HOUSE of REPRESENTATIVES
STATE OF MICHIGAN

Appropriations Requests for Legislatively Directed Spending Items

1. The sponsoring representative's first name:
   Jason

2. The sponsoring representative's last name:
   Woolford

3. The cosponsoring representatives' names. All cosponsors must be listed. If none, please type 'n/a.' A signed letter from the sponsor approving the co-sponsorship and a signed letter from the member wishing to co-sponsor are required. Attach letters at question #9 below.
   n/a

4. Name of the entity that the spending item is intended for:
   City of Howell

5. Physical address of the entity that the spending item is intended for:
   611 E Grand River Ave Howell, MI 48843

6. If there is not a specific recipient, the intended location of the project or activity:
   I-96 and South Michigan Ave., Howell, MI 48843

7. Name of the representative and the district number where the legislatively directed spending item is located:
   Representative Jason Woolford 50th House District

8. Purpose of the legislatively directed spending item. Please include how it provides a public benefit and why it is an appropriate use of taxpayer funding. Please also demonstrate that the item does not violate Article IV, S 30 of the Michigan Constitution.
   The Areas we have in need of infrastructure improvements are D-19 (S Michigan Ave) and the I-96 interchange. This interchange has been failing for over 4 decades and has had no to little funding made available to fix it. This interchange is the only direct connection to Howell City Downtown and Marion Township. Additionally, the City is seeking funds to help connect D-19 to Lucy Road, commonly called "the loop road". The need for this road to alleviate truck traffic from downtown has been compounded to include an emergency route and bypass when trains are blocking all City intersections for

long periods of time. This current interchange severely limits emergency response to the southern portion of Howell and the greater area of Marion Township by County services.

potential development and job creation these infrastructure improvements can bring to the City of Howell, Livingston County and the State of Michigan. Currently well-known automotive companies are considering this area to develop a potential. Developers have estimated that 1000 high paying skilled jobs would come to this area providing research & development in the transportation and energy fields.

This is a unique opportunity, and the benefits would be wide ranging for all aspects of the greater community including real estate, job creation and a strong local economy.

9. Attach documents here if needed:
   Attachments added to the end of this file.

10. The amount of state funding requested for the legislatively directed spending item.
    6000000

11. Has the legislatively directed spending item previously received any of the following types of funding? Check all that apply.
    ["Local"]

12. Please select one of the following groups that describes the entity requesting the legislatively directed spending item:
    Local unit government

13. For a non-profit organization, has the organization been operating within Michigan for the preceding 36 months?
    Not applicable

14. For a non-profit organization, has the entity had a physical office within Michigan for the preceding 12 months?
    Not applicable

15. For a non-profit organization, does the organization have a board of directors?
    Not applicable

16. For a non-profit organization, list all the active members on the organization's board of directors and any other officers. If this question is not applicable, please type 'n/a.'
    n/a

17. "I certify that neither the sponsoring representative nor the sponsoring representative's staff or immediate family has a direct or indirect pecuniary interest in the legislatively directed spending item."

Yes, this is correct

18. Anticipated start and end dates for the legislatively directed spending item:
    Assuming that appropriation is received in the Fall of 2025, construction would proceed immediately and last approximately 1-year

19. “I hereby certify that all information provided in this request is true and accurate.”
    Yes

Traffic Impact Analysis for D-19 and the Proposed National Street Extension

FOR

City of Howell, Michigan

Revised
June 2009

Prepared by:

HUBBELL, ROTH & CLARK, INC.
Consulting Engineers
555 Hulet Drive • P.O. Box 824
Bloomfield Hills, MI 48303-0824

Table of Contents

APPENDICES

Executive Summary

The City of Howell proposes to extend National Street, south of Grand River Avenue (BL96), to the intersection of D-19/I-96 WB ramps. This new alignment, called the National Street Extension, is intended to provide access to proposed developments along its route and also to reduce future traffic on Grand River Avenue and D-19/Pinckney/Michigan Corridor by providing an alternative route to traveling through Historic Downtown Howell.

HRC prepared a traffic model of the study area using Synchro software to evaluate the existing and future roadway capacity of the roadway network in the study area. Specifically, the traffic impact study undertook the following tasks:

1. Explain the existing traffic volumes and the methodology used to calculate traffic projected to use the National Street Extension
2. Perform Synchro analyses for existing, 2015 and 2030 conditions with and without the National Street Extension at four signalized intersections: Grand River Avenue/National Street; Grand River Avenue/Michigan Avenue(M-155); Pickney(Michigan)/Marion(Mason); and D-19/I-96 WB ramps.
3. Evaluate locations for connecting National Street to D-19.
4. Perform signal warrant analyses for up to two locations, if required
5. Evaluate signal alternatives
6. Perform roundabout analysis for the D-19/I-96 ramps intersection for future years 2015 and 2030 using RODEL software
7. Provide report documenting the findings of the study

Prior Reviews / Approvals

HRC and the City have submitted several critical aspects of this study to MDOT for review and approval prior to the preparation of this final document. These submittals have included the following:

1. Growth Rates: HRC has received and utilized approved rates provided by MDOT.
2. Impact from Latson Road interchange: MDOT has provided a one-time adjustment to traffic volumes to account for the opening of the Latson Road interchange before 2015. This adjustment is used in this study.

3. Trip Generation / Site Development: HRC has submitted the proposed traffic volumes expected as part of the development along National Street, based on zoning and acreage. These projections have been approved by MDOT.
4. Roundabout Geometric Design: While this study focuses on the operational aspects of the project area, it also includes a proposed roundabout at the intersection of D-19/National Street/I-96 ramps. The geometric details of this roundabout have been reviewed by MDOT's Geometric Design Unit and have received a favorable response.
5. HRC submitted a ramp diverge analysis to MDOT. Their initial review did not indicate any concerns.
6. HRC directed by MDOT to add fourth lane to the I-96 WB Ramp approach at the intersection with D-19 under the signalized alternative.

Results

HRC's analyses indicate that the four signalized intersections will operate with an overall LOS D or better for all the scenarios. A caveat to this conclusion is that geometric and operational changes are necessary in the future 2015 and 2030 scenarios in order to achieve an acceptable level of service. For example, in the future 2030 scenario both D-19/I-96 WB ramps and D-19/Marion intersections are LOS F without geometric improvements in the AM and PM peak hours, and Grand River Avenue/National Street intersection is a LOS E in the AM peak hour and LOS F in the PM peak hour without geometric improvements.

Recommendations

HRC is recommending improvements to the four signalized intersections as well as two other intersections in the study area for the Future 2015 and 2030 scenarios. To achieve the level of service shown in Section 8, HRC made the following changes to the intersections:

- D-19/I-96 WB Ramps – This intersection will significantly change with the growth in background traffic, the National Street Extension and the projected development along the extension in the future. HRC recommends a multi-lane roundabout instead of geometric improvements to the signalized intersection. The roundabout was found to operate at a Level of Service B, while a signalized intersection was shown to queue beyond the length of the exit ramp and onto mainline I-96. The final location for connecting National Street to D-19 is detailed in Section 2.
- Pinckney (Michigan)/Marion(Mason) – A 90 second cycle length is recommended to achieve a desirable level of service. Dedicated left turn phases are recommended for northbound Pinckney

and eastbound Marion/westbound Mason, with modernization to accommodate the addition of left turn phasing. An overlap phase is also recommended for the eastbound right turning vehicles. At some point before full build out of development on National Street an eastbound exclusive right turn lane and extended right and left turn lane storage lengths will be necessary, but should be verified by a development study prior to installation.

- Grand River Avenue/Michigan Avenue – The 90 second cycle length was not changed. However, HRC recommends that the splits and left turn phasing be modified to accommodate future traffic.
- Michigan Avenue/Sibley Street – This intersection is approximately 280 feet south of Grand River Avenue. It is recommended that the signal timing plan here be coordinated with the plan running at Grand River Avenue/Michigan Avenue.
- Grand River Avenue/National Street – This intersection will significantly change with the extension of National Street to D-19 in the future. HRC recommends an exclusive right turn lane for the northbound approach of National Street. Because of the high volume of left-turning traffic during the PM peak hour, HRC recommends dedicated left turn phases for westbound Grand River Avenue and southbound National Street. HRC also recommends adding an overlap phase for the northbound right turn lane. A 90 second cycle length was used for the 2015 and 2030 analyses during the AM and PM peak periods.
- Lucy Road, between CSX Railroad Crossing and Grand River Avenue – Between the time of the opening of the National Street Extension and the full build out of the property along the National Street Extension, it is recommended to pave this section of Lucy Road to relieve the stress of the increased demand on the intersection of Grand River Avenue/National Street. Westbound left turns and northbound right turns could be split more evenly between the two intersections if this section of Lucy Road were paved to handle the additional traffic.

Outstanding Issues

Based on the submittal of this traffic impact study, the following issues are yet to be resolved:

- Receiving formal MDOT geometric approval for the roundabout and permitting through the TSC.
- The City of Howell will address the following issues under a separate cover.
    - Dedication of property for future I-96 ramp modernization.
    - Relocation of the existing Park & Ride Facility.
    - Intersection of Grand River Avenue/National Street will be designed to accommodate WB-62 vehicles as they turn on Grand River Avenue from northbound National Street.

Section 1 - Introduction

The City of Howell recently reconstructed D-19 (Pinckney Road) to add a center left turn lane for a length of approximately 0.5 mile. There is a signalized intersection at D-19 and the westbound off and on ramps of I-96 south of the project limits. The City wanted to evaluate the most efficient way to accommodate and connect a future by-pass road called the National Street Extension. Several options were investigated and after reviewing the critical elements a four leg multi-lane roundabout at the intersection of D-19/I-96 WB ramps, it was determined that a roundabout was the best option for connecting the National Street Extension to the existing intersection.

National Street Extension is intended to be an alternate route for traffic through historic downtown Howell to the D-19 and I-96 interchange and to provide access to developments in a previously inaccessible section of the City. The National Street Extension is being funded with municipal bonds.

The City of Howell retained Hubbell, Roth and Clark, Inc. (HRC) to conduct a traffic impact study for intersection of D-19, I-96 WB ramps and the National Street Extension. The study was prepared with the collaboration of the Michigan Department of Transportation and the Livingston County Road Commission. The study included the following items:

1. What are the existing and future traffic volumes in the study area?
2. What are the levels of service at various key intersections for existing and future conditions?
3. Should more of these intersections be signalized?
4. Is a roundabout a better option for the National Street Extension to D-19?
5. Should Lucy Road be connected to the National Street Extension north of CSX railroad crossing?

The study:

- Explains the existing traffic volumes and the methodology used to calculate traffic projected to use the National Street Extension;
- Performs Synchro analyses for existing, background 2015 and 2030 and future 2015 and 2030 conditions;
- Evaluates the performance of the I-96 WB Off ramp with and without the National Street Extension; and

- Evaluates and compares roundabout capacity analysis using Rodel software for future years 2015 and 2030 conditions.

HRC prepared a traffic model of the study area (See Figure 1) using Synchro v7 software to evaluate the existing and future capacity of the roadway network in the study area. The roundabout analysis was conducted using Rodel software. The freeway ramp analysis was conducted using Highway Capacity Software.

STUDY AREA

N

NOT TO SCALE

JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 1
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE P.O. BOX 824	
JUNE-2009	BLOOMFIELD HILLS, MICH. 48303-0824	

Section 2 - Alternatives Considered for National Street Extension Connection

As part of the National Street Extension, several locations were reviewed for the new intersection with D-19. The City's preferred location is at the existing intersection of D-19/I-96 WB ramps. The tie-in alternatives considered are as follows:

Intersection at Morgan Drive (Considered)

HRC and the City reviewed an alternative that would connect the National Street Extension with Morgan Drive as shown in Figure 2. As part of the connection, the existing unsignalized D-19/Morgan Drive intersection would be reconstructed as either a roundabout or signalized intersection. After a revised horizontal alignment was developed for this alternative, several concerns were raised.

The first concern is the increased construction cost. It was estimated that the road construction cost would increase by over $1,000,000 due to the additional length and the need to construct the road over wetlands which involved significant deep peat excavation. This alignment would also require relocation of the City's sludge drying beds adjacent to the wastewater treatment plant. Relocating the sludge beds would cost an additional $250,000 for a total project cost increase of $1,250,000. In addition to the increased costs, the impact to the adjacent wetlands is far greater for this option.

The second concern is the additional right of way needed for this alignment. The National Street Extension project not only provides relief for downtown traffic on Grand River Avenue, but also development opportunities for the property owners along the roadway. The Morgan Drive alignment significantly reduces the amount of developable land. Property owners have indicated that the right of way needed for the National Street Extension would not be granted if the connection point is at Morgan Drive due to the development restrictions it causes. In addition to the property needed to extend National Street, additional right of way would be needed along existing Morgan Drive, including at the intersection with D-19. The additional right of way acquisition costs have not been estimated as part of this study.

The third concern with the Morgan Drive connection relates to traffic operations for the intersections of D-19/Morgan Drive and D-19/I-96 WB ramps. A primary goal of the National Street Extension is to

reduce traffic volume in the downtown area along Grand River Avenue by providing a bypass from Grand River Avenue to D-19 and I-96. Considering this, the proposed traffic volumes will reach the D-19/I-96 intersection even if National Street is connected at Morgan Drive. The connection of National Street to D-19 at Morgan Drive would continue to provide access for the vehicles to arrive at the D-19/I-96 WB ramps intersection. The D-19/Morgan Drive intersection was analyzed as signalized.

During the AM peak, southbound D-19 traffic at Morgan Drive backs up to the intersection at Marion/Mason. All traffic exiting the I-96 WB ramp and wishing to use National Street will be required to turn left onto D-19. As a result the ramp traffic queues onto the freeway. Also, westbound traffic on the National Street Extension at Morgan Drive queues over 1.5 miles while trying to access D-19.

Table 1: Intersection Level of Service for the Morgan Drive Connection Signalized Alternative

Intersection	D-19/I-96 WB Ramps	D-19/Morgan Drive
AM PEAK		
Future 2015	B	B
Future 2030	C	D
PM PEAK		
Future 2015	C	**E**
Future 2030	D	**F**

The option of connecting National Street to D-19 at Morgan Drive was also reviewed for the feasibility of installing a roundabout at D-19/Morgan Drive. Adequate right-of-way on the west side of D-19 is not available to construct a roundabout suitable to handle the projected traffic.

New intersection north of I-96 Ramps and South of Morgan Drive (Considered)

HRC and the City also reviewed potential intersection locations between Morgan Drive and the I-96 ramps. However, due to the City's wastewater treatment plant location, these options were limited to immediately north of I-96 or just south of Morgan Drive. The location just north of I-96 presented a significant proximity/operational problem since it would be within 200 feet of the existing signal at the I-96 ramps. This option would require the purchase of a gas station which would result in significant costs to the City. In addition, in order to construct National Street in this location, a primary Panhandle pipeline may also need relocation. HRC and the City have held several meetings about this project with Panhandle pipeline and they have expressed significant concerns regarding any relocations, which would be at the City's expense. The effort and expense of any relocation of this pipeline is well beyond the scope of this project.

The option of connecting National Street to D-19 just south of Morgan Drive and north of the treatment plant was not considered in detail. This option would require a new intersection within 400 feet of the Morgan Drive intersection and would also result in a new signalized intersection approximately 700 feet from the I-96 signal. In addition, due to the close proximity to Morgan Drive, this option was caused more operational issues when compared to the option of using Morgan Drive.

The effect of moving the National Street connection to a location on D-19 is to relocate traffic at the intersection of D-19/I-96 West ramps from the east leg to the north leg for traffic entering I-96 from National Street.

Either location described above would also result in the majority of the National Street traffic eventually getting to the existing I-96 intersection, as previously discussed in the Morgan Drive section. These options would also increase the amount of wetland impacts when compared to the I-96 intersection option.

Intersection at I-96 WB ramps (Preferred)

HRC and the City concluded that the existing intersection at D-19 and the westbound I-96 ramps is the preferred location to connect the National Street Extension to D-19. This preferred alternative location is evaluated in more detail throughout this report.

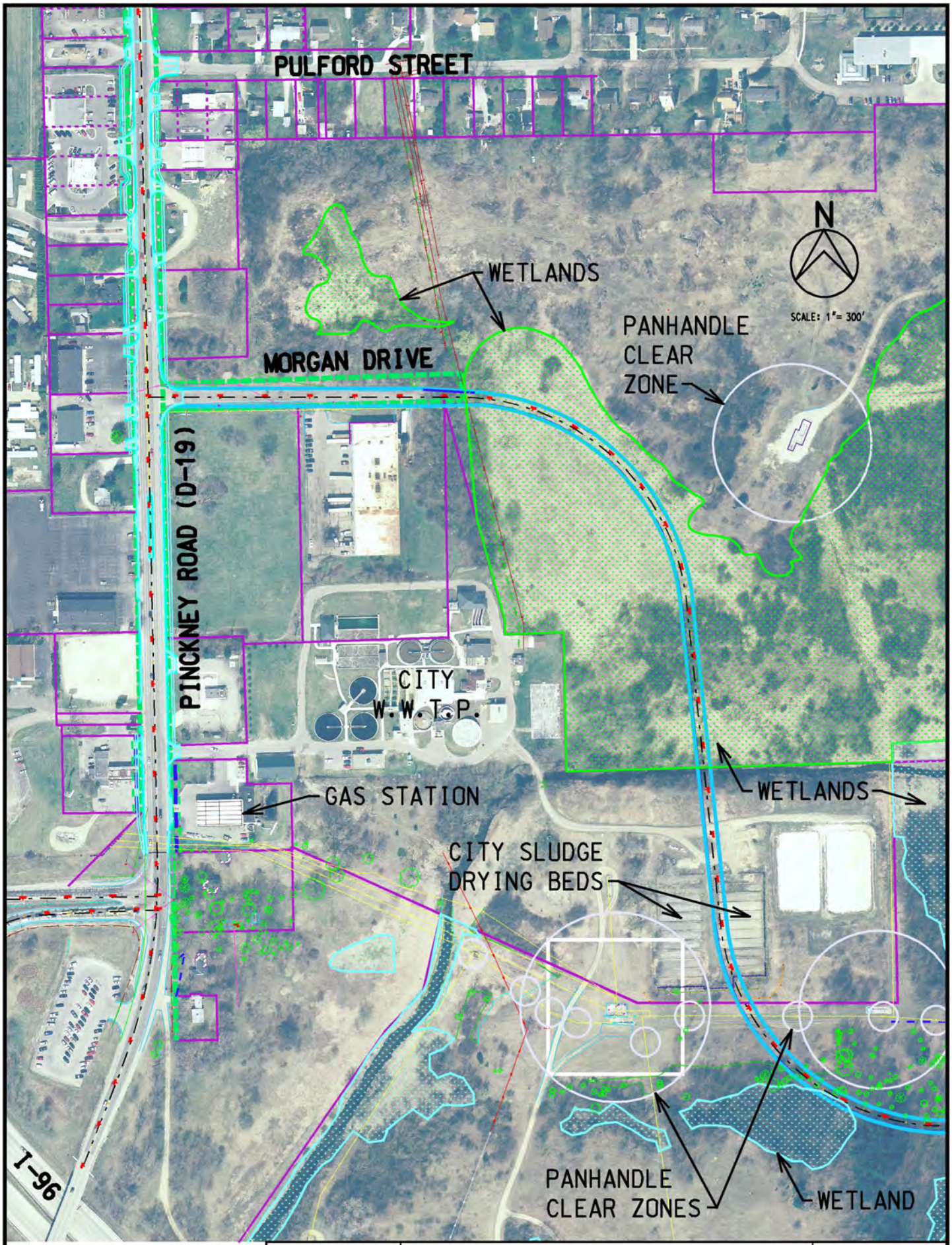
Due to the presence of the existing Panhandle gas storage facilities, Howell's Wastewater Treatment Plant and extensive wetlands within the National Street Extension site, the best connection to D-19 is at the existing intersection at the I-96 ramps. This direct connection results in lower costs for the construction of the National Street Extension, improved traffic capacity and minimized impacts to the wetlands and utilities.

HRC and the City have coordinated this project with the property owner's where National Street is being extended. This project is intended to provide not only a bypass for the downtown traffic, but also access to property that will be developed by the owners. Providing this new development is not only important to the owners, but also to the City. The existing site conditions along National Street provide limited locations for not only the road but also for viable locations for development and parking facilities. Since the property owners will need to provide the necessary right of way, the road itself needs to provide reasonable access and development in order to make it worthwhile. After extensive conversations with the property owners, months of design and traffic modeling, geotechnical research and coordination with

Panhandle Pipeline representatives, the most desirable access is at the existing I-96 intersection when compared to the other alternatives considered.

Summary

The traffic impacts of connecting National Street to D-19 at the I-96 ramps are documented in detail in this study. As part of the study, the operation of a signalized intersection was evaluated as well as that of a four-legged roundabout. A roundabout will provide an exceptional level of service (LOS B) while a signalized intersection will ultimately fail with a level of service of E, even with geometric improvements. This improved operations at the D-19/I-96 WB ramps intersection was one key factor in the City's desire to construct a roundabout at this location.



NATIONAL STREET CONNECTION AT MORGAN DRIVE	JOB NO. 20070425 DATE JUNE 2009	HUBBELL, ROTH & CLARK, INC. CONSULTING ENGINEERS 3399 E. GRAND RIVER AVE. SUITE 102 HOWELL, MICHIGAN 48843-7555	FIG. 2

Section 3 - Existing Traffic Volumes

The study area was bounded by: D-19/Pinckney/Michigan Corridor from I-96 at the south to Grand River Avenue at the north; Grand River Avenue from Michigan Avenue in the west to Lucy Road in the east; and the National Street Extension from National Street to the intersection of D-19/I-96 WB ramps.

The City of Howell provided peak hour turning movement counts, taken in September 2005, at the majority of the key intersections within the study area. HRC supplied the peak hour turning movement counts for Grand River Avenue and Michigan Avenue which were taken in February 2005. The intersections studied were:

1.	D-19 & I-96 WB Ramps	Signalized
2.	D-19/Pinckney Road & Pulford Street.	Non-signalized
3.	Pinckney Road/Michigan Avenue & Marion Street/Mason Road	Signalized
4.	Michigan Avenue(M-155) & Livingston Street	Non-signalized
5.	Michigan Avenue(M-155) & Washington Street	Non-signalized
6.	Grand River Avenue & Michigan Avenue(M-155)	Signalized
7.	Grand River Avenue & Court Street	Non-signalized
8.	Grand River Avenue & Barnard Street	Non-signalized
9.	Grand River Avenue & Fowler Street	Non-signalized
10.	Grand River Avenue & National Street	Signalized

For the key intersection of D-19/I-96 WB ramps, the Michigan Department of Transportation (MDOT) provided peak hour turning movement counts taken in August 2004. MDOT also supplied the current traffic signal timings for the four signalized intersections to be analyzed within the study area.

Roadway Geometry

The D-19/Pinckney/Michigan corridor is predominantly two lanes and runs north-south. The corridor has three names in the study area. D-19 is the segment from south of the I-96 WB ramps north to Pulford Street; it is a four-lane road with a speed limit of 45 mph. Pinckney Road is the segment between Pulford Street north to Marion Street and the speed limit is lowered to 35 mph. The Michigan Avenue (M-155) segment is between Marion Street and Grand River Avenue and the speed limit is only 25 mph. The number of local streets crossing Michigan Avenue (M-155) increases as it approaches Grand River Avenue.

Grand River Avenue (BL96) is a mix of a five and three lane roadway with a speed limit of 35 mph. On-street parking is allowed on certain segments of Grand River Avenue in downtown Howell. The roadway has been improved at the signalized intersections with Michigan Avenue (M-155) and National Street.

Intersection Geometry

The intersections of greatest importance in this study are D-19/I-96 WB ramps and Grand River Avenue/National Street. The National Street Extension will connect these two intersections and is expected to impact the intersection operations.

As shown in Photograph 1, the intersection of D-19/I-96 WB ramps has three legs and is signalized. There is a dedicated right turn lane on southbound D-19 and an intersection passing lane on northbound D-19. The off ramp and on-ramp are adjacent to each other.

Photograph 1: Southbound D-19 North of I-96 WB Ramps

As shown in Photograph 2, the intersection of Grand River Avenue/National Street is a signalized, four leg intersection. The approaches on Grand River Avenue have been improved to five lanes with a dedicated left turn lane. National Street is three-lanes with a dedicated left turn lane and a shared through and right turn lane. Immediately west of National Street, Grand River Avenue narrows to three

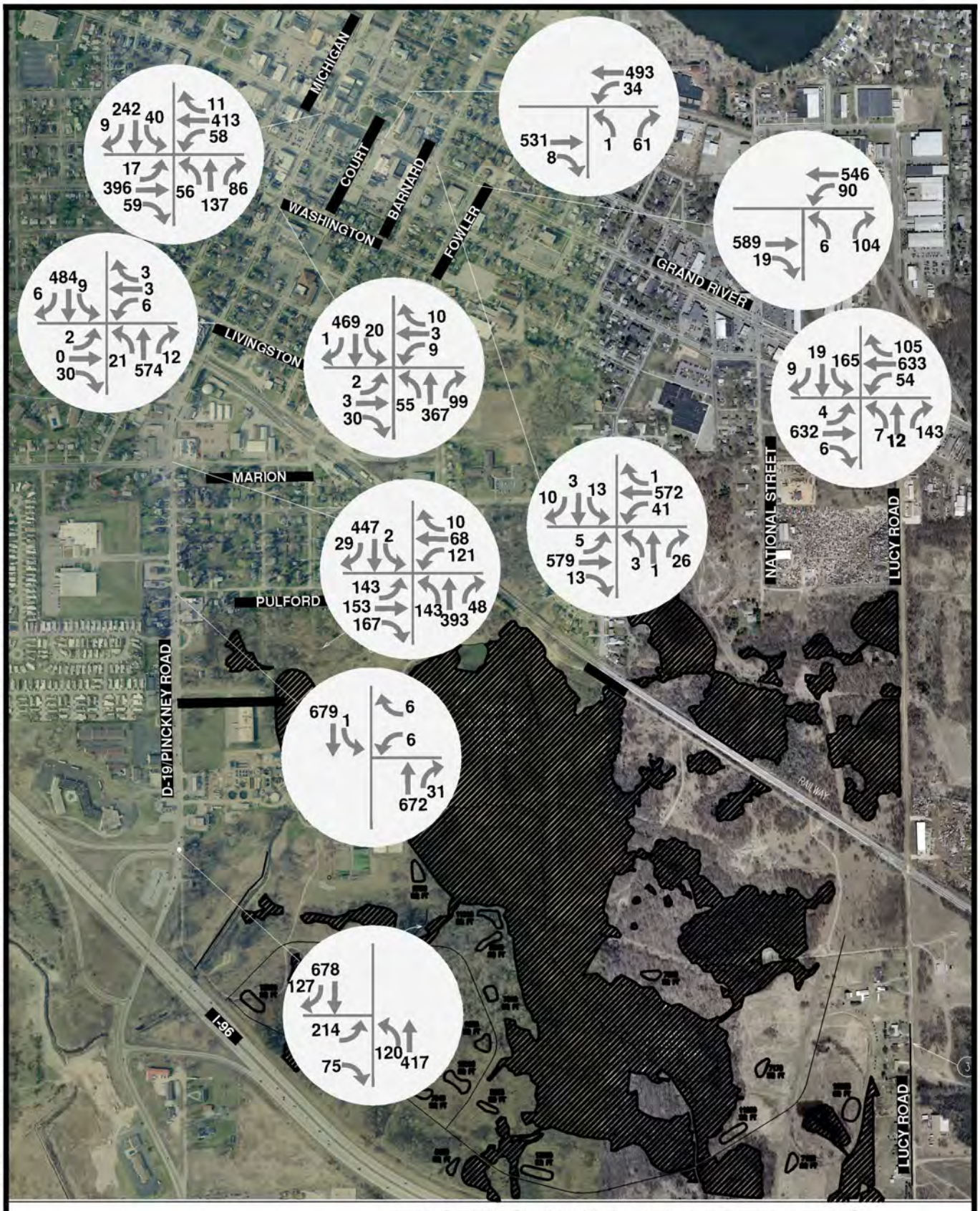
lanes. Approximately 1,500 feet east of National Street, the center left turn lane on Grand River Avenue ends just before a railroad bridge overpass.

Photograph 2: Northbound National Street at Grand River Avenue

Existing Traffic Volumes

MDOT provided turning movement count data for the peak hours of 7:00 to 8:00 AM and 5:00 to 6:00 PM for the intersection of D-19/I-96 WB ramps. From the turning movement counts taken by the City of Howell, the peak hours for the intersection of Grand River Avenue/National Street were 7:15 to 8:15 AM and 4:30 to 5:30 PM. The peak hours for the remainder of the eight intersections within the study area varied by location. Given the inconsistency of peak times, HRC recommended using the same peak hours for the level of service analysis as for the intersection of D-19/I-96 WB ramps. Therefore, the peak hours for the analysis were 7:00 to 8:00 AM and 5:00 to 6:00 PM with the exception that MDOT and LCRC directed that the counts performed for the Grand River Signal Optimization project for the 4:30 to 5:30 PM period be used for level of service analysis at Grand River Avenue and National Street.

Figures 3 and 4 display the existing traffic volumes at all the study intersections for the AM peak hour and the PM peak hour respectively.

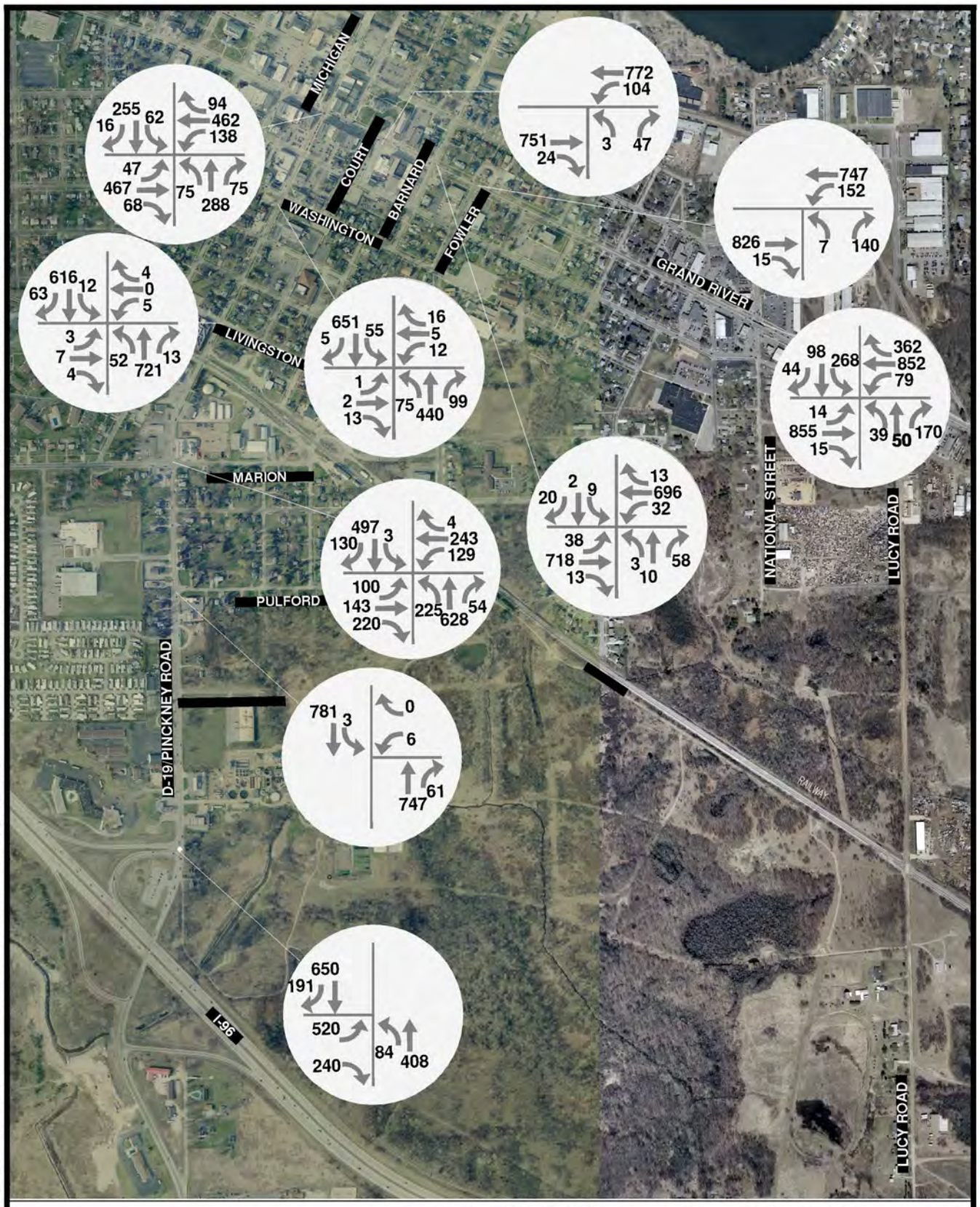


EXISTING (2005) 7-8 AM TRAFFIC

N

NOT TO SCALE

JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 3
20070429	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		



EXISTING (2005) 5-6 PM TRAFFIC

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JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 4
20070429	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE P.O. BOX 824	
JUNE 2009	BLOOMFIELD HILLS, MICH. 48303-0824	

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Section 4 - Background Traffic Growth

Background traffic is the considered the growth in traffic volumes between the time when traffic counts are taken and a future analysis year. Background traffic growth is due to development or traffic pattern changes outside of the study area, but which affect traffic within the study area. Two specific analysis years were chosen due to dates associated with the National Street project. For analysis purposes, the scenarios are:

- Existing scenario refers to September 2005 traffic volumes. (See Figures 3 and 4, Section 3)
- 2015 scenario is the projected build-out date for new development along the National Street Extension.
- 2030 scenario provides analysis for a twenty year horizon for the study area as requested by MDOT.

HRC calculated background growth for each of these scenarios and then annually until 2030: in order to project traffic to the 2015 and 2030 scenarios. It must be noted that the use of growth rates can overestimate the number of vehicles when used to project for a period greater than five years.

To determine traffic growth factors, HRC compared the turning movement counts taken by the Livingston County Road Commission (LCRC) in September 2001 with the counts taken by the City of Howell in 2005. In the table below, the PM peak hour volumes have increased an average of 6.6% for the four (4) years. This translates into an annual growth rate of 1.65%. The AM peak hour volumes grew an average of only 1.2% over the four years or an annual growth rate of 0.3%.

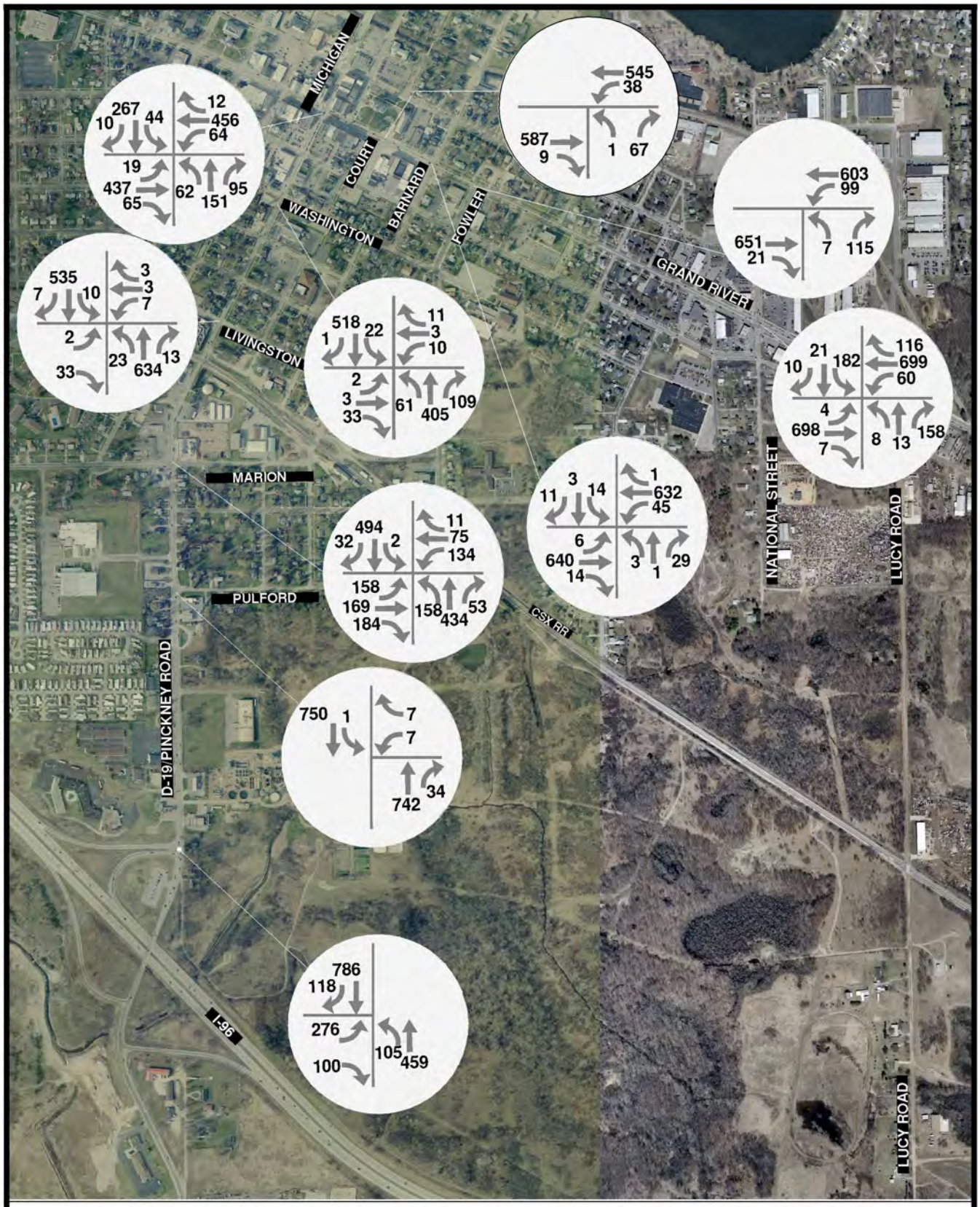
Table 2: Peak Hour Traffic Comparison between 2001 & 2005

Intersection	AM Peak		PM Peak	
	2001 LCRC Count	**2005 City Count**	**2001 LCRC Count**	**2005 City Count**
Pinckney & Pulford	1615	1567	1525	1868
Pinckney & Marion	1672	1914	1944	2446
Michigan & Washington	1197	1208	1519	1486
Grand River & Court	1291	1164	1713	1781
Grand River & Barnard	1415	1274	1645	1762
Grand River & Fowler	1259	1402	2058	1993
Grand River & National	1832	1873	2958	2909
Totals	**10281**	**10402**	**13362**	**14245**
Average Growth Rate	10402/10281 = **1.2%**		14245/13362 = **6.6%**	

Discussions with LCRC, MDOT and consultation with the Southeast Michigan Council of Governments' (SEMCOG) Regional Transportation Model resulted in the direction that a 1 percent annual growth rate be applied to traffic within the City of Howell for both the AM and PM peak period. A 1.5 percent annual growth rate, as directed by MDOT, was used for traffic outside the City of Howell limits, which affects some turning movements at the intersection of D-19/I-96 WB ramps. In addition one time factors were applied at the intersection of D-19/I-96 WB ramps to account for changes in traffic patterns due to the opening of the I-96 interchange at Latson Road before 2015.

Figures 5 and 6 show the intersection volumes for the 2015 scenario for the AM and PM peak hours respectively.

Figures 7 and 8 show the intersection volumes for the 2030 scenario for the AM and PM peak hours respectively.

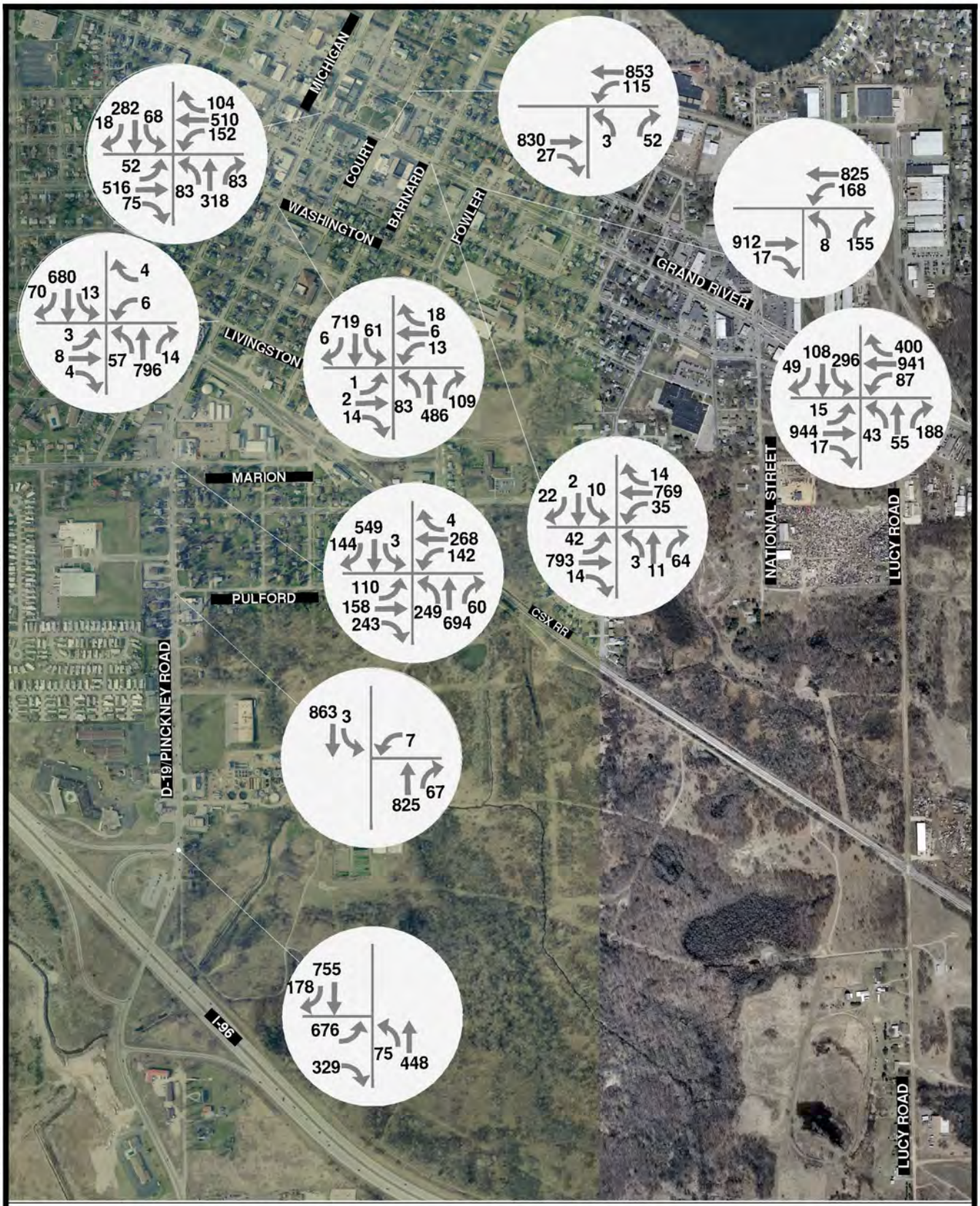


EXISTING PLUS BACKGROUND (2015) 7 - 8 AM TRAFFIC

N

NOT TO SCALE

JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 5
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		



EXISTING PLUS BACKGROUND (2015) 5 - 6 PM TRAFFIC

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JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 6
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		

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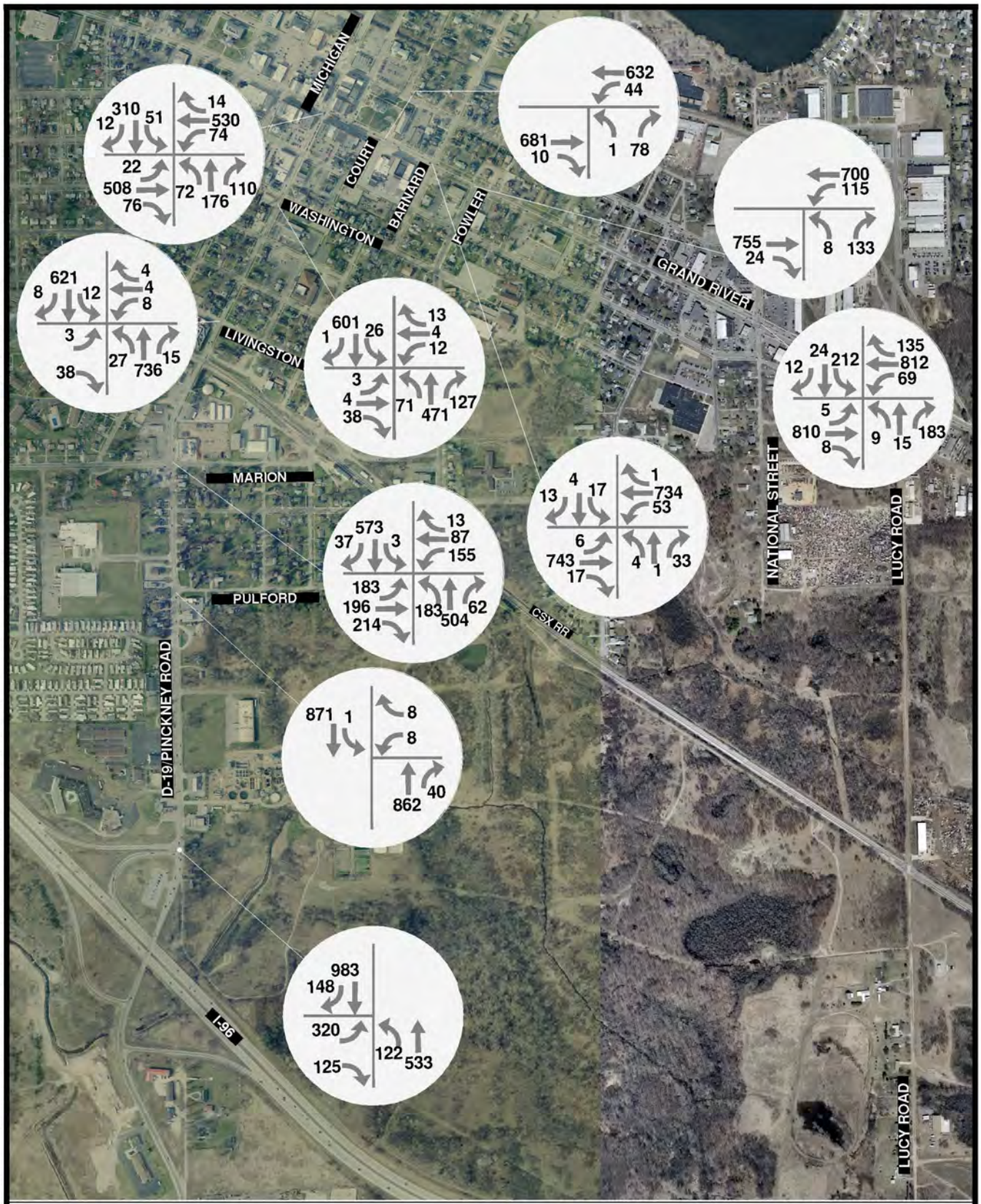

EXISTING PLUS BACKGROUND (2030) 7 - 8 AM TRAFFIC

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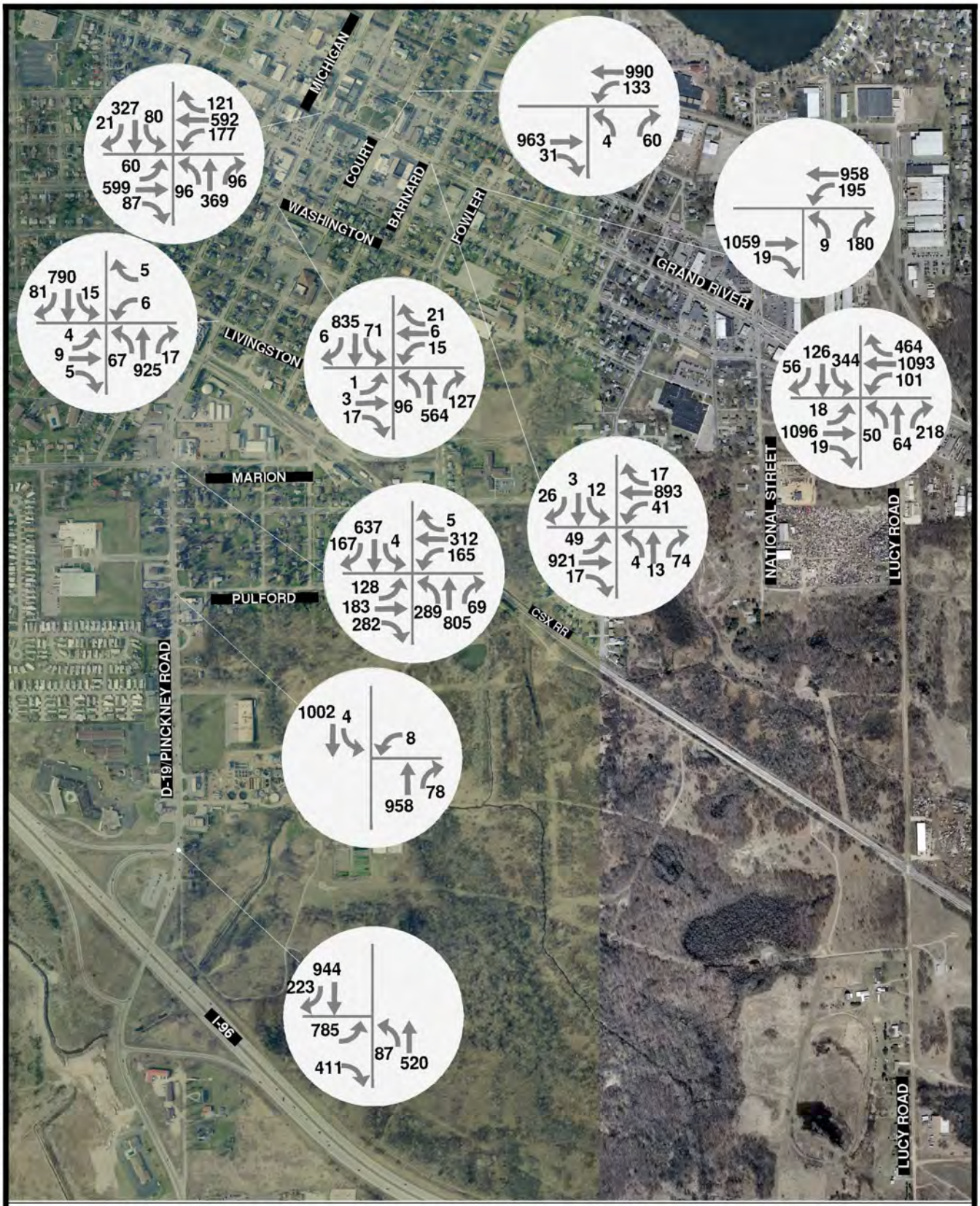
NOT TO SCALE

JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 7
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		

USER NAME = Meredith Michael DESIGN FILE = V:\200704\20070425\V\2030_BKGR_AM Traf_7.dwg CLR. TBL. = \\bhplot\TIFF PEN TBL. = gm_01_standards.ctb TIME = 6/11/2009 2:29:54 PM



EXISTING PLUS BACKGROUND (2030) 5 - 6 PM TRAFFIC

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JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 8
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		

USER NAME = Meredith Michael DESIGN FILE = V:\20070425\V\2030_BKGR_PM Trof_8.dwg CLR. TBL. = \\bhplot\TIFF PEN TBL. = gm_01_standards.ctb TIME = 6/11/2009 2:32:15 PM

Section 5 - Level of Service Analysis – Without National Street

HRC analyzed the intersection level of service at all ten intersections for three traffic scenarios for both the AM and PM peak hours assuming that the National Street Extension has not been built.

