AMERICAN STRUCTUREPOINT INC.

Traffic Impact Study

For
Proposed Development
Westfield, Indiana

Prepared for:

CrossRoads Church at Westfield

Prepared by:

American Structurepoint, Inc.
7260 Shadeland Station
Indianapolis, Indiana 46256

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Traffic Impact Study

For

Proposed Development

Westfield, Indiana

I certify that this Traffic Impact Study has been prepared by me or under my immediate supervision and that I have experience and training in the field of traffic and transportation engineering.

Jeromy L. Grenard

Jeromy Grenard, PE, PTOE
Indiana Registration #10504827

Amanda M. Johnson

Amanda M. Johnson, EI

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Executive Summary

Study Purpose and Scope

The purpose of this traffic impact study (TIS) is to evaluate the operational impacts of the proposed development on the surrounding road network, specifically Springmill Road, in Westfield, Indiana. The study summarizes the traffic forecast and identifies the operational impacts for two different site access scenarios.

The scenarios examined in this study are as follows.

- Scenario 1 – Year 2012 AM and PM peak hour traffic, with existing lane configurations.
- Scenario 2 – Year 2014 AM and PM peak hour traffic, with existing lane configurations.
- Scenario 3 – Year 2014 AM and PM peak hour traffic, with the addition of the proposed development traffic and one full-access drive onto Springmill Road.
- Scenario 4 – Year 2014 AM and PM peak hour traffic, with the addition of the proposed development traffic with one full-access drive onto the existing drive north of the gas station and one full-access drive on Lakeville Crossing.

The year 2014 was assumed to be the year at which the development will be fully developed.

The study intersections were as follows:

- Springmill Road and existing drive north of gas station (Scenarios 1, 2, 3, and 4)
- Springmill Road and proposed development drive (Scenario 3 only)
- 161st Street and Springmill Road (Scenarios 1, 2, 3, and 4) – In addition to the development driveways on Springmill Road, the intersection of 161st Street and Springmill road was studied to ensure queue lengths from either intersection do not spill back to the adjacent intersection.

Additionally, improvements required within the right-of-way have been identified for Scenarios 3 and 4.

Background Information

The *Westfield Thoroughfare Plan* was used to determine the classifications of the study area roadways. The existing roadway conditions and land uses within the study area were also reviewed and considered.

The proposed development is to consist of 4,088 square feet of bank or office land uses. Because trip generation for a bank land use is higher than for an office building, a bank was used for the purposes of this study in order to estimate the maximum traffic impacts. Two site design options have been provided. Site configuration 1 (study scenario 3) provides only one access; a full access driveway which provides direct access to Springmill Road. Site configuration 2 (study scenario 4) provides two access points into the adjacent development, but no direct access to Springmill Road. Traffic from the existing retail land uses within the adjacent development was included.

Traffic Forecast

Traffic volumes have been forecasted by determining the base year (2012) traffic volumes using existing traffic data provided by the City of Westfield, then applying a background traffic growth rate to obtain the 2014 traffic volumes, and then adding in any new trips generated by the development to the 2014 background traffic.

Capacity Analysis

A capacity analysis has been performed at each of the study intersections for the above-mentioned scenarios. To facilitate the analysis, Synchro (Version 8) was used to perform the capacity analysis at signalized and stop-controlled intersections. An acceptable level of service (LOS) for this study was considered to be LOS "D" or better at each of the study intersections.

Findings

The study intersection at 161st Street & Springmill Road will operate at or above acceptable levels of service during the AM and PM peak hours for all study scenarios. Queues from this intersection are not expected to extend north to the study driveways.

The intersection at Springmill Road and the existing drive will operate above acceptable levels of service for all study scenarios during the AM peak hour. This intersection currently operates below acceptable levels of service in the PM peak hour, and will continue to operate below acceptable levels of service for all study scenarios. Throughout the capacity analysis it became apparent that the southbound left-turn lane at this intersection would benefit from being extended to accommodate a 100-ft storage length. This would prevent left turning vehicles from blocking the southbound through lane.

If site configuration 1 is chosen, the proposed drive will operate at or above acceptable levels of service in both the AM and PM peak hour. The drive should be constructed with one entering lane, and two exiting lanes. If site configuration 2 is chosen, the access drives should both be constructed with one entry lane and one exit lane. Two access points would not increase traffic volumes at the existing drive. However, one access point along Springmill Road would provide direct access to the adjacent development which would reduce the number of new trips on the roadway system.

Study Purpose and Scope

Study Purpose

The purpose of this traffic impact study (TIS) is to evaluate the operational impacts of a proposed development on Springmill Road in Westfield, Indiana. The proposed development is to be located on the east side of Springmill Road north of the intersection of 161st Street & Springmill Road. The study summarizes the traffic forecast and identifies the operational impacts for two different access scenarios. In addition to analyzing the impacts of the development on the study intersections, the study attempts to answer relevant questions to this particular development:

- What are the operational and safety effects of an additional drive along Springmill Road?
- What improvements will be required within the right-of-way for each of the access options?
- What are the drive configurations that would be necessary for each of the access options?

Study Scope

The study estimates the number of new trips that will be generated by the proposed development and shows how these new trips are distributed to the surrounding public roadway system. The proposed development is to consist of 4,088 square feet of either bank or general office land uses. The year 2014 was assumed to be the year at which the development will be fully developed. Another multi-use development currently exists directly to the south and east of the proposed development.

The study area is bounded by 161st Street to the south, the edge of the proposed site to the north, Springmill Road to the west and Lakeville Crossing to the east. **Figure 1** shows the overall study area. The study intersections include the following:

- Springmill Road and existing drive north of gas station (Scenarios 1, 2, 3, and 4)
- Springmill Road and proposed development drive (Scenario 3 only)
- 161st Street and Springmill Road (Scenarios 1, 2, 3, and 4) – In addition to the development driveways on Springmill Road, the intersection of 161st Street and Springmill road was studied to ensure queue lengths from either intersection do not spill back to the adjacent intersection.

A traffic capacity analysis has been performed using Synchro, Version 8 software for each of the study scenarios. The scenarios examined in this study are as follows.

- Scenario 1 – Year 2012 AM and PM peak hour traffic, with existing lane configurations.
- Scenario 2 – Year 2014 AM and PM peak hour traffic, with existing lane configurations.
- Scenario 3 – Year 2014 AM and PM peak hour traffic, with the addition of the proposed development traffic and one full-access drive onto Springmill Road.
- Scenario 4 – Year 2014 AM and PM peak hour traffic, with the addition of the proposed development traffic with one full-access drive onto the gas station drive and one full-access on Lakeville Crossing.

Finally, conceptual drawings have been provided to graphically demonstrate the approach lane configurations necessary for each study driveway.

The study procedures follow the *Applicant's Guide to Traffic Impact Study* (from INDOT).

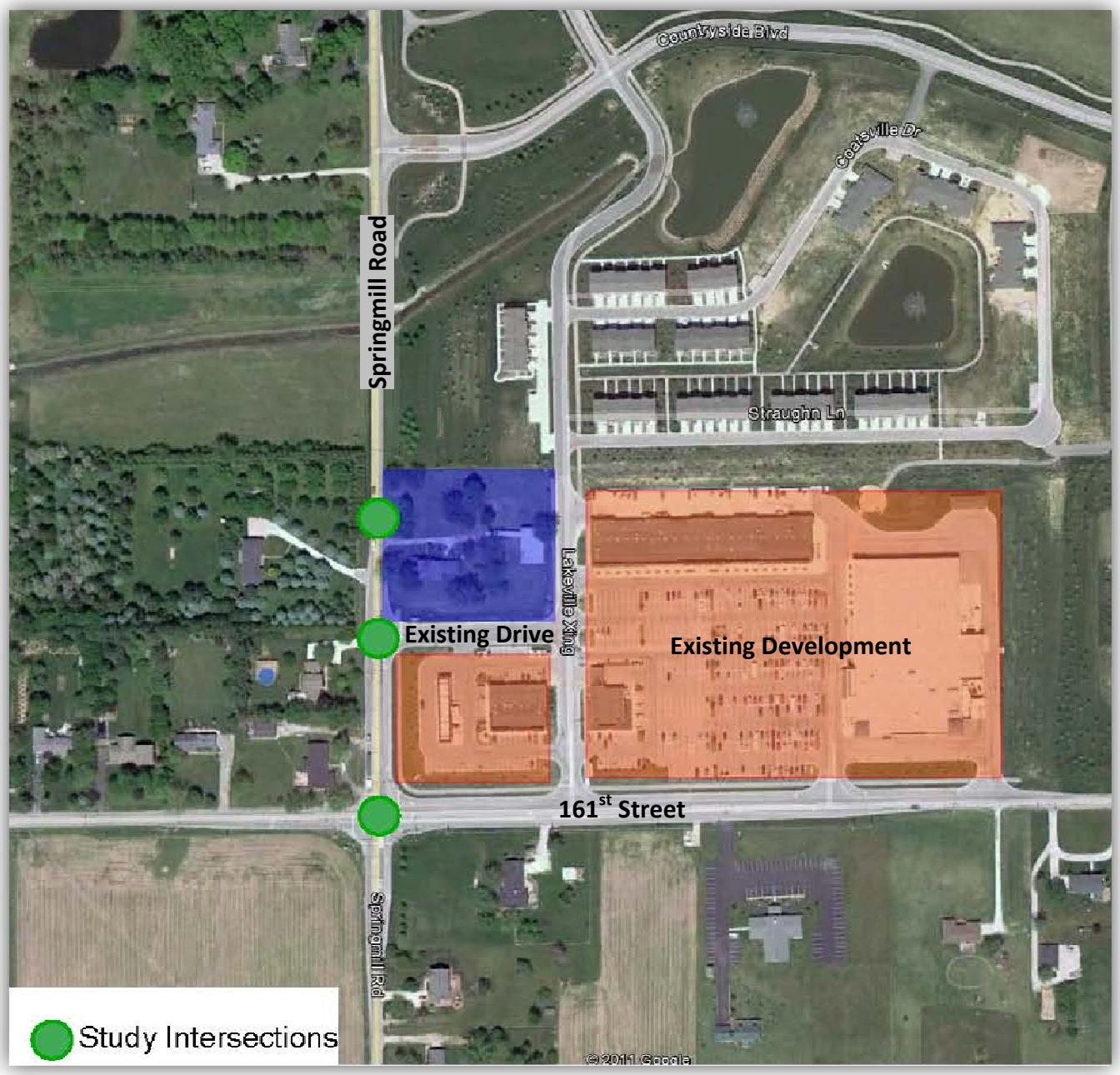

Figure 1 – Study Area

Background Information

Proposed Development

The proposed development is to be located on a site north of the intersection of 161st Street & Springmill Road, as shown in **Figure 2** below. The owner has specified the proposed development will consist of approximately 4,088 square feet of office or bank land uses. For the purpose of this study, only the bank land use option was used because it produces a higher trip generation; therefore, any findings within this report will represent the most intense scenario for traffic impacts.

Two access options have been defined for the proposed bank. Site Configuration 1 provides direct access to Springmill Road while Site Configuration 2 provides direct access to the adjacent development and no direct access to Springmill Road. These configurations are shown on **Figure 2** and **Figure 3**.

Figure 2 – Site Configuration 1

Figure 3 – Site Configuration 2

Existing Roadway Conditions Within Study Area

- Springmill Road: Springmill Road is a 2-lane north-south facility. The speed limit within the vicinity of the study area is posted at 45 mph. It is classified in the Westfield Thoroughfare Plan as a secondary arterial.

