

MEMO

VIA EMAIL: srobinson@brodersachse.com

To: Broder Sachse Real Estate

From: Jacob Swanson, PE, PTOE
Paul Bonner, EIT
Fleis & VandenBrink

Date: December 31, 2024

Re: Proposed Commercial Development
Royal Oak, Michigan
Traffic Impact Study

1 INTRODUCTION

This memorandum presents the results of the Traffic Impact Study (TIS) for the proposed commercial development in Royal Oak Michigan. The project site is located generally in the northwest quadrant of the intersection of 14-Mile Road & Coolidge Highway (South), as shown in the attached **Figure 1**. The proposed development includes the construction of a convenience store with fuel and an automated car wash; the project site is on land that is currently occupied by a former shipping warehouse, which will be razed with the construction of the proposed development plan. Site access is proposed via two (2) full access driveways along 14-Mile Road; one (1) driveway opposite the existing signalized intersection of 14-Mile Road & Coolidge Road (South), and one (1) driveway located approximately 250-feet west of Coolidge Road (South). Both study roadways are under the jurisdiction of the City of Royal Oak, which has requested the completion of a TIS, as part of the site plan approval process and for permitting of site access for the proposed development.

The scope of work for this study was developed based on Fleis & VandenBrink's (F&V) knowledge of the study area, understanding of the development program, accepted traffic engineering practices, and information published by the Institute of Transportation Engineer (ITE). The study analyses were completed using Synchro/SimTraffic (Version 11) traffic analysis software. Sources of data for this study include F&V subconsultant Quality Counts (QC), the City of Royal Oak, the Southeast Michigan Council of Governments (SEMCOG), and ITE.

2 BACKGROUND

2.1 EXISTING ROAD NETWORK

The lane use and traffic control at the study intersections are shown in the attached **Figure 2** and the study roadways are further described below. For the purposes of this study, all minor streets and driveways were assumed to have an operating speed of 25 miles per hour (mph), unless otherwise noted.

14-Mile Road runs in the east / west directions, adjacent to the south side of the project site. The study section of roadway is classified as an *Other Principal Arterial*, is under the jurisdiction of the City of Royal Oak, and has a posted speed limit of 40-mph. The study section of 14-Mile Road provides a typical four-lane cross-section, with two (2) lanes of travel in each direction, west of Coolidge Highway (South), and provides a typical five-lane cross-section, with two (2) lanes of travel in each direction and a center two-way left-turn lane (TWLTL), east of Coolidge Highway (North). At the intersection with Coolidge Highway (South), 14-Mile Road widens to provide dual (2) westbound left-turn lanes. Additionally, at the intersection with Coolidge Highway (North), 14-Mile Road widens to provide dual (2) eastbound left-turn lanes and an exclusive westbound left-turn lane.

Coolidge Highway (North) runs in the north / south directions, east of the railroad bridge. The study section of roadway is classified as a *Minor Arterial*, is under the jurisdiction of the City of Royal Oak, and has a posted speed limit of 35-mph. The study section of Coolidge Highway (North) provides a typical five-lane cross-section, with two (2) lanes of travel in each direction and a center TWLTL. At the signalized intersection with 14-Mile Road, Coolidge Highway (North) widens to provide an additional lane; therefore, the southbound approach to the intersection is comprised of dual (2) left-turn lanes and dual (2) right-turn lanes. The northbound approach to the intersection is a private driveway servicing the AAM Metal Forming facility.

Coolidge Highway (South) runs in the north / south directions, west of the railroad bridge. The study section of roadway is classified as a *Minor Arterial*, is under the jurisdiction of the City of Royal Oak, and has a posted speed limit of 35-mph. The study section of Coolidge Highway (South) provides a four-lane, median divided cross-section, with two (2) lanes of travel in each direction. At the signalized intersection with 14-Mile Road, Coolidge Highway (South) widens to provide an exclusive left-turn lane and dual (2) right-turn lanes along the northbound approach.

2.2 EXISTING TRAFFIC VOLUMES

F&V subconsultant QC collected existing weekday Turning Movement Count (TMC) data on Wednesday, November 8, 2023, during the AM (7:00 AM to 9:00 AM) and PM (4:00 PM to 6:00 PM) peak periods, at the following study intersections:

- 14-Mile Road & Coolidge Highway (North)
- 14-Mile Road & Coolidge Highway (South)

During the collection of the TMC data, Peak Hour Factors (PHFs), pedestrian and bicycle volumes, and commercial truck percentages were recorded and used in the traffic analysis. The peak hours of the study intersections were utilized and the through volumes were balanced upwards through the roadway network and carried through the proposed site driveways. Therefore, the traffic volumes used in the analysis and shown in the attached traffic volume figures may not match the raw traffic volumes shown in the data collection.

The weekday AM and PM peak hours for the adjacent study roadway network were observed to generally occur between 7:30 AM to 8:30 AM and 4:30 PM to 5:30 PM, respectively. Additionally, F&V obtained the current signal timing permits from the City of Royal Oak for the signalized study intersections of 14-Mile Road & Coolidge Highway (South) and 14-Mile Road & Coolidge Highway (North). The existing 2023 peak hour traffic volumes used in the analysis are shown in the attached **Figure 3**. All applicable background data referenced in this memorandum are attached.

3 EXISTING CONDITIONS (2023)

Existing peak hour vehicle delays and Levels of Service (LOS) were calculated at the study intersections using Synchro/SimTraffic (Version 11) traffic analysis software. This analysis was based on the existing lane use and traffic control shown in the attached **Figure 2**, the existing peak hour traffic volumes shown in the attached **Figure 3**, and methodologies presented in the *Highway Capacity Manual, 6th Edition* (HCM6). However, the operations at both of the signalized study intersections are not supported by the HCM6 methodology; therefore, HCM 2000 was determined to be more appropriate for evaluation at these intersections.

Descriptions of LOS “A” through “F” as defined in the HCM, are attached. Typically, LOS D is considered acceptable, with LOS A representing minimal delay, and LOS F indicating failing conditions. Additionally, SimTraffic network simulations were reviewed to evaluate network operations and vehicle queues. The results for the existing conditions analysis are attached and shown in **Table 2**.

The results of the existing conditions analysis indicates that all approaches and movements at the study intersections are currently operating acceptably, at LOS D or better, during both the AM and PM peak periods.

However, review of SimTraffic network simulations indicates periods of long vehicle queues for the eastbound left-turn movement at the signalized intersection of 14-Mile Road & Coolidge Highway (North) during the AM peak hour. These vehicle queues were observed to occasionally extend through the intersection of 14-Mile Road & Coolidge Highway (South), resulting in delays and vehicle queueing for traffic making an eastbound through movement along 14-Mile Road and a northbound right-turn movement along Coolidge Highway (South). However, these vehicle queues were typically observed to dissipate and were not present throughout the entire AM peak hour. Review of SimTraffic microsimulations during the PM peak hour indicates generally acceptable operations; the majority of queues were observed to be serviced within each cycle length.

Table 1: Existing Intersection Operations

Intersection		Control	Approach	Existing Conditions			
				AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	14-Mile Road & Coolidge Highway (North)	Signalized	EBL	52.0	D	24.5	C
			EBTR	2.9	A	4.2	A
			WBL	18.4	B	23.1	C
			WBTR	27.2	C	36.9	D
			NB	0.0*	A	0.0*	A
			SBL	46.8	D	47.8	D
			SBR	29.3	C	22.8	C
			Overall	28.7	C	25.2	C
2	14-Mile Road & Coolidge Highway (South)	Signalized	EBTR	41.9	D	39.9	D
			WBL	24.5	C	21.3	C
			WBT	16.9	B	17.2	B
			NBL	47.1	D	41.8	D
			NBR	13.8	B	13.7	B
			Overall	25.0	C	24.0	C

* Indicates no vehicle volume present

4 BACKGROUND CONDITIONS (2024)

Historical population and economic profile data was obtained for the City of Royal Oak from the Southeast Michigan Council of Governments (SEMCOG) database, in order to calculate a background growth rate to project the existing 2023 peak hour traffic volumes to the site buildout year of 2024. Population and employment projections from 2020 to 2050 were reviewed and showed average annual growth rates of approximately 0.16% and 0.88%, respectively. Therefore, a conservative background growth rate of **1.0%** per year was applied to the existing peak hour traffic volumes, in order to forecast the background 2024 peak hour traffic volume **without the proposed development**, as shown in the attached **Figure 4**.

In addition to background growth, it is important to account for traffic that will be generated by approved developments within the study area that have yet to be constructed or are currently under construction. At the time of this study, no background developments were identified within the vicinity of the project site.

Background peak hour vehicle delays and LOS **without the proposed development** were calculated at the study intersections based on the existing lane use and traffic control shown in the attached **Figure 2**, the background peak hour traffic volumes shown in the attached **Figure 4**, and methodologies presented in the HCM. The results of the background conditions analysis are attached and summarized in **Table 2**.

Table 2: Background Intersection Operations

Intersection		Control	Approach	Existing Conditions				Background Conditions				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	14-Mile Road & Coolidge Highway (North)	Signal	EBL	52.0	D	24.5	C	53.1	D	24.7	C	1.1	-	0.2	-
			EBTR	2.9	A	4.2	A	2.9	A	4.3	A	0.0	-	0.1	-
			WBL	18.4	B	23.1	C	18.4	B	23.1	C	0.0	-	0.0	-
			WBTR	27.2	C	36.9	D	27.3	C	37.3	D	0.1	-	0.4	-
			NB	0.0*	A	0.0*	A	0.0*	A	0.0*	A	0.0	-	0.0	-
			SBL	46.8	D	47.8	D	46.9	D	48.1	D	0.1	-	0.3	-
			SBR	29.3	C	22.8	C	29.4	C	23.0	C	0.1	-	0.2	-
			Overall	28.7	C	25.2	C	29.0	C	25.5	C	0.3	-	0.3	-

Intersection		Control	Approach	Existing Conditions				Background Conditions				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
2	14-Mile Road & Coolidge Highway (South)	Signal	EBTR	41.9	D	39.9	D	42.3	D	40.6	D	0.4	-	0.7	-
			WBL	24.5	C	21.3	C	24.5	C	21.3	C	0.0	-	0.0	-
			WBT	16.9	B	17.2	B	17.0	B	17.3	B	0.1	-	0.1	-
			NBL	47.1	D	41.8	D	47.1	D	41.8	D	0.0	-	0.0	-
			NBR	13.8	B	13.7	B	13.8	B	13.8	B	0.0	-	0.1	-
			Overall	25.0	C	24.0	C	25.2	C	24.2	C	0.2	-	0.2	-

NOTE: *Indicates no vehicle volume present

The results of the background conditions analysis indicates that all approaches and movements at the study intersections are expected to continue to operate in a manner similar to existing conditions. Review of SimTraffic microsimulations also indicate operations similar to those observations made during the existing conditions analysis. Periods of long vehicle queues were still observed during the AM peak hour for the eastbound left-turn movement at the intersection of 14-Mile Road & Coolidge Highway (North). These vehicle queues were observed to occasionally extend through and cause blockages at the intersection with Coolidge Highway (South); however, these queues were typically observed to dissipate within the AM peak hour. Additionally, SimTraffic microsimulations indicate generally acceptable operations during the PM peak hour.

5 SITE TRIP GENERATION

The number of weekday peak hour (AM and PM) and daily vehicle trips that would be generated by the proposed development were calculated using the rates published by the Institute of Transportation Engineers (ITE) in the *Trip Generation Manual, 11th Edition*. The proposed development includes the construction of a convenience store with fuel and an automated car wash. The ITE trip generation database does not provide car wash trip generation projection data during the AM peak hour; therefore, the PM peak hour projections were utilized for the AM peak hour, in order to provide a conservative analysis. The site trip generation forecast utilized for this study is summarized in **Table 3**.

Table 3: Site Trip Generation Summary

Land Use	ITE Code	Amount	Units	Average Daily Traffic (vpd)	AM Peak Hour (vph)			PM Peak Hour (vph)		
					In	Out	Total	In	Out	Total
Gas Station with Convenience Market	945	16	VFP	5,532	253	253	506	215	215	430
<i>Pass-By (76% AM, 75% PM)</i>				4,177	193	193	386	162	162	324
New Trips				1,355	60	60	120	53	53	106
Automated Car Wash	948	1	Tunnel	780	39	39	78	39	39	78
<i>Pass-By (50%)</i>				390	19	19	38	19	19	38
New Trips				390	20	20	40	20	20	40
Total Trips				6,312	292	292	584	254	254	508
<i>Total Pass-By</i>				<i>4,567</i>	<i>212</i>	<i>212</i>	<i>424</i>	<i>181</i>	<i>181</i>	<i>362</i>
Total New Trips				1,745	80	80	160	73	73	146

As is typical of commercial developments, a portion of the trips generated by the proposed development are from vehicles already on the adjacent roadway network that will pass the site on their way from an origin to their ultimate destination. Therefore, not all traffic at the site driveways is necessarily new traffic added to the street system. These trips are therefore reduced from the total external trips generated by a study site. This percentage of the trips generated by the development are considered "pass-by", which are already present on the adjacent roadway network. The percentage of pass-by used in this analysis was determined based on the rates published by ITE in the *Trip Generation Manual, 11th Edition*. However, ITE does not provide pass-by data for Automated Car Wash (ITE #948); therefore, a conservative pass-by rate of 50% was utilized for the proposed development, based on observations at similar type developments.

6 SITE TRIP DISTRIBUTION

The vehicular trips that would be generated by the proposed development were assigned to the study roadway network based on the proposed site access plan and driveway configurations, the existing peak hour traffic patterns in the adjacent roadway network, and the methodologies published by ITE. The ITE trip distribution methodology assumes that new trips will enter the network and access the development, then leave the development and return to their direction of origin, whereas pass-by trips will enter and exit the development in their original direction of travel. The site trip distributions utilized in the analysis are summarized in **Table 4**.

Table 4: Site Trip Distribution

New Trips				Pass-By Trips (14-Mile Road)		
AM	PM	To/From	Via	Direction	AM	PM
21%	36%	North	Coolidge Highway			
21%	18%	South	Coolidge Highway	Westbound Left	22%	28%
32%	23%	East	14-Mile Road	Westbound Through	41%	37%
26%	23%	West	14-Mile Road	Eastbound Through	37%	35%
100%	100%	Total			100%	100%

The vehicular traffic volumes shown in **Table 3** were distributed to the study roadway network according to the distribution shown in **Table 4**. Therefore, the site-generated trips shown in the attached **Figure 5** were added to the background peak hour traffic volumes shown in the attached **Figure 4**, in order to calculate the future traffic volumes, with the addition of the proposed development. Future peak hour traffic volumes are shown in the attached **Figure 6**.

7 FUTURE CONDITIONS (2024)

Future peak hour vehicle delays and LOS *with the addition of the site-generated trips*, were calculated based on the proposed lane use and traffic control shown in the attached **Figure 2**, the future peak hour traffic volumes shown in the attached **Figure 6**, and the methodologies presented in the HCM.

Additionally, with the construction of the proposed E. Site Drive, which will be aligned directly opposite Coolidge Highway (South), the existing traffic signal will need to be upgraded to provide signal heads for ingress/egress movements to/from the proposed development. Therefore, the current signal timing plan was optimized to accommodate additional phases for the southbound approach and the eastbound left-turn movement, while maintaining the current cycle lengths, to avoid disrupting the coordination with other signals along the 14-Mile Road corridor. The results of the future conditions analysis are attached and summarized in **Table 5**.

The results of the future conditions analysis indicates that all approaches and movements at the study intersections are expected to continue to operate acceptably, at LOS D or better during both peak periods, in a manner similar to the background conditions analysis, with the exception of the following:

14-Mile Road & Coolidge Highway (North)

- During the AM peak hour: The eastbound left-turn movement is expected to operate at LOS E.

Review of SimTraffic network simulations indicate similar operations to the background conditions analysis; periods of long vehicle queues were observed for the eastbound left-turn movement. Additionally, when these vehicle queues occasionally extend through the 14-Mile Road & Coolidge Highway (South) intersection, they also block egress operations at the proposed E. Site Drive.

14-Mile Road & W. Site Drive

- The Synchro intersection LOS analysis indicates acceptable operations for the southbound approach, with both peak periods operating at LOS C.

However, review of SimTraffic microsimulations indicate long vehicle queues along the southbound approach, resulting from the insufficient spacing from the signalized intersection of 14-Mile Road & Coolidge Highway (South). Additionally, the vehicle queues generated by the eastbound approach at the signalized intersection do not provide sufficient gaps within the through traffic along 14-Mile Road, in order to accommodate left-turn traffic exiting the proposed development and traveling east.

Table 5: Future Intersection Operations

Intersection		Control	Approach	Background Conditions				Future Conditions				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	14-Mile Road & Coolidge Highway (North)	Signal	EBL	53.1	D	24.7	C	59.0	E	34.8	C	5.9	D→E	10.1	-
			EBTR	2.9	A	4.3	A	4.1	A	7.6	A	1.2	-	3.3	-
			WBL	18.4	B	23.1	C	18.4	B	23.1	C	0.0	-	0.0	-
			WBTR	27.3	C	37.3	D	27.8	C	38.3	D	0.5	-	1.0	-
			NB	0.0*	A	0.0*	A	0.0*	A	0.0*	A	0.0	-	0.0	-
			SBL	46.9	D	48.1	D	46.9	D	48.1	D	0.0	-	0.0	-
			SBR	29.4	C	23.0	C	29.9	C	23.5	C	0.5	-	0.5	-
			Overall	29.0	C	25.5	C	30.8	C	28.6	C	1.8	-	3.1	-
2	14-Mile Road & Coolidge Highway (South) / E. Site Drive	Signal	EBL	N/A				53.5	D	45.7	D	N/A			
			EBTR	42.3	D	40.6	D	40.4	D	41.7	D	-1.9	-	1.1	-
			WBL	24.5	C	21.3	C	38.2	D	32.3	C	13.7	C→D	11.0	-
			WBTR	17.0	B	17.3	B	19.2	B	16.6	B	2.2	-	-0.7	-
			NBTL	47.1	D	41.8	D	49.1	D	41.8	D	2.0	-	0.0	-
			NBR	13.8	B	13.8	B	23.2	C	21.2	C	9.4	B→C	7.4	B→C
			SBL	N/A				50.6	D	48.6	D	N/A			
			SBTR	N/A				48.3	D	43.9	D	N/A			
			Overall	25.2	C	24.2	C	30.6	C	28.8	C	5.4	-	4.6	-
3	14-Mile Road & W. Site Drive	Stop (Minor)	EBL	N/A				8.7	A	8.51	A	N/A			
			WB					Free							
			SB					17.2	C	17.1	C				

Note: *Indicates no vehicle volume present

8 FUTURE CONDITIONS WITH IMPROVEMENTS (2024)

8.1 14-MILE ROAD & COOLIDGE HIGHWAY (NORTH)

Mitigation measures were investigated in order to improve the poor LOS observed during the future conditions analysis and improve the vehicle queueing observed during the existing and future conditions analyses at the signalized study intersection of 14-Mile Road & Coolidge Highway (North). Signal timing optimizations were reviewed and were determined to adequately improve all approaches and movements to LOS D or better during both peak periods; in addition to significantly reducing the vehicle queueing that was observed along the eastbound left-turn movement. The recommended improvements and optimizations, for the signalized study intersection of 14-Mile Road & Coolidge Highway (North), are summarized below:

- Revise the signal timing operations to assign "NO RECALL" for the northbound approach. *This may need to include repairing the vehicle detector loops, if they are currently malfunctioning.*
- Optimize the signal timing during both the AM and PM peak periods in order to provide additional green time for the eastbound left-turn phase.

8.2 14-MILE ROAD & W. SITE DRIVE

Mitigation measures were investigated in order to improve the safety and operational concerns identified at the proposed W. Site Drive on 14-Mile Road, due to the impact of the eastbound vehicle queueing and close proximity from the signalized study intersection of 14-Mile Road & Coolidge Highway (South) / E. Site Drive.

Therefore, the W. Site Drive was evaluated as operating with Right-In/Right-Out (RIRO) only access. The site generated traffic volumes were redistributed to the E. Site Drive, in order to accommodate this operation and determine the impact at the adjacent study intersections. The site generated traffic volumes with the alternative

mitigation geometry (RIRO) are shown in the attached **Figure 7** and were added to the background peak hour traffic volumes shown in the attached **Figure 4**, in order to calculate the future traffic volumes with the revised geometry, as shown in the attached **Figure 8**.

8.3 RIGHT-TURN TREATMENT EVALUATION

The City of Royal Oak does not maintain right-turn treatment warranting criteria; therefore, the MDOT warrants were utilized to evaluate the proposed site driveways along 14-Mile Road. The proposed W. Site Drive is recommended to operate as a Right-In/Right-Out (RIRO) access only, due to safety concerns; therefore, the left-turn lane criteria were not evaluated. This analysis was based on the future peak hour traffic volumes shown in the attached **Figure 8**. The results of the analysis are shown on the attached warrant charts and is summarized in **Table 6**.

Table 6: Right-Turn Lane Warrant Analysis Summary

14-Mile Road Intersection	AM Peak Hour	PM Peak Hour	Recommendation
E. Site Drive	Right-Turn Lane	Right-Turn Lane	Right-Turn Lane
W. Site Drive	Right-Turn Taper	Right-Turn Taper	Right-Turn Taper

The result of the analysis indicates that the full-width right-turn deceleration lane is recommended along westbound 14-Mile Road at the proposed E. Site Drive. Additionally, a right-turn deceleration taper is recommended along westbound 14-Mile Road at the proposed W. Site Drive.