- Existing scenario - existing volumes.
- Background 2015 scenario – existing traffic volumes projected through 2015.
- Background 2030 scenario – existing traffic volumes projected through 2030.

Signalized Intersections

HRC used the current signal timing plans in the Synchro analysis (timing permits provided by MDOT with revision dates between 12/2006 and 11/2007). The D-19/I-96 WB Ramp intersection is an uncoordinated semi-actuated four phase signal and the cycle length varies based on the number of vehicles that arrive and actuate the signal. The Pinckney/Marion intersection has a 90 second cycle length with a two-phase operation. The Grand River Avenue/Michigan Avenue intersection operates a 90 second cycle length; it is a four-phase operation with a leading protected left-turn phase. The Grand River Avenue/National Street intersection also operates a 90 second cycle length with a two-phase operation.

Analysis Procedure for Signalized Intersections

The procedures for analysis and criteria were those outlined in 2000 Highway Capacity Manual. This manual defines level of service for signalized intersections in terms of control delay. Delay may be measured in the field, or it may be estimated. 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 volume to capacity ratio for the lane group or approach in question.

Table 3: Level of Service Criteria for Signalized Intersections

Level of Service	Stopped Delay per Vehicle (Seconds)	Delay Level
A	<10	Little or no delay
B	10 ≤ 20	Short traffic delays
C	20 ≤ 35	Average traffic delays
D	35 ≤ 55	Long traffic delays
E	55 ≤ 80	Very long traffic delays
F	>80	Severe congestion

Level of Service A describes operations with very low control delay up to 10.0 sec per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level of Service B describes operations with control delay in the range of 10.1 to 20.0 sec per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for Level of Service A, causing higher levels of average delay.

Level of Service C describes operations with control delay in the range of 20.1 to 35.0 sec per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

Level of Service D describes operations with control delay in the range of 35.1 to 55.0 sec per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volume to capacity ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

Level of Service E describes operations with control delay in the range of 55.1 to 80.0 sec per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high volume to capacity ratios. Individual cycle failures are frequent occurrences.

Level of Service F describes operations with control delay in excess of 80.1 sec per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with over saturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high volume to capacity ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

Level of Service (LOS) Analysis for Signalized Intersections

The table below shows the LOS summaries for the four signalized intersections. The complete Synchro reports can be found in Appendix B. All intersections achieve a LOS D or better during the AM and PM

peak hours for all scenarios. Traffic signal timing was optimized to accommodate traffic growth at some study intersections. In the case of the D-19/I-96 WB ramps intersection the I-96 ramps were favored at the expense of D-19 in signal timing optimization to prevent queues from forming on the I-96 WB Off Ramp.

Table 4: Level of Service for the Intersection of D-19/I-96 WB Ramps

Movement	Scenario					
	AM Peak Hour			PM Peak Hour		
	Existing	Background 2015	Background 2030	Existing	Background 2015	Background 2030
EBL	D	D	D	E	D	F
EBR	C	C	C	C	B	C
NBL	A	A	B	B	C	C
NBT						
SBT	A	B	C	C	D	E
SBR	A	A	A	C	B	A
Overall	**B**	**B**	**C**	**C**	**C**	**E**

Table 5: Level of Service for the Intersection of Pickney/Michigan & Marion/Mason

Movement	Scenario					
	AM Peak Hour			PM Peak Hour		
	Existing	Background 2015*	Background 2030*	Existing	Background 2015*	Background 2030*
EBL	C	C	C	C	C	C
EBT	C	D	D	D	C	C
EBR		D	D		C	C
WBL	E	C	D	F	C	C
WBT	C	D	D	C	D	E
WBR						
NBL	C	C	E	C	D	F
NBT	B	B	B	C	C	D
NBR						
SBL	B	B	B	A	C	C
SBT	B	C	D	B	D	E
SBR	B	B	B	B	C	B
Overall	**C**	**C**	**D**	**C**	**D**	**E**

* Includes additional EB Mason right turn lane, NB Pickney lagging permitted protected left turn phase, and EB Mason/WB Marion leading permitted protected left turn phase.

Table 6: Level of Service for the Intersection of Grand River/Michigan

Movement	Scenario					
	AM Peak Hour			PM Peak Hour		
	Existing	Background 2015	Background 2030	Existing	Background 2015	Background 2030
EBL	D	D	D	D	D	D
EBT	C	C	C	C	C	D
EBR						
WBL	D	D	D	D	D	D
WBT	B	B	C	B	C	D
WBR						
NBL	D	D	D	E	D	E
NBT	B	C	C	D	D	D
NBR						
SBL	D	D	D	D	D	D
SBT	D	D	D	C	C	C
SBR						
Overall	**C**	**C**	**C**	**C**	**D**	**D**

Table 7: Level of Service for the Intersection of Grand River/National Street

Movement	Scenario					
	AM Peak Hour			PM Peak Hour		
	Existing	Background 2015	Background 2030*	Existing	Background 2015	Background 2030*
EBL	A	A	B	B	B	C
EBT	B	A	C	B	B	D
EBR						
WBL	B	A	B	B	C	C
WBT	C	B	C	C	D	F
WBR	B	A	B	B	B	B
NBL	B	C	C	C	C	C
NBT	C	C	D	C	C	D
NBR						
SBL	C	D	D	D	D	F
SBT	B	C	C	C	C	B
SBR						
Overall	**B**	**B**	**C**	**C**	**C**	**E**

* Includes SB National Street and WB Grand River Avenue permitted protected left turn phases.

Analysis Procedure for Unsignalized Intersections

The procedures for analysis and criteria for unsignalized intersections were also outlined in 2000 Highway Capacity Manual. At an un-signalized intersection with stop control on the minor approach, LOS F occurs when there are not enough gaps of suitable size to allow a minor-street demand to safely cross through traffic on the major street. This is typically evident from extremely long control delays experienced by minor-street traffic and by queuing on the minor approaches. LOS F may also appear in

the form of drivers on the minor street selecting smaller than usual gaps. In such cases, safety may be a problem, and some disruption to the major traffic stream may result. Note that LOS F may not always result in long queues but in adjustments to normal gap acceptance behavior.

At Two Way Stop Controlled intersections, the critical movement, often the minor-street left turn, may control the overall performance of the intersection. The lower threshold for LOS F is set at 50 seconds of delay per vehicle. In some cases, the delay equations will predict delays greater than 50 seconds for minor-street movements under very low-volume conditions on the minor street (less than 25 veh/h). A LOS F threshold is reached with a movement capacity of approximately 85 veh/h or less.

Table 8: Level of Service Criteria for Un-signalized Intersections

Level of Service	Stopped Delay Per Vehicle (Seconds)
A	<10
B	10 ≤ 15
C	15 ≤ 25
D	25 ≤ 35
E	35 ≤ 50
F	>50

Level of Service (LOS) Analysis for Unsignalized Intersections

HRC performed level of service analysis using Synchro software at the six unsignalized intersections in the study area for the four scenarios. The complete Synchro reports can be found in Appendix B. The Synchro results show that in most cases, the major street turning movements are operating at a LOS A or B, but the stop controlled minor streets are experiencing a LOS F.

Traffic Signal Warrant Analysis for Unsignalized Intersections

Warrant analyses for unsignalized intersections are conducted to determine whether they qualify for signalization. The signal warrants require minimum traffic thresholds in order to warrant installing a traffic signal. There are six unsignalized intersections in the study area. Based on the existing peak hour volumes, the minor streets would not qualify for a traffic signal as their traffic volumes are too low. Therefore, warrant analyses at the unsignalized intersections were not pursued further.

Section 6 - Trip Generation – With National Street

One of the most critical elements of a traffic impact study is estimating the amount of traffic to be generated by proposed developments. This is usually done by using trip generation rates or equations. Trip generation rates or equations provide an estimate of all trips generated by a site.

Rates are commonly expressed in trips per unit of development. For example, trips per dwelling unit are commonly used for residential developments, while trips per 1,000 square feet of gross floor area are used for offices and retail. Equations provide a direct estimate of trips based upon development units being multiplied in a mathematical relationship.

Trips are defined as a single or one directional movement with either the origin or destination of the trip inside the study site. Thus, a car entering and leaving a site would be recorded as generating two trips. Trip generation estimates are often the most critical factors in assessing impacts and needs of a proposed development.

Target Area

In accordance with the February 14, 2007 meeting of the City of Howell, MDOT and LCRC, the trip generation report was revised. It was decided by MDOT and the City of Howell that the current City Master Plan should be used to determine the anticipated trips generated by development along the National Street Extension. The basis for the land uses and acreage figures was provided by the Amended Loop Road (National Street Extension) Target Area Plan completed in August 2006 as an addendum to the City of Howell Master Plan. Several alternatives were discussed in the plan and one was selected as the Preferred Land Use Alternative. The National Street target area includes a large amount of wetlands that make the land unsuitable for development. Figure 9 shows the target area overlaid with the preferred land-uses and the amount of buildable acreage for each land use. A summary of the buildable acreage is also shown in Table 9.

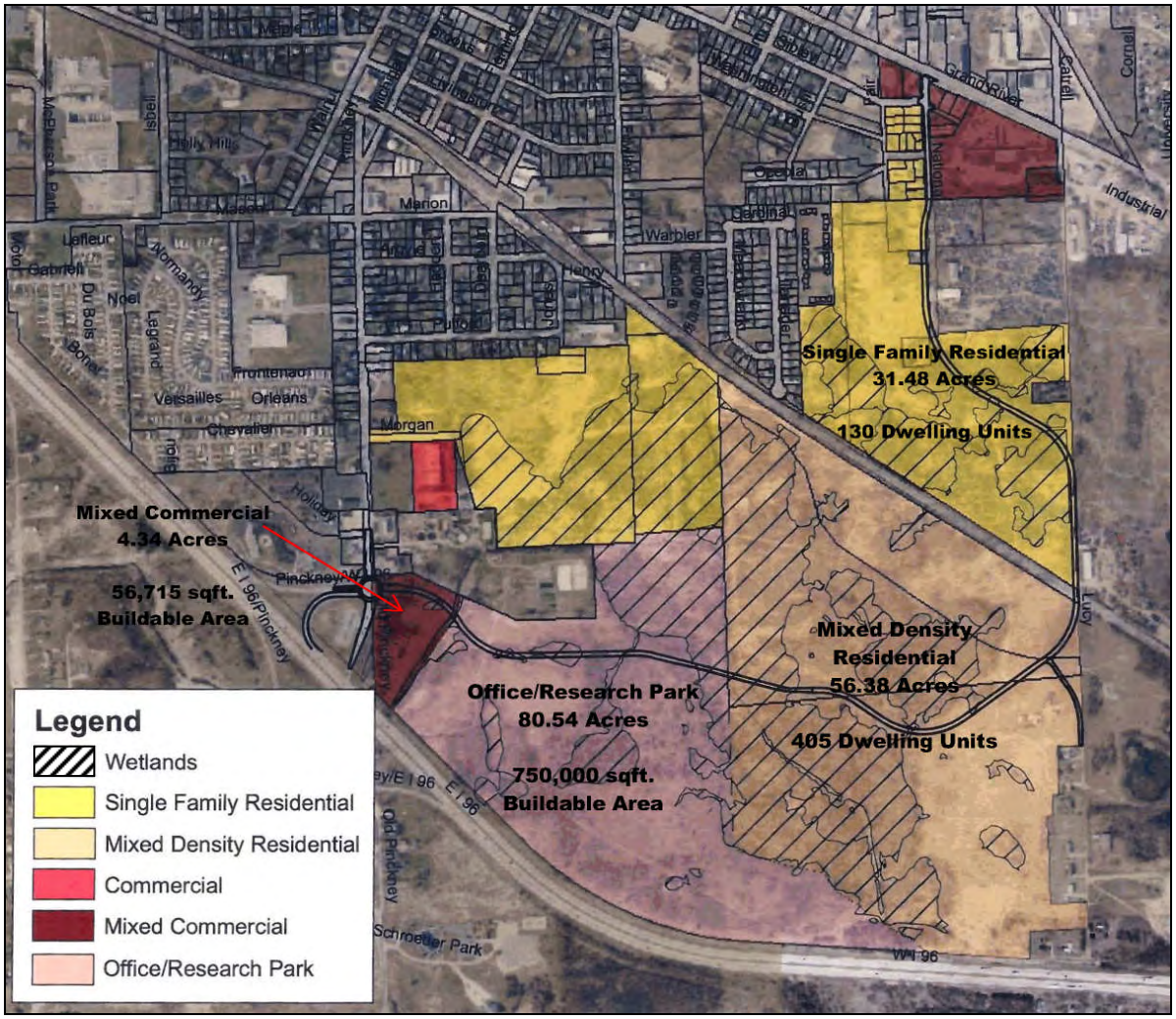


Figure 9. Preferred Land Use Alternative

Source: City of Howell Master Plan, Amended Loop Road (National Street Extension) Target Area Plan, August 2006

The trip generation methodology assumed certain maximum lot coverage by land use;

- a maximum lot coverage of 30% was used for the mixed commercial land use
- a maximum lot coverage of 80% was used for the single family residential land use
- a maximum lot coverage of 80% was used for the mixed density residential land use
- for the office/research park land use, HRC consulted with the City Planner and city's planning consultant to determine an appropriate building size for the site, location and economic conditions. It was concluded that this site could support a maximum buildout of the Office/Research Park land use of approximately 750,000 square feet. As a comparison, ITE's Trip Generation Manual provides information on sizes of office developments studied. Under General Office Building the average square footage is 220,000 SF, under corporate headquarters Building the average square footage is 275,000 SF, under the Single Tenant Office Building the

average square footage is 164,000 SF and under the Medical-Dental Office Building the average square footage is 35,000 SF. Based on ITE studies, an office/research park of even 750,000 SF is an exceptionally large development.

Table 9: Buildable Land and Maximum Build-Out

Land Use	Buildable Land Area		Buildings GFA / DU[1]
	Acres	Square Feet	
Mixed Commercial	4.34	189,050	56,715 GFA
Single Family Residential (min lot size 8,400 SF)	31.48	1,371,312	130 DU
Mixed Density Residential (min lot size 4,840 SF)	56.38	2,455,913	405 DU
Office/Research Park	80.54	3,508,322	750,000 GFA

Trip Generation Rates

There are several sources for trip generation rates and equations, which are based on data collected from locations in the United States and Canada. These are compilations of data that have been gathered over many years for various land uses. National data sources are starting points in estimating the amount of traffic that may be generated by a specific building or land use. Whenever possible, the National rates should be adjusted to reflect local or forecasted conditions. These National sources are not intended to be used without question, deviation or sound judgment. They often reflect what are supposed to be the average or typical conditions. Data collected from local sites may be more representative than National averages of other developments within the area.

The most widely used source of National Trip Generation data is the Trip Generation Manual, published by the Institute of Transportation Engineers. The information in this report is almost solely derived from suburban and urban sites. Data included in trip generation was obtained from actual driveway counts of vehicular traffic entering and exiting the site. The seventh edition contains more than 2,000 data sets from individual trip generation studies. The report also includes discussions on the application and use of trip generation rates and equations; descriptions of the characteristics of each land use; maximum/minimum average rates for weekdays, weekends and peak hours of the generator and adjacent street traffic; and additional statistical data regarding data variability.

[1] GFA = Gross Floor Area DU = Dwelling Unit

Based on the land uses in the Preferred Land Use Alternative, appropriate land use codes from the ITE Trip Generation Manual were selected. The following table provides the daily as well as the AM and PM peak hour trip volumes. Where the coefficient of determination factor was ≥ .75, the fitted curve equation was used to generate the trips.

Table 10: Summary of Trip Generation Analysis by Land Use

Land Use (ITE Code)	Intensity	Daily		AM Peak		PM Peak	
		In	Out	In	Out	In	Out
Mixed Commercial Shopping Center (820)	56.715 SF GFA	2,349	2,349	36	23	207	224
Office/Research Park General Office Building (710)	750 SF GFA	4,129	4,129	997	95	156	763
Single Family Residential Single Family Detached (210)	130 DU	662	662	32	78	86	50
Mixed Density Residential Res. Condo/Townhouse (230)	405 DU	1,054	1,054	27	131	127	62
Total Trips		**8,194**	**8,194**	**1092**	**327**	**576**	**1099**

MDOT was concerned that, "the Preferred Land Use Alternative (Figure 9) shows a shaded area of "mixed commercial" at the intersection of Grand River Avenue/National Street and a shaded area of "commercial" near Morgan Drive. These land uses were not accounted for in the trip generation calculations."

These areas were accounted for in the analysis, specifically:

- The shaded mixed commercial area at the intersection of Grand River Avenue/National Street is currently a strip commercial center and a gas station and this area is not anticipated to be redeveloped. The strip commercial development was in place when traffic counts were taken, thus the trips from this development are already included in the traffic impact study.
- The shaded commercial area at Morgan Drive is currently a commercial use that is not anticipated to be redeveloped. The commercial development was in place when traffic counts were taken, thus the trips from this development are already included in the traffic impact study.

Pass-By and Diverted Linked Trips

The Preferred Land Use Alternative includes mixed commercial which is affected by the pass-by trip phenomenon. HRC followed guidelines for pass-by trips provided by the second edition of the Trip Generation Handbook published by the Institute of Transportation Engineers. The effect of the Pass-by trip reduction will be seen in the future intersection volumes and not at the driveways. Table 11 provides

the percentages of pass-by trips during the PM peak for the mixed commercial. It should be noted that there were no pass-by data for trips in the AM peak hour.

Table 11: PM Peak Hour Pass-By Trip Adjustment

Land Use	Intensity	Daily		AM Peak		PM Peak	
		In	Out	In	Out	In	Out
Mixed Commercial	56.715 SF GFA	2,349	2,349	36	23	207	224
Pass-By (ITE Avg.- PM)	34%					70	76
New External		2,349	2,349	36	23	137	148

In summary, the Preferred Land Use Alternative for the Loop Road target area will generate the following trips that will need to be assigned to the two key intersections, Grand River Avenue/National Street and D-19/I-96 WB ramps.

Table 12: Adjusted Trip Generation for the Loop Road

Land Use	Daily		AM Peak		PM Peak	
	In	Out	In	Out	In	Out
Total New External Trips	8,194	8,194	1,092	327	506	1023

Section 7 - Trip Distribution and Assignment – With National Street

Traffic expected to be generated by a project must be distributed and assigned to the roadway system so that the impacts of the proposed project on roadway links and intersections within the study area can be analyzed. After an estimate of the total traffic into and out of the site has been made, that traffic must be distributed and assigned to the roadway system. The trip distribution step produces estimates of trip origins and destinations. The assignment step produces estimates of the amount of site traffic that will use certain access routes between their origin and destination.

HRC evaluated the existing traffic patterns in Howell to determine the future travel demand on the National Street Extension in the City of Howell. HRC suggested a methodology to the City to estimate the number of potential users of the National Street Extension. The City of Howell staff identified Sibley Street as a possible alternate route for vehicles on westbound Grand River Avenue intending to go south on Michigan Avenue and traffic on northbound Michigan Avenue intending to go eastbound on Grand River Avenue. Heavy demand and peak hour congestion attract many drivers to use less congested and easily accessible Sibley Street to avoid the Grand River Avenue/Michigan Avenue intersection. HRC proposed conducting a license plate survey to identify how many vehicles were using Sibley Street to access southbound Michigan Avenue or eastbound Grand River Avenue. HRC also counted turn movements during the peak hours at Grand River Avenue/Michigan Avenue to identify and quantify the demand for the National Street Extension.

License Plate Survey

HRC conducted a limited origin-destination study using the license plate survey technique. The license plate survey uses a simple technique of tracking a vehicle through a study area by observation at selected points.

HRC staff and the City of Howell Public Works Department employees conducted the survey on February 3, 2005 from 7:00-9:00 AM in the morning and 4:00-6:00 PM in the afternoon. The city recommended doing the survey on Court Street, Fowler Street and National Street as the key routes between Grand River Avenue and Sibley Street. Four stations were established and one observer was assigned at each station to record license plates. The field data collected was thoroughly analyzed and license plates recorded at the four stations were compared. The matching license plates were determined to be the cut-through traffic.

During the 7:00 – 9:00 AM time period, observers counted 121 vehicles making a right turn from northbound Michigan Avenue onto eastbound Sibley Street. The survey identified 47 vehicles that eventually turned eastbound onto Grand River Avenue. Observers counted 79 vehicles making a left turn from westbound Sibley Street onto southbound Michigan Avenue. Of these, the survey identified 13 vehicles that had originated on Grand River Avenue. See Figure 10.

During the 4:00 – 6:00 PM time period, observers counted 175 vehicles making a right turn from northbound Michigan Avenue onto eastbound Sibley Street. Out of these, the survey identified 70 vehicles or 40% of the total that were destined for Grand River Avenue. A total of 379 vehicles made a left turn from westbound Sibley Street onto southbound Michigan Avenue. The survey identified 130 vehicles that were destined for D-19. See Figure 11. The tables below summarize the results of the license plate survey.

Table 13: License Plate Survey Results
7:00-9:00 AM February 3, 2005

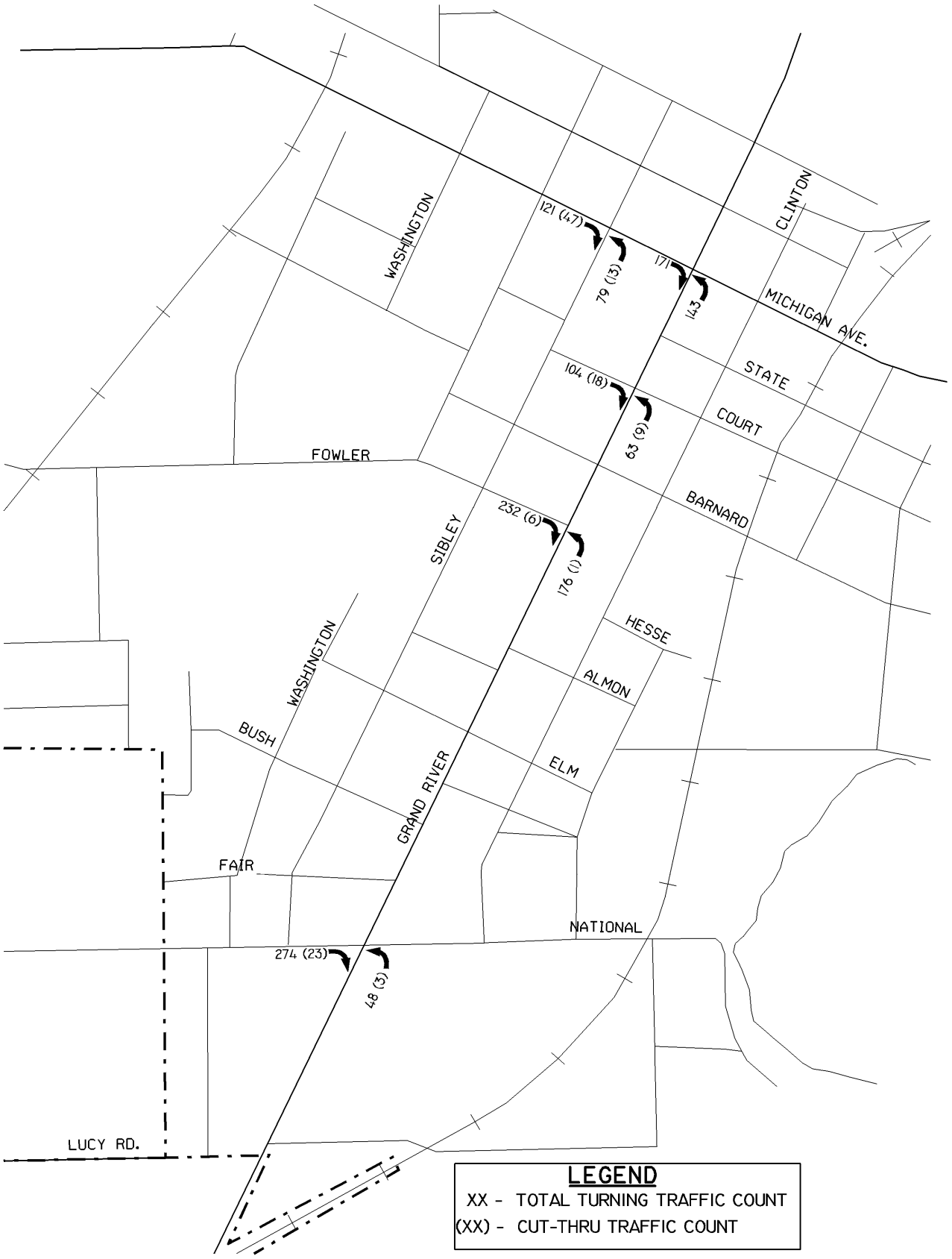
From Michigan Avenue Via	**To Grand River Avenue Via**			**Total**	**Percent**
Sibley Street	Court	Fowler	National		
121	18	6	23	47	39%
To Michigan Avenue Via	**From Grand River Avenue Via**			**Total**	**Percent**
Sibley Street	Court	Fowler	National		
79	9	1	3	13	16%

Table 14: License Plate Survey Results
4:00-6:00 PM February 3, 2005

From Michigan Avenue Via	**To Grand River Avenue Via**			**Total**	**Percent**
Sibley Street	Court	Fowler	National		
175	20	14	36	70	40%
To Michigan Avenue Via	**From Grand River Avenue Via**			**Total**	**Percent**
Sibley Street	Court	Fowler	National		
379	84	24	22	130	34%

The license plate survey shows that a significant number of motorists use Sibley Street to avoid the Grand River Avenue/Michigan Avenue intersection. About 40 percent of the traffic heading for eastbound Grand River Avenue is turning onto Sibley Street to access Grand River Avenue. The percentage of traffic from Grand River Avenue cutting over to Sibley Street varies from 16% in the AM peak to 34% in the PM peak.

It is important to note that license plates were counted at only three cross streets on Grand River Avenue and there are more than three cross streets that connect Grand River Avenue to Sibley Street. Counts



LEGEND

XX - TOTAL TURNING TRAFFIC COUNT

(XX) - CUT-THRU TRAFFIC COUNT

LICENSE PLATE SURVEY (FEBRUARY 3, 2005)
7:00 AM- 9:00 AM
AM PEAK TRAFFIC VOLUMES

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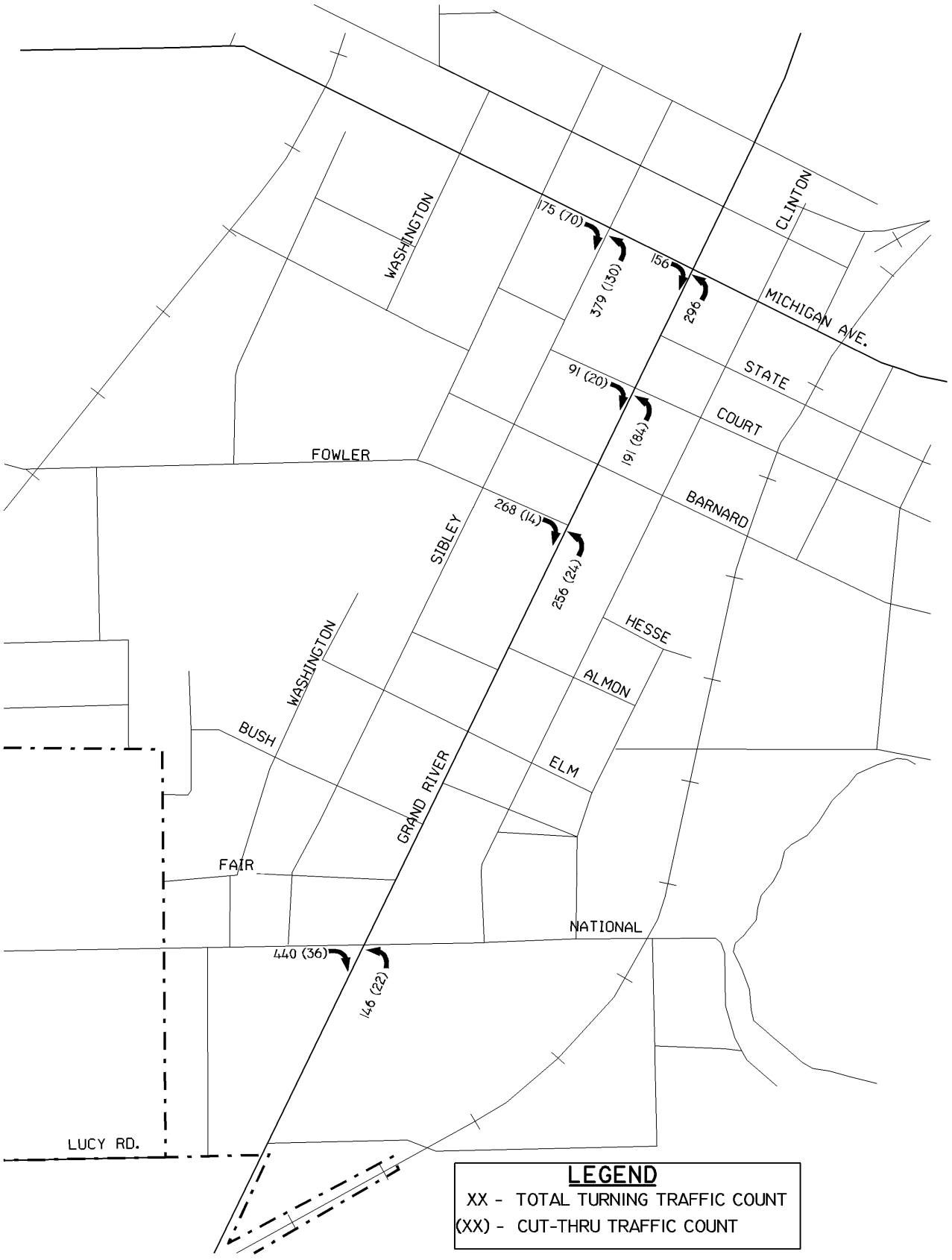
JOB NO. 20070425	HUBBELL, ROTH & CLARK, INC.	FIG. 10
DATE JUNE 2009	CONSULTING ENGINEERS 555 HULET DRIVE P.O. BOX 824 BLOOMFIELD HILLS, MICH. 48303-0824	



LEGEND

XX - TOTAL TURNING TRAFFIC COUNT

(XX) - CUT-THRU TRAFFIC COUNT

LICENSE PLATE SURVEY (FEBRUARY 3, 2005)
4:00 PM- 6:00 PM
PM PEAK TRAFFIC VOLUMES

N

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JOB NO. 20070425	HUBBELL, ROTH & CLARK, INC.	FIG. 11
DATE JUNE 2009	CONSULTING ENGINEERS 555 HULET DRIVE P.O. BOX 824 BLOOMFIELD HILLS, MICH. 48303-0824	

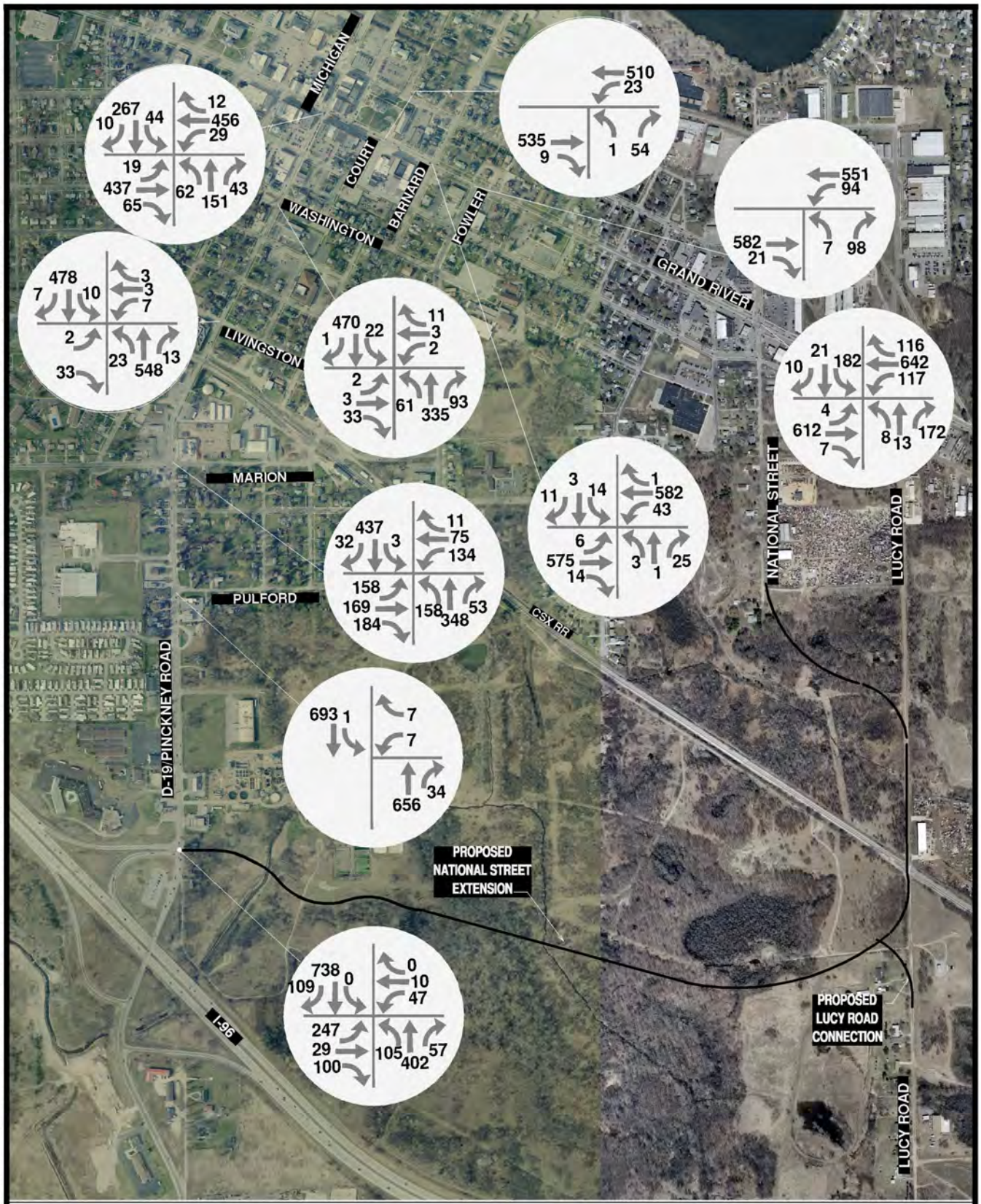
were taken at these locations based on the recommendations by the City of Howell staff. Therefore it is reasonable to estimate that if all cross streets were surveyed, 50% of northbound right-turn traffic and westbound left-turning traffic at the intersection of Michigan Avenue/Sibley Street could be using Sibley Street as an alternative to Grand River Avenue. It is also reasonable to estimate that this same traffic will use the National Street Extension, once it is available.

Future 2015 and 2030 Traffic Volumes

Future 2015 and 2030 traffic volumes on the network needed to be estimated with the National Street Extension. Beginning with the existing 2005 volumes at the intersections, HRC used the following methodology to calculate traffic expected to use the National Street Extension.

- As directed by MDOT, background traffic growth rate of 1% per year was used for both the AM and PM peak hour, with 1.5% per year used for traffic outside the City of Howell affecting some turning movements at the intersection of D-19/I-96 WB ramps. One time adjustments were made to specific turning movements at the D-19/I-96 WB ramps intersection in 2015 to account for the effects of the proposed I-96/Latson Road interchange.
- 50% of all trips turning left from Grand River Avenue to Michigan Avenue and all trips turning right from Michigan Avenue to Grand River Avenue will elect to utilize the National Street Extension to get to D-19. This logic is verified by the results of the travel demand forecast modeling work performed by SEMCOG for the 2030 Regional Transportation Plan. SEMCOG projected that a bypass would attract approximately 3,300 trips daily from Grand River Avenue and D-19. In urban areas, a rule of thumb is that the PM peak hour represents 8% to 12% of the average daily trips. HRC calculated that 300 trips will be diverted to the National Street Extension during the PM peak hour, which represents 9.1% of the average daily trips. The forecast modeling results can be found in Appendix F.
- New trips generated by the development along the National Street Extension were assigned to the roadway so that 70% will head west to intersection of D-19/I-96 WB ramps and 30% will go towards the intersection of Grand River Avenue/National Street. This split was based on the relative volume of traffic carried on Grand River Avenue (BL-96) versus I-96 according to the 2004 annual average 24-hour traffic volumes collected by MDOT. In 2004, the annual average on BL-96 is 18,200 and on I-96 is 45,800 (the average for the counts taken on segments on either side of the D-19 interchange).

The detailed tables showing how the turning movements for the future 2015 and 2030 were derived, using the methodology above, are included in Appendix C. Figures 12 – 15 show the future 2015 and 2030 traffic volumes with a National Street Extension.



