, HSG B	55	28.7	8.523	20.384
	Woodland, HSG C	70	27.5	1.705	3.907
	Agriculture, HSG B	58	28.6	22.418	53.430
	Agriculture, HSG C	71	27.3	19.467	44.287
	Impervious	98	8.1	4.237	2.860
				<b>26.73</b>	<b>64.136</b>

**Table 11. South Watershed Existing Stay-On Calculations**

	Land Use	CN	100% Stay-On Target (in/yr)	Area	Target Stay-On Volume (ac-ft)
South	Open, HSG B	61	28.4	162.156	383.769
	Open, HSG C	71	27.3	10.566	24.038
	Woodland, HSG B	55	28.7	32.956	78.820
	Woodland, HSG C	70	27.5	5.980	13.704
	Agriculture, HSG B	58	28.6	141.514	337.275
	Agriculture, HSG C	71	27.3	14.997	34.118
	Impervious	98	8.1	27.493	18.558
				<b>27.00</b>	<b>395.662</b>

**Table 12. Northeast Watershed Existing Stay-On Calculations**

	Land Use	CN	100% Stay-On Target (in/yr)	Area	Target Stay-On Volume (ac-ft)
Northeast	Open, HSG B	61	28.4	168.841	399.590
	Open, HSG C	71	27.3	47.361	107.746
	Woodland, HSG B	55	28.7	46.645	111.559
	Woodland, HSG C	70	27.5	7.009	16.062
	Agriculture, HSG B	58	28.6	199.609	475.735
	Agriculture, HSG C	71	27.3	36.119	82.171
	Impervious	98	8.1	65.982	44.538
				<b>25.98</b>	<b>571.566</b>

**Table 13. North Watershed Existing Stay-On Calculations**

	Land Use	CN	100% Stay-On Target (in/yr)	Area	Target Stay-On Volume (ac-ft)
North	Open, HSG B	61	28.4	4.802	11.365
	Woodland, HSG B	55	28.7	0.743	1.777
	Agriculture, HSG B	58	28.6	38.836	92.559
	Impervious	98	8.1	0.176	0.119
				<b>28.50</b>	<b>44.557</b>

**Table 14. Existing vs. Proposed Conditions Stay-On**

Watershed	Existing		Proposed		
	Area	Target Stay-On Volume (ac-ft)	Area	Stay-On Depth (in)	Stay-On Volume (ac-ft)
*East	64.14	142.89	10.67	28.81	25.62
South	395.66	890.28	419.14	26.73	933.63
Northeast	571.57	1,237.40	589.81	26.52	1,303.48
North	44.56	105.82	56.29	28.05	131.58

*\*100% stay-on for the proposed conditions. The proposed stay-on volume is less than the existing due to a smaller contributing area.*

### 3.4 SUMMARY OF STORMWATER MANAGEMENT SPACE NEEDS

**Table 15** summarizes each watershed’s impervious surface cover and space requirements for stormwater controls to meet the performance standards for the GFN, based on the stormwater analyses described above. The impervious area percentages are calculated for only the new development areas.

**Table 15. Stormwater Area Requirements by Watershed and Impervious Percentage**

Watershed	Impervious Percentage	Stormwater Management Area
East	7.5%	-
South	32.9%	4.4%
Northeast	40.7%	5.6%
North	27.4%	4.5%

## CHAPTER 4 – RECOMMENDATIONS & IMPROVEMENTS

### 4.1 STORMWATER MODELING RECOMMENDATIONS

- For new development in the neighborhood, design practices to maintain pre-development peak runoff rates for the 1, 2, 10, 100, and 200-year, 24-hour design storm. The maximum pre-development runoff curve number in such calculations shall be those shown in the table below.

Pre-Development Land Use	Hydrologic Soil Group Curve Number			
	A	B	C	D
Woodland	30	55	70	77
Grassland	39	61	71	78
*Cropland	30	58	71	78

*\*Curve numbers equivalent to meadow land use*

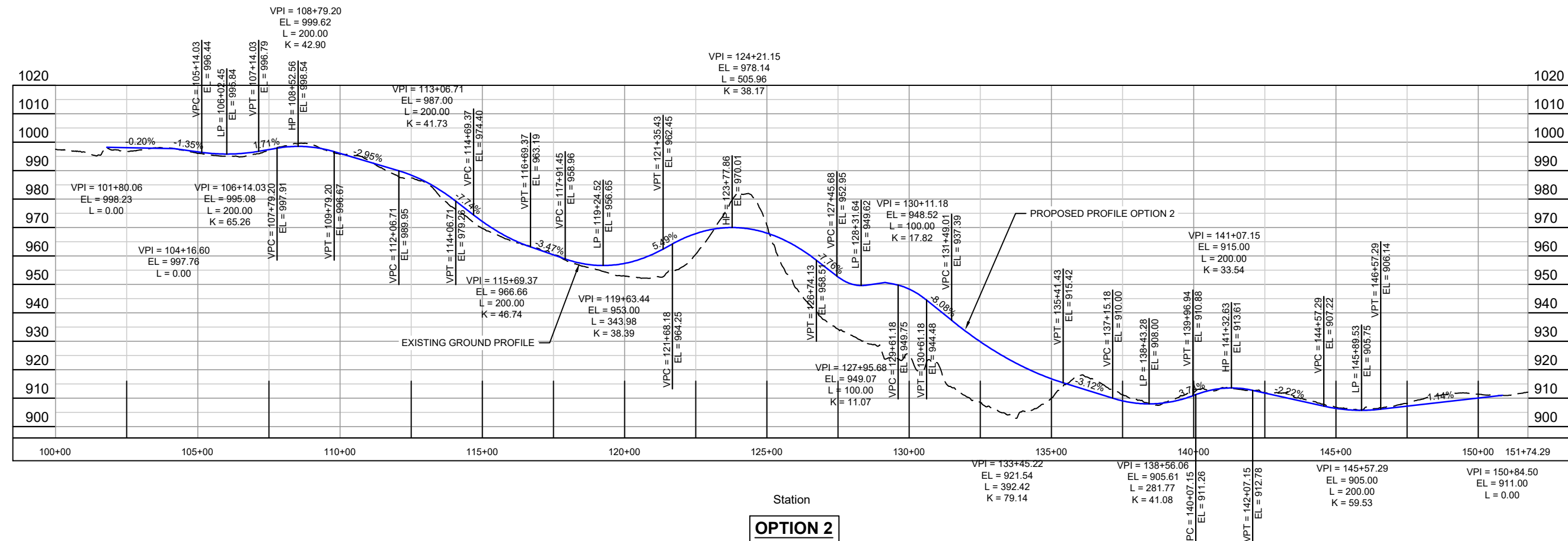
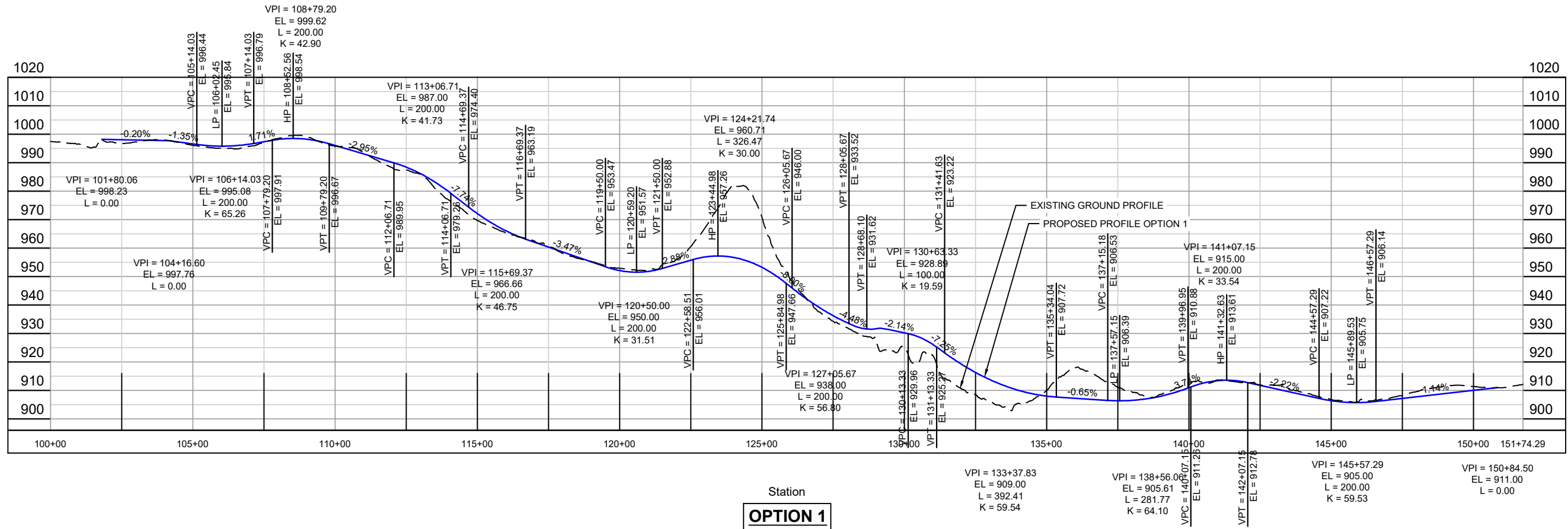
- Maintain 100% of pre-development infiltration volume, with no caps on area required and no exemptions for roads or soil type, based on the 1981 annual rainfall series.
- Impervious area percentages for proposed land use types shall not exceed the table below without changes in the stormwater management areas.

Land Use	Street	Driveway	Sidewalk	Roof	Open
ROW (New)	40%	4%	6%	-	50%
Low Density Residential	-	10%	3%	12%	75%
Medium Density Residential	-	10%	3%	25%	62%
Medium High Density Residential	-	10%	7%	33%	50%
High Density Residential / Business Park	-	10%	10%	35%	45%
Neighborhood Mixed Use	-	25%	10%	55%	10%

### 4.2 WATER RESOURCES RECOMMENDATIONS AND IMPROVEMENTS

- During the Blaney Road extension south of Irish Lane, it is recommended that the overflow elevation of the closed depression east of the railroad tracks be lowered. Improvements to the drainageway headed north shall also be considered. This was recommended as a potential alternative during the Curry Court and Old Indian Trail Study to help reduce flooding in the neighborhood. During the study it was determined that it was not a viable solution because the landowner was not willing to give the City a stormwater easement.
- Most of the development will occur at the edges of the neighborhood. Based on existing topography, it was assumed that the development will require seven stormwater practice locations, which include a pair system approach with a wet pond and infiltration basin. The stormwater practices could be designed to serve multiple developments depending on how each future developer purchases the land.

- All new culverts under roadways shall be designed to convey runoff from the 200-year, 24-hour storm event.
- Stormwater facilities should be integrated into the landscape and aesthetic design of open space to support the creation and restoration of natural landscape including restored/enhanced wetlands.
- A strategic effort should be made to restore the potentially restorable wetlands shown the Waubesa wetlands report (A Watershed Plan for Conserving Waubesa Wetlands by Joanne Kline). Potentially restorable wetlands located in proposed open space should be considered for restoration/enhancement to promote natural connectivity through proposed environmental corridors along with mitigating flooding to the neighborhood and improving water quality in Swan and Murphys Creek. It has been determined that there are five locations for potentially restorable wetlands.



PROJECT DATE:	DRAWN BY:	NO.	DATE	REVISION	BY:
12/3/2024 10:16 AM, G:\07\0729\0729051\CADD\C3D\Greenfield\Greenfield Design.dwg	Init				
	Init				
	Init				

**PRELIMINARY**

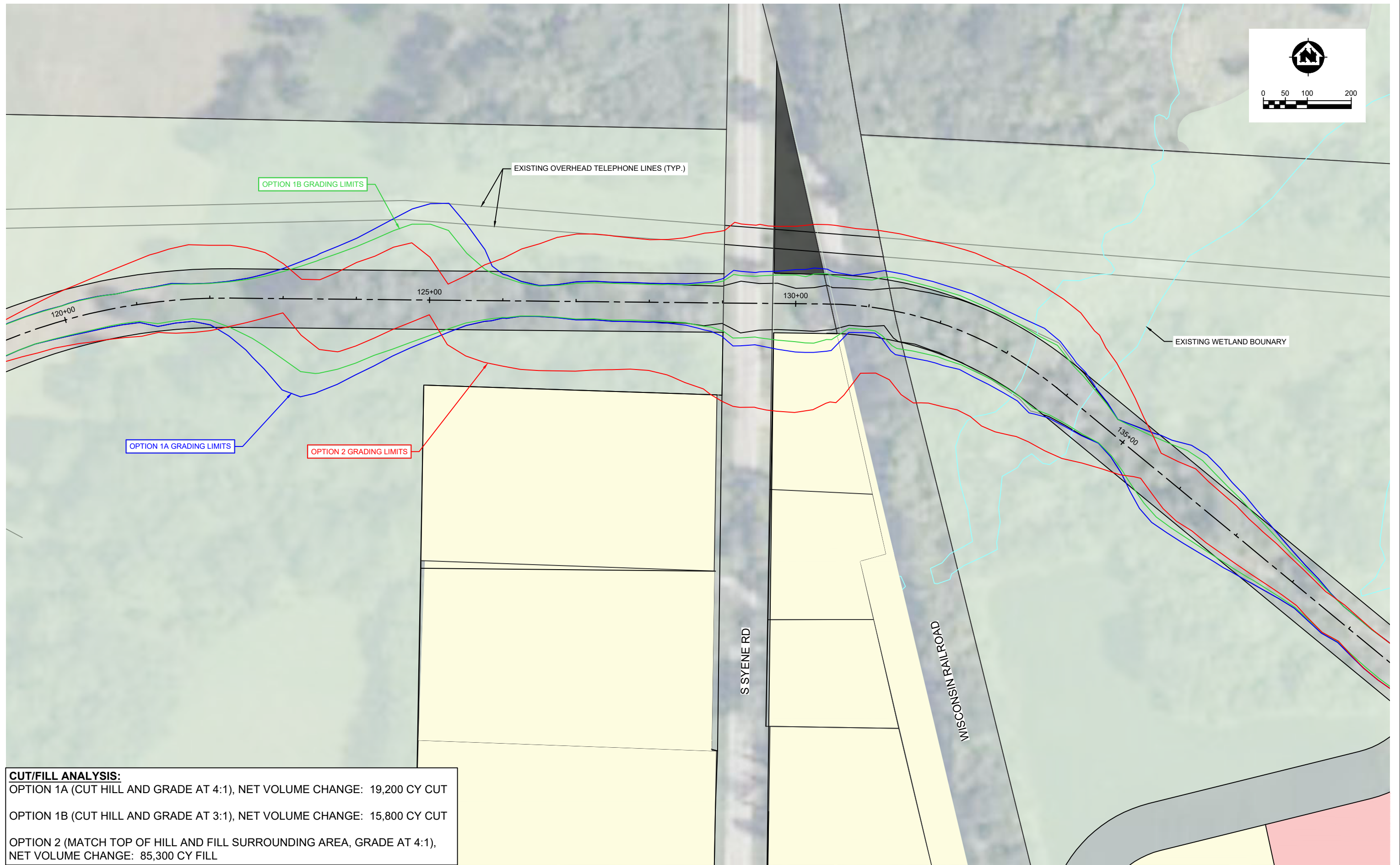
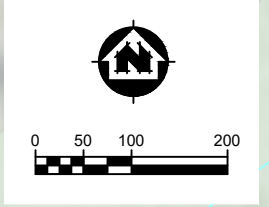


ENGINEERING | ARCHITECTURE | SURVEYING  
 FUNDING | PLANNING | ENVIRONMENTAL  
 1702 Pankratz St Madison, WI 53704  
 (608) 242-7779 www.msa-ps.com  
 © MSA Professional Services, Inc.