The results of the future improvements analysis, with the implementation of the recommended signal timing optimization, RIRO restriction, and westbound right-turn lane, are attached and summarized in **Table 7**.

Table 7: Future Intersection Operations

Intersection		Control	Approach	Future Conditions				Future w/ IMP				Difference			
				AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
				Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS	Delay (s/veh)	LOS
1	14-Mile Road & Coolidge Highway (North)	Signal	EBL	59.0	E	34.8	C	26.4	C	23.4	C	-32.6	E→C	-11.4	-
			EBTR	4.1	A	7.6	A	2.5	A	4.6	A	-1.6	-	-3.0	-
			WBL	18.4	B	23.1	C	21.2	C	22.3	C	2.8	B→C	-0.8	-
			WBTR	27.8	C	38.3	D	33.2	C	35.3	D	5.4	-	-3.0	-
			NB	0.0*	A	0.0*	A	0.0*	A	0.0*	A	0.0	-	0.0	-
			SBL	46.9	D	48.1	D	46.9	D	48.1	D	0.0	-	0.0	-
			SBR	29.9	C	23.5	C	18.2	B	14.3	B	-11.7	C→B	-9.2	C→B
			Overall	30.8	C	28.6	C	22.3	C	22.4	C	-8.5	-	-6.2	-
2	14-Mile Road & Coolidge Highway (South) / E. Site Drive	Signal	EBL	53.5	D	45.7	D	50.5	D	46.5	D	-3.0	-	0.8	-
			EBTR	40.4	D	41.7	D	39.2	D	36.6	D	-1.2	-	-5.1	-
			WBL	38.2	D	32.3	C	46.8	D	33.7	C	8.6	-	1.4	-
			WBT	19.2	B	16.6	B	16.3	B	12.6	B	-2.9	-	-4.0	-
			WBR	N/A				5.5	A	9.9	A	N/A			
			NBTL	49.1	D	41.8	D	47.9	D	50.0	D	-1.2	-	8.2	-
			NBR	23.2	C	21.2	C	24.7	C	23.8	C	1.5	-	2.6	-
			SBL	50.6	D	48.6	D	50.4	D	49.5	D	-0.2	-	0.9	-
			SBTR	48.3	D	43.9	D	45.8	D	40.7	D	-2.5	-	-3.2	-
			Overall	30.6	C	28.8	C	30.8	C	27.6	C	0.2	-	-1.2	-
3	14-Mile Road & W. Site Drive	Stop (Minor)	EBL	8.7	A	8.5	A	N/A				N/A			
			WB	Free				Free				N/A			
			SB	17.2	C	17.1	C	10.3	B	10.1	B	-6.9	C→B	-7.0	C→B

NOTE: *Indicates no vehicle volume present

8.4 SUMMARY

The results of the future conditions with improvements analysis indicates that, with the implementation of the recommended mitigation measures, all study intersection approaches and movements are expected to operate acceptably, at LOS D or better during both peak periods.

Review of SimTraffic network simulations also indicates acceptable operations throughout the study roadway network during both peak periods. Occasional periods of vehicle queues were still observed at the signalized study intersections; however, the majority of these vehicle queues were observed to be processed through the signalized intersection within each cycle length and any remaining vehicle queues were observed to dissipate within the peak periods.

Additionally, the long egress vehicle queues present along the W. Site Drive approach that were caused by the eastbound queues generated by the signal were observed to be reduced, as the egress right-turn traffic was no longer delayed by the left-turn traffic attempting to find gaps to exit the site driveway. Furthermore, egress left-turn traffic at the E. Site Drive was observed to more easily depart the site, without the eastbound left-turn vehicle queues from Coolidge Highway (North) blocking 14-Mile Road.

9 CONCLUSIONS

The conclusions of this TIS are as follows:

1. Existing Conditions (2023)

- The results of the existing conditions analysis indicates that all approaches and movements at the study intersections are currently operating acceptably, at LOS D or better during both peak periods.
- Review of SimTraffic network simulations indicates periods of long vehicle queues, during the AM peak hour, for the eastbound left-turn movement at the signalized study intersection of 14-Mile Road & Coolidge Highway (North). These vehicle queues were observed to occasionally extend through the Coolidge Highway (South) intersection, resulting in delays and vehicle queueing for eastbound through and northbound right-turn traffic. Review of SimTraffic microsimulations during the PM peak hour indicates generally acceptable operations; the majority of queues were observed to be serviced within each cycle length.

2. Background Conditions (2024)

- A conservative **1.0%** annual background growth rate was utilized to project the existing 2023 peak hour traffic volumes to the site buildout year of 2024.
- The results of the background conditions analysis indicates that all study intersections are expected to continue to operate in a manner similar to the existing conditions analysis, with only minor increases in delays. Review of SimTraffic network simulations also indicates similar operations throughout the study roadway network to those observed during existing conditions.

3. Future Conditions (2024)

- The results of the future conditions analysis, with the addition of the site-generated traffic, indicates that all study intersection approaches and movements will continue to operate acceptably, at LOS D or better during both peak periods, in a manner similar to the background conditions analysis, with the exception of the following:
 - **14-Mile Road & Coolidge Highway (North):** The eastbound left-turn movement is expected to operate at LOS E during the AM peak hour. Review of SimTraffic microsimulations indicates periods of long vehicle queues for the eastbound left-turn movement. Additionally, when extended through the Coolidge Highway (South) intersection, these queues were also observed to block egress operations at the proposed E. Site Drive.
 - **14-Mile Road & W. Site Drive:** The Synchro intersection LOS analysis indicates acceptable operations for the southbound approach, with both peak periods operating at LOS C. However, SimTraffic microsimulations indicates long vehicle queues, resulting from the insufficient spacing and vehicle queues generated by the eastbound approach at the nearby signalized intersection.

4. Access Management

- The results of the right-turn treatment evaluation analysis indicates the following:
 - A right-turn lane is recommended on 14-Mile Road at the proposed E. Site Drive.
 - A right-turn taper is recommended on 14-Mile Road at the proposed W. Site Drive.

5. Future Conditions with Improvements

- Intersection improvements were reviewed, in order to mitigate the impact of the proposed development plan on the adjacent roadway network. The following mitigation measures were identified:
 - **14-Mile Road & Coolidge Highway (North):** Signal timing optimizations / modifications were reviewed and were determined to adequately improve all study intersection approaches and movements to LOS D or better during both peak periods; in addition to significantly reducing the vehicle queueing observed for the eastbound left-turn movement.
 - **14-Mile Road & W. Site Drive:** Mitigation measures were investigated in order to improve the safety and operational concerns identified at the proposed site driveway on 14-Mile Road, due to the impact of the vehicle queueing and close proximity from the signalized study intersection of 14-Mile Road & Coolidge Highway (South). The W. Site Drive was evaluated as operating with Right-In/Right-Out (RIRO) only access. The site generated traffic volumes were redistributed to the E. Site Drive, in order to accommodate this operation and determine the impact at the adjacent study intersections.
- The results of the future conditions with improvements analysis indicates that, with the implementation of the recommended mitigation measures, all study intersection approaches and movements are expected to operate acceptably, at LOS D or better during both peak periods.
- Review of SimTraffic microsimulations also indicates acceptable operations throughout the study roadway network during both peak periods. Occasional periods of vehicle queues were still observed at the signalized study intersections; however, the majority of these vehicle queues were observed to be processed through the signalized intersection within each cycle length and any remaining vehicle queues were observed to dissipate within the peak periods.
- Additionally, the long egress vehicle queues present along the W. Site Drive approach were observed to be reduced, as the egress right-turn traffic was no longer delayed by the left-turn traffic attempting to find gaps to exit the site driveway. Furthermore, egress left-turn traffic at the E. Site Drive was observed to more easily depart the site, without the eastbound left-turn vehicle queues from Coolidge Highway (North) blocking 14-Mile Road.

10 RECOMMENDATIONS

The recommendation of this TIS are as follows:

- **14-Mile Road & Coolidge Highway (North)**
 - Optimize the signal timing during both the AM and PM peak hours.
 - Revise the signal timing operations to assign “NO RECALL” for the northbound approach. *This may need to include repairing the vehicle detector loops, if they are currently malfunctioning.*
- **14-Mile Road & Coolidge Highway (South)/E. Site Drive**
 - Provide a right-turn deceleration lane on 14-Mile Road at the proposed E. Site Drive.
- **W. Site Drive on 14-Mile Road**
 - Provide Right-In/Right-Out (RIRO) only access for the proposed W. Site Drive.
 - Provide a right-turn deceleration taper on 14-Mile Road at the proposed W. Site Drive.

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



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

Attachments: Figures 1 – 8
Proposed Site Plan
Traffic Volume Data
Signal Timing Permits
Synchro / SimTraffic Results
Auxiliary Lane Warrants

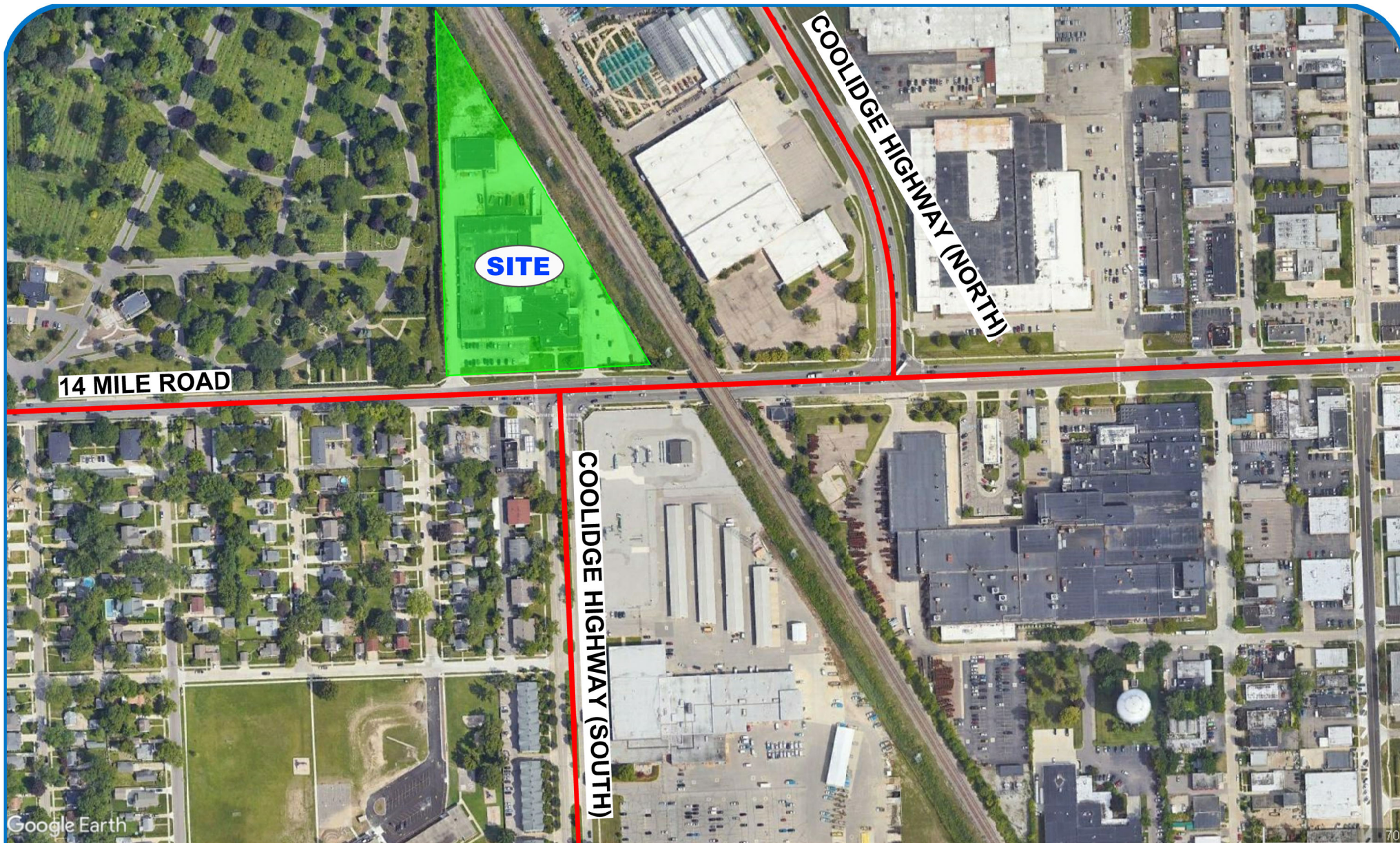


FIGURE 1 SITE LOCATION

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND



SITE LOCATION



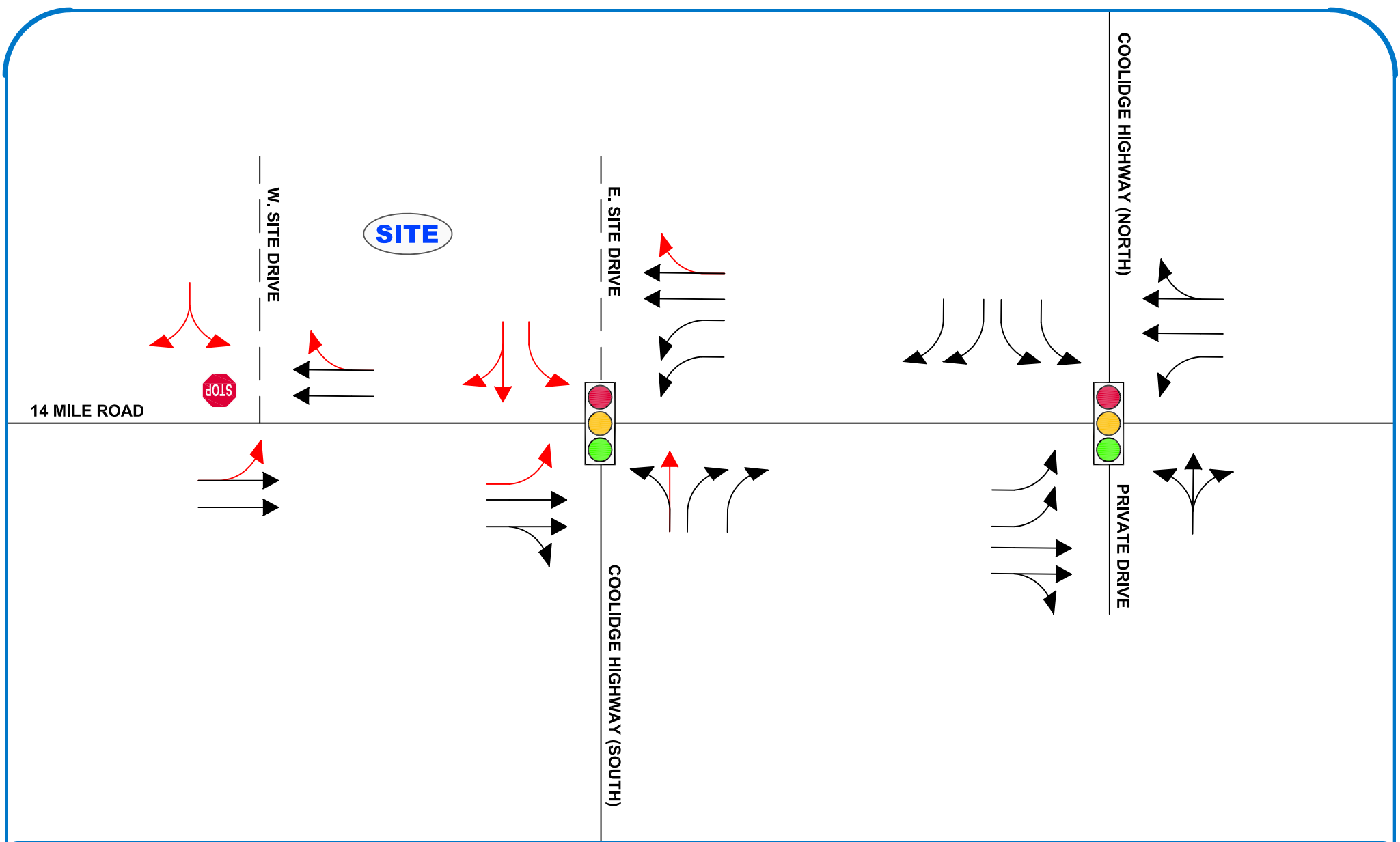


FIGURE 2

LANE USE AND TRAFFIC CONTROL

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

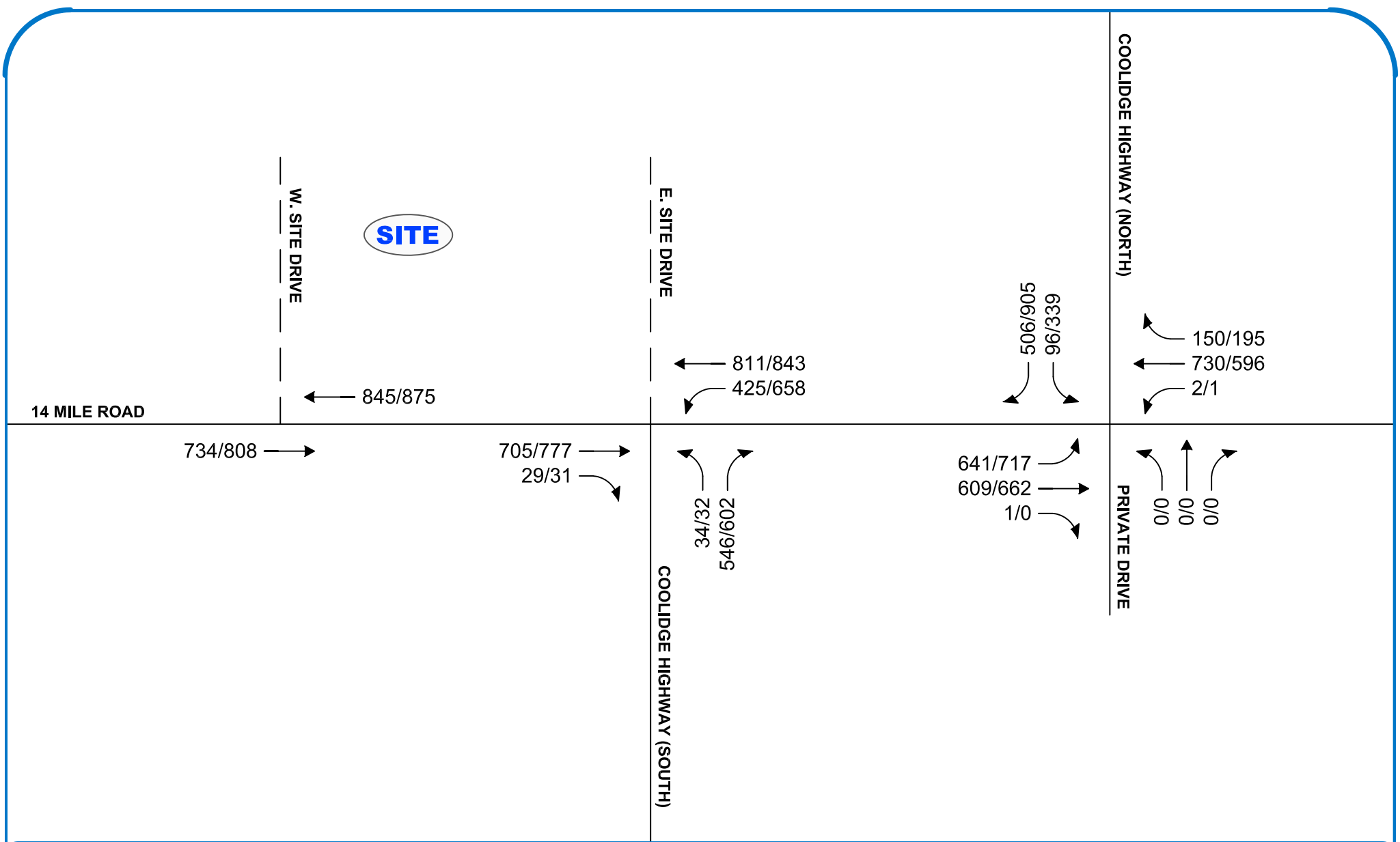


FIGURE 3

EXISTING TRAFFIC VOLUMES

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)