FUTURE (2015) AM WITHOUT DEVELOPMENT TRAFFIC

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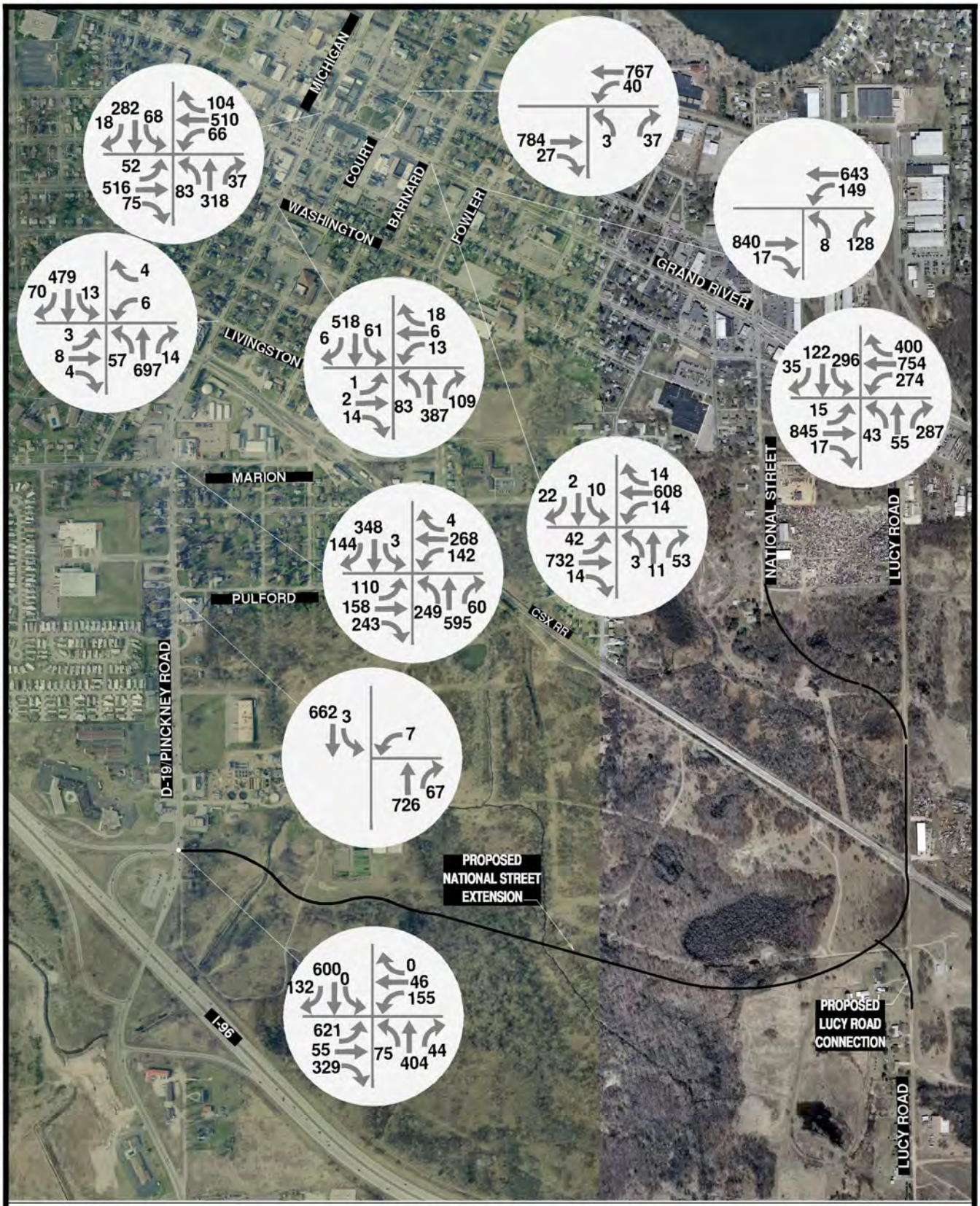
JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 12
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. P.O. BOX 824, 48303-0824	
JUNE 2009		



FUTURE (2015) PM WITHOUT DEVELOPMENT TRAFFIC

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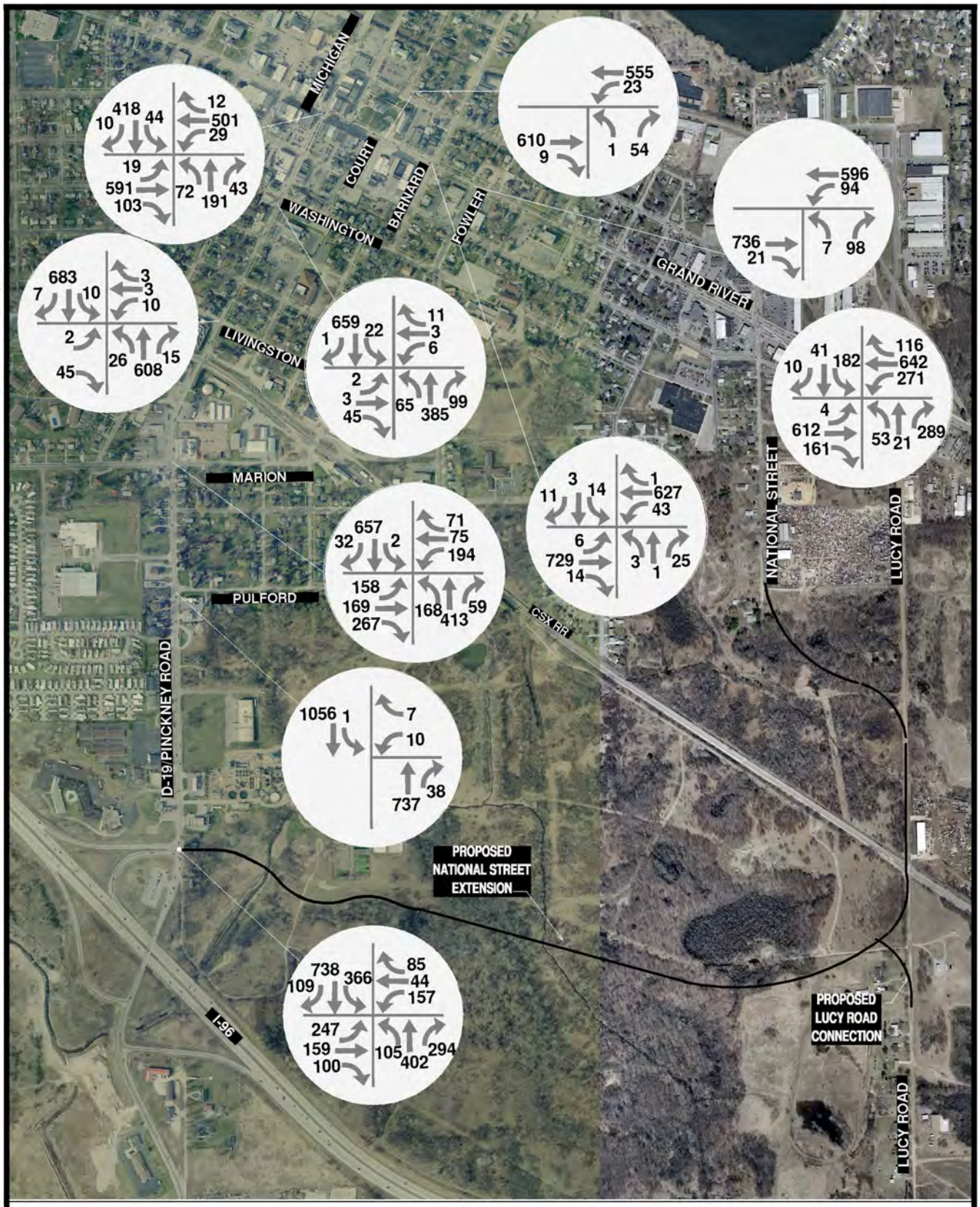
JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 13
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. P.O. BOX 824, 48303-0824	
JUNE 2009		



FUTURE (2015) AM TRAFFIC

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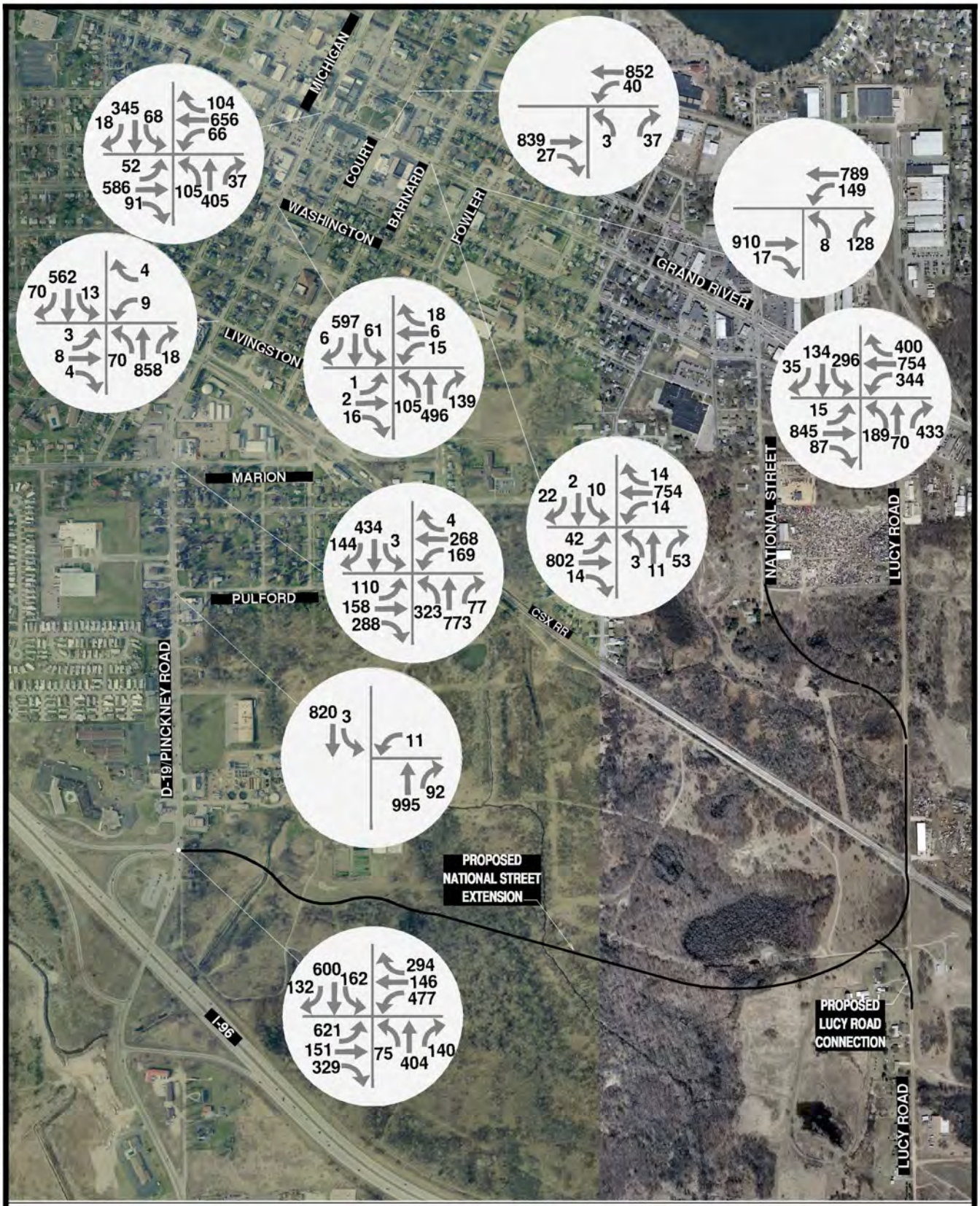
JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 14
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		



FUTURE (2015) PM TRAFFIC

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NOT TO SCALE

JOB NO.	HUBBELL, ROTH & CLARK, INC.	FIG. 15
20070425	CONSULTING ENGINEERS	
DATE	555 HULET DRIVE, BLOOMFIELD HILLS, MICH. 48303-0824 P.O. BOX 824	
JUNE 2009		

Left Turn Phasing Warrants

Guidelines regarding warrants for left turn protection published on the MDOT website on December 8, 2006, entitled "Left-Turn Phasing Signal Guidelines", states:

"Left turn protection should be considered at signalized intersections when:

- the left-turn peak hour volume exceeds 90 vehicles per hour (VPH) or 50 VPH on streets with through traffic over 45 mph, or
- the product of opposing through hourly volume (VHP) and left-turn hourly volumes (VHP) exceeds 50,000, if there is one opposing lane or 100,000, if there are two opposing lanes, or
- a crash pattern is evident at the intersection which could be corrected with left-turn phasing."

This policy is more conservative than some of the commonly used techniques for warranting left-turn phasing as noted in the April 1986 ITE Journal article *A Summary Of The Use Of Warrants For The Installation Of Left-Turn Phasing At Signalized Intersections*:

- Warrants Based on Volumes
  - Cross product of left turn x opposing — 2 lane exceeds 30,000-50,000; 4 lane exceeds 50,000-100,000

Grand River Avenue/National Street

Existing PM peak hour left turn volumes for southbound National Street exceed 200 VPH, but the cross product with northbound through vehicles does not exceed 50,000 until you consider northbound through and right turning vehicles in the Background 2015 scenario. In the Future 2015 scenario the cross product of southbound left turns and northbound through and right turns exceeds 100,000. Northbound National Street left turning volumes do not reach the warrant thresholds for protection.

Westbound Grand River Avenue Future 2015 PM peak hour left turn volumes exceed 200 VPH, and the cross product with eastbound through vehicles exceed 100,000. Eastbound Grand River Avenue left turning volumes do not reach the warrant thresholds for protection.

Pinckney(Michigan)/Marion(Mason)

Existing PM peak hour left turn volumes for northbound Pinckney exceed 200 VPH, and the cross product with southbound through vehicles exceeds 100,000 in the existing condition. Southbound Michigan Avenue (M-155) left turning volumes do not reach the warrant thresholds for protection. However, at this location north-south left turns should be protected due to sight distance restrictions on the north leg.

Eastbound and westbound Marion Street (Mason) left turns do not reach the 200 VPH threshold, nor does the cross product with opposing through vehicles exceed 100,000. In the Future 2015 PM peak hour scenario the cross product of westbound left turns and eastbound through and right turns exceeds 50,000.

Lucy Road Connection Analysis

HRC evaluated future operation of Lucy Road when the National Street Extension is constructed and operational. Lucy Road is currently unpaved, parallel to National Street and intersects with Grand River Avenue approximately 1,130 feet east of National Street (see Figure 1). It intersects CSX railway line at grade and dead ends just north of I-96.

The National Street Extension alignment will use the existing CSX railway line crossing at Lucy Road because a second at grade crossing in this area was unacceptable to CSX. The National Street Extension will divide Lucy Road into two sections. Lucy Road south of CSX railway line will be connected to the National Street Extension via un-signalized intersection. Lucy Road north of the CSX railway line is being evaluated for the following options.

- Cul-de-sac at the southern end
- Un-signalized intersection with the National Street Extension

In order to determine the best option for Lucy Road, the traffic volume on Lucy Road and near by intersection needs to be considered. Lucy Road is an unpaved low volume road operating below capacity. The following table provides peak hour and daily traffic demand on Lucy Road.

Table 15: Average Daily Traffic on Lucy Road
Source: Livingston County Road Commission

Time	5/19/2004	4/28/2003	4/29/2003	4/30/2003
8:00	30	12	21	14
9:00	54	8	23	11
17:00	42	14	16	10
18:00	34	10	11	11
Daily	605	188	211	244

Lucy Road's future connection to the National Street Extension could possibly impact the operation of the Grand River Avenue/National Street intersection. A connection between Lucy Road and the National Street Extension may reduce the turning traffic to/from the east at Grand River

Avenue/National Street. Motorists heading westbound on Grand River Avenue turning left at National Street to go southbound may use Lucy Road when the left turn demand exceeds 300 vehicles per hour.

The following table provides estimates of future peak hour turning traffic volume at Grand River Avenue/National Street for the two key movements that may be affected by future alignment of Lucy Road. The table provides the comparison of traffic with and without the Lucy Road.

Table 16: Turning Traffic at Grand River Avenue/National Street

Period	Scenario	Northbound Right Turn	Westbound Left Turn
2015			
AM Peak	Without Lucy Road Connection	289	271
	With Lucy Road Connection	217	203
PM Peak	Without Lucy Road Connection	433	344
	With Lucy Road Connection	251	235
2030			
AM Peak	Without Lucy Road Connection	335	314
	With Lucy Road Connection	323	239
PM Peak	Without Lucy Road Connection	502	400
	With Lucy Road Connection	323	261

A cul-de-sac will eliminate National Street Extension access to Lucy Road and as a result the intersection of Grand River Avenue/Lucy Road will not be able to serve additional traffic if bottlenecks occur at Grand River Avenue/National Street.

By connecting Lucy Road with the National Street Extension, Grand River Avenue/National Street intersection will benefit due to reduce traffic load during peak hours. HRC estimates that during peak hours when the left turn demand is in excess of 300 vph, approximately 25-35% of this traffic is expected to seek an alternative route via Lucy Road. These volumes are reflected in the Synchro files used for the level of service analysis found in Section 8. HRC therefore, recommends connecting Lucy Road to the National Street Extension through an un-signalized intersection and controlled by a stop sign for Lucy Road traffic.

Section 8 - Level of Service Analysis – With National Street

HRC analyzed the intersection level of service at all ten intersections for future scenarios for both the AM and PM peak hours with traffic diverted to the new National Street Extension and traffic generated by developments in accordance with the Amended Loop Road Target Area Plan completed in August 2006 as an addendum to the City of Howell Master Plan.

Analysis Procedure for Signalized Intersections

As explained in Section 5, the procedures for analysis and criteria were those outlined in 2000 Highway Capacity Manual. The following AM and PM peak hour scenarios were studied:

- Future 2015 with National Street Extension and future development traffic volumes without Geometric Improvements
- Future 2015 without future development traffic volumes on National Street Extension with Geometric Improvements
- Future 2015 with National Street Extension and future development traffic volumes with Geometric Improvements
- Future 2015 with National Street Extension and future development traffic volumes without Geometric Improvements
- Future 2030 with National Street Extension and future development traffic volumes with Geometric Improvements

Table 17 details the overall level of service for the signalized intersections in the study area during the AM and PM peak hours. Tables 18 through 21 provide the level of service by movement for each of the study intersections for the five scenarios during the AM and PM peak hours.

Table 17: Overall Intersection Level of Service with National Street Extension

Period	Scenario	D-19/I-96 WB Ramps	Michigan/ Marion	Grand River/ Michigan	Grand River/ National
AM Peak Hour	Future 2015 without Geometric Improvements	F	F	C	C
	Future 2015 without Development Traffic with Geometric Improvements	B	C	C	C
	Future 2015 with Geometric Improvements	C	D	C	C
	Future 2030 without Geometric Improvements	F	F	D	E
	Future 2030 with Geometric Improvements	D	E	D	C
PM Peak Hour	Future 2015 without Geometric Improvements	F	E	D	E
	Future 2015 without Development Traffic with Geometric Improvements	C	C	C	C
	Future 2015 with Geometric Improvements	C	D	D	C
	Future 2030 without Geometric Improvements	F	F	D	F
	Future 2030 with Geometric Improvements	D	E	D	C

Table 18: Level of Service for the Intersection of D-19/I-96 WB Ramps

AM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements[1]	**w/ Geometric Improvements & w/o Development Volumes[2]**	**w/ Geometric Improvements & Development Volumes[2]**	**w/o Geometric Improvements[1]**	**w/ Geometric Improvements & Development Volumes[2]**
EBL	D	C	C	F	D
EBT	D	C	D	E	D
EBR		C	C		C
WBL	E	D	D	F	D
WBT	D	D	D	D	C
WBR	D	-	D	C	C
NBL	C	B	C	E	C
NBT		A	C		D
NBR					
SBL	-	-	C	-	D
SBT	F	B	C	F	C
SBR	B	A	B	B	B
Overall	**F**	**B**	**C**	**F**	**D**
PM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements[1]	**w/ Geometric Improvements & w/o Development Volumes[2]**	**w/ Geometric Improvements & Development Volumes[2]**	**w/o Geometric Improvements[1]**	**w/ Geometric Improvements & Development Volumes[2]**
EBL	F	C	D	F	D
EBT	F	C	C	F	C
EBR		C	C		D
WBL	F	C	D	F	D
WBT	D	C	C	C	C
WBR	D	-	C	D	D
NBL	D	B	C	D	C
NBT		B	C		D
NBR					
SBL	-	-	C	-	D
SBT	F	B	C	F	D
SBR	B	B	C	B	C
Overall	**F**	**C**	**C**	**F**	**D**

[1]Includes left turn phase for EB I-96 Ramp/WB National Street
[2]Includes left turn phases for all approaches

Table 19: Level of Service for the Intersection of Pickney/Michigan and Marion/Mason

AM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements[4]	**w/ Geometric Improvements & w/o Development Volumes[34]**	**w/ Geometric Improvements & Development Volumes[34]**	**w/o Geometric Improvements[4]**	**w/ Geometric Improvements & Development Volumes[34]**
EBL	C	C	C	C	D
EBT	F	D	D	F	D
EBR		D	D		D
WBL	F	C	E	F	F
WBT	C	D	D	C	D
WBR					
NBL	F	C	E	F	F
NBT	C	B	B	C	B
NBR					
SBL	B	C	B	B	B
SBT	F	C	D	F	F
SBR	A	C	A	B	B
Overall	**F**	**C**	**D**	**F**	**E**
PM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements[4]	**w/ Geometric Improvements & w/o Development Volumes[34]**	**w/ Geometric Improvements & Development Volumes[34]**	**w/o Geometric Improvements[4]**	**w/ Geometric Improvements & Development Volumes[34]**
EBL	C	C	C	C	C
EBT	F	C	C	F	D
EBR		C	C		C
WBL	D	C	C	E	C
WBT	C	D	D	D	F
WBR					
NBL	E	C	D	F	E
NBT	E	C	D	F	E
NBR					
SBL	C	C	C	C	C
SBT	E	C	D	D	E
SBR	C	D	C	C	C
Overall	**E**	**C**	**D**	**F**	**E**

[3]Includes additional EB Mason right turn lane and extended right turn and left turn lane storage lengths
[4]Includes NB Pickney and EB Mason/WB Marion lead permitted left turn phases and overlap phase for EB right turns

Table 20: Level of Service for the Intersection of Grand River/Michigan

AM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements	**w/ Geometric Improvements & w/o Development Volumes**	**w/ Geometric Improvements & Development Volumes**	**w/o Geometric Improvements**	**w/ Geometric Improvements & Development Volumes**
EBL	D	D	D	D	D
EBT	C	C	C	D	D
EBR					
WBL	D	D	D	D	D
WBT	C	B	C	D	D
WBR					
NBL	D	D	D	D	E
NBT	B	C	C	C	C
NBR					
SBL	D	D	D	D	D
SBT	D	D	D	D	D
SBR					
Overall	**C**	**C**	**C**	**D**	**D**
PM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements	**w/ Geometric Improvements & w/o Development Volumes**	**w/ Geometric Improvements & Development Volumes**	**w/o Geometric Improvements**	**w/ Geometric Improvements & Development Volumes**
EBL	D	D	D	D	D
EBT	C	C	C	D	D
EBR					
WBL	D	D	D	D	D
WBT	D	C	D	D	D
WBR					
NBL	D	D	D	E	E
NBT	D	C	C	E	D
NBR					
SBL	D	D	D	D	D
SBT	D	C	C	D	D
SBR					
Overall	**D**	**C**	**D**	**D**	**D**

Table 21: Level of Service for the Intersection of Grand River/National Street

AM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements[5]	**w/ Geometric Improvements & w/o Development Volumes[56]**	**w/ Geometric Improvements & Development Volumes[56]**	**w/o Geometric Improvements[5]**	**w/ Geometric Improvements & Development Volumes[567]**
EBL	C	B	C	C	B
EBT	D	C	C	E	C
EBR					
WBL	C	B	C	E	C
WBT	C	C	C	D	B
WBR	B	B	B	B	
NBL	C	C	C	C	D
NBT	D	C	C	D	D
NBR		D	D		C
SBL	D	C	C	E	D
SBT	B	B	B	B	C
SBR					C
Overall	**C**	**C**	**C**	**E**	**C**
PM Peak Hour					
Move-ment	**Future 2015**			**Future 2030**	
	w/o Geometric Improvements[5]	**w/ Geometric Improvements & w/o Development Volumes[56]**	**w/ Geometric Improvements & Development Volumes[56]**	**w/o Geometric Improvements[5]**	**w/ Geometric Improvements & Development Volumes[567]**
EBL	D	C	C	C	C
EBT	F	C	D	D	D
EBR					
WBL	E	C	D	F	D
WBT	D	B	C	D	B
WBR	B	A	A	B	
NBL	D	D	D	D	E
NBT	F	D	C	F	C
NBR		C	C		C
SBL	E	D	C	F	D
SBT	B	C	D	C	C
SBR					B
Overall	**E**	**C**	**C**	**F**	**C**

[5]Includes permitted left turn phases for SB National Street and WB Grand River Avenue and overlap phase for NB right turns

[6]Includes additional NB National Street right turn lane

[7]Includes WB Grand River Avenue right turn lane converted to shared through/right turn lane and additional SB National Street right turn lane

A previous MDOT review questioned the B### nodes that appeared in the SimTraffic reports. From the *Traffic Signal Software- User Guide for Synchro Studio 7, Synchro plus SimTraffic and 3D Viewer* published by Trafficware (Page 23-12),

> "B## is a column that is not always present and is used for reports on the queue for a bend link. If an approach link has a bend upstream, the queue for the bend link is recorded separately. The queue is reported with the downstream intersection because the queue is caused by that intersection. The queue for the bend links is recorded separately because the number of lanes can change at the bend."

At the D-19/I-96 WB ramps intersection, one limiting factor is the maximum three lanes approaching the intersection at the exit ramp due to the short decision distance on the I-96 WB Off ramp. The decision distance for the ramp is not adequate to allow for a four lane approach. MDOT has directed HRC to analyze the signalized intersection with a fourth lane for right turn traffic with 300 feet of storage. Under these traffic volumes a roundabout with a similar three lane entry from the ramps will show better performance for a longer period of time. This is described in more detail in Section 10 - Roundabout Analysis.

Recommendations

- D-19/I-96 WB Ramps – This intersection will significantly change with the growth in background traffic, the National Street Extension and the projected development along the extension in the future. HRC recommends a multi-lane roundabout instead of geometric improvements to the signalized intersection.
- Pinckney (Michigan)/Marion(Mason) – A 90 second cycle length is recommended to achieve a desirable level of service. Dedicated left turn phases are recommended for northbound Pinckney and eastbound Marion/westbound Mason, with modernization to accommodate the addition of left turn phasing. An overlap phase is also recommended for the eastbound right turning vehicles. At some point before full build out of development on National Street an eastbound exclusive right turn lane and extended right and left turn lane storage lengths will be necessary, but should be verified by a development study prior to installation.
- Grand River Avenue/Michigan Avenue – The 90 second cycle length was not changed. However, HRC recommends that the splits and left turn phasing be modified to accommodate future traffic.
- Michigan Avenue/Sibley Street – This intersection is adjacent to Grand River Avenue. It is recommended that the signal timing plan here be coordinated with the plan running at Grand River Avenue/Michigan Avenue.

- Grand River Avenue/National Street – This intersection will significantly change with the extension of National Street to D-19 in the future. HRC recommends an exclusive right turn lane for the northbound approach of National Street. Because of the high volume of left-turning traffic during the PM peak hour, HRC recommends dedicated left turn phases for westbound Grand River Avenue and southbound National Street. HRC also recommends adding an overlap phase for the northbound right turn lane. A 90 second cycle length was used for the 2015 and 2030 analyses during the AM and PM peak periods.
- Lucy Road, between CSX Railroad Crossing and Grand River Avenue – between the time of the opening of the National Street Extension and the full build out of the property along the National Street Extension it is recommended to pave this section of Lucy Road to alternate path for right turning vehicles because of the increased demand on the intersection of Grand River Avenue/National Street. Westbound left turns and northbound right turns could be split more evenly between the two intersections if this section of Lucy Road were paved to handle the additional traffic.

Section 9 - I-96 WB Off Ramp Analysis – With National Street

To analyze the operations of an off ramp there are two separate analyses to be performed:

1. Diverge analysis – capacity analysis of the freeway to ramp connection using Highway Capacity Software
2. Ramp terminal analysis – capacity and queuing analyses of the intersection at the end of the ramp using Synchro

Diverge Analysis

MDOT requested that HRC provide a diverge analysis to determine what year the ramp will fail based on the freeway/ramp junction. Diverge analysis refers to the ability of traffic to exit the mainline freeway and merge onto the ramp. A diverge analysis looks at the amount of traffic carried by the freeway and the distance ramp traffic is given to exit the freeway and enter the ramp area.

The diverge point from I-96 WB to the I-96 WB Off Ramp was analyzed using Highway Capacity Software (HCM+) for the AM and PM peak hours for two scenarios with and without the added traffic from the National Street development for the two analysis years associated with the roundabout analysis:

- Future 2015 – Existing traffic projected to 2015 using revised growth rates provided by MDOT.
- Future 2030 – Future 2015 traffic projected to 2030 using revised growth rates provided by MDOT.

Westbound I-96 traffic exiting at D-19 was projected to increase at a growth rate of 1.5% per year from existing 2005 traffic volumes with an 18% increase in 2015 to account for the effects of the opening of the Latson Road / I-96 interchange. The following table details the level of service for the freeway /ramp diverge.

Table 22: Level of Service Results of Diverge Analysis
I-96 WB / I-96 WB Off Ramp

Period	Scenario	Future 2015	Future 2030
AM Peak	Without National Street Extension	B	C
	With National Street Extension	B	C
PM Peak	Without National Street Extension	B	B
	With National Street Extension	B	B

In the year 2030, the ramp diverge area will operate at an acceptable level of service with or without the addition of National Street traffic. The ramp does not fail between now and the year 2030.

Queuing Analysis for the I-96 WB Off Ramp

HRC was asked by MDOT to determine at what year the queue from the signalized intersection on the I-96 WB Off Ramp would reach a point of interference with the I-96 WB freeway traffic. Based on I-96 WB Off ramp geometry, the distance to the gore area of the ramp is between 500 and 600 feet. To ensure no interference with the I-96 freeway traffic, a distance of 500 feet was taken as the maximum distance. The background analyses are based on optimized signal timings. The future analyses include maximum laneage and optimized signal timings. PM peak hour was reviewed due to higher ramp volumes.

The Synchro traffic model uses two links to model the I-96 WB Off Ramp (one link for the approach to the intersection and the second for the loop segment that extends to the gore area of the freeway ramp). Queues are reported for each turning movement and the longest of the eastbound queues will be used to determine the maximum queue length. SimTraffic queues are reported by link, requiring that the queues for the two links making up the total ramp be added together to obtain the total queue length.

Table 23: Queue Analysis for the I-96 WB Off Ramp

Period	Scenario	Synchro 95th Percentile Queue (feet)	SimTraffic 95th Percentile Queue (feet)
PM Peak Hour	Background 2015	624	304+623=927
	Future 2015	243	351+770=1,121
	Background 2030	811	308+615=923
	Future 2030	336	287+610=1,197

The 95th percentile queue will exceed the ramp distance when the background 2015 PM Peak hour scenario is in place.

Section 10 - Roundabout Analysis – With National Street

For the roundabout analysis, HRC and the City partnered with DLZ Michigan, Inc. (DLZ) to evaluate the performance of a roundabout and compare it against a signalized option at the D-19/I-96/National Street interchange. An analysis of the intersection was performed using the roundabout modeling software Rodel for the year 2030 peak hour volumes to determine the required geometry and future Level of Service. The roundabout was analyzed at the 50 percent confidence level for capacity (i.e., the capacity that is most likely to occur at the intersection). The roundabout was also tested at the 85 percent confidence level (i.e., a pessimistic capacity) to ensure the roundabout would provide acceptable LOS in a "worst case" scenario.

Based on the Rodel analysis, all approaches would have two-lane entries except for the I-96 off ramp which would be three lanes (Figure 16). The roundabout would have two circulating lanes that are each 16 feet wide (curb face to curb face) except for the south part of the circulating road which would have three 14-foot wide circulating lanes. The diameter of the roundabout would be approximately 210 feet.

The Rodel analysis showed that the above-noted geometry would provide LOS A in year the 2030 for the AM and PM peak hours at the 50 percent confidence level, with an average delay per vehicle of 5.1 and 6.0 seconds, respectively. At the 85 percent confidence level, the roundabout would still provide acceptable traffic operations for this scenario in 2030 (LOS A with average delay of 8.5 seconds in the AM and LOS B with average delays of 10.0 seconds in the PM). See attached Rodel outputs in Appendix E.

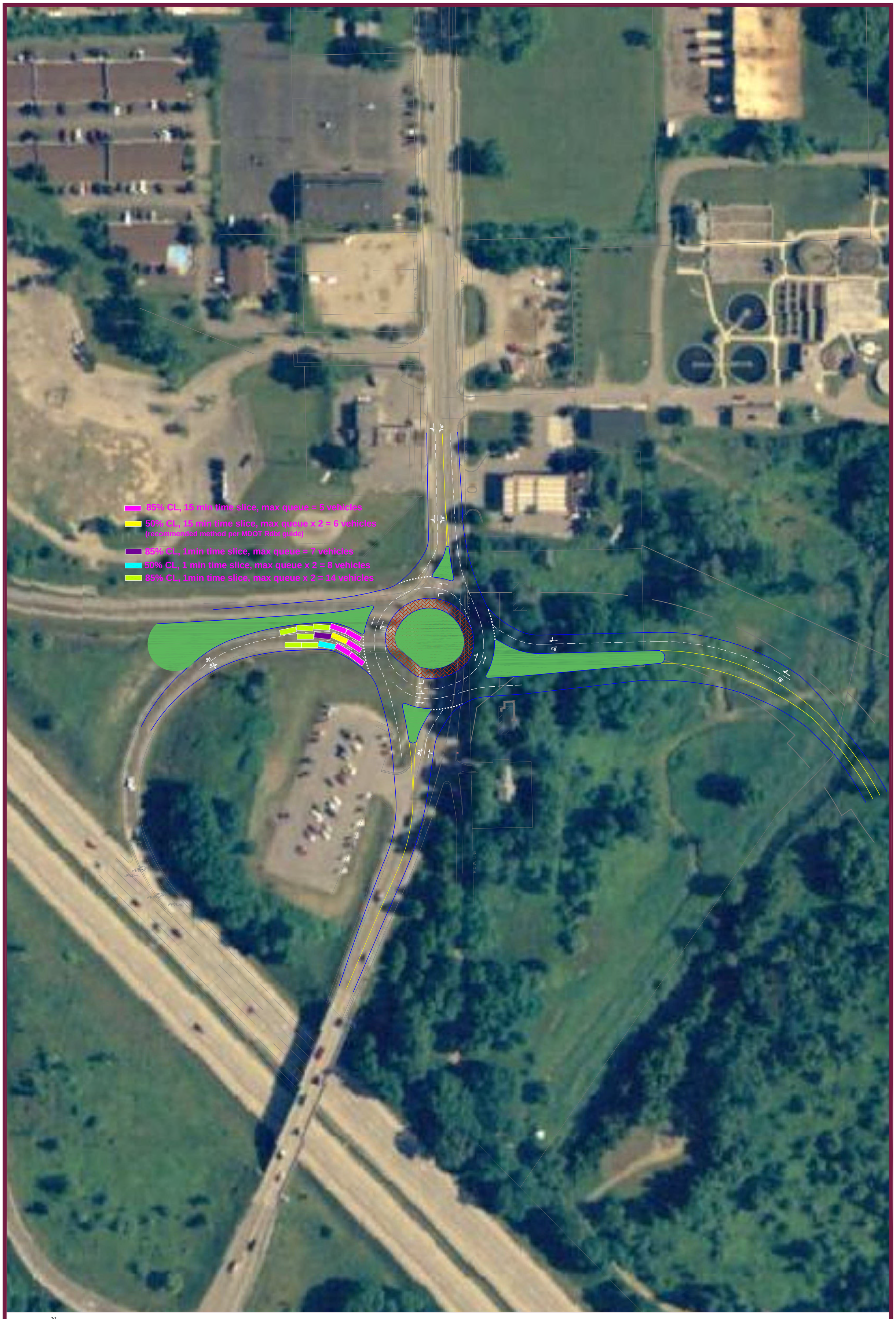
If traffic volumes eventually exceed the 2030 projections, right turn semi-bypass lanes could be constructed on the eastbound and westbound approaches to increase capacity and provide acceptable operations. The eastbound bypass lane would likely need to be constructed first. These improvements would be relatively low cost and would increase total capacity at the roundabout by approximately 25 percent.

Queuing Analysis for the I-96 WB Off Ramp

This geometry was also analyzed to determine potential queue lengths on the eastbound approach (I-96 off ramp). In order to ensure queues from the roundabout would not back down the off ramp and onto

the freeway, a worst-case scenario was used to determine the queue length. Using 2030 traffic volumes and 1-minute time slices in Rodel, the maximum queue at the 85 percent confidence level was doubled to determine the maximum number of vehicles queuing. This resulted in a queue of 14 vehicles. As shown in Figure 16, the queue length would be approximately 130 feet long and would not back up anywhere near the freeway. As per the MDOT roundabout guide, the preferred method for calculating queue length is to double the maximum queue at the 50 percent confidence level. Using this method, the queue would be six vehicles (approximately 50 feet). Considering this information, the maximum queue expected at the roundabout in 2030 is likely less than 10 cars.

When compared to the traffic signal option, the roundabout provides better Level of Service, shorter queues and does not negatively impact the operation of the I-96 Off ramp.



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Scale: 1" =60' (at 24"x30")

Figure 16

DLZ

Section 11 - Conclusions and Recommendations

Conclusions

HRC was directed by MDOT to use growth rates to project background traffic volumes for the years 2015 and 2030 and HRC developed a methodology for calculating the traffic expected to use a new bypass called the National Street Extension. Trips to be generated by proposed projects along the National Street Extension were assigned to the network and incorporated into the future 2015 scenario.

When projecting traffic to the background 2015 and 2030 scenarios, growth rates were utilized because the regional transportation planning model could not provide specific growth factors for each intersection turning movement. The use of growth rates can overestimate the number of vehicles when used to project for a period greater than five years. The Future 2015 Scenario includes the redistribution of traffic due to the connection of the National Street Extension, and the additional traffic due to the development expected along the National Street Extension. Future 2030 traffic was projected using Future 2015 traffic and growth rates provided by MDOT to project traffic to 2030.

Using Synchro software, HRC conducted capacity analyses for ten intersections in the study area within the City of Howell. Four of these intersections are signalized. The remaining six intersections do not warrant signalization. HRC developed five scenarios to analyze: Existing, Background 2015, Background 2030, and Future 2015 and Future 2030 with a National Street Extension.

The benefits of the National Street Extension are seen in two unsignalized intersections and one signalized intersection. Both Grand River Avenue/Barnard and Grand River Avenue/Washington showed an improvement between Background 2015 and Future 2015 scenarios in several turning movements level of service with the opening of the National Street Extension. The signalized intersection of Grand River Avenue/Michigan Avenue will have an overall delay reduction and improvement in some turning movements due to signal timing modifications only.

An alternative to traffic signalization was evaluated at the D-19/I-96 WB ramps. Using RODEL software, HRC and DLZ, Inc. evaluated a four leg multi-lane roundabout for Future 2030 volumes. The RODEL results showed that a roundabout will handle traffic volumes in 2030 with a LOS B or better.

Recommendations

HRC is recommending improvements to several signalized intersections in the study area for the Future 2015 and 2030 scenarios. To achieve the level of service shown in Section 8, HRC made the following changes to the intersections:

- D-19/I-96 WB Ramps – This intersection will significantly change with the growth in background traffic, the National Street Extension and the projected development along the extension in the future. HRC recommends a multi-lane roundabout instead of geometric improvements to the signalized intersection. The roundabout was found to operate at a Level of Service B, while a signalized intersection was shown to queue beyond the length of the exit ramp. The selection of this location for connecting National Street is detailed in Section 2.
- Pinckney (Michigan)/Marion(Mason) – A 90 second cycle length is recommended to achieve a desirable level of service. Dedicated left turn phases are recommended for northbound Pinckney and eastbound Marion/westbound Mason, with modernization to accommodate the addition of left turn phasing. An overlap phase is also recommended for the eastbound right turning vehicles. At some point before full build out of development on National Street an eastbound exclusive right turn lane and extended right and left turn lane storage lengths will be necessary, but should be verified by a development study prior to installation.
- Grand River Avenue/Michigan Avenue – The 90 second cycle length was not changed. However, HRC recommends that the splits and left turn phasing be modified to accommodate future traffic.
- Michigan Avenue/Sibley Street – This intersection is adjacent to Grand River Avenue. It is recommended that the signal timing plan here be coordinated with the plan running at Grand River Avenue/Michigan Avenue.
- Grand River Avenue/National Street – This intersection will significantly change with the extension of National Street to D-19 in the future. HRC recommends an exclusive right turn lane for the northbound approach of National Street. Because of the high volume of left-turning traffic during the PM peak hour, HRC recommends dedicated left turn phases for westbound Grand River Avenue and southbound National Street. HRC also recommends adding an overlap phase for the northbound right turn lane. A 90 second cycle length was used for the 2015 and 2030 analyses during the AM and PM peak periods.
- Lucy Road, between CSX Railroad Crossing and Grand River Avenue – Between the time of the opening of the National Street Extension and the full build out of the property along the National Street Extension, it is recommended to pave this section of Lucy Road to relieve the stress of the increased demand on the intersection of Grand River Avenue/National Street. Westbound left

turns and northbound right turns could be split more evenly between the two intersections if this section of Lucy Road were paved to handle the additional traffic.

Section 12 - Qualifications of Preparers

Richard Beaubien, P.E., PTOE

Associate
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Education
B.S., Civil Engineering
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Professional Engineer, Missouri
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Professional Engineer, Florida
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Affiliations
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American Society of Civil Engineers

Engineering Society of Detroit

Past International President-Institute of Transportation Engineers

Intelligent Transportation Society of America

Intelligent Transportation Society of Michigan

International Municipal Signal Association

Mr. Beaubien has been the Transportation Director for Hubbell, Roth & Clark, Inc. since 1989. He has 40 years of experience in municipal traffic engineering, transportation planning, highway design, traffic system operations, right-of-way acquisition, and Intelligent Transportation Systems.

Professional Experience

Mr. Beaubien's prior experience includes 14 years as the Transportation Director for the City of Troy, Michigan; 2 years as Chief Engineer for Reid, Cool & Michalski Traffic and Transportation Engineers; and 5 years as a Highway Engineer for the Federal Highway Administration. He chairs the Metro Detroit Incident Management Coordinating Committee. He was the 2006 – 2007 President of the Intelligent Transportation Society of Michigan.

Mr. Beaubien has been recognized as a traffic engineering expert in litigation involving traffic crashes. He is a registered professional engineer in Michigan, Illinois, Missouri, Florida and California. He has been certified as a Professional Traffic Operations Engineer by the Transportation Professional Certification Board, Washington, D.C. He is a past International President of the Institute of Transportation Engineers and a recipient of the Institute's Marsh Award.

Advanced Traffic Management System
Road Commission of Macomb County
Project Manager for the Road Commission of Macomb County to design and install an Advanced Traffic Management System (ATMS) for portions of Mound Road, Metropolitan Parkway and Harper Avenue. This project adds four new systems to the closed-loop signal system being implemented throughout Macomb County. This project integrates the latest technology for traffic signal systems, which communicates directly with the Road Commission's Traffic Operations Center in Mt. Clemens. The project provides a wireless communication system between traffic signal systems, ITS components and the Traffic Operations Center. The benefits of this new system include an improved traffic flow with the capability to change traffic signal timings based on traffic volumes and in the case of emergency situations as well as reductions in operations expenses on signals.

Road Safety Audit for the Proposed Brandon Elementary School
Charter Township of Brandon
Project Manger for the road safety audit of a driveway onto Oakwood Road from the proposed Brandon Elementary School. A road safety audit is an examination of a roadway, in which an independent qualified auditor identifies and reports on safety issues. The road safety audit included: 24 hour traffic volumes and speeds; sight distance evaluation; a detailed crash analysis; projected traffic volumes and patterns for the proposed elementary school and recommended road improvements for safe access to and from the site.

Richard Beaubien, P.E., PTOE

Associate
Transportation Department Head

International Right-of-Way Association

National Society of Professional Engineers

Michigan Society of Professional Engineers

SEMCOG Transportation Advisory Council

Transportation Research Board

Awards

President's Award, Intelligent Transportation Society of Michigan, 2003

Marsh Award, Institute of Transportation Engineers, 1998

Coordinating Council Award, Institute of Transportation Engineers, 1996

Arthur C. Gibson Award, Institute of Transportation Engineers, Michigan Section, 1990

Engineer of the Year, Michigan Society of Professional Engineers, Oakland Chapter, 1987

Outstanding Civil Engineer, American Society of Civil Engineers, Southeast Michigan Branch, 1986

Outstanding Engineer in Government, Michigan Society of Professional Engineers, 1985

Traffic Circulation Analysis – Ann Arbor High School
City of Ann Arbor
Project Manager for a Circulation and Safety Study to improve overall safety in and around school campus for drivers, bus users and pedestrians. Analyzed existing traffic conditions, identified deficiencies and suggested countermeasures. Conducted license plate survey to track traffic on the school premise. Performed capacity analysis using HCS and detailed crash analysis at two intersections and two driveways.

Intersection Safety Audits
City of Wixom
Project Manager for Safety Studies at three intersections in Wixom. Performed peak hour turning movement counts, collected 24-hour traffic volume and speed data, reviewed crash history, reviewed geometrics, and suggested countermeasures with cost estimates for two adjacent intersections on Beck Road in Wixom.

Williams Lake Road Environmental Assessment
Road Commission for Oakland County
Project Development Study to evaluate alternative alignments and geometry for Williams Lake Road in Waterford Township. Conducted traffic and safety analyses to determine the preferred alternative for a realigned Williams Lake Road. Conducted traffic crash analysis and license plate survey to determine the safety and traffic flow impacts of the proposed realignment. Assessed environmental impacts.

Oakland County Signal Systems Optimization Project, Phase 2
Road Commission for Oakland County
Project Manager for the Road Commission for Oakland County project to analyze and retime 324 traffic signals in 13 communities in southeast Oakland County. The project was funded by MDOT with a federal grant from the Congestion Mitigation Air Quality program. The program improved the efficiency and safety of the roadway network and improved air quality by optimizing the signal timings and providing of progression on the major corridors.

I-696/Franklin Road Interchange Roadway Network Evaluation
City of Southfield
Project Manager for a roadway network evaluation, including signal retiming, with the construction of slip ramps at Franklin Road to improve access to the area without detrimental effects on the operation of I-696. Southfield retained HRC to determine if the slip ramps were constructed as planned, what local road system improvements would be needed to make both slip ramps operate effectively. HRC tested the design strategies using Synchro and the CORSIM simulation model with policy and program priorities as determined by the City of Southfield.

Oakland County SCATS Clearance Interval Study
Road Commission for Oakland County
Project Manager for the Road Commission for Oakland County project to develop clearance interval timing for Sydney Coordinated Adaptive Traffic Systems (SCATS) signals in Oakland County. A total of 274 intersections were surveyed for approach speed, grade, pedestrian and vehicle clearance distances. Data collected for each SCATS signal was

used to calculate the required vehicle change and clearance intervals according to RCOC and ITE standards. Results were calculated and reported in an easy to use spreadsheet format.

Squirrel Road Corridor Traffic Study
Auburn Hills, Michigan
Project Manager for development of a Master Plan for road improvements in eastern Auburn Hills and western Rochester Hills, Michigan. HRC was retained by the Cities of Auburn Hills and Rochester Hills to study the future needs of the Squirrel Road Corridor in the City of Auburn Hills. The study area included the eastern part of Auburn Hills, and a portion of the western part of the City of Rochester Hills. The study area suggested intersection and segment improvements where needed.

Northville Traffic Study
Northville, Michigan
Project Manager for the City of Northville Downtown Traffic Study. The City of Northville retained HRC in 1998 to undertake a comprehensive citywide traffic study to determine what improvements, if any, will be necessary to safely accommodate the future traffic volumes. An important emphasis was on retaining the city's small town heritage and attractive downtown shopping area.

State Farm Intersection Safety Studies
Road Commission for Oakland County
Project Manager for the State Farm Insurance project to conduct a traffic operations and safety study at three high crash intersections.

The safety work consisted of identifying existing safety issues through a thorough analysis of traffic crash data and traffic conflict characteristics for each of the study intersections. The study of traffic conflicts augments the traffic crash analysis by providing real-time information about potential collision causation.

The traffic operations work included a review of the physical and geometric attributes of the intersection, adjacent land uses and turn movement counts during the AM and PM Peak hours. HRC then conducted capacity analysis by intersection by approach by time of day.

Tienken Road Corridor Study
Rochester Hills, Michigan
Project Manager for a study of Tienken Road in Rochester Hills, Michigan to evaluate what road, signal, and pedestrian improvements are needed to accommodate development activities in the northeast portion of the City.

The HRC team analyzed a comprehensive array of data about the corridor including topographical data, environmental assessment and right-of-way. The major roads in the area were simulated using CORSIM/NETSIM software in order to simulate existing traffic conditions and to test which future alternative had a high probability of success.

Access Management Study for Main Street
City of Adrian
Project Manager for a study to analyze the safety and operational

characteristics of access to a redevelopment site near downtown Adrian.

26 Mile Road Corridor Study
Road Commission of Macomb County
Project Manager for an environmental assessment of 26 Mile Road in Macomb County, Michigan. The Road Commission of Macomb County selected a team headed by Hubbell, Roth & Clark, Inc. (HRC) to prepare an Environmental Assessment for the 26 Mile Road corridor in Macomb County. This project required the analysis of the impacts of upgrading 26 Mile Road (2-lane rural type road) in Macomb County, Michigan. The limits of the project were the Oakland County line (Dequindre Road extended) on the west to the St. Clair County line on the east.

M-15 Access Management Plan
Michigan Department of Transportation
Project Manager for the MDOT project to develop an Access Management Plan for M-15, I-75 to I-69. The M-15 corridor is 20 miles long, traverses through seven communities and is maintained by two county road commissions. Recommendations for existing problems focused on Access Management techniques such as sharing and consolidating driveways, separating driveways from intersections, and correcting offset problems.