GREENFIELD NEIGHBORHOOD  
 CITY OF FITCHBURG  
 DANE COUNTY, WI

GREENFIELD HILL GRADING PROFILE OPTIONS

PROJECT NO.  
07729051  
 SHEET  
1



**CUT/FILL ANALYSIS:**  
 OPTION 1A (CUT HILL AND GRADE AT 4:1), NET VOLUME CHANGE: 19,200 CY CUT  
 OPTION 1B (CUT HILL AND GRADE AT 3:1), NET VOLUME CHANGE: 15,800 CY CUT  
 OPTION 2 (MATCH TOP OF HILL AND FILL SURROUNDING AREA, GRADE AT 4:1),  
 NET VOLUME CHANGE: 85,300 CY FILL

PROJECT DATE:	DRAWN BY:	NO.	DATE	REVISION	BY:
	Init	-	-		-
	Init	-	-		-
	Init	-	-		-

PLOT DATE: 12/3/2024 10:47 AM, G:\07\0729\0729051\CADD\C3D\Greenfield\Greenfield Design.dwg

**PRELIMINARY**

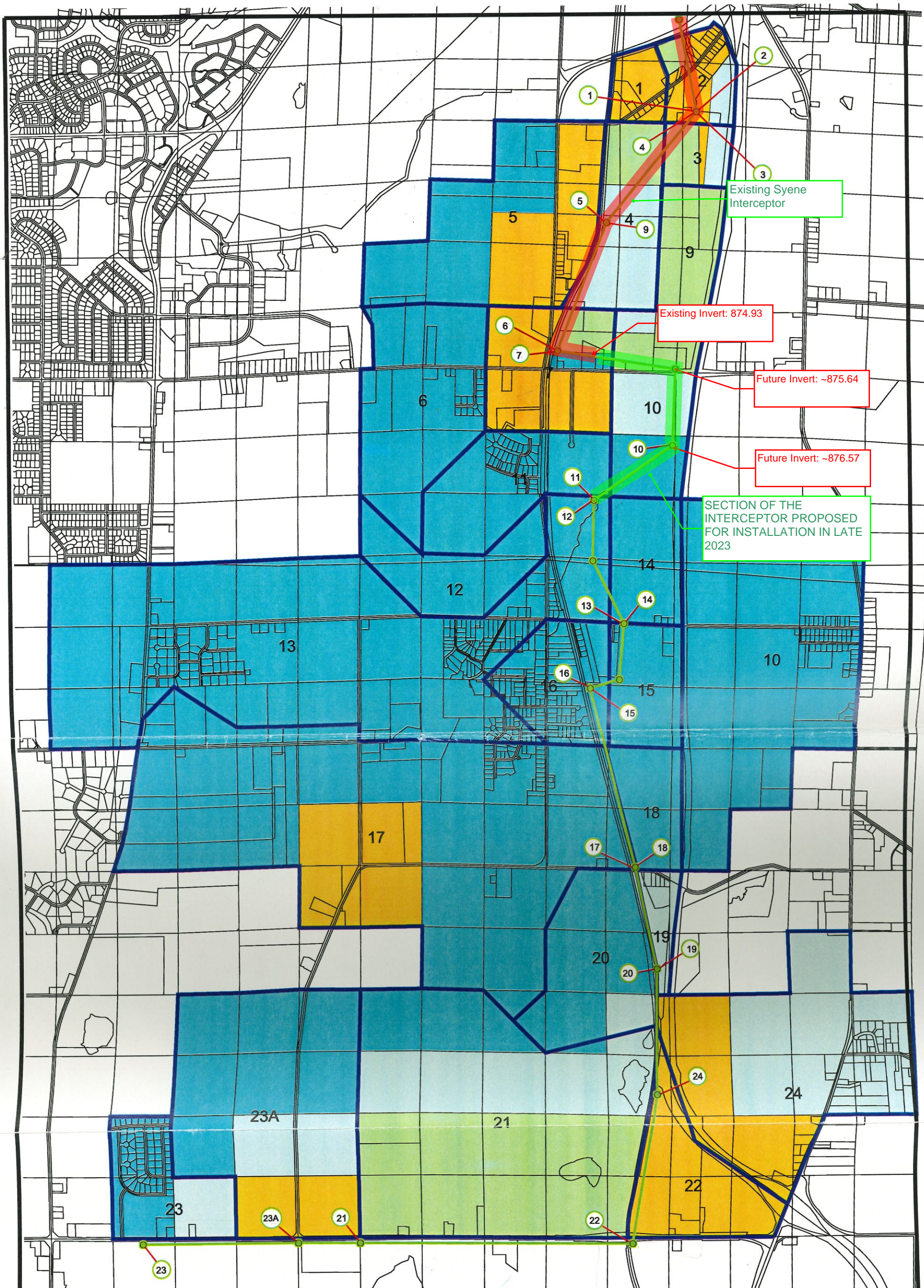


ENGINEERING | ARCHITECTURE | SURVEYING  
 FUNDING | PLANNING | ENVIRONMENTAL  
 1702 Pankratz St Madison, WI 53704  
 (608) 242-7779 www.msa-ps.com  
 © MSA Professional Services, Inc.

GREENFIELD NEIGHBORHOOD  
 CITY OF FITCHBURG  
 DANE COUNTY, WI

GREENFIELD HILL GRADING PLAN OPTIONS

PROJECT NO.  
07729051  
 SHEET  
2



Existing Syene Interceptor







Existing Invert: 874.93

Future Invert: ~875.64

Future Invert: ~876.57

SECTION OF THE INTERCEPTOR PROPOSED FOR INSTALLATION IN LATE 2023

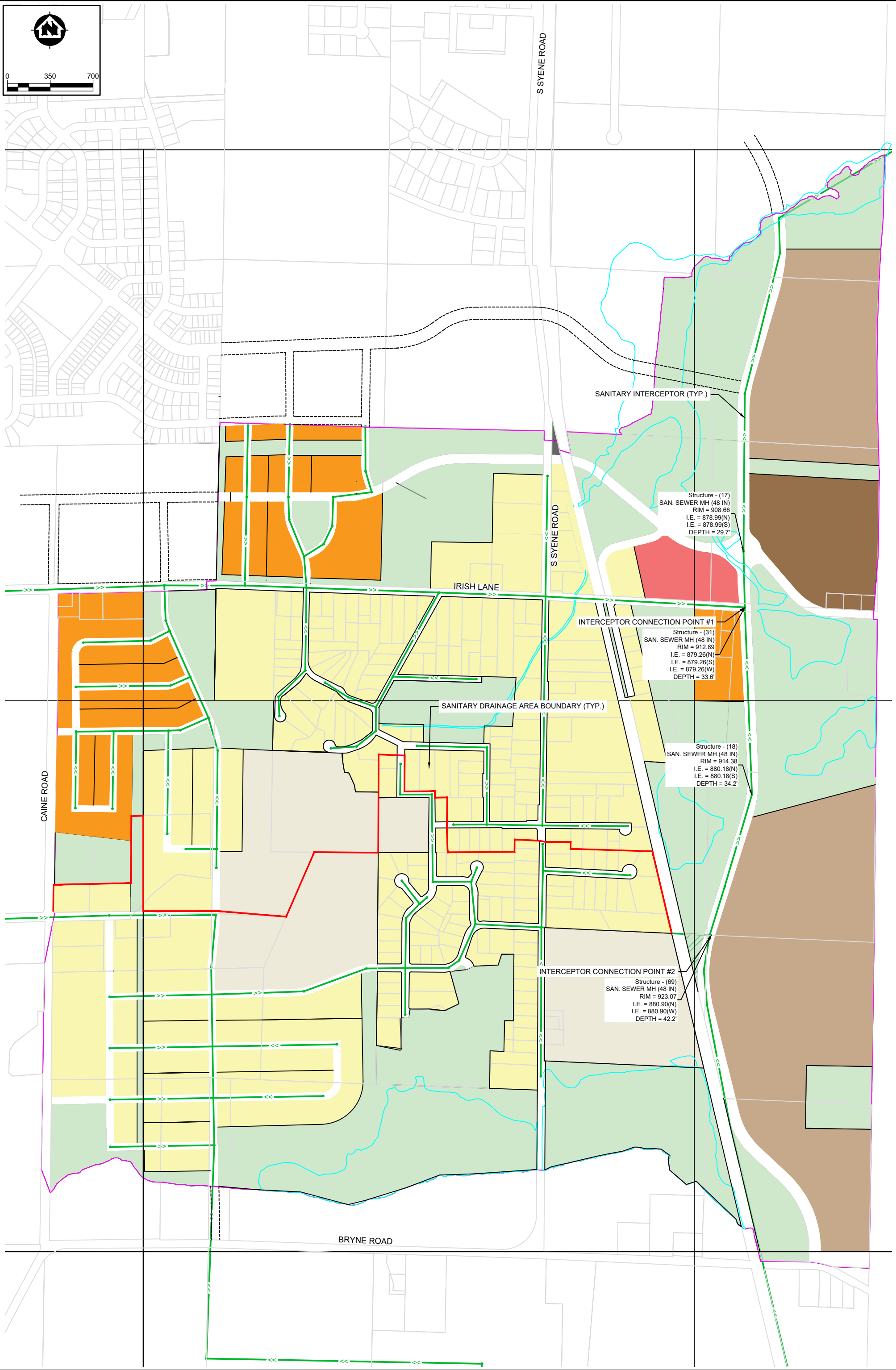
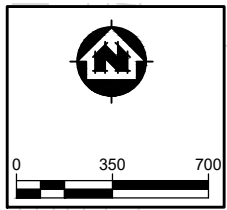
**Fitchburg Syene Interceptor**

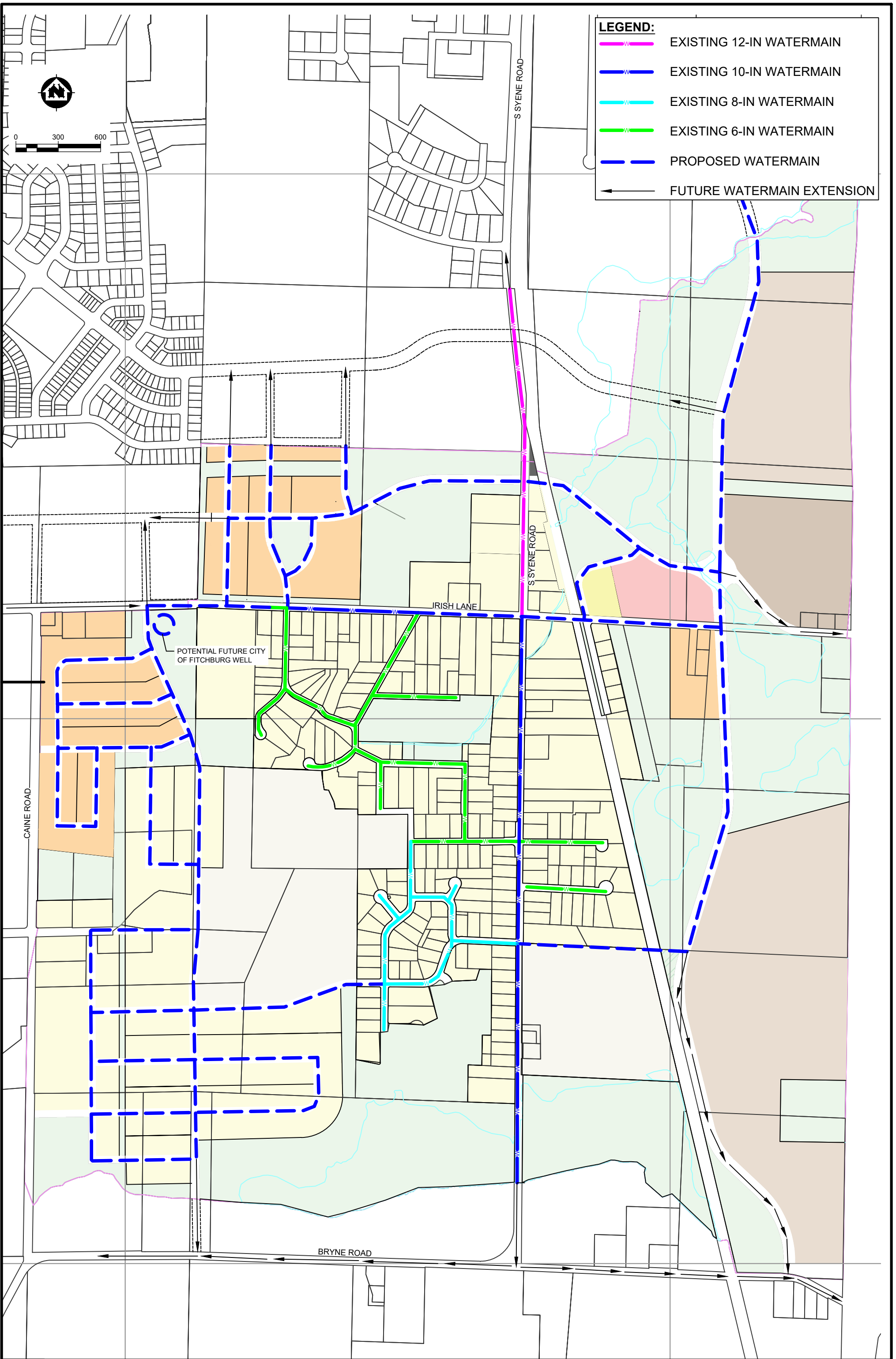
	Anticipated Land Use		Tributary Area
	HIGH DENSITY RESIDENTIAL		
	SIGNAL FAMILY RESIDENTIAL		
	INDUSTRIAL		
	COMMERCIAL/MEDIUM RESIDENTIAL		

2000 0 2000 4000 Feet



**FIGURE NO. 2.02-1**  
**SYENE INTERCEPTOR**  
**TRIBUTARY AREAS**  
**FITCHBURG, WISCONSIN**





**LEGEND:**

- EXISTING 12-IN WATERMAIN
- EXISTING 10-IN WATERMAIN
- EXISTING 8-IN WATERMAIN
- EXISTING 6-IN WATERMAIN
- - - PROPOSED WATERMAIN
- ← FUTURE WATERMAIN EXTENSION

POTENTIAL FUTURE CITY OF FITCHBURG WELL

CAINE ROAD

IRISH LANE

S SYENE ROAD

S SYENE ROAD

BRYNE ROAD

## Traffic Review

A high-level review of the significant intersections that are most likely to be impacted by the Greenfield Development was completed as part of the neighborhood plan. The study intersections were selected by the City and are listed below:

- Whalen Road & Caine Road (existing minor street stop-control)
- Irish Lane & Caine Road (existing minor street stop-control)
- Syene Rd & Collector A (proposed new intersection)

The review accounts for the impact the new development is expected to have on the study intersections and any recommended improvements that may be necessary to maintain acceptable operations at the study intersections. The proposed land use and development area is shown in Figure 1.

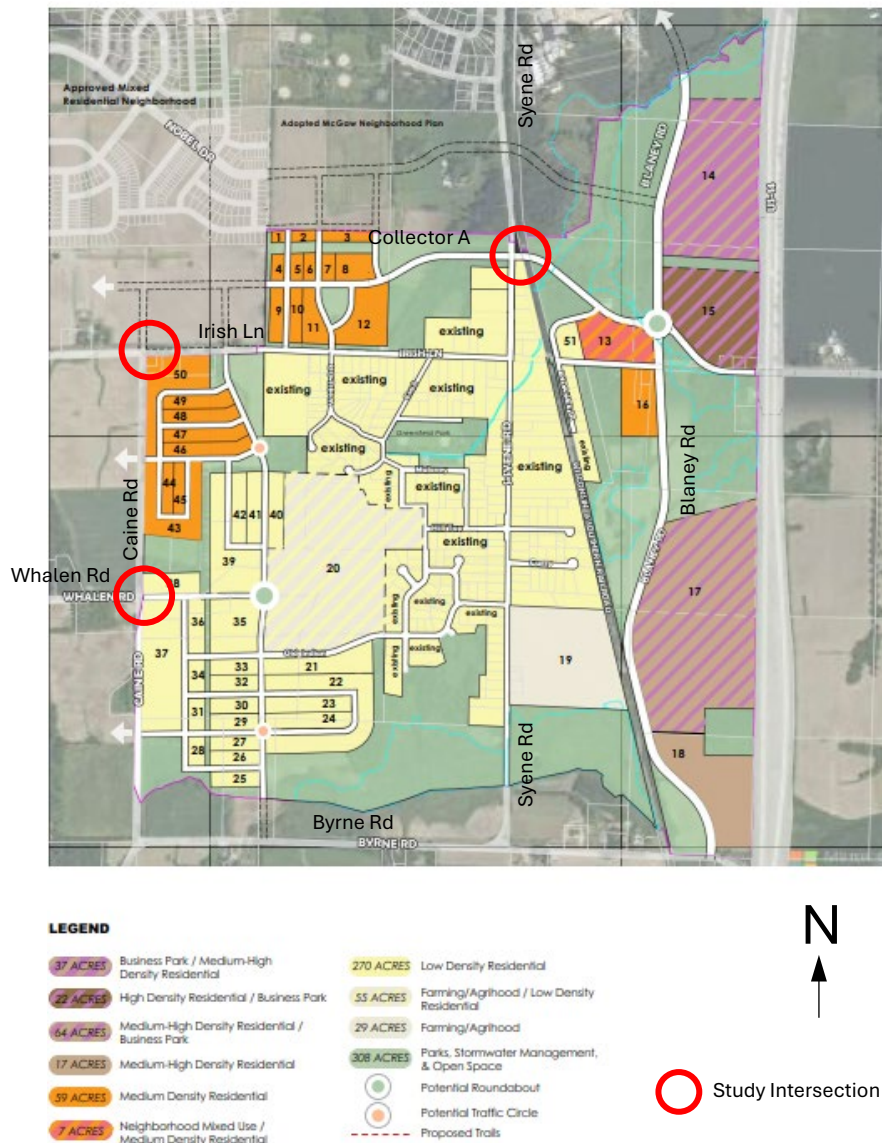


Figure 1: Greenfield Development Site Overview

The anticipated land use for the development was provided by the Greenfield Development land use plan. The number of dwelling units and building sizes for each of the development land uses were estimated based on lot acreage and land use density. Two potential development options were identified as part of the land use plan. The first assumes greater residential development lots 14, 15, and 17 near USH 14 and the second assumes a business park in lots 14, 15, and 17. The development limits include the area east of Caine Road, west of USH 14, north of Byrne Road, and south of Irish Lane. As shown in Figure 1, the new development proposes adding Blaney Road between Byrne Road and Lacy Road and adding several new collector roadways within the development. Full buildout of the development is expected to be completed by 2045.

#### *Existing & Proposed Transportation System*

The existing intersection at Caine Road & Whalen Road is minor street stop controlled on the east and west approaches with one lane on each approach. Both Caine Road and Whalen Road have a rural cross section without existing pedestrian or bike facilities present at the intersection.

The existing intersection at Irish Lane & Caine Road is a T-intersection with minor street stop control on the south approach. All three approaches with one lane on each approach. Both Irish Lane and Caine Road have a rural cross section without existing pedestrian or bike facilities present at the intersection.