NORTH
SCALE: NOT TO SCALE

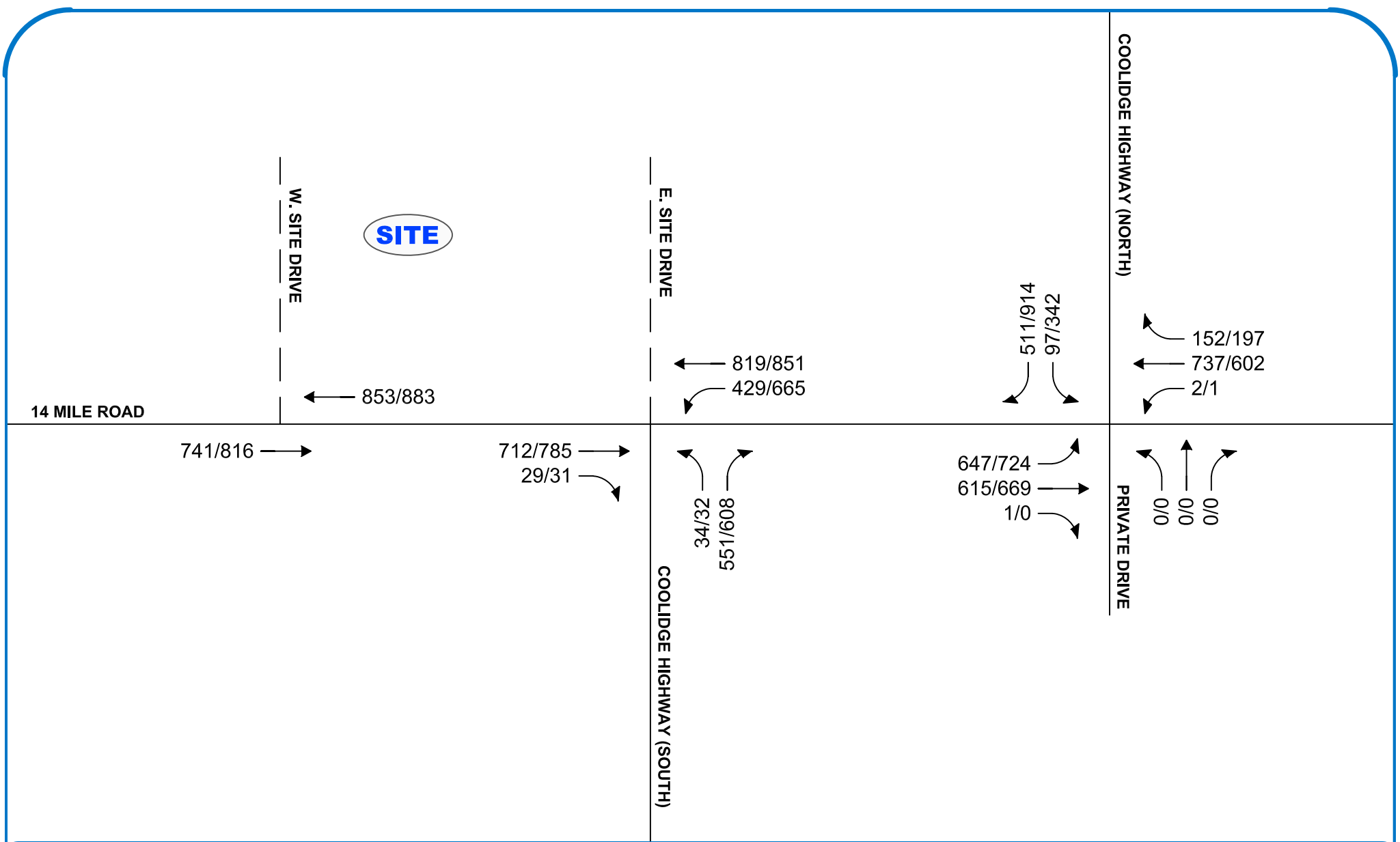


FIGURE 4

BACKGROUND TRAFFIC VOLUMES

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)



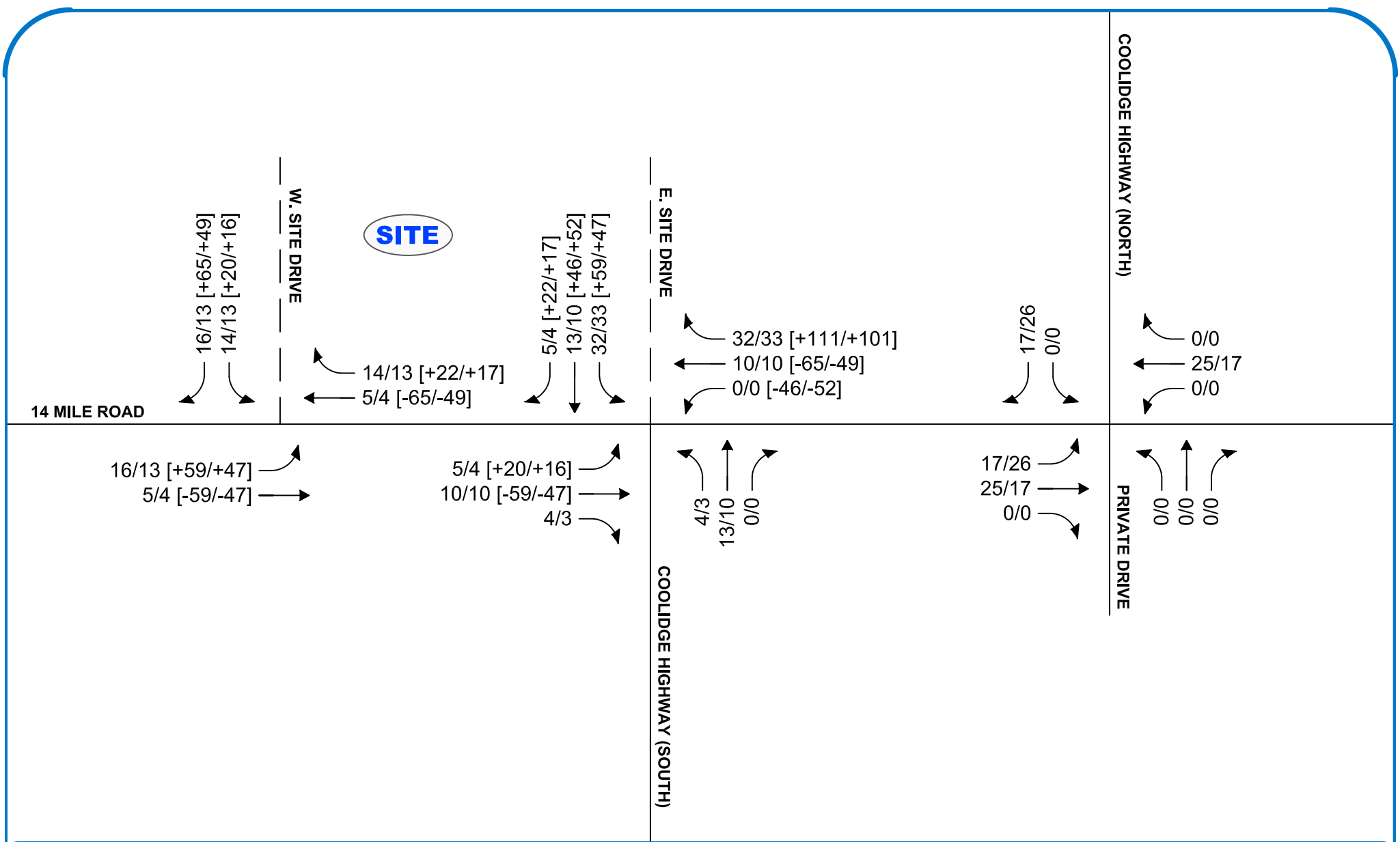


FIGURE 5

SITE-GENERATED TRAFFIC VOLUMES

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)
- +/-[000/000] PASS-BY [AM/PM]



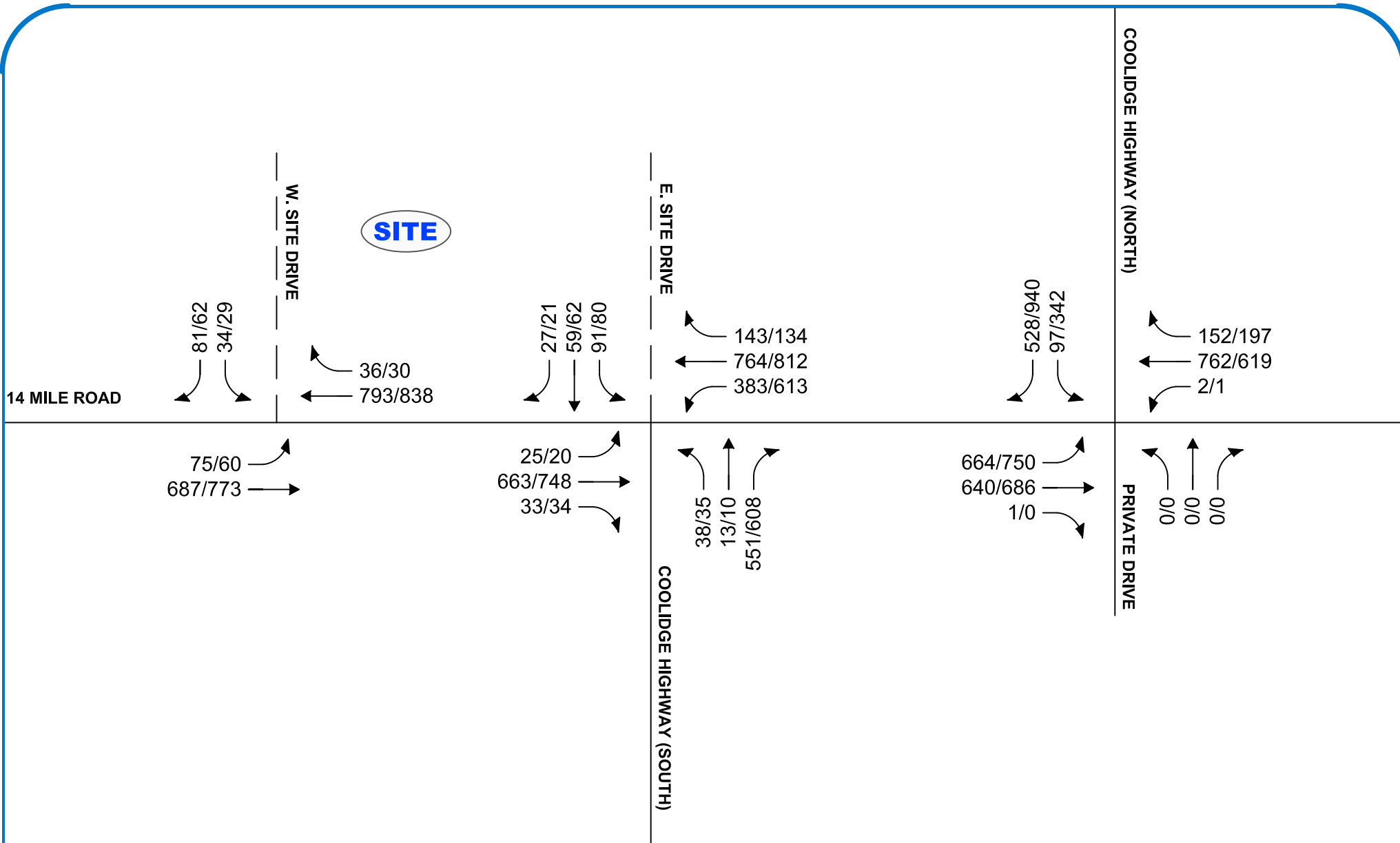


FIGURE 6

FUTURE TRAFFIC VOLUMES

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)



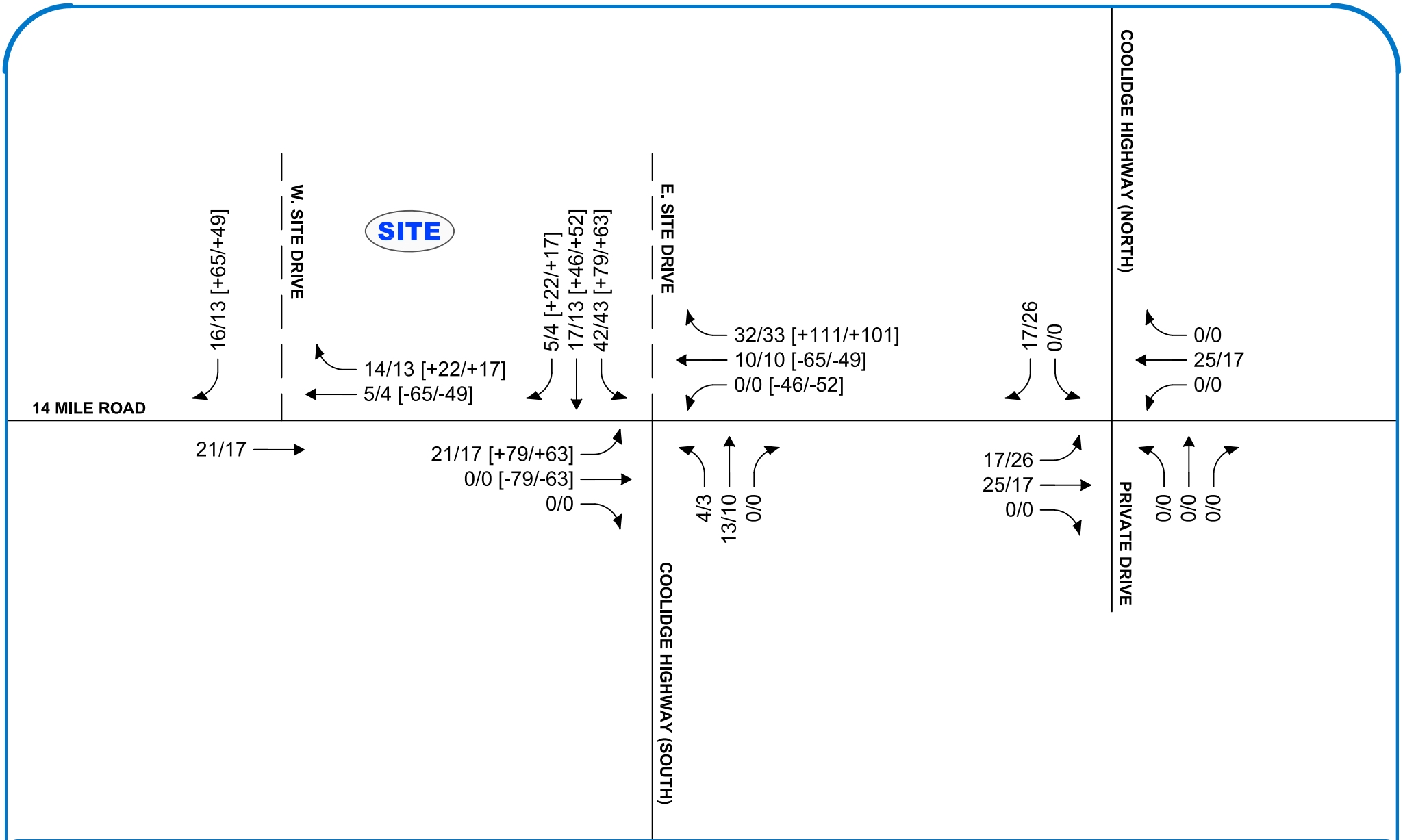


FIGURE 7

SITE-GENERATED IMPROVEMENTS TRAFFIC VOLUMES

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)
- +/-[000/000] PASS-BY [AM/PM]



NORTH
SCALE: NOT TO SCALE

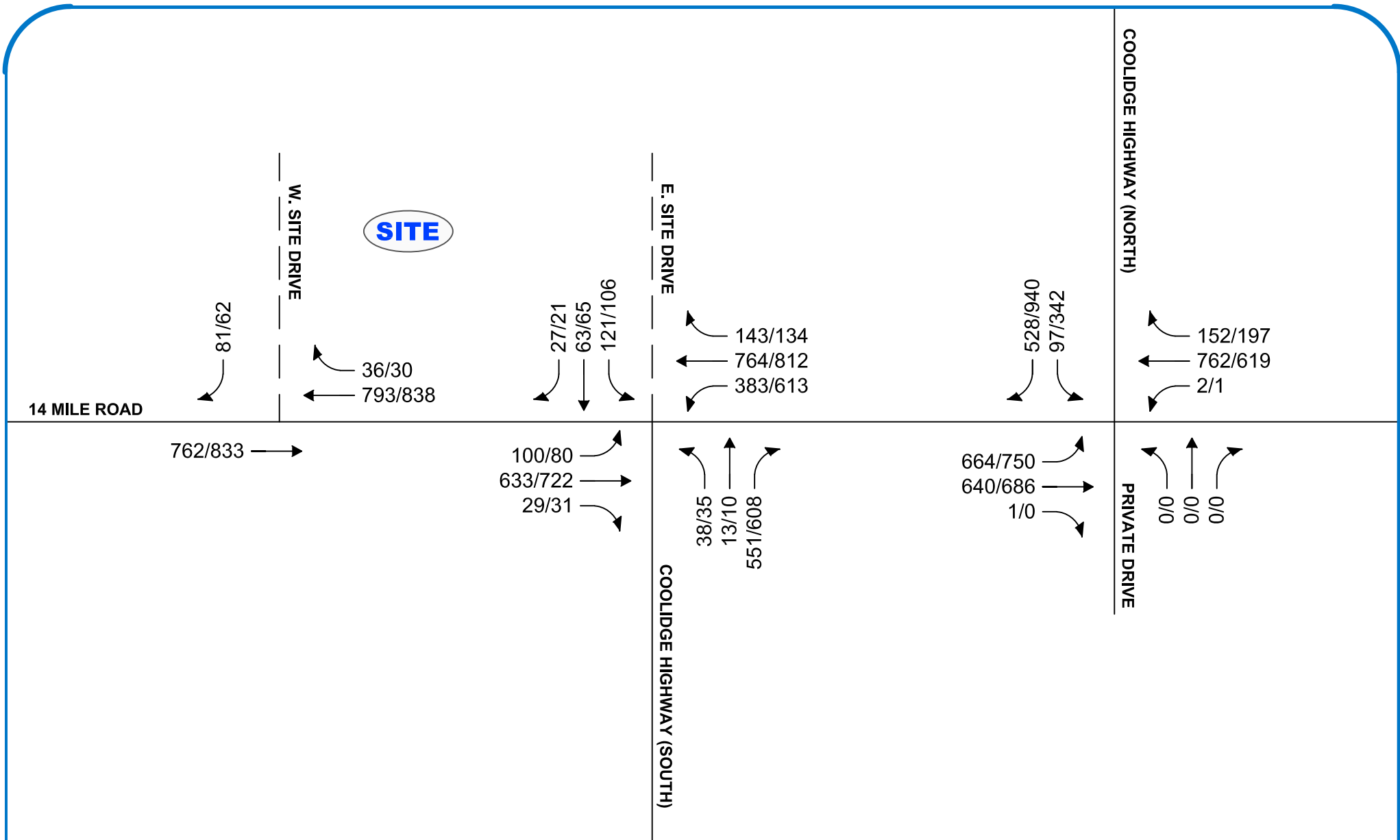


FIGURE 8
FUTURE IMPROVEMENTS
TRAFFIC VOLUMES

14- MILE & COOLIDGE COMMERCIAL - ROYAL OAK, MI

LEGEND

- ROADS
- PROPOSED ROADS
- TRAFFIC VOLUMES (AM/PM)



NORTH
 SCALE: NOT TO SCALE

LEGEND

	PROPERTY LINE		PAINTED STOP BAR W/ STOP SIGN
	PROPOSED 6" CONCRETE CURB & GUTTER		TRAFFIC FLOW ARROWS
	PROPOSED SIDEWALK		PROPOSED SIGN
	PROPOSED CONCRETE		PROPOSED FIRE LANE SIGN
	PROPOSED HEAVY DUTY ASPHALT PAVEMENT		PARKING ROW COUNT
	PROPOSED STANDARD DUTY ASPHALT PAVEMENT		ADA PARKING SPACE
	DRIVE-THRU STACKING		SIDEWALK RAMP
	PROPOSED LIGHT POLE		

NOTES

1. FOR ADDITIONAL INFORMATION REFERENCE THE STANDARD NOTES SHEET, STANDARD DETAILS SHEET(S), AND ANY MUNICIPALITY AND/OR JURISDICTIONAL DETAILS ATTACHED TO THIS PLAN SET.
2. SEE TOPOGRAPHIC SURVEY FOR INVERTS AND RIMS OF EXISTING STORM SEWER.
3. FOR STORM SEWER AND DETENTION CALCULATIONS, REFERENCE THE DRAINAGE AREA PLAN AND STORMWATER MANAGEMENT CALCULATIONS..
4. SEE MASTER UTILITY & CROSSING PLAN FOR CROSSING INFORMATION AND UTILITY ROUTING.
5. SUBJECT PARCEL IS NOT ADJACENT TO, NOR ON THE SAME BLOCK AS A RESIDENTIALLY ZONED PARCEL. PER THE CITY OF ROYAL OAK ZONING ORDINANCE, NO SETBACKS ARE REQUIRED. IF A SETBACK IS TO BE PROVIDED, IT SHALL BE NO LESS THAN 5'.