- 161st Street: 161st Street is a 2-lane east-west facility. The speed limit within the vicinity of the study area is posted at 45 mph. It is classified in the Westfield Thoroughfare Plan as a secondary arterial.

The study intersection of Springmill Road and 161st Street is a signalized intersection. The intersection of Springmill Road and the existing access drive is an unsignalized stop-sign controlled intersection with the access drive stopping for Springmill Road. The existing lane configurations can be seen on **Figure 9**.

Existing Land Use Within Study Area

The land uses near the proposed development consist primarily of single family homes or multi-family homes. Directly adjacent to the proposed site; however, is a multi-use development. This development includes gas station, grocery store, restaurants, specialty retail, fitness center, and bank land uses.

Traffic Forecast

Traffic has been forecasted by determining the base year (2012) traffic volumes using existing traffic data provided by the City of Westfield, then applying a background traffic growth rate to obtain the 2014 traffic volumes, and then adding in any new trips generated by the development to the 2014 background traffic. The following sections of the report provide greater detail of these steps.

Existing Traffic Data

Manual turning movement counts were provided by the City of Westfield. They were collected at the intersection of 161st Street & Springmill Road on September 28, 2011. Since these counts were performed only three months ago and no significant development has occurred within the study area during those months, the counts obtained in September 2011 were assumed to be the existing year 2012 counts. In addition, the City of Westfield provided 24-hour average daily traffic (ADT) counts for 161st Street and Springmill Road in the vicinity of the study area. The ADT counts were taken earlier in November 2007. Since these counts are quite old, they were only used to assist in determining the distribution of the development traffic volumes.

In order to determine turning movement volumes at the existing access drive and Springmill Road, entering and exiting volumes were estimated based on guidelines provided in *ITE's Trip Generation Report*[1]. **Table 1** shows the total projected trips from the existing development. Appropriate reductions as described in the *Trip Generation Handbook*[2] were applied to the trips before they were distributed to the existing drive along Spring Mill Road. This procedure is described in more detail later within this report.

Table 1 – Trip Generation for Existing Land Uses

Land Use	ITE Code	AM Peak		PM Peak	
		Enter	Exit	Enter	Exit
Gas Station	944	49	47	56	55
Specialty Retail	814	28	31	10	13
Bank	912	29	23	54	54
Grocery	850	140	90	343	329
Restaurant	932	10	13	33	25
Fitness Center	492	99	92	109	76
Townhomes	230	5	27	25	12

Figure 4 shows the 2012 existing traffic volumes. The raw data for the traffic counts are provided in **Appendix A** of this report.

[1] *Trip Generation Report, 8th Edition,* ITE. 2008.
[2] *Trip Generation Handbook, 2nd Edition,* ITE. 2004.

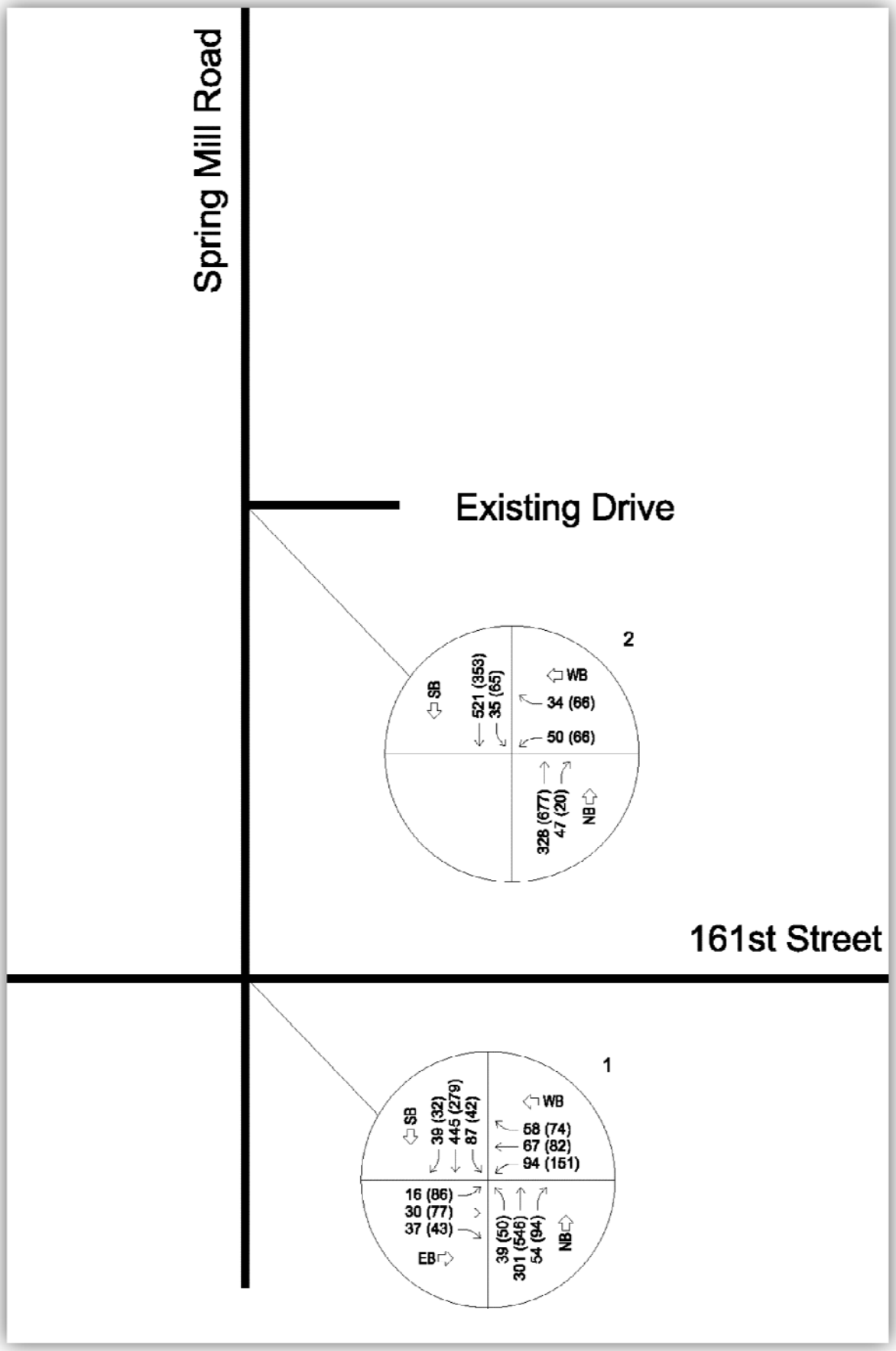

Figure 4 – Existing Traffic Volumes

Background Traffic Growth

It has been assumed the site will be fully developed by the year 2014, and therefore the year 2014 was chosen as the horizon year. In order to estimate the existing traffic volumes that will be present on the study area roadways for the year 2014, the background traffic growth must be determined.

Background traffic growth refers to the growth of traffic volumes that occur over time due to influences outside of the study area. These influences can range from transportation improvements to the status of the economy. Typically, the background traffic growth rate is determined by comparing historic traffic counts with current traffic counts.

The background growth rates used in a previous INDOT report[3] were used. This study analyzed SR 32 through the city of Westfield which is directly to the north of the proposed site. The INDOT study used growth rates ranging from 1.4% per year to 2.7% per year. For the proposed bank traffic study, the average of these rates was used; 2% per year. This growth rate is most likely a conservative growth rate.

It should also be noted that this growth rate was applied in a linear manner, as opposed to compounded. Linear growth is growth that occurs at a constant amount per year, as opposed to an exponentially growing amount added each year (compound growth).

Trip Generation

The Institute of Transportation Engineers (ITE) *Trip Generation Report, 8th Edition* was used to calculate the generated trips for the proposed development conditions. The owner anticipates that either a general office or a bank is proposed to be constructed at the site. A trip generation was performed on both options, but found that a proposed bank would produce more trips. Therefore, traffic volumes from a proposed bank were used for the analysis. **Table 2** contains the number of AM peak and PM peak trips that would be generated by the proposed development.

Pass-By Trips

Pass-by trips consist of those that are an intermediate stop en route from a trip origin to a trip destination. For example, on the way home (destination) from work (origin), many people stop along their route to get fuel (intermediate stop). This is not a new trip for the overall area but does change the travel pattern of the individual vehicles that were already present.

The ITE *Trip Generation Handbook* provides estimated pass-by trip percentages for each land use and was used to determine the appropriate pass-by percentages for the proposed bank. These percentages were applied to the generated traffic volumes and the non pass-by trips represent the new trips added to the roadway system by the proposed bank. The pass-by trip reductions are shown in **Table 2**.

[3] *Project Summary for SR 32 from US 31 to SR 38 in Hamilton County,* INDOT. April 2008

Table 2 – Trip Generation for Proposed Land Uses

Land Use	ITE Code	Size (SF)	AM Enter	AM Exit	PM Enter	PM Exit
Bank	912	4,088	28	22	53	53
Pass-By (47%)			13	10	25	25
Non Pass-By (53%)			15	12	28	28

It is noted the AM and PM peak hour mentioned in the above tables refers to the peak hour of the adjacent street traffic, not to the peak hour of the development.

Internal Trips

Internal trips are trips which have origins and destinations within a development and never actually travel on the public roadway system. Internal trips will occur during Scenario 4 if Site Configuration 2 is constructed. Site Configuration 2 is connected to the existing development and some trips can be expected to begin and/or end at the proposed development. Based on procedures set forth in the ITE *Trip Generation Handbook,* a 20% internal trip rate was applied to the traffic volumes for Scenario 4. Although trips could still begin and end at the existing development with Site Configuration 1, these trips were considered negligible for the analysis since far less vehicles would likely begin or end at the existing development due to the location of the access drives.

Trip Distribution and Traffic Assignment

The existing land uses and transportation system were taken into account when determining where to distribute the newly generated trips. In addition to the land uses and transportation system, the existing traffic volumes on 161st Street and Springmill Road were used to determine the percentage of traffic that would use each route. **Figure 5** shows the trip distribution amounts.