As part of the proposed development, a new intersection on Syene Road approximately 1,110 feet north of the existing Irish Lane & Syene Road intersection would be created. Railroad tracks owned by Wisconsin & Southern Railroad are located approximately 135 feet east of the proposed intersection with Collector A. With the new proposed crossing, it is assumed the existing railroad crossing on Irish Lane would be eliminated; however, further coordination with Wisconsin & Southern Railroad and the Wisconsin Department of Transportation (WisDOT) Office of the Commissioner of Railroads would be required for the new railroad crossing on Collector A.

#### *Trip Generation*

Utilizing the *ITE Trip Generation Manual, 11th Edition*, trip generation rates were applied for the proposed land uses. In Option A, lots adjacent to USH 14 are assumed to be mid and high-density residential land use. Based on guidance from the City, 70% of the high density residential development were assumed to be mid-rise multi-family housing and 30% to be low-rise multi-family housing. The trip generation table for Option A is shown in [Exhibit 1](#).

In Option B, the lots adjacent to USH 14 are assumed to be either general office or manufacturing land use. The trip generation table for Option B is shown in [Exhibit 2](#). The calculated peak hour trips were assigned to the study intersections based on trip distribution percentages.

Analysis of development options A and B was also completed for a potential interchange on USH 14 near Irish Lane. Land use was assumed to remain the same for the interchange alternative, but the distribution of new trips were adjusted based on a change in routes with the new interchange. No adjustments to existing background traffic were made for the interchange alternative analysis.

One set of the overall (global) trip distribution percentages were estimated based on traffic data collected at area intersections, historical count data, and expected routing of land uses in the

proposed development. Adjustments were made based on engineering judgement of observed employment centers in the area and likely travel routes, given the significant residential component of the proposed development.

Local distributions at intersections are based on the engineering judgement of a combination of anticipated travel time within the new roadway network proposed in the development, and the location of the destination relative to the development's access points.

A future extension of Collector A to align with the north approach of Irish Lane and Caine Road is expected to be completed with the development and was considered while determining the distribution of the new trips. Traffic calming is expected to be introduced to Irish Lane between Caine Road and Syene Road in the future as development occurs and is expected to redirect a small amount of traffic from Irish Lane to the new Collector A roadway. For analysis purposes, it was assumed 35% of the new trips would use Collector A, and 25% would use Irish Lane based on the relocation of the railroad crossing from Irish Lane to Collector A, and the traffic calming on Irish Lane.

A summary of the expected distributions without the USH 14 interchange is listed below and shown in [Exhibit 3](#).

- 35% to/from the north on Syene Road
- 15% to/from the north on Blaney Road
- 15% to/from the east on Irish Lane
- 5% to/from the southeast on Byrne Road
- 5% to/from the southwest on Caine Road
- 10% to/from the west on Whalen Road
- 15% to/from the west on Irish Lane

With the addition of an interchange on USH 14, it is assumed that a majority of new traffic heading north and south would shift away from the local arterial and collectors and to USH 14. A summary of the expected distributions with a potential USH 14 interchange is listed below and shown in [Exhibit 4](#).

- 10% to/from the north on Syene Road
- 45% to/from the north on USH 14
- 20% to/from the south on USH 14
- 10% to/from the west on Whalen Road
- 15% to/from the west on Irish Lane

#### *Traffic Analysis and Improvements*

Weekday peak hour traffic counts (6:00 AM – 9:00 AM and 3:00 PM – 6:00 PM) were collected at major intersections near the study area in December of 2023. These intersections include Byrne Road & Caine Road, Caine Road & Irish Lane, and Irish Lane & Syene Road. The most recent average growth rate used by WisDOT for Dane County, which is 0.5%, was applied to the traffic counts to forecast volumes to the 2045 full build condition.

The study intersections were identified by the city after traffic data was collected; therefore, no traffic counts were collected at Caine Road & Whalen Road. An estimate of the existing traffic at the study

intersections was required to perform analysis and were estimated using the traffic counts from the nearby major intersections collected for this study. Given the lack of development west of the Whalen Road intersection, the existing turning movements to/from the west approach are expected to be relatively low and were assumed to be negligible. To estimate the impact of moving the railroad crossing from Irish Lane to Collector A, existing traffic turning to/from the east approach of the Irish Lane & Syene Road intersection was moved to the new intersection with Collector A & Syene Road.

Since the overall AM peak hour volumes are lower than the PM peak hour, only the PM peak period was included in the analysis. The analysis of the study intersections includes expected capacity, level of service, and queueing analysis.

A westbound right turn lane at the intersection of Irish Lane & Caine Road is recommended based on the results of a WisDOT turn lane warrant analysis. The turn lane warrant analyses account for the design speed of the roadway, percentage of turning vehicles, and the number of conflicting oncoming vehicles to provide guidance for turn lanes at an intersection. As additional future development occurs near the Greenfield Development, observed turning movements rise, or safety concerns develop, additional turn lanes may need be considered in the future. Left and right turn lanes are not expected to be warranted on Caine Road at Whalen Road based on the expected low turning volumes; therefore, turn lane warrants were not evaluated for the Caine Road & Whalen Road intersection.

*Capacity, Level of Service, and Queueing Analysis*

The operational and capacity analyses were completed using Synchro and HCS software and using *Highway Capacity Manual (HCM) 7<sup>th</sup> Edition* methodologies and WisDOT headway values, as specified in TEOpS 16-15-20.2.1. This type of analysis assigns a level of service (LOS) to each movement. LOS is a quantitative measure that refers to the overall quality of flow at an intersection ranging from very good, LOS “A,” to very poor, LOS “F”. The delay is measured in seconds per vehicle, which can be used to determine the level of service for the intersection. **Table 1** represents the delay criteria used for determining the LOS at an intersection.

*Table 1, Highway Capacity Manual Level of Service*

LOS	Unsignalized Average Control Delay (seconds/vehicle)	Signalized Average Control Delay (seconds/vehicle)	Delay Type
A “Very Good”	0 – 10	0-10	Short
B	>10 – 15	>10 – 20	
C	>15 – 25	>20-35	
D Improvement Threshold	>25 – 35	>35-55	Moderate
E	>35 – 50	>55-80	
F “Very Poor”	>50	>80	Long

---

Should delay or capacity fall below the improvement threshold (lower than LOS D), alternate traffic control changes may be considered as part of this study. Both Scenarios A & B were analyzed for both

the interchange and non-interchange alternatives. The results of the analysis at each of the study intersections are discussed below. Full operational analysis outputs can be viewed in [Appendix A](#).

#### Whalen Road & Caine Road

This intersection was analyzed with existing control and lane geometry. There is one shared lane on all approaches with stop control on the east and west approaches. Based on the results of the operational analysis, all approaches are expected to operate at or above LOS B for each of the Scenarios A & B, and with or without the interchange. Analysis results for both Scenarios A & B for the non-interchange and interchange alternatives are included in [Exhibit 5](#).

#### Irish Lane & Caine Road

It was assumed the north leg at the intersection was added with the development and the intersection was analyzed as a minor street stop control on the northbound and southbound approaches with one shared lane on the remaining approaches. Based on the results of the operational analysis, all approaches except for the northbound lane are expected to operate at or above LOS C for each of the Scenarios A & B, and with or without the interchange. The analysis shows the northbound lane operates at LOS F for each of the scenarios analyzed, which is below the improvement threshold (LOS D).

Potential improvements considered at this intersection were a traffic signal, roundabout, and adding turn lanes on Caine Road. As part of the analysis, traffic signal warrant analysis was completed including the expected traffic from the anticipated development and forecasted traffic counts. The Manual on Uniform Traffic Control Devices (MUTCD) specifies nine warrants used to justify the consideration of a traffic signal at an intersection. Based on the location of the intersections and surrounding land use, only Warrant 1 (eight-hour vehicular volume), Warrant 2 (four-hour vehicular volume), and Warrant 3 (peak hour volume) were evaluated. The remaining signal warrants were not intensively reviewed as part of the analysis as the existing roadway infrastructure and land use does not apply to the remaining warrants.

None of the volume warrants are expected to be met at this intersection, nor were any close to being met. An interim improvement measure that could be considered is the addition of a northbound left turn lane on Caine Road. The results of the analysis with the northbound left turn lane show the northbound through/right turn lane operates at LOS B and the northbound left turn lane is expected to operate at LOS E. The results of the queue analysis show adding the northbound left turn lane would decrease the reported 95<sup>th</sup> percentile queue length of the northbound approach from 175 feet to 75 feet for the northbound left turn lane. Analysis results for both Scenarios A & B for the non-interchange and interchange alternatives are included in [Exhibit 5](#).

#### Syene Rd & Collector A

Traffic signal warrants were not evaluated at this intersection as part of this analysis. However, based on the anticipated development volumes at this intersection, it is assumed traffic signal warrants would be met. Only a traffic signal and roundabout alternative will be included as part of the future planning review.

Based on the results of the traffic analysis, all approaches operate above LOS D for the traffic signal and roundabout scenarios for both development Scenarios A and B, and with or without the USH 14 interchange. Slight differences in the configuration of the approaches were utilized to achieve traffic analysis results of LOS D or better for each of the alternatives. Analysis results and lane configurations for the traffic signal and roundabout alternatives for both Scenarios A & B for each the non-interchange and interchange alternatives are included in [Exhibit 5](#).

## Recommendations

The recommended intersection alternatives for the study intersections are suggested to allow for safe and efficient operations to accommodate the new development, as well as identify intersections to monitor for additional improvements once future development traffic increases and/or further development occurs. Improvement recommendations for each of the three study intersections are summarized below.

### Whalen Road & Caine Road

Considering the analysis reports all movements at or above LOS B and no significant queueing is expected, no improvements are recommended based on the results of the traffic analysis. The existing minor street stop control on Whalen Road & Caine Road should remain. The City should continue to monitor the intersection and consider future improvements if dictated by safety or traffic operation issues as the development progresses and traffic increases at this intersection.

### Irish Lane & Caine Road

Typically, when traffic signal warrants are not met, it is not recommended to change the intersection control type to traffic signals or a roundabout. The installation of a traffic signals at intersections where warrants are not met could violate driver expectancy and increase crashes at the intersection, in addition to increasing delay along Irish Lane. Similarly, the number of crashes could increase if a roundabout is constructed where warrants have not been met. In the interim, the City should add one eastbound right turn lane and one northbound right turn lane. As development occurs, the City should continue to monitor the intersection and consider future analysis if dictated by safety or traffic operation issues as the development progresses and traffic increases at this intersection.

### Syene Rd & Collector A

As the area continues to develop, the results of the traffic analysis show that both a traffic signal and roundabout would operate acceptably. A roundabout typically can handle additional capacity and has greater safety benefits when compared to a signalized intersection. Based on the results of the analysis, potential intersection configurations for each development scenario and potential interchange alternative are shown in [Exhibit 6](#).

With the proximity of the railroad to the intersections, each the traffic signal and roundabout alternatives would require coordination with the railroad and special attention during design. The intersection should include any safety equipment at the crossing recommended by the railroad. The potential new railroad crossing on Collector A would cross through the turn lanes for the signalized alternative. If a roundabout is preferred, the City should reserve additional right of way at the

intersection to allow for a roundabout to be constructed in the future. Given the larger footprint of a roundabout and the proximity of the tracks, the alignment of the roundabout may need to shift slightly west to allow enough clearance to the new railroad crossing on Collector A. Further study would be required prior to design.

# Exhibit 1, Trip Generation Table Scenario A

Greenfield Development															
ITE Land Use	ITE Land Use Code	Parcel Acres	FAR Density	Size	Units		Weekday Two-way	AM Peak Hour			PM Peak Hour				
								Total	In	Out	Total	In	Out		
Single-Family Detached Housing	210	-	-	2669	Dwelling Units	Rate		0.00	0.00		0.00	0.00			
						Percentage		25%	75%		63%	37%			
						Raw Trips	20,709	1,480	370	1,110	2,180	1,375	805		
						Minus Linked Trips	0%	Trips	0	0	0	0	0		
						Driveway Trips	20,709	1,480	370	1,110	2,180	1,375	805		
						Minus Pass-by Trips	0%	Trips	0	0	0	0	0		
						New Trips	20,709	1,480	370	1,110	2,180	1,375	805		
Multi-Family Housing (Low-Rise)	220	-	-	508	Dwelling Units	Rate		0.00	0.00		0.00	0.00			
						Percentage		24%	76%		63%	37%			
						Raw Trips	3,330	180	45	135	240	150	90		
						Minus Linked Trips	0%	Trips	0	0	0	0	0		
						Driveway Trips	3,330	485	45	135	240	150	90		
						Minus Pass-by Trips	0%	Trips	0	0	0	0	0		
						New Trips	3,330	485	45	135	240	150	90		
Multi-Family Housing (Mid-Rise)	221	-	-	557	Dwelling Units	Rate		0.00	0.00		0.00	0.00			
						Percentage		23%	77%		61%	39%			
						Raw Trips	2,610	235	55	180	220	135	85		
						Minus Linked Trips	0%	Trips	0	0	0	0	0		
						Driveway Trips	2,610	235	55	180	220	135	85		
						Minus Pass-by Trips	0%	Trips	0	0	0	0	0		
						New Trips	2,610	235	55	180	220	135	85		
High-Turnover (Sit-Down) Restaurant	932	2.0	-	3.6	1,000 sf	Rate	107.20				9.05	5.52	3.53		
						Percentage						61%	39%		
						Raw Trips	385					35	20	15	
						Minus Linked Trips	20%	Trips	(75)	Not open during AM Peak of Adjacent Street			(5)	(5)	0
						Driveway Trips	310						30	15	15
						Minus Pass-by Trips	0%	Trips	0			0	0	0	
						New Trips	310					30	15	15	
Strip Retail Plaza (<40ksf)	822	2.0	-	16.5	1,000 sf	Rate	54.45	2.36	1.42	0.94		0.00	0.00		
						Percentage			60%	40%		50%	50%		
						Raw Trips	900	40	25	15	110	55	55		
						Minus Linked Trips	20%	Trips	(180)	(10)	(5)	(5)	(20)	(10)	(10)
						Driveway Trips	720	30	20	10	90	45	45		
						Minus Pass-by Trips	0%	Trips	0	0	0	0	0	0	
						New Trips	720	30	20	10	90	45	45		
Development Trip Generation Summary							Weekday Two-way	AM Peak Hour			PM Peak Hour				
							Raw Trip Generation	27,934	1,935	495	1,440	2,785	1,735	1,050	
							Linked Trips	(255)	(10)	(5)	(5)	(25)	(15)	(10)	
							Total Driveway Trips	27,679	1,925	490	1,435	2,760	1,720	1,040	
							Pass-by Trips	0	0	0	0	0	0	0	
							Total New Trips	27,679	1,925	490	1,435	2,760	1,720	1,040	

All land uses shown in this exhibit use trip generation rates from the *ITE Trip Generation Manual, 11<sup>th</sup> Edition*, unless otherwise noted  
 Fitted curve equation used when Total Rate is not shown  
 All trips rounded to the nearest 5

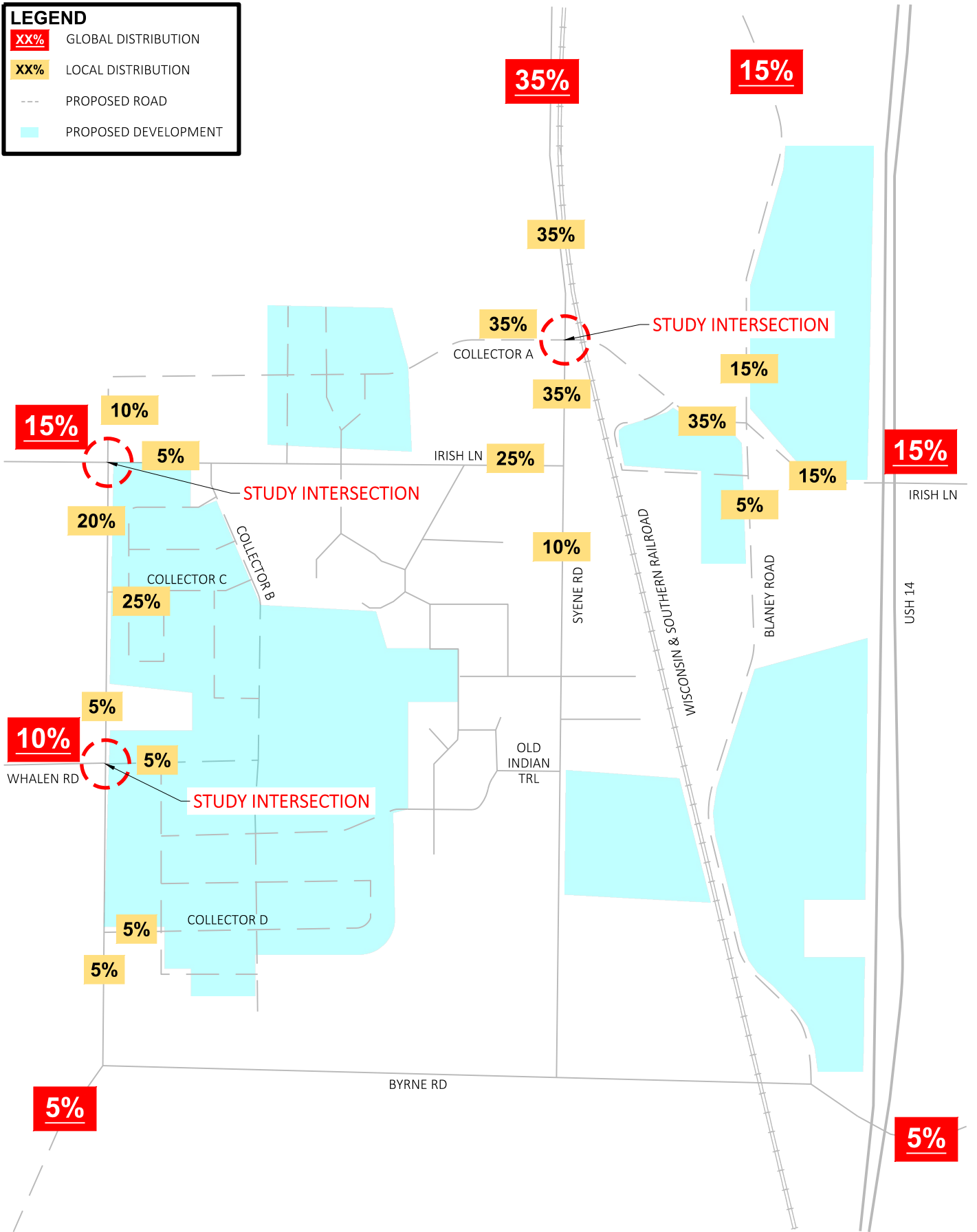
# Exhibit 1, Trip Generation Table Scenario B