SITE DATA

PARCEL SUMMARY

PARCEL ID#	NET AREA	ZONING
20-32-351-001	~5.61 ACRES	GENERAL INDUSTRIAL

BUILDING SUMMARY

TENANT	AREA
SHEETZ	6,139 SF
TIDAL WAVE	3,620 SF
EXISTING BLDG.	8,724 SF*

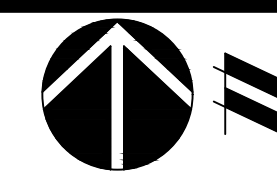
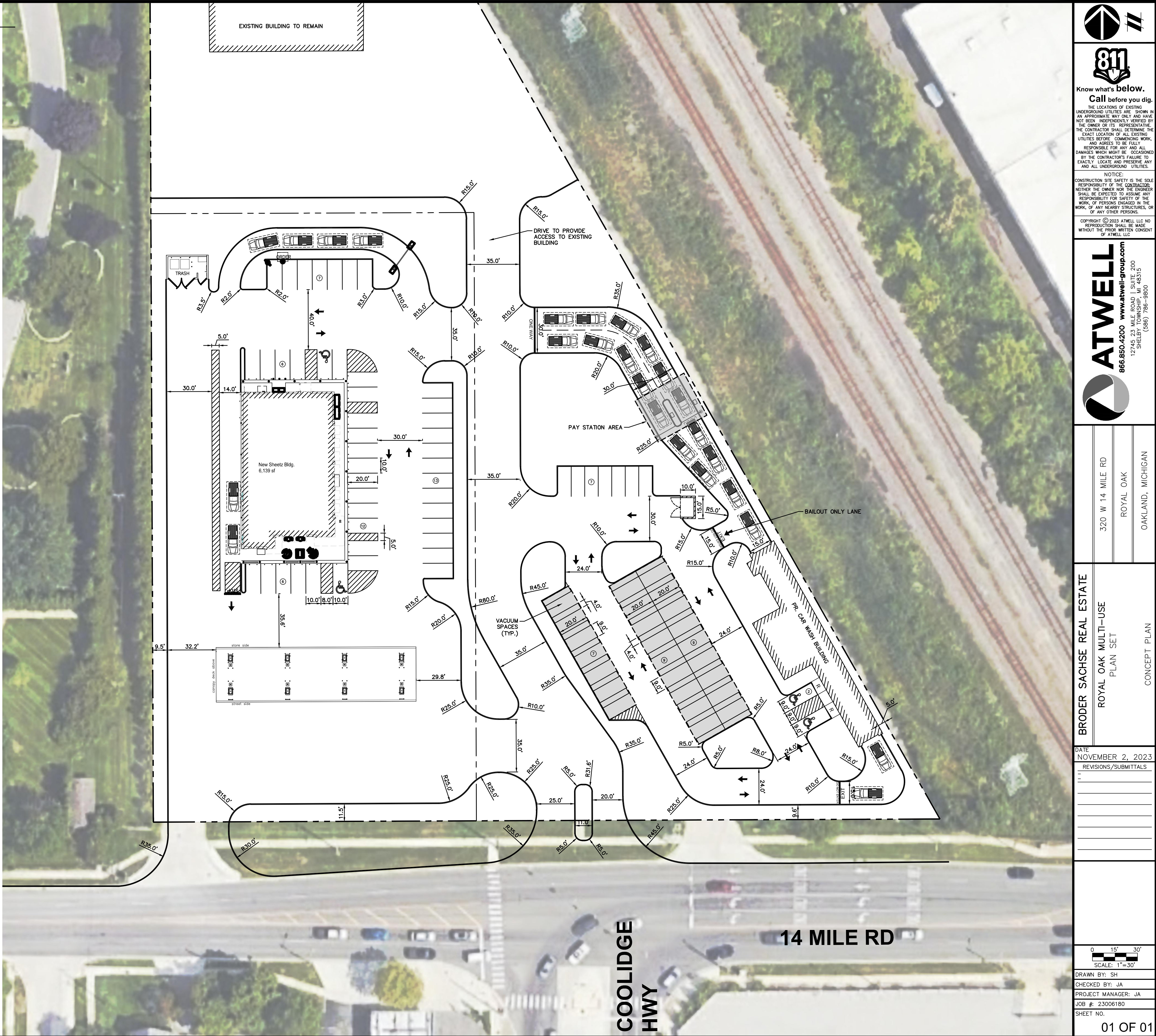
*UNKNOWN SIZE. MEASURED BASED OFF AERIAL IMAGERY.

PARKING SUMMARY

TENANT	PROVIDED	REQUIRED	FORMULA
SHEETZ	44 SPACES	31 SPACES	1/200 UFA
TIDAL WAVE	34 SPACES	5 SPACES	1/800 UFA
TOTAL	78 SPACES	36 SPACES	

ACCESSIBLE PARKING DATA

	PROPOSED	REQUIRED	FORMULA
TOTAL	4 SPACES	2 SPACES	BASED ON TOTAL SPACES



Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE: CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR. NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

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SHELBY TOWNSHIP, MI 48315
(360) 786-9600



320 W 14 MILE RD	ROYAL OAK	OAKLAND, MICHIGAN
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BRODER SACHSE REAL ESTATE	ROYAL OAK MULTI-USE PLAN SET	CONCEPT PLAN
---------------------------	------------------------------	--------------

DATE: NOVEMBER 2, 2023

REVISIONS/SUBMITTALS



DRAWN BY: SH

CHECKED BY: JA

PROJECT MANAGER: JA

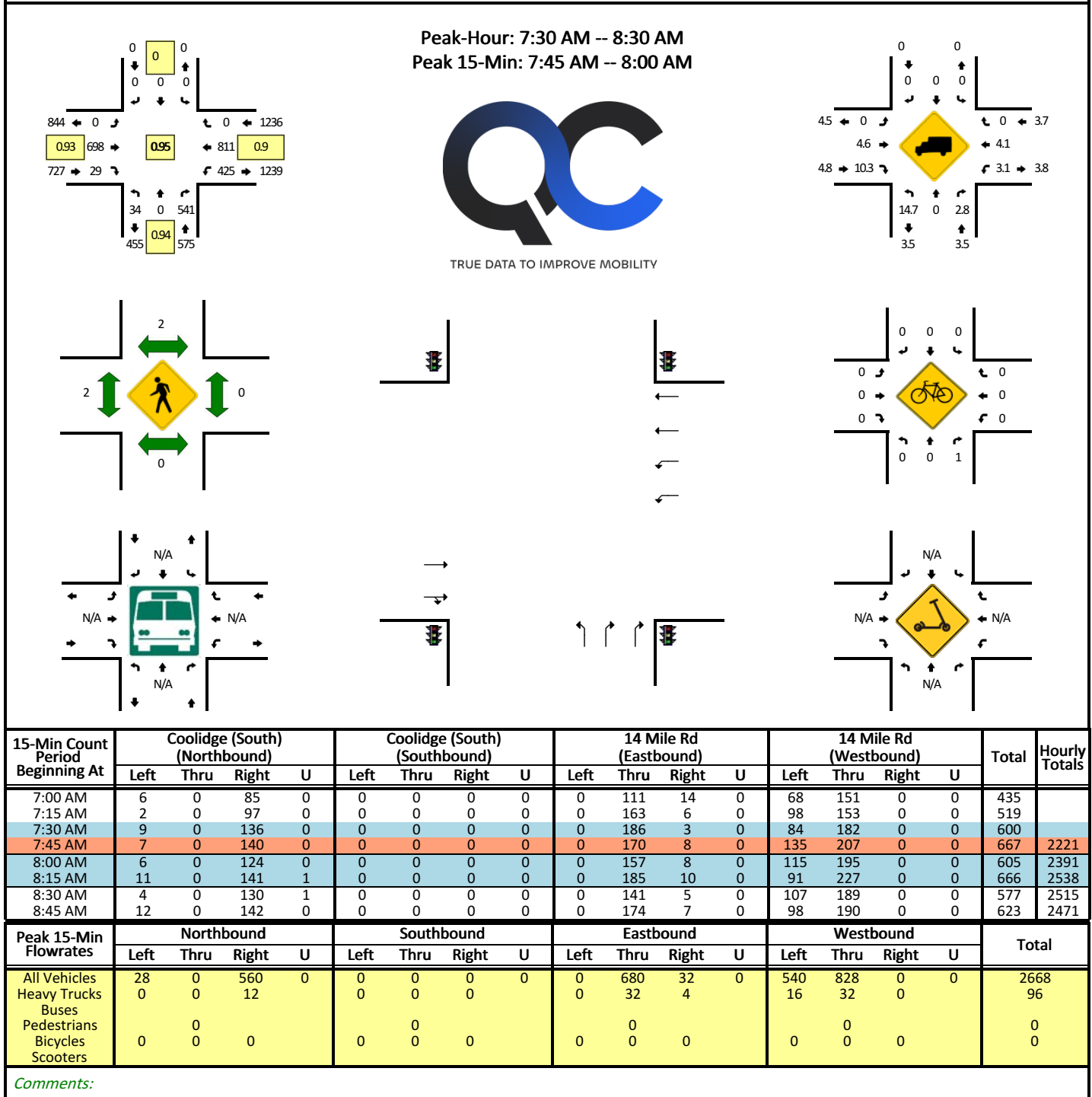
JOB #: 23006180

SHEET NO. 01 OF 01

CAD FILE: \\WSR-CVL\23006180\DWG\PLAN SETS\CONCEPT\23006180_C103

LOCATION: Coolidge (South) -- 14 Mile Rd
CITY/STATE: Royal Oak, MI

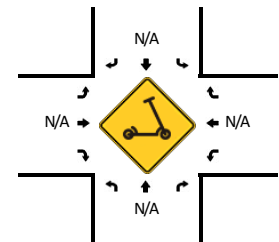
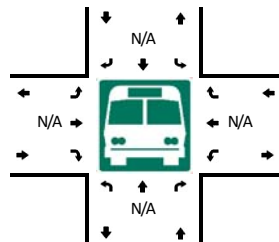
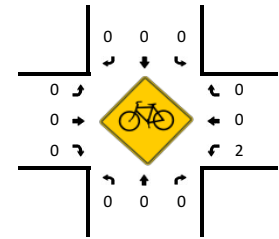
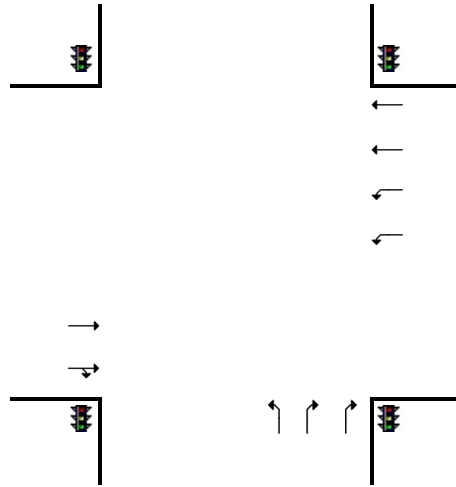
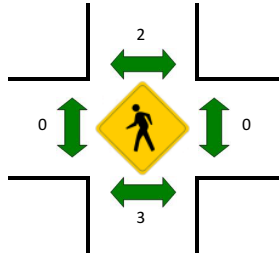
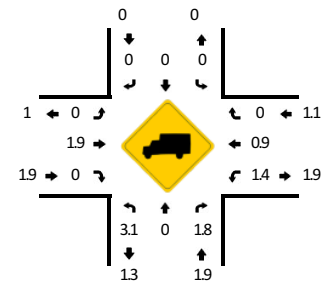
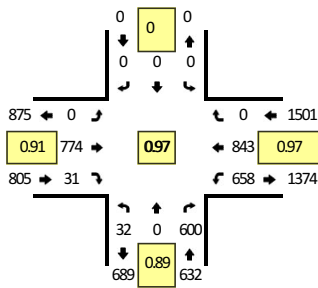
QC JOB #: 16393001
DATE: Wed, Nov 8 2023



LOCATION: Coolidge (South) -- 14 Mile Rd
CITY/STATE: Royal Oak, MI

QC JOB #: 16393002
DATE: Wed, Nov 8 2023

Peak-Hour: 4:30 PM -- 5:30 PM
 Peak 15-Min: 5:15 PM -- 5:30 PM

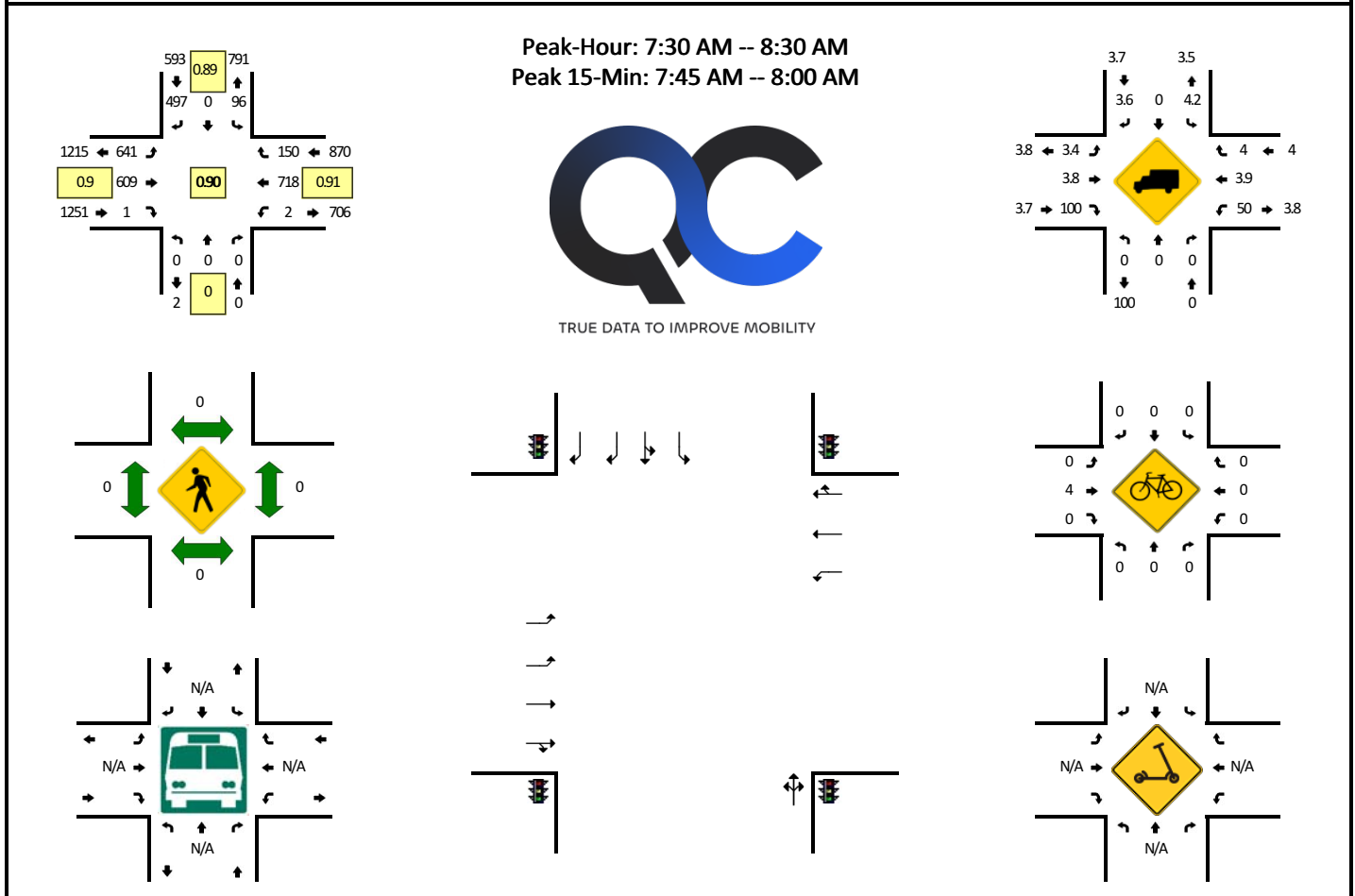


15-Min Count Period Beginning At	Coolidge (South) (Northbound)				Coolidge (South) (Southbound)				14 Mile Rd (Eastbound)				14 Mile Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	14	0	143	1	0	0	0	0	0	184	9	0	155	218	0	0	724	
4:15 PM	4	0	126	0	0	0	0	0	0	155	7	0	162	189	0	0	643	
4:30 PM	12	0	165	0	0	0	0	0	0	210	4	0	162	202	0	0	755	
4:45 PM	8	0	143	0	0	0	0	0	0	166	10	0	159	207	0	0	693	2815
5:00 PM	5	0	147	0	0	0	0	0	0	184	10	0	173	215	0	0	734	2825
5:15 PM	7	0	145	0	0	0	0	0	0	214	7	0	164	219	0	0	756	2938
5:30 PM	11	0	138	0	0	0	0	0	0	199	4	0	162	190	0	0	704	2887
5:45 PM	5	0	118	0	0	0	0	0	0	168	9	0	151	163	0	0	614	2808
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	28	0	580	0	0	0	0	0	0	856	28	0	656	876	0	0	3024	
Heavy Trucks	4	0	28		0	0	0		0	12	0		8	8	0		60	
Buses																		
Pedestrians		4				0				0				0			4	
Bicycles	0	0	0		0	0	0		0	0	0		4	0	0		4	
Scooters																		

Comments:

LOCATION: Coolidge (North) -- 14 Mile Rd
CITY/STATE: Royal Oak, MI

QC JOB #: 16393003
DATE: Wed, Nov 8 2023



15-Min Count Period Beginning At	Coolidge (North) (Northbound)				Coolidge (North) (Southbound)				14 Mile Rd (Eastbound)				14 Mile Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	0	0	0	11	0	79	0	76	106	0	0	1	135	21	0	429	
7:15 AM	0	0	1	0	21	0	114	0	116	133	0	0	2	141	10	0	538	
7:30 AM	0	0	0	0	13	0	100	0	148	166	0	0	1	175	27	0	630	
7:45 AM	0	0	0	0	22	0	144	0	188	158	1	0	0	193	44	1	751	2348
8:00 AM	0	0	0	0	29	0	132	0	138	140	0	0	0	171	42	0	652	2571
8:15 AM	0	0	0	0	32	0	121	0	167	145	0	0	0	179	37	0	681	2714
8:30 AM	0	0	0	0	33	0	130	0	161	109	0	0	0	177	35	0	645	2729
8:45 AM	0	0	0	0	43	0	136	0	160	154	1	0	0	149	34	1	678	2656
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	0	0	0	88	0	576	0	752	632	4	0	0	772	176	4	3004	
Heavy Trucks	0	0	0	0	0	0	16	0	24	24	4	0	0	32	12	0	112	
Buses																		
Pedestrians		0				0				0				0			0	
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0	
Scooters																		

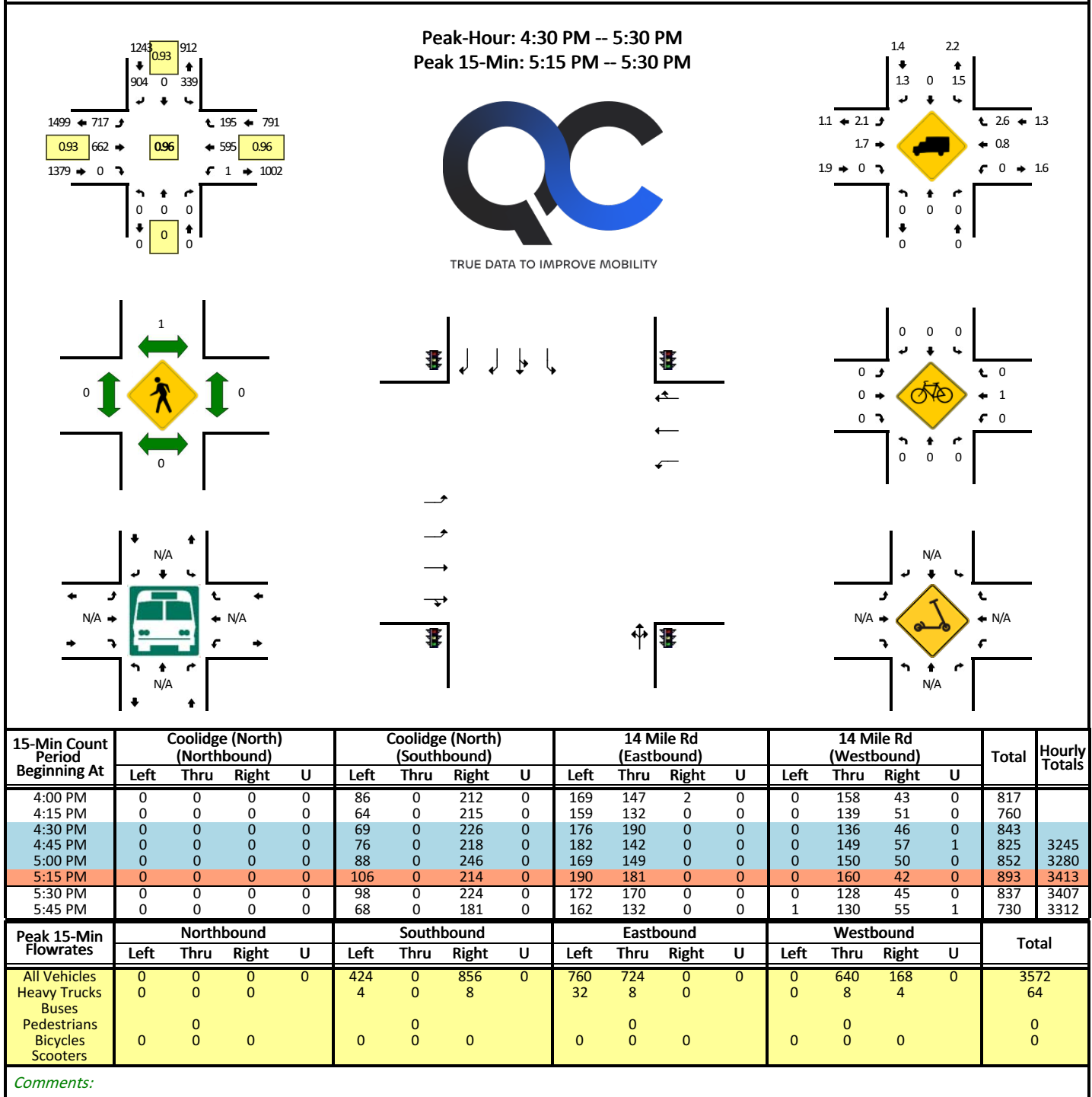
Comments:

Report generated on 11/14/2023 5:14 AM

SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

LOCATION: Coolidge (North) -- 14 Mile Rd
CITY/STATE: Royal Oak, MI

QC JOB #: 16393004
DATE: Wed, Nov 8 2023



NTCIP TRAFFIC SIGNAL TIMING PERMIT

	PHASE	1	2	3	4	5	6	7	8	TIMING INSTALLED	PRE-EMPT COUNTDOWN PEDS ☐
APPROACH										REMARKS	☐
MINIMUM GREEN											☐
PASSAGE / EXTEND1											
MAXIMUM GREEN NO. 1											
MAXIMUM GREEN NO. 2											
YELLOW CLEARANCE											
ALL RED CLEARANCE											
WALK											
FLASHING DON'T WALK (FDW) CLEARANCE											
EXT PED CLR (EOG, EOY, 3.0s)											
WALK REST MODIFIER (Y, N)											
START UP STATE (G/W, R, G, Y)											
VEHICLE RECALL (NONE, MIN, MAX, SOFT)											
PEDESTRIAN RECALL (NONE, RECL, OTHR)											
DUAL ENTRY (Y, N)											
MODE (CRD, MIN, MAX, NOCRD)											
DAILY FLASH (Y, R, DK, NA)											
CONFLICT FLASH (Y, R, DK)											
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
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	FLASH HOURS: to DAILY ☐ NONE ☐																																																																																																														
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:15%;">PHASE</th> <th colspan="10">VEHICLE OVERLAPS</th> </tr> <tr> <th></th> <th>Overlap Phase</th> <th>Load Bay</th> <th>Phases Overlapped</th> <th>T.G. (s)</th> <th>Y (s)</th> <th>R (s)</th> <th>FYA Phases Perm</th> <th>Prot</th> <th>Flash Daily</th> <th>Confl</th> </tr> <tr><td>1</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>2</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>3</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>4</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>5</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>7</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>	PHASE	VEHICLE OVERLAPS											Overlap Phase	Load Bay	Phases Overlapped	T.G. (s)	Y (s)	R (s)	FYA Phases Perm	Prot	Flash Daily	Confl	1	=										2	=										3	=										4	=										5	=										6	=										7	=										8	=										CONTROLLER and FIRMWARE# ☐ Siemens (SEPAC) ☐ ECONOLITE (EOS) ☐ Other: _____
PHASE	VEHICLE OVERLAPS																																																																																																														
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	Job # (If Applicable): _____																																																																																																														

ADVANCED TIMING PARAMETERS FORM

SYSTEM INFORMATION		LEFT-TURN PHASING						RING AND BARRIER STRUCTURE																					
System Type: ☐ Central Group ID ☐ TBC ☐ None ☐ Other:		Phase # / Description		Permissive-Protected		Protected-Only		R1	B1				B2				B3				B4								
				Lead	Lag	Split	Lead		Lag																				
		Location ID: Interconnect: ☐ HARDWIRE ☐ FIBER-OPTIC ☐ RADIO ☐ SERIAL RADIO ☐ IP RADIO ☐ TBC ☐ GPS CLOCK ☐ CELL MODEM ☐ NONE ☐ Other:				☐	☐	☐	☐	☐	R2																		
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		Movements and Call Delay (s)						Locking				Push-Button Crossing Locations																	
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SCHEDULING INFORMATION

Schedule #	Days of Week	Start Date	End Date	Day Plan #	Events
<i>Example Values</i>					
1	Saturday and Sunday	January 1st	December 31st	1	#1 - Normal #4 - 23:00 - 06:00
2	Monday - Friday	January 1st	December 31st	2	#1 - Normal #2 - AM Peak 06:00 - 09:00 #3 - PM Peak 14:00 - 18:00

PREPARED BY:

DATE:

LOCATION:

CONTROL SECTION-SPOT #

PREEMPTION INFORMATION FORM

Preemption Description:																				Preempt System Data								
Preempt # =	SEPAC	EOS	Phases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	☐ Locking ☐ Non-Locking	Ring MIN GRN/WLK (s)	1	2	3	4	Preempt Overrides Flash ☐		
Entry Ped CI			Vehicle	Track																								
Entry Yellow				Dwell																								
Entry Red CI				Cycle																								
Track Green			Ped	Exit																	Delay (s) Extend (s) Duration (s)	Order of Priority	PE1	PE2	PE3	PE4	PE5	PE6
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Track Yellow				Dwell																								
Track Red CI			Cycle																	Max Call (s)								
Dwell Green			Overlap Vehicle	Overlap	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Lockout (s)		REMARKS :					
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Exit Yellow				Dwell																								
Exit Red CI			Cycle																									

NTCIP TRAFFIC SIGNAL TIMING PERMIT

	PHASE	1	2	3	4	5	6	7	8	TIMING INSTALLED	PRE-EMPT COUNTDOWN PEDS ☐
APPROACH										REMARKS	☐
MINIMUM GREEN											☐
PASSAGE / EXTEND1											
MAXIMUM GREEN NO. 1											
MAXIMUM GREEN NO. 2											
YELLOW CLEARANCE											
ALL RED CLEARANCE											
WALK											
FLASHING DON'T WALK (FDW) CLEARANCE											
EXT PED CLR (EOG, EOY, 3.0s)											
WALK REST MODIFIER (Y, N)											
START UP STATE (G/W, R, G, Y)											
VEHICLE RECALL (NONE, MIN, MAX, SOFT)											
PEDESTRIAN RECALL (NONE, RECL, OTHR)											
DUAL ENTRY (Y, N)											
MODE (CRD, MIN, MAX, NOCRD)											
DAILY FLASH (Y, R, DK, NA)											
CONFLICT FLASH (Y, R, DK)											
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
EVNT/ACTN PLN	OFFSET	CYCLE									
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EVNT/ACTN PLN	OFFSET	CYCLE									

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<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:15%;">PHASE</th> <th colspan="10">VEHICLE OVERLAPS</th> </tr> <tr> <th></th> <th>Overlap Phase</th> <th>Load Bay</th> <th>Phases Overlapped</th> <th>T.G. (s)</th> <th>Y (s)</th> <th>R (s)</th> <th>FYA Phases Perm</th> <th>Prot</th> <th>Flash Daily</th> <th>Confl</th> </tr> <tr><td>1</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>2</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>3</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>4</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>5</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>6</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>7</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>8</td><td>=</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>	PHASE	VEHICLE OVERLAPS											Overlap Phase	Load Bay	Phases Overlapped	T.G. (s)	Y (s)	R (s)	FYA Phases Perm	Prot	Flash Daily	Confl	1	=										2	=										3	=										4	=										5	=										6	=										7	=										8	=										CONTROLLER and FIRMWARE# ☐ Siemens (SEPAC) ☐ ECONOLITE (EOS) ☐ Other: PREPARED BY: DATE: LOCATION: CITY/TWP: COUNTY : MILE POINT CONTROL SECTION-SPOT # Job # (If Applicable):
PHASE	VEHICLE OVERLAPS																																																																																																														
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ADVANCED TIMING PARAMETERS FORM

SYSTEM INFORMATION		LEFT-TURN PHASING						RING AND BARRIER STRUCTURE																
System Type: ☐ Central Group ID ☐ TBC ☐ None ☐ Other:		Phase # / Description		Permissive-Protected		Protected-Only		R1	B1				B2				B3				B4			
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SCHEDULING INFORMATION

Schedule #	Days of Week	Start Date	End Date	Day Plan #	Events
<i>Example Values</i>					PREPARED BY: DATE:
1	Saturday and Sunday	January 1st	December 31st	1	#1 - Normal #4 - 23:00 - 06:00
2	Monday - Friday	January 1st	December 31st	2	#1 - Normal #2 - AM Peak 06:00 - 09:00 #3 - PM Peak 14:00 - 18:00
					LOCATION:
					CONTROL SECTION-SPOT #

PREEMPTION INFORMATION FORM

Preemption Description:																				Preempt System Data								
Preempt # =	SEPAC	EOS	Phases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	☐ Locking ☐ Non-Locking	Ring MIN GRN/WLK (s)	1	2	3	4	Preempt Overrides Flash ☐		
Entry Ped CI			Vehicle	Track																								
Entry Yellow				Dwell																								
Entry Red CI				Cycle																								
Track Green			Ped	Exit																	Delay (s) Extend (s) Duration (s)	Order of Priority	PE1	PE2	PE3	PE4	PE5	PE6
Track Ped CI				Track																								
Track Yellow				Dwell																								
Track Red CI			Cycle																	Max Call (s)								
Dwell Green			Overlap Vehicle	Overlap	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Lockout (s)		REMARKS :					
Exit Ped CI				Track																	Link PE #							
Exit Yellow				Dwell																								
Exit Red CI			Cycle																									
Preemption Description:																												
Preempt # =	SEPAC	EOS	Phases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	☐ Locking ☐ Non-Locking	Ring MIN GRN/WLK (s)	1	2	3	4	Preempt Overrides Flash ☐		
Entry Ped CI			Vehicle	Track																								
Entry Yellow				Dwell																								
Entry Red CI				Cycle																								
Track Green			Ped	Exit																	Delay (s) Extend (s) Duration (s)	Order of Priority	PE1	PE2	PE3	PE4	PE5	PE6
Track Ped CI				Track																								
Track Yellow				Dwell																								
Track Red CI			Cycle																	Max Call (s)		REMARKS :						
Dwell Green			Overlap Vehicle	Overlap	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Lockout (s)							
Exit Ped CI				Track																	Link PE #							
Exit Yellow				Dwell																								
Exit Red CI			Cycle																									
Preemption Description:																												
Preempt # =	SEPAC	EOS	Phases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	☐ Locking ☐ Non-Locking	Ring MIN GRN/WLK (s)	1	2	3	4	Preempt Overrides Flash ☐		
Entry Ped CI			Vehicle	Track																								
Entry Yellow				Dwell																								
Entry Red CI				Cycle																								
Track Green			Ped	Exit																	Delay (s) Extend (s) Duration (s)	Order of Priority	PE1	PE2	PE3	PE4	PE5	PE6
Track Ped CI				Track																								
Track Yellow				Dwell																								
Track Red CI			Cycle																	Max Call (s)		REMARKS :						
Dwell Green			Overlap Vehicle	Overlap	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Lockout (s)							
Exit Ped CI				Track																	Link PE #							
Exit Yellow				Dwell																								
Exit Red CI			Cycle																									
Preemption Description:																												
Preempt # =	SEPAC	EOS	Phases	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	☐ Locking ☐ Non-Locking	Ring MIN GRN/WLK (s)	1	2	3	4	Preempt Overrides Flash ☐		
Entry Ped CI			Vehicle	Track																								
Entry Yellow				Dwell																								
Entry Red CI				Cycle																								
Track Green			Ped	Exit																	Delay (s) Extend (s) Duration (s)	Order of Priority	PE1	PE2	PE3	PE4	PE5	PE6
Track Ped CI				Track																								
Track Yellow				Dwell																								
Track Red CI			Cycle																	Max Call (s)		REMARKS :						
Dwell Green			Overlap Vehicle	Overlap	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Lockout (s)							
Exit Ped CI				Track																	Link PE #							
Exit Yellow				Dwell																								
Exit Red CI			Cycle																									



Community Profiles

YOU ARE VIEWING DATA FOR:

City of Royal Oak

203 S Troy St
Royal Oak, MI 48067-2634
<http://www.romi.gov>

SEMCOG
MEMBER

Census 2020 Population: 58,211
Area: 11.8 square miles

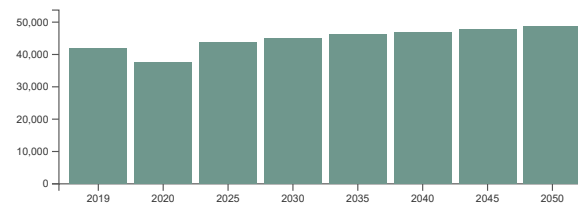
[VIEW COMMUNITY EXPLORER MAP](#)

[VIEW 2020 CENSUS MAP](#)

Economy & Jobs

Link to American Community Survey (ACS) Profiles: **Select a Year** **Economic**

Forecasted Jobs



Note: The base year for the employment forecast is 2019, as 2020 employment was artificially low due to the COVID recession.

Source: **SEMCOG 2050 Regional Development Forecast**

Forecasted Jobs by Industry Sector

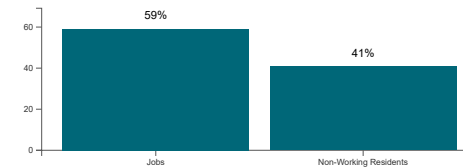
Forecasted Jobs By Industry Sector	2019	2020	2025	2030	2035	2040	2045	2050	Change 2019-2050	Pct Change 2019-2050
Natural Resources, Mining, & Construction	1,499	1,468	2,142	2,211	2,193	2,083	2,071	2,021	522	34.8%
Manufacturing	1,637	1,499	1,800	1,786	1,780	1,702	1,639	1,615	-22	-1.3%
Wholesale Trade	946	890	966	985	1,009	1,014	1,027	1,079	133	14.1%
Retail Trade	3,160	2,807	2,936	2,792	2,644	2,541	2,462	2,408	-752	-23.8%
Transportation, Warehousing, & Utilities	1,147	1,135	1,401	1,438	1,479	1,457	1,496	1,555	408	35.6%
Information & Financial Activities	5,979	5,298	6,177	6,309	6,420	6,529	6,651	6,714	735	12.3%
Professional and Technical Services & Corporate HQ	3,723	3,559	4,335	4,629	4,892	5,051	5,303	5,571	1,848	49.6%
Administrative, Support, & Waste Services	2,612	1,940	2,281	2,389	2,519	2,608	2,727	2,832	220	8.4%
Education Services	1,324	1,231	1,407	1,438	1,433	1,446	1,465	1,500	176	13.3%
Healthcare Services	12,751	12,159	13,208	13,697	14,306	14,731	15,229	15,644	2,893	22.7%
Leisure & Hospitality	4,895	3,581	4,921	5,038	5,134	5,222	5,297	5,354	459	9.4%
Other Services	1,942	1,711	1,868	1,993	2,065	2,093	2,163	2,202	260	13.4%
Public Administration	341	324	340	339	341	341	344	352	11	3.2%
Total Employment Numbers	41,956	37,602	43,782	45,044	46,215	46,818	47,874	48,847	6,891	16.4%

Note: The base year for the employment forecast is 2019, as 2020 employment was artificially low due to the COVID recession.

Source: SEMCOG 2050 Regional Development Forecast

Daytime Population

Daytime Population	ACS 2016
Jobs	33,183
Non-Working Residents	22,897
Age 15 and under	8,208
Not in labor force	13,072
Unemployed	1,617
Daytime Population	56,080



Source: 2012-2016 American Community Survey 5-Year Estimates and 2012-2016 Census Transportation Planning Products Program (CTPP). For additional information, visit SEMCOG's [Interactive Commuting Patterns Map](#)

Note: The number of residents attending school outside Southeast Michigan is not available. Likewise, the number of students commuting into Southeast Michigan to attend school is also not known.



Community Profiles

YOU ARE VIEWING DATA FOR:

City of Royal Oak

203 S Troy St
Royal Oak, MI 48067-2634
<http://www.romi.gov>



Census 2020 Population: 58,211

Area: 11.8 square miles

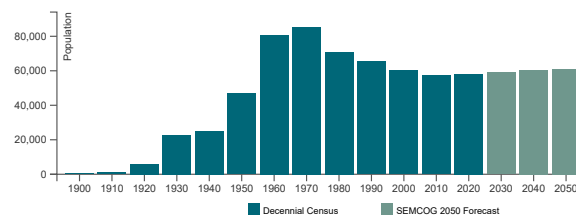
[VIEW COMMUNITY EXPLORER MAP](#)

[VIEW 2020 CENSUS MAP](#)

Population and Households

Link to American Community Survey (ACS) Profiles: [Select a Year](#) [Social | Demographic](#)
Population and Household Estimates for Southeast Michigan, 2022

Population Forecast



Note for City of Royal Oak : Incorporated in 1927 from Village of Royal Oak. Population numbers prior to 1927 are of the village.

Population and Households

Population and Households	Census 2020	Census 2010	Change 2010-2020	Pct Change 2010-2020	SEMOG Jul 2022	SEMOG 2050
Total Population	58,211	57,236	975	1.7%	57,038	61,090
Group Quarters Population	225	404	-179	-44.3%	316	480
Household Population	57,986	56,832	1,154	2.0%	56,722	60,610
Housing Units	31,244	30,207	1,037	3.4%	31,400	-
Households (Occupied Units)	29,364	28,063	1,301	4.6%	28,887	30,234
Residential Vacancy Rate	6.0%	7.1%	-1.1%	-	8.0%	-
Average Household Size	1.97	2.03	-0.05	-	1.96	2.00

Source: U.S. Census Bureau and SEMCOG 2050 Regional Development Forecast

Components of Population Change

Components of Population Change	2000-2005 Avg.	2006-2010 Avg.	2011-2018 Avg.
Natural Increase (Births - Deaths)	256	252	288
Births	906	770	751
Deaths	650	518	463
Net Migration (Movement In - Movement Out)	-1,063	-10	177
Population Change (Natural Increase + Net Migration)	-807	242	465

Source: Michigan Department of Community Health Vital Statistics, U.S. Census Bureau, and SEMCOG

Household Types

Household Types	Census 2010	ACS 2021	Change 2010-2021	Pct Change 2010-2021	SEMOG 2050
With Seniors 65+	5,732	6,287	555	9.7%	-
Without Seniors	22,331	22,684	353	1.6%	-
Live Alone, 65+	2,999	3,139	140	4.7%	-
Live Alone, <65	8,620	9,070	450	5.2%	-
2+ Persons, With children	5,620	5,104	-516	-9.2%	-
2+ Persons, Without children	10,824	11,658	834	7.7%	-
Total Households	28,063	28,971	908	3.2%	-

Source: U.S. Census Bureau, Decennial Census, 2017-2021 American Community Survey 5-Year Estimates, and SEMCOG 2050 Regional Development Forecast

Level of Service Criteria for Stop Sign Controlled Intersections

The level of service criteria are given in Exhibit 20-2. As used here, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue until the vehicle departs from the stop line; this time includes the time required for the vehicle to travel from the last-in-queue position to the first-in-queue position, including deceleration of vehicles from free-flow speed to the speed of vehicles in queue.

The average total delay for any particular controlled movement is a function three (capacity) factors: distribution of gaps in the major-street traffic stream, driver judgment in selecting gaps through which to execute the desired maneuvers, and the follow-up headways required by each driver in a queue.

The basic capacity model assumes gaps in the conflicting movements are randomly distributed. When traffic signals are present on the major street, upstream of the subject intersection, flows may not be random but will likely have some platoon structure. Although the procedures in this chapter provide a method for approximating the operations of a TWSC intersection with an upstream signal, the operations of such an intersection is arguably best handled by including it in a complete simulation

Exhibit 20-2. Level of Service Criteria for Stop-Controlled Intersections (Motor Vehicles)

LEVEL OF SERVICE	AVERAGE CONTROL DELAY (sec/veh)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Average total delay less than 10 sec/veh is defined as Level of Service (LOS) A. Follow-up times of less than 5 sec have been measured when there is no conflicting traffic for a minor street movement, so control delays of less than 10 sec/veh are appropriate for low flow conditions. A total delay of 50 sec/veh is assumed as the break point between LOS E and F.

The LOS criteria for TWSC intersections differ somewhat from the criteria used in Chapter 19 for signalized intersections, primarily because user perceptions differ among transportation facility types. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will present greater delay than an unsignalized intersection. Additionally, several driver behavior considerations combine to make delays at signalized intersections less onerous than at unsignalized intersections. For example, drivers at signalized intersections are able to relax during the red interval, where drivers on the minor approaches to unsignalized intersections must remain attentive to the task of identifying acceptable gaps and vehicle conflicts. Also, there is often much more variability in the amount of delay experienced by individual drivers at unsignalized than signalized intersections. For these reasons, it is considered that the total delay threshold for any given level of service is less for an unsignalized intersection than for a signalized intersection.

LOS F exists when there are insufficient gaps of suitable size to allow a side street demand to cross safely through a major street traffic stream. This level of service is generally evident from extremely long total delays experienced by side street traffic and by queueing on the minor approaches. The method, however, is based on a constant critical gap size - that is, the critical gap remains constant, no matter how long the side street motorist waits. LOS F may also appear in the form of side street vehicles' selecting smaller-than-usual gaps. In such cases, safety may be a problem and some disruption to the major traffic stream may result. It is important to note that LOS F may not always result in long queues but may result in adjustments to normal gap acceptance behavior. The latter is more difficult to observe on the field than queueing, which is more obvious.

Level of Service for Signalized Intersections

Level of service for signalized intersections is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. LOS can be characterized for the entire intersection, each intersection approach, and each lane group. Specifically, level-of-service (LOS) criteria are stated in terms of the average stopped delay per vehicle. The criteria are given in Exhibit 19-8. Delay may be measured in the field or estimated using procedures presented later in this chapter. Delay is a complex measure and is dependent on a number of variables, including the quality of progression, the cycle length, the green ratio, and the v/c ratio for the lane group in question.