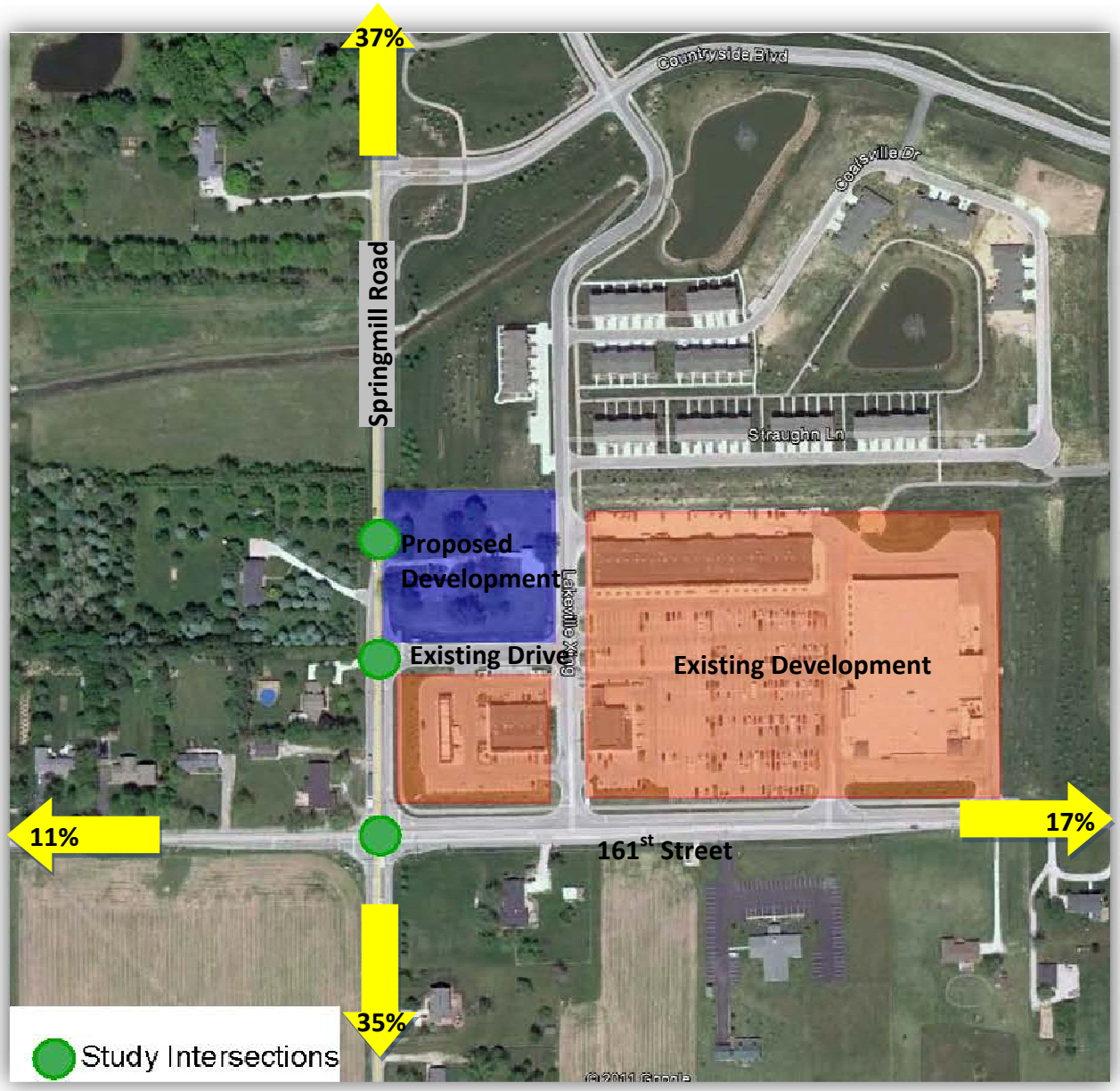

Figure 5 – Trip Distribution

Resulting 2014 Traffic Volumes

After applying the background growth rate of 2.0 percent per year to the 2012 traffic volumes and adding in trips generated by the proposed development, the total 2014 traffic volumes were obtained for each of the study scenarios. **Figure 6** through **Figure 8** illustrate the anticipated 2014 traffic volumes at the study intersection and access drives for study scenarios 2 through 4.

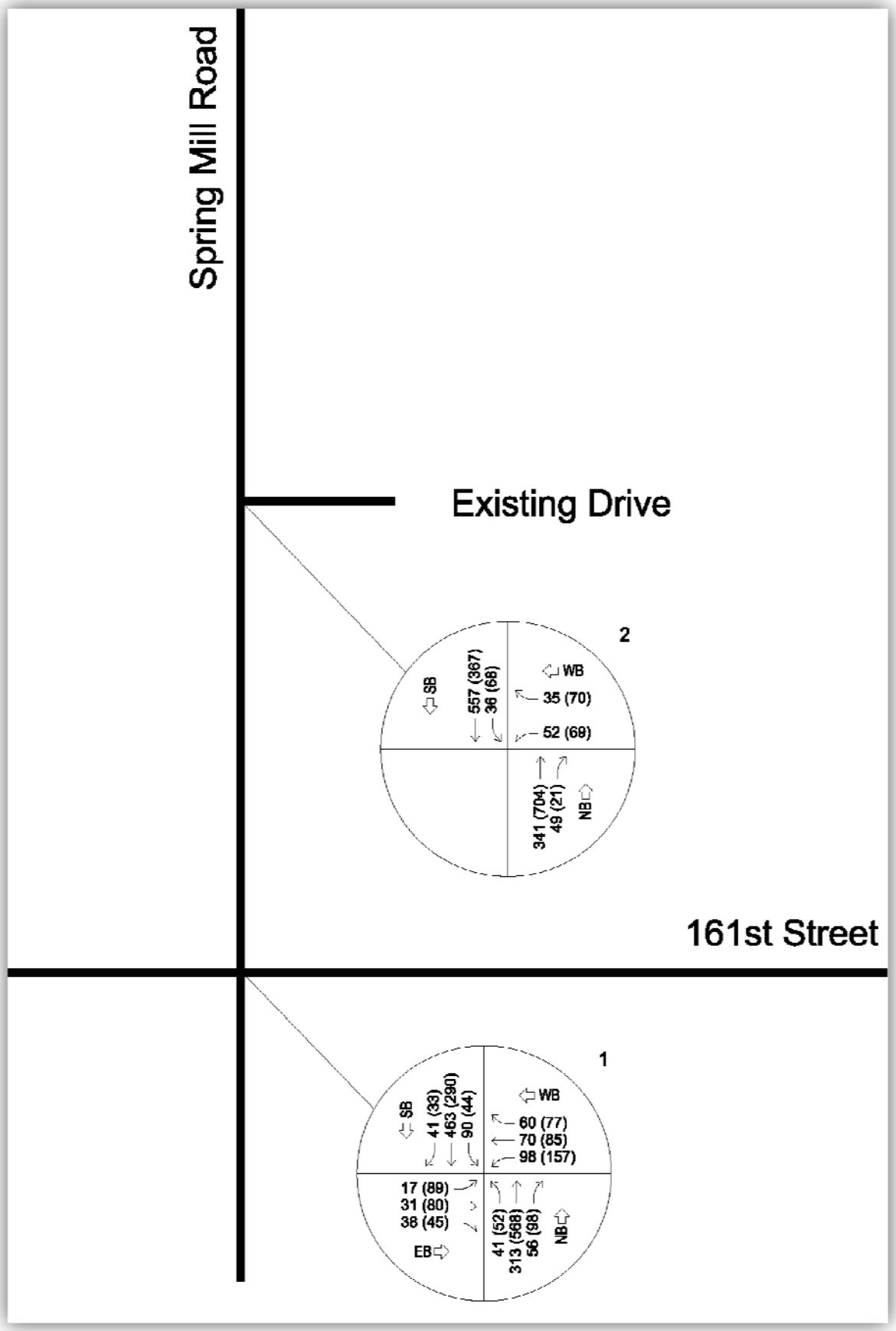

Figure 6 – Scenario 2: Year 2014 Traffic Volumes

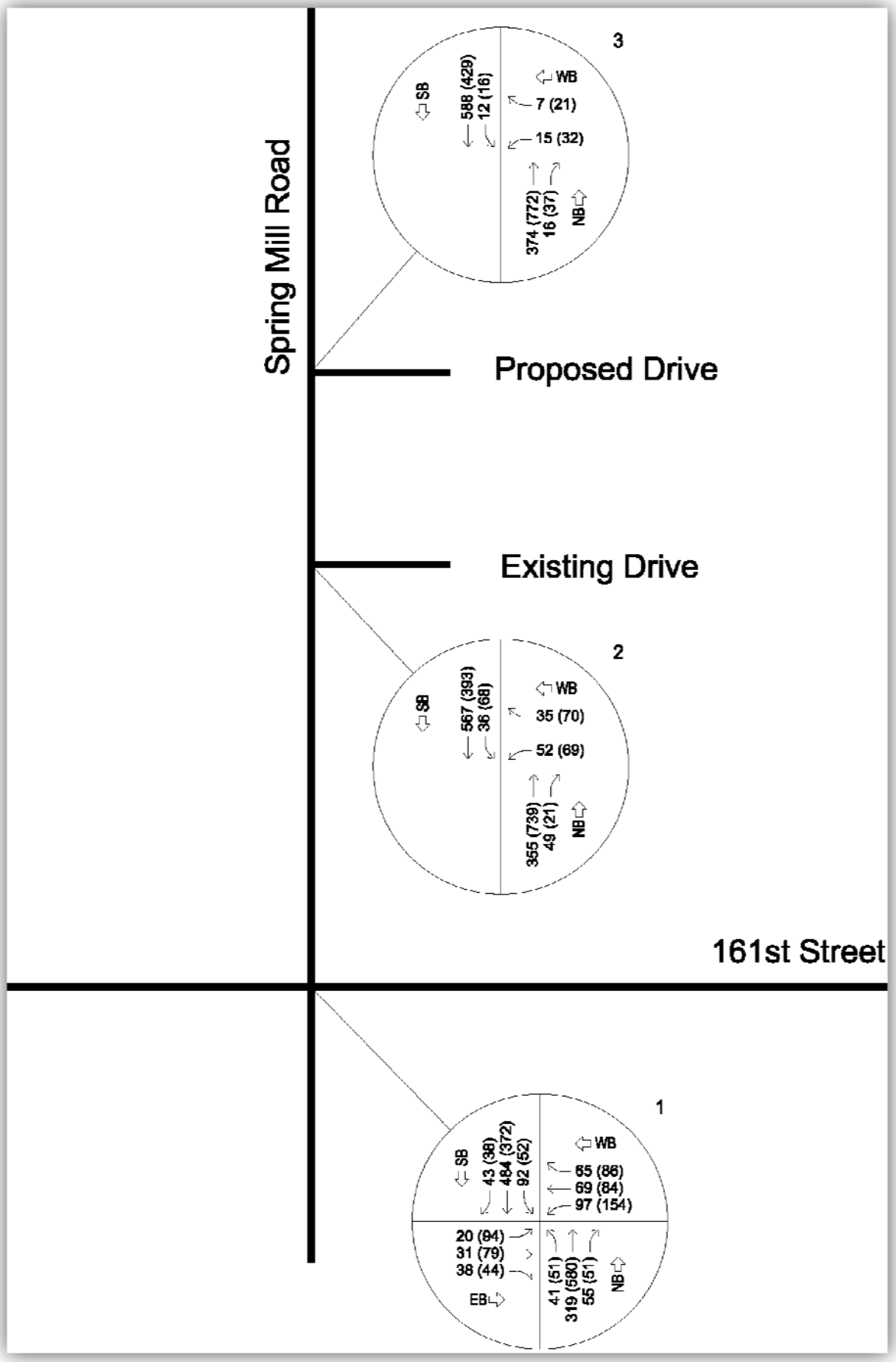

Figure 7 – Scenario 3: Year 2014 Traffic Volumes with Site Configuration 1

Figure 8 – Scenario 4: Year 2014 Traffic Volumes with Site Configuration 2

Capacity Analysis

A capacity analysis has been performed for each study intersection and each study scenario based on the methodology outlined in the *Highway Capacity Manual* (TRB 2010). The standard parameter used to evaluate traffic operating conditions is referred to as the level-of-service (LOS). There are six LOS (A through F), which relate to driving conditions from best to worst, respectively. LOS for both signalized and unsignalized intersections are defined in terms of control delay per vehicle, which is a direct correlation to driver discomfort, frustration, fuel consumption, and lost travel time. **Table 3** provides the LOS criteria as defined in the *Highway Capacity Manual*. To facilitate the analysis, Synchro and SimTraffic (Version 8) were used to perform the capacity analysis at signalized and stop-controlled intersections and driveways. The output from Synchro includes the average vehicle control delay, LOS, average queue length, and 95th percentile (or maximum) queue length.

Table 3 – Level of Service Criteria for Signalized and Unsignalized Intersections

LOS	Control Delay Per Vehicle (second)	
	Signalized Intersection	Unsignalized Intersection
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

The capacity analysis has been performed at the study intersections for each of the study scenarios summarized here in **Table 4**.

