NORTHVILLE DOWNS
TRAFFIC IMPACT STUDY

CITY OF NORTHVILLE, MICHIGAN

JUNE 20, 2018
REVISED NOVEMBER 26, 2018

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Agency Review	Date	Comments
OHM Advisors	9/10/2018	

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References

American Association of State Highway and Transportation Officials (AASHTO). (2011). *A Policy on Geometric Design of Highways and Streets.* Washington DC.

Federal Highway Administration, Michigan Department of Transporation, Michigan State Police. (2011). *Michigan Manual on Uniform Traffic Control Devices.*

Institute of Transportation Engineers. (2017). *Trip Generation Manual, 10th Edition.* Washington DC.

National Research Council (U.S.) Transportation Research Board. (2000). *Highway Capacity Manual, 4th Edition (HCM 2000).* Washington, D.C.: Transportation Research Board.

National Research Council (U.S.) Transportation Research Board. (2016). *Highway Capacity Manual, 6th Edition (HCM6).* Washington, D.C.: Transportation Research Board.

Papacostas, & Prevedouros. (2001). *Transportation Engineering and Planning.*

Stover, V. G., & Koepke, F. J. (2006). *Transportation and Land Development* (Vol. 2nd Edition). Washington DC: Institute of Transportation Engineers (ITE).

1 INTRODUCTION

This report presents the results of a Traffic Impact Study (TIS) for the proposed development in the City of Northville, Michigan. The project site is located generally in the northeast quadrant of the Sheldon Avenue/Center Street and Hines Drive/7 Mile Road intersection on the property that was previously occupied by Northville Downs, as shown on **Figure 1**. The proposed development includes the construction of mixed-use office/commercial and residential units. The development includes site access to Cady Street, Griswold Street, Beal Street, Fairbrook Street, and Center Street.

The scope of this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practice and information published by the Institute of Transportation Engineers (ITE). In addition, the City of Northville and the Wayne County Department of Public Service (WCDPS) were contacted regarding the scope of work for this study. The study analyses were completed using Synchro and SimTraffic (Version 10) traffic analysis software. The study intersections analyzed for this TIS include:

- Main Street & Center Street,
- Main Street & Hutton Street,
- Main Street & Griswold Street,
- Cady Street & Center Street,
- Cady Street & Hutton Street,
- Cady Street & Griswold Street,
- Beal Street & Griswold Street,
- Beal Street & River Street,
- Beal Street & Northville Road (S. Main Street),
- Center Street & Fairbrook Street,
- 7 Mile Road/Hines Drive & Center Street/Sheldon Avenue,
- 7 Mile Road & Hines Drive,
- 7 Mile Road & River Street,
- N. 7 Mile Road & Northville Road (S. Main Street),
- S. 7 Mile Road & Northville Road, and
- The proposed site driveway intersections.

The purpose of this study is to identify the traffic related impacts, if any, of the proposed development project on the adjacent road network. Specific tasks undertaken for this study include the following:

1. Obtain and review the proposed site plan which includes the proposed land use, density, and desired site access locations.
2. Provide an analysis of the traffic-related impacts of the proposed development at the study intersections.
3. Conduct a site visit and collect a field inventory for the site locations. The inventory will include: the existing geometries, lane use, and traffic control at the study intersections.
4. Collect weekday AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak period turning movement counts at the study intersections. Weekday counts will be collected on a day in which events are not being held at Northville Downs.
5. Identify the existing AM and PM peak hour traffic volumes at the study intersections based on the traffic count data collected.
6. Calculate the **Existing** vehicle delays, Levels of Service (LOS), and vehicle queues at the study intersections based on the methodologies of the *Highway Capacity Manual, 6th Edition* using Synchro (Version 10) traffic analysis software.
7. Calculate the future background traffic volumes based on an appropriate traffic growth rate to the project build-out year and the applicable background developments (outside of the study area) in the immediate vicinity of the project area as provided by City of Northville Planning Department for use in this study.

8. Calculate the **Background (without the proposed development)** vehicle delays, LOS, and vehicle queues at the study intersections and identify improvements (if any) that would be required to mitigate any unacceptable background traffic conditions.
9. Forecast the number of AM and PM peak hour trips that would be generated by the proposed development based on data published by the Institute of Transportation Engineers (ITE) in *Trip Generation, 10th Edition* and the *ITE Trip Generation Handbook, 3rd Edition.*
10. Assign the trips that would be generated by the proposed development to the adjacent road network based on existing traffic patterns and methodologies outlined in the *ITE Transportation and Land Development, 2nd Edition.*
11. Combine the site-generated traffic assignments with the background traffic forecasts to establish the Future AM and PM peak hour traffic volumes for each alternative.
12. Calculate the **Future (with the proposed development)** vehicle delays, LOS, and vehicle queues at the study intersections.
13. Evaluate the applicable traffic signal warrants using the projected traffic volumes, the traffic volume data collected, and the standards published in the current *Michigan Manual on Uniform Traffic Control Devices (MMUTCD).*
14. Identification of improvements (if any) for the study road network that would be required to accommodate the site-generated traffic volumes, including the potential need for auxiliary taper/lanes according to City of Northville standards for all scenarios.

Sources of data for this study include traffic counts conducted by F&V subconsultant Traffic Data Collection, Inc. (TDC), information provided by the developer, City of Northville, Wayne County Department of Public Services (WCDPS), and ITE. All background information is provided in **Appendix A**.

FIGURE 1

SITE LOCATION MAP

NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND

SITE SITE LOCATION

NORTH

SCALE: NOT TO SCALE

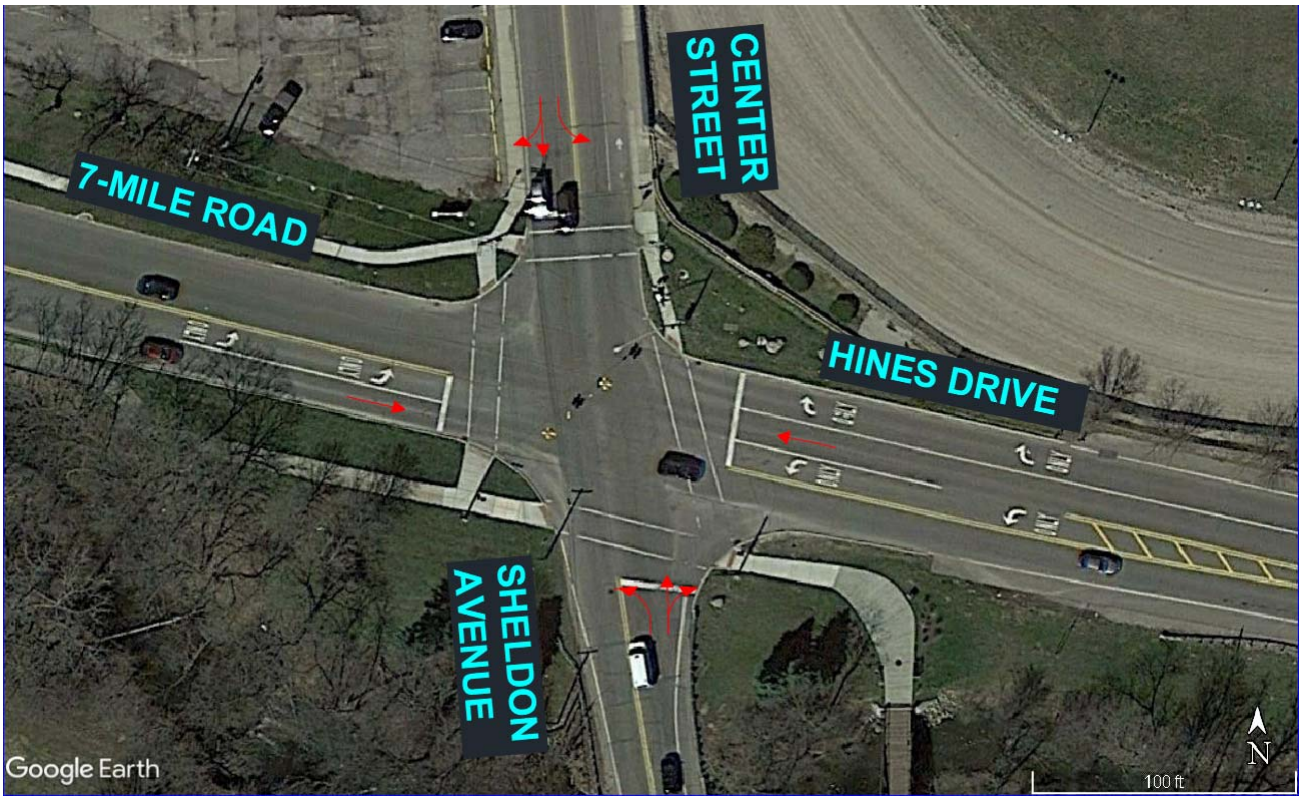
F&V

2 BACKGROUND DATA

2.1 EXISTING ROAD NETWORK

Vehicle transportation for the proposed development is provided via Center Street, Cady Street, and Beal Street. Regional transportation is provided via I-96, I-275, and M-14; with access to these routes within 5 miles of the project site location. The lane use and traffic control at the study intersections are shown on **Figure 2** and the study roadways are further described below. For the purposes of this study, all minor streets and driveways are assumed to have an operating speed of 25 miles per hour (mph).

Center Street / Sheldon Avenue runs in the north and south directions. The study section of roadway north of Hines Drive/7 Mile Road is known as Center Street, has an Average Annual Daily Traffic (AADT) volume of 13,166 vehicles per day (SEMCOG 2010), and is under the jurisdiction of the City of Northville. The section of roadway south of 7 Mile Road is known as Sheldon Avenue, has an Average Annual Daily Traffic (AADT) volume of 20,555 vehicles per day (MDOT 2014), and is under the jurisdiction of Wayne County. The study section of roadway has a posted speed limit of 35 mph south of Cady Street and a posted speed limit of 25 mph north of Cady Street. The portion of roadway north of Cady Street has on-street parking and the portion south of Cady Street has on-street bike lanes. The roadway is a typical two-lane cross-section, with one lane in each direction. At its intersection with Hines Drive/7 Mile Road, the roadway is striped as a single shared lane for northbound and southbound traffic. However, vehicles on the northbound and southbound approaches utilize the available pavement width as a short left-turn lane and a shared through/right-turn lane; this is further depicted in the aerial image below. The functional classification of Center Street / Sheldon Avenue through the study area is *Principal Arterial*.

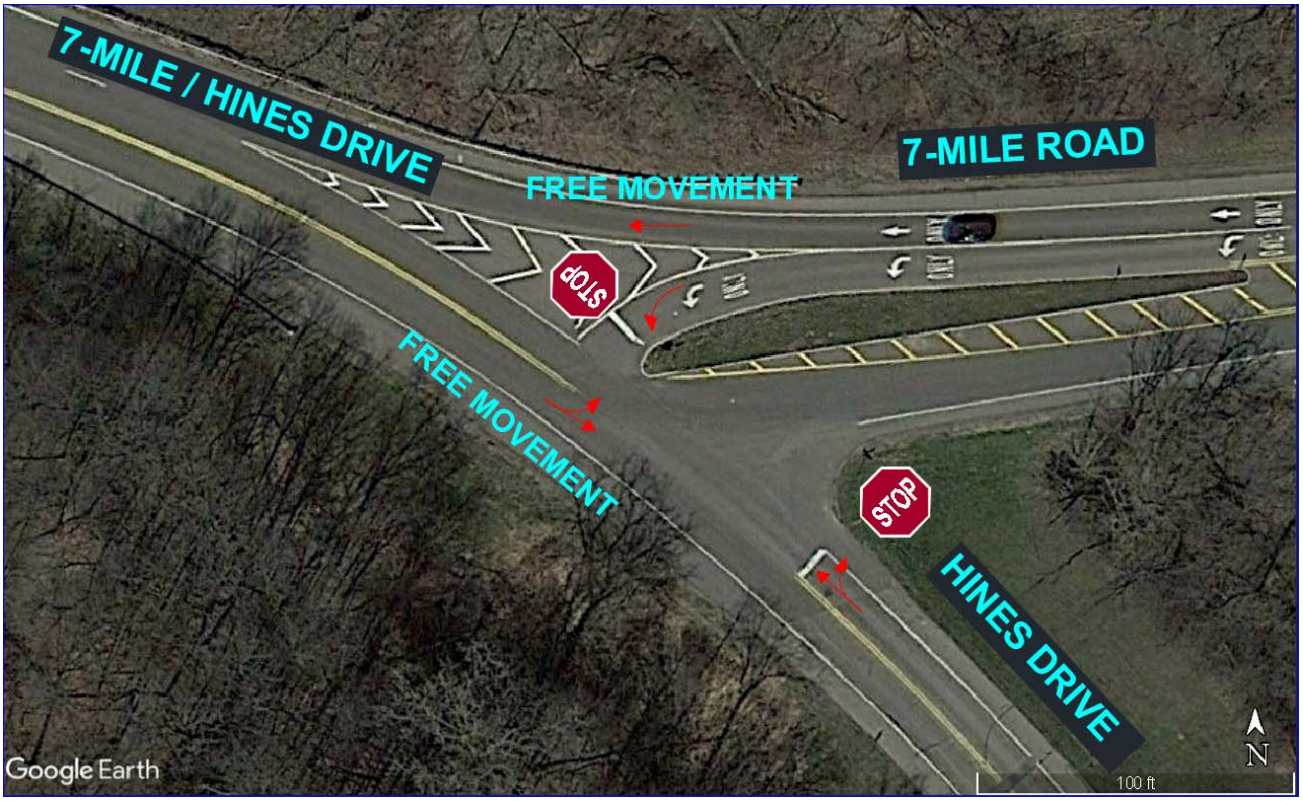


Main Street runs in the east and west directions and has an AADT volume of 7,337 vehicles per day (MDOT 2006). The study section of Main Street is under the jurisdiction of the City of Northville and has a posted speed limit of 25 mph. The roadway is a two-lane cross-section with one lane in each direction and on-street parking on both sides of the road. On-street parking typically ends prior to an intersection, in order to provide short (25-50 ft typical) right-turn lanes at the intersections. The section of roadway east of Griswold Street becomes S. Main Street; for the purposes of this report S. Main Street is labeled Northville Road, specifically at the intersection with Beal Street. The functional classification of Main Street through the study area is *Minor Arterial*.