LOS A describes operations with a control delay of 10 s/veh or less. This level is typically assigned when the volume-to-capacity ratio is low and either progression is extremely favorable or the cycle length is very short. If LOS A is the result of favorable progression, most vehicles arrive during a green indication and travel through the intersection without stopping.

LOS B describes operations with control delay between 10 and 20 s/veh. This level is typically assigned when the volume-to-capacity ratio is low and either progression is highly favorable or the cycle length is short. More vehicles stop than with LOS A.

Exhibit 19.8. Level-of-Service Criteria for Signalized Intersections (Motorized Vehicles)

LEVEL OF SERVICE	STOPPED DELAY PER VEHICLE (SEC)
A	≤ 10.0
B	> 10.0 and ≤ 20.0
C	> 20.0 and ≤ 35.0
D	> 35.0 and ≤ 55.0
E	> 55.0 and ≤ 80.0
F	> 80.0

1. If the v/c ratio for a lane group exceeds 1.0, a LOS F is assigned to the individual lane group. LOS for approach-based and intersection-wide assessments are determined solely by the control delay.

LOS C describes operations with control delay between 20 and 35 s/veh. This level is typically assigned when progression is favorable or the cycle length is moderate. Individual *cycle failures* (i.e. one or more queued vehicles are not able to depart as a result of insufficient capacity during the cycle) may begin to appear at this level. The number of vehicle stopping is significant, although many vehicles still pass through the intersection without stopping.

LOS D describes operations with control delay between 35 and 55 s/veh. This level is typically assigned when the volume-to-capacity ratio is high and either progression is ineffective or the cycle length is long. Many vehicles stop and individual cycle failures are noticeable.

LOS E describes operations with control delay between 55 and 80 s/veh. This level is typically assigned when the volume-to-capacity ratio is high, progression is unfavorable, and the cycle length is long. Individual cycle failures are frequent.

LOS F describes operations with control delay exceeding 80 s/veh or a volume-to-capacity ratio greater than 1.0. This level, considered to be unacceptable to most drivers, often occurs with over-saturation, that is, when arrival flow rates exceed the capacity of the intersection. This level is typically assigned when the volume-to-capacity ratio is high, progression is very poor, and the cycle length is long. Most cycles fail to clear the queue.

Source: Highway Capacity Manual, 6th Edition. Transportation Research Board, National Research Council

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Existing Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	641	609	1	2	730	150	0	0	0	96	0	506
Future Volume (vph)	641	609	1	2	730	150	0	0	0	96	0	506
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.97					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3544	3653		1827	3560					3544		2877
Flt Permitted	0.95	1.00		0.37	1.00					0.95		1.00
Satd. Flow (perm)	3544	3653		717	3560					3544		2877
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	712	677	1	2	802	165	0	0	0	108	0	569
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	240
Lane Group Flow (vph)	712	678	0	2	967	0	0	0	0	108	0	329
Confl. Bikes (#/hr)			4									
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	2%	2%	2%	4%	4%	4%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	23.8	75.6		46.6	46.6					12.0		35.8
Effective Green, g (s)	23.8	75.6		46.6	46.6					12.0		35.8
Actuated g/C Ratio	0.22	0.69		0.42	0.42					0.11		0.33
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	766	2510		303	1508					386		936
v/s Ratio Prot	c0.20	0.19			c0.27					0.03		c0.08
v/s Ratio Perm				0.00								0.04
v/c Ratio	0.93	0.27		0.01	0.64					0.28		0.35
Uniform Delay, d1	42.3	6.6		18.3	25.1					45.0		28.3
Progression Factor	0.83	0.41		1.00	1.00					1.00		1.00
Incremental Delay, d2	16.8	0.2		0.0	2.1					1.8		1.0
Delay (s)	52.0	2.9		18.4	27.2					46.8		29.3
Level of Service	D	A		B	C					D		C
Approach Delay (s)		28.0			27.2			0.0			32.1	
Approach LOS		C			C			A			C	
Intersection Summary												
HCM 2000 Control Delay			28.7			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			57.1%			ICU Level of Service				B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South) & 14 Mile Road

Existing Conditions
AM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↘↙	↑↑	↘	↗↗
Traffic Volume (vph)	705	29	425	811	34	546
Future Volume (vph)	705	29	425	811	34	546
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9		5.9	5.9	5.4	5.9
Lane Util. Factor	0.95		0.97	0.95	1.00	0.88
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3598		3544	3654	1827	2866
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3598		3544	3654	1827	2866
Peak-hour factor, PHF	0.93	0.93	0.90	0.90	0.94	0.94
Adj. Flow (vph)	758	31	472	901	36	581
RTOR Reduction (vph)	3	0	0	0	0	22
Lane Group Flow (vph)	786	0	472	901	36	559
Confl. Peds. (#/hr)					2	
Confl. Bikes (#/hr)						1
Heavy Vehicles (%)	5%	5%	4%	4%	4%	4%
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	8	1
Permitted Phases						8
Actuated Green, G (s)	31.1		50.1	62.1	11.6	61.7
Effective Green, g (s)	31.1		50.1	62.1	11.6	61.7
Actuated g/C Ratio	0.28		0.46	0.56	0.11	0.56
Clearance Time (s)	5.9		5.9	5.9	5.4	5.9
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1017		1614	2062	192	1607
v/s Ratio Prot	c0.22		0.13	c0.25	0.02	c0.16
v/s Ratio Perm						0.04
v/c Ratio	0.77		0.29	0.44	0.19	0.35
Uniform Delay, d1	36.2		18.8	13.8	44.9	13.2
Progression Factor	1.00		1.28	1.18	1.00	1.00
Incremental Delay, d2	5.7		0.4	0.6	2.2	0.6
Delay (s)	41.9		24.5	16.9	47.1	13.8
Level of Service	D		C	B	D	B
Approach Delay (s)	41.9			19.5	15.7	
Approach LOS	D			B	B	
Intersection Summary						
HCM 2000 Control Delay			25.0		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.52			
Actuated Cycle Length (s)			110.0		Sum of lost time (s)	17.2
Intersection Capacity Utilization			48.6%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Existing Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	717	662	0	1	596	195	0	0	0	339	0	905
Future Volume (vph)	717	662	0	1	596	195	0	0	0	339	0	905
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.96					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3614	3725		1881	3611					3650		2962
Flt Permitted	0.95	1.00		0.34	1.00					0.95		1.00
Satd. Flow (perm)	3614	3725		665	3611					3650		2962
Peak-hour factor, PHF	0.93	0.93	0.93	0.95	0.95	0.95	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	771	712	0	1	627	205	0	0	0	365	0	973
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	263
Lane Group Flow (vph)	771	712	0	1	832	0	0	0	0	365	0	710
Confl. Peds. (#/hr)	1					1						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	24.8	55.6		25.6	25.6					12.0		36.8
Effective Green, g (s)	24.8	55.6		25.6	25.6					12.0		36.8
Actuated g/C Ratio	0.28	0.62		0.28	0.28					0.13		0.41
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	995	2301		189	1027					486		1211
v/s Ratio Prot	c0.21	0.19			c0.23					c0.10		0.16
v/s Ratio Perm				0.00								0.08
v/c Ratio	0.77	0.31		0.01	0.81					0.75		0.59
Uniform Delay, d1	30.0	8.1		23.1	29.9					37.6		20.7
Progression Factor	0.67	0.49		1.00	1.00					1.00		1.00
Incremental Delay, d2	4.5	0.3		0.1	6.9					10.2		2.1
Delay (s)	24.5	4.2		23.1	36.9					47.8		22.8
Level of Service	C	A		C	D					D		C
Approach Delay (s)		14.8			36.8			0.0			29.6	
Approach LOS		B			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			25.2			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			21.6			
Intersection Capacity Utilization			62.9%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South) & 14 Mile Road

Existing Conditions
PM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↘↙	↑↑	↘	↗↗
Traffic Volume (vph)	777	31	658	843	32	602
Future Volume (vph)	777	31	658	843	32	602
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9		5.9	5.9	5.4	5.9
Lane Util. Factor	0.95		0.97	0.95	1.00	0.88
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3702		3650	3762	1863	2933
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3702		3650	3762	1863	2933
Peak-hour factor, PHF	0.91	0.91	0.95	0.95	0.89	0.89
Adj. Flow (vph)	854	34	693	887	36	676
RTOR Reduction (vph)	3	0	0	0	0	13
Lane Group Flow (vph)	885	0	693	887	36	663
Confl. Peds. (#/hr)		3	3			
Heavy Vehicles (%)	2%	2%	1%	1%	2%	2%
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	8	1
Permitted Phases						8
Actuated Green, G (s)	25.1		40.1	46.1	7.6	47.7
Effective Green, g (s)	25.1		40.1	46.1	7.6	47.7
Actuated g/C Ratio	0.28		0.45	0.51	0.08	0.53
Clearance Time (s)	5.9		5.9	5.9	5.4	5.9
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1032		1626	1926	157	1554
v/s Ratio Prot	c0.24		0.19	c0.24	0.02	c0.19
v/s Ratio Perm						0.04
v/c Ratio	0.86		0.43	0.46	0.23	0.43
Uniform Delay, d1	30.8		17.1	14.0	38.5	12.8
Progression Factor	1.00		1.21	1.19	1.00	1.00
Incremental Delay, d2	9.2		0.6	0.5	3.4	0.9
Delay (s)	39.9		21.3	17.2	41.8	13.7
Level of Service	D		C	B	D	B
Approach Delay (s)	39.9			19.0	15.1	
Approach LOS	D			B	B	
Intersection Summary						
HCM 2000 Control Delay			24.0		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	17.2
Intersection Capacity Utilization			57.7%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	262	299	634	566	28	403	340	81	141	313	246
Average Queue (ft)	227	254	285	157	2	228	175	12	62	153	69
95th Queue (ft)	305	342	757	560	14	338	280	48	115	255	186
Link Distance (ft)			683	683		1008	1008		1033	1033	
Upstream Blk Time (%)			3	0							
Queuing Penalty (veh)			18	1							
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	15	28				0				2	0
Queuing Penalty (veh)	46	84				0				6	0

Intersection: 2: Coolidge Hwy (South) & 14 Mile Road

Movement	EB	EB	WB	WB	WB	WB	NB	NB	NB
Directions Served	T	TR	L	L	T	T	L	R	R
Maximum Queue (ft)	228	213	192	209	284	279	89	290	199
Average Queue (ft)	200	162	91	122	136	160	32	133	45
95th Queue (ft)	237	231	157	186	226	253	73	229	130
Link Distance (ft)	181	181			683	683		671	671
Upstream Blk Time (%)	27	8							
Queuing Penalty (veh)	101	28							
Storage Bay Dist (ft)			200	200			200		
Storage Blk Time (%)			0	0	1			2	
Queuing Penalty (veh)			0	1	4			1	

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB
Directions Served	LT	T
Maximum Queue (ft)	283	201
Average Queue (ft)	84	30
95th Queue (ft)	232	152
Link Distance (ft)	2115	2115
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 291

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	238	238	102	88	9	349	333	237	277	526	275
Average Queue (ft)	127	146	40	34	0	219	174	135	175	229	149
95th Queue (ft)	206	215	82	75	5	315	274	229	254	400	298
Link Distance (ft)			683	683		1008	1008		1033	1033	
Upstream Blk Time (%)										0	
Queuing Penalty (veh)										0	
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	0	0								10	0
Queuing Penalty (veh)	0	1								45	2

Intersection: 2: Coolidge Hwy (South) & 14 Mile Road

Movement	EB	EB	WB	WB	WB	WB	NB	NB	NB
Directions Served	T	TR	L	L	T	T	L	R	R
Maximum Queue (ft)	227	220	185	221	238	264	82	235	156
Average Queue (ft)	201	163	104	133	123	165	25	124	39
95th Queue (ft)	237	225	160	182	203	234	64	202	104
Link Distance (ft)	181	181			683	683		671	671
Upstream Blk Time (%)	26	5							
Queuing Penalty (veh)	108	22							
Storage Bay Dist (ft)			200	200			200		
Storage Blk Time (%)			0	0	0			1	
Queuing Penalty (veh)			0	0	2			0	

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB
Directions Served	LT	T
Maximum Queue (ft)	259	193
Average Queue (ft)	75	20
95th Queue (ft)	209	135
Link Distance (ft)	2115	2115
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 181

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Background Conditions

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↕↔		↔	↕↔			↕↔		↔↔		↔↔
Traffic Volume (vph)	647	615	1	2	737	152	0	0	0	97	0	511
Future Volume (vph)	647	615	1	2	737	152	0	0	0	97	0	511
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.97					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3544	3653		1827	3560					3544		2877
Flt Permitted	0.95	1.00		0.37	1.00					0.95		1.00
Satd. Flow (perm)	3544	3653		711	3560					3544		2877
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	719	683	1	2	810	167	0	0	0	109	0	574
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	238
Lane Group Flow (vph)	719	684	0	2	977	0	0	0	0	109	0	336
Confl. Bikes (#/hr)			4									
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	2%	2%	2%	4%	4%	4%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	23.8	75.6		46.6	46.6					12.0		35.8
Effective Green, g (s)	23.8	75.6		46.6	46.6					12.0		35.8
Actuated g/C Ratio	0.22	0.69		0.42	0.42					0.11		0.33
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	766	2510		301	1508					386		936
v/s Ratio Prot	c0.20	0.19			c0.27					0.03		c0.08
v/s Ratio Perm				0.00								0.04
v/c Ratio	0.94	0.27		0.01	0.65					0.28		0.36
Uniform Delay, d1	42.4	6.6		18.3	25.2					45.0		28.3
Progression Factor	0.83	0.41		1.00	1.00					1.00		1.00
Incremental Delay, d2	17.9	0.2		0.0	2.2					1.8		1.1
Delay (s)	53.1	2.9		18.4	27.3					46.9		29.4
Level of Service	D	A		B	C					D		C
Approach Delay (s)		28.6			27.3			0.0			32.2	
Approach LOS		C			C			A			C	
Intersection Summary												
HCM 2000 Control Delay			29.0			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)			21.6			
Intersection Capacity Utilization			57.5%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South) & 14 Mile Road

Background Conditions
AM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↘↙	↑↑	↘	↗↗
Traffic Volume (vph)	712	29	429	819	34	551
Future Volume (vph)	712	29	429	819	34	551
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9		5.9	5.9	5.4	5.9
Lane Util. Factor	0.95		0.97	0.95	1.00	0.88
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3598		3544	3654	1827	2866
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3598		3544	3654	1827	2866
Peak-hour factor, PHF	0.93	0.93	0.90	0.90	0.94	0.94
Adj. Flow (vph)	766	31	477	910	36	586
RTOR Reduction (vph)	3	0	0	0	0	22
Lane Group Flow (vph)	794	0	477	910	36	564
Confl. Peds. (#/hr)					2	
Confl. Bikes (#/hr)						1
Heavy Vehicles (%)	5%	5%	4%	4%	4%	4%
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	8	1
Permitted Phases						8
Actuated Green, G (s)	31.1		50.1	62.1	11.6	61.7
Effective Green, g (s)	31.1		50.1	62.1	11.6	61.7
Actuated g/C Ratio	0.28		0.46	0.56	0.11	0.56
Clearance Time (s)	5.9		5.9	5.9	5.4	5.9
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1017		1614	2062	192	1607
v/s Ratio Prot	c0.22		0.13	c0.25	0.02	c0.16
v/s Ratio Perm						0.04
v/c Ratio	0.78		0.30	0.44	0.19	0.35
Uniform Delay, d1	36.3		18.8	13.9	44.9	13.2
Progression Factor	1.00		1.28	1.19	1.00	1.00
Incremental Delay, d2	5.9		0.4	0.6	2.2	0.6
Delay (s)	42.3		24.5	17.0	47.1	13.8
Level of Service	D		C	B	D	B
Approach Delay (s)	42.3			19.6	15.7	
Approach LOS	D			B	B	
Intersection Summary						
HCM 2000 Control Delay			25.2		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.53			
Actuated Cycle Length (s)			110.0		Sum of lost time (s)	17.2
Intersection Capacity Utilization			48.9%		ICU Level of Service	A
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Background Conditions

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	724	669	0	1	602	197	0	0	0	342	0	914
Future Volume (vph)	724	669	0	1	602	197	0	0	0	342	0	914
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.96					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3614	3725		1881	3611					3650		2962
Flt Permitted	0.95	1.00		0.33	1.00					0.95		1.00
Satd. Flow (perm)	3614	3725		657	3611					3650		2962
Peak-hour factor, PHF	0.93	0.93	0.93	0.95	0.95	0.95	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	778	719	0	1	634	207	0	0	0	368	0	983
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	261
Lane Group Flow (vph)	778	719	0	1	841	0	0	0	0	368	0	722
Confl. Peds. (#/hr)	1					1						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	24.8	55.6		25.6	25.6					12.0		36.8
Effective Green, g (s)	24.8	55.6		25.6	25.6					12.0		36.8
Actuated g/C Ratio	0.28	0.62		0.28	0.28					0.13		0.41
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	995	2301		186	1027					486		1211
v/s Ratio Prot	c0.22	0.19			c0.23					c0.10		0.16
v/s Ratio Perm				0.00								0.08
v/c Ratio	0.78	0.31		0.01	0.82					0.76		0.60
Uniform Delay, d1	30.1	8.1		23.1	30.0					37.6		20.8
Progression Factor	0.67	0.49		1.00	1.00					1.00		1.00
Incremental Delay, d2	4.6	0.3		0.1	7.3					10.5		2.2
Delay (s)	24.7	4.3		23.1	37.3					48.1		23.0
Level of Service	C	A		C	D					D		C
Approach Delay (s)		14.9			37.3			0.0			29.8	
Approach LOS		B			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			25.5			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.72									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			21.6			
Intersection Capacity Utilization			63.4%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South) & 14 Mile Road

Background Conditions
PM Peak Hour

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↘↙	↑↑	↘	↗↗
Traffic Volume (vph)	785	31	665	851	32	608
Future Volume (vph)	785	31	665	851	32	608
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9		5.9	5.9	5.4	5.9
Lane Util. Factor	0.95		0.97	0.95	1.00	0.88
Frpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3702		3650	3762	1863	2933
Flt Permitted	1.00		0.95	1.00	0.95	1.00
Satd. Flow (perm)	3702		3650	3762	1863	2933
Peak-hour factor, PHF	0.91	0.91	0.95	0.95	0.89	0.89
Adj. Flow (vph)	863	34	700	896	36	683
RTOR Reduction (vph)	3	0	0	0	0	13
Lane Group Flow (vph)	894	0	700	896	36	670
Confl. Peds. (#/hr)		3	3			
Heavy Vehicles (%)	2%	2%	1%	1%	2%	2%
Turn Type	NA		Prot	NA	Prot	pm+ov
Protected Phases	2		1	6	8	1
Permitted Phases						8
Actuated Green, G (s)	25.1		40.1	46.1	7.6	47.7
Effective Green, g (s)	25.1		40.1	46.1	7.6	47.7
Actuated g/C Ratio	0.28		0.45	0.51	0.08	0.53
Clearance Time (s)	5.9		5.9	5.9	5.4	5.9
Vehicle Extension (s)	3.0		3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	1032		1626	1926	157	1554
v/s Ratio Prot	c0.24		0.19	c0.24	0.02	c0.19
v/s Ratio Perm						0.04
v/c Ratio	0.87		0.43	0.47	0.23	0.43
Uniform Delay, d1	30.9		17.1	14.1	38.5	12.9
Progression Factor	1.00		1.21	1.19	1.00	1.00
Incremental Delay, d2	9.7		0.6	0.5	3.4	0.9
Delay (s)	40.6		21.3	17.3	41.8	13.8
Level of Service	D		C	B	D	B
Approach Delay (s)	40.6			19.1	15.2	
Approach LOS	D			B	B	
Intersection Summary						
HCM 2000 Control Delay			24.2		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.60			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	17.2
Intersection Capacity Utilization			58.1%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	262	299	625	565	18	355	331	83	127	264	233
Average Queue (ft)	234	265	382	248	1	222	182	17	61	160	86
95th Queue (ft)	310	353	855	705	9	322	287	59	110	252	207
Link Distance (ft)			683	683		1008	1008		1033	1033	
Upstream Blk Time (%)			5	0							
Queuing Penalty (veh)			29	1							
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	14	39								3	0
Queuing Penalty (veh)	43	119								8	0

Intersection: 2: Coolidge Hwy (South) & 14 Mile Road

Movement	EB	EB	WB	WB	WB	WB	NB	NB	NB
Directions Served	T	TR	L	L	T	T	L	R	R
Maximum Queue (ft)	232	220	178	229	262	295	144	256	197
Average Queue (ft)	201	169	86	120	141	174	36	137	51
95th Queue (ft)	237	231	146	186	222	263	86	231	148
Link Distance (ft)	181	181			683	683		671	671
Upstream Blk Time (%)	32	9							
Queuing Penalty (veh)	120	34							
Storage Bay Dist (ft)			200	200			200		
Storage Blk Time (%)			0	0	1			3	
Queuing Penalty (veh)			0	0	4			1	

