FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

MEMO

VIA EMAIL HollyD@romi.gov

To:	**Ms. Holly J. Donoghue, P.E** **City Engineer, Royal Oak, MI**
From:	**Julie Kroll, PE, PTOE** **Fleis & VandenBrink**
Date:	**June 20, 2022**
Re:	**Road Diet Corridor Study, 11-Mile Road** **City of Royal Oak, Michigan** **Traffic Engineering Study**

1. INTRODUCTION

This memorandum presents the results of the Road Diet Traffic Study for the 11-Mile Road corridor through the City of Royal Oak, Michigan. The City of Royal Oak is evaluating the possibility of a road diet through restriping the existing five-lane and four-lane sections of the 11-Mile Road corridor, between Woodward Avenue (M-1) to the west and Stephenson Highway to the east. The potential road diet will provide a three-lane roadway cross-section, with one (1) lane in each direction and a two-way center left-turn lane. The primary goal of the proposed road diet is improved safety and reduce traffic crashes along the corridor. The project limits are between Woodward Avenue (M-1) and Stephenson Highway, as shown on the attached **Figure 1**. Additional roadway information is summarized in **Table 1**.

Table 1: Existing Roadway Information (11-Mile Road)

	Woodward Avenue (M-1) to Troy Street	Troy Street to Minerva Avenue	Minerva Avenue to Stephenson Highway
Lane	5-lanes (2 lanes each direction and TWLTL)	4-lanes (2 lanes each direction)	5-lanes (2 lanes each direction and TWLTL)
Average Daily Traffic (2019)	14,000 vpd	14,600 vpd	
Functional Classification	Minor Arterial		
Posted Speed Limit	25 - 35 mph		

This study has been completed to examine the traffic operations and capacity, safety, and geometric needs of the corridor, including the following study intersections:

1. 11-Mile Road & Woodward Avenue (M-1)
2. 11-Mile Road & Maxwell Avenue
3. 11-Mile Road & Lafayette Ave. / Sherman Dr.
4. 11-Mile Road & Washington Avenue
5. 11-Mile Road & Center Street
6. 11-Mile Road & Main Street
7. 11-Mile Road & Troy Street
8. 11-Mile Road & Gainsborough Avenue
9. 11-Mile Road & Campbell Road
10. 11-Mile Road & SB Stephenson Highway
11. 11-Mile Road & NB Stephenson Highway

The study includes the evaluation of the existing intersections operations and recommendations, including safety improvements, signal timing optimization along 11-Mile Road, geometric improvements, and other measures that would be effective in improving the operations along the roadway corridor. The study analyses were completed using Synchro and SimTraffic (Version 11) traffic analysis software.

F&V

2. Data Collection

The existing weekday turning movement traffic volume data were collected by F&V subconsultant Gewalt Hamilton Associates (GHA) on Tuesday, November 16, 2021. Intersection Turning Movement Counts (TMC) were collected during the weekday AM (7:00 AM to 9:00 AM), MD (11:00 AM to 1:00 PM) and PM (4:00 PM to 6:00 PM) peak periods at all study intersections. The data collection included Peak Hour Factors (PHFs), pedestrian volumes, and commercial truck percentages which were used in the analysis in accordance with MDOT Electronic Traffic Control Devices guidelines. Peak hours at each intersection were utilized and through volumes were carried along the main study roadways and were balanced to determine the volumes at the site driveways in accordance with MDOT guidelines.

Due to the impact of COVID-19 and the subsequent closure of businesses and schools, the collected traffic volume data may not be representative of "typical" operations. Therefore, historical traffic volume data was reviewed, and adjustment factors were determined to calculate baseline existing 2022 traffic volumes. COVID adjustment factors are summarized in **Table 2** and the raw traffic volume data are attached. The baseline existing 2022 peak hour traffic volumes utilized in the study analyses are shown on the attached **Figure 2**.

Table 2: COVID Traffic Volume Adjustment Factors

COVID Adjustment Factors	
AM	15%
MD	0%
PM	11%

F&V collected an inventory of existing lane use and traffic controls, as shown on the attached **Figure 3**. Additionally, **Exhibit 1** below provides a generalized depiction of the existing cross-section geometries along the study sections of 11-Mile Road. The City of Royal Oak recently implemented updated signal timing along 11-Mile Road; therefore, the current signal timing optimization that was implemented along this corridor was utilized for this evaluation.

3. Existing (2022) Conditions Analysis

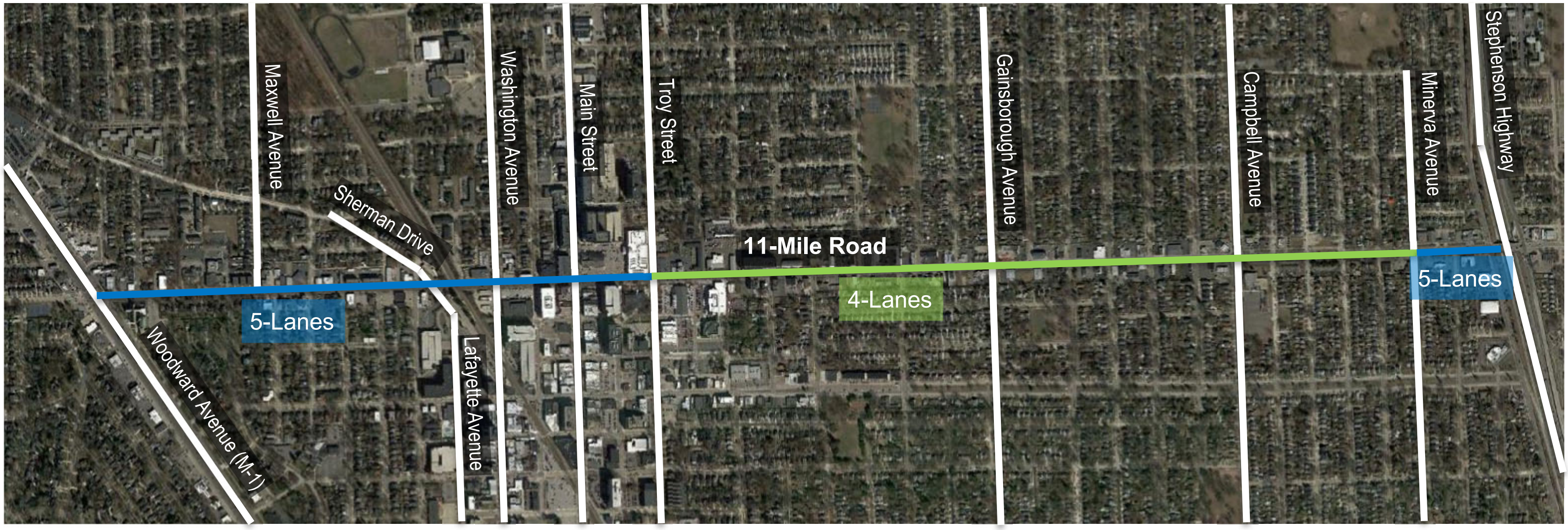
Existing peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 11) traffic analysis software. This analysis was performed based on the existing peak hour traffic volumes shown on the attached **Figure 2**, the existing lane use and traffic control shown on the attached **Figure 3**, and the methodologies presented in the *Highway Capacity Manual 6th, Edition* (HCM). *Note: HCM 6th Edition does not support non-NEMA phasing (Woodward Avenue and Stephenson Highway intersections); therefore, HCM 2000 methodology was utilized for the delay and LOS analyses at these study intersections.*

Typically, LOS D is considered acceptable, with LOS A representing minimal delay, and LOS F indicating failing conditions. Additionally, SimTraffic network simulations were reviewed to evaluate network operations and vehicle queueing throughout the study roadway network. The results for the existing conditions analysis are attached and summarized in **Table 3**.

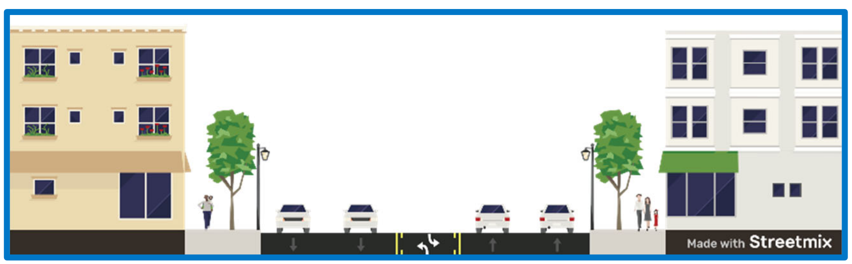
Table 3: Existing Geometry (4-Lanes) Intersection Operations

	Intersection	Control	Approach	Existing Conditions (2022)					
				AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	11-Mile Road & Woodward Avenue (M-1)	Signalized	EBT	28.4	C	23.0	C	39.9	D
			EBR	37.0	D	25.2	C	52.0	D
			WBT	18.5	B	22.6	C	57.0	E
			WBR	31.9	C	31.1	C	98.6	F
			NBT	17.8	B	15.4	B	15.2	B
			NBR	10.9	B	12.0	B	11.4	B
			SBT	16.3	B	15.8	B	17.4	B
			SBR	10.6	B	11.8	B	11.1	B
			Overall	**18.7**	**B**	**17.0**	**B**	**24.1**	**C**

Exhibit 1 – Existing Geometry – 11-Mile Road Corridor



5-Lane Cross-Section



4-Lane Cross-Section

* The images above provide a generalized depiction of the existing 4-lane and 5-lane roadway cross-sections along 11-Mile Road.

Table 3 (continued)

	Intersection	Control	Approach	Existing Conditions (2022)					
				AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2	11-Mile Road & Maxwell Avenue	Signalized	EBL	0.3	A	9.2	A	0.3	A
			EBT	0.1	A	11.2	B	0.2	A
			WBTR	0.4	A	0.3	A	0.3	A
			SBL	38.8	D	36.2	D	51.1	D
			SBR	50.8	D	37.7	D	55.2	E
			Overall	**6.9**	**A**	**7.8**	**A**	**3.3**	**A**
3	11-Mile Road & Lafayette Avenue / Sherman Drive	Signalized	EBL	6.4	A	6.5	A	5.3	A
			EBTR	19.3	B	0.4	A	0.5	A
			WBL	5.8	A	5.3	A	4.3	A
			WBTR	0.4	A	0.3	A	0.4	A
			NBL	42.1	D	36.3	D	52.5	D
			NBTR	47.0	D	39.8	D	57.5	E
			SB	44.0	D	40.6	D	54.4	D
			Overall	**15.3**	**B**	**8.4**	**A**	**9.0**	**A**
4	11-Mile Road & Washington Avenue	Signalized	EBL	16.0	B	16.9	B	17.0	B
			EBTR	7.0	A	11.5	B	17.2	B
			WBL	16.2	B	16.9	B	17.3	B
			WBTR	8.4	A	11.3	B	5.7	A
			NBL	24.8	C	20.4	C	29.9	C
			NBTR	31.2	C	25.3	C	37.5	D
			SBL	24.7	C	19.8	B	30.1	C
			SBT	33.5	C	25.7	C	38.5	D
			SBR	30.1	C	23.8	C	34.8	C
			Overall	**17.7**	**B**	**16.7**	**B**	**21.8**	**C**
5	11-Mile Road & Center Street	Signalized	EBL	0.1	A	0.0	A	0.1	A
			EBTR	0.3	A	0.3	A	0.3	A
			WBL	0.2	A	0.1	A	0.2	A
			WBTR	0.2	A	0.2	A	0.2	A
			SB	47.7	D	41.9	D	61.0	E
			Overall	**1.2**	**A**	**1.2**	**A**	**1.8**	**A**
6	11-Mile Road & Main Street	Signalized	EBL	18.8	B	15.6	B	19.1	B
			EBTR	10.0	B	9.1	A	9.7	A
			WBL	19.5	B	16.0	B	19.5	B
			WBTR	28.7	C	9.9	A	11.5	B
			NBL	24.6	C	22.6	C	27.9	C
			NBTR	35.7	D	32.6	C	41.5	D
			SBL	25.2	C	23.1	C	29.1	C
			SBT	30.0	C	28.0	C	34.8	C
			SBR	28.4	C	26.8	C	31.7	C
			Overall	**26.0**	**C**	**20.5**	**C**	**25.3**	**C**