Northville Road runs in the north and south directions and has an AADT volume of 15,900 vehicles per day (SEMCOG 2009). The study section of Northville is under the jurisdiction of the WCDPS and has a speed limit that varies from 25mph to 40mph. At the intersection of Beal Street and Northville Road (S. Main Street), the speed limit of Northville Road is 25mph in both directions. At the intersection of N. 7 Mile Road and Northville Road (S. Main Street), the speed limit of Northville Road is 35mph in both directions. At the intersection of S. 7 Mile Road and Northville Road, the speed limit of Northville Road in the northbound and southbound directions is 40mph and 35mph, respectively. The roadway is a four-lane cross-section with two lanes in each direction; the roadway begins undivided at S. 7 Mile Road, splits and becomes median separated at N. 7 Mile Road, then reconnects just past Beal Street. At the intersection of Northville Road (S. Main Street) and N. 7 Mile Road, a 30-ft median crossing is provided with yield control for the westbound and eastbound movements to and from 7 Mile Road. The functional classification of Northville Road through the study area is *Minor Arterial.*

7 Mile Road runs in the east and west directions and has an AADT volume of 7,035 vehicles per day (SEMCOG 2009). The study section of 7 Mile Road is under the jurisdiction of WCDPS and has a posted speed limit of 35 mph. The study section of 7 Mile Road is split at Northville Road; for the purpose of this report, the section to the east of Northville Road will be referred to as S. 7 Mile Road. For the intersection of Northville Road and the west portion of 7 Mile Road, the intersection will be referred to as Northville Road and N. 7 Mile Road. The section of roadway to the west is a typical two-lane cross-section with one lane in each direction. The section of roadway to the east is a typical three-lane cross-section, with one lane in each direction and a center two-way left-turn lane. The functional classification of 7 Mile Road through the study area is *Minor Arterial*.

Edward N. Hines Drive generally runs in the north and south directions; however, the study section of Edward N. Hines Drive runs in the east/southeast and west/northwest directions. The study section of Hines Drive is under the jurisdiction of WCDPS, has a posted speed limit of 40 mph south of 7 Mile Road, and has a posted speed limit of 35 mph north of 7 Mile Road. The section of Hines Drive between Center Street and 7 Mile Road has an AADT volume of 10,200 vehicles per day (SEMCOG 2009); the section south of 7 Mile Road has an AADT volume of 2,933 vehicles per day (MDOT 2012). The roadway is a typical two-lane cross-section with one lane in each direction. The functional classification of Edward N. Hines Drive through the study area is *Principal Arterial*. The figure below further depicts the intersection of Edward N. Hines Drive and 7 Mile Road.



Cady Street runs in the east and west directions. The study section of Cady Street is under the jurisdiction of the City of Northville and has a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction and has on-street parking on both sides of the road between Hutton Street and Griswold Street. The functional classification of Cady Street through the study area is *Local Road*.

Griswold Street generally runs in the north and south directions and has an AADT volume of 7,018 vehicles per day (MDOT 2012). The study section of Griswold Street has a posted speed limit of 35 mph. Griswold Street is under the jurisdiction of the WCDPS to the north of Main Street and under the jurisdiction of the City of Northville to the south. The roadway is a typical two-lane cross-section with one lane in each direction and has on-street parking, on the west side of the road, south of Main Street. The functional classification of Griswold Street is classified as *Minor Arterial* to the north of Main Street and *Local Road* to the south.

Hutton Street runs in the north and south directions and is under the jurisdiction of the City of Northville with a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction and has on-street parking north of Main Street, on both sides of the roadway. The functional classification of Hutton Street through the study area is *Local Road*.

River Street runs in the north and south directions. The study section of River Street is under the jurisdiction of the City of Northville and has a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction. The functional classification of River Street through the study area is *Local Road*.

Beal Street runs in the east and west directions and is under the jurisdiction of the City of Northville with a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction. The functional classification of Beal Street through the study area is *Local Road*.

Fairbrook Street runs in the east and west directions and is under the jurisdiction of the City of Northville with a posted speed limit of 25 mph. The roadway has a typical two-lane cross-section with one lane in each direction and has on-street parking on both sides of the roadway. The functional classification of Fairbrook Street through the study area is *Local Road*.

2.2 EXISTING TRAFFIC VOLUMES

Existing traffic volume data at the study intersections were collected by F&V subconsultant TDC on May 15, 2018 and October 18, 2018 for the Weekday AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM). The data collection for this site was intentionally taken on a day in which events were not being held at the current Northville Downs racetrack to avoid any additional traffic generated by the current facility. These data were used as a baseline to establish the current peak hour traffic volumes for the analysis of existing traffic conditions. During collection of the manual intersection turning movement counts, pedestrian data and commercial truck percentages were recorded and used in the traffic analysis. Peak Hour Factors (PHFs) were also calculated for each study intersection approach.

The peak hour volumes for each intersection were utilized for this study and the volumes were balanced upward through the study network. At locations where access is provided between study intersections, “dummy” intersections were used to account for sink and source volumes, and through volumes were carried along the main study roadways. The AM and PM peak hours of existing network traffic were identified to generally occur between 8:00 AM to 9:00 AM and 5:00 PM to 6:00 PM, respectively, for a typical weekday. The traffic volume data are included in **Appendix A** and the existing peak hour traffic volumes are summarized on **Figure 3**.

NORTHVILLE ROAD (S. MAIN STREET)

NB NORTHVILLE ROAD

SB NORTHVILLE ROAD

MAIN STREET

BEAL STREET

CADY STREET

RIVER STREET

GRISWOLD STREET

GRISWOLD STREET

7 MILE ROAD

S. 7 MILE ROAD

NORTHVILLE ROAD

E. SITE DRIVE

FREE MOVEMENT

HINES DRIVE

SITE

FAIRBROOK STREET

HUTTON STREET

N. SITE DRIVE

NW. SITE DRIVE

W. SITE DRIVE

CENTER STREET

SHELDON AVENUE

CADY STREET

SW. SITE DRIVE

FIGURE 2
LANE USE AND TRAFFIC CONTROL

NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND

- ROADS
- PROPOSED ROADS
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION
- EXISTING LANE USE
- PROPOSED LANE USE

NORTH

SCALE: NOT TO SCALE

F&V

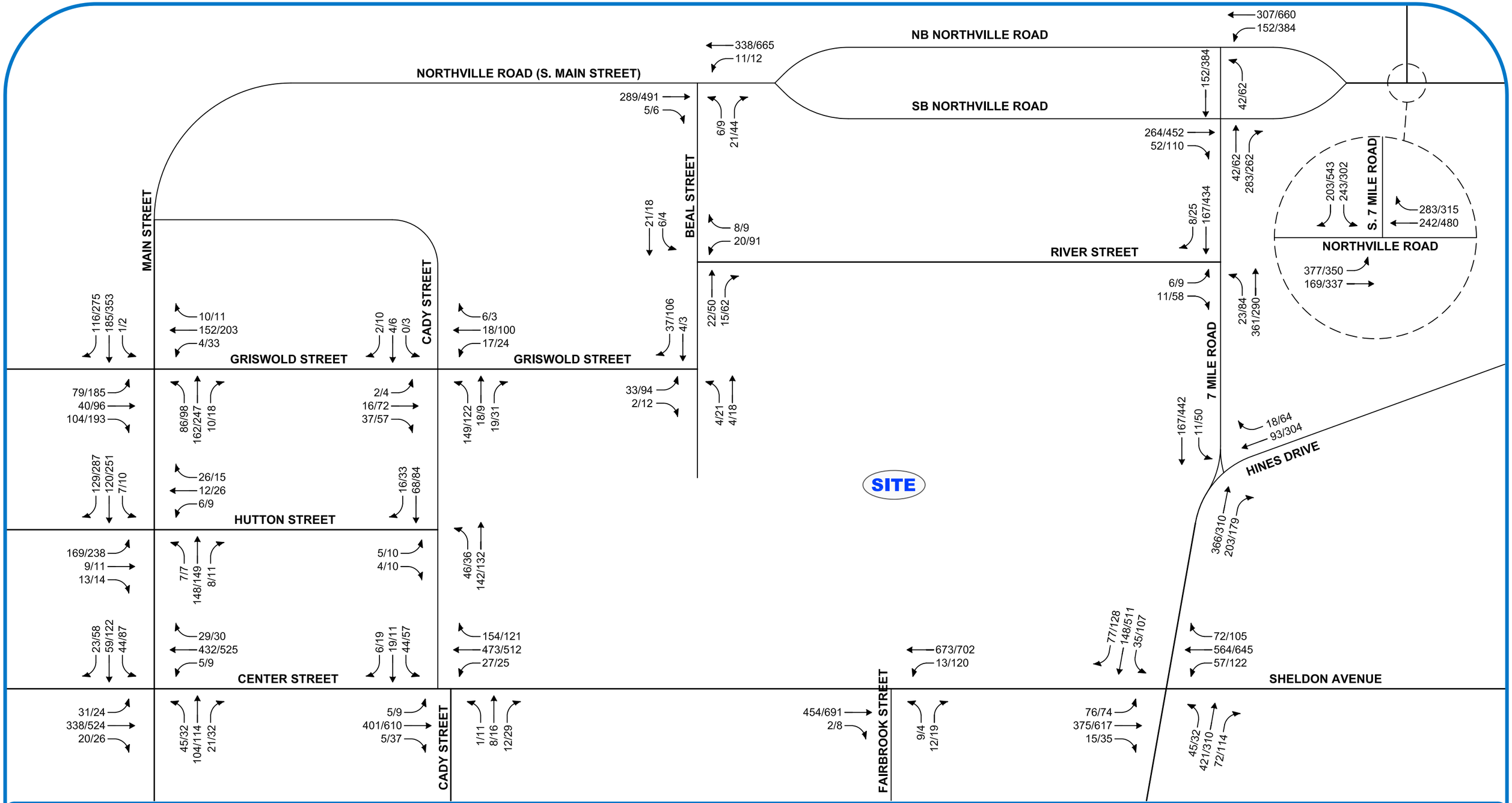


FIGURE 3
EXISTING TRAFFIC VOLUMES

NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

NORTH

SCALE: NOT TO SCALE

F&V

3 ANALYSIS

3.1 EXISTING CONDITIONS

The existing AM and PM peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro (Version 10) traffic analysis software. The results of the analysis of existing conditions were based on the existing lane use and traffic control shown on **Figure 2**, the existing traffic volumes shown on **Figure 3**, and the methodologies presented in the Highway Capacity Manual (HCM) 6th Edition.

There are several study intersections where the traffic control used are not supported by the HCM 6th Edition analysis methodology; therefore, HCM2000 and SimTraffic simulation delays were determined to be more appropriate for use at these intersections. All remaining study intersections and driveways were analyzed using the HCM 6th Edition methodology. These intersections are summarized below:

- Griswold Street & Beal Street: The two-way stop control (along the eastbound and southbound approaches) for the T-intersection is not supported by the HCM. Therefore, SimTraffic delays were utilized.
- 7 Mile Road & Hines Drive: The stop control for northbound Hines Drive and the westbound left-turn movement for 7 Mile Road is not supported by the HCM. Therefore, SimTraffic delays were utilized.
- Northbound and Southbound Northville Road & N. 7 Mile Road: The yield control for the intersection of N. 7 Mile Road with NB Northville Road and SB Northville Road is not supported by HCM 6th edition. Therefore, HCM 2000 analysis was utilized.

Descriptions of LOS "A" through "F" as defined in the HCM are provided in **Appendix B** for signalized and unsignalized intersections. Typically, LOS D is considered acceptable, with LOS A representing minimal delay, and LOS F indicating failing conditions. The results of the analysis of existing conditions are presented in **Appendix B** and are summarized in **Table 1**.

Table 1: Existing Intersection Operations

Intersection		Control	Approach	Existing Conditions 2018			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Main Street & Center Street	Signalized	EB	19.9	B	20.1	C
			WB	18.9	B	19.2	B
			NB	9.8	A	10.0	A
			SB	8.6	A	10.2	B
			Overall	**11.9**	**B**	**12.9**	**B**
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A
			EBR	0.0	A	0.0	A
			WBTL	6.7	A	7.6	A
			WBR	7.1	A	9.1	A
			NB	17.2	B	19.1	B
			SBTL	21.4	C	69.3	E
			SBR	16.5	B	16.5	B
			Overall	**10.3**	**B**	**21.9**	**C**
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.5	B
			EBTR	10.1	B	11.0	B
			WBTL	10.1	B	11.8	B
			WBTR	10.5	B	12.5	B
			NB	15.0	B	16.4	B
			SB	16.8	B	29.3	C
			Overall	**12.7**	**B**	**17.5**	**B**

Intersection		Control	Approach	Existing Conditions 2018			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
4	Cady Street & Center Street	Stop (Minor)	EB	19.3	C	37.7	E
			WB	44.5	E	137.8	F
			NBL	8.4	A	9.2	A
			SBL	9.0	A	8.9	A
5	Cady Street & Hutton Street	Stop (Minor)	EBL	7.6	A	7.6	A
			WB	Free		Free	
			SB	10.7	B	10.2	B
6	Cady Street & Griswold Street	Stop (Minor)	EB	10.7	B	12.8	B
			WB	9.5	A	10.2	B
			NBL	7.4	A	7.6	A
			SBL	7.3	A	7.4	A
7*	Beal Street & Griswold Street	Stop (Minor)	EB	4.2	A	4.8	A
			WB	Free		Free	
			SB	4.2	A	4.7	A
8	Beal Street & River Street	Stop (Minor)	EB	Free		Free	
			WBL	7.3	A	7.4	A
			NB	9.1	A	9.7	A
9	Center Street & Fairbrook Street	Stop (Minor)	EB	22.4	C	27.6	D
			NBL	8.5	A	10.0	A
			SB	Free		Free	
10	Sheldon Avenue / Center Street & 7 Mile Road / Hines Drive	Signalized	EBL	20.5	C	33.5	C
			EBTR	32.9	C	26.5	C
			WBL	37.3	D	38.9	D
			WBT	18.2	B	28.2	C
			WBR	17.3	B	18.2	B
			NBL	20.4	C	40.5	D
			NBTR	21.5	C	26.5	C
			SBL	33.5	C	41.8	D
			SBTR	15.8	B	22.3	C
			Overall	**23.6**	**C**	**27.0**	**C**
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free	
			WBL	13.7	B	18.0	C
			WBT	Free		Free	
			NBT	17.0	C	50.4	F
12	7 Mile Road & River Street	Stop (Minor)	EBL	7.7	A	8.7	A
			WB	Free		Free	
			SB	11.2	B	13.5	B
15	Northville Road & Beal Street	Stop (Minor)	EB	10.4	B	12.0	B
			NBL	8.0	A	8.5	A
			SB	Free		Free	
16*	SB Northville Road & N. 7 Mile Road	Stop/Yield (Minor)	EBT	11.5	B	14.4	B
			EBR	12.2	B	13.6	B
			WB	14.7	B	101.5	F
			SB	Free		Free	

Intersection		Control	Approach	Existing Conditions 2018			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
17*	NB Northville Road & N. 7 Mile Road	Yield (Minor)	EBL	14.4	B	32.8	D
			NBTL	4.8	A	5.9	A
			NBT	Free		Free	
18	Northville Road & S. 7 Mile Road	Signalized	WBL	21.5	C	22.3	C
			WBR	9.8	A	15.0	B
			NBT	38.7	D	121.9	F
			NBTR	58.0	E	124.7	F
			SBL	55.2	E	43.5	D
			SBT	11.3	B	12.0	B
			Overall	**36.3**	**D**	**56.6**	**E**

* Indicates SimTraffic delay or HCM2000 analysis used

The results of the existing conditions analysis indicate that all study intersection approaches and movements currently operate acceptably at a LOS D or better, with the exception of the following:

3.1.1 Main Street and Hutton Street

- The southbound left/through movement currently operates at a LOS E during the PM peak hour.