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB	WB
Directions Served	LT	T	T
Maximum Queue (ft)	343	306	3
Average Queue (ft)	121	60	0
95th Queue (ft)	326	248	2
Link Distance (ft)	2115	2115	181
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Zone Summary

Zone wide Queuing Penalty: 361

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	248	260	232	105	13	351	329	274	320	467	275
Average Queue (ft)	135	153	60	35	1	225	189	159	199	228	152
95th Queue (ft)	235	249	198	82	8	326	299	276	314	364	306
Link Distance (ft)			683	683		1008	1008		1033	1033	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	1	3								10	0
Queuing Penalty (veh)	3	9								45	1

Intersection: 2: Coolidge Hwy (South) & 14 Mile Road

Movement	EB	EB	WB	WB	WB	WB	NB	NB	NB
Directions Served	T	TR	L	L	T	T	L	R	R
Maximum Queue (ft)	223	216	190	213	256	288	115	268	186
Average Queue (ft)	204	171	109	138	133	176	29	127	40
95th Queue (ft)	233	233	170	189	217	254	78	218	121
Link Distance (ft)	181	181			683	683		671	671
Upstream Blk Time (%)	34	11							
Queuing Penalty (veh)	139	46							
Storage Bay Dist (ft)			200	200			200		
Storage Blk Time (%)			0	0	0			1	
Queuing Penalty (veh)			0	0	2			0	

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB
Directions Served	LT	T
Maximum Queue (ft)	318	257
Average Queue (ft)	105	49
95th Queue (ft)	267	192
Link Distance (ft)	2115	2115
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Zone Summary

Zone wide Queuing Penalty: 247

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Future Conditions

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	664	640	1	2	762	152	0	0	0	97	0	528
Future Volume (vph)	664	640	1	2	762	152	0	0	0	97	0	528
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.98					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3544	3653		1827	3563					3544		2877
Flt Permitted	0.95	1.00		0.36	1.00					0.95		1.00
Satd. Flow (perm)	3544	3653		685	3563					3544		2877
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	738	711	1	2	837	167	0	0	0	109	0	593
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	230
Lane Group Flow (vph)	738	712	0	2	1004	0	0	0	0	109	0	363
Confl. Bikes (#/hr)			4									
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	2%	2%	2%	4%	4%	4%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	23.8	75.6		46.6	46.6					12.0		35.8
Effective Green, g (s)	23.8	75.6		46.6	46.6					12.0		35.8
Actuated g/C Ratio	0.22	0.69		0.42	0.42					0.11		0.33
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	766	2510		290	1509					386		936
v/s Ratio Prot	c0.21	0.19			c0.28					0.03		c0.08
v/s Ratio Perm				0.00								0.04
v/c Ratio	0.96	0.28		0.01	0.67					0.28		0.39
Uniform Delay, d1	42.7	6.7		18.3	25.4					45.0		28.6
Progression Factor	0.87	0.58		1.00	1.00					1.00		1.00
Incremental Delay, d2	22.0	0.2		0.0	2.3					1.8		1.2
Delay (s)	59.0	4.1		18.4	27.8					46.9		29.9
Level of Service	E	A		B	C					D		C
Approach Delay (s)		32.0			27.8			0.0			32.5	
Approach LOS		C			C			A			C	
Intersection Summary												
HCM 2000 Control Delay			30.8			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			58.6%			ICU Level of Service				B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Future Conditions

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	663	33	383	764	143	38	13	551	91	59	27
Future Volume (vph)	25	663	33	383	764	143	38	13	551	91	59	27
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9	5.9		5.9	5.9			5.4	5.9	5.4	5.4	
Lane Util. Factor	1.00	0.95		0.97	0.95			1.00	0.88	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.99	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3594		3544	3580			1864	2862	1863	1869	
Flt Permitted	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	
Satd. Flow (perm)	1863	3594		3544	3580			1864	2862	1863	1869	
Peak-hour factor, PHF	0.92	0.93	0.93	0.90	0.90	0.92	0.94	0.92	0.94	0.92	0.92	0.92
Adj. Flow (vph)	27	713	35	426	849	155	40	14	586	99	64	29
RTOR Reduction (vph)	0	3	0	0	12	0	0	0	148	0	15	0
Lane Group Flow (vph)	27	745	0	426	992	0	0	54	438	99	78	0
Confl. Peds. (#/hr)	2											
Confl. Bikes (#/hr)	1											
Heavy Vehicles (%)	2%	5%	5%	4%	4%	2%	4%	2%	4%	2%	2%	2%
Turn Type	Prot	NA		Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6		8	8	1	4	4	
Permitted Phases	8											
Actuated Green, G (s)	4.8	31.1		34.1	60.4			11.4	45.5	10.8	10.8	
Effective Green, g (s)	4.8	31.1		34.1	60.4			11.4	45.5	10.8	10.8	
Actuated g/C Ratio	0.04	0.28		0.31	0.55			0.10	0.41	0.10	0.10	
Clearance Time (s)	5.9	5.9		5.9	5.9			5.4	5.9	5.4	5.4	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	81	1016		1098	1965			193	1183	182	183	
v/s Ratio Prot	0.01	c0.21		c0.12	c0.28			0.03	c0.11	c0.05	0.04	
v/s Ratio Perm	0.04											
v/c Ratio	0.33	0.73		0.39	0.50			0.28	0.37	0.54	0.42	
Uniform Delay, d1	51.0	35.7		29.8	15.5			45.5	22.3	47.3	46.7	
Progression Factor	1.00	1.00		1.26	1.19			1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.4	4.7		0.8	0.7			3.6	0.9	3.3	1.6	
Delay (s)	53.5	40.4		38.2	19.2			49.1	23.2	50.6	48.3	
Level of Service	D	D		D	B			D	C	D	D	
Approach Delay (s)	40.8			24.8				25.4			49.4	
Approach LOS	D			C				C			D	
Intersection Summary												
HCM 2000 Control Delay	30.6			HCM 2000 Level of Service					C			
HCM 2000 Volume to Capacity ratio	0.57											
Actuated Cycle Length (s)	110.0			Sum of lost time (s)					22.6			
Intersection Capacity Utilization	55.8%			ICU Level of Service					B			
Analysis Period (min)	15											
c Critical Lane Group												

HCM 6th TWSC
3: 14 Mile Road & W. Site Drive

Future Conditions
AM Peak Hour

Intersection						
Int Delay, s/veh	1.7					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑↑	
Traffic Vol, veh/h	75	687	793	36	34	81
Future Vol, veh/h	75	687	793	36	34	81
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	93	93	90	90	92	92
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	81	739	881	40	37	88
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	921	0	-	0	1433	461
Stage 1	-	-	-	-	901	-
Stage 2	-	-	-	-	532	-
Critical Hdwy	4.2	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.25	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	1064	-	-	-	230	*771
Stage 1	-	-	-	-	687	-
Stage 2	-	-	-	-	553	-
Platoon blocked, %	1	-	-	-	1	1
Mov Cap-1 Maneuver	1064	-	-	-	200	*771
Mov Cap-2 Maneuver	-	-	-	-	200	-
Stage 1	-	-	-	-	598	-
Stage 2	-	-	-	-	553	-
Approach	EB	WB		SB		
HCM Control Delay, s	1.3	0		17.2		
HCM LOS	C					
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1064	-	-	-	-	418
HCM Lane V/C Ratio	0.076	-	-	-	-	0.299
HCM Control Delay (s)	8.7	0.5	-	-	-	17.2
HCM Lane LOS	A	A	-	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	-	1.2
Notes						
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Future Conditions

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	750	686	0	1	619	197	0	0	0	342	0	940
Future Volume (vph)	750	686	0	1	619	197	0	0	0	342	0	940
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.96					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3614	3725		1881	3614					3650		2962
Flt Permitted	0.95	1.00		0.32	1.00					0.95		1.00
Satd. Flow (perm)	3614	3725		636	3614					3650		2962
Peak-hour factor, PHF	0.93	0.93	0.93	0.95	0.95	0.95	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	806	738	0	1	652	207	0	0	0	368	0	1011
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	258
Lane Group Flow (vph)	806	738	0	1	859	0	0	0	0	368	0	753
Confl. Peds. (#/hr)	1					1						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	24.8	55.6		25.6	25.6					12.0		36.8
Effective Green, g (s)	24.8	55.6		25.6	25.6					12.0		36.8
Actuated g/C Ratio	0.28	0.62		0.28	0.28					0.13		0.41
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	995	2301		180	1027					486		1211
v/s Ratio Prot	c0.22	0.20			c0.24					c0.10		0.17
v/s Ratio Perm				0.00								0.08
v/c Ratio	0.81	0.32		0.01	0.84					0.76		0.62
Uniform Delay, d1	30.4	8.2		23.1	30.2					37.6		21.1
Progression Factor	0.97	0.89		1.00	1.00					1.00		1.00
Incremental Delay, d2	5.4	0.3		0.1	8.1					10.5		2.4
Delay (s)	34.8	7.6		23.1	38.3					48.1		23.5
Level of Service	C	A		C	D					D		C
Approach Delay (s)		21.8			38.3			0.0			30.1	
Approach LOS		C			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			28.6			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			21.6			
Intersection Capacity Utilization			64.5%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Future Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	20	748	34	613	812	134	35	10	608	80	62	21
Future Volume (vph)	20	748	34	613	812	134	35	10	608	80	62	21
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9	5.9		5.9	5.9			5.4	5.9	5.4	5.4	
Lane Util. Factor	1.00	0.95		0.97	0.95			1.00	0.88	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	0.98			1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3699		3650	3675			1887	2933	1863	1886	
Flt Permitted	0.95	1.00		0.95	1.00			0.96	1.00	0.95	1.00	
Satd. Flow (perm)	1863	3699		3650	3675			1887	2933	1863	1886	
Peak-hour factor, PHF	0.92	0.91	0.91	0.95	0.95	0.92	0.89	0.92	0.89	0.92	0.92	0.92
Adj. Flow (vph)	22	822	37	645	855	146	39	11	683	87	67	23
RTOR Reduction (vph)	0	4	0	0	14	0	0	0	104	0	14	0
Lane Group Flow (vph)	22	855	0	645	987	0	0	50	579	87	76	0
Confl. Peds. (#/hr)			3	3								
Heavy Vehicles (%)	2%	2%	2%	1%	1%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Prot	NA		Prot	NA		Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	3.1	24.0		28.1	49.0			8.5	36.6	6.8	6.8	
Effective Green, g (s)	3.1	24.0		28.1	49.0			8.5	36.6	6.8	6.8	
Actuated g/C Ratio	0.03	0.27		0.31	0.54			0.09	0.41	0.08	0.08	
Clearance Time (s)	5.9	5.9		5.9	5.9			5.4	5.9	5.4	5.4	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	64	986		1139	2000			178	1192	140	142	
v/s Ratio Prot	0.01	c0.23		c0.18	0.27			0.03	c0.15	c0.05	0.04	
v/s Ratio Perm									0.05			
v/c Ratio	0.34	0.87		0.57	0.49			0.28	0.49	0.62	0.54	
Uniform Delay, d1	42.5	31.5		25.9	12.8			37.9	19.7	40.4	40.1	
Progression Factor	1.00	1.00		1.20	1.26			1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.2	10.2		1.3	0.6			3.9	1.4	8.3	3.9	
Delay (s)	45.7	41.7		32.3	16.6			41.8	21.2	48.6	43.9	
Level of Service	D	D		C	B			D	C	D	D	
Approach Delay (s)		41.8			22.8			22.6			46.2	
Approach LOS		D			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			28.8			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			22.6			
Intersection Capacity Utilization			62.5%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM 6th TWSC
3: 14 Mile Road & W. Site Drive

Future Conditions
PM Peak Hour

Intersection						
Int Delay, s/veh	1.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑		↑↑	
Traffic Vol, veh/h	60	773	838	30	29	62
Future Vol, veh/h	60	773	838	30	29	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	95	95	92	92
Heavy Vehicles, %	2	2	1	1	2	2
Mvmt Flow	66	849	882	32	32	67
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	914	0	-	0	1455	457
Stage 1	-	-	-	-	898	-
Stage 2	-	-	-	-	557	-
Critical Hdwy	4.14	-	-	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	2.22	-	-	-	3.52	3.32
Pot Cap-1 Maneuver	1091	-	-	-	220	*770
Stage 1	-	-	-	-	693	-
Stage 2	-	-	-	-	537	-
Platoon blocked, %	1	-	-	-	1	1
Mov Cap-1 Maneuver	1091	-	-	-	195	*770
Mov Cap-2 Maneuver	-	-	-	-	195	-
Stage 1	-	-	-	-	613	-
Stage 2	-	-	-	-	537	-
Approach	EB	WB		SB		
HCM Control Delay, s	1	0		17.1		
HCM LOS	C					
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1091	-	-	-	-	397
HCM Lane V/C Ratio	0.06	-	-	-	-	0.249
HCM Control Delay (s)	8.5	0.4	-	-	-	17.1
HCM Lane LOS	A	A	-	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	-	1
Notes						
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	262	300	693	669	22	328	332	82	128	253	212
Average Queue (ft)	248	284	473	262	1	206	181	15	60	135	69
95th Queue (ft)	302	346	887	699	11	295	284	51	113	217	164
Link Distance (ft)			676	676		1008	1008		1033	1033	
Upstream Blk Time (%)			8	0							
Queuing Penalty (veh)			55	1							
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	23	51								1	0
Queuing Penalty (veh)	73	163								4	0

Intersection: 2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	TR	L	L	T	TR	LT	R	R	L	TR
Maximum Queue (ft)	174	253	237	180	244	340	355	160	268	205	296	261
Average Queue (ft)	44	208	169	91	118	143	179	50	162	77	152	110
95th Queue (ft)	138	272	243	151	190	251	297	109	249	183	369	323
Link Distance (ft)		188	188			676	676		671	671	410	410
Upstream Blk Time (%)	0	26	6								11	11
Queuing Penalty (veh)	0	94	20								0	0
Storage Bay Dist (ft)	100			200	200			200				
Storage Blk Time (%)		48		0	0	2			4			
Queuing Penalty (veh)		12		0	0	7			2			

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB	WB	WB	SB
Directions Served	LT	T	T	TR	LR
Maximum Queue (ft)	286	198	168	174	403
Average Queue (ft)	111	33	20	20	133
95th Queue (ft)	257	151	113	117	356
Link Distance (ft)	2115	2115	188	188	505
Upstream Blk Time (%)			1	1	3
Queuing Penalty (veh)			4	5	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Zone Summary

Zone wide Queuing Penalty: 441

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	262	300	557	402	13	389	341	279	321	326	273
Average Queue (ft)	186	211	202	134	1	224	204	154	192	183	114
95th Queue (ft)	305	335	606	439	7	336	307	259	288	279	238
Link Distance (ft)			676	676		1008	1008		1033	1033	
Upstream Blk Time (%)			1	0							
Queuing Penalty (veh)			8	0							
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	9	16				0				4	0
Queuing Penalty (veh)	31	57				0				21	1

Intersection: 2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Movement	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	TR	L	L	T	TR	LT	R	R	L	TR
Maximum Queue (ft)	172	241	245	190	222	249	275	218	313	224	138	129
Average Queue (ft)	30	203	174	112	133	106	152	43	162	72	67	52
95th Queue (ft)	108	268	242	175	191	198	237	122	264	178	122	103
Link Distance (ft)		188	188			676	676		671	671	410	410
Upstream Blk Time (%)	0	28	7									
Queuing Penalty (veh)	0	112	29									
Storage Bay Dist (ft)	100			200	200			200				
Storage Blk Time (%)		50		0	0	0			4			
Queuing Penalty (veh)		10		0	1	2			2			

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB	WB	WB	SB
Directions Served	LT	T	T	TR	LR
Maximum Queue (ft)	421	380	139	151	329
Average Queue (ft)	143	71	15	15	127
95th Queue (ft)	435	354	95	94	371
Link Distance (ft)	2115	2115	188	188	505
Upstream Blk Time (%)			1	1	9
Queuing Penalty (veh)			4	4	0
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

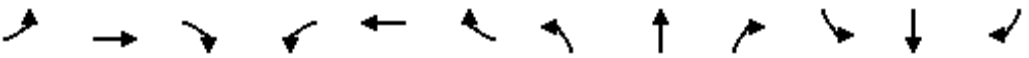
Zone Summary

Zone wide Queuing Penalty: 280

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Future Conditions w/ IMP
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	🔴🔴	🔴🔴		🔴	🔴🔴			🔴		🔴🔴		🔴🔴
Traffic Volume (vph)	664	640	1	2	762	152	0	0	0	97	0	528
Future Volume (vph)	664	640	1	2	762	152	0	0	0	97	0	528
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.98					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3544	3653		1827	3563					3544		2877
Flt Permitted	0.95	1.00		0.38	1.00					0.95		1.00
Satd. Flow (perm)	3544	3653		731	3563					3544		2877
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.92	0.92	0.92	0.89	0.89	0.89
Adj. Flow (vph)	738	711	1	2	837	167	0	0	0	109	0	593
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	180
Lane Group Flow (vph)	738	712	0	2	1004	0	0	0	0	109	0	413
Confl. Bikes (#/hr)			4									
Heavy Vehicles (%)	4%	4%	4%	4%	4%	4%	2%	2%	2%	4%	4%	4%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	39.8	86.8		41.8	41.8					12.0		51.8
Effective Green, g (s)	39.8	86.8		41.8	41.8					12.0		51.8
Actuated g/C Ratio	0.36	0.79		0.38	0.38					0.11		0.47
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	1282	2882		277	1353					386		1490
v/s Ratio Prot	c0.21	0.19			c0.28					0.03		c0.10
v/s Ratio Perm				0.00								0.04
v/c Ratio	0.58	0.25		0.01	0.74					0.28		0.28
Uniform Delay, d1	28.3	3.0		21.2	29.4					45.0		17.7
Progression Factor	0.88	0.78		1.00	1.00					1.00		1.00
Incremental Delay, d2	1.6	0.2		0.0	3.7					1.8		0.5
Delay (s)	26.4	2.5		21.2	33.2					46.9		18.2
Level of Service	C	A		C	C					D		B
Approach Delay (s)		14.7			33.1			0.0			22.6	
Approach LOS		B			C			A			C	
Intersection Summary												
HCM 2000 Control Delay			22.3			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			110.0			Sum of lost time (s)				21.6		
Intersection Capacity Utilization			58.6%			ICU Level of Service				B		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Future Conditions w/ IMP
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	100	633	29	383	764	143	38	13	551	121	63	27
Future Volume (vph)	100	633	29	383	764	143	38	13	551	121	63	27
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9	5.9		5.9	5.9	5.4		5.4	5.9	5.4	5.4	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00		1.00	0.88	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	0.99	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85		1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.96	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3595		3544	3654	1667		1864	2860	1863	1873	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.96	1.00	0.95	1.00	
Satd. Flow (perm)	1863	3595		3544	3654	1667		1864	2860	1863	1873	
Peak-hour factor, PHF	0.92	0.93	0.93	0.90	0.90	0.92	0.94	0.92	0.94	0.92	0.92	0.92
Adj. Flow (vph)	109	681	31	426	849	155	40	14	586	132	68	29
RTOR Reduction (vph)	0	3	0	0	0	65	0	0	160	0	14	0
Lane Group Flow (vph)	109	709	0	426	849	90	0	54	426	132	83	0
Confl. Peds. (#/hr)	2											
Confl. Bikes (#/hr)	1											
Heavy Vehicles (%)	2%	5%	5%	4%	4%	2%	4%	2%	4%	2%	2%	2%
Turn Type	Prot	NA		Prot	NA	pm+ov	Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6	4	8	8	1	4	4	
Permitted Phases						6			8			
Actuated Green, G (s)	11.5	31.1		31.1	50.7	63.7		12.2	43.3	13.0	13.0	
Effective Green, g (s)	11.5	31.1		31.1	50.7	63.7		12.2	43.3	13.0	13.0	
Actuated g/C Ratio	0.10	0.28		0.28	0.46	0.58		0.11	0.39	0.12	0.12	
Clearance Time (s)	5.9	5.9		5.9	5.9	5.4		5.4	5.9	5.4	5.4	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	194	1016		1001	1684	965		206	1125	220	221	
v/s Ratio Prot	c0.06	c0.20		0.12	c0.23	0.01		0.03	c0.11	c0.07	0.04	
v/s Ratio Perm						0.04			0.04			
v/c Ratio	0.56	0.70		0.43	0.50	0.09		0.26	0.38	0.60	0.38	
Uniform Delay, d1	46.9	35.3		32.2	20.8	10.3		44.8	23.8	46.0	44.8	
Progression Factor	1.00	1.00		1.42	0.74	0.53		1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.7	4.0		1.1	0.9	0.0		3.1	1.0	4.4	1.1	
Delay (s)	50.5	39.2		46.8	16.3	5.5		47.9	24.7	50.4	45.8	
Level of Service	D	D		D	B	A		D	C	D	D	
Approach Delay (s)		40.7			24.2			26.7			48.5	
Approach LOS		D			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			30.8				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.56									
Actuated Cycle Length (s)			110.0				Sum of lost time (s)			22.6		
Intersection Capacity Utilization			56.5%				ICU Level of Service			B		
Analysis Period (min)			15									
c Critical Lane Group												