Greenfield Development														
ITE Land Use	ITE Land Use Code	Parcel Acres	FAR Density	Size	Units		Weekday Two-way	AM Peak Hour			PM Peak Hour			
								Total	In	Out	Total	In	Out	
Single-Family Detached Housing	210	-	-	1213	Dwelling Units	Rate		0.00	0.00		0.00	0.00		
						Percentage		25%	75%		63%	37%		
						Raw Trips	10,025	720	180	540	1,040	655	385	
						Minus Linked Trips	0%	0	0	0	0	0	0	
						Driveway Trips	10,025	720	180	540	1,040	655	385	
						Minus Pass-by Trips	0%	0	0	0	0	0	0	
						New Trips	10,025	720	180	540	1,040	655	385	
Multi-Family Housing (Low-Rise)	220	-	-	316	Dwelling Units	Rate		0.00	0.00		0.00	0.00		
						Percentage		24%	76%		63%	37%		
						Raw Trips	2,100	120	30	90	155	100	55	
						Minus Linked Trips	0%	0	0	0	0	0	0	
						Driveway Trips	2,100	485	30	90	155	100	55	
						Minus Pass-by Trips	0%	0	0	0	0	0	0	
						New Trips	2,100	485	30	90	155	100	55	
High-Turnover (Sit-Down) Restaurant	932	2.0	-	3.6	1,000 sf	Rate	107.20				9.05	5.52	3.53	
						Percentage						61%	39%	
						Raw Trips	385				35	20	15	
						Minus Linked Trips	20%	(75)			(5)	(5)	0	
						Driveway Trips	310				30	15	15	
						Minus Pass-by Trips	0%	0			0	0	0	
						New Trips	310				30	15	15	
Strip Retail Plaza (<40ksf)	822	2.0	-	16.5	1,000 sf	Rate	54.45	2.36	1.42	0.94		0.00	0.00	
						Percentage			60%	40%		50%	50%	
						Raw Trips	900	40	25	15	110	55	55	
						Minus Linked Trips	20%	(180)	(10)	(5)	(5)	(20)	(10)	(10)
						Driveway Trips	720	30	20	10	90	45	45	
						Minus Pass-by Trips	0%	0	0	0	0	0	0	
						New Trips	720	30	20	10	90	45	45	
General Office Building	710	37.2	0.24	388.9	1,000 sf	Rate		0.00	0.00		0.00	0.00		
						Percentage		88%	12%		17%	83%		
						Raw Trips	3,780	540	475	65	515	90	425	
						Minus Linked Trips	0%	0	0	0	0	0	0	
						Driveway Trips	3,780	540	475	65	225	90	425	
						Minus Pass-by Trips	0%	0	0	0	0	0	0	
						New Trips	3,780	540	475	65	225	90	425	
Manufacturing	140	63.9	0.24	668.0	1,000 sf	Rate		0.00	0.00		0.00	0.00		
						Percentage		76%	24%		31%	69%		
						Raw Trips	2,720	415	315	100	565	175	390	
						Minus Linked Trips	0%	0	0	0	0	0	0	
						Driveway Trips	2,720	415	315	100	565	175	390	
						Minus Pass-by Trips	0%	0	0	0	0	0	0	
						New Trips	2,720	415	315	100	565	175	390	
General Office Building	710	22.1	0.24	231.0	1,000 sf	Rate		0.00	0.00		0.00	0.00		
						Percentage		88%	12%		17%	83%		
						Raw Trips	2,405	345	305	40	335	60	275	
						Minus Linked Trips	0%	0	0	0	0	0	0	
						Driveway Trips	2,405	345	305	40	335	60	275	
						Minus Pass-by Trips	0%	0	0	0	0	0	0	
						New Trips	2,405	345	305	40	335	60	275	
Development Trip Generation Summary							Weekday Two-way	Total	AM Peak Hour		Total	PM Peak Hour		
							Raw Trip Generation	22,315	2,180	1,330	850	2,755	1,155	1,600
							Linked Trips	(255)	(10)	(5)	(5)	(25)	(15)	(10)
							Total Driveway Trips	22,060	2,170	1,325	845	2,730	1,140	1,590
							Pass-by Trips	0	0	0	0	0	0	0
							Total New Trips	22,060	2,170	1,325	845	2,730	1,140	1,590

All land uses shown in this exhibit use trip generation rates from the *ITE Trip Generation Manual, 11<sup>th</sup> Edition*, unless otherwise noted  
 Fitted curve equation used when Total Rate is not shown  
 All trips rounded to the nearest 5

**LEGEND**

- XX% GLOBAL DISTRIBUTION
- XX% LOCAL DISTRIBUTION
- PROPOSED ROAD
- PROPOSED DEVELOPMENT



**LEGEND**

- XX% GLOBAL DISTRIBUTION
- XX% LOCAL DISTRIBUTION
- PROPOSED ROAD
- PROPOSED DEVELOPMENT

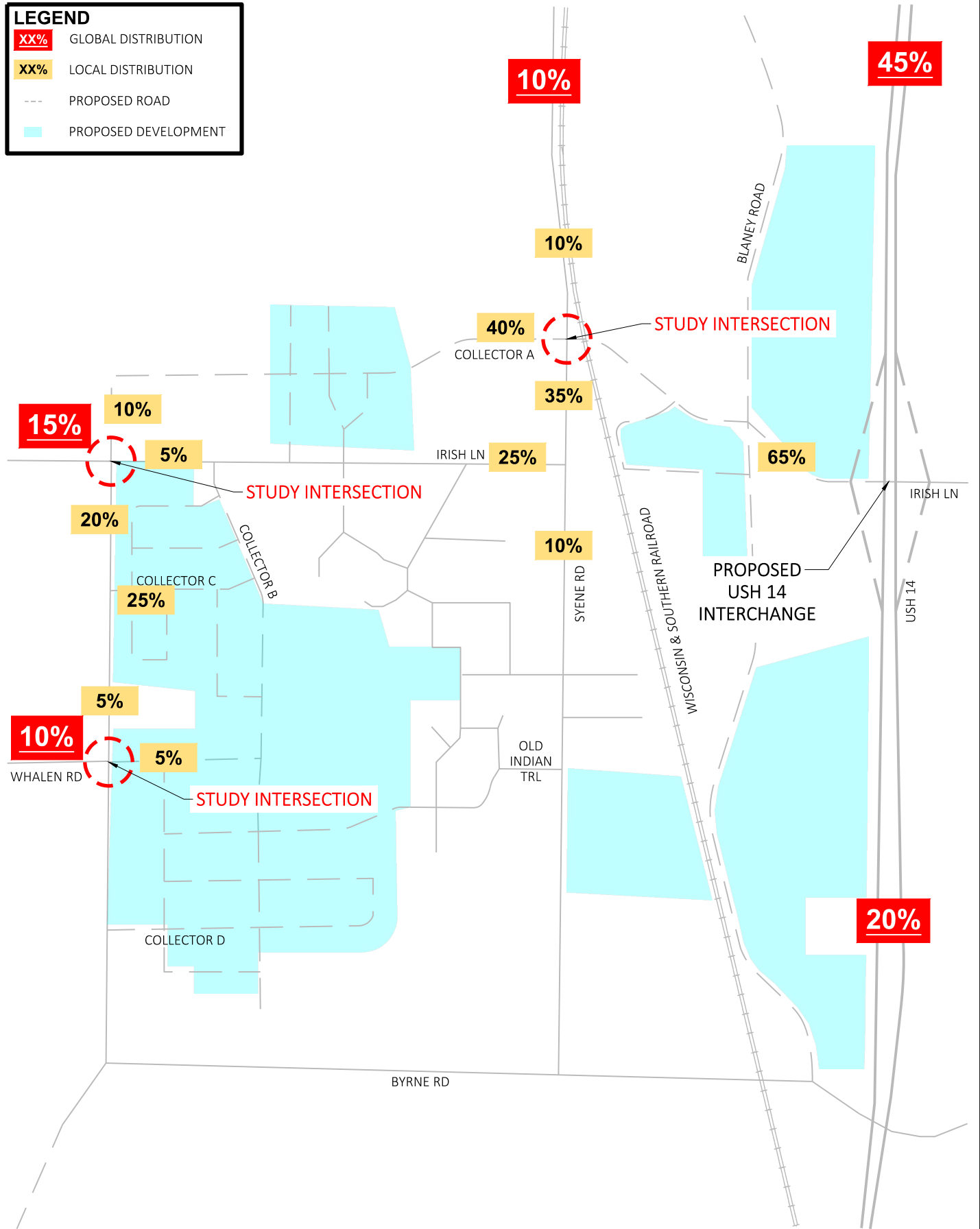




EXHIBIT  
4

**Exhibit 4 - Trip Distribution Percentage With Interchange**  
GREENFIELD NEIGHBORHOOD PLAN  
FITCBURG, WI DANE COUNTY


**Exhibit 5, 2045 Scenario A No-Interchange Alternative  
Build Traffic Capacity/LOS Analysis  
Improved Transportation System**


Node 100	Whalen Rd & Caine Rd							Control TWSC	Operations HCM 7th Ed
Peak	Approach	● EB →		● WB ←		NB ↑		SB ↓	
		All		All		All		All	
	# of Lanes	1		1		1		1	
	Storage (ft)	---		---		---		---	
PM	LOS	B		B		A		A	
	Delay (s)	11.3		10.2		7.4		7.3	
	v/c	0.28		0.08		0.01		0.00	
	Queue (ft)	25		25		25		25	

● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 200	Irish Ln & Caine Rd							Control TWSC	Operations HCM 7th Ed
Peak	Approach	EB →		WB ←		● NB ↑		● SB ↓	
		L/T	R	All		L	T/R	All	
	# of Lanes	1	1	1				1	
	Storage (ft)	---	250	---		250	---	---	
PM	LOS	A	A	A		E	B	C	
	Delay (s)	7.6	-	8.3		42.0	14.2	23.9	
	v/c	0.00		0.01		0.59	0.25	0.52	
	Queue (ft)	25		25		75	25	75	

- Operations not calculated for movements with no vehicular conflict  
● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 300	Collector A & Syene Rd							Control Signal	Operations HCM 7th Ed			
Peak	Approach	EB →		WB ←		NB ↑			SB ↓			
		L	T/R		L	T/R	L	T	R	L	T	R
	# of Lanes	1	1		1	1	1	1	1	1	1	1
	Storage (ft)	200	---		200	---	200	---	200	200	---	200
PM	LOS	B	B		B	C	C	B	B	B	C	B
	Delay (s)	13.8	18.9		13.3	28.9	23.6	16.3	15.0	18.8	25.8	15.4
	v/c	0.48	0.54		0.53	0.86	0.01	0.51	0.33	0.06	0.84	0.38
	Queue (ft)	50	125		100	300	25	150	75	25	300	100

Node 300	Collector A & Syene Rd							Control Roundabout	Operations HCM 7th Ed
Peak	Approach	EB →		WB ←		NB ↑		SB ↓	
		All		All		L/T	R YBP	L/T	R YBP
	# of Lanes	1		1		1	1	1	1
	Storage (ft)	---		---		---	---	---	---
PM	LOS	C		D		A	A	C	A
	Delay (s)	19.1		32.5		7.4	4.5	23.3	6.0
	v/c	0.65		0.89		0.32	0.20	0.74	0.27
	Queue (ft)	125		300		25	25	175	25

R YBP: Right-turn yielding bypass

**Color Legend**

- LOS F, at/over-capacity condition, or storage at/exceeding capacity
- LOS E
- v/c or queue storage close to capacity
- Thru movement queue likely restricting access to adjacent lane

**Exhibit 5, 2045 Scenario A Interchange Alternative  
Build Traffic Capacity/LOS Analysis  
Improved Transportation System**

Node 100	Whalen Rd & Caine Rd									Control TWSC	Operations HCM 7th Ed	
Peak	Approach	● EB →			● WB ←			NB ↑		SB ↓		
		All			All			All		All		
	# of Lanes	1			1			1		1		
	Storage (ft)	---			---			---		---		
PM	LOS	B			B			A		A		
	Delay (s)	11.3			10.2			7.4		7.3		
	v/c	0.28			0.08			0.01		0.00		
	Queue (ft)	25			25			25		25		

● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 200	Irish Ln & Caine Rd								Control TWSC	Operations HCM 7th Ed	
Peak	Approach	EB →		WB ←			● NB ↑		● SB ↓		
		L/T	R	All			L	T/R	All		
	# of Lanes	1	1	1					1		
	Storage (ft)	---	250	---			250	---	---		
PM	LOS	A	A	A			E	B	C		
	Delay (s)	7.6	-	8.3			42.0	14.2	23.9		
	v/c	0.00		0.01			0.59	0.25	0.52		
	Queue (ft)	25		25			75	25	75		

- Operations not calculated for movements with no vehicular conflict  
● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 300	Collector A & Syene Rd											Control Signal	Operations HCM 7th Ed
Peak	Approach	EB →			WB ←			NB ↑			SB ↓		
		L	T	T/R	L	T	T/R	L	T	R	L	T	R
	# of Lanes	1	1	1	2	1	1	1	1	1	1	1	1
	Storage (ft)	200	---	---	250	---	---	200	---	200	200	---	200
PM	LOS	C	C	C	C	B	B	B	B	B	B	B	B
	Delay (s)	28.0	23.5	23.4	24.2	17.1	17.0	17.5	15.2	18.4	16.2	16.1	14.8
	v/c	0.50	0.61	0.61	0.80	0.62	0.62	0.00	0.20	0.61	0.05	0.36	0.13
	Queue (ft)	50	125	125	150	200	200	25	50	150	25	100	25


Node 300	Collector A & Syene Rd									Control Roundabout	Operations HCM 7th Ed	
Peak	Approach	EB →			WB ←			NB ↑		SB ↓		
		All			L	All	L/T		R YBP	L	T/R	
	# of Lanes	1			1	1	1		1	1	1	1
	Storage (ft)	---			---	---	---		---	---	---	---
PM	LOS	D			A	B	A		A	B	D	
	Delay (s)	25.9			8.5	11.1	5.4		7.4	10.1	26.8	
	v/c	0.76			0.49	0.63	0.12		0.39	0.04	0.66	
	Queue (ft)	175			25	125	25		50	25	125	

R YBP: Right-turn yielding bypass


**Color Legend**

- LOS F, at/over-capacity condition, or storage at/exceeding capacity
- LOS E
- v/c or queue storage close to capacity
- Thru movement queue likely restricting access to adjacent lane


**Exhibit 5, 2045 Scenario B No-Interchange Alternative  
Build Traffic Capacity/LOS Analysis  
Improved Transportation System**


Node 100	Whalen Rd & Caine Rd							Control TWSC	Operations HCM 7th Ed
Peak	Approach	● EB →		● WB ←		NB ↑		SB ↓	
		All		All		All		All	
	# of Lanes	1		1		1		1	
	Storage (ft)	---		---		---		---	
PM	LOS	B		B		A		A	
	Delay (s)	10.9		10.7		7.5		7.3	
	v/c	0.20		0.13		0.01		0.00	
	Queue (ft)	25		25		25		25	

● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 200	Irish Ln & Caine Rd							Control TWSC	Operations HCM 7th Ed
Peak	Approach	EB →		WB ←		● NB ↑		● SB ↓	
		L/T	R	All		L	T/R	All	
	# of Lanes	1	1	1				1	
	Storage (ft)	---	250	---		250	---	---	
PM	LOS	A	A	A		D	C	C	
	Delay (s)	7.6	-	8.0		30.3	16.0	17.3	
	v/c	0.00		0.01		0.59	0.37	0.32	
	Queue (ft)	25		25		100	50	25	





- Operations not calculated for movements with no vehicular conflict  
● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 300	Collector A & Syene Rd							Control Signal	Operations HCM 7th Ed			
Peak	Approach	EB →		WB ←		NB ↑			SB ↓			
		L	T/R		L	T/R	L	T	R	L	T	R
	# of Lanes	1	1		1	1	1	1	1	1	1	1
	Storage (ft)	200	---		200	---	200	---	200	200	---	200
PM	LOS	B	C		B	C	B	B	B	C	B	B
	Delay (s)	13.8	20.2		12.8	26.4	18.7	18.1	15.0	20.7	16.3	13.6
	v/c	0.58	0.73		0.46	0.81	0.00	0.72	0.45	0.07	0.62	0.25
	Queue (ft)	100	200		75	225	25	200	100	25	175	75