A review of network simulations indicates acceptable operations and all queues were observed to be serviced within the cycle length.

3.1.2 Main Street and Griswold Street

The intersection LOS on all approaches were seen to operate acceptably; however occasional periods of long vehicle queues were observed on the southbound approach during the PM peak hour. These queues were observed to dissipate and are not present throughout the duration of the peak hour.

3.1.3 Cady Street and Center Street

- The westbound approach currently operates at a LOS E and LOS F during the AM and PM peak hours, respectively. Additionally, the eastbound approach operates at a LOS E during the PM peak hour.

Although intersection LOS analysis indicates poor operations, a review of SimTraffic the simulations indicates that the signalized intersections allow for gaps in traffic, therefore, vehicles on Cady Street are serviced without significant vehicle queues.

3.1.4 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

Review of the network simulations indicates acceptable traffic operations during the AM peak hours. During the PM peak hour, long vehicle queues were observed for the northbound approach. These queues exist throughout the entire peak hour and are a result of the approach being near capacity and northbound left-turning vehicles blocking the northbound through traffic while waiting for gaps in the southbound through traffic. Periods of long vehicle queues were also observed on the westbound movements; however, they were not present throughout the entire peak hour. These queues are the result of left-turning vehicle queues exceeding the turn lane storage length and causing backup in the through lane and the right-turn lane. Additionally, occasional periods of long vehicle queues were observed on the southbound approach and were created by southbound left-turning vehicles waiting for gaps in northbound traffic. These queues were observed to dissipate quickly as a result of the northbound left-turning vehicles blocking the northbound through vehicles and therefore creating gaps in traffic for the southbound left-turning vehicles.

3.1.5 7 Mile Road and Hines Drive

- The northbound approach currently operates at a LOS F during the PM peak hour.

Brief periods of long vehicle queues are observed at the northbound approach during the PM peak hour; however, these vehicle queues are a result of the westbound vehicle queues at the intersection of 7 Mile Road

and Center Street. Simulations indicate that the queuing created at the intersection of 7 Mile Road and Center Street causes upstream blocking at Hines Drive for 1% of the PM peak hour. During the remaining portion of the peak hour, the signalized intersection of 7 Mile Road and Center Street allows for gaps in traffic, allowing northbound vehicles to progress through the intersection.

3.1.6 Northville Road (S. Main Street) and N. 7 Mile Road

- The yield-controlled westbound through movement currently operates at a LOS F during the PM peak hour.

Although intersection LOS analysis indicates poor operations, a review of SimTraffic the simulations indicates acceptable operations during both peak periods. Occasional periods of short queues were observed at the yield-controlled intersections; however, these vehicles were observed to find gaps within the opposing traffic, created by the signalized intersections.

Additionally, the most recent available three years of crash data were reviewed to assess any potential safety hazards created by northbound vehicles queuing while attempting to turn onto N. 7 Mile Road. The results of the crash analysis indicated that there were no rear-end crashes at the intersection of Northville Road (S. Main Street) and N. 7 Mile Road, as a result of northbound vehicles waiting to make left turns.

3.1.7 Northville Road and S. 7 Mile Road

- The northbound through/right and southbound left-turn movements currently operate at a LOS E during the AM peak hour.
- The northbound approach currently operates at a LOS F during the PM peak hour.

A review of network simulations indicates occasional periods of long vehicle queues for the southbound left-turn movement during the AM and PM peak periods; however, these queues are typically observed to be serviced within the cycle length. Additionally, brief periods of long vehicle queues were observed for the northbound approach during the PM peak period. These queues were observed to dissipate and are not present throughout the duration of the peak hour.

3.2 EXISTING IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements in the existing condition, mitigation measures were investigated. Signal cycle length and timing changes were analyzed.

3.2.1 Main Street and Hutton Street

The results of this analysis indicate that signal timing optimization (i.e. providing more green time for the northbound and southbound approaches) is enough to improve all approaches to operating at a LOS D or better during the PM peak period. A review of network simulations confirms acceptable operations.

3.2.2 Main Street and Griswold Street

A review of network simulations indicates that signal timing optimization (i.e. providing more green time for the northbound and southbound approaches) was observed to reduce vehicle queues on the southbound approach.

3.2.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

Signal timing adjustments were investigated; however, it was determined that signal timing adjustments alone would not address the operational deficiencies previously identified. In order to address the operational deficiencies at this intersection, geometric improvements were investigated. The results of this analysis indicate widening Center Street/Sheldon Avenue to provide an additional through lane in the northbound direction would improve existing operations; however, this improvement is a regional improvement that is outside of the scope of this study. WCDPS should consider improvements on Center Street and 7 Mile Road to increase the capacity of this regional route.

In order to address the operational deficiencies at this intersection, alternative mitigation measures were evaluated. Due to the constrained nature, the alternative measures at this intersection will require considerable modifications to the area. The alternative options and the results of the operational analysis are summarized in **Table 2** and further described below; the existing roadway conditions were included for comparison purposes.

Table 2: Center Street & 7 Mile Road Alternatives Analysis (Existing Conditions)

Peak Period	Approach	Existing Conditions				Signalization Improvement				Increased NB LT Storage				Roundabout			
		Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)
AM	EBL	20.5	C	44	151	23.2	C	52	165	20.6	C	47	158	8.3	A	139*	256*
	EBTR	32.9	C	195	336	49.6	D	261	436	41.9	D	235	432				
	WBL	37.3	D	28	68	28.4	C	26	67	25.1	C	19	52	4.7	A	20	46
	WBT	18.2	B	52	104	27.3	C	65	129	24.4	C	59	118				
	WBR	17.3	B	13	38	23.1	C	21	64	20.4	C	15	51			6	26
	NBL	20.4	C	16	35	20.9	C	31	85	21.0	C	55	215	10.7	B	1246	2562
	NBT	21.5	C	434	869	49.4	D	507	957	38.9	D	317	555				
	NBR									19.7	B	27	79			68	103
	SBL	33.5	C	67*	133*	28.1	C	48	88	25.1	C	45	90	5.1	A	78*	161*
	SBTR	15.8	B	127*	204*	27.6	C	134*	233*	27.7	C	145*	239*			3	18
	Overall	23.6	C	N/A	N/A	39.7	D	N/A	N/A	33.2	C	N/A	N/A	7.9	A	N/A	N/A
PM	EBL	33.5	C	33	111	31.3	C	40	138	28.1	C	42	139	10.1	B	87*	166*
	EBTR	26.5	C	153	249	52.9	D	207	341	45.0	D	265	478				
	WBL	38.9	D	98	159	33.1	C	77	150	29.8	C	86	160	8.2	A	46	80
	WBT	28.2	C	284*	529*	49.3	D	270	425	44.5	D	310	509				
	WBR	18.2	B	136	414	26.4	C	95	256	23.8	C	146	383			17	54
	NBL	40.5	D	21	30	28.0	C	61	102	29.8	C	177	399	13.8	B	2644	5119
	NBT	26.5	C	4389	8588	57.1	E	2517	4997	36.2	D	766	1664				
	NBR									16.8	B	39	94			72	94
	SBL	41.8	D	47	97	29.4	C	46	89	23.8	C	51	107	13.0	B	198*	200*
	SBTR	22.3	C	192*	270*	37.8	D	225*	276*	40.5	D	226*	276*			6	26
	Overall	27.0	C	N/A	N/A	46.0	D	N/A	N/A	37.8	D	N/A	N/A	11.5	B	N/A	N/A

* Indicates that the queue length has exceeded the link distance. Therefore, may not accurately represent intersection conditions

Option 1: Signalization Improvements

The intersection operations with this alternative includes the following:

- Restriping the NB approach to provide a through/right lane and an exclusive 60-ft left-turn lane *(Note: On the NB approach the left-turn storage length would be limited by existing geometric constraints of the bridge)*.
- Restriping the SB approach to provide a through/right lane and an exclusive left-turn lane.
- Upgrade to a fully actuated signal.
- Provide permissive/protected left-turn phasing for all approaches (Left-turn Warrant in **Appendix E**).
- Providing overlap phasing for westbound right-turn movement.
- Optimize traffic signal timings and cycle lengths during peak periods.

In order to implement this alternative; the existing traffic signal will need to be replaced and upgraded to a fully actuated signal with left-turn signal heads, and the northbound and southbound approaches will need to be restriped.

The results of the analysis indicates that the through movements and overall intersection showed a degradation in delay and LOS; however, the delay and LOS were improved for the left-turning movements. Although the intersection LOS analysis indicates poor operation for the northbound through movement during the PM peak period, a review of network simulations indicates slightly reduced vehicle queues. Additionally, reduced vehicle queues were observed for the westbound movements during the PM peak period.

Option 2: Increased Northbound Left-Turn Storage

The intersection operations with this alternative includes the following:

- Widening the NB approach to provide a 300-ft left-turn lane and a 50-ft right-turn lane.
- Restriping the SB approach to provide through/right lane and an exclusive left-turn lane.
- Upgrade to a fully actuated signal.
- Provide permissive/protected left-turn phasing for all approaches.
- Providing overlap phasing for northbound and westbound right-turn movements.
- Optimize traffic signal timings and cycle lengths during peak periods.

In order to implement this alternative; the bridge along Sheldon Road across Johnson Creek will need to be widened to provide adequate left-turn storage space.

The results of the analysis are similar to those observed for **Option 1**; indicating that the through movements and overall intersection showed a degradation in delay and LOS, while the delay and LOS were improved for the left-turning movements. A review of network simulations indicate that much greater reduction in vehicle queues on the northbound approach is observed by providing additional northbound left-turn storage. Additionally, reduced vehicle queues were observed for the westbound movements.

Option 3: Roundabout

The intersection operations with this alternative includes constructing a roundabout; the configuration was modeled and evaluated by OHM Advisors. To implement this alternative, the WCDPS will need to acquire significant ROW, in order to fit the roundabout as designed. Additionally, potential wetland mitigation may be needed, as the proposed roundabout extends into the southeast portion of the site.

The Rodel model and analysis performed by OHM Advisors for this intersection indicates that all approaches will experience a reduction in LOS and delay over existing conditions with the installation of a roundabout. F&V performed additional analysis using the HCM methodology and SimTraffic simulations which indicate that the northbound approach during the AM peak periods and the southbound approach during both peak periods were observed to experience significantly increased vehicle queues. Additionally, observations indicate reduced vehicle queues for the eastbound and westbound movements during both peak periods, and slightly reduced vehicle queues for the northbound approach during the PM peak period. Vehicles at the southbound approach were observed to have difficulties in finding gaps in traffic due to the high volume of conflicting movements (i.e. the westbound through and northbound left-turning vehicles). The result of increased vehicle queueing for the southbound approach can be seen throughout the network, with the queues extending down Center Street and eliminating the available gaps in traffic for the minor stop-controlled approaches. The long vehicle queues on the southbound approach were observed to be present and increasing throughout the peak hour.

In general, a roundabout reduces crash severity, but may increase crash frequency. Based on the existing crash data, there is currently not an issue with injury crashes occurring at this intersection. In addition, a roundabout does not provide the safest option for pedestrians and bicycles, as the free-flowing movement does not create consistent gaps for crossing traffic.

3.2.4 7 Mile Road and Hines Drive

The signal improvements at the intersection of 7 Mile Road and Center Street decreased the delay on the northbound approach; however, the westbound queues at 7 Mile Road and Center Street were still observed to back up near the intersection during the PM peak hour. Therefore, further mitigation is recommended through geometric improvements.

- Construct a northbound right turn lane.

3.2.5 Northville Road (S. Main Street) and N. 7 Mile Road

Although microsimulations indicated acceptable operations at the intersection of Northville Road (S. Main Street) and N. 7 Mile Road, several potential mitigation measures were identified to reduce the vehicle delays identified in the LOS analysis and improve safety at this intersection. The potential improvements that the WCDPS may want to consider are as follows:

- Eliminate the bi-directional cross-over.
- Provide a directional northbound left-turn (J-turn) and prohibit eastbound left-turns.
- Provide a median U-turn south of N. 7 Mile Road to facilitate eastbound left-turns.
- Consider intersection signalization.

For the purpose of this report, intersection signalization was evaluated and modeled as a mitigation measure. The applicable traffic signal warrants outlined in the most recent edition of the *MMUTCD* were evaluated at this intersection. At this intersection; Warrant 1 (8-Hour Vehicular Volume), Warrant 2 (4-Hour Vehicular Volume), and Warrant 3 (Peak-Hour) were evaluated. The results of the signal warrant analysis are presented in **Appendix E** and are summarized in **Table 3**.

Table 3: Existing Signal Warrant Analysis Summary

Northville Road and N. 7 Mile Road		
Warrant 1: Eight Hour		YES
Condition A	*Hours Met*	8
	Warrant Met	YES
Condition B	*Hours Met*	5
	Warrant Met	NO
Warrant 2: Four-Hour	*Hours Met*	7
	Warrant Met	YES
Warrant 3: Peak-Hour	*Hours Met*	2
	Warrant Met	YES

The results of the signal warrant evaluation indicate that traffic signal **is warranted** at the study intersection under existing conditions.