Table 4 – Study Scenarios

Scenario	Year	Analysis Hours	Site Configuration
1	2012	AM & PM Peak	N/A
2	2014	AM & PM Peak	N/A
3	2014	AM & PM Peak	1
4	2014	AM & PM Peak	2

Lane Configurations

The existing traffic data, the traffic forecast for the years 2014, and the existing intersection lane configurations were used as the input for the capacity analysis. A turn-lane warrant analysis was also performed using procedures described in the *Indiana Driveway Permit Manual*[4] to determine the need for improvements within the Springmill Road right-of-way for study scenarios 3 and 4. From this analysis, it was determined that the proposed drive should consist of two exiting lanes and the northbound approach should have an exclusive right-turn lane and the southbound approach should have an exclusive left-turn lane. In addition, the existing southbound left-turn lane at the existing drive along Spring Mill Road currently includes a very limited amount of storage. After an initial capacity analysis and traffic simulation, an extensive queue was forming on the southbound approach at the existing drive due to the limited storage of the southbound left-turn lane. Therefore, the recommended storage length (100 feet) was included within the analysis of scenarios 3 and 4.

Figure 9 shows the existing intersection lane configurations at the study intersections.

Figure 10 and **Figure 11** show the proposed year 2014 intersection lane configurations at the study intersections for study scenarios 3 and 4. **Appendix B** provides the software output from the capacity analysis.

[4] *Driveway Permit Manual,* INDOT, 1996.

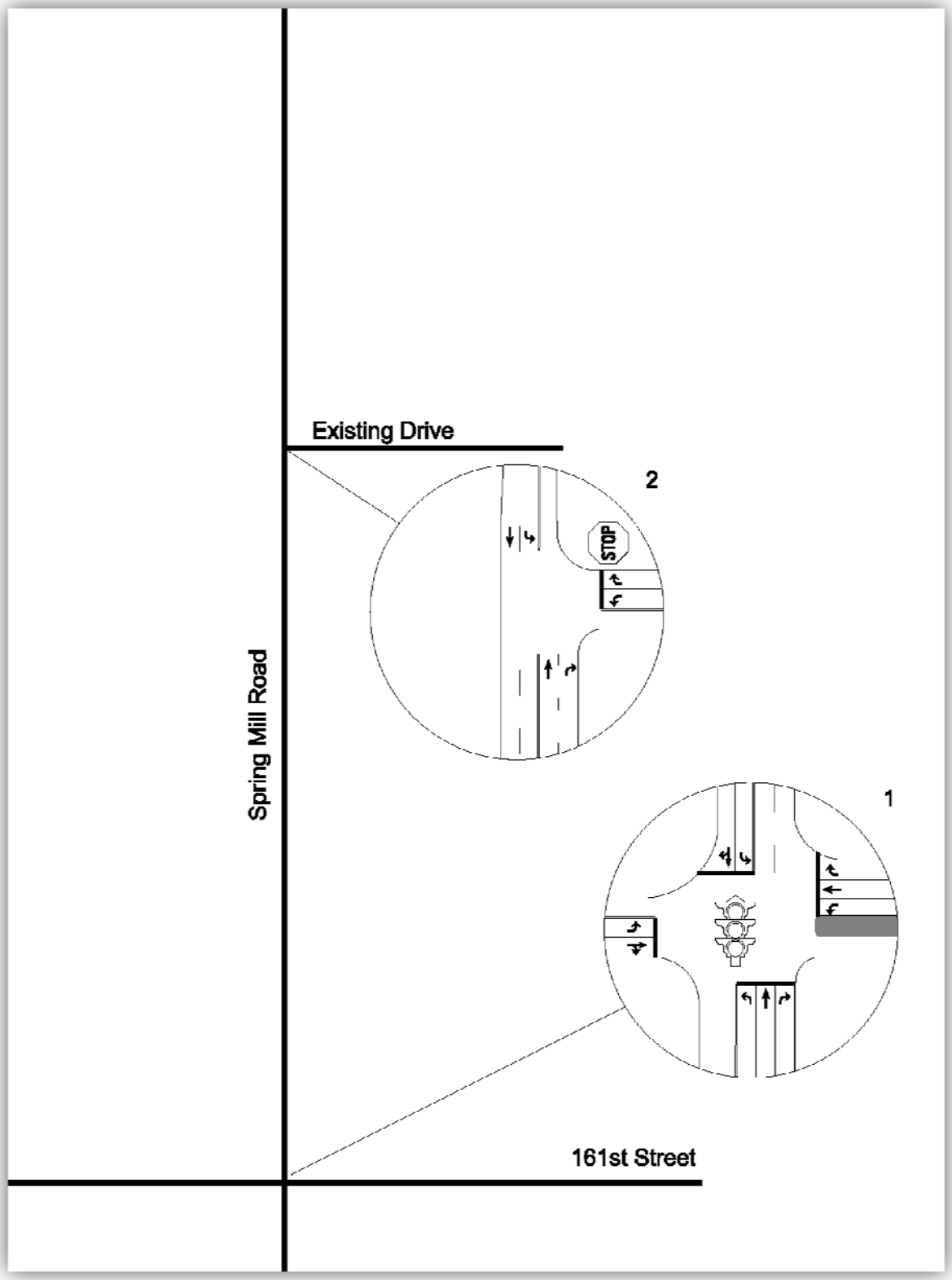

Figure 9 – Existing Intersection Lane Configurations (Scenario 1 & 2)

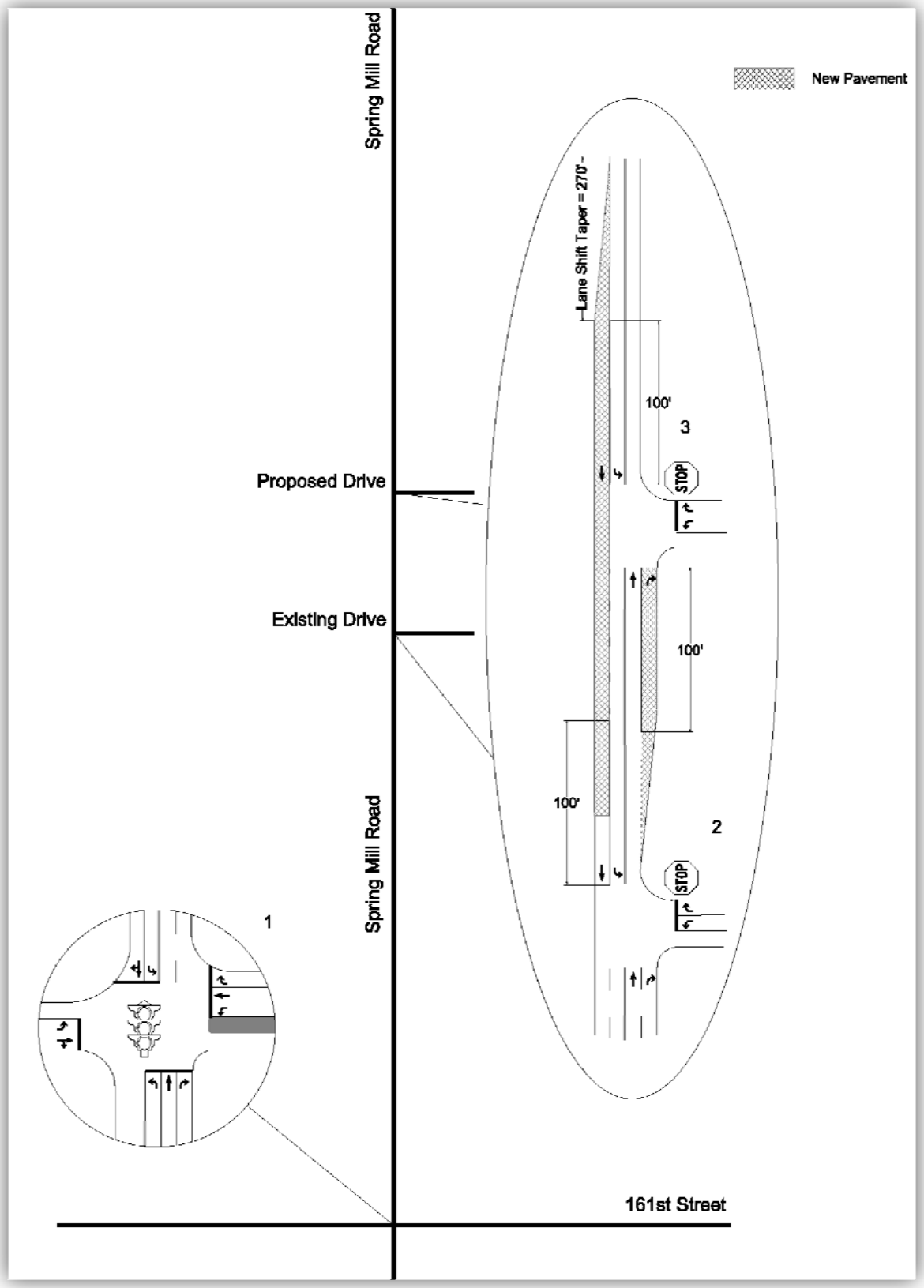

Figure 10 – Proposed Year 2014 Intersection Lane Configurations for Site Configuration 1 (Scenario 3)

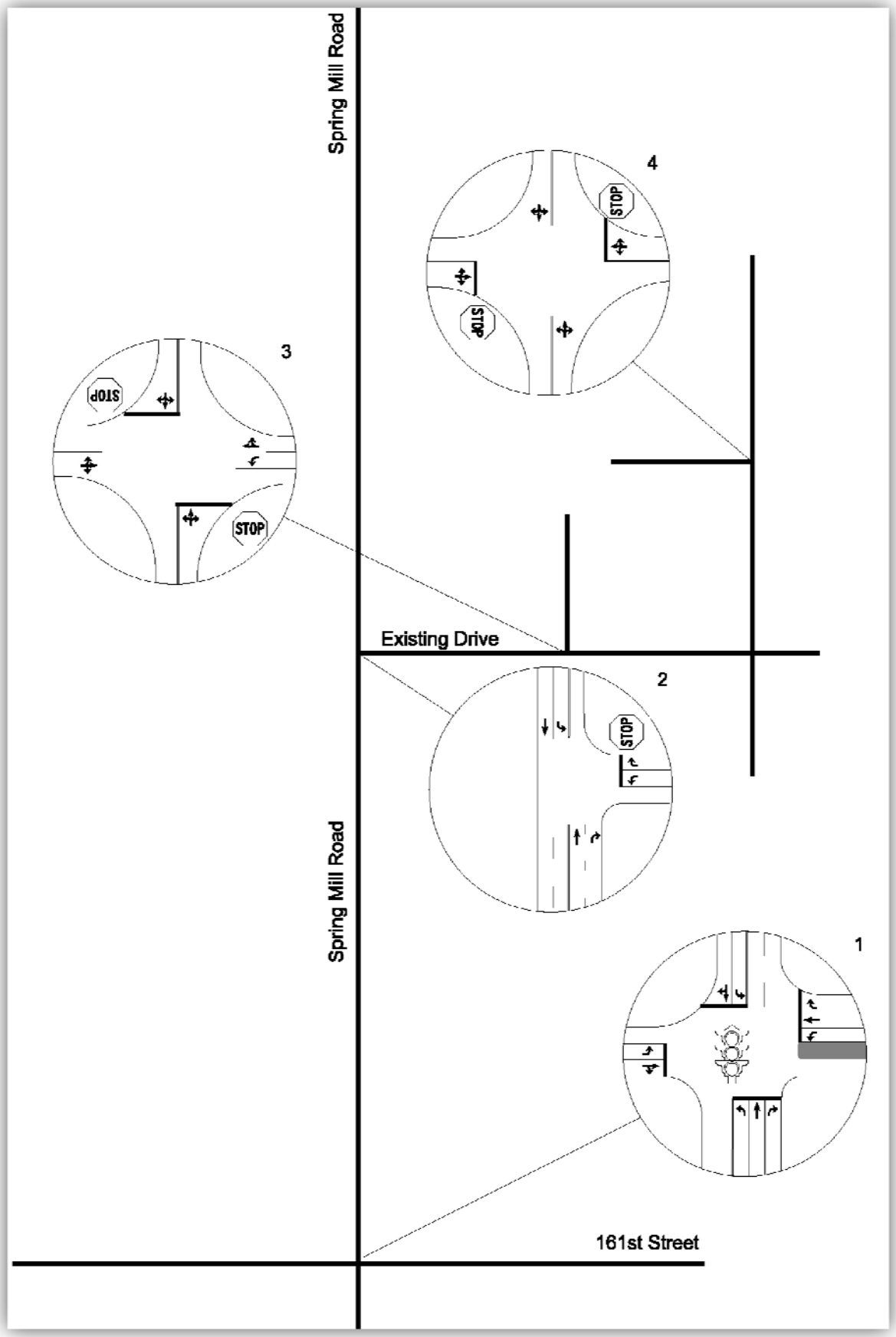

Figure 11 – Proposed Year 2014 Intersection Lane Configurations for Site Configuration 2 (Scenario 4)

Level of Service and Delay Results

Table 5 shows the intersection of 161st Street and Springmill Road will continue to operate at an acceptable LOS in the year 2014. In terms of delay, none of the scenarios impact the intersection much worse than any of the other scenarios.