Node 300	Collector A & Syene Rd							Control Roundabout	Operations HCM 7th Ed
Peak	Approach	EB →		WB ←		NB ↑		SB ↓	
		All		All		L/T	R YBP	All	
	# of Lanes	1		1		1	1	1	
	Storage (ft)	---		---		---	---	---	
PM	LOS	C		C		B	A	C	
	Delay (s)	24.2		23.4		13.5	6.0	16.3	
	v/c	0.80		0.76		0.55	0.30	0.67	
	Queue (ft)	225		175		75	25	125	

R YBP: Right-turn yielding bypass

**Color Legend**

-  LOS F, at/over-capacity condition, or storage at/exceeding capacity
-  LOS E
-  v/c or queue storage close to capacity
-  Thru movement queue likely restricting access to adjacent lane

**Exhibit 5, 2045 Scenario B Interchange Alternative  
Build Traffic Capacity/LOS Analysis  
Improved Transportation System**

Node 100	Whalen Rd & Caine Rd							Control TWSC	Operations HCM 7th Ed
Peak	Approach	● EB →		● WB ←		NB ↑		SB ↓	
		All		All		All		All	
	# of Lanes	1		1		1		1	
	Storage (ft)	---		---		---		---	
PM	LOS	B		B		A		A	
	Delay (s)	10.9		10.7		7.5		7.3	
	v/c	0.20		0.13		0.01		0.00	
	Queue (ft)	25		25		25		25	
INT									
7.2									

● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 200	Irish Ln & Caine Rd							Control TWSC	Operations HCM 7th Ed
Peak	Approach	EB →		WB ←		● NB ↑		● SB ↓	
		L/T	R	All		L	T/R	All	
	# of Lanes	1	1	1		1	---	1	
	Storage (ft)	---	250	---		250	---	---	
PM	LOS	A	A	A		D	C	C	
	Delay (s)	7.6	-	8.0		31.0	16.1	17.4	
	v/c	0.00		0.01		0.60	0.38	0.32	
	Queue (ft)	25		25		100	50	25	
INT									
10.8									

- Operations not calculated for movements with no vehicular conflict  
● Approach with Stop control  
Queues rounded to the nearest 25 ft

Node 300	Collector A & Syene Rd										Control Signal	Operations HCM 7th Ed	
Peak	Approach	EB →			WB ←			NB ↑			SB ↓		
		L	T	T/R	L	T	T/R	L	T	R	L	T	R
	# of Lanes	1	1	1	2	1	1	1	1	1	1	1	1
	Storage (ft)	200	---	---	200	---	---	200	---	250	200	---	200
PM	LOS	C	C	C	C	B	B	B	B	C	B	B	B
	Delay (s)	26.7	26.7	26.4	24.9	16.2	16.2	15.6	14.3	23.4	15.5	14.5	13.4
	v/c	0.60	0.78	0.78	0.75	0.51	0.51	0.00	0.25	0.82	0.05	0.29	0.08
	Queue (ft)	25	100	100	125	125	125	25	75	225	25	75	25
INT										B			
20.0													







Node 300	Collector A & Syene Rd							Control Roundabout	Operations HCM 7th Ed
Peak	Approach	EB →		WB ←		NB ↑		SB ↓	
		L/T		T/R	L	T/R	L/T	R YBP	All
	# of Lanes	1		1	1	1	1	1	1
	Storage (ft)	---		---	---	---	---	---	---
PM	LOS	A		A	A	A	A	C	B
	Delay (s)	9.7		9.9	6.8	8.3	7.9	24.8	13.6
	v/c	0.42		0.45	0.35	0.46	0.21	0.78	0.43
	Queue (ft)	50		50	50	50	25	200	50
INT									
12.5									

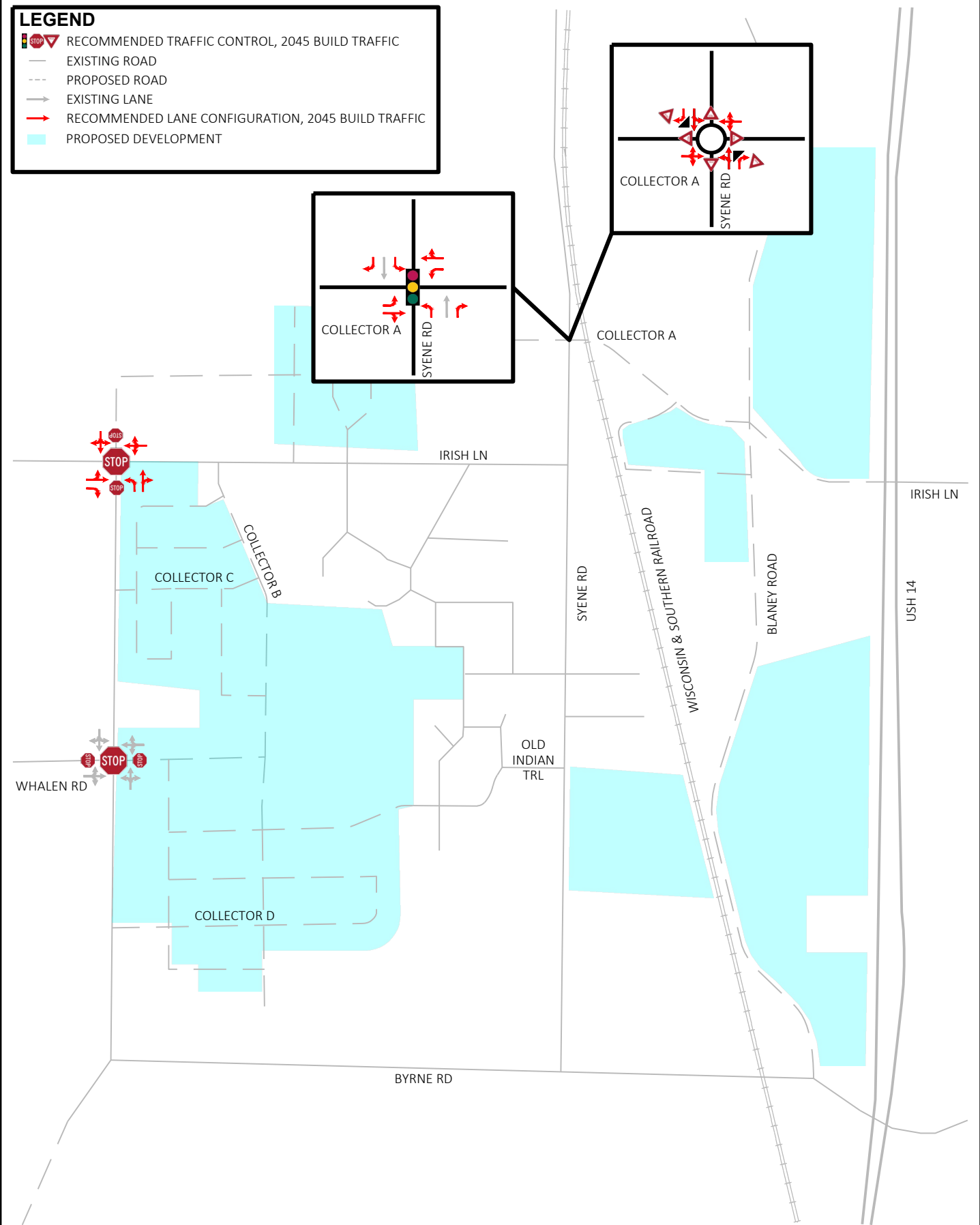
R YBP: Right-turn yielding bypass

**Color Legend**







	LOS F, at/over-capacity condition, or storage at/exceeding capacity
	LOS E
	v/c or queue storage close to capacity
	Thru movement queue likely restricting access to adjacent lane

**LEGEND**

-  RECOMMENDED TRAFFIC CONTROL, 2045 BUILD TRAFFIC
-  EXISTING ROAD
-  PROPOSED ROAD
-  EXISTING LANE
-  RECOMMENDED LANE CONFIGURATION, 2045 BUILD TRAFFIC
-  PROPOSED DEVELOPMENT



**LEGEND**

-  RECOMMENDED TRAFFIC CONTROL, 2045 BUILD TRAFFIC
-  EXISTING ROAD
-  PROPOSED ROAD
-  EXISTING LANE
-  RECOMMENDED LANE CONFIGURATION, 2045 BUILD TRAFFIC
-  PROPOSED DEVELOPMENT

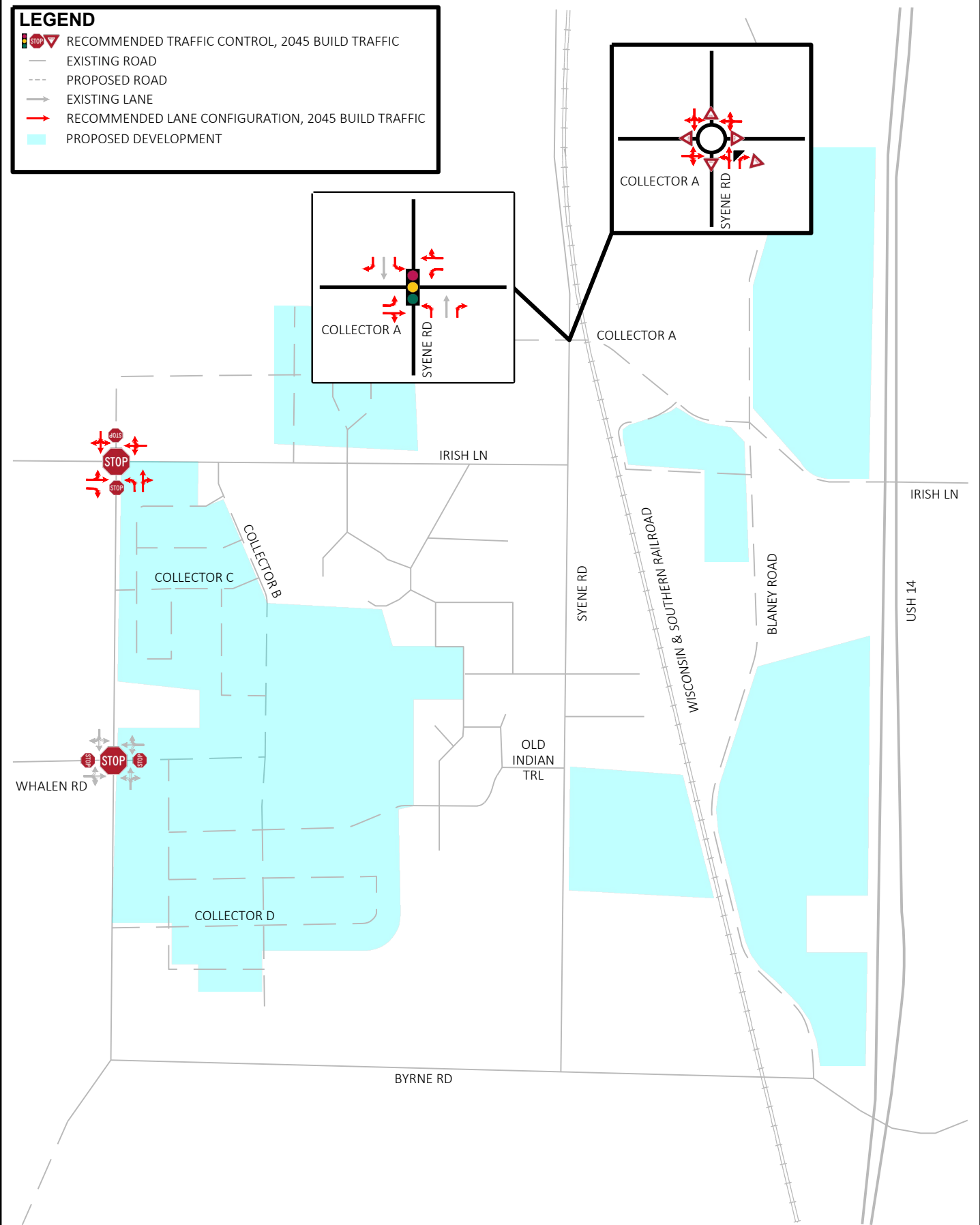








EXHIBIT  
7

Exhibit 7 - Intersection Improvements No Interchange Scenario B  
GREENFIELD NEIGHBORHOOD PLAN  
FITCHBURG, WI DANE COUNTY

**LEGEND**

-  RECOMMENDED TRAFFIC CONTROL, 2045 BUILD TRAFFIC
-  EXISTING ROAD
-  PROPOSED ROAD
-  EXISTING LANE
-  RECOMMENDED LANE CONFIGURATION, 2045 BUILD TRAFFIC
-  PROPOSED DEVELOPMENT

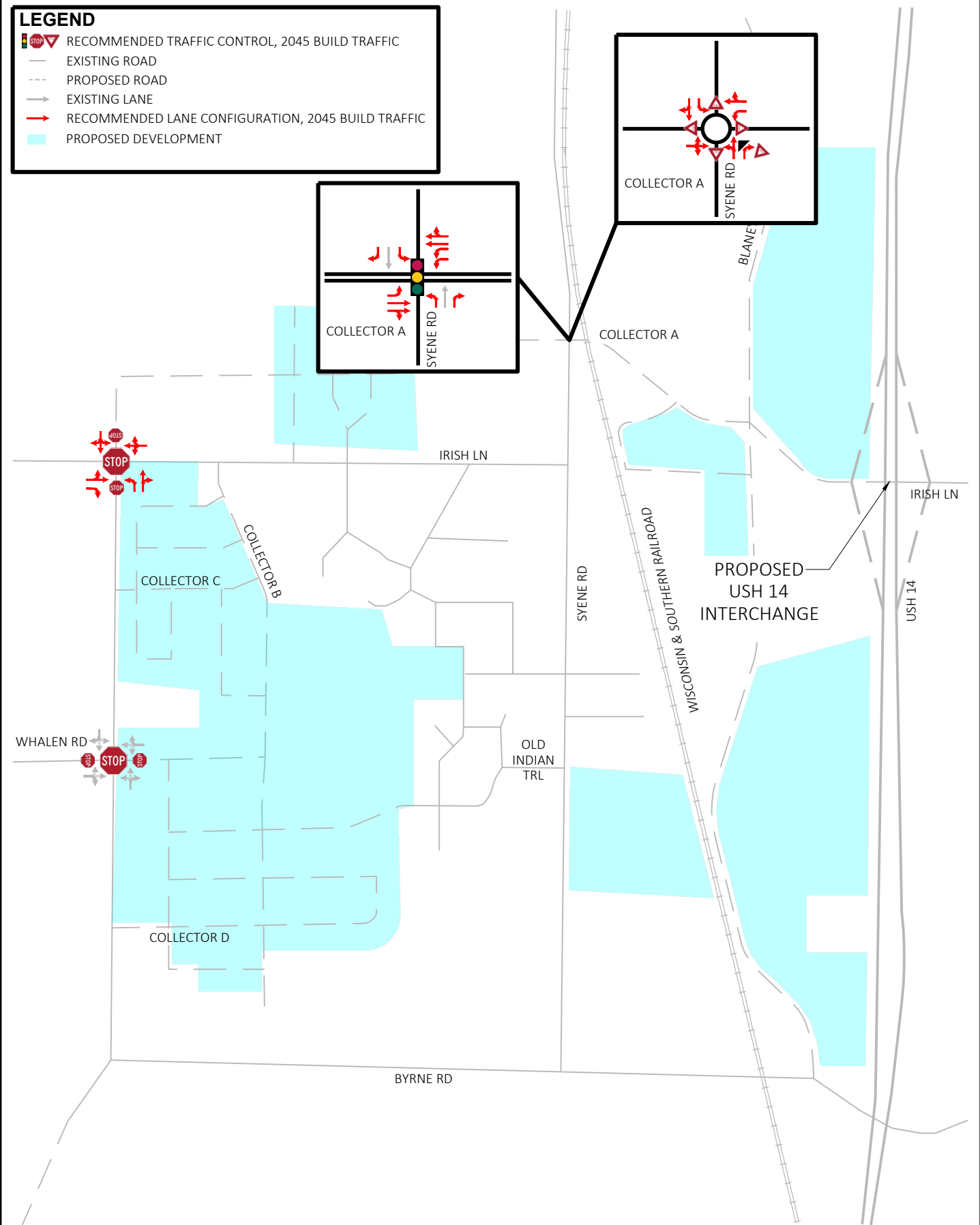








EXHIBIT  
8

Exhibit 8 - Intersection Improvements Interchange Scenario A  
GREENFIELD NEIGHBORHOOD PLAN  
FITCHBURG, WI DANE COUNTY

**LEGEND**

-  RECOMMENDED TRAFFIC CONTROL, 2045 BUILD TRAFFIC
-  EXISTING ROAD
-  PROPOSED ROAD
-  EXISTING LANE
-  RECOMMENDED LANE CONFIGURATION, 2045 BUILD TRAFFIC
-  PROPOSED DEVELOPMENT