After analyzing the intersection with signalization, all movements and approaches improved to a LOS C or better. A review of network simulations indicates acceptable operations for all movements.

3.2.6 Northville Road and S. 7 Mile Road

The results of this analysis indicate that signal timing optimization (i.e. providing more green time for the northbound and southbound movements) is enough to improve all approaches to operating at a LOS D or better during the AM and PM peak periods. A review of network simulations confirms acceptable operations.

3.2.7 Existing Conditions with Improvements

Intersection operations and vehicle queues with the recommended improvements are summarized in **Table 4** and **Table 5**, respectively.

Table 4: Existing Intersection Operations with Improvements

Intersection		Control	Approach	Existing Conditions 2018				Existing Conditions 2018 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	No Change		18.0	B
			EBR	0.0	A	0.0	A			15.6	B
			WBTL	6.7	A	7.6	A			13.4	B
			WBR	7.1	A	9.1	A			17.0	B
			NB	17.2	B	19.1	B			14.5	B
			SBTL	21.4	C	69.3	E			42.2	D
			SBR	16.5	B	16.5	B			10.6	B
			Overall	**10.3**	**B**	**21.9**	**C**			**21.9**	**C**
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.5	B	No Change		23.3	C
			EBTR	10.1	B	11.0	B			15.4	B
			WBTL	10.1	B	11.8	B			16.5	B
			WBTR	10.5	B	12.5	B			17.8	B
			NB	15.0	B	16.4	B			11.9	B
			SB	16.8	B	29.3	C			18.0	B
			Overall	**12.7**	**B**	**17.5**	**B**			**16.9**	**B**
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	13.7	B	18.0	C	16.5	C	24.5	D
			WBT	Free		Free		Free		Free	
			NB	17.0	C	50.4	F	20.2	C	48.3	E
16 & 17	Northville Road & N. 7 Mile Road	Stop/Yield Signalized [IMP]	EBL	14.4	B	32.8	D	31.5	C	26.8	C
			EBR	12.2	B	13.6	B	14.7	B	13.6	B
			WB [NBL]	14.7	B	101.5	F	3.2	A	9.2	A
			NBT	Free		Free		0.1	A	0.3	A
			SBT	Free		Free		25.0	C	30.1	C
			SBTR	Free		Free		25.1	C	30.4	C
			Overall	**N/A**	**N/A**	**N/A**	**N/A**	**12.5**	**B**	**13.5**	**B**
18	Northville Road & S. 7 Mile Road	Signalized	WBL	21.5	C	22.3	C	34.8	C	33.0	C
			WBR	9.8	A	15.0	B	12.9	B	21.9	C
			NBT	38.7	D	121.9	F	28.5	C	40.7	D
			NBTR	58.0	E	124.7	F	33.9	C	41.9	D
			SBL	55.2	E	43.5	D	31.6	C	29.3	C
			SBT	11.3	B	12.0	B	10.1	B	0.6	A
			Overall	**36.3**	**D**	**56.6**	**E**	**27.0**	**C**	**27.9**	**C**

* Indicates SimTraffic delay analysis used

Table 5: Existing Vehicle Queues (feet) with Improvements

Intersection		Control	Approach	Existing Conditions 2018				Existing Conditions 2018 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Avg	95th %	Avg	95th %	Avg	95th %	Avg	95th %
2	Main Street & Hutton Street	Signalized	EBTL	No Changes		45	95	No Changes		69	135
			EBR			4	22			9	32
			WBTL			76	149			91	173
			WBR			61	106			73	116
			NB			21	49			14	36
			SBTL			102	165			79	139
			SBR			6	23			5	19
3	Main Street & Griswold Street	Signalized	EBTL	No Changes		97	163	No Changes		113	186
			EBTR			65	118			83	140
			WBTL			64	108			76	127
			WBTR			106	167			126	195
			NB			74	114			74	119
			SB			216	391			159	267
11	7 Mile Road & Hines Drive	Stop (NW Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	0	0	2	15	0	0	1	9
			WBT	Free		Free		Free		Free	
			NB	51	89	193	407	47	85	167	413

3.3 BACKGROUND CONDITIONS

Historical traffic volume data was not available in the area; therefore, population and employment data were used in order to determine the applicable growth rate for the existing traffic volumes to the project build-out year of 2023. The SEMCOG community profile for the City of Northville was reviewed and showed an average annual growth rate of 0.20% population growth and a 0.07% employment growth from 2015 to 2045. Therefore, a growth rate of 0.2% per year along all roadways was utilized in this study for the analysis of background conditions ***without the proposed development.***

In addition to background growth, it is important to account for traffic that will be generated by approved and/or proposed developments within the vicinity of the study area that have yet to be constructed or are currently under construction. The following developments were identified by the City of Northville:

- Cady Project – 6 unit condominium (South side of Cady Street, east of Center Street)
- Corner House – 11 unit condominium (NW corner of Griswold Street and Cady Street)
- McDonald Ford Site – 60 unit townhouses (South side of 7 Mile Road, near S. Main Street)
- Foundry Flask – 140 unit apartments (SE corner of Griswold Street and Cady Street)

The number of AM and PM peak hour vehicle trips that would be generated by the proposed developments were forecast based on data published by ITE in the *Trip Generation Manual, 10th Edition* and the ITE *Trip Generation Handbook, 3rd Edition*. The trip distribution that was determined for the proposed Northville Downs development was used to distribute the trip projections for these developments. The background 2023 traffic volumes are shown on **Figure 4**.

3.4 BACKGROUND OPERATIONS

The background traffic growth was applied to the existing traffic volumes shown on **Figure 3** to determine the background traffic volumes shown on **Figure 4**. Background peak hour vehicle delays and LOS were calculated based on the existing lane use and traffic control shown on **Figure 2**, the background traffic volumes shown on **Figure 4**, and the methodologies presented in the HCM. The results of the analysis of background conditions are presented in **Appendix C** and are summarized in **Table 6**.

Table 6: Background Intersection Operations

Intersection		Control	Approach	Existing Conditions 2018				Background Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Main Street & Center Street	Signalized	EB	19.9	B	20.1	C	20.0	B	20.1	C
			WB	18.9	B	19.2	B	18.9	B	19.4	B
			NB	9.8	A	10.0	A	10.0	B	10.1	B
			SB	8.6	A	10.2	B	8.7	A	10.4	B
			Overall	**11.9**	**B**	**12.9**	**B**	**12.0**	**B**	**13.1**	**B**
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	0.3	A	0.3	A
			EBR	0.0	A	0.0	A	0.0	A	0.0	A
			WBTL	6.7	A	7.6	A	6.7	A	7.6	A
			WBR	7.1	A	9.1	A	7.1	A	9.2	A
			NB	17.2	B	19.1	B	17.3	B	19.4	B
			SBTL	21.4	C	69.3	E	21.5	C	70.5	E
			SBR	16.5	B	16.5	B	16.5	B	16.5	B
			Overall	**10.3**	**B**	**21.9**	**C**	**10.3**	**B**	**22.2**	**C**

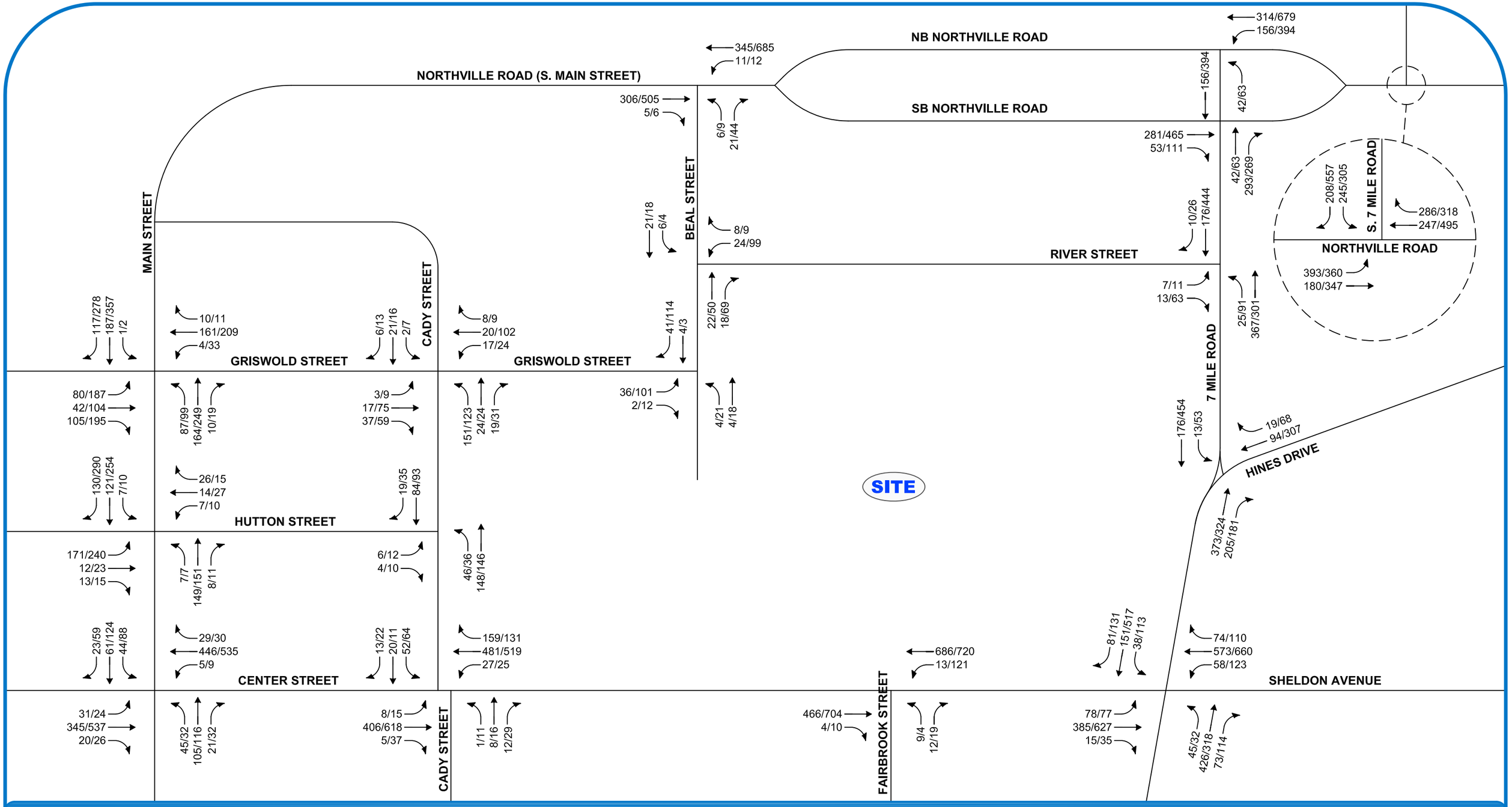


FIGURE 4
BACKGROUND TRAFFIC VOLUMES

NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

NORTH

SCALE: NOT TO SCALE

F&V

Intersection		Control	Approach	Existing Conditions 2018				Background Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.5	B	12.0	B	15.7	B
			EBTR	10.1	B	11.0	B	10.1	B	11.1	B
			WBTL	10.1	B	11.8	B	10.1	B	11.8	B
			WBTR	10.5	B	12.5	B	10.5	B	12.5	B
			NB	15.0	B	16.4	B	15.1	B	16.5	B
			SB	16.8	B	29.3	C	16.9	B	31.0	C
			Overall	**12.7**	**B**	**17.5**	**B**	**12.8**	**B**	**18.1**	**B**
4	Cady Street & Center Street	Stop (Minor)	EB	19.3	C	37.7	E	19.9	C	41.2	E
			WB	44.5	E	137.8	F	52.9	F	199.4	F
			NBL	8.4	A	9.2	A	8.4	A	9.3	A
			SBL	9.0	A	8.9	A	9.1	A	9.0	A
5	Cady Street & Hutton Street	Stop (Minor)	EBL	7.6	A	7.6	A	7.6	A	7.6	A
			WB	Free		Free		Free		Free	
			SB	10.7	B	10.2	B	11.1	B	10.5	B
6	Cady Street & Griswold Street	Stop (Minor)	EB	10.7	B	12.8	B	11.3	B	14.1	B
			WB	9.5	A	10.2	B	9.9	A	11.1	B
			NBL	7.4	A	7.6	A	7.4	A	7.6	A
			SBL	7.3	A	7.4	A	7.3	A	7.5	A
7*	Beal Street & Griswold Street	Stop (Minor)	EB	4.2	A	4.8	A	4.7	A	5.1	A
			WB	Free		Free		Free		Free	
			SB	4.2	A	4.7	A	4.3	A	4.8	A
8	Beal Street & River Street	Stop (Minor)	EB	Free		Free		Free		Free	
			WBL	7.3	A	7.4	A	7.3	A	7.5	A
			NB	9.1	A	9.7	A	9.2	A	9.7	A
9	Center Street & Fairbrook Street	Stop (Minor)	EB	22.4	C	27.6	D	23.3	C	29.1	D
			NBL	8.5	A	10.0	A	8.5	A	10.1	B
			SB	Free		Free		Free		Free	
10	Sheldon Avenue / Center Street & 7 Mile Road / Hines Drive	Signalized	EBL	20.5	C	33.5	C	20.6	C	33.9	C
			EBTR	32.9	C	26.5	C	33.6	C	27.0	C
			WBL	37.3	D	38.9	D	38.3	D	40.9	D
			WBT	18.2	B	28.2	C	18.2	B	28.6	C
			WBR	17.3	B	18.2	B	17.4	B	18.3	B
			NBTL	20.4	C	40.5	D	20.8	C	42.3	D
			NBR	21.5	C	26.5	C	21.9	C	28.2	C
			SBL	33.5	C	41.8	D	34.9	C	45.7	D
			SBTR	15.8	B	22.3	C	16.0	B	22.8	C
			Overall	**23.6**	**C**	**27.0**	**C**	**24.1**	**C**	**28.0**	**C**
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	13.7	B	18.0	C	13.3	B	16.5	C
			WBT	Free		Free		Free		Free	
			NB	17.0	C	50.4	F	16.8	C	87.7	F
12	7 Mile Road & River Street	Stop (Minor)	EBL	7.7	A	8.7	A	7.7	A	8.8	A
			WB	Free		Free		Free		Free	
			SB	11.2	B	13.5	B	11.4	B	14.2	B