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↗
Traffic Vol, veh/h	0	762	793	36	0	81
Future Vol, veh/h	0	762	793	36	0	81
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	93	93	90	90	92	92
Heavy Vehicles, %	5	5	4	4	2	2
Mvmt Flow	0	819	881	40	0	88
Major/Minor	Major1	Major2		Minor2		
Conflicting Flow All	-	0	-	0	-	461
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	3.32
Pot Cap-1 Maneuver	0	-	-	-	0	*771
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %		-	-	-		1
Mov Cap-1 Maneuver	-	-	-	-	-	*771
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Approach	EB	WB		SB		
HCM Control Delay, s	0	0		10.3		
HCM LOS				B		
Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1		
Capacity (veh/h)	-	-	-	771		
HCM Lane V/C Ratio	-	-	-	0.114		
HCM Control Delay (s)	-	-	-	10.3		
HCM Lane LOS	-	-	-	B		
HCM 95th %tile Q(veh)	-	-	-	0.4		
Notes						
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon

HCM Signalized Intersection Capacity Analysis

1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Future Conditions w/ IMP

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↕↕		↔	↕↕			↕		↔↔		↔↔
Traffic Volume (vph)	750	686	0	1	619	197	0	0	0	342	0	940
Future Volume (vph)	750	686	0	1	619	197	0	0	0	342	0	940
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Lane Util. Factor	0.97	0.95		1.00	0.95					0.97		0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Flpb, ped/bikes	1.00	1.00		1.00	1.00					1.00		1.00
Frt	1.00	1.00		1.00	0.96					1.00		0.85
Flt Protected	0.95	1.00		0.95	1.00					0.95		1.00
Satd. Flow (prot)	3614	3725		1881	3614					3650		2962
Flt Permitted	0.95	1.00		0.37	1.00					0.95		1.00
Satd. Flow (perm)	3614	3725		725	3614					3650		2962
Peak-hour factor, PHF	0.93	0.93	0.93	0.95	0.95	0.95	0.92	0.92	0.92	0.93	0.93	0.93
Adj. Flow (vph)	806	738	0	1	652	207	0	0	0	368	0	1011
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	260
Lane Group Flow (vph)	806	738	0	1	859	0	0	0	0	368	0	751
Confl. Peds. (#/hr)	1					1						
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	1%	1%	1%
Turn Type	Prot	NA		Perm	NA					Prot		pm+ov
Protected Phases	5	2			6		4	4		8		5
Permitted Phases				6								8
Actuated Green, G (s)	34.8	66.8		26.8	26.8					12.0		46.8
Effective Green, g (s)	34.8	66.8		26.8	26.8					12.0		46.8
Actuated g/C Ratio	0.39	0.74		0.30	0.30					0.13		0.52
Clearance Time (s)	5.2	6.0		6.0	6.0					5.2		5.2
Vehicle Extension (s)	3.0	3.0		3.0	3.0					3.0		3.0
Lane Grp Cap (vph)	1397	2764		215	1076					486		1711
v/s Ratio Prot	c0.22	0.20			c0.24					c0.10		0.17
v/s Ratio Perm				0.00								0.08
v/c Ratio	0.58	0.27		0.00	0.80					0.76		0.44
Uniform Delay, d1	21.8	3.7		22.2	29.1					37.6		13.4
Progression Factor	1.01	1.17		1.00	1.00					1.00		1.00
Incremental Delay, d2	1.3	0.2		0.0	6.2					10.5		0.8
Delay (s)	23.4	4.6		22.3	35.3					48.1		14.3
Level of Service	C	A		C	D					D		B
Approach Delay (s)		14.4			35.3			0.0			23.3	
Approach LOS		B			D			A			C	
Intersection Summary												
HCM 2000 Control Delay			22.4			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			21.6			
Intersection Capacity Utilization			64.5%			ICU Level of Service			C			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Future Conditions w/ IMP
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	722	31	613	812	134	35	10	608	106	65	21
Future Volume (vph)	80	722	31	613	812	134	35	10	608	106	65	21
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.9	5.9		5.9	5.9	5.4		5.4	5.9	5.4	5.4	
Lane Util. Factor	1.00	0.95		0.97	0.95	1.00		1.00	0.88	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85		1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.96	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3700		3650	3762	1667		1887	2933	1863	1889	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.96	1.00	0.95	1.00	
Satd. Flow (perm)	1863	3700		3650	3762	1667		1887	2933	1863	1889	
Peak-hour factor, PHF	0.92	0.91	0.91	0.95	0.95	0.92	0.89	0.92	0.89	0.92	0.92	0.92
Adj. Flow (vph)	87	793	34	645	855	146	39	11	683	115	71	23
RTOR Reduction (vph)	0	4	0	0	0	58	0	0	82	0	13	0
Lane Group Flow (vph)	87	823	0	645	855	88	0	50	601	115	81	0
Confl. Peds. (#/hr)			3	3								
Heavy Vehicles (%)	2%	2%	2%	1%	1%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Prot	NA		Prot	NA	pm+ov	Split	NA	pm+ov	Split	NA	
Protected Phases	5	2		1	6	4	8	8	1	4	4	
Permitted Phases						6			8			
Actuated Green, G (s)	7.1	25.1		28.1	46.1	54.4		5.9	34.0	8.3	8.3	
Effective Green, g (s)	7.1	25.1		28.1	46.1	54.4		5.9	34.0	8.3	8.3	
Actuated g/C Ratio	0.08	0.28		0.31	0.51	0.60		0.07	0.38	0.09	0.09	
Clearance Time (s)	5.9	5.9		5.9	5.9	5.4		5.4	5.9	5.4	5.4	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	146	1031		1139	1926	1007		123	1108	171	174	
v/s Ratio Prot	0.05	c0.22		c0.18	0.23	0.01		0.03	c0.17	c0.06	0.04	
v/s Ratio Perm						0.04			0.04			
v/c Ratio	0.60	0.80		0.57	0.44	0.09		0.41	0.54	0.67	0.47	
Uniform Delay, d1	40.1	30.1		25.9	13.9	7.4		40.4	21.9	39.5	38.8	
Progression Factor	1.00	1.00		1.24	0.87	1.33		1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.4	6.5		1.6	0.6	0.0		9.7	1.9	10.0	2.0	
Delay (s)	46.5	36.6		33.7	12.6	9.9		50.0	23.8	49.5	40.7	
Level of Service	D	D		C	B	A		D	C	D	D	
Approach Delay (s)		37.5			20.7			25.6			45.6	
Approach LOS		D			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			27.6				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)		22.6			
Intersection Capacity Utilization			63.1%				ICU Level of Service		B			
Analysis Period (min)			15									

c Critical Lane Group

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↗
Traffic Vol, veh/h	0	833	838	30	0	62
Future Vol, veh/h	0	833	838	30	0	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	-	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	95	95	92	92
Heavy Vehicles, %	2	2	1	1	2	2
Mvmt Flow	0	915	882	32	0	67
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	-	0	-	0	-	457
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Critical Hdwy	-	-	-	-	-	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-
Critical Hdwy Stg 2	-	-	-	-	-	-
Follow-up Hdwy	-	-	-	-	-	3.32
Pot Cap-1 Maneuver	0	-	-	-	0	*770
Stage 1	0	-	-	-	0	-
Stage 2	0	-	-	-	0	-
Platoon blocked, %	-	-	-	-	-	1
Mov Cap-1 Maneuver	-	-	-	-	-	*770
Mov Cap-2 Maneuver	-	-	-	-	-	-
Stage 1	-	-	-	-	-	-
Stage 2	-	-	-	-	-	-
Approach	EB	WB		SB		
HCM Control Delay, s	0	0		10.1		
HCM LOS	B					
Minor Lane/Major Mvmt	EBT	WBT	WBR	SBLn1		
Capacity (veh/h)	-	-	-	770		
HCM Lane V/C Ratio	-	-	-	0.088		
HCM Control Delay (s)	-	-	-	10.1		
HCM Lane LOS	-	-	-	B		
HCM 95th %tile Q(veh)	-	-	-	0.3		
Notes						
~: Volume exceeds capacity		\$: Delay exceeds 300s		+: Computation Not Defined		*: All major volume in platoon

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	253	274	77	91	18	407	362	82	137	256	233
Average Queue (ft)	141	161	20	22	2	228	202	12	62	131	63
95th Queue (ft)	228	240	53	63	10	337	312	44	119	216	158
Link Distance (ft)			676	676		1008	1008		1033	1033	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)	0	1				0				1	0
Queuing Penalty (veh)	1	2				0				3	0

Intersection: 2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Movement	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	TR	L	L	T	T	R	LT	R	R	L
Maximum Queue (ft)	174	260	236	204	229	245	225	121	188	280	209	192
Average Queue (ft)	113	209	162	111	136	115	123	11	46	148	58	88
95th Queue (ft)	208	276	230	181	201	201	200	47	110	241	150	157
Link Distance (ft)		193	193			676	676			671	671	398
Upstream Blk Time (%)	0	15	3									
Queuing Penalty (veh)	0	57	12									
Storage Bay Dist (ft)	100			200	200			200	200			
Storage Blk Time (%)	5	41		0	0	0	1	0		2		
Queuing Penalty (veh)	15	41		0	1	2	1	0		1		

Intersection: 2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Movement	SB
Directions Served	TR
Maximum Queue (ft)	138
Average Queue (ft)	51
95th Queue (ft)	106
Link Distance (ft)	398
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB	SB
Directions Served	T	T	R
Maximum Queue (ft)	211	152	77
Average Queue (ft)	46	9	37
95th Queue (ft)	151	72	63
Link Distance (ft)	2109	2109	505
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Zone Summary

Zone wide Queuing Penalty: 138

Intersection: 1: Private Drive/Coolidge Hwy (North) & 14 Mile Road

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	SB
Directions Served	L	L	T	TR	L	T	TR	L	L	R	R
Maximum Queue (ft)	182	189	83	87	4	358	293	282	317	309	270
Average Queue (ft)	99	119	30	37	0	204	186	165	199	179	108
95th Queue (ft)	162	178	69	75	3	304	261	276	302	280	239
Link Distance (ft)			676	676		1008	1008		1033	1033	
Upstream Blk Time (%)											
Queuing Penalty (veh)											
Storage Bay Dist (ft)	225	225			450			1000			200
Storage Blk Time (%)		0				0				4	0
Queuing Penalty (veh)		0				0				20	1

Intersection: 2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

Movement	EB	EB	EB	WB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	TR	L	L	T	T	R	LT	R	R	L
Maximum Queue (ft)	174	241	230	221	229	168	203	73	179	314	226	157
Average Queue (ft)	91	203	150	126	147	86	120	10	40	147	64	69
95th Queue (ft)	192	264	223	195	202	150	183	43	106	247	158	130
Link Distance (ft)		193	193			676	676			671	671	398
Upstream Blk Time (%)	0	16	2									
Queuing Penalty (veh)	0	69	10									
Storage Bay Dist (ft)	100			200	200			200	200			
Storage Blk Time (%)	3	44		0	0	0	0	0		3		
Queuing Penalty (veh)	11	35		1	2	0	0	0		1		

Intersection: 2: Coolidge Hwy (South)/E. Site Drive & 14 Mile Road

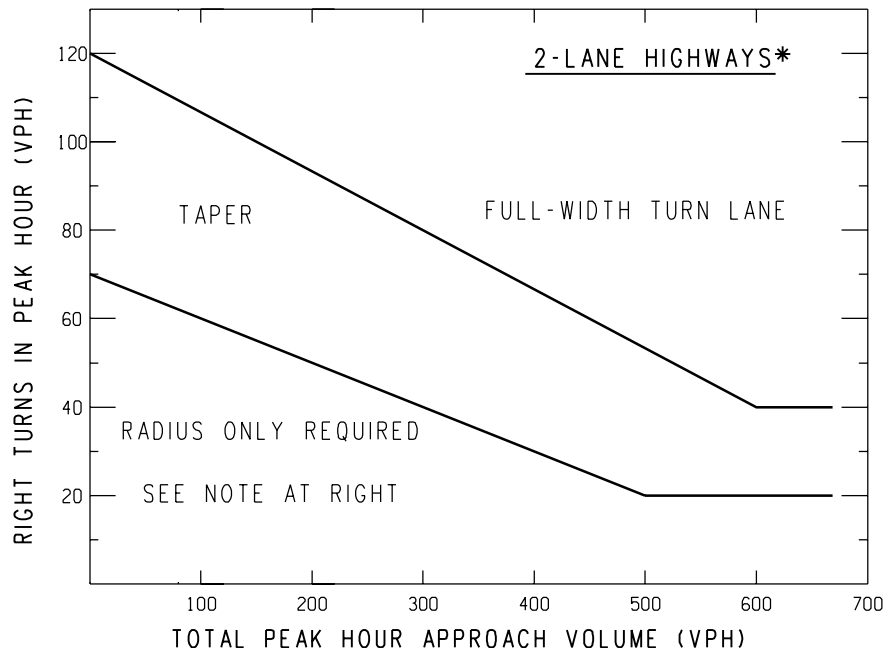
Movement	SB
Directions Served	TR
Maximum Queue (ft)	98
Average Queue (ft)	43
95th Queue (ft)	83
Link Distance (ft)	398
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 3: 14 Mile Road & W. Site Drive

Movement	EB	EB	WB	SB
Directions Served	T	T	TR	R
Maximum Queue (ft)	202	101	8	67
Average Queue (ft)	46	6	0	33
95th Queue (ft)	152	53	6	60
Link Distance (ft)	2109	2109	193	505
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Zone Summary

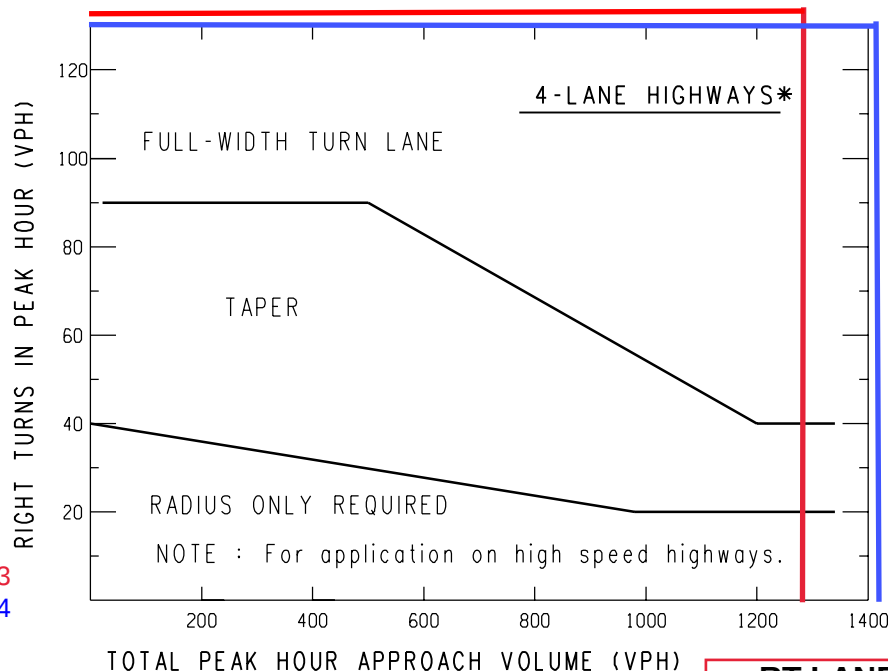
Zone wide Queuing Penalty: 151



NOTE:

For posted speeds at or under 45 mph, peak hour right turns greater than 40 vph, and total peak hour approach less than 300 vph, adjust right turn volumes.

Adjust peak hour right turns = Peak hour right turns - 20



*If a center left-turn lane exists (i.e. 3 or 5 lane highway), subtract the number of left turns in approach volume from the total approach volume to get an adjusted total approach volume.

AM=143
PM=134

AM=1,290
PM=1,560

**RT LANE
Recommended**

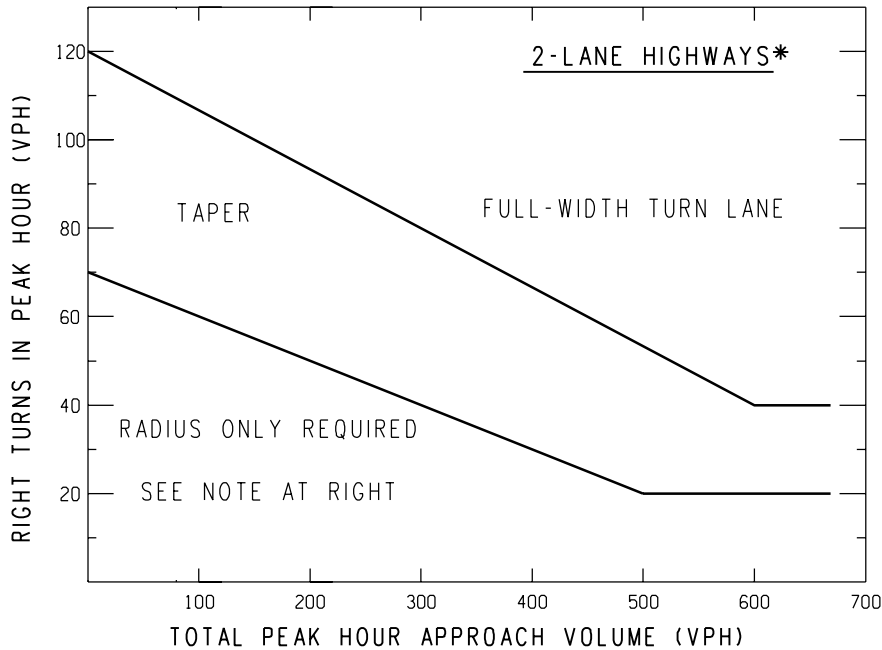
Sample Problem:

The Design Speed is 55 mph. The Peak Hour Approach Volume is 300 vph. The Number of Right Turns in the Peak Hour is 100 vph. Determine if a right turn lane is recommended.

Solution:

Figure indicates that the intersection of 300 vph and 100 vph is located above the upper trend line; thus, a right-turn lane may be recommended.

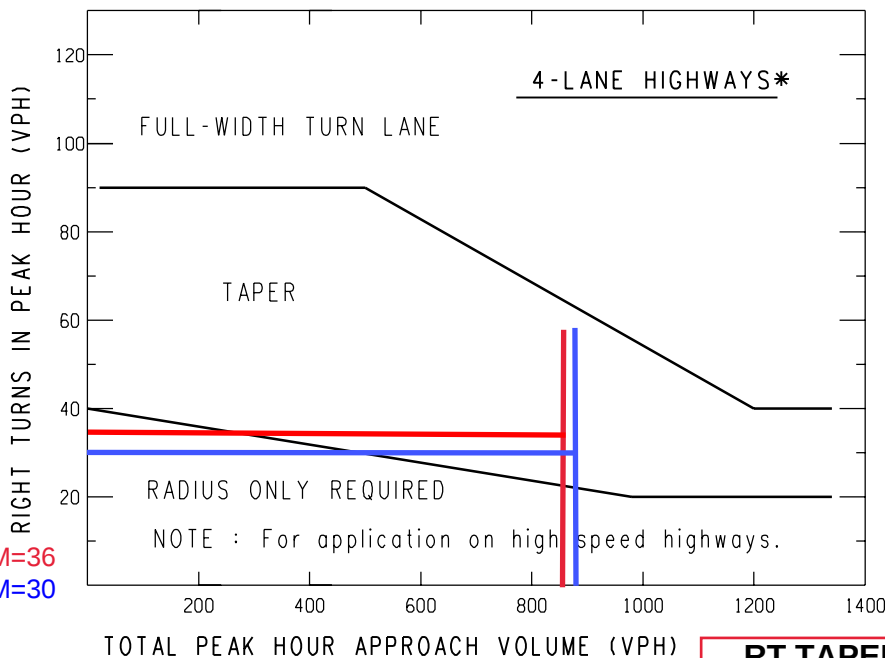
 Michigan Department of Transportation		TRAFFIC VOLUME GUIDELINES FOR RIGHT-TURN LANES AND TAPERS	
TRAFFIC AND SAFETY NOTE			
DRAWN BY: MTS	08/05/2004	604A	SHEET 2 OF 2
CHECKED BY: JAT	PLAN DATE:		
FILE: K:\DGN\ts notes\Note604A tsn.dgn		REV. 08/05/2004	



NOTE:

For posted speeds at or under 45 mph, peak hour right turns greater than 40 vph, and total peak hour approach less than 300 vph, adjust right turn volumes.

Adjust peak hour right turns = Peak hour right turns - 20



*If a center left-turn lane exists (i.e. 3 or 5 lane highway), subtract the number of left turns in approach volume from the total approach volume to get an adjusted total approach volume.

AM=36
PM=30

AM=829
PM=868

**RT TAPER
Recommended**

Sample Problem:

The Design Speed is 55 mph. The Peak Hour Approach Volume is 300 vph. The Number of Right Turns in the Peak Hour is 100 vph. Determine if a right turn lane is recommended.

Solution:

Figure indicates that the intersection of 300 vph and 100 vph is located above the upper trend line; thus, a right-turn lane may be recommended.

 Michigan Department of Transportation	
TRAFFIC AND SAFETY NOTE	
DRAWN BY: MTS	08/05/2004
CHECKED BY: JAT	PLAN DATE:
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**TRAFFIC VOLUME GUIDELINES
FOR RIGHT-TURN LANES AND TAPERS**

604A

SHEET
2 OF 2

REV. 08/05/2004