Abbott Road Environmental Assessment
City of East Lansing
Transportation Manager responsible for developing and evaluating design concepts to widen Abbott Road from 2 to 5 lanes to meet future capacity needs. Concepts included safety and access management concerns.

Evergreen Corridor Study
Detroit, Michigan
Project Manager for the AAA Michigan Study of the Evergreen Corridor in the City of Detroit. AAA Michigan retained HRC to conduct a safety study for the Evergreen Road corridor (between 8 Mile Road and Warren Avenue). The purpose of this study was to conduct a review of the traffic conditions and collision characteristics of the Evergreen Road corridor, to identify any operational deficiencies that may be affecting traffic safety, and to develop countermeasures to reduce the collision risk along the corridor. The study also included re-timing of the signals along the corridor.

M-24 Corridor Study
Project Manager for study of M-24 corridor to document existing traffic conditions, forecast future traffic volumes and develop long- and short-term corridor improvements.

Macomb County Traffic Operations Center
Road Commission of Macomb County
Project Manager for the development of an ITS Master Plan and the Design/Build of a Traffic Operations Center for the Road Commission of Macomb County in Mt. Clemens, Michigan. The new traffic operations center was designed to monitor and communicate with 170 signalized intersections on the most congested arterials in southern Macomb County. In addition to building a new facility to centralize all of the traffic signal operations, the project developed an Intelligent Transportation Systems

Master Plan to guide the Road Commission's future investments in technologies and equipment to improve traffic flow and reduce congestion throughout the county.

ITS/ATMS/ATIS Deployment-Metro Detroit
Project Manger for the HRC portion of the design/build of 145 miles of ITS equipment on metro Detroit freeways. HRC was part of the Iteris (formerly Rockwell) team responsible for the implementation of one of the world's largest freeway instrumentation projects in Metropolitan Detroit. Nearly 145 miles of freeway were equipped with both Advanced Transportation Management System (ATMS) and Advanced Traveler Information System (ATIS) elements. A major feature of the project was the integration of MDOT's intelligent transportation systems center (MITS Center) in downtown Detroit with the Road Commission for Oakland County's arterial traffic operations center in Waterford Township.

Oakland County Real Time, Adaptive, Advanced Traffic Management
Project Manager for the first phase of the FAST-TRAC project in Oakland County, Michigan. The project installed an advanced Traffic Management System which incorporates the Sydney Coordinated Adaptive Traffic System (SCATS) for real time adaptive traffic control and Autoscope Machine Vision Vehicle Detection System. This is the first application of the SCATS Traffic Control System in the western hemisphere. This is also the first widespread application of the Autoscope Machine Vision Vehicle Detection System to an arterial street system. HRC's role in this project included plans for the new Traffic Operations Center.

Presentations/Publications

"A Regional Concept of Transportation Operations for Metropolitan Detroit," 14th World Congress on Intelligent Transport Systems, Technical Paper 1068, Beijing, China, October 2007.

"The Metro Detroit Regional Transportation Operations Collaboration and Coordination Initiative," Institute of Transportation Engineers 2006 Annual Meeting Compendium of Technical Papers, August 2006.

"Traffic Incident Management in Metro Detroit: A Prelude to Regional Operations," Institute of Transportation Engineers 2004 Annual Meeting Compendium of Technical Papers, August 2004

"How a Good Traffic Engineering Program Can Help Defend Public Agencies," Institute of Transportation Engineers 2001 Annual Meeting Compendium of Technical Papers, August 2001

"Working Together for a Safer Construction Zone," Institute of Transportation Engineers 2000 Annual Meeting Compendium of Technical Papers, August 2000

"What Every City Should Know About Intelligent Transportation Systems," National League of Cities Issues and Options, Volume 7, No. 1, January/February 1999, (with Beata Lamparski), pp. 7-11.

"Harmonization Programs: What is the Role of Liability?", Compendium of Technical Papers, Institute of Transportation Engineers Conference on Enhancing Transportation Safety in the 21st Century, March 1999.

"The Joy of Traffic Engineering… and ITE," ITE Journal, Vol. 68, No. 10, October 1998, pp. 34-36.

"Designing and Building ITS for Metro Detroit Freeways - Lessons Learned," 1998 Compendium of Technical Papers, Institute of Transportation Engineers, August 1998.

"Does Traffic Calming Make Streets Safer?" Compendium of Technical Papers, Institute of Transportation Engineers, Conference on Harmonizing Transportation and Community Goals, March 1998.

"Early Winners for Metro Detroit's Incident Management Program," 1996 ITE International Conference Resource Papers, March 1996, pp. 21-25.

"Advanced Technology - A Tool for Urban Traffic Engineers in Incident Management," 1995 Compendium of Technical Papers, Institute of Transportation Engineers, August 1995, pp. 248-252.

"Metro Detroit's Incident Management Program - Applying ITS Technology," ITE Journal, Vol. 65, No. 4, April 1995 (with Kunwar Rajendra), pp. 19-24.

"Smart Streets - A Tool for Urban Traffic Engineers," Traffic Technology International '95, pp. 162-167.

"Incident Management as a Platform for IVHS Deployment in Metropolitan Detroit," Compendium of Technical Papers, Institute of Transportation Engineers, Canadian District, June 1994, pp. 307-321.

"Bringing 'Smart Streets' to Metropolitan Detroit," Planning & Zoning News, Vol. 12, No. 7, May 1994 (with Kunwar Rajendra) pp. 14-17.

Colleen Hill, P.E., PTOE

Transportation Project Engineer

Education

B.S., C.E., Transportation
Wayne State University 2000

M.S., C.E., Transportation
Wayne State University 2002

Professional Registration/ Certification

Professional Engineer, Michigan
No. 51514

Professional Traffic Operations Engineer
No. 1427

Affiliations

American Society of Civil Engineers

Institute of Transportation Engineers

Michigan Traffic Signal Summit

Tau Beta Pi, The Engineering Honor Society

Women's Transportation Seminar

Ms. Hill prepares transportation studies, impact studies for land developments, traffic crash analysis, traffic operations, and safety studies. Responsible for modeling and simulating transportation networks to optimize, also evaluating safety and operational improvements. Software proficiency in Highway Capacity Software, Synchro/SimTraffic, CORSIM, ACCUSIM II, MicroStation, Autodesk Map 3D, RODEL. Also responsible for preparing traffic control and detours plans, traffic signal design and layout plans. Officer of the Institute of Transportation Engineers, Michigan Section.

Professional Experience

Abbott Road Environmental Assessment
City of East Lansing
Responsible for preparing Environmental Assessment to widen one mile of Abbott Road from a 2 to 5 lane road. Prepared crash analysis and responsible for design concept report. Conducted noise analysis in accordance with provisions of 23 CFR Section 772 of Federal Code of Regulations. Type I project did not trigger noise abatement measures.

Road Safety Audit for the Proposed Brandon Elementary School
Charter Township of Brandon
Project Engineer for the road safety audit of a driveway onto Oakwood Road from the proposed Brandon Elementary School. Ms. Hill performed a sight distance evaluation and a detailed crash analysis for the road segment to be accessed by the proposed driveway. A road safety audit is an examination of a roadway, in which an independent qualified auditor identifies and reports on safety issues. The road safety audit included: 24 hour traffic volumes and speeds; sight distance evaluation; a detailed crash analysis; projected traffic volumes and patterns for the proposed elementary school and recommended road improvements for safe access to and from the site.

Traffic Circulation Analysis for Ann Arbor Huron High School
City of Ann Arbor
Circulation and Safety Study to improve overall safety in and around school campus for drivers, bus users and pedestrians. Analyzed existing traffic conditions, identified deficiencies and suggested countermeasures. Conducted license plate survey to track traffic on the school premise. Performed capacity analysis using HCS and detailed crash analysis at two intersections and two driveways.

Intersection Safety Audits
City of Wixom
Safety Studies at two intersections in Wixom. Performed peak hour turning movement counts, collected 24-hour traffic volume and speed data, reviewed crash history, reviewed geometrics, and suggested countermeasures with cost estimates for two adjacent intersections on Beck Road in Wixom.

Oakland County SCATS Clearance Interval Study
Road Commission for Oakland County
Coordinated the data collection effort for a total of 274 intersections included in the project. Each intersection was surveyed for approach speed, grade, pedestrian and vehicle clearance distances. Developed a user-friendly

spreadsheet to calculate and report vehicle and pedestrian clearance intervals.

Squirrel Road Corridor Study
City of Auburn Hills
Involved in data collection, development and optimization of 35 mile network using Synchro for the study to evaluate the future capacity needs of the Squirrel Road Corridor. Study area encompassed 36 signalized intersections, 5 interchanges, and several unsignalized intersections.

Oakland County Signal Systems Optimization Project (Phase 2)
Road Commission for Oakland County
Performed QA/QC for transportation networks modeled and optimized through this project. Calculated clearance intervals as per RCOC accepted practice. Performed safety analysis for over 160 study intersections, performed traffic crash pattern analysis and prepared recommendations for safety improvements. Prepared red-lined traffic signal timing plans. Also assisted with field checks of installed signal timing plans and prepared recommendations for revised signal timing.

26 Mile Road Environmental Assessment
Road Commission of Macomb County
Collected turning movement counts and geometric information for 27 intersections along 26 Mile Road in Macomb County. Performed traffic crash analysis for intersections and segments in the study area. Modeled the 19 mile long corridor using Synchro software for Build and No Build scenarios.

Williams Lake Road Environmental Assessment
Waterford Township
Conducted a traffic and safety analysis to better determine appropriate termini of the project and provide the necessary justification for the preferred alternative for a realigned Williams Lake Road. Conducted traffic crash analysis and license plate survey to determine the safety and traffic flow impacts of the proposed realignment. Conducted air quality analysis for microscale carbon monoxide pollution using CAL3QHC, Version 2.0. CO concentrations were all below NAAQS for 1-hour and 8-hour exposures.

State Farm Intersection Safety Studies
Road Commission for Oakland County
Reviewed geometrics, traffic volume, traffic crash and traffic conflict characteristics for three high crash intersections. Evaluated existing safety issues, recommended potential traffic safety engineering countermeasures, and developed an implementation plan of action.

M-15 Access Management Plan
Michigan Department of Transportation
Performed driveway spacing analysis using MDOT, Oakland and Genesee County Standards. Responsible for performing traffic crash analysis for driveways and intersections along the M-15 corridor over its 20 mile length between I-75 and I-69.

Rochester Road and South Boulevard Traffic Signal Design
City of Troy
Prepared plans and special provisions per RCOC standards for construction and installation of a redesigned traffic signal. Configured traffic signal contact height and sag using SIGSPAN.

Opdyke Road Traffic Signal Design
Bloomfield Township/City of Bloomfield Hills
Prepared plans and special provisions per RCOC standards for the construction and installation of two traffic signals, one of which was incorporated into the adjacent rail-highway grade crossing. Plans were prepared in accordance with the Michigan Manual of Uniform Traffic Control Devices. Coordinated construction activities with Canadian National Railroad.

Acacia Park Drain Relief- Traffic Signal Removal
Village of Beverly Hills
Prepared traffic signal and overhead sign removal plans and specifications/special provisions for the removal from service of a SCATS traffic signal. Coordinated permit approval from RCOC for traffic signal removal. Plans were prepared in accordance with RCOC Standards, the Michigan Manual of Traffic Control Devices, or as modified by the Engineer to meet site specific requirements.

Presentations/Publications

"Intersection Safety within a Signal Optimization Project," Institute of Transportation Engineers 2004 Technical Conference and Exhibit Compendium of Technical Papers, March 2004 (with Stephen B. Dearing, P.E.).

"Intersection Safety within a Signal Optimization Project," Presented Institute of Transportation Engineers 2004 Technical Conference and Exhibit, March 31, 2004.

"Intersection Safety within a Signal Optimization Project," Presented Institute of Transportation Engineers Michigan Section Technical Session, February 12, 2004.

"Michigan ITE Website Update," Presented Institute of Transportation Engineers Michigan Section Technical Session, February 12, 2004.

"Change and Clearance Interval Design on Red-Light Running and Late Exits," Transportation Research Record, No. 1856 (p. 193-201), Washington D.C., 2003 (with Kerrie L. Schattler and Tapan K. Datta).

Appendix A

Intersection Turning Volumes

Pinckney and Pulford

City of Howell 2005 Counts

AM PEAK

	NB				SB				WB				Total
	TH		RT		LT		TH		LT		RT		
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
7:00-7:15	103	10	3	0	1	0	163	6	0	0	3	0	289
7:15-7:30	146	3	13	0	0	0	153	10	3	0	0	0	328
7:30-7:45	180	14	6	0	0	0	162	9	2	0	1	0	374
7:45-8:00	208	8	9	0	0	0	169	7	1	0	2	0	404
8:00-8:15	244	19	13	0	2	0	164	16	1	0	2	0	461
8:15-8:30	137	9	6	0	0	0	141	10	0	0	1	0	304
8:30-8:45	168	3	4	0	1	0	166	12	3	0	2	0	359
8:45-9:00	171	10	23	0	1	0	148	11	0	0	1	1	366
Peak Hour	778		41		2		648		7		5		1481
Study Peak Hour	637	35	31	0	1	0	647	32	6	0	6	0	1395
Study Peak Hour Truck %		5%		0%		0%		5%		0%		0%	
				0.781111				0.965909				1	

PM PEAK

	NB				SB				WB				Total
	TH		RT		LT		TH		LT		RT		
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
4:00-4:15	238	9	2	0	0	0	191	8	2	1	0	0	451
4:15-4:30	282	8	8	0	0	0	206	4	1	0	2	0	511
4:30-4:45	233	9	13	0	2	0	219	5	3	0	1	0	485
4:45-5:00	201	4	3	0	1	0	196	5	0	0	0	0	410
5:00-5:15	191	16	14	0	3	0	235	3	2	0	0	0	464
5:15-5:30	190	6	17	0	0	0	217	4	2	0	0	0	436
5:30-5:45	143	4	17	0	0	0	148	1	2	0	0	0	315
5:45-6:00	190	7	13	0	0	0	169	4	0	0	0	0	383
Peak Hour	907		38		6		856		6		3		1816
Study Peak Hour	714	33	61	0	3	0	769	12	6	0	0	0	1598
Study Peak Hour Truck %		4%		0%		0%		2%		0%		#DIV/0!	
				0.914027				0.813278				0.75	

Pinkney and Marion

City of Howell September, 2005 Counts

AM PEAK

	NB						SB						EB						WB						
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
7:00-7:15	18	7	64	2	8	0	1	0	100	1	2	0	34	0	34	0	35	3	25	0	3	0	1	0	338
7:15-7:30	33	1	86	3	10	0	0	0	95	3	5	1	33	0	10	1	27	8	23	0	15	2	2	0	358
7:30-7:45	29	6	99	0	20	1	1	0	125	2	14	0	33	0	35	2	40	4	38	2	26	0	1	1	479
7:45-8:00	41	8	136	3	8	1	0	0	120	1	7	0	42	1	39	2	43	7	33	0	22	0	4	1	519
8:00-8:15	31	11	127	4	15	0	0	0	102	6	7	1	27	0	36	1	36	7	23	2	17	1	5	0	459
8:15-8:30	27	9	112	2	15	0	2	0	105	4	8	0	37	3	30	0	45	10	28	0	18	2	0	0	457
8:30-8:45	32	3	118	0	14	0	1	0	96	5	15	0	37	0	41	3	41	7	25	1	15	2	2	1	459
8:45-9:00	33	5	119	2	25	0	1	0	99	5	9	0	41	0	36	0	25	3	22	0	19	0	3	0	447
Peak Hour	128		474		58		3		452		36		139		140		164		122		83		10		1809
	121	22	385	8	46	2	2	0	440	7	28	1	142	1	118	5	145	22	119	2	66	2	8	2	1694
Study Peak Hour Truck %		15%		2%		4%		0%		2%		3%		1%		4%		13%		2%		3%		20%	
					0.74111675						0.8415493						0.80783582						0.73161765		

PM PEAK

	NB						SB						EB						WB						
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
4:00-4:15	43	6	166	1	16	0	2	0	117	4	40	0	27	0	28	0	54	3	42	0	47	0	2	0	598
4:15-4:30	38	6	147	2	12	0	1	0	144	3	34	2	22	3	31	0	37	1	34	1	49	1	5	0	573
4:30-4:45	45	3	140	3	14	0	3	0	137	2	43	1	26	0	29	1	50	4	31	0	61	1	2	0	596
4:45-5:00	38	4	162	1	17	1	6	0	137	2	37	1	36	0	22	0	47	3	26	0	53	2	1	0	596
5:00-5:15	37	8	144	4	15	2	0	0	122	1	41	4	19	0	60	0	61	4	35	1	77	3	1	0	639
5:15-5:30	45	5	144	4	14	2	1	0	128	3	44	1	30	0	32	0	64	1	29	1	66	1	0	0	615
5:30-5:45	59	4	159	0	9	0	1	0	124	0	42	0	31	1	18	0	50	4	35	0	56	2	2	0	597
5:45-6:00	63	4	170	3	11	1	1	0	119	0	39	0	19	0	33	0	33	3	28	0	37	1	1	0	566
Peak Hour	165		590		60		10		524		165		111		143		222		121		257		4		2372
	204	21	617	11	49	5	3	0	493	4	166	5	99	1	143	0	208	12	127	2	236	7	4	0	2417
Study Peak Hour Truck %		9%		2%		9%		0%		1%		3%		1%		0%		5%		2%		3%		0%	
					0.900						0.94774011						0.82678571						0.8034188		

Michigan and Livingston

City of Howell September, 2005 Counts

AM PEAK

	NB						SB						EB						WB						
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
7:00-7:15	5	0	94	2	0	0	1	0	107	2	2	0	1	0	0	0	7	0	2	0	0	0	0	0	223
7:15-7:30	1	2	113	2	6	0	4	0	89	5	3	0	1	0	0	0	5	0	2	0	1	0	0	0	234
7:30-7:45	4	0	162	4	5	0	2	0	137	7	1	0	0	0	0	0	10	1	0	0	2	0	1	0	336
7:45-8:00	9	0	195	2	1	0	2	0	135	2	0	0	0	0	0	0	7	0	2	0	0	0	2	0	357
8:00-8:15	7	1	194	4	4	0	0	0	112	5	0	0	0	0	1	0	14	0	1	0	0	0	0	0	343
8:15-8:30	4	0	161	1	0	0	3	0	102	1	0	0	0	0	0	0	7	0	0	0	1	0	0	0	280
8:30-8:45	5	0	142	4	3	0	1	0	105	2	1	0	1	0	0	0	9	1	0	0	0	0	1	0	275
8:45-9:00	4	0	165	6	5	0	0	0	118	2	0	0	0	0	0	0	6	0	0	0	0	0	4	0	310
Peak Hour																									
Study Peak Hour	19	2	564	10	12	0	9	0	468	16	6	0	2	0	0	0	29	1	6	0	3	0	3	0	1150
Study Peak Hour Truck %		10%		2%		0%		0%		3%		0%		0%		#DIV/0!		3%		0%		0%		0%	
					0.73309179						0.84863946						0.72727273						0.75		

PM PEAK

	NB						SB						EB						WB						
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
4:00-4:15	31	1	173	4	14	0	3	0	161	1	5	0	2	0	0	0	0	0	1	0	0	0	0	0	396
4:15-4:30	10	0	147	1	2	0	3	0	166	1	9	0	1	0	1	0	0	0	0	0	2	0	1	0	344
4:30-4:45	7	0	185	1	9	0	0	0	160	3	5	0	0	0	0	0	0	0	1	0	1	0	1	0	373
4:45-5:00	10	0	192	2	2	0	4	0	170	3	10	0	1	0	2	0	0	0	2	0	1	0	1	0	400
5:00-5:15	7	0	188	1	2	0	2	0	213	3	18	0	0	0	0	0	0	0	3	0	0	0	3	0	440
5:15-5:30	13	0	170	1	2	0	2	1	171	3	6	0	3	0	0	0	2	0	1	0	0	0	1	0	376
5:30-5:45	20	2	188	1	6	0	2	1	133	3	34	0	0	0	0	0	0	0	0	0	0	0	0	0	390
5:45-6:00	10	0	171	1	3	0	4	0	88	2	5	0	0	0	7	0	2	0	1	0	0	0	0	0	294
Peak Hour	50		738		12		10		687		68		4		2		2		6		1		5		1585
Study Peak Hour	50	2	717	4	13	0	10	2	605	11	63	0	3	0	7	0	4	0	5	0	0	0	4	0	1500
Study Peak Hour Truck %		4%		1%		0%		17%		2%		0%		0%		0%		0%		0%		######		0%	
					0.906						0.73199153						0.38888889						0.375		

Michigan and Washington

City of Howell September 2005 Counts

AM PEAK

	NB						SB						EB						WB							
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total	
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T		
7:00-7:15	5	0	53	2	10	0	3	0	83	2	0	0	0	0	0	0	7	0	1	0	1	0	0	0	167	
7:15-7:30	14	0	82	1	26	0	3	0	110	4	0	0	0	0	2	0	8	0	1	0	0	0	0	0	251	
7:30-7:45	11	0	108	4	32	0	5	0	123	11	0	0	1	0	0	0	8	0	2	0	2	0	4	0	311	
7:45-8:00	25	0	112	5	31	0	9	0	130	6	1	0	1	0	1	0	7	0	5	0	0	0	6	0	339	1068
8:00-8:15	20	0	96	3	32	0	9	0	125	6	2	0	0	0	2	0	3	0	2	0	1	0	2	0	303	1204
8:15-8:30	15	0	100	1	24	0	6	0	90	4	0	0	1	0	0	0	5	0	0	0	3	0	6	0	255	1208
8:30-8:45	9	0	96	5	29	0	8	0	92	3	2	0	0	0	0	0	4	0	3	0	1	0	4	0	256	1153
8:45-9:00	17	0	115	4	29	0	15	0	87	4	3	0	0	0	3	0	6	0	2	0	0	0	6	0	291	1105
Peak Hour	71	0	416	13	119	0	29	0	468	27	3	0	3	0	3	0	23	0	9	0	6	0	18	0	1208	
Study Peak Hour	55	0	355	12	99	0	20	0	446	23	1	0	2	0	3	0	30	0	9	0	3	0	10	0	1068	
Study Peak Hour Truck %		0%		3%		0%		0%		5%		0%		0%		0%		0%		0%		0%		0%		
					0.75289017						0.8390411						0.875						0.5			

PM PEAK

	NB						SB						EB						WB							
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT			
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	Total	
4:00-4:15	11	0	96	2	20	0	13	0	159	4	7	0	1	0	0	0	5	0	3	0	1	0	5	0	327	
4:15-4:30	24	0	123	1	29	0	11	0	173	2	1	0	0	0	1	0	5	0	3	0	0	0	4	0	377	
4:30-4:45	10	0	100	0	18	0	13	0	143	5	1	0	1	0	0	0	4	0	5	0	1	0	4	0	305	
4:45-5:00	16	0	150	0	37	0	23	0	167	4	7	0	0	0	3	0	5	0	1	0	1	0	2	0	416	1425
5:00-5:15	21	0	107	1	22	0	16	0	190	5	3	0	0	0	0	0	2	0	5	0	1	0	6	0	379	1477
5:15-5:30	25	0	105	3	21	0	17	0	145	6	1	0	0	0	1	0	7	0	3	0	1	0	5	0	340	1440
5:30-5:45	17	0	105	1	21	0	13	0	160	3	1	0	1	0	0	0	2	0	0	0	1	0	4	0	329	1464
5:45-6:00	12	0	117	1	35	0	9	0	141	1	0	0	0	0	1	0	2	0	4	0	2	0	1	0	326	1374
Peak Hour	71		480		106		63		673		12		1		4		16		14		3		16		1459	
Study Peak Hour	75	0	434	6	99	0	55	0	636	15	5	0	1	0	2	0	13	0	12	0	5	0	16	0	1374	
Study Peak Hour Truck %		0%		1%		0%		0%		2%		0%		0%		0%		0%		0%		0%		0%		
					0.930						0.83060748						0.5						0.6875			

Grand River and Court

City of Howell September 2005 Counts

AM PEAK

	NB				EB				WB				
	LT		RT		TH		RT		LT		TH		
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	Total
7:00-7:15	0	0	18	0	96	1	1	0	10	0	89	6	**221**
7:15-7:30	0	0	5	0	139	8	2	0	5	0	173	5	**337**
7:30-7:45	1	0	20	0	138	3	1	0	9	0	104	10	**286**
7:45-8:00	0	0	18	0	141	5	4	0	10	0	101	5	**284** 1128
8:00-8:15	0	0	10	0	123	3	1	0	16	0	96	8	**257** **1164**
8:15-8:30	0	0	13	1	104	5	2	0	6	0	97	15	**243** 1070
8:30-8:45	0	0	14	0	145	5	2	0	15	0	130	6	**317** 1101
8:45-9:00	1	0	16	0	170	5	0	0	7	0	120	11	**330** 1147
Peak Hour	1		53		541		8		40		474		**1117**
Study Peak Hour	1	0	61	0	514	17	8	0	34	0	467	26	**1128**
Study Peak Hour Truck %		0%		0%		3%		0%		0%		5%	
				0.738				0.898				0.72	

PM PEAK

	NB				EB				WB				
	LT		RT		TH		RT		LT		TH		
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	Total
4:00-4:15	1	0	9	0	200	7	5	0	23	0	170	8	**423**
4:15-4:30	1	0	12	0	166	3	0	0	27	0	155	8	**372**
4:30-4:45	1	0	16	0	183	4	4	0	30	0	185	12	**435**
4:45-5:00	0	0	6	1	215	2	4	0	18	0	200	10	**456** 1686
5:00-5:15	1	0	14	0	176	2	6	1	28	0	195	3	**426** 1689
5:15-5:30	0	0	6	0	212	4	7	0	37	0	197	1	**464** **1781**
5:30-5:45	2	0	13	0	167	11	7	0	19	0	195	1	**415** 1761
5:45-6:00	0	0	14	0	178	1	3	0	20	0	180	0	**396** 1701
Peak Hour	2		42		786		21		113		777		**1741**
Study Peak Hour	3	0	47	0	733	18	23	1	104	0	767	5	**1701**
Study Peak Hour Truck %		0%		0%		2%		4%		0%		1%	
				0.833				0.869				0.932	

Y:\200408\20040841\Design\ProjectData\Traffic\Synchro\transfer\March2007\ssheets\CityProvided_TrafCounts_Truck.xls
GR_Court

Grand River and Barnard

City of Howell September, 2005 Counts

AM PEAK

	NB						SB						EB						WB						
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
7:00-7:15	2	0	0	0	6	0	7	0	1	0	3	0	1	0	95	7	4	0	10	0	120	7	0	0	263
7:15-7:30	0	0	0	0	2	0	1	0	0	0	1	0	2	0	136	7	1	0	7	0	200	7	0	0	364
7:30-7:45	0	0	1	0	9	0	3	0	1	0	4	0	1	0	153	3	4	0	14	0	112	10	1	0	316
7:45-8:00	1	0	0	0	9	0	2	0	1	0	2	0	1	0	166	12	4	0	10	0	110	6	0	0	324
8:00-8:15	1	0	1	0	12	0	1	0	1	0	2	0	1	0	114	4	4	0	9	0	115	5	0	0	270
8:15-8:30	0	0	1	0	12	1	5	0	3	0	2	0	1	0	107	6	4	0	8	0	95	9	0	0	254
8:30-8:45	1	0	2	0	13	0	3	0	1	0	3	0	3	0	135	3	2	0	4	0	105	5	3	0	283
8:45-9:00	1	0	1	0	15	0	2	0	0	0	3	0	0	0	162	8	4	0	7	0	130	5	0	0	338
Peak Hours	2		2		32		7		3		9		5		569		13		40		537		1		1220
Study Peak Hour	3	0	1	0	26	0	13	0	3	0	10	0	5	0	550	29	13	0	41	0	542	30	1	0	1267
Study Peak Hour Truck %	0%		0%		0%		0%		0%		0%		0%		5%		0%		0%		5%		0%		
					0.75						0.59090909						0.81557377						0.71728972		

PM PEAK

	NB						SB						EB						WB						
	LT		TH		RT		LT		TH		RT		LT		TH		RT		LT		TH		RT		Total
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T	
4:00-4:15	1	0	2	0	9	0	3	0	0	0	4	0	8	0	203	7	4	0	12	0	226	5	1	0	485
4:15-4:30	3	0	1	0	13	0	0	0	4	0	7	0	4	0	187	3	2	0	17	0	186	10	3	0	440
4:30-4:45	1	0	2	0	10	0	1	0	0	0	4	0	2	0	169	1	1	0	11	0	192	19	6	0	419
4:45-5:00	1	0	1	0	9	0	2	0	1	0	9	0	6	0	161	4	2	0	16	0	190	10	6	0	418
5:00-5:15	1	0	1	0	16	0	4	0	1	0	5	0	4	0	184	7	3	0	11	0	225	4	4	0	470
5:15-5:30	0	0	1	0	9	0	3	0	1	0	3	0	4	0	166	3	1	0	15	0	180	2	2	0	390
5:30-5:45	1	0	1	0	13	0	1	0	0	0	4	0	8	0	170	3	6	0	6	0	200	2	4	0	419
5:45-6:00	1	0	7	0	20	0	1	0	0	0	8	0	16	0	160	3	3	0	6	0	105	0	3	0	333
Peak Hours	6		6		41		6		5		24		20		720		9		56		794		16		1703
Study Peak Hour	3	0	10	0	58	0	9	0	2	0	20	0	32	0	680	16	13	0	38	0	710	8	13	0	1612
Study Peak Hour Truck %	0%		0%		0%		0%		0%		0%		0%		2%		0%		0%		1%		0%		
					0.63392857						0.775						0.93560606						0.78790984		

City of Howell September 2005 Counts

Grand River and Fowler

AM PEAK

	NB				EB				WB			
	LT		RT		TH		RT		LT		TH	
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T
7:00-7:15	1	0	16	0	114	1	1	0	9	0	111	6
7:15-7:30	1	0	20	1	145	9	7	0	21	1	190	7
7:30-7:45	3	0	26	0	143	4	7	0	27	0	95	8
7:45-8:00	1	0	41	0	166	7	4	0	31	2	125	4
8:00-8:15	1	0	27	1	141	3	4	0	20	0	103	7
8:15-8:30	0	0	25	1	131	6	1	0	15	0	110	18
8:30-8:45	1	0	25	1	160	5	4	0	25	0	122	5
8:45-9:00	6	0	39	4	157	8	16	0	29	2	126	12
Peak Hour	6		114		595		22		99		513	
Study Peak Hour	6	0	103	1	568	21	19	0	88	3	521	25
Study Peak Hour Truck %		0%		1%		4%		0%		3%		5%
				0.655				0.859				0.727

PM PEAK

	NB				EB				WB			
	LT		RT		TH		RT		LT		TH	
	PC	T	PC	T	PC	T	PC	T	PC	T	PC	T
4:00-4:15	1	0	29	2	192	7	2	0	32		184	9
4:15-4:30	2	0	40	0	180	3	5	0	25	1	195	10
4:30-4:45	1	0	41	1	208	5	3	0	32	1	201	14
4:45-5:00	2	0	41	0	222	3	1	0	47	1	178	11
5:00-5:15	1	0	38	0	200	5	3	0	39	0	185	3
5:15-5:30	3	0	40	0	212	4	4	0	43	0	198	2
5:30-5:45	2	0	27	0	201	2	2	0	32	1	200	3
5:45-6:00	1	0	33	2	200	2	6	0	37	0	155	1
Peak Hour	7		160		842		11		161		762	
Study Peak Hour	7	0	138	2	813	13	15	0	151	1	738	9
Study Peak Hour Truck %		0%		1%		2%		0%		1%		1%

MDOT Turning Movement Count Report - Cars & Trucks

INT ID	CO #	ROAD 1	ROAD 2	COMMUNITY	TMC DATE
116	116	E Grand River Rd	N National St	Howell	10/4/2005

Start Time	NB Left	NB Thru	NB Right	NB Ped	NB App Total	EB Left	EB Thru	EB Right	EB Ped	EB App Total	SB Left	SB Thru	SB Right	SB Ped	SB App Total	WB Left	WB Thru	WB Right	WB Ped	WB App Total	Interval Total
7:00 AM	1	2	19	0	22	0	109	0	0	109	26	4	2	0	32	11	121	13	0	145	308
7:15 AM	2	3	39	0	44	3	129	0	0	132	37	3	3	0	43	17	188	31	0	236	455
7:30 AM	3	2	42	0	47	0	188	2	0	190	52	8	4	0	64	7	162	36	0	205	506
7:45 AM	1	5	43	0	49	1	206	4	0	211	50	4	0	0	54	19	162	25	0	206	520
8:00 AM	4	3	27	0	34	4	111	1	0	116	42	8	1	0	51	19	125	34	0	178	379
8:15 AM	1	0	34	1	35	0	124	4	0	128	39	7	4	0	50	12	141	30	0	183	396
8:30 AM	1	7	33	0	41	2	152	0	0	154	45	5	2	0	52	23	137	33	0	193	440
8:45 AM	3	11	62	2	76	0	208	7	0	215	57	12	2	0	71	21	167	30	0	218	580
11:00 AM	4	11	30	0	45	4	196	4	0	204	47	11	5	0	63	19	167	34	0	220	532
11:15 AM	4	7	37	0	48	3	182	5	0	190	40	14	11	0	65	15	176	44	0	235	538
11:30 AM	6	7	38	0	51	0	196	8	0	204	48	4	4	0	56	15	172	41	1	228	539
11:45 AM	4	3	57	0	64	3	187	6	1	196	66	13	4	1	83	28	191	54	1	273	616
12:00 PM	8	13	57	0	78	2	239	2	0	243	71	14	8	0	93	25	208	62	1	295	709
12:15 PM	12	5	35	0	52	6	213	6	1	225	58	13	1	0	72	21	209	55	1	285	634
12:30 PM	12	6	53	0	71	1	189	5	0	195	59	11	8	0	78	19	221	57	0	297	641
12:45 PM	13	10	46	0	69	1	178	7	1	186	55	15	8	0	78	19	222	50	0	291	624
4:00 PM	10	14	40	0	64	4	229	4	0	237	58	12	10	1	80	21	210	77	1	308	689
4:15 PM	4	13	50	2	67	5	182	6	0	193	45	13	7	0	65	19	220	68	0	307	632
4:30 PM	5	13	43	4	61	4	206	1	1	211	72	18	12	0	102	26	209	68	0	303	677
4:45 PM	5	6	51	2	62	2	197	5	0	204	71	18	9	0	98	26	234	93	0	353	717
5:00 PM	12	18	39	0	69	2	214	3	2	219	78	22	12	0	112	16	227	100	0	343	743
5:15 PM	17	13	37	1	67	6	238	6	2	250	47	40	11	2	98	11	182	101	0	294	709
5:30 PM	9	8	41	1	58	1	220	4	0	225	52	28	7	0	87	8	185	74	1	267	637
5:45 PM	5	12	43	0	60	4	198	4	0	206	76	18	5	0	99	36	214	103	1	353	718
Total	146	192	996	13	1334	58	4491	94	8	4643	1291	315	140	4	1746	453	4450	1313	7	6216	13939
App %	10.9	14.4	74.7			1.2	96.7	2.0			73.9	18.0	8.0			7.3	71.6	21.1			
Total %	1.0	1.4	7.1		9.6	0.4	32.2	0.7		33.3	9.3	2.3	1.0		12.5	3.2	31.9	9.4		44.6	
HV %	9	4	3			9	5	9			2	3	4			2	5	2			

Appendix B

Intersection Level of Service
Without National Street Extension

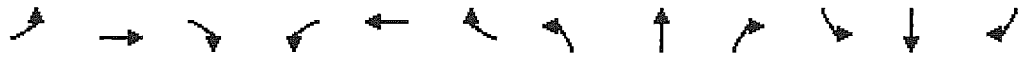
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	214	75	120	417	678	127
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.6	6.6	6.6
Lane Util. Factor	1.00	1.00		0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.99	1.00	1.00
Satd. Flow (prot)	1863	1667		3684	1961	1667
Flt Permitted	0.95	1.00		0.61	1.00	1.00
Satd. Flow (perm)	1863	1667		2287	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	233	82	130	453	737	138
RTOR Reduction (vph)	0	67	0	0	0	45
Lane Group Flow (vph)	233	15	0	583	737	93
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	16.5	16.5		60.9	60.9	60.9
Effective Green, g (s)	16.5	16.5		60.9	60.9	60.9
Actuated g/C Ratio	0.18	0.18		0.68	0.68	0.68
Clearance Time (s)	6.0	6.0		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	342	306		1548	1327	1128
v/s Ratio Prot	c0.13				c0.38	
v/s Ratio Perm		0.01		0.25		0.06
v/c Ratio	0.68	0.05		0.38	0.56	0.08
Uniform Delay, d1	34.3	30.3		6.3	7.5	5.0
Progression Factor	1.00	1.00		1.00	0.98	1.39
Incremental Delay, d2	5.5	0.1		0.7	1.5	0.1
Delay (s)	39.8	30.4		7.0	8.8	7.1
Level of Service	D	C		A	A	A
Approach Delay (s)	37.3			7.0	8.6	
Approach LOS	D			A	A	

Intersection Summary			
HCM Average Control Delay	13.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	75.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	143	153	167	121	68	10	143	393	48	2	447	29
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.92		1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1696		1845	1879		1652	1925		1900	1961	1650
Flt Permitted	0.69	1.00		0.33	1.00		0.36	1.00		0.31	1.00	1.00
Satd. Flow (perm)	1362	1696		633	1879		625	1925		622	1961	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	177	189	206	166	93	14	193	531	65	2	532	35
RTOR Reduction (vph)	0	43	0	0	6	0	0	5	0	0	0	10
Lane Group Flow (vph)	177	352	0	166	101	0	193	591	0	2	532	25
Heavy Vehicles (%)	1%	4%	13%	3%	2%	20%	15%	2%	4%	0%	2%	3%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	28.9	28.9		28.9	28.9		49.1	49.1		49.1	49.1	49.1
Effective Green, g (s)	28.9	28.9		28.9	28.9		49.1	49.1		49.1	49.1	49.1
Actuated g/C Ratio	0.32	0.32		0.32	0.32		0.55	0.55		0.55	0.55	0.55
Clearance Time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Grp Cap (vph)	437	545		203	603		341	1050		339	1070	900
v/s Ratio Prot		0.21			0.05			0.31			0.27	
v/s Ratio Perm	0.13			c0.26			c0.31			0.00		0.02
v/c Ratio	0.41	0.65		0.82	0.17		0.57	0.56		0.01	0.50	0.03
Uniform Delay, d1	23.8	26.2		28.1	21.9		13.4	13.4		9.3	12.8	9.4
Progression Factor	1.00	1.00		1.00	1.00		1.23	1.26		1.15	1.22	1.36
Incremental Delay, d2	2.8	5.8		29.3	0.6		6.5	2.1		0.0	1.6	0.1
Delay (s)	26.6	32.0		57.4	22.5		23.0	19.0		10.8	17.2	12.9
Level of Service	C	C		E	C		C	B		B	B	B
Approach Delay (s)		30.3			43.7			20.0			16.9	
Approach LOS		C			D			B			B	

Intersection Summary			
HCM Average Control Delay	24.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	10	81	40	10	10	20	279	60	10	349	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87		1.00	0.92		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1614		1770	1723		1770	1813		1770	1863	1583
Flt Permitted	0.74	1.00		0.69	1.00		0.47	1.00		0.48	1.00	1.00
Satd. Flow (perm)	1384	1614		1291	1723		881	1813		899	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	11	88	43	11	11	22	303	65	11	379	11
RTOR Reduction (vph)	0	57	0	0	7	0	0	9	0	0	0	5
Lane Group Flow (vph)	11	42	0	43	15	0	22	359	0	11	379	6
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	31.2	31.2		31.2	31.2		47.2	47.2		47.2	47.2	47.2
Effective Green, g (s)	31.2	31.2		31.2	31.2		47.2	47.2		47.2	47.2	47.2
Actuated g/C Ratio	0.35	0.35		0.35	0.35		0.52	0.52		0.52	0.52	0.52
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Grp Cap (vph)	480	560		448	597		462	951		471	977	830
v/s Ratio Prot		0.03			0.01			0.20			c0.20	
v/s Ratio Perm	0.01			c0.03			0.02			0.01		0.00
v/c Ratio	0.02	0.07		0.10	0.02		0.05	0.38		0.02	0.39	0.01
Uniform Delay, d1	19.4	19.7		19.9	19.4		10.4	12.7		10.3	12.8	10.2
Progression Factor	1.00	1.00		1.00	1.00		0.72	0.68		1.03	0.81	1.19
Incremental Delay, d2	0.1	0.3		0.4	0.1		0.2	1.1		0.1	0.9	0.0
Delay (s)	19.4	20.0		20.3	19.5		7.7	9.7		10.6	11.3	12.2
Level of Service	B	B		C	B		A	A		B	B	B
Approach Delay (s)		19.9			20.0			9.6			11.3	
Approach LOS		B			C			A			B	

Intersection Summary				
HCM Average Control Delay	12.2	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.27			
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6	
Intersection Capacity Utilization	37.0%	ICU Level of Service	A	
Analysis Period (min)	15			

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	396	59	58	413	11	56	137	86	40	242	9
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.94		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3653		1863	3711		1863	1847		1863	1950	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3653		1863	3711		1863	1847		1863	1950	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	22	501	75	83	590	16	59	144	91	49	299	11
RTOR Reduction (vph)	0	12	0	0	2	0	0	25	0	0	2	0
Lane Group Flow (vph)	22	564	0	83	604	0	59	210	0	49	308	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	3.0	32.1		7.0	36.1		7.1	21.5		5.4	19.8	
Effective Green, g (s)	3.0	32.1		7.0	36.1		7.1	21.5		5.4	19.8	
Actuated g/C Ratio	0.03	0.36		0.08	0.40		0.08	0.24		0.06	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	62	1303		145	1489		147	441		112	429	
v/s Ratio Prot	0.01	0.15		c0.04	c0.16		c0.03	0.11		0.03	c0.16	
v/s Ratio Perm												
v/c Ratio	0.35	0.43		0.57	0.41		0.40	0.48		0.44	0.72	
Uniform Delay, d1	42.6	22.0		40.1	19.3		39.4	29.4		40.8	32.5	
Progression Factor	1.00	1.00		0.88	0.67		1.27	0.61		1.00	1.00	
Incremental Delay, d2	3.5	1.1		4.5	0.7		1.7	0.8		2.7	5.7	
Delay (s)	46.0	23.1		39.7	13.7		51.8	18.7		43.6	38.2	
Level of Service	D	C		D	B		D	B		D	D	
Approach Delay (s)		23.9			16.8			25.3			38.9	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM Average Control Delay	24.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	56.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	632	6	54	633	105	7	12	143	165	19	9
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3720		1863	1961	1500	1863	1689		1863	1865	
Flt Permitted	0.16	1.00		0.28	1.00	1.00	0.73	1.00		0.63	1.00	
Satd. Flow (perm)	314	3720		540	1961	1500	1437	1689		1229	1865	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	5	832	8	65	763	127	8	14	172	220	25	12
RTOR Reduction (vph)	0	1	0	0	0	62	0	0	0	0	8	0
Lane Group Flow (vph)	5	839	0	65	763	65	8	186	0	220	29	0
Parking (#/hr)			0			0						
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	45.9	45.9		45.9	45.9	45.9	32.0	32.0		32.0	32.0	
Effective Green, g (s)	45.9	45.9		45.9	45.9	45.9	32.0	32.0		32.0	32.0	
Actuated g/C Ratio	0.51	0.51		0.51	0.51	0.51	0.36	0.36		0.36	0.36	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Grp Cap (vph)	160	1897		275	1000	765	511	601		437	663	
v/s Ratio Prot		0.23			c0.39			0.11			0.02	
v/s Ratio Perm	0.02			0.12		0.04	0.01			c0.18		
v/c Ratio	0.03	0.44		0.24	0.76	0.08	0.02	0.31		0.50	0.04	
Uniform Delay, d1	11.0	14.0		12.3	17.7	11.3	18.8	21.0		22.8	19.0	
Progression Factor	0.75	0.97		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.7		2.0	5.5	0.2	0.1	1.3		4.1	0.1	
Delay (s)	8.6	14.3		14.3	23.2	11.5	18.8	22.3		26.9	19.1	
Level of Service	A	B		B	C	B	B	C		C	B	
Approach Delay (s)		14.3			21.0			22.2			25.7	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	19.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	75.4%	ICU Level of Service	D
Analysis Period (min)	15		

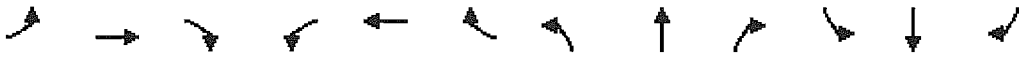
c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	520	240	84	408	650	191
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.6	6.6	6.6
Lane Util. Factor	1.00	1.00		0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.99	1.00	1.00
Satd. Flow (prot)	1863	1667		3694	1961	1667
Flt Permitted	0.95	1.00		0.63	1.00	1.00
Satd. Flow (perm)	1863	1667		2332	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	565	261	91	443	707	208
RTOR Reduction (vph)	0	133	0	0	0	95
Lane Group Flow (vph)	565	128	0	534	707	113
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	28.6	28.6		48.8	48.8	48.8
Effective Green, g (s)	28.6	28.6		48.8	48.8	48.8
Actuated g/C Ratio	0.32	0.32		0.54	0.54	0.54
Clearance Time (s)	6.0	6.0		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	592	530		1264	1063	904
v/s Ratio Prot	c0.30				c0.36	
v/s Ratio Perm		0.08		0.23		0.07
v/c Ratio	0.95	0.24		0.42	0.67	0.12
Uniform Delay, d1	30.1	22.7		12.2	14.7	10.1
Progression Factor	1.00	1.00		1.00	1.40	2.59
Incremental Delay, d2	25.9	0.2		1.0	2.5	0.2
Delay (s)	55.9	22.9		13.3	23.1	26.4
Level of Service	E	C		B	C	C
Approach Delay (s)	45.5			13.3	23.9	
Approach LOS	D			B	C	