Intersection		Control	Approach	Existing Conditions 2018				Background Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
15	Northville Road & Beal Street	Stop (Minor)	EB	10.4	B	12.0	B	10.5	B	12.2	B
			NBL	8.0	A	8.5	A	8.0	A	8.5	A
			SB	Free		Free		Free		Free	
16*	SB Northville Road & N. 7 Mile Road	Stop/Yield (Minor)	EBT	11.5	B	14.4	B	11.7	B	14.6	B
			EBR	12.2	B	13.6	B	12.5	B	13.9	B
			WB	14.7	B	101.5	F	15.2	C	118.7	F
			SB	Free		Free		Free		Free	
17*	NB Northville Road & N. 7 Mile Road	Yield (Minor)	EBL	14.4	B	32.8	D	14.7	B	35.1	E
			NBTL	4.8	A	5.9	A	4.9	A	5.9	A
			NBT	Free		Free		Free		Free	
18	Northville Road & S. 7 Mile Road	Signalized	WBL	21.5	C	22.3	C	21.5	C	22.4	C
			WBR	9.8	A	15.0	B	9.9	A	15.3	B
			NBT	38.7	D	121.9	F	39.3	D	131.2	F
			NBTR	58.0	E	124.7	F	59.3	E	133.6	F
			SBL	55.2	E	43.5	D	63.4	E	45.6	D
			SBT	11.3	B	12.0	B	11.4	B	12.1	B
			Overall	**36.3**	**D**	**56.6**	**E**	**38.7**	**D**	**60.1**	**E**

* Indicates SimTraffic delay or HCM2000 analysis used

The results of the background conditions analysis indicate that all study intersection approaches and movements will continue to operate in a manner similar to existing conditions, with the exception of the following:

- The westbound approach at the unsignalized intersection of **Cady Street & Center Street** will degrade to a LOS F during the AM peak hour.
    - Although increased delay during the AM and PM peak periods was observed, network simulations indicate that the gaps provided by the signalized intersections provide acceptable operations for Cady Street, with minor vehicle queues being observed.
- The northbound approach at the unsignalized intersection of **7 Mile Road & Hines Drive** showed a noticeable increase in delay during the PM peak hour.
    - Brief periods of long vehicle queues continue to occur at the northbound approach of 7 Mile Road and Hines Drive during the PM peak hour; however, these vehicle queues continue to be present as a result of the westbound vehicle queues at the intersection of 7 Mile Road and Center Street. Simulations indicate that the queuing created at the intersection of 7 Mile Road and Center Street causes upstream blocking at Hines Drive for 9% of the PM peak hour.
- The eastbound left-turn movement at the yield-controlled intersection of **NB Northville Road (S. Main Street) & N. 7 Mile Road** will degrade to a LOS E during the PM peak hour
    - Although increased delay during the AM and PM peak periods was observed, network simulations indicate that the gaps provided by the signalized intersections provide acceptable operations for vehicles attempting to make left-turns.

3.5 BACKGROUND IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements under background conditions, mitigation measures that were identified under existing conditions were applied. The results of this analysis are summarized in **Table 8** and indicate that all study intersection approaches and movements would operate acceptably at a LOS D or better during both peak periods, with the exception of following:

3.5.1 Main Street and Hutton Street

The results of this analysis indicate that signal timing optimization (i.e. providing more green time for the northbound and southbound approaches) is enough to improve all approaches to operating at a LOS D or better during PM peak period. A review of network simulations confirms acceptable operations.

3.5.2 Main Street and Griswold Street

A review of network simulations indicates that signal timing optimization (i.e. providing more green time for the northbound and southbound approaches) was observed to reduce vehicle queues on the southbound approach.

3.5.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

In order to address the operational deficiencies at this intersection, the previously identified alternative mitigation measures were again evaluated. The alternative options and the results of the operational analysis are summarized in **Table 7**.

Table 7: Center Street & 7 Mile Road Alternatives Analysis (Background Conditions)

Peak Period	Approach	Existing Conditions				Signalization Improvement				Increased NB LT Storage				Roundabout			
		Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)
AM	EBL	20.6	C	51	165	23.6	C	49	162	20.9	C	49	165	8.6	A	133*	263*
	EBTR	33.6	C	215	406	52.1	D	256	446	44.0	D	275	544				
	WBL	38.3	D	36	85	29.2	C	24	67	25.8	C	20	51	4.8	A	24	51
	WBT	18.2	B	52	118	27.8	C	61	120	24.9	C	55	113				
	WBR	17.4	B	16	50	23.4	C	18	53	20.7	C	15	50			8	34
	NBL	20.8	C	15	33	21.4	C	32	82	21.5	C	58	225	11.3	B	1148	2353
	NBT	21.9	C	402	747	52.8	D	574	1117	40.7	D	341	703				
	NBR									20.0	B	30	84			68	104
	SBL	34.9	C	81*	184*	29.7	C	46	89	25.9	C	47	93	5.2	A	81*	168*
	SBTR	16.0	B	131*	221*	28.3	C	142*	236*	28.6	C	151*	254*			1	7
	Overall	24.1	C	N/A	N/A	41.7	D	N/A	N/A	34.5	C	N/A	N/A	8.2	A	N/A	N/A
PM	EBL	33.9	C	25	83	31.3	C	42	146	28.6	C	33	117	10.7	B	77	140
	EBTR	27.0	C	159	277	53.8	D	251	433	47.1	D	244	407				
	WBL	40.9	D	102	168	34.5	C	84	155	31.9	C	84	154	8.7	A	49	84
	WBT	28.6	C	369*	666*	49.3	D	306	514	45.9	D	298	483				
	WBR	18.3	B	237*	614*	26.3	C	123	366	24.2	C	138	374			15	55
	NBL	42.3	D	21	32	30.1	C	57	102	31.6	C	148	357	15.5	C	3031	5765
	NBT	28.2	C	5772	10682	66.2	F	3541	7401	38.2	D	813	1730				
	NBR									17.1	B	31	85			68	103
	SBL	45.7	D	43	93	32.4	C	52	100	24.7	C	45	88	14.1	B	198*	198*
	SBTR	22.8	C	203*	274*	39.9	D	231*	272*	42.0	D	235*	260*			5	22
	Overall	28.0	C	N/A	N/A	49.3	D	N/A	N/A	39.4	D	N/A	N/A	12.5	B	N/A	N/A

* Indicates that the queue length has exceeded the link distance. Therefore, may not accurately represent intersection conditions

Option 1: Signalization Improvements

The results of the analysis are similar to existing conditions, indicating that the through movements and overall intersection show a degradation in delay and LOS; however, the delay and LOS were improved for the left-turning movements. Although the intersection LOS analysis indicates poor operation for the northbound through movement during the PM peak period, a review of network simulations indicates slightly reduced vehicle queues. An increased delay and reduced LOS were also observed for the westbound approach during the PM peak period; however, the vehicle queues observed in network simulations were noticeably reduced.

Option 2: Increased Northbound Left-Turn Storage

The results of the analysis are similar to **Option 1**, with much greater reductions in northbound vehicle queues observed during the PM peak period. The through movements and overall intersection show a degradation in delay and LOS; however, the delay and LOS were improved for the left-turning movements. Additionally, reduced vehicle queues were observed during the PM peak period for the westbound movements.

Option 3: Roundabout

The results are similar to existing conditions, with the Rodel analysis indicating that the installation of a roundabout at this intersection will result in decreased delays for all approaches. A review of network simulations however, indicates similar operations to those observed in existing conditions, with long southbound vehicle queues forming and causing back-ups throughout the network.

3.5.4 7 Mile Road and Hines Drive

The signal improvements at the intersection of 7 Mile Road and Center Street significantly decreased the delay on the northbound approach; however, the westbound queues at 7 Mile Road and Center Street were still observed to back up near the intersection during the PM peak hour.

3.5.5 Northville Road (S. Main Street) and N. 7 Mile Road

The results of this analysis indicate that, with intersection signalization, all movements and approaches improved to a LOS C or better. A review of network simulations indicates acceptable operations for all movements.

3.5.6 Northville Road and S. 7 Mile Road

The results of this analysis indicate that signal timing optimization (i.e. providing more green time for the northbound and southbound movements) is enough to improve all approaches to operating at a LOS D or better during the AM and PM peak periods. A review of network simulations confirms acceptable operations.

3.5.7 Background Conditions with Improvements

Intersection operations and vehicle queues with the recommended improvements are summarized in **Table 8** and **Table 9**, respectively.

Table 8: Background Intersection Operations with Improvements

Intersection		Control	Approach	Background Conditions 2023				Background Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	No Change		18.7	B
			EBR	0.0	A	0.0	A			16.2	B
			WBTL	6.7	A	7.6	A			14.3	B
			WBR	7.1	A	9.2	A			18.4	B
			NB	17.3	B	19.4	B			14.4	B
			SBTL	21.5	C	70.5	E			39.9	D
			SBR	16.5	B	16.5	B			10.0	A
			Overall	**10.3**	**B**	**22.2**	**C**			**22.1**	**C**
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.7	B	No Change		23.7	C
			EBTR	10.1	B	11.1	B			15.4	B
			WBTL	10.1	B	11.8	B			16.5	B
			WBTR	10.5	B	12.5	B			18.0	B
			NB	15.1	B	16.5	B			12.0	B
			SB	16.9	B	31.0	C			18.4	B
			Overall	**12.8**	**B**	**18.1**	**B**			**17.1**	**B**
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	13.3	B	16.5	C	20.4	C	22.2	D
			WBT	Free		Free		Free		Free	
			NB	16.8	C	87.7	F	20.1	C	45.4	E
16 & 17	Northville Road & N. 7 Mile Road	Stop/Yield Signalized [IMP]	EBL	14.7	B	35.1	E	31.5	C	26.9	C
			EBR	12.5	B	13.9	B	15.0	B	13.7	B
			WB [NBL]	15.2	C	118.7	F	3.3	A	9.5	A
			NBT	Free		Free		0.1	A	0.3	A
			SBT	Free		Free		25.2	C	30.5	C
			SBTR	Free		Free		25.4	C	30.8	C
			Overall	**N/A**	**N/A**	**N/A**	**N/A**	**12.8**	**B**	**13.6**	**B**
18	Northville Road & S. 7 Mile Road	Signalized	WBL	21.5	C	22.4	C	35.0	C	33.2	C
			WBR	9.9	A	15.3	B	13.0	B	22.6	C
			NBT	39.3	D	131.2	F	28.7	C	42.3	D
			NBTR	59.3	E	133.6	F	34.2	C	43.6	D
			SBL	63.4	E	45.6	D	32.8	C	30.7	C
			SBT	11.4	B	12.1	B	10.2	B	0.6	A
			Overall	**38.7**	**D**	**60.1**	**E**	**27.4**	**C**	**28.8**	**C**

* Indicates SimTraffic delay analysis used

Table 9: Background Vehicle Queues (feet) with Improvements

Intersection		Control	Approach	Background Conditions 2023				Background Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Avg	95th %	Avg	95th %	Avg	95th %	Avg	95th %
2	Main Street & Hutton Street	Signalized	EBTL	No Changes		47	97	No Changes		68	122
			EBR			6	26			8	32
			WBTL			84	164			97	187
			WBR			66	112			77	119
			NB			21	52			16	41
			SBTL			104	176			83	140
			SBR			7	25			4	18
3	Main Street & Griswold Street	Signalized	EBTL	No Changes		100	172	No Changes		119	198
			EBTR			75	134			86	148
			WBTL			66	110			79	133
			WBTR			109	170			129	188
			NB			81	127			79	124
			SB			346	580			189	355
11	7 Mile Road & Hines Drive	Stop (NW Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	0	3	1	10	0	0	0	5
			WBT	Free		Free		Free		Free	
			NB	48	89	295	864	50	92	161	332

3.6 SITE TRIP GENERATION

The number of AM and PM peak hour vehicle trips that would be generated by the proposed development was forecast based on data published by ITE in the *Trip Generation Manual, 10th Edition* and the ITE *Trip Generation Handbook, 3rd Edition*. Additional data published by SEMCOG was also used in the analysis in conjunction with the ITE methodology. The trip generation analysis summarized below considers all multi-modal impacts (vehicles, pedestrians, transit and bikes). By using the national database for the proposed development and then adjusting based on local data, we have presented a conservative approach tailored to the specific needs of the City of Northville.

3.6.1 Vehicular Trip Generation Analysis

The first step in evaluating the trip generation for the proposed development is to calculate the trip generation using the ITE *Trip Generation Manual (10th Edition)*. The proposed development includes 53 single-family units, 493 multi-family units, and 18,700 square feet of commercial development. The ITE Trip Generation Manual Land Uses 210, 221, and 820 (Single-Family Detached Housing, Mid-Rise Multifamily Housing, and Shopping Center) were used for this study as they represent the best fit for this development. The land use descriptions are summarized below, and **Table 10** and **Table 11** shows the corresponding trip generation (vehicle trips) for the proposed commercial and residential developments.

Land Use 210-Single-Family Detached Housing*: Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.*

Land Use 221-Multifamily Housing, Mid-Rise*: Mid-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have between three and 10 levels (floors).*

Land Use 820-Shopping Center*: shopping center is an integrated group of commercial establishments that is planned, developed, owned, and managed as a unit. A shopping center's composition is related to its market area in terms of size, location, and type of store. A shopping center also provides on-site parking facilities sufficient to serve its own parking demands.*

Table 10: Commercial Development Trip Generation

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Retail	820	18,700	SF	1,923	11	7	18	75	82	157
Total Internal Capture					*2*	*1*	*3*	*8*	*21*	*29*
Pass-By (34%)					*3*	*2*	*5*	*23*	*21*	*44*
Total New Trips					**6**	**4**	**10**	**44**	**40**	**84**

Table 11: Residential Development Trip Generation

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Single-Family Detached Housing	210	53	D.U.	580	11	31	42	35	20	55
Multifamily Housing (Mid-Rise)	221	493	D.U.	2,685	42	121	163	125	80	205
Total Trips					53	152	205	160	100	260
Total Internal Capture					*1*	*2*	*3*	*21*	*8*	*29*
Total New Trips					**52**	**150**	**202**	**139**	**92**	**231**

Internal trip capture is the portion of trips generated by a mixed-used development that would begin and end within the development; resulting in no additional trips added to the adjacent road network. The internal trip capture spreadsheet is provided in **Appendix A.** Additionally, a portion of the site-generated commercial trips are already present on the adjacent road network and are interrupted to visit the site. These trips are known as "pass-by" trips and result in turning movements at the site driveways, but do not increase traffic volumes on

the adjacent road network. The percentage of pass-by trips was determined based on the rates published by ITE in the Trip Generation Handbook, 3rd Edition.