Table 5 – Summary of Capacity Analysis for 161st Street & Springmill Road

Scenarios	Analysis Year	AM Peak		PM Peak	
		LOS	Avg. Delay (sec/veh)	LOS	Avg. Delay (sec/veh)
1	2012	B	13.6	B	18.1
2	2014	B	14.0	B	18.5
3	2014	B	13.9	B	18.8
4	2014	B	14.0	B	18.5

Table 6 shows that the intersection of Springmill Road and the existing drive will continue to operate at or above an acceptable LOS during the AM peak hour for all scenarios. The PM peak hour currently operates below acceptable levels of service and will continue to operate below acceptable levels of service for all scenarios. The Synchro output in **Appendix B** demonstrates that the unacceptable delay only occurs on the westbound approach, which is the exit from the development. The northbound approach is a free flow approach and therefore will not experience significant delay. The southbound left-turn will experience some delay but does not fall below LOS B for any scenario. This is important to note because it demonstrates that queues are not expected to extend to the through movements with a southbound left turn lane storage of 100 feet. In other words, the unacceptable LOS should not affect the public road, only the development drive. It should be noted that during the PM peak hour, the LOS goes from F to E from scenario 3 to scenario 4. Delay is measured per vehicle. Since the number of vehicles increased from scenario 3 to scenario 4, but the overall delay did not significantly increase, the average delay per vehicle actually reduced. This is further demonstrated when viewing the queue lengths. The queue length did increase from scenario 3 to scenario 4, reflecting the increased traffic volumes.

Table 6 – Summary of Capacity Analysis for Springmill Road & Existing Drive

Scenarios	Analysis Year	AM Peak			PM Peak		
		LOS*	Avg. Delay (sec/veh)*	95th % Queue (ft)*	LOS*	Avg. Delay (sec/veh)*	95th % Queue (ft)*
1	2012	C	21.3	47	E	35.7	72
2	2014	C	23.8	54	E	44.5	75
3	2014	C	25.0	55	F	57.0	86
4	2014	D	25.4	60	E	49.0	91

* *Represents the worst approach.*

Table 7 shows the intersection of Springmill Road and the proposed drive will operate at or above acceptable levels of service during the AM and PM peak hour for scenario 3. This scenario represents the site configuration 2 when all of the proposed bank traffic will use this single drive.

Table 7 – Summary of Capacity Analysis for Springmill Road & Proposed Drive

Scenarios	Analysis Year	AM Peak			PM Peak		
		LOS*	Avg. Delay (sec/veh)*	95th % Queue (ft)*	LOS*	Avg. Delay (sec/veh)*	95th % Queue (ft)*
3	2014	C	21.0	29	D	30.2	22

* *Represents the worst approach.*

Findings

The capacity analysis has shown that the proposed bank does not have a significant impact on the study intersections for either of the site configurations. The acceptable level of service for this study is LOS D. The intersection of 161st Street and Springmill Road operates at or above acceptable levels of service during all scenarios. The intersection of Springmill Road and the existing drive operates at or above acceptable levels of service during the AM peak hour for all scenarios. This intersection currently operates at LOS E during the PM peak hour and will continue to operate at LOS E or F for each of the site configurations.

The *INDOT Driveway Permit Manual* was consulted when determining what lane configurations are necessary at both of the study access drives.

Configuration 1: If site configuration 1 is chosen, the proposed access drive should consist of one entering lane and two exiting lanes. The northbound approach should consist of a through lane and a right-turn lane with a storage length of 100 feet and a taper length of 100 feet. The southbound approach should consist of a left-turn lane with a storage length of 100 feet and a taper length of 100 feet and a through lane. The existing southbound left-turn lane at the existing drive should also be extended to include 100 feet of storage and a 100 foot taper.

Configuration 2: The access drives should consist of one entering lane and one exiting lane per guidelines in the *INDOT Driveway Permit Manual*. The existing southbound left-turn lane at the existing drive should also be extended to include 100 feet of storage and a 100 foot taper.

Regardless of whether site configuration 1 or site configuration 2 is constructed, the existing southbound left-turn lane at the existing drive should be extended. Not only is this configuration recommended per the *INDOT Driveway Permit Manual,* it would also reduce the risk of southbound left-turn queues blocking the southbound through movement. The capacity analysis shows all queues can be accommodated with the proposed turn lane lengths.

Appendices

Appendix A – 2011 Study Intersection Turning Movement Counts

Appendix B – Synchro Output for Capacity Analysis

Appendix A

2011 Study Intersection Turning Movement Counts

Traffic Engineering, Inc.
Chet M. Skwarcan, PE
317-340-9724

File Name : 161st at Springmill AM
Site Code : 02222222
Start Date : 9/27/2011
Page No : 1

Groups Printed- Unshifted - Bank 1

	Spring Mill From North				161st From East				Spring Mill From South				161st From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
07:00 AM	9	104	17	0	14	17	22	0	15	87	4	0	5	6	5	0	305
07:15 AM	9	110	18	0	15	20	21	0	16	105	4	0	6	8	6	0	338
07:30 AM	10	131	32	0	15	19	27	0	17	50	16	1	13	9	1	0	341
07:45 AM	11	100	20	1	14	11	24	0	6	59	15	0	13	7	4	0	285
Total	39	445	87	1	58	67	94	0	54	301	39	1	37	30	16	0	1269
08:00 AM	9	76	8	0	6	12	24	0	8	45	5	0	7	4	4	0	208
08:15 AM	4	89	17	0	7	18	27	0	11	54	13	0	4	8	8	0	260
08:30 AM	6	94	21	0	6	13	16	0	10	62	34	0	20	16	16	0	314
08:45 AM	2	90	14	0	10	13	23	0	8	53	6	0	9	11	5	0	244
Total	21	349	60	0	29	56	90	0	37	214	58	0	40	39	33	0	1026
Grand Total	60	794	147	1	87	123	184	0	91	515	97	1	77	69	49	0	2295
Apprch %	6	79.2	14.7	0.1	22.1	31.2	46.7	0	12.9	73.2	13.8	0.1	39.5	35.4	25.1	0	
Total %	2.6	34.6	6.4	0	3.8	5.4	8	0	4	22.4	4.2	0	3.4	3	2.1	0	
Unshifted	59	777	146	1	84	119	176	0	89	506	87	1	75	66	47	0	2233
% Unshifted	98.3	97.9	99.3	100	96.6	96.7	95.7	0	97.8	98.3	89.7	100	97.4	95.7	95.9	0	97.3
Bank 1	1	17	1	0	3	4	8	0	2	9	10	0	2	3	2	0	62
% Bank 1	1.7	2.1	0.7	0	3.4	3.3	4.3	0	2.2	1.7	10.3	0	2.6	4.3	4.1	0	2.7

	Spring Mill From North					161st From East					Spring Mill From South					161st From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 7:00:00 AM to 8:45:00 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 7:00:00 AM																					
7:00:00 AM	9	104	17	0	130	14	17	22	0	53	15	87	4	0	106	5	6	5	0	16	305
7:15:00 AM	9	110	18	0	137	**15**	**20**	21	0	56	16	**105**	4	0	**125**	6	8	**6**	0	20	338
7:30:00 AM	10	**131**	**32**	0	**173**	15	19	**27**	0	**61**	**17**	50	**16**	**1**	84	**13**	**9**	1	0	23	**341**
7:45:00 AM	**11**	100	20	**1**	132	14	11	24	0	49	6	59	15	0	80	13	7	4	0	**24**	285
Total Volume	39	445	87	1	572	58	67	94	0	219	54	301	39	1	395	37	30	16	0	83	1269
% App. Total	6.8	77.8	15.2	0.2		26.5	30.6	42.9	0		13.7	76.2	9.9	0.3		44.6	36.1	19.3	0		
PHF	.886	.849	.680	.250	.827	.967	.838	.870	.000	.898	.794	.717	.609	.250	.790	.712	.833	.667	.000	.865	.930
Unshifted	39	440	87	1	567	58	67	93	0	218	54	299	39	1	393	35	29	15	0	79	1257
% Unshifted	100	98.9	100	100	99.1	100	100	98.9	0	99.5	100	99.3	100	100	99.5	94.6	96.7	93.8	0	95.2	99.1
Bank 1	0	5	0	0	5	0	0	1	0	1	0	2	0	0	2	2	1	1	0	4	12
% Bank 1	0	1.1	0	0	0.9	0	0	1.1	0	0.5	0	0.7	0	0	0.5	5.4	3.3	6.3	0	4.8	0.9

Traffic Engineering, Inc.
Chet M. Skwarcan, PE
317-340-9724

File Name : 161st at Springmill PM
Site Code : 00066666
Start Date : 9/28/2011
Page No : 1

Groups Printed- Unshifted - Bank 1

	Spring Mill From North				161st From East				Spring Mill From South				161st From West				
Start Time	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Right	Thru	Left	Peds	Int. Total
04:00 PM	7	42	14	0	9	12	19	1	19	87	10	0	12	15	15	0	262
04:15 PM	2	54	9	0	11	14	25	0	31	94	14	0	8	15	15	0	292
04:30 PM	3	49	13	0	16	13	27	0	20	129	12	0	19	13	12	0	326
04:45 PM	1	52	10	0	18	20	35	0	22	116	5	0	5	16	8	0	308
Total	13	197	46	0	54	59	106	1	92	426	41	0	44	59	50	0	1188
05:00 PM	5	80	14	0	14	15	28	0	25	123	11	0	4	10	13	1	343
05:15 PM	5	66	12	0	19	14	39	0	18	153	8	0	15	24	28	0	401
05:30 PM	11	67	10	0	26	18	42	0	22	142	17	0	7	17	20	1	400
05:45 PM	11	66	6	0	15	35	42	0	29	128	14	0	17	26	25	0	414
Total	32	279	42	0	74	82	151	0	94	546	50	0	43	77	86	2	1558
Grand Total	45	476	88	0	128	141	257	1	186	972	91	0	87	136	136	2	2746
Apprch %	7.4	78.2	14.4	0	24.3	26.8	48.8	0.2	14.9	77.8	7.3	0	24.1	37.7	37.7	0.6	
Total %	1.6	17.3	3.2	0	4.7	5.1	9.4	0	6.8	35.4	3.3	0	3.2	5	5	0.1	
Unshifted	45	468	86	0	125	140	252	1	183	958	91	0	86	134	136	0	2705
% Unshifted	100	98.3	97.7	0	97.7	99.3	98.1	100	98.4	98.6	100	0	98.9	98.5	100	0	98.5
Bank 1	0	8	2	0	3	1	5	0	3	14	0	0	1	2	0	2	41
% Bank 1	0	1.7	2.3	0	2.3	0.7	1.9	0	1.6	1.4	0	0	1.1	1.5	0	100	1.5