Intersection Summary			
HCM Average Control Delay	29.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	88.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	143	220	129	243	4	225	628	54	3	497	130
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.91		1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1765		1863	1938		1743	1927		1900	1980	1650
Flt Permitted	0.42	1.00		0.24	1.00		0.38	1.00		0.21	1.00	1.00
Satd. Flow (perm)	839	1765		474	1938		693	1927		425	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	120	172	265	161	304	5	250	698	60	3	523	137
RTOR Reduction (vph)	0	62	0	0	1	0	0	3	0	0	0	38
Lane Group Flow (vph)	120	375	0	161	308	0	250	755	0	3	523	99
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	26.9	26.9		26.9	26.9		51.1	51.1		51.1	51.1	51.1
Effective Green, g (s)	26.9	26.9		26.9	26.9		51.1	51.1		51.1	51.1	51.1
Actuated g/C Ratio	0.30	0.30		0.30	0.30		0.57	0.57		0.57	0.57	0.57
Clearance Time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Grp Cap (vph)	251	528		142	579		393	1094		241	1124	937
v/s Ratio Prot		0.21			0.16			c0.39			0.26	
v/s Ratio Perm	0.14			c0.34			0.36			0.01		0.06
v/c Ratio	0.48	0.71		1.13	0.53		0.64	0.69		0.01	0.47	0.11
Uniform Delay, d1	25.8	28.1		31.6	26.3		13.2	13.8		8.5	11.4	8.9
Progression Factor	1.00	1.00		1.00	1.00		1.21	1.24		0.95	1.05	1.18
Incremental Delay, d2	6.4	7.9		116.0	3.5		6.3	2.9		0.1	1.3	0.2
Delay (s)	32.2	36.0		147.5	29.8		22.3	20.1		8.2	13.4	10.8
Level of Service	C	D		F	C		C	C		A	B	B
Approach Delay (s)		35.2			70.1			20.7			12.8	
Approach LOS		D			E			C			B	

Intersection Summary			
HCM Average Control Delay	30.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	20	105	190	25	66	24	345	88	13	416	32
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87		1.00	0.89		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1863	1714		1863	1747		1863	1901		1863	1961	1667
Flt Permitted	0.69	1.00		0.67	1.00		0.41	1.00		0.40	1.00	1.00
Satd. Flow (perm)	1359	1714		1314	1747		806	1901		775	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	29	22	114	207	27	72	26	375	96	14	452	35
RTOR Reduction (vph)	0	74	0	0	47	0	0	10	0	0	0	16
Lane Group Flow (vph)	29	62	0	207	52	0	26	461	0	14	452	19
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	31.2	31.2		31.2	31.2		47.2	47.2		47.2	47.2	47.2
Effective Green, g (s)	31.2	31.2		31.2	31.2		47.2	47.2		47.2	47.2	47.2
Actuated g/C Ratio	0.35	0.35		0.35	0.35		0.52	0.52		0.52	0.52	0.52
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Grp Cap (vph)	471	594		456	606		423	997		406	1028	874
v/s Ratio Prot		0.04			0.03			c0.24			0.23	
v/s Ratio Perm	0.02			c0.16			0.03			0.02		0.01
v/c Ratio	0.06	0.10		0.45	0.09		0.06	0.46		0.03	0.44	0.02
Uniform Delay, d1	19.6	19.9		22.8	19.8		10.5	13.4		10.4	13.2	10.3
Progression Factor	1.00	1.00		1.00	1.00		0.61	0.48		1.06	0.92	1.40
Incremental Delay, d2	0.3	0.3		3.2	0.3		0.2	1.3		0.1	1.1	0.0
Delay (s)	19.9	20.3		26.0	20.1		6.6	7.7		11.1	13.2	14.5
Level of Service	B	C		C	C		A	A		B	B	B
Approach Delay (s)		20.2			24.1			7.7			13.2	
Approach LOS		C			C			A			B	

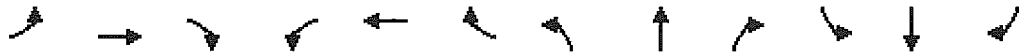
Intersection Summary			
HCM Average Control Delay	14.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	467	68	138	462	94	75	288	75	62	255	16
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.97		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3654		1863	3631		1863	1900		1863	1943	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3654		1863	3631		1863	1900		1863	1943	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	52	519	76	150	502	102	84	324	84	69	283	18
RTOR Reduction (vph)	0	12	0	0	17	0	0	11	0	0	2	0
Lane Group Flow (vph)	52	583	0	150	587	0	84	397	0	69	299	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	5.4	27.7		9.9	32.2		7.0	21.6		6.8	21.4	
Effective Green, g (s)	5.4	27.7		9.9	32.2		7.0	21.6		6.8	21.4	
Actuated g/C Ratio	0.06	0.31		0.11	0.36		0.08	0.24		0.08	0.24	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	112	1125		205	1299		145	456		141	462	
v/s Ratio Prot	0.03	c0.16		c0.08	c0.16		c0.05	c0.21		0.04	0.15	
v/s Ratio Perm												
v/c Ratio	0.46	0.52		0.73	0.45		0.58	0.87		0.49	0.65	
Uniform Delay, d1	40.9	25.7		38.8	22.1		40.1	32.9		39.9	30.9	
Progression Factor	1.00	1.00		0.88	0.73		1.27	0.85		1.00	1.00	
Incremental Delay, d2	3.0	1.7		9.5	0.8		5.2	15.7		2.7	3.1	
Delay (s)	43.9	27.4		43.7	16.9		56.1	43.8		42.6	34.0	
Level of Service	D	C		D	B		E	D		D	C	
Approach Delay (s)		28.7			22.3			45.9			35.6	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	31.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	14	855	15	79	852	362	39	50	170	268	98	44
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3716		1863	1961	1500	1863	1733		1863	1870	
Flt Permitted	0.09	1.00		0.22	1.00	1.00	0.66	1.00		0.56	1.00	
Satd. Flow (perm)	167	3716		430	1961	1500	1291	1733		1093	1870	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	16	972	17	86	926	393	41	53	181	291	107	48
RTOR Reduction (vph)	0	1	0	0	0	187	0	0	0	0	18	0
Lane Group Flow (vph)	16	988	0	86	926	206	41	234	0	291	137	0
Parking (#/hr)			0			0						
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	46.9	46.9		46.9	46.9	46.9	31.0	31.0		31.0	31.0	
Effective Green, g (s)	46.9	46.9		46.9	46.9	46.9	31.0	31.0		31.0	31.0	
Actuated g/C Ratio	0.52	0.52		0.52	0.52	0.52	0.34	0.34		0.34	0.34	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Grp Cap (vph)	87	1936		224	1022	782	445	597		376	644	
v/s Ratio Prot		0.27			c0.47			0.14			0.07	
v/s Ratio Perm	0.10			0.20		0.14	0.03			c0.27		
v/c Ratio	0.18	0.51		0.38	0.91	0.26	0.09	0.39		0.77	0.21	
Uniform Delay, d1	11.4	14.1		12.9	19.6	12.0	20.0	22.4		26.4	20.9	
Progression Factor	0.83	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.5	0.9		4.9	13.0	0.8	0.4	1.9		14.4	0.8	
Delay (s)	14.0	14.3		17.8	32.5	12.8	20.4	24.3		40.7	21.6	
Level of Service	B	B		B	C	B	C	C		D	C	
Approach Delay (s)		14.3			26.1			23.7			34.1	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	23.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	97.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

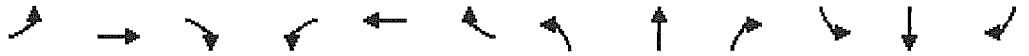
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	276	100	105	459	786	118
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.6	6.6	6.6
Lane Util. Factor	1.00	1.00		0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.99	1.00	1.00
Satd. Flow (prot)	1863	1667		3691	1961	1667
Flt Permitted	0.95	1.00		0.59	1.00	1.00
Satd. Flow (perm)	1863	1667		2197	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	300	109	114	499	854	128
RTOR Reduction (vph)	0	86	0	0	0	45
Lane Group Flow (vph)	300	23	0	613	854	83
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	18.7	18.7		58.7	58.7	58.7
Effective Green, g (s)	18.7	18.7		58.7	58.7	58.7
Actuated g/C Ratio	0.21	0.21		0.65	0.65	0.65
Clearance Time (s)	6.0	6.0		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	387	346		1433	1279	1087
v/s Ratio Prot	c0.16				c0.44	
v/s Ratio Perm		0.01		0.28		0.05
v/c Ratio	0.78	0.07		0.43	0.67	0.08
Uniform Delay, d1	33.7	28.6		7.5	9.6	5.7
Progression Factor	1.00	1.00		1.00	1.10	1.18
Incremental Delay, d2	9.4	0.1		0.9	2.4	0.1
Delay (s)	43.0	28.7		8.5	13.0	6.9
Level of Service	D	C		A	B	A
Approach Delay (s)	39.2			8.5	12.2	
Approach LOS	D			A	B	

Intersection Summary			
HCM Average Control Delay	16.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	158	169	184	134	75	11	158	434	53	2	494	32
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	4.0	6.1	6.1	4.0	6.1		4.0	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1923	1504	1845	1881		1652	1924		1900	1961	1650
Flt Permitted	0.53	1.00	1.00	0.59	1.00		0.23	1.00		0.22	1.00	1.00
Satd. Flow (perm)	1045	1923	1504	1145	1881		397	1924		434	1961	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	195	209	227	184	103	15	214	586	72	2	588	38
RTOR Reduction (vph)	0	0	130	0	6	0	0	5	0	0	0	18
Lane Group Flow (vph)	195	209	97	184	112	0	214	653	0	2	588	20
Heavy Vehicles (%)	1%	4%	13%	3%	2%	20%	15%	2%	4%	0%	2%	3%
Turn Type	pm+pt		Perm	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	27.2	14.2	14.2	20.8	11.0		51.9	50.0		36.0	36.0	36.0
Effective Green, g (s)	27.2	14.2	14.2	20.8	11.0		51.9	50.0		36.0	36.0	36.0
Actuated g/C Ratio	0.30	0.16	0.16	0.23	0.12		0.58	0.56		0.40	0.40	0.40
Clearance Time (s)	4.0	6.1	6.1	4.0	6.1		4.0	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	437	303	237	341	230		368	1069		174	784	660
v/s Ratio Prot	c0.06	c0.11		c0.06	0.06		0.06	c0.34			c0.30	
v/s Ratio Perm	0.07		0.06	0.07			0.27			0.00		0.01
v/c Ratio	0.45	0.69	0.41	0.54	0.49		0.58	0.61		0.01	0.75	0.03
Uniform Delay, d1	24.5	35.8	34.1	29.6	36.9		26.1	13.5		16.3	23.1	16.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.19	1.19		0.76	0.82	0.62
Incremental Delay, d2	0.7	6.4	1.2	1.6	1.6		2.2	2.4		0.1	6.5	0.1
Delay (s)	25.2	42.2	35.3	31.2	38.5		33.1	18.4		12.5	25.4	10.3
Level of Service	C	D	D	C	D		C	B		B	C	B
Approach Delay (s)		34.5			34.0			22.0			24.4	
Approach LOS		C			C			C			C	

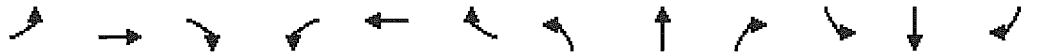
Intersection Summary			
HCM Average Control Delay	27.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	13.9
Intersection Capacity Utilization	68.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	11	89	44	11	11	22	308	66	11	385	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87		1.00	0.92		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1614		1770	1723		1770	1813		1770	1863	1583
Flt Permitted	0.74	1.00		0.69	1.00		0.52	1.00		0.52	1.00	1.00
Satd. Flow (perm)	1381	1614		1279	1723		964	1813		974	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	12	12	97	48	12	12	24	335	72	12	418	12
RTOR Reduction (vph)	0	89	0	0	11	0	0	4	0	0	0	3
Lane Group Flow (vph)	12	20	0	48	13	0	24	403	0	12	418	9
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	7.8	7.8		7.8	7.8		70.6	70.6		70.6	70.6	70.6
Effective Green, g (s)	7.8	7.8		7.8	7.8		70.6	70.6		70.6	70.6	70.6
Actuated g/C Ratio	0.09	0.09		0.09	0.09		0.78	0.78		0.78	0.78	0.78
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
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)	120	140		111	149		756	1422		764	1461	1242
v/s Ratio Prot		0.01			0.01			0.22			c0.22	
v/s Ratio Perm	0.01			c0.04			0.02			0.01		0.01
v/c Ratio	0.10	0.15		0.43	0.09		0.03	0.28		0.02	0.29	0.01
Uniform Delay, d1	37.9	38.0		39.0	37.8		2.1	2.7		2.1	2.7	2.1
Progression Factor	1.00	1.00		1.00	1.00		0.58	0.67		0.72	0.60	0.76
Incremental Delay, d2	0.4	0.5		2.7	0.3		0.1	0.4		0.0	0.4	0.0
Delay (s)	38.2	38.5		41.7	38.1		1.3	2.3		1.6	2.0	1.6
Level of Service	D	D		D	D		A	A		A	A	A
Approach Delay (s)		38.5			40.5			2.2			2.0	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	8.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	437	65	64	456	12	62	151	95	44	267	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.94		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3653		1863	3711		1863	1847		1863	1950	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3653		1863	3711		1863	1847		1863	1950	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	24	553	82	91	651	17	65	159	100	54	330	12
RTOR Reduction (vph)	0	11	0	0	2	0	0	27	0	0	2	0
Lane Group Flow (vph)	24	624	0	91	666	0	65	232	0	54	340	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	3.1	32.6		7.3	36.8		5.6	20.5		5.6	20.5	
Effective Green, g (s)	3.1	32.6		7.3	36.8		5.6	20.5		5.6	20.5	
Actuated g/C Ratio	0.03	0.36		0.08	0.41		0.06	0.23		0.06	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	64	1323		151	1517		116	421		116	444	
v/s Ratio Prot	0.01	0.17		c0.05	c0.18		c0.03	0.13		0.03	c0.17	
v/s Ratio Perm												
v/c Ratio	0.38	0.47		0.60	0.44		0.56	0.55		0.47	0.77	
Uniform Delay, d1	42.5	22.1		39.9	19.2		41.0	30.7		40.8	32.5	
Progression Factor	1.00	1.00		0.82	0.87		0.98	0.80		1.00	1.00	
Incremental Delay, d2	3.7	1.2		5.7	0.8		5.9	1.5		2.9	7.7	
Delay (s)	46.2	23.3		38.4	17.4		46.2	26.1		43.7	40.3	
Level of Service	D	C		D	B		D	C		D	D	
Approach Delay (s)		24.1			19.9			30.1			40.7	
Approach LOS		C			B			C			D	

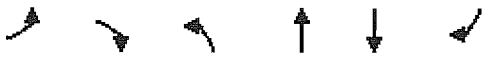
Intersection Summary			
HCM Average Control Delay	26.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	698	7	60	699	116	8	13	158	182	21	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3720		1863	1961	1500	1863	1690		1863	1868	
Flt Permitted	0.19	1.00		0.27	1.00	1.00	0.73	1.00		0.56	1.00	
Satd. Flow (perm)	366	3720		524	1961	1500	1432	1690		1098	1868	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	5	918	9	72	842	140	10	16	190	243	28	13
RTOR Reduction (vph)	0	1	0	0	0	56	0	0	0	0	10	0
Lane Group Flow (vph)	5	926	0	72	842	84	10	206	0	243	31	0
Parking (#/hr)			0			0						
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	54.3	54.3		54.3	54.3	54.3	23.6	23.6		23.6	23.6	
Effective Green, g (s)	54.3	54.3		54.3	54.3	54.3	23.6	23.6		23.6	23.6	
Actuated g/C Ratio	0.60	0.60		0.60	0.60	0.60	0.26	0.26		0.26	0.26	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
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)	221	2244		316	1183	905	376	443		288	490	
v/s Ratio Prot		0.25			c0.43			0.12			0.02	
v/s Ratio Perm	0.01			0.14		0.06	0.01			c0.22		
v/c Ratio	0.02	0.41		0.23	0.71	0.09	0.03	0.47		0.84	0.06	
Uniform Delay, d1	7.2	9.4		8.2	12.4	7.5	24.7	27.9		31.5	24.9	
Progression Factor	0.59	0.80		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.5		1.7	3.7	0.2	0.0	0.8		19.6	0.1	
Delay (s)	4.4	8.1		9.9	16.1	7.7	24.7	28.7		51.1	25.0	
Level of Service	A	A		A	B	A	C	C		D	C	
Approach Delay (s)		8.0			14.5			28.5			47.3	
Approach LOS		A			B			C			D	

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	82.0%	ICU Level of Service	D
Analysis Period (min)	15		

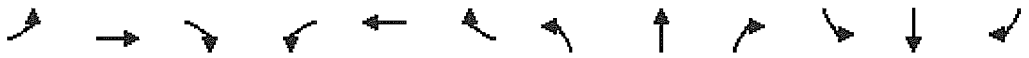
c Critical Lane Group



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	676	329	75	448	755	178
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.6	6.6	6.6
Lane Util. Factor	1.00	1.00		0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.99	1.00	1.00
Satd. Flow (prot)	1863	1667		3699	1961	1667
Flt Permitted	0.95	1.00		0.51	1.00	1.00
Satd. Flow (perm)	1863	1667		1895	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	735	358	82	487	821	193
RTOR Reduction (vph)	0	53	0	0	0	102
Lane Group Flow (vph)	735	305	0	569	821	91
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	37.3	37.3		40.1	40.1	40.1
Effective Green, g (s)	37.3	37.3		40.1	40.1	40.1
Actuated g/C Ratio	0.41	0.41		0.45	0.45	0.45
Clearance Time (s)	6.0	6.0		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	772	691		844	874	743
v/s Ratio Prot	c0.39				c0.42	
v/s Ratio Perm		0.18		0.30		0.05
v/c Ratio	0.95	0.44		0.94dl	0.94	0.12
Uniform Delay, d1	25.5	18.9		19.8	23.8	14.6
Progression Factor	1.00	1.00		1.00	0.91	0.75
Incremental Delay, d2	21.4	0.5		4.3	14.7	0.2
Delay (s)	46.9	19.3		24.1	36.3	11.3
Level of Service	D	B		C	D	B
Approach Delay (s)	37.9			24.1	31.5	
Approach LOS	D			C	C	

Intersection Summary			
HCM Average Control Delay	32.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	103.2%	ICU Level of Service	G
Analysis Period (min)	15		

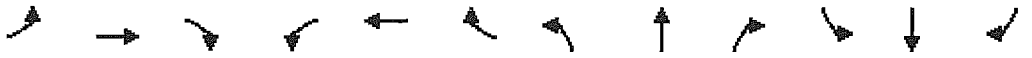
dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	158	243	142	268	4	249	694	60	3	549	144
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	4.0	6.1	6.1	4.0	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1938		1743	1927		1900	1980	1650
Flt Permitted	0.24	1.00	1.00	0.55	1.00		0.16	1.00		0.14	1.00	1.00
Satd. Flow (perm)	483	2000	1619	1079	1938		296	1927		270	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	133	190	293	178	335	5	277	771	67	3	578	152
RTOR Reduction (vph)	0	0	189	0	1	0	0	3	0	0	0	72
Lane Group Flow (vph)	133	190	104	178	339	0	277	835	0	3	578	80
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		Perm	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		6	2			5	
Permitted Phases	4		4	8			2			5		5
Actuated Green, G (s)	26.2	18.4	18.4	26.6	18.6		47.6	47.6		29.6	29.6	29.6
Effective Green, g (s)	26.2	18.4	18.4	26.6	18.6		47.6	47.6		29.6	29.6	29.6
Actuated g/C Ratio	0.29	0.20	0.20	0.30	0.21		0.53	0.53		0.33	0.33	0.33
Clearance Time (s)	4.0	6.1	6.1	4.0	6.1		5.9	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	262	409	331	389	401		351	1019		89	651	543
v/s Ratio Prot	c0.04	0.10		0.04	c0.18		0.11	c0.43			0.29	
v/s Ratio Perm	0.10		0.06	0.09			0.31			0.01		0.05
v/c Ratio	0.51	0.46	0.31	0.46	0.85		0.79	0.82		0.03	0.89	0.15
Uniform Delay, d1	25.0	31.5	30.4	24.7	34.3		29.9	17.6		20.5	28.6	21.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.18	1.25		1.07	1.13	1.25
Incremental Delay, d2	1.5	0.8	0.5	0.9	15.1		12.4	5.5		0.7	16.1	0.6
Delay (s)	26.6	32.3	31.0	25.6	49.4		47.5	27.5		22.6	48.5	27.1
Level of Service	C	C	C	C	D		D	C		C	D	C
Approach Delay (s)		30.4			41.2			32.5			44.0	
Approach LOS		C			D			C			D	

Intersection Summary			
HCM Average Control Delay	36.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.9
Intersection Capacity Utilization	84.2%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

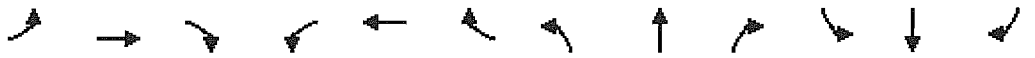


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	25	20	100	175	20	60	20	400	80	10	500	25
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.88		1.00	0.89		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1863	1716		1863	1741		1863	1912		1863	1961	1667
Flt Permitted	0.70	1.00		0.67	1.00		0.41	1.00		0.42	1.00	1.00
Satd. Flow (perm)	1374	1716		1320	1741		798	1912		824	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	27	22	109	190	22	65	22	435	87	11	543	27
RTOR Reduction (vph)	0	87	0	0	52	0	0	6	0	0	0	7
Lane Group Flow (vph)	27	44	0	190	35	0	22	516	0	11	543	20
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	18.3	18.3		18.3	18.3		60.1	60.1		60.1	60.1	60.1
Effective Green, g (s)	18.3	18.3		18.3	18.3		60.1	60.1		60.1	60.1	60.1
Actuated g/C Ratio	0.20	0.20		0.20	0.20		0.67	0.67		0.67	0.67	0.67
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
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)	279	349		268	354		533	1277		550	1310	1113
v/s Ratio Prot		0.03			0.02			0.27			c0.28	
v/s Ratio Perm	0.02			c0.14			0.03			0.01		0.01
v/c Ratio	0.10	0.13		0.71	0.10		0.04	0.40		0.02	0.41	0.02
Uniform Delay, d1	29.1	29.3		33.4	29.2		5.1	6.8		5.0	6.9	5.0
Progression Factor	1.00	1.00		1.00	1.00		0.60	0.79		1.37	1.27	1.76
Incremental Delay, d2	0.2	0.2		8.3	0.1		0.1	0.7		0.1	0.7	0.0
Delay (s)	29.3	29.5		41.7	29.3		3.1	6.0		7.0	9.5	8.9
Level of Service	C	C		D	C		A	A		A	A	A
Approach Delay (s)		29.4			37.8			5.9			9.4	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	516	75	152	510	104	83	318	83	68	282	18
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.97		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3655		1863	3631		1863	1900		1863	1943	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3655		1863	3631		1863	1900		1863	1943	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	58	573	83	165	554	113	93	357	93	76	313	20
RTOR Reduction (vph)	0	12	0	0	18	0	0	10	0	0	2	0
Lane Group Flow (vph)	58	644	0	165	649	0	93	440	0	76	331	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	7.1	24.0		10.6	27.5		8.3	23.6		7.8	23.1	
Effective Green, g (s)	7.1	24.0		10.6	27.5		8.3	23.6		7.8	23.1	
Actuated g/C Ratio	0.08	0.27		0.12	0.31		0.09	0.26		0.09	0.26	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	147	975		219	1109		172	498		161	499	
v/s Ratio Prot	0.03	c0.18		c0.09	c0.18		c0.05	c0.23		0.04	0.17	
v/s Ratio Perm												
v/c Ratio	0.39	0.66		0.75	0.59		0.54	0.88		0.47	0.66	
Uniform Delay, d1	39.4	29.4		38.4	26.4		39.0	31.9		39.1	30.0	
Progression Factor	1.00	1.00		1.12	1.22		1.17	0.69		1.00	1.00	
Incremental Delay, d2	1.7	3.5		9.2	1.5		3.3	16.3		2.2	3.3	
Delay (s)	41.2	32.9		52.2	33.6		49.0	38.1		41.3	33.3	
Level of Service	D	C		D	C		D	D		D	C	
Approach Delay (s)		33.5			37.3			40.0			34.8	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM Average Control Delay	36.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	70.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	944	17	87	941	400	43	55	188	296	108	49
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3716		1863	1961	1500	1801	1676		1863	1869	
Flt Permitted	0.09	1.00		0.18	1.00	1.00	0.65	1.00		0.52	1.00	
Satd. Flow (perm)	168	3716		358	1961	1500	1226	1676		1027	1869	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	17	1073	19	95	1023	435	46	59	200	322	117	53
RTOR Reduction (vph)	0	1	0	0	0	165	0	0	0	0	20	0
Lane Group Flow (vph)	17	1091	0	95	1023	270	46	259	0	322	150	0
Parking (#/hr)			0			0						
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	46.8	46.8		46.8	46.8	46.8	31.1	31.1		31.1	31.1	
Effective Green, g (s)	46.8	46.8		46.8	46.8	46.8	31.1	31.1		31.1	31.1	
Actuated g/C Ratio	0.52	0.52		0.52	0.52	0.52	0.35	0.35		0.35	0.35	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
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)	87	1932		186	1020	780	424	579		355	646	
v/s Ratio Prot		0.29			c0.52			0.15			0.08	
v/s Ratio Perm	0.10			0.27		0.18	0.04			c0.31		
v/c Ratio	0.20	0.56		0.51	1.00	0.35	0.11	0.45		0.91	0.23	
Uniform Delay, d1	11.5	14.7		14.1	21.6	12.6	20.0	22.8		28.1	21.0	
Progression Factor	1.15	1.06		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.8	1.2		9.7	28.9	1.2	0.1	0.6		25.7	0.2	
Delay (s)	18.1	16.8		23.8	50.5	13.9	20.1	23.3		53.8	21.1	
Level of Service	B	B		C	D	B	C	C		D	C	
Approach Delay (s)		16.8			38.6			22.9			42.5	
Approach LOS		B			D			C			D	

Intersection Summary			
HCM Average Control Delay	30.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	104.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	320	125	122	533	983	148
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.6	6.6	6.6
Lane Util. Factor	1.00	1.00		0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.99	1.00	1.00
Satd. Flow (prot)	1863	1667		3691	1961	1667
Flt Permitted	0.95	1.00		0.50	1.00	1.00
Satd. Flow (perm)	1863	1667		1856	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	348	136	133	579	1068	161
RTOR Reduction (vph)	0	78	0	0	0	60
Lane Group Flow (vph)	348	58	0	712	1068	101
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	20.7	20.7		56.7	56.7	56.7
Effective Green, g (s)	20.7	20.7		56.7	56.7	56.7
Actuated g/C Ratio	0.23	0.23		0.63	0.63	0.63
Clearance Time (s)	6.0	6.0		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	428	383		1169	1235	1050
v/s Ratio Prot	c0.19				c0.54	
v/s Ratio Perm		0.03		0.38		0.06
v/c Ratio	0.81	0.15		1.48dl	0.86	0.10
Uniform Delay, d1	32.8	27.6		10.0	13.5	6.6
Progression Factor	1.00	1.00		1.00	1.10	0.99
Incremental Delay, d2	11.2	0.2		2.4	6.5	0.1
Delay (s)	44.1	27.8		12.4	21.5	6.6
Level of Service	D	C		B	C	A
Approach Delay (s)	39.5			12.4	19.5	
Approach LOS	D			B	B	

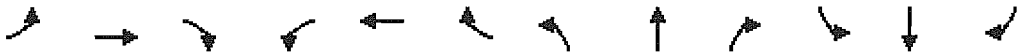
Intersection Summary			
HCM Average Control Delay	21.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	99.4%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	196	214	155	87	13	183	504	62	3	573	37
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	6.1	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1923	1504	1845	1879		1652	1924		1900	1961	1650
Flt Permitted	0.66	1.00	1.00	0.36	1.00		0.12	1.00		0.12	1.00	1.00
Satd. Flow (perm)	1311	1923	1504	705	1879		203	1924		236	1961	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	226	242	264	212	119	18	247	681	84	4	682	44
RTOR Reduction (vph)	0	0	132	0	6	0	0	5	0	0	0	18
Lane Group Flow (vph)	226	242	132	212	131	0	247	760	0	4	682	26
Heavy Vehicles (%)	1%	4%	13%	3%	2%	20%	15%	2%	4%	0%	2%	3%
Turn Type	pm+pt		Perm	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	22.0	14.1	14.1	22.0	14.1		49.9	49.9		33.9	33.9	33.9
Effective Green, g (s)	22.0	14.1	14.1	22.0	14.1		49.9	49.9		33.9	33.9	33.9
Actuated g/C Ratio	0.24	0.16	0.16	0.24	0.16		0.55	0.55		0.38	0.38	0.38
Clearance Time (s)	6.1	6.1	6.1	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	371	301	236	272	294		275	1067		89	739	622
v/s Ratio Prot	0.05	c0.13		c0.07	0.07		c0.10	0.39			0.35	
v/s Ratio Perm	0.10		0.09	0.12			c0.40			0.02		0.02
v/c Ratio	0.61	0.80	0.56	0.78	0.45		0.90	0.71		0.04	0.92	0.04
Uniform Delay, d1	29.3	36.6	35.1	29.8	34.4		32.6	14.8		17.8	26.8	17.8
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.06	1.08		1.00	0.97	1.00
Incremental Delay, d2	2.8	14.3	2.8	13.2	1.1		26.3	3.5		0.9	18.7	0.1
Delay (s)	32.1	51.0	37.9	43.0	35.5		60.9	19.5		18.8	44.5	17.8
Level of Service	C	D	D	D	D		E	B		B	D	B
Approach Delay (s)		40.4			40.0			29.6			42.8	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	37.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	508	76	74	530	14	72	176	110	51	310	12
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.94		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3653		1863	3711		1863	1847		1863	1950	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3653		1863	3711		1863	1847		1863	1950	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	28	643	96	106	757	20	76	185	116	63	383	15
RTOR Reduction (vph)	0	12	0	0	2	0	0	26	0	0	2	0
Lane Group Flow (vph)	28	727	0	106	775	0	76	275	0	63	396	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	3.3	30.8		7.5	35.0		5.6	22.1		5.6	22.1	
Effective Green, g (s)	3.3	30.8		7.5	35.0		5.6	22.1		5.6	22.1	
Actuated g/C Ratio	0.04	0.34		0.08	0.39		0.06	0.25		0.06	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	68	1250		155	1443		116	454		116	479	
v/s Ratio Prot	0.02	c0.20		c0.06	c0.21		c0.04	0.15		0.03	c0.20	
v/s Ratio Perm												
v/c Ratio	0.41	0.58		0.68	0.54		0.66	0.60		0.54	0.83	
Uniform Delay, d1	42.4	24.3		40.1	21.2		41.3	30.1		41.0	32.1	
Progression Factor	1.00	1.00		1.11	1.23		0.92	0.88		1.00	1.00	
Incremental Delay, d2	4.0	2.0		8.6	1.0		12.1	2.2		5.1	11.2	
Delay (s)	46.4	26.3		52.9	27.2		49.9	28.6		46.1	43.4	
Level of Service	D	C		D	C		D	C		D	D	
Approach Delay (s)		27.0			30.3			32.9			43.7	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	32.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	30.0
Intersection Capacity Utilization	63.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	810	8	69	812	135	9	15	183	212	24	12
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		4.0	6.1	6.1	6.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3720		1863	1961	1500	1863	1689		1863	1863	
Flt Permitted	0.10	1.00		0.13	1.00	1.00	0.73	1.00		0.35	1.00	
Satd. Flow (perm)	203	3720		259	1961	1500	1423	1689		687	1863	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	7	1066	11	83	978	163	11	18	220	283	32	16
RTOR Reduction (vph)	0	1	0	0	0	66	0	0	0	0	11	0
Lane Group Flow (vph)	7	1076	0	83	978	97	11	238	0	283	37	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm			pm+pt		
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	38.7	38.7		48.6	48.6	48.6	17.3	17.3		29.3	29.3	
Effective Green, g (s)	38.7	38.7		48.6	48.6	48.6	17.3	17.3		29.3	29.3	
Actuated g/C Ratio	0.43	0.43		0.54	0.54	0.54	0.19	0.19		0.33	0.33	
Clearance Time (s)	6.1	6.1		4.0	6.1	6.1	6.0	6.0		4.0	6.0	
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)	87	1600		245	1059	810	274	325		328	607	
v/s Ratio Prot		0.29		0.02	c0.50			0.14		c0.08	0.02	
v/s Ratio Perm	0.03			0.16		0.06	0.01			c0.20		
v/c Ratio	0.08	0.67		0.34	0.92	0.12	0.04	0.73		0.86	0.06	
Uniform Delay, d1	15.1	20.6		13.0	19.0	10.2	29.6	34.2		27.0	20.9	
Progression Factor	1.11	0.93		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	2.2		0.8	14.5	0.3	0.1	8.3		20.2	0.0	
Delay (s)	18.6	21.3		13.8	33.4	10.5	29.7	42.4		47.2	20.9	
Level of Service	B	C		B	C	B	C	D		D	C	
Approach Delay (s)		21.3			29.1			41.9			43.4	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	28.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	10.1
Intersection Capacity Utilization	90.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	785	411	87	520	944	223
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.6	6.6	6.6
Lane Util. Factor	1.00	1.00		0.95	1.00	1.00
Frt	1.00	0.85		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.99	1.00	1.00
Satd. Flow (prot)	1863	1667		3699	1961	1667
Flt Permitted	0.95	1.00		0.51	1.00	1.00
Satd. Flow (perm)	1863	1667		1887	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	853	447	95	565	1026	242
RTOR Reduction (vph)	0	36	0	0	0	104
Lane Group Flow (vph)	853	411	0	660	1026	138
Turn Type		Perm	Perm			Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	35.0	35.0		42.4	42.4	42.4
Effective Green, g (s)	35.0	35.0		42.4	42.4	42.4
Actuated g/C Ratio	0.39	0.39		0.47	0.47	0.47
Clearance Time (s)	6.0	6.0		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	725	648		889	924	785
v/s Ratio Prot	c0.46				c0.52	
v/s Ratio Perm		0.25		0.35		0.08
v/c Ratio	1.18	0.63		1.09dl	1.11	0.18
Uniform Delay, d1	27.5	22.3		19.4	23.8	13.7
Progression Factor	1.00	1.00		1.00	0.75	0.43
Incremental Delay, d2	93.5	2.0		5.6	59.2	0.3
Delay (s)	121.0	24.3		24.9	77.1	6.2
Level of Service	F	C		C	E	A
Approach Delay (s)	87.8			24.9	63.6	
Approach LOS	F			C	E	

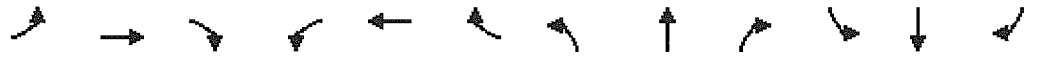
Intersection Summary			
HCM Average Control Delay	65.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.14		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	120.6%	ICU Level of Service	H
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	183	282	165	312	5	289	805	69	4	637	167
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	6.1
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1938		1743	1927		1900	1980	1650
Flt Permitted	0.21	1.00	1.00	0.49	1.00		0.11	1.00		0.14	1.00	1.00
Satd. Flow (perm)	419	2000	1619	967	1938		210	1927		275	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	154	220	340	206	390	6	321	894	77	4	671	176
RTOR Reduction (vph)	0	0	77	0	1	0	0	3	0	0	0	51
Lane Group Flow (vph)	154	220	263	206	395	0	321	968	0	4	671	125
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		pm+ov	pm+pt			pm+pt			Perm		pm+ov
Protected Phases	7	4	5	3	8		5	2			6	7
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	26.7	18.9	29.0	26.9	19.0		45.1	45.1		29.1	29.1	36.9
Effective Green, g (s)	26.7	18.9	29.0	26.9	19.0		45.1	45.1		29.1	29.1	36.9
Actuated g/C Ratio	0.30	0.21	0.32	0.30	0.21		0.50	0.50		0.32	0.32	0.41
Clearance Time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	251	420	522	368	409		277	966		89	640	677
v/s Ratio Prot	c0.05	0.11	0.06	0.05	c0.20		0.13	c0.50			0.34	0.02
v/s Ratio Perm	0.13		0.11	0.12			c0.45			0.01		0.06
v/c Ratio	0.61	0.52	0.50	0.56	0.97		1.16	1.00		0.04	1.05	0.19
Uniform Delay, d1	25.4	31.6	24.7	25.0	35.2		35.9	22.4		20.9	30.4	17.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.17	1.26		0.95	0.94	0.79
Incremental Delay, d2	4.4	1.2	0.8	1.8	35.4		91.7	21.8		0.9	48.5	0.1
Delay (s)	29.8	32.7	25.4	26.8	70.6		133.7	50.0		20.8	77.0	13.5
Level of Service	C	C	C	C	E		F	D		C	E	B
Approach Delay (s)		28.6			55.6			70.8			63.6	
Approach LOS		C			E			E			E	

Intersection Summary			
HCM Average Control Delay	57.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.2%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	60	599	87	177	592	121	96	369	96	80	327	21
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.97		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3654		1863	3630		1863	1900		1863	1943	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3654		1863	3630		1863	1900		1863	1943	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	67	666	97	192	643	132	108	415	108	89	363	23
RTOR Reduction (vph)	0	13	0	0	18	0	0	9	0	0	2	0
Lane Group Flow (vph)	67	750	0	192	757	0	108	514	0	89	384	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	7.3	20.9		10.9	24.5		8.9	25.8		8.4	25.3	
Effective Green, g (s)	7.3	20.9		10.9	24.5		8.9	25.8		8.4	25.3	
Actuated g/C Ratio	0.08	0.23		0.12	0.27		0.10	0.29		0.09	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	151	849		226	988		184	545		174	546	
v/s Ratio Prot	0.04	c0.21		c0.10	c0.21		c0.06	c0.27		0.05	0.20	
v/s Ratio Perm												
v/c Ratio	0.44	0.88		0.85	0.77		0.59	0.94		0.51	0.70	
Uniform Delay, d1	39.4	33.4		38.7	30.1		38.8	31.4		38.8	29.0	
Progression Factor	1.00	1.00		1.07	1.31		1.43	0.67		1.00	1.00	
Incremental Delay, d2	2.1	12.9		11.1	2.3		4.4	23.8		2.5	4.1	
Delay (s)	41.5	46.3		52.6	41.7		60.1	44.7		41.4	33.1	
Level of Service	D	D		D	D		E	D		D	C	
Approach Delay (s)		45.9			43.9			47.3			34.6	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	43.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	1096	19	101	1093	464	50	64	218	344	126	56
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	0.88		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3716		1863	1961	1500	1801	1676		1863	1870	
Flt Permitted	0.13	1.00		0.11	1.00	1.00	0.63	1.00		0.26	1.00	
Satd. Flow (perm)	248	3716		208	1961	1500	1200	1676		519	1870	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	20	1245	22	110	1188	504	53	68	232	374	137	61
RTOR Reduction (vph)	0	1	0	0	0	175	0	0	0	0	19	0
Lane Group Flow (vph)	20	1266	0	110	1188	329	53	300	0	374	179	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm			pm+pt		
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	31.6	31.6		44.0	44.0	44.0	19.9	19.9		33.9	33.9	
Effective Green, g (s)	31.6	31.6		44.0	44.0	44.0	19.9	19.9		33.9	33.9	
Actuated g/C Ratio	0.35	0.35		0.49	0.49	0.49	0.22	0.22		0.38	0.38	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
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)	87	1305		218	959	733	265	371		315	704	
v/s Ratio Prot		0.34		0.04	c0.61			0.18		c0.11	0.10	
v/s Ratio Perm	0.08			0.21		0.22	0.04			c0.34		
v/c Ratio	0.23	0.97		0.50	1.24	0.45	0.20	0.81		1.19	0.25	
Uniform Delay, d1	20.6	28.7		19.2	23.0	15.1	28.6	33.2		26.5	19.3	
Progression Factor	1.08	0.97		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.6	17.8		1.8	116.4	2.0	0.4	12.2		111.6	0.2	
Delay (s)	27.9	45.7		21.0	139.4	17.0	28.9	45.5		138.1	19.5	
Level of Service	C	D		C	F	B	C	D		F	B	
Approach Delay (s)		45.5			98.0			43.0			97.1	
Approach LOS		D			F			D			F	

Intersection Summary			
HCM Average Control Delay	76.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	117.2%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Appendix C

2015 and 2030 Traffic Volume Detail With National Street

Table C1: Traffic at D-19/I-96 WB Ramps

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	120	417	-	-	678	127	214	-	75	-	-	-	1631
Background 2015	**105**	**459**	**-**	**-**	**786**	**118**	**276**	**-**	**100**	**-**	**-**	**-**	**1,844**
Background 2030	**122**	**533**	**-**	**-**	**983**	**148**	**320**	**-**	**125**	**-**	**-**	**-**	**2,231**
Use National St. Ext.	-	-57	57	-	-48	-9	-29	29	-	47	10	-	0
Future 2015 w/ National St. Ext.	**105**	**402**	**57**	**-**	**738**	**109**	**247**	**29**	**100**	**47**	**10**	**-**	**1,844**
National St. Ext. Development	-	-	237	366	-	-	-	130	-	110	34	85	962
Future 2015 w/ National St. Ext. Development	**105**	**402**	**294**	**366**	**738**	**109**	**247**	**159**	**100**	**157**	**44**	**85**	**2,806**
Future 2030 w/ National St. Ext. Development	**122**	**467**	**341**	**425**	**923**	**136**	**287**	**185**	**125**	**182**	**51**	**99**	**3,343**
Scenario	**Northbound**			**Southbound**			**Eastbound**			**Westbound**			**Total**
	LT	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	
PM PEAK													
Existing	84	408	-	-	650	191	520	-	240	-	-	-	2,093
Background 2015	**75**	**448**	**-**	**-**	**755**	**178**	**676**	**-**	**329**	**-**	**-**	**-**	**2,461**
Background 2030	**87**	**520**	**-**	**-**	**944**	**223**	**785**	**-**	**411**	**-**	**-**	**-**	**2,970**
Use National St. Ext.	-	-44	44	-	-155	-46	-55	55	-	155	46	-	0
Future 2015 w/ National St. Ext.	**75**	**404**	**44**	**-**	**600**	**132**	**621**	**55**	**329**	**155**	**46**	**-**	**2,461**
National St. Ext. Development	-	-	96	162	-	-	-	96	-	322	100	294	1,070
Future 2015 w/ National St. Ext. Development	**75**	**404**	**140**	**162**	**600**	**132**	**621**	**151**	**329**	**477**	**146**	**294**	**3,531**
Future 2030 w/ National St. Ext. Development	**87**	**469**	**163**	**188**	**750**	**165**	**721**	**175**	**411**	**554**	**170**	**341**	**4,194**

Table C2: Traffic at D-19 (Pinckney Road)/Pulford St.

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	-	672	31	1	679	-	-	-	-	6	-	6	1,395
Background 2015	**-**	**742**	**34**	**1**	**750**	**-**	**-**	**-**	**-**	**7**	**-**	**7**	**1,541**
Background 2030	**-**	**862**	**40**	**1**	**871**	**-**	**-**	**-**	**-**	**8**	**-**	**8**	**1,790**
Use National St. Ext.	-	-86	-	-	-57	-	-	-	-	-	-	-	-143
Future 2015 w/ National St. Ext.	**-**	**656**	**34**	**1**	**693**	**-**	**-**	**-**	**-**	**7**	**-**	**7**	**1,398**
National St. Ext. Development	-	81	4	-	363	-	-	-	-	3	-	-	451
Future 2015 w/ National St. Ext. Development	**-**	**737**	**38**	**1**	**1,056**	**-**	**-**	**-**	**-**	**10**	**-**	**7**	**1,849**
Future 2030 w/ National St. Ext. Development	**-**	**856**	**44**	**1**	**1,226**	**-**	**-**	**-**	**-**	**11**	**-**	**8**	**2,146**
Scenario	**Northbound**			**Southbound**			**Eastbound**			**Westbound**			**Total**
	LR	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	
PM PEAK													
Existing	-	747	61	3	781	-	-	-	-	6	-	0	1,598
Background 2015	**-**	**825**	**67**	**3**	**863**	**-**	**-**	**-**	**-**	**7**	**-**	**0**	**1,765**
Background 2030	**-**	**958**	**78**	**4**	**1,002**	**-**	**-**	**-**	**-**	**8**	**-**	**0**	**2,050**
Use National St. Ext.	-	-99	-	-	-201	-	-	-	-	-	-	-	-300
Future 2015 w/ National St. Ext.	**-**	**726**	**67**	**3**	**662**	**-**	**-**	**-**	**-**	**7**	**-**	**0**	**1,465**
National St. Ext. Development	-	269	25	-	158	-	-	-	-	4	-	-	456
Future 2015 w/ National St. Ext. Development	**-**	**995**	**92**	**3**	**820**	**-**	**-**	**-**	**-**	**11**	**-**	**0**	**1,921**
Future 2030 w/ National St. Ext. Development	**-**	**1,355**	**107**	**4**	**952**	**-**	**-**	**-**	**-**	**12**	**-**	**0**	**2,430**

Table C3: Traffic at Pinckney (Michigan)/Marion St. (Mason)

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	143	393	48	2	447	29	143	153	167	121	68	10	1724
Background 2015	**158**	**434**	**53**	**2**	**494**	**32**	**158**	**169**	**184**	**134**	**75**	**11**	**1,904**
Background 2030	**183**	**504**	**62**	**3**	**573**	**37**	**183**	**196**	**214**	**155**	**87**	**13**	**2,210**
Use National St. Ext.	-	-86	-	-	-57	-	-	-	-	-	-	-	-143
Future 2015 w/ National St. Ext.	**158**	**348**	**53**	**3**	**437**	**32**	**158**	**169**	**184**	**134**	**75**	**11**	**1,816**
National St. Ext. Development	10	65	6	-	220	-	-	-	83	60	-	60	504
Future 2015 w/ National St. Ext. Development	**168**	**413**	**59**	**2**	**657**	**32**	**158**	**169**	**267**	**194**	**75**	**71**	**2,265**
Future 2030 w/ National St. Ext. Development	**195**	**480**	**69**	**3**	**767**	**37**	**183**	**196**	**311**	**225**	**87**	**82**	**2,630**
Scenario	**Northbound**			**Southbound**			**Eastbound**			**Westbound**			**Total**
	LT	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	**LT**	**TH**	**RT**	
PM PEAK													
Existing	225	628	54	3	497	130	100	143	220	129	243	4	2,376
Background 2015	**249**	**694**	**60**	**3**	**549**	**144**	**110**	**158**	**243**	**142**	**268**	**4**	**2,624**
Background 2030	**289**	**805**	**69**	**4**	**637**	**167**	**128**	**183**	**282**	**165**	**312**	**5**	**3,046**
Use National St. Ext.	-	-99	-	-	-201	-	-	-	-	-	-	-	-300
Future 2015 w/ National St. Ext.	**249**	**595**	**60**	**3**	**348**	**144**	**110**	**158**	**243**	**142**	**268**	**4**	**2,324**
National St. Ext. Development	74	178	17	-	86	-	-	-	45	27	-	-	427
Future 2015 w/ National St. Ext. Development	**323**	**773**	**77**	**3**	**434**	**144**	**110**	**158**	**288**	**169**	**268**	**4**	**2,751**
Future 2030 w/ National St. Ext. Development	**374**	**897**	**89**	**4**	**504**	**167**	**128**	**183**	**334**	**197**	**312**	**5**	**3,194**

Table C4: Traffic at Michigan (M-155)/Livingston St.