	Intersection	Control	Approach	Existing Conditions (2022)					
				AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
7	11-Mile Road & Troy Street	Signalized	EBL	0.1	A	0.1	A	0.1	A
			EBTR	0.3	A	0.2	A	0.3	A
			WBL	0.2	A	0.1	A	0.1	A
			WBTR	0.4	A	0.2	A	0.3	A
			NBL	46.6	D	42.3	D	56.3	E
			NBT	44.8	D	41.1	D	52.8	D
			NBR	43.2	D	44.8	D	54.6	D
			SBL	45.9	D	41.9	D	56.2	E
			SBT	43.0	D	40.6	D	51.7	D
			SBR	42.1	D	41.7	D	51.0	D
			Overall	**7.9**	**A**	**7.9**	**A**	**11.7**	**B**
8	11-Mile Road & Gainsborough Avenue	Signalized	EBTL	0.2	A	0.2	A	0.3	A
			EBTR	0.2	A	0.3	A	0.3	A
			WBTL	5.0	A	5.0	A	1.7	A
			WBTR	5.1	A	5.0	A	1.7	A
			NB	46.0	D	41.4	D	58.6	E
			SB	48.3	D	41.8	D	57.2	E
			Overall	**5.6**	**A**	**4.7**	**A**	**4.6**	**A**
9	11-Mile Road & Campbell Road	Signalized	EBL	21.8	C	17.1	B	22.9	C
			EBTR	34.7	C	28.3	C	22.1	C
			WBL	21.6	C	17.0	B	24.3	C
			WBTR	36.9	D	29.4	C	33.5	C
			NBL	24.2	C	23.1	C	28.2	C
			NBTR	40.9	D	33.5	C	44.7	D
			SBL	25.7	C	23.1	C	29.8	C
			SBTR	34.6	C	32.7	C	40.0	D
			Overall	**35.1**	**D**	**29.3**	**C**	**35.1**	**D**
10	11-Mile Road & SB Stephenson Highway	Signalized	EBT	17.4	B	8.2	A	13.2	B
			EBR	19.8	B	8.6	A	14.4	B
			WBL	1.9	A	4.4	A	7.1	A
			WBT	1.2	A	3.9	A	6.9	A
			SBL	43.3	D	38.2	D	34.1	C
			SBT	43.3	D	37.4	D	34.1	C
			SBR	41.0	D	35.3	D	30.5	C
			Overall	**16.7**	**B**	**16.2**	**B**	**18.6**	**B**
11	11-Mile Road & NB Stephenson Highway	Signalized	EBL	2.8	A	1.5	A	2.0	A
			EBT	1.8	A	1.7	A	2.6	A
			WBT	8.4	A	6.7	A	8.5	A
			WBR	7.7	A	6.4	A	7.9	A
			NBL	46.4	D	41.3	D	38.8	D
			NBT	44.4	D	39.1	D	36.8	D
			NBR	43.2	D	38.0	D	35.8	D
			Overall	**11.7**	**B**	**11.9**	**B**	**11.3**	**B**

The results of the existing conditions analysis indicate that all study intersection approaches and movements currently operate acceptably at a LOS D or better during all peak periods (AM, MD, & PM) analyzed, with the exception of the following:

11-Mile Road & Woodward Avenue (M-1)

- During PM peak hour: The westbound right-turn movement and the westbound through movement are currently operating at LOS F and LOS E, respectively.

Although the Synchro LOS analysis indicates poor operations for the westbound approach, review of the SimTraffic network simulations indicates a 95th percentile queue length of approximately 157-feet (6-7 vehicles) or less. Additionally, microsimulation observations indicate that the majority of vehicle queues were serviced within each cycle length and any residual vehicle queues were observed to dissipate and were not present throughout the peak hour.

11-Mile Road & Maxwell Avenue

- During PM peak hour: The southbound right-turn movement is currently operating at LOS E.

Although the Synchro LOS analysis indicates poor operations for the southbound right-turn movement, review of the microsimulations indicates a 95th percentile queue length of approximately 53-feet (~2 vehicles), which is not significant. Additionally, SimTraffic network simulation observations indicate that all vehicle queues were serviced within each cycle length.

11-Mile Road & Lafayette Avenue / Sherman Drive

- During PM peak hour: The northbound shared through/right lane is currently operating at LOS E.

Although the Synchro LOS analysis indicates poor operations for the westbound approach, review of the SimTraffic network simulations indicates a 95th percentile queue length of approximately 146-feet (5-6 vehicles) or less. Additionally, microsimulation observations indicate that the majority of vehicle queues were serviced within each cycle length and any residual vehicle queues were observed to dissipate and were not present throughout the peak hour.

11-Mile Road & Center Street

- During PM peak hour: The southbound approach is currently operating at LOS E.

Although the Synchro LOS analysis indicates poor operations for the southbound right-turn movement, review of the microsimulations indicates a 95th percentile queue length of approximately 56-feet (2-3 vehicles), which is not significant. Additionally, SimTraffic network simulation observations indicate that all vehicle queues were serviced within each cycle length.

11-Mile Road & Troy Street

- During PM peak hour: The northbound left-turn movement and the southbound left-turn movement are currently operating at LOS E.

Although the Synchro LOS analysis indicates poor operations for the westbound approach, review of the SimTraffic network simulations indicates a 95th percentile queue length of approximately 86-feet (3-4 vehicles) or less. Additionally, microsimulation observations indicate that the majority of vehicle queues were serviced within each cycle length and any residual vehicle queues were observed to dissipate and were not present throughout the peak hour.

11-Mile Road & Gainsborough Avenue

- During PM peak hour: The northbound and southbound approaches are currently operating at LOS E.

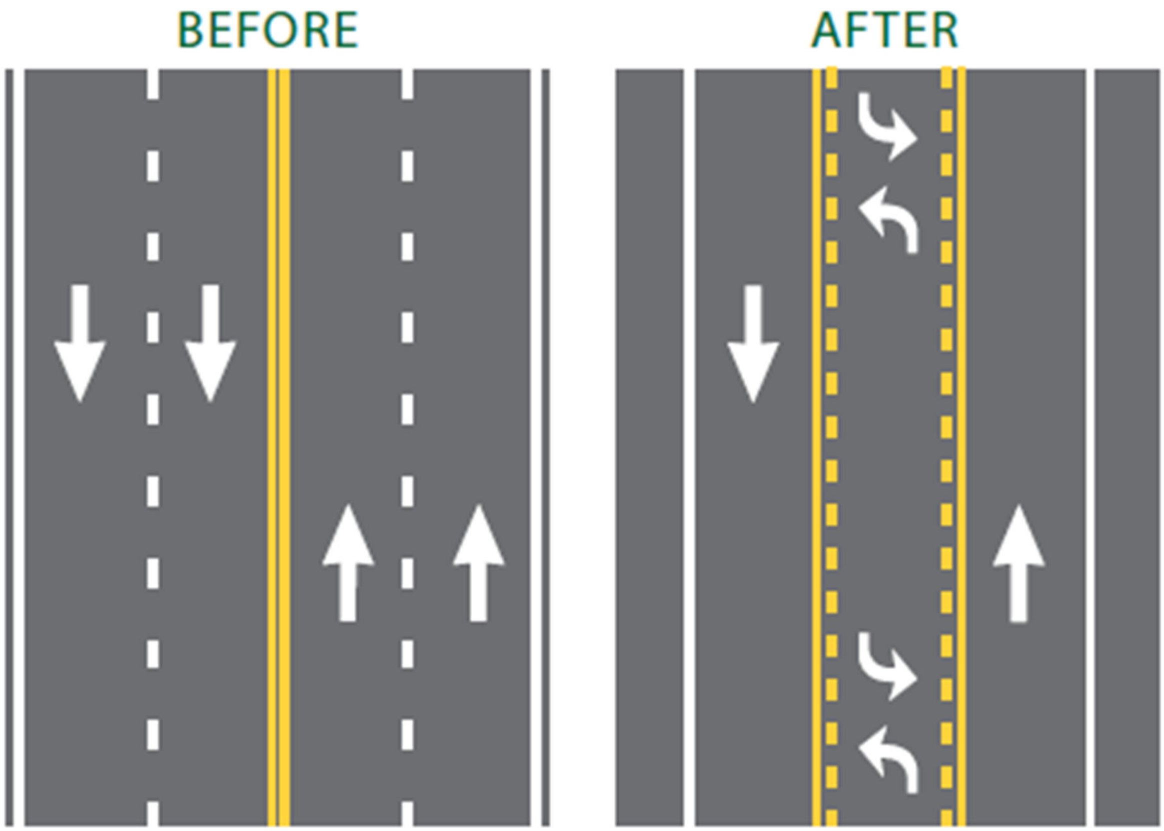
Although the Synchro LOS analysis indicates poor operations for the southbound right-turn movement, review of the microsimulations indicates a 95th percentile queue length of approximately 68-feet (2-3 vehicles), which is not significant. Additionally, SimTraffic network simulation observations indicate that all vehicle queues were serviced within each cycle length.

Remaining Study Network

Review of SimTraffic network simulations for the remaining study roadway network intersections indicates generally acceptable operations during all peak periods.

4. Road Diet (3-Lanes) - Opening Day (2022) Analysis

The City of Royal Oak is considering a road diet through restriping the existing five-lane and four-lane sections of the 11-Mile Road corridor, between Woodward Avenue (M-1) to the west and Stephenson Highway to the east. The proposed road diet is designed to provide a three-lane roadway throughout the study corridor, with one (1) lane in each direction and a two-way center left-turn lane.



Therefore, the proposed road diet configuration (3-lanes) was evaluated along the 11-Mile Road corridor, based on the existing traffic volumes shown on the attached **Figure 2**, to determine the feasibility of a road diet for this corridor and to determine if any improvements are recommended to accommodate such a road diet. *Note: The Woodward Avenue (M-1) and Stephenson Highway intersections with 11-Mile Road are the project limits for this study; therefore, the proposed road diet lane configuration at these study intersections was assumed to remain unchanged with the implementation of the proposed road diet.*

The road diet intersection operations analysis results are attached and are summarized in **Table 4**. The results of the road diet evaluation indicate that, with the implementation of the proposed three-lane road-diet, all study intersection approaches and movements will continue to operate acceptably, in a manner similar to the existing conditions analysis, with the exception of the following:

11-Mile Road & Main Street

- <u>During AM peak hour:</u> The westbound shared through/right lane is expected to operate at LOS E.

Review of SimTraffic network simulations indicates periods of long vehicle queues for the westbound approach during the AM and PM peak hours; however, these vehicle queues were typically observed to dissipate and were not present throughout the peak periods. Review of the existing peak hour traffic volumes indicates that there is a moderately high volume of westbound right-turn traffic during the AM (~95 vehicles) and PM (~110 vehicles) peak hours that is contributing to the delay for the shared westbound through/right lane. Additionally, the vehicle queueing generated by the westbound approach was observed to occasionally extend back through and block the adjacent study intersections.

11-Mile Road & Campbell Road

- During PM peak hour: The westbound shared through/right lane is expected to operate at LOS E.

Review of SimTraffic network simulations indicates long vehicle queues for the westbound approach during the PM peak hour; these vehicle queues were generally present throughout the PM peak period. Review of the existing peak hour traffic volumes indicates that there is a moderately high volume of westbound right-turn traffic during the AM (~110 vehicles), MD (~90 vehicles), and PM (~135 vehicles) peak hours that is contributing to the delay for the shared westbound through/right lane. However, review of SimTraffic microsimulations indicates generally acceptable operations during the AM and MD peak periods.

Mitigation measures to improve the LOS at the identified intersections above are provided in the following section.

Remaining Study Network

Review of SimTraffic network simulations for the remaining study roadway network intersections indicates generally acceptable operations during all peak periods. However, occasional periods of vehicle queues were observed for the eastbound right-turn movements at the study intersections of 11-Mile Road & Center Street and 11-Mile Road & Main Street during the AM and PM peak hours. These queues would typically dissipate and were not present throughout the peak periods; however, the vehicle queueing was occasionally observed to exceed the roadway segment, resulting in vehicle queues extending through adjacent intersections and impacting the microsimulation operations at those intersections. Microsimulation observations at all other study intersections indicates generally acceptable operations, with no additional significant delays and/or excessive vehicle queueing observed.