	Spring Mill From North					161st From East					Spring Mill From South					161st From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 4:00:00 PM to 5:45:00 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 5:00:00 PM																					
5:00:00 PM	5	**80**	**14**	0	**99**	14	15	28	0	57	25	123	11	0	159	4	10	13	**1**	28	343
5:15:00 PM	5	66	12	0	83	19	14	39	0	72	18	**153**	8	0	179	15	24	**28**	0	67	401
5:30:00 PM	**11**	67	10	0	88	**26**	18	**42**	0	86	22	142	**17**	0	**181**	7	17	20	1	45	400
5:45:00 PM	11	66	6	0	83	15	**35**	42	0	**92**	**29**	128	14	0	171	**17**	**26**	25	0	**68**	**414**
Total Volume	32	279	42	0	353	74	82	151	0	307	94	546	50	0	690	43	77	86	2	208	1558
% App. Total	9.1	79	11.9	0		24.1	26.7	49.2	0		13.6	79.1	7.2	0		20.7	37	41.3	1		
PHF	.727	.872	.750	.000	.891	.712	.586	.899	.000	.834	.810	.892	.735	.000	.953	.632	.740	.768	.500	.765	.941
Unshifted	32	276	40	0	348	73	82	147	0	302	94	541	50	0	685	43	76	86	0	205	1540
% Unshifted	100	98.9	95.2	0	98.6	98.6	100	97.4	0	98.4	100	99.1	100	0	99.3	100	98.7	100	0	98.6	98.8
Bank 1	0	3	2	0	5	1	0	4	0	5	0	5	0	0	5	0	1	0	2	3	18
% Bank 1	0	1.1	4.8	0	1.4	1.4	0	2.6	0	1.6	0	0.9	0	0	0.7	0	1.3	0	100	1.4	1.2

Appendix B

Synchro Output for Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	16	30	37	94	67	58	39	301	54	87	445	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
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)	1770	1707		1770	1863	1583	1770	1863	1583	1770	1840	
Flt Permitted	0.71	1.00		0.51	1.00	1.00	0.35	1.00	1.00	0.46	1.00	
Satd. Flow (perm)	1320	1707		956	1863	1583	654	1863	1583	862	1840	
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.79	0.79	0.79	0.83	0.83	0.83
Adj. Flow (vph)	18	34	43	104	74	64	49	381	68	105	536	47
RTOR Reduction (vph)	0	38	0	0	0	54	0	0	25	0	3	0
Lane Group Flow (vph)	18	39	0	104	74	10	49	381	43	105	580	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	8.9	8.2		15.1	11.3	11.3	45.2	42.9	46.7	48.2	44.4	
Effective Green, g (s)	8.9	8.2		15.1	11.3	11.3	45.2	42.9	46.7	48.2	44.4	
Actuated g/C Ratio	0.12	0.11		0.20	0.15	0.15	0.61	0.57	0.63	0.65	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	161	187		235	282	239	430	1070	1074	602	1094	
v/s Ratio Prot	0.00	0.02		c0.02	0.04		0.00	0.20	0.00	c0.01	c0.32	
v/s Ratio Perm	0.01			c0.07		0.01	0.07		0.02	0.10		
v/c Ratio	0.11	0.21		0.44	0.26	0.04	0.11	0.36	0.04	0.17	0.53	
Uniform Delay, d1	29.3	30.3		25.3	28.0	27.1	6.6	8.5	5.4	5.3	9.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.6		1.3	0.5	0.1	0.1	0.9	0.0	0.1	1.8	
Delay (s)	29.6	30.8		26.7	28.5	27.1	6.7	9.4	5.4	5.4	10.8	
Level of Service	C	C		C	C	C	A	A	A	A	B	
Approach Delay (s)		30.6			27.4			8.6			10.0	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM Average Control Delay	13.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	74.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	50	34	328	47	35	521
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.79	0.79	0.83	0.83
Hourly flow rate (vph)	56	38	415	59	42	628
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.91	0.91			0.91	
vC, conflicting volume	1127	415			475	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1089	304			369	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	73	94			96	
cM capacity (veh/h)	208	667			1078	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	56	38	415	59	42	628
Volume Left	56	0	0	0	42	0
Volume Right	0	38	0	59	0	0
cSH	208	667	1700	1700	1078	1700
Volume to Capacity	0.27	0.06	0.24	0.03	0.04	0.37
Queue Length 95th (ft)	26	4	0	0	3	0
Control Delay (s)	28.5	10.7	0.0	0.0	8.5	0.0
Lane LOS	D	B			A	
Approach Delay (s)	21.3		0.0		0.5	
Approach LOS	C					

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	55	105	121	126	63	52	135	33	71	206
Average Queue (ft)	16	42	55	38	24	22	62	7	23	80
95th Queue (ft)	44	82	103	83	53	47	117	28	52	163
Link Distance (ft)		495		930	930		242		254	254
Upstream Blk Time (%)										0
Queuing Penalty (veh)										0
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)		0					1			
Queuing Penalty (veh)		0					1			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	SB	SB
Directions Served	L	R	R	L	T
Maximum Queue (ft)	57	41	4	43	20
Average Queue (ft)	24	14	0	10	1
95th Queue (ft)	47	34	3	35	11
Link Distance (ft)	303	303	254		342
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				10	
Storage Blk Time (%)				1	0
Queuing Penalty (veh)				6	0

Network Summary

Network wide Queuing Penalty: 8

HCM Signalized Intersection Capacity Analysis
3: Spring Mill Road & 161st Street

1/18/2012

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	86	77	43	151	82	74	50	546	94	42	279	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
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)	1770	1762		1770	1863	1583	1770	1863	1583	1770	1834	
Flt Permitted	0.69	1.00		0.43	1.00	1.00	0.48	1.00	1.00	0.28	1.00	
Satd. Flow (perm)	1291	1762		795	1863	1583	886	1863	1583	523	1834	
Peak-hour factor, PHF	0.77	0.77	0.77	0.83	0.83	0.83	0.95	0.95	0.95	0.89	0.89	0.89
Adj. Flow (vph)	112	100	56	182	99	89	53	575	99	47	313	36
RTOR Reduction (vph)	0	27	0	0	0	71	0	0	39	0	5	0
Lane Group Flow (vph)	112	129	0	182	99	18	53	575	60	47	344	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	16.1	11.4		22.5	14.6	14.6	38.6	36.4	44.3	38.6	36.4	
Effective Green, g (s)	16.1	11.4		22.5	14.6	14.6	38.6	36.4	44.3	38.6	36.4	
Actuated g/C Ratio	0.22	0.15		0.30	0.20	0.20	0.52	0.49	0.60	0.52	0.49	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	312	272		346	368	313	489	918	1035	310	903	
v/s Ratio Prot	0.02	0.07		c0.06	0.05		0.00	c0.31	0.01	c0.00	0.19	
v/s Ratio Perm	0.06			c0.10		0.01	0.05		0.03	0.07		
v/c Ratio	0.36	0.47		0.53	0.27	0.06	0.11	0.63	0.06	0.15	0.38	
Uniform Delay, d1	24.1	28.5		20.1	25.1	24.1	8.9	13.8	6.1	10.0	11.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	1.3		1.4	0.4	0.1	0.1	3.2	0.0	0.2	1.2	
Delay (s)	24.8	29.8		21.6	25.5	24.1	9.0	17.0	6.2	10.2	12.9	
Level of Service	C	C		C	C	C	A	B	A	B	B	
Approach Delay (s)		27.7			23.2			14.9			12.6	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	18.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	73.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	57.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	66	67	677	20	65	353
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.89	0.89	0.95	0.95
Hourly flow rate (vph)	73	74	761	22	68	372
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.73	0.73			0.73	
vC, conflicting volume	1269	761			783	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1185	491			521	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	47	82			91	
cM capacity (veh/h)	139	423			765	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	73	74	761	22	68	372
Volume Left	73	0	0	0	68	0
Volume Right	0	74	0	22	0	0
cSH	139	423	1700	1700	765	1700
Volume to Capacity	0.53	0.18	0.45	0.01	0.09	0.22
Queue Length 95th (ft)	64	16	0	0	7	0
Control Delay (s)	56.5	15.3	0.0	0.0	10.2	0.0
Lane LOS	F	C			B	
Approach Delay (s)	35.7		0.0		1.6	
Approach LOS	E					

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	106	132	162	134	72	102	260	170	54	148
Average Queue (ft)	49	62	81	48	33	26	154	26	19	70
95th Queue (ft)	89	110	137	94	61	67	263	103	42	134
Link Distance (ft)		495		930	930		242		254	254
Upstream Blk Time (%)							2			
Queuing Penalty (veh)							0			
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)		0					13			
Queuing Penalty (veh)		0					19			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	SB
Directions Served	L	R	R	L
Maximum Queue (ft)	94	65	4	82
Average Queue (ft)	35	26	0	26
95th Queue (ft)	72	53	3	60
Link Distance (ft)	303	303	254	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				10
Storage Blk Time (%)				8
Queuing Penalty (veh)				28

Network Summary

Network wide Queuing Penalty: 47

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	17	31	38	98	70	60	41	313	56	90	463	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
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)	1770	1709		1770	1863	1583	1770	1863	1583	1770	1840	
Flt Permitted	0.71	1.00		0.48	1.00	1.00	0.33	1.00	1.00	0.45	1.00	
Satd. Flow (perm)	1316	1709		890	1863	1583	611	1863	1583	833	1840	
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.79	0.79	0.79	0.83	0.83	0.83
Adj. Flow (vph)	20	36	44	109	78	67	52	396	71	108	558	49
RTOR Reduction (vph)	0	39	0	0	0	56	0	0	27	0	3	0
Lane Group Flow (vph)	20	41	0	109	78	11	52	396	44	108	604	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	8.9	8.2		16.7	12.1	12.1	44.3	42.0	46.6	47.3	43.5	
Effective Green, g (s)	8.9	8.2		16.7	12.1	12.1	44.3	42.0	46.6	47.3	43.5	
Actuated g/C Ratio	0.12	0.11		0.22	0.16	0.16	0.59	0.56	0.62	0.63	0.58	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	161	188		253	302	257	399	1049	1074	576	1073	
v/s Ratio Prot	0.00	0.02		c0.03	0.04		0.00	0.21	0.00	c0.01	c0.33	
v/s Ratio Perm	0.01			c0.07		0.01	0.07		0.03	0.11		
v/c Ratio	0.12	0.22		0.43	0.26	0.04	0.13	0.38	0.04	0.19	0.56	
Uniform Delay, d1	29.3	30.3		24.1	27.3	26.4	7.1	9.0	5.4	5.7	9.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.3	0.6		1.2	0.5	0.1	0.1	1.0	0.0	0.2	2.1	
Delay (s)	29.6	30.9		25.2	27.8	26.4	7.3	10.1	5.4	5.8	11.8	
Level of Service	C	C		C	C	C	A	B	A	A	B	
Approach Delay (s)		30.6			26.3			9.2			10.9	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	74.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	52	35	341	49	36	557
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.79	0.79	0.83	0.83
Hourly flow rate (vph)	58	39	432	62	43	671
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.90	0.90			0.90	
vC, conflicting volume	1189	432			494	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1154	309			379	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	69	94			96	
cM capacity (veh/h)	188	656			1059	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	58	39	432	62	43	671
Volume Left	58	0	0	0	43	0
Volume Right	0	39	0	62	0	0
cSH	188	656	1700	1700	1059	1700
Volume to Capacity	0.31	0.06	0.25	0.04	0.04	0.39
Queue Length 95th (ft)	31	5	0	0	3	0
Control Delay (s)	32.5	10.8	0.0	0.0	8.5	0.0
Lane LOS	D	B			A	
Approach Delay (s)	23.8		0.0		0.5	
Approach LOS	C					