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	21	574	12	9	484	6	2	0	30	6	3	3	1,150
Background 2015	**23**	**634**	**13**	**10**	**535**	**7**	**2**	**0**	**33**	**7**	**3**	**3**	**1,270**
Background 2030	**27**	**736**	**15**	**12**	**621**	**8**	**3**	**0**	**38**	**8**	**4**	**4**	**1,476**
Use National St. Ext.	-	-86	-	-	-57	-	-	-	-	-	-	-	-143
Future 2015 w/ National St. Ext.	**23**	**548**	**13**	**10**	**478**	**7**	**2**	**0**	**33**	**7**	**3**	**3**	**1,127**
National St. Ext. Development	3	60	2	-	205	-	-	-	12	3	-	-	285
Future 2015 w/ National St. Ext. Development	**26**	**608**	**15**	**10**	**683**	**7**	**2**	**0**	**45**	**10**	**3**	**3**	**1,412**
Future 2030 w/ National St. Ext. Development	**30**	**706**	**18**	**12**	**793**	**8**	**3**	**0**	**52**	**11**	**4**	**4**	**1,641**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	52	721	13	12	616	63	3	7	4	5	0	4	1,500
Background 2015	**57**	**796**	**14**	**13**	**680**	**70**	**3**	**8**	**4**	**6**	**0**	**4**	**1,655**
Background 2030	**67**	**925**	**17**	**15**	**790**	**81**	**4**	**9**	**5**	**6**	**0**	**5**	**1,924**
Use National St. Ext.	-	-99	-	-	-201	-	-	-	-	-	-	-	-300
Future 2015 w/ National St. Ext.	**57**	**697**	**14**	**13**	**479**	**70**	**3**	**8**	**4**	**6**	**0**	**4**	**1,355**
National St. Ext. Development	13	161	4	-	83	-	-	-	-	3	-	-	264
Future 2015 w/ National St. Ext. Development	**70**	**858**	**18**	**13**	**562**	**70**	**3**	**8**	**4**	**9**	**0**	**4**	**1,619**
Future 2030 w/ National St. Ext. Development	**82**	**997**	**21**	**15**	**653**	**81**	**4**	**9**	**5**	**10**	**0**	**5**	**1,882**

Table C5: Traffic at Michigan (M-155)/Washington St.

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	55	367	99	20	469	1	2	3	30	9	3	10	1,068
Background 2015	**61**	**405**	**109**	**22**	**518**	**1**	**2**	**3**	**33**	**10**	**3**	**11**	**1,178**
Background 2030	**71**	**471**	**127**	**26**	**601**	**1**	**3**	**4**	**38**	**12**	**4**	**13**	**1,371**
Use National St. Ext.	-	-70	-16	-	-48	-	-	-	-	-8	-	-	-142
Future 2015 w/ National St. Ext.	**61**	**335**	**93**	**22**	**470**	**1**	**2**	**3**	**33**	**2**	**3**	**11**	**1,036**
National St. Ext. Development	4	50	6	-	189	-	-	-	12	4	-	-	265
Future 2015 w/ National St. Ext. Development	**65**	**385**	**99**	**22**	**659**	**1**	**2**	**3**	**45**	**6**	**3**	**11**	**1,301**
Future 2030 w/ National St. Ext. Development	**75**	**447**	**115**	**26**	**765**	**1**	**3**	**4**	**52**	**7**	**4**	**13**	**1,512**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	75	440	99	55	651	5	1	2	13	12	5	16	1,374
Background 2015	**83**	**486**	**109**	**61**	**719**	**6**	**1**	**2**	**14**	**13**	**6**	**18**	**1,518**
Background 2030	**96**	**564**	**127**	**71**	**835**	**6**	**1**	**3**	**17**	**15**	**6**	**21**	**1,762**
Use National St. Ext.	-	-99	-	-	-201	-	-	-	-	-	-	-	-300
Future 2015 w/ National St. Ext.	**83**	**387**	**109**	**61**	**518**	**6**	**1**	**2**	**14**	**13**	**6**	**18**	**1,218**
National St. Ext. Development	22	109	30	-	79	-	-	-	2	2	-	-	244
Future 2015 w/ National St. Ext. Development	**105**	**496**	**139**	**61**	**597**	**6**	**1**	**2**	**16**	**15**	**6**	**18**	**1,462**
Future 2030 w/ National St. Ext. Development	**122**	**576**	**162**	**71**	**693**	**6**	**1**	**3**	**19**	**18**	**6**	**21**	**1,698**

Table C6: Traffic at Grand River/Michigan (M-155)

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	56	137	86	40	242	9	17	396	59	58	413	11	1,524
Background 2015	**62**	**151**	**95**	**44**	**267**	**10**	**19**	**437**	**65**	**64**	**456**	**12**	**1,682**
Background 2030	**72**	**176**	**110**	**51**	**310**	**12**	**22**	**508**	**76**	**74**	**530**	**14**	**1,955**
Use National St. Ext.	-	-	-52	-	-	-	-	-	-	-35	-	-	-87
Future 2015 w/ National St. Ext.	**62**	**151**	**43**	**44**	**267**	**10**	**19**	**437**	**65**	**29**	**456**	**12**	**1,595**
National St. Ext. Development	10	40	-	-	151	-	-	154	38	-	45	-	438
Future 2015 w/ National St. Ext. Development	**72**	**191**	**43**	**44**	**418**	**10**	**19**	**591**	**103**	**29**	**501**	**12**	**2,033**
Future 2030 w/ National St. Ext. Development	**83**	**222**	**50**	**51**	**486**	**12**	**22**	**687**	**120**	**34**	**582**	**14**	**2,363**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	75	288	75	62	255	16	47	467	68	138	462	94	2,047
Background 2015	**83**	**318**	**83**	**68**	**282**	**18**	**52**	**516**	**75**	**152**	**510**	**104**	**2,261**
Background 2030	**96**	**369**	**96**	**80**	**327**	**21**	**60**	**599**	**87**	**177**	**592**	**121**	**2,625**
Use National St. Ext.	-	-	-46	-	-	-	-	-	-	-86	-	-	-132
Future 2015 w/ National St. Ext.	**83**	**318**	**37**	**68**	**282**	**18**	**52**	**516**	**75**	**66**	**510**	**104**	**2,129**
National St. Ext. Development	22	87	-	-	63	-	-	70	16	-	146	-	404
Future 2015 w/ National St. Ext. Development	**105**	**405**	**37**	**68**	**345**	**18**	**52**	**586**	**91**	**66**	**656**	**104**	**2,533**
Future 2030 w/ National St. Ext. Development	**122**	**470**	**43**	**80**	**400**	**21**	**60**	**680**	**106**	**77**	**762**	**121**	**2,942**

Table C7: Traffic at Grand River/Court St.

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	1	-	61	-	-	-	-	531	8	34	493	-	1,128
Background 2015	**1**	**-**	**67**	**-**	**-**	**-**	**-**	**587**	**9**	**38**	**545**	**-**	**1,247**
Background 2030	**1**	**-**	**78**	**-**	**-**	**-**	**-**	**681**	**10**	**44**	**632**	**-**	**1,446**
Use National St. Ext.	-	-	-13	-	-	-	-	-52	-	-15	-35	-	-115
Future 2015 w/ National St. Ext.	**1**	**-**	**54**	**-**	**-**	**-**	**-**	**535**	**9**	**23**	**510**	**-**	**1,132**
National St. Ext. Development	-	-	-	-	-	-	-	75	-	-	45	-	120
Future 2015 w/ National St. Ext. Development	**1**	**-**	**54**	**-**	**-**	**-**	**-**	**610**	**9**	**23**	**555**	**-**	**1,252**
Future 2030 w/ National St. Ext. Development	**1**	**-**	**63**	**-**	**-**	**-**	**-**	**708**	**10**	**26**	**644**	**-**	**1,452**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	3	-	47	-	-	-	-	751	24	104	772	-	1,701
Background 2015	**3**	**-**	**52**	**-**	**-**	**-**	**-**	**830**	**27**	**115**	**853**	**-**	**1,880**
Background 2030	**4**	**-**	**60**	**-**	**-**	**-**	**-**	**963**	**31**	**133**	**990**	**-**	**2,181**
Use National St. Ext.	-	-	-15	-	-	-	-	-46	-	-75	-86	-	-222
Future 2015 w/ National St. Ext.	**3**	**-**	**37**	**-**	**-**	**-**	**-**	**784**	**27**	**40**	**767**	**-**	**1,658**
National St. Ext. Development	-	-	-	-	-	-	-	55	-	-	85	-	140
Future 2015 w/ National St. Ext. Development	**3**	**-**	**37**	**-**	**-**	**-**	**-**	**839**	**27**	**40**	**852**	**-**	**1,798**
Future 2030 w/ National St. Ext. Development	**4**	**-**	**43**	**-**	**-**	**-**	**-**	**974**	**31**	**46**	**989**	**-**	**2,087**

Table C8: Traffic at Grand River/Barnard St.

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	3	1	26	13	3	10	5	579	13	41	572	1	1,267
Background 2015	**3**	**1**	**29**	**14**	**3**	**11**	**6**	**640**	**14**	**45**	**632**	**1**	**1,399**
Background 2030	**4**	**1**	**33**	**17**	**4**	**13**	**6**	**743**	**17**	**53**	**734**	**1**	**1,626**
Use National St. Ext.	-	-	-4	-	-	-	-	-65	-	-2	-50	-	-121
Future 2015 w/ National St. Ext.	**3**	**1**	**25**	**14**	**3**	**11**	**6**	**575**	**14**	**43**	**582**	**1**	**1,278**
National St. Ext. Development	-	-	-	-	-	-	-	154	-	-	45	-	199
Future 2015 w/ National St. Ext. Development	**3**	**1**	**25**	**14**	**3**	**11**	**6**	**729**	**14**	**43**	**627**	**1**	**1,477**
Future 2030 w/ National St. Ext. Development	**4**	**1**	**29**	**17**	**4**	**13**	**6**	**846**	**17**	**50**	**728**	**1**	**1,716**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	3	10	58	9	2	20	38	718	13	32	696	13	1,612
Background 2015	**3**	**11**	**64**	**10**	**2**	**22**	**42**	**793**	**14**	**35**	**769**	**14**	**1,779**
Background 2030	**4**	**13**	**74**	**12**	**3**	**26**	**49**	**921**	**17**	**41**	**893**	**17**	**2,070**
Use National St. Ext.	-	-	-11	-	-	-	-	-61	-	-21	-161	-	-254
Future 2015 w/ National St. Ext.	**3**	**11**	**53**	**10**	**2**	**22**	**42**	**732**	**14**	**14**	**608**	**14**	**1,525**
National St. Ext. Development	-	-	-	-	-	-	-	70	-	-	146	-	216
Future 2015 w/ National St. Ext. Development	**3**	**11**	**53**	**10**	**2**	**22**	**42**	**802**	**14**	**14**	**754**	**14**	**1,741**
Future 2030 w/ National St. Ext. Development	**4**	**13**	**62**	**12**	**3**	**26**	**49**	**931**	**17**	**17**	**875**	**17**	**2,026**

Table C9: Traffic at Grand River/Fowler St.

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	6	-	104	-	-	-	-	589	19	90	546	-	1,354
Background 2015	**7**	**-**	**115**	**-**	**-**	**-**	**-**	**651**	**21**	**99**	**603**	**-**	**1,496**
Background 2030	**8**	**-**	**133**	**-**	**-**	**-**	**-**	**755**	**24**	**115**	**700**	**-**	**1,735**
Use National St. Ext.	-	-	-17	-	-	-	-	-69	-	-5	-52	-	-143
Future 2015 w/ National St. Ext.	**7**	**-**	**98**	**-**	**-**	**-**	**-**	**582**	**21**	**94**	**551**	**-**	**1,353**
National St. Ext. Development	-	-	-	-	-	-	-	154	-	-	45	-	199
Future 2015 w/ National St. Ext. Development	**7**	**-**	**98**	**-**	**-**	**-**	**-**	**736**	**21**	**94**	**596**	**-**	**1,552**
Future 2030 w/ National St. Ext. Development	**8**	**-**	**114**	**-**	**-**	**-**	**-**	**854**	**24**	**110**	**692**	**-**	**1,802**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	7	-	140	-	-	-	-	826	15	152	747	-	1,887
Background 2015	**8**	**-**	**155**	**-**	**-**	**-**	**-**	**912**	**17**	**168**	**825**	**-**	**2,085**
Background 2030	**9**	**-**	**180**	**-**	**-**	**-**	**-**	**1,059**	**19**	**195**	**958**	**-**	**2,420**
Use National St. Ext.	-	-	-27	-	-	-	-	-72	-	-19	-182	-	-300
Future 2015 w/ National St. Ext.	**8**	**-**	**128**	**-**	**-**	**-**	**-**	**840**	**17**	**149**	**643**	**-**	**1,785**
National St. Ext. Development	-	-	-	-	-	-	-	70	-	-	146	-	216
Future 2015 w/ National St. Ext. Development	**8**	**-**	**128**	**-**	**-**	**-**	**-**	**910**	**17**	**149**	**789**	**-**	**2,001**
Future 2030 w/ National St. Ext. Development	**9**	**-**	**148**	**-**	**-**	**-**	**-**	**1,057**	**19**	**173**	**916**	**-**	**2,322**

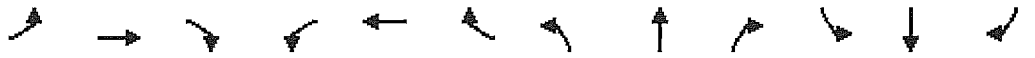
Table C10: Traffic at Grand River/National Street

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM PEAK													
Existing	7	12	143	165	19	9	4	632	6	54	633	105	1,789
Background 2015	**8**	**13**	**158**	**182**	**21**	**10**	**4**	**698**	**7**	**60**	**699**	**116**	**1,976**
Background 2030	**9**	**15**	**183**	**212**	**24**	**12**	**5**	**810**	**8**	**69**	**812**	**135**	**2,294**
Use National St. Ext.	-	-	86	-	-	-	-	-86	-	57	-57	-	0
Future 2015 w/ National St. Ext.	**8**	**13**	**244**	**182**	**21**	**10**	**4**	**612**	**7**	**117**	**642**	**116**	**1,976**
National St. Ext. Development	45	8	45	-	-	-	-	-	154	-	-	-	252
Future 2015 w/ National St. Ext. Development	**53**	**21**	**289**	**182**	**41**	**10**	**4**	**612**	**161**	**271**	**642**	**116**	**2,402**
Future 2030 w/ National St. Ext. Development	**61**	**25**	**335**	**212**	**48**	**12**	**5**	**711**	**186**	**314**	**746**	**135**	**2,790**

Scenario	Northbound			Southbound			Eastbound			Westbound			Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
PM PEAK													
Existing	39	50	170	268	98	44	14	855	15	79	852	362	2,846
Background 2015	**43**	**55**	**188**	**296**	**108**	**49**	**15**	**944**	**17**	**87**	**941**	**400**	**3,143**
Background 2030	**50**	**64**	**218**	**344**	**126**	**56**	**18**	**1,096**	**19**	**101**	**1,093**	**464**	**3,649**
Use National St. Ext.	-	-	99	-	14	-14	-	-99	-	187	-187	-	0
Future 2015 w/ National St. Ext.	**43**	**55**	**287**	**296**	**122**	**35**	**15**	**845**	**17**	**274**	**754**	**400**	**3,143**
National St. Ext. Development	146	15	146	-	12	-	-	-	70	70	-	-	459
Future 2015 w/ National St. Ext. Development	**189**	**70**	**433**	**296**	**134**	**35**	**15**	**845**	**87**	**344**	**754**	**400**	**3,602**
Future 2030 w/ National St. Ext. Development	**220**	**82**	**502**	**344**	**156**	**40**	**18**	**982**	**101**	**400**	**876**	**464**	**4,185**

Appendix D

Level of Service Capacity Analysis with National Street



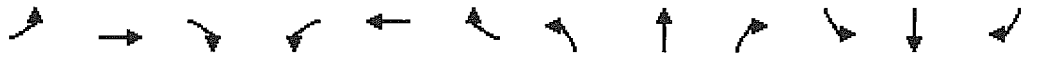
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	247	159	100	157	44	85	105	402	294	366	738	109
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		0.95			1.00	1.00
Frt	1.00	0.94		1.00	1.00	0.85		0.94			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.98	1.00
Satd. Flow (prot)	1863	1847		1863	1961	1667		3497			1929	1667
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.51			0.45	1.00
Satd. Flow (perm)	1863	1847		1863	1961	1667		1784			887	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	268	173	109	171	48	92	114	437	320	398	802	118
RTOR Reduction (vph)	0	26	0	0	0	84	0	93	0	0	0	43
Lane Group Flow (vph)	268	256	0	171	48	8	0	778	0	0	1200	75
Turn Type	Prot			Prot		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8	2			6		6
Actuated Green, G (s)	17.3	15.0		10.2	7.9	7.9		46.4			46.4	46.4
Effective Green, g (s)	17.3	15.0		10.2	7.9	7.9		46.4			46.4	46.4
Actuated g/C Ratio	0.19	0.17		0.11	0.09	0.09		0.51			0.51	0.51
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)	357	307		211	172	146		918			456	858
v/s Ratio Prot	c0.14	c0.14		0.09	0.02							
v/s Ratio Perm						0.00		0.44			c1.35	0.04
v/c Ratio	0.75	0.83		0.81	0.28	0.06		0.85			2.63	0.09
Uniform Delay, d1	34.4	36.4		39.1	38.5	37.7		18.9			21.9	11.1
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	1.00
Incremental Delay, d2	8.6	17.4		20.5	0.9	0.2		9.6			740.5	0.2
Delay (s)	43.0	53.8		59.5	39.4	37.9		28.4			762.4	11.3
Level of Service	D	D		E	D	D		C			F	B
Approach Delay (s)		48.6			50.0			28.4			695.2	
Approach LOS		D			D			C			F	

Intersection Summary			
HCM Average Control Delay	322.4	HCM Level of Service	F
HCM Volume to Capacity ratio	2.02		
Actuated Cycle Length (s)	90.2	Sum of lost time (s)	18.6
Intersection Capacity Utilization	121.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	158	169	267	194	75	71	168	413	59	2	657	32
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	6.1
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.91		1.00	0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1762		1863	1826		1743	1907		1900	1980	1650
Flt Permitted	0.51	1.00		0.22	1.00		0.11	1.00		0.35	1.00	1.00
Satd. Flow (perm)	1008	1762		433	1826		193	1907		694	1980	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	195	209	330	266	103	97	227	558	80	2	782	38
RTOR Reduction (vph)	0	63	0	0	38	0	0	5	0	0	0	8
Lane Group Flow (vph)	195	476	0	266	162	0	227	633	0	2	782	30
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt			pm+pt			pm+pt			Perm		pm+ov
Protected Phases	7	4		3	8		5	2			6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	27.6	18.9		26.0	18.1		45.1	45.1		32.1	32.1	40.8
Effective Green, g (s)	27.6	18.9		26.0	18.1		45.1	45.1		32.1	32.1	40.8
Actuated g/C Ratio	0.31	0.21		0.29	0.20		0.50	0.50		0.36	0.36	0.45
Clearance Time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	6.1
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)	394	370		251	367		219	956		248	706	748
v/s Ratio Prot	0.05	c0.27		c0.09	0.09		c0.08	0.33			0.39	0.00
v/s Ratio Perm	0.10			0.21			c0.44			0.00		0.01
v/c Ratio	0.49	1.29		1.06	0.44		1.04	0.66		0.01	1.11	0.04
Uniform Delay, d1	24.2	35.6		29.9	31.5		22.7	16.8		18.7	28.9	13.7
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.76	0.89	0.69
Incremental Delay, d2	1.0	147.7		73.5	0.9		70.7	3.6		0.1	67.0	0.0
Delay (s)	25.2	183.3		103.4	32.4		93.3	20.4		14.3	92.8	9.5
Level of Service	C	F		F	C		F	C		B	F	A
Approach Delay (s)		141.3			72.9			39.5			88.8	
Approach LOS		F			E			D			F	

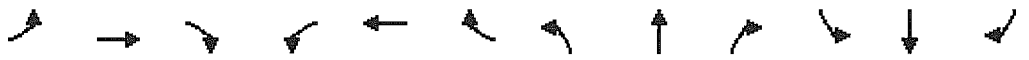
Intersection Summary			
HCM Average Control Delay	84.8	HCM Level of Service	F
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	10	80	40	10	10	20	300	60	10	540	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87		1.00	0.92		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1863	1700		1863	1814		1863	1912		1863	1961	1667
Flt Permitted	0.74	1.00		0.69	1.00		0.42	1.00		0.53	1.00	1.00
Satd. Flow (perm)	1457	1700		1360	1814		828	1912		1041	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	11	87	43	11	11	22	326	65	11	587	11
RTOR Reduction (vph)	0	80	0	0	10	0	0	4	0	0	0	2
Lane Group Flow (vph)	11	18	0	43	12	0	22	387	0	11	587	9
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	7.3	7.3		7.3	7.3		71.1	71.1		71.1	71.1	71.1
Effective Green, g (s)	7.3	7.3		7.3	7.3		71.1	71.1		71.1	71.1	71.1
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.79	0.79		0.79	0.79	0.79
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
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)	118	138		110	147		654	1510		822	1549	1317
v/s Ratio Prot		0.01			0.01			0.20			c0.30	
v/s Ratio Perm	0.01			c0.03			0.03			0.01		0.01
v/c Ratio	0.09	0.13		0.39	0.08		0.03	0.26		0.01	0.38	0.01
Uniform Delay, d1	38.3	38.4		39.2	38.2		2.0	2.5		2.0	2.8	2.0
Progression Factor	1.00	1.00		1.00	1.00		0.97	1.23		0.55	0.49	0.36
Incremental Delay, d2	0.3	0.4		2.3	0.2		0.1	0.3		0.0	0.4	0.0
Delay (s)	38.6	38.8		41.5	38.5		2.1	3.4		1.1	1.8	0.7
Level of Service	D	D		D	D		A	A		A	A	A
Approach Delay (s)		38.8			40.5			3.3			1.8	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	7.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	45.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			



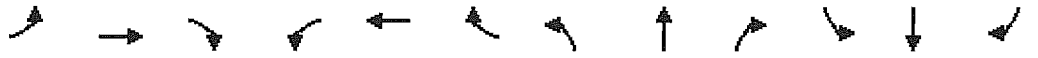
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	591	103	29	501	12	72	191	43	44	418	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3643		1863	3713		1863	1907		1863	1954	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3643		1863	3713		1863	1907		1863	1954	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	24	748	130	41	716	17	76	201	45	54	516	12
RTOR Reduction (vph)	0	14	0	0	1	0	0	9	0	0	1	0
Lane Group Flow (vph)	24	864	0	41	732	0	76	237	0	54	527	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	2.8	29.1		4.2	30.5		5.6	27.1		5.6	27.1	
Effective Green, g (s)	2.8	29.1		4.2	30.5		5.6	27.1		5.6	27.1	
Actuated g/C Ratio	0.03	0.32		0.05	0.34		0.06	0.30		0.06	0.30	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	58	1178		87	1258		116	574		116	588	
v/s Ratio Prot	0.01	c0.24		c0.02	0.20		c0.04	0.12		0.03	c0.27	
v/s Ratio Perm												
v/c Ratio	0.41	0.73		0.47	0.58		0.66	0.41		0.47	0.90	
Uniform Delay, d1	42.8	27.0		41.8	24.5		41.3	25.1		40.8	30.1	
Progression Factor	1.00	1.00		1.08	1.22		0.89	0.78		1.00	1.00	
Incremental Delay, d2	4.7	4.1		3.4	1.7		12.4	0.5		2.9	16.2	
Delay (s)	47.5	31.1		48.5	31.6		49.0	20.0		43.7	46.3	
Level of Service	D	C		D	C		D	B		D	D	
Approach Delay (s)		31.5			32.5			26.8			46.1	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	34.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	612	161	203	642	116	53	21	217	182	41	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	0.86		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3609		1863	1961	1500	1801	1636		1863	1905	
Flt Permitted	0.23	1.00		0.11	1.00	1.00	0.71	1.00		0.28	1.00	
Satd. Flow (perm)	456	3609		223	1961	1500	1351	1636		544	1905	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	5	805	212	245	773	140	64	25	261	243	55	13
RTOR Reduction (vph)	0	25	0	0	0	69	0	0	0	0	8	0
Lane Group Flow (vph)	5	992	0	245	773	71	64	286	0	243	60	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm			pm+pt		
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	29.0	29.0		45.5	45.5	45.5	19.4	19.4		32.4	32.4	
Effective Green, g (s)	29.0	29.0		45.5	45.5	45.5	19.4	19.4		32.4	32.4	
Actuated g/C Ratio	0.32	0.32		0.51	0.51	0.51	0.22	0.22		0.36	0.36	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
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)	147	1163		302	991	758	291	353		298	686	
v/s Ratio Prot		0.27		0.09	c0.39			0.17		c0.06	0.03	
v/s Ratio Perm	0.01			c0.32		0.05	0.05			c0.23		
v/c Ratio	0.03	0.85		0.81	0.78	0.09	0.22	0.81		0.82	0.09	
Uniform Delay, d1	20.9	28.5		19.6	18.2	11.5	29.1	33.6		24.6	19.0	
Progression Factor	1.20	0.96		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	7.6		15.1	6.1	0.2	0.4	13.1		15.6	0.1	
Delay (s)	25.5	35.1		34.8	24.2	11.8	29.5	46.7		40.2	19.1	
Level of Service	C	D		C	C	B	C	D		D	B	
Approach Delay (s)		35.1			25.0			43.5			35.6	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	32.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	84.0%	ICU Level of Service	E
Analysis Period (min)	15		

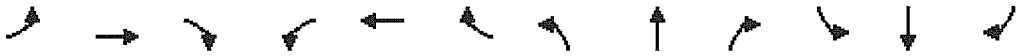
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	621	151	329	477	146	294	75	404	140	162	600	132
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		0.95			1.00	1.00
Frt	1.00	0.90		1.00	1.00	0.85		0.97			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.99	1.00
Satd. Flow (prot)	1863	1759		1863	1961	1667		3577			1940	1667
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.50			0.60	1.00
Satd. Flow (perm)	1863	1759		1863	1961	1667		1816			1176	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	675	164	358	518	159	320	82	439	152	176	652	143
RTOR Reduction (vph)	0	84	0	0	0	163	0	30	0	0	0	76
Lane Group Flow (vph)	675	438	0	518	159	157	0	643	0	0	828	67
Turn Type	Prot			Prot		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8	2			6		6
Actuated Green, G (s)	20.6	17.0		17.0	13.4	13.4		37.4			37.4	37.4
Effective Green, g (s)	20.6	17.0		17.0	13.4	13.4		37.4			37.4	37.4
Actuated g/C Ratio	0.23	0.19		0.19	0.15	0.15		0.42			0.42	0.42
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)	426	332		352	292	248		755			489	693
v/s Ratio Prot	c0.36	c0.25		0.28	0.08							
v/s Ratio Perm						0.09		0.35			c0.70	0.04
v/c Ratio	1.58	1.32		1.47	0.54	0.63		0.85			1.69	0.10
Uniform Delay, d1	34.7	36.5		36.5	35.5	36.0		23.8			26.3	16.0
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	1.00
Incremental Delay, d2	274.0	163.9		227.1	2.1	5.2		11.6			320.7	0.3
Delay (s)	308.7	200.4		263.6	37.5	41.1		35.4			347.0	16.3
Level of Service	F	F		F	D	D		D			F	B
Approach Delay (s)		261.5			156.2			35.4			298.3	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM Average Control Delay	203.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	128.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group



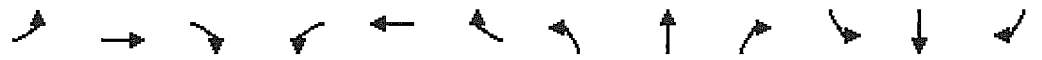
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	158	288	169	268	4	323	773	77	3	434	144
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	6.1
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.90		1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1750		1863	1938		1743	1922		1900	1980	1650
Flt Permitted	0.33	1.00		0.17	1.00		0.17	1.00		0.19	1.00	1.00
Satd. Flow (perm)	655	1750		340	1938		321	1922		379	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	133	190	347	211	335	5	359	859	86	3	457	152
RTOR Reduction (vph)	0	73	0	0	1	0	0	4	0	0	0	48
Lane Group Flow (vph)	133	464	0	211	339	0	359	941	0	3	457	104
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt			pm+pt			pm+pt			Perm		pm+ov
Protected Phases	7	4		3	8		5	2			6	7
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	30.6	22.9		31.0	23.1		41.1	41.1		21.1	21.1	28.8
Effective Green, g (s)	30.6	22.9		31.0	23.1		41.1	41.1		21.1	21.1	28.8
Actuated g/C Ratio	0.34	0.25		0.34	0.26		0.46	0.46		0.23	0.23	0.32
Clearance Time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	6.1
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)	328	445		251	497		369	878		89	464	528
v/s Ratio Prot	0.03	c0.27		c0.07	0.18		0.15	c0.49			0.23	0.02
v/s Ratio Perm	0.10			0.22			0.29			0.01		0.05
v/c Ratio	0.41	1.04		0.84	0.68		0.97	1.07		0.03	0.98	0.20
Uniform Delay, d1	21.6	33.6		24.1	30.1		31.9	24.4		26.6	34.3	22.2
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.98	1.00	0.94
Incremental Delay, d2	0.8	54.2		21.6	3.9		39.4	51.6		0.7	37.7	0.2
Delay (s)	22.5	87.7		45.7	34.0		71.3	76.0		26.8	71.8	21.0
Level of Service	C	F		D	C		E	E		C	E	C
Approach Delay (s)		74.8			38.5			74.7			59.0	
Approach LOS		E			D			E			E	

Intersection Summary			
HCM Average Control Delay	65.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	105.0%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	586	91	66	656	104	105	405	37	68	345	18
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3650		1863	3649		1863	1936		1863	1946	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3650		1863	3649		1863	1936		1863	1946	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	58	651	101	72	713	113	118	455	42	76	383	20
RTOR Reduction (vph)	0	13	0	0	13	0	0	4	0	0	2	0
Lane Group Flow (vph)	58	739	0	72	813	0	118	493	0	76	401	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	5.6	27.6		5.6	27.6		9.9	25.2		7.6	22.9	
Effective Green, g (s)	5.6	27.6		5.6	27.6		9.9	25.2		7.6	22.9	
Actuated g/C Ratio	0.06	0.31		0.06	0.31		0.11	0.28		0.08	0.25	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	116	1119		116	1119		205	542		157	495	
v/s Ratio Prot	0.03	0.20		c0.04	c0.22		c0.06	c0.25		0.04	0.21	
v/s Ratio Perm												
v/c Ratio	0.50	0.66		0.62	0.73		0.58	0.91		0.48	0.81	
Uniform Delay, d1	40.8	27.1		41.2	27.8		38.1	31.3		39.3	31.5	
Progression Factor	1.00	1.00		1.09	1.19		1.32	0.65		1.00	1.00	
Incremental Delay, d2	3.4	3.1		6.7	2.8		3.7	18.8		2.3	9.5	
Delay (s)	44.2	30.2		51.6	36.0		54.1	39.0		41.7	41.0	
Level of Service	D	C		D	D		D	D		D	D	
Approach Delay (s)		31.2			37.3			41.9			41.1	
Approach LOS		C			D			D			D	

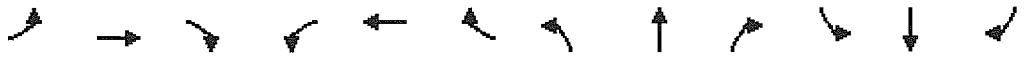
Intersection Summary			
HCM Average Control Delay	37.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	845	87	239	754	400	189	70	323	296	134	35
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		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	0.88		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3673		1863	1961	1500	1801	1661		1863	1900	
Flt Permitted	0.17	1.00		0.13	1.00	1.00	0.64	1.00		0.14	1.00	
Satd. Flow (perm)	328	3673		261	1961	1500	1216	1661		280	1900	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	17	960	99	260	820	435	201	74	344	322	146	38
RTOR Reduction (vph)	0	9	0	0	0	194	0	0	0	0	10	0
Lane Group Flow (vph)	17	1050	0	260	820	241	201	418	0	322	174	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		pm+ov	Perm			pm+pt		
Protected Phases		2		1	6	7		8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	23.9	23.9		38.9	38.9	49.9	22.0	22.0		39.0	39.0	
Effective Green, g (s)	23.9	23.9		38.9	38.9	49.9	22.0	22.0		39.0	39.0	
Actuated g/C Ratio	0.27	0.27		0.43	0.43	0.55	0.24	0.24		0.43	0.43	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.0	6.0	6.0		6.0	6.0	
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)	87	975		271	848	832	297	406		315	823	
v/s Ratio Prot		c0.29		0.09	c0.42	0.04		0.25		c0.13	0.09	
v/s Ratio Perm	0.05			0.32		0.13	0.17			c0.32		
v/c Ratio	0.20	1.08		0.96	0.97	0.29	0.68	1.03		1.02	0.21	
Uniform Delay, d1	25.6	33.0		21.2	24.9	10.6	30.8	34.0		22.8	15.9	
Progression Factor	1.13	0.99		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.8	51.4		43.0	23.9	0.2	6.0	52.5		56.5	0.1	
Delay (s)	33.7	84.2		64.2	48.8	10.8	36.8	86.5		79.4	16.0	
Level of Service	C	F		E	D	B	D	F		E	B	
Approach Delay (s)		83.4			40.5			70.3			56.3	
Approach LOS		F			D			E			E	

Intersection Summary			
HCM Average Control Delay	60.1	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.2
Intersection Capacity Utilization	104.2%	ICU Level of Service	G
Analysis Period (min)	15		

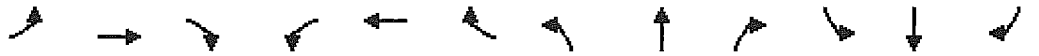
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	247	29	100	47	10	0	105	402	57	0	738	109
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.6	6.6			6.6	6.6
Lane Util. Factor	0.97	1.00	1.00	0.97	1.00		1.00	0.95			0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.98			1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	3614	1961	1667	3614	1961		1863	3656			3725	1667
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.31	1.00			1.00	1.00
Satd. Flow (perm)	3614	1961	1667	3614	1961		617	3656			3725	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	268	32	109	51	11	0	114	437	62	0	802	118
RTOR Reduction (vph)	0	0	92	0	0	0	0	11	0	0	0	48
Lane Group Flow (vph)	268	32	17	51	11	0	114	488	0	0	802	70
Turn Type	Prot		Perm	Prot		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2			6		6
Actuated Green, G (s)	15.0	12.7	12.7	4.1	1.8		43.8	43.8			43.8	43.8
Effective Green, g (s)	15.0	12.7	12.7	4.1	1.8		43.8	43.8			43.8	43.8
Actuated g/C Ratio	0.19	0.16	0.16	0.05	0.02		0.55	0.55			0.55	0.55
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.6	6.6			6.6	6.6
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)	684	314	267	187	45		341	2022			2060	922
v/s Ratio Prot	c0.07	0.02		0.01	c0.01			0.13			c0.22	
v/s Ratio Perm			0.01				0.18					0.04
v/c Ratio	0.39	0.10	0.07	0.27	0.24		0.33	0.24			0.39	0.08
Uniform Delay, d1	28.1	28.4	28.2	36.1	38.0		9.7	9.1			10.1	8.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.4	0.1	0.1	0.8	2.8		2.6	0.3			0.6	0.2
Delay (s)	28.5	28.5	28.3	36.9	40.9		12.3	9.4			10.6	8.4
Level of Service	C	C	C	D	D		B	A			B	A
Approach Delay (s)		28.4			37.6			10.0			10.4	
Approach LOS		C			D			A			B	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	79.2	Sum of lost time (s)	18.6
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		

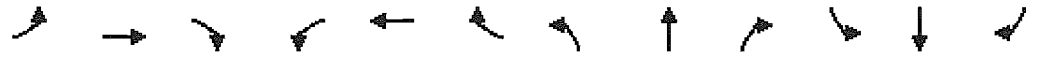
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	158	169	184	134	75	11	158	348	53	3	437	32
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	4.0	6.1	6.1	4.0	6.1		4.0	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1912		1743	1904		1900	1980	1650
Flt Permitted	0.68	1.00	1.00	0.45	1.00		0.30	1.00		0.33	1.00	1.00
Satd. Flow (perm)	1349	2000	1619	877	1912		554	1904		668	1980	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	195	209	227	184	103	15	214	470	72	4	520	38
RTOR Reduction (vph)	0	0	134	0	6	0	0	6	0	0	0	20
Lane Group Flow (vph)	195	209	93	184	112	0	214	536	0	4	520	18
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		Perm	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	21.7	13.7	13.7	21.7	13.7		54.2	52.3		37.3	37.3	37.3
Effective Green, g (s)	21.7	13.7	13.7	21.7	13.7		54.2	52.3		37.3	37.3	37.3
Actuated g/C Ratio	0.24	0.15	0.15	0.24	0.15		0.60	0.58		0.41	0.41	0.41
Clearance Time (s)	4.0	6.1	6.1	4.0	6.1		4.0	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	373	304	246	299	291		479	1106		277	821	684
v/s Ratio Prot	0.05	c0.10		c0.05	0.06		0.05	c0.28			c0.26	
v/s Ratio Perm	0.08		0.06	0.09			0.21			0.01		0.01
v/c Ratio	0.52	0.69	0.38	0.62	0.39		0.45	0.48		0.01	0.63	0.03
Uniform Delay, d1	28.9	36.1	34.3	28.9	34.4		19.4	11.0		15.5	20.9	15.6
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.35	1.26	1.85
Incremental Delay, d2	1.3	6.3	1.0	3.7	0.8		0.7	1.5		0.1	3.6	0.1
Delay (s)	30.2	42.5	35.3	32.6	35.2		20.1	12.5		21.0	30.0	28.9
Level of Service	C	D	D	C	D		C	B		C	C	C
Approach Delay (s)		36.1			33.6			14.7			29.9	
Approach LOS		D			C			B			C	

Intersection Summary			
HCM Average Control Delay	27.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



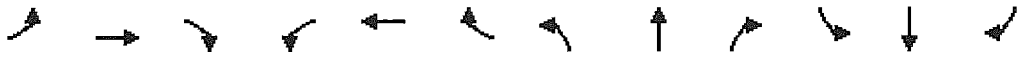
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	10	80	40	10	10	20	300	60	10	540	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87		1.00	0.92		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1863	1700		1863	1814		1863	1912		1863	1961	1667
Flt Permitted	0.74	1.00		0.69	1.00		0.42	1.00		0.53	1.00	1.00
Satd. Flow (perm)	1457	1700		1360	1814		828	1912		1041	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	11	87	43	11	11	22	326	65	11	587	11
RTOR Reduction (vph)	0	80	0	0	10	0	0	4	0	0	0	2
Lane Group Flow (vph)	11	18	0	43	12	0	22	387	0	11	587	9
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	7.3	7.3		7.3	7.3		71.1	71.1		71.1	71.1	71.1
Effective Green, g (s)	7.3	7.3		7.3	7.3		71.1	71.1		71.1	71.1	71.1
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.79	0.79		0.79	0.79	0.79
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
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)	118	138		110	147		654	1510		822	1549	1317
v/s Ratio Prot		0.01			0.01			0.20			c0.30	
v/s Ratio Perm	0.01			c0.03			0.03			0.01		0.01
v/c Ratio	0.09	0.13		0.39	0.08		0.03	0.26		0.01	0.38	0.01
Uniform Delay, d1	38.3	38.4		39.2	38.2		2.0	2.5		2.0	2.8	2.0
Progression Factor	1.00	1.00		1.00	1.00		0.73	0.66		0.63	0.57	0.45
Incremental Delay, d2	0.3	0.4		2.3	0.2		0.1	0.4		0.0	0.7	0.0
Delay (s)	38.6	38.8		41.5	38.5		1.6	2.0		1.3	2.3	0.9
Level of Service	D	D		D	D		A	A		A	A	A
Approach Delay (s)		38.8			40.5			2.0			2.2	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	7.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	45.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	437	65	29	456	12	62	151	43	44	267	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3653		1863	3711		1863	1896		1863	1950	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3653		1863	3711		1863	1896		1863	1950	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	24	553	82	41	651	17	65	159	45	54	330	12
RTOR Reduction (vph)	0	11	0	0	2	0	0	12	0	0	2	0
Lane Group Flow (vph)	24	624	0	41	666	0	65	192	0	54	340	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	3.0	33.1		4.7	34.8		7.3	21.2		7.0	20.9	
Effective Green, g (s)	3.0	33.1		4.7	34.8		7.3	21.2		7.0	20.9	
Actuated g/C Ratio	0.03	0.37		0.05	0.39		0.08	0.24		0.08	0.23	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	62	1343		97	1435		151	447		145	453	
v/s Ratio Prot	0.01	0.17		c0.02	c0.18		c0.03	0.10		0.03	c0.17	
v/s Ratio Perm												
v/c Ratio	0.39	0.46		0.42	0.46		0.43	0.43		0.37	0.75	
Uniform Delay, d1	42.6	21.7		41.3	20.6		39.4	29.3		39.4	32.1	
Progression Factor	1.00	1.00		0.82	0.71		1.04	1.13		1.00	1.00	
Incremental Delay, d2	4.0	1.2		2.4	0.9		1.9	0.7		1.6	6.9	
Delay (s)	46.6	22.9		36.5	15.6		43.0	33.7		41.0	39.0	
Level of Service	D	C		D	B		D	C		D	D	
Approach Delay (s)		23.7			16.8			36.0			39.3	
Approach LOS		C			B			D			D	