Table 4: Road Diet Geometry (3-Lanes) Intersection Operations – Opening Day (2022)

	Intersection	Control	Approach	Existing Conditions (2022)						Road Diet (Opening Day 2022)						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	11-Mile Road & Woodward Avenue (M-1)	Signalized	EBT	28.4	C	23.0	C	39.9	D	28.4	C	23.0	C	39.9	D	0.0	-	0.0	-	0.0	-
			EBR	37.0	D	25.2	C	52.0	D	37.0	D	25.2	C	52.0	D	0.0	-	0.0	-	0.0	-
			WBT	18.5	B	22.6	C	57.0	E	19.9	B	21.8	C	55.4	E	1.4	-	-0.8	-	-1.6	-
			WBR	31.9	C	31.1	C	98.6	F	31.6	C	30.0	C	95.7	F	-0.3	-	-1.1	-	-2.9	-
			NBT	17.8	B	15.4	B	15.2	B	17.8	B	15.4	B	15.2	B	0.0	-	0.0	-	0.0	-
			NBR	10.9	B	12.0	B	11.4	B	10.9	B	12.0	B	11.4	B	0.0	-	0.0	-	0.0	-
			SBT	16.3	B	15.8	B	17.4	B	16.3	B	15.8	B	17.4	B	0.0	-	0.0	-	0.0	-
			SBR	10.6	B	11.8	B	11.1	B	10.6	B	11.8	B	11.1	B	0.0	-	0.0	-	0.0	-
			Overall	**18.7**	**B**	**17.0**	**B**	**24.1**	**C**	**18.8**	**B**	**16.9**	**B**	**23.9**	**C**	**0.1**	**-**	**-0.1**	**-**	**-0.2**	**-**
2	11-Mile Road & Maxwell Avenue	Signalized	EBL	0.3	A	9.2	A	0.3	A	0.3	A	2.7	A	0.3	A	0.0	-	-6.5	-	0.0	-
			EBT	0.1	A	11.2	B	0.2	A	0.5	A	3.7	A	0.7	A	0.4	-	-7.5	B→A	0.5	-
			WBTR	0.4	A	0.3	A	0.3	A	0.8	A	0.6	A	0.7	A	0.4	-	0.3	-	0.4	-
			SBL	38.8	D	36.2	D	51.1	D	38.8	D	36.2	D	51.1	D	0.0	-	0.0	-	0.0	-
			SBR	50.8	D	37.7	D	55.2	E	50.8	D	37.7	D	55.2	E	0.0	-	0.0	-	0.0	-
			Overall	**6.9**	**A**	**7.8**	**A**	**3.3**	**A**	**7.3**	**A**	**4.6**	**A**	**3.7**	**A**	**0.4**	**-**	**-3.2**	**-**	**0.4**	**-**
3	11-Mile Road & Lafayette Avenue / Sherman Drive	Signalized	EBL	6.4	A	6.5	A	5.3	A	6.4	A	6.5	A	5.3	A	0.0	-	0.0	-	0.0	-
			EBTR	19.3	B	0.4	A	0.5	A	24.6	C	0.9	A	1.2	A	5.3	B→C	0.5	-	0.7	-
			WBL	5.8	A	5.3	A	4.3	A	8.1	A	5.3	A	4.3	A	2.3	-	0.0	-	0.0	-
			WBTR	0.4	A	0.3	A	0.4	A	0.9	A	0.7	A	0.7	A	0.5	-	0.4	-	0.3	-
			NBL	42.1	D	36.3	D	52.5	D	42.1	D	36.3	D	52.5	D	0.0	-	0.0	-	0.0	-
			NBTR	47.0	D	39.8	D	57.5	E	47.0	D	39.8	D	57.5	E	0.0	-	0.0	-	0.0	-
			SB	44.0	D	40.6	D	54.4	D	44.0	D	40.6	D	54.4	D	0.0	-	0.0	-	0.0	-
			Overall	**15.3**	**B**	**8.4**	**A**	**9.0**	**A**	**17.5**	**B**	**8.7**	**A**	**9.4**	**A**	**2.2**	**-**	**0.3**	**-**	**0.4**	**-**
4	11-Mile Road & Washington Avenue	Signalized	EBL	16.0	B	16.9	B	17.0	B	17.2	B	17.5	B	17.5	B	1.2	-	0.6	-	0.5	-
			EBTR	7.0	A	11.5	B	17.2	B	10.3	B	17.2	B	25.5	C	3.3	A→B	5.7	-	8.3	B→C
			WBL	16.2	B	16.9	B	17.3	B	16.7	B	17.9	B	20.9	C	0.5	-	1.0	-	3.6	B→C
			WBTR	8.4	A	11.3	B	5.7	A	14.6	B	15.7	B	8.5	A	6.2	A→B	4.4	-	2.8	-
			NBL	24.8	C	20.4	C	29.9	C	24.8	C	20.4	C	29.9	C	0.0	-	0.0	-	0.0	-
			NBTR	31.2	C	25.3	C	37.5	D	31.2	C	25.3	C	37.5	D	0.0	-	0.0	-	0.0	-
			SBL	24.7	C	19.8	B	30.1	C	24.7	C	19.8	B	30.1	C	0.0	-	0.0	-	0.0	-
			SBT	33.5	C	25.7	C	38.5	D	33.5	C	25.7	C	38.5	D	0.0	-	0.0	-	0.0	-
			SBR	30.1	C	23.8	C	34.8	C	30.1	C	23.8	C	34.8	C	0.0	-	0.0	-	0.0	-
			Overall	**17.7**	**B**	**16.7**	**B**	**21.8**	**C**	**20.3**	**C**	**19.5**	**B**	**25.1**	**C**	**2.6**	**B→C**	**2.8**	**-**	**3.3**	**-**

** Decreased delays and improved LOS are the result of improved progression and arrival on green factors and HCM methodology*

	Intersection	Control	Approach	Existing Conditions (2022)						Road Diet (Opening Day 2022)						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
5	11-Mile Road & Center Street	Signalized	EBL	0.1	A	0.0	A	0.1	A	0.0	A	0.0	A	0.0	A	-0.1	-	0.0	-	-0.1	-
			EBTR	0.3	A	0.3	A	0.3	A	0.6	A	0.4	A	0.5	A	0.3	-	0.1	-	0.2	-
			WBL	0.2	A	0.1	A	0.2	A	0.1	A	0.1	A	0.1	A	-0.1	-	0.0	-	-0.1	-
			WBTR	0.2	A	0.2	A	0.2	A	0.2	A	0.4	A	0.4	A	0.0	-	0.2	-	0.2	-
			SB	47.7	D	41.9	D	61.0	E	47.7	D	41.9	D	61.0	E	0.0	-	0.0	-	0.0	-
			Overall	**1.2**	**A**	**1.2**	**A**	**1.8**	**A**	**1.3**	**A**	**1.4**	**A**	**1.9**	**A**	**0.1**	**-**	**0.2**	**-**	**0.1**	**-**
6	11-Mile Road & Main Street	Signalized	EBL	18.8	B	15.6	B	19.1	B	28.0	C	16.0	B	21.8	C	9.2	B→C	0.4	-	2.7	B→C
			EBTR	10.0	B	9.1	A	9.7	A	13.8	B	11.9	B	14.6	B	3.8	-	2.8	A→B	4.9	A→B
			WBL	19.5	B	16.0	B	19.5	B	19.7	B	16.4	B	20.7	C	0.2	-	0.4	-	1.2	B→C
			WBTR	28.7	C	9.9	A	11.5	B	56.7	E	12.9	B	20.7	C	28.0	C→E	3.0	A→B	9.2	B→C
			NBL	24.6	C	22.6	C	27.9	C	24.6	D	22.6	C	27.9	C	0.0	C→D	0.0	-	0.0	-
			NBTR	35.7	D	32.6	C	41.5	D	35.7	D	32.6	C	41.5	D	0.0	-	0.0	-	0.0	-
			SBL	25.2	C	23.1	C	29.1	C	25.2	C	23.1	C	29.1	C	0.0	-	0.0	-	0.0	-
			SBT	30.0	C	28.0	C	34.8	C	30.0	C	28.0	C	34.8	C	0.0	-	0.0	-	0.0	-
			SBR	28.4	C	26.8	C	31.7	C	28.4	C	26.8	C	31.7	C	0.0	-	0.0	-	0.0	-
			Overall	**26.0**	**C**	**20.5**	**C**	**25.3**	**C**	**33.8**	**C**	**21.6**	**C**	**28.2**	**C**	**7.8**	**-**	**1.1**	**-**	**2.9**	**-**
7	11-Mile Road & Troy Street	Signalized	EBL	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.0	-	0.0	-	0.0	-
			EBTR	0.3	A	0.2	A	0.3	A	0.6	A	0.5	A	0.8	A	0.3	-	0.3	-	0.5	-
			WBL	0.2	A	0.1	A	0.1	A	0.2	A	0.1	A	0.1	A	0.0	-	0.0	-	0.0	-
			WBTR	0.4	A	0.2	A	0.3	A	0.9	A	0.4	A	0.6	A	0.5	-	0.2	-	0.3	-
			NBL	46.6	D	42.3	D	56.3	E	46.6	D	42.3	D	56.3	E	0.0	-	0.0	-	0.0	-
			NBT	44.8	D	41.1	D	52.8	D	44.8	D	41.1	D	52.8	D	0.0	-	0.0	-	0.0	-
			NBR	43.2	D	44.8	D	54.6	D	43.2	D	44.8	D	54.6	D	0.0	-	0.0	-	0.0	-
			SBL	45.9	D	41.9	D	56.2	E	45.9	D	41.9	D	56.2	E	0.0	-	0.0	-	0.0	-
			SBT	43.0	D	40.6	D	51.7	D	43.0	D	40.6	D	51.7	D	0.0	-	0.0	-	0.0	-
			SBR	42.1	D	41.7	D	51.0	D	42.1	D	41.7	D	51.0	D	0.0	-	0.0	-	0.0	-
			Overall	**7.9**	**A**	**7.9**	**A**	**11.7**	**B**	**8.2**	**A**	**8.1**	**A**	**12.0**	**B**	**0.3**	**-**	**0.2**	**-**	**0.3**	**-**
8	11-Mile Road & Gainsborough Avenue	Signalized	EBL	0.2	A	0.2	A	0.3	A	0.0	A	0.0	A	0.4	A	-0.2	-	-0.2	-	0.1	-
			EBTR	0.2	A	0.3	A	0.3	A	0.5	A	0.5	A	0.7	A	0.3	-	0.2	-	0.4	-
			WBL	5.0	A	5.0	A	1.7	A	0.0	A	0.0	A	1.3	A	-5.0	-	-5.0	-	-0.4	-
			WBTR	5.1	A	5.0	A	1.7	A	0.4	A	0.4	A	2.4	A	-4.7	-	-4.6	-	0.7	-
			NB	46.0	D	41.4	D	58.6	E	46.0	D	41.4	D	58.6	E	0.0	-	0.0	-	0.0	-
			SB	48.3	D	41.8	D	57.2	E	48.3	D	41.8	D	57.2	E	0.0	-	0.0	-	0.0	-
			Overall	**5.6**	**A**	**4.7**	**A**	**4.6**	**A**	**3.6**	**A**	**2.8**	**A**	**5.1**	**A**	**-2.0**	**-**	**-1.9**	**-**	**0.5**	**-**

** Decreased delays and improved LOS are the result of improved progression and arrival on green factors and HCM methodology*