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	48	100	121	91	66	62	179	80	58	218
Average Queue (ft)	16	38	56	41	29	20	63	10	24	84
95th Queue (ft)	42	77	109	78	56	51	133	45	48	172
Link Distance (ft)		495		930	930		242		254	254
Upstream Blk Time (%)										0
Queuing Penalty (veh)										0
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)		0					2			
Queuing Penalty (veh)		0					2			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	SB
Directions Served	L	R	R	L
Maximum Queue (ft)	69	41	18	44
Average Queue (ft)	29	15	1	12
95th Queue (ft)	54	36	10	37
Link Distance (ft)	303	303	254	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)				10
Storage Blk Time (%)				1
Queuing Penalty (veh)				8

Network Summary

Network wide Queuing Penalty: 10

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	89	80	45	157	85	77	52	568	98	44	290	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
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)	1770	1763		1770	1863	1583	1770	1863	1583	1770	1834	
Flt Permitted	0.69	1.00		0.42	1.00	1.00	0.46	1.00	1.00	0.26	1.00	
Satd. Flow (perm)	1287	1763		779	1863	1583	860	1863	1583	485	1834	
Peak-hour factor, PHF	0.77	0.77	0.77	0.83	0.83	0.83	0.95	0.95	0.95	0.89	0.89	0.89
Adj. Flow (vph)	116	104	58	189	102	93	55	598	103	49	326	37
RTOR Reduction (vph)	0	26	0	0	0	74	0	0	39	0	5	0
Lane Group Flow (vph)	116	136	0	189	102	19	55	598	64	49	358	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	16.4	11.7		22.8	14.9	14.9	38.6	36.4	44.3	38.6	36.4	
Effective Green, g (s)	16.4	11.7		22.8	14.9	14.9	38.6	36.4	44.3	38.6	36.4	
Actuated g/C Ratio	0.22	0.16		0.31	0.20	0.20	0.52	0.49	0.60	0.52	0.49	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	315	278		345	374	318	474	914	1030	290	900	
v/s Ratio Prot	0.02	0.08		c0.06	0.05		0.00	c0.32	0.01	c0.01	0.20	
v/s Ratio Perm	0.06			c0.11		0.01	0.06		0.03	0.08		
v/c Ratio	0.37	0.49		0.55	0.27	0.06	0.12	0.65	0.06	0.17	0.40	
Uniform Delay, d1	24.1	28.5		20.2	25.1	24.0	9.0	14.2	6.3	10.4	12.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	1.4		1.8	0.4	0.1	0.1	3.6	0.0	0.3	1.3	
Delay (s)	24.8	29.9		21.9	25.5	24.1	9.1	17.8	6.3	10.6	13.3	
Level of Service	C	C		C	C	C	A	B	A	B	B	
Approach Delay (s)		27.8			23.4			15.6			13.0	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	74.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	69	70	704	21	68	367
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.89	0.89	0.95	0.95
Hourly flow rate (vph)	77	78	791	24	72	386
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.71	0.71			0.71	
vC, conflicting volume	1320	791			815	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1249	507			540	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	38	81			90	
cM capacity (veh/h)	123	404			734	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	77	78	791	24	72	386
Volume Left	77	0	0	0	72	0
Volume Right	0	78	0	24	0	0
cSH	123	404	1700	1700	734	1700
Volume to Capacity	0.62	0.19	0.47	0.01	0.10	0.23
Queue Length 95th (ft)	80	18	0	0	8	0
Control Delay (s)	73.4	16.0	0.0	0.0	10.4	0.0
Lane LOS	F	C			B	
Approach Delay (s)	44.5		0.0		1.6	
Approach LOS	E					

Intersection Summary			
Average Delay	5.3		
Intersection Capacity Utilization	54.6%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	108	145	185	125	74	123	254	140	59	189
Average Queue (ft)	51	65	82	53	33	28	157	22	20	78
95th Queue (ft)	92	116	141	99	61	76	269	87	45	151
Link Distance (ft)		495		930	930		242		254	254
Upstream Blk Time (%)						0	2			0
Queuing Penalty (veh)						0	0			0
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)	0	0					13			
Queuing Penalty (veh)	0	0					20			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	NB	SB	SB
Directions Served	L	R	T	R	L	T
Maximum Queue (ft)	96	72	4	4	72	20
Average Queue (ft)	36	27	0	0	28	1
95th Queue (ft)	75	53	3	3	58	14
Link Distance (ft)	303	303	254	254		342
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)					10	
Storage Blk Time (%)					8	0
Queuing Penalty (veh)					31	0

Network Summary

Network wide Queuing Penalty: 51

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	31	38	97	69	65	41	319	55	92	484	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
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)	1770	1709		1770	1863	1583	1770	1863	1583	1770	1840	
Flt Permitted	0.71	1.00		0.54	1.00	1.00	0.32	1.00	1.00	0.45	1.00	
Satd. Flow (perm)	1317	1709		1008	1863	1583	593	1863	1583	834	1840	
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.79	0.79	0.79	0.83	0.83	0.83
Adj. Flow (vph)	23	36	44	108	77	72	52	404	70	111	583	52
RTOR Reduction (vph)	0	39	0	0	0	62	0	0	26	0	3	0
Lane Group Flow (vph)	23	41	0	108	77	10	52	404	44	111	632	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	9.1	7.6		13.7	9.9	9.9	45.3	43.0	46.8	48.3	44.5	
Effective Green, g (s)	9.1	7.6		13.7	9.9	9.9	45.3	43.0	46.8	48.3	44.5	
Actuated g/C Ratio	0.12	0.10		0.18	0.13	0.13	0.61	0.58	0.63	0.65	0.60	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	171	175		225	249	211	399	1080	1084	591	1104	
v/s Ratio Prot	0.00	0.02		c0.02	0.04		0.00	0.22	0.00	c0.01	c0.34	
v/s Ratio Perm	0.01			c0.06		0.01	0.08		0.03	0.11		
v/c Ratio	0.13	0.23		0.48	0.31	0.05	0.13	0.37	0.04	0.19	0.57	
Uniform Delay, d1	28.9	30.6		26.4	29.1	28.0	6.6	8.4	5.2	5.1	9.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.7		1.6	0.7	0.1	0.1	1.0	0.0	0.2	2.2	
Delay (s)	29.3	31.3		28.0	29.8	28.1	6.8	9.4	5.2	5.3	11.2	
Level of Service	C	C		C	C	C	A	A	A	A	B	
Approach Delay (s)		30.8			28.6			8.6			10.3	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	13.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	74.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	52	35	355	49	36	567
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.79	0.79	0.83	0.83
Hourly flow rate (vph)	58	39	449	62	43	683
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.90	0.90			0.90	
vC, conflicting volume	1219	449			511	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1187	330			399	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	68	94			96	
cM capacity (veh/h)	179	639			1041	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	58	39	449	62	43	683
Volume Left	58	0	0	0	43	0
Volume Right	0	39	0	62	0	0
cSH	179	639	1700	1700	1041	1700
Volume to Capacity	0.32	0.06	0.26	0.04	0.04	0.40
Queue Length 95th (ft)	33	5	0	0	3	0
Control Delay (s)	34.4	11.0	0.0	0.0	8.6	0.0
Lane LOS	D	B			A	
Approach Delay (s)	25.0		0.0		0.5	
Approach LOS	C					

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	39.8%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	15	7	374	16	12	588
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.79	0.79	0.83	0.83
Hourly flow rate (vph)	17	8	473	20	14	708
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			586			
pX, platoon unblocked	0.93	0.93			0.93	
vC, conflicting volume	1211	473			494	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1189	397			418	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	91	99			99	
cM capacity (veh/h)	191	607			1061	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	17	8	473	20	14	708
Volume Left	17	0	0	0	14	0
Volume Right	0	8	0	20	0	0
cSH	191	607	1700	1700	1061	1700
Volume to Capacity	0.09	0.01	0.28	0.01	0.01	0.42
Queue Length 95th (ft)	7	1	0	0	1	0
Control Delay (s)	25.7	11.0	0.0	0.0	8.4	0.0
Lane LOS	D	B			A	
Approach Delay (s)	21.0		0.0		0.2	
Approach LOS	C					

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	40.9%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	56	96	127	87	67	67	176	75	61	212
Average Queue (ft)	16	41	62	40	27	21	60	11	27	80
95th Queue (ft)	45	80	112	80	55	51	130	46	52	157
Link Distance (ft)		495		931	931		242		254	254
Upstream Blk Time (%)							0			0
Queuing Penalty (veh)							0			1
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)							1			
Queuing Penalty (veh)							1			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	SB	SB
Directions Served	L	R	L	T
Maximum Queue (ft)	71	48	53	43
Average Queue (ft)	26	19	11	1
95th Queue (ft)	55	42	38	24
Link Distance (ft)	309	309		182
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)			190	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 8: Spring Mill Road & Site Access

Movement	WB	WB	SB
Directions Served	L	R	L
Maximum Queue (ft)	34	22	31
Average Queue (ft)	9	6	4
95th Queue (ft)	29	21	21
Link Distance (ft)	270	270	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			50
Storage Blk Time (%)			0
Queuing Penalty (veh)			0

Network Summary

Network wide Queuing Penalty: 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	94	79	44	154	84	86	51	580	51	52	372	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
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)	1770	1763		1770	1863	1583	1770	1863	1583	1770	1837	
Flt Permitted	0.69	1.00		0.44	1.00	1.00	0.38	1.00	1.00	0.26	1.00	
Satd. Flow (perm)	1288	1763		824	1863	1583	712	1863	1583	485	1837	
Peak-hour factor, PHF	0.77	0.77	0.77	0.83	0.83	0.83	0.95	0.95	0.95	0.89	0.89	0.89
Adj. Flow (vph)	122	103	57	186	101	104	54	611	54	58	418	43
RTOR Reduction (vph)	0	26	0	0	0	85	0	0	20	0	4	0
Lane Group Flow (vph)	122	134	0	186	101	19	54	611	34	58	457	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	16.2	11.5		21.0	13.9	13.9	39.6	37.4	44.5	39.6	37.4	
Effective Green, g (s)	16.2	11.5		21.0	13.9	13.9	39.6	37.4	44.5	39.6	37.4	
Actuated g/C Ratio	0.22	0.15		0.28	0.19	0.19	0.53	0.50	0.60	0.53	0.50	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	312	273		324	349	297	411	939	1035	297	926	
v/s Ratio Prot	0.02	0.08		c0.05	0.05		0.00	c0.33	0.00	c0.01	0.25	
v/s Ratio Perm	0.06			c0.11		0.01	0.07		0.02	0.10		
v/c Ratio	0.39	0.49		0.57	0.29	0.07	0.13	0.65	0.03	0.20	0.49	
Uniform Delay, d1	24.3	28.7		21.5	25.9	24.8	8.9	13.6	6.1	10.0	12.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.8	1.4		2.5	0.5	0.1	0.1	3.5	0.0	0.3	1.9	
Delay (s)	25.2	30.1		23.9	26.4	24.9	9.0	17.1	6.1	10.3	14.0	
Level of Service	C	C		C	C	C	A	B	A	B	B	
Approach Delay (s)		27.9			24.8			15.6			13.6	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	18.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	74.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	69	70	739	21	68	393
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.89	0.89	0.95	0.95
Hourly flow rate (vph)	77	78	830	24	72	414
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.71	0.71			0.71	
vC, conflicting volume	1387	830			854	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1340	553			586	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	28	79			90	
cM capacity (veh/h)	107	377			699	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	77	78	830	24	72	414
Volume Left	77	0	0	0	72	0
Volume Right	0	78	0	24	0	0
cSH	107	377	1700	1700	699	1700
Volume to Capacity	0.72	0.21	0.49	0.01	0.10	0.24
Queue Length 95th (ft)	95	19	0	0	9	0
Control Delay (s)	97.6	17.0	0.0	0.0	10.7	0.0
Lane LOS	F	C			B	
Approach Delay (s)	57.0		0.0		1.6	
Approach LOS	F					

Intersection Summary			
Average Delay	6.4		
Intersection Capacity Utilization	56.5%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	32	21	772	37	16	429
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.95	0.95	0.89	0.89
Hourly flow rate (vph)	36	23	813	39	18	482
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			586			
pX, platoon unblocked	0.77	0.77			0.77	
vC, conflicting volume	1331	813			852	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1280	607			657	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	74	94			97	
cM capacity (veh/h)	137	382			716	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	36	23	813	39	18	482
Volume Left	36	0	0	0	18	0
Volume Right	0	23	0	39	0	0
cSH	137	382	1700	1700	716	1700
Volume to Capacity	0.26	0.06	0.48	0.02	0.03	0.28
Queue Length 95th (ft)	24	5	0	0	2	0
Control Delay (s)	40.2	15.0	0.0	0.0	10.2	0.0
Lane LOS	E	C			B	
Approach Delay (s)	30.2		0.0		0.4	
Approach LOS	D					

Intersection Summary			
Average Delay	1.4		
Intersection Capacity Utilization	50.6%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	127	125	169	103	74	143	260	169	61	206
Average Queue (ft)	51	65	80	49	35	28	154	16	23	90
95th Queue (ft)	96	112	142	90	62	78	268	76	49	170
Link Distance (ft)		495		931	931		242		254	254
Upstream Blk Time (%)						0	2			0
Queuing Penalty (veh)						0	0			0
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)	0	0				0	14			
Queuing Penalty (veh)	0	0				0	14			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	NB	SB
Directions Served	L	R	T	R	L
Maximum Queue (ft)	110	68	4	9	66
Average Queue (ft)	44	29	0	0	27
95th Queue (ft)	86	52	3	4	56
Link Distance (ft)	309	309	254	254	
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)					190
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 8: Spring Mill Road & Site Access

Movement	WB	WB	NB	NB	SB
Directions Served	L	R	T	R	L
Maximum Queue (ft)	78	31	4	13	42
Average Queue (ft)	22	12	0	0	11
95th Queue (ft)	56	30	3	5	36
Link Distance (ft)	265	265	183		
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				50	50
Storage Blk Time (%)					0
Queuing Penalty (veh)					1

Network Summary

Network wide Queuing Penalty: 15

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	31	38	99	70	60	41	318	55	92	466	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.92		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99	
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)	1770	1709		1770	1863	1583	1770	1863	1583	1770	1839	
Flt Permitted	0.71	1.00		0.50	1.00	1.00	0.33	1.00	1.00	0.44	1.00	
Satd. Flow (perm)	1316	1709		929	1863	1583	611	1863	1583	827	1839	
Peak-hour factor, PHF	0.87	0.87	0.87	0.90	0.90	0.90	0.79	0.79	0.79	0.83	0.83	0.83
Adj. Flow (vph)	22	36	44	110	78	67	52	403	70	111	561	51
RTOR Reduction (vph)	0	40	0	0	0	57	0	0	26	0	3	0
Lane Group Flow (vph)	22	40	0	110	78	10	52	403	44	111	609	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	9.0	7.5		15.2	10.6	10.6	44.3	42.0	46.6	47.3	43.5	
Effective Green, g (s)	9.0	7.5		15.2	10.6	10.6	44.3	42.0	46.6	47.3	43.5	
Actuated g/C Ratio	0.12	0.10		0.21	0.14	0.14	0.60	0.57	0.63	0.64	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	169	173		243	267	227	402	1059	1084	578	1082	
v/s Ratio Prot	0.00	0.02		c0.03	0.04		0.00	0.22	0.00	c0.01	c0.33	
v/s Ratio Perm	0.01			c0.06		0.01	0.07		0.03	0.11		
v/c Ratio	0.13	0.23		0.45	0.29	0.04	0.13	0.38	0.04	0.19	0.56	
Uniform Delay, d1	28.9	30.6		24.9	28.3	27.3	6.9	8.8	5.2	5.5	9.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.7		1.3	0.6	0.1	0.1	1.0	0.0	0.2	2.1	
Delay (s)	29.2	31.3		26.3	28.9	27.4	7.0	9.8	5.2	5.6	11.5	
Level of Service	C	C		C	C	C	A	A	A	A	B	
Approach Delay (s)		30.8			27.4			8.9			10.6	
Approach LOS		C			C			A			B	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	73.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	61	40	337	60	46	539
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.79	0.79	0.83	0.83
Hourly flow rate (vph)	68	44	427	76	55	649
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.90	0.90			0.90	
vC, conflicting volume	1187	427			503	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1152	308			392	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	64	93			95	
cM capacity (veh/h)	186	659			1050	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	68	44	427	76	55	649
Volume Left	68	0	0	0	55	0
Volume Right	0	44	0	76	0	0
cSH	186	659	1700	1700	1050	1700
Volume to Capacity	0.36	0.07	0.25	0.04	0.05	0.38
Queue Length 95th (ft)	39	5	0	0	4	0
Control Delay (s)	35.0	10.9	0.0	0.0	8.6	0.0
Lane LOS	D	B			A	
Approach Delay (s)	25.4		0.0		0.7	
Approach LOS	D					

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	38.4%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	48	129	120	105	62	56	157	46	62	224
Average Queue (ft)	16	44	56	41	28	18	67	9	26	79
95th Queue (ft)	43	92	102	82	54	47	130	32	53	169
Link Distance (ft)		495		931	931		242		254	254
Upstream Blk Time (%)										0
Queuing Penalty (veh)										0
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)		0					2			
Queuing Penalty (veh)		0					2			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	SB	SB
Directions Served	L	R	R	L	T
Maximum Queue (ft)	80	52	4	48	24
Average Queue (ft)	32	20	0	15	1
95th Queue (ft)	60	42	3	42	17
Link Distance (ft)	309	309	254		336
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				100	
Storage Blk Time (%)					0
Queuing Penalty (veh)					0

Network Summary

Network wide Queuing Penalty: 2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	94	79	44	160	86	78	51	578	96	49	296	38
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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	0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
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)	1770	1763		1770	1863	1583	1770	1863	1583	1770	1831	
Flt Permitted	0.69	1.00		0.44	1.00	1.00	0.46	1.00	1.00	0.26	1.00	
Satd. Flow (perm)	1285	1763		824	1863	1583	849	1863	1583	490	1831	
Peak-hour factor, PHF	0.77	0.77	0.77	0.83	0.83	0.83	0.95	0.95	0.95	0.89	0.89	0.89
Adj. Flow (vph)	122	103	57	193	104	94	54	608	101	55	333	43
RTOR Reduction (vph)	0	26	0	0	0	76	0	0	37	0	5	0
Lane Group Flow (vph)	122	134	0	193	104	18	54	608	64	55	371	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	pm+ov	pm+pt	NA	
Protected Phases	7	4		3	8		5	2	3	1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	16.2	11.5		21.0	13.9	13.9	39.6	37.4	44.5	39.6	37.4	
Effective Green, g (s)	16.2	11.5		21.0	13.9	13.9	39.6	37.4	44.5	39.6	37.4	
Actuated g/C Ratio	0.22	0.15		0.28	0.19	0.19	0.53	0.50	0.60	0.53	0.50	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
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)	311	273		324	349	297	480	939	1035	299	923	
v/s Ratio Prot	0.02	0.08		c0.06	0.06		0.00	c0.33	0.01	c0.01	0.20	
v/s Ratio Perm	0.06			c0.11		0.01	0.06		0.03	0.09		
v/c Ratio	0.39	0.49		0.60	0.30	0.06	0.11	0.65	0.06	0.18	0.40	
Uniform Delay, d1	24.3	28.7		21.6	26.0	24.8	8.6	13.5	6.2	9.9	11.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.8	1.4		2.9	0.5	0.1	0.1	3.4	0.0	0.3	1.3	
Delay (s)	25.2	30.1		24.5	26.4	24.9	8.7	17.0	6.2	10.2	12.7	
Level of Service	C	C		C	C	C	A	B	A	B	B	
Approach Delay (s)		27.9			25.1			15.0			12.4	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	74.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	62.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	89	89	693	56	82	292
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.90	0.90	0.89	0.89	0.95	0.95
Hourly flow rate (vph)	99	99	779	63	86	307
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)			336			
pX, platoon unblocked	0.72	0.72			0.72	
vC, conflicting volume	1259	779			842	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1166	501			588	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	27	76			88	
cM capacity (veh/h)	136	412			713	

Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total	99	99	779	63	86	307
Volume Left	99	0	0	0	86	0
Volume Right	0	99	0	63	0	0
cSH	136	412	1700	1700	713	1700
Volume to Capacity	0.73	0.24	0.46	0.04	0.12	0.18
Queue Length 95th (ft)	105	23	0	0	10	0
Control Delay (s)	81.5	16.5	0.0	0.0	10.7	0.0
Lane LOS	F	C			B	
Approach Delay (s)	49.0		0.0		2.4	
Approach LOS	E					

Intersection Summary			
Average Delay	7.4		
Intersection Capacity Utilization	55.9%	ICU Level of Service	B
Analysis Period (min)	15		

Intersection: 3: Spring Mill Road & 161st Street

Movement	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	TR	L	T	R	L	T	R	L	TR
Maximum Queue (ft)	115	134	152	114	64	132	261	174	57	204
Average Queue (ft)	49	65	79	51	31	27	159	26	21	74
95th Queue (ft)	90	109	133	96	58	86	280	91	48	147
Link Distance (ft)		495		931	931		242		254	254
Upstream Blk Time (%)						0	2			0
Queuing Penalty (veh)						0	0			0
Storage Bay Dist (ft)	150		450			170		100		
Storage Blk Time (%)	0	0					12			
Queuing Penalty (veh)	0	0					18			

Intersection: 6: Spring Mill Road & Gas Station Drive

Movement	WB	WB	NB	SB	SB
Directions Served	L	R	R	L	T
Maximum Queue (ft)	109	81	12	78	14
Average Queue (ft)	49	34	1	32	0
95th Queue (ft)	91	63	8	65	10
Link Distance (ft)	309	309	254		342
Upstream Blk Time (%)					
Queuing Penalty (veh)					
Storage Bay Dist (ft)				100	
Storage Blk Time (%)				0	
Queuing Penalty (veh)				0	

Network Summary

Network wide Queuing Penalty: 19