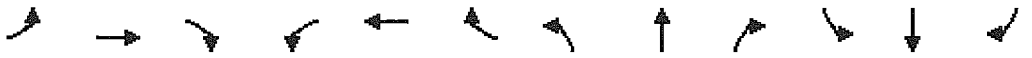
Intersection Summary			
HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	57.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	612	7	117	642	116	8	13	244	182	21	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3719		1863	1961	1500	1801	1895	1611	1863	1868	
Flt Permitted	0.21	1.00		0.17	1.00	1.00	0.73	1.00	1.00	0.57	1.00	
Satd. Flow (perm)	405	3719		341	1961	1500	1384	1895	1611	1125	1868	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	5	805	9	141	773	140	10	16	294	243	28	13
RTOR Reduction (vph)	0	1	0	0	0	70	0	0	0	0	8	0
Lane Group Flow (vph)	5	813	0	141	773	70	10	16	294	243	33	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm		Perm	pm+pt		
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	31.1	31.1		45.0	45.0	45.0	19.9	19.9	19.9	32.9	32.9	
Effective Green, g (s)	31.1	31.1		45.0	45.0	45.0	19.9	19.9	19.9	32.9	32.9	
Actuated g/C Ratio	0.35	0.35		0.50	0.50	0.50	0.22	0.22	0.22	0.37	0.37	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	140	1285		302	981	750	306	419	356	469	683	
v/s Ratio Prot		0.22		0.04	c0.39			0.01		c0.04	0.02	
v/s Ratio Perm	0.01			0.19		0.05	0.01		c0.18	0.15		
v/c Ratio	0.04	0.63		0.47	0.79	0.09	0.03	0.04	0.83	0.52	0.05	
Uniform Delay, d1	19.5	24.7		14.5	18.6	11.8	27.5	27.5	33.4	21.9	18.4	
Progression Factor	0.84	1.01		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	2.3		1.1	6.4	0.2	0.0	0.0	14.4	1.0	0.0	
Delay (s)	16.9	27.2		15.7	25.0	12.0	27.5	27.6	47.8	22.9	18.5	
Level of Service	B	C		B	C	B	C	C	D	C	B	
Approach Delay (s)		27.1			22.0			46.2			22.3	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	621	55	329	155	46	0	75	404	44	0	600	132
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0		6.6	6.6			6.6	6.6
Lane Util. Factor	0.97	1.00	1.00	0.97	1.00		1.00	0.95			0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99			1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	3614	1961	1667	3614	1961		1863	3670			3725	1667
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.35	1.00			1.00	1.00
Satd. Flow (perm)	3614	1961	1667	3614	1961		677	3670			3725	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	675	60	358	168	50	0	82	439	48	0	652	143
RTOR Reduction (vph)	0	0	151	0	0	0	0	9	0	0	0	76
Lane Group Flow (vph)	675	60	207	168	50	0	82	478	0	0	652	67
Turn Type	Prot		Perm	Prot		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4			8	2			6		6
Actuated Green, G (s)	21.1	18.8	18.8	8.9	6.6		29.7	29.7			29.7	29.7
Effective Green, g (s)	21.1	18.8	18.8	8.9	6.6		29.7	29.7			29.7	29.7
Actuated g/C Ratio	0.28	0.25	0.25	0.12	0.09		0.39	0.39			0.39	0.39
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0		6.6	6.6			6.6	6.6
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)	1003	485	412	423	170		265	1434			1456	651
v/s Ratio Prot	c0.19	0.03		0.05	0.03			0.13			c0.18	
v/s Ratio Perm			c0.12				0.12					0.04
v/c Ratio	0.67	0.12	0.50	0.40	0.29		0.31	0.33			0.45	0.10
Uniform Delay, d1	24.4	22.2	24.6	31.1	32.5		16.0	16.2			17.1	14.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	1.8	0.1	1.0	0.6	1.0		3.0	0.6			1.0	0.3
Delay (s)	26.2	22.3	25.6	31.7	33.5		19.1	16.8			18.1	15.0
Level of Service	C	C	C	C	C		B	B			B	B
Approach Delay (s)		25.8			32.1			17.2			17.5	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	76.0	Sum of lost time (s)	12.6
Intersection Capacity Utilization	63.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	158	243	142	268	4	249	595	60	3	348	144
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	6.1	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1938		1743	1922		1900	1980	1650
Flt Permitted	0.24	1.00	1.00	0.56	1.00		0.40	1.00		0.13	1.00	1.00
Satd. Flow (perm)	478	2000	1619	1094	1938		741	1922		263	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	133	190	293	178	335	5	277	661	67	3	366	152
RTOR Reduction (vph)	0	0	189	0	1	0	0	4	0	0	0	101
Lane Group Flow (vph)	133	190	104	178	339	0	277	724	0	3	366	51
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		Perm	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	25.5	18.6	18.6	25.5	18.6		46.4	46.4		30.4	30.4	30.4
Effective Green, g (s)	25.5	18.6	18.6	25.5	18.6		46.4	46.4		30.4	30.4	30.4
Actuated g/C Ratio	0.28	0.21	0.21	0.28	0.21		0.52	0.52		0.34	0.34	0.34
Clearance Time (s)	6.1	6.1	6.1	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	243	413	335	369	401		494	991		89	669	557
v/s Ratio Prot	c0.04	0.10		0.04	c0.18		0.06	c0.38			0.18	
v/s Ratio Perm	0.11		0.06	0.10			0.23			0.01		0.03
v/c Ratio	0.55	0.46	0.31	0.48	0.85		0.56	0.73		0.03	0.55	0.09
Uniform Delay, d1	25.6	31.3	30.3	25.6	34.3		21.5	16.9		20.0	24.2	20.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.16	1.21	1.79
Incremental Delay, d2	2.5	0.8	0.5	1.0	15.1		1.5	4.7		0.7	3.1	0.3
Delay (s)	28.1	32.1	30.8	26.6	49.4		23.0	21.7		23.9	32.4	36.8
Level of Service	C	C	C	C	D		C	C		C	C	D
Approach Delay (s)		30.6			41.5			22.0			33.7	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	30.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	81.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	20	100	190	20	60	20	430	80	10	420	30
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.88		1.00	0.89		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1863	1716		1863	1741		1863	1915		1863	1961	1667
Flt Permitted	0.70	1.00		0.67	1.00		0.46	1.00		0.39	1.00	1.00
Satd. Flow (perm)	1374	1716		1320	1741		901	1915		774	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	22	109	207	22	65	22	467	87	11	457	33
RTOR Reduction (vph)	0	86	0	0	51	0	0	6	0	0	0	11
Lane Group Flow (vph)	22	45	0	207	36	0	22	548	0	11	457	22
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	19.4	19.4		19.4	19.4		59.0	59.0		59.0	59.0	59.0
Effective Green, g (s)	19.4	19.4		19.4	19.4		59.0	59.0		59.0	59.0	59.0
Actuated g/C Ratio	0.22	0.22		0.22	0.22		0.66	0.66		0.66	0.66	0.66
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
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)	296	370		285	375		591	1255		507	1286	1093
v/s Ratio Prot		0.03			0.02			c0.29			0.23	
v/s Ratio Perm	0.02			c0.16			0.02			0.01		0.01
v/c Ratio	0.07	0.12		0.73	0.10		0.04	0.44		0.02	0.36	0.02
Uniform Delay, d1	28.1	28.4		32.8	28.3		5.5	7.5		5.4	7.0	5.4
Progression Factor	1.00	1.00		1.00	1.00		0.78	1.00		0.73	0.57	0.63
Incremental Delay, d2	0.1	0.1		8.9	0.1		0.1	1.0		0.1	0.7	0.0
Delay (s)	28.2	28.6		41.7	28.4		4.4	8.5		4.0	4.6	3.4
Level of Service	C	C		D	C		A	A		A	A	A
Approach Delay (s)		28.5			37.8			8.3			4.5	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM Average Control Delay	14.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	52.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	516	75	66	510	104	83	318	37	68	282	18
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.97		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3655		1863	3631		1863	1930		1863	1943	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3655		1863	3631		1863	1930		1863	1943	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	58	573	83	72	554	113	93	357	42	76	313	20
RTOR Reduction (vph)	0	11	0	0	16	0	0	4	0	0	2	0
Lane Group Flow (vph)	58	645	0	72	651	0	93	395	0	76	331	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	6.6	25.4		7.0	25.8		8.6	25.7		7.9	25.0	
Effective Green, g (s)	6.6	25.4		7.0	25.8		8.6	25.7		7.9	25.0	
Actuated g/C Ratio	0.07	0.28		0.08	0.29		0.10	0.29		0.09	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	137	1032		145	1041		178	551		164	540	
v/s Ratio Prot	0.03	0.18		c0.04	c0.18		c0.05	c0.20		0.04	0.17	
v/s Ratio Perm												
v/c Ratio	0.42	0.63		0.50	0.62		0.52	0.72		0.46	0.61	
Uniform Delay, d1	39.9	28.2		39.8	27.9		38.7	28.9		39.0	28.3	
Progression Factor	1.00	1.00		1.17	1.09		1.35	0.63		1.00	1.00	
Incremental Delay, d2	2.1	2.9		2.3	2.5		2.6	4.2		2.1	2.1	
Delay (s)	42.0	31.0		48.9	32.8		54.8	22.5		41.1	30.3	
Level of Service	D	C		D	C		D	C		D	C	
Approach Delay (s)		31.9			34.3			28.6			32.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	66.2%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	845	17	274	754	400	43	55	287	296	122	35
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.0	6.0	6.0	6.1	6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3715		1863	1961	1500	1801	1895	1611	1863	1895	
Flt Permitted	0.32	1.00		0.12	1.00	1.00	0.65	1.00	1.00	0.45	1.00	
Satd. Flow (perm)	636	3715		227	1961	1500	1230	1895	1611	884	1895	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	17	960	19	298	820	435	46	59	305	322	133	38
RTOR Reduction (vph)	0	1	0	0	0	136	0	0	0	0	13	0
Lane Group Flow (vph)	17	978	0	298	820	299	46	59	305	322	158	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		pm+ov	Perm		pm+ov	pm+pt		
Protected Phases		2		1	6	7		8	1	7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	28.5	28.5		51.8	51.8	61.8	10.1	10.1	27.3	26.1	26.1	
Effective Green, g (s)	28.5	28.5		51.8	51.8	61.8	10.1	10.1	27.3	26.1	26.1	
Actuated g/C Ratio	0.32	0.32		0.58	0.58	0.69	0.11	0.11	0.30	0.29	0.29	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.0	6.0	6.0	6.1	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	201	1176		443	1129	1030	138	213	489	365	550	
v/s Ratio Prot		c0.26		0.13	c0.42	0.03		0.03	0.12	c0.10	0.08	
v/s Ratio Perm	0.03			0.26		0.17	0.04		0.07	c0.16		
v/c Ratio	0.08	0.83		0.67	0.73	0.29	0.33	0.28	0.62	0.88	0.29	
Uniform Delay, d1	21.6	28.5		19.1	13.9	5.5	36.8	36.6	26.9	29.2	24.7	
Progression Factor	1.16	0.92		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.8	6.7		4.0	4.1	0.2	1.4	0.7	2.5	21.3	0.3	
Delay (s)	25.8	33.1		23.1	18.0	5.7	38.3	37.3	29.4	50.5	25.0	
Level of Service	C	C		C	B	A	D	D	C	D	C	
Approach Delay (s)		33.0			15.5			31.5			41.7	
Approach LOS		C			B			C			D	

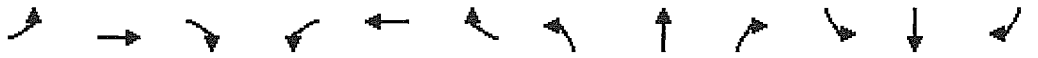
Intersection Summary			
HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.2
Intersection Capacity Utilization	90.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	247	159	100	157	44	85	105	402	294	366	738	109
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.6	6.6		6.6	6.6	6.6
Lane Util. Factor	0.97	1.00	1.00	0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3614	1961	1667	3614	1961	1667	1863	3489		1863	3725	1667
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.19	1.00		0.21	1.00	1.00
Satd. Flow (perm)	3614	1961	1667	3614	1961	1667	375	3489		410	3725	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	268	173	109	171	48	92	114	437	320	398	802	118
RTOR Reduction (vph)	0	0	93	0	0	84	0	145	0	0	0	53
Lane Group Flow (vph)	268	173	16	171	48	8	114	612	0	398	802	65
Turn Type	Prot		Perm	Prot		Perm	pm+pt			pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8	2			6		6
Actuated Green, G (s)	14.3	12.8	12.8	9.3	7.8	7.8	27.4	21.5		46.1	33.6	33.6
Effective Green, g (s)	14.3	12.8	12.8	9.3	7.8	7.8	27.4	21.5		46.1	33.6	33.6
Actuated g/C Ratio	0.16	0.15	0.15	0.11	0.09	0.09	0.32	0.25		0.53	0.39	0.39
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.6	6.6		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	595	289	246	387	176	150	220	864		519	1442	645
v/s Ratio Prot	c0.07	c0.09		0.05	0.02		0.04	0.18		c0.16	0.22	
v/s Ratio Perm			0.01			0.00	0.13			c0.25		0.04
v/c Ratio	0.45	0.60	0.07	0.44	0.27	0.06	0.52	0.71		0.77	0.56	0.10
Uniform Delay, d1	32.7	34.6	31.9	36.3	36.9	36.1	32.3	29.8		23.4	20.8	17.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	0.5	3.3	0.1	0.8	0.8	0.2	2.1	4.9		6.7	1.6	0.3
Delay (s)	33.2	37.9	32.0	37.1	37.7	36.3	34.4	34.7		30.1	22.3	17.3
Level of Service	C	D	C	D	D	D	C	C		C	C	B
Approach Delay (s)		34.5			37.0			34.6			24.2	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM Average Control Delay	30.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	86.8	Sum of lost time (s)	18.6
Intersection Capacity Utilization	74.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	158	169	267	194	75	71	168	413	59	2	657	32
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	6.1
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1826		1743	1907		1900	1980	1650
Flt Permitted	0.45	1.00	1.00	0.41	1.00		0.10	1.00		0.41	1.00	1.00
Satd. Flow (perm)	896	2000	1619	812	1826		175	1907		820	1980	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	195	209	330	266	103	97	227	558	80	2	782	38
RTOR Reduction (vph)	0	0	69	0	38	0	0	6	0	0	0	16
Lane Group Flow (vph)	195	209	261	266	162	0	227	632	0	2	782	22
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		pm+ov	pm+pt			pm+pt			Perm		pm+ov
Protected Phases	7	4	5	3	8		5	2			6	7
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	21.1	12.3	21.0	21.3	12.4		50.7	50.7		36.1	36.1	44.9
Effective Green, g (s)	21.1	12.3	21.0	21.3	12.4		50.7	50.7		36.1	36.1	44.9
Actuated g/C Ratio	0.23	0.14	0.23	0.24	0.14		0.56	0.56		0.40	0.40	0.50
Clearance Time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	306	273	378	296	252		250	1074		329	794	823
v/s Ratio Prot	0.06	0.10	0.07	c0.09	0.09		c0.09	0.33			c0.39	0.00
v/s Ratio Perm	0.09		0.09	c0.12			0.42			0.00		0.01
v/c Ratio	0.64	0.77	0.69	0.90	0.64		0.91	0.59		0.01	0.98	0.03
Uniform Delay, d1	29.5	37.5	31.5	31.8	36.7		23.9	12.8		16.2	26.7	11.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.76	0.92	0.40
Incremental Delay, d2	4.3	12.1	5.4	27.7	5.5		33.1	2.4		0.0	28.2	0.0
Delay (s)	33.8	49.5	36.9	59.4	42.2		57.0	15.2		12.4	52.9	4.6
Level of Service	C	D	D	E	D		E	B		B	D	A
Approach Delay (s)		39.7			52.0			26.2			50.5	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	40.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	17.9
Intersection Capacity Utilization	80.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	10	80	40	10	10	20	300	60	10	540	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87		1.00	0.92		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1863	1700		1863	1814		1863	1912		1863	1961	1667
Flt Permitted	0.74	1.00		0.69	1.00		0.42	1.00		0.53	1.00	1.00
Satd. Flow (perm)	1457	1700		1360	1814		828	1912		1041	1961	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	11	87	43	11	11	22	326	65	11	587	11
RTOR Reduction (vph)	0	80	0	0	10	0	0	4	0	0	0	2
Lane Group Flow (vph)	11	18	0	43	12	0	22	387	0	11	587	9
Turn Type	Perm			Perm			Perm			Perm		Perm
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	7.3	7.3		7.3	7.3		71.1	71.1		71.1	71.1	71.1
Effective Green, g (s)	7.3	7.3		7.3	7.3		71.1	71.1		71.1	71.1	71.1
Actuated g/C Ratio	0.08	0.08		0.08	0.08		0.79	0.79		0.79	0.79	0.79
Clearance Time (s)	5.8	5.8		5.8	5.8		5.8	5.8		5.8	5.8	5.8
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)	118	138		110	147		654	1510		822	1549	1317
v/s Ratio Prot		0.01			0.01			0.20			c0.30	
v/s Ratio Perm	0.01			c0.03			0.03			0.01		0.01
v/c Ratio	0.09	0.13		0.39	0.08		0.03	0.26		0.01	0.38	0.01
Uniform Delay, d1	38.3	38.4		39.2	38.2		2.0	2.5		2.0	2.8	2.0
Progression Factor	1.00	1.00		1.00	1.00		1.19	1.49		0.46	0.49	0.31
Incremental Delay, d2	0.3	0.4		2.3	0.2		0.1	0.3		0.0	0.4	0.0
Delay (s)	38.6	38.8		41.5	38.5		2.5	4.1		0.9	1.8	0.6
Level of Service	D	D		D	D		A	A		A	A	A
Approach Delay (s)		38.8			40.5			4.0			1.8	
Approach LOS		D			D			A			A	

Intersection Summary			
HCM Average Control Delay	8.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.6
Intersection Capacity Utilization	45.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	591	103	29	501	12	72	191	43	44	418	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3643		1863	3713		1863	1907		1863	1954	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3643		1863	3713		1863	1907		1863	1954	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	24	748	130	41	716	17	76	201	45	54	516	12
RTOR Reduction (vph)	0	14	0	0	1	0	0	9	0	0	1	0
Lane Group Flow (vph)	24	864	0	41	732	0	76	237	0	54	527	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	2.8	29.1		4.2	30.5		5.6	27.1		5.6	27.1	
Effective Green, g (s)	2.8	29.1		4.2	30.5		5.6	27.1		5.6	27.1	
Actuated g/C Ratio	0.03	0.32		0.05	0.34		0.06	0.30		0.06	0.30	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	58	1178		87	1258		116	574		116	588	
v/s Ratio Prot	0.01	c0.24		c0.02	0.20		c0.04	0.12		0.03	c0.27	
v/s Ratio Perm												
v/c Ratio	0.41	0.73		0.47	0.58		0.66	0.41		0.47	0.90	
Uniform Delay, d1	42.8	27.0		41.8	24.5		41.3	25.1		40.8	30.1	
Progression Factor	1.00	1.00		1.08	1.20		0.82	0.84		1.00	1.00	
Incremental Delay, d2	4.7	4.1		3.4	1.7		12.4	0.5		2.9	16.2	
Delay (s)	47.5	31.1		48.7	31.0		46.1	21.5		43.7	46.3	
Level of Service	D	C		D	C		D	C		D	D	
Approach Delay (s)		31.5			32.0			27.3			46.1	
Approach LOS		C			C			C			D	

Intersection Summary			
HCM Average Control Delay	34.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	591	103	29	501	12	72	191	43	44	418	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3643		1863	3713		1863	1907		1863	1954	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3643		1863	3713		1863	1907		1863	1954	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	24	748	130	41	716	17	76	201	45	54	516	12
RTOR Reduction (vph)	0	14	0	0	1	0	0	9	0	0	1	0
Lane Group Flow (vph)	24	864	0	41	732	0	76	237	0	54	527	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	2.8	29.1		4.2	30.5		5.6	27.1		5.6	27.1	
Effective Green, g (s)	2.8	29.1		4.2	30.5		5.6	27.1		5.6	27.1	
Actuated g/C Ratio	0.03	0.32		0.05	0.34		0.06	0.30		0.06	0.30	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	58	1178		87	1258		116	574		116	588	
v/s Ratio Prot	0.01	c0.24		c0.02	0.20		c0.04	0.12		0.03	c0.27	
v/s Ratio Perm												
v/c Ratio	0.41	0.73		0.47	0.58		0.66	0.41		0.47	0.90	
Uniform Delay, d1	42.8	27.0		41.8	24.5		41.3	25.1		40.8	30.1	
Progression Factor	1.00	1.00		1.08	1.20		0.82	0.84		1.00	1.00	
Incremental Delay, d2	4.7	4.1		3.4	1.7		12.4	0.5		2.9	16.2	
Delay (s)	47.5	31.1		48.7	31.0		46.1	21.5		43.7	46.3	
Level of Service	D	C		D	C		D	C		D	D	
Approach Delay (s)		31.5			32.0			27.3			46.1	
Approach LOS		C			C			C			D	

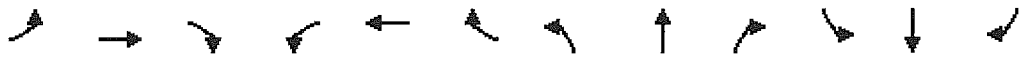
Intersection Summary			
HCM Average Control Delay	34.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	612	161	203	642	116	53	21	217	182	41	10
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3609		1863	1961	1500	1801	1895	1611	1863	1905	
Flt Permitted	0.25	1.00		0.11	1.00	1.00	0.71	1.00	1.00	0.56	1.00	
Satd. Flow (perm)	483	3609		220	1961	1500	1351	1895	1611	1099	1905	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	5	805	212	245	773	140	64	25	261	243	55	13
RTOR Reduction (vph)	0	25	0	0	0	68	0	0	0	0	8	0
Lane Group Flow (vph)	5	992	0	245	773	72	64	25	261	243	60	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm		Perm	pm+pt		
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	29.5	29.5		46.3	46.3	46.3	18.6	18.6	18.6	31.6	31.6	
Effective Green, g (s)	29.5	29.5		46.3	46.3	46.3	18.6	18.6	18.6	31.6	31.6	
Actuated g/C Ratio	0.33	0.33		0.51	0.51	0.51	0.21	0.21	0.21	0.35	0.35	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0	6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	158	1183		309	1009	772	279	392	333	445	669	
v/s Ratio Prot		0.27		0.09	c0.39			0.01		c0.04	0.03	
v/s Ratio Perm	0.01			c0.31		0.05	0.05		c0.16	0.15		
v/c Ratio	0.03	0.84		0.79	0.77	0.09	0.23	0.06	0.78	0.55	0.09	
Uniform Delay, d1	20.5	28.0		19.5	17.5	11.1	29.7	28.7	33.8	23.0	19.6	
Progression Factor	1.20	0.96		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	6.8		13.0	5.6	0.2	0.4	0.1	11.4	1.4	0.1	
Delay (s)	25.1	33.9		32.5	23.1	11.4	30.2	28.8	45.2	24.4	19.6	
Level of Service	C	C		C	C	B	C	C	D	C	B	
Approach Delay (s)		33.8			23.7			41.3			23.3	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM Average Control Delay	29.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	71.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	621	151	329	477	146	294	75	404	140	162	600	132
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.6	6.6	6.6		6.6	6.6	6.6
Lane Util. Factor	0.97	1.00	1.00	0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3614	1961	1667	3614	1961	1667	1863	3582		1863	3725	1667
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.23	1.00		0.29	1.00	1.00
Satd. Flow (perm)	3614	1961	1667	3614	1961	1667	453	3582		573	3725	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	675	164	358	518	159	320	82	439	152	176	652	143
RTOR Reduction (vph)	0	0	178	0	0	22	0	37	0	0	0	77
Lane Group Flow (vph)	675	164	180	518	159	298	82	554	0	176	652	66
Turn Type	Prot		Perm	Prot		pm+ov	pm+pt			pm+pt		Perm
Protected Phases	7	4		3	8	1	5	2		1	6	
Permitted Phases			4			8	2			6		6
Actuated Green, G (s)	16.4	14.6	14.6	14.1	12.3	21.2	23.4	17.5		29.4	20.5	20.5
Effective Green, g (s)	16.4	14.6	14.6	14.1	12.3	21.2	23.4	17.5		29.4	20.5	20.5
Actuated g/C Ratio	0.20	0.18	0.18	0.18	0.15	0.26	0.29	0.22		0.37	0.26	0.26
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.6	6.6	6.6		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	738	357	303	635	300	577	236	781		353	951	426
v/s Ratio Prot	c0.19	0.08		0.14	0.08	c0.06	0.03	0.15		0.06	c0.18	
v/s Ratio Perm			c0.11			0.12	0.08			0.13		0.04
v/c Ratio	0.91	0.46	0.60	0.82	0.53	0.52	0.35	0.71		0.50	0.69	0.16
Uniform Delay, d1	31.3	29.3	30.1	31.9	31.3	25.2	28.8	29.0		25.6	27.0	23.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	15.8	0.9	3.1	8.0	1.8	0.8	0.9	5.4		1.1	4.0	0.8
Delay (s)	47.1	30.3	33.3	39.8	33.1	26.0	29.7	34.5		26.7	31.0	24.0
Level of Service	D	C	C	D	C	C	C	C		C	C	C
Approach Delay (s)		40.7			34.3			33.9			29.2	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	34.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	80.3	Sum of lost time (s)	19.2
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	110	158	288	169	268	4	323	773	77	3	434	144
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	6.1
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1938		1743	1922		1900	1980	1650
Flt Permitted	0.23	1.00	1.00	0.55	1.00		0.29	1.00		0.14	1.00	1.00
Satd. Flow (perm)	454	2000	1619	1086	1938		524	1922		277	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	133	190	347	211	335	5	359	859	86	3	457	152
RTOR Reduction (vph)	0	0	121	0	1	0	0	4	0	0	0	87
Lane Group Flow (vph)	133	190	226	211	339	0	359	941	0	3	457	65
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		pm+ov	pm+pt			pm+pt			Perm		pm+ov
Protected Phases	7	4	5	3	8		5	2			6	7
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	25.0	18.1	30.2	25.0	18.1		46.9	46.9		28.9	28.9	35.8
Effective Green, g (s)	25.0	18.1	30.2	25.0	18.1		46.9	46.9		28.9	28.9	35.8
Actuated g/C Ratio	0.28	0.20	0.34	0.28	0.20		0.52	0.52		0.32	0.32	0.40
Clearance Time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	6.1
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	236	402	543	361	390		437	1002		89	636	656
v/s Ratio Prot	0.04	0.10	0.06	c0.04	c0.17		0.11	c0.49			0.23	0.01
v/s Ratio Perm	0.11		0.08	0.12			0.32			0.01		0.03
v/c Ratio	0.56	0.47	0.42	0.58	0.87		0.82	0.94		0.03	0.72	0.10
Uniform Delay, d1	26.0	31.7	23.1	26.9	34.8		26.3	20.2		21.0	27.0	17.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.10	1.11	1.63
Incremental Delay, d2	3.1	0.9	0.5	2.4	18.2		11.8	17.1		0.7	6.7	0.1
Delay (s)	29.0	32.6	23.6	29.3	53.0		38.0	37.3		23.7	36.6	27.8
Level of Service	C	C	C	C	D		D	D		C	D	C
Approach Delay (s)		27.2			44.0			37.5			34.3	
Approach LOS		C			D			D			C	

Intersection Summary			
HCM Average Control Delay	35.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	90.9%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	52	586	91	66	656	104	105	405	37	68	345	18
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3650		1863	3649		1863	1936		1863	1946	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3650		1863	3649		1863	1936		1863	1946	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	58	651	101	72	713	113	118	455	42	76	383	20
RTOR Reduction (vph)	0	13	0	0	13	0	0	3	0	0	2	0
Lane Group Flow (vph)	58	739	0	72	813	0	118	494	0	76	401	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	5.6	25.2		5.7	25.3		9.9	27.5		7.6	25.2	
Effective Green, g (s)	5.6	25.2		5.7	25.3		9.9	27.5		7.6	25.2	
Actuated g/C Ratio	0.06	0.28		0.06	0.28		0.11	0.31		0.08	0.28	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	116	1022		118	1026		205	592		157	545	
v/s Ratio Prot	0.03	0.20		c0.04	c0.22		c0.06	c0.25		0.04	0.21	
v/s Ratio Perm												
v/c Ratio	0.50	0.72		0.61	0.79		0.58	0.83		0.48	0.74	
Uniform Delay, d1	40.8	29.3		41.1	29.9		38.1	29.1		39.3	29.4	
Progression Factor	1.00	1.00		1.10	1.11		1.33	0.64		1.00	1.00	
Incremental Delay, d2	3.4	4.4		6.8	4.8		3.7	9.4		2.3	5.1	
Delay (s)	44.2	33.7		51.9	38.0		54.2	28.0		41.7	34.5	
Level of Service	D	C		D	D		D	C		D	C	
Approach Delay (s)		34.4			39.1			33.0			35.6	
Approach LOS		C			D			C			D	

Intersection Summary			
HCM Average Control Delay	35.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	845	87	239	754	400	189	70	323	296	134	35
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.0	6.0	6.0	6.1	6.0	6.0	
Lane Util. Factor	1.00	0.95		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	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1863	3673		1863	1961	1500	1801	1895	1611	1863	1900	
Flt Permitted	0.16	1.00		0.12	1.00	1.00	0.64	1.00	1.00	0.54	1.00	
Satd. Flow (perm)	314	3673		236	1961	1500	1216	1895	1611	1051	1900	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	17	960	99	260	820	435	201	74	344	322	146	38
RTOR Reduction (vph)	0	8	0	0	0	177	0	0	0	0	11	0
Lane Group Flow (vph)	17	1051	0	260	820	258	201	74	344	322	173	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		pm+ov	Perm		pm+ov	pm+pt		
Protected Phases		2		1	6	7		8	1	7	4	
Permitted Phases	2			6		6	8		8	4		
Actuated Green, G (s)	27.1	27.1		44.3	44.3	53.3	18.6	18.6	29.7	33.6	33.6	
Effective Green, g (s)	27.1	27.1		44.3	44.3	53.3	18.6	18.6	29.7	33.6	33.6	
Actuated g/C Ratio	0.30	0.30		0.49	0.49	0.59	0.21	0.21	0.33	0.37	0.37	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.0	6.0	6.0	6.1	6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	95	1106		317	965	888	251	392	532	474	709	
v/s Ratio Prot		c0.29		0.10	c0.42	0.03		0.04	0.08	c0.07	0.09	
v/s Ratio Perm	0.05			0.30		0.14	c0.17		0.13	0.19		
v/c Ratio	0.18	0.95		0.82	0.85	0.29	0.80	0.19	0.65	0.68	0.24	
Uniform Delay, d1	23.2	30.8		20.6	19.9	9.0	33.9	29.5	25.7	22.9	19.4	
Progression Factor	1.17	0.99		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.9	16.8		15.5	9.3	0.2	16.5	0.2	2.7	3.9	0.2	
Delay (s)	31.1	47.2		36.1	29.2	9.2	50.5	29.7	28.4	26.7	19.6	
Level of Service	C	D		D	C	A	D	C	C	C	B	
Approach Delay (s)		46.9			24.6			35.7			24.1	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM Average Control Delay	32.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.2
Intersection Capacity Utilization	90.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	287	185	125	182	51	99	122	467	341	425	923	136
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		0.95			1.00	1.00
Frt	1.00	0.94		1.00	1.00	0.85		0.95			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.98	1.00
Satd. Flow (prot)	1863	1842		1863	1961	1667		3498			1930	1667
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.51			0.37	1.00
Satd. Flow (perm)	1863	1842		1863	1961	1667		1799			730	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	312	201	136	198	55	108	133	508	371	462	1003	148
RTOR Reduction (vph)	0	27	0	0	0	93	0	93	0	0	0	45
Lane Group Flow (vph)	312	310	0	198	55	15	0	919	0	0	1465	103
Turn Type	Prot			Prot		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8	2			6		6
Actuated Green, G (s)	14.4	17.2		10.0	12.8	12.8		45.4			45.4	45.4
Effective Green, g (s)	14.4	17.2		10.0	12.8	12.8		45.4			45.4	45.4
Actuated g/C Ratio	0.16	0.19		0.11	0.14	0.14		0.50			0.50	0.50
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)	294	347		204	275	234		896			363	830
v/s Ratio Prot	c0.17	c0.17		0.11	0.03							
v/s Ratio Perm						0.01		0.51			c2.01	0.06
v/c Ratio	1.06	0.89		0.97	0.20	0.06		1.03			4.04	0.12
Uniform Delay, d1	38.4	36.1		40.5	34.7	34.0		22.9			22.9	12.3
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	1.00
Incremental Delay, d2	69.6	24.0		54.3	0.4	0.1		36.8			1372.7	0.3
Delay (s)	108.0	60.1		94.8	35.0	34.1		59.7			1395.6	12.6
Level of Service	F	E		F	D	C		E			F	B
Approach Delay (s)		83.1			67.5			59.7			1268.7	
Approach LOS		F			E			E			F	

Intersection Summary			
HCM Average Control Delay	601.1	HCM Level of Service	F
HCM Volume to Capacity ratio	2.93		
Actuated Cycle Length (s)	91.2	Sum of lost time (s)	18.6
Intersection Capacity Utilization	141.6%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

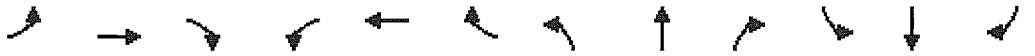
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	196	311	225	87	82	195	480	69	3	767	37
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.91		1.00	0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1762		1863	1826		1743	1908		1900	1980	1650
Flt Permitted	0.46	1.00		0.22	1.00		0.11	1.00		0.12	1.00	1.00
Satd. Flow (perm)	910	1762		438	1826		193	1908		249	1980	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	226	242	384	308	119	112	264	649	93	4	913	44
RTOR Reduction (vph)	0	63	0	0	38	0	0	5	0	0	0	7
Lane Group Flow (vph)	226	563	0	308	193	0	264	737	0	4	913	37
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt			pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	26.8	17.9		26.8	17.9		45.1	45.1		32.1	32.1	32.1
Effective Green, g (s)	26.8	17.9		26.8	17.9		45.1	45.1		32.1	32.1	32.1
Actuated g/C Ratio	0.30	0.20		0.30	0.20		0.50	0.50		0.36	0.36	0.36
Clearance Time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
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)	367	350		271	363		219	956		89	706	589
v/s Ratio Prot	0.06	c0.32		c0.11	0.11		c0.10	0.39			0.46	
v/s Ratio Perm	0.12			0.23			c0.51			0.02		0.02
v/c Ratio	0.62	1.61		1.14	0.53		1.21	0.77		0.04	1.29	0.06
Uniform Delay, d1	25.4	36.0		29.2	32.3		37.4	18.2		18.9	28.9	19.1
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.85	0.93	0.82
Incremental Delay, d2	3.1	286.5		96.6	1.5		127.4	6.0		0.9	142.1	0.2
Delay (s)	28.4	322.5		125.8	33.8		164.9	24.2		17.1	169.1	15.8
Level of Service	C	F		F	C		F	C		B	F	B
Approach Delay (s)		244.5			86.4			61.1			161.5	
Approach LOS		F			F			E			F	

Intersection Summary			
HCM Average Control Delay	140.4	HCM Level of Service	F
HCM Volume to Capacity ratio	1.26		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	108.4%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

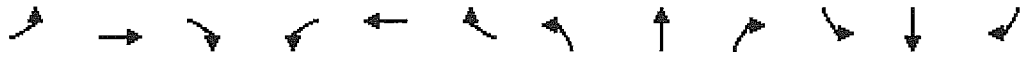
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	687	120	34	582	14	83	222	50	51	486	12
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3642		1863	3712		1863	1906		1863	1954	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3642		1863	3712		1863	1906		1863	1954	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	28	870	152	49	831	20	87	234	53	63	600	15
RTOR Reduction (vph)	0	15	0	0	1	0	0	9	0	0	1	0
Lane Group Flow (vph)	28	1007	0	49	850	0	87	278	0	63	614	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	2.8	25.8		4.2	27.2		6.4	29.8		6.2	29.6	
Effective Green, g (s)	2.8	25.8		4.2	27.2		6.4	29.8		6.2	29.6	
Actuated g/C Ratio	0.03	0.29		0.05	0.30		0.07	0.33		0.07	0.33	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	58	1044		87	1122		132	631		128	643	
v/s Ratio Prot	0.02	c0.28		c0.03	0.23		c0.05	0.15		0.03	c0.31	
v/s Ratio Perm												
v/c Ratio	0.48	0.96		0.56	0.76		0.66	0.44		0.49	0.95	
Uniform Delay, d1	42.9	31.6		42.0	28.4		40.7	23.6		40.4	29.5	
Progression Factor	1.00	1.00		1.07	1.31		1.01	0.91		1.00	1.00	
Incremental Delay, d2	6.2	20.5		5.9	3.5		11.0	0.5		3.0	24.5	
Delay (s)	49.1	52.2		50.8	40.9		52.3	21.8		43.3	54.1	
Level of Service	D	D		D	D		D	C		D	D	
Approach Delay (s)		52.1			41.4			28.9			53.1	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	46.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	711	186	235	746	135	61	25	251	212	48	12
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	1.00	0.85	1.00	0.86		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3610		1863	1961	1500	1801	1637		1863	1902	
Flt Permitted	0.15	1.00		0.12	1.00	1.00	0.70	1.00		0.23	1.00	
Satd. Flow (perm)	292	3610		238	1961	1500	1336	1637		457	1902	
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	7	936	245	283	899	163	73	30	302	283	64	16
RTOR Reduction (vph)	0	26	0	0	0	78	0	0	0	0	10	0
Lane Group Flow (vph)	7	1155	0	283	899	85	73	332	0	283	70	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm			pm+pt		
Protected Phases		2		1	6			8		7	4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	26.9	26.9		43.1	43.1	43.1	20.8	20.8		34.8	34.8	
Effective Green, g (s)	26.9	26.9		43.1	43.1	43.1	20.8	20.8		34.8	34.8	
Actuated g/C Ratio	0.30	0.30		0.48	0.48	0.48	0.23	0.23		0.39	0.39	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
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)	87	1079		296	939	718	309	378		302	735	
v/s Ratio Prot		c0.32		0.11	c0.46			0.20		c0.08	0.04	
v/s Ratio Perm	0.02			0.35		0.06	0.05			c0.28		
v/c Ratio	0.08	1.07		0.96	0.96	0.12	0.24	0.88		0.94	0.10	
Uniform Delay, d1	22.7	31.6		23.1	22.6	13.0	28.1	33.4		24.4	17.6	
Progression Factor	1.20	0.94		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6	47.1		40.2	20.7	0.3	0.4	20.0		35.2	0.1	
Delay (s)	28.7	76.9		63.3	43.3	13.3	28.5	53.3		59.5	17.6	
Level of Service	C	E		E	D	B	C	D		E	B	
Approach Delay (s)		76.6			43.9			48.9			50.3	
Approach LOS		E			D			D			D	

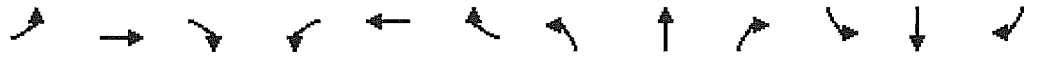
Intersection Summary			
HCM Average Control Delay	57.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.2
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	721	175	411	554	170	341	87	469	163	188	750	165
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		0.95			1.00	1.00
Frt	1.00	0.89		1.00	1.00	0.85		0.97			1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99			0.99	1.00
Satd. Flow (prot)	1863	1754		1863	1961	1667		3577			1941	1667
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.51			0.54	1.00
Satd. Flow (perm)	1863	1754		1863	1961	1667		1829			1060	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	784	190	447	602	185	371	95	510	177	204	815	179
RTOR Reduction (vph)	0	51	0	0	0	132	0	30	0	0	0	77
Lane Group Flow (vph)	784	586	0	602	185	239	0	752	0	0	1019	102
Turn Type	Prot			Prot		Perm	Perm			Perm		Perm
Protected Phases	7	4		3	8			2			6	
Permitted Phases						8	2			6		6
Actuated Green, G (s)	15.0	18.0		15.0	18.0	18.0		38.4			38.4	38.4
Effective Green, g (s)	15.0	18.0		15.0	18.0	18.0		38.4			38.4	38.4
Actuated g/C Ratio	0.17	0.20		0.17	0.20	0.20		0.43			0.43	0.43
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0		6.6			6.6	6.6
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0		3.0			3.0	3.0
Lane Grp Cap (vph)	311	351		311	392	333		780			452	711
v/s Ratio Prot	c0.42	c0.33		0.32	0.09							
v/s Ratio Perm						0.14		0.41			c0.96	0.06
v/c Ratio	2.52	1.67		1.94	0.47	0.72		0.96			2.25	0.14
Uniform Delay, d1	37.5	36.0		37.5	31.8	33.6		25.1			25.8	15.8
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00			1.00	1.00
Incremental Delay, d2	693.9	313.3		432.7	0.9	7.2		24.5			571.6	0.4
Delay (s)	731.4	349.3		470.2	32.7	40.8		49.6			597.4	16.2
Level of Service	F	F		F	C	D		D			F	B
Approach Delay (s)		560.1			262.8			49.6			510.5	
Approach LOS		F			F			D			F	

Intersection Summary			
HCM Average Control Delay	384.0	HCM Level of Service	F
HCM Volume to Capacity ratio	2.16		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	149.9%	ICU Level of Service	H
Analysis Period (min)	15		

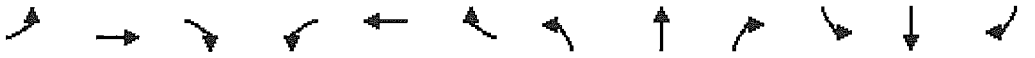
c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	183	334	197	312	5	374	897	89	4	504	167
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.90		1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	1750		1863	1938		1743	1922		1900	1980	1650
Flt Permitted	0.20	1.00		0.19	1.00		0.18	1.00		0.15	1.00	1.00
Satd. Flow (perm)	389	1750		372	1938		326	1922		295	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	154	220	402	246	390	6	416	997	99	4	531	176
RTOR Reduction (vph)	0	73	0	0	1	0	0	4	0	0	0	48
Lane Group Flow (vph)	154	549	0	246	395	0	416	1092	0	4	531	128
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt			pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4		3	8		5	2			6	
Permitted Phases	4			8			2			6		6
Actuated Green, G (s)	28.6	20.9		29.0	21.1		43.1	43.1		27.1	27.1	27.1
Effective Green, g (s)	28.6	20.9		29.0	21.1		43.1	43.1		27.1	27.1	27.1
Actuated g/C Ratio	0.32	0.23		0.32	0.23		0.48	0.48		0.30	0.30	0.30
Clearance Time (s)	6.1	6.1		6.1	6.1		5.9	5.9		5.9	5.9	5.9
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)	251	406		251	454		315	920		89	596	497
v/s Ratio Prot	0.05	c0.31		c0.09	0.20		0.15	c0.57			0.27	
v/s Ratio Perm	0.14			0.23			c0.48			0.01		0.08
v/c Ratio	0.61	1.35		0.98	0.87		1.32	1.19		0.04	0.89	0.26
Uniform Delay, d1	23.9	34.6		27.6	33.1		32.5	23.4		22.3	30.0	23.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.03	1.02
Incremental Delay, d2	4.4	174.1		51.0	16.5		164.9	95.0		0.9	17.6	1.2
Delay (s)	28.3	208.6		78.7	49.6		197.4	118.5		23.1	48.6	25.5
Level of Service	C	F		E	D		F	F		C	D	C
Approach Delay (s)		172.8			60.7			140.2			42.7	
Approach LOS		F			E			F			D	

Intersection Summary			
HCM Average Control Delay	114.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.27		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	117.3%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group



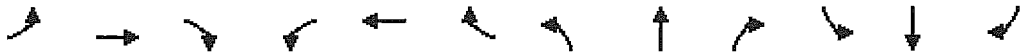
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	60	680	106	77	762	121	122	470	43	80	400	21
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3650		1863	3649		1863	1936		1863	1946	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3650		1863	3649		1863	1936		1863	1946	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	67	756	118	84	828	132	137	528	48	89	444	23
RTOR Reduction (vph)	0	14	0	0	14	0	0	4	0	0	2	0
Lane Group Flow (vph)	67	860	0	84	946	0	137	572	0	89	465	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	6.3	25.4		6.4	25.5		9.5	26.6		7.6	24.7	
Effective Green, g (s)	6.3	25.4		6.4	25.5		9.5	26.6		7.6	24.7	
Actuated g/C Ratio	0.07	0.28		0.07	0.28		0.11	0.30		0.08	0.27	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	130	1030		132	1034		197	572		157	534	
v/s Ratio Prot	0.04	0.24		c0.05	c0.26		c0.07	c0.30		0.05	0.24	
v/s Ratio Perm												
v/c Ratio	0.52	0.84		0.64	0.91		0.70	1.00		0.57	0.87	
Uniform Delay, d1	40.4	30.3		40.7	31.2		38.9	31.7		39.6	31.1	
Progression Factor	1.00	1.00		1.06	1.13		1.34	0.68		1.00	1.00	
Incremental Delay, d2	3.4	8.0		6.2	9.5		9.4	36.2		4.6	14.4	
Delay (s)	43.8	38.3		49.3	44.6		61.4	57.7		44.2	45.5	
Level of Service	D	D		D	D		E	E		D	D	
Approach Delay (s)		38.7			45.0			58.4			45.3	
Approach LOS		D			D			E			D	

Intersection Summary			
HCM Average Control Delay	46.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	982	101	261	876	464	220	82	323	344	156	40
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		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	0.88		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3673		1863	1961	1500	1801	1669		1863	1901	
Flt Permitted	0.13	1.00		0.11	1.00	1.00	0.62	1.00		0.14	1.00	
Satd. Flow (perm)	262	3673		218	1961	1500	1184	1669		280	1901	
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	20	1116	115	284	952	504	234	87	344	374	170	43
RTOR Reduction (vph)	0	9	0	0	0	233	0	0	0	0	10	0
Lane Group Flow (vph)	20	1222	0	284	952	271	234	431	0	374	203	0
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt		Perm	Perm			pm+pt		
Protected Phases		2		1	5			8		7	4	
Permitted Phases	2			5		5	8			4		
Actuated Green, G (s)	29.9	29.9		44.9	44.9	44.9	22.0	22.0		33.0	33.0	
Effective Green, g (s)	29.9	29.9		44.9	44.9	44.9	22.0	22.0		33.0	33.0	
Actuated g/C Ratio	0.33	0.33		0.50	0.50	0.50	0.24	0.24		0.37	0.37	
Clearance Time (s)	6.1	6.1		6.1	6.1	6.1	6.0	6.0		6.0	6.0	
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)	87	1220		271	978	748	289	408		191	697	
v/s Ratio Prot		0.33		0.10	c0.49			0.26		c0.11	0.11	
v/s Ratio Perm	0.08			c0.42		0.18	0.20			c0.61		
v/c Ratio	0.23	1.00		1.05	0.97	0.36	0.81	1.06		1.96	0.29	
Uniform Delay, d1	21.7	30.1		24.0	22.0	13.8	32.0	34.0		27.0	20.2	
Progression Factor	1.08	0.93		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.6	25.2		67.8	22.4	0.3	15.3	60.2		449.6	0.2	
Delay (s)	29.1	53.1		91.8	44.3	14.1	47.3	94.2		476.6	20.4	
Level of Service	C	D		F	D	B	D	F		F	C	
Approach Delay (s)		52.7			43.3			77.7			311.1	
Approach LOS		D			D			E			F	

Intersection Summary			
HCM Average Control Delay	88.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.35		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	113.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	287	185	125	182	51	99	122	467	341	425	923	136
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.6	6.6		6.6	6.6	6.6
Lane Util. Factor	0.97	1.00	1.00	0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3614	1961	1667	3614	1961	1667	1863	3490		1863	3725	1667
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.22	1.00		0.14	1.00	1.00
Satd. Flow (perm)	3614	1961	1667	3614	1961	1667	440	3490		275	3725	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	312	201	136	198	55	108	133	508	371	462	1003	148
RTOR Reduction (vph)	0	0	113	0	0	94	0	145	0	0	0	55
Lane Group Flow (vph)	312	201	23	198	55	14	133	734	0	462	1003	93
Turn Type	Prot		Perm	Prot		Perm	pm+pt			pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8	2			6		6
Actuated Green, G (s)	11.2	14.8	14.8	7.9	11.5	11.5	29.2	21.9		47.4	33.5	33.5
Effective Green, g (s)	11.2	14.8	14.8	7.9	11.5	11.5	29.2	21.9		47.4	33.5	33.5
Actuated g/C Ratio	0.13	0.17	0.17	0.09	0.13	0.13	0.33	0.25		0.53	0.38	0.38
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.6	6.6		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	456	327	278	322	254	216	262	862		485	1407	630
v/s Ratio Prot	c0.09	c0.10		0.05	0.03		0.04	0.21		c0.20	0.27	
v/s Ratio Perm			0.01			0.01	0.13			c0.31		0.06
v/c Ratio	0.68	0.61	0.08	0.61	0.22	0.06	0.51	0.85		0.95	0.71	0.15
Uniform Delay, d1	37.1	34.3	31.2	38.9	34.6	33.9	21.7	31.8		24.2	23.5	18.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	4.2	3.4	0.1	3.5	0.4	0.1	1.5	10.3		29.0	3.1	0.5
Delay (s)	41.3	37.7	31.3	42.4	35.0	34.0	23.2	42.2		53.3	26.6	18.7
Level of Service	D	D	C	D	C	C	C	D		D	C	B
Approach Delay (s)		38.1			38.8			39.7			33.5	
Approach LOS		D			D			D			C	