3.6.2 ITE Residential Modal Split

The vehicle trips for the residential development in **Table 11** were then converted to person trips by using the baseline vehicle mode split and baseline vehicle occupancy rates published by ITE in Appendix B of the ITE *Trip Generation Handbook, 3rd Edition.* The vehicle mode splits and vehicle occupancy rates for the studies contained within the *Trip Generation Manual* are provided below.

AM PEAK HOUR					
Inbound			Outbound		
Personal Vehicle	Truck	Vehicle Occupancy	Personal Vehicle	Truck	Vehicle Occupancy
0.892	0.070	1.13	0.968	0.010	1.09
PM PEAK HOUR					
Inbound			Outbound		
Personal Vehicle	Truck	Vehicle Occupancy	Personal Vehicle	Truck	Vehicle Occupancy
0.963	0.010	1.15	0.947	0.015	1.21
WEEKDAY					
Personal Vehicle		Truck		Vehicle Occupancy	
0.943		0.010		1.145	

The above factors were applied to the total new vehicle trips generated by the residential development in **Table 11** to provide the total number of person-trips generated by the proposed residential development. This was accomplished by dividing the number of total site-generated vehicle trips by the personal vehicle mode split (i.e. "personal vehicle" in the tables above) and multiplying by the vehicle occupancy to obtain the total number of site-generated person-trips. The total person trips are summarized in **Table 12**.

Table 12:Person-Trip Generation per *ITE Trip Generation Handbook, 3rd Edition*

Land Use	Amount	Units	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
				In	Out	Total	In	Out	Total
Single-Family & Multi-Family Housing	546	D.U.	3,967	65	169	234	164	116	280

3.7 City of Northville Modal Split

With the trips converted to Person-Trips using the ITE methodology, a modal split was applied to determine the number of site-generated trips using a variety of mode choices *(Note: Approximately 8% of residents worked from home and therefore did not generate any commuting trips).* This was calculated by applying the modal splits for the City of Northville as published by SEMCOG:

	Commuting Modal Splits in Northville
Vehicle	**0.879**
Walk	**0.032**
Bike	**0.011**
Transit	**0.000**

These factors were applied to the Person-Trips in **Table 9** to calculate the modal split trip generation for the proposed residential development. For walking, cycling, and transit mode choices, one person-trip corresponds to one pedestrian, bike, or transit trip, and no further adjustment were required. However, site-generated vehicle trips must be adjusted to reflect appropriate vehicle occupancy in accounting for multiple-occupant vehicles. Therefore, the SEMCOG *Transportation Demand Management (TDM) in Southeast Michigan* document was referenced to obtain vehicle occupancy rates relevant to Michigan communities. The document specified an average vehicle occupancy of 1.1 persons/vehicle for work-related trips and 1.4 persons/vehicle for non-work-

related trips. Therefore, it was assumed that residential site-generated vehicle trips would have a vehicle occupancy of 1.1 persons/vehicle for AM and PM peak hour trips and an average of 1.25 persons/vehicle for daily trips. The modal split trip generation for the proposed residential development is summarized in **Table 13**. *Note: The values have been rounded up to the nearest whole number.*

Table 13: Residential Modal Split Trip Generation

Mode of Transportation	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Vehicular	**2,790**	**52**	**135**	**187**	**131**	**92**	**223**
Walk	127	2	6	8	6	4	10
Bike	44	1	2	3	2	2	4

3.8 SITE TRIP DISTRIBUTION

The vehicular trips that would be generated by the proposed development were assigned to the study roads based on existing peak hour traffic patterns in the adjacent roadway network and the methodologies published by ITE. The adjacent street traffic volumes were used to develop the trip distribution. To determine trips distribution for residential developments using the adjacent street traffic it is assumed that the trips in the AM are home-to-work based trips, and in the PM are work-to-home based trips. Therefore, the global trip generation is based on trips in the AM going from the residential development exiting the study network and returning to the study network in the PM. The ITE trip distribution methodology assumes that new trips will return to their direction of origin, while pass-by trips enter and exit the development in their original direction of travel. The site trip distributions used in the analysis are summarized in **Table 14**.

Table 14: New Site Trip Distribution

New Trips					
Residential				Commercial	
AM	PM	To/From	Via	AM	PM
16%	12%	North	Center Street	12%	12%
5%	5%		Hutton Street	6%	7%
11%	10%		Griswold Street	7%	12%
15%	18%	South	Sheldon Avenue	21%	17%
7%	8%		Hines Drive	3%	5%
13%	16%		Northville Road	15%	13%
21%	17%	East	7-Mile Road	13%	13%
3%	4%	West	Main Street	5%	3%
2%	1%		Cady Street	1%	1%
0%	0%		Fairbrook Street	1%	3%
7%	9%		7 Mile Road	16%	14%
100%	**100%**	**Total**		**100%**	**100%**

Commercial Pass-by Trips			
From / To	Via	AM	PM
North to South	Center Street	35%	44%
South to North	Center Street	49%	41%
East to West	Cady Street	5%	6%
West to East	Cady Street	11%	9%
Total		100%	100%

The vehicular traffic volumes shown in **Table 10** and **Table 13** were distributed to the roadway network according to the distribution shown in **Table 14**. As the proposed development has several access points, the internal distribution is fairly evenly distributed, which minimizes the overall impact on the study network. The site generated trips are shown on **Figure 5** and were added to the future background traffic volumes shown on **Figure 4** to calculate the future peak hour traffic volumes shown on **Figure 6**.

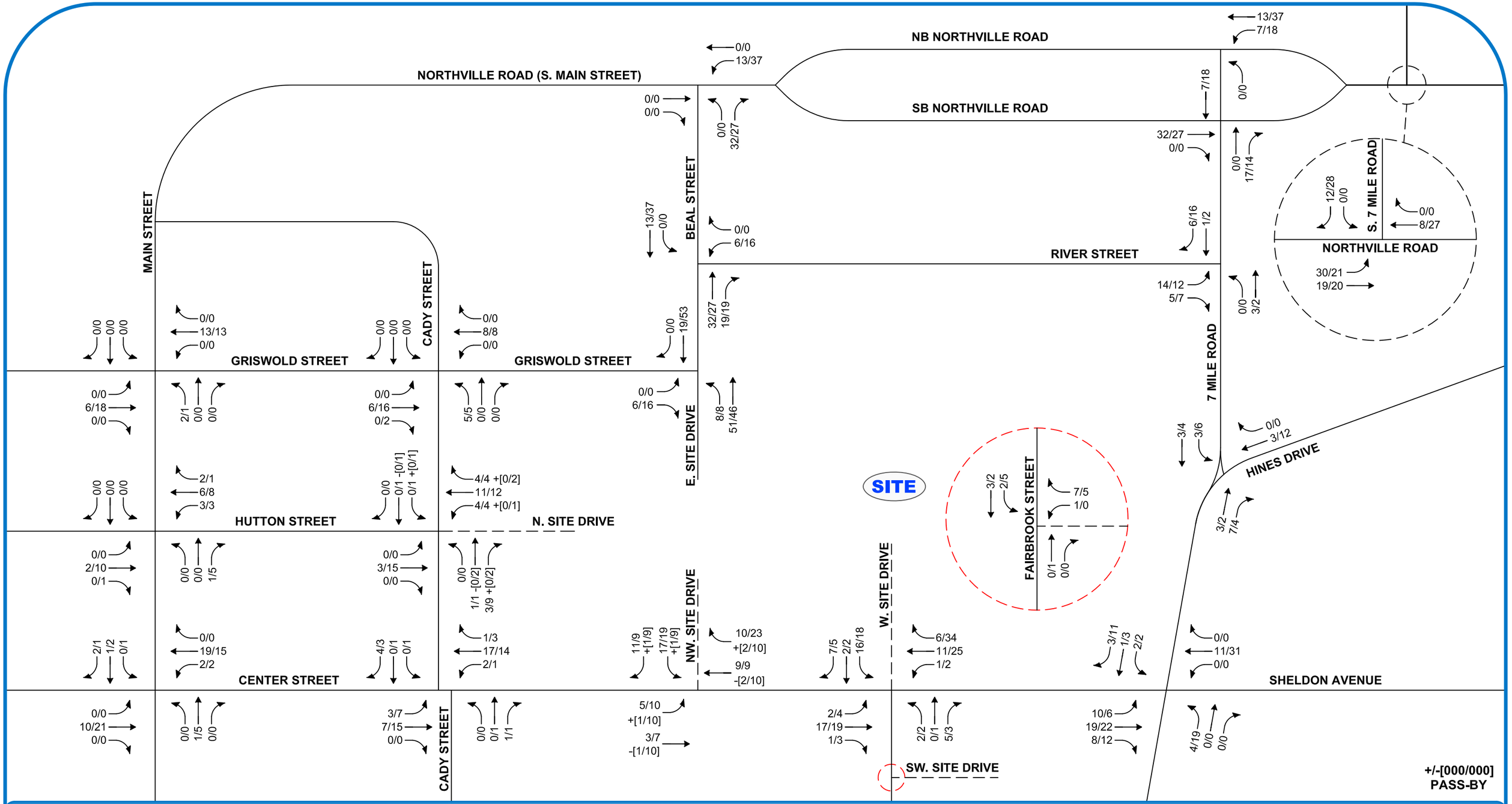


FIGURE 5
SITE-GENERATED TRAFFIC VOLUMES

NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

NORTH

SCALE: NOT TO SCALE

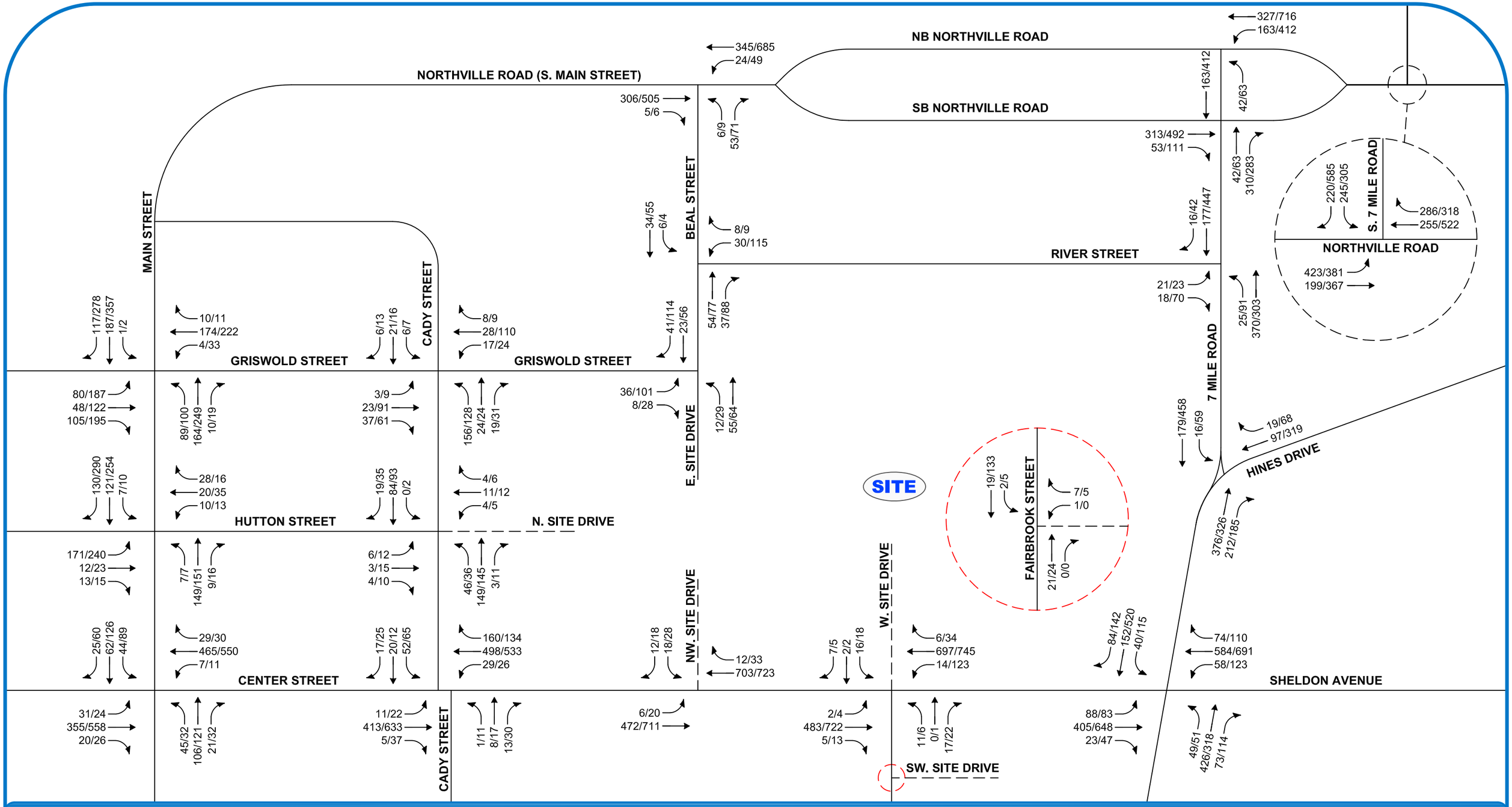


FIGURE 6
FUTURE TRAFFIC VOLUMES

NORTHVILLE DOWNS TIS - NORTHVILLE, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)
- SIGNALIZED INTERSECTION
- UNSIGNALIZED INTERSECTION

NORTH

SCALE: NOT TO SCALE

F&V

3.9 FUTURE CONDITIONS

Future peak hour vehicle delays and LOS ***with the proposed development*** were calculated based on the existing lane use and traffic control shown on **Figure 2**, the proposed site access plan, the future traffic volumes shown on **Figure 6**, and the methodologies presented in the HCM. The results of the future conditions analysis are presented in **Appendix D** and are summarized in **Table 15.**