	Intersection	Control	Approach	Existing Conditions (2022)						Road Diet (Opening Day 2022)						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
9	11-Mile Road & Campbell Road	Signalized	EBL	21.8	C	17.1	B	22.9	C	25.3	C	18.0	B	35.7	D	3.5	-	0.9	-	12.8	C→D
			EBTR	34.7	C	28.3	C	22.1	C	43.8	D	27.8	C	16.5	B	9.1	C→D	-0.5	-	-5.6	C→B
			WBL	21.6	C	17.0	B	24.3	C	23.8	C	17.8	B	25.0	C	2.2	-	0.8	-	0.7	-
			WBTR	36.9	D	29.4	C	33.5	C	47.9	D	34.2	C	55.4	E	11.0	-	4.8	-	21.9	C→E
			NBL	24.2	C	23.1	C	28.2	C	24.2	C	23.1	C	28.2	C	0.0	-	0.0	-	0.0	-
			NBTR	40.9	D	33.5	C	44.7	D	40.9	D	33.5	C	44.7	D	0.0	-	0.0	-	0.0	-
			SBL	25.7	C	23.1	C	29.8	C	25.7	C	23.1	C	29.8	C	0.0	-	0.0	-	0.0	-
			SBTR	34.6	C	32.7	C	40.0	D	34.6	C	32.7	C	40.0	D	0.0	-	0.0	-	0.0	-
			Overall	**35.1**	**D**	**29.3**	**C**	**35.1**	**D**	**38.5**	**D**	**30.1**	**C**	**38.8**	**D**	**3.4**	**-**	**0.8**	**-**	**3.7**	**-**
10	11-Mile Road & SB Stephenson Highway	Signalized	EBT	17.4	B	8.2	A	13.2	B	17.8	B	13.3	B	13.2	B	0.4	-	5.1	A→B	0.0	-
			EBR	19.8	B	8.6	A	14.4	B	20.4	C	14.0	B	14.4	B	0.6	B→C	5.4	A→B	0.0	-
			WBL	1.9	A	4.4	A	7.1	A	1.9	A	4.4	A	7.1	A	0.0	-	0.0	-	0.0	-
			WBT	1.2	A	3.9	A	6.9	A	1.2	A	3.9	A	6.9	A	0.0	-	0.0	-	0.0	-
			SBL	43.3	D	38.2	D	34.1	C	43.3	D	38.2	D	34.1	C	0.0	-	0.0	-	0.0	-
			SBT	43.3	D	37.4	D	34.1	C	43.3	D	37.4	D	34.1	C	0.0	-	0.0	-	0.0	-
			SBR	41.0	D	35.3	D	30.5	C	41.0	D	35.3	D	30.5	C	0.0	-	0.0	-	0.0	-
			Overall	**16.7**	**B**	**16.2**	**B**	**18.6**	**B**	**16.9**	**B**	**18.0**	**B**	**18.6**	**B**	**0.2**	**-**	**1.8**	**-**	**0.0**	**-**
11	11-Mile Road & NB Stephenson Highway	Signalized	EBL	2.8	A	1.5	A	2.0	A	3.0	A	1.5	A	2.0	A	0.2	-	0.0	-	0.0	-
			EBT	1.8	A	1.7	A	2.6	A	1.8	A	1.7	A	2.6	A	0.0	-	0.0	-	0.0	-
			WBT	8.4	A	6.7	A	8.5	A	8.4	A	6.7	A	8.5	A	0.0	-	0.0	-	0.0	-
			WBR	7.7	A	6.4	A	7.9	A	7.7	A	6.4	A	7.9	A	0.0	-	0.0	-	0.0	-
			NBL	46.4	D	41.3	D	38.8	D	46.4	D	41.3	D	38.8	D	0.0	-	0.0	-	0.0	-
			NBT	44.4	D	39.1	D	36.8	D	44.4	D	39.1	D	36.8	D	0.0	-	0.0	-	0.0	-
			NBR	43.2	D	38.0	D	35.8	D	43.2	D	38.0	D	35.8	D	0.0	-	0.0	-	0.0	-
			Overall	**11.7**	**B**	**11.9**	**B**	**11.3**	**B**	**11.8**	**B**	**11.9**	**B**	**11.3**	**B**	**0.1**	**-**	**0.0**	**-**	**0.0**	**-**

** Decreased delays and improved LOS are the result of improved progression and arrival on green factors and HCM methodology*

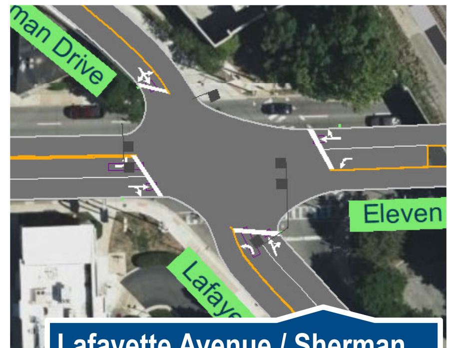
5. Recommended Intersection Geometry

Mitigation measures were reviewed with the addition of the road diet to improve the operations, including signal timing adjustments and recommended intersection geometry. Each of the study intersections and recommended intersection geometry and improvements, if any, are summarized in **Exhibit 2** below and shown on the on the attached **Figure 4.** Additionally, **Exhibit 3** provides the sections recommended for a road diet and potential conversion options for the existing cross-section geometries along the study sections of 11-Mile Road.

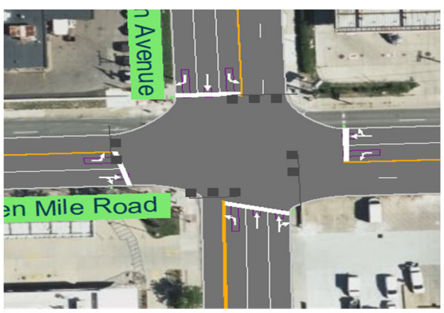
Exhibit 2 – Recommended Intersection Geometry

Woodward Avenue (M-1)
- No changes.
- Transition to/from the three-lane section is recommended to the east of this intersection.

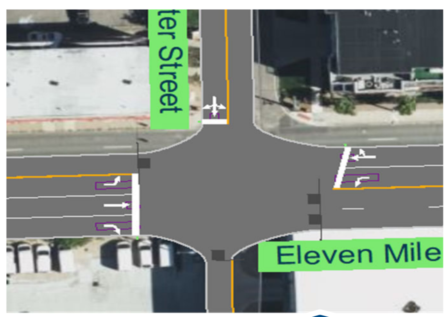
Maxwell Avenue
- No mitigation



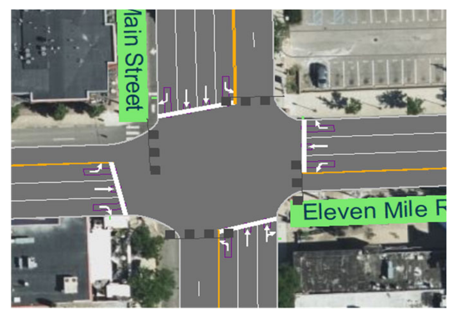
Lafayette Avenue / Sherman Drive
- No mitigation



Washington Avenue
- No mitigation.



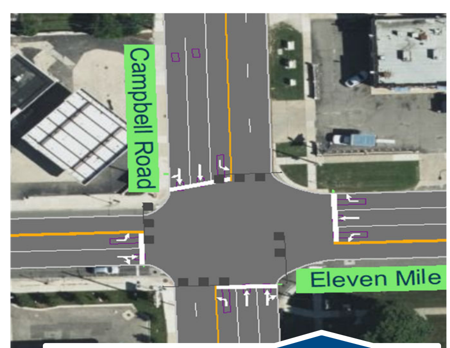
Center Street
- Provide an exclusive EB right-turn lane.



Main Street
- Provide exclusive EB and WB right-turn lanes.

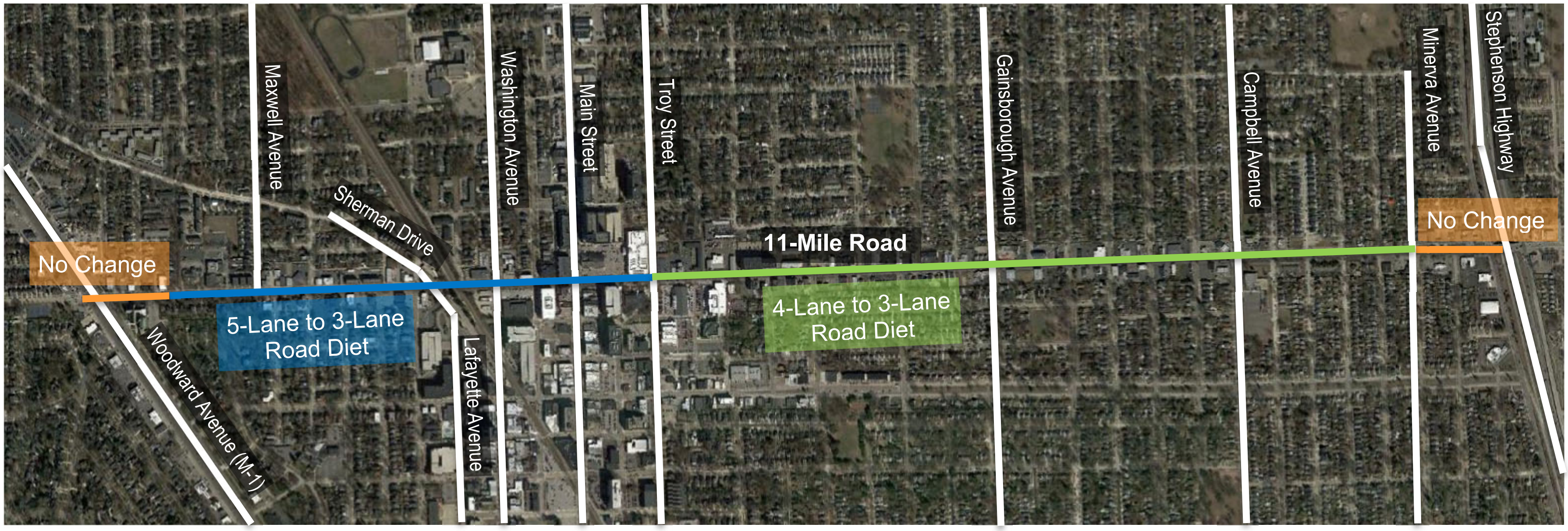
Troy Street
- No mitigation.

Gainsborough Avenue
- No mitigation.

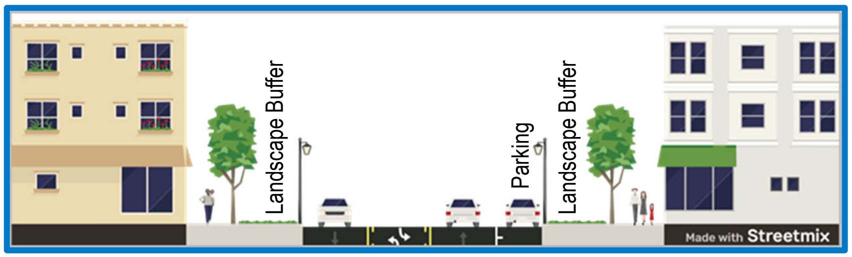


Campbell Road
- Provide an exclusive WB right-turn lane.

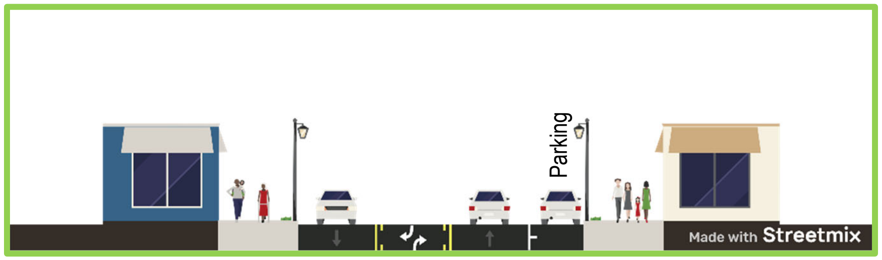
Exhibit 3 – Recommended Geometry – 11-Mile Road Corridor



5-Lane to 3-Lane Road Diet



4-Lane to 3-Lane Road Diet



* The images above depict potential road diet conversion options for the existing 4-lane and 5-lane roadway cross-sections along 11-Mile Road.