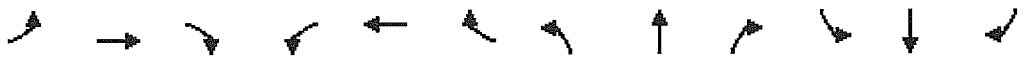
Intersection Summary			
HCM Average Control Delay	36.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	88.7	Sum of lost time (s)	18.6
Intersection Capacity Utilization	82.1%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	183	196	311	225	87	82	195	480	69	3	767	37
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.93		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1826		1743	1908		1900	1980	1650
Flt Permitted	0.38	1.00	1.00	0.35	1.00		0.09	1.00		0.16	1.00	1.00
Satd. Flow (perm)	747	2000	1619	677	1826		173	1908		312	1980	1650
Peak-hour factor, PHF	0.81	0.81	0.81	0.73	0.73	0.73	0.74	0.74	0.74	0.84	0.84	0.84
Adj. Flow (vph)	226	242	384	308	119	112	264	649	93	4	913	44
RTOR Reduction (vph)	0	0	40	0	38	0	0	6	0	0	0	14
Lane Group Flow (vph)	226	242	344	308	193	0	264	736	0	4	913	30
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		pm+ov	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4	5	3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	21.3	13.4	21.5	21.3	13.4		50.6	50.6		36.6	36.6	36.6
Effective Green, g (s)	21.3	13.4	21.5	21.3	13.4		50.6	50.6		36.6	36.6	36.6
Actuated g/C Ratio	0.24	0.15	0.24	0.24	0.15		0.56	0.56		0.41	0.41	0.41
Clearance Time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	276	298	387	264	272		239	1073		127	805	671
v/s Ratio Prot	0.07	0.12	0.08	c0.10	0.11		c0.10	0.39			0.46	
v/s Ratio Perm	0.12		0.13	c0.17			c0.52			0.01		0.02
v/c Ratio	0.82	0.81	0.89	1.17	0.71		1.10	0.69		0.03	1.13	0.05
Uniform Delay, d1	30.8	37.1	33.1	32.8	36.4		36.9	14.0		16.0	26.7	16.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.77	0.84	0.67
Incremental Delay, d2	17.0	15.4	21.0	108.1	8.2		89.1	3.6		0.4	75.1	0.1
Delay (s)	47.8	52.5	54.1	140.9	44.6		126.0	17.6		12.8	97.6	10.9
Level of Service	D	D	D	F	D		F	B		B	F	B
Approach Delay (s)		52.0			99.6			46.1			93.3	
Approach LOS		D			F			D			F	

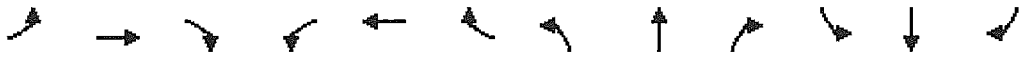
Intersection Summary			
HCM Average Control Delay	69.7	HCM Level of Service	E
HCM Volume to Capacity ratio	1.09		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	90.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



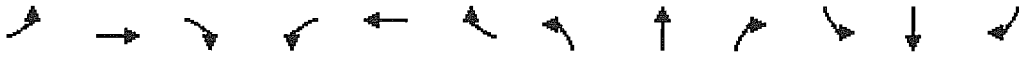
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	22	687	120	34	582	14	83	222	50	51	486	12
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3642		1863	3712		1863	1906		1863	1954	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3642		1863	3712		1863	1906		1863	1954	
Peak-hour factor, PHF	0.79	0.79	0.79	0.70	0.70	0.70	0.95	0.95	0.95	0.81	0.81	0.81
Adj. Flow (vph)	28	870	152	49	831	20	87	234	53	63	600	15
RTOR Reduction (vph)	0	15	0	0	1	0	0	9	0	0	1	0
Lane Group Flow (vph)	28	1007	0	49	850	0	87	278	0	63	614	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	3.1	26.1		4.7	27.7		5.6	29.6		5.6	29.6	
Effective Green, g (s)	3.1	26.1		4.7	27.7		5.6	29.6		5.6	29.6	
Actuated g/C Ratio	0.03	0.29		0.05	0.31		0.06	0.33		0.06	0.33	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	64	1056		97	1142		116	627		116	643	
v/s Ratio Prot	0.02	c0.28		c0.03	0.23		c0.05	0.15		0.03	c0.31	
v/s Ratio Perm												
v/c Ratio	0.44	0.95		0.51	0.74		0.75	0.44		0.54	0.95	
Uniform Delay, d1	42.6	31.4		41.5	28.0		41.5	23.7		41.0	29.5	
Progression Factor	1.00	1.00		0.78	1.20		0.92	1.02		1.00	1.00	
Incremental Delay, d2	4.7	18.6		3.9	4.2		23.0	0.5		5.1	24.5	
Delay (s)	47.3	49.9		36.1	37.7		61.0	24.6		46.1	54.1	
Level of Service	D	D		D	D		E	C		D	D	
Approach Delay (s)		49.9			37.6			33.1			53.3	
Approach LOS		D			D			C			D	

Intersection Summary			
HCM Average Control Delay	44.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	72.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	711	186	235	746	135	61	25	251	212	48	12
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1		6.0	6.0	6.1	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1863	3610		1863	3640		1801	1895	1611	1863	1961	1667
Flt Permitted	0.27	1.00		0.10	1.00		0.72	1.00	1.00	0.47	1.00	1.00
Satd. Flow (perm)	528	3610		204	3640		1356	1895	1611	930	1961	1667
Peak-hour factor, PHF	0.76	0.76	0.76	0.83	0.83	0.83	0.83	0.83	0.83	0.75	0.75	0.75
Adj. Flow (vph)	7	936	245	283	899	163	73	30	302	283	64	16
RTOR Reduction (vph)	0	24	0	0	13	0	0	0	0	0	0	12
Lane Group Flow (vph)	7	1157	0	283	1049	0	73	30	302	283	64	4
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt			Perm		pm+ov	pm+pt		Perm
Protected Phases		2		1	6			8	1	7	4	
Permitted Phases	2			6			8		8	4		4
Actuated Green, G (s)	32.4	32.4		53.5	53.5		10.8	10.8	25.8	24.4	24.4	24.4
Effective Green, g (s)	32.4	32.4		53.5	53.5		10.8	10.8	25.8	24.4	24.4	24.4
Actuated g/C Ratio	0.36	0.36		0.59	0.59		0.12	0.12	0.29	0.27	0.27	0.27
Clearance Time (s)	6.1	6.1		6.1	6.1		6.0	6.0	6.1	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	190	1300		398	2164		163	227	462	331	532	452
v/s Ratio Prot		c0.32		c0.12	0.29			0.02	0.11	c0.07	0.03	
v/s Ratio Perm	0.01			0.30			0.05		0.08	c0.16		0.00
v/c Ratio	0.04	0.89		0.71	0.48		0.45	0.13	0.65	0.85	0.12	0.01
Uniform Delay, d1	18.7	27.1		21.0	10.4		36.8	35.4	28.2	30.6	24.7	24.0
Progression Factor	0.76	0.95		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	8.6		5.9	0.8		2.0	0.3	3.3	18.9	0.1	0.0
Delay (s)	14.6	34.3		26.9	11.2		38.8	35.7	31.5	49.4	24.8	24.0
Level of Service	B	C		C	B		D	D	C	D	C	C
Approach Delay (s)		34.2			14.5			33.1			44.0	
Approach LOS		C			B			C			D	

Intersection Summary			
HCM Average Control Delay	27.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.2
Intersection Capacity Utilization	69.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	721	175	411	554	170	341	87	469	163	188	750	165
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.6	6.6		6.6	6.6	6.6
Lane Util. Factor	0.97	1.00	1.00	0.97	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3614	1961	1667	3614	1961	1667	1863	3582		1863	3725	1667
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.21	1.00		0.20	1.00	1.00
Satd. Flow (perm)	3614	1961	1667	3614	1961	1667	415	3582		383	3725	1667
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	784	190	447	602	185	371	95	510	177	204	815	179
RTOR Reduction (vph)	0	0	154	0	0	158	0	37	0	0	0	79
Lane Group Flow (vph)	784	190	293	602	185	213	95	650	0	204	815	100
Turn Type	Prot		Perm	Prot		Perm	pm+pt			pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8	2			6		6
Actuated Green, G (s)	20.6	18.0	18.0	18.6	16.0	16.0	24.7	18.9		27.9	20.5	20.5
Effective Green, g (s)	20.6	18.0	18.0	18.6	16.0	16.0	24.7	18.9		27.9	20.5	20.5
Actuated g/C Ratio	0.23	0.20	0.20	0.21	0.18	0.18	0.28	0.21		0.32	0.23	0.23
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.6	6.6		6.6	6.6	6.6
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	845	401	341	763	356	303	212	768		246	867	388
v/s Ratio Prot	c0.22	0.10		0.17	0.09		0.03	0.18		c0.07	c0.22	
v/s Ratio Perm			c0.18			0.13	0.10			0.19		0.06
v/c Ratio	0.93	0.47	0.86	0.79	0.52	0.70	0.45	0.85		0.83	0.94	0.26
Uniform Delay, d1	33.0	30.9	33.8	32.9	32.6	33.8	25.1	33.2		24.2	33.2	27.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	16.0	0.9	19.3	5.4	1.3	7.2	1.5	11.1		20.1	19.1	1.6
Delay (s)	49.0	31.8	53.2	38.3	33.9	41.0	26.6	44.3		44.3	52.3	29.2
Level of Service	D	C	D	D	C	D	C	D		D	D	C
Approach Delay (s)		48.0			38.5			42.2			47.5	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	44.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	88.1	Sum of lost time (s)	12.6
Intersection Capacity Utilization	76.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	128	183	334	197	312	5	374	897	89	4	504	167
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1881	2000	1619	1863	1938		1743	1922		1900	1980	1650
Flt Permitted	0.28	1.00	1.00	0.35	1.00		0.13	1.00		0.17	1.00	1.00
Satd. Flow (perm)	562	2000	1619	690	1938		245	1922		332	1980	1650
Peak-hour factor, PHF	0.83	0.83	0.83	0.80	0.80	0.80	0.90	0.90	0.90	0.95	0.95	0.95
Adj. Flow (vph)	154	220	402	246	390	6	416	997	99	4	531	176
RTOR Reduction (vph)	0	0	71	0	1	0	0	4	0	0	0	93
Lane Group Flow (vph)	154	220	331	246	395	0	416	1092	0	4	531	83
Heavy Vehicles (%)	1%	0%	5%	2%	3%	0%	9%	2%	9%	0%	1%	3%
Turn Type	pm+pt		pm+ov	pm+pt			pm+pt			Perm		Perm
Protected Phases	7	4	5	3	8		5	2			6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)	21.9	14.1	31.2	27.7	17.0		47.1	47.1		24.1	24.1	24.1
Effective Green, g (s)	21.9	14.1	31.2	27.7	17.0		47.1	47.1		24.1	24.1	24.1
Actuated g/C Ratio	0.24	0.16	0.35	0.31	0.19		0.52	0.52		0.27	0.27	0.27
Clearance Time (s)	6.1	6.1	5.9	6.1	6.1		5.9	5.9		5.9	5.9	5.9
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	251	313	561	352	366		413	1006		89	530	442
v/s Ratio Prot	0.05	0.11	0.11	c0.08	c0.20		0.19	c0.57			0.27	
v/s Ratio Perm	0.10		0.09	0.13			0.34			0.01		0.05
v/c Ratio	0.61	0.70	0.59	0.70	1.08		1.01	1.09		0.04	1.00	0.19
Uniform Delay, d1	28.7	36.0	24.2	25.2	36.5		31.4	21.4		24.4	33.0	25.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.92	0.95	0.89
Incremental Delay, d2	4.4	7.0	1.7	6.0	70.0		46.1	54.6		0.9	38.9	0.9
Delay (s)	33.1	42.9	25.8	31.2	106.5		77.6	76.0		23.4	70.2	23.4
Level of Service	C	D	C	C	F		E	E		C	E	C
Approach Delay (s)		32.1			77.6			76.4			58.4	
Approach LOS		C			E			E			E	

Intersection Summary			
HCM Average Control Delay	63.7	HCM Level of Service	E
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.1
Intersection Capacity Utilization	100.9%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	60	680	106	77	762	121	122	470	43	80	400	21
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1863	3650		1863	3649		1863	1936		1863	1946	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1863	3650		1863	3649		1863	1936		1863	1946	
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.90	0.90	0.90
Adj. Flow (vph)	67	756	118	84	828	132	137	528	48	89	444	23
RTOR Reduction (vph)	0	14	0	0	14	0	0	3	0	0	2	0
Lane Group Flow (vph)	67	860	0	84	946	0	137	573	0	89	465	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases												
Actuated Green, G (s)	6.8	24.8		7.0	25.0		10.1	27.8		6.4	24.1	
Effective Green, g (s)	6.8	24.8		7.0	25.0		10.1	27.8		6.4	24.1	
Actuated g/C Ratio	0.08	0.28		0.08	0.28		0.11	0.31		0.07	0.27	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	141	1006		145	1014		209	598		132	521	
v/s Ratio Prot	0.04	0.24		c0.05	c0.26		c0.07	c0.30		0.05	0.24	
v/s Ratio Perm												
v/c Ratio	0.48	0.86		0.58	0.93		0.66	0.96		0.67	0.89	
Uniform Delay, d1	39.9	30.9		40.1	31.7		38.3	30.5		40.8	31.7	
Progression Factor	1.00	1.00		1.10	1.23		1.36	0.66		1.00	1.00	
Incremental Delay, d2	2.5	9.2		4.4	13.6		6.6	24.9		12.8	17.3	
Delay (s)	42.4	40.1		48.6	52.5		58.8	45.0		53.6	49.0	
Level of Service	D	D		D	D		E	D		D	D	
Approach Delay (s)		40.3			52.2			47.6			49.8	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	47.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	982	101	261	876	464	220	82	323	344	156	40
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	12	12	12	12	12	12	11	11	11	12	12	12
Total Lost time (s)	6.1	6.1		6.1	6.1		6.0	6.0	6.1	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1863	3673		1863	3532		1801	1895	1611	1863	1961	1667
Flt Permitted	0.13	1.00		0.11	1.00		0.65	1.00	1.00	0.54	1.00	1.00
Satd. Flow (perm)	262	3673		218	3532		1231	1895	1611	1057	1961	1667
Peak-hour factor, PHF	0.88	0.88	0.88	0.92	0.92	0.92	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	20	1116	115	284	952	504	234	87	344	374	170	43
RTOR Reduction (vph)	0	9	0	0	74	0	0	0	0	0	0	28
Lane Group Flow (vph)	20	1222	0	284	1382	0	234	87	344	374	170	15
Parking (#/hr)			0			0						
Turn Type	Perm			pm+pt			Perm		pm+ov	pm+pt		Perm
Protected Phases		2		1	5			8	1	7	4	
Permitted Phases	2			5			8		8	4		4
Actuated Green, G (s)	29.9	29.9		46.9	46.9		20.0	20.0	30.9	31.0	31.0	31.0
Effective Green, g (s)	29.9	29.9		46.9	46.9		20.0	20.0	30.9	31.0	31.0	31.0
Actuated g/C Ratio	0.33	0.33		0.52	0.52		0.22	0.22	0.34	0.34	0.34	0.34
Clearance Time (s)	6.1	6.1		6.1	6.1		6.0	6.0	6.1	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	87	1220		313	1841		274	421	553	409	675	574
v/s Ratio Prot		c0.33		0.11	c0.39			0.05	0.08	c0.05	0.09	
v/s Ratio Perm	0.08			0.36			0.19		0.14	c0.26		0.01
v/c Ratio	0.23	1.00		0.91	0.75		0.85	0.21	0.62	0.91	0.25	0.03
Uniform Delay, d1	21.7	30.1		23.6	17.0		33.6	28.5	24.7	29.1	21.2	19.5
Progression Factor	0.67	0.65		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.6	25.2		28.2	1.8		21.9	0.2	2.2	24.6	0.2	0.0
Delay (s)	20.1	44.6		51.8	18.7		55.5	28.8	26.9	53.7	21.4	19.5
Level of Service	C	D		D	B		E	C	C	D	C	B
Approach Delay (s)		44.2			24.1			37.2			41.8	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	34.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.2
Intersection Capacity Utilization	92.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix E

Roundabout Level of Service
Capacity Analysis

50% CL, 15-minute time slice RODEL Analysis (Default)

```
*************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP            174  *
*************************************************************************
* E    (m)    8.50  12.80   8.50   8.50          * TIME PERIOD    min     90  *
* L'   (m)   10.00  53.00  10.00 150.0           * TIME SLICE     min     15  *
* V    (m)    7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD  (m)   42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI  (d)   20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA  (m)   65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0      0          * FLOW PEAK am/op/pm     AM  *
*                                               *                           *
*************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *             *         *
*D-19 SB   *1.05*  136  923  425  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  125  185  287  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  341  467  122  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  99   51   182  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*************************************************************************
* FLOW        veh    1484    597    930    332              *                 *
* CAPACITY    veh    2289   1984   1390   1866              * AVDEL s     5.1 *
* AVE DELAY  mins    0.08   0.04   0.14   0.04              * L  O  S       A *
* MAX DELAY  mins    0.11   0.06   0.23   0.05              * VEH HRS     4.7 *
* AVE QUEUE   veh       2      0      2      0              * COST  $    71.0 *
* MAX QUEUE   veh       3      1      3      0              *                 *
*************************************************************************

*************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP            175  *
*************************************************************************
* E    (m)    8.50  12.80   8.50   8.50          * TIME PERIOD    min     90  *
* L'   (m)   10.00  53.00  10.00 150.0           * TIME SLICE     min     15  *
* V    (m)    7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD  (m)   42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI  (d)   20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA  (m)   65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP       0      0      0      0          * FLOW PEAK am/op/pm     PM  *
*************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *             *         *
*D-19 SB   *1.05*  165  750  188  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  411  175  721  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  163  469  87   0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  341  170  554  0            *1.00*50*0.75 1.125 0.75*15 45 75 *
*************************************************************************
*                                                *                      *
* FLOW        veh    1103   1307    719   1065  *                      *
* CAPACITY    veh    1968   2015   1278   1589  * AVDEL s     6.0 *
* AVE DELAY  mins    0.07   0.10   0.11   0.13  * L  O  S       A *
* MAX DELAY  mins    0.10   0.16   0.17   0.22  * VEH HRS     7.0 *
* AVE QUEUE   veh       1      2      1      2  * COST  $   105.5 *
* MAX QUEUE   veh       2      3      2      3  *                      *
*                                                *                      *
*************************************************************************
```

85% CL, 15-minute time slice RODEL Analysis (Default)

```
*******************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP                176  *
*******************************************************************************
* E     (m)     8.50  12.80   8.50   8.50          * TIME PERIOD    min      90  *
* L'    (m)    10.00  53.00  10.00  150.0          * TIME SLICE     min      15  *
* V     (m)     7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD   (m)    42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI   (d)    20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA   (m)    65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0          * FLOW PEAK am/op/pm     AM  *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *              *         *
*D-19 SB   *1.05*  136  923  425  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  125  185  287  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  341  467  122  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  99   51   182  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*******************************************************************************
* FLOW        veh    1484    597    930    332              *                 *
* CAPACITY    veh    2092   1787   1193   1670              * AVDEL s     8.5 *
* AVE DELAY  mins    0.10   0.05   0.29   0.04              * L  O  S       A *
* MAX DELAY  mins    0.16   0.07   0.54   0.06              * VEH HRS     7.9 *
* AVE QUEUE   veh       3      1      5      0              * COST  $   118.6 *
* MAX QUEUE   veh       4      1      8      0              *                 *
*******************************************************************************


*******************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP                177  *
*******************************************************************************
* E     (m)     8.50  12.80   8.50   8.50          * TIME PERIOD    min      90  *
* L'    (m)    10.00  53.00  10.00  150.0          * TIME SLICE     min      15  *
* V     (m)     7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD   (m)    42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI   (d)    20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA   (m)    65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0          * FLOW PEAK am/op/pm     PM  *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *              *         *
*D-19 SB   *1.05*  165  750  188  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  411  175  721  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  163  469  87   0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  341  170  554  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*******************************************************************************
* FLOW        veh    1103   1307    719   1065              *                 *
* CAPACITY    veh    1772   1818   1081   1392              * AVDEL s    10.0 *
* AVE DELAY  mins    0.09   0.15   0.19   0.25              * L  O  S       B *
* MAX DELAY  mins    0.14   0.27   0.31   0.48              * VEH HRS    11.7 *
* AVE QUEUE   veh       2      3      2      5              * COST  $   175.2 *
* MAX QUEUE   veh       2      5      3      8              *                 *
*                                                          *                 *
*******************************************************************************
```

50% CL, 1-minute time slice RODEL Analysis

```
*****************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP              180  *
*****************************************************************************
* E     (m)     8.50  12.80   8.50   8.50          * TIME PERIOD    min     90  *
* L'    (m)    10.00  53.00  10.00  150.0          * TIME SLICE     min      1  *
* V     (m)     7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD   (m)    42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI   (d)    20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA   (m)    65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0          * FLOW PEAK am/op/pm     AM  *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *              *         *
*D-19 SB   *1.05*  136  923  425  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  125  185  287  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  341  467  122  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  99   51   182  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*****************************************************************************
* FLOW         veh    1484    597    930    332              *                *
* CAPACITY     veh    2289   1983   1390   1866              * AVDEL s     5.3 *
* AVE DELAY   mins    0.08   0.04   0.15   0.04              * L  O  S       A *
* MAX DELAY   mins    0.10   0.05   0.21   0.04              * VEH HRS     5.0 *
* AVE QUEUE    veh       2      0      2      0              * COST  $    74.3 *
* MAX QUEUE    veh       3      1      4      0              *                *
*****************************************************************************

*****************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP              181  *
*****************************************************************************
*                                                           *                *
* E     (m)     8.50  12.80   8.50   8.50          * TIME PERIOD    min     90  *
* L'    (m)    10.00  53.00  10.00  150.0          * TIME SLICE     min      1  *
* V     (m)     7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD   (m)    42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI   (d)    20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA   (m)    65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0          * FLOW PEAK am/op/pm     PM  *
*****************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                            *    *  *              *         *
*D-19 SB   *1.05*  165  750  188  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  411  175  721  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  163  469  87   0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  341  170  554  0           *1.00*50*0.75 1.125 0.75*15 45 75 *
*****************************************************************************
* FLOW         veh    1103   1307    719   1065              *                *
* CAPACITY     veh    1968   2015   1278   1589              * AVDEL s     6.4 *
* AVE DELAY   mins    0.07   0.10   0.12   0.14              * L  O  S       A *
* MAX DELAY   mins    0.09   0.15   0.16   0.21              * VEH HRS     7.4 *
* AVE QUEUE    veh       1      2      1      2              * COST  $   111.3 *
* MAX QUEUE    veh       2      4      2      4              *                *
*****************************************************************************
```

85% CL, 1-minute time slice RODEL Analysis

```
*******************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP                182  *
*******************************************************************************
* E     (m)     8.50  12.80   8.50   8.50          * TIME PERIOD    min     90  *
* L'    (m)    10.00  53.00  10.00  150.0          * TIME SLICE     min      1  *
* V     (m)     7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD   (m)    42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI   (d)    20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA   (m)    65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0          * FLOW PEAK am/op/pm     AM  *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *               *         *
*D-19 SB   *1.05*  136  923  425  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  125  185  287  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  341  467  122  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  99   51   182  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*******************************************************************************
* FLOW        veh    1484    597    930    332              *                 *
* CAPACITY    veh    2092   1786   1193   1669              * AVDEL s     9.0 *
* AVE DELAY  mins    0.11   0.05   0.31   0.05              * L  O  S       A *
* MAX DELAY  mins    0.15   0.06   0.56   0.05              * VEH HRS     8.3 *
* AVE QUEUE   veh       3      1      5      0              * COST  $   124.8 *
* MAX QUEUE   veh       4      1     10      0              *                 *
*******************************************************************************

*******************************************************************************
*  10:4:08          CITY OF HOWELL D-19/I-96 WESTBOUND RAMP                183  *
*******************************************************************************
* E     (m)     8.50  12.80   8.50   8.50          * TIME PERIOD    min     90  *
* L'    (m)    10.00  53.00  10.00  150.0          * TIME SLICE     min      1  *
* V     (m)     7.60   5.50   4.50   4.00          * RESULTS PERIOD min  15 75  *
* RAD   (m)    42.00  56.00  65.50  36.50          * TIME COST     $/hr  15.00  *
* PHI   (d)    20.00  20.00  20.00  20.00          * FLOW PERIOD    min  15 75  *
* DIA   (m)    65.00  65.00  65.00  65.00          * FLOW TYPE  pcu/veh    VEH  *
* GRAD SEP        0      0      0      0          * FLOW PEAK am/op/pm     PM  *
*******************************************************************************
* LEG NAME *PCU *FLOWS (1st exit 2nd etc...U)*FLOF*CL*  FLOW RATIO   *FLOW TIME*
*          *    *                             *    *  *               *         *
*D-19 SB   *1.05*  165  750  188  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*I-96 EB   *1.05*  411  175  721  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*D-19 NB   *1.05*  163  469  87   0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*NATIONL WB*1.05*  341  170  554  0           *1.00*85*0.75 1.125 0.75*15 45 75 *
*******************************************************************************
* FLOW        veh    1103   1307    719   1065              *                 *
* CAPACITY    veh    1770   1817   1081   1392              * AVDEL s    10.7 *
* AVE DELAY  mins    0.10   0.16   0.20   0.27              * L  O  S       B *
* MAX DELAY  mins    0.13   0.28   0.30   0.51              * VEH HRS    12.5 *
* AVE QUEUE   veh       2      4      2      5              * COST  $   187.5 *
* MAX QUEUE   veh       3      7      4     10              *                 *
*                                                          *                 *
*******************************************************************************
```

Appendix F

SEMCOG Letter

SEMCOG . . . *Local Governments Advancing Southeast Michigan*

Southeast Michigan Council of Governments • 535 Griswold Street, Suite 300 • Detroit, Michigan 48226-3602 • 313-961-4266 • *Fax 313-961-486*
www.semcog.org

February 18, 2005

Richard F. Beaubien
Hubbell, Roth & Clark, Inc.
555 Hulet
Bloomfield Hills, MI 48302

Dear Mr. Beaubien:

Per your request, enclosed is a summary of the projected SEMCOG travel demand forecast model results. Specifically, the growth rate is an increase of around 21 percent, between year 2005 base and 2005 alternative with Howell Loop Rd.

The project limits used are:
Howell Loop Rd. connecting I-96 to WB off ramps at Pinckney to Grand River at National.

The projections use SEMCOG 2030 Regional Transportation Plan land use data sets. The input data for the travel model are based on the forecasted socio-economic data adopted for SEMCOG 2030 RTP process. Please note that the model is designed to analyze traffic patterns and congestion on a regional level. When looking at the community level, the data may be skewed due to the relatively large size of our regional activity zones, the detail level of roadway network (i.e., only major roadways are included in our regional model), and the location of centroid connectors.

Please be advised that the SEMCOG network is not dense enough in the study area to provide adequate representation of traffic patterns in this analysis. If you would like us to complete a more refined model run as part of your study, please contact us.

To determine the growth rates, traffic count and socioeconomic data should be used. Traffic count data is available on the SEMCOG web site at: www.semcog.org. Further study of the socioeconomic impacts to the study area is highly recommended.

If you have any questions regarding the enclosed information, please give me a call at 313-961-4266.

Sincerely,

Stephanie J. Taylor
Senior Transportation Planner

Cc: Li-yang Feng, Coordinator

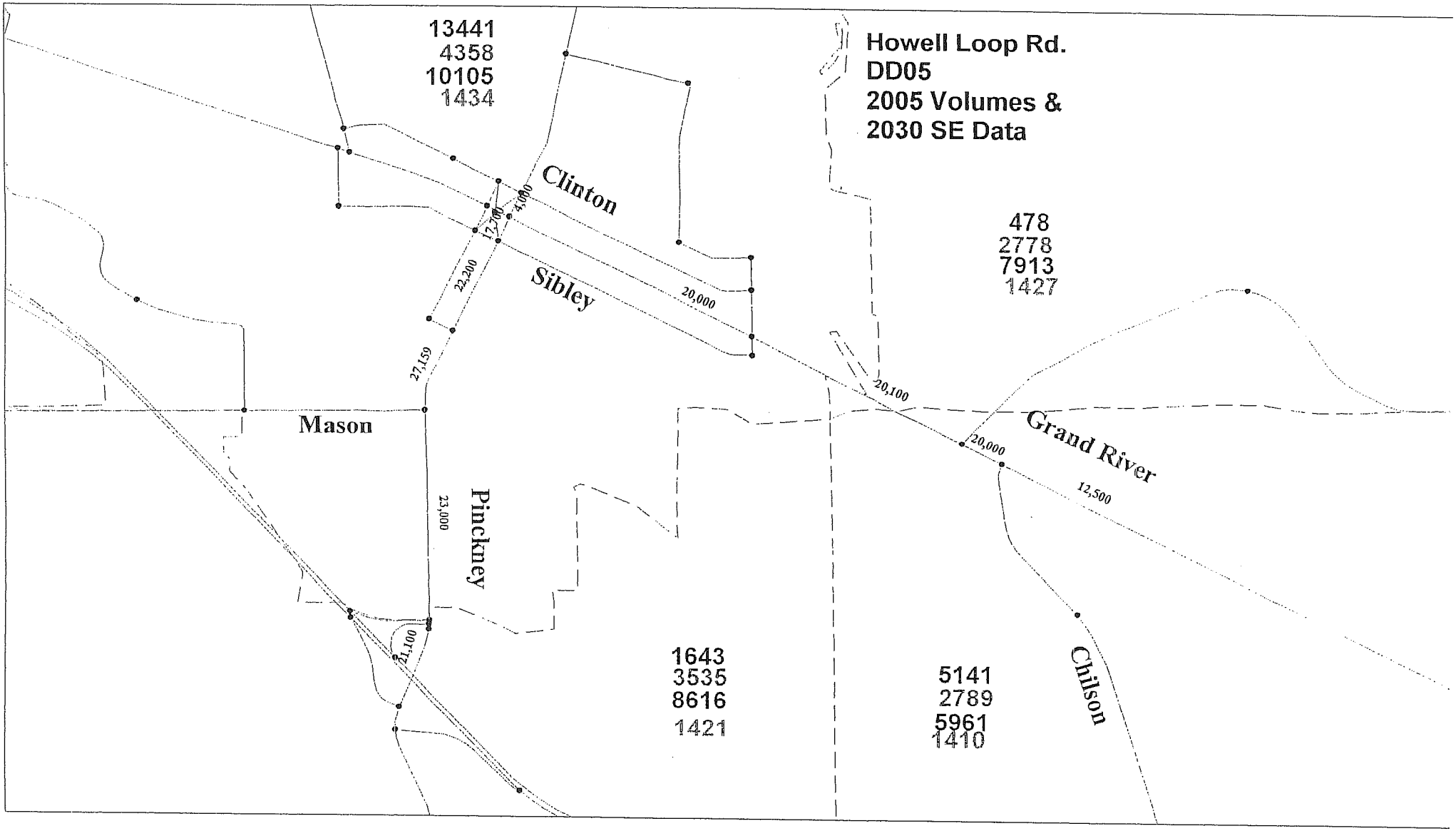
Howell Loop Rd.

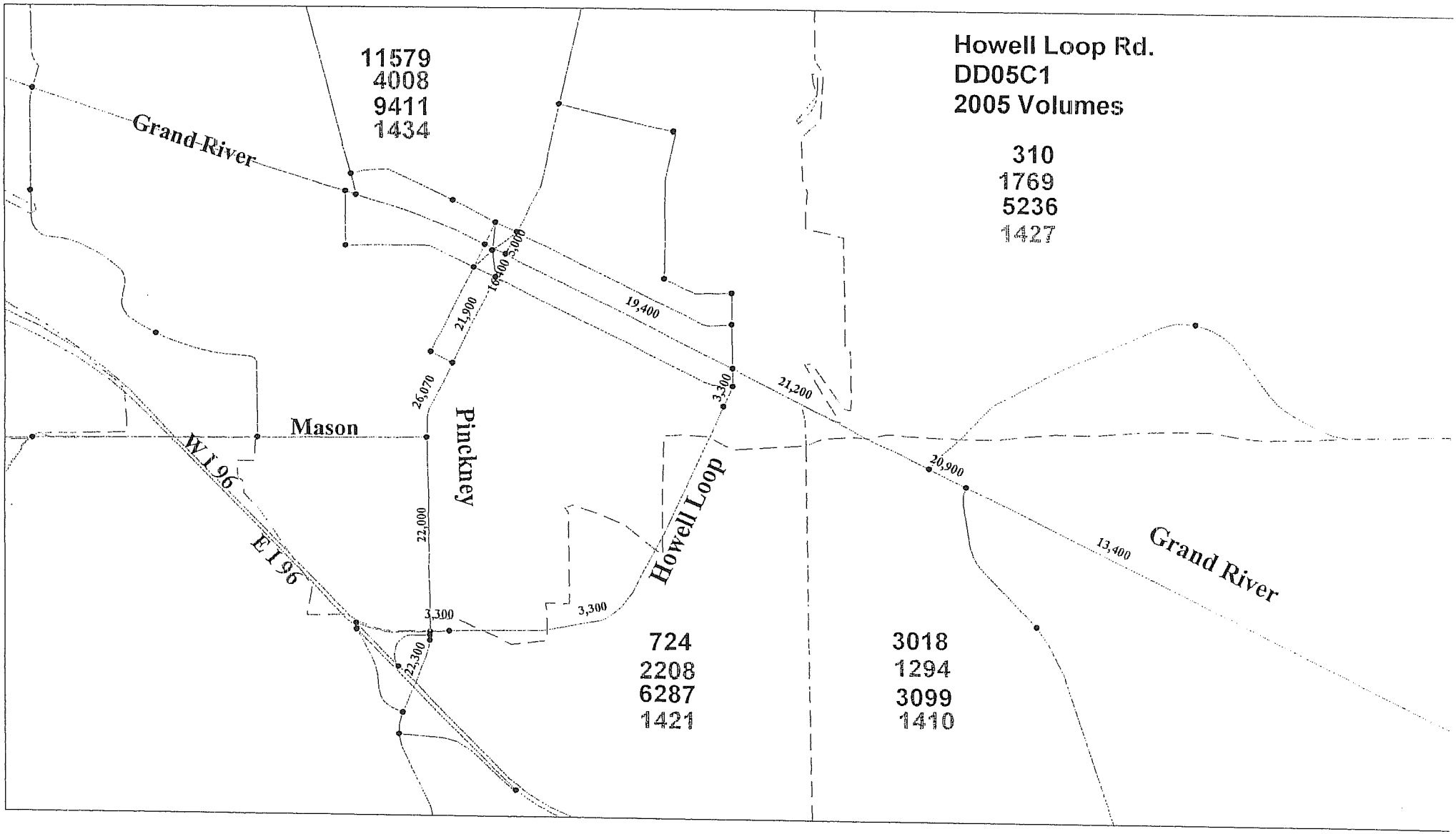
Table 1. Projected Howell Loop Rd. Zones Socioeconomic Data Changes Between Model Years 2005 and 2030

TAZ ID	2005 Socioeconomic Data			2030 Socioeconomic Data			Changing Percentage (%)		
	Population	Households	Employment	Population	Households	Employment	POP	HH	EMP
1410	3,099	1,294	3,018	5,961	2,789	5,141	92.4%	115.5%	70.3%
1421	6,287	2,208	724	8,616	3,535	1,643	37.0%	60.1%	126.9%
1427	5,236	1,769	310	7,913	2,778	478	51.1%	57.0%	54.2%
1434	9,411	4,008	11,579	10,105	4,358	13,441	7.4%	8.7%	16.1%
Total/Avg	24,033	9,279	15,631	32,595	13,460	20,703	35.6%	45.1%	32.4%

Table 2. Projected Howell Loop Rd. Volume Changes Between Model Runs Base 2005 and Alt. 2005

Link ID	Name	Intersection		Base 2005 Vol	Alt 2005 Vol	Changing Percentage (%)	No. of Lanes			
		From	To				AB05	BA05	CENT05	
4813	Grand River	Pinckney	Howell Loop	20,000	19,400	-3.0%	2	2	1	
4814	Grand River	Howell Loop	Golf Club	20,100	21,200	5.5%	2	2	1	
4815	Grand River	Golf Club	Chilson	20,000	20,900	4.5%	2	2	1	
4816	Grand River	Chilson	Latson	12,500	13,400	7.2%	2	2	1	
5189	Pinckney	I-96	Howell Loop	21,100	22,300	5.7%	2	2	0	
5192	Pinckney	Howell Loop	Mason	23,000	22,000	-4.3%	2	2	0	
48784954	Pinckney	Mason	Sibley	24,650	24,000	-2.6%	1	1	0	
49534952	Pinckney	Sibley	Clinton	10,850	10,700	-1.4%	1	1	0	
20032	Howell Loop	Grand River			3,300		2	2	0	
20033	Howell Loop				3,300		1	1	1	
20034	Howell Loop		Pinckney		3,300		2	2	0	
Total/Avg				176,700	214,600	21.4%				


Howell Loop Rd.
DD05
2005 Volumes &
2030 SE Data
13441
4358
10105
1434
Clinton
4,000
17,700
22,200
Sibley
20,000
27,159
478
2778
7913
1427
20,100
Grand River
20,000
12,500
Mason
Pinckney
23,000
21,100
1643
3535
8616
1421
5141
2789
5961
1410
Chilson


Howell Loop Rd.
DD05C1
2005 Volumes
11579
4008
9411
1434
310
1769
5236
1427
724
2208
6287
1421
3018
1294
3099
1410
Grand River
Mason
Pinckney
Howell Loop
W I 96
E I 96
Grand River
19,400
21,900
16,400
5,000
26,070
3,300
21,200
20,900
13,400
22,000
3,300
3,300
22,300

Rusty Orben - Director, State Relations
State Government and Community Affairs

500 Water Street, J-150
Jacksonville, Florida 32202

March 31, 2025

Via Email Attachment

The Honorable Jason Woolford
N-899 House Office Building
P.O. Box 30014
Lansing, MI 48909

Re: CSX Support – City of Howell Grade Separation Funding Request

Dear Representative Woolford:

I write to provide CSX Transportation's support to the City of Howell's request for state funding towards improvements at the D-19 and I-96 interchange. This project will advance important public safety projects, including a critical bypass road and a grade separation and at-grade crossing elimination.

CSX Transportation has been engaged with City on mitigation efforts around occupied crossings due to normal rail service to local and regional customers. Our team has made adjustments to railroad operations in response to the City's requests since 2024. However, as you know, the only way to permanently address the issue is to eliminate crossings altogether. To that end, CSX stands ready to support the City's request for funding towards this local project.

Should you have any questions or require additional information, feel free to contact me directly.

Sincerely,

Rusty Orben
Director of State Relations – Ohio & Michigan
CSX Transportation, Inc.

Michael J. Murphy
Sheriff

Jason C. Pless
Undersheriff

LIVINGSTON COUNTY

OFFICE OF THE SHERIFF

150 S. HIGHLANDER WAY • HOWELL, MICHIGAN 48843
TELEPHONE (517) 546-2440 • FAX (517) 552-2542

March 25, 2025

Dear Representative Woolford,

Please allow this correspondence to serve as overwhelming support for any funding that can improve the I-96/D-19 interchange in Howell and request your support in constructing a new roundabout. This area is already a hot mess, and with future development it will only get worse. This area was never designed to handle the amount of traffic it sees daily. Improvements are needed to enhance our transportation network's functionality, safety, and future resilience.

As you know, traffic congestion at this interchange has long been a challenge. This is compounded by the frequent blockage of South Michigan Avenue (D-19) and other roads at train crossings in the area. These backups disrupt daily commutes and pose significant safety risks, as emergency response vehicles are often delayed in reaching their destinations during peak congestion.

This area experiences severe congestion, causing delays and challenges for residents, businesses, and commuters alike. More critically, the congestion hinders emergency response vehicles, slowing their ability to reach those in need quickly and safely. A roundabout would effectively address these issues by offering:

1. **Smoother Traffic Flow**: This modern design would reduce stop-and-go delays, facilitating faster and more efficient movement through this busy area.
2. **Enhanced Emergency Response**: By improving accessibility and alleviating bottlenecks, emergency vehicles can navigate the interchange more efficiently, saving precious time in critical situations.
3. **Future-Ready Infrastructure**: The proposed roundabout design accommodates the planned **loop road**, ensuring the interchange remains functional and sustainable as our community grows.

This project represents a significant opportunity to create a safer, more reliable transportation network for our county while demonstrating a forward-thinking approach to urban planning. We ask you to advocate for this vital improvement and work with your colleagues to allocate the funds necessary to bring this vision to life.

Thanks in advance for your support of this important project.

Michael J Murphy - Sheriff

HOWELL AREA FIRE AUTHORITY

1211 W. GRAND RIVER AVENUE, HOWELL, MI 48843
EMAIL: hafdmain@gmail.com
PHONE: (517) 546-0560

Dear Representative Woolford,

We hope this letter finds you well. We are reaching out to emphasize the urgent need for funding improvements to the I-96/D-19 interchange in Howell and request your support in constructing a new roundabout. This is a crucial step toward enhancing our transportation network's functionality, safety, and future resilience.

As you may be aware, traffic congestion at this interchange has long been a challenge. This is compounded by the frequent blockage of South Michigan Avenue (D-19) and other roads at train crossings in the area. These backups disrupt daily commutes and could pose significant safety risks, as emergency response vehicles are sometimes delayed in reaching their destinations during peak congestion.

The current design of this exchange does not meet the demands of our rapidly growing community. Livingston County has been the highest growth rate county in Michigan for many years. This area experiences severe congestion, causing delays and challenges for residents, businesses, and commuters alike. The congestion can hinder emergency response vehicles, slowing their ability to reach those in need quickly and safely. A roundabout would effectively address these issues by offering:

1. **Smoother Traffic Flow**: This modern design would reduce stop-and-go delays, facilitating faster and more efficient movement through this busy area.

2. **Enhanced Emergency Response**: By improving accessibility and alleviating bottlenecks, emergency vehicles can navigate the interchange more efficiently, saving precious time in critical situations.

3. **Future-Ready Infrastructure**: The proposed roundabout design accommodates the planned **loop road**, ensuring the interchange remains functional and sustainable as our community grows.

This project represents a significant opportunity to create a safer, more reliable transportation network for our city while demonstrating a forward-thinking approach to urban planning. We ask you to advocate for this vital improvement and work with your colleagues to allocate the funds necessary to bring this vision to life.

Ronald Hicks
Fire Chief

Livingston County
Emergency Management

1911 Tooley Road
Howell, Michigan 48855
Telephone 517.540-7926
Fax 517.546.6788

Emergency Management Director: Therese Cremonte

Dear Representative Woolford, March 25, 2025

We hope this letter finds you well. We are reaching out to emphasize the urgent need for funding improvements to the I-96/D-19 interchange in Howell and request your support in constructing a new roundabout. This is a crucial step toward enhancing our transportation network's functionality, safety, and future resilience.

As you may be aware, traffic congestion at this interchange has long been a challenge. This is compounded by the frequent blockage of South Michigan Avenue (D-19) and other roads at train crossings in the area. These backups disrupt daily commutes and pose significant safety risks, as emergency response vehicles are often delayed in reaching their destinations during peak congestion.
The current design of this exchange does not meet the demands of our rapidly growing community.

Livingston County has been the highest growth rate county in Michigan for many years. This area experiences severe congestion, causing delays and challenges for residents, businesses, and commuters alike. More critically, the congestion hinders emergency response vehicles, slowing their ability to reach those in need quickly and safely. A roundabout would effectively address these issues by offering:

1. Smoother Traffic Flow: This modern design would reduce stop-and-go delays, facilitating faster and more efficient movement through this busy area.

2. Enhanced Emergency Response: By improving accessibility and alleviating bottlenecks, emergency vehicles can navigate the interchange more efficiently, saving precious time in critical situations.

3. Future-Ready Infrastructure: The proposed roundabout design accommodates the planned loop road, ensuring the interchange remains functional and sustainable as our community grows.

This project represents a significant opportunity to create a safer, more reliable transportation network for our city while demonstrating a forward-thinking approach to urban planning. We ask you to advocate for this vital improvement and work with your colleagues to allocate the funds necessary to bring this vision to life.

Thank you for your attention to this critical matter. We are happy to provide additional details or discuss this project at your earliest convenience.

Sincerely,

Therese Cremonte P.E.M.
Emergency Management Director
Livingston County Emergency Management

MICHAEL DUNN
Chief of Police

POLICE DEPARTMENT

611 E. Grand River * Howell, MI 48843
(517) 546-1330 * FAX (517) 546-2114

Dear Representative Woolford, 03/25/2025

I hope this letter finds you well. I am reaching out to emphasize the urgent need for funding improvements to the I-96/D-19 interchange in Howell and request your support in constructing a new roundabout. This is a crucial step toward enhancing our transportation network's functionality, safety, and future resilience.

As you may be aware, traffic congestion at this interchange has long been a challenge. This is compounded by the frequent blockage of South Michigan Avenue (D-19) and other roads at train crossings in the area. These backups disrupt daily commutes and pose significant safety risks, as emergency response vehicles are often delayed in reaching their destinations during peak congestion. Most recently the transport of a 14-year-old critically injured car accident victim had to be re-routed back through the crash scene by EMS due to the train stoppage on South Michigan Avenue in order to get the child to Mott Children's Hospital.

The current design of this exchange does not meet the demands of our rapidly growing community. Livingston County has been the highest growth rate county in Michigan for many years. This area experiences severe congestion, causing delays and challenges for residents, businesses, and commuters alike. More critically, the congestion hinders emergency response vehicles, slowing their ability to reach those in need quickly and safely. A roundabout would effectively address these issues by offering:

1. **Smoother Traffic Flow**: This modern design would reduce stop-and-go delays, facilitating faster and more efficient movement through this busy area.
2. **Enhanced Emergency Response**: By improving accessibility and alleviating bottlenecks, emergency vehicles can navigate the interchange more efficiently, saving precious time in critical situations.

3. **Future-Ready Infrastructure**: The proposed roundabout design accommodates the planned **loop road**, ensuring the interchange remains functional and sustainable as our community grows.

This project represents a significant opportunity to create a safer, more reliable transportation network for our city while demonstrating a forward-thinking approach to urban planning. We ask you to advocate for this vital improvement and work with your colleagues to allocate the funds necessary to bring this vision to life.

Thank you for your attention to this critical matter. We are happy to provide additional details or discuss this project at your earliest convenience.

Respectfully,

Michael P. Dunn
Chief of Police