Table 15: Future Intersection Operations

Intersection		Control	Approach	Background Conditions 2023				Future Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	Main Street & Center Street	Signalized	EB	20.0	B	20.1	C	20.0	B	20.3	C
			WB	18.9	B	19.4	B	19.0	B	19.6	B
			NB	10.0	B	10.1	B	10.3	B	10.3	B
			SB	8.7	A	10.4	B	8.8	A	10.7	B
			Overall	**12.0**	**B**	**13.1**	**B**	**12.1**	**B**	**13.3**	**B**
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	0.3	A	0.3	A
			EBR	0.0	A	0.0	A	0.0	A	0.1	A
			WBTL	6.7	A	7.6	A	6.7	A	7.6	A
			WBR	7.1	A	9.2	A	7.1	A	9.2	A
			NB	17.3	B	19.4	B	17.5	B	20.4	C
			SBTL	21.5	C	70.5	E	21.5	C	74.3	E
			SBR	16.5	B	16.5	B	16.5	B	16.5	B
			Overall	**10.3**	**B**	**22.2**	**C**	**10.5**	**B**	**23.5**	**C**
3	Main Street & Griswold Street	Signalized	EBTL	12.0	B	15.7	B	12.2	B	15.9	B
			EBTR	10.1	B	11.1	B	10.1	B	11.1	B
			WBTL	10.1	B	11.8	B	10.1	B	11.8	B
			WBTR	10.5	B	12.5	B	10.5	B	12.5	B
			NB	15.1	B	16.5	B	15.4	B	16.8	B
			SB	16.9	B	31.0	C	17.0	B	34.0	D
			Overall	**12.8**	**B**	**18.1**	**B**	**12.9**	**B**	**19.1**	**B**
4	Cady Street & Center Street	Stop (Minor)	EB	19.9	C	41.2	E	20.5	C	47.0	E
			WB	52.9	F	199.4	F	60.4	F	271.4	F
			NBL	8.4	A	9.3	A	8.4	A	9.3	A
			SBL	9.1	A	9.0	A	9.2	A	9.1	A
5	Cady Street & Hutton Street	Stop (Minor)	EBL	7.6	A	7.6	A	7.6	A	7.6	A
			WBL	Free		Free		0.0**	A	7.5	A
			NB	N/A		N/A		12.0	B	11.5	B
			SB	11.1	B	10.5	B	11.7	B	11.5	B
6	Cady Street & Griswold Street	Stop (Minor)	EB	11.3	B	14.1	B	11.6	B	14.9	B
			WB	9.9	A	11.1	B	10.0	B	11.3	B
			NBL	7.4	A	7.6	A	7.4	A	7.6	A
			SBL	7.3	A	7.5	A	7.3	A	7.5	A
7*	Beal Street & Griswold Street	Stop (Minor)	EB	4.7	A	5.1	A	4.9	A	5.8	A
			WB	Free		Free		Free		Free	
			SB	4.3	A	4.8	A	4.6	A	5.0	A
8	Beal Street & River Street	Stop (Minor)	EB	Free		Free		Free		Free	
			WBL	7.3	A	7.5	A	7.5	A	7.6	A
			NB	9.2	A	9.7	A	9.7	A	10.5	B

Intersection		Control	Approach	Background Conditions 2023				Future Conditions 2023			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
9	Center Street & Fairbrook Street	Stop (Minor)	EB	23.3	C	29.1	D	25.3	D	44.8	E
			WB	N/A		N/A		35.7	E	162.3	F
			NBL	8.5	A	10.1	B	8.6	A	10.2	B
			SBL	Free		Free		9.3	A	9.5	A
10	Sheldon Avenue / Center Street & 7 Mile Road / Hines Drive	Signalized	EBL	20.6	C	33.9	C	20.8	C	36.9	D
			EBTR	33.6	C	27.0	C	33.6	C	27.0	C
			WBL	38.3	D	40.9	D	38.7	D	41.2	D
			WBT	18.2	B	28.6	C	18.3	B	28.8	C
			WBR	17.4	B	18.3	B	17.5	B	18.5	B
			NBTL	20.8	C	42.3	D	22.0	C	48.7	D
			NBR	21.9	C	28.2	C	22.4	C	31.2	C
			SBL	34.9	C	45.7	D	37.8	D	53.8	D
			SBTR	16.0	B	22.8	C	16.7	B	24.8	C
			Overall	**24.1**	**C**	**28.0**	**C**	**24.5**	**C**	**29.9**	**C**
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	13.3	B	16.5	C	14.7	B	25.3	D
			WBT	Free		Free		Free		Free	
			NB	16.8	C	87.7	F	15.9	C	217.0	F
12	7 Mile Road & River Street	Stop (Minor)	EBL	7.7	A	8.8	A	7.8	A	8.8	A
			WB	Free		Free		Free		Free	
			SB	11.4	B	14.2	B	12.8	B	16.5	C
13	Center Street & NW. Site Drive	Stop (Minor)	WB	N/A		N/A		23.5	C	40.6	E
			NB					Free		Free	
			SBL					9.3	A	9.6	A
14	Fairbrook Street & SW. Site Drive	Stop (Minor)	EB	N/A		N/A		Free		Free	
			WBL					7.3	A	7.3	A
			NB					8.5	A	8.4	A
15	Northville Road & Beal Street	Stop (Minor)	EB	10.5	B	12.2	B	10.4	B	12.5	B
			NBL	8.0	A	8.5	A	8.0	A	8.7	A
			SB	Free		Free		Free		Free	
16*	SB Northville Road & N. 7 Mile Road	Stop/Yield (Minor)	EBT	11.7	B	14.6	B	12.0	B	15.0	C
			EBR	12.5	B	13.9	B	13.2	B	14.6	B
			WB	15.2	C	118.7	F	16.2	C	155.8	F
			SB	Free		Free		Free		Free	
17*	NB Northville Road & N. 7 Mile Road	Yield (Minor)	EBL	14.7	B	35.1	E	15.1	C	40.0	E
			NBTL	4.9	A	5.9	A	4.9	A	6.0	A
			NBT	Free		Free		Free		Free	
18	Northville Road & S. 7 Mile Road	Signalized	WBL	21.5	C	22.4	C	21.5	C	22.4	C
			WBR	9.9	A	15.3	B	10.0	B	16.1	B
			NBT	39.3	D	131.2	F	40.4	D	144.9	F
			NBTR	59.3	E	133.6	F	59.3	E	146.9	F
			SBL	63.4	E	45.6	D	81.5	F	51.2	D
			SBT	11.4	B	12.1	B	11.4	B	12.2	B
			Overall	**38.7**	**D**	**60.1**	**E**	**43.6**	**D**	**65.5**	**E**

* Indicates SimTraffic delay or HCM2000 analysis used
** Indicates no traffic volume present

The results of the future conditions analysis indicate that all study intersection approaches and movements will continue to operate acceptably at a LOS D or better with the exception of the following as shown in **Table 15** and summarized below:

3.9.1 Main Street and Hutton Street

- The southbound left/through movement will continue to operate at a LOS E during the PM peak hour.

A review of network simulations indicates acceptable operations and all queues were observed to be serviced within the cycle length.

3.9.2 Main Street and Griswold Street

The intersection LOS on all approaches were seen to operate acceptably; however occasional periods of long vehicle queues were observed on the southbound approach during the PM peak hour. These queues were observed to be present throughout the duration of the peak hour.

3.9.3 Cady Street and Center Street

- The westbound approach will operate at a LOS F during the AM and PM peak hours. Additionally, the eastbound approach will operate at a LOS E during the PM peak hour.

Although intersection LOS indicate failing operations along Cady Street; a review of the simulations indicates that the signalized intersections allow for gaps in traffic, therefore, vehicles on Cady Street are serviced with only minor vehicle queues.

3.9.4 Center Street and Fairbrook Street

- The westbound approach will operate at a LOS E and LOS F during the AM and PM peak hours, respectively. Additionally, the eastbound approach will operate at a LOS E during the PM peak hour.

A review of network simulations indicates that during the AM peak period, the signalized intersections allow for gaps in traffic, therefore, vehicles on Fairbrook Street are serviced with only minor vehicle queues. During the PM peak hour, brief periods of vehicle queues were observed on the eastbound approach; however, these queues were observed to dissipate quickly and were not present throughout the entire peak hour. Periods of long vehicle queues were also observed for the westbound approach; however, they were not present throughout the entire peak period.

3.9.5 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

During the PM peak hour, long vehicle queues were observed for the northbound approach and were present during the entire peak period. A review of network simulations indicates that brief periods of long vehicle queues were also observed on the southbound approach during the PM peak hour. These queues were observed to dissipate quickly, as the northbound through traffic was stopped often by northbound left-turning vehicles, which created many opportunities for southbound left-turning vehicles to progress through the intersection. Periods of long vehicle queues were also observed on the westbound movements and were present for the majority of the peak hour.

3.9.6 7 Mile Road and Hines Drive

- The northbound approach will operate at a LOS F during the PM peak hour.

Brief periods of long vehicle queues are observed at the northbound and westbound approaches during the PM peak hour; however, these vehicle queues are a result of the westbound vehicle queues at the intersection of 7 Mile Road and Center Street. Simulations indicate that the queuing created at the intersection of 7 Mile Road and Center Street causes upstream blocking at Hines Drive for 13% of the PM peak hour. During the remaining portion of the peak hour, the signalized intersection of 7 Mile Road and Center Street allows for gaps in traffic, allowing northbound vehicles to progress through the intersection.

3.9.7 Center Street and NW. Site Drive

- The westbound approach will operate at a LOS E during the PM peak hour.

Although intersection LOS indicate poor operations along the site drive; a review of the simulations indicates that egress vehicles easily find gaps in traffic; therefore, vehicles on NW. Site Drive are serviced with only minimal vehicle queues.

3.9.8 Northville Road (S. Main Street) and N. 7 Mile Road

- The yield-controlled westbound through movement will operate at a LOS F during the PM peak hour.
- The yield-controlled eastbound left-turn movement will operate at a LOS E during the PM peak hour.

Although intersection LOS analysis indicates poor operations, a review of SimTraffic the simulations indicates acceptable operations during both peak periods. Occasional periods of short queues were observed at the yield-controlled intersections; however, the gaps provided by the signalized intersections provide acceptable operations for vehicles attempting to make left-turns.

3.9.9 Northville Road and S. 7 Mile Road

- During the AM peak hour, the northbound through/right and southbound left-turn movements currently operate at a LOS E and LOS F, respectively.
- The northbound approach currently operates at a LOS F during the PM peak hour.

A review of network simulations indicates occasional periods of long vehicle queues for the southbound left-turn movement during the AM and PM peak periods; however, these queues are typically observed to be serviced within the cycle length. Additionally, brief periods of long vehicle queues were observed for the northbound approach during the PM peak period. These queues were observed to dissipate and are not present throughout the duration of the peak hour.

3.10 FUTURE IMPROVEMENTS

In order to improve traffic operations to a LOS D or better for all intersection approaches and movements under future conditions, mitigation measures that were identified under existing and background conditions were applied. The results of this analysis are summarized in **Table 17** and indicate that all study intersection approaches and movements would operate acceptably at a LOS D or better during both peak periods, with the exception of 7 Mile Road & Hines Drive.

3.10.1 Main Street and Hutton Street

The results of this analysis indicate that signal timing optimization (i.e. providing more green time for the northbound and southbound approaches) is enough to improve all approaches to operating at a LOS D or better during PM peak period. A review of network simulations confirms acceptable operations.

3.10.2 Main Street and Griswold Street

A review of network simulations indicates that signal timing optimization (i.e. providing more green time for the northbound and southbound approaches) was observed to reduce vehicle queues on the southbound approach.

3.10.3 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

In order to address the operational deficiencies at this intersection, the previously identified alternative mitigation measures were again evaluated. The alternative options and the results of the operational analysis are summarized in **Table 16**.

Table 16: Center Street & 7 Mile Road Alternatives Analysis (Future Conditions)

Peak Period	Approach	Existing Conditions				Signalization Improvement				Increased NB LT Storage				Roundabout			
		Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)	Delay (s/veh)	LOS	Average (ft)	95th % (ft)
AM	EBL	20.8	C	48	154	24.1	C	46	155	21.6	C	37	127	9.8	A	170*	293*
	EBTR	33.6	C	194	329	54.3	D	256	418	45.7	D	229	426				
	WBL	38.7	D	32	79	29.8	C	23	58	26.6	C	24	63	5.1	A	23	54
	WBT	18.3	B	48	102	28.3	C	59	121	25.6	C	60	123				
	WBR	17.5	B	19	51	23.9	C	19	59	21.3	C	17	50			8	32
	NBL	22.0	C	15	31	21.8	C	33	86	22.2	C	71	255	13.2	B	1985	3694
	NBT	22.4	C	482	891	54.8	D	622	1245	42.5	D	408	827				
	NBR									20.1	C	30	82			66	106
	SBL	37.8	D	87*	169*	33.2	C	52	100	27.1	C	53*	113*	5.6	A	117*	221*
	SBTR	16.7	B	136*	224*	29.4	C	160*	245*	29.9	C	158*	254*			2	15
	Overall	24.5	C	N/A	N/A	43.1	D	N/A	N/A	35.8	D	N/A	N/A	9.2	A	N/A	N/A
PM	EBL	36.9	D	61	155	32.0	C	52	153	30.3	C	63	176	12.7	B	94	178
	EBTR	27.0	C	188	346	53.1	D	235	413	46.7	D	235	401				
	WBL	41.2	D	105	163	34.6	C	82	153	33.1	C	93	160	11.2	B	67	213
	WBT	28.8	C	415*	713*	52.3	D	295	479	49.4	D	322	528				
	WBR	18.5	B	309*	738*	27.0	C	139	377	25.9	C	171	424			34	177
	NBL	48.7	D	21	30	36.4	D	64	103	39.1	D	177	401	24.0	C	3859	7360
	NBT	31.2	C	6991	14061	78.5	F	3677	7116	43.5	D	1906	4129				
	NBR									17.7	B	32	87			68	103
	SBL	53.8	D	58*	128*	34.7	C	62	135	27.0	C	50	94	18.2	C	197*	200*
	SBTR	24.8	C	211*	286*	46.1	D	232*	265*	49.1	D	237*	257*			9	33
	Overall	29.9	C	N/A	N/A	54.6	D	N/A	N/A	43.3	D	N/A	N/A	17.3	C	N/A	N/A

* Indicates that the queue length has exceeded the link distance. Therefore, may not accurately represent intersection conditions

Option 1: Signalization Improvements

The results of the analysis are similar to background conditions, indicating that the through movements and overall intersection show a degradation in delay and LOS; however, the delay and LOS were improved for the left-turning movements. Although the intersection LOS analysis indicates failing operations for the northbound through movement during the PM peak period, a review of network simulations indicates slightly reduced vehicle queues. Additionally, reduced vehicle queues were observed for the westbound movements. During the AM peak hour, network simulations show acceptable operations with only minor increases in vehicle queues.