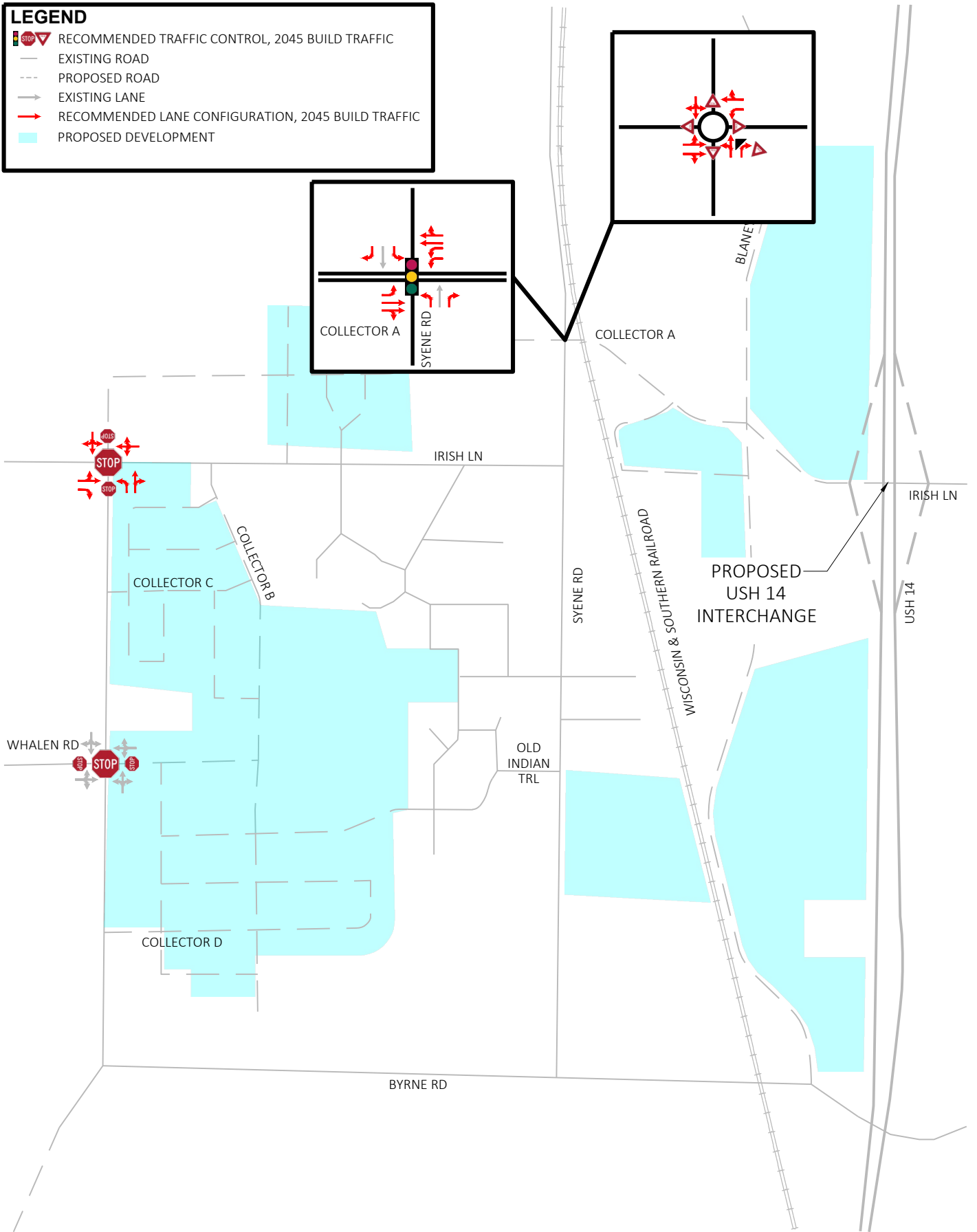


EXHIBIT  
9

**Exhibit 9 - Intersection Improvements Interchange Scenario B**  
GREENFIELD NEIGHBORHOOD PLAN  
FITCHBURG, WI DANE COUNTY

Intersection												
Int Delay, s/veh	8.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	85	85	20	1	50	1	15	10	1	1	15	50
Future Vol, veh/h	85	85	20	1	50	1	15	10	1	1	15	50
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	100	100	24	1	59	1	18	12	1	1	18	59

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	126	98	47	118	126	12	76	0	0	13	0	0
Stage 1	49	49	-	48	48	-	-	-	-	-	-	-
Stage 2	76	48	-	70	79	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.11	6.51	6.21	4.14	-	-	4.13	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.509	4.009	3.309	2.236	-	-	2.227	-	-
Pot Cap-1 Maneuver	848	792	1022	861	766	1071	1510	-	-	1599	-	-
Stage 1	964	854	-	968	857	-	-	-	-	-	-	-
Stage 2	933	855	-	942	831	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	772	782	1022	725	756	1071	1510	-	-	1599	-	-
Mov Cap-2 Maneuver	772	782	-	725	756	-	-	-	-	-	-	-
Stage 1	963	853	-	957	847	-	-	-	-	-	-	-
Stage 2	857	845	-	812	831	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s/v	11.26		10.15		4.28		0.11	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1020	-	-	797	760	24	-	-
HCM Lane V/C Ratio	0.012	-	-	0.28	0.08	0.001	-	-
HCM Control Delay (s/veh)	7.4	0	-	11.3	10.2	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1.2	0.3	0	-	-

Intersection												
Int Delay, s/veh	11.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔	↔	↔			↔	
Traffic Vol, veh/h	1	200	180	10	140	1	110	105	5	1	170	1
Future Vol, veh/h	1	200	180	10	140	1	110	105	5	1	170	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	250	-	-	-	250	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	1	235	212	12	165	1	129	124	6	1	200	1























Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	166	0	0	447	0	0	526	427	235	488	638	165
Stage 1	-	-	-	-	-	-	238	238	-	189	189	-
Stage 2	-	-	-	-	-	-	288	189	-	299	449	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.14	6.54	6.24	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.536	4.036	3.336	3.527	4.027	3.327
Pot Cap-1 Maneuver	1412	-	-	1119	-	-	459	517	799	488	393	877
Stage 1	-	-	-	-	-	-	761	705	-	811	742	-
Stage 2	-	-	-	-	-	-	715	740	-	707	570	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1412	-	-	1119	-	-	221	510	799	364	388	877
Mov Cap-2 Maneuver	-	-	-	-	-	-	221	510	-	364	388	-
Stage 1	-	-	-	-	-	-	760	704	-	801	733	-
Stage 2	-	-	-	-	-	-	513	731	-	578	570	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s/v	0.02			0.55			28.14			23.85		
HCM LOS							D			C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	221	519	9	-	-	119	-	-	389
HCM Lane V/C Ratio	0.586	0.25	0.001	-	-	0.011	-	-	0.52
HCM Control Delay (s/veh)	42	14.2	7.6	0	-	8.3	0	-	23.9
HCM Lane LOS	E	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	3.3	1	0	-	-	0	-	-	2.9

Lanes, Volumes, Timings  
300: Syene Rd & Collector A

PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	160	210	1	265	400	10	1	260	225	15	425	260
Future Volume (vph)	160	210	1	265	400	10	1	260	225	15	425	260
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	200		0	200		0	200		200	200		200
Storage Lanes	1		0	1		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			No			No
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		594			351			417			541	
Travel Time (s)		11.6			6.8			6.3			8.2	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	62%	100%	100%	62%
Heavy Vehicles (%)	3%	3%	3%	5%	5%	5%	1%	1%	1%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	178	234	0	294	455	0	1	289	155	17	472	179
Turn Type	D,P+P	NA		D,P+P	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	8			4			2		2	6		6
Detector Phase	7	4		3	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	6.0	10.0		6.0	10.0		15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	10.5	16.0		10.5	16.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	11.0	22.0		13.0	24.0		25.0	25.0	25.0	25.0	25.0	25.0
Total Split (%)	18.3%	36.7%		21.7%	40.0%		41.7%	41.7%	41.7%	41.7%	41.7%	41.7%
Maximum Green (s)	6.5	16.0		8.5	18.0		19.0	19.0	19.0	19.0	19.0	19.0
Yellow Time (s)	3.5	4.0		3.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	6.0		4.5	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	None	None		None	None		Min	Min	Min	Min	Min	Min
Walk Time (s)												
Flash Don't Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio	0.46	0.50		0.53	0.76		0.01	0.49	0.31	0.06	0.81	0.36
Control Delay (s/veh)	12.5	22.7		13.2	29.9		14.0	20.0	17.7	15.0	31.8	18.4

Lanes, Volumes, Timings  
300: Syene Rd & Collector A

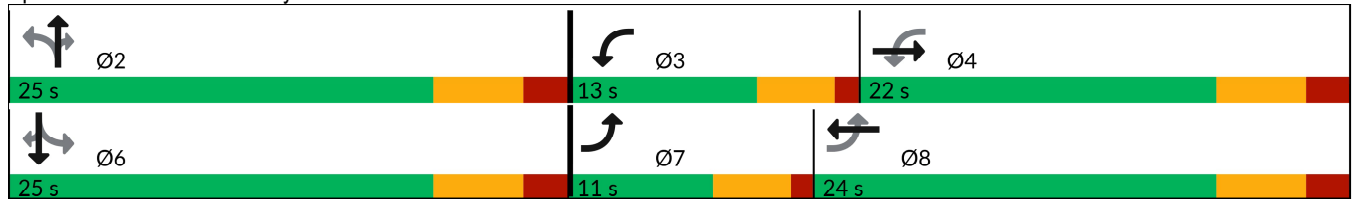
PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	12.5	22.7		13.2	29.9		14.0	20.0	17.7	15.0	31.8	18.4
Queue Length 50th (ft)	32	71		58	152		0	83	42	4	153	49
Queue Length 95th (ft)	62	129		103	#301		3	146	84	16	#293	95
Internal Link Dist (ft)		514			271			337			461	
Turn Bay Length (ft)	200			200			200		200	200		200
Base Capacity (vph)	386	516		561	598		164	625	532	329	625	532
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.46	0.45		0.52	0.76		0.01	0.46	0.29	0.05	0.76	0.34

Intersection Summary























Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 57.5  
 Natural Cycle: 60  
 Control Type: Actuated-Uncoordinated  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 300: Syene Rd & Collector A

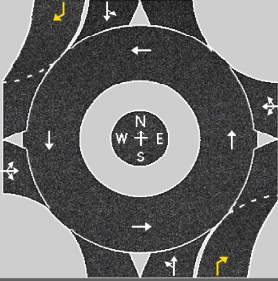


HCM 7th Signalized Intersection Summary  
300: Syene Rd & Collector A

PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	160	210	1	265	400	10	1	260	225	15	425	260
Future Volume (veh/h)	160	210	1	265	400	10	1	260	225	15	425	260
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1856	1856	1826	1826	1826	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	178	233	1	294	444	11	1	289	155	17	472	179
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	3	3	3	5	5	5	1	1	1	1	1	1
Cap, veh/h	368	435	2	550	515	13	184	562	476	297	562	476
Arrive On Green	0.10	0.24	0.24	0.16	0.29	0.29	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	1767	1846	8	1739	1774	44	787	1885	1598	953	1885	1598
Grp Volume(v), veh/h	178	0	234	294	0	455	1	289	155	17	472	179
Grp Sat Flow(s),veh/h/ln	1767	0	1854	1739	0	1818	787	1885	1598	953	1885	1598
Q Serve(g_s), s	3.6	0.0	5.9	6.6	0.0	12.7	0.1	6.8	4.0	0.8	12.6	4.8
Cycle Q Clear(g_c), s	3.6	0.0	5.9	6.6	0.0	12.7	12.6	6.8	4.0	7.6	12.6	4.8
Prop In Lane	1.00		0.00	1.00		0.02	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	368	0	437	550	0	528	184	562	476	297	562	476
V/C Ratio(X)	0.48	0.00	0.54	0.53	0.00	0.86	0.01	0.51	0.33	0.06	0.84	0.38
Avail Cap(c_a), veh/h	398	0	553	550	0	610	229	668	566	351	668	566
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.8	0.0	17.9	12.3	0.0	18.0	23.5	15.6	14.6	18.8	17.6	14.9
Incr Delay (d2), s/veh	1.0	0.0	1.0	1.0	0.0	10.9	0.0	0.7	0.4	0.1	8.2	0.5
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.3	0.0	2.3	2.2	0.0	6.1	0.0	2.5	1.3	0.2	5.6	1.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	13.8	0.0	18.9	13.3	0.0	28.9	23.6	16.3	15.0	18.8	25.8	15.4
LnGrp LOS	B		B	B		C	C	B	B	B	C	B
Approach Vol, veh/h	412			749			445			668		
Approach Delay, s/veh	16.7			22.8			15.9			22.8		
Approach LOS	B			C			B			C		
Timer - Assigned Phs	2		3		4		6		7		8	
Phs Duration (G+Y+Rc), s	22.0		13.0		18.6		22.0		10.1		21.6	
Change Period (Y+Rc), s	6.0		4.5		6.0		6.0		4.5		6.0	
Max Green Setting (Gmax), s	19.0		8.5		16.0		19.0		6.5		18.0	
Max Q Clear Time (g_c+I1), s	14.6		8.6		7.9		14.6		5.6		14.7	
Green Ext Time (p_c), s	0.8		0.0		0.7		1.4		0.0		0.9	
<b>Intersection Summary</b>												
HCM 7th Control Delay, s/veh				20.3								
HCM 7th LOS				C								

# HCS Roundabouts Report

General Information				Site Information				
Analyst	MSA				Intersection	Syene Road & Collector A		
Agency or Co.					E/W Street Name	Collector A		
Date Performed	3/4/2025				N/S Street Name	Syene Road		
Analysis Year	2045				Analysis Time Period, hrs	0.25		
Time Analyzed	PM Peak				Peak Hour Factor	0.90		
Project Description	Scenario A				Jurisdiction	City of Fitchburg		

## Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment	LTR				LTR				LT							
Volume (V), veh/h	0	160	210	1	0	265	400	10	0	1	260	225	0	15	425	260
Percent Heavy Vehicles, %	3	3	3	3	5	5	5	5	1	1	1	1	1	1	1	1
Flow Rate (v <sub>PCE</sub> ), pc/h	0	183	240	1	0	309	467	12	0	1	292	252	0	17	477	292
Right-Turn Bypass	None				None				Yielding							
Conflicting Lanes	1				1				1							
Pedestrians Crossing, p/h	0				0				0							
Proportion of CAVs, %	0															

## Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s		4.7000			4.7000			4.7000	4.0000		4.7000	4.0000
Follow-Up Headway, s		2.6000			2.6000			2.6000	2.3000		2.6000	2.3000

## Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v <sub>e</sub> ), pc/h		424			788			293	252		494	292
Entry Volume, veh/h		412			750			290	250		489	289
Circulating Flow (v <sub>c</sub> ), pc/h	803			476			440			777		
Exiting Flow (v <sub>ex</sub> ), pc/h	257			468			487			787		
Capacity (C <sub>PCE</sub> ), pc/h		649			883			914	1277		665	1081
Capacity (c), veh/h		630			841			905	1264		658	1070
v/c Ratio (x)		0.65			0.89			0.32	0.20		0.74	0.27

## Delay and Level of Service

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		19.1			32.5			7.4	4.5		23.3	6.0
Lane LOS		C			D			A	A		C	A
95% Queue Length, Q <sub>95</sub> (veh)		4.8			12.0			1.4	0.7		6.6	1.1
95% Queue Length, Q <sub>95</sub> (ft)		122.9			312.0			35.3	17.6		166.3	27.7
Approach Delay, s/veh   LOS	19.1		C	32.5		D	6.1		A	16.9		C
Intersection Delay, s/veh   LOS	19.6						C					

Intersection												
Int Delay, s/veh	7.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		+			+			+			+	
Traffic Vol, veh/h	55	55	20	1	80	1	15	10	1	1	15	80
Future Vol, veh/h	55	55	20	1	80	1	15	10	1	1	15	80
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	65	65	24	1	94	1	18	12	1	1	18	94

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	161	115	65	100	162	12	112	0	0	13	0	0
Stage 1	67	67	-	48	48	-	-	-	-	-	-	-
Stage 2	94	48	-	52	114	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.11	6.51	6.21	4.14	-	-	4.13	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.509	4.009	3.309	2.236	-	-	2.227	-	-
Pot Cap-1 Maneuver	804	775	999	884	732	1071	1466	-	-	1599	-	-
Stage 1	943	839	-	968	857	-	-	-	-	-	-	-
Stage 2	913	855	-	963	803	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	691	765	999	781	723	1071	1466	-	-	1599	-	-
Mov Cap-2 Maneuver	691	765	-	781	723	-	-	-	-	-	-	-
Stage 1	943	838	-	957	847	-	-	-	-	-	-	-
Stage 2	801	844	-	867	802	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s/v10.95			10.71		4.32		0.08	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1020	-	-	758	726	16	-	-
HCM Lane V/C Ratio	0.012	-	-	0.202	0.133	0.001	-	-
HCM Control Delay (s/veh)	7.5	0	-	10.9	10.7	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.8	0.5	0	-	-

Intersection												
Int Delay, s/veh	10.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔	↔	↔			↔	
Traffic Vol, veh/h	1	175	120	10	160	1	165	160	5	1	115	1
Future Vol, veh/h	1	175	120	10	160	1	165	160	5	1	115	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	250	-	-	-	250	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	1	206	141	12	188	1	194	188	6	1	135	1























Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	189	0	0	347	0	0	488	421	206	515	562	189
Stage 1	-	-	-	-	-	-	208	208	-	212	212	-
Stage 2	-	-	-	-	-	-	279	213	-	302	349	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.14	6.54	6.24	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.536	4.036	3.336	3.527	4.027	3.327
Pot Cap-1 Maneuver	1384	-	-	1217	-	-	487	521	830	469	435	851
Stage 1	-	-	-	-	-	-	789	726	-	788	725	-
Stage 2	-	-	-	-	-	-	723	723	-	705	631	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1384	-	-	1217	-	-	330	514	830	293	429	851
Mov Cap-2 Maneuver	-	-	-	-	-	-	330	514	-	293	429	-
Stage 1	-	-	-	-	-	-	788	725	-	779	717	-
Stage 2	-	-	-	-	-	-	579	715	-	518	631	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s/v	0.03			0.47			23.13			17.28		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	330	520	10	-	-	105	-	-	430
HCM Lane V/C Ratio	0.587	0.373	0.001	-	-	0.01	-	-	0.32
HCM Control Delay (s/veh)	30.3	16	7.6	0	-	8	0	-	17.3
HCM Lane LOS	D	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	3.5	1.7	0	-	-	0	-	-	1.4

Lanes, Volumes, Timings  
300: Syene Rd & Collector A

PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	240	320	1	175	285	10	1	365	310	15	315	170
Future Volume (vph)	240	320	1	175	285	10	1	365	310	15	315	170
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	250		0	250		0	200		200	200		200
Storage Lanes	1		0	1		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			No			No
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		594			493			417			541	
Travel Time (s)		11.6			9.6			6.3			8.2	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	62%	100%	100%	62%
Heavy Vehicles (%)	3%	3%	3%	5%	5%	5%	1%	1%	1%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	267	357	0	194	328	0	1	406	214	17	350	117
Turn Type	D.P+P	NA		D.P+P	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases	8			4			2		2	6		6
Detector Phase	7	4		3	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	6.0	10.0		6.0	10.0		15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	10.5	16.0		10.5	16.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	14.0	23.0		11.0	20.0		26.0	26.0	26.0	26.0	26.0	26.0
Total Split (%)	23.3%	38.3%		18.3%	33.3%		43.3%	43.3%	43.3%	43.3%	43.3%	43.3%
Maximum Green (s)	9.5	17.0		6.5	14.0		20.0	20.0	20.0	20.0	20.0	20.0
Yellow Time (s)	3.5	4.0		3.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	1.0	2.0		1.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	6.0		4.5	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	None	None		None	None		Min	Min	Min	Min	Min	Min
Walk Time (s)												
Flash Don't Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio	0.56	0.61		0.43	0.78		0.00	0.69	0.43	0.08	0.59	0.23
Control Delay (s/veh)	14.0	23.5		12.0	36.2		13.0	24.2	18.7	15.1	21.4	16.1

Lanes, Volumes, Timings  
300: Syene Rd & Collector A

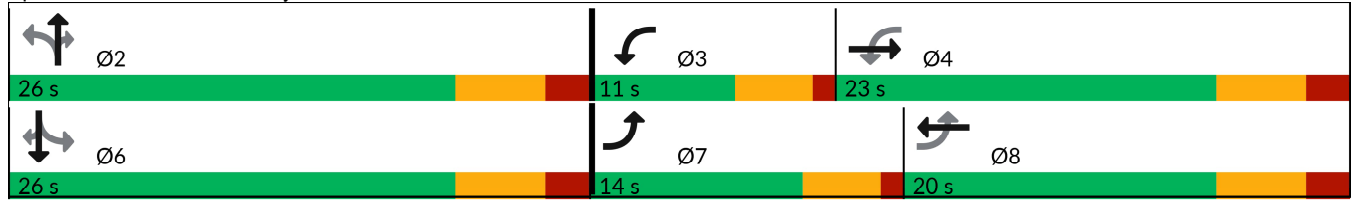
PM Peak

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	14.0	23.5		12.0	36.2		13.0	24.2	18.7	15.1	21.4	16.1
Queue Length 50th (ft)	49	108		34	105		0	123	58	4	101	30
Queue Length 95th (ft)	97	#203		71	#228		3	206	110	16	174	64
Internal Link Dist (ft)		514			413			337			461	
Turn Bay Length (ft)	250			250			200		200	200		200
Base Capacity (vph)	499	598		451	454		297	675	574	243	675	574
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.54	0.60		0.43	0.72		0.00	0.60	0.37	0.07	0.52	0.20

Intersection Summary























Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 56.1  
 Natural Cycle: 55  
 Control Type: Actuated-Uncoordinated  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 300: Syene Rd & Collector A




HCM 7th Signalized Intersection Summary  
300: Syene Rd & Collector A

PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	240	320	1	175	285	10	1	365	310	15	315	170
Future Volume (veh/h)	240	320	1	175	285	10	1	365	310	15	315	170
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1856	1856	1826	1826	1826	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	267	356	1	194	317	11	1	406	214	17	350	117
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	3	3	3	5	5	5	1	1	1	1	1	1
Cap, veh/h	463	485	1	423	391	14	272	562	477	229	562	477
Arrive On Green	0.15	0.26	0.26	0.11	0.22	0.22	0.30	0.30	0.30	0.30	0.30	0.30
Sat Flow, veh/h	1767	1849	5	1739	1754	61	933	1885	1598	810	1885	1598
Grp Volume(v), veh/h	267	0	357	194	0	328	1	406	214	17	350	117
Grp Sat Flow(s),veh/h/ln	1767	0	1855	1739	0	1815	933	1885	1598	810	1885	1598
Q Serve(g_s), s	5.6	0.0	8.8	4.0	0.0	8.6	0.0	9.7	5.5	1.0	8.0	2.8
Cycle Q Clear(g_c), s	5.6	0.0	8.8	4.0	0.0	8.6	8.1	9.7	5.5	10.6	8.0	2.8
Prop In Lane	1.00		0.00	1.00		0.03	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	463	0	486	423	0	404	272	562	477	229	562	477
V/C Ratio(X)	0.58	0.00	0.73	0.46	0.00	0.81	0.00	0.72	0.45	0.07	0.62	0.25
Avail Cap(c_a), veh/h	531	0	627	454	0	505	365	750	636	309	750	636
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.6	0.0	17.0	12.1	0.0	18.5	18.7	15.8	14.3	20.5	15.2	13.4
Incr Delay (d2), s/veh	1.2	0.0	3.2	0.8	0.0	7.9	0.0	2.3	0.7	0.1	1.1	0.3
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.9	0.0	3.6	1.3	0.0	4.0	0.0	3.6	1.7	0.2	2.9	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	13.8	0.0	20.2	12.8	0.0	26.4	18.7	18.1	15.0	20.7	16.3	13.6
LnGrp LOS	B		C	B		C	B	B	B	C	B	B
Approach Vol, veh/h		624			522			621			484	
Approach Delay, s/veh		17.4			21.4			17.0			15.8	
Approach LOS		B			C			B			B	
Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		21.0	10.1	19.2		21.0	12.1	17.2				
Change Period (Y+Rc), s		6.0	4.5	6.0		6.0	4.5	6.0				
Max Green Setting (Gmax), s		20.0	6.5	17.0		20.0	9.5	14.0				
Max Q Clear Time (g_c+I1), s		11.7	6.0	10.8		12.6	7.6	10.6				
Green Ext Time (p_c), s		1.9	0.0	1.0		1.4	0.2	0.6				
<b>Intersection Summary</b>												
HCM 7th Control Delay, s/veh			17.9									
HCM 7th LOS			B									

# HCS Roundabouts Report

General Information				Site Information				
Analyst	MSA				Intersection	Syene Road & Collector A		
Agency or Co.					E/W Street Name	Collector A		
Date Performed	3/4/2025				N/S Street Name	Syene Road		
Analysis Year	2045				Analysis Time Period, hrs	0.25		
Time Analyzed	PM Peak				Peak Hour Factor	0.90		
Project Description	Scenario B				Jurisdiction	City of Fitchburg		

## Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment	LTR				LTR				LT				LTR			
Volume (V), veh/h	0	240	320	1	0	175	285	10	0	1	365	310	0	15	315	170
Percent Heavy Vehicles, %	3	3	3	3	5	5	5	5	1	1	1	1	1	1	1	1
Flow Rate (v <sub>PCE</sub> ), pc/h	0	275	366	1	0	204	333	12	0	1	410	348	0	17	354	191
Right-Turn Bypass	None				None				Yielding				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		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s		4.7000			4.7000			4.7000	4.0000		4.7000	
Follow-Up Headway, s		2.6000			2.6000			2.6000	2.3000		2.6000	

## Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v <sub>e</sub> ), pc/h		642			549			411	348		562	
Entry Volume, veh/h		623			523			407	345		556	
Circulating Flow (v <sub>c</sub> ), pc/h	575			686			658			538		
Exiting Flow (v <sub>ex</sub> ), pc/h	383			525			697			559		
Capacity (C <sub>PCE</sub> ), pc/h		804			724			744	1156		833	
Capacity (c), veh/h		781			690			736	1144		825	
v/c Ratio (x)		0.80			0.76			0.55	0.30		0.67	

## Delay and Level of Service

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		24.2			23.4			13.5	6.0		16.3	
Lane LOS		C			C			B	A		C	
95% Queue Length, Q <sub>95</sub> (veh)		8.3			7.0			3.4	1.3		5.4	
95% Queue Length, Q <sub>95</sub> (ft)		212.5			182.0			85.7	32.8		136.1	
Approach Delay, s/veh   LOS	24.2		C	23.4		C	10.1		B	16.3		C
Intersection Delay, s/veh   LOS	17.9						C					

Intersection												
Int Delay, s/veh	8.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	85	85	20	1	50	1	15	10	1	1	15	50
Future Vol, veh/h	85	85	20	1	50	1	15	10	1	1	15	50
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	100	100	24	1	59	1	18	12	1	1	18	59

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	126	98	47	118	126	12	76	0	0	13	0	0
Stage 1	49	49	-	48	48	-	-	-	-	-	-	-
Stage 2	76	48	-	70	79	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.11	6.51	6.21	4.14	-	-	4.13	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.509	4.009	3.309	2.236	-	-	2.227	-	-
Pot Cap-1 Maneuver	848	792	1022	861	766	1071	1510	-	-	1599	-	-
Stage 1	964	854	-	968	857	-	-	-	-	-	-	-
Stage 2	933	855	-	942	831	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	772	782	1022	725	756	1071	1510	-	-	1599	-	-
Mov Cap-2 Maneuver	772	782	-	725	756	-	-	-	-	-	-	-
Stage 1	963	853	-	957	847	-	-	-	-	-	-	-
Stage 2	857	845	-	812	831	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s/v	11.26		10.15		4.28		0.11	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1020	-	-	797	760	24	-	-
HCM Lane V/C Ratio	0.012	-	-	0.28	0.08	0.001	-	-
HCM Control Delay (s/veh)	7.4	0	-	11.3	10.2	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	1.2	0.3	0	-	-

Intersection												
Int Delay, s/veh	11.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔	↔	↔			↔	
Traffic Vol, veh/h	1	200	180	10	140	1	110	105	5	1	170	1
Future Vol, veh/h	1	200	180	10	140	1	110	105	5	1	170	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	250	-	-	-	250	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	1	235	212	12	165	1	129	124	6	1	200	1























Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	166	0	0	447	0	0	526	427	235	488	638	165
Stage 1	-	-	-	-	-	-	238	238	-	189	189	-
Stage 2	-	-	-	-	-	-	288	189	-	299	449	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.14	6.54	6.24	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.536	4.036	3.336	3.527	4.027	3.327
Pot Cap-1 Maneuver	1412	-	-	1119	-	-	459	517	799	488	393	877
Stage 1	-	-	-	-	-	-	761	705	-	811	742	-
Stage 2	-	-	-	-	-	-	715	740	-	707	570	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1412	-	-	1119	-	-	221	510	799	364	388	877
Mov Cap-2 Maneuver	-	-	-	-	-	-	221	510	-	364	388	-
Stage 1	-	-	-	-	-	-	760	704	-	801	733	-
Stage 2	-	-	-	-	-	-	513	731	-	578	570	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s/v	0.02			0.55			28.14			23.85		
HCM LOS							D			C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	221	519	9	-	-	119	-	-	389
HCM Lane V/C Ratio	0.586	0.25	0.001	-	-	0.011	-	-	0.52
HCM Control Delay (s/veh)	42	14.2	7.6	0	-	8.3	0	-	23.9
HCM Lane LOS	E	B	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	3.3	1	0	-	-	0	-	-	2.9

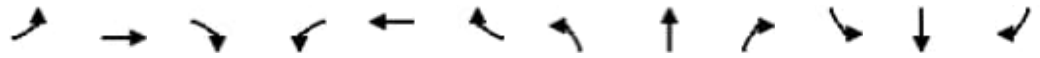
Lanes, Volumes, Timings  
300: Syene Rd & Collector A

PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	365	1	520	660	10	1	95	390	15	170	85
Future Volume (vph)	50	365	1	520	660	10	1	95	390	15	170	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	200		0	250		0	200		200	200		200
Storage Lanes	1		0	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			No			No
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		594			511			417			541	
Travel Time (s)		11.6			10.0			6.3			8.2	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	62%	100%	100%	62%
Heavy Vehicles (%)	3%	3%	3%	5%	5%	5%	1%	1%	1%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	56	407	0	578	744	0	1	106	269	17	189	59
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		6
Detector Phase	7	4		3	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	6.0	10.0		8.0	10.0		15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	12.5	16.0		13.5	16.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	13.0	16.0		20.0	23.0		24.0	24.0	24.0	24.0	24.0	24.0
Total Split (%)	21.7%	26.7%		33.3%	38.3%		40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
Maximum Green (s)	7.5	10.0		14.5	17.0		18.0	18.0	18.0	18.0	18.0	18.0
Yellow Time (s)	3.5	4.0		3.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	6.0		5.5	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	None	None		None	None		Min	Min	Min	Min	Min	Min
Walk Time (s)												
Flash Don't Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio	0.27	0.66		0.74	0.58		0.00	0.20	0.60	0.05	0.36	0.13
Control Delay (s/veh)	26.9	28.6		26.9	18.7		15.0	17.1	24.4	15.6	18.9	16.5

Lanes, Volumes, Timings  
300: Syene Rd & Collector A

PM Peak

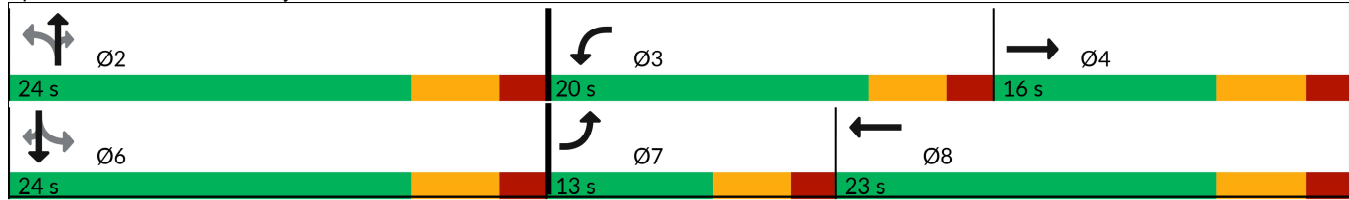


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	26.9	28.6		26.9	18.7		15.0	17.1	24.4	15.6	18.9	16.5
Queue Length 50th (ft)	18	68		91	116		0	28	81	4	52	15
Queue Length 95th (ft)	48	#119		147	#188		3	60	147	17	99	39
Internal Link Dist (ft)		514			431			337			461	
Turn Bay Length (ft)	200			250			200		200	200		200
Base Capacity (vph)	231	616		849	1290		380	595	505	410	595	505
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.66		0.68	0.58		0.00	0.18	0.53	0.04	0.32	0.12

Intersection Summary























Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 57  
 Natural Cycle: 55  
 Control Type: Actuated-Uncoordinated  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 300: Syene Rd & Collector A




HCM 7th Signalized Intersection Summary  
300: Syene Rd & Collector A

PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	365	1	520	660	10	1	95	390	15	170	85
Future Volume (veh/h)	50	365	1	520	660	10	1	95	390	15	170	85
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1856	1856	1826	1826	1826	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	56	406	1	578	733	11	1	106	269	17	189	59
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	3	3	3	5	5	5	1	1	1	1	1	1
Cap, veh/h	111	666	2	725	1178	18	357	522	443	371	522	443
Arrive On Green	0.06	0.18	0.18	0.21	0.34	0.34	0.28	0.28	0.28	0.28	0.28	0.28
Sat Flow, veh/h	1767	3608	9	3374	3499	52	1141	1885	1598	1016	1885	1598
Grp Volume(v), veh/h	56	198	209	578	363	381	1	106	269	17	189	59
Grp Sat Flow(s),veh/h/ln	1767	1763	1854	1687	1735	1816	1141	1885	1598	1016	1885	1598
Q Serve(g_s), s	1.7	5.6	5.6	8.8	9.5	9.5	0.0	2.3	7.9	0.7	4.4	1.5
Cycle Q Clear(g_c), s	1.7	5.6	5.6	8.8	9.5	9.5	4.4	2.3	7.9	3.0	4.4	1.5
Prop In Lane	1.00		0.00	1.00		0.03	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	111	326	342	725	584	611	357	522	443	371	522	443
V/C Ratio(X)	0.50	0.61	0.61	0.80	0.62	0.62	0.00	0.20	0.61	0.05	0.36	0.13
Avail Cap(c_a), veh/h	245	326	342	904	584	611	420	627	531	427	627	531
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	24.5	20.3	20.3	20.1	15.1	15.1	17.5	15.0	17.0	16.2	15.7	14.7
Incr Delay (d2), s/veh	3.5	3.3	3.1	4.1	2.0	2.0	0.0	0.2	1.4	0.1	0.4	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	2.3	2.4	3.4	3.5	3.6	0.0	0.8	0.2	0.1	1.6	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	28.0	23.5	23.4	24.2	17.1	17.0	17.5	15.2	18.4	16.2	16.1	14.8
LnGrp LOS	C	C	C	C	B	B	B	B	B	B	B	B
Approach Vol, veh/h		463			1322			376			265	
Approach Delay, s/veh		24.0			20.2			17.5			15.9	
Approach LOS		C			C			B			B	
Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		21.0	17.1	16.0		21.0	8.9	24.2				
Change Period (Y+Rc), s		6.0	5.5	6.0		6.0	5.5	6.0				
Max Green Setting (Gmax), s		18.0	14.5	10.0		18.0	7.5	17.0				
Max Q Clear Time (g_c+I1), s		9.9	10.8	7.6		6.4	3.7	11.5				
Green Ext Time (p_c), s		0.9	0.9	0.5		0.9	0.0	2.1				
<b>Intersection Summary</b>												
HCM 7th Control Delay, s/veh			20.0									
HCM 7th LOS			C									