Table 5: Road Diet Geometry (3-Lanes) w/ Mitigation Measures – Opening Day (2022) Intersection Operations

	Intersection	Control	Approach	Road Diet (Opening Day 2022)						Road Diet (Opening Day) w/ IMPs						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
5	11 Mile Road & Center Street	Signalized [IMPs]	EBL	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	A	0.0	-	0.0	-	0.0	-
			EBTR [EBT]	0.6	A	0.4	A	0.5	A	0.5	A	0.3	A	0.4	A	-0.1	-	-0.1	-	-0.1	-
			EBTR [EBR]	0.6	A	0.4	A	0.5	A	0.0	A	0.1	A	0.0	A	-0.6	-	-0.3	-	-0.5	-
			WBL	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.0	-	0.0	-	0.0	-
			WBTR	0.2	A	0.4	A	0.4	A	0.5	A	0.4	A	0.5	A	0.3	-	0.0	-	0.1	-
			SB	47.7	D	41.9	D	61.0	E	47.7	D	41.9	D	61.0	E	0.0	-	0.0	-	0.0	-
			Overall	**1.3**	**A**	**1.4**	**A**	**1.9**	**A**	**1.3**	**A**	**1.3**	**A**	**1.9**	**A**	**0.0**	**-**	**-0.1**	**-**	**0.0**	**-**
6	11 Mile Road & Main Street	Signalized [IMPs]	EBL	28.0	C	16.0	B	21.8	C	21.0	C	15.7	B	19.7	B	-7.0	-	-0.3	-	-2.1	C→B
			EBTR [EBT]	13.8	B	11.9	B	14.6	B	12.6	B	10.2	B	12.0	B	-1.2	-	-1.7	-	-2.6	-
			EBTR [EBR]	13.8	B	11.9	B	14.6	B	8.4	A	8.1	A	8.2	A	-5.4	B→A	-3.8	B→A	-6.4	B→A
			WBL	19.7	B	16.4	B	20.7	C	19.5	B	16.1	B	20.0	B	-0.2	-	-0.3	-	-0.7	C→B
			WBTR [WBT]	56.7	E	12.9	B	20.7	C	31.3	C	11.0	B	14.1	B	-25.4	E→C	-1.9	-	-6.6	C→B
			WBTR [WBR]	56.7	E	12.9	B	20.7	C	19.5	B	8.9	A	9.8	A	-37.2	E→B	-4.0	B→A	-10.9	C→A
			NBL	24.6	D	22.6	C	27.9	C	24.6	D	22.6	C	27.9	C	0.0	-	0.0	-	0.0	-
			NBTR	35.7	D	32.6	C	41.5	D	35.7	D	32.6	C	41.5	D	0.0	-	0.0	-	0.0	-
			SBL	25.2	C	23.1	C	29.1	C	25.2	C	23.1	C	29.1	C	0.0	-	0.0	-	0.0	-
			SBT	30.0	C	28.0	C	34.8	C	30.0	C	28.0	C	34.8	C	0.0	-	0.0	-	0.0	-
			SBR	28.4	C	26.8	C	31.7	C	28.4	C	26.8	C	31.7	C	0.0	-	0.0	-	0.0	-
			Overall	**33.8**	**C**	**21.6**	**C**	**28.2**	**C**	**26.6**	**C**	**20.8**	**C**	**26.0**	**C**	**-7.2**	**-**	**-0.8**	**-**	**-2.2**	**-**
9	11 Mile Road & Campbell Road	Signalized [IMPs]	EBL	25.3	C	18.0	B	35.7	D	22.8	C	17.1	B	23.7	C	-2.5	-	-0.9	-	-12.0	D→C
			EBTR	43.8	D	27.8	C	16.5	B	43.8	D	27.8	C	16.5	B	0.0	-	0.0	-	0.0	-
			WBL	23.8	C	17.8	B	25.0	C	23.8	C	17.8	B	25.0	C	0.0	-	0.0	-	0.0	-
			WBTR [WBT]	47.9	D	34.2	C	55.4	E	39.9	D	30.7	C	38.3	D	-8.0	-	-3.5	-	-17.1	E→D
			WBTR [WBR]	47.9	D	34.2	C	55.4	E	33.6	C	27.7	C	29.8	C	-14.3	D→C	-6.5	-	-25.6	E→C
			NBL	24.2	C	23.1	C	28.2	C	24.2	C	23.1	C	28.2	C	0.0	-	0.0	-	0.0	-
			NBTR	40.9	D	33.5	C	44.7	D	40.9	D	33.5	C	44.7	D	0.0	-	0.0	-	0.0	-
			SBL	25.7	C	23.1	C	29.8	C	25.7	C	23.1	C	29.8	C	0.0	-	0.0	-	0.0	-
			SBTR	34.6	C	32.7	C	40.0	D	34.6	C	32.7	C	40.0	D	0.0	-	0.0	-	0.0	-
			Overall	**38.5**	**D**	**30.1**	**C**	**38.8**	**D**	**36.9**	**D**	**29.3**	**C**	**34.8**	**C**	**-1.6**	**-**	**-0.8**	**-**	**-4.0**	**D→C**

OPENING DAY (2022) IMPROVEMENTS SUMMARY

The results of the Opening Day (2022) intersection operations analysis indicates that, with the implementation of the recommended lane use / geometry, all study intersection approaches and movements will operate acceptably. Review of SimTraffic microsimulations also indicates acceptable operations, with improved vehicle queueing observed at the study intersections of concern. Additionally, with the recommended geometry, all study intersections are expected to operate acceptably, during the AM, MD, and PM peak hours.

Review of SimTraffic network simulations for the remaining study roadway network intersections indicates generally acceptable operations during all peak periods. Microsimulation observations indicate no significant delays or excessive vehicle queueing at all study intersections.

The change in intersection delay from existing operations to the 3-lane operations, with the recommended mitigation measures, is summarized in **Table 6** and indicates that the maximum increase in intersection delay is 2-3 seconds and the maximum increase in turning movement delay is less than 10 seconds. Therefore, the overall increase in delay associated with the proposed road diet is negligible.

Table 6: Road Diet Delay Summary (2022) w/ Mitigation Measures

	AM Peak Hour	MD Peak Hour	PM Peak Hour
Max Intersection Increase in Delay	2.6 sec	2.8 sec	3.3 sec
Max Turning Movement Increase in Delay	9.1 sec	5.7 sec	8.3 sec
11-Mile Corridor Travel Time Increase	0.5 min (EB) 0.9 min (WB)	0.4 min (EB) 0.2 min (WB)	1.8 min (EB) 0.8 min (WB)

6. HORIZON YEAR (2042) ANALYSIS

Historical traffic volume data along the study section of 11-Mile Road was reviewed and indicated a negative annual growth in the area; therefore, a conservative annual background growth rate of 0.25% was applied to the existing 2022 traffic volumes to forecast the Horizon Year (2042) traffic volumes, as shown in the attached **Figure 5**. The Horizon Year (2042) peak hour analysis was performed assuming the implementation of the recommended improvements previously identified.

Therefore, the Horizon Year (2042) conditions analysis was evaluated based on the recommended lane use and traffic control shown on the attached **Figure 4**, the Horizon Year (2042) traffic volumes shown on the attached **Figure 5**, and the methodologies presented in the HCM6. The Horizon Year (2042) analysis compares the Horizon Year (2042) traffic volumes under current conditions compared to the recommended geometry; the results of the analysis are summarized in **Table 8**. The results of the Horizon Year (2042) analysis indicates that, with the recommended intersection geometries identified in the Opening Day (2022) analysis, all study intersection approaches and movements will operate acceptably during all peak periods.

Review of SimTraffic network simulations indicates acceptable operations throughout the study network. Occasional periods of vehicle queues were observed in the downtown area (Washington Avenue to Troy Street) during the AM and PM peak hours; however, these queues were observed to dissipate and were not present throughout the peak periods. Additionally, occasional periods of vehicle queueing was also observed for the westbound approach at the 11-Mile Road & Campbell Road intersection during the PM peak hour; however, these queues were also observed to quickly dissipate and were not present throughout the PM peak hour.

At the Horizon Year (2042) buildout, signal timing optimization should be re-evaluated in order to optimize the intersection operations and mitigate future delays throughout the corridor; however, no additional geometric improvements are recommended. The overall increase in delay associated with the proposed road diet is negligible and is summarized in **Table 7**.

Table 7: Road Diet Delay Summary (2042) w/ Mitigation Measures

	AM Peak Hour	MD Peak Hour	PM Peak Hour
Max Intersection Increase in Delay	6.3 sec	3.4 sec	1.8 sec
Max Turning Movement Increase in Delay	15.7 sec	7.0 sec	5.8 sec
11-Mile Corridor Travel Time Increase	0.7 min (EB) 1.0 min (WB)	0.5 min (EB) 0.2 min (WB)	2.4 min (EB) 1.2 min (WB)

Table 8: Road Diet Geometry (3-Lanes) w/ Mitigation Measures – Horizon Year (2042) Intersection Operations

	Intersection	Control	Approach	Existing Conditions (2042)						Road Diet (Horizon Year 2042)						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	11 Mile Road & Woodward Avenue (M-1)	Signalized	EBT	28.5	C	23.1	C	40.3	D	28.5	C	23.1	C	40.3	D	0.0	-	0.0	-	0.0	-
			EBR	38.3	D	25.4	C	54.7	D	38.3	D	25.4	C	54.7	D	0.0	-	0.0	-	0.0	-
			WBT	18.4	B	22.2	C	57.7	E	20.2	C	21.8	C	55.2	E	1.8	B→C	-0.4	-	-2.5	-
			WBR	34.3	C	31.4	C	111.5	F	34.2	C	30.7	C	108.2	F	-0.1	-	-0.7	-	-3.3	-
			NBT	18.7	B	15.7	B	15.9	B	18.7	B	15.7	B	15.9	B	0.0	-	0.0	-	0.0	-
			NBR	11.0	B	12.0	B	11.6	B	11.0	B	12.0	B	11.6	B	0.0	-	0.0	-	0.0	-
			SBT	17.0	B	16.2	B	18.4	B	17.0	B	16.2	B	18.4	B	0.0	-	0.0	-	0.0	-
			SBR	10.7	B	11.9	B	11.3	B	10.7	B	11.9	B	11.3	B	0.0	-	0.0	-	0.0	-
			Overall	**19.5**	**B**	**17.3**	**B**	**25.5**	**C**	**19.5**	**B**	**17.3**	**B**	**25.2**	**C**	**0.0**	**-**	**0.0**	**-**	**-0.3**	**-**
2	11 Mile Road & Maxwell Avenue	Signalized	EBL	0.3	A	9.3	A	0.4	A	0.3	A	2.8	A	1.3	A	0.0	-	-6.5	-	0.9	-
			EBT	0.1	A	11.4	B	0.2	A	0.5	A	3.8	A	0.8	A	0.4	-	-7.6	B→A	0.6	-
			WBTR	0.4	A	0.3	A	0.3	A	0.9	A	0.6	A	3.7	A	0.5	-	0.3	-	3.4	-
			SBL	38.4	D	36.3	D	51.2	D	38.4	D	36.3	D	51.2	D	0.0	-	0.0	-	0.0	-
			SBR	50.6	D	37.8	D	55.6	E	50.6	D	37.8	D	55.6	E	0.0	-	0.0	-	0.0	-
			Overall	**6.8**	**A**	**8.0**	**A**	**3.4**	**A**	**7.3**	**D**	**4.7**	**A**	**5.2**	**A**	**0.5**	**A→D**	**-3.3**	**-**	**1.8**	**-**
3	11 Mile Road & Lafayette Avenue / Sherman Drive	Signalized	EBL	6.7	A	6.7	A	5.5	A	6.7	A	6.7	A	5.5	A	0.0	-	0.0	-	0.0	-
			EBTR	19.9	B	0.4	A	0.5	A	25.6	C	1.0	A	3.1	A	5.7	B→C	0.6	-	2.6	-
			WBL	6.2	A	5.4	A	4.5	A	8.7	A	5.4	A	4.7	A	2.5	-	0.0	-	0.2	-
			WBTR	0.5	A	0.3	A	0.4	A	0.9	A	0.7	A	0.8	A	0.4	-	0.4	-	0.4	-
			NBL	41.6	D	36.0	D	52.2	D	41.6	D	36.0	D	52.2	D	0.0	-	0.0	-	0.0	-
			NBTR	46.2	D	39.4	D	56.9	E	46.2	D	39.4	D	56.9	E	0.0	-	0.0	-	0.0	-
			SB	43.8	D	40.5	D	54.2	D	43.8	D	40.5	D	54.2	D	0.0	-	0.0	-	0.0	-
			Overall	**15.5**	**B**	**8.3**	**A**	**9.0**	**A**	**17.8**	**B**	**8.7**	**A**	**10.2**	**B**	**2.3**	**-**	**0.4**	**-**	**1.2**	**A→B**
4	11 Mile Road & Washington Avenue	Signalized	EBL	16.2	B	17.0	B	17.2	B	18.6	B	17.9	B	17.2	B	2.4	-	0.9	-	0.0	-
			EBTR	7.4	A	11.9	B	17.7	B	23.1	C	18.9	B	11.9	B	15.7	A→C	7.0	-	-5.8	-
			WBL	16.4	B	17.1	B	17.7	B	18.4	B	18.4	B	18.4	B	2.0	-	1.3	-	0.7	-
			WBTR	8.8	A	11.6	B	6.2	A	16.8	B	16.9	B	9.7	A	8.0	A→B	5.3	-	3.5	-
			NBL	24.8	C	20.4	C	30.0	C	24.8	C	20.4	C	30.0	C	0.0	-	0.0	-	0.0	-
			NBTR	31.5	C	25.4	C	37.7	D	31.5	C	25.4	C	37.7	D	0.0	-	0.0	-	0.0	-
			SBL	24.7	C	19.8	B	30.3	C	24.7	C	19.8	B	30.3	C	0.0	-	0.0	-	0.0	-
			SBT	33.9	C	25.9	C	39.0	D	33.9	C	25.9	C	39.0	D	0.0	-	0.0	-	0.0	-
			SBR	30.2	C	23.9	C	34.9	C	30.2	C	23.9	C	34.9	C	0.0	-	0.0	-	0.0	-
			Overall	**18.0**	**B**	**17.0**	**B**	**22.2**	**C**	**24.3**	**C**	**20.4**	**C**	**21.3**	**C**	**6.3**	**B→C**	**3.4**	**B→C**	**-0.9**	**-**

** Decreased delays and improved LOS are the result of improved progression, arrival on green factors, and/or recommended improvements*

Intersection		Control	Approach	Existing Conditions (2042)						Road Diet (Horizon Year 2042)						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
5	11 Mile Road & Center Street	Signalized	EBL	0.1	A	0.0	A	0.1	A	0.1	A	0.0	A	0.0	A	0.0	-	0.0	-	-0.1	-
			EBT	0.3	A	0.3	A	0.3	A	0.5	A	0.3	A	0.4	A	0.2	-	0.0	-	0.1	-
			EBR	0.3	A	0.3	A	0.3	A	0.0	A	0.1	A	0.0	A	-0.3	-	-0.2	-	-0.3	-
			WBL	0.2	A	0.1	A	0.2	A	0.1	A	0.1	A	0.2	A	-0.1	-	0.0	-	0.0	-
			WBTR	0.3	A	0.2	A	0.2	A	0.4	A	0.4	A	0.5	A	0.1	-	0.2	-	0.3	-
			SB	47.9	D	41.9	D	61.8	E	47.9	D	41.9	D	61.8	E	0.0	-	0.0	-	0.0	-
			Overall	**1.2**	**A**	**1.2**	**A**	**1.9**	**A**	**1.3**	**A**	**1.3**	**A**	**2.0**	**A**	**0.1**	**-**	**0.1**	**-**	**0.1**	**-**
6	11 Mile Road & Main Street	Signalized	EBL	19.3	B	15.7	B	19.3	B	22.2	C	15.9	B	20.2	C	2.9	B→C	0.2	-	0.9	B→C
			EBT	10.6	B	9.4	A	10.3	B	13.8	B	10.7	B	13.2	B	3.2	-	1.3	A→B	2.9	-
			EBR	10.6	B	9.4	A	10.3	B	8.9	A	8.3	A	8.6	A	-1.7	B→A	-1.1	-	-1.7	B→A
			WBL	19.8	B	16.2	B	19.8	B	19.9	B	16.4	B	20.4	C	0.1	-	0.2	-	0.6	B→C
			WBT	29.9	C	10.4	B	12.3	B	34.9	C	11.8	B	15.5	B	5.0	-	1.4	-	3.2	-
			WBR	29.9	C	10.4	B	12.3	B	20.1	C	9.3	A	10.3	B	-9.8	-	-1.1	B→A	-2.0	-
			NBL	24.7	C	22.7	C	28.0	C	24.7	C	22.7	C	28.0	C	0.0	-	0.0	-	0.0	-
			NBTR	36.4	D	33.3	C	42.8	D	36.4	D	33.3	C	42.8	D	0.0	-	0.0	-	0.0	-
			SBL	25.3	C	23.2	C	29.5	C	25.3	C	23.2	C	29.5	C	0.0	-	0.0	-	0.0	-
			SBT	30.1	C	28.1	C	35.2	D	30.1	C	28.1	C	35.2	D	0.0	-	0.0	-	0.0	-
			SBR	28.4	C	26.8	C	31.8	C	28.4	C	26.8	C	31.8	C	0.0	-	0.0	-	0.0	-
			Overall	**26.6**	**C**	**20.9**	**C**	**26.0**	**C**	**27.7**	**C**	**21.2**	**C**	**26.9**	**C**	**1.1**	**-**	**0.3**	**-**	**0.9**	**-**
7	11 Mile Road & Troy Street	Signalized	EBL	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.1	A	0.0	-	0.0	-	0.0	-
			EBTR	0.3	A	0.3	A	0.4	A	0.7	A	0.6	A	0.9	A	0.4	-	0.3	-	0.5	-
			WBL	0.2	A	0.1	A	0.2	A	0.2	A	0.1	A	0.2	A	0.0	-	0.0	-	0.0	-
			WBTR	0.4	A	0.2	A	0.3	A	1.1	A	0.5	A	0.7	A	0.7	-	0.3	-	0.4	-
			NBL	46.5	D	42.2	D	56.2	E	46.5	D	42.2	D	56.2	E	0.0	-	0.0	-	0.0	-
			NBT	44.5	D	41.0	D	52.5	D	44.5	D	41.0	D	52.5	D	0.0	-	0.0	-	0.0	-
			NBR	42.9	D	44.8	D	54.4	D	42.9	D	44.8	D	54.4	D	0.0	-	0.0	-	0.0	-
			SBL	45.8	D	41.9	D	56.2	E	45.8	D	41.9	D	56.2	E	0.0	-	0.0	-	0.0	-
			SBT	42.7	D	40.4	D	51.4	D	42.7	D	40.4	D	51.4	D	0.0	-	0.0	-	0.0	-
			SBR	41.8	D	41.4	D	50.6	D	41.8	D	41.4	D	50.6	D	0.0	-	0.0	-	0.0	-
			Overall	**7.8**	**A**	**7.9**	**A**	**11.6**	**B**	**8.2**	**A**	**8.2**	**A**	**11.9**	**B**	**0.4**	**-**	**0.3**	**-**	**0.3**	**-**

** Decreased delays and improved LOS are the result of improved progression, arrival on green factors, and/or recommended improvements*

	Intersection	Control	Approach	Existing Conditions (2042)						Road Diet (Horizon Year 2042)						Difference					
				AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak		AM Peak		MD Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
8	11 Mile Road & Gainsborough Avenue	Signalized	EBL	0.2	A	0.2	A	0.3	A	0.0	A	0.0	A	0.5	A	-0.2	-	-0.2	-	0.2	-
			EBTR	0.2	A	0.3	A	0.4	A	0.5	A	0.6	A	0.8	A	0.3	-	0.3	-	0.4	-
			WBL	5.1	A	5.0	A	1.8	A	0.0	A	0.0	A	1.3	A	-5.1	-	-5.0	-	-0.5	-
			WBTR	5.2	A	5.1	A	1.8	A	0.5	A	0.4	A	2.5	A	-4.7	-	-4.7	-	0.7	-
			NB	46.0	D	41.5	D	58.6	E	46.0	D	41.5	D	58.6	E	0.0	-	0.0	-	0.0	-
			SB	48.4	D	42.0	D	57.2	E	48.4	D	42.0	D	57.2	E	0.0	-	0.0	-	0.0	-
			Overall	**5.5**	**A**	**4.7**	**A**	**4.7**	**A**	**3.5**	**A**	**2.8**	**A**	**5.2**	**A**	**-2.0**	**-**	**-1.9**	**-**	**0.5**	**-**
9	11 Mile Road & Campbell Road	Signalized	EBL	22.3	C	17.3	B	23.6	C	23.4	C	17.3	B	25.6	C	1.1	-	0.0	-	2.0	-
			EBTR	35.4	D	28.6	C	22.8	C	45.8	D	28.5	C	18.7	B	10.4	-	-0.1	-	-4.1	C→B
			WBL	22.0	C	17.2	B	24.8	C	24.5	C	18.1	B	25.7	C	2.5	-	0.9	-	0.9	-
			WBT	37.7	D	29.8	C	34.8	C	41.2	D	31.2	C	40.6	D	3.5	-	1.4	-	5.8	C→D
			WBR	37.7	D	29.8	C	34.8	C	34.2	C	28.0	C	30.7	C	-3.5	D→C	-1.8	-	-4.1	-
			NBL	24.4	C	23.3	C	28.7	C	24.4	C	23.3	C	28.7	C	0.0	-	0.0	-	0.0	-
			NBTR	43.3	D	34.2	C	46.9	D	43.3	D	34.2	C	46.9	D	0.0	-	0.0	-	0.0	-
			SBL	26.3	C	23.3	C	30.7	C	26.3	C	23.3	C	30.7	C	0.0	-	0.0	-	0.0	-
			SBTR	35.7	D	33.3	C	41.4	D	35.7	D	33.3	C	41.4	D	0.0	-	0.0	-	0.0	-
			Overall	**36.3**	**D**	**29.8**	**C**	**36.5**	**D**	**38.4**	**D**	**29.9**	**C**	**36.6**	**D**	**2.1**	**-**	**0.1**	**-**	**0.1**	**-**
10	11 Mile Road & SB Stephenson Highway	Signalized	EBT	17.9	B	9.9	A	13.6	B	18.1	B	15.3	B	13.6	B	0.2	-	5.4	A→B	0.0	-
			EBR	20.5	C	10.4	B	15.0	B	20.8	C	16.2	B	15.0	B	0.3	-	5.8	-	0.0	-
			WBL	2.1	A	4.6	A	7.7	A	2.1	A	4.6	A	7.7	A	0.0	-	0.0	-	0.0	-
			WBT	1.3	A	4.0	A	7.3	A	1.3	A	4.0	A	7.3	A	0.0	-	0.0	-	0.0	-
			SBL	43.0	D	38.1	D	33.8	C	43.0	D	38.1	D	33.8	C	0.0	-	0.0	-	0.0	-
			SBT	43.2	D	37.2	D	33.8	C	43.2	D	37.2	D	33.8	C	0.0	-	0.0	-	0.0	-
			SBR	40.7	D	35.1	D	30.1	C	40.7	D	35.1	D	30.1	C	0.0	-	0.0	-	0.0	-
			Overall	**16.9**	**B**	**16.8**	**B**	**18.8**	**B**	**17.0**	**B**	**18.7**	**B**	**18.8**	**B**	**0.1**	**-**	**1.9**	**-**	**0.0**	**-**
11	11 Mile Road & NB Stephenson Highway	Signalized	EBL	3.0	A	1.5	A	2.1	A	3.1	A	1.5	A	2.1	A	0.1	-	0.0	-	0.0	-
			EBT	1.8	A	1.7	A	2.7	A	1.8	A	1.7	A	2.7	A	0.0	-	0.0	-	0.0	-
			WBT	8.4	A	6.8	A	8.6	A	8.4	A	6.8	A	8.6	A	0.0	-	0.0	-	0.0	-
			WBR	7.8	A	6.5	A	8.0	A	7.8	A	6.5	A	8.0	A	0.0	-	0.0	-	0.0	-
			NBL	46.5	D	41.5	D	38.7	D	46.5	D	41.5	D	38.7	D	0.0	-	0.0	-	0.0	-
			NBT	44.4	D	39.1	D	36.7	D	44.4	D	39.1	D	36.7	D	0.0	-	0.0	-	0.0	-
			NBR	43.1	D	38.0	D	35.6	D	43.1	D	38.0	D	35.6	D	0.0	-	0.0	-	0.0	-
			Overall	**11.8**	**B**	**11.9**	**B**	**11.4**	**B**	**11.8**	**D**	**11.9**	**B**	**11.4**	**B**	**0.0**	**B→D**	**0.0**	**-**	**0.0**	**-**

** Decreased delays and improved LOS are the result of improved progression, arrival on green factors, and/or recommended improvements*

7. Safety Study

1. Crash Analysis

A crash analysis was conducted at the study intersections and roadway segments along the 11-Mile Road corridor. Historical traffic crash data were provided by the city. In addition, F&V obtained historical crash data from Michigan Traffic Crash Facts (MTCF). The crash analysis includes crashes from most recent five years (January 1, 2016 to December 31, 2020) of available data. There were a total 586 crashes reported along the study corridor in the past five years. There were 140 crashes with injuries, including eight (8) "Type A" injury crashes; however, there were no fatalities.

The general crash type along the corridor is Rear-End – Straight (38%), Angle Crashes (32%), and Sideswipe-Same Direction (11%) crashes. The majority of crashes at the signalized intersections are angle crashes and rear end crashes, which is typical of signalized intersections. Review of the UD-10 reports for these intersections indicate that the crashes were distributed equally from all directions of travel, suggesting that a directional crash pattern was not present. All the crashes included in this analysis are summarized in **Chart 1**. The individual intersection and segment crash types along the 11-Mile Road corridor are summarized in **Table 9**. Review of the summary data indicate that the majority of crashes occurred at the 11-Mile Road intersections with Woodward Avenue (M-1), Campbell Road, and Stephenson Highway and along the roadway segments between Troy Street and Stephenson Highway. It should be noted that these segments are the sections of roadway along the corridor with four-lanes and without the presence of a two-way center left-turn lane.

Chart 1: Percentage of Crashes by Type

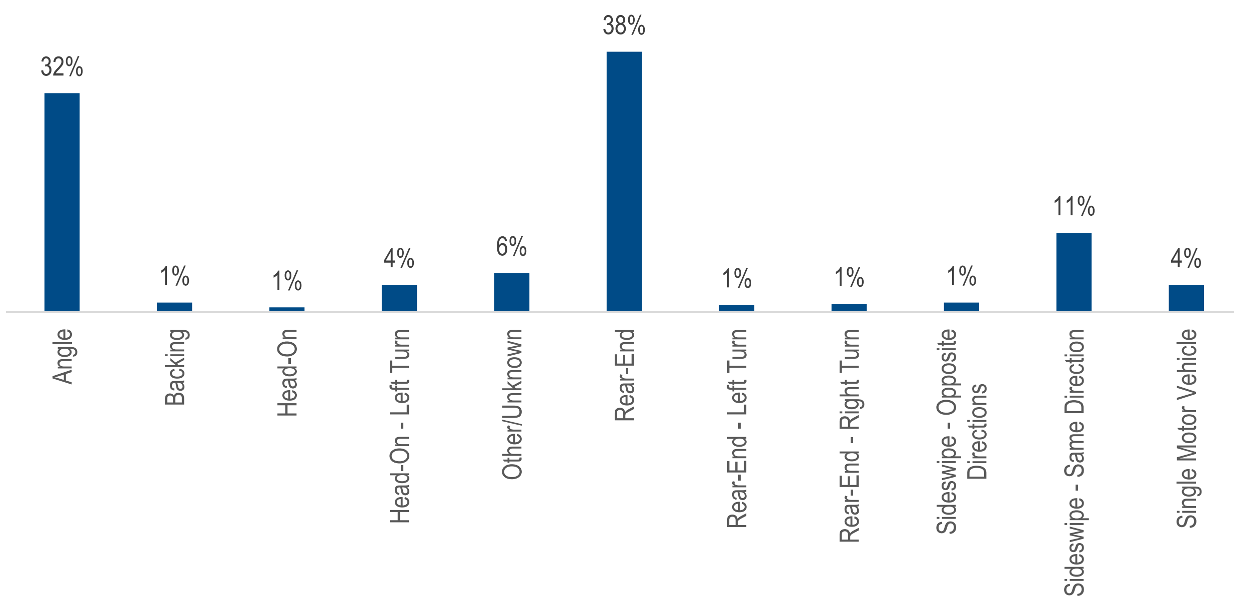


Table 9: Intersection and Segment Crash Summary by Crash Type

11-Mile Road Location		Single Motor Vehicle	Head On	Head On Left-Turn	Angle	Rear End (Straight)	Rear End (Left-Turn)	Rear End (Right-Turn)	Sideswipe-Same	Sideswipe-Opposite	Other/Unknown	Total	Percentage
11-Mile Road & Woodward Avenue (M-1)	Intersection	2	0	0	30	35	0	4	12	1	3	**87**	15%
Woodward Avenue (M-1) to Maxwell Avenue	Segment	0	0	0	2	7	0	0	1	0	0	**10**	2%
11-Mile Road & Maxwell Avenue	Intersection	0	0	0	1	3	0	0	0	0	2	**6**	1%
Maxwell Avenue to Lafayette Ave. / Sherman Dr.	Segment	3	0	0	0	5	0	0	0	0	2	**10**	2%
11-Mile Road & Lafayette Ave. / Sherman Dr.	Intersection	2	0	1	1	9	0	0	0	0	0	**13**	2%
Lafayette Ave. / Sherman Dr. to Washington Avenue	Segment	2	0	0	0	8	0	0	3	0	0	**13**	2%
11-Mile Road & Washington Avenue	Intersection	0	1	4	12	3	1	0	3	0	4	**28**	5%
Washington Avenue to Center St	Segment	0	0	0	0	1	0	0	0	0	0	**1**	0%
11-Mile Road & Center Street	Intersection	0	0	0	2	0	0	0	0	0	2	**4**	1%
Center Street to Main Street	Segment	0	0	0	3	1	0	0	2	0	1	**13**	2%
11-Mile Road & Main Street	Intersection	1	0	3	4	17	0	0	5	1	3	**34**	6%
Main Street to Troy Street	Segment	1	0	1	6	7	0	0	4	0	2	**21**	3%
Troy Street & 11-Mile Road	Intersection	0	0	0	8	1	0	0	1	0	4	**14**	2%
Troy Street to Gainsborough Avenue	Segment	1	1	1	12	23	2	1	6	0	2	**49**	8%
11-Mile Rd & Gainsborough Avenue	Intersection	0	1	0	3	3	0	0	0	0	0	**7**	1%
Gainsborough Avenue to Campbell Road	Segment	2	0	1	15	17	1	0	7	1	5	**49**	8%
11-Mile Road & Campbell Road	Intersection	2	0	5	15	27	1	1	0	0	2	**53**	9%
Campbell Road to S Stephenson Hwy	Segment	1	1	0	9	6	0	0	4	0	0	**21**	4%
11-Mile Road & S Stephenson Hwy	Intersection	3	0	3	25	9	0	1	6	4	6	**57**	10%
S Stephenson Hwy to N Stephenson Hwy	Segment	0	0	0	1	16	0	0	4	0	0	**21**	4%
11-Mile Road & N Stephenson Hwy	Intersection	3	0	4	36	16	1	0	9	1	5	**75**	13%
Total		**23**	**4**	**23**	**185**	**214**	**6**	**7**	**67**	**8**	**43**	**586**	**100%**

Table 10: Road Conditions Summary

Road Conditions		
Condition	**Number of Crashes**	**%**
Dry	442	75%
Unknown	4	1%
Wet	102	17%
Snowy/Icy/Slush	38	7%
Total	**586**	**100%**

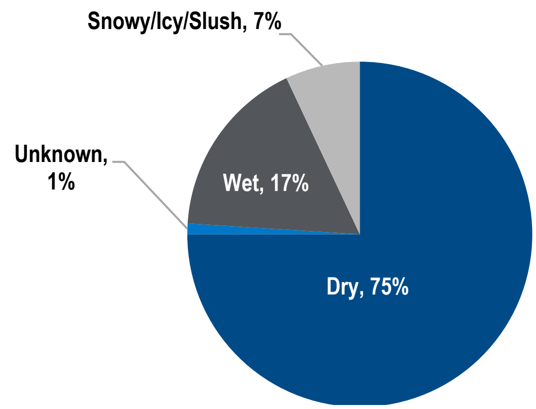


Table 11: Light Conditions Summary

Light Conditions		
Condition	**Number of Crashes**	**%**
Dark-Unlighted	8	1%
Dark-lighted	141	24%
Dusk	7	1%
Dawn	8	1%
Daylight	422	72%
Total	**586**	**100%**

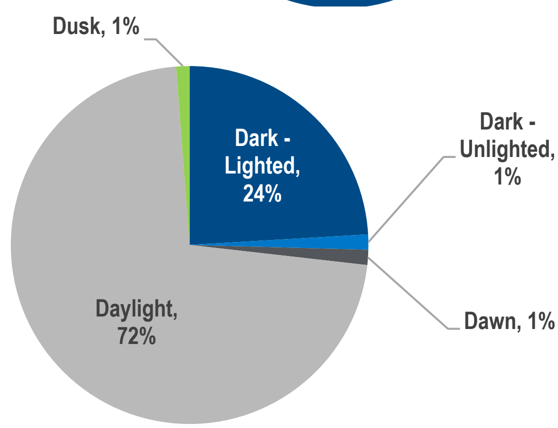
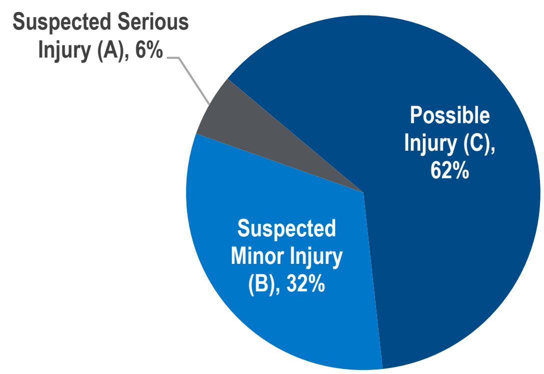


Table 12: Crashes with Injury

Worst Injury in Crash		
Severity	**Crashes with Injury**	**% of Injuries**
Fatalities	0	0%
"A" Injuries	8	6%
"B" Injuries	45	32%
"C" Injuries	87	62%
Total	**140**	**100%**



The SEMCOG Crash Analysis Process *Regional Critical Intersection Crash Rates, Frequencies and Casualty Ratios: By Presence or Absence of Signalization* was used to compare the actual crash rates and frequencies to the regional rates for similar intersection operations. The study area included in this analysis is located within the SEMCOG region. Therefore, the data provided by SEMCOG provides an applicable comparison to the crash rates experienced within the study area. The results of the analysis are summarized in **Table 13**.

Table 13: Study Network Intersection Crash Comparison

Intersection		Average ADT (Entering Volume vpd)	Total (5 years)	Crash Frequency (crashes/year)			Crash Rate (crashes per MV)		
				Intersection Annual Crash Frequency	SEMCOG Average Annual Crash Frequency	Difference	Intersection Crash Rate	SEMCOG Average Crash Rate	Difference
1	11-Mile Road & Woodward Avenue	78,050	87	17.4	32.67	-15.27	0.61	1.06	-0.45
2	11-Mile Road & Maxwell Avenue	12,525	6	1.2	4.69	-3.49	0.26	0.87	-0.61
3	11-Mile Road & Lafayette Ave. / Sherman Dr.	13,430	13	2.6	4.69	-2.09	0.53	0.87	-0.34
4	11-Mile Road & Washington Avenue	18,905	28	5.6	4.69	0.91	0.81	0.87	-0.06
5	11-Mile Road & Center Street	12,675	4	0.8	4.69	-3.89	0.17	0.87	-0.70
6	11-Mile Road & Main Street	25,190	34	6.8	8.77	-1.97	0.74	0.96	-0.22
7	11-Mile Road & Troy Street	13,835	14	2.8	4.69	-1.89	0.55	0.87	-0.32
8	11-Mile Road & Gainsborough Avenue	11,185	7	1.4	4.69	-3.29	0.34	0.87	-0.53
9	11-Mile Road & Campbell Road	28,225	53	10.6	8.77	1.83	1.03	0.96	0.07
10	11-Mile Road & SB Stephenson Highway	15,960	57	11.4	4.69	6.71	1.96	0.87	1.09
11	11-Mile Road & NB Stephenson Highway	12,025	75	15.0	4.69	10.31	3.42	0.87	2.55

The results of the analysis indicates that majority of the study intersections currently have crash frequencies (crashes per year) and crash rates (crashes per million entering vehicles) below to the SEMCOG average for intersections with similar characteristics. The study intersections of 11-Mile Road with Washington Avenue, Campbell Road, and SB & NB Stephenson Highway all have crash frequencies above the SEMCOG average; however, the intersection with Washington Avenue has a crash rate below the SEMCOG average and the intersection with Campbell Road has a similar crash rate that is comparable to similar intersections within Southeast Michigan. The study intersections of 11-Mile Road & SB Stephenson Highway and 11-Mile Road & NB Stephenson Highway both have higher crash frequencies and crash rates, as compared to the SEMCOG average.

Detailed review of the crash reports (UD-10s) was performed at the intersection with crash rates higher than the SEMCOG average. The results of the investigation indicate that the majority of crashes that occurred at the 11-Mile Road & Campbell Road intersection were rear-end crashes (51%), which is typical of signalized intersections. Further review of the crash reports indicates that the majority of crashes at the 11-Mile Road & NB/SB Stephenson Highway intersections were angle crashes (>40%). However, Stephenson Highway is the project limits for this study; therefore, no changes to the roadway geometry or traffic control operations are recommended as part of this study.

2. Highway Safety Manual Analysis

The Federal Highway Administration (FHWA) has identified Road Diets a proven safety countermeasure and promotes them as a safety-focused design alternative to a traditional four-lane. In order to determine the predictive impact on safety, an analysis was performed according to the Highway Safety Manual (HSM) crash predictive methodology. The analysis included the evaluation of the existing operations along the 11-Mile Road corridor and a safety review of the operations after the implementation of the recommended road diet to provide corridor-wide three-lane striping.

The latest HSM predictive methods analysis spreadsheet, provided by the MDOT Safety Programs Unit, was utilized to determine the expected and predicted crashes associated with the existing conditions and proposed road diet conditions. This analysis used the urban/sub-urban segments model and the crash prediction values provided by MDOT in the HSM spreadsheet. The results of the analysis are summarized in **Table 14** below and the detailed HSM summary sheets are attached.

Table 14: Highway Safety Analysis Summary

Scenario	Property Damage Only (PDO)		Fatal and Injury (FI)		Total			
	Predicted Crashes per Year	Crash Rate (Crashes / mile / year)	Predicted Crashes per Year	Crash Rate (Crashes / mile / year)	Predicted Crashes per Year	Reduction (%)	Crash Rate (Crashes / mile / year)	Reduction (%)
Troy St. & Gainsborough Ave.	2.73	5.46	0.55	1.11	3.29		6.57	
Road Diet (4-lane to 3-lane)	2.42	4.84	0.38	0.76	2.80	**14.8%**	5.60	**14.8%**
Gainsborough Ave. & Campbell Rd.	2.13	6.09	0.41	1.16	2.54		7.26	
Road Diet (4-lane to 3-lane)	1.87	5.33	0.28	0.80	2.15	**15.5%**	6.13	**15.5%**
Campbell Rd. & Stephenson Hwy.	0.91	2.45	0.24	0.66	1.15		3.11	
Road Diet (4-lane to 3-lane)	0.80	2.15	0.17	0.45	0.96	**16.5%**	2.60	**16.5%**

It should be noted that the 11-Mile Road segments east of Troy Street have 4-lane cross-sections with two (2) lanes in each direction, whereas the 11-Mile Road segments west of Troy Street have 5-lane cross-sections with two (2) lanes in each direction and a center two-way left-turn lane. The HSM methodology does not provide Crash Modification Factors (CMFs) for 5-lane to 3-lane roadway conversions; therefore, the HSM analysis was only performed for the sections of 11-Mile Road to the east of Troy Street.

The result of the analysis indicates that the 4-lane to 3-lane road diet is expected to reduce the predicted crash rates and frequencies by approximately 15-17% per year throughout the 11-Mile Road study corridor to the east of Troy Street.

8. Conclusions

The conclusions of this Traffic Study are as follows:

1. Existing (2022) Geometry (4-Lanes) Analysis

A. Intersection delays are currently experienced at the following 11 Mile Road study intersections:

- Woodward Avenue (M-1): The WBR and WBT are currently operating at LOS F and LOS E, respectively, during the PM peak hour.
- Maxwell Avenue: The SBR is currently operating at LOS E during the PM peak hour.
- Lafayette Avenue / Sherman Drive: The NB shared through/right lane is currently operating at LOS E during the PM peak hour.
- Center Street: The SB approach is currently operating at LOS E during the PM peak hour.
- Troy Street: The NBL and SBL are currently operating at LOS E during the PM peak hour.
- Gainsborough Avenue: The NB and SB approaches are currently operating at LOS E during the PM peak hour.

B. Although the Synchro LOS analysis indicates poor operations for these study intersection approaches and movements, review of SimTraffic network simulations indicates acceptable operations during all peak periods. Review of microsimulations indicates a 95th percentile queue length of approximately 162-feet (6-7 vehicles) or less for all of the approaches and movements identified above; additionally, the majority of vehicle queues were observed to be serviced within each intersection cycle length.

2. Opening Day (2022) – Road Diet (3-Lanes) Analysis

A. All the study intersection approaches and movements will continue to operate in a manner similar to existing conditions, with the following additional delays:

- 11-Mile Road & Main Street: The WB shared through/right movement is expected to operate at LOS E during the AM peak hour. By adding a right-turn lane, this is mitigated to a LOS C.
- 11-Mile Road & Campbell Road: The WB shared through/right movement is expected to operate at LOS E during the PM peak hour. By adding a right-turn lane, this is mitigated to a LOS D.

B. Review of SimTraffic network simulations indicates occasional periods of long vehicle queues in the downtown (Washington Avenue to Troy Street) area during the AM and PM peak periods; these queues were typically observed to dissipate within the peak hour. Additionally, long vehicle queues were observed for the westbound approach at Campbell Road during the PM peak hour; these queues were not observed to dissipate and were present throughout the PM peak period.

- However, the installation of dedicated right-turn lanes will mitigate these projected back-ups.

C. Review of the SimTraffic network simulations during the AM and PM peak periods at the remaining study intersections indicates generally acceptable operations. Additionally, review of the SimTraffic microsimulations during the MD peak hour indicates acceptable operations throughout the study network, with minimal vehicle queueing observed.

D. Signal timing optimization (improved platooning and progression) is recommended for the entire corridor and right-turn lanes are recommended on the following approaches:

- EB 11-Mile Road at Center Street
- EB 11-Mile Road at Main Street
- WB 11-Mile Road at Main Street
- WB 11-Mile Road at Campbell Road

E. The change intersection delay from existing 4-lane operations to the 3-lane operations with the recommended mitigation measures is summarized below and shows that the average increase in intersection delay is 2-3 seconds and the maximum movement delay is less than 10 seconds. Therefore, the overall increase in delay associated with the road diet is negligible.

Road Diet Delay Summary (2022) w/ Mitigation Measures

	AM Peak Hour	MD Peak Hour	PM Peak Hour
Max Intersection Increase in Delay	2.6 sec	2.8 sec	3.3 sec
Max Turning Movement Increase in Delay	9.1 sec	5.7 sec	8.3 sec
11-Mile Corridor Travel Time Increase	0.5 min (EB) 0.9 min (WB)	0.4 min (EB) 0.2 min (WB)	1.8 min (EB) 0.8 min (WB)

3. Horizon Year (2042) – Road Diet (3-Lanes) Analysis

A. The results of the analysis indicates that the study intersection approaches and movements will continue to operate acceptably, in a manner similar to Opening Day (2022) conditions, with minor increases in delays and vehicle queueing due to the 20-year period of traffic growth.

B. At the Horizon Year (2042) buildout, signal timing optimization should be re-evaluated in order to optimize the intersections and mitigate future delays throughout the corridor; however, no additional geometric improvements are recommended. The overall increase in delay associated with the road diet is summarized below and shows a negligible increase in vehicle delay over 20 years.

Road Diet Delay Summary (2042) w/ Mitigation Measures

	AM Peak Hour	MD Peak Hour	PM Peak Hour
Max Intersection Increase in Delay	6.3 sec	3.4 sec	1.8 sec
Max Turning Movement Increase in Delay	15.7 sec	7.0 sec	5.8 sec
11-Mile Corridor Travel Time Increase	0.7 min (EB) 1.0 min (WB)	0.5 min (EB) 0.2 min (WB)	2.4 min (EB) 1.2 min (WB)

4. Safety Analysis

A. The result of the crash analysis indicates that there were a total of 586 crashes reported along the 11-Mile Road corridor in past five years (2016-2020); of these crashes, 140 involved injuries, including eight (8) “Type A” injuries. The general crash type trends were Rear-End – Straight Crashes (38%), Angle Crashes (32%), and Sideswipe-Same Direction (11%) crashes.

B. The analysis indicates that the majority of the study intersections have crash frequencies and crash rates below the SEMCOG average for comparable intersections. Additionally, although the crash frequencies at the intersections of 11-Mile Rd. & Washington Ave. and 11-Mile Road & Campbell Road are slightly higher than the SEMCOG region average, the crash rates at Washington Ave. is less and at Campbell Road is comparable to similar intersections within Southeast Michigan.

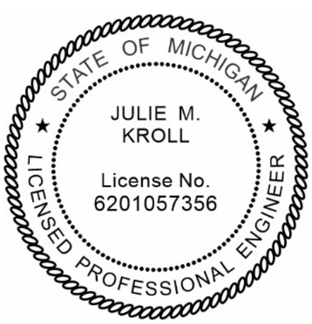
C. A safety review was performed according to the Highway Safety Manual (HSM) crash predictive methodology. The result of the analysis indicates that 4-lane to 3-lane road diet would reduce the predicted crash rates and frequencies by approximately 15-17% per year throughout the 11-Mile Road study corridor to the east of Troy Street.

9. Recommendations

- The primary goal of this road diet is to improve safety and reduce the crashes along the 11-Mile Road corridor. The result of the analysis indicates that crashes are expected to be reduced by **15-17%.**
- It is recommended that the road diet is implemented. There are several options to consider for the extra space created by the eliminated lanes, such as parking space, bike lanes, additional green space, etc. The use of the additional space is up to the discretion of the city.
- In addition, signal timing optimization should be considered and re-evaluated with the implementation of a Road Diet, in order to improve the projected intersections operations by providing progression along the corridor and coordination with the adjacent roadway system. Similarly, signal timing optimizations should be re-evaluated to accommodate actual Horizon Year (2042) conditions.
- The intersection and roadway geometry recommended to accommodate the implementation of the road diet (3-Lanes) is shown on the attached **Figure 4** and summarized below.

Intersection	Recommended Geometry
11-Mile Road & Woodward Avenue (M-1)	**No Change** Transition to 3-Lanes east of this intersection
11-Mile Road & Maxwell Avenue	**Road Diet** Provide exclusive EB left-turn and through lanes Provide a WB shared through/right lane
11-Mile Rd. & Lafayette Ave. / Sherman Dr.	**Road Diet** Provide an exclusive left-turn lane and a shared through/right lane in both directions (EB / WB)
11-Mile Road & Washington Avenue	**Road Diet** Provide an exclusive left-turn lane and a shared through/right lane in both directions (EB / WB)
11-Mile Road & Center Street	**Road Diet w/ IMPs** Provide exclusive EB through, left-, and right-turn lanes Provide an exclusive WB left-turn and a shared through/right lane
11-Mile Road & Main Street	**Road Diet w/ IMPs** Provide exclusive left-turn, through, and right-turn lanes in both directions (EB / WB)
11-Mile Road & Troy Street	**Road Diet** Provide an exclusive left-turn lane and a shared through/right lane in both directions (EB / WB)
11-Mile Road & Gainsborough Avenue	**Road Diet** Provide an exclusive left-turn lane and a shared through/right lane in both directions (EB / WB)
11-Mile Road & Campbell Road	**Road Diet w/ IMPs** Provide an exclusive EB left-turn lane and a shared through/right lane Provide exclusive WB left-turn, through, and right-turn lanes
11-Mile Road & Stephenson Highway	**No Change** Transition to 3-Lanes east of this intersection

Any questions related to this memorandum, study, analysis, and results should be addressed to Fleis & VandenBrink.



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Michigan.

Attached: Figures 1-5
Traffic Volume Data
HCM LOS Description
Synchro Results