Option 2: Increased Northbound Left-Turn Storage

The results of the analysis are similar to **Option 1**, with much greater reductions in northbound vehicle queues observed during the PM peak period. Additionally, increased delays and reduced LOS were observed for the westbound approach; however, reduced vehicle queues were observed. During the AM peak hour, network simulations show acceptable operations with only minor increases in vehicle queues.

Option 3: Roundabout

The results are similar to background conditions, with the Rodel analysis indicating that the installation of a roundabout at this intersection will result in decreased delays for all approaches. A review of network simulations however, indicates similar operations to those observed in background conditions, with long southbound vehicle queues forming and causing back-ups throughout the network.

3.10.4 7 Mile Road and Hines Drive

The signal improvements at the intersection of 7 Mile Road and Center Street significantly decreased the delay on the northbound approach; however, the westbound queues at 7 Mile Road and Center Street were still observed to back up near the intersection during the PM peak hour.

3.10.5 Northville Road (S. Main Street) and N. 7 Mile Road

The results of this analysis indicate that, with intersection signalization, all movements and approaches improved to a LOS C or better. A review of network simulations indicates acceptable operations for all movements.

3.10.6 Northville Road and S. 7 Mile Road

The results of this analysis indicate that signal timing optimization (i.e. providing more green time for the northbound and southbound movements) is enough to improve all approaches to operating at a LOS D or better during the AM and PM peak periods. A review of network simulations confirms acceptable operations.

3.10.7 Future Conditions with Improvements

Intersection operations and vehicle queues with the recommended improvements are summarized in **Table 17** and **Table 18**, respectively.

Table 17: Future Intersection Operations with Improvements

Intersection		Control	Approach	Future Conditions 2023				Future Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2	Main Street & Hutton Street	Signalized	EBTL	0.3	A	0.3	A	No Change		19.3	B
			EBR	0.0	A	0.1	A			16.8	B
			WBTL	6.7	A	7.6	A			15.1	B
			WBR	7.1	A	9.2	A			19.9	B
			NB	17.5	B	20.4	C			14.9	B
			SBTL	21.5	C	74.3	E			36.9	D
			SBR	16.5	B	16.5	B			9.4	A
			Overall	**10.5**	**B**	**23.5**	**C**			**22.1**	**C**
3	Main Street & Griswold Street	Signalized	EBTL	12.2	B	15.9	B	No Change		26.1	C
			EBTR	10.1	B	11.1	B			16.4	B
			WBTL	10.1	B	11.8	B			17.6	B
			WBTR	10.5	B	12.5	B			19.3	B
			NB	15.4	B	16.8	B			11.4	B
			SB	17.0	B	34.0	D			17.7	B
			Overall	**12.9**	**B**	**19.1**	**B**			**17.6**	**B**
11*	7 Mile Road & Hines Drive	Stop (NB Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	14.7	B	25.3	D	18.8	C	27.5	D
			WBT	Free		Free		Free		Free	
			NB	15.9	C	217.0	F	19.3	C	71.8	F
16 & 17	Northville Road & N. 7 Mile Road	Stop/Yield Signalized [IMP]	EBL	15.1	C	40.0	E	31.5	C	26.9	C
			EBR	13.2	B	14.6	B	15.4	B	13.9	B
			WB [NBL]	16.2	C	155.8	F	3.4	A	10.3	B
			NBT	Free		Free		0.1	A	0.3	A
			SBT	Free		Free		25.7	C	31.4	C
			SBTR	Free		Free		25.8	C	31.6	C
			Overall	**N/A**	**N/A**	**N/A**	**N/A**	**13.2**	**B**	**14.0**	**B**

Intersection		Control	Approach	Future Conditions 2023				Future Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
18	Northville Road & S. 7 Mile Road	Signalized	WBL	21.5	C	22.4	C	35.0	C	33.2	C
			WBR	10.0	B	16.1	B	13.2	B	24.2	C
			NBT	40.4	D	144.9	F	29.1	C	45.0	D
			NBTR	59.3	E	146.9	F	34.2	C	46.3	D
			SBL	81.5	F	51.2	D	35.2	C	34.1	C
			SBT	11.4	B	12.2	B	10.3	B	0.6	A
			Overall	**43.6**	**D**	**65.5**	**E**	**27.9**	**C**	**30.5**	**C**

* Indicates SimTraffic delay analysis used

Table 18: Future Vehicle Queues with Improvements

Intersection		Control	Approach	Future Conditions 2023				Future Conditions 2023 (With Improvements)			
				AM Peak		PM Peak		AM Peak		PM Peak	
				Average (ft)	95th % (ft)	Average (ft)	95th % (ft)	Average (ft)	95th % (ft)	Average (ft)	95th % (ft)
2	Main Street & Hutton Street	Signalized	EBTL	No Changes		47	98	No Changes		70	129
			EBR			9	32			13	39
			WBTL			84	167			97	191
			WBR			68	112			74	118
			NB			26	60			21	52
			SBTL			117	196			83	140
			SBR			8	26			5	19
3	Main Street & Griswold Street	Signalized	EBTL	No Changes		105	182	No Changes		127	212
			EBTR			78	137			88	146
			WBTL			70	117			78	124
			WBTR			109	158			129	189
			NB			78	124			70	116
			SB			358	568			184	360
11	7 Mile Road & Hines Drive	Stop (NW Hines & WBL 7 Mile)	EB	Free		Free		Free		Free	
			WBL	0	0	19	151	0	0	1	10
			WBT	Free		Free		Free		Free	
			NB	45	78	620	1652	48	83	244	546

4 CONCLUSIONS

The conclusions of this TIS are as follows:

4.1 EXISTING CONDITIONS

The results of the existing conditions analysis showed that all study intersection approaches and movements currently operate acceptably at a LOS D or better during all peak periods, with the exception of the following:

4.1.1 Main Street and Hutton Street

The SB left/through movement currently operates at a LOS E during the PM peak hour.

4.1.2 Main Street and Griswold Street

The SB left/through movement at Main Street and Griswold Street currently operates at a LOS E during the PM peak hour. The SB approach was observed to have occasional periods of long vehicle queues during the PM peak period. These queues were observed to dissipate and not present throughout the peak hour.

4.1.3 Cady Street and Center Street

The WB approach at Cady Street and Center Street currently operates at a LOS E and LOS F, during the AM and PM peak periods, respectively. Additionally, the EB approach currently operates at a LOS E during the PM peak hour. Network simulations indicate that the signalized intersections allow for gaps in traffic and therefore Cady Street traffic is serviced with minimal vehicle queues.

4.1.4 Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive

The NB approach was observed to have long vehicle queues during the PM peak period. These queues are the result of insufficient capacity on Sheldon Avenue to accommodate the existing vehicular demand. The existing bridge on Sheldon Avenue on the south leg of this intersection limits the space available for northbound left-turning vehicles to queue, thus blocking through traffic on the northbound approach.

In addition, the WB approach was observed to have periods of long vehicle queues during the PM peak period. These queues are the result of left-turning vehicles exceeding the turn lane storage length and blocking the through and right-turn lanes.

To mitigate the existing intersection delays at this intersection, two alternative measures were evaluated:

Option 1: Intersection Signalization Improvements

This alternative measure would require that the existing traffic signal be replaced and upgraded to a fully actuated signal with left-turn signal heads. The proposed intersection configuration is as follows:

- Restriping the NB approach to provide a through/right lane and an exclusive 60-ft left-turn lane *(Note: On the NB approach the left-turn storage length would be limited by existing geometric constraints of the bridge)*.
- Restriping the SB approach to provide a through/right lane and an exclusive left-turn lane.
- Upgrade to a fully actuated signal.
- Provide permissive/protected left-turn phasing for all approaches (Left-turn Warrant in **Appendix E**).
- Providing overlap phasing for westbound right-turn movement.
- Optimize traffic signal timings and cycle lengths during peak periods.

The results of the analysis indicates that the through movements and overall intersection showed a degradation in delay and LOS; however, the delay and LOS were improved for the left-turning movements. Although the intersection LOS analysis indicates poor operation for the northbound through movement during the PM peak period, a review of network simulations indicates slightly reduced vehicle queues. Additionally, reduced vehicle queues were observed for the westbound movements during the PM peak period.

Option 2: Increased Northbound Left-Turn Storage

This alternative measure would require the widening of the Sheldon Avenue bridge across the Johnson Creek in order to provide adequate left-turn storage. The proposed intersection configuration is as follows:

- Widening the NB approach to provide a 300-ft left-turn lane and a 50-ft right-turn lane.
- Restriping the SB approach to provide through/right lane and an exclusive left-turn lane.
- Upgrade to a fully actuated signal.
- Provide permissive/protected left-turn phasing for all approaches.
- Providing overlap phasing for northbound and westbound right-turn movements.
- Optimize traffic signal timings and cycle lengths during peak periods.

The analysis results for this alternative are similar to those observed for **Option 1**; indicating that the through movements will experience increased delays, however, the left-turn movements will experience decreased delays. Network simulations indicate that the northbound approach will experience significant decreases in vehicle queuing; additionally, reduced vehicle queues were observed for the westbound approach.

Option 3: Roundabout

This alternative includes the installation of a roundabout at this intersection. OHM Advisors provided the preliminary design and Rodel model that was used in the intersection analysis. To implement this alternative measure, the WCDPS would need to acquire significant ROW, in order to fit the roundabout as designed. Additionally, wetlands are a concern in the southeast portion of the site; therefore, potential mitigation may be required.

The Rodel model and analysis performed by OHM Advisors; indicates that all approaches will experience a reduction in delay and LOS over existing conditions. F&V performed additional analysis using the HCM methodology and SimTraffic simulations which, indicates that the southbound approach will experience significantly increased vehicle queues during both peak periods. These queues are expected to back up along Center Street, eliminating the potential gaps for the minor stop-controlled intersections. The long southbound vehicle queues were not observed to dissipate and are present throughout the peak periods.

4.1.5 7 Mile Road and Hines Drive

The NB approach of 7 Mile Road and Hines Drive currently operates at a LOS F during the PM peak period. Network simulations indicate that the delay is caused by the WB queue spillback from the adjacent intersection of Sheldon Avenue/Center Street and 7 Mile Road/Hines Drive.

4.1.6 Northville Road (S. Main Street) and N. 7 Mile Road

The yield-controlled westbound through movement currently operates at a LOS F during the PM peak hour. Although intersection LOS analysis indicates poor operations, a review of SimTraffic the simulations indicates acceptable operations during both peak periods. Occasional periods of short queues were observed at the yield-controlled intersections; however, these vehicles were observed to find gaps within the opposing traffic, created by the signalized intersections.

- Several potential mitigation measures were identified to reduce vehicle delays and improve safety. The potential improvements that the WCDPS may want to consider are as follows:
    - Eliminate the bi-directional cross-over
    - Provide a directional northbound left-turn (J-turn) and prohibit eastbound left-turns
    - Provide a median U-turn south of N. 7 Mile Road to facilitate eastbound left-turns.
    - Consider intersection signalization
        - A signal warrant analysis indicates that a signal **is warranted** for existing conditions.

4.1.7 Northville Road and S. 7 Mile Road

The northbound through/right and southbound left-turn movements currently operate at a LOS E during the AM peak hour. Additionally, the northbound approach currently operates at a LOS F during the PM peak hour. A review of network simulations indicates occasional periods of long vehicle queues for the southbound left-turn

movement during the AM and PM peak periods; however, these queues are typically observed to be serviced within the cycle length. Additionally, brief periods of long vehicle queues were observed for the northbound approach during the PM peak period. These queues were observed to dissipate and are not present throughout the duration of the peak hour.

4.2 Background Conditions

- An average annual background growth rate of 0.2% was applied to the existing 2018 traffic volumes to calculate the future 2023 background traffic volumes. In addition, several proposed developments planned in the vicinity of the site were identified and included as part of the background traffic volumes.
- The 2023 background traffic operations ***without the proposed development*** will continue to operate in a manner similar to existing conditions. The mitigation measures identified in the existing conditions were applied and found to adequately mitigate the projected delays.

4.3 Future Conditions

With the addition of the development, several study intersection approaches and movements will continue to operate at a LOS E or F during the peak periods and with long vehicle queues. The mitigation measures identified in the existing condition analysis were therefore considered for the future conditions and along with additional signal timing optimizations were found to mitigate the delays created by the development. All proposed signal timing modifications are provided in **Appendix D**.

- **No additional improvements are recommended to mitigate future conditions.**

Overall, the operational deficiencies within the study network are due to existing conditions and not the addition of site generated traffic. The impact of this development on the roadway network is lessened by the following factors:

Site Access

The proposed development is located within an existing roadway network. As a result, there are many different roadways in which traffic will enter and exit the s network. Additionally, the proposed development has numerous points of access into the site. Both of these factors create an even distribution throughout the study network and does not overly impact any one site driveway or intersection within the network.

Trip Generation

The proposed development generates a relatively low number of trips for development of this size. This is due to 1) the primary land use is residential, and 2) it is located within a downtown community. In addition, the current land use for site (Horse Race Track) has the potential to generate more traffic during the evening and weekends than the proposed residential development is expected to generate.

Land Use	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Residential	2,790	52	135	187	131	92	223
Commercial	1,923	11	7	18	44	40	84
Total New Vehicular Trips	**4,713**	**63**	**142**	**205**	**175**	**132**	**307**

5 RECOMMENDATIONS

The recommendations of this TIS are as follows:

	Existing	Background	Future
2. Main Street & Hutton Street			
Optimize traffic signal timings during PM peak period (Provide more NB/SB green time)	X		
3. Main Street & Griswold Street			
Optimize traffic signal timings during PM peak period (Provide more NB/SB green time)	X		
10. Sheldon Avenue/Center Street & 7 Mile Road/Hines Drive			
Mitigation	X		
11. 7-Mile Road & Hines Drive			
Construct a northbound right-turn lane on Hines Drive	X		
15-16. Northville Road (S. Main Street) & N. 7 Mile Road			
Mitigation	X		
17. Northville Road & S. 7 Mile Road			
Optimize traffic signal timings during peak periods (Provide more NB/SB green time)	X		