# HCS Roundabouts Report

General Information				Site Information				
Analyst	MSA				Intersection	Syene Road & Collector A		
Agency or Co.					E/W Street Name	Collector A		
Date Performed	3/4/2025				N/S Street Name	Syene Road		
Analysis Year	2045				Analysis Time Period, hrs	0.25		
Time Analyzed	PM Peak				Peak Hour Factor	0.90		
Project Description	Scenario A_Interchange				Jurisdiction	City of Fitchburg		

## Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
	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	1	1	0	0	0	1	0	0	1	1	0
Lane Assignment	LTR				L	LTR			LT				L	TR		
Volume (V), veh/h	0	50	365	1	0	520	660	10	0	1	95	390	0	15	170	85
Percent Heavy Vehicles, %	3	3	3	3	5	5	5	5	1	1	1	1	1	1	1	1
Flow Rate (v <sub>PCE</sub> ), pc/h	0	57	418	1	0	607	770	12	0	1	107	438	0	17	191	95
Right-Turn Bypass	None				None				Yielding				None			
Conflicting Lanes	2				1				1				2			
Pedestrians Crossing, p/h	0				0				0				0			
Proportion of CAVs, %	0															

## Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s		4.8000		4.7000	4.4000			4.7000	4.0000	4.7000	4.4000	
Follow-Up Headway, s		2.6000		2.5000	2.5000			2.6000	2.3000	2.5000	2.5000	

## Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v <sub>e</sub> ), pc/h		476		607	782			108	438	17	286	
Entry Volume, veh/h		462		578	745			107	434	17	283	
Circulating Flow (v <sub>c</sub> ), pc/h	815			165			492			1378		
Exiting Flow (v <sub>ex</sub> ), pc/h	435			866			176			799		
Capacity (c <sub>PCE</sub> ), pc/h		627		1229	1246			870	1109	384	431	
Capacity (c), veh/h		609		1171	1187			861	1098	381	427	
v/c Ratio (x)		0.76		0.49	0.63			0.12	0.39	0.04	0.66	

## Delay and Level of Service

Approach	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		25.9		8.5	11.1			5.4	7.4	10.1	26.8	
Lane LOS		D		A	B			A	A	B	D	
95% Queue Length, Q <sub>95</sub> (veh)		6.9		2.8	4.7			0.4	1.9	0.1	4.7	
95% Queue Length, Q <sub>95</sub> (ft)		176.6			122.2			10.1	47.9	2.5	118.4	
Approach Delay, s/veh   LOS	25.9		D	10.0		A	7.0		A	25.9		D
Intersection Delay, s/veh   LOS	14.0						B					

Intersection												
Int Delay, s/veh	7.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		+			+			+			+	
Traffic Vol, veh/h	55	55	20	1	80	1	15	10	1	1	15	80
Future Vol, veh/h	55	55	20	1	80	1	15	10	1	1	15	80
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	65	65	24	1	94	1	18	12	1	1	18	94

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	161	115	65	100	162	12	112	0	0	13	0	0
Stage 1	67	67	-	48	48	-	-	-	-	-	-	-
Stage 2	94	48	-	52	114	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.11	6.51	6.21	4.14	-	-	4.13	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.509	4.009	3.309	2.236	-	-	2.227	-	-
Pot Cap-1 Maneuver	804	775	999	884	732	1071	1466	-	-	1599	-	-
Stage 1	943	839	-	968	857	-	-	-	-	-	-	-
Stage 2	913	855	-	963	803	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	691	765	999	781	723	1071	1466	-	-	1599	-	-
Mov Cap-2 Maneuver	691	765	-	781	723	-	-	-	-	-	-	-
Stage 1	943	838	-	957	847	-	-	-	-	-	-	-
Stage 2	801	844	-	867	802	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s/v10.95			10.71		4.32		0.08	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1020	-	-	758	726	16	-	-
HCM Lane V/C Ratio	0.012	-	-	0.202	0.133	0.001	-	-
HCM Control Delay (s/veh)	7.5	0	-	10.9	10.7	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.8	0.5	0	-	-

Intersection												
Int Delay, s/veh	10.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔	↔	↔	↔			↔	
Traffic Vol, veh/h	1	175	120	10	165	1	165	160	5	1	115	1
Future Vol, veh/h	1	175	120	10	165	1	165	160	5	1	115	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	250	-	-	-	250	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	85	85	85	85	85	85	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	1	1	1	4	4	4	3	3	3
Mvmt Flow	1	206	141	12	194	1	194	188	6	1	135	1























Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	195	0	0	347	0	0	494	427	206	521	568	195
Stage 1	-	-	-	-	-	-	208	208	-	218	218	-
Stage 2	-	-	-	-	-	-	285	219	-	302	349	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.14	6.54	6.24	7.13	6.53	6.23
Critical Hdwy Stg 1	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.14	5.54	-	6.13	5.53	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.536	4.036	3.336	3.527	4.027	3.327
Pot Cap-1 Maneuver	1378	-	-	1217	-	-	483	517	830	465	431	844
Stage 1	-	-	-	-	-	-	789	726	-	782	721	-
Stage 2	-	-	-	-	-	-	718	718	-	705	631	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1378	-	-	1217	-	-	326	511	830	289	426	844
Mov Cap-2 Maneuver	-	-	-	-	-	-	326	511	-	289	426	-
Stage 1	-	-	-	-	-	-	788	725	-	773	713	-
Stage 2	-	-	-	-	-	-	574	710	-	518	631	-

Approach	EB			WB			NB			SB		
HCM Control Delay, s/v	0.03			0.45			23.55			17.42		
HCM LOS							C			C		

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	326	517	10	-	-	102	-	-	426
HCM Lane V/C Ratio	0.595	0.376	0.001	-	-	0.01	-	-	0.323
HCM Control Delay (s/veh)	31	16.1	7.6	0	-	8	0	-	17.4
HCM Lane LOS	D	C	A	A	-	A	A	-	C
HCM 95th %tile Q(veh)	3.6	1.7	0	-	-	0	-	-	1.4

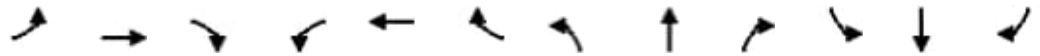
Lanes, Volumes, Timings  
300: Syene Rd & Collector A

PM Peak

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	555	1	345	455	10	1	125	550	15	145	55
Future Volume (vph)	80	555	1	345	455	10	1	125	550	15	145	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	12
Grade (%)		0%			0%			0%			0%	
Storage Length (ft)	200		0	200		0	200		250	200		200
Storage Lanes	1		0	2		0	1		1	1		1
Taper Length (ft)	25			25			25			25		
Right Turn on Red			Yes			Yes			No			No
Link Speed (mph)		35			35			45			45	
Link Distance (ft)		594			591			417			541	
Travel Time (s)		11.6			11.5			6.3			8.2	
Confl. Peds. (#/hr)												
Confl. Bikes (#/hr)												
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Growth Factor	100%	100%	100%	100%	100%	100%	100%	100%	62%	100%	100%	62%
Heavy Vehicles (%)	3%	3%	3%	5%	5%	5%	1%	1%	1%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	0	0	0
Parking (#/hr)												
Mid-Block Traffic (%)		0%			0%			0%			0%	
Shared Lane Traffic (%)												
Lane Group Flow (vph)	89	618	0	383	517	0	1	139	379	17	161	38
Turn Type	Prot	NA		Prot	NA		Perm	NA	Perm	Perm	NA	Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases							2		2	6		6
Detector Phase	7	4		3	8		2	2	2	6	6	6
Switch Phase												
Minimum Initial (s)	6.0	10.0		6.0	10.0		15.0	15.0	15.0	15.0	15.0	15.0
Minimum Split (s)	11.5	16.0		11.5	16.0		21.0	21.0	21.0	21.0	21.0	21.0
Total Split (s)	13.0	19.0		15.0	21.0		26.0	26.0	26.0	26.0	26.0	26.0
Total Split (%)	21.7%	31.7%		25.0%	35.0%		43.3%	43.3%	43.3%	43.3%	43.3%	43.3%
Maximum Green (s)	7.5	13.0		9.5	15.0		20.0	20.0	20.0	20.0	20.0	20.0
Yellow Time (s)	3.5	4.0		3.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	6.0		5.5	6.0		6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag		Lead	Lag							
Lead-Lag Optimize?	Yes	Yes		Yes	Yes							
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Minimum Gap (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Time Before Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Time To Reduce (s)	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Recall Mode	None	None		None	None		Min	Min	Min	Min	Min	Min
Walk Time (s)												
Flash Don't Walk (s)												
Pedestrian Calls (#/hr)												
v/c Ratio	0.41	0.80		0.71	0.50		0.00	0.24	0.76	0.04	0.27	0.08
Control Delay (s/veh)	30.3	31.5		32.1	20.1		13.0	16.0	29.7	14.1	16.4	14.4

Lanes, Volumes, Timings  
300: Syene Rd & Collector A

PM Peak

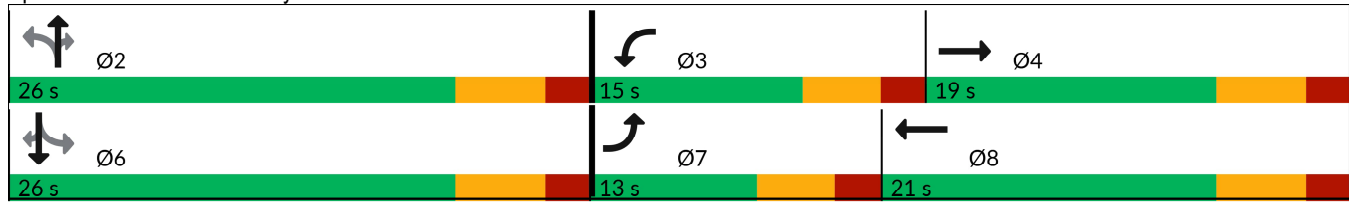


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (s/veh)	30.3	31.5		32.1	20.1		13.0	16.0	29.7	14.1	16.4	14.4
Queue Length 50th (ft)	30	110		67	84		0	35	118	4	42	9
Queue Length 95th (ft)	68	#189		#122	130		3	71	#232	16	81	27
Internal Link Dist (ft)		514			511			337			461	
Turn Bay Length (ft)	200			200			200		250	200		200
Base Capacity (vph)	229	796		553	1040		430	657	559	439	657	559
Starvation Cap Reductn	0	0		0	0		0	0	0	0	0	0
Spillback Cap Reductn	0	0		0	0		0	0	0	0	0	0
Storage Cap Reductn	0	0		0	0		0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.78		0.69	0.50		0.00	0.21	0.68	0.04	0.25	0.07

Intersection Summary























Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 57.4  
 Natural Cycle: 60  
 Control Type: Actuated-Uncoordinated  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 300: Syene Rd & Collector A




HCM 7th Signalized Intersection Summary  
300: Syene Rd & Collector A

PM Peak

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	80	555	1	345	455	10	1	125	550	15	145	55
Future Volume (veh/h)	80	555	1	345	455	10	1	125	550	15	145	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Lane Width Adj.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1856	1856	1856	1826	1826	1826	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	89	617	1	383	506	11	1	139	379	17	161	38
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	3	3	3	5	5	5	1	1	1	1	1	1
Cap, veh/h	148	789	1	514	996	22	407	548	464	348	548	464
Arrive On Green	0.08	0.22	0.22	0.15	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	1767	3611	6	3374	3472	75	1193	1885	1598	890	1885	1598
Grp Volume(v), veh/h	89	301	317	383	253	264	1	139	379	17	161	38
Grp Sat Flow(s),veh/h/ln	1767	1763	1854	1687	1735	1812	1193	1885	1598	890	1885	1598
Q Serve(g_s), s	2.5	8.3	8.3	5.6	6.3	6.3	0.0	2.9	11.4	0.8	3.4	0.9
Cycle Q Clear(g_c), s	2.5	8.3	8.3	5.6	6.3	6.3	3.5	2.9	11.4	3.7	3.4	0.9
Prop In Lane	1.00		0.00	1.00		0.04	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	148	385	405	514	498	520	407	548	464	348	548	464
V/C Ratio(X)	0.60	0.78	0.78	0.75	0.51	0.51	0.00	0.25	0.82	0.05	0.29	0.08
Avail Cap(c_a), veh/h	257	444	467	621	504	526	522	730	619	434	730	619
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.8	19.0	19.0	20.9	15.4	15.4	15.6	14.0	17.0	15.4	14.2	13.3
Incr Delay (d2), s/veh	3.9	7.7	7.4	4.0	0.8	0.8	0.0	0.2	6.3	0.1	0.3	0.1
Initial Q Delay(d3), s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.1	3.8	3.9	2.2	2.2	2.3	0.0	1.0	4.3	0.1	1.2	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d), s/veh	26.7	26.7	26.4	24.9	16.2	16.2	15.6	14.3	23.4	15.5	14.5	13.4
LnGrp LOS	C	C	C	C	B	B	B	B	C	B	B	B
Approach Vol, veh/h		707			900			519			216	
Approach Delay, s/veh		26.6			19.9			20.9			14.4	
Approach LOS		C			B			C			B	
Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		21.0	13.4	17.3		21.0	9.8	20.8				
Change Period (Y+Rc), s		6.0	5.5	6.0		6.0	5.5	6.0				
Max Green Setting (Gmax), s		20.0	9.5	13.0		20.0	7.5	15.0				
Max Q Clear Time (g_c+I1), s		13.4	7.6	10.3		5.7	4.5	8.3				
Green Ext Time (p_c), s		1.2	0.3	1.0		0.8	0.0	1.6				
<b>Intersection Summary</b>												
HCM 7th Control Delay, s/veh			21.6									
HCM 7th LOS			C									

# HCS Roundabouts Report

General Information				Site Information				
Analyst	MSA				Intersection		Syene Road & Collector A	
Agency or Co.					E/W Street Name		Collector A	
Date Performed	3/4/2025				N/S Street Name		Syene Road	
Analysis Year	2045				Analysis Time Period, hrs		0.25	
Time Analyzed	PM Peak				Peak Hour Factor		0.90	
Project Description	Scenario B_Interchange				Jurisdiction		City of Fitchburg	

## Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Movement																
Number of Lanes (N)	0	0	2	0	0	1	1	0	0	0	1	0	0	0	1	0
Lane Assignment	LT		TR		L		TR				LT				LTR	
Volume (V), veh/h	0	80	555	1	0	345	455	10	0	1	125	480	0	15	145	55
Percent Heavy Vehicles, %	3	3	3	3	5	5	5	5	1	1	1	1	1	1	1	1
Flow Rate (v <sub>PCE</sub> ), pc/h	0	92	635	1	0	402	531	12	0	1	140	539	0	17	163	62
Right-Turn Bypass	None				None				Yielding				None			
Conflicting Lanes	1				1				2				2			
Pedestrians Crossing, p/h	0				0				0				0			
Proportion of CAVs, %	0															

## Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB			
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	
Critical Headway, s	4.7000	4.4000		4.7000	4.4000			4.8000	4.8000			4.8000	
Follow-Up Headway, s	2.5000	2.5000		2.5000	2.5000			2.6000	2.8000			2.6000	

## Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB			
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	
Entry Flow (v <sub>e</sub> ), pc/h	342	386		402	543			141	539			242	
Entry Volume, veh/h	332	375		383	517			140	534			240	
Circulating Flow (v <sub>c</sub> ), pc/h	582			233			744			934			
Exiting Flow (v <sub>ex</sub> ), pc/h	652			594			244			566			
Capacity (c <sub>PCE</sub> ), pc/h	824	865		1152	1174			672	695			558	
Capacity (c), veh/h	800	840		1097	1118			665	688			553	
v/c Ratio (x)	0.42	0.45		0.35	0.46			0.21	0.78			0.43	

## Delay and Level of Service

Approach	EB			WB			NB			SB			
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	
Lane Control Delay (d), s/veh	9.7	9.9		6.8	8.3			7.9	24.8			13.6	
Lane LOS	A	A		A	A			A	C			B	
95% Queue Length, Q <sub>95</sub> (veh)	2.1	2.3		1.6	2.5			0.8	7.5			2.2	
95% Queue Length, Q <sub>95</sub> (ft)	53.8	58.9		41.6	65.0			20.2	189.0			55.4	
Approach Delay, s/veh   LOS	9.8		A	7.6		A	21.3		C	13.6		B	
Intersection Delay, s/veh   LOS	12